

# CALIFORNIA FISH AND GAME

"CONSERVATION THROUGH EDUCATION"

VOLUME 99

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NUMBER 4



# California Fish and Game

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## Notes from the Editor

With this issue comes the close of volume 99 of *California Fish and Game*, California's longest-running continuously published scientific journal. In 1914, when *California Fish and Game* first appeared, I doubt that the then editor considered the possibility that the journal would still be published 100 years later; I am pleased to see that it is, and I trust that Leadership appreciates the effort that has gone into producing it over the past century. Surely the initial editor, H. C. Bryant, did not envision a time in which the journal would be produced electronically and become available immediately to researchers throughout the world.

*California Fish and Game* was first published electronically as Volume 99 (3), earlier this year. With electronic publication, the journal also became one of "open access" and is available at no cost to interested researchers. There are many advantages to open access journals, among which are unrestricted access to research publications. Open access provides a worldwide audience larger than that of any subscription-based journal and, thus, increases the visibility and impact of published works. Open access also enhances indexing and retrieval power, and eliminates the need for permissions to reproduce and distribute content. I think it is safe to announce that *California Fish and Game* is fully committed to free, international access to all articles as soon as they are published.

With the close of volume 99, I want to thank Paul Hofmann, who has resigned after serving as an Associate Editor for nearly 20 years. I also want to acknowledge the willingness of several incoming Associate Editors that will be responsible for processing manuscripts in their respective areas of expertise, and who will be announced in the first issue of Volume 100. All Associate Editors serve in a volunteer capacity, and without their dedication and desire to help *California Fish and Game* be the successful journal that it is, publication could not continue.

I also want especially to acknowledge the contributions of Ms. Debra Hamilton, who handles all of the layout work for the journal (in addition to her regular responsibilities in the Audio Visual Unit), and those of Ms. Kirsten Macintyre, who has handled the mailing list, invoicing for page charges, complaints from subscribers, and the distribution of back issues, as well as supporting requests from the editor for better equipment, compatible software, and occasional travel expenditures. The amount of effort put forth by Debra and Kirsten in producing *California Fish and Game* is not readily apparent, and it is essential that their efforts be recognized.

During 2014, the California Department of Fish and Wildlife will publish the 100th volume of *California Fish and Game*. Several special issues are planned to commemorate this occasion, with the plan that each special issue will follow a particular theme. I look forward to the publication of volume 100, and to continuing the fine tradition that has been the flagship of this publication over the past 100 years.

Vernon C. Bleich  
*Editor-in-Chief*

## **The historical range of beaver (*Castor canadensis*) in coastal California: an updated review of the evidence**

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The North American beaver (*Castor canadensis*) has not been considered native to the watersheds of coastal California or the San Francisco Bay Area. These assertions form the basis of current wildlife management policies regarding that aquatic mammal, and they date to the first half of the 20th century. This review challenges those long-held assumptions based on verifiable (physical) and documented (reliable observational) records. Novel findings are facilitated by recently digitized information largely inaccessible prior to the 21st century. Understanding that beaver are native to California's coastal watersheds is important, as their role in groundwater recharge, repair of stream channel incision, and restoration of wetlands may be critically important to the conservation of threatened salmonids, as well as endangered amphibians and riparian-dependent birds.

**Key words:** beaver, California, *Castor canadensis*, fur trade, historic range, San Francisco Bay

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The currently recognized historic range of the beaver (*Castor canadensis*) in California, according to the California Department of Fish and Wildlife (CDFW) (California Department of Fish and Game 2005, Zeiner et al. 1990) includes only the Central Valley,

the Pit, McCloud and Klamath River drainages of far northern California, and the lower Colorado River in the extreme southeastern corner of the State. This limited range appears to be based on monographs by early twentieth century zoologists Joseph Grinnell (1937) and Donald Tappe (1942). Both authors excluded the San Francisco Bay Area from the beaver's confirmed native range except where the delta of the Sacramento and San Joaquin Rivers (Delta) reaches the easternmost portion of Suisun Bay. Those authorities also concluded the range of beavers did not extend into southern California except along the lower Colorado River. Grinnell et al. (1937) also excluded all coastal watersheds from the early 20th century range except the upper Klamath River from the Scott River and east. Tappe (1942) extended the historical range relative to Grinnell to include the lower Klamath and Trinity Rivers and other coastal streams, but only as far south as the Little River, about 57 km south of the Klamath. Tappe (1942:14) speculated that, south of these northernmost California coastal streams, beaver were absent because the climate was more arid, and that coastal "stream beds are for the most part rocky and steep with but little beaver food growing along them, conditions which limit their suitability for this animal."

Tappe's description of coastal stream geomorphology is inaccurate for many watersheds south of the Klamath River, where numerous streams pass through low-gradient alluvial valleys rich with silt, creating habitat conditions quite suitable for beaver. While far south of the Klamath River precipitation does appreciably decrease, the notion that aridity limits beaver populations conflicts with the well-established historic and contemporary occurrences of beaver in the lower Colorado River, and the Alamo River in the Imperial Valley (Grinnell et al. 1937), the Mojave River (Lovich 2012), the Virgin and Humboldt Rivers of Nevada, Arizona's Gila and San Pedro Rivers (the latter known to fur trapper James Ohio Pattie as "Beaver River") (Allen 1895), and watersheds in the Mexican States of Sonora and Tamaulipas (Morgan 1868, Naiman 1988).

Casting further doubt on Tappe's speculation that more southerly coastal streams are unsuitable for beaver are observations that numerous colonies have for decades thrived in coastal streams. For example, beaver are reportedly present along the Big River in Mendocino County (Hall 1966), Pescadero Creek in San Mateo County, Meadow Creek in San Luis Obispo County (Christopher 2004), the Salsipuedes Creek tributary to the Santa Ynez River in Santa Barbara County, San Mateo Creek in San Diego and Orange Counties, and Tualota Creek in Riverside County (Longcore et al. 2007) and Temecula Creek in San Diego County (Atkinson et al. 2003), both tributary to the Santa Margarita River.

Grinnell et al. (1937) and Tappe (1942) also excluded the Sierra Nevada, opining that beaver did not occur above 305 meters (1,000 feet) in the rivers draining into the California Central Valley. However, recent physical evidence indicates that beaver lived in the Sierra Nevada until at least 1850 (James and Lanman 2012). In addition, Lanman et al. (2012) reported multiple reliable observer records of beaver in streams in watersheds from the western and eastern slopes of the Sierra Nevada, extending from the northern to southern boundaries of that mountain range. These findings prompted our search for evidence that might extend the historic range of beaver to coastal California watersheds.

In this paper, we review available verifiable (physical) and documented (reliable observational) records of the historic presence of beaver in California coastal watersheds and tributaries to San Francisco Bay, facilitated by relatively open access to recently digitized archival materials. Supplementary evidence is also reviewed and includes ethnographic information, reviews of geographic place names, and historical newspaper accounts, all of which serve primarily to support the higher order levels of evidence. We hypothesize that



beaver were native to the streams and rivers of California's coast and San Francisco Bay and that the exclusion of these areas in the early 20th century range maps proposed by Grinnell et al. (1937) and Tappe (1942) were primarily a result of the near extirpation of beaver from most of California prior to their research, the absence of pre-20th century specimens from California museums, and limited access to historic records, which at the time (unlike today) were widely dispersed, uncatalogued and not yet digitized.

## MATERIALS AND METHODS

*Study areas and time period.*—To organize the geographic breadth of the evidence, we divided our study area into five regions: (1) coastal watersheds in Del Norte, Siskiyou, and Humboldt counties including the Klamath River west of (and inclusive of) the Scott River; (2) coastal watersheds of Sonoma and Marin counties; (3) tributaries to San Francisco Bay (parts of Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo and San Francisco counties) including San Pablo Bay but not Suisun Bay; (4) coastal watersheds of Monterey, San Luis Obispo, Santa Barbara, Ventura and Los Angeles counties; and (5) coastal watersheds of Riverside, Orange and San Diego counties (Figures 1–3). With the exception of archaeological beaver remains from the Subatlantic Holocene (< 2,400 years BP), the time period of the evidence investigated to support the historic presence of beaver in California begins with the Spanish settlement of San Diego in 1769 and ends before 1923, when a 28-year long state-wide program of beaver translocations program began (Hensley 1946, Lynn and Glading 1949, Anonymous 1950).

