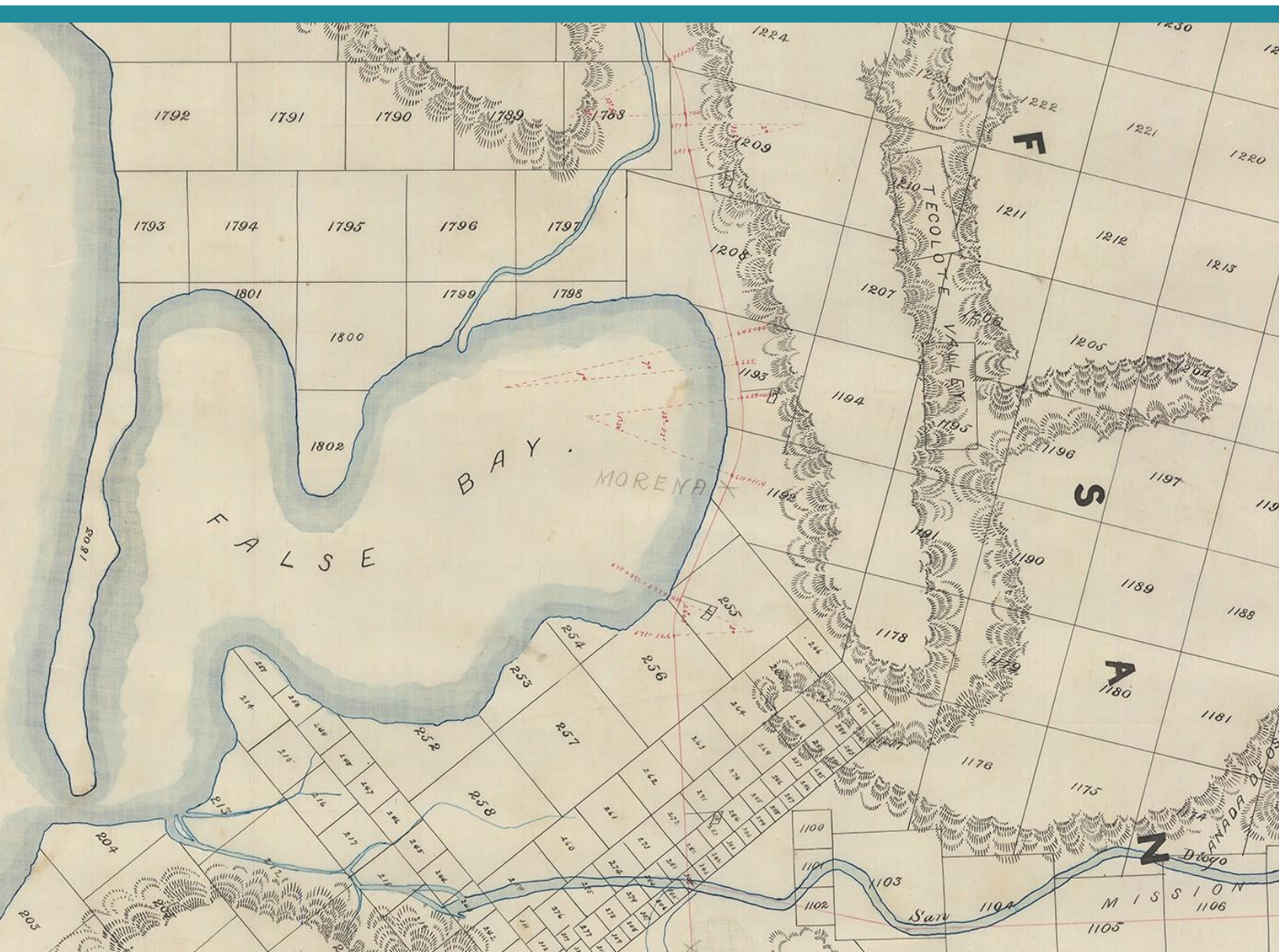


Mission Bay-Tecolote Creek Historical Ecology Reconnaissance Study



PREPARED BY • the San Francisco Estuary Institute

PREPARED FOR • San Diego Bird Alliance

AUTHORS • Helen Casendino

Ben Satzman

Sean Baumgarten



SFEI | San Francisco
Estuary Institute

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Cover image: Map of the Location of the California Southern Railroad (California Southern Railroad 1881). *Courtesy of the California State Railroad Museum*. The San Diego River is seen draining into southwestern Mission Bay. The red line on the eastern shore of the Bay represents the planned path of the California Southern Railroad.

Introduction

This report summarizes methods and findings from a reconnaissance-level historical ecology study of Tecolote Creek Watershed (“Watershed”) and southeastern Mission Bay (“Bay”) in San Diego County, California. The primary objective of the study was to gather and document information about historical landscape patterns and ecological conditions in the region prior to major Euro-American modification to inform restoration planning. The study leverages and builds on prior historical ecology work by the San Francisco Estuary Institute (SFEI) and partners in Mission Bay, including wetland mapping based on U.S. Coast Survey T-sheets (Grossinger et al. 2011) and a reconnaissance study focused on the northern portion of Mission Bay around Rose Canyon (Safran et al. 2016). Information about historical ecological conditions in the region can be used to help identify opportunities to enhance ecological resilience and native biodiversity support, set locally appropriate restoration goals, and guide design of restoration projects.

Mission Bay and the Tecolote Creek Watershed are within the ancestral territory of the ‘Iipay and Tipai Kumeyaay communities, which spans present-day San Diego County and extends into Baja California (Viejas Band of Kumeyaay Indians 2014). Prior to Euro-American settlement and modification, these areas supported flourishing, productive ecosystems with a diversity of wildlife. Over the last nearly 250 years, the system’s functioning has been greatly impacted by urban development, flood control projects, and other land and water use changes. Though highly modified, Mission Bay and surrounding areas continue to support large expanses of open space and a diversity of native plants and animals. Current restoration plans spearheaded by the ReWild Mission Bay Coalition and informed by SFEI’s prior historical ecology research call for extensive wetland restoration in former tidal marsh areas on the northeast side of Mission Bay (Everest International Consultants, Inc. 2018), and there is substantial potential for further conservation and restoration efforts within Mission Bay and the Tecolote Creek Watershed.

This reconnaissance study focused on collection and compilation of selected high-priority data sources and documentation of emerging findings, and does not include comprehensive data collection or digital mapping of historical landscape patterns. Research focused primarily on historical landscape patterns—i.e., habitat distribution and channel configuration—though limited information was also collected on topics such as vegetation community composition and structure, streamflow patterns, wildlife support, Indigenous management practices, and landscape change over time. The following sections present a summary of the study area and environmental context, research methods, emerging findings, and potential next steps and future research directions.

Study Area and Environmental Context

The project's geographic scope includes alluvial areas of the Tecolote Creek Watershed, its drainage into Mission Bay, and a portion of the inner Bay encompassing present-day Fiesta Island (~3,600 acres; **Fig. 1**). The full Watershed is 6,348 acres. The study area lies within coastal San Diego, characterized by a mix of hot-summer Mediterranean and cold semi-arid climates with mild, wet winters and warm, dry summers, and average annual precipitation totaling approximately 10 inches (SDCWA 2024). The climates influence the types and distribution of vegetation, surface water availability, and other ecological patterns of the region.

