

## Sensing the Past: Perspectives on Remote Sensing and Collaborative Archaeology from Coastal California

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**Abstract:** This paper summarizes over a decade of collaborative eco-archaeological research along the central coast of California involving researchers from the University of California, Berkeley, tribal citizens from the Amah Mutsun Tribal Band, and California Department of Parks and Recreation archaeologists. Our research employs remote sensing methods to document and assess cultural resources threatened by coastal erosion and geophysical methods to identify archaeological deposits, minimize impacts on sensitive cultural resources, and provide tribal and state collaborators with a suite of data to consider before proceeding with any form of invasive archaeological excavation. Our case study of recent eco-archaeological research developed to define the historical biogeography of threatened and endangered anadromous salmonids demonstrates how remote sensing technologies help identify dense archaeological deposits, remove barriers, and create bridges through equitable and inclusive research practices between archaeologists and the Amah Mutsun Tribal Band. These experiences have resulted in the incorporation of remote sensing techniques as a central approach of the Amah Mutsun Tribal Band when conducting archaeology in their traditional territories.

**Keywords:** Amah Mutsun Tribal Band; Indigenous archaeology; Collaborative archaeology; Community-based participatory research; California archaeology; Indigenous stewardship

## Introduction

Over a decade ago, Kent Lightfoot [1] advocated for a rethinking of archaeological research designs and demonstrated how equitable, inclusive, and community-based participatory research practices facilitated research with the Kashaya Pomo tribe in northern California while including the perspectives of a diversity of stakeholders, including Russian citizens, local Sonoma County residents, and other local tribal nations. In his seminal paper, Lightfoot [1] argued for implementing low-impact and “surgical” excavation strategies conceptualized using a medical analogy model, suggesting that researchers fully evaluate surface, near-surface, and subsurface materials via low-impact techniques before implementing invasive subsurface excavations.

These low-impact and minimally-invasive field strategies to document the structure of an archaeological site involve several stages, as outlined by Lightfoot [1]. First, researchers begin with a comprehensive mapping of the site(s) via topographic maps, digital elevations models, and/or terrestrial and aerial LiDAR. Second, researchers establish a grid system for surface survey at systematic intervals and conduct intensive surface collection with standardized sampling, recovery, and quantification strategies. These data from near-surface deposits are used to create isopleth maps for each material class encountered, providing critical data about potential activity areas, house features, and assisting in the location of potentially dense and diverse surface and subsurface materials. Third, researchers conduct geophysical surveys of the site, including ground-penetrating radar, magnetometry, and electromagnetic resistivity, especially in promising locations identified in earlier research phases. Lastly, based on the findings from previous research phases, collaborators work together to identify locations of interest for subsurface excavations. The strategies to record site composition offered by Lightfoot [1] contrasted with common exploratory excavation strategies in use within California archaeology at the time. Beginning with the least intrusive field methods before proceeding to more highly intrusive methods, this multistage research approach allows earlier stages of research to inform subsequent stages and provides crucial flexibility for collaborative archaeological projects.

This innovative research design and development of low-impact field methods advocated by Lightfoot [1] over a decade ago have influenced a new generation of archaeologists and continue to be refined (2). These approaches have been implemented across California and beyond to study European colonialism (3–7), Native Californian persistence (8–10), indigenous fire management strategies (11–17), and the stewardship of marine and estuarine fisheries by Amah Mutsun and Coast Miwok ancestors (18–21). In all these examples, the field methods advocated by Lightfoot [1] were critical to guiding subsequent subsurface excavation strategies, along with studying and integrating the cultural heritage of Native Californian tribal communities. Nonetheless, the low-impact field procedures advocated by Lightfoot [1] have not been explicitly reported and illustrated in previous studies (20,21). In this paper, we attempt to remedy this dearth of data.

This paper outlines a recent community-based collaborative archaeological research project with the Amah Mutsun Tribal Band that implements geophysical techniques and low-impact archaeological methods to investigate human-environmental and human-salmon relationships of relevance to the goals of Amah Mutsun, California State Parks, other state and federal agencies, and conservation groups. Specifically, our project is directed towards the recovery of ancient anadromous salmon (*Oncorhynchus* sp.) remains to provide historical

datasets of salmon distribution and genetic diversity. We demonstrate how advances in archaeological geophysics and their implementation by California archaeologists were a critical component in trust-building between the Amah Mutsun Tribal Band and University of California archaeologists. Based on examples from our recent field research and other case studies that span over a decade, we demonstrate that the implementation of archaeological geophysics has become a fundamental approach of the Amah Mutsun Tribal Band when conducting archaeological research in their traditional territories.