*Specimen and records search.*—We searched for specimens of beaver prior to 1923 in all museum collections participating in the Mammal Networked Information System (MaNIS) (<http://manisnet.org/>) and the Arctos Multi-Institution and Multi-Collection Museum Database (<http://arctos.database.museum/>) via Boolean searches. In addition, we contacted curators of mammal collections at the California Academy of Sciences (CAS), Natural History Museum of Los Angeles County (NHMLAC), Moore Laboratory of Zoology, Museum of Vertebrate Zoology (MVZ), San Diego Museum of Natural History, Santa Barbara Museum of Natural History, Santa Cruz Museum of Natural History, National Museum of Natural History (USNM), and the UCLA Dickey Collection. We used Web of Knowledge, Google, and Google Scholar to search for historical fur-trapper records and ethnographic evidence of beaver. We queried FAUNMAP (<http://www.ucmp.berkeley.edu/neomap/search.html>) for *Castor* remains found in late Holocene archaeological sites, and contacted eight county historical societies for relevant source material. We also identified references from citations in other publications that reviewed the historic ranges of other California mammals (Schmidt 1991; Bockstoce 2005), and searched historical newspaper accounts at the Library of Congress digitized "Historic American Newspapers" (1836–1922) (<http://chroniclingamerica.loc.gov/>), the California Digital Newspaper Collection (1847–present) (<http://cdnc.ucr.edu/cdnc>), and NewspaperArchive (1847–present) (<http://newspaperarchive.com/>). Further, we searched geographic place names using the United States Geological Survey (USGS) Geographic Names Information System (GNIS) (<https://geonames.usgs.gov/pls/gnispublic>) and toponomastic references (Gudde and Bright 2004, Durham 1998).

Evidence was ordered into three categories of decreasing reliability in accordance with a classification scheme modified from Aubry et al. (2007). We considered physical evidence of beaver such as specimens in museum collections and zooarchaeological evidence to be the highest level of evidence (hereafter, verifiable records); documented first person

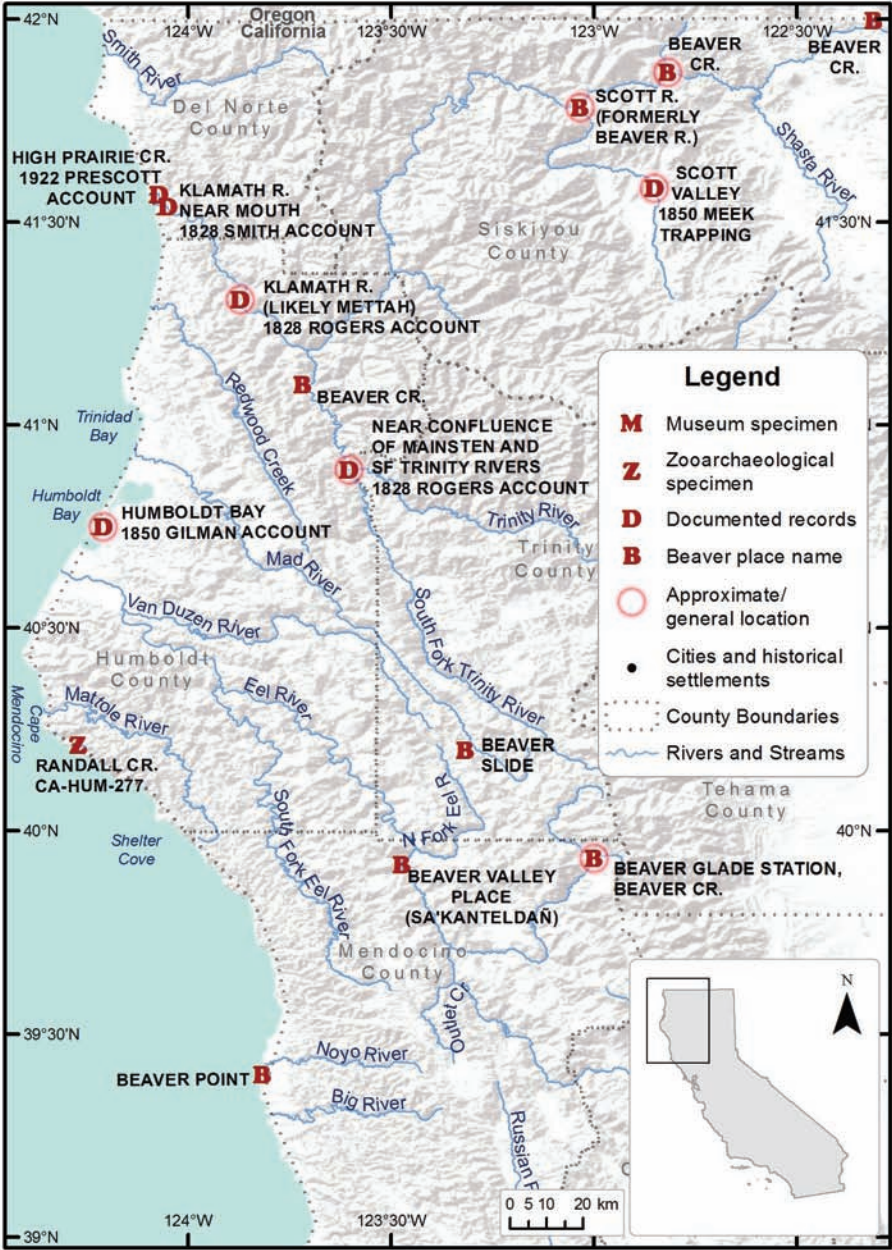


FIGURE 1.—Verifiable records (collection locations for museum specimens and zooarchaeological specimen locations) and locations for historical documentary records (reliable observers) and geographic place names including the word “beaver” for study region 1 (coastal watersheds in Del Norte, Siskiyou and Humboldt counties, including the Klamath River west of the Shasta Valley, and extreme northern Mendocino County), California, September 2013.

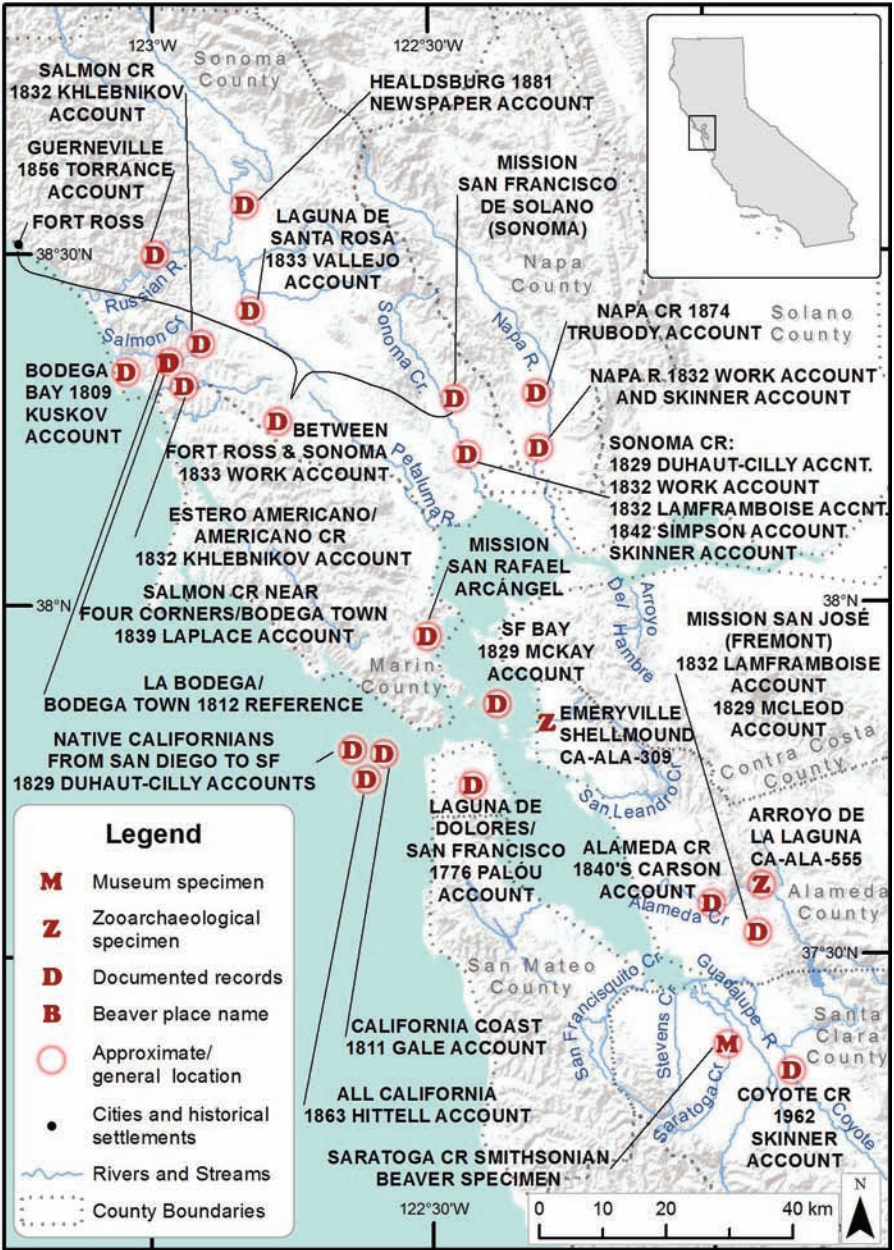


FIGURE 2.—Verifiable records (collection locations for museum specimens and zooarchaeological specimen locations) and locations for historical documentary records (reliable observers) and geographic place names including the word “beaver” for study region 2 (coastal watersheds in western Sonoma and Marin counties) and study region 3 (all counties with tributaries to San Francisco Bay west of the Carquinez Strait), California, September 2013.



