Journal of California and Great Basin Anthropology | Vol. 41, No. 2 (2021) | pp. 187–205

The Eco-Archaeological Investigation of Indigenous Stewardship Practices on the Santa Cruz Coast

KENT G. LIGHTFOOT
Department of Anthropology,
University of California, Berkeley

ROB Q. CUTHRELL
Archaeological Research Facility,
University of California, Berkeley

MARK G. HYLKEMA
California State Parks, Santa Cruz District

VALENTIN LOPEZ
Chairman, Amah Mutsun Tribal Band

DIANE GIFFORD-GONZALEZ
Department of Anthropology,
University of California, Santa Cruz

ROBERTA A. JEWETT
Archaeological Research Facility,
University of California, Berkeley

MICHAEL A. GRONE
Archaeological Research Facility,
University of California, Berkeley

GABRIEL M. SANCHEZ
Department of Anthropology,
Michigan State University

PETER A. NELSON
Federated Indians of Graton Rancheria
Departments of ESPM and Ethnic Studies,
University of California, Berkeley

ALEC J. APODACA
Department of Anthropology,
University of California, Berkeley

ARIADNA GONZALEZ
Archaeological Research Facility,
University of California, Berkeley

KATHRYN FIELD
Archaeological Research Facility,
University of California, Berkeley

JORDAN BROWN
Department of Anthropology,
University of California, Berkeley

ALEXII SIGONA
Amah Mutsun Tribal Band
Department of ESPM,
University of California, Berkeley

PAUL V. A. FINE
Department of Integrative Biology,
University of California, Berkeley

This paper discusses recent findings from a collaborative, eco-archaeological investigation of Indigenous landscape and seascape stewardship practices on the Santa Cruz coast. Employing a low-impact, fine-grained approach, the research team unearthed evidence for the long-term maintenance of coastal prairies extending back at least 1,200 years. The paper argues that Indigenous communities facilitated the development of this biological community by igniting frequent cultural burns over many generations that greatly enhanced the quantity, diversity, and availability of fire-enhanced plants and animals in their territories. The research team also found evidence for Indigenous stewardship practices that enabled the long-term sustainability of important fisheries of small-schooling fishes and shellfish populations over many centuries. The article by Sigona, Apodaca, and Lopez in this issue discusses in more detail how the Amah Mutsun Tribal Band's partnership in this eco-archaeological program is facilitating Indigenous-led stewardship of terrestrial and coastal resources, the protection of ancestral places, and cultural education programs.

This paper highlights the major findings of an on-going collaborative, eco-archaeological program that is investigating Indigenous landscape and seascape stewardship practices spanning the last 7,000 years on the Central California coast. A team of scholars from the Amah Mutsun Tribal Band (AMTB), California State Parks, and the University of California campuses at Berkeley (UCB) and Santa Cruz (UCSC) recently completed a low-impact, fine-grained study of four sites on the Santa Cruz Coast. The low-impact methodology was developed to accentuate the recovery of important information from archaeological sites while minimizing impacts to ancestral places. Building upon previous work conducted in the region (e.g., Cuthrell 2013a, 2013b; Hildebrandt et al. 2007; Hylkema 1991, 2002; Jones and Hildebrandt 1990, 1994), this paper employs the findings from this study to address four major research issues concerning the timing, development, scale, and contemporary relevancy of Indigenous landscape and seascape stewardship practices on the Central California coast.

The paper by Sigona, Apodaca, and Lopez, in this issue, discusses how the Amah Mutsun Tribal Band's partnership in this eco-archaeological program is furthering the tribe's natural resource stewardship and cultural educational programs. They show how tribal participation in eco-archaeological research is contributing to Indigenous-led ecological restoration plans, the protection and preservation of ancestral places, and educational curricula designed for tribal youths and others. A significant outgrowth of this collaborative, eco-archaeological program is the training of tribal archaeologists and the development of Indigenous methods for undertaking "integrative" cultural resource surveys, as detailed in the second paper (Sigona et al. this issue).

INDIGENOUS STEWARDSHIP PRACTICES

We define Indigenous stewardship in the same way that Fowler and Lepofsky (2011:286) conceptualize "traditional resource and environmental management"—that is, "as the application of traditional ecological knowledge to maintain or enhance the abundance, diversity and/or availability of natural resources or ecosystems." Indigenous stewardship represents the cumulative knowledge gained from people's interactions with local environments over many centuries that has been passed down from one generation to the next (Anderson 2005:4–5; Fowler and Lepofsky 2011; Lepofsky 2009). We recognize that stewardship practices—knowing what works best for enhancing particular resources under specific environmental conditions—is built upon a history of daily routines involving people's intimate relationships with plants and animals. As Turner (2005:14) notes, mistakes were no doubt made through time when specific resources were neglected or overharvested, but it was part of a learning process that allowed for feedback that could be corrected or fine-tuned in the future (see Berkes and Turner 2006). It was through the cumulative actions of multiple generations that Indigenous people learned about stewardship practices that might serve to augment the diversity, quantity, and/or availability of specific resources in local ecosystems.

A rich literature documents the various Indigenous stewardship practices employed to enhance terrestrial resources in California (e.g., Anderson 2005, 2018; Blackburn and Anderson 1993; Lewis 1993; Lightfoot and Parrish 2009). Indigenous communities constructed productive anthropogenic landscapes through a variety of methods, including tillage, pruning, seed broadcasting, weeding, and irrigation. One of their primary stewardship tools was the use of "good fires." Native people initiated cultural burns for many reasons: to clear undergrowth; to control insect infestations; to facilitate hunting; to encourage plants to produce young, straight stems for cordage, baskets, and other household materials; to reduce fuel loads; and to enhance the productivity, diversity, and sustainability of plants and animals used for foods, raw materials, and medicines (Anderson 2018). Depending on the frequency, timing, and spatial distribution of fires, Indigenous populations often worked to enhance the biodiversity and sustainability of economic resources, substantially altering local habitat structures (see Hankins 2021; Lake 2021; Lightfoot and Parrish 2009:94–122; Long et al. 2020a).

The scale and organization of cultural burning in Native California probably varied greatly across time and space, from fires set by individuals, hunting parties, and small kin groups to more coordinated communal activities conducted by members of larger community groups and polities (Lightfoot et al. 2013a:290). By igniting a series of small, low-intensity fires in their tribal territories, Native peoples would have created

patchy mosaics of biotic communities characterized by vegetation stands at different stages of succession (Hankins 2021; Lewis 1993:82–85; Lightfoot and Parrish 2009:97–112). Regular burning would have also decreased fuel loads that may have reduced the occurrence of large catastrophic fires (Anderson 2018:382–383; Lake and Christianson 2019).

Indigenous stewardship also involved shoreline management practices that enhanced the productivity or availability of wetland and intertidal resources. Scholars working on the Pacific Northwest Coast of North America have highlighted the significance of Indigenous seascape stewardship in supporting the long-term sustainability of vertebrate and invertebrate fisheries. Documented stewardship practices involved the construction of engineered coastal landscapes, including the creation of clam beds, stream scraping, holding ponds, fish weirs, and the use of shell middens as construction materials (Caldwell et al. 2012; Cannon and Burchell 2009; Grier 2014; Groesbeck et al. 2014; Lepofsky and Caldwell 2013; Lepofsky et al. 2015). While Indigenous seascape stewardship practices involving engineered coastlines are not as well documented in California, there are ethnographic observations of clam gardens in Tomales Bay (Baker 1992; Grone 2020). California archaeologists are currently investigating possible examples of coastal stewardship that allowed Indigenous communities to harvest huge quantities of shellfish and other coastal resources in ways that sustained these populations over thousands of years by removing predators, shifting village locations, "fishing up the food web," and employing plucking and stripping methods of gathering (Braje et al. 2009; Erlandson et al. 2008; Erlandson et al. 2009; Jones and Richman 1995; Whitaker 2008). Our recent eco-archaeological fieldwork in Central California suggests that there is considerable promise in the study of shoreline stewardship practices affecting intertidal and wetland resources, as discussed below.

THE CONSEQUENCES OF SETTLER COLONIALISM

Today, there is an enormous opportunity in California for archaeologists to partner with tribes and resource agencies in researching Indigenous landscape and seascape stewardship practices that have been transformed with colonialism. Settler colonialism over the last 250 years in California created a truly dark age for Indigenous people who faced blatant discrimination, horrendous genocide, pervasive land appropriations, and various policies designed to inhibit their landscape and seascape stewardship practices (Castillo 1978; Heizer and Almquist 1971; Hurtado 1988; Lightfoot 2005:210–233; Lindsay 2012; Madley 2016). We recognize that many of these injustices continue today. For example, in 1793, colonial proclamations prohibited cultural burning by both "Christian and Gentile Indians," resulting in "severe punishment" for those who continued to tend the land in this way (Timbrook et al. 1993:129–133). These early colonial fire prohibitions eventually morphed into the later American fire suppression policies of the late 1800s and 1900s that not only kept Native peoples from tending their lands but encouraged concerted efforts to take fire out of the ecosystem by extinguishing all wildfires (Stephens and Sugihara 2018).

Despite these many challenges, tribes today have emerged from the dark age as reinvigorated polities who are initiating programs designed to revitalize their languages, health, cultural practices, land bases, and intimate relationships with the environment. A major focus of many tribes is the implementation of Traditional Ecological Knowledge (TEK) in the stewardship of tribal lands and waters. While there are many facets to the revitalization of tribal lands, a crucial element is bringing cultural burning back to prominent resource patches that have been deprived of Indigenous tending for many years. With the growing recognition that fire suppression policies and the criminalization of Indigenous stewardship practices have done much long-term harm to the environment and lives of everyone in California, tribes across the state are now working with federal, state, and non-government resource agencies to bring good fires back to their traditional territories (Codero-Lamb et al. 2018; Goode 2015; Hankins 2021; Lake 2021; Lake et al. 2017; Lake et al. 2018; Long et al. 2020a; Long et al. 2020b; Marks-Block et al. 2019; Marks-Block et al. 2021).

COLLABORATIVE ECO-ARCHAEOLOGY

We believe that eco-archaeological programs undertaken in partnership with tribes and agencies can do much to advocate for and enable the revitalization of Indigenous

stewardship practices in the lands and waters of California. We define eco-archaeology as an approach that employs multiple ecological and archaeological data sets to construct a robust perspective about human interactions with the environment over time. We employ the tenets of historical ecology that consider human agency at the landscape scale in examining how people engaged with local environments over multiple generations (Balée 1998, 2006; Balée and Erickson 2006; Crumley 1994). This approach recognizes from the outset that all human societies impact their local environments; that both agrarian and non-agrarian societies engage in the domestication of landscapes through various actions, including burning, transplanting, pruning, mound construction, and the like; and that human interactions with local environments may be beneficial or detrimental for the overall health and sustainability of biological communities when viewed in the *longue durée* (Balée 2006; Balée and Erickson 2006; Erickson 2006, Erickson and Balée 2006).

Eco-archaeological programs implement fine-grained methods designed specifically to recover artifacts, archaeobotanical remains, zooarchaeological specimens, sediment samples, and other relevant materials from archaeological contexts that provide insights about the cultural practices of past people and their relationships with local environments (see Cuthrell 2013a, 2013b). Recovering the physical remains of plants and animals that were harvested and possibly tended by Native people is an important component of eco-archaeological investigations of past stewardship practices. In addition, eco-archaeological programs utilize pertinent ecological data sets collected from non-archaeological contexts that offer insights about local soils, climate conditions, vegetation patterns, faunal populations, fire regimes, and water conditions (e.g., Klimaszewski-Patterson et al. 2018; Klimaszewski-Patterson et al. 2021; Lightfoot and Lopez 2013; Lightfoot et al. 2013b; Stephens and Fry 2005). Using radiocarbon chronologies, these different data sets can be integrated into regionally specific, historical baselines that represent a wealth of information about Indigenous peoples' interactions with local environments over time.

Eco-archaeological studies undertaken in partnership with tribes can complement Native oral traditions, ethnohistoric observations, and ethnographic reports by providing additional information about Indigenous relations with the land and sea, particularly where there are gaps in tribal knowledge about specific kinds of stewardship practices. Eco-archaeological research can provide important sources of information for tribes and resource agencies in making decisions about revitalizing degraded environments, restoring plants and animals impacted by colonialism, and reviving dormant Indigenous stewardship practices (Braje and Rick 2013; Lightfoot et al. 2013b:287–291; Lyman 2006; Rick and Lockwood 2012; Scharf 2014).

ECO-ARCHAEOLOGY ON THE CENTRAL CALIFORNIA COAST

We have implemented one such eco-archaeological program to examine the timing, development, scale, and contemporary relevance of Indigenous landscape and seascape maintenance on the Central California coast. The central axis of our collaborative program is the Amah Mutsun Tribal Band, whose ancestral villages and territories included lands south of San Francisco Bay and whose tribal members descend from survivors of the Santa Cruz and San Juan Bautista Franciscan missions. After enduring two and a half centuries of destructive and demoralizing entanglements with Spanish, Mexican, and American settler-colonists who successively decimated the tribe, drove them from their homeland, and punished them for applying TEK practices, the AMTB has launched an ambitious and successful program of cultural revitalization and environmental restoration. This has included founding the Amah Mutsun Land Trust (AMLT) and training younger tribal members (the Native Stewardship Corps) in tribal landscape and seascape stewardship practices (Lopez 2013, 2021; see article by Sigona, Apodaca, and Lopez in this issue). The tribal land trust (AMLT) employs Indigenous knowledge, oral histories, oral traditions, and pertinent ethnohistoric observations and ethnographic accounts (e.g., working with hitherto unpublished notes by J. P. Harrington on Mutsun practices) to develop a pathway forward in bringing TEK practices back to Amah Mutsun lands. They have also reached out to pertinent scholars and resource agencies to help facilitate their cultural and environmental revitalization program. They are particularly interested in working with scholars who can help them assess ethnohistorically and archaeologically

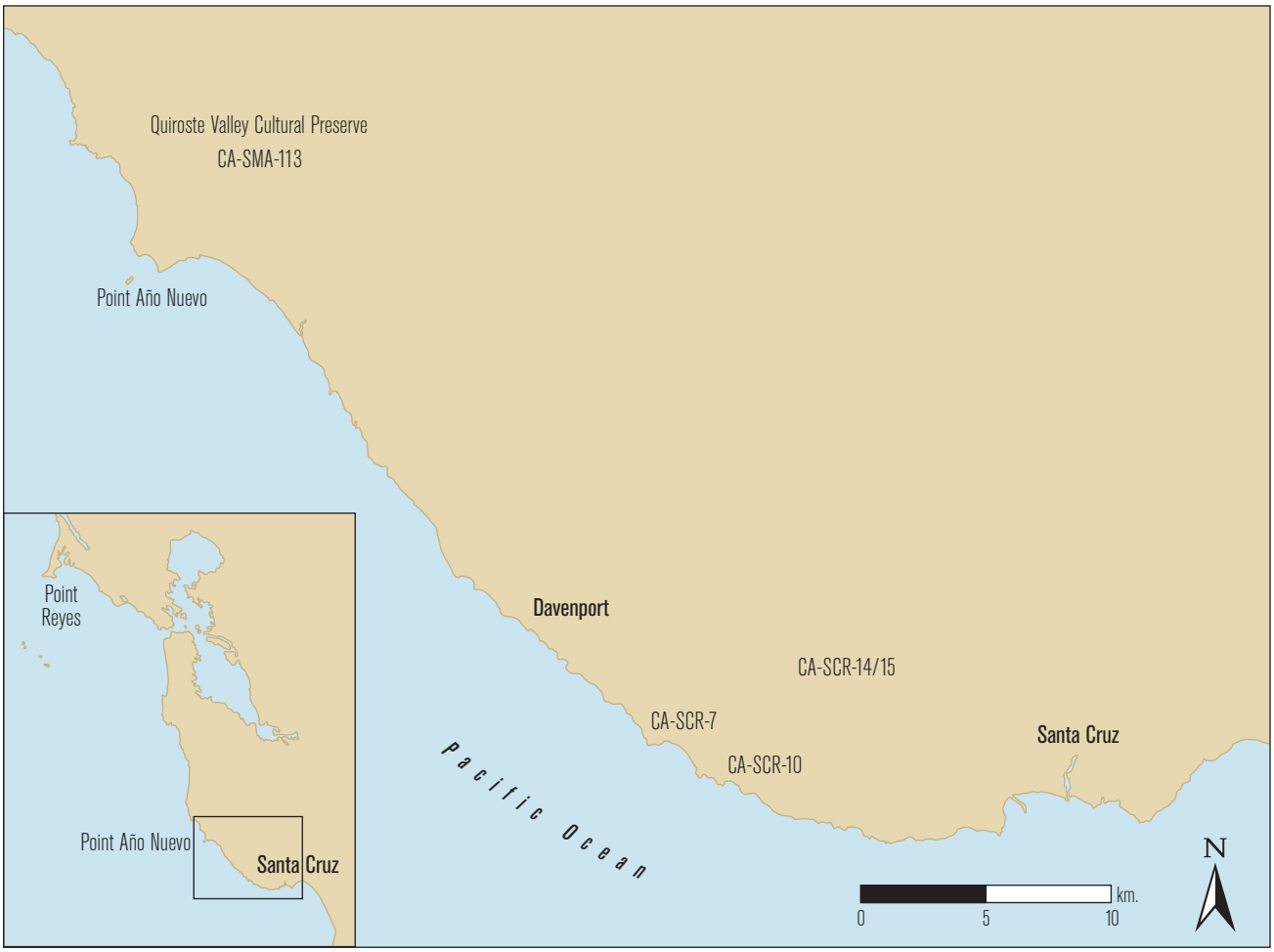

Figure 1. Santa Cruz Coast Study Area.

documented TEK practices as an aid to bringing these out of dormancy after many years of colonialism.

The First Phase of Eco-Archaeological Research

Our collaborative eco-archaeological research program was founded in the early 2000s when a collective of scholars from the AMTB, California State Parks, UCB, and UCSC initiated the study of past Indigenous landscape stewardship practices in Quiroste Valley in Año Nuevo State Park (Fig. 1), the homeland of the historic Quiroste tribe (see Hylkema and Cuthrell 2013). The traditional lands of the Quiroste in the coastal Central California region extended from Point Año Nuevo northward to Pescadero Marsh and inland into the Santa Cruz Mountains (Hylkema and Cuthrell 2013). The results of this eco-archaeological research demonstrated that local Native groups employed fire to maintain highly productive grasslands interspersed with forest/savanna communities containing California hazel, California lilac, and redwood trees from at least 1000–1300 cal CE (Table 1). Excavations at CA-SMA-113, an extensive village site, unearthed evidence that Indigenous people harvested a diverse range of food plants, including seeds of grasses (Poaceae), panicled bulrush (*Scirpus microcarpus*), coast tarweed (*Madia* spp.), clover (*Trifolium* spp.), composites (Asteraceae), California hazel (*Corylus cornuta* ssp. *californica*), tanoak (*Notholithocarpus densiflorus*), and other plants (Cuthrell 2013a, 2013b). They also hunted or trapped a substantial number of mule deer (*Odocoileus hemionus*), various lagomorphs, and voles (*Microtus* sp.), which would have thrived in the mixed mosaic of grassland and open woodland environment (Gifford-Gonzalez et al. 2013).

The high proportions of grassland-associated food plants, high density of hazelnut remains, high ratio of voles (specially adapted to grassland habitats) to wood

Table 1
INFORMATION ON THE SETTING AND CHRONOLOGY OF CA-SMA-113, CA-SCR-7, CA-SCR-10, CA-SCR-14, AND CA-SCR-15

Site	Setting	# AMS Dates (2-sig Calibration)	Primary Age of Occupation	References
CA-SMA-113	Interior Valley	24	1,000–1,300 C.E.	Cuthrell 2013b: Appendix E
CA-SCR-7	Coast	27	4,800–3,600 B.C.E. 2,700–2,200 B.C.E.	Lightfoot et al. 2021: Appendix 3
CA-SCR-10	Terrace	14	3,800–3,200 B.C.E. 680–880 C.E.	Lightfoot et al. 2021: Appendix 3
CA-SCR-14	Interior Foothills	8	1,000–1,700 C.E.	Lightfoot et al. 2021: Appendix 3
CA-SCR-15	Interior Foothills	9	1,050–1,400 C.E.	Lightfoot et al. 2021: Appendix 3

rats (*Neotoma* sp., which prefer dense woodland or forest environments), and the dominance of fire-enhanced shrubs and trees, stand in sharp contrast to the fire-intolerant vegetation that populates Quiroste Valley today and indicates more open forest and fire-adapted species flourished there in the past. In synthesizing the results of multiple lines of evidence drawn from relevant ethnohistorical, archaeological, phytolith, pollen/charcoal, dendroecological, and genetic data sets, we concluded that local groups employed frequent, low-intensity fires to convert north coast scrub and Douglas fir forests into extensive coastal grasslands or prairies in Late Holocene times. This greatly enhanced the diversity, quantity, and predictability of plant and animal resources for human subsistence. We argued that lightning ignitions alone (with fire return intervals of 50–100 years) were insufficient to sustain these coastal prairies. We showed that the long-term maintenance of coastal grasslands in Central California instead required a sub-decadal fire return interval, with fires probably set at intervals of one to five years (Cuthrell 2013a, 2013b; Lightfoot et al. 2013b). Otherwise, these grasslands would convert to dense northern coast scrub and conifer forests, as has happened across much of this region with historic fire suppression.

The Second Phase of Eco-archaeological Research

We built upon our earlier work in designing our next stage of research, which is addressing four major goals concerning the timing, development, geographic scale, and contemporary relevancy of Indigenous landscape and seascape stewardship practices on the greater Santa Cruz coast.

The first goal is to examine when people may have first initiated sustained cultural burning and seascape stewardship practices in the broader region. Expanding our work beyond Quiroste Valley, we extended the time-depth of our investigation before and after 1000–1300 CE. We are particularly interested in examining sites on the greater Santa Cruz coast with occupations dating to the Middle Holocene (4,000–1,000 B.C.E.), Late Holocene (1,000 B.C.E.–1500 C.E.), and Historic periods.

The second goal is to examine whether and how local Indigenous communities may have modified stewardship practices over time. Research on the long-term development of anthropogenic fire regimes is incipient in California. We are particularly interested in examining how Native people may have altered stewardship practices during the Medieval Climatic Anomaly (MCA), a climatic regime from about 900–1300 C.E. marked by prolonged intervals of decreased precipitation, "epic" droughts, and warmer summer temperatures (Jones et al. 1999; Klimaszewski-Patterson et al. 2021). Similarly, we are interested in the Little Ice Age from about 1350–1850 C.E. to explore how overall cooler temperatures may have structured fire regimes and coastal conditions in Late Holocene times. We are also attentive to examining the timing and development of seascape stewardship practices in the region and how they may have overlapped with terrestrial stewardship activities.

The third goal is to evaluate the geographic scale of Indigenous landscape and seascape stewardship practices on the Central California coast. There is considerable debate about the degree of landscape modifications undertaken by Native Californians. While some scholars

believe cultural burning was employed widely in California and the American West (Anderson 2018; Hankins 2021), others contend that the magnitude of these practices has been greatly exaggerated in the anthropological literature and that natural causes (e.g., lightning ignitions) were the primary factors influencing Holocene fire regimes (Barrett et al. 2005; Vale 1998). These debates raise the important issue of scale in considering how Indigenous populations employed cultural burning. In expanding our study to include the Santa Cruz coast, we aimed to evaluate whether cultural burning at Quiroste Valley was an isolated case initiated by the historic Quiroste people or part of a broader pattern of landscape stewardship instituted by other tribes in Central California.

Our fourth goal is to consider how the findings from our eco-archaeological research may be employed by the Amah Mutsun Tribal Band and California State Parks in generating plans for the contemporary management and revitalization of state park lands between Point Año Nuevo and Santa Cruz. We believe the results of our work may provide important insights for enhancing the richness and diversity of native species, thereby improving the health of biological communities, and reducing fuel loads and minimizing the risks of catastrophic fires. Our research team is exploring how lessons from the past can directly contribute to developing new protocols for the contemporary management of public spaces rooted in the deep history of tribal practices.

THE SANTA CRUZ COAST: APPROACH, METHODS, AND CONTEXT

We address these four research goals using a low-impact, eco-archaeological approach designed to minimize impacts to ancestral places, avoid disturbances to burials and other sacred remains, and maximize the recovery of useful information about tribal histories and cultural resources. Our low-impact field methodology emphasized the use of surface and near-surface prospection to obtain information about site structure, features, and cultural materials prior to any significant subsurface investigations (Lightfoot 2008:218–221; Sanchez et al. 2021). These procedures included detailed site mapping, geophysical survey, and systematic surface collections. We employed ground penetrating radar (GPR) to inspect the subsurface deposits of site areas with minimal vegetation coverage. One or more transects were walked using a GSSI SIR 3000 GPR unit with a 400 MHz antenna to record subsurface profiles. Careful analysis of the output provided information on the depth of deposits and the detection of subsurface features, such as potential house floors and burials (Nelson 2021). We systematically recorded archaeological remains from across site areas using a series of surface units measuring 0.25 m.^{2} and 0.5 m.^{2}. Crew members used trowels to cut through the duff/grassroots to expose and collect five liters of soil from the unit that was screened through 3.2 mm. mesh. A catch-and-release methodology was employed so that no archaeological materials were permanently removed from the surface units (Gonzalez 2016). Artifacts and zooarchaeological remains were identified, quantified, and weighed using portable digital scales before being carefully returned to the units.

This first phase of surface and near-surface investigation was then followed by subsurface testing if warranted and agreed upon by our collaborative research team members. We employed first phase results (e.g., geophysical anomalies, artifact spatial distributions) to select the placement of subsurface units. For those, we implemented an intensive recovery methodology of bulk soil processing, flotation, and fine screening using 4 mm., 2 mm., and 1 mm. mesh that emphasized the collection of artifacts, zooarchaeological remains, and archaeobotanical specimens. We employed a diverse range of subsurface units, including auger units, profile units, and excavation units (0.5×0.5 m., 1×1 m.). We also collected near-surface soils in the proximity of several sites for phytolith analysis.

We focused our field research on sites that had chronological components spanning Middle Holocene, Late Holocene, and Historic times situated between the modern communities of Davenport and Santa Cruz on the coast of Santa Cruz County (Fig. 1) located ca. 20–40 km. south of Quiroste Valley in the homeland of the historical Cotoni tribe (Hylkema and Cuthrell 2013:227). Varied shorelines and diverse vegetation mosaics characterize the study area's environmental setting. The region has a few broad, sandy beaches but is predominantly characterized by rocky shorelines with small, sandy coves, often backed by cliffs comprising tectonically uplifted marine terraces. Immediately behind the coastal plain are the foothills

of the Santa Cruz Mountains that consist of a mosaic of riparian forest, northern coastal scrub, coastal sage scrub, conifer forest, mixed conifer-hardwood forests, and coastal prairie. Coastal prairies can flourish under the influence of a cool maritime climate some distance from the coast proper—on marine terraces and in the foothills of the Santa Cruz Mountains under ca. 350 m. (California Native Grasslands Ass. 2021; Kraft et al. 2007; Ornduff et al. 2003:156–159).

The Santa Cruz Mountains themselves rise to 810 m. above sea level. Today, they are covered by a diverse array of shrublands, as well as varied forest types characterized by oaks, bay, buckeye, hazel and closed-cone conifer forest, with Douglas fir (*Pseudotsuga menziesii*) and coast redwoods (*Sequoia sempervirens*) as the dominant tree species. The Santa Cruz Mountains and coastal plains are transected by small and often deeply incised drainages, with larger streams debouching in small estuaries along the coast. Redwoods and riparian plant communities line these watercourses to their lower reaches, where distinctive estuarine plant communities dominate.

This paper focuses on four sites in the study area: CA-SCR-7, CA-SCR-10, CA-SCR-14, and CA-SCR-15 (see Fig. 1). Our field investigations at each site are briefly described below.

CA-SCR-7

CA-SCR-7, or the Sand Hill Bluff Site, is an extensive complex of sand dunes and archaeological deposits located on the coastal terrace, covering an estimated 8.3 ha., that has received considerable attention by archaeologists (Hildebrandt et al. 2007; Jones and Hildebrandt 1990). The site has yielded Middle Holocene dates and the presence of an extinct flightless duck, *Chendytes lawi* (Jones et al. 2008). We focused our work at Locus 1, which consists of an imposing sand dune mound where two distinct archaeological strata had been previously defined: a Lower Midden Stratum at the base of the sand dune and a distinctive Upper Midden Stratum at the top of the eroding sand dune (see Hildebrandt et al. 2007). We employed a field strategy of placing two column units in the Upper Midden, one column unit in the Lower Midden, and three auger units and four other column units in areas in between these two known strata. The geophysical survey of Locus 1 provided excellent information for the placement of these additional subsurface units. Our purpose was to obtain fine-grained samples from the upper and lower deposits and evaluate whether other extant archaeological deposits could be found in the mound's internal area.

Our findings indicate that the sand dune complex is interlaced with other archaeological strata above the Lower Midden and below the Upper Midden. We detected a relatively dense assemblage of flaked stone tools, moderate densities of fish, terrestrial and marine mammals, and waterbird remains, but a paucity of groundstone artifacts and archaeobotanical specimens (see Lightfoot et al. 2021). The 27 radiocarbon dates from these various strata indicate two chronological periods are represented in Locus 1: Component A from ca. 4,800–3,600 cal B.C.E. and Component B from ca. 2,700–2,200 cal B.C.E. (Table 1).

We also worked at Locus 4, which contains a broad scatter of artifacts found in adjacent former agricultural fields. For years, these fields, walked by farmers and artifact collectors, have produced significant projectile point collections, described by Hylkema (2021). The survey of Locus 4 involved the inspection of 76 surface units (each measuring 0.25 $m.^2$), which provided insights into what people were doing in the hinterland of Locus 1.

CA-SCR-10

CA-SCR-10 is a large shell midden (ca. 400 × 250 m.) that has been under active row crop cultivation for many years. Previous archaeological work has taken place along the southwest periphery of the site by Jones and Hildebrandt (1994), along with excavations by Cabrillo College and California State Parks in 2011. Despite many years of plowing, our field team observed a mounded area in the center of the site that rose slightly above the relatively flat periphery. During a brief interval in October 2016 when the field was fallow, we initiated a study of this central area that involved a geophysical survey, the recording of archaeological materials from 38 surface units, and the excavation of three auger units. This work aimed to better define the archaeological context of the central, low mounded area. Our field investigation also involved the excavation of a 1 × 1 m. unit placed near a unit previously excavated by the Cabrillo College team at the agricultural field's southeastern edge, where they detected a dense

assemblage of shell, vertebrate remains, and artifacts to a depth of 1.7 meters below the surface. The purpose of our excavation was to obtain fine-grained samples that would enhance and build upon the findings from this previous excavation.

Our limited subsurface investigation of the site's central area yielded primarily Monterey chert flakes and debitage. Three radiocarbon dates from the auger units' basal levels returned dates ranging from ca. 3,800–3,200 cal B.C.E. (Table 1). Our excavation of the 1×1 m. unit detected archaeological materials to a depth of 1.44 m. below the surface. Unfortunately, we observed evidence of recent historical disturbance to a depth of about one meter below the surface, as evidenced by plastic wrappers and other contemporary materials. We did uncover intact archaeological deposits at depths of about 112 cm. to 144 cm. below the surface. Here we unearthed a series of cultural features, including shell concentrations, clusters of fire-cracked rocks, and ash lenses, associated with Monterey chert artifacts, groundstone implements, and ethnobotanical remains described below (Lightfoot et al. 2021). Eleven radiocarbon dates for this unit confirmed the upper deposits' mixed nature, while the intact strata with archaeological features revealed a tight range of dates from ca. 680–880 cal C.E. (Table 1). Our discussion of CA-SCR-10 in this paper will focus on the materials from these *in situ* deposits.

CA-SCR-14

CA-SCR-14, situated in the foothills 2.0 km. from the coast on the southeastern bank of Laguna Creek, measures ca. 80×35 m. in size. We observed a rich midden deposit with Monterey chert artifacts, shellfish, and vertebrate faunal remains on relatively flat ground that extended down the slope of the creek bank. Field crews initiated a geophysical survey and the systematic investigation of 35 surface units. The geophysical work revealed anomalies that might represent intact subsurface cultural features. The placement of two 0.5×0.5 m. units based on this information revealed an intact fire-cracked rock feature in one unit and in the other an area probably used for dumping refuse on the site's periphery, as evidenced by multiple, small discrete deposits of ashy, ecofact-rich material. The eight radiocarbon dates for the two units indicate a Late Holocene occupation ca. 1000–1700 cal C.E. (Table 1), and more conservatively, with the removal of dates from potentially disturbed near-surface contexts, about 1000–1510 C.E. (Lightfoot et al. 2021).

CA-SCR-15

CA-SCR-15 is a nearby, upland neighbor of CA-SCR-14. This large midden site sits above Laguna Creek on a ridge with a low knoll connected to an extensive grassy field where we observed Monterey chert debitage, flakes, shellfish, and vertebrate faunal remains covering an area of ca. 130×70 m. We undertook a geophysical survey, the systematic surface inspection of 44 0.25 $m.^2$ units, and excavation of two 0.5×0.5 m. units. One excavation unit located in the grassland area east of the knoll contained a high density of surface artifacts. The other excavation unit was placed on the knoll using GPR and findings from surface units that revealed high densities of surface artifacts and shellfish remains in the area. Field workers excavated a fire-cracked rock feature and cultural materials to a depth of 60 cm. below the surface. The western unit produced a much greater density of cultural materials than the eastern unit. We obtained nine radiocarbon dates from these units: seven of these dates revealed a relatively tight age range from ca. 1050–1400 cal C.E. (Table 1), while the other two were more questionable given the possibility of subsoil mixing and near surface disturbances. It is possible that the site occupation could extend into the 1500s to early 1600s C.E. (Lightfoot et al. 2021).

RESULTS

Our purpose here is to highlight the major findings from our study in addressing the four research goals concerning the timing, development, scale, and contemporary relevancy of Indigenous landscape and seascape stewardship practices on the Santa Cruz coast.

Goal 1: When Did Indigenous People First Initiate Sustained Cultural Burning?

The analysis of the archaeobotanical remains from the four sites and other pertinent sites is compatible with the interpretation that Indigenous people employed cultural burning to facilitate the creation and maintenance of coastal prairies west of the Santa Cruz Mountains

from ca. 700 to 1500 cal C.E. (Cuthrell 2021a, 2021b). Furthermore, it appears they harvested plant and animal resources from patchy mosaics of biotic communities consisting of grassland, shrubland, forest, and riparian resources. The earliest evidence for intensive grassland harvesting is from CA-SCR-10 in archaeological contexts dating to ca. 680–970 cal CE. Here we detected high densities of grass seeds and hazelnuts (*Corylus cornuta* ssp. *californica*) along with lesser quantities of other plant foods. The investigation revealed moderate soil phytolith content, indicating some level of grassland vegetation in the nearby environs over the long term. People gathered wood for fuels and raw materials from redwood (*Sequoia sempervirens*), willow (*Salix* sp.), alder (*Alnus* sp.), California bay (*Umbellularia californica*), and other trees from the nearby riparian corridor of Baldwin Creek and habitats farther inland and at higher elevations.

Later evidence for the intensive gathering of coastal prairie resources is found at the upland sites of CA-SCR-14 and CA-SCR-15 from ca. 1000–1500 cal C.E. At this time, people continued to gather grass seeds and hazelnuts, along with tarweed (*Madia* sp.), clover (*Trifolium* sp.), panicled bulrush (*Scirpus microcarpus*), tanoak (*Notholithocarpus densiflorus*), oak (*Quercus* sp.), and California bay. People obtained wood for fuel and other uses primarily from redwoods, California lilacs (*Ceanothus thyrsiflorus*), oaks, and pines. The findings from the phytolith study indicate the maintenance of long-term grasslands in the nearby foothill environs of these inland sites. Our study suggests that this biological community was probably maintained on the marine terraces and other favorable places extending up into the coastal foothills.

The findings from these three sites, along with those from CA-SMA-113, strongly suggest that Indigenous communities employed stewardship practices that facilitated the long-term upkeep of coastal prairies situated within a productive, patchy landscape mosaic that probably included not only grasslands but also neighboring woodlands, wetlands, and forests with fire-adapted species such as hazelnut, California lilac, and redwood (Cuthrell 2013a, 2013b, 2021a, 2021b). All these sites have evidence of ground-stone assemblages, fire-cracked rocks, and other materials that indicate terrestrial plant processing (Cuthrell 2013b; Gonzalez and Field 2021; Gonzalez et al. 2021). Other corroborating evidence for the long-term existence of coastal prairies is provided by the study of faunal remains, particularly rodents that are sensitive to habitat type, such as California voles, which prefer open grassy ecosystems (Gifford-Gonzalez 2021; Gifford-Gonzalez et al. 2013). The aDNA investigation of California voles from both archaeological and modern contexts indicates that genetic intermixture took place over a broad swath on the Santa Cruz coast and beyond, which may also suggest the maintenance of extensive coastal prairies in the past (Fine et al. 2021).

The convergence of multiple lines of evidence drawn from the archaeobotanical data (fire enhanced food plants such as grasses, hazelnuts, tarweed, etc.), the anthracological data (fire compatible plants gathered for fuel and raw materials such as redwood and California lilac), the phytolith data (phytolith concentrations showing some evidence of nearby grasslands), and the above faunal studies is strong support for an anthropogenic fire regime from at least ca. 700–1500 C.E. The fire regime would have been characterized by a much shorter, sub-decadal fire interval than a natural fire regime based on lightning-ignited fires alone, with fire return intervals estimated to occur at 50–100-year intervals. We conclude that Native stewards tended frequent cultural burns over many generations on the Santa Cruz coast that greatly enhanced the quantity, extent, and diversity of fire-enhanced plants and animals in their territories.

While our findings indicate that Native people implemented cultural burning on the Santa Cruz coast by at least 1,200 years ago, we found little evidence that the inhabitants of the earlier Sand Hill Bluff site (4,800–2,200 cal B.C.E.) harvested and used resources from coastal grasslands (Cuthrell 2021a, 2021b). The paucity of archaeobotanical remains at this site compared to the others is striking. The Indigenous residents probably used some local terrestrial plant foods, such as tanoak, oak, California bay, manzanita (*Arctostaphylos* sp.), and soaproot (*Chlorogalum* sp.), but these were observed sporadically. The primary fuel used at the site appears to have been locally available redwood driftwood. Given the age and context of the site (i.e., sand dune matrix), the scarcity of macrobotanical remains may be the product of various taphonomic processes and/or the antiquity of the deposits. However, the paucity of ground stone implements further suggests that the tending of terrestrial plants was not a focus of the site's inhabitants (Gonzalez

and Field 2021; Gonzalez et al. 2021). Instead, our findings indicate the focus was the harvesting and processing of a diverse array of marine resources, along with the hunting of at least some terrestrial game (see below).

We emphasize here that the near absence of grassland-associated plant foods at CA-SCR-7 does not negate the possibility that Indigenous cultural burning or the maintenance of coastal prairies took place *elsewhere* in the region prior to 700 C.E. (e.g., in Middle Holocene and early Late Holocene times). A significant finding from the investigation of archaeobotanical remains from nine sites distributed from Año Nuevo Point south to Santa Cruz was their consistent *lack* of evidence for terrestrial plant food processing, consumption, or deposition at near-coastal locales dating to Middle to Late Holocene times (Cuthrell 2021a, 2021b). In contrast, the most robust evidence for terrestrial plant remains, particularly those gathered from coastal prairies, was from inland sites (e.g., CA-SMA-113, CA-SCR-10, CA-SCR-14, CA-SCR-15) that are all post-700 C.E. in age. Our findings suggest that when people inhabited ocean-view sites they maintained a strong marine-oriented economy, and that when they shifted residence to more interior locations they continued to harvest coastal resources but also incorporated grassland-related and other terrestrial foods into their subsistence practices. We now recognize that a full evaluation of our first goal concerning when people first initiated sustained cultural burning on the Santa Cruz coast must be based on the study of more inland sites that predate 700 C.E.

Goal 2: Is There Evidence for How Local Communities May Have Modified and Developed Stewardship Practices Over Time?

We found little correlation between major episodes of climate change and alterations in Indigenous communities' intensive use of grassland foods on the Santa Cruz coast. We recognize that our overall dating of coastal prairie resources in archaeological contexts from ca. 700–1500 C.E. that serve as a proxy for frequent cultural burning is not fine-tuned enough to examine specific climatic events. However, our findings thus far suggest that people were probably igniting fires before, during, and after the Medieval Climatic Anomaly (MCA) (ca. 900–1300 C.E.), when temperatures and drought conditions may have increased along with the frequency of fires (Klimaszewski-Patterson et al. 2021). It appears that people relied on fire from cultural burning before the MCA and probably continued to rely on fire from cultural burning (possibly supplemented by occasional lightning ignitions) to keep the coastal prairies open and productive during this period of climatic warming. Our study also indicates that coastal grasslands continued to be maintained during the early years of the Little Ice Age (ca. 1350–1850 C.E.), when cooler conditions prevailed. Thus, our study suggests that Indigenous people implemented a regime of frequent cultural burning under diverse climatic conditions on the Santa Cruz coast that sustained this important biological community over many centuries.

We did observe significant changes in Indigenous stewardship practices when viewed in the *longue durée*—over the last 7,000 years. Our findings documented a general trend in Late Holocene times for increasing resource intensification that involved the greater use of smaller food packages harvested from both the land and sea. Here we are building upon recent eco-archaeological work undertaken elsewhere on the Central California coast (Point Reyes National Seashore) indicating that Native communities harvested grassland resources and facilitated the maintenance of coastal prairies at about the same time they were stewarding sustainable fisheries and shellfish populations in their territories. Full publication of these results awaits tribal input. The high points are as follows.

There is evidence for the intensive harvesting of grassland resources by at least 1300–1400 cal C.E., and previous paleoenvironmental investigations of the fire history of the Point Reyes National Seashore based on dendroecological, palynological, and charcoal accumulation studies strongly suggest cultural burning took place over at least the last 2,000 years (Cuthrell 2020; Lightfoot et al. 2020). Evidence also exists for the long-term stewardship of fisheries that allowed people to sustain the mass harvesting of small and medium-size forage fish, including Pacific herring (*Clupea pallasii*), Pacific sardines (*Sardinops sagax*), and Northern anchovies (*Engraulis mordax*), using nets and probably boats by at least 700 cal C.E. (Sanchez et al. 2018). Research undertaken by Sanchez (2020) suggests a relatively standard mesh size was employed in the use of gill nets over more than 1,300 years. This is interpreted

as strong evidence for Indigenous stewardship of the Clupeid fishery that allowed Indigenous fisher people to mass capture forage fish for many centuries without jeopardizing the long-term health of the herring and sardine populations.

Coast Miwok elders, ethnographic observations, and our recent eco-archaeological research suggest that Indigenous stewardship practices were employed to build and maintain clam gardens and to improve the productivity of native clam species through selective harvesting and habitat enhancement (Apodaca 2018; Grone 2020). A study of the average size of native littleneck clams (*Leukoma staminea*) from three Tomales Bay sites using a bivariate regression formula revealed a productive and diverse shellfishery maintained by Coast Miwok people over the past 1,300 years (Grone 2020:49–68).

Our investigation of the Santa Cruz sites indicates a similar transformation in Indigenous stewardship practices from Middle Holocene to Late Holocene times. The residents of Sand Hill Bluff from 4,800–2,200 cal B.C.E. implemented a generalized, broad-spectrum maritime economy that involved the harvesting and processing of a diverse range of shellfish, fishes, pelagic birds and shorebirds, marine mammals, kelp, and surfgrass. They gathered mussels throughout most of the year by both plucking and stripping them from patches that produced relatively large meat packages (Grone 2020:25–48, 2021). They fished for intertidal species such as surfperches, greenlings, rockfish, and skates, as well as a few small schooling fish probably captured in nets (Sanchez 2021a).

In Late Holocene times (e.g., 700–1500 C.E.), when we observe our first strong evidence for terrestrial stewardship practices involving intensive harvesting of grassland foods and cultural burning, we see a shift from the earlier generalized marine harvesting pattern to a more focused marine economy for the people who inhabited CA-SCR-10, CA-SCR-14, CA-SCR-15, and CA-SMA-113. All four of these Late Holocene sites appear to be residential sites situated a slight distance from the coast. We recognize that when people occupied nearby Late Holocene coastal sites they may have harvested a more diverse range of coastal resources (see Boone 2012; Gifford-Gonzalez et al. 2013:302–307). Yet despite this caveat, we do see a trend at the four interior residential sites for people to be more focused on smaller food-packages from not only the land but also the sea at this time. There was now a greater emphasis on the harvesting of small foraging fish, especially Clupeids, including herring and sardine and Northern anchovy, probably using nets (Sanchez 2021a; Gifford-Gonzalez et al. 2013:297–309). Kelp and surfgrass continued to be collected and transported to these sites. While mussels continued to be the primary shellfish gathered, they were smaller overall and gathered over a tighter period of the year (winter and spring). Furthermore, Native gatherers appear to have employed the stripping method of collecting that earmarked specific patches for intensive gathering while allowing other patches to remain fallow for two or more years. Grone's (2020, 2021) research suggests that people intensively stripped discrete patches for mussels and other ride alongs at a specific time of the year while letting other unused patches replenish their shellfish numbers. He argues that this stewardship practice facilitated the bulk collection of mussels while maintaining the sustainability of the shellfish population over time (see also Whitaker 2008).

An important outcome of our eco-archaeological work is the potential for developing a better understanding of how Indigenous people implemented strategies of resource intensification in Late Holocene times on the Central California coast. Resource intensification typically involves people working harder to increase the productivity per unit of area. It is well documented that this can result in decreasing foraging efficiency as people increasingly use costly, lower-ranked, small food packages, a process that is often associated with resource depression and the over-exploitation of larger prime food packages (Basgall 1987; Broughton 1994, 1999). Our research suggests another potential scenario—the process of resource intensification, in some times and places, may have involved Indigenous stewardship practices designed to enhance the diversity, quantity, and sustainability of both terrestrial and maritime resources in local places. Our findings from Central California indicate that some Native people in Late Holocene times incorporated stewardship practices that allowed them to intensify the harvesting of small food packages while still maintaining the long-term viability of specific kinds of resources, such as coastal prairies, fisheries, and shellfish populations. This is a research issue that we will consider in more detail in future work.

Goal 3: Is There Evidence that People Initiated Anthropogenic Burning at a Regional Scale on the Central California Coast?

Our study indicates that the evidence for anthropogenic landscape burning at Quiroste Valley by the ethnographically observed Quiroste people was not an isolated case (Hylkema and Cuthrell 2013). The investigation of sites on the Santa Cruz coast in the homeland of the historical Cotoni tribe indicates evidence for the maintenance of coastal prairies spanning back to 700–800 cal C.E. We also found evidence for frequent cultural burning at the Point Reyes National Seashore, the homeland of the Coast Miwok people, that extends back at least 600 years (Cuthrell 2020). Thus, our findings suggest that Indigenous cultural burning was part of a broader phenomenon that transcended the specific cultural histories and languages of local tribes. Our findings are thus far consistent with the hypothesis proposed by Weiser and Lepofsky (2009) that anthropogenic coastal prairies were once common on the Pacific Coast of North America, extending from southern British Columbia through Washington, Oregon, and into California in Late Holocene and Historic times.

Goal 4: How Can Lessons from the Past Generated by Eco-Archaeological Research Provide Useful Information for Tribes and Resource Agencies Today?

Eco-archaeological research provides valuable information for the Amah Mutsun Tribal Band and California State Parks to generate plans for ecological restoration programs, to facilitate various tribal revitalization programs, and to bring good fires back to the land. We have found that collaborative research teams comprised of tribal members, resource agency specialists, university faculty and students, and other scholars can produce an incredible synergy for unearthing new insights about the past that are very much applicable to our contemporary world. There is a growing appreciation for the important role that eco-archaeology can play in providing historical baselines for ecological restorations, conservation biology, and environmental management programs (e.g., Braje and Rick 2013; Lightfoot et al. 2013a; Lyman 2006; Rick and Erlandson 2008; Rick and Lockwood 2012). Our findings, summarized above, provide diachronically derived information about the nature of past anthropogenic fire regimes, the plants and animals that once flourished on the Santa Cruz coast, and the kinds of Indigenous stewardship practices that facilitated these productive habitats.

We emphasize that our shared goal for revitalizing the land and sea on the Santa Cruz coast is not to reconstruct a pre-colonial world. California is a very different place today than anything ever experienced in the past, given its immense population, the developing effects of global climate change, the expanding urban/wildland interface, fragmentary land holdings, multiple invasions of foreign plants and animals, air and water contamination, and the displacement of many tribes from their lands and environs, to name a few of its challenges. There is no going back. Nevertheless, collaborative eco-archaeological research can provide one path forward for understanding what these past worlds looked like and what might be incorporated in creating blueprints for developing protocols for better managing our landscapes and seascapes today. We believe that a crucial component for any ecological restoration program in California is incorporating local tribes and modern Indigenous stewardship practices into landscape and resource management plans (Lake 2021; Lake et al. 2018; Lightfoot 2021; Long et al. 2020a, 2020b; Marks-Block et al. 2021). These practices may include frequent cultural burning; fuel reduction programs designed to minimize the risks of major conflagrations; the removal of harmful invasive species; the enhancement of extant native species; and the reintroduction of native plants and animals that have become rare. An excellent example of the latter is the Amah Mutsun initiated project directed by Sanchez (2021b) that is investigating the native range of salmon recovered from eco-archaeological research that will provide crucial information for the AMTB and California State Parks for the future restoration and protection of streams and specific salmon species.

The accompanying article by Alexii Sigona, Alec Apodaca, and Valentin Lopez (this issue) outlines how the Amah Mutsun Tribal Band uses our collaborative eco-archaeological research on the broader Santa Cruz coast to facilitate their ongoing land and sea restoration programs and cultural educational curriculum. The tribe is committed to the ecological revitalization of their traditional territory and to bringing back many indigenous plants and animals that were recovered in our eco-archaeological research and that are now rare,

threatened, or locally extirpated. As described in the following paper, the tribe is employing their land trust, the AMLT, to facilitate the conservation and restoration of Indigenous cultural and natural resources within their traditional territory. The AMLT is working with various resource agencies (e.g., California State Parks, Bureau of Land Management) to bring back Indigenous stewardship practices through the employment of young tribal members as part of the Native Stewardship Corps. Sigona, Apodaca, and Lopez discuss the relevancy of the eco-archaeological work to these various programs that include bringing good fire back to the land, creating an Indigenous Cultural Resource Management Program, and the development of an Amah Mutsun Youth Camp.

CONCLUSIONS

We argue that low-impact, collaborative eco-archaeological work with tribes and resource agencies, as demonstrated by our on-going study of the Central California coast, can be of significant relevance to our modern world. Our conclusions may be summarized in three points.

First, our findings indicate that Indigenous stewardship of terrestrial and coastal resources took place over many centuries on the Central California coast. There is now evidence for the long-term maintenance of coastal prairies on the Santa Cruz coast extending back at least 1,200 years. We argue that Indigenous communities facilitated the development and sustainability of this ecosystem by igniting frequent cultural burns over many generations that greatly enhanced the quantity, diversity, and availability of fire-enhanced plants and animals in their territories. Coastal grasslands appear to have been a major component of the Central California coast and elsewhere along the Pacific Coast of North America before colonial and later historical fire suppression policies threatened their existence. There is also evidence along the broader Central California coast for Indigenous stewardship practices that enabled the long-term sustainability of important fisheries and shellfish populations over many centuries.

Second, most of our evidence for Indigenous landscape and seascape stewardship is associated with Late Holocene sites. We recognize that this may reflect a sampling bias that precludes the finding of eco-archaeological data concerning Indigenous stewardship in earlier sites. Most of our work has focused on Late Holocene sites located on or near the coast. Future investigations need to take place on more Middle Holocene and Late Holocene coastal sites, but particularly on sites of Middle and Late Holocene age situated in the interior. Our current findings indicate that the process of resource intensification in some times and places may have involved Indigenous stewardship practices designed to enhance the diversity, quantity, and sustainability of both terrestrial and maritime resources in local places. Our findings suggest that Native people incorporated stewardship practices into their lives so that they could intensify food harvests of small food packages while still maintaining the long-term viability of specific kinds of resources, such as coastal prairies, fisheries, and shellfish populations—an issue that will be considered further in future work.

Finally, we argue that there is immense potential for archaeologists to partner with tribes and resource agencies in undertaking eco-archaeological research on Indigenous landscape and seascape stewardship practices. Tribes across California are initiating programs designed to revitalize their languages, health, cultural practices, land bases, and intimate relationships with the environment. There is much that archaeologists can do to facilitate these programs through tribal partnerships. We can provide them with historical baselines by collecting a wealth of eco-archaeological data on the plants and animals once stewarded by Native people, as well as information on local environmental conditions, fire regimes, coastal water conditions, etc. The construction of regionally specific, historical baselines can provide important information for tribes and resource agencies for making decisions about the revitalization of biological communities and ecological restoration plans, the contemporary stewardship of terrestrial and coastal resources, and cultural education programs, as exemplified in the accompanying article by Sigona, Apodaca, and Lopez.

ACKNOWLEDGMENTS

Our collaborative, eco-archaeological project was generously funded by the National Science Foundation (BCS-1523648), the Research Institute for Humanity and Nature (RIHN), and the UC Berkeley Class of 1960 Chair in Undergraduate

Education. The work would not have been possible without the assistance, hard work, and support of members of the Amah Mutsun Tribal Band, the Amah Mutsun Land Trust, and the Native Stewardship Corps. We are indebted to the Santa Cruz District, California State Parks for their help in supporting the work and for providing camping facilities and other amenities. We thank Stephanie Mills for her kindness, encouragement, and continued interest in the project.

REFERENCES

Anderson, M. Kat
2005 *Tending the Wild: Native American Knowledge and the Management of California's Natural Resources*. Berkeley: University of California Press.

2018 The Use of Fire by Native Americans in California. In *Fire in California's Ecosystems*, Jan W. Van Wagtendonk, Neil G. Sugihara, Scott L. Stephens, Andrea E. Thode, Kevin E. Shaffer, and Joann Fites-Kaufman, eds., pp. 381–397. Berkeley: University of California Press.

Apodaca, Alec J.
2018 Exploring Clam Bed Tending at CA-MRN-202: Selective Harvesting of Pacific Gaper Clam (*Tresus nuttallii*) from the Toms Point Trading Post, in Tomales Bay, California. *Proceedings of the Society for California Archaeology* 32:305–318.

Baker, Rob
1992 The Clam "Gardens" of Tomales Bay. *News from Native California* 6(2):28–29.

Balée, William
1998 Historical Ecology: Premises and Postulates. In *Advances in Historical Ecology*, William Balée, ed., pp. 13–29. New York: Columbia University Press.

2006 The Resarch Program of Historical Ecology. *Annual Review of Anthropology* 35:75–98.

Balée, William, and Clark L. Erickson
2006 Time, Complexity, and Historical Ecology. In *Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands*, William Balée and Clark L. Erickson, eds., pp. 1–17. New York: Columbia University Press.

Barrett, Stephen W., Thomas Swetnam, and William L Baker
2005 Indian Fire Use: Deflating the Legend. *Fire Management Today* 65(3):31–34.

Basgall, Mark E.
1987 Resource Intensification among Hunter-Gatherers: Acorn Economies in Prehistoric California. *Research in Economic Anthropology* 9:21–52.

Bendix, Jacob
2002 Pre-European Fire in California Chaparral. In *Fire, Native Peoples, and the Natural Landscape*, Thomas R. Vale, ed., pp. 269–293. Covelo, California: Island Press.

Berkes, Firet, and Nancy Turner
2006 Knowledge, Learning and the Evolution of Conservation Practice for Social-Ecologial System Resilience. *Human Ecology* 34(4):479–494.

Blackburn, Thomas C., and Kat Anderson (eds.)
1993 *Before the Wilderness: Environmental Management by Native Californians*. Menlo Park, California: Ballena Press.

Boone, Cristie M.
2012 *Integrating Zooarchaeology and Modelling: Trans-Holocene Fishing in Monterey Bay, California*. Ph.D. dissertation, University of California, Santa Cruz.

Braje, Todd J., and Torben C. Rick
2013 From Forest Fires to Fisheries Management: Anthropology, Conservation Biology, and Historical Ecology. *Evolutionary Anthropology* 22:303–311.

Braje, Todd J., Jon M. Erlandson, Torben C. Rick,
Paul K. Dayton, and Marco B. A. Hartch
2009 Fishing from Past to Present: Continuity and Resilience of Red Abalone Fisheries on the Channel Islands, California. *Ecological Applications* 19(4):906–919.

Broughton, Jack M.
1994 Late Holocene Resource Intensification in Sacramento Valley, California: The Vertebrate Evidence. *Journal of Archaeological Science* 21:501–514.

1999 Resource Depression and Intensification during the Late Holocene, San Francisco Bay: Evidence from the Emeryville Shellmound Vertebrate Fauna. *Anthropological Records* 32. Berkeley, California: University of California Press.

Caldwell, Megan E., Dana Lepofsky, Georgia Combes,
Micelle Washington, John R. Welch, and John Harper
2012 A Bird's Eye View of Northern Coast Salish Intertidal Resource Management Features, Southern British Columbia, Canada. *Canada Journal of Island and Coastal Archaeology* 7(2):219–233.

California Native Grasslands Association
2021 Coastal Prairie Described At-A-Glance. *www.cnga.org/prairie*.

Cannon, Audrey, and Meghan Burchell
2009 Clam-Growth Stage Profiles as a Measure of Harvest Intensity and Resource Management on the Central Coast of British Columbia. *Journal of Archaeological Science* 36:1050–1060.

Castillo, Edward D.
1978 The Impact of Euro-American Exploration and Settlement. In *Handbook of North American Indians, Volume 8, California*, Robert F. Heizer, ed., pp. 99–127. Washington, D.C.: Smithsonian Institution.

Codero-Lamb, Julie, Jared Dahl Aldern, and Teresa Romero
2018 Bring Back the Good Fires. *News from Native California* 31(3):14–17.

Crumley, Carole L.
1994 Historical Ecology: A Multidimensional Ecological Orientation. In *Historical Ecology: Cultural Knowledge and Changing Landscapes*, Carole L. Crumley, ed., pp. 1–16. Santa Fe, New Mexico: School of American Research Press.

Cuthrell, Rob Q.
2013a Archaeobotanical Evidence for Indigenous Burning Practices and Foodways at CA-SMA-113. *California Archaeology* 5(2):265–290.

2013b *An Eco-Archaeological Study of Late Holocene Indigenous Foodways and Landscape Management Practices at Quiroste Valley Cultural Preserve, San Mateo County, California*. Ph.D. dissertation, University of California, Berkeley.

2020 Analysis of Archaeobotanical and Phytolith Materials. In *Historical Ecology and Archaeology of Landscapes at Point Reyes National Seashore (HEALPR)*, Kent G. Lightfoot, Rob Q. Cuthrell, Peter A. Nelson, Michael A. Grone, Gabriel M. Sanchez, Roberta A. Jewett, Nick Tipon, Alec J. Apodaca, and Ariadna Gonzalez, eds. Report on file at the Archaeological Research Facility, University of California, Berkeley.

2021a Archaeobotanical Data from Nine Sites on the Central California Coast: Implications for Indigenous Ethnobotanical Practices and Prescribed Burning. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

2021b Archaeobotanical Research at Eight Archaeological Sites West of the Santa Cruz Mountains: Implications for Subsistence Practices and Anthropogenic Burning. In *The Study of Indigenous Landscape and Seascape Stewardship Practices on the Santa Cruz Coast: A Collaborative Eco-Archaeological Approach*, Kent G. Lightfoot, Rob Q. Cuthrell, Mark G. Hylkema, Valentin Lopez, Diane Gifford-Gonzalez, Roberta A. Jewett, Michael A. Grone, Gabriel M. Sanchez, Peter A. Nelson, Alec J. Apodaca, Ariadna Gonzalez, Kathryn Field, and Alexii Sigona, eds. Report on file at the Archaeological Research Facility, University of California, Berkeley.

Erickson, Clark L.
2006 The Domesticated Landscapes of the Bolivian Amazon. In *Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands*, William Balée and Clark L. Erickson, eds., pp. 235–278. New York: Columbia University Press.

Erickson, Clark L., and William Balée
2006 The Historical Ecology of a Complex Landscape in Bolivia. In *Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands*, William Balée and Clark L. Erickson, eds., pp. 187–233. New York: Columbia University Press.

Erlandson, Jon M., Torben C. Rick, Todd J. Braje, Alexis Steinberg, and Rene L. Vellanoweth
2008 Human Impacts on Ancient Shellfish: A 10,000 Year Record from San Miguel Island, California. *Journal of Archaeological Science* 35:2144–2152.

Erlandson, Jon M., Torben C. Rick, and Todd J. Braje
2009 Fishing Up the Food Web? 12,000 Years of Maritime Subsistence and Adaptive Adjustments on California's Channel Islands. *Pacific Science* 63:711–724.

Fine, Paul V. A., Cameron S. Milne, Beth Shapiro, Diane Gifford-Gonzalez, Gabriel M. Sanchez, and Kent G. Lightfoot
2021 The Use of Ancient DNA to Investigate Movement of Vole Populations during the Past 7,000 Years: Implications for Past Land Management Practices. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Fowler, Catherine S., and Dana Lepofsky
2011 Traditional Resource and Environmental Management. In *Ethnobiology*, E. N. Anderson, Deborah Pearsall, Eugene Hunn, and Nancy Turner, eds., pp. 285–304. New York: Wiley-Blackwell

Gifford-Gonzalez, Diane
2021 Faunal Contributions to Landscape Management Research on the Central Coast of California. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Gifford-Gonzalez, Diane, Cristie M. Boone, and Rachel E. B. Reid
2013 The Fauna from Quiroste: Insights into Indigenous Foodways, Culture, and Land Modification. *California Archaeology* 5(2):291–317.

Gonzalez, Ariadna, and Kathryn Field
2021 The Analysis of Artifacts from Four Santa Cruz Sites. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Gonzalez, Ariadna, Kathryn Field, and Kent G. Lightfoot
2021 The Analysis of Lithic Artifacts. In *The Study of Indigenous Landscape and Seascape Stewardship Practices on the Santa Cruz Coast: A Collaborative Eco-Archaeological Approach*, Kent G. Lightfoot, Rob Q. Cuthrell, Mark G. Hylkema, Valentin Lopez, Diane Gifford-Gonzalez, Roberta A. Jewett, Michael A. Grone, Gabriel M. Sanchez, Peter A. Nelson, Alec J. Apodaca, Ariadna Gonzalez, Kathryn Field, and Alexii Sigona, eds. Report on file at the Archaeological Research Facility, University of California, Berkeley.

Gonzalez, Sara L.
2016 Indigenous Values and Methods in Archaeological Practice: Low-Impact Archaeology through the Kashaya Pomo Interpretive Trail Project. *American Antiquity* 81(3):533–549.

Goode, Ron W.
2015 Tribal-Traditional Ecological Knowledge. *News from Native California* 3:23–28.

Grier, Colin
2014 Landscape Construction, Ownership and Social Change in the Southern Gulf Islands of British Columbia. *Canadian Journal of Archaeology* 38:211–249.

Groesbeck, Amy S., Kirsten Rowell, Dana Lepofsky, and Anne K. Salomon
2014 Ancient Clam Gardens Increased Shellfish Production: Adaptive Strategies From the Past Can Inform Food Security Today. *PLoS One* (3): e91235. Doi:91210.91371/journal.pone.0091235.

Grone, Michael A.
2020 *Of Molluscs and Middens: Historical Ecology of Indigenous Shoreline Stewardship along the Central Coast of California*. Ph.D. dissertation, University of California, Berkeley.
2021 Ancient Mussel Bed Harvesting and Indigenous Stewardship Practices on the Central California Coast. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Hankins, Don
2021 Reading the Landscape for Fire. *Bay Nature* 21(1): 28–35.

Heizer, Robert F., and Alan F. Almquist
1971 *The Other Californians: Prejudice and Discrimination under Spain, Mexico, and the United States to 1920*. Berkeley, California: University of California Press.

Hildebrandt, William R., Deborah A. Jones, and Mark G. Hylkema
2007 *Sand Hill Bluff Site: CA-SCR-7*. National Register of Historic Places Registration Form. MS on file at California Department of Parks and Recreation, Sacramento, California.

Hurtado, Albert L.
1988 *Indian Survival on the California Frontier*. New Haven, Connecticut: Yale University Press.

Hylkema, Mark G.
1991 Prehistoric Native American Adaptations along the Central California Coast of San Mateo and Santa Cruz Counties. Master's thesis, San Jose State University.
2002 Tidal Marsh, Oak Woodlands, and Cultural Florescence in the Southern San Francisco Bay Region. In *Catalysts to Complexity: The Late Holocene on the California Coast*, Jon Erlandson and Terry Jones, eds., pp. 233–262. Los Angeles, California: Cotsen Institute of Archaeology, University of California, Los Angeles.
2021 Middle Holocene Projectile Points from the Santa Cruz Coast of Northern Monterey Bay. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Hylkema, Mark G., and Rob Q. Cuthrell
2013 An Archaeological and Historical View of Quiroste Tribal Genesis. *California Archaeology* 5(2):225–245.

Jones, Deborah A., and William R. Hildebrandt
1990 *Archaeological Excavation at Sand Hill Bluff: Portions of a Prehistoric Site CA-SCR-7, Santa Cruz County, California*. Davis, California: Far Western Anthropological Research Group, Inc.
1994 *Archaeological Investigations at Sites CA-SCR-10, CA-SCR-17, CA-SCR-304, and CA-SCR-38/123 for the North Coast Treated Water Main Project, Santa Cruz County, California*. Davis, California: Far Western Anthropological Research Group, Inc.

Jones, Terry L., and Jennifer R. Richman
1995 On Mussels: *Mytilus californianus* as a Prehistoric Resource. *North American Archaeologist* 16(1):33–58.

Jones, Terry L., Gary M. Brown, L. Mark Raab, Janet L. McVickar, W.Geoffrey Spaulding, Douglas J. Kennett, Andrew York, and Phillip L. Walker
1999 Environmental Imperatives Reconsidered: Demographic Crises in Western North America during the Medieval Climatic Anomaly. *Current Anthropology* 40(2):137–170.

Jones, Terry L., Judith F. Porcasi, Jon M. Erlandson, H. Dallas, T. A. Wake, and R. Schwaderer
2008 The Protracted Holocene Extinction of California's Flightless Sea Duck (*Chendytes lawi*) and Its Implications for the Pleistocene Overkill Hypothesis. *Proceedings of the National Academy of Sciences* 105 (11):4105–4108.

Klimaszewski-Patterson, Anna, Peter J. Weisberg, Scott A. Mensing, and Robert M. Scheller
2018 Using Paleolandscape Modeling to Investigate the Impact of Native American-Set Fires on Pre-Columbian Forests in the Southern Sierra Nevada, California, USA. *Annals of the American Association of Geographers* 108(6):1635–1654.

Klimaszewski-Patterson, Anna, Christopher T. Morgan, and Scott A. Mensing
2021 Identifying a Pre-Columbian Anthropocene in California. *Annals of the American Association of Geographers* 111(3):784–794.

Kraft, Kathleen, Claudia Luke, Kathleen Harrison, Linda Esposito, and Jackie Sones
2007 *Conservation Priorities for Coastal Prairie in Sonoma and Marin Counties. Proceedings of the Sonoma-Marin Coastal Prairie Workshop, November 6, 2006, UC Davis Bodega Marine Laboratory, Bodega Bay, California*. Occidental, California: Ocean Song Farm and Wilderness Center.

Lake, Frank K.
2021 Indigenous Fire Stewardship: Federal/Tribal Partnerships for Wildland Fire Research and Management. *Fire Management Today* 79(1):30–39.

Lake, Frank K., and Amy C. Christianson
2019 Indigenous Fire Stewardship. In *Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires*, Samuel L. Manzello, ed. https://doi.org/10.1007/978-3-319-51727-8_225-1: Springer, Cham.

Lake, Frank K., Vita Wright, Penelope Morgan, Mary McFadzen, Dave McWethy, and Camille Stevens-Rumann
2017 Returning Fire to the Land: Celebrating Traditional Knowledge and Fire. *Journal of Forestry* 115(5):343–353.

Lake, Frank K., J. A. Parrotta, C. P. Giardian, I. Davidson-Hunt, and Y. Uprety
2018 Integration of Traditional and Western Knowledge in Forest Landscape Restoration. In *Forest Landscape Restoration: Integrated Approaches to Support Effective Implementation*, S. Mansourian and J. Parrotta, eds., pp. 198–226. New York: Routledge.

Lepofsky, Dana
2009 The Past, Present and Future of Traditional Resource and Environmental Management. *Journal of Ethnobiology* 29(2):161–166.

Lepofsky, Dana, and Megan E. Caldwell
2013 Indigenous Marine Resource Management on the Northwest Coast of North America. *Ecological Processes* 2(12):1–12.

Lepofsky, Dana, Nicole F. Smith, Nathan Cardinal, John Harper, Mary Morris, G. Eloy White, Randy Bouchard, Dorothy I. D. Kennedy, Anne K. Salomon, Michelle Puckett, and Kirsten Rowell
2015 Ancient Shellfish Mariculture on the Northwest Coast of North America. *American Antiquity* 80(2):236–259.

Lewis, Henry T.
1993 Patterns of Indian Burning in California: Ecology and Ethnohistory. In *Before the Wilderness: Environmental Management by Native Californians*, Thomas C. Blackburn and Kat Anderson, eds., pp. 55–116. Menlo Park, California: Ballena Press.

Lightfoot, Kent G.
2005 *Indians, Missionaries, and Merchants: The Legacy of Colonial Encounters on the California Frontiers*. Berkeley, California: University of California Press.
2008 Collaborative Research Programs: Implications for the Practice of North American Archaeology. In *Collaborating at the Trowel's Edge: Teaching and Learning in Indigenous Archaeology*, Stephen W. Silliman, ed., pp. 211–227. Tucson, Arizona: University of Arizona Press.
2021 Catastrophic Fires, Colonialism, and the Revitalization of Indigenous Cultural Burning in California. Hot Spots, *Fieldsights*, July 27. https://culanth.org/fieldsights/catastrophic-fires-colonialism-and-the-revitalization-of-indigenous-cultural-burning-in-california.

Lightfoot, Kent G., and Otis Parrish
2009 *California Indians and their Environment: An Introduction*. Berkeley, California: University of California Press.

Lightfoot, Kent G., and Valentin Lopez
2013 The Study of Indigenous Management Practices in California: An Introduction. *California Archaeology* 5(2):209–219.

Lightfoot, Kent G., Rob Q. Cuthrell, Chuck J. Striplen, and Mark G. Hylkema
2013a Rethinking the Study of Landscape Management Practices Among Hunter-Gatherers in North America. *American Antiquity* 78(2):285–301.

Lightfoot, Kent G., Rob Q. Cuthrell, Cristie M. Boone, Roger Byrne, Andrea B. Chavez, Laurel Collins, Alicia Cowart, Rand R. Evett, Fine V. A. Paul, Diane Gifford-Gonzalez, Mark G. Hylkema, Valentin Lopez, Tracy M. Misiewicz, and Rachel E. B. Reid
2013b Anthropogenic Burning on the Central California Coast in Late Holocene and Early Historical Times: Findings, Implications, and Future Directions. *California Archaeology* 5(2):371–390.

Lightfoot, Kent G., Rob Q. Cuthrell, Peter A. Nelson, Michael A. Grone, Gabriel M. Sanchez, Roberta A. Jewett, Nick Tipon, Alec J. Apodaca, and Ariadna Gonzalez
2020 *Historical Ecology and Archaeology of Landscapes at Point Reyes National Seashore (HEALPR).* Report on file at the Archaeological Research Facility, University of California, Berkeley.

Lightfoot, Kent G., Rob Q. Cuthrell, Mark G. Hylkema, Valentin Lopez, Diane Gifford-Gonzalez, Roberta A. Jewett, Michael A. Grone, Gabriel M. Sanchez, Peter A. Nelson, Alec J. Apodaca, Ariadna Gonzalez, Kathryn Field, and Alexii Sigona
2021 *The Study of Indigenous Landscape and Seascape Stewardship Practices on the Santa Cruz Coast: A Collaborative Eco-Archaeological Approach.* Report on file at the Archaeological Research Facility, University of California, Berkeley.

Lindsay, Brendan C.
2012 *Murder State: California Native American Genocide 1846–1873*. Lincoln, Nebraska: University of Nebraska Press.

Long, Jonathan W., Frank K. Lake, Ron W. Goode, and Benrita Mae Burnette
2020a How Traditional Tribal Perspectives Influence Ecosystem Restoration. *Ecopsychology* 12(2):71–82.

Long, Jonathan W., Ron W. Goode, and Frank K. Lake
2020b Recentering Ecological Restoration with Tribal Perspectives. *Fremontia* 48(1):14–19.

Lopez, Valentin
2013 The Amah Mutsun Band: Reflections on Collaborative Archaeology. *California Archaeology* 5(2):221–223.
2021 The Study of Indigenous Landscape and Seascape Stewardship Practices: Taking It to the Next Step. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Lyman, Lee
2006 Paleozoology in the Service of Conservation Biology. *Evolutionary Anthropology* 15:11–19.

Madley, Benjamin
2016 *An American Genocide: The United States and the California Indian Catastrophe*. New Haven, Connecticut: Yale University Press.

Marks-Block, Tony, Frank K. Lake, and Lisa M. Curran
2019 Effects of Understory Fire Management Treatments on California Hazelnut, An Ecocultural Resource of the Karuk and Yurok Indians in the Pacific Northwest. *Forest Ecology and Management* 450:1–12.

Marks-Block, Tony, Frank K. Lake, Rebecca Bliege Bird, and Lisa M. Curran
2021 Revitalizing Karuk and Yurok Cultural Burning to Enhance California Hazelnut for Basketweaving in Northwestern California, USA. *Fire Ecology* 17(6): https://doi.org/10.1186/s42408-42021-00092-42406.

Nelson, Peter A.
2021 Ground Penetrating Radar Survey on the Santa Cruz Coast. Paper presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper archived by the Society for California Archaeology.

Ornduff, Robert, Phyllis M. Faber, and Todd Keeler-Wolf
2003 *Introduction to California Plant Life*. Revised ed. California Natural History Guides 69. Berkeley, California: University of California Press.

Rick, Torben C., and Jon M. Erlandson (eds.)
2008 *Human Impacts on Ancient Marine Ecosystems: A Global Perspective*. Berkeley, California: University of California Press.

Rick, Torben C., and Bowman Lockwood
2012 Integrating Paleobiology, Archaeology, and History to Inform Biological Conservation. *Conservation Biology* 27(1):45–54.

Sanchez, Gabriel M.
2020 Indigenous Stewardship of Marine and Estuarine Fisheries?: Reconstructing the Ancient Size of Pacific Herring through Linear Regression Models. *Journal of Archaeological Science Reports* 29(https://doi.org/10.1016/j.jasrep.2019.102061).

2021a Middle and Late Holocene Faunal Remains from the Santa Cruz Coast In *The Study of Indigenous Landscape and Seascape Stewardship Practices on the Santa Cruz Coast: A Collaborative Eco-Archaeological Approach*, Kent G. Lightfoot, Rob Q. Cuthrell, Mark G. Hylkema, Valentin Lopez, Diane Gifford-Gonzalez, Roberta A. Jewett, Michael A. Grone, Gabriel M. Sanchez, Peter A. Nelson, Alec J. Apodaca, Ariadna Gonzalez, Kathryn Field, and Alexii Sigona, eds. Report Prepared for California Department of Parks and Recreation, Santa Cruz District.Berkeley, California:Archaeological Research Facility, University of California.

2021b Investigating the Native Range of California's Endangered Anadromous Salmon. Paper Presented at the 2021 Annual Meeting for the Society for California Archaeology, A Virtual Event. Paper Archived by the Society for California Archaeology.

Sanchez, Gabriel M., Kenneth Gobalet, Roberta A. Jewett, Rob Q. Cuthrell, Michael Grone, Paul Engel, and Kent G. Lightfoot
2018 The Historical Ecology of Central California Coast Fishing: Perspectives from Point Reyes National Seashore. *Journal of Archaeological Science* 100:1–15.

Sanchez, Gabriel M., Michael A. Grone, Alec J. Apodaca, Scott Byram, Valentin Lopez, and Roberta A. Jewett
2021 Sensing the Past: Perspectives on Collaborative Archaeology and Ground Penetrating Radar Techniques from Central California. *Remote Sensing* 13:285. https://doi.org/10.3390/rs13020285.

Scharf, Elizabeth A.
2014 Deep Time: The Emerging Role of Archaeology in Landscape Ecology. *Landscape Ecology* 29:563–569.

Stephens, Scott L., and Danny L. Fry
2005 Fire History in Coast Redwood Stands in the Northeastern Santa Cruz Mountains, California. *Fire Ecology* 1(1):2–19.

Stephens, Scott L., and Neil G. Sugihara
2018 Fire Management and Policy since European Settlement. In *Fire in California's Ecosystem*, Jan W. Van Wagtendonk, Neil G. Sugihara, Scott L. Stephens, Andrea E. Thode, Kevin E. Shaffer, and Joann Fites-Kaufman, eds., pp. 399–410. Berkeley, California: University of California Press.

Timbrook, Jan, John R. Johnson, and David D. Earle
1993 Vegetation Burning by the Chumash. In *Before the Wilderness: Environmental Management by Native Californians*, Thomas C. Blackburn and Kat Anderson, eds., pp. 117–149. Menlo Park, California: Ballena Press.

Turner, Nancy
2005 *The Earth's Blanket: Traditional Teaching for Sustainable Living*. Seattle, Washington: University of Washington Press.

Vale, Thomas R.
1998 The Myth of the Humanized Landscape: An Example from Yosemite National Park. *Natural Areas Journal* 18(3):231–236.

Weiser, Andrea, and Dana Lepofsky
2009 Ancient Land Use and Management of Ebey's Prairie, Whidbey Island, Washington. *Journal of Ethnobiology* 29(2):184–212.

Whitaker, Adrian
2008 Incipient Aquaculture in Prehistoric California?: Long-term Productivity and Sustainability vs. Immediate Returns for the Harvest of Marine Invertebrates. *Journal of Archaeological Science* 35(4):1114–1123.