### *Background*

#### *Collaborative eco-archaeology with the Amah Mutsun, UC-Berkeley, and California State Parks*

The Amah Mutsun Tribal Band are the descendants of the indigenous peoples forcefully removed from their traditional territories spanning portions of present-day San Mateo, Santa Cruz, San Benito, San Jose, and Monterey counties and taken to Mission San Juan Bautista and Mission Santa Cruz. Since time immemorial, the Amah Mutsun Tribal Band's ancestors have accumulated knowledge of human-environmental relationships in central California (17). However, because of Spanish missionization from 1769 to 1821, which worked to suppress indigenous cultural practices and erode tribal culture, tribal knowledge was altered, and other traditions lost. Furthering these changes were the seven missions established within the Amah Mutsun's traditional territories between 1770-97 and Spanish laws prohibiting indigenous burning practices (17,22). During the Mexican Period (1821-48), the secularization of the missions in 1834-36 by the Mexican government resulted in indigenous people leaving the missions to work as manual laborers on the ranchos established in lands previously held by the missions and now under the control of Mexico (22,23). With the onset of the American Period (1850-present), state and federal officials sanctioned and facilitated a coordinated genocide of California's indigenous peoples between 1848 and 1900 (24-29).

Furthermore, as outlined by Madley (30), disease, dislocation, and starvation increased the number of deaths. Abduction, forced labor, high mortality rates on reservations, unrelenting murders, and battles and atrocious massacres by state militias and federal troops also took countless lives (30). Therefore, throughout these three periods of colonialism, the Amah Mutsun and other indigenous people's main concern was survival (17). Most California tribes, including the Amah Mutsun, were unable to continue passing on their indigenous knowledge regarding traditional resource and environmental management practices and other cultural traditions (17), which led to these practices becoming dormant in later historic times.

In 2007, archaeologists from UC-Berkeley approached the Amah Mutsun Tribal Band to initiate an eco-archaeological study of indigenous fire use in central California at Quiroste Valley in Año Nuevo State Park (31). Initial archaeological surveys in the Quiroste Valley during the 1980s resulted in the recording of over a dozen ancient and historic sites. During 2004-06, Cabrillo Community College led test excavations and obtained radiocarbon dating assays that suggested a contact era site within the valley, potentially *Casa Grande*, a Quiroste village visited by the Portola expedition in 1769 (31). A collaborative project involving California State Parks, the Amah Mutsun Tribal Band, and UC-Berkeley was initially facilitated by Chuck Striplen, an Amah Mutsun tribal member and a former Ph.D. student in the Department of Environmental Science and Policy Management who was pursuing dissertation research on fire ecology and the historical ecology of California's forests.

Through this partnership, a collaborative enterprise was developed to study anthropogenic burning and indigenous landscape management practices in Quiroste Valley

(11,17). While initially hesitant of archaeology and collaborating with archaeologists, the Amah Mutsun approved the archaeological research. Their decision was based on an agreement made with the archaeologists to minimize impacts to any sites investigated and to avoid the unnecessary disturbance of sensitive cultural materials—such as human remains and sacred objects—through low-impact archaeological methods, including geophysics. Therefore, advances in archaeological geophysics and their incorporation in low-impact field strategies were critical in this research. The collaborative program emphasized the inclusion of tribal members in all phases of research and recognized the final decision-making authority of the Amah Mutsun Tribal Band (17). As a result of these agreements, the Amah Mutsun Tribal Band, researchers from the Department of Anthropology, UC-Berkeley, and California State Parks initiated field research in the Quiroste Valley in 2007.

By 2009, California State Parks had created the 220-acre Quiroste Valley Cultural Preserve that is co-managed by the Amah Mutsun. The cultural preserve was established to protect cultural resources, restore native vegetation, and re-implement traditional resource and environmental management practices. In 2012, the Amah Mutsun Native Stewardship Corps was formed to involve young adult tribal members in the conservation and research of the tribe and the Amah Mutsun Land Trust (AMLT)—a nonprofit organization directed toward conservation, restoration, stewardship, education, and research on aboriginal lands. The AMLT, the Native Stewardship Corps, and the Amah Mutsun's active conservation and research result from a 2005 decision by the Amah Mutsun Tribal Council that the community must re-engage in the stewardship of their traditional territories. Therefore, after many years of struggle to regain access to their traditional territories and practices, the Amah Mutsun are now working to restore the indigenous knowledge that was suppressed during colonization (17). Given that they do not currently possess landholdings within their tribal territory, the stewardship of their traditional lands has been facilitated by creating partnerships with public and private landowners.