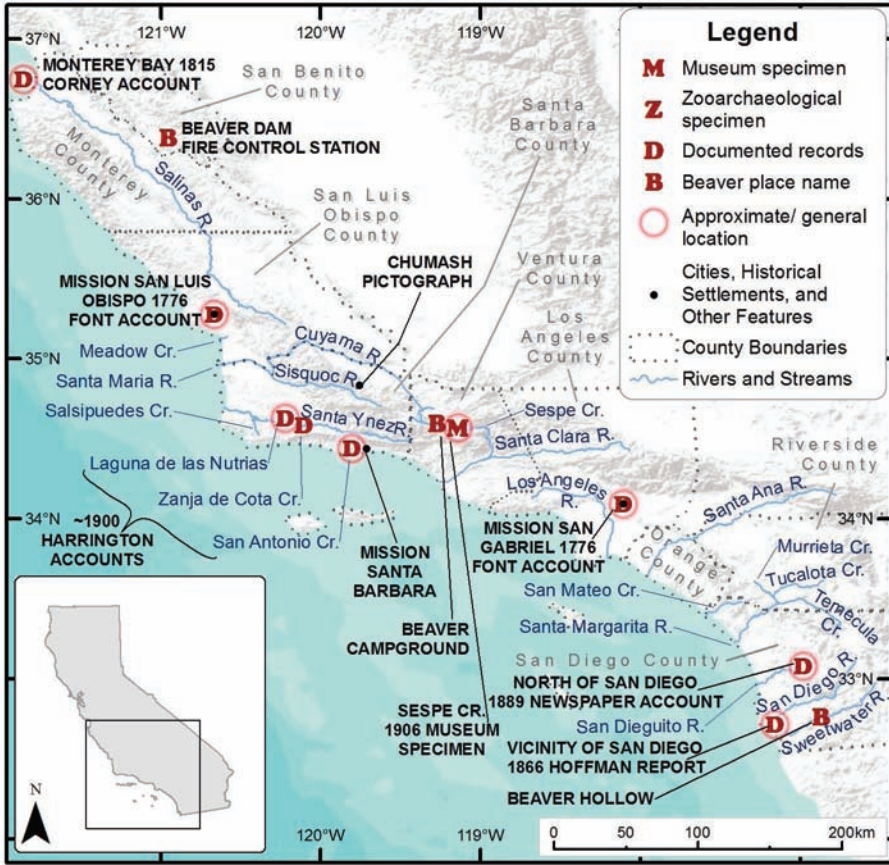


FIGURE 3.—Verifiable records (collection locations for museum specimens and zooarchaeological specimen locations), and locations for historical documentary records (reliable observers) and geographic place names including the word “beaver” for study region 4 (coastal watersheds in Monterey, San Luis Obispo, Santa Barbara, Ventura and Los Angeles counties), and for study region 5 (coastal watersheds in Orange, Riverside and San Diego Counties), California, September 2013.

accounts of the historical occurrence of beaver by reliable observers such as scientists, trappers, or rangers as the next highest level of evidence (hereafter, documented records); and evaluation of habitat suitability, ethnolinguistic and ethnographic information, and geographic place names as a lower level of evidence (hereafter, supplementary evidence). Aubry et al. (2007) referred to his third order level of evidence as “anecdotal” but narrowly defined this as visual observation made at a distance or tracks; therefore, we prefer the term “supplementary” to include our expanded definition of this categorization. Historical newspaper accounts were counted as documentary records if an animal was killed or captured as per Aubry et al. (2007), or as supplementary evidence if the article merely mentioned a beaver sighting.

## RESULTS

*Verifiable evidence, all five coastal regions.*—The FAUNMAP query revealed no late Holocene *Castor* remains in archaeological sites in any of the regions studied. However, independent investigations identified beaver remains in the excavations of the Emeryville Shellmound, located on Temescal Creek, 37 m from San Francisco Bay in Alameda County (Figure 2). A “beaver [*C. canadensis*] tooth” from AD 300–500 (1500–1700 years Before Present (BP)) was found in the Emeryville Shellmound, CA-ALA-309 (Bennyhoff 1986; Uhle 1907). In addition, Cope (1985) identified three beaver bones, dating to 700 to 2600 radiocarbon years BP. Further, Broughton (1995: Table E8) identified an incisor tooth from Uhle’s stratum 8. Associated material from that stratum is 2070 radiocarbon years BP.

On Arroyo de la Laguna Creek west of Interstate 680 in Pleasanton, Alameda County, a beaver lower incisor was found at the CA-ALA-555 site (Figure 2). The tooth was not radiocarbon dated, but was located in the lower part of the site that dates to 2200–1650 BP (Wiberg 1986). Arroyo de la Laguna is a low gradient, perennial stream in the Alameda Creek watershed and drains to San Francisco Bay.

Archaeologists uncovered a beaver molar at CA-HUM-277 on the southern coast of Humboldt County (Levulett 1985) (Figure 1). This site, located on coastal Randall Creek, just south of the Mattole River, dates to between 1000 and 500 years BP based on the depth at which it was found (W. Hildebrandt, Far Western Anthropological Research Group, personal communication, 2013). However, the specimen has not undergone radioisotopic analysis.

*Museum specimens, all five coastal regions.*—A MaNIS search combined with direct inquiries to California museums for pre-1923 *Castor* specimens located only a single vouchered specimen. That specimen, a beaver skull (catalogued MVZ Mammals 4918) was collected by John Hornung on 19 May 1906 on Sespe Creek, a tributary of the Santa Clara River, Ventura County. Grinnell (1937) was hesitant to accept the provenance of this specimen and placed a question mark by its location on his range map. Hornung, an NHMLAC zoologist, had collected many specimens for the MVZ as well as the American Museum of Natural History (Loomis 1901, Osborn 1910) and CAS (Howell 1923). Recently digitized correspondence between Grinnell and Hornung has become available and settles this longstanding question. When Grinnell wrote Hornung asking for further details regarding the specimen; Hornung (1914:1–2) wrote back: “... In reference to the beaver, I will say that I murdered the specimen in question 3 miles east of Cold Springs. I was on horseback and saw on the river, enormously swollen as the date which you have [19 May 1906], what appeared to me as a dead large dog surrounded by branches of a big stump. This stump was swimming in the water, but anchored in a tangled mass of some kind of a vine. After some maneuvering I could reach this animal with a stick. As soon as I touched it, it showed its teeth, and I knew then what unexpected find I had made... A shot ended the animal’s sufferings, and I secured the skull which you have...”. Hartman Cold Springs Ranch (34° 33’ N, 119° 15’ W) is located on upper Sespe Creek in the Sierra Madre Mountains at 1,025 m elevation and the creek along this stretch is quite low gradient, i.e. suitable beaver habitat. Interestingly there is a Beaver Camp on the USGS GNIS at 1,000 m elevation about 1 km east of Hartman Cold Springs Ranch, although its toponomastic origin is not known (Figure 3). In addition to the 1906 Sespe Creek beaver specimen, Hornung (1914:2) told Grinnell: “There are still quite a few beaver in Southern California, myself being so lucky as to get hold of one as late as Dec. 24, 1913, 3 weeks ago.”

A search of museums outside of California for pre-1923 beaver specimens revealed a beaver skull identified as *C. c. subauratus* (USNM 580354) collected in December 1855 in Santa Clara, Santa Clara County, California by John Graham Cooper. Cooper lived in Mountain View, California from 19 October to 1 December 1855 and collected specimens for the USNM in Arroyo Quito (now Saratoga Creek) (Coan 1982), which flows to south San Francisco Bay and was, until the 1870s, tributary to the Guadalupe River watershed (Figure 2). This is the probable site of collection of the Santa Clara beaver specimen.

*Documented records and supplementary evidence of beaver from the California maritime fur trade.*—James Cook's discovery of sea otter (*Enhydra lutris*) on the west coast of North America in 1778 led quickly to American ships from Boston dominating the maritime fur trade south of Russian America (Alaska) (Bockstoce 2005). In addition, Vicente Vasadrá y Vega instructed California's Mission Indians to procure otter pelts for Spain beginning in 1786 (Ogden 1932). Evidence that American ships also took beaver from California's coastal watersheds is suggested by the log of the ship *Albatross*, which states that while hunting and trading for fur seals (*Callorhinus ursinus* and *Arctocephalus townsendi*) and sea otter on the Columbia River and California coast, the ship also obtained 248 beaver pelts (Bancroft 1886). Another example of sea otter hunters taking coastal beaver is the Russian American Fur Company ship *Kodiak*, piloted by Ivan Kuskov who sailed into Bodega Bay in 1809 and returned to Novoarkhangelsk (Sitka, Alaska) with beaver skins and otter pelts (Thompson 1896). When French sea captain Auguste Bernard Duhaut-Cilly visited the coastal settlements of Alta California [Upper California as opposed to Baja California] in 1827–1828 on the ship *Heros*, he described the Indians hunting beaver: "For the skin of a rabbit or a beaver the bow is bent, and the lethal arrow does not fly through the air with impunity... To prevent the sound of the string from warning the game, they wrap a small part of it with a sleeve of beaver skin" (Duhaut-Cilly 1834).

Decades before Jedediah Smith led California's first overland beaver hunt and reached the Klamath River mouth in Del Norte County in 1828 (Dale et al. 1918, Smith et al. 1834) and before Peter Skene Ogden sent Hudson's Bay Company parties to the area from Oregon (Warner 1966), coastal Native Americans had apparently provided beaver, along with sea otter pelts, to the visiting oceanic fur hunters: "From their rocky lookouts the Indians of this remote coast had seen ships of many nations come and go, had even traded for knives and trinkets, the beaver and otter skins being so plentiful that they wore them for clothing" (Maloney 1940). In 1831 the Hudson's Bay Company at Fort Vancouver (on the Columbia River) complained that American ships had caused the price of beaver to rise fivefold on the coast and, after plying the coastal fur trade on the West Coast, Captain John Dominis of the *Owhyhee* returned to Boston with 8,000–9,000 beaver pelts (Gibson 2000).

*Documented records and supplementary evidence of beaver in coastal watersheds: Del Norte, Siskiyou, and Humboldt Counties, including the Klamath River west of the Scott River.*— Documented records for this region begin with the accounts of Jedediah Smith's 1828 journey from the Sacramento Valley near Red Bluff (Tehama County) northwest across the mountains to the Pacific Ocean. Smith's party observed beaver sign along the Trinity River near the border of Humboldt and Trinity counties and traded with Yurok Indians for beaver pelts while crossing the Klamath River at Met-tah as well as on the ridge between the Klamath River and Redwood Creek in Humboldt County (Dale et al. 1918, Lewis 1943). Smith also noted beaver sign on 5 June 1828 near the mouth of the Klamath River in Del

Norte County: "In the vicinity I saw some Beaver sign but the tide setting up interfered with the design of trapping" (Smith et al. 1934:96). These are the first reports of beaver on the lower Klamath River watershed, and the first record of beaver in the tidal zone of a California stream. Grinnell noted that beaver were plentiful on upper Klamath River tributaries such as the Shasta River and Scott River in Siskiyou County until 1911 (Grinnell et al. 1937). Fur trapper Joseph Meek took 1,800 beaver from the Scott River in 1850 (Tappe 1942). A letter written to Grinnell 29 January 1922 by Fish and Game Deputy H. S. Prescott documents observation of beaver sign "up-river of Requa" in 1915–1916, and explains that these lower Klamath River beaver were extirpated in 1917. In 1922, Prescott also noted beaver sign (willow cuttings) on High Prairie Creek, near the mouth of the Klamath River at Requa (Prescott 1922). Grinnell et al. (1937) remained skeptical of this record and placed a question mark on their map of MVZ beaver records near the confluence of the Trinity and Klamath Rivers labeled "*C. c. shastensis*." Tappe's later report (1942) cited additional take of beaver on the lower Klamath in February 1827 by Peter Skene Ogden's Hudson's Bay Company (Ogden and Elliot 1910). Based on the totality of the Smith and Ogden reports, Tappe (1942) and Hensley (1946) extended Grinnell's historic range map for beaver all the way to coastal Del Norte and Humboldt counties.

California's north coast was hunted by American and Hudson's Bay Company fur brigades in 1832–1833, and beaver were encountered in small numbers. In 1832, Ewing Young's American fur brigade ascended Putah Creek from the Sacramento River and reached the coast about 120 km north of Fort Ross. From there they trapped up the coast to the Umpqua River in Oregon "with little success" (Warner 1907:187, Hill 1923:32). In 1833, Michel Laframboise trapped from Bodega up the coast to Fort Vancouver in Oregon "along the ridge that runs parallel to the sea" (Nunis 1968a:153). Although we could not determine how many beaver Laframboise took from the North Coast Range, Hudson's Bay Company records indicate that his hunt was successful (Nunis 1968a). In April 1850, the *Laura Virginia* entered Humboldt Bay and Charles Gilman (1901:40) wrote then of the fauna of the Humboldt Bay area, "...what exceeds all I ever saw is the quantity of game and fish. Elk, deer, black bear, and grizzly bear, beaver, otter, geese, ducks, curlews, snipe, robin, partridge are without number..."

Supplementary historical evidence of beaver from the watersheds of the North Coast includes multiple toponomastic references including the word "beaver." The Scott River was formerly known as the Beaver River by nineteenth century trappers (Gudde and Bright 2004). Several additional geographic place names are found in this region, including two Beaver Creeks in Humboldt County and another Beaver Creek as well as a Beaver Point in Mendocino County (Table 1). One of the Humboldt County "Beaver Creeks" could be ascribed to a Mr. Jacob Beaver, who lived in 1890 at the Beaver Creek that meets Redwood Creek at Beaver Flat, and is one mile from Beaver School (Turner and Turner 2010). However, the other Beaver Creek in Humboldt County flows into the Trinity River in a valley separated from the Beaver residence by 14.3 km as well as 1,200 m elevation Pine Ridge-Hupa Mountain. In addition, no eponymous origin for the Beaver Creek and Beaver Glade Station on the Middle Fork of the Eel River could be found. Whether Beaver Point referred to sea otter which were sometimes called "sea beaver" is unknown. Ethnolinguistic records of North Coast Indian tribes are replete with the respective words for beaver (Table 2) including *sa'kAntEtdAn* (Beaver Valley Place) and is located on the Eel River mainstem upstream of Bell Springs Creek and just south of the Trinity County-Mendocino County line (Baumhoff 1958).

**TABLE 1.**—Geographic place names in coastal watersheds incorporating the word “beaver” (including the Klamath River watershed west of the Scott River). All place names are from USGS GNIS except Beaver Valley Place (Baumhoff 1958:172) and Laguna de los Nutrias (Harrington 1981), California, September 2013.

| Name of Geographic Feature   | County        | GPS (DMS) Coordinates of Feature or Stream Mouth | Coastal Watershed                  |
|--|---------------|--|------------------------------------|
| Scott River (formerly Beaver River)                                  | Siskiyou      | 41° 47' N, 123° 02' W                            | Klamath River                      |
| Beaver Creek   | Humboldt      | 41° 06' N, 123° 43' W                            | Trinity River to Klamath River     |
| Beaver Creek, Beaver Ridge, Beaver Butte, Beaver Flat, Beaver School | Humboldt      | 41° 01' N, 123° 52' W                            | Redwood Creek                      |
| Beaver Slide   | Trinity       | 40° 12' N, 123° 19' W                            | Mad River                          |
| Beaver Valley Place  | Mendocino     | 39° 55' N, 123° 28' W                            | Eel River                          |
| Beaver Creek, Beaver Glade Station                                   | Mendocino     | 39° 56' N, 123° 00' W                            | Middle Fork Eel River to Eel River |
| Beaver Point   | Mendocino     | 39° 24' N, 123° 49' W                            | South of mouth of Noyo River       |
| Beaver Dam Fire Control Station                                      | San Benito    | 36° 23' N, 120° 56' W                            | San Benito River to Pajaro River   |
| Laguna de las Nutrias or Tsəpək isiyo (Chumash for Beaver Lake)      | Santa Barbara | 34° 37' N, 120° 17' W                            | Santa Ynez River                   |
| Beaver Campground  | Ventura       | 34° 36' N, 119° 15' W                            | Sespe Creek to Santa Clara River   |
| Beaver Camp  | Ventura       | 34° 33' N, 119° 15' W                            | Sespe Creek to Santa Clara River   |
| Beaver Hollow  | San Diego     | 32° 46' N, 116° 51' W                            | Sweetwater River                   |

*Documented records and supplementary evidence of beaver in coastal watersheds: western Sonoma and Marin Counties.*—After Ivan Kuskov’s first visit to Bodega Bay in 1809 (and return to Sitka with beaver pelts), he returned in 1811 on the schooner *Chirikof*, and explored the Russian River for 80 km upstream. Next, Kuskov established the Russian



**TABLE 2.**—Tabulation of words for beaver used by Native American tribes inhabiting California's coastal watersheds, 2013.

| Tribe  | Counties<br>from North<br>to South | Coastal Watershed<br>or Bay/Channel  | Indian Word   | Source <sup>1</sup>         |
|--|------------------------------------|--------------------------------------|---|-----------------------------|
| Tolowa   | Del Norte                          | Smith River<br>(Crescent City)       | <i>sah'-hot</i>   | Merriam                     |
| Karok  | Siskiyou                           | Klamath River<br>(Happy Camp)        | <i>sah'-peneetch</i><br><i>sa-pin-itch</i>              | Merriam<br>Powers           |
| Coast Yurok                                    | Humboldt                           | Trinidad Bay                         | <i>tes-a'r</i>  | Heizer                      |
| Wiyot  | Humboldt                           | Humboldt Bay                         | <i>he-wo'-li</i>  | Merriam                     |
| Whilkut  | Humboldt                           | Redwood Creek                        | <i>tch'wah'-i</i>                                       | Merriam                     |
| Lolangkok/<br>Sinkyone                         | Humboldt                           | South Fork Eel<br>River              | <i>ba-chen'-tel</i>                                     | Merriam                     |
| Huchnom  | Mendocino                          | Eel River<br>(Round Valley)          | <i>tik-keh</i>  | Powers                      |
| Pomo   | Mendocino                          | Eel River<br>(Round Valley)          | <i>kat-si-keh'</i>                                      | Powers                      |
| Northern Pomo/<br>Tabate                       | Mendocino                          | Navarro River<br>(Anderson Valley)   | <i>kah-ke'</i>  | Merriam                     |
| Central Pomo/<br>Yokaia/Yukai                  | Mendocino                          | Russian River<br>(Ukiah)             | <i>kah-ke'</i><br><i>ka-tai-u-ki'ah</i><br><i>ko-o'</i> | Merriam<br>Powers<br>Powers |
| Northern Pomo/<br>Kaiyu                        | Lake                               | Tule Lake, Blue<br>Lakes             | <i>chin-nor</i><br><i>chi-nor</i>                       | Merriam<br>Powers           |
| Central Pomo/<br>Shanel                        | Mendocino                          | Russian River<br>(Hopland)           | <i>kaht'-ka</i>   | Merriam<br>Powers           |
| Wappo  | Sonoma                             | Russian River<br>(Alexander Valley)  | <i>ma'-nah ow'-we</i>                                   | Merriam                     |
| Pomo/<br>Gallinomero                           | Sonoma                             | Russian River<br>(Healdsburg)        | <i>tek'-keh</i>   | Powers                      |
| Southern Pomo/<br>Makahmo                      | Sonoma                             | Russian River<br>(Cloverdale Valley) | <i>tek'-ke</i><br><i>tek'-keh</i>                       | Merriam<br>Powers           |
| Kashaya Pomo/<br>Venaambakaiia/<br>Chwachamaju | Sonoma                             | Russian River<br>(Fort Ross)         | <i>ikh-shi</i><br><i>khavena</i><br><i>ʔ'ek:e</i>       | Powers<br>Powers<br>Walker  |
| Bodega Miwok/<br>Olamentke                     | Sonoma                             | Bodega Bay                           | <i>poo</i>  | K&VW                        |

TABLE 2.—Continued.

| Tribe                               | Counties<br>from North<br>to South | Coastal Watershed<br>or Bay/Channel   | Indian Word   | Source <sup>1</sup>                |
|-------------------------------------|------------------------------------|---------------------------------------|---|------------------------------------|
| Mutsun<br>Costanoan/<br>Tcho-ko-yem | Sonoma                             | Mission Sonoma<br>(Sonoma Creek)      | <i>timis</i><br><i>ti-mis</i>                                   | Powers<br>Powers                   |
| Coast Miwok                         | Marin                              | Tomaes Bay                            | <i>kah-ka'</i>  | Merriam                            |
| Mutsun<br>Costanoan                 | Santa Cruz                         | San Lorenzo River                     | <i>ha-mi-h'l, gupi</i><br><i>gupi</i>                           | Heizer<br>Powers                   |
| Rumsen<br>Costanoan                 | Monterey                           | Salinas River                         | <i>sur-ris</i>  | Heizer                             |
| Chumash<br>Ineseno                  | Santa<br>Barbara                   | Santa Ynez River                      | <i>che-puk'</i><br><i>c'ipik</i><br><i>tsəpək</i>               | Merriam<br>Applegate<br>Harrington |
| Chumash<br>Barbareño                | Santa<br>Barbara                   | Santa Barbara<br>Channel              | <i>ol-ko-osh</i><br><i>c'əpək</i>                               | Powers<br>Henry                    |
| Chumash<br>Ventureño                | Ventura                            | Santa Clara River<br>Ventura River    | <i>tsə'pək</i>  | Henry                              |
| Gabrieleno/<br>Tongva               | Los Angeles                        | Santa Ana River,<br>Los Angeles River | <i>tooleva'che',</i><br><i>toliiva'chi'</i><br><i>'eveenxar</i> | Merriam                            |
| Lui-seño                            | San Diego                          | San Luis Rey River                    | <i>'eveeenxal</i>   | Harrington                         |
| Kumeyaay<br>(Diegueno)              | San Diego                          | San Diego River,<br>Tijuana River     | <i>epin</i>   | Ware                               |

<sup>1</sup>Applegate 2007, Harrington 1981, Heizer 1974, Henry 2012, Kostromitinov and Von Wrangell 1974 (K&VW), Merriam 1979, Powers 1877, Walker 2012, Ware 1968

colony of Fort Ross 26 km north of Bodega Head in today's Sonoma County (Thompson 1896). G. K. Blok (1933:189-190) described the natural resources of the Russian settlement near "La Bodega": "The rich, fertile soil and the abundance of seal, otter and beaver were the principal factors which favored this colonization." Fort Ross official Kyrill T. Khlebnikov reported that, "...although it happens rarely, nonetheless one does sometimes see close to the American settlements American lions and amphibious animals such as river beavers and otters" (Dmytryshyn and Crownhart 1976:142). The "American settlements" were lands granted by Mariano Vallejo to three Americans to prevent Russian expansion southwest of Bodega (Gudde and Bright 2004). These lands included the coastal watersheds of Salmon Creek (Sonoma County), Americano Creek (Sonoma and Marin counties) and Russian River tributary Atascadero Creek (Sonoma County). In August 1839, Captain Cyrille Laplace of the *Artemise*, while travelling with Fort Ross manager Alexander Rotchev to the Khlebnikov Ranch (now the town of Bodega), reported unmistakable beaver sign. Laplace (Farris and Laplace 2006:54) said, "...we had stopped a moment by a little river [Salmon Creek] on the banks of which my traveling companion pointed out to me the former habitations of beaver, probably destroyed by the Indians to catch the rich prize that lay within." Rotchev then explained how the Indians close the entrance to beaver lodges in order to catch and club them.

Alexander McLeod of the Hudson's Bay Company's reported in 1829, "The Country to the northward of Bodega is said to be rich in Beaver and no encouragement given to the Indians to hunt" (Nunis 1968b:34). In 1833, John Work led a Hudson's Bay Company fur brigade from Fort Vancouver, Oregon to the Sonoma Mission (then Mission San Francisco Solano). On 5 April, Work writes of some American trappers who said that between the Russian establishment (Ft. Ross) and the Mission at Sonoma they "caught very few beaver" (Maloney and Work 1944:19). Although Maloney (1943) reports that John Work found no beaver on the coast from Fort Ross to Cape Mendocino, he turned east probably around Shelter Cove, and on crossing the Russian River on the way to Clear Lake wrote that there "are supposed to be beaver in the lower part of this Russian river" (Maloney 1944:30). This report is consistent with another Sonoma County account regarding S. H. Torrance, who settled on the Russian River across from Guerneville in 1856, and "engaged in trapping beaver and in hunting," dressing the skins and making them into gloves for sale (Lewis Publishing Company 1889:573). Mariano Vallejo, on a return trip from Fort Ross to Mission Sonoma, provided another report of beaver in the Russian River watershed: "Four leagues away, more or less one finds Livantuligueni [Laguna de Santa Rosa], which forms in its basin great tulare lakes teaming with beaver. One can find here, as well as in other places, some vestiges [left by] the foreigners who hunted these animals" (Vallejo 2000:6). Vallejo (2000:5-6) described seeing Indians who by the "many hundreds were coming down from their hill country to bring to the fort [Ross] the hides of wild animals which they traded for tobacco, kerchiefs and liquor."

Supplementary evidence of beaver in this region includes an historic newspaper account and also places beaver in the Russian River watershed: "Beavers are being trapped near Healdsburg" (Sacramento Daily Union 25 February 1881). The Southern Pomo, who inhabited the lower half of the Russian River, had a word for beaver: *t'ek:e* (N. Alexander Walker, UC Santa Barbara, personal communication, 2011) and beavers in their oral legends (Luthin 2002). In addition there are words for beaver for virtually all the coastal tribes in this region (Table 2).

*Documented records and supplementary evidence of beaver in coastal watersheds: San Francisco Bay Area counties.*—Although Grinnell et al. (1937) and Tappe (1942) concluded that beaver were not present historically in the watersheds of the San Francisco Bay Area downstream /west of the Carquinez Strait, more recent reviews indicate that beaver "was one of the most valued of the animals taken," and found in abundance (Skinner 1962:157). The earliest documentary record is from the second Anza Expedition sent to found the Presidio at San Francisco. When the expedition halted on the banks of the Laguna de los Dolores (the site of the future Mission Dolores) on 22 June 1776, Father Francisco Palóu wrote of the Indians, "The men go totally naked, although here and there one covers his shoulders with a sort of a little cape of beaver skins and pelican feathers" (Bolton and Palou 1930:390). Over fifty years later, in August 1827, Duhaut-Cilly (1834:243) observed the Indians at Mission Sonoma, "the young men are letting fly their arrows at the beaver..."

In 1829, Alexander R. McLeod reported on the progress of the first Hudson's Bay Company fur brigade sent to California, "Beaver is become an article of traffic on the Coast as at the Mission of St. Joseph [Fremont] alone upwards of Fifteen hundred Beaver Skins were collected from the natives at a trifling value and sold to Ships at 3 Dollars" (Nunis 1968b:34). Skinner (1962) cited Thomas McKay's statement that in one year [1829] the Hudson's Bay Company took 4,000 beaver skins on the shores of San Francisco Bay. In 1832, fur trapper Michel Laframboise travelled from the "Bonaventura River" (Sacramento

River) to San Francisco and then the missions of San Jose (Fremont), San Francisco Solano (Sonoma) and San Rafael Arcangel (San Rafael). La Framboise stated that the Bay of San Francisco abounds in beaver and that he “made his best hunt in the vicinity of the missions” (Maloney and Work 1943:343). While staying with General Vallejo, Sir George Simpson of the Hudson’s Bay Company wrote in 1842, “Beaver and otter have recently been caught within half a mile of Mission San Francisco de Solano [Mission Sonoma]” (Simpson 1847:313). In 1840, the port of Alviso, Alameda County, shipped beaver pelts, cattle hides and tallow to San Francisco (Mehaffy 1999). In the 1840s Kit Carson was granted rights to trap beaver on Alameda Creek in the East Bay where they “abounded...from the mouth of its canyon to the broad delta on the bay” (MacGregor 1976:13, Gustaitis 1995:69). Skinner (1962:162) wrote that there is evidence that beaver were found historically “in small numbers at least” in Coyote Creek (Santa Clara County), and Sonoma Creek (eastern Sonoma County) and the Napa River (Napa County), although he did not provide primary sources. This is consistent with John Work’s 1832 Hudson’s Bay Company expedition account of beaver on Sonoma Creek in April (Maloney 1944), and on the Napa River in May (Maloney 1944, Grossinger 2012). Also William Trubody, who arrived in California in 1849, wrote of catching beaver on Napa Creek (upper Napa River) (Trubody and Camp 1937). Supplementary evidence of beaver in the San Francisco Bay Area include words for beaver in the Coast Miwok and Mutsun Costanoans at Mission San Rafael and Mission Santa Cruz (Table 2), but toponomastic references to beaver were not found.

*Documentary records and supplementary evidence of beaver in coastal watersheds: Monterey, San Luis Obispo, Santa Barbara, Ventura and Los Angeles counties.*—There are several reliable observer records of beaver in these watersheds, complementing the MVZ specimen from Sespe Creek. Before citation of accounts from the 18th century Spanish explorations up coastal California, the translation of the Spanish word for beaver merits discussion. The early diaries of the Spanish padres refer to both sea otter and beaver as “nutria,” which in modern Spanish means “otter.” However, the historian Herbert Eugene Bolton generally translates “nutria” as beaver, unless the words “nutria marinas” meaning sea otter, are used (Bolton and Font 1930, Bolton and Palou 1930). Further evidence of the use of the word “nutria” for beaver may be found in other records of the Spanish padres and government officials in the late 18th century (Garces and Coues 1900, Barrows and Wolfskill 1902). The misuse of “nutria” instead of “castor” for beaver by the late 18th century Spanish in the American southwest occurred because both Eurasian otter (*Lutra lutra*) and beaver (*Castor fiber*) were extirpated in Spain by the 17th century (Halley et al. 2012). The third possible translation of “nutria” as meaning river otter (*Lontra canadensis*) is unlikely in the accounts below, as this latter species’ range is not considered to extend south of the Pajaro River watershed either historically or currently (Grinnell et al. 1937, Morejohn 1969, Zeiner et al. 1990).

On the second Anza Expedition, Father Pedro Font, on 24 February 1776, described coastal Chumash women wearing beaver capes (Bolton and Font 1930). Next, Font visited the San Luis Obispo Mission on 2 March 1776 and wrote of the Indians, “... the women wear capes of deer and beaver skin” (Bolton and Font 1930:272). Visiting the mission again on 23 April 1776, Font says that Father Cavaller “gave Senor Ansa... thirty-odd beaver skins...and gave me personally two choice beaver skins” (Bolton and Font 1930:454). In October 1818, English explorer Peter Corney sailed into

Monterey Bay on the *Santa Rosa*. He described the fauna of the Monterey area: "There are many bears, wolves, foxes, deer, beavers, etc..." (Corney and Alexander 1896:44).

John Peabody Harrington (1981) provided three documentary records (circa 1900) of beaver in two coastal watersheds of Santa Barbara County: Zanja de Cota Creek, a perennial tributary of the Santa Ynez River downstream from the modern day Cachuma Dam, and San Antonio Creek's Los Alamos Valley in Los Alamos. Harrington also wrote that on the historic Rancho Santa Rosa on the Santa Ynez River, "There is Otter lake, commonly called in Sp. 'Laguna de las Nutrias'... Otter lake is called in Indian 'tšəpək isiyo,' meaning 'Laguna de los Castores.'" These animals are sometimes called las nutrias but incorrectly for they are really beavers. The otter is an ocean creature. The Indians call otter 'ukpaaš. The Sp. speaking people, however, Laguna de las nutrias. It should be called, however, Laguna de los Castores." The modern Spanish word for beaver is "castor."

In addition to the above documented observer records, there is significant ethnographic evidence that beaver lived in the region. On the Montgomery Potrero, the divide between the upper watersheds of the Cuyama and Sisquoc Rivers in eastern Santa Barbara County, a Chumash pictograph appears to represent a beaver (Lee and Horne 1978) (Figure 3). Additionally, the Hearst Museum in Berkeley has a Ventureño Chumash shaman's rain-making kit, collected in 1948 when it was estimated at 100 years old by archaeologists Frank Fenenga and Francis A. Riddell. The kit was made from the skin of a beaver tail and kept in a tobacco sack. The shaman, Somik, was elderly when he lived at Fort Tejon in the 1870s (Phoebe Hearst Museum of Anthropology 1-84666). Timbrook (2007:180) relates a Chumash story where "a willow stick that had been cut by a beaver was thought to have the power to bring water. The Chumash would treat the stick with 'ayip (a ritually powerful substance made from alum) and then plant it in the ground to create a permanent spring of water." In addition the Barbareño and Ventureño Chumash had a Beaver Dance (Timbrook 2007). Finally, the coastal Chumash tribes had words for beaver or *Chipik*, spelled *č'əpək'* in Barbareño and *tšə'pək* in Ventureño (Timothy Henry, California State Fullerton, personal communication, 2012), and *č'ipik* in Ineseño (Samala) (Applegate 2007).

A documentary record of historic beaver presence on the Los Angeles River is Father Pedro Font's description of the Beneme (Mojave) and Jeniguechi (San Jacinto branch of the Cahuilla) Indians of Mission San Gabriel Arcangel on 5 January 1776, "...the women wear a bit of deer skin with which they cover themselves, and likewise an occasional cloak of beaver or rabbit skin" (Bolton and Font 1930:178-179). In addition, the Tongva or Gabrieleno Indians of Mission San Gabriel had words for beaver *tooleva'che*, *toliiva'chi*, *'evenxar* (Merriam 1979) (Table 2). Although not coastal watersheds, we found Indian words for beaver in the arid Antelope and Mojave Valleys, the Kitanemuk words *cipi?ki* and *hurst* (Anderton 1988), and the Mojave word *'apen* (Munro et al. 1992), respectively.

*Documentary records and supplementary evidence of beaver in coastal watersheds: Riverside, Orange and San Diego counties.*—We found two documented historic records of beaver in San Diego County. The first is contained in an 1864 report on the region's geography, geology, flora and fauna by David Hoffman, an early San Diego physician (Graves 1964). Hoffman (1864:154) stated, "Of the animal kingdom we have a very fair variety. The grizzly bear, the mountain sheep, the antelope, the black bear, the deer, the pole-cat, the beaver, the wild-cat, the otter, the fox, the badger, the hare, the squirrel, and cayotes[sic] innumerable." The second record is contained in a 20 January 1889 historical newspaper

article, "A beaver weighing forty pounds was on exhibition on Fifth street yesterday, having been trapped by Joe McCord, who lives north of the city. It was the largest specimen ever taken in this section" (San Diego Union 20 January 1889). The phrase "largest specimen" suggests that other beavers had previously been caught.

Supplementary evidence of beaver in San Diego County includes a creek named Beaver Hollow, tributary to the Sweetwater River (Durham 2001) (Figure 3). Beaver Hollow is named on the historical USGS Topo Map for Cuyamaca in 1903, 20 years before CDFG began beaver re-introductions in California (Goode 1903). The Kumeyaay (Diegueno) people had a word for beaver *epín* (Wares 1968).

## DISCUSSION

Surprisingly few contemporary studies have been conducted with the primary goal of determining the historical geographic range of a particular species (Schwartz et al. 2007). As with the recent discovery of physical evidence of beaver in the Sierra Nevada (James and Lanman 2012), we located verifiable records extending the known historic range of beaver to the North Coast, the San Francisco Bay Area, and a coastal watershed in southern California. These records include museum specimens collected from Sespe Creek in Ventura County in 1906 and from Saratoga Creek in Santa Clara County in 1855, both collected by highly reputable zoologists. Additional physical evidence in the form of zooarchaeological specimens was located near coastal Randall Creek, south of the Mattole River in Humboldt County, and on Temescal and Alameda creeks, two San Francisco Bay tributaries in northern and southern Alameda County, respectively.

In four of the five study regions, we also found many documented records indicating that beaver were native historically. In contrast, only two reliable historical observer records were located in San Diego County. Similarly, many geographic place names including the word "beaver" were found but only one, Beaver Hollow Creek, located on the Sweetwater River watershed, was located in San Diego County. Cox et al. (2002) reported that faunal place names have high fidelity to their historical ranges and may be important indicators of their historical distribution. The relative lack of toponomastic references to beaver in San Diego County could relate to low species density, or the near extirpation of beaver prior to American colonization. Using the USGS GNIS to search for Spanish place names for "beaver" in coastal California using the contemporary Spanish "castor" or early colonial Spanish "nutria" (Garces and Coues 1900, Bolton and Font 1930, Bolton and Palou 1930) words for beaver yielded no references. We note that there is only a single beaver place name in the Central Valley of California, "Castoria", which is the historical name for La Framboise's 1832 "French Camp" in the San Joaquin Valley (Gudde and Bright 2004). This near absence of toponomastic beaver references in Central Valley watersheds occurs despite the fact that beaver have always been recognized as both native and numerous there. Aybes and Yalden (1995) posited that faunal place names are more common for charismatic species and noted that there are 200 places in Britain containing "wolf" but only 20 for "beaver."

Although not definitive evidence, we did find Indian words for beaver in two separate San Diego County tribes. In addition, the fact that beaver translocated in the 1940s still thrive on the San Mateo Creek and Santa Margarita River coastal watersheds suggest that habitat is quite suitable for beaver in San Diego County. In a documented record even farther south, Eugene Duflot de Mofras, the 19th century naturalist and explorer, described Baja California's mammalian fauna in 1841 as, "The wildcat, bear, coyote, maneless



American lion, wild goat, deer, polecat, ground squirrel, beaver, and fresh-water otter are the principal quadrupeds of Old [Baja] California” (Wilbur and De Mofras 1937:154). However, de Mofras’ attribution of beaver and river otter to the Baja Peninsula may have been in reference to the Colorado River delta.

Evidence of habitat suitability for beaver in California’s coastal watersheds includes the ongoing survival of the species in coastal watersheds since state-sponsored translocations 70–80 years ago. The 1923–1950 CDFG translocations to three quarters of California’s 58 counties resulted in increases in the state’s beaver population from 1,300 in 1942 (Tappe 1942) to 20,000 in 1950 (Anonymous 1950). Counties with coastal and Bay

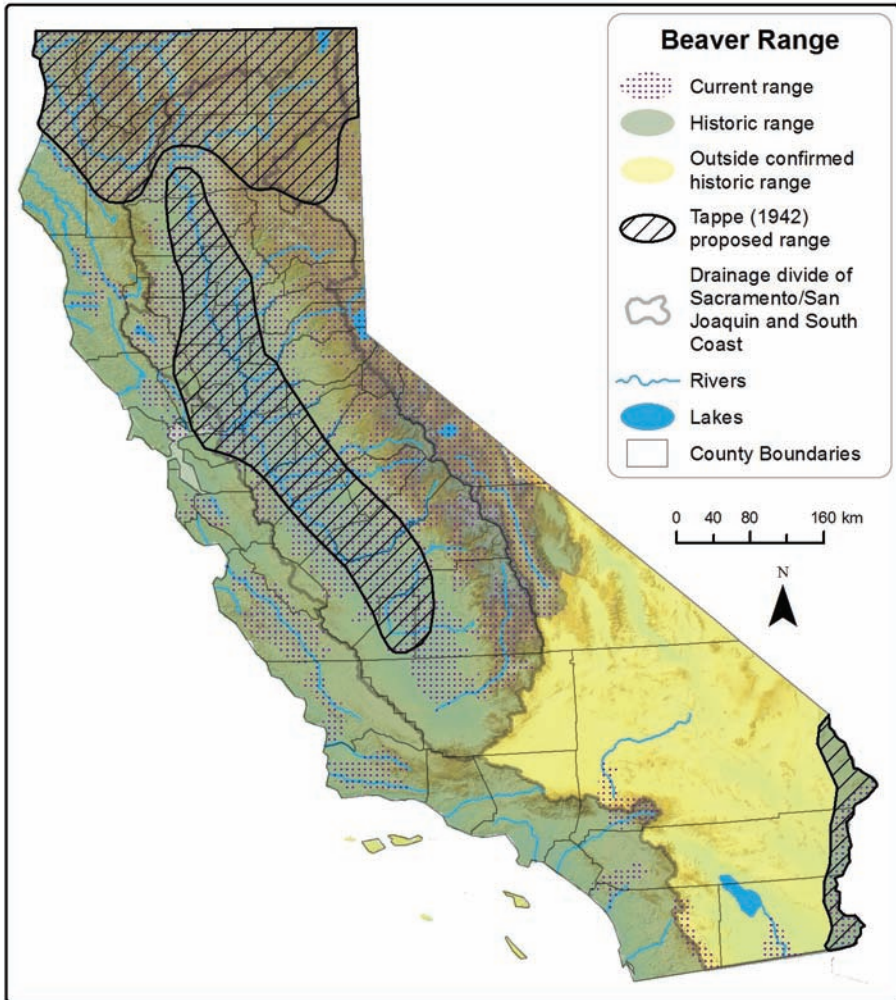


FIGURE 4.—Updated historical range map and current distribution of *Castor canadensis* in California. The current distribution was derived by combining ranges from CDFG (2005) and Asarian (2013) and conversion to 5th-field hydrologic units (watersheds) — except along the Mexican border where original CDFG polygons were retained — and removing Noyo River population in Mendocino County shown in the CDFG (2005) map, which has been extirpated; September 2013.

Area watersheds that received these beaver translocations included (north to south) Del Norte, Siskiyou, Humboldt, Mendocino, Marin, Napa, Contra Costa, Alameda, San Mateo, Santa Cruz, Monterey, San Benito, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Riverside, Orange and San Diego (Hensley 1946, Lynn and Glading 1949). Maps (CDFG 2005, Asarian 2013) of current beaver populations show that descendants of the translocated beavers or of undiscovered relict beaver populations continue to thrive in most of these coastal and Bay Area counties (Figure 4).

Although we found several important archaeological sites with subfossil beaver remains, the zooarchaeological record for beaver in California was relatively sparse. It is possible that beaver are not common in Indian middens because it was difficult to hunt the aquatic mammal. Although Indians hunted beaver from east to west across North America, beaver still thrived until the Indians were availed of steel traps from the American, Russian and European fur traders. Shimkin (1947: 268) wrote: "Originally, he [the beaver] could not be killed off at will, but the introduction of steel traps and tough axes made his defense of water, mud house, and ice quite vain." Bettinger (2010) noted that, "Although the beaver was fairly common all over western North America, it was not a key Native American resource (at least not west of the Mississippi) until historic times. The data show that beaver do not appear much in the archaeological records as a major element in the fauna. It begins to occur with increasing frequency in historic times undoubtedly as the result of western technology, most notably axes and Newhouse style beaver traps." The following report supports the idea that beaver were not a major food source although they were considered valuable to the Yuki tribe of the Middle Fork Eel river in Mendocino County. Anthropologist George Foster (1944:6) wrote, "A rich man owned hides of beaver, otter, mink, panther, bear and occasionally elk." Foster also included beaver in his list of animals not killed or eaten by the Yuki, suggesting that they were either difficult to catch, rare, or obtained only by trade. The nearby Huchnom tribe, who lived upstream of the Middle Fork Eel River along the mainstem Eel River and its tributaries, did consume beaver (Foster 1944:Appendix I): "netted in water, shot with bow; good eating; skin saved for quivers," although it is not clear if the aquatic mammal was a major food item. Difficulty hunting beaver would have ceased once maritime fur traders provided iron traps and guns to coastal tribes. The maritime fur trade stripped California's coast and the San Francisco Bay Area of fur-bearing mammals for four decades prior to the arrival of the first overland fur brigades led by Jedediah Smith in 1828 and John Work, Ewing Young and Michel Laframboise in 1832–1833. Therefore, the short interval between the arrival of the white man and the decimation of California's Indians would have left little time for beaver bones to be accumulated in Indian villages.

Why were documented observational records of coastal beaver difficult to find? As noted above, there was a maritime "California Fur Rush" that began 40 years before the Hudson's Bay Company and its meticulous diarists reached coastal California (Wikipedia Contributors 2013). Along with the Mission padres, ships from New England and Russia solicited the coastal Indians for furs, including beaver as well as otter, perhaps as early as the arrival of the first Boston ship to the West Coast in 1787 (Bolton and Font 1930, Nunis 1968b, Thompson 1896). Over a year before Jedediah Smith reached the mouth of the Klamath River in 1828, Peter Skene Ogden reported that his trappers encountered Indians four days from there who had "various trading articles from the American ships" (Ogden and Elliot 1910:215). While the furs lasted, the employment of Native Americans to obtain pelts was a continent-wide phenomenon (Dolin 2010). The Pilgrims began trading for beaver in 1621 and "The Bible and the Beaver were the two mainstays of the Plymouth Colony in its early



years” (Dolin 2010:xiv). Just as the early colonies on the eastern seaboard employed the Indians in the rapid eradication of beaver, the maritime fur traders and European populations of California’s earliest settlements likely provided the native population with the tools and the motive to hunt beaver to near extirpation on the West Coast. Thus, a largely unrecorded beaver hunt scoured California’s coastal watersheds well before the first American and British overland fur hunters arrived with diaries in hand. It does not take long to exhaust a region of its furs. For example, sea otter and other fur bearing mammals were so depleted along the California’s coast by 1841 that the Russian American Fur Company abandoned and sold Fort Ross just 30 years after it had been established (Thompson 1896).

Because the Spanish and Russian early settlements were limited to a relatively thin strip along California’s coast and shipborne fur seekers could only trade with coastal Indians, beaver populations sufficiently inland from the coast were relatively unscathed until the American and Hudson’s Bay Company overland fur brigades arrived. The widely travelled explorer Captain Thomas Farnham wrote in 1840 that beaver were very numerous in the Delta’s “hundreds of small rushcovered islands” and that, “There is probably no spot of equal extent in the whole continent of North America which contains so many of these muchsought animals (Farnham 1857:383).” It seems probable that these superabundant inland beaver could have colonized coastal watersheds historically.

Although we could not demonstrate a uniform and homogeneous distribution of beaver throughout all of California’s coastal watersheds, there is no reason to believe they would not have been able to occupy any suitable habitat. Traversing between watersheds is not difficult for beaver, since two- to three-year-old beavers may naturally disperse over 30 km by land or 50 km by stream (Muller-Schwarze and Sun 2003). This has been recently demonstrated in coastal northern California by the apparent overland recolonization of beavers from the Sonoma Creek watershed into the Russian River basin (Santa Rosa Creek) in 2011 and from the Outlet Creek watershed to the South Fork Eel River sub-basin in 2012 (Asarian 2013). It is also likely that beaver in California have, or will, use saltwater, i.e., San Francisco Bay and the Pacific Ocean, to move from one coastal stream to another, since beaver are well known to travel along coastlines and cross saltwater to colonize new territory such as islands off Alaska, British Columbia, and Washington (Anderson et al. 2009), or in Norway (Halley et al. 2013). This hypothesis is supported by recent reports of beaver constructing dams and lodges in oligohaline tidal marsh in the Skagit River delta of Puget Sound, and at higher densities than beaver in fluvial systems (Hood 2012).

While a great deal of historical information is presently digitized and our review of that material was exhaustive, additional information might be obtained with further research. More historical records of beavers may be located in California and Nevada state archives, college or university special collections, newly digitized historical newspapers, as well as Hudson Bay Company archives in Canada and the National Academy of Sciences in St. Petersburg, Russia. Naturalist collectors from various European countries visited California in the 19th and early 20th centuries (Beidleman 2006), but we did not search for North American beaver specimens in foreign museum collections. Searching archaeological specimens collected from sites associated with historical accounts and grossly catalogued as “small mammal” could yield additional physical evidence. Also, ground-penetrating radar (Kramer 2012) and radiocarbon dating of buried ancient beaver dams exposed by eroding, incised streams (James and Lanman 2012) are novel approaches to finding physical evidence of historic beaver yet to be employed in coastal watersheds. Additional research analyzing undigitized zooarchaeological records in California could provide additional evidence.

Using modern data acquisition and investigative techniques, we have extracted and synthesized multiple lines of evidence (physical, ethnographic, historical, as well as habitat suitability) indicating that beaver were historically widely distributed from extreme northern to southern coastal California, probably as far south as San Diego County. Deciphering the historical ecology of California is particularly challenging given that the State's first museum, the CAS, was not founded until 1853. The only California museum with a 19th century zoology collection, it was destroyed (except for a single cartful of specimens) in the 1906 San Francisco earthquake and fire (Lanman et al. 2012).

Grinnell et al. (1937) and Tappe's (1942) research was initiated almost 100 years after the Hudson's Bay Company in 1843 stopped sending fur brigades to California (Nunis 1968a:169) and the Russians abandoned Fort Ross for lack of furs in 1841 (Thompson 1896). Before statewide translocations of beaver from the 1920s to 1950s, California beaver were nearly extinct except for their last refuges, the great marshes of the Central Valley's Sacramento-San Joaquin River Delta, the Colorado River in southeastern California, and the Pit River in northeastern California. These factors likely limited the abilities of Grinnell et al. (1937) and Tappe (1942) to accurately reconstruct the historical distribution of beaver. In addition, it is not clear whether Grinnell was trying to determine the historical range of beaver, or simply trying to establish the current range of beaver in the early 20th century, since he relied heavily on local MVZ records plus observations from trappers and rangers mainly within the decade prior to his 1937 publication, *Fur-bearing Mammals of California*. Consistent with our findings, recent investigations significantly extended the historical ranges established by Grinnell et al. (1937) for other mammals in California, such as the ringtail (*Bassariscus astutus*) (Orloff 1988) and gray wolf (*Canis lupus*) (Schmidt 1991).

Neither Grinnell et al. (1937) nor Tappe (1942) explored coastal watersheds looking for evidence of beaver, even when presented with physical evidence that beaver were present in these systems (e.g., Sespe Creek). Tappe (1942) limited his field surveys to areas where beaver were known to exist. Most beaver observation points in Tappe's (1942) range map are based on direct personal observation or observations of his living colleagues. Thus Tappe's (1942) range map is perhaps more accurately described as a map of the remnant strongholds of California beaver in the early 20th century, after more than 100 years of unregulated commercial trapping and conversion to agriculture of alluvial valley bottoms where prime beaver habitat was located.

Considering the role of beavers as allogenic ecosystem engineers (Jones et al. 1994), establishing the aquatic mammal as native to California's coastal and San Francisco Bay watersheds may be of particular importance. Studies conducted and reviewed by Pollock et al. (2003, 2007) in semi-arid Western habitats, have found that re-introduction of beaver can rapidly aggrade stream sediments, elevating incised channels and reconnecting them to their floodplains, ultimately converting formerly incised xeric valleys into gently sloping ones with more abundant riparian vegetation.

There has been a tendency to underestimate the influence of beaver on ecosystems (Pollock et al. 1994). The presence of beaver has been shown to increase bird, fish, invertebrate, amphibian and mammalian abundance and diversity (Naiman et al. 1988, Rosell et al. 2005). As an integral part of the ecosystem of historic California, beaver may have benefitted many threatened species. Colonization of southern California streams by beaver is associated with increased riparian habitat, especially dense shrubby willow, which is critical habitat for federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (Finch and Stoleson 2000) and least Bell's vireo (*Vireo bellii pusillus*) (Muller-Schwarze

and Sun 2000) populations. There is evidence that beaver dams provide important refugia for endangered California red-legged frogs (*Rana draytonii*) (Alvarez et al. 2013) and western pond turtles (*Actinemys marmorata*) (Alvarez et al. 2007, Lovich 2012). Similarly, beaver ponds and bank burrows appear to provide refugia for endangered tidewater goby (*Eucyclogobius newberryi*) (USFWS 2005). In a historical ecology study of the San Gabriel River in southern California, it was estimated that since 1870, 86% of historical wetlands have been lost especially in the lower floodplain (Stein et al. 2010). In contrast, in the tidal Copper River delta beaver activity has been shown to increase freshwater surface area and to prevent seasonal drying of the floodplain (Cooper 2007). Allowing beaver to recolonize their historic range could reverse the ongoing loss of wetland habitat in California's coastal watersheds.

Documenting that beaver were historically extant in California's coastal streams may have important implications for declining salmonid populations. Pollock et al. (2003) reviewed reports of beaver "perennializing" formerly seasonal streams, and Tappe (1942) noted summer flows in several streams in northern California increased after beaver colonized upstream reaches. Gallagher et al. (2012) reported on limiting factors for coho salmon (*Oncorhynchus kisutch*) populations in coