CALIFORNIA'S FIFTH
CLIMATE CHANGE
ASSESSMENT



Coastal Chumash Village Areas at Risk From Sea Level Rise and Coastal Hazards

An Original Research Report for:

California's Fifth Climate Change Assessment

Prepared By:
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Cover Image: Kumqaq' (Point Conception area). Photo by McGinnis.

About California's Fifth Climate Change Assessment

California's Climate Change Assessments are the state's scientific foundation for understanding future climate-related vulnerability across California's regions and systems. Senate Bill 1320 (Stern, 2020) requires the State to report the impacts and risks of climate change across California at least every five years, beginning with California's Fifth Climate Change Assessment (Fifth Assessment). Building on decades of climate research and previous Assessments, the Fifth Assessment presents new findings about California's climate future, with a dedicated focus on Tribal partnerships, public engagement, and communities most vulnerable to climate impacts.

The Fifth Assessment's research and tools are designed to fill knowledge gaps about California's climate future, inspire strategic climate actions, and shape planning, investments, and policies at the state, regional, and local scales. Guided by research priorities identified by state, Tribal, and local leaders, community representatives, and subject matter experts, its findings are designed to help illuminate potential climate futures, the challenges they may present, and the opportunities to build resilience through adaptation pathways.

For the full suite of Fifth Assessment research products, please visit: www.ClimateAssessment.ca.gov.

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Executive Summary

On Christmas Eve in 2025, a "bomb cyclone" hit the California coast. The cyclone was driven by temperature differentials in the atmosphere – the convergence of dry sub-Arctic air with moist subtropical air over the eastern Pacific Ocean generated heavy precipitation with high winds that impacted Central and Southern California (Maue, 2025). The impacts from the cyclone included significant coastal erosion, flooding, and storm-related damage. While the media emphasized the social and economic impacts from the cyclone, there are likely impacts to coastal Chumash cultural heritage areas that will remain undocumented and yet to be addressed or mitigated.

A total of 148 Chumash village sites have been identified from Malibu to San Luis Obispo, including 11 on Santa Cruz Island, eight on Santa Rosa Island, and two on San Miguel Island (Glassow, 1993). Chumash homelands encompass San Luis Obispo, Santa Barbara, Ventura, and parts of Los Angeles counties, which include approximately 200 miles of coastline. The Chumash names for the northern Channel Islands is Tuqan (San Miguel), Wi'ma (Santa Rosa), Limuw (Santa Cruz and can be translated to mean "in the sea is the meaning of the language spoken"), Anyapax (Anacapa) (King, 1990).

As human-induced climate change accelerates sea level rise (SLR) and other pressures on traditional cultural resources and coastal ecosystems, coastal hazards will increase in frequency and duration. The threat posed by coastal hazards and SLR to coastal Chumash cultural heritage is not merely the potential loss of traditional cultural materials but also the loss of cultural landscapes. Cultural areas of significance are part of living relationships with land, water, and non-human relatives, and the degradation of these places reflects the potential diminishment of Chumash cultural practices and maritime traditions. There are spiritual and sacred foundations to Chumash places that should not be overlooked or underappreciated in an assessment of coastal hazards posed by climate change.

Colonization has limited coastal access for the Chumash. Few of the coastal Chumash areas that are at risk today from coastal hazards are accessible by Chumash. No coastal site is under the authority or the management jurisdiction of the Chumash people. Prior to colonization, the Chumash could move their village sites to adapt to natural climate events, such as major storms. Today Chumash cannot relocate coastal village areas that are at risk. Moreover, Chumash may have difficulty accessing coastal areas to document traditional cultural sites or monitor for the impacts to cultural resources.

There is a new climate-related challenge that should be understood and addressed accordingly if coastal Chumash cultural heritage areas are to be preserved. Tribes

sustained their cultures and lifestyles in turbulent cycles of natural climate change. Today climate events, such as major storms, and long-term changes to regional coastal and marine ecosystems are threatening the essential fabric of traditional cultural heritage in coastal California. Few studies have documented these risks and hazards to the detriment of coastal cultural heritage.

Climate change is a contemporary reflection of myriad threats posed by colonialization. The paradox is that as climate change continues to impact coastal Chumash heritage areas, Chumash have limited access and management authority, and often lack the capacity to engage and collaborate as sovereign governments in local, state, and federal climate change planning. The challenge is reflected in the history of colonization that has separated Chumash people from coastal places inhabited for millennia.

The Goal of this Report

The Santa Ynez Band of Chumash Indians (SYBCI) is the only federally recognized Chumash Tribe.[1] The SYBCI is a partner and co-steward with federal and state resource agencies in coastal and marine conservation activities.[2] The SYBCI is a Southern California representative of the Tribal Marine Stewardship Network (TMSN), and an active member in the West Coast Ocean Alliance (WCOA) Tribal Caucus. Since 2020, the SYBCI has produced assessments of climate vulnerabilities for reservation lands and developed climate adaptation strategies for these lands. This report incorporates valuable information that is found in the Climate Change Adaptation Plan (CCAP) completed by the Santa Ynez Chumash Environment Office (SYCEO) in 2023 (SYBCI, 2023). The CCAP includes information from meetings with Chumash members on adaptation measures and strategies. Meetings with the Coastal Band and the Wishtoyo community, and interviews with Tribal leaders of the Coastal, Santa Ynez, Northern, and Ventureño/Barbareño Chumash Bands were conducted. In addition, the CCAP was informed by survey responses from 60 Chumash community members. Responses identified 40 locations, 74 plant species, and 48 animal species

1 The SYBCI is a part of the larger Chumash community in Central and Southern California. The SYBCI occupies a reservation of 137 acres by Zanja de Cota Creek in Santa Ynez, California. The Tribe has approximately 200 enrolled members, among the larger Chumash community consisting of approximately 5,000 members. CalEPA deemed 33 parcels of land in Santa Barbara County to be under the SYBCI control and as disadvantaged communities. The SYBCI owns and operates the Chumash Casino Resort. Income from this operation helps to fund important community resources such as the health clinic, fire department, education, and the Santa Ynez Chumash Museum and Cultural Center.

2 The SYBCI is a co-steward of the designated Chumash Heritage National Marine Sanctuary (CHNMS) and is co-managing four marine conservation areas designated in California waters. The SYBCI is a member in the CHNMS's Intergovernmental Policy Council (IPC) which serves as a regional forum for partners to exchange information and coordinate policies to protect marine life and cultural resources within the sanctuary. Chumash representatives are members of the CHNMS's Indigenous Cultures Advisory Panel and Sanctuary Advisory Council (SAC).

of cultural significance (SYBCI, 2023). 90% of the survey respondents believe that "climate change is impacting Chumash cultural resources" (SYBCI, 2023). The CCAP also includes adaptation recommendations made by Chumash participants in the plan.

This report represents the first study of the level of severity from risks posed by coastal hazards and SLR on 33 coastal Chumash village areas. These village areas were identified by the Culture Department of the SYBCI and are also described in public documents. As human-induced climate change accelerates SLR and drives increases in sea surface temperature (SST), the risks posed by coastal hazards such as beach loss and flooding will increase in frequency and duration (Bograd et al., 2008; Breitburg et al., 2019; Office of Environmental Health Hazard Assessment, 2022; NOAA, 2026).[3] The report is a product of the SYBCI's concerted effort to better understand the nature of these threats and to support a community-based effort that can foster and develop comprehensive strategies to monitor, mitigate, and adapt to the risks posed by anthropogenic climate change on coastal Chumash cultural heritage (SYBCI, 2019; 2020a, b; 2024).

This study prioritizes the confidentiality of Chumash Tribal cultural resource knowledge. The exact location of coastal Chumash village areas that are part of the coastal hazard assessment is not represented or described in this report. Sensitive cultural information is protected through storage and labeling within an internal and confidential database. Confidential information collected during this project will remain the property of the Tribe. Overall, Chumash emphasize Tribal data sovereignty, including how data ownership, control, access, and confidentiality are upheld throughout this project. This report's use of Tribal information aligns with Tribal governance, research ethics, and culturally appropriate data practices.

Coastal Hazards and Chumash Cultural Heritage

Coastal hazards have been present for thousands of years on a cyclical basis. These natural cycles are changing due to the multiple impacts that are associated with recent ecological, atmospheric, and oceanographic disturbance events caused by anthropogenic climate change, including coastal dune and cliff erosion, tidal flooding, storm wave flooding, and coastal confluence flooding, resulting from the combination of river flooding and coastal wave interactions. Coastal hazards are influenced by warming of SST among other potential pressures, including ocean acidification, that have been shown to impact marine life. The coastal hazard assessment focuses on

3 This report focuses on SLR and coastal hazards that are associated with the risks to the traditional coastal area inhabited by Chumash people posed by large-scale anthropogenic climate change. There are other climate-related risks, including the general warming of sea surface temperature, marine heat waves, ocean acidification, deoxygenation, among other marine related pressures from large-scale climate disturbance that influence coastal ecosystems.

the 33 coastal Chumash village areas that have been identified along the coast from Morro Bay to Malibu Point. The report does not include an assessment of inland or Channel Island village sites. The study supplements the coastal hazard assessment by providing a general description of the impacts of climate change on the region's ecosystems and native species diversity and offers adaptation recommendations corresponding to threats posed by climate change to coastal Chumash cultural heritage. Coastal areas, plants, and animals that were identified by Chumash are described in the study.

The coastal hazard assessment includes analysis of data and information on coastal ecosystems, including dune and cliff erosion; tidal and storm wave flooding; and coastal confluence flooding resulting from the combination of river/creek flooding and coastal wave interactions (California Sea Level Rise Guidance, 2024; Myers et al., 2017). Changes in SST influence the abundance, distribution, and viability of coastal species and marine life that have long been used by Chumash. As this report notes, the region's animals and plants are essential to the collective continuance of Chumash culture. Benthic species, such as white and black abalone, are at risk today from overuse and changes to the marine environment, but these marine species are part of the co-evolutionary maritime Chumash society. The capacity of species to adapt to human impacts is further constrained by the impacts and pressures on ecosystems posed by climate change. Despite research on coastal hazards and their environmental impacts, there is limited understanding of how these hazards are affecting Chumash cultural heritage, underscoring the importance of this study (Reeder et al., 2012; Newland et al., 2017; Rick et al., 2020).

Coastal hazards contribute to the loss of coastal Chumash cultural heritage. This study builds on an initial study produced by the SYBCI in 2025 which found coastal Chumash village areas are exposed to hazards such as coastal dune and cliff erosion, tidal flooding, storm wave flooding, and coastal confluence flooding resulting from the combination of river flooding and coastal wave interactions (McGinnis et al., 2025). Since the last ice age, hundreds of coastal Chumash village sites have likely been lost from rising sea levels. Anthropogenic climate change continues to exacerbate the impacts of coastal hazards on coastal Chumash cultural heritage areas. Major storm events and changes to coastal processes, including the erosion of sandy beaches, coastal bluffs and dunes, and human impacts to coastal watersheds, such as major flooding events, influence the severity of risks to coastal ecosystems and Chumash cultural heritage. No identification or documentation of Chumash coastal village areas that are submerged in the marine environment exists (Reeder-Myers et al., 2015). But, there remain thousands of coastal Chumash cultural areas that are currently in use by Chumash people. The Chumash recognize the probability that hundreds of sites have likely been lost (Reeder et al., 2012).

The fact that areas have been lost or are at risk does not diminish the cultural significance of these coastal Chumash heritage areas – coastal places that are at risk are essential to the maintenance of the collective continuance of Chumash culture. Coastal places that are at risk from coastal hazards and SLR remain culturally and spiritually significant. The Chumash language and identity are irrevocably connected to the spiritual and cultural significance of the coastal areas long inhabited by Chumash.

Overview of Sections

Section One begins with a contextualization of the ways in which Chumash have been adapting to and building resilience to changes in the climate for millennia. The ecology of the region is influenced by shorter-term and longer-term changes in oceanographic and atmospheric processes, such as changes in SST and SLR. Natural climate variability in the region occurs across multiple time scales. Long-term changes include ice ages and associated changes in global sea levels. Shorter-term patterns include natural cycles, such as El Niño and La Niña events, which influence drought and other climate conditions. These processes also shape and influence regional ecosystems, including changes in the abundance and distribution of native species and marine dynamics over time.

Section Two builds on the preliminary findings from a coastal hazard assessment completed in 2025 by Michael McGinnis, Dave Revell and Matt Jamieson for the SYBCI (McGinnis et al., 2025). This study identifies coastal village areas, as well as plant and animal species, which are significant to the Chumash. Coastal Chumash village areas are at risk from increased coastal erosion, coastal wave flooding, and the confluence of fluvial and coastal wave flooding around estuaries. The study does not include coastal areas of the northern Channel Islands.

Section Three describes key issues and opportunities for future climate change planning and provides adaptive recommendations by SYBCI to protect animals and plants that are threatened or at risk from climate change. In all cases, resources should be provided so that Tribes can participate fully in planning processes and activities, but especially when Tribal cultural heritage is at risk or threatened by climate-related pressures. Appendix I lists adaptation measures that are important to consider in future climate adaptation planning. The last section describes action items that can foster future integrated climate assessments and planning efforts to better protect coastal Chumash cultural heritage and resources.

In general, there is a need to create space for innovation and change within the Tribal sphere and the broader community so that a more in-depth understanding of the severity of risks to coastal Chumash village areas can contribute to future vulnerability assessments and climate adaptation strategic plans. Chumash communities face

ongoing and often unsupported requests to engage in formal consultation with coastal resource agencies, as required by local, state, and federal laws. These requests frequently relate to the protection of irreplaceable traditional cultural resources and register-eligible historic properties along the coast. Without additional resources and information of the severity of risk to coastal Chumash cultural heritage, Chumash may find it difficult to respond to formal consultation requests and engage in future climate planning.

Planning for ecocultural resilience requires an understanding of the cultural links and ecological connections that unite Chumash people with the living communities (plants, animals, and insects) of the region (Hankins, 2024; Swiderska et al., 2025). The community continues to evolve and adapt together in response to changing conditions. However, coastal hazards driven by climate change are increasingly placing the continuance of Chumash cultural and ecological heritage at risk, including long-standing stewardship practices and maritime traditions.

I. The Chumash and the Ecology of the Coastal Province

> *"Change is inevitable. We accept what the environment has to offer and the opportunity that has been given to us to experience should change in order to grow. Chumash traditions have always focused on the world around them and adapted with the environment."*
>
> *-Chanse Zavalla, SYBCI Cultural Monitor*[4]

The Chumash have sustained their diverse customs, cultural beliefs, maritime sensibility, and traditional knowledge for thousands of years. Chumash embrace their irrevocable connection and coexistence with nature. Chumash language, knowledge, and belief systems reflect ecological and cultural relationships with the natural worlds.

This section provides a synthesis of public information on the connections and relationships between the Chumash and the region's ecosystems. Tribally held confidential information is not used in this section. This section includes a description of oceanographic and atmospheric processes that influence the ecology of the coastal region long inhabited by Chumash. The section also includes a list of animals and plants that are identified by Chumash as significant for various cultural reasons, including economic and material use, and for ceremonial, sacred, and spiritual values. One key finding of this section is that Chumash adapted to natural climate variability including shorter- and longer-term cycles of warmer and cooler SST. Changes in SST influenced the Chumash use of coastal and marine resources.

The ecology of the region is dynamic and complex, and Chumash co-evolved with a richly diverse region of animals, plants, and insects. Cultural adaptation is an essential trait of Chumash people, who remain keenly aware of the ecology of the region. The range of values that Chumash have for animals and plants is also described in this section. As this report shows, large-scale anthropogenic climate change and associated coastal hazards threaten coastal Chumash cultural heritage.

Chumash Maritime Society

The Chumash developed North America's earliest seafaring economy.[5] The presence of cultural materials found in three sites on the northern Channel Islands shows that the Chumash sea-based economy can be dated from 12,200 to 11,400 years ago

4 Personal communication with Dr. Wendy Teeter, December 27, 2024.

5 No author. Smithsonian Insider. March 3, 2011. Accessed online on April 2, 2025. https://insider.si.edu/2011/03/californias-channel-islands-may-have-once-held-north-americas-earliest-seafaring-economy/

(Balter, 2011). The use by Chumash of the tomol and redwood plank canoe was the foundation of traditional maritime practice (Hudson et al., 1978). In an analysis of the maritime history of the Chumash, Roberta Cordero (McGinnis and Cordero, 2004) writes,

> *"Chumash people are restoring our heritage of intimacy with the sea for the dual purpose of protecting her and as a means of rediscovering our dignity and identity as a people sprung from this place. Much of this revitalization is concentrated around resurgence of the canoes. In this way, we are hoping once again to "know the ways of the sea" to counter the terrible despair voiced through our ancestor, Saqt'ele, when he believed there would be no more canoes because of all that had been taken away. It is a beginning...That intimate knowledge of "the ways" of a habitat also supported the adoption of a natural and non-detrimental means to expand a resource, i.e., vegetation burning to increase the availability of high-nutrition resources such as chia and other edible flower seeds which could be successfully stored against periods of drought. It also made the Chumash excellent and versatile fishermen."*

Spanish missionization moved Chumash people away from their villages to focus on the mission where their families were often separated and confined. Tribes are now often identified by the mission where their ancestors were kept, for example the Ventureño Chumash are the descendants of people who lived at the Buenaventura mission; Santa Ynez Chumash are the people confined to Santa Ines Mission, even if the families originally came from many villages. Early Chumash were migratory and occupied temporary camps. Over time permanent settlements were established to support specialized trade, economic, political, and occupational structures. Over the last 2,500 years, trade networks comprised a prominent feature of coastal Chumash societies, resulting in the exchange of inland mammals, plants, rocks, and minerals for marine resources (shellfish, marine fish, shell beads). One hypothesis is that Chumash migrated seasonally, inhabiting coastal village areas to exploit marine resources in the spring and summer and moving inland in the winter to fish for the southern steelhead in the Santa Ynez River (Alagona et al., 2012).

Chumash relationships with coastal and marine ecosystems are ongoing and living. Living knowledge systems of Chumash culture are based on an awareness of the natural cycles of the region that are influenced by a dynamic and ever-changing ecological region. Chumash adapted to and evolved with the natural changes and cycles that influence the ecology of the region (Stine, 1994). Chumash understood these cycles of change, and their knowledge and belief systems led to political and economic reform that supported an intergenerational history of ecocultural resilience. Much of the coastal areas historically inhabited by the Chumash should be considered cultural keystone places, that not only provided places for living and gathering food but also influenced the development of diverse Chumash cultural

identities, languages, stories, and ceremonial practices (Cuerrier et al., 2015). Coastal areas were more than just places for living and gathering food and special areas continue to be used for Tribal celebration and cultural renewal practices. Species, such as swordfish, are more than food. Animals and plants embody spiritual significance and a culturally sacred worldview. Chumash society was shaped by the cultivation of cultural, economic, and political strategies that fostered adaptation and resilience to dynamic change in the ecology of the region (Glassow, 1996). Adapting to natural climate variability is a part of Chumash society (SYBCI, 2020a, b). Several species have a vital role in Chumash songs, rituals, and dance, and are understood as relatives with whom Chumash people maintain ongoing relationships and learn from generationally. Chumash resilience to natural climate variability was historically based on a profound awareness and connectivity with a more-than-human community. For thousands of years, Chumash developed complex social systems that supported adaptation and cultural resilience (King, 1990; Glassow, 1996). Sea levels have risen for thousands of years, and Indigenous people may have traveled and migrated along the shoreline from the north to settle coastal regions as food became more available (Balter, 2011; Briner et al., 2018).[6] As coastal and marine ecosystems changed Chumash adopted new fishing strategies and food gathering activities (King, 1990; Glassow, 1996). Overall, the ecology of the coastal province is dynamic and ever-changing, and Chumash historically adapted to the natural changes in the climate, including prolonged periods of drought and associated changes to food availability (Glassow, 1996).

The Dynamic Coastal and Marine Region

The risks and threats posed by climate change to coastal Chumash cultural heritage are, in part, driven by a complex relationship between oceanographic and atmospheric processes. While this report emphasizes the risks posed by climate change from coastal hazards, it is important to provide a general summary of the impacts of climate change on marine life.

The seasonal patterns of collecting foods by Chumash people followed the cycles of natural climate variability. Chumash maritime activities evolved to respond to changes in the region's ecology. For example, fishhooks were created to only catch

6 The Chumash are one of the longest known inhabitants of any coastline in the Americas, beginning at least 13,000 years ago. Given a rise in sea levels of 165 ft (50 m) since the Last Glacial Maximum (LGM) approximately 19,000 to 20,000 years ago, the planet entered a phase of warming and deglaciation, with significant ice sheet retreat and rising sea levels beginning around 19,000 years ago. The Pacific Coast Migration Model suggests early ancestors of Chumash may have traveled along the shoreline to reach the Americas relatively soon after the LGM. However, rising sea levels have made it hard to find evidence of early coastal settlements in the Americas because early records are likely submerged. The retreating ice sheets didn't yield an interior pathway until about 14,000 years ago, and the strip of land that suddenly became accessible wasn't suitable for animals and humans until about 13,000 to 12,600 years ago.

certain-sized fish, ensuring continuity from one generation to the next. Seaweed, kelp, eelgrass, and other marine plants sustained Chumash populations as food, clothing, and utilitarian tools, like cordage. The Chumash adapted to changes in the presence or absence of coastal and marine life by changing their diet and resource focus to reflect changes to food availability. As noted in the SYBCI vulnerability assessment for reservation lands inhabited by the SYBCI (SYBCI, 2022):

> *"Many Indigenous cultural practices rely on natural or seasonal cycles associated with changes in weather patterns, plants, and animals. Increased temperatures, extreme heat, and heat waves affect the traditional timing of Chumash cultural practices due to climate's effect on the landscape. Warmer temperatures and changes to precipitation patterns may cause plants to fail to grow in one area and be able to grow in another. Some species may be able to expand their range, while others may experience a decrease in range. The Tribe has already seen traditional plants migrating to different areas and the off-season blooming and fruiting of many species."*

Cordero et al. (2019) write:

> *"Indeed, what many contemporarily view as an idealized, untouched, wild, and pristine California landscape prior to European colonization was in fact a result of thousands of years of reciprocal relationship, tending, and cultivation by the Native peoples of these areas. For the Chumash people who have inherited a deep and unending responsibility to care for a place – restoring and maintaining traditional relationships creates integrated health both within and between the ecological and human communities."*

During the Chumash ancestors' long tenure before Euromerican contact, the marine component of the Chumash diet consisted of over 150 types of marine fishes as well as a variety of shellfish including crabs, lobsters, mussels, abalone, clams, oysters, chitons, and other gastropods (McGinnis and Cordero, 2004). Shellfish were also important to the economy and material culture. The following survey of fishing methods and implements used is exemplary of the complex knowledge and skilled craftsmanship that the people applied to every aspect of their lives and livelihoods. Roberta Cordero (McGinnis and Cordero, 2004) writes in a characterization of Chumash maritime history:

> *"As with fish, shellfish and game, the Chumash people's diet of plant foods was impressive not only for the variety gleaned by a sedentary hunter-gatherer society, but also for the knowledge and ingenuity shown in maximizing desired foods. It is well known that acorn was a chief staple. Still widely used by California Native people, this highly nutritious food was valued by the ancestors as a relatively non-perishable food which could be stored for winter use as well as for periods of drought when the oak trees' production was reduced."*

Changes to SST are one historical feature of the natural climate variability of the Southern California Bight, the coastal region extending from Point Conception to Punta Colonel in Baja California, Mexico. SST was also a principal factor that influenced the abundance of marine resources that was available to Chumash. In the Santa Barbara (SB) Channel, shorter- and longer-term natural climate events that include natural cycles of changes in SST are well documented (Dailey et al., 2023). For example, marine geologists investigate core samples taken from the benthic area (i.e., the sea floor) of the marine system, which store 735,000 years of information about natural cycles of change often associated with cooler and warmer water temperature regimes. Marine geologists document changes in the presence of fossils identified in the sediment of the sea floor of the SB Channel. In addition, sediment core samples are used by scientists to examine the level of substances, such as carbon or methane, in the atmosphere (Cannariato et al., 1999; White et al., 2013). Core samples studied by a team of interdisciplinary scientists show that benthic species (identified in the fossil record and benthic sediment) likely adapted and were resilient to natural changes and regime shifts in water temperature; benthic species migrate to escape the warming marine waters of the Southern California Bight associated with shorter- and longer-term cycles.

The coastal and marine ecosystems of the region are influenced by a marine transition area where the warmer marine waters of the Southern California Bight mix with the cooler waters of the California Current large marine ecosystem (LME) (Ubanksi, 2019). This mixing of ecosystems contributes to the high native species diversity of the region that includes the coastal-marine interface and coastal watersheds that influence the ecology of the marine system.

Chumash people have a relationship and connection to coastal wetlands of the region. Coastal wetland ecosystems were essential foraging and hunting areas for the Chumash, and Chumash contributed to the ecological complexity and function of coastal ecosystems (Erlandson and Jones, 2002). Wetlands are nurseries to the sea for several species such as California halibut. Chumash stewardship practices contributed to the health and productivity of these wetlands and estuarine systems. Wetlands were essential to the well-being of Chumash culture.

Changes to the Marine Region

The Chumash maritime heritage is irrevocably connected to the marine region. Chumash maritime culture is influenced by the dynamic ecology of the northeast Pacific Ocean and the California Current LME (Samhouri et al., 2017). There are shorter-term changes brought on by the cycle of El Niño and La Niña. Food abundance and availability was also influenced by these shorter-term cycles and changes in SST. This cyclic climate pattern in the California Current LME affects weather and the abundance and distribution of marine life. Changes in storm

activity, wind patterns, rainfall, oceanographic changes, and changes in SST follow the cyclic pattern of El Niño and La Niña. El Niño and La Niña influence the ecology of the marine region, the presence or absence of marine life, and the overall productivity of marine ecosystems. During an El Niño, marine mammals and birds find it more difficult to reproduce and feed their young. The Southern California Bight is influenced by short-term warming and cooling events (Dailey et al., 2023). For instance, there may be warmer water fish in the region, such as swordfish or tuna, while some fishes and invertebrates move to cooler waters above Point Conception. Chumash were aware of these changes and adapted to them. Fishing strategies, for instance, changed to respond to changes in marine ecosystems brought on by natural climate variability.

Longer-term (or interdecadal) changes, or what is referred to as regime shifts, reflect 30- to 40-year periods of change in SST (Dailey et al., 2023). These regime shifts represent a temporal pattern of warmer to cooler to warmer oceanographic processes. Regime shifts change the ecology of the marine system (for instance, oceanographic processes such as mesoscale events like eddies and currents change with warmer SST). During a warming period, winds may dissipate in the spring, which decreases the abundance and distribution of nutrients (or, more generally, upwelling conditions) of the California Current LME.

Within the last decade, marine heatwaves, or MHWs, have been an additional pressure on marine life that is valuable to the Chumash. MHWs occur when ocean temperatures are much warmer than usual for an extended period; they are specifically defined by the difference between the current temperature and the expected temperature for a specific location and time of year. MHWs are a growing field of study worldwide because of their effects on ecosystem structure, native species diversity, and regional economies (NOAA, 2026). Marine heatwaves disrupt ecosystem structure and function via altered food webs and energy flux. Large-scale MHWs have occurred each of the last six years (2019-2024), all typically beginning during the spring in the far offshore region of the open North Pacific, impacting the West Coast during the fall, and finally terminating during late winter. Of the last six years, five of these were the largest heatwaves on record for the eastern North Pacific since monitoring began in 1982. The current heatwave forecast suggests MHW's may continue for the next several months in the far offshore regions.[7] The diminishment of marine life long used by Chumash, such as kelp and abalone, is likely a result of MHWs within the marine region.

Abalone has been a vital, multifaceted resource for the Chumash people for over 10,000 years, serving as a staple food, a crucial material for tools and trade, and a

7 For a profile of marine heat waves within the California Current LME, see the "Marine Heat Waves" overview provided by the Physical Sciences Laboratory at NOAA. Retrieved on June 5, 2026 and available at https://psl.noaa.gov/marine-heatwaves/

sacred element in cultural ceremonies. Revered for its iridescent, mother-of-pearl interior, the shell is deeply connected to Chumash identity and the sea (Gamble, 2020). Several abalone species are threatened or endangered in California, with white and black abalone listed under the federal Endangered Species Act. Warming SST, including MHWs, will continue to impact the white and black abalone populations that were essential marine species to Chumash.

Warming SST is not the only climate-driven pressure on marine life. Increases in atmospheric and oceanographic concentrations of carbon dioxide contribute to changes in ocean pH levels.[8] While long-term data for California waters are limited, carbon dioxide measurements at one offshore location near Point Conception show increases in seawater carbon dioxide levels accompanied by increasing acidity (measured as pH). Increasing acidification will likely continue to impact shellfish, such as mussels, and may contribute to abrupt changes in primary marine production, including the decline in plankton. Olivella shells are from marine gastropod mollusks that are gathered by the Tribe for use in shell money, jewelry, and regalia. These species are becoming scarcer and traditional areas for gathering are often no longer accessible. Ocean acidification will likely have an impact on this species.

Ocean acidity and rising SST are long-term and large-scale pressures on marine life (Dore et al., 2009; Sutton et al., 2011; Kekuewa et al., 2022). Climate impacts on marine habitats, such as kelp, are reported in scientific literature. Data on the abundance and distribution of kelp in the marine region dates to 1911. Kelp status within the California Current LME is below expectation. A total of 72% of kelp beds have canopies below their historic norms (California Ocean Protection Council, 2025). 2026 is the third lowest year on record since 1984. Kelp canopy is declining coastwide. Over the past 40 years, kelp canopies have decreased at a rate of 10% per decade. Kelp forests were vital to the Chumash people, serving as a cornerstone of their marine ecosystem for food, medicinal resources, and material culture for thousands of years. These ecosystems provided essential habitats for fish and mammals, and they remain culturally significant to Chumash.

Note, myriad pressures on coastal and marine ecosystems have synergistic impacts. Fishing, water pollution, the introduction of non-native invasive species, habitat loss, and anthropogenic climate change should be understood from a cumulative perspective. Impacts, such as commercial fishing or the loss of coastal wetlands from urban development, should not be considered in isolation from other pressures and stressors. The management challenge is to address the synergistic threats posed by climate change and the range of other pressures on coastal and marine ecosystems. While we cannot control climate or nature, we can control human use and our impacts

8 For a general characterization of ocean acidification, see ArcGIS StoryMaps. No date. The Changing Pacific: Exploring Ocean Acidification along the California Current. Retrieved on June 5, 2026 available at: https://storymaps.arcgis.com/stories/4c0b0413c20a4388b106b4774946b847

on the natural world. The warming of SST and increasing ocean acidification constrain the capacity of marine life to adapt to climate change. Despite a history that shows that marine life has adapted to both long- and short-term changes and cycles, there is increasing evidence that shows that many species historically used by the Chumash, such as several species of shellfish and fishes, are at risk (McGinnis, 2026).

Part of the challenge involves modern belief structures and colonial worldviews that threatened Indigenous cultural heritage and contributed to the dramatic loss in coastal and marine ecosystems. Colonial worldviews and values led to the loss of traditional languages and knowledge systems in California. Today, these same colonial worldviews support a perceived separation of human beings from the natural world. Chumash worldviews do not support this modern perception; there is no separate world. Changes to the coastal province long inhabited by Chumash are noted below.

Changes to the Coastal Province

Chumash communities carry valuable stories and cultural practices of how to adapt to changes in the natural world. Social, political, and economic systems in Chumash society changed in response to the pressures brought on by natural climate variability and other climate events, such as drought and advances in maritime practices, such as the use of the tomol (plank canoe) and diverse fishing strategies (Applegate, 1978). The coastal province is part of the California Mediterranean type ecosystem (MTE) that has long served as a refuge area for Chumash people during times of food and water insecurity. The concept of refugia is explored further below. Climate refugia are essential to evolution and adaptation. Climate refugia areas often are areas where species migrate to survive and adapt to the changes to ecosystems brought on by climate change and natural climate variability. For example, human communities may move to the coast to survive the impacts of long-term drought that impact a culture's food and water security. Animals migrate to find new foraging areas and suitable habitats to survive the impacts of climate events, such as the catastrophic impacts of fire, and natural climate cycles, including the warming of SST.

MTEs are found in California, Chile, South Africa, Australia, and the Mediterranean Basin. These MTEs have been referred to as revolutionary climates and experience rapid "revolutionary" shifts in their climatic regimes due to global climate change. These regions, which cover 2% of the Earth's land area, are becoming significantly hotter, drier, and more prone to extreme disturbances (Arranz et al., 2024). The MTEs, such as the coastal province long inhabited by Chumash people, are areas where the rich native species diversity supports cultural diversity. Key characteristics of the context of climate change that is impacting the California MTE include (Petersen et al., 2026):

- Increased Aridity and Heat: Climate projections indicate a substantial decrease in rainfall and rising temperatures, leading to a more arid environment.
- Intensified Drought: Drought periods are becoming longer, more intense, and starting earlier in the season, which severely impacts the ecosystem's ability to recover.
- Persistent Heat Waves: The frequency and intensity of heat wave anomalies are increasing.
- Altered Fire Regimes: Similar drought trends are driving higher risks of fire, which is the primary disturbance factor in the region.
- Increased Soil Salinity: The combination of higher temperatures and reduced precipitation is expected to increase soil salinity, threatening agricultural production and native plant life.
- These changes are contributing to significant implications for native species diversity, coastal habitats, and coastal cultural resources.

The 2024 California Sea Level Rise Guidance summarizes the most recent risks from SLR and coastal hazards as follows:

- Rising seas will exacerbate coastal hazards such as compound flooding that reflects the combination of SLR, storm events, and groundwater rise. SLR will continue to impact public infrastructure, private development, livelihoods, public health and safety, and natural systems. In the coming decades, these hazards and their associated social and economic impacts will be the most evident manifestation of future climate change in coastal communities.
- Over time, SLR will increase the frequency of coastal flooding events, which occur when SLR amplifies short-term elevated water levels associated with higher tides, large storms, El Niño events, or when large waves coincide with high tides. California coastal communities need to be aware of and prepared for a rapid increase in the overall frequency of high-tide flooding beginning in the 2030s.
- SLR will increase rates of retreat of coastal cliffs and bluffs, the erosion and/or landward migration of beaches, and the loss of coastal wetlands, tidal marshes, and sand dunes where barriers exist to their landward migration. Without intervention, 20-60% of California's sandy beaches could be seasonally or permanently lost due to SLR (Vitousek et al., 2017).
- In coastal areas with shallow unconfined groundwater, the water table will rise with SLR. This groundwater rise can mobilize soil contaminants, compromise below-ground infrastructure, and may result in saltwater intrusion into freshwater aquifers. The societal impacts of shallow and emerging groundwater are projected to be comparable to overland flooding impacts during the 21st Century.

- Storm events will become more damaging and dangerous as climate change andSLR continue. Impacts from high-intensity coastal storms in combination with SLR and high tides include accelerated cliff and bluff erosion, coastal flooding and beach loss, and subsurface contaminant mobilization. SLR will increase the exposure of communities, assets, services, and culturally key areas to significant impacts from coastal storms.

The Chumash utilized the coastal watersheds of the region for resources including raw materials, food, and water supply (Erlandson and Jones, 2002). The capacity of a coastal watershed to provide sand to beaches has been altered by the construction of dams and extraction of water for human consumption and agricultural uses. In the major rivers along the region, there has been a 40% reduction in sand coming out of the Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers (Griggs et al., 2005). This does not include the dozens of other debris basins and check dams that also trap sand and restrict aquatic species movement across this region. Concrete flood control channels also affect habitats and change water velocities while reducing the ability of the rivers and creeks to evolve over time. These same watershed alterations also affect the movement of cultural artifacts that may otherwise be moved downriver toward the ocean.

The alteration of the hydrological cycle can contribute to major flooding and erosion of sediments within a coastal watershed. These same watershed alterations affect the movement of cultural artifacts that may otherwise be moved downriver toward the ocean. The disruption of coastal watershed processes that influence the replenishment and transport of sand exacerbates the general impacts of coastal erosion that influence the status of Chumash cultural resources and coastal-dependent species.

Coastal watersheds are of foundational importance to Chumash, serving as the nexus of cultural identity, spiritual life, and physical sustenance. The Chumash maintain a deep, reciprocal relationship with watershed ecosystems, treating the land, estuaries, and ocean as an interconnected, living entity.

Coastal watersheds long inhabited by Chumash are also important to indicator species, such as wild southern steelhead salmon. Chumash have long inhabited the Santa Ynez River watershed; archaeological evidence identifies the presence of steelhead remains in Chumash village areas along the river (Spanne, 1975).[9] The river drains the north slope of the Santa Ynez Mountains, the south slope of the San Rafael Mountains, as well as much of the southern half of Santa Barbara County. The four main waterbodies are the Santa Ynez River, Alamo Pintado Creek, Adobe Creek, and Alisal Creek. A simple fish spear called ti'wo'y was used to spear steelhead salmon.

9 Within the Santa Ynez River and watershed, there were likely historical runs of chinook and coho salmon.

The shaft was made from toyon with a bone point fixed with asphaltum into a hole at the end and was likely used for spearing salmon in streams. The relationships between rainbow trout and sea-run, or anadromous, Southern California steelhead, and Chumash reliance on these species are complex. Salmon and Chumash adapted to dramatic natural changes to coastal watersheds and marine ecosystems, including long periods of drought. For instance, two droughts lasted over 100 years, including the drought period from 892 to 1112 (220 years) and from 1209 to 1350 (141 years). The longest drought of the 20th Century lasted 6 years during 1987-1992.

Southern steelhead salmon are the oldest of wild steelhead salmon. This salmon survived the ice age before the current Holocene Epoch, which began approximately 10,000 years ago. As the ice retreated from the south to the north, these southern steelhead salmon moved to the north from the south coast creeks and rivers along the west coast (Alagona et al., 2012). The region includes all naturally-spawned anadromous coastal rainbow trout populations downstream of natural and human-made barriers in streams from the Santa Maria River to the Tijuana River. They are most abundant in the four largest watersheds in the northern portion of their range: the Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers. Every steelhead salmon and rainbow trout of the West Coast has some genetic heritage that links the sub-species and distinct population to the Southern California steelhead salmon. The Santa Ynez River once supported the largest runs of southern steelhead throughout their range, likely between 20,000 to 30,000 adults per year, while the other large watersheds supported runs of a few thousand adults per year. In the last five years, the number of adult anadromous steelhead has declined significantly, to the point that it is now rare to see them in the wild (Alagona et al., 2012).

Coastal Wetlands

Aquatic ecosystems play a critical role in maintaining native species diversity along the coast. Wetland ecosystems played a fundamental role in Chumash communities; major village sites are located near historical wetland areas and estuaries, such as the Goleta Slough. The biological productivity of coastal wetlands makes them highly effective in carbon sequestration and storage. California's coastal wetlands are adapted to periodic and seasonal flooding, especially the bar-built estuaries and perched water tables of the California coast. Coastal ecosystems are vulnerable to the impacts of SLR and other coastal hazards. Most coastal wetlands are within one tidal range of mean sea level. Thus, as sea levels rise, wetlands have limited space to migrate to upland areas especially given the urbanization of associated coastal lands. Increased nearshore wave intensity and large storm events are predicted to increase shoreline erosion, breaking natural barriers, and increasing the likelihood of more frequent and potentially permanent inundation, leading to habitat conversion from wetland to mudflats to open water. Areas permanently below the rising tide level will be converted to open water and lead to a meaningful change in coastal wetland habitat.

The inflow of freshwater and saltwater determines the salinity of the soil, which directly affects the distribution of plants, and therefore wildlife, within the wetland. The predicted variability of rainfall and temperature, particularly with respect to increasingly common drought and increased storm intensity, could challenge even very adaptive wetland plants and animals. Migratory bird species, marine fish (particularly juveniles), and rare plant species depend on coastal wetland habitats for food and shelter. Two-thirds of the federally listed threatened and endangered species depend on aquatic habitats during part of their life cycle. Several wetland-dependent species that are important to Chumash are currently threatened and endangered including: tidewater goby, steelhead, snowy plover, willow flycatcher, Coastal Range newt, Western Pond Turtle, and Waqaq' (the endangered California red legged frog) (SYBCI, 2022).

Ecological benefits of healthy coastal wetlands are their ability to trap sediment, capture nutrients, and perform chemical detoxification, thus improving water quality of south coast groundwater. If droughts become more frequent and intense, water that previously made its way into coastal wetlands, and then into groundwater, could significantly decline or could be increasingly sequestered behind dams. This lack of fresh water and associated sediments would further degrade wetland habitats, reduce vertical accretion, and deplete groundwater levels and degrade water quality. Wetlands may also be able to adapt to rising water levels over time by trapping sediment, a process referred to as vertical accretion. Given the south coast's high variability in rainfall and freshwater input from year to year, and unknown changes to channel morphology, the ability of wetland accretion rates to keep up with rising sea levels is unclear.

The importance of coastal wetland ecosystems and the estimated loss of coastal wetlands are as follows:

- A total of 55% of the state-listed animals and 25% of the threatened plants depend on coastal wetlands, such as saltwater marshes, vernal pools, and sloughs (Noss et al., 1995).
- A total of 43% of the federally listed species rely directly on wetlands for survival (Noss et al., 1995).
- The estimated loss in estuarine wetlands is from 75-90% (Noss et al., 1995).

Coastal wetlands are of profound, multifaceted importance to the Chumash, serving as critical hubs for sustenance, spiritual practice, cultural identity, and ecological stewardship. Wetlands, estuaries, and coastal dunes are essential to Chumash cultural heritage, connecting the mainland to the Channel Islands and facilitating a reciprocal relationship with "Grandmother Ocean". Wetlands and estuaries provide rich resources including clams, mussels, abalone, crabs, and a variety of fish. Wetlands and estuaries are crucial as a daily food source and provide materials for trade and

traditional crafts, such as basketry and shell bead currency. Wetlands are also part of a broader landscape that is tied to traditional narratives and represent a "land back" movement for Chumash to recover threatened cultural practices and reclaim sacred sites. Wetlands and surrounding coastal areas contain ancestral sites that are invaluable for understanding Chumash maritime society and for the Chumash to maintain a living culture and collective continuance.

Coastal Beaches

Coastal beaches and the adjacent waters are the core of Chumash cultural identity, spiritual life, and historical survival. Historically the social and economic structure of Chumash culture was shaped by an intimate and intergenerational connection and relationship with the California LME and SCB. Chumash people have maintained a profound, reciprocal relationship with the coastal ecosystems of the region (Glassow, 1996). Chumash use of the coastal beach ecosystems extends far beyond simple resource extraction, integrating spiritual stewardship with sophisticated ecological management. SLR, coastal erosion, and extreme weather events threaten the physical integrity of Chumash ancestral sites and the continuity of Chumash traditional practices.

According to the study by Vitousek et al. (2023), it is projected that between 25% and 70% of California's beaches could be lost by the end of the century due to rising sea levels and coastal erosion. The further narrowing and/or loss of future beaches (and the ecosystems supported by those beaches) will primarily result from accumulating SLR combined with a lack of ample sediment and sand in the system, which together will continue to drive the landward erosion of beaches, effectively drowning them between the rising ocean and the backing cliffs and/or urban hardscape.

Beach loss will continue to have dramatic consequences on coastal Chumash village areas and archaeological sites. With respect to cultural identity, Chumash identify strongly as "seashell people" or "bead makers". Beaches are the source of the olivella shells used to create beads, which were once the basis of a widespread shell-money economy used for trade, even in the interior and desert regions. Beaches and the adjacent rocky intertidal and nearshore rocky areas provide essential food resources. Mussels, clams (such as the Pismo clam), abalone, and kelp, are staples in the traditional Chumash diet. In addition, coastal locations are considered sacred. Beaches are crucial for the use of the tomol, which were historically used for trading with other regions and hunting marine mammals and are still used today to navigate the Santa Barbara Channel.

If there are no beaches in the future, the urban coastal areas of the south coast will be exposed to major coastal hazards and climate events, such as King Tides and storm activity, that will have significant economic consequences to private property

and public coastal areas. Beaches and coastal wetland ecosystems are barriers that protect the urban environment from coastal hazards. Continued loss of coastal Chumash village areas and archaeological sites is expected.

To understand the significance of these coastal ecosystems to Chumash, consider the following takeaways. The coastal region inhabited by Chumash provided abundant marine resources, including fish and shellfish, essential for their diet. The region's diverse ecosystems supported a variety of plant life used for food, medicine, and materials. The coastline facilitated trade and cultural exchange with neighboring tribes and communities. The Chumash utilized the ocean for transportation, using canoes (tomols) for fishing and trade. Coastal sites held spiritual significance, with many locations tied to their cultural beliefs and practices. The region's natural beauty and resources fostered a deep cultural connection to Chumash ancestors, the country, and more-than-human community. Chumash adapted to natural changes to coastal and marine ecosystems by developing cultural, economic and political reforms.

Finding Refuge

Along southern coastal California, entire ecological communities are considered threatened or endangered. The federal government indicated that coastal sage scrub communities and several other coastal ecosystems in Southern California are endangered or threatened ecosystems (Noss et al., 1995). Studies of the general decline of habitat and associated native species diversity in the southern and central California MTE note the following:

- The native plants of coastal California are so vulnerable to anthropogenic climate change that two-thirds of these endemics could suffer more than an 80% reduction in geographic range by the end of the century (Noss et al., 1995).
- The estimated loss in riparian communities throughout the state is 90-95% (Noss et al., 1995).
- The estimated loss in vernal pools is 90% (Noss et al., 1995).

The risks posed by climate change will continue to threaten coastal marine ecosystems and coastal Chumash cultural heritage. An unknown number of Chumash archaeological sites are now submerged. Not a single Chumash site has been identified in the ocean so far. This is likely due to physical and coastal processes, such as wave action, which have disturbed submerged traditional cultural materials.

In the past, Tribal communities and coastal villages were moved by Tribes to adapt to changes to the coast. As human-induced climate change accelerates SLR and other pressures, coastal hazards will increase in frequency and duration, expanding flood

extents and accelerating the threat to remaining Chumash coastal cultural heritage areas. The loss of coastal Chumash cultural heritage is not merely the loss of tangible objects, such as archaeological artifacts. The loss of coastal Chumash heritage has intangible consequences as well. There are spiritual and sacred foundations to Chumash places that should not be overlooked or underappreciated in an assessment of threats and risks posed by climate change.

Colonization has had many impacts on Chumash cultural heritage. Few of the coastal Chumash areas that are at risk today from coastal hazards are accessible to Chumash or are managed areas under Chumash authority. The collective continuance of Tribal cultural and ecological heritage along the coast is in jeopardy. Thousands of years of Chumash practices of stewardship and maritime traditions are at risk. The erosion of coastal Chumash village areas is a type of slow violence that is, metaphorically, whittling away at the Tribal maritime traditions and coastal cultural heritage areas. The violence of colonialism and missionization of the Chumash people displaced communities and substantively contributed to the decline of oral tradition, history, and language. There is currently no plan for reparation or a plan for resolution to return lands and coastal areas to the Chumash.

Coastal areas that were once inhabited by the Chumash have become private property or are under some type of public land ownership that is often inaccessible to the Chumash. The separation of land and community from Native peoples contributes to a general decline in the diversity of spoken traditional languages and associated cultural practices– an intergenerational injustice.

The continued loss of cultural heritage represents a long-term pattern of environmental racism and climate injustice (Lester et al., 2023). Chumash heritage is an embodiment of beliefs, customs, and material attributes that historically influence the development of societies. Cultural heritage is not only a reference to cultural artifacts but also includes the human activities and places that contribute to ritual, ceremony, stories of creation, and cultivation of knowledge and language. These cultural heritage areas also are places where ancestors remain, and access to these cultural areas is essential to Chumash collective continuance.

Climate refugia serve to foster cultural resilience in the face of food and water insecurity brought on by drought, floods, fires, and famine (McGinnis, 2008; 2011; 2016). Climate refugia are specific areas that remain relatively buffered from contemporary climate change over time (Morelli et al., 2017). These locations allow plants, animals, and ecosystems to persist even as regional or global climates shift rapidly. In conservation biology, climate refugia areas are described as "slow lanes" for native species diversity, providing temporary or long-term "safe havens" that buy time for species to adapt or eventually migrate to new suitable habitats.

Animals and Plants Important to Chumash

Chumash cosmology is based on an intergenerational value and gratitude to the land, waters, and living beings of the region (Cordero et al., 2019). Chumash support a sacred responsibility to protect, care for, and live in deeply knowledgeable, reciprocal, and regenerative relationships with these non-human relatives. The maintenance of the region's habitat and species is exemplified by the Chumash authors of the Chumash Ecosystem Services Assessment produced for the Channel Islands National Marine Sanctuary's most recent Condition Report that describes the general status of the marine environment and its importance to Chumash heritage. Cordero et al. (2019) describe the relationship between the people, land, marine system, and the ancestors that are part of place and community:

> *"Even though the Chumash have been dispossessed of their islands and surrounding waters, they always have been and will always be there. They are there in the ecosystems shaped by untold generations of Chumash traditional tending. They are there as protectors of the buried ancestors and villages. And they are there through the prayers of people longing for reconnection with their home. Their relatives exist there too – dolphins, foxes, oaks, olivellas, abalone. The Chumash are the islands and the waters. Tending that relationship is the collective birthright and sacred responsibility of all Chumash people."*

In 2023, the Tribe produced the Climate Change Adaptation Plan (CCAP) that was completed by the Santa Ynez Chumash Environment Office (SYCEO). The CCAP incorporated information from databases maintained by SYCEO which include identification of 207 individual plant, fish, reptile, amphibian, and bird species of Chumash cultural significance. The CCAP was informed by survey responses from 60 Chumash community members. Responses identified 40 locations, 74 plant species, and 48 animal species of cultural significance (SYBCI, 2023). Ninety percent of the survey respondents who participated in the CCAP believe that "climate change is impacting Chumash cultural resources."

Below, the section includes a list of plants and animals identified by Chumash participants in the CCAP activities. The section also provides a brief characterization of the cultural significance of the species. With respect to plant species used by Chumash, Roberta Cordero (McGinnis and Cordero, 2004: 16) notes that of the relevant native plant species, there are 70 genera known to have been eaten by Chumash. About half of those occur after fire and 15 others—sometimes called "fire followers"—reach their peak of abundance in areas that were burned the previous year. Traditional burning of coastal areas, including sage scrub communities, was an essential part of cultural practice to foster food security for the Chumash. Virtually every part of the landscape today has been influenced by Chumash burning activities; these burning activities were an essential part of the stewardship by Chumash of the region.

Plants with Chumash cultural uses

- California pigweed (often Amaranthus species) is primarily a nutritious food source, with its seeds harvested and ground into flour to make mush and cakes, like other vital native seed foods like chia. As a wild resource, its leaves are used as greens, and the seeds provide high nutritional value.
- Dogbane (Indian hemp) is primarily used for creating exceptionally strong, durable cordage (twine/rope) and as a crucial, though toxic, medicinal herb. The inner bark provided fibers for nets, fishing lines, bags, and bowstrings, while the plant was also used in managing stored foods.
- The Chumash people value native thistles, including Indian thistle and related species, as a versatile source of food, medicine, and utility in daily life. They consume young thistle stalks and roots for nourishment, while utilizing the plant for treating ailments like headaches.
- Khutash (Brewer's redmaids) are a vital, high-status food source and a sacred offering. The seeds are harvested, toasted, and ground into a nutritious oily meal or dough, ranking among the most expensive food items in Chumash culture.
- The Mariposa lily, particularly the Catalina Mariposa Lily, is an edible bulb, which is a nutritious food source. Harvested with digging sticks, these starchy, almond-flavored bulbs are eaten raw, roasted, or baked in earthen ovens. They were a vital food source, especially in early spring.
- California Goosefoot is a versatile, year-round source of food and traditional medicine. The seeds are ground into flour for bread or porridge, young leaves/stems were consumed as vegetables, and the roots were used for soap.
- Miner's lettuce is a traditional food and medicinal plant that is a nutritious green in early spring. Rich in Vitamin C, it is eaten raw or cooked, and used as a remedy for ailments like rheumatism and poison oak.
- Bluedicks is a crucial, staple food source for the Chumash, especially on the Channel Islands, providing a reliable source of starch for thousands of years. The edible underground corms are gathered in vast quantities, managed as a crop, and are eaten raw, roasted, or dried, serving as a dependable, year-round nutrient source.
- i'lepesh (Chia sage) is a highly nutritious food staple, a potent medicine for wounds and eye issues, and a key trade item. Valued for its endurance-boosting properties, it is used by hunters for energy and managed through ecological burning to maximize harvest.
- Clover is a vital, nutritious food source often eaten raw and provides essential vitamins and protein. Beyond direct consumption, it is part of a managed landscape, with clover-rich meadows maintained through controlled burning, which enhanced soil fertility and attracted game, playing a critical role in their subsistence strategies.

- Molush (Mugwort) is a medicinal and spiritual herb utilized for over 13,000 years to treat physical ailments like poison oak and to facilitate spiritual practices such as lucid dreaming, protection from evil spirits, and dream enhancement. It is considered a "dream sage" for ensuring meaningful dreams.
- Bear root, or chuchupate, serves as both a powerful medicine and a protective talisman. It is frequently carried or worn to repel rattlesnakes and is used medicinally to treat respiratory issues, such as colds and sore throats, by chewing or smoking the root.
- The Wild Cucumber is a potent medicinal and utilitarian plant, and is vital for treating hair loss, pain, and skin issues, despite all parts of the plant being toxic. Its massive, starchy tuber, which can weigh hundreds of pounds, is pulverized to stun fish in streams and tide pools, while the hard seeds are used for games, jewelry, and in creating paint for rock art.
- Indian tobacco is a vital sacred medicine used in spiritual ceremonies, healing rituals, and social covenants. It is considered a sacred plant for prayer, connecting the physical world with the spirit world, rather than a recreational substance.
- The Prickly Pear cactus is an essential food and medicinal material. It serves as a critical source of hydration and nutrition, particularly during dry seasons, while its fruit and pads (nopales) are used for food, and its sap is employed for technical and medicinal purposes.
- The Coast Live Oak was used for over 5,000 years, providing a primary food source, materials for daily life, and medicine. The 'ixpanīš (acorns) are a staple food, while the tree itself provided fuel, tools, and ecological benefits that shape Chumash life.
- The Arroyo Willow is used to make shelter, tools, and medicine. It was used to build dome-shaped homes, ceremonial enclosures, ramadas, and cradles. Additionally, the bark is used as a natural pain reliever for headaches and toothaches, and its presence signals essential freshwater sources.
- Wey'wey (White Sage) is considered a sacred, multifaceted plant essential for spiritual, medicinal, and nutritional well-being. It is used to cleanse spirits and calm senses, treats illnesses as a daily medicine, and serves as a food source, often respected as "grandmother" for its care and utility.
- i'lepesh (Chia Sage) is essential to cultural practices and is a high-energy staple food, essential medicine, and a highly prized trade item. Valued for its endurance-boosting properties, it is consumed by runners and hunters and used for its medicinal, ceremonial, and nutritional benefits.
- Khapshik (White sage) is a sacred, everyday plant essential for spiritual, medicinal, and nutritional well-being. It serves as a daily medicine for purification, healing, and ceremony, helping to maintain balance and protect against negative energy. It is widely used for cleansing rituals, and for treating ailments like colds and sore throats.

- Blue Elderberry serves as a key resource for making durable tools, particularly essential "self-bows" for hunting, musical instruments like flutes and clapper sticks, and as a significant, though not primary, source of food and traditional medicine.
- Tule (bulrush) is a fundamental, versatile resource essential for building homes, constructing watercraft, and crafting daily tools. It provided materials for thatched, domed homes ('ap), durable boats, mats, and baskets. The plant also played a key role in regional commerce and was used by Northern Chumash for transportation, with its pith used as a waterproofing sealant.
- Square Bulrush (often referred to as tule) is essential for building dome-shaped homes ('aps), creating mats, and constructing watercraft. It was used for essential shelter covering, versatile basket weaving, food, and as a natural material in building, acting as a crucial component of their everyday life.
- California Bulrush, often referred to as "tule," is used for building seaworthy boats, creating essential household items like mats and baskets, and providing materials for shelter. Its versatility made it a foundational resource for maritime travel, construction, and daily living.
- The California Bay Laurel is a multi-purpose plant that serves as a vital source of medicine, food, and ceremonial protection.
- The Chaparral Yucca is a vital multi-use resource for the Chumash, serving as a staple food source, a durable material for fiber, and a component for tools. It provides a reliable, seasonal food source—particularly the edible flowers, roasted stalks, and seeds—and can be used to create strong twine and fishing lines.
- Broad-leafed Milkweed provides durable, high-quality fiber for making strong cordage, fishing nets, and hunting gear, alongside medicinal and edible uses. The plant is harvested, processed for its fiber, and sometimes used for chewing gum.
- Narrow leafed milkweed is valued for its durable fibers used in making strong cordage, fishing nets, and hunting gear. Beyond its practical use as a fiber plant, it is utilized for medicinal purposes, food (young shoots), and its sap is utilized as chewing gum.

A total of 28 different marine and terrestrial animals were identified by Chumash who participated in the CCAP survey and workshops. Chumash community respondents identified animals by common name, and multiple species may be considered as such (e.g., an owl could refer to a Barn owl, Burrowing owl, or California Spotted Owl, among others). Below, a sample of ocean invertebrates, marine mammals, amphibians, reptiles, terrestrial mammals, fish (freshwater and saltwater), and birds is listed.

Birds

- The California Quail provides materials for cultural, ceremonial, and aesthetic purposes. These birds were hunted and trapped for their meat, contributing to the diverse diet of the Chumash, who lived along the coast and inland areas where the quail were plentiful.
- The Chumash value the Peregrine Falcon. In the Chumash language, the peregrine falcon is known as Helek, a name also given to the first modern tomol built in 1976 to revive their maritime heritage.
- The Chumash traditionally used Red-tailed Hawk (and often eagle) feathers for fletching their arrows, specifically using two Red-tailed Hawk feathers and one eagle feather to ensure the arrows flew straight.
- The Chumash people hold the Golden Eagle (known in traditional narratives as Sl'ow or sometimes the "Giant Eagle") in high reverence as a sacred sky deity. It is regarded as a creature of great power and pride, often associated with the sun and as a protector that watches over the land.
- Red-winged Blackbirds and Brewer's Blackbirds are important as cultural, ceremonial, and ecological indicators. They are featured in specific tribal dances, honored in ceremonies, and, due to their distinct behaviors, serve as indicators of seasons and environmental changes.
- The Chumash people hold the California Condor in high regard, associating the endangered bird with supernatural powers, celestial events, and renewal, often using their feathers and bones in sacred rituals and ceremonial regalia. They are revered as sky spirits and "condor shamans" could use them to find missing people. This bird is listed as critically endangered.
- The Chumash people, specifically the Ventureño and Ineseño bands, traditionally recognize the Great Horned Owl, known in their language as muhu, as a significant figure in their culture. Owls are generally revered in Chumash culture, with the Great Horned Owl specifically associated with wisdom, clarity of mind, and the spirit.
- The woodpecker. particularly the red-tufted variety, is a significant figure in culture, often appearing in oral traditions as a "messenger" or "helper" during the Great Flood. The bird is viewed as a source of wisdom, and its red feathers are highly valued for adorning ceremonial dance regalia. Its red-tufted feathers are considered medicinal and symbolic of good fortune, friendship, and happiness.
- The Belted Kingfisher holds significance as a skillful, water-dependent bird that mirrors the maritime, fishing-dependent traditional culture.
- The Common Raven is a species highly significant in Chumash cultural and spiritual life.

- The American Crow and the closely related raven have significant cultural, spiritual, and narrative importance, featuring prominently as an intelligent, sometimes mischievous figure in traditional stories and representing a deep connection to the natural world.
- The Mourning Dove is a symbol of feminine energy, a bringer of new life or rain, and a messenger that connects the physical and spiritual realms.
- Ducks serve as a reliable source of food and raw materials for clothing and tools, particularly along the coast and in marshy areas. Ducks were once hunted using decoys made from tule reeds and feathers to attract them, along with using bows, arrows, and snares.

Mammals

- California mule deer are native to the coastal, chaparral, and oak woodland habitats and are a key resource for food, clothing, and tools.
- Tule elk are essential resources, serving as a vital source of food, clothing, and materials for tools. As a deeply respected animal, the elk held significant cultural importance, symbolizing wealth and maintaining a connection between the people, the land, and their spiritual traditions. The Tule elk recovered from over-exploitation and hunting that occurred during the late 1800s by settlers.
- Eurasian wild boar (introduced by Europeans and non-native)
- Rio Grande Wild turkey (introduced by Europeans and non-native)
- The Desert Cottontail Rabbit is a crucial, year-round source of food and materials and provides essential protein, fur for blankets, and hides for clothing. They are especially important for inland communities, supplementing their diet alongside deer and staples such as acorns.
- California Grizzly Bear (please note black bears were not plentiful, and the Grizzly remains an essential totem species in ceremony). The last Grizzly bear was hunted to extinction in California by 1911 despite the bear's presence with native grasslands on the California flag.
- The American badger is a source of food, materials, and a figure in oral traditions, representing a "fierce" and "courageous" creature. Badger claws were used in traditional items, and the animal was hunted along with other terrestrial species by the Chumash.
- The California Valley Coyote, a subspecies native to the region, is a major figure in Chumash cosmology, often deified as "Shnilemun" or "Coyote of the Sky". This sky deity is considered a protector who looked after the welfare of humans.
- The Chumash people utilized and revered the Island Fox, a diminutive species that evolved from the mainland gray fox through insular dwarfism. These

foxes, about 35% smaller than their ancestors, were kept as sacred pets, dream helpers, and used for pelts, often being transported between islands in tomols. The Island Fox was listed as endangered in 2004 but achieved one of the fastest recoveries in Endangered Species Act history, with the subspecies removed from the endangered species list in 2016.

- The Chumash people historically used the Southern Sea Otter, a subspecies of the sea otter native to the central California coast. Highly valued for their dense, thick pelts, Chumash used otters to craft capes, robes, and blankets, and were considered a major commodity. The subspecies is listed as threatened under the Endangered Species Act.
- *Ololkoy* (dolphin) is considered a sacred brother and sister, not a resource to be used. According to the "Rainbow Bridge" creation story, when the goddess Hutash transformed falling people into sea creatures, they became dolphins, specifically associated with the species found along the California coast.
- Pinnipeds (seals and sea lions) are vital to the Chumash people and were a major source of food, raw materials for tools, and cultural resources. They provided essential fats, hides, and bone, and their seasonal aggregation on the Channel Islands made them a key, albeit heavily hunted, marine resource for subsistence and trade. Pinnipeds are marine mammals that are protected under federal and state statutes.
- Whale species were of immense cultural, spiritual, and material importance to the Chumash people, functioning as sacred beings that symbolized abundance, power, and the interconnectedness of life. Whales provided vital resources (food, oil, bones for tools/housing), influenced ceremonial life, and were revered as benevolent guardians of the sea. Whales are marine mammals that are protected under federal and state environmental law.

Fishes, Reptiles and Amphibians

- *Isha'kowoch* (Southern California steelhead salmon) was once a vital, sacred, and abundant winter food source for the Chumash people, sustaining their communities for over 10,000 years with fat-rich nutrients. Beyond subsistence, this iconic fish was integral to their cultural, spiritual, and ecological life, honored through ceremonies and recognized as a key relative in their ancestral ecosystem.
- Rainbow trout were once a vital, high-protein food source and a significant component of the cultural landscape for the Chumash people, especially as a reliable winter food source. These fish were harvested from local waterways like the Santa Ynez River and supported the sustenance of inland and coastal communities. The subspecies are listed as endangered.
- Walleye and Barred Surf Perch serve as a dependable, year-round staple food source and a key component of their coastal economy. Caught nearshore

in the marine environment using nets and lines, these fish provide essential nutrients, allowing for diet diversification alongside shellfish, larger pelagic fish, and marine mammals.

- Pacific Cod is a key source of food and is a major commodity in Chumash trading networks. Coastal and island villages used sophisticated tomol plank canoes to fish for deepwater species, exchanging their catch for inland resources like obsidian and skins.
- White and Black Sea Bass were critical to the Chumash people, serving as a staple food source, an economic commodity for trade, and a component of their maritime culture. They were part of a diverse marine diet—including over 150 fish species.
- *'Elye'wun* (The Pacific Swordfish) holds immense value and is revered as a powerful "master of the sea" and the marine equivalent to humans. They are honored for driving whales ashore to provide food, honored in ceremonies like the Swordfish Dance, and depicted in sacred rock art.
- Blainville's horned lizard (often called the horned toad or "horny toad") holds significant cultural, spiritual, and symbolic importance. Chumash revere the lizard as a "Grandfather" figure. They are held as protectors, spiritual healers, and symbols of luck, resilience, and strength.
- The Southern Pacific Rattlesnake has spiritual, ritualistic, and practical value and is a powerful entity rather than merely a feared animal. They are central to protection rituals, used in specialized ceremonies to demonstrate shamanic power, and managed through herbal knowledge.
- The Western Pond Turtle was harvested from local waterways for food. Beyond sustenance, turtles hold cultural significance across Native American nations as symbols of longevity, protection, and creation. The turtle is listed by California as a species of concern.
- The California Tiger Salamander holds significance in Chumash culture primarily as a "water creature" connected to the lower world and underworld spirits, often associated with the balance of water and ecological health. These animals are viewed within a worldview where all things are considered alive, intelligent, and potentially dangerous, reflecting a deep, respectful, and reciprocal relationship with nature. The species is listed as endangered.

Marine Invertebrates

- Red and Black Abalone were foundational to the Chumash people, serving as a critical, versatile resource for over 12,000 years. They provided a staple food source, while their shells were vital for crafting tools, creating ornamental jewelry and regalia, establishing currency, and enhancing spiritual ceremonies. White and black abalone are currently listed by NOAA Fisheries Service as federally endangered under the Endangered Species Act. All seven of the

United States' abalone species that live on the West Coast are now listed as Critically Endangered or Endangered on the International Union for Conservation of Nature, or IUCN, Red List of Threatened Species.

- The Bent-nosed Clam and Pismo Clam were once a reliable staple food source and, in the case of the Pismo clam, provided raw material for currency and trade. These clams formed part of the diverse marine diet found in coastal middens, with Pismo shells specifically used for making clam shell disk beads.
- The Owl Limpet was utilized for thousands of years as part of Chumash maritime subsistence economy. These large intertidal mollusks, with shells reaching over 100 mm, were collected for their nutritious muscular foot and served as a dependable, accessible protein source along the rocky California coastline.
- The Purple Dwarf Olive shell is the raw material for manufacturing shell bead money used for over 2,000 years. These beads functioned as a standardized currency, facilitating widespread trade networks throughout California and as far away as the American Southwest.
- The Ochre Sea Star is vital to the Chumash people primarily as a keystone species that maintains the health and biodiversity of the intertidal zones. By feeding on California mussels, they prevent these bivalves from overcrowding rocky shores, ensuring a diverse ecosystem that supports a wide range of marine life essential to the Chumash, a traditional maritime culture.
- The California Spiny Chiton, along with other intertidal shellfish, served as a key traditional food source for the Chumash people, providing reliable sustenance along the coast. This chiton, commonly found in rocky crevices, allowed for easy gathering of protein-rich meat with minimal effort, forming a critical component of their maritime subsistence strategy.
- Red and Purple Sea Urchins served as a vital food source, providing rich nutrients, and were part of the complex, interconnected coastal ecosystem.
- The California Mussel provides a reliable source of protein for over 12,000 years. Collected along the Pacific Coast, these mussels were heavily consumed, used for tools, and served as critical sustenance, particularly for Channel Island communities. Chumash relied on the native Olympia oyster alongside other shellfish like abalone, mussels, and clams, as a vital source of protein.
- Rock crabs—including the red rock crab, brown rock crab, and yellow crab—are a year-round nutrient-dense food source that was easily gathered from rocky shorelines and shallow coastal waters.
- Dentalium (tusk shells) were highly prized by the Chumash and other California Native American groups, acting as a significant form of currency, status symbol, and adornment. These shells were used in trade, crafted into jewelry/regalia, and held deep spiritual significance.

The lists noted above are by no means exhaustive. Historically Chumash utilized over 150 species of native plants and developed fishing techniques for well over a hundred kinds of fish. Their diverse diet and material culture were supported by extensive traditional knowledge of marine, coastal, and inland environments. Chumash gathered shellfish like mussels, clams, and abalone. Chumash hunted marine mammals such as sea otters, seals, and sea lions. Chumash hunted large and small animals including deer, rabbits, squirrels, and bears. These resources provided food, medicine, shelter (dome-shaped homes), clothing, and materials for advanced crafts like the tomol.

Summary

The impacts of climate change on Chumash cultural heritage include physical destruction of culturally valuable habitat, plants, and animals; the loss of access to cultural areas of significance; the disruption of ancestral knowledge and traditions tied to the cultural landscape; and the diminishment of the availability of valuable species that are sacred and life-giving. Coastal hazards include coastal dune and cliff erosion, tidal flooding, storm wave flooding, compound flooding that combines coastal and inland flooding from storm events, and coastal confluence flooding. Coastal Chumash heritage and cultural materials are increasingly at risk from being washed away or permanently submerged. For the Chumash, the plants and animals of the region are living relatives.

Chumash adapted to changes in the region's marine and coastal habitats for millennia. Climate change acts as a double-edged sword, degrading the tangible remains of the Chumash cultural heritage while contributing to the decline and loss of ecosystem health and integrity. Ultimately, rising sea levels and intensified storm surges degrade ancient village sites and "middens" (archaeological deposits); thousands of years of ancestral cultural heritage and history are being lost. Simultaneously, the warming of SST and acidification of coastal waters are driving away culturally vital species, such as the abalone and olivella snails used for food and traditional regalia. Climate change jeopardizes the cultural continuity of the Chumash, as the specific plants, animals, and seasonal cycles that dictate ceremonies and traditional knowledge become increasingly unpredictable.

Chumash access to culturally sacred and ecologically sensitive coastal areas that are at risk from climate change is made more difficult by the history of colonization, privatization of coastal areas, and the forced removal of Chumash from traditional areas of inhabitation. As noted in the CCAP, over 90% of respondents in a Chumash vulnerability assessment stated that climate change has already impacted their ability to access traditional cultural sites. The major findings of this section are:

- Increased coastal erosion and flooding are permanently destroying irreplaceable village sites, burial grounds, and artifacts before they can be protected or documented.
- Warming of SST, SLR, acidification, and degradation of coastal ecosystems, such as beaches, wetlands, and estuaries continue to reduce the availability of traditional materials, such as specific shells for bead-making and kelp forests that support local fisheries. Extreme heat and changing seasonal cycles have forced the Chumash to adjust the timing of traditional ceremonies that rely on specific weather patterns or flora/fauna behaviors. Habitats for culturally essential species are shifting or disappearing. Ocean acidification and warming SST, including marine heat waves, are damaging marine life that is essential to Chumash identity. For example, larval crabs are experiencing shell dissolution, and traditional resources like olivella shells—used for regalia and shell money—are becoming increasingly scarce and unavailable.
- Rising seas threaten to submerge low-lying coastal areas used for solstice ceremonies and spiritual gatherings, severing the physical connection to ancestral lands. Rising tides and high-energy storms are eroding coastal cultural sites, exposing and destroying artifacts before they can be documented. Sites like Morro Bay, vital for solstice ceremonies and gathering natural resources, face permanent inundation with projected SLR.
- The rapid pace of climate change outruns the historical seasonal markers used by elders to pass down ecological and ceremonial wisdom. Changes in climate affect the timing of spiritual ceremonies and the ability to gather medicinal plants. Traditional plants like Chia Sage and Chuchupate have already migrated to higher elevations or vanished from traditional gathering areas. The coastal archaeological record is a non-renewable resource that holds 13,000 years of human history. These "windows of opportunity" to learn from ancestral village locations are rapidly closing as sites are washed out to sea or scavenged. The loss of physical access to ancestral sites hinders the teaching of youth by elders, breaking the continuity of cultural knowledge transfer.

Appropriate planning and decision-making tools should be developed that can strengthen and improve Chumash engagement and consultation protocols that ensure scientific and traditional knowledge systems can be used to inform Tribes and resource managers about the nature of risk posed by climate change on traditional cultural resources. This will require more than further documentation of coastal village areas at risk and more detailed studies on the coastal ecosystems that are threatened by climate change. Engagement and consultation protocol will require the confidentiality of Tribal information and knowledge, and a deeper awareness and understanding of climate planners about the risks posed by climate change to traditional heritage.

In addition, formal consultation requests by public agencies to Chumash are increasing because of the impacts and threats from climate change on cultural resources and coastal ecosystems. As the severity of risks to coastal cultural heritage areas and ecosystems intensifies, we can expect more formal consultation requests from resource agencies to Chumash staff. The Chumash receive the burden of fiscal responsibility to respond to these local, regional, and statewide consultation requests. Chumash cultural monitoring will be required to document the ongoing impacts and pressures on coastal Chumash cultural resources. However, given the steady increase in consultation requests, Chumash may not have the resources to participate in local community engagement activities and respond to consultation requests. Tribes may face constraints in staff resources, access to technical information, and availability of interpretive data needed to engage fully in consultation processes for coastal projects related to climate change.

II. Cultural Heritage Exposure to Sea Level Rise and Coastal Hazards

California SLR guidance documents note that climate change will impact coastal tribes' cultural heritage. Yet, no clear characterization of the impacts of climate change on coastal Chumash cultural heritage exists. In addition, a review of existing municipal climate adaptation strategies indicates that few plans include protective or mitigation measures addressing risks from SLR to coastal Chumash cultural heritage. These gaps are particularly evident for coastal village sites, burial sites and cemeteries, sacred sites, important coastal habitat areas, and other culturally significant places.[10]

A substantive focus of California's climate adaptation framework emphasizes the role of local authorities and regional planning efforts.[11] California SB 272's requirements regarding Tribal cultural resources focus on compliance under the California Environmental Quality Act (CEQA), including formal Tribal consultation (as required by AB 52) and engagement with Tribal authorities. SB 272 includes the following provisions:

- SB 272 mandates local agencies to identify and address Tribal cultural resources in their planning processes.
- It requires consultation with California Native American Tribes when a project may impact tribal cultural resources.
- The bill emphasizes the importance of preserving Tribal cultural heritage during environmental reviews.
- Agencies must include Tribal cultural resources in their environmental impact assessments (EIA).
- SB 272 aims to enhance collaboration between local governments and Tribal communities.
- Compliance with SB 272 is essential for projects to meet CEQA requirements effectively.

10 This project included a review of climate action plans in the study area. The California Climate Action Plan Database (CCAP Database) that is a creation of Cal Poly San Luis Obispo's Initiative for Climate Leadership and Resilience. The CCAP Database includes city and county climate action plans (CAPs) from California. As of January 2023, the CCAP Database includes 253 CAPs and associated data. There is a CCAP Library containing a PDF copy of all CAPs in the database. https://climate.calpoly.edu/CCAP

11 California SB 272 requires all municipalities and local governments within coastal zones and the San Francisco Bay shoreline to address SLR and coastal resilience by integrating adaptation plans into their Local Coastal Programs (LCPs) or Regional Shoreline Plans by January 1, 2034.

To date, few counties or cities have incorporated planning elements in updated general plans, local coastal plans, or zoning ordinances that clearly focus on protective measures for Tribal cultural resources and archaeological sites. To fully participate as sovereign governments in future local and regional climate adaptation planning, Tribes will likely require resources that support collaboration, consultation, and partnership-building efforts with other local, state, and federal partners. Tribal engagement and consultation are not just a matter of public outreach or stakeholder management. Tribal engagement and consultation in climate planning require a legal, political, and ethical framework that supports Tribal sovereignty. The recognition of Chumash sovereignty in climate planning ultimately requires the development of a government-to-government partnership between Tribal governments and federal, state, or local resource agencies.

This section represents one of the first studies funded by the State of California to assess the severity of coastal hazards on coastal Indigenous village areas and coastal archaeological sites. The section provides an analysis of coastal hazards and SLR. The section provides findings from data and information that are used by federal, state, and local coastal planners. The study includes the use of geospatial coastal hazard models that have been used in Phase I coastal vulnerability assessments completed for coastal cities and counties of the region, including the City of Goleta, City of Santa Barbara, City of Oxnard, Ventura County, and Santa Barbara County. The hazards used in this assessment include projected coastal erosion, coastal wave flooding, and tidal inundation hazards with up to 5 ft (1.5 m) of SLR, which has an associated time horizon of 2090–2140 (California Ocean Protection Council, 2024). Mapped locations of coastal Chumash village areas are not exact locations. Information on coastal Chumash village areas was provided by the SYBCI's Culture Department. The village areas are also public information. Tribal staff members carefully reviewed this report to ensure that no confidential information was used in this study and report.

One key finding from the coastal hazard assessment is that roughly 30% of the 33 coastal Chumash village areas were determined to be at severe risk from coastal hazards including SLR. Table 1 lists the cultural keystone places that have been identified by members of the Chumash community during the CCAP planning activities, and the severity of risks from coastal hazards.

Table 1. Keystone Places identified by Chumash at Some Level of Risk from Coastal Hazards in the CCAP (SYBCI, 2023).

Area or Site Identified by Chumash during the CCAP activities	Severity of Risk from Coastal Hazards
Avila Beach	Moderate
Pismo Beach	Moderate
Point Conception	Moderate to High
Burton Mound	Not identified in this study
Rancho Guadalupe Dunes Preserve	Moderate
Carpinteria Wetland	High
Channel Islands	Not identified in this study
Saticoy (Santa Clara River)	Moderate to High
Satwiwa	Low
Gaviota	Moderate
Shalawa Meadow (Hammonds Meadow)	Moderate
Humaliwo	Not identified in this study
Jalama Beach	Moderate
Sisquoc River	Moderate
Spyglass (Pismo)	Moderate
Goleta Slough	High
Morro Bay	Low
Vandenberg	Moderate
Ventura Beach	High
Ventura River Mouth	Moderate to High

To assess the exposure of 33 coastal Chumash village areas to coastal hazards associated with climate change, the Coastal Storm Modeling System (CoSMoS) was applied across the study area. CoSMoS is a dynamic modeling approach that allows detailed predictions of coastal flooding due to both future SLR and storms integrated with long-term coastal evolution (i.e., beach changes and cliff/bluff retreat) over large geographic areas (100s of kilometers).[12] Coastal hazards data used in this analysis were sourced from the following publicly available datasets:

- Coastal Storm Wave Flooding. The Nature Conservancy (TNC) Coastal Resilience[13] (5 ft of SLR with a 100-year storm) and U.S. Geological Survey (USGS) CoSMoS[14] (4.9 ft of SLR with a 100-year storm), Federal Emergency Management Agency[15] (existing hazard from a 100-year storm event)
- Coastal Confluence Flooding. TNC Coastal Resilience (5 ft of SLR with a 100-year storm)
- Coastal Erosion (Dune and Cliff). TNC Coastal Resilience (2100 under high erosion)
- Rising Tides. USGS CoSMoS (6.5 ft of SLR and a 1-year storm event).

Note that the coastal hazards data described above use diverse SLR projections for storm-related events.

An analysis of coastal hazard exposure and the potential severity of impacts to Chumash coastal village sites was determined for each coastal hazard and village site area. This severity was assessed based on two factors: the timing of hazard (i.e., how soon and how likely the hazard is), and extent of hazards by 5 ft of SLR[16] (i.e., how much of the historical extent of the village site area is exposed). This information was passed into a severity matrix as noted below. Note, it is a challenge to identify the "right-sized" analyses that identify the severity of risks and physical effects of SLR and other coastal hazards. Screening-level analyses can be useful to identify the types of hazards that may need to be more closely evaluated, for example with more detailed modeling or analysis, in certain areas.

- Low Severity (identified in green on Map 1 below) = Timing of impact is long, or likelihood of impact is small, and hazard extent is small.

12 Our Coast Our Future website provides a detailed overview for each individual hazard used in this study, and how the United States Geological Survey models hazards. Available at: https://ourcoastourfuture.org/science-and-modeling/

13 Available at: https://maps.coastalresilience.org/california/

14 Available at: https://ourcoastourfuture.org/hazard-map/

15 Available at: https://msc.fema.gov/portal/advanceSearch

16 The use of 5ft of SLR to identify the severity of risk to coastal Chumash village areas is based on information provided in the California Coastal Commission (CCC) Sea Level Rise Policy Guidance Final Adopted 2024 Update, 2024. Appendix B. Developing Local Hazard Conditions Based on Regional or Local Sea Level Rise Using Best Available Science. November 13. The 2024 State SLR Guidance produced by the OPC in 2024 is considered the best available science on California's regional SLR, and the CCC recommends using it when SLR projections are needed.

- Medium Severity (identified in yellow on Map 1 below) = Timing of impact is long, or likelihood of impact is small, but hazard extent is large, or timing of impact is soon, or likelihood of impact is large, but hazard extent is small.
- High Severity (identified in red on Map 1 below) = Timing of impact is soon, or likelihood of impact is large, and hazard extent is large.

Village Site Locations

Mapped coastal village areas represent general locations of Chumash habitation identified by the SYBCI's Culture Department and cannot fully account for the highly variable nature of settlement patterns (both seasonally and over the thousands of years of habitation), or landscape changes including a changing coastline, and the evolution of features such as rivers and estuaries that are influenced by changing water levels/flow, sediment supply, and human influence. These are not the only locations of coastal Chumash village areas. The sites selected for this study are coastal Chumash village areas that are described in public documents. Coastal village areas associated with the northern Channel Islands were not evaluated in this study. No confidential information from the Chumash was used in the coastal hazard assessment or report.

Impacts of Coastal Hazards on Chumash Village Areas

Coastal Cliff and Dune Erosion

Coastal cliff and dune erosion pose a significant threat to cultural heritage. This is of heightened concern for locations of Chumash settlement along dunes and sand spits, where erosion distances with SLR are projected to be more significant than cliff-backed shorelines. Shell middens, lithic scatters, and artifacts may be deposited by coastal and terrestrial processes and covered by wind-driven sand transport and remain buried in coastal dunes. Increasing sea levels will cause coastal dunes to migrate inland, and as the shoreline shifts, buried cultural items and ancestors may become dislodged and washed away by storm waves.

Storm Wave Flooding

One implication associated with climate change is a projected increase in storminess and extreme waves along the California coast. Storm wave flooding may lead to temporary inundation of Chumash areas during large storm wave events, particularly in the lower lying bar coastal wetland sites, and especially when they correspond with high tides. Storm wave flooding is also a contributing factor in accelerating coastal cliff and dune erosion. Floodwaters can increase salinity in soils; promote more rapid decay of cultural materials; have the potential to move or expose traditional archaeological sites; and can reduce traditional access to low-lying coastal heritage sites.

Compound Flooding

Climate change is projected to lead to an increase in the intensity of rainfall events. These intense rainfall events can lead to flooding of waterways, and along the coast this can be exacerbated by ocean processes and high tides. Compound flooding describes the increase in fluvial flooding due to coastal processes and SLR. Several village areas correspond with low-lying coastal areas that are near the outlet of a waterway that are potentially exposed to confluence flooding. Compound flooding can have a significant impact on sediment supply and move a riverbed, causing additional burial or exposure of village sites and ancestors. Additionally, these areas are more likely to have artifacts eroded from higher in the coastal watersheds and transported in river outwash, thus increasing the concentration of potentially exposed cultural artifacts.

Rising Tides

Rising tides will expose low-lying areas near coastal marshlands to ocean waters. Rising tides may lead to more long-term inundation of village sites. This study evaluated rising tides up to 5 ft of SLR while models project SLR up to 6.5 ft. This SLR horizon corresponds with the California Ocean Protection Council's (OPC) projections for 2100 under a high SLR scenario.

Other Hazards Not Evaluated

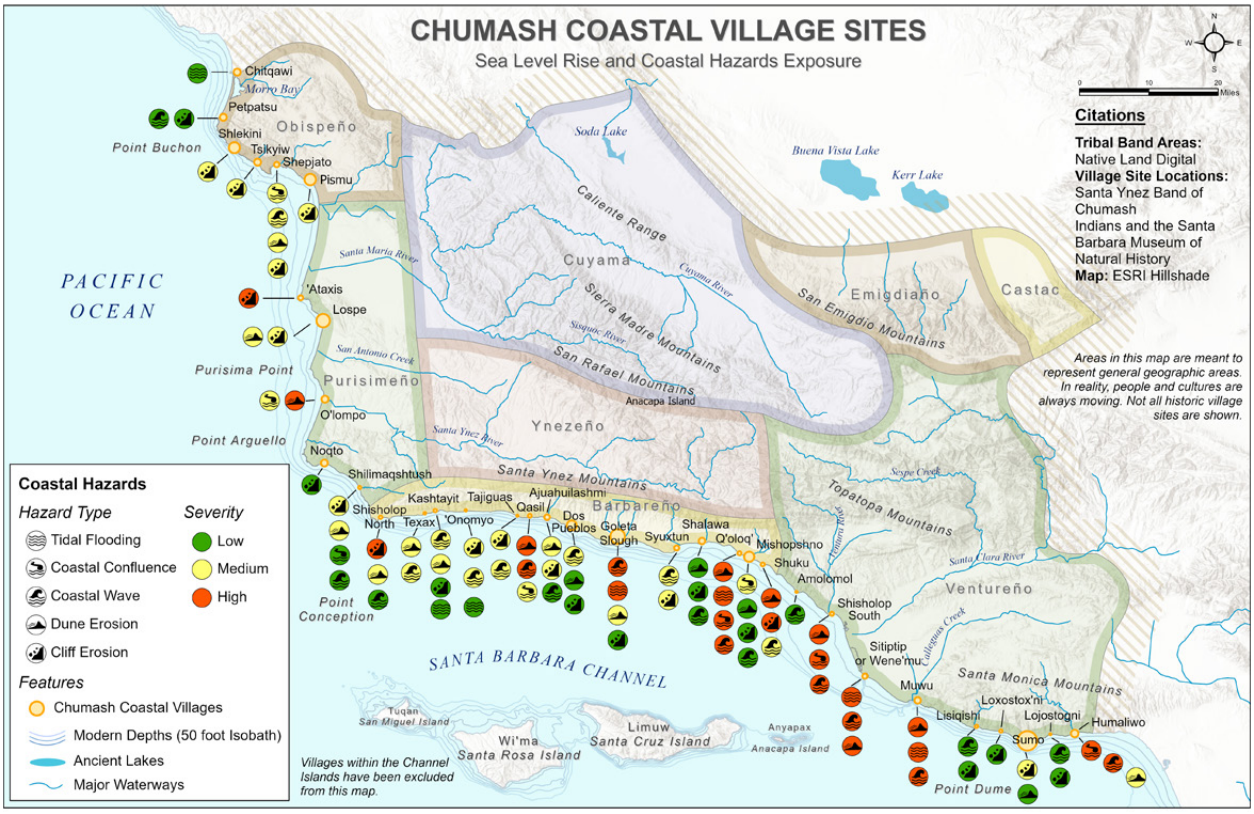
Emerging groundwater, increasing ocean temperature, and ocean acidification, while not evaluated explicitly, can interact with the hazards listed above and accelerate the degradation of cultural items. These other coastal hazards are not explored in this section. The primary goal of this section is to provide a preliminary coastal hazard assessment based on available data and information that is used in climate vulnerability assessments.

Map 1 depicts 33 coastal Chumash village areas identified by the Tribe and the coastal hazards associated with each village area.

The hazards represented on the map are identified as follows:

- Coastal Wave = Coastal Storm Wave Flooding
- Coastal Confluence = Coastal Confluence Flooding
- Dune Erosion and Cliff Erosion = Coastal Erosion (Dune and Cliff)
- Tidal Flooding = Rising Tides

Map 1. Coastal Hazards and Village Site Exposure Highlights.



Source: (McGinnis et al., 2025)

Coastal Hazards and Village Site Exposure Highlights

The ecologically productive estuaries at the mouth of drainages were often home to coastal Chumash villages. These sandbar strands and estuaries constitute many of the most highly exposed Chumash village areas, including Helo' on Mescaltitlan Island, S'axpilil on the northern boundary of the ancestral Goleta slough, Sismikiw near Campus Point (associated with the Goleta Slough area), Q'oloq' (Sand Point), Sitiptip or Wene'mu (Silver Strand), and Muwu (Point Mugu). These locations are especially fragile due to their exposure to dynamic coastal processes and are impacted by sediment sources from the transverse mountain range of the Santa Ynez and the Santa Monica Mountains to the south.

Detailed below is a more detailed description of some of the most exposed coastal Chumash village areas (listed north to south):

- **Morro Bay** (Frontal Estero Bay watershed). Several coastal Chumash villages are associated with Morro Bay. Lisamu (Morro Bay Rock) is a sacred site for the Chumash. Lisamu is currently protected as the Morro Rock State Preserve.

However, some 120 years ago, Lisamu served as a quarry for some of the armor stone in the Port San Luis breakwater, which was recently returned to the site by the U.S. Army Corps of Engineers. SYBCI nominated Morro Rock as a Traditional Cultural Place (TCP) to the National Register of Historic Places.

The City of Morro Bay updated its Local Coastal Plan (LCP) in 2020 as part of the Morro Bay Plan, an integrated planning project that included a General Plan update, LCP update, Zoning Code update, and Downtown Waterfront Strategic Plan. Models used to assess coastal vulnerability in Morro Bay show that with 6.6 ft (2 m) of SLR, tidal inundation would result in significant impacts to both infrastructure and habitats, such as the salt marsh. In addition, Morro Bay is one of the estuaries within the U.S. Environmental Protection Agency's (EPA) National Estuary Program (NEP). The Morro Bay NEP implements on-the-ground habitat restoration projects to increase resiliency in the estuary and the Morro Bay watershed.

The City of Morro Bay's comprehensive Local Coastal Plan (LCP) update, known as Plan Morro Bay (certified 2021-2024), included outreach and planning aimed at protecting cultural resources, involving Chumash perspectives and engagement. The process specifically addressed, analyzed, and proposed mitigation for potential impacts on traditional cultural resources.

- **Pismu** (Pismo and Avuka Beach areas). It was referred to as a place to find pismu or chapopote which is a type of asphalt tar used by Chumash during the construction of tomols and as an adhesive for decorations and sealing water jugs. Several village sites are situated along a cliff-backed coastline. The coastal bluff and cliff site is vulnerable to erosion in medium-to-long-term horizons.
- **Shepjato** exists farther to the northwest of Pismu at low-lying Avila Beach. This location is highly exposed to a range of coastal hazards in the medium to long-term.
- **Ataxit** to the south of the Santa Maria River has a high level of severity for cliff erosion.
- **O'lompo** (Santa Ynez River Estuary). The estuary and major parts of the Santa Ynez watershed are under the primary management authority of Vandenberg Space Force Base (VSFB). The abundant Chumash cultural material that is scattered throughout Vandenberg SFB is testimony to early occupation by Chumash. The Chumash and their ancestors lived in this coastal area for more than 9,000 years. Chumash historically lived in the coastal village areas near the estuary but would leave to hunt, fish, and collect plant foods, and these activities created archaeological sites that formed one of the most complete and culturally rich sites in the region. O'lompo and the surrounding coastal area are at substantial risk from continued cliff erosion.

As a US Department of Defense site and federally managed coastal area, Chumash access is coordinated through the Vandenberg Cultural Resources Team and requires adherence to base security protocols. The coastal area is relatively undisturbed because urban, industrial, agricultural, and recreational pressures have not destroyed the diverse native coastal habitats. However, a series of four dams on the river have reduced sediment supply and habitat for listed endangered southern steelhead populations.

The Vandenberg Space Force Base (VSFB) Integrated Natural Resources Management Plan (INRMP) and associated environmental management efforts were completed in 2021 and involved active partnership and consultation with Chumash. The base works closely with the Elders Council of the Santa Ynez Band of Chumash Indians to protect cultural and natural resources, including over 2,000 archeological sites.

- **Kumqaq'** (the Point Conception area). The coastal area is culturally significant to Chumash, especially the Shmuwich and Samala Chumash. The area is referred to in Chumash oral tradition as the Western Gate or "where souls bathe prior to departing for the afterlife" (Rick et al., 2022; Haley and Wilcoxon, 1999). The sacred area of Kumqaq' includes two major Chumash villages: Shilimaqshtush and Shisholop North. These villages and a third closely related satellite settlement of Shisholop called 'Upop yield a variety of ethnohistorical information on the Chumash who lived near Kumqaq.' The Chumash ties to the Kumqaq' region are woven into the shell middens and lithic scatters of the past 9,000 years or more through the villages of the mission era and into present-day communities. To Samala Chumash people, Kumqaq' is part of life. The area is exposed to cliff and dune erosion, and the beaches are exposed to coastal wave flooding.
- **Helo' on Mescaltitlan Island, S'axpilil on the northern edge, Sismikiw** near Campus Point (associated with the Goleta Slough area). The Santa Barbara Municipal Airport and Goleta Slough are located within and around ancestral Chumash village areas. For thousands of years, the Slough held much more water and formed a large lagoon. Near the mouth of this lagoon stood two islands with at least 30 large permanent homes. This village—called Helo' and later renamed Mescalitan—was inhabited for at least 1,000 years, and perhaps as long as 4,000. During this period, the Slough was home to an abundance of fish, birds, deer, coyotes, bears, and small game. The slough is the former confluence of five creeks and was once a large deep-water bay and the mouth was a large estuary. An intense rain event occurred in 1862 and brought approximately 14 ft of sediment into the bay and turned it into a shallow saltmarsh and wetland complex. In the 1940s, portions of Mescaltitlan Island were bulldozed to fill the estuary and create the Santa Barbara Municipal Airport as part of World War II preparations. Concrete-lined flood control channels and sediment debris basins were built to reduce flood risk, and these

areas currently trap sediments and reduce habitat value, posing challenges to aquatic ecosystems and species of importance to the Chumash. Coastal development and human alterations have contributed to the major loss of this Chumash cultural area (Glassow, 2020). There are severe risks from tidal flooding and coastal wave impacts.

Farther south, Goleta Beach was also an important maritime heritage location. The low-lying area around the slough is highly exposed to tidal inundation and coastal wave hazards. Goleta Beach is also vulnerable to dune erosion hazards. There is currently an intergovernmental advisory body, the Goleta Slough Management Committee (GSMC), which meets regularly to discuss the challenges and opportunities to address issues facing the slough and watershed. GSMC was formed in 1991 to serve in an advisory capacity to local governments and state and federal agencies to ensure that the issues associated with the Goleta Slough Ecosystem Management Plan Area, comprising 2,250 acres of habitat and adjoining lands, are addressed in a comprehensive manner, irrespective of jurisdictional boundaries.

The ecological significance of the slough and surrounding area is described and recognized in management plans that have been prepared since the 1980s, including the Goleta Slough Ecosystem Management Plan in 1997 and the Goleta Slough Existing Conditions and Monitoring Report in 2012. The Goleta Slough Area Sea Level Rise and Management Plan (hereafter the "Plan") was completed in 2015 comprises an update of previous slough management plans and includes new detailed information and analysis of future conditions projected to occur as climate changes over the next century. Studies used to prepare the Plan found that an increase in volume of the slough is an expected result of SLR. This could create tidal wetlands in areas that are currently blocked from tidal action, resulting in a more frequent open lagoon mouth. This increase in lagoon volume could reduce the need for mechanical breaching and provide an increase in ecosystem services provided by the wetlands. Lesser amounts of SLR (around 1 foot) would result in more frequent closed conditions, whereas high SLR (3 to 5 ft) may maintain an open inlet for much of the year.

The Plan involved collaboration with local Chumash representatives to protect cultural resources. The planning process included public meetings, focus groups, and direct input from stakeholders, including the SYBCI, particularly to address the impact SLR on coastal sites and traditional gathering areas.

The Santa Barbara Airport (SBA) is preparing a Climate Adaptation Plan that will build on the City of Santa Barbara Sea Level Rise Adaptation Plan prepared in 2021 and the Goleta Slough Area Sea Level Rise and Management Plan completed in 2015. The Climate Adaptation Plan (CAP) will address the potential impacts of increased flooding due to future projected SLR and increased rainfall with climate change. The

CAP will also incorporate the latest recommendations described in the California Sea Level Rise Guidance (2024). The City will update its Airport and Goleta Slough Coastal Land Use Plan (LUP) to incorporate adaptation-related policies identified from the vulnerability assessment and adaptation plan. Throughout the phases of the study, public meetings and workshops will be held to provide opportunities for community engagement and input. The SYBCI has participated in planning workshops and will continue to engage in the adaptation planning activities.[17]

- **Q'oloq,' Mishopshnow, and Shuku** (located in and around the Carpinteria salt marsh and beaches). Multiple Chumash villages are in and around modern-day Carpinteria. Carpinteria was named after the Portola expedition. Of the nearby village sites, Q'oloq is among the most vulnerable because it is a low-lying sand spit backed by tidal marsh. There is also a range of near-term hazards such as dune erosion, as well as confluence-induced and tidal flooding, and storm wave flooding. The area's cultural heritage is at substantial risk from all the coastal hazards noted in this section.

In 2019, the City of Carpinteria completed a vulnerability assessment. Cultural resources were not considered in the vulnerability assessment nor were there any Chumash Tribes engaged in the process. Based on available documentation, the City of Carpinteria's 2019 Sea Level Rise Vulnerability Assessment and Adaptation Plan (SLRVAAP) did not include direct, in-process engagement with Chumash Tribes, nor did it specifically evaluate impacts to cultural resources. The 2019 report focused primarily on city infrastructure, such as coastal hazards, flooding, and erosion, as part of a General Plan update.

- **Shisholop** (southern Ventura). This area is a coastal location with high exposure to coastal hazards and SLR. The village site is believed to have been a Chumash provincial capital and was a regional center of trade, politics, and religion.

California State Parks, in conjunction with the Surfrider Foundation, California State Coastal Conservancy, and the California Coastal Commission, implemented the Surfer's Point Managed Shoreline Retreat Project. This project was undertaken to preserve the popular surf break, protect the bike path and coastal access from storm wave flooding and erosion, and enhance the dune ecology. The Surfer's Point Managed Shoreline Retreat Project involved Chumash participation and consultation. The project documentation indicates that the City of Ventura collaborated with interested Tribes, particularly during the development of Phase 2, to ensure meaningful engagement and acknowledgment of ancestral lands.

- **Sitiptip or Wene'mu** (*Port Hueneme*). The village name signifies a resting place, and it is located midway between other prominent Chumash villages of Shisholop South and Muwu. Parts of the village are exposed to coastal wave flooding and tidal inundation and have been highly impacted by development.

17 Personal communication with Nakia Zavalla. Cultural Liaison, SYBCI. April 2026.

- **Muwu** *(Point Mugu)*—Muwu, meaning "beach" in Chumash, was an important launching site for tomols and a village site. The site is located on a low-lying stretch of land between the mountains and sea and is exposed to dune erosion, tidal inundation, and coastal wave flooding. The offshore marine area was an essential fishing area for Chumash people.

Naval Base Ventura County (NBVC) Point Mugu developed a Historic Archaeological Resources Protection Plan (HARP) in February 2001. It was designed to be used by project planners in conjunction with the Environmental Protection Branch at NBVC Point Mugu to provide management consistency and compliance with laws, regulations, and directives on historic preservation.

- **Humaliwo** (Malibu Point)—This site is called Humaliwo, which in Chumash means "where the surf sounds loudly." The Chumash village is near the Malibu Surfrider State Beach and lagoon. The site is listed on the Federal Historic Register. Humaliwo was a center of Chumash life for thousands of years through Spanish contact. Rindge Dam on Malibu Creek has reduced the supply of sediment to the beach, and the village is highly exposed to coastal erosion. With SLR, the site may soon be exposed to coastal wave flooding and confluence-related flooding from Malibu Creek.

The City of Malibu Coastal Vulnerability Assessment was delayed because of health considerations due to the COVID-19 pandemic. The city resumed work on the project in the spring of 2023. Based on available reports from the City of Malibu, the Coastal Vulnerability Assessment (CVA) launched in 2023 primarily focused on technical assessments of SLR and gathered community input through public workshops, with no specific mention of direct consultation with Chumash participants in the public meeting summaries. The specific CVA documentation for Malibu largely emphasized general community engagement.

Summary

Several takeaways for this section are noted below:

- Coastal vulnerability assessments and climate adaptation plans should be sensitive to the range of Chumash values and perceptions of risk related to coastal cultural resources.
- The loss of coastal Chumash cultural heritage is not merely the loss of tangible objects, such as archaeological artifacts. There are spiritual and sacred foundations to Chumash places that should not be overlooked or underappreciated in an assessment of threats and risks posed by climate change.
- The risks posed by climate change to coastal Chumash cultural areas are increasing. The region has always faced coastal hazards, including coastal dune

and cliff erosion, tidal flooding, storm wave flooding, and coastal confluence flooding, resulting from the combination of river flooding and coastal wave interactions. As climate change accelerates SLR and other pressures, coastal hazards will increase in frequency and duration, expanding flood extents and accelerating the threat to Chumash remaining cultural heritage areas.

- Ongoing climate vulnerability assessment and adaptation planning need to provide resources to Chumash to participate, engage, and collaborate in each stage of climate planning activities. Inclusive partnerships between governments and Tribes are the best path forward in knowledge and value sharing.
- Consultation requests by local, state, and federal resource agencies are increasing because of coastal impacts from climate change, including major storm events and King tides. Tribes are challenged by constant and unsupported requests to engage and formally consult with public agencies, as required by local, state, and federal laws, in climate-related coastal and land use issues that include Tribal cultural resources and places, such as the exposure or loss of a significant site due to a flood, fire, or storm event.
- California, regional, and local (or municipal) climate vulnerability assessments need to move beyond engagement with "stakeholders" and should emphasize collaborative, co-management approaches that can strengthen knowledge sharing and dialogues that include Tribes. Tribal members are not stakeholders in coastal and land-use planning activities; Tribes are sovereign governments. Tribal representatives should be partners in coastal vulnerability studies and associated climate adaptation strategies so that Tribal experience, knowledge, and values are part of climate planning activities.
- Tribal members and staff should be partners in coastal hazard assessments that, to the extent possible, support a cross-sectoral approach that incorporates social, ecological, culture and economic factors in climate change planning and co-management. Attention should be given to interdisciplinary strategies that help avoid, prevent, or minimize climate change short and long-term impacts to cultural resources.
- Strategic planning should indicate areas where further work will be required to increase the existing understanding of climate risks (including the possibility of catastrophic climate change), ecological and cultural vulnerabilities, and adaptation options and barriers. Identify additional cross-cutting, supportive strategies such as public engagement, networking, decision support, monitoring, periodic review of adaptation effectiveness, and fundamental policy changes. Establish feedback mechanisms that provide for the modification of strategies when needed.
- Chumash Tribes should be provided with additional resources to contribute to future vulnerability assessments and climate adaptation strategies. Future

collaborative efforts should include funding, capacity building, education, and outreach support that can foster new partnerships that integrate traditional Chumash values and interests in planning efforts that identify risks from coastal hazards and support adaptation measures that can be implemented by Chumash, local, state, and federal partners.

III. Steps Toward Ecocultural Resilience

The SYBCI's Climate Change Adaptation Plan (SYBCI, 2023) includes information from meetings with the Coastal Band and the Wishtoyo community, and interviews with Tribal leaders of the Coastal, Santa Ynez, Northern, and Ventureño/Barbareño Chumash Bands. These meetings and interviews of Chumash who participated in the CCAP activities recommend several adaptation measures that are noted below in Table 2.

Table 2. Policy Adaptation Actions. This table highlights different governmental or legal processes that are recommended by Chumash members who participated in the CCAP activities (SYBCI, 2023).

Adaption Strategy	Description
Create designations for permanent coastal and land conservation	Encourage conservation easements to conserve native plants, animal species, and cultural areas
Draft agreements between the Chumash, State and Federal Agencies	Ensure the Chumash right to gather traditional and cultural significant plant species found in coastal areas.
Review and comment on coastal development and management plans to protect key species & habitats	Ensure participation in decision-making processes by commenting on coastal management plans and policies to protect cultural resources and native species diversity
Utilize Chumash Ecological Knowledge (CEK) to augment coastal and watershed-based conservation practices	Infuse Indigenous languages and use traditional storytelling to strengthen conservation practices and education
Facilitate Ecological Community Adjustments	Focus restoration efforts heavily on native species that are expected to adapt to future climatic conditions; assist range expansion for species suitable in certain locations; establish new mixes of native species that would be suitable under future conditions

Adaption Strategy	Description
Expand Tribal Nurseries	Hire additional Chumash staff to expand nurseries (i.e., collect seeds, propagate, and re-introduce native plants)
Restore Riparian Systems	Restore a diversity of native trees, shrubs, and herbaceous species to increase stream shading, provide a source of woody debris, stabilize soil, provide wildlife habitat, and increase wildlife connectivity in riparian areas
Minimize risk of invasive species establishment	Increase monitoring for invasives to ensure early detection; Ensure abundant and diverse native species understory to limit the potential for spread of invasive species
Conduct surveys to monitor locations of key culturally significant plant and animal species	Invest in continuous monitoring of plant and animal species to identify migration patterns and suitable habitats in the face of climate change
Invest in educational signage and community outreach channels to encourage environmental awareness and stewardship	Incorporate signage with English and native languages in significant habitat and cultural site areas to increase awareness and reduce impacts to sensitive resources
Develop "living shorelines" to minimize coastal erosion and maintain coastal processes	Create biologically diverse subtidal and low intertidal habitats with materials that reduce wave energy and prevent erosion (such as eelgrass beds and oyster reefs)
Clean out culverts on a regular basis to restore drainage capacity and reduce flooding	Conduct regular maintenance of culverts and debris removal to avoid flood risks

Additional adaptation recommendations are noted in Appendix I. Appendix I is based on a survey of existing climate adaptation plans and strategies that have been developed by Tribal, local, state, and federal governments. There are several ongoing climate-related coastal planning activities that are taking place in the County of Santa Barbara (Appendix II).

In addition, to strengthen planning efforts so that risks to coastal Chumash cultural resources can be better identified a future study should build on this preliminary screening of the severity of coastal hazards by emphasizing additional coastal Chumash cultural areas and resources and coastal habitat areas that were home essential areas for Chumash. The ecologically productive estuaries at the mouth of drainages were often home to coastal Chumash villages. These sandbar strands and estuaries constitute many of the most highly exposed village sites, such as those at Q'oloq,' Sitiptip or Wene'mu, and Muwu. These locations are especially fragile due to their exposure to dynamic coastal processes and are impacted by sediment sources from the transverse mountain range of the Santa Ynez and the Santa Monica Mountains to the south. A more detailed vulnerability study that focuses on cultural Chumash cultural areas of significance including coastal wetlands and estuaries is one priority identified by the SYBCI's Cultural Department.

To produce a more detailed climate adaptation plan, a future study by the SYBCI should emphasize the following: the creation of a cultural vulnerability index that can be used in vulnerability assessments that better integrate cultural places at risk; a comprehensive assessment for coastal habitats and associated native species, such Environmentally Sensitive Habitat Areas (ESHA); and an expanded identification of coastal hazard assessment of other Tribal cultural heritage areas, such as additional coastal village sites and areas of significant cultural resources that are located near coastal wetlands, river and creek mouths, and places of Tribal cultural significance. In addition, a more concerted effort to establish Tribal capacity and capability is needed to implement a future adaptation plan and for various climate planning activities, including required formal consultation.

As of June 2026, the SYBCI staff are collaborating with program officers at the OPC to garner funds to support a more comprehensive two-year coastal hazards assessment and associated climate adaptation plan that will focus on coastal Chumash cultural sites, including coastal wetlands, estuaries, and cultural areas of significance.

Overall, a new strategic approach to climate change policy and planning is warranted today. The Tribe recommends several measures to strengthen existing policy tools and planning instruments that can support Chumash co-stewardship and engagement in climate planning:

- First, given the severity of risks posed by coastal hazards and SLR to coastal Chumash village areas, there is a need to enhance Chumash access to coastal areas at risk. Plans need to be developed that support adequate access so that appropriate cultural monitoring protocols are developed and implemented by Chumash members and staff.
- Second, plans that support co-management and co-stewardship planning and decision-making strategies are needed for culturally sensitive vulnerability

assessments that clarify the spatial and temporal scale of risks posed by coastal hazards and SLR to coastal Chumash cultural heritage areas and ecosystems. New climate management strategies and plans are needed given the natural history of Chumash inhabitation in the region, the level of severe risks posed by coastal hazards on Chumash cultural heritage, and the impacts of climate change on the region's coastal and marine ecosystems.

- Third, Chumash Tribal Bands will need to decide what locations or sites that are at substantial risk need to be relocated or better protected using nature-based solutions (consistent with Reiblich et al., 2017; California Natural Resources Agency, 2022). A collaborative approach that is inclusive of diverse Chumash interests and values in climate vulnerability assessment and adaptation decision-making and planning should be cultivated. Other sites at various levels of risk may need to be left in place. Careful analysis of upland issues related to coastal watersheds and coastal hazards related to wildfire and debris flows should also be evaluated. Engaging Tribes as partners in co-management of culturally significant areas that are at risk from climate change. Tribes are not stakeholders. Tribes are sovereign governments and should be treated as such in climate planning. Assessments and plans should prioritize Tribally led and managed stewardship projects and cultural preservation strategies that foster ecocultural resilience.
- Fourth, periodic cross-cultural training opportunities and activities that foster climate assessment and planning and traditional cultural awareness around interactions with Tribal groups are needed. Protocols to prioritize respect, reciprocity, and free, prior, and informed consent in all climate assessment and planning activities where traditional cultural resources are at risk are needed. These training activities can also establish and abide by anti-discrimination policies approved and/or developed by Tribes.
- Fifth, Tribes should partner with other government authorities to establish protections and protocols for Tribal access to monitor protocol for coastal sites at risk from coastal hazards and SLR. The protocol should include details for future decision-making and authority around Tribal knowledge and data gathered during monitoring of cultural areas, including archaeological sites, at risk from coastal hazards and SLR. This should include the establishment of clear planning strategies with Tribal participants for knowledge requests, use, sharing, and mobilization across government authorities for formal consultation and Tribal engagement that is a necessary part of climate change planning. In addition, monitoring and public access protocols should be developed that honor diverse Tribal preferences for data management, collection, analysis, and use. These protocols should facilitate Tribal participation and information sharing in collaboratives and beyond, creating an atmosphere of consent. Similarly, resource agencies should acknowledge the diversity of Tribal science and knowledge, how it differs from non-Tribal science, and the ways in which

traditional knowledge can be better protected. The monitoring and access protocol should also incorporate models of Indigenous data governance and data protection at all levels of climate assessment and planning.

Conclusion

Chumash cultural heritage is an embodiment of beliefs, customs, and material attributes. Chumash believe that life and death are decided by the Sun and Sky Coyote, called Snilemun in Chumash. Roberta Cordero (McGinnis and Cordero, 2004) describes:

> *"Every year Sun and Sky Coyote play a gambling game called 'peon' to decide if the year will be wet or dry. If the Sun wins, the year will be hot and dry, food and medicine will be scarce, and many people will die. If Sky Coyote wins, the year will be cool and wet, food and medicine will be abundant, and people will survive. The Sun is hot, dry, and unforgiving to humans. Sky Coyote is beneficial to humans and is seen in the sky as the North Star.*
>
> *Knowing the position of Sky Coyote in the sky helps prevent people from becoming lost. However, Sky Coyote cannot always be trusted. He is a trickster according to legends and can sometimes cause floods and other problems. The Chumash use ceremonies and prayers to encourage the balance between the Sun and Sky Coyote each year. If the proper balance is achieved, health can be maintained."*

Chumash oral tradition, language, and knowledge is place-based and embedded in interactions and relationships with nature. The natural world is considered an extension of the human community. Traditional understanding of place is based on a keen awareness and reciprocal gratitude that is sustained by cultural practices and belief systems that are derived from an intimate connection and participation with other members of the community. These connections remain part of oral tradition and maritime practices.

Recognition of the risks posed by coastal hazards to Chumash village areas is one step toward development of planning tools and policy instruments that emphasize Chumash as co-stewards in future climate vulnerability assessments, climate adaptation, and cultural heritage preservation. This report shows that 24 out of 33 (or roughly 73%) coastal village areas are at medium to high level of severe risk to impacts from coastal hazards and SLR. Chumash should have greater access to coastal heritage areas at risk so that these areas are monitored by Chumash members, and that the risks are documented over time.

The preservation of cultural heritage areas is essential to the Chumash pursuit of collective continuance. Kyle Whyte (2020) writes:

> *"Collective continuance considers existence as emanating from relationships between humans and nonhumans that are in constant motion, embracing diversity and constituted by reciprocal responsibilities. When these relationships flourish, they can facilitate a society's resilience or its members' capacity to self-determine how to adjust to changes and challenges in ways that avoid preventable harms and support their freedom and aspirations (including those of nonhumans)."*

Whyte elaborates on the claim that food systems are connected to a society's ability to exercise their collective self-determination (Whyte, 2017). For example, the preservation of wild salmon habitat illustrates the connection between Tribal self-determination and ecology. Whyte argues that settler colonial domination occurs when one society secures its culture by permanently inhabiting the other and erasing the capacities that were historically in place for the Tribe's self-determination.

As this report described, Chumash connection and customs evolved to reflect changes in marine and coastal ecosystems of the region. Historically Chumash adapted to natural changes and climate cycles that were influenced by oceanographic conditions in the California Current LME and Southern California Bight. Chumash resilience is reflected in an array of maritime practices that were developed to respond to changes to marine and coastal ecosystems. Chumash used a variety of fishing strategies including fish traps, dip nets, gill nets, seines, hook and line, harpoons, bows and arrows, spears, and natural fish poisons. Chumash traded marine resources through the social and economic networks that were developed by Chumash bands. The varied Chumash maritime culture is diverse and depends on a rich array of animals and plants. Many animals, such as swordfish, played a central role in Chumash maritime songs, ceremonies, rituals, and dances.

The abundance of Chumash cultural materials found in the coastal region, including the Channel Islands, have contributed to an understanding of Chumash trade networks, fishing practices, and submerged village sites. The use of the tomol, for example, is a profound example of the connection Chumash have to coastal areas. Until it was formally disbanded around 1834, the Brotherhood of the Tomol governed the manufacture and use of the tomols. Akin to Pacific Islanders and other Indigenous Polynesian cultures, the Brotherhood of the Tomol is founded on a kinship-based orientation of specialists with traditional maritime knowledge that unites Chumash affiliation to the ocean and each other. Tomol construction and tomol use are interweaving manifestations of a profoundly deep connection between maritime culture and marine ecosystems. Knowledge of the sea was passed on from one generation to another.

Today, the continual crossing of the Santa Barbara Channel by the paddlers of the tomol represents a symbolic realization of the deep connections that Chumash

peoples have with the region's more than human community. The crew on the tomol collaborate and work together – the unity among the crew reflects the path taken by Chumash ancestors. The knowledge of the winds, currents, and greater spiritual cosmos guide each tomol crossing. As Mati Waiya, the founder and director of Wishtoyo, writes (Cordero et al., 2019: 205):

> *"How important the tomol is*
> *That broke through the stagnant level of our existence into a higher level of consciousness*
> *Being in another dimension*
> *The ancestors are right next to us experiencing all of the senses smells, actions, sights*
> *Touching base with the past."*

The use of the traditional tomol remains an essential part of Chumash maritime culture that extends traditional identity to the coastal ecosystems of the region, the Santa Barbara Channel, and the northern Channel Islands.

The multiple consequences of climate change include the physical destruction of culturally valuable habitat, plants and animals; the loss of access to cultural materials of significance to the collective continuance of Chumash; the disruption of ancestral knowledge and traditions tied to the cultural landscape; and the diminishment of the availability of coastal places that are sacred and life-giving. Coastal hazards include coastal dune and cliff erosion, tidal flooding, storm wave flooding, compound flooding that combines coastal and inland flooding from storm events, and coastal confluence flooding. Coastal areas are the foundation to Chumash maritime identity, spiritual life, and historical survival. Chumash values of the coastal ecosystems extend far beyond simple resource use, integrating spiritual stewardship with sophisticated ecological management.

Climate change acts as a double-edged sword, degrading the tangible remains of the Chumash cultural heritage while contributing to the decline of coastal ecosystem integrity. Simultaneously, the warming of SST and acidification impact culturally valuable species. The report shows:

- Increased coastal erosion and flooding are permanently destroying irreplaceable village sites, burial grounds, and cultural materials before a comprehensive assessment of the level of severity of risks to these cultural areas can be documented.
- Warming of SST, SLR, acidification, and degradation of coastal ecosystems, such as beaches, wetlands, and estuaries continue to reduce the availability of traditional materials. Ocean acidification and warming SST, including marine heat waves are damaging marine life that is essential to Chumash identity.

Rising seas threaten to submerge low-lying coastal areas used for solstice ceremonies and spiritual gatherings and threaten the physical connection Chumash have with ancestral coastal areas.

- The loss of access by Chumash to ancestral coastal areas hinders the teaching of youth by elders, breaking the continuity of cultural knowledge transfer. The rapid pace of climate change outruns the historical seasonal markers used by traditional elders to pass down ecological and ceremonial wisdom. Changes in climate affect the timing of spiritual ceremonies and the ability to gather medicinal plants.

Empirical studies by Benjamin Halpern and colleagues (Halpern et al., 2012; Halpern et al., 2025) at the National Center for Ecological Analysis and Synthesis (NCEAS) includes an assessment of five categories of pressures: climate (SST, air-heat index, and SLR); ocean chemistry (ocean acidification and dissolved oxygen); land-based pressures (including nutrient input, light pollution, and human population density); net primary productivity; and fisheries biomass loss. The scientists show that coastal and marine ecosystem change is occurring on a much more rapid scale than earlier projected. Halpern and colleagues have found that these cumulative pressures on coastal and marine ecosystems will double (and potentially triple) by mid-century (Halpern et al., 2025). Warming events, such as marine heat waves, will contribute to the cumulative impacts that are associated with climate change, including coastal hazards and SLR, on coastal Chumash cultural heritage areas.

The most recent data on SST suggests that the cooling trend associated with La Niña is over.[18] The NOAA forecast is for a major El Niño event that will likely peak intensity during the 2026/2027 Winter season. (Note, forecasts are based on models that show SST could rise above 3.1 Celsius by November 2016. The most significant El Niño recorded was in 1887 and SST rose to 2.7 degrees Celsius during that event.) Several models forecast that the El Niño event that is developing in the Pacific Ocean is likely the most severe in the recorded history of ENSO events (since the 1877 event), and will likely cause major atmospheric and oceanographic changes along the West Coast, including increased storm activities, impacts of food and water security, and exacerbate the impacts of climate change on coastal and marine ecosystems. A historic El Niño event in 1877 triggered droughts, heatwaves and famines that caused the deaths of tens of millions of people worldwide, with devastating effects on agriculture and society.

Coastal hazards and major coastal erosion events will likely occur during this year's forecasted El Niño. Based on scientific evidence the severity of impacts from coastal hazards will likely intensify, and these risks will continue to threaten coastal Chumash

18 ENSO Forecast Dashboard available at: https://dashboard.theclimatebrink.com/#enso

coastal heritage areas. Climate adaptation planning has yet to address the severe threats and risks to coastal Chumash cultural heritage.

Several takeaways from this report are:

- Coastal vulnerability assessments and climate adaptation plans should be sensitive to the range of traditional values and perceptions of risk related to coastal cultural heritage.
- The risks posed by climate change to coastal Chumash cultural areas are increasing. While this study focuses on 33 coastal Chumash village areas, a more comprehensive study and assessment of the impacts of coastal hazards on traditional cultural resources along the California coastal is warranted. California's coast has always faced coastal hazards, including coastal dune and cliff erosion, tidal flooding, storm wave flooding, and coastal confluence flooding, resulting from the combination of river flooding and coastal wave interactions. As climate change accelerates SLR and other pressures, coastal hazards will increase in frequency and duration, expanding flood extents and accelerating the threat to remaining Chumashcultural heritage areas.
- Ongoing climate vulnerability assessment and adaptation planning need to provide resources to Chumash to participate, engage, and collaborate in each stage of climate planning activities.
- Inclusive partnerships between governments and Tribes are the best path forward in knowledge and value sharing.
- Consultation requests by local, state, and federal resource agencies are increasing because of coastal impacts from climate change, including major storm events and King tides. Tribes are challenged by constant and unsupported requests to engage and formally consult with public agencies, as required by local, state, and federal laws, in climate-related coastal and land use issues that include Tribal cultural resources and places, such as the exposure or loss of a significant site due to a flood, fire, or storm event.
- California, regional and local (or municipal) climate vulnerability assessments need to move beyond engagement with "stakeholders" and should emphasize collaborative, co-management approaches that can strengthen knowledge sharing and dialogues that include Tribes. Tribal members are not stakeholders in coastal and land-use planning activities; Tribes are sovereign governments. Tribal representatives should be partners in coastal vulnerability studies and associated climate adaptation strategies so that Tribal experience, knowledge, and values are part of climate planning activities.
- Strategic planning should indicate areas where further work will be required to increase the existing understanding of climate risks (including the possibility of catastrophic climate change), ecological and cultural vulnerabilities, and adaptation options and barriers. Identify additional cross-cutting, supportive

strategies such as public engagement, networking, decision support, monitoring, periodic review of adaptation effectiveness, and fundamental policy changes. Establish feedback mechanisms that provide for the modification of strategies when needed.

- Chumash Tribes (and other coastal Tribes in California) should be provided with additional resources to contribute to future vulnerability assessments and climate adaptation strategies. Future collaborative efforts should include funding, capacity building, education, and outreach support that can foster new partnerships that integrate traditional Chumash values and interests into planning efforts that identify risks from coastal hazards and support adaptation measures that can be implemented by Chumash, local, state, and federal partners.
- Planning and decision-making tools should be developed that can strengthen and improve Chumash engagement and consultation protocols that ensure scientific and traditional knowledge systems can be used to inform Tribes and resource managers about the nature of risk posed by climate change on traditional cultural resources.
- Comprehensive Tribal monitoring protocols that support further documentation of the risks to coastal Chumash cultural heritage are essential to future climate change assessment and planning.

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Appendix 1 – Adaptation Measures

This Appendix includes tables of adaptation measures that were produced for this project. The tables represent a synthesis of available adaptation recommendations that are described in existing climate adaptation plans.

Table A-1. Types of Coastal Adaptation Measures for the Protection of Traditional Cultural Heritage at Risk from Coastal Hazards

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits
Nature-Based ("Soft")	Enhance Ecosystem Goods and Service and preserve coastal Traditional cultural areas at risk from coastal hazards.	Maintaining and enhancing coastal wetland ecosystems, dune areas, riparian habitat, estuaries and coastal processes to absorb storm energy, reduce beach and coastal bluff erosion, and minimize the impacts of coastal flooding will likely reduce the risks to Traditional cultural areas. Priority areas for considering the adoption of soft strategies include coastal wetland areas, such as the Morro Bay, the Santa Ynez River estuary, Goleta Slough and Carpinteria Salt Marsh. Adopting nature-based and soft coastal adaptation measures to protect coastal wetlands and Traditional cultural areas should be a high priority. Additional study and assessment of the link between Traditional cultural areas and wetland ecosystems of the study area are warranted.
Nature-Based ("Soft")	Living Shorelines	Utilizing native species of plants, regional sand and sediment, and organic materials to 'stabilize' shorelines rather than adopting "hard" measures such as the use of concrete and armoring alternatives to beach loss and coastal erosion. Traditional cultural resources may exist along important dunes, wetlands, river/creek mouths, and bluff areas. The priority should be to utilize soft measures to protect these sensitive coastal areas.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits
Structural ("Hard")	Coastal Defense	Building seawalls, bulkheads, breakwaters, and revetments to protect existing infrastructure contribute to beach loss, coastal bluff erosion, wetland habitat loss, etc. Hard coastal defense strategies will also likely threaten coastal Traditional cultural areas that are sensitive to coastal hazards.
Hybrid Soft/ Hard	Coastal Resilience	In addition to nature-based solutions, a hybrid soft/hard approach such as a horizontal levee may be needed to address the impacts of coastal areas at high risk.
Accommodate	Resilient Design	Traditional cultural areas that are identified as minimal risk areas should be identified and carefully monitored, especially during major storm events, including King tides. A resilient, adaptive and co-management effort to monitor Traditional cultural areas along the coast should be established that combines knowledge systems from professional expertise from the sciences, coastal planners, climate planners, and Tribal members. Enhancing drainage systems may prevent or reduce the risks of coastal flooding and the associated coastal hazards on coastal Traditional cultural areas.
Policy/Planning	Managed Retreat	Relocating infrastructure/homes inland, acquiring high-risk land, and implementing zoning setbacks.
Policy/Planning	Coastal Zoning	Updating land-use plans and local coastal plans to prohibit urban and industrial development in high-risk zones.
Information	Risk Assessment	Using early warning systems for storms and mapping vulnerability to SLR and coastal hazards. The creation of a Tribally led interdisciplinary monitoring program of coastal Traditional cultural areas that are identified at high to moderate levels of severe risk from coastal hazards should be created and implemented to strengthen the integration of Traditional knowledge in risk assessment and analysis.

Table A-2. Coastal Adaptation Measures for Maintaining and Enhancing Coastal Wetland Ecosystems, Bluff and Dune Habitat

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Anticipate and facilitate wetland inland/upland migration through site assessment, acquisition, and management (e.g., barrier removal).	Preserve coastal wetland habitat for coastal dependent species, including species that depend on aquatic habitat.	Maintain native species diversity including coastal wetland habitats, including the preservation of coastal watershed area.	There may be no land available for wetland migration, due to the density of urban development.
Support the migration of coastal wetland ecosystems to inland areas. Setbacks, density restrictions, land use planning elements, and coastal land preservation strategies can be used to support wetland migration.	Preserve coastal wetland habitat for coastal dependent species, including species that depend on aquatic habitat.	Maintain native species diversity including coastal wetland habitats, including the preservation of coastal watershed area.	There may be no land available for wetland migration, due to the density of urban development. Coastal land is also extremely expensive in southern and central California.
Support wetland accretion by introducing sediment.	Maintain and improve sediment transport in coastal watersheds.	Maintains sediment transport to wetlands. Wetlands function as buffer areas that can protect coastal lands from storm activities, etc.	Requires adaptation and integrated coastal planning across political, economic, and administrative jurisdictions.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Land use plans should prohibit "hard shore" approach to coastal wetlands, dunes, and bluff protection. Ultimately, land use plans should support the removal of hard protective areas, such as groins and seawalls, riverine and tidal dikes.	Maintain and improve general coastal wetland, dune, and bluff ecosystem health and integrity.	Preserve native species diversity and coastal ecosystem goods and services.	The costs of removing hard shore structures, including dikes, seawalls, and groins, will likely also require other coastal land use strategies that may be expensive.
Incorporate wetland and dune preservation plans in land-use planning for infrastructure, and development (e.g., transportation planning, sewer utilities).	Maintain and improve general coastal wetland, dune, and bluff ecosystem health and integrity.	Preserve native species diversity and coastal ecosystem goods and services.	May be costly.
Preserve and enhance the complexity of native plant species diversity in tidal marshes, seagrass meadows, estuaries, and dune areas.	Maintain and improve habitat for vulnerable species and special status species.	Native plant species diversity in coastal wetlands protects habitat from coastal erosion, protects from the impacts of storm-related activities, including King tides, can filter pollutants, and absorb atmospheric CO2.	Same as above.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Identify and protect ecologically significant ("critical") coastal wetland areas such as nursery grounds, spawning grounds, and areas of high native species diversity.	Assists in planning for non-native plant species removal. Preserve critical habitat areas for Special status species and other vulnerable species.	Protecting critical areas may promote native species diversity and support general ecosystem goods and services, including plans to support "climate refuge" areas and nurseries for aquatic, coastal and marine species, such as halibut, steelhead salmon, red-legged frogs, and other species.	May require local, state, and federal coastal land protection measures and strategies for private coastal land preservation, such as easements.
Establish rolling easements.	Maintain water quality. Maintain sediment transport within the coastal watershed.	May provide a coastal land buffer from the impacts of coastal hazards, including sea level rise, bluff, and beach erosion.	Same as above
Incorporate consideration of climate change into management plans for wetlands and dunes and associated species.	Preserve critical habitat areas for special status species and other vulnerable species associated with coastal wetland and dune habitat.	Protect wetland and dune ecosystem goods and services while maintaining important infrastructure for urban and rural coastal areas.	May require local, state, and federal coastal land protection measures and strategies for wetland and dune habitats.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Promote natural accretion through management strategies such as promoting feeder bluffs, revegetation with native species that capture sand, use of sand fencing, and development of sediment management plans and policies.	Preserve critical habitat areas for special status species and other vulnerable species associated with coastal wetland and dune habitat.	Protect wetland ecosystem goods and services while maintaining important infrastructure for urban and rural coastal areas.	May require local, state, and federal coastal land protection measures and strategies for wetland and dune habitats.
Reduce local non-climate stressors (e.g., recreational use, resource extraction) to enhance resilience to climate changes.	Preserve critical habitat areas for special status species and other vulnerable species associated with coastal wetland and dune habitat.	Protect wetland ecosystem goods and services while maintaining important infrastructure for urban and rural coastal areas.	May require local, state, and federal coastal land protection measures and strategies for wetland and dune habitats.
Restore natural sediment transport processes to ensure continued renourishment of beaches and dunes.	Same as above.	Same as above.	May require local, state, and federal land use measures and strategies.
Identify and protect potential refugia.	Same as above.	Same as above.	Same as above.
Increase education and outreach to improve public awareness of climate impacts and the need for climate-informed management.	Create education and public outreach programs.	Enhance public awareness.	Requires funding.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Maintain/restore natural tidal and hydrologic connectivity (e.g., water exchange, flow rates) to improve water quality and promote accretion.	Maintain and improve habitat for vulnerable species and special status species.	Preserve native species diversity and coastal ecosystem goods and services.	May require local, state, and federal land use measures and strategies.

Table A-3. Coastal Adaptation Measures for Maintaining and Enhancing Beach Ecosystems and Sand Transport

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Develop plans for sand and beach to enhance and/or support existing beach areas.	Preserve beach habitat for special status species, such as the snowy plover. Maintain sandy beaches to support sand transport systems along the nearshore.	Establish a beach system that can protect coastal land areas. Replenish sand lost from coastal erosion and other coastal hazards.	Long-term monitoring of the "sandshed" is necessary to understand the interdecadal regime "shifts" that influence the amount of sand on beaches of the region, among other factors within the sand transport system. There are impacts and costs associated with beach replenishment. Identification of ecological and cultural impacts of beach replenishment should be carefully evaluated.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Avoid use of "hard" structures to trap sand, such as the construction of coastal groins, bluff retention devices among others, which interrupt longshore sand transport	Preserve coastal ecosystems and maintain shorelines.	Creates natural shore face and beach ecosystems.	Same as above.

As noted in the above table, this Appendix supports a preference for "soft" measures to maintain and enhance coastal shorelines is preferred over "hard" measures. This preference is consistent with the scientific literature on the significant ecological and economic impacts of "hard" strategies and options to address beach loss and coastal bluff erosion. Soft measures to address beach and bluff erosion can better protect coastal lands (and infrastructure) than can hard solutions. Soft solutions are more natural and may include fabrics, beach nourishment, beach dewatering systems, sandbags, and other strategies. Hard solutions involve rock, concrete, and steel, and have been shown to exacerbate beach and bluff loss from human activities, including the pressures, impacts and threats posed by anthropogenic climate disturbance. Hard engineered structures, such as rock revetments, walls and accelerating beach and bluff erosion due to increased wave reflection and/or the impact these structures have on altering natural shoreline processes, including the lateral sand transport system and other coastal processes.

Table A-4. Coastal Adaptation Measures for Maintaining Shorelines and Beaches through "Soft" Measures

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Replace shoreline armoring with "living" shorelines by strategies that combine beach nourishment, planting native plants, etc.	Maintain and enhance coastal wetland ecosystems. Preserve coastal habitat for special status species and vulnerable species. Preserve coastal lands.	Reduction of ecological effects of armoring, including the impacts of downdrift beach loss and loss of beach habitat loss.	A careful benefit-cost analysis should be conducted to compare diverse living strategies and the costs associated with each strategy. Analysis should consider technical and economic feasibility issues.
Remove hard engineered structures to allow natural coastal processes and natural beach replenishment.	Maintain sediment transport	Allows for shoreline migration	This option may be costly and contribute to the loss of private property along the coast.
Plant native plants in suitable coastal habitats, such as sand dunes, riparian areas, coastal wetland, and bluff areas, to stabilize sediment transport, and to reduce beach and bluff erosion.	Maintain and enhance coastal ecosystems such as wetlands to preserve habitat for special status species and vulnerable species.	Natural sediment transport systems can maintain general coastal and watershed ecosystem goods and services.	See above.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Redefine local land use plans with respect to coastal erosion areas and areas at risk from flooding. Restrict or prohibit coastal land development in areas based on the severity of risk levels from coastal and bluff erosion. Redefine riverine flood hazard zones to match projected expansion of flooding frequency and extent.	Maintain and enhance coastal ecosystems such as wetlands and aquatic habitat associated with coastal riparian areas within creeks and riverbanks. Several planning strategies support the management goal of preservation of coastal ecosystems, such as the creation of an overlay zone, setback areas, conservation easements, rolling easements, transferable development rights (TDR), building restrictions, land acquisition, and the creation of a Riparian Trust Fund to preserve and enhance riparian areas on private ranch land.	New land and coastal land use plans should focus on available coastal areas that warrant stronger protection measures.	This option is appropriate for coastal areas yet to be developed in the study area, including the Gaviota coast and VASB. The option will require changes in the Local Coastal Plan and Zoning Ordinances. The option may also need to be codified in special land use plans, such as the Gaviota Coast Plan developed by Santa Barbara County and certified on November 7, 2018, by the California Coastal Commission.
Increase coastal and shoreline and coastal bluff setbacks and easements	Maintain and enhance coastal ecosystems such as wetlands and bluff areas.	See above.	Will not help areas already developed. See above.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Composite systems – incorporate elements of two or more methods (e.g., breakwater, sand fill, and planting vegetation)	Same as above.	Incorporates the benefits of multiple systems.	"Softer approaches" (e.g., vegetation, beach nourishment) require more maintenance over time and can become costly. There is a need to secure long-term funding to support and monitor strategies that combine multiple options. A careful benefit-cost analysis should be conducted to compare diverse living strategies and the costs associated with each strategy. Analysis should consider technical and economic feasibility issues.

In general, approximately 38% of the Southern California shoreline is armored (developed with seawalls, revetments, or other structures) to protect against erosion. While overall, only a small percentage of California's total land is developed, the coastal zone is heavily impacted, with the four most developed southern counties reaching 33% armoring, highlighting intense, concentrated development in that region.[19]

19 Griggs, G., and K. Patsch. 2019. The Protection/Hardening of California's Coast: Times Are Changing. J. OF COASTAL RESEARCH 35(5):1051-1061 (June).

Table A-5. Coastal Adaptation Measures for Local Coastal Planning and Coastal Infrastructure

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Manage realignment and deliberately realign engineered structures that influence the ecology of rivers, creeks, coastal wetlands, and coastlines	Preserve coastal habitat. Maintain/ enhance coastal wetlands. Maintain sediment transport.	Reduces engineering costs; protects ecosystems and coastal wetlands; allows for natural migration of sediments in rivers, creeks, and along coastal beaches.	Can be costly
Prioritize the establishment of a coastal land acquisition and preservation program at local and regional scales. One focus could be on prioritizing the purchase of coastal areas that are degraded or disturbed for conservation, preservation, and enhancement.	Preserve coastal habitat for vulnerable species and special status species. Maintain/ enhance coastal wetlands, bluffs, and other coastal habitat.	Can provide a buffer to inland areas; prevents development on the land	A careful benefit-cost analysis should be conducted to compare diverse living strategies and the costs associated with each strategy. Analysis should consider technical and economic feasibility constraints.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Incorporate consideration of climate change risks in local coastal plans for new infrastructure (e.g., homes, businesses).	Preserve habitat for vulnerable species and special status species associated with coastal ecosystems.	Builds the capacity within county and city local coastal planning to address risks from a precautionary approach.	Landowners will likely resist relocating away from prime coastal locations.
Design and utilize infrastructure that can accommodate climate changes, including portable and/or elevated and flood-resilient infrastructure	Same as above.	Same as above.	Same as above.
Improve stormwater management (e.g., bioswales, permeable pavement, street trees/catchment/ storage) to reduce flooding in developed areas.	Preserve coastal ecosystems.	Improve water quality, aquatic habitat and ecosystem goods and service.	May require local, state, and federal land use measures and strategies.

The biogeographic ranges of native animals and endemic plants in California have already shifted in response to changing temperatures and water availability. Looking ahead, existing ecological systems will, in most places, change as species respond individualistically to climate-driven change and as biophysical processes that structure ecosystems become less hospitable to current plant and animal assemblages. As noted in this report, a vast majority of special status species depend on aquatic habitat, such as coastal wetland ecosystems, during some part of their life cycle. As society adapts to new climate regimes, shifting infrastructure and resource uses may further alter the status of ecosystems and the associated societal benefits.

Table A-6. Adaptation Options for Preserving Coastal Habitat for Vulnerable and Special Status Species

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Purchase upland development rights or property rights.	Maintain/ enhance aquatic habitats, including riparian areas, coastal grasslands, dunes, wetlands, and other valuable habitat areas. Maintain water quality.	May foster wetland migration to upland areas. May protect species, such as raptors, which depend on upland areas that are associated with coastal wetlands.	A careful benefit-cost analysis should be conducted to compare diverse living strategies and the costs associated with each strategy. Analysis should consider technical and economic feasibility constraints.
Adapt protection measures that are based on the identification of biogeographical areas, such as an ecological transition zone, and critical habitats, such as environmental sensitive habitat areas or ESHAs, that may serve as climate refugia. Coastal planning should focus on connecting coastal areas with appropriate corridors to support the migration of native species. Coastal wetlands and riparian areas, for example, should have larger boundaries and buffer areas to sustain habitat values.	Maintain general coastal ecosystem goods and services. Maintain and enhance native species diversity. Protect special status species.	May sustain and enhance the diversity of coastal native species that are vulnerable to the threats and associated impacts from large-scale climate disturbance.	Same as above. A systematic monitoring program should be adopted to assess the ecosystem-wide benefits of climate refugia along the coast.

Coastal Adaptation Measure	Coastal Management Goals	Potential Benefits	Potential Constraints
Replicate habitat types in multiple areas to spread minimize associated risks from climate disturbance on habitat.	Same as above	Same as above.	Coastal areas may not be available to replicate habitats. Same as above.

Appendix II: Coastal Resilience and Adaptation Projects Summary of Contacts and Resources

City of Goleta-Local Coastal Program (LCP) Project
Website: www.cityofgoleta.org/LCP
Contact: LCP@cityofgoleta.gov

UCSB Shoreline Adaptation Project
Website: https://bit.ly/4oYVjW
Contact: shari.Hammond@ucsb.edu

Goleta Slough Area Coastal Resilience Plan
Website: https://www.rcc.city/
Contact: lbarron@rcc.city, mflorsheim@rcc.city

Santa Barbara Airport Climate Adaptation Plan
Website: FlySBA.com/CAP
Contact: Jmetzger@SantaBarbaraCA.gov

Santa Barbara 30-Year Waterfront Adaptation Plan
Website: SantaBarbaraCA.gov/Adaptation
Contacts: TBolton@SantaBarbaraCA.gov, MHetrick@SantaBarbaraCA.gov, MWells@SantaBarbaraCA.gov

Carpinteria Living shoreline Plan
Website: https://bit.ly/485c76O
Contacts: delaynim@carpinteriaca.gov, teresa@strategicearth.com, priya@strategicearth.com

BeachSMART- Santa Barbara County
Website: www.beachsmart.org
Contact: BeachSMART@countyofsb.org