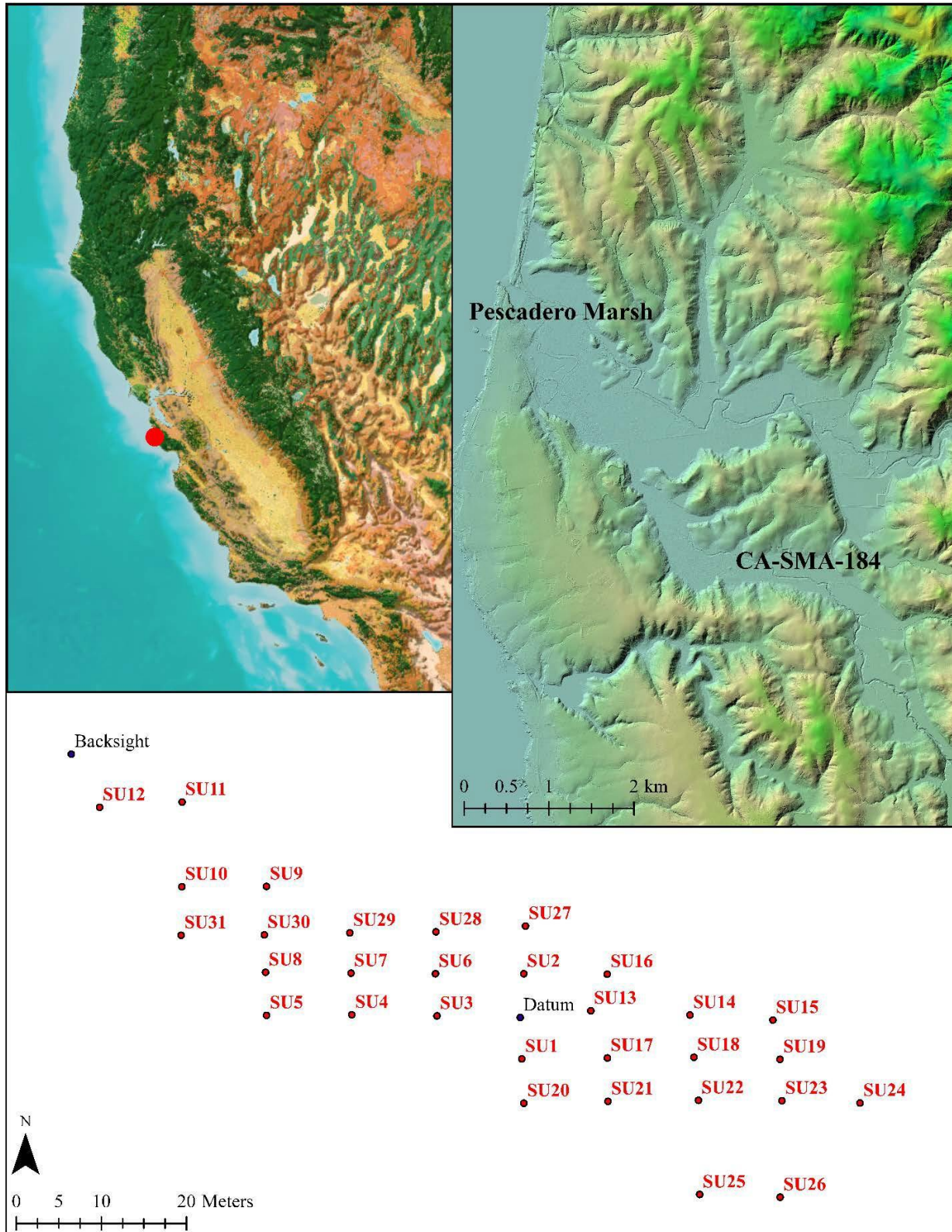
### *Current project*

In 2018, at the request of Valentin Lopez, Chairman of Amah Mutsun Tribal Band, Sanchez initiated an eco-archaeological and museum-based research project to provide information on the historical ecology of anadromous salmon (*Oncorhynchus* sp.) and other ecological constituents of relevance to the tribe (12–14,16,17). The research project aims to inform the conservation and management of native salmon species in San Mateo, Santa Cruz, and Monterey Counties, given recent debates regarding the historical biogeography of native anadromous salmon and the potential extirpation or extinction of these cultural keystone species (20,21). California is home to 32 distinct salmonid fishes, either endemic to California or at the southern extent of their ranges (32). Research suggests California will lose more than half of its native salmonids in the next half-century (32). Restoration of these iconic organisms requires protection and rehabilitation of coastal streams and habitat and the protection of salmonid genetic diversity.

Despite pressing concerns regarding anadromous salmonids' extirpation, their historical biogeography is still highly debated (33–36). Some researchers have argued that the endangered Coho salmon (*Oncorhynchus kisutch*) is not native south of the San Francisco Bay (36), while others suggest Coho are native as far south as Santa Cruz County (33,34). Given that species are most susceptible to extinction and extirpation at the edge of their ranges (37), clarifying the biogeographical extent of anadromous salmonids along the central California coast is highly relevant. While their native status is still under debate, Coho salmon and steelhead (*O. mykiss*

*irideus*) south of San Francisco are listed as endangered under the Federal Endangered Species Act and the California Endangered Species Act (32,36). Knowledge of the historical presence and extent of Coho salmon and steelhead biogeography is necessary to guide restoration planning and future management decision-making. To facilitate our salmonid research, we partnered with Peninsula Open Space Trust and California Department of Parks and Recreation to identify archaeological sites in San Mateo, Santa Cruz, and Monterey Counties and archaeological museum collections adjacent to known or probable salmonid streams.

In the summer of 2019, we initiated a field project at CA-SMA-184, known as the Butano Mound that is preserved and managed by Peninsula Open Space Trust (Figure 1). Butano Mound was selected as an initial project area for three reasons. First, the site is located near Butano Creek that may have historically supported both Coho salmon and steelhead (38). Second, in the summer of 2019, the Butano Creek Reconnection Project was initiated and was designed to remove sediments in the Butano Creek and Pescadero Marsh in order to support salmon conservation and habitat rehabilitation efforts (39). Therefore, our historical ecological research of the Butano Mound had the potential to provide data that could inform current and future salmon conservation in the immediate study area. Third, a previous archaeological survey of the Butano Mound suggested the site was a village and thus offered the opportunity to recover highly dense and diverse cultural materials that might include salmonid remains from food-related activities given its proximity to Butano Creek and the Pescadero Marsh (40).



**Figure 1. Left:** Overview of the California coast with the general location of the project area. **Right:** Inset map of the project area and the location of the Butano Mound and Pescadero Marsh.

**Bottom:** Schematic of the surface survey units. The exact location of the mound is excluded to protect the site.

## Methods and Materials

We initiated our field research at the Butano Mound by establishing a datum and backsight using a Trimble GeoXH600 receiver with a Trimble Tornado GNSS antenna capable of providing sub-centimeter accuracy (Figure 1). The datum was established near the mound's central apex based on digital elevation models referenced during the project's background research phase. Next, we used a Sokia SET 530r3 Total Station to establish a surface survey grid comprised of 31 units. Survey units were spaced at 5 m intervals along the north/south axis and 10 m intervals along the east/west axis to establish site boundaries. Three crews, each comprised of two field members, surveyed each surface survey unit with the following established low-impact and catch and release surface survey methods (1,2).

First, we created a 40 cm radius circle applying the "dog-leash" method (41) from each unit datum to establish the unit's boundaries. Next, field crews removed surface vegetation within their unit to expose cultural materials. Then, crews collected three liters of sediment, sampling equally from all sections of the unit. The three liters were screened over 1/8" mesh sieves, and all cultural materials sorted, counted, weighed, and recorded *in situ*. After each unit was analyzed, cultural materials were returned to their respective units. These data were then quantified to provide density maps of cultural materials (i.e., faunal remains, lithics, fire-cracked rock, and shellfish remains) in order to identify locations with dense and diverse shell midden deposits (Figure 2).

To analyze surface material densities, we applied the kernel density tool from the spatial analyst toolbox and density toolset in ArcMap 10.7 to create density maps (42). The kernel density estimations calculated the respective materials classes (i.e., faunal remain counts, Monterey chert, fire-cracked rock, and total shellfish weight) per square meter and were created using the GEODESIC method (42). These material classes are used as proxies for various human activities and practices of interest, such as food processing and preparation (shellfish, fauna, fire-cracked rock) and stone tool maintenance and production (Monterey chert). The results of the surface surveys and density maps provided insightful information on the site structure and spatial patterning of archaeological remains across the Butano Mound that was incorporated into our decision-making concerning subsequent fieldwork.

Based on the surface survey results and density estimations, we established two ground-penetrating radar grids to investigate locations that appeared to represent dense shell midden deposits (Figure 3). Ground-penetrating radar grid one measured 11 m x 8 m, and grid two measured 15 m x 10 m. Both ground-penetrating radar grids were surveyed with the following methods and procedures. Each unit was surveyed with three ground-penetrating radar transects per meter. All transects were initiated from the units southwest corner with transects running north (odd numbers) and south (even numbers). The transect interval was approximately 33 cm with transect distance measured by a calibrated survey wheel. We used a GSSI SIR4000 with a 400 MHz antennae. Ground-penetrating radar grids were post-processed in the GPR Slice Program (Version 7.MT), and individual files presented in GPR Viewer (Version Beta 1.8.5). We recorded GNSS data for most transect files, including exploratory transects outside of the formal grids.

Based on the combination of the surface survey and ground-penetrating radar results, we selected three excavation units for further study. Each unit measured 1 x 1 m with cultural

materials screened over 1/8" mesh sieves (Figure 3). Excavations were conducted in 10 cm arbitrary levels. In addition, we removed ca. 10-20 liter bulk sediment samples from each arbitrary level for fine-grained recovery of materials such as small non-dietary gastropods, fish vertebrae, and macrobotanical remains via water flotation.

## Results

### Surface survey units

Of the 31 surface survey units (SU) we sampled, analyzed, and quantified at Butano Mound, only the western and northwest units produced dense and diverse cultural materials (Figure 2). Our analysis began by calculating the density of shellfish remains by gram weight to locate potential dense shell midden deposits. Our findings and field observations highlight dense shellfish concentrations in the vicinity of SU 28. The eastern portion of the site had much fewer shellfish remains. These trends towards high densities of materials in the western portion of the site were further corroborated by the faunal, fire-cracked rock, and Monterey chert densities. Therefore, across all material classes, the densities of cultural materials were consistently highest in the site's western portion. Figure 2 highlights these trends by representing shellfish remains, faunal remains, fire-cracked rock (FCR), and Monterey chert densities. Densities are the highest at SU 28 and SU 6 across all materials, but high densities are also present near SU 9, 30, 8, 5, 4, and 31.

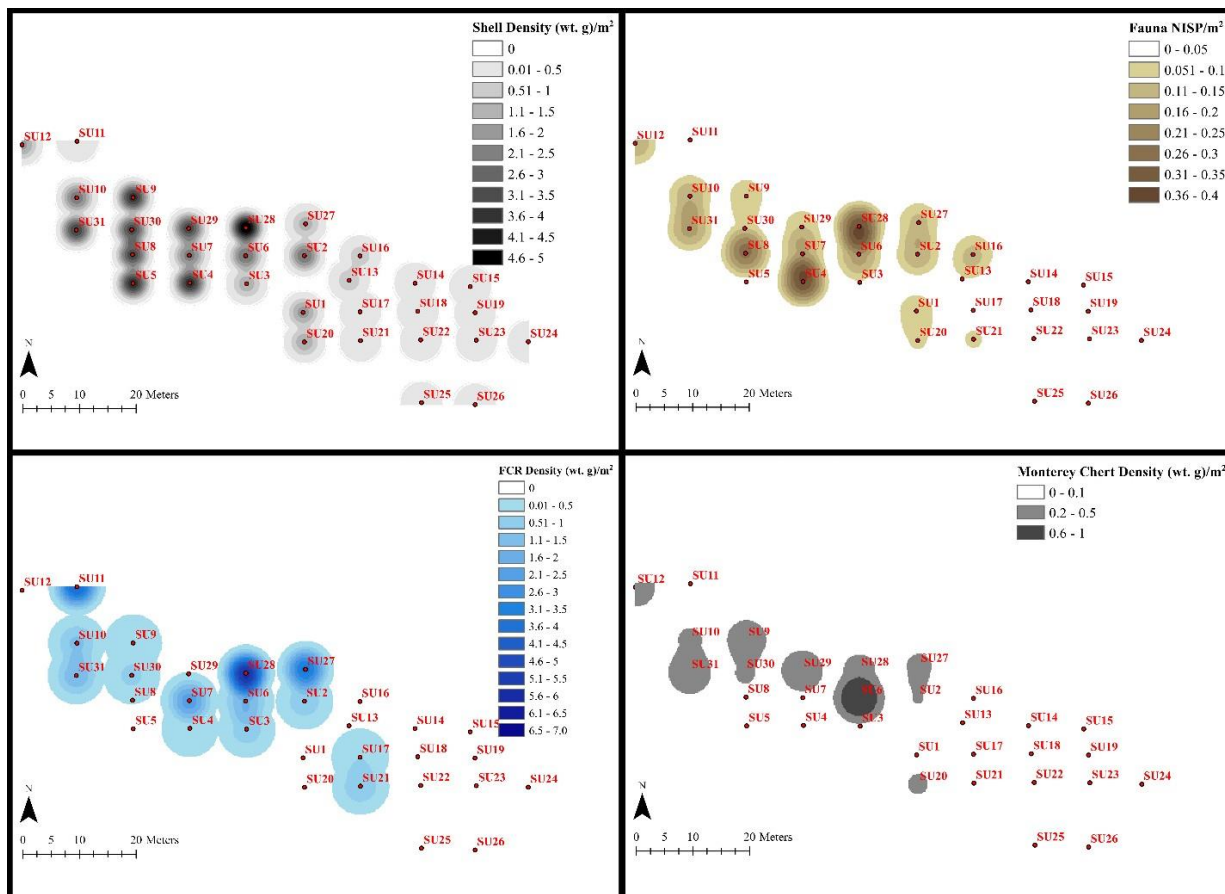
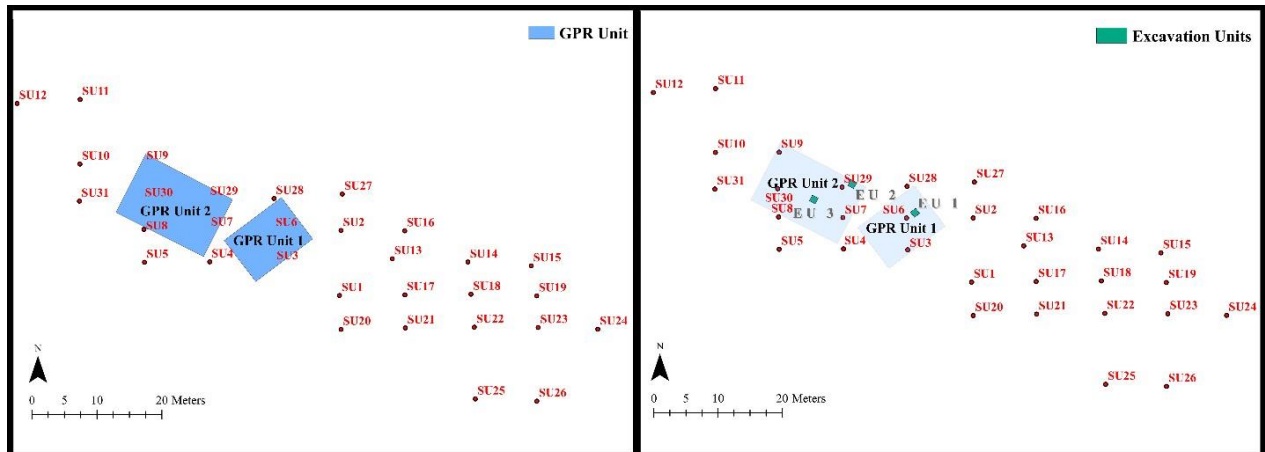


Figure 2. Density maps of surface survey data by material type.

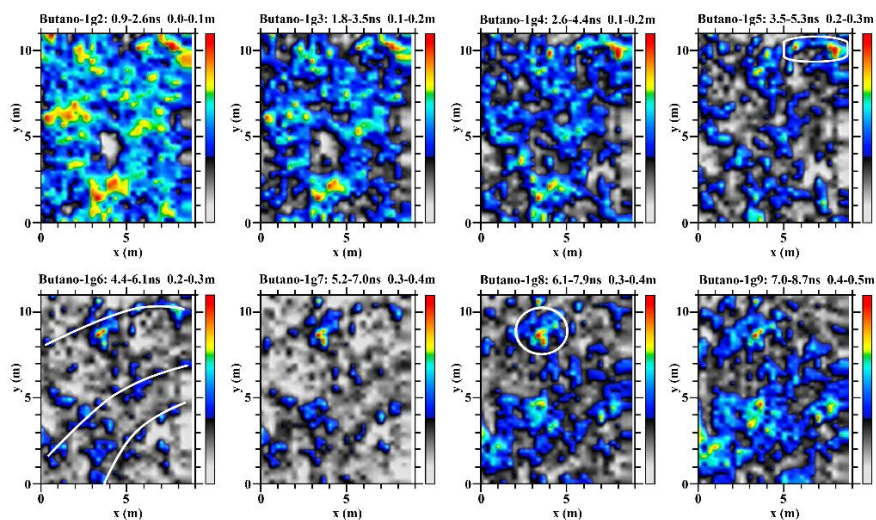


## Ground-penetrating radar Grid 1

The ground-penetrating radar survey of grid 1 resulted in 25 transect files (files 25-50), which begin in the southwest corner (0N/0E); therefore, transects represent the Y-axis (Figure 3). Our survey identified curvilinear striations traced with white lines in slice 6—slices 2-9 shown—(Figure 4). These striations may result from plowing of the mound historically and represent plow scars or stratigraphic incline intersections. Apart from the curvilinear striations, two potential feature areas were identified in the northern half of the grid—see Figure 4 slices 5 and 8. These features are highlighted by higher amplitudes noted in most amplitude slice maps and are interpreted as probable features or dense midden deposits that differ from the surrounding sediments. After communicating these results with all collaborators, we selected the potential feature in slice 5, which is located near SU 28 and SU 6 in a portion of the site with high densities of cultural materials and because the area had higher amplitudes in the majority of amplitude slice maps (Figures 2 and 3).



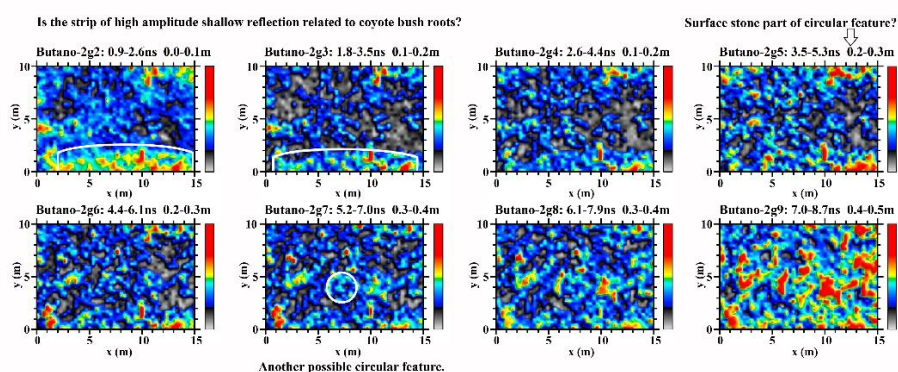
**Figure 3.** Approximate locations of the ground-penetrating radar grids 1 and 2 and excavation units 1-3.



**Figure 4.** Ground-penetrating radar depth slice comparisons for grid 1.

## Grid 2

The ground-penetrating radar survey of grid 2 resulted in 46 transect files (53-98), which begin in the southwest corner (ON/OE); therefore, transects represent the Y-axis (Figure 3). We identified two locations of interest for testing based on the amplitude slice maps (Figure 5). The first is a potential circular feature identified in slice 5. The potential circular feature was also noted during the surface survey as a possible area of interest for further subsurface excavations given the presence of a circular feature of rounded cobbles, which may represent a hearth feature. The second possible circular feature (shown in slice 7) was selected because it does not appear to be part of a curvilinear configuration that may represent rodent burrowing and may represent an intact feature or dense shell midden deposits.



**Figure 5.** Ground-penetrating radar depth slice comparisons for grid 2.

## Excavation units

We decided to place three excavation units based on the surface survey results and ground-penetrating radar data. One 1 m x 1 m excavation unit was placed within ground-penetrating radar grid 1 (EU 1) and two 1 m x 1 m excavation units within grid 2 (EU2 and EU3). As previously mentioned, we identified high densities of artifactual materials in the site's western area during the catch and release surface survey. The ground-penetrating radar survey undertaken in this area identified potential features represented by high amplitude areas and hyperbole in amplitude slice maps and individual transect files. Therefore, the units were placed in high amplitude areas, which may represent features.

## Unit 1

Excavation unit 1 (EU1) was placed in grid 1 in a location we believed may contain intact deposits, although curvilinear striations identified in amplitude slice maps suggested the potential that the site had been previously plowed, which is not uncommon for shell middens along this section of the coast (11). The excavation and ground-truthing of the unit produced various materials, including faunal remains, lithics, and fire-cracked rock. Two levels were excavated in the unit, which terminated at roughly 23-30 cm bd as sterile sediments occur below these depths. Twenty liters of sediment were sampled from each level. The unit included dense shell midden deposits that included evidence of rodent bioturbation and historic plowing. However, no intact features, such as the remnant hearths of earth ovens, were encountered. Evidence for plowing included a water-worn cobble with multiple plow scars. Excavation of the unit resulted in the recovery of complete salmonid vertebra. We were, therefore, optimistic that further excavations could result in a larger salmon sample size.

### Unit 2

Excavation unit 2 (EU2) was placed in grid 2, where based on the ground-penetrating radar and surface survey data, we believed there might be a circular feature. Two levels were excavated in EU2 with bulk sediment samples taken. The unit terminated at ~25 cm bd after encountering sterile sediments at this depth. Consistent with our findings from EU1, EU 2 included dense shell midden deposits that exhibited evidence of rodent bioturbation on the southern sections of the unit and plow zone type midden deposits.

The first level 0-10 cm bd produced multiple Split Punched (Type D-1) and Wide Sequins (Type M1d) Olivella (*Olivella biplicata*) beads (43). Wide Sequins and Split Punched Olivella beads are typical of central California Olivella beads reported exclusively in Middle/Late Period Transition (cal AD 1010-1210) contexts. Elsewhere Wide Sequins have been recovered in contexts that suggest they were sewn side-by-side on fabric (43). Like the Wide Sequins, the Split Punched beads are also temporally diagnostic of the Middle/Late Period Transition (43). The Butano Mound chronology will be further investigated by forthcoming high-resolution accelerator mass spectrometry (AMS) radiocarbon dating of recovered archaeobotanical and faunal remains.

### Unit 3

Excavation unit 3 (EU3) was placed in grid 2 to test an area that may contain a circular feature based on the ground-penetrating radar data. EU3 terminated at about 20 cm bd as sterile sediments occur below these depths. Upon ground-truthing the shell midden deposits, we encountered dense cultural deposits that included evidence of rodent bioturbation and further evidence that the mound had been plowed historically. In the southeast corner of the unit, we found that midden deposits were present below the sterile clay that underlies the site, likely due to bioturbation.

To test our assumptions, we placed augers within EU1 and EU2 below the sterile clay to a depth of about 60 cm and found multiple deeply buried rodent burrows with midden in them. Despite the historical and natural disturbances, our field efforts resulted in the recovery of faunal and paleoethnobotanical data, which appear to be well preserved based on the recovery of visually observable macroremains of hazelnut (*Corylus cornuta* var. *californica*) and wood charcoal from 1/8" screening and preliminary analyses of flotation samples.

## Discussion

Our historical ecological research project was designed to recover ancient and historical evidence of salmon remains and other eco-archaeological datasets from archaeological sites and museum collections from Santa Cruz, San Mateo, and Monterey Counties to inform ongoing debates regarding the native status of threatened and endangered salmon species. The collaborative research project applies low-impact archaeological field methods that rely critically on the incorporation of archaeological geophysics and other surface and near-surface investigations to guide excavation strategies. Our recent research at the Butano Mound highlights how the low-impact field methods advocated by Lightfoot (1) is a fundamental process of collaborative archaeological research programs and directly complement Amah Mutsun approaches to archaeology.

Our findings from recent fieldwork at the Butano Mound demonstrate how the application of low-impact field methodologies are a critical component of conducting indigenous

archaeology in our collaborative work with the Amah Mutsun Tribal Band that aims to preserve and revitalize their cultural heritage. Through our study and analysis of digital elevation models, surface survey through the application of catch and release methods (1,2,41), geophysical survey, and small-scale excavations, we are recovering eco-archaeological data that are directly relevant to our community partners and local conservation issues. Our current research and collaboration with the Amah Mutsun is an outgrowth of a broader eco-archaeological research program initiated in 2007 (see above). The ability to use and apply archaeological geophysics was critical to developing a trusting, collaborative relationship between the Amah Mutsun and UC-Berkeley archaeologists. It provided a method to study ancestral sites that minimized impacts on these spaces and increased the likelihood that sensitive areas and materials would not be disturbed. Archaeological geophysics is now a central approach of the Amah Mutsun when conducting archaeology in their traditional territories.

Although the materials of our 2019 field research are still being processed, our preliminary findings suggest that the Butano Mound likely represents an inland village location, based on the diversity of materials recovered. Additionally, temporally diagnostic Wide Sequins and Split Punched Olivella beads suggest occupation of the site around cal AD 1010-1210 or during the Middle/late Period transition in central California. These findings are especially relevant as the Butano Mound is contemporaneous with the Quiroste Valley village site CA-SMA-113, which has provided strong evidence of anthropogenic landscape management via small scale fires to expand coastal grassland prairies (11,12,15,16). Therefore, our current study can broaden discussions regarding anthropogenic landscape management by the Quiroste tribelet outside of the Quiroste Valley (31).

The salmonid remains recovered from the Butano Mound, and a select sample from museum collections are currently awaiting molecular analyses. Unfortunately, our laboratory and molecular analyses and additional field research at CA-SMA-184 and other adjacent sites are currently delayed due to the COVID-19 pandemic and the wildfires that have recently ravaged California and our study area.

## **Conclusion**

Our collaborative eco-archaeological research at CA-SMA-184, otherwise known as the Butano Mound, was designed to recover ancient salmon remains that could inform the conservation and management of modern salmon species and applied low-impact archaeological field methods and geophysics to guide all phases of archaeological fieldwork. This collaborative, community-based archaeological research was initiated at the request of the Amah Mutsun Tribal Band, as they are highly concerned about the present state of salmonids in their traditional territories and elsewhere along the coast.

In this paper, we have summarized how developments in archaeological field methodologies through the advancement of low-impact archaeological field strategies and archaeological geophysics have facilitated research between the Amah Mutsun, UC-Berkeley, and recently Michigan State University archaeologists. We further suggest that these methodological developments in field research are a critical component of trust-building and provided critical data for all collaborative partners so that informed decisions could guide all phases of archaeological research. These approaches are vital to preserving and revitalizing the region's cultural heritage and minimizing unnecessary impacts on the cultural resources of the Amah Mutsun.

While our excavations at the Butano Mound encountered shell midden deposits previously disturbed by rodent bioturbation and historical plowing, our field research resulted in the recovery of dense and diverse cultural materials. Although we encountered evidence of site disturbance, we were able to recover a diversity of well-preserved cultural materials. In addition, stratigraphic evidence, the shallow nature of the deposits, and diagnostic Olivella beads suggest a short term occupation of the Butano Mound. The archaeological data we recovered are currently being processed and analyzed at Michigan State University and UC-Berkeley and will contribute valuable historical baseline data regarding local vertebrate and invertebrate fauna, and paleoethnobotanical data that is highly relevant to the Amah Mutsun, the scientific community, state and federal agencies, and conservation groups.

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**Author Contributions:** G.S.: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing—Original draft preparation, Writing—Review and editing, Visualization; M.G.: Investigation, Writing—Original draft preparation, Writing—Review and editing; A.A.: Investigation, Writing—Original draft preparation, Writing—Review and editing; S.B.: Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization; V.L.: Conceptualization, Investigation, Writing—Review and editing; R.J.: Investigation, Writing—Review and editing. All authors have read and agreed to the published version of the manuscript.

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