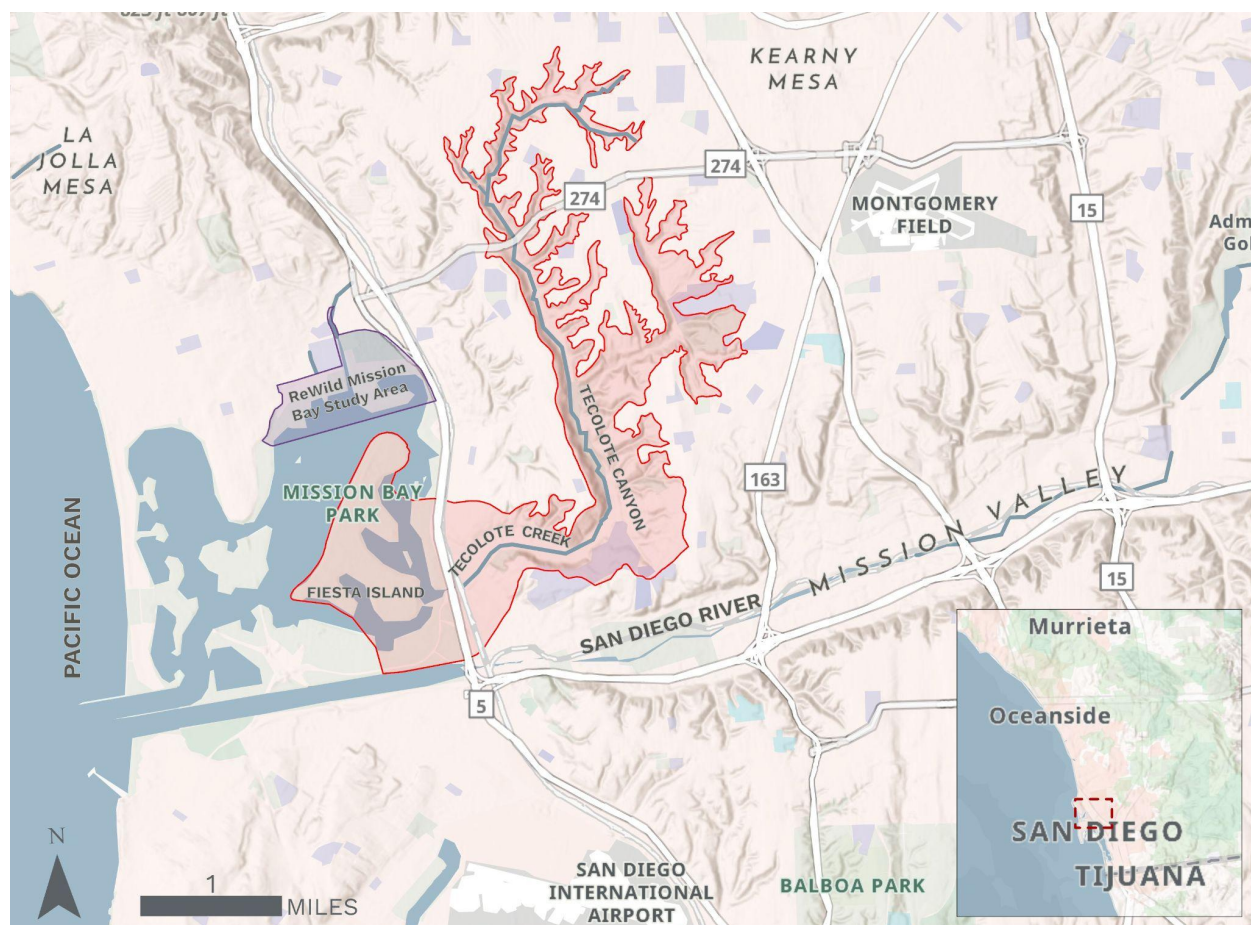


Figure 1. Map of the Study Area (highlighted in red), which covers the alluvial areas of the Tecolote Creek Watershed, its drainage into Mission Bay, and a portion of the inner Bay encompassing present-day Fiesta Island. The northeast corner of Mission Bay includes the study area for the Rewild Mission Bay effort, a project led by the San Diego Bird Alliance (SDBA) to develop wetland restoration plans in the area.

The topography of Tecolote Canyon (“Canyon”) is defined by steep ravines and relatively flat mesas, which are part of a sequence of uplifted marine terraces formed during the Eocene epoch (Kennedy and Tan 2008). A channelized section of Tecolote Creek (“Creek”) drains directly into the eastern edge of Mission Bay, a large, but shallow tidal embayment that today functions as a recreational waterway

and urban park. Directly south of Mission Bay, the San Diego River flows west out of Mission Valley and through a series of engineered flood channels, before emptying into the Pacific Ocean. Contemporary vegetation along Tecolote Canyon's slopes and atop the mesas includes coastal sage scrub, chaparral, and non-native grasslands. On the Canyon floor, dense riparian vegetation, dominated by coast live oak (*Quercus agrifolia*) and California sycamore (*Platanus racemosa*), is found along Tecolote Creek (Tecolote Canyon Nature Center 2025). Mission Bay is largely dominated by artificial islands, hardened shorelines and open water; however, a small patch of intertidal vegetated wetland is located in northeast Mission Bay at the Kendall-Frost Marsh Reserve/Northern Wildlife Preserve.

Major modifications to the landscape of the region began with the settlement of Spanish colonizers in the late 18th century and their establishment of Mission San Diego de Alcalá. The Mexican government's granting of pueblo lands in the 1830s marked a shift toward privatized land ownership that began to reshape the area. The late 19th century saw the construction of the California Southern Railroad along Mission Bay's eastern shore, followed by intense dredging and development to create Fiesta Island and the rest of Mission Bay Park in the mid-20th century. The Tecolote Creek Watershed experienced ranching and agriculture by early settlers (commonplace throughout the San Diego region by the mid-19th century), the channelization of Tecolote Creek, and widespread residential and recreational development on the Canyon's rims and parts of its interior throughout the 20th century (Tecolote Canyon Nature Center 2025). Where historically southeastern Mission Bay was made up of hundreds of acres of wetlands, winding tidal sloughs, wide expanses of mudflats, and pockets of subtidal waters, today the landscape is dominated by constructed islands (e.g., Fiesta Island) and bay fill supporting recreational activities for residents of the greater San Diego area.

Methods

Selected high-value historical texts, photographs, and maps were collected to document historical landscape patterns and ecosystem functions prior to major Euro-American modification (ca. 1850). Archival data were collected from five local and regional institutions, including the San Diego Public Library, the San Diego History Center, UC San Diego Special Collections, the San Diego Natural History Museum, and the Tecolote Canyon Nature Center. Further data were collected from a range of online databases (e.g., Biodiversity Heritage Library, Online Archive of California, University of California Libraries), using keywords relevant to the study area. Including relevant sources collected during the prior historical ecology study (Safran et al. 2016), the project team compiled ~300 photos (landscape and aerial) and sketches, ~130 maps (e.g., soil surveys, U.S. Coast Survey T-sheets and other charts, U.S. Geological Survey [USGS] topographic maps, and County Surveyor's records), ~100 textual accounts (e.g., newspaper articles, Public Land Survey records, and early explorer's diaries), and ~2,000 historical plant records and specimen data.

High-value spatial data were georeferenced, geolocated, and compiled in a geodatabase using ESRI's ArcGIS Pro 3.3.0. Historical aerial imagery (SDDPW 1928) was acquired from the County of San Diego's Department of Public Works (SDDPW) and georeferenced to form a mosaic of images covering the entire study extent (photos were not orthorectified). Relevant excerpts from high-priority historical texts were also transcribed. Compiled materials were synthesized to identify emerging findings related to the study area's historical landscape.

Emerging Findings

In the area furthest from marine influence, Mission Bay in the mid 1800s was a mosaic of subtidal and tidal habitats that provided diverse resources for wildlife and Kumeyaay communities. The Bay's hundreds of acres of tidal marshes historically lay next to the rich floodplain of the San Diego River and the productive shrublands of Tecolote Canyon. Emerging findings about this biodiverse landscape (described in more detail in the following sections) include:

- The majority of southeastern Mission Bay was composed of extensive, contiguous tidal marsh with a high density of tidal sloughs and a large mudflat. These habitats provided essential habitat resources for avian and aquatic fauna, and provided cultural and subsistence resources for local Kumeyaay communities.
- Inland of the nearby tidal marshes, a broad sand flat at the mouth of Mission Valley was a historical floodplain of the San Diego River which inundated during periods of heavy rainfall. The course of the San Diego River shifted between Mission Bay and San Diego Bay, both naturally and due to human interference. During periods when the river's course was directed toward Mission Bay, water would only reach the salty Bay in the winter months.
- Tecolote Creek, winding roughly 7 miles through the entirety of Tecolote Canyon, would occasionally drain into Mission Bay during heavy rainfall, but otherwise dissipated in the Bay's tidal marshes. Riparian vegetation along the bottom of the Canyon was generally low-density, consisting primarily of coast live oak and California sycamore, and offered habitat for nesting birds (e.g., Bullock's oriole [*Icterus bullockii*]) and a range of other wildlife species (e.g., arboreal salamander [*Aneides lugubris*]).
- Grasslands, alkali meadows, and vernal pool complexes spanned the area adjacent to the San Diego River's sandy floodplain and the mouth of Tecolote Creek. The Kumeyaay's use of fire to encourage the growth of particular plant species and increase wildfire resilience played an essential role in maintaining the region's grasslands.
- Tecolote Canyon's hillslopes were primarily occupied by dense chaparral on the north-facing slopes and open sage scrub on the drier south- and west-facing slopes, providing habitat for species like California quail (*Callipepla californica*), Bell's sparrow (*Artemisiospiza belli*), and pronghorn antelope (*Antilocapra americana*).

Wide Expanses of Tidal Marsh and Mudflats

The southeastern corner of Mission Bay historically consisted of hundreds of acres of mudflats (~226 acres) and contiguous tidal marsh (~433 acres) (Bache 1852b, Bache 1857, Stephens 1908, Fry and Croker 1933, U.S. War Department 1945, Grossinger et al. 2011; **Fig. 2**). These marshes were threaded with a network of tidal sloughs, some possibly representing former courses of the San Diego River, that would drain during low tide Bache 1857, USGS 1903, Stephens 1908, SDDPW 1928, Fry and Croker 1933; **Figs. 3 and 4**). Pickleweed (*Salicornia pacifica*) and saltgrass (*Distichlis spicata*) (Storie and Carpenter 1930b) were widespread in higher-elevation marsh platforms (Hertlein and Grant 1944), alongside species in the *Haplopappus* and *Atriplex* genera (Purer 1942). California cordgrass (*Spartina foliosa*) also occurred in extensive stands at lower marsh elevations, sometimes in association with pickleweed, and thrived in saline areas away from freshwater influence (Purer 1942, Hertlein and Grant 1944). Other tidal marsh species observed on the shores of Mission Bay include arrow grass (*Triglochin concinna* var. *concinna*, Orcutt 1883), dwarf glasswort (*Salicornia bigelovii*, Furgason 1931), woolly seablite (*Suaeda taxifolia*), goldenthread dodder (*Cuscuta pacifica* var. *pacifica*, Purer 1938a), and Parish's glasswort (*Arthrocnemum subterminale*, Purer 1938b). Cordgrass, pickleweed and other salt marsh species played an important role in shaping the extent of tidal flats in the Bay by reducing sedimentation during flood events and preventing erosion (Hertlein and Grant 1944).

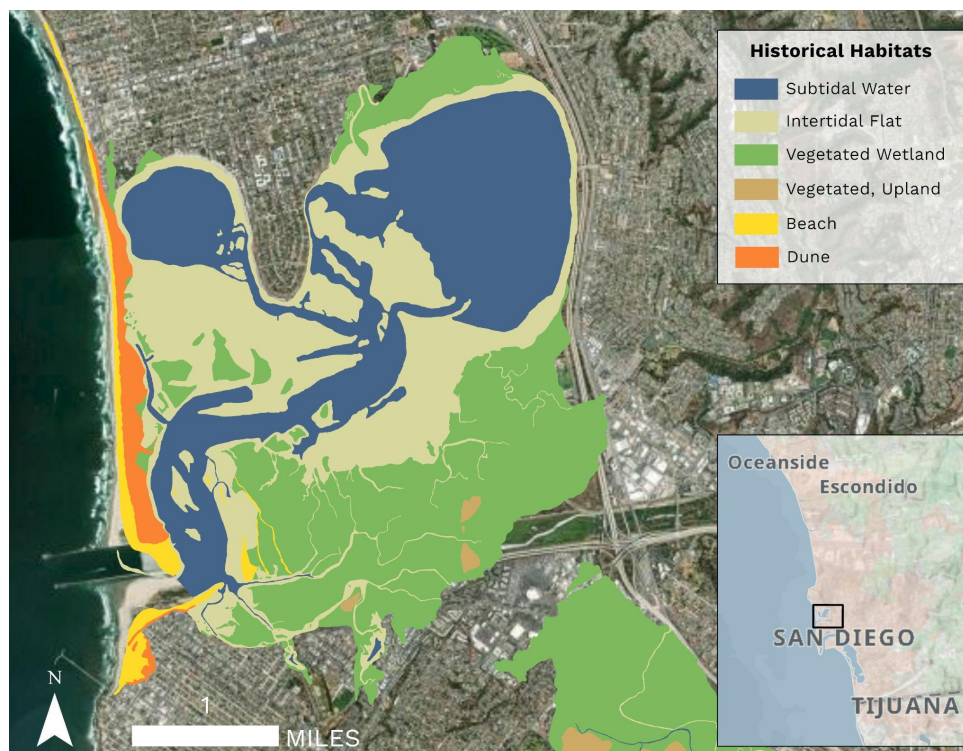


Figure 2. Historical estuarine and related habitats of Mission Bay, as shown by the 1852 T-363 Sheet.

Mapping of Mission Bay's historical habitats was completed as part of Grossinger et al. 2011's atlas of U.S. Coast Survey T-Sheets documenting historical wetlands of the Southern California Coast.



Figure 3. An aerial view looking southwest across extensive mudflats, tidal marsh, and wide sloughs in Mission Bay from 1937, prior to major dredging. The urban grid of San Diego's Ocean Beach neighborhood is seen in the background to the left, with the entrance to Mission Bay directly to the right (Erickson 1937a, courtesy of the San Diego History Center).

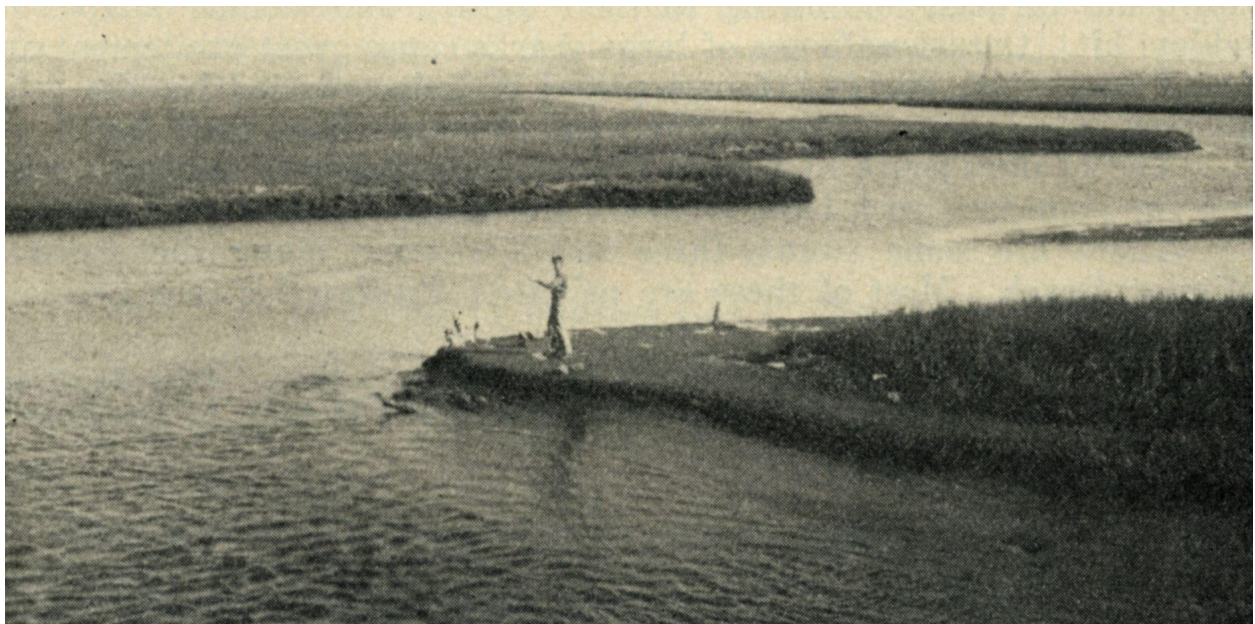


Figure 4. A fisherman along a large slough in Mission Bay, with Old Town San Diego in the background. (Fry and Croker 1933, courtesy of San Diego State University)

The Kumeyaay harvested tidal marsh plant species for various purposes. In her autobiography, Delfina Cuero writes, “There were a lot of [vegetables or eating greens] all over near the ocean... When [*Spartina foliosa*] grows big, we made them into bundles for house walls... The leaves and stems [of *Batis maritima*] can be chewed fresh for the water in them, or they are boiled and eaten as a vegetable” (Cuero and Shipek 1991). Salt itself was also a resource commonly harvested by the Kumeyaay (Cuero and Shipek 1991). While not mapped in the 1852 U.S. Coast Survey T-Sheet (Bache 1852b), the presence of salt flats along the southern and eastern edges of Mission Bay is documented

in Juan Crespí's 1769 diary, historical aerial imagery and the 1930 Soil Survey of the El Cajon Area, which describes Alviso very fine sandy loam as "having a heavy crust of alkaline or saline salts" during the summer months (Storie and Carpenter 1930b, Davidson 1936, Crespí and Brown 2001). Likely referring to southern Mission Bay, Crespí described "good-sized salines having very good white salt," but it remains unclear how extensive salt flats were in the Spanish explorer period (Crespí and Brown 2001).

"In late autumn the marshes are beautiful with the red coloring from the anthocyanin in the succulent leaves of *Suaeda* and the stems of *Salicornia*. Acres of *Spartina* in Mission Bay... look like rich fields of grain"

- Purer, 1942

Mission Bay's tidal marshes and mudflats provided essential foraging habitat for thousands of resident and migratory shorebirds (e.g., black-bellied plover [*Pluvialis squatarola*], Stephens 1919), waterfowl (e.g., brant [*Branta bernicla*]), and other avian species (e.g., California black rail [*Laterallus jamaicensis* ssp. *coturniculus*], Stephens 1909); Western gull [*Larus occidentalis*], Stephens 1905) (Fages 1769, Fry and Croker 1933, Kendall 1949, Hubbs 1955; **Fig. 5**). While waterfowl hunting in Mission Bay by the Kumeyaay pre-dated colonial occupation (Connolly 2025), it grew in popularity among European-American settlers in the late 19th century. A settlement called "Duckville" was built in the mudflats near the mouth of Tecolote Creek to attract recreational waterfowl hunters, and was repeatedly damaged by flooding in the early 20th century (USGS 1903, San Francisco Call 1906).



Figure 5. Looking southwest, the eastern shore of Mission Bay, where Point Loma can be seen in the background. In the middleground, a group of birds are seen adjacent to a patch of tidal marsh (Bowman 1936, courtesy of San Diego State University).

The mudflats in Mission Bay historically supported a diverse marine invertebrate community (ZoBell and Felltham 1942). These species provided food for shorebirds and the local Kumeyaay (Cuero and Shipek 1991), who also traded shells to inland tribes (Connolly 2025). Historically abundant in the flats were species like the giant burrowing anemone (*Harenactis attenuata*), California horn snail (*Cerithideopsis californica*), Pacific calico scallop (*Argopecten ventricosus*), and burrowing shrimp (*Callinassa* spp.) (Pilsbry and Smith 1907, Child 1908, Morrison 1930, Fry and Croker 1933, Junior League of San Diego 1960). Mission Bay's mudflats also provided breeding habitat for annelid species (Kofoed 1904). Common clams in Mission Bay's mudflats included the California tagelus (*Tagelus californianus*), smooth Venus clam (*Chione fluctifraga*), wavy chione (*Chione undatella*), and the gaper clam (*Tresus nuttallii*) (Fry and Croker 1933, Crooks 2001). Although not explicitly described as occurring on intertidal flats in Mission Bay, native Olympia oysters (*Ostrea lurida*) were said to have been common, often latched onto the rocks of the east shoreline (Pilsbry and Smith 1907, Morrison 1930, Barrett 1963).

Pockets of Rich Subtidal Waters

The subtidal waters of inner Mission Bay (~261 acres)—which historically occupied the northern end of present-day Fiesta Island (Bache 1852b, Alden 1856)—covered a muddy bottom that supported seaweed species like hookweed (*Hypnea musciformis*) (Morrison 1930; **Fig. 6**). Eelgrass (*Zostera marina*) meadows were generally more common towards the mouth of Mission Bay (Hubbs 1947), and served a range of ecological functions including nursery habitat for juvenile fish and food for wintering brant (Morrison 1930, CDPW 1946, Hubbs 1955). Early accounts describe Mission Bay as teeming with marine fauna, including harbor seals (*Phoca vitulina*), skates and rays (e.g., round stingray [*Urobatis halleri*]), and bony fishes like giant kelpfish (*Heterostichus rostratus*), California killifish (*Fundulus*

parvipinnis) and flathead grey mullet (*Mugil cephalus*) (Fowler 1923, Fry and Croker 1933, Wells 1935, Junior League of San Diego 1960). Local Kumeyaay communities employed various fishing techniques, using 'eha kuayow—the Kumeyaay word for tule boats—to travel along Mission Bay, San Diego Bay, and the coastline (Crespí and Brown 2001, Gallegos 2017, Renascence et al. 2025).

“On a fairly calm winter afternoon when there is a minus tide, the channels of the eastern bay are as interesting a spot as any nature lover can imagine... Sharks, skates, rays and true fishes dash hurriedly out of the way...”

- Fry and Croker, 1933

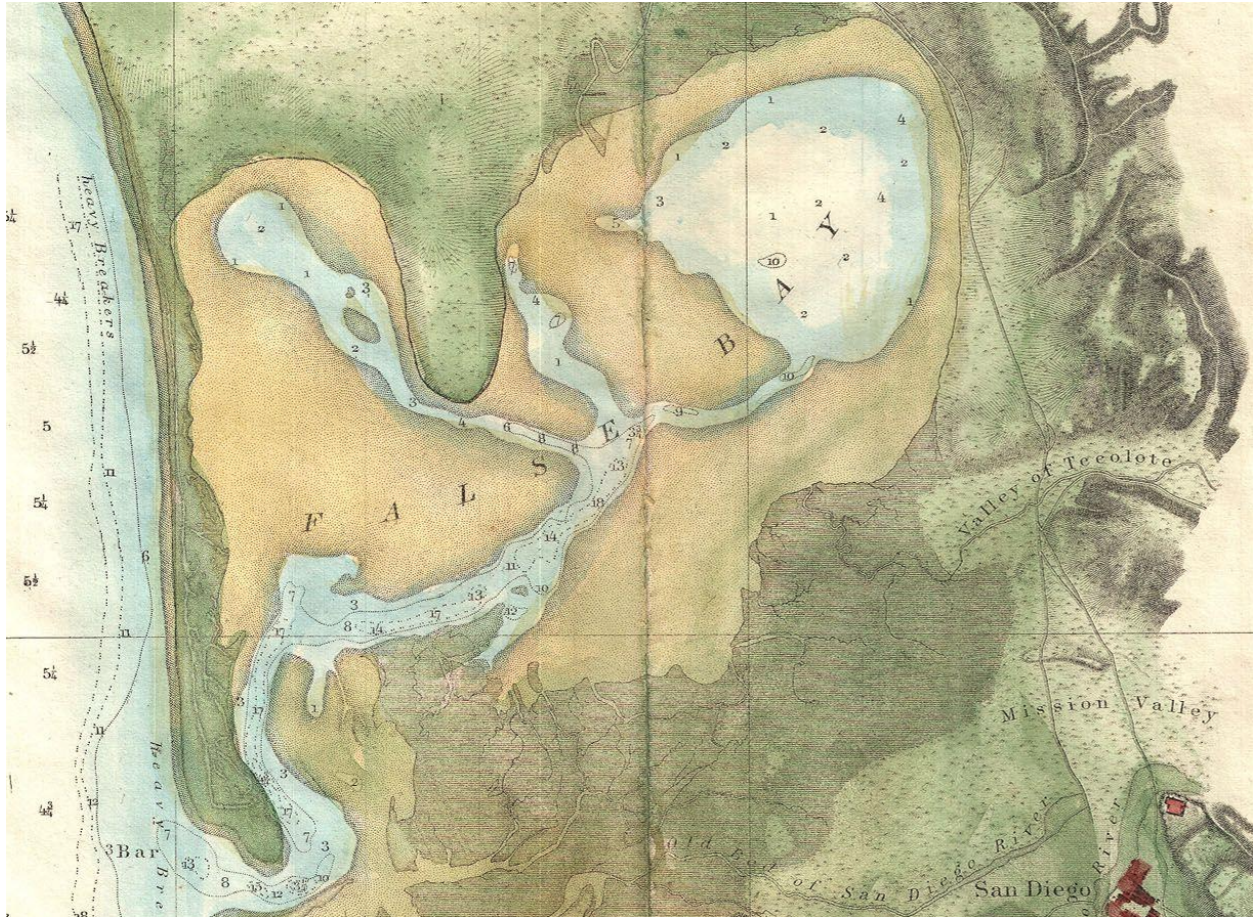


Figure 6. An 1857 U.S. Coast Survey Chart capturing a mosaic of subtidal, tidal, and terrestrial habitats in and around Mission Bay, then called 'False Bay' (Bache 1857, courtesy of NOAA).

Sebastián Vizcaíno, an early Spanish explorer, suggested in the early 17th century that False Bay—its name until “Mission Bay” was popularized in the early 20th century—was “a good port” and its entrance had a depth “of little more than two fathoms [~12 feet]” (Vizcaíno and Bolton 1908). However, an 1856 U.S. Coast Survey H-Sheet shows that the subtidal waters of eastern Mission were quite shallow, with depths ranging between 2-10 feet below Mean Lower Low Water (MLLW) (Alden 1856), while in 1853 G.H. Derby described the Bay as being “filled with shoals and sand bars” and having “hardly sufficient water at low tide for an ordinary sail boat” (Derby 1853 in Hertlein and Grant 1944). Later accounts support that Mission Bay became increasingly unnavigable for vessels further into the 19th century (Smythe 1908). Escalating sediment input from extensive ranching in the region (Lightner 2013) or other nearby development (e.g., railroad construction along Mission Bay’s eastern shore), in addition to siltation from the intentional re-routing of the San Diego River into Mission Bay, may have caused a decrease in Mission Bay’s depth over time (Wilson 1951, Crooks 1998).

A Dynamic San Diego River

Bordering Mission Bay's tidal marshes and mudflats to the southeast was the delta of the San Diego River—referred to as a “sandy plain” or “sand flat” by early sources (Derby 1853a, Gunn 1887, Duhaut-Cilly and Carter 1929, Erickson 1937b; **Fig. 7**). A number of tidal sloughs and strips of marsh vegetation extended from Mission Bay into this floodplain (Fry and Croker 1933).

During periods of heavy rainfall, the San Diego River would inundate a broad expanse of land south of Mission Bay, creating quicksand-like conditions experienced by those who tried to cross the channel (Derby 1853 in Harlow 1987, Pascoe 1870, Cleveland 1874, Davidson 1936). Nearby, possibly just beyond the river's historical floodplain, lay Cosoy/Matt Kusa'ay, a Kumeyaay village site whose name may translate to “it is dry” (Connolly 2021). The Kumeyaay built rock ridges on alluvial fans and placed boulders and brush on narrower channel corridors to encourage springs and streams to pool and enhance water availability for their agricultural systems (Shipek 1993, Viejas Band of Kumeyaay Indians 2014). As noted in an 1858 General Land Office Survey of the Pueblo Lands of San Diego, several small lagoons existed along the eastern rim of Mission Bay (Hays 1858), though it is unclear to what extent they were tidally influenced. The lagoons may partially explain the attraction of this part of Mission Bay for waterfowl hunting operations during the 19th and early 20th centuries.

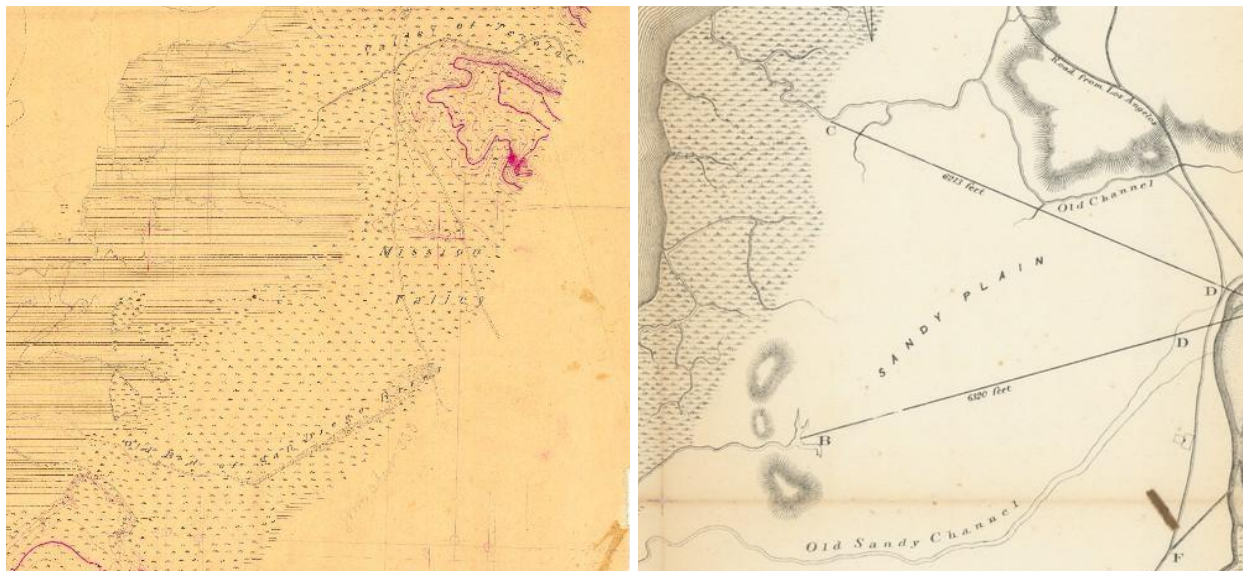


Figure 7. Two 19th century maps capturing the San Diego River delta and tidal-terrestrial transition zone in southeastern Mission Bay. Symbology in the 1852 T-Sheet (left) shows a gradual transition from tidal marsh to upland habitats, while the 1853 map by George H. Derby labels the area as “Sandy Plain” (**Left:** Bache 1852b, courtesy of NOAA; **Right:** Derby 1853a, courtesy of the San Diego History Center).

The San Diego River migrated across its floodplain during wet periods, occasionally draining via branching channels into San Diego Bay, Mission Bay, or both (Bancroft 1886, U.S. War Department 1945, Junior League of San Diego 1960). Its dynamism supported different successional stages of habitats, with early maps showing numerous abandoned channels and tidal sloughs that were former

courses of the river (Clayton and Hesse 1851, Bache 1852b, Derby 1853a, Handburg 1872). Nineteenth century shifts in the river's course were both natural and the result of anthropogenic influence (Hayes 1874 in Kuhn and Shepard 1984, Barfield, n.d.). An 1821 flood caused the San Diego River to flow into Mission Bay, yet only four years later, in 1825, additional flooding split the river's flows between Mission Bay and San Diego Bay (Derby 1853b, Gunn 1876, Bancroft 1886, Wyman 1937). Over the next 15 years, the river gradually migrated toward San Diego Bay, until flooding in 1840 closed off its last channel into Mission Bay and made San Diego Bay its primary exit point (Bancroft 1886, Duflot de Mofras and Wilbur 1937).

The 1853 construction of the Derby Dike, a levee embankment, temporarily pushed the San Diego River into Mission Bay; the levee failed only two years later in 1855 and the river flowed back into San Diego Bay until it was reconstructed in 1877, forcing waters again into Mission Bay for several decades (Derby 1853b, Bancroft 1886, Fredrich 1989). Eventually, floodway construction in 1953 sent the river directly out to the Pacific Ocean.

“The town...is situated at the foot of a high hill on a sand flat, two miles wide, reaching from the head of San Diego Bay to False Bay”

- Gunn, 1887

The San Diego River was the primary source of freshwater for Mission Bay (Morrison 1930). Early evidence suggests surface flows only drained into Mission Bay during the wet season (Eigenmann 1892, Los Angeles Herald 1895, Fry and Croker 1933, Wells 1935), with shallow subsurface freshwater likely continuing to flow even during the dry season (Derby 1853b). The construction of upstream impoundments—one built as early as 1813 by Mission San Diego de Alcalá—likely decreased the river's flow into Mission Bay and increased salinity levels in the Bay over time (Los Angeles Star 1852, ZoBell and Felltham 1942).

While the San Diego River was largely responsible for silting Mission Bay (Bache 1852a, Hoopes 1935), the “small intermittent streams which occasionally flow from Tecolote Canyon and Rose Canyon... built small deltas,” which contributed a relatively small amount of sediment to Mission Bay (Hertlein and Grant 1944). Tecolote Creek drained directly into Mission Bay during heavy rainfall (Fry and Croker 1933), but otherwise dissipated in the Bay's tidal marshes (Bache 1852b, USGS 1903, SDDPW 1928).

Diversity in the Tidal-Terrestrial Transition Zone

The tidal-terrestrial transition zone broadly encompasses areas where Mission Bay interfaces with the San Diego River's sandy floodplain, the mouth of Tecolote Canyon and the upland areas north of the mouth. This transitional area likely supported a diversity of early successional riparian scrub, grassland, and seasonal wetlands such as alkali meadow and vernal pool complex (Menzies and Eastwood 1924, Storie and Carpenter 1930b, Wieslander 1935, Crespi and Brown 2001). The 1930 soil

survey provides the most spatially explicit evidence for these habitats in the tidal-terrestrial zone (**Fig. 8**). Accounts from Foster very fine sandy loam and San Marcos fine sandy loam both mention the presence of saltgrass and high alkali concentrations, strong indicators of alkali meadows (Storie and Carpenter 1930b). Accumulated salt beyond the tidal marsh plain is also visible in the 1928 historical aerial imagery (SDDPW 1928). The Huerhuero fine sandy loam, Aliso fine sandy loam, and Olivenhain gravelly sandy loam soil types are indicative of vernal pool complexes, with descriptions of “hog-wallow” mounds—often referred to as Mima mounds—and underlying hardpan sediments (Storie and Carpenter 1930b). Mima mounds are visible in some areas of the historical aerial imagery overlapping these soils. Although botanical evidence is limited, there is a 1939 record of Coulter goldfields (*Lasthenia glabrata* ssp. *coulteri*)—associated with vernal pools, coastal salt marsh, and playas—from eastern Mission Bay (Gander 1939).



Figure 8. A cropped view of the 1930 Soil Map of the El Cajon Area, showing the southeastern portion of Mission Bay and the mouths of Tecolote Canyon and Mission Valley. The San Marcos fine sandy loam (Sf) and Foster very fine sandy loam (Fv) soils were high in alkali content and supported saltgrass, two indicators of alkali meadow habitats. The Huerhuero fine sandy loam (Hs), Aliso fine sandy loam (Af), and Olivenhain gravelly sandy loam (Og) soils are indicators of vernal pool complexes (Storie and Carpenter 1930a, courtesy of the University of Alabama).

Eighteenth century accounts suggest that the landscape surrounding Mission Bay was largely barren of trees, with Juan Crespí recalling shrubs and a “bare range of sheer soil, quite grass-grown” on the eastern shore (Crespí and Brown 2001). Late 19th and early 20th century sources also suggest the upland areas immediately east of Mission Bay were treeless, and dominated by either grasslands or shrublands (Fitch 1887, Holmes 1915, San Diego History Center 1926). Difficulty in distinguishing between grassland, shrubland, and seasonal wetland habitats is largely attributed to spatial unspecificity in historical sources and the complex effects of fire, grazing, introduced annual grasses, and other disturbances on the landscape.

Baja California oatgrass (*Sphenopholis interrupta* ssp. *californica*)—an endemic species presumed extinct due to the landscape impacts of colonization until recent rediscovery (Wilken-Robertson 2018, Mulligan 2020, Connolly 2025)—may have occurred in these grasslands. However, the extent of its historical distribution, and whether it is in fact the same extinct grass presumed to be semi-domesticated by the Kumeyaay, is still unknown (Shipek 1982, Hillman and Harris 2014).

“Many areas were burned each year just as the plants began drying, before the fire could spread because most things were still too green.”

- Shipek, 1991

The Kumeyaay used sophisticated landscape management strategies to encourage the growth of desirable vegetation and increase ecosystem resilience (Viejas Band of Kumeyaay Indians 2014, Wilken-Robertson 2018, Connolly 2025). Their use of fire, for example, played an essential role in maintaining the area’s grasslands

(Ascención 1602 in Wilken-Robertson 2018, Cuero and Shipek 1991, Gallegos 2017). The frequent burning of chaparral and other vegetation promoted the growth of subsistence and medicinal plants, helped attract wildlife hunted by the Kumeyaay, and reduced the risk of damaging wildfires (Cuero and Shipek 1991, Connolly 2025). Although many native grasses were quickly replaced by those brought over from Europe, continued grazing across the San Diego region played a key role in the maintenance of grasslands (Hays 1858, Watson 1912, Lightner 2013).

Tecolote Creek and Riparian Vegetation on the Canyon Floor

Historically, Tecolote Creek began at the north end of Tecolote Canyon near present-day Sequoia Elementary School and flowed south for ~7 miles within the Canyon before it turned west and met the edge of Mission Bay. Tecolote Creek was historically an ephemeral/intermittent stream, and only drained directly into the Bay during periods of heavy rainfall (Freeman 1854, USGS 1903, Wood 1913, Fry and Croker 1933). The presence of floodplain alluvium in the Canyon suggests water may have exited the Creek’s narrow riparian corridor during major rainstorms (Holmes and Pendleton 1918, Storie and Carpenter 1930a/b).

Riparian vegetation spanning the low-lying areas of the Canyon included coast live oak (*Quercus agrifolia*, Abbott 1945), California sycamore (*Platanus racemosa*, Higgins 1949), Mexican rush (*Juncus mexicanus*, Cleveland 1885a), and Baltic rush (*Juncus balticus*, Cleveland 1885b) (Hays 1858, CCH 2025, GBIF 2025; **Fig. 9**). Willows (*Salix* spp.) and Fremont cottonwood (*Populus fremontii*) were likely also a part of this composition of riparian vegetation, but available archival data did not provide explicit historical evidence. Arboreal salamanders (*Aneides lugubris*, Gander 1929) were historically present among the Creek’s riparian woodlands and chaparral. Sycamore trees provided nesting habitat for the barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), Bullock’s oriole (*Icterus bullockii*), and a

range of other species (Woodward 1921, Swank 2016, Tecolote Canyon Nature Center 2025). The name “Tecolote” originated from the Mexican-Spanish word for “owl,” which was derived from the Aztec language Nahuatl (Gudde and Bright 1998).



Figure 9. The mouth of Tecolote Canyon with Mission Bay and Mount Soledad in the background. The riparian forest of Tecolote Creek is seen in the middle ground alongside early development in the Canyon (*San Diego History Center 1926, courtesy of the San Diego History Center*).

The downstream portion of Tecolote Creek has been subject to substantial modification, most prominently with the development of the California Southern Railroad along the Creek’s mouth and the eastern border of Mission Bay in the 1880s (**see Cover Image**). Multiple floods in the 1950s threatened homes and destroyed a bridge on Knoxville Street (Kosits ca. 1980, Battle 2013), and by 1958 the City of San Diego had completed concretizing a 1 mile stretch of downstream Tecolote Creek, pushing the course of the channel a few hundred feet south in the process (DUDEK et al. 2018).

By the late 20th century, runoff from urban growth in and around the Canyon—namely the construction of the Tecolote Canyon Golf Course in the 1960s—shifted Tecolote Creek’s flow from intermittent or ephemeral to perennial (SDDPW 1928, Battle 1989). Comparison between historical and modern aerial imagery shows an increase in the density of upstream riparian cover between 1928 and 2023, likely a result of this flow-regime change (SDDPW 1928, Maxar Technologies 2023); **Fig. 10**). Other riparian systems in the region, including the Tijuana River, experienced this same pattern of increased riparian density with increased water discharge associated with urbanization (Safran et al. 2017). Given that grazing in the Canyon began in the early 1870s and persisted into the 1950s, it is possible that riparian vegetation patterns depicted in early 20th century sources reflect the impacts of this disturbance (Battle 1989).



Figure 10. Comparison between the extent of riparian vegetation along Tecolote Creek in historic (left) and modern (right) aerial imagery. Development and urban runoff have caused a shift in streamflow from intermittent to perennial, likely contributing to an increase in riparian forest density (**Left:** SDDPW 1928, courtesy of SDDPW; **Right:** Maxar 2023).

A Mosaic of Habitats on the Hillslopes and Lower Mesas

Hillslopes in Tecolote Canyon were primarily occupied by dense chaparral and relatively more open coastal sage scrub (Kruger 1919, Hamilton 1920), with several sources suggesting grassy openings along the Canyon floor (Wright 1919, SDDPW 1928, Wieslander 1935) and vernal pool complexes on the higher hillslopes and adjacent mesas (Storie and Carpenter 1930b). James E. Freeman described “grass and brush” in Tecolote Canyon in an early survey of the area (Freeman 1854), and this habitat mosaic is clearly visible in historical aerial imagery (SDDPW 1928). Chaparral habitat was more prevalent along north-facing slopes, while sage scrub habitat dominated drier south- and west-facing slopes, a pattern which can also be seen in the historical aerial imagery (SDDPW 1928, Tecolote Canyon Nature Center 2025; **Fig. 11**).

Descriptions of multiple soil classes from the 1930 soil survey provide strong evidence for the presence of vernal pool complexes on the mesas above Tecolote Canyon. Redding gravelly sandy loam and Olivenhain fine sandy loam are both described as having impervious substratums and “hog-wallow” mounds with intervening depressions that retained water after “heavy rains,” characteristics consistent with other vernal pool complexes in San Diego County (Storie and Carpenter 1930b, Bauder and McMillan 1998). Historical aerial imagery also documents these features on the flat mesas just beyond the edges of the Canyon (SDDPW 1928), following a distribution described in Cox 1984 (Cox 1984).

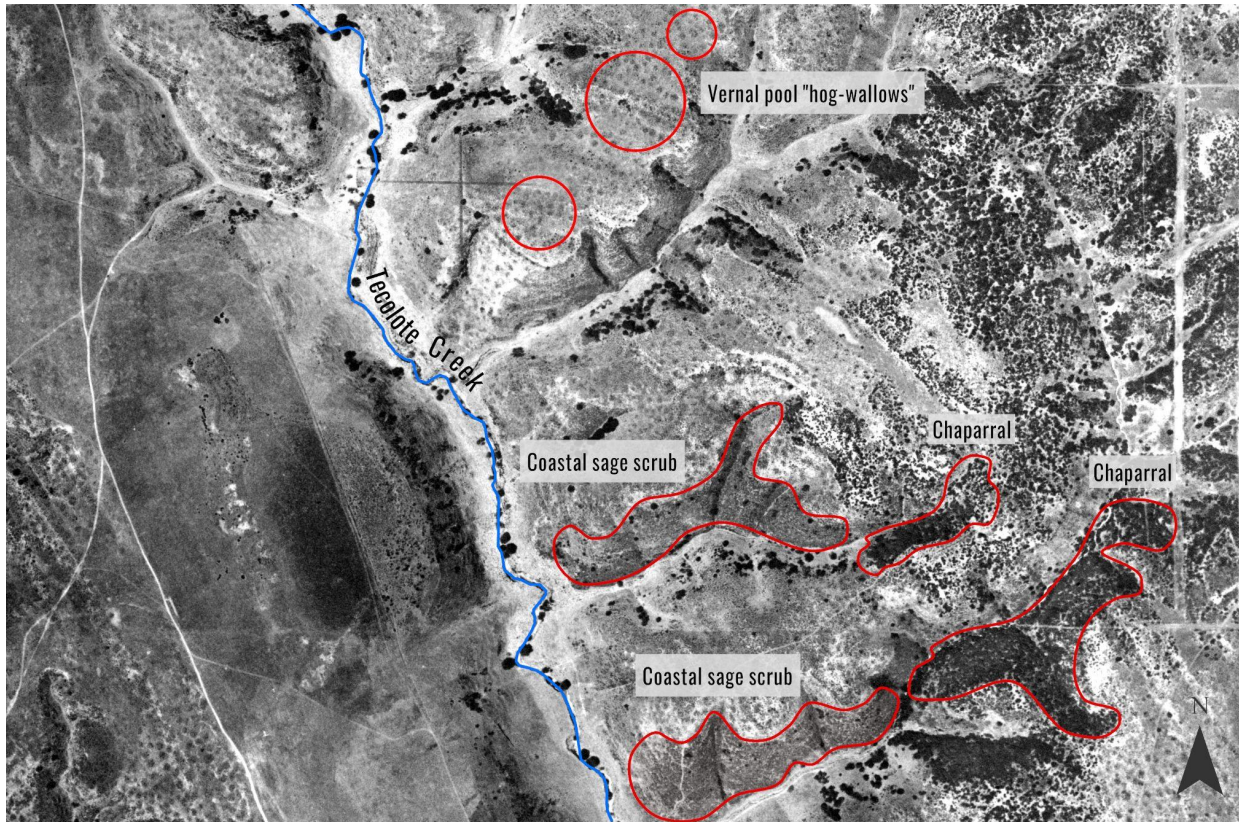


Figure 11. Historical aerial image capturing the mosaic of riparian forest, chaparral and coastal sage scrub within Tecolote Canyon, and vernal pool complexes on the adjacent mesas. Chaparral habitat likely occurred along north-facing slopes, while sage scrub habitat dominated drier south- and west-facing slopes. Tecolote Creek enters from the upper-left corner of the photo and flows south (SDDPW 1928, courtesy of SDDPW).

“Started along the shore of the second harbor here at San Diego [Mission Bay]. At some spots along the way a little sagebrush [rosemary] and some unknown shrubs are to be seen”

- Crespi, 1769

Characteristic chaparral species included chamise (*Adenostoma fasciculatum*, Wieslander 1935, TCCAC 1982), toyon (*Heteromeles arbutifolia*, Curtiss 1952), and woollyleaf ceanothus (*Ceanothus tomentosus*, Purer 1938c). Characteristic sage scrub species included California sagebrush (*Artemisia californica*), lemonade berry (*Rhus integrifolia*,

California buckwheat (*Eriogonum fasciculatum*), and laurel sumac (*Malosma laurina*) (Wieslander 1935, TCCAC 1982). Community-based activism in the mid- to late 20th century resulted in the protection of much of the Canyon from development (TCCAC 1982). As a result, the Canyon’s chaparral and sage scrub communities have persisted over time, though changes such as altered fire regimes have likely affected vegetation patterns, density, and community composition (**Figs. 12 and 13**).



Figure 12. A 1969 view of Tecolote Canyon capturing the assemblage of dense chaparral and open sage scrub habitat (San Diego Planning Department 1969, courtesy of the San Diego History Center).

Juan Crespí described the abundance of hares and rabbits (e.g., black-tailed jackrabbit [*Lepus californicus*], Cass 1908a) near Mission Bay, which were “very plentiful about this harbor” (Crespí and Brown 2001). Shrublands would have provided these and other mammals like the Dulzura kangaroo rat (*Dipodomys simulans*, Cass 1908b) cover from predators like coyotes (*Canis latrans*) that lived around Mission Bay (Hinds and Belcher 1844, Hayes and Wolcott 1929). Larger herbivores, including pronghorn antelope (*Antilocapra americana*) and deer (*Odocoileus* spp.), occupied the region’s shrublands and were hunted by the local Kumeyaay (Hopkins 1929, Viejas Band of Kumeyaay Indians 2014). Dense shrubland vegetation also offered habitat for California quail (*Callipepla californica*, Cass 1908c), which were historically abundant in the area (Hopkins 1929, Hastings 1957) and hunted in Tecolote Canyon (San Diego Union and Daily Bee 1902). A variety of avian fauna occupied the Canyon, including birds of prey (e.g., red-tailed hawk [*Buteo jamaicensis*], Heaton 1926) and passerine species (e.g., Bell’s sparrow [*Artemisiospiza belli*], Harter 1932).



Figure 13. View of a person riding a horse in the eastern part of Tecolote Canyon. Chaparral vegetation is seen on the hillslope (Hamilton 1920, courtesy of UCSD Special Collections).

Next Steps

This reconnaissance historical ecology study provides a foundation for informing future restoration efforts in southeastern Mission Bay and Tecolote Canyon, and for envisioning what ecological functions might be restored across the landscape. The information compiled and synthesized as part of this reconnaissance effort represents a subset of the available historical data, and further research would both broaden and deepen the emerging findings documented here. There are a number of potential future research directions that could be undertaken to develop a more holistic understanding of historical landscape patterns, processes, and functions in the region, including:

- Expansion of the geographic scope to include the entirety of Mission Bay and key portions of contributing watersheds.

- Engagement and collaboration with Kumeyaay tribal members to incorporate traditional knowledge and stewardship practices and deepen the understanding of historical ecological conditions and shape restoration visions
- Collection of additional archival data sources such as historical maps, textual accounts, photographs, and early botanical and wildlife records.
- Review of archaeological and biological data (e.g., core samples, eDNA, pollen analyses) to gain a more comprehensive understanding of faunal and plant species present historically.
- Synthesis of the assembled data to develop digital mapping representing prevailing ecological patterns in the area, building on the existing T-sheet-based mapping (Grossinger et al. 2011).
- Targeted analysis of historical hydrologic patterns and variability, wildlife support and other ecological functions, land use history, or other key topics.
- Comparison of historical and contemporary landscape patterns to quantify changes over time and identify restoration opportunities and targets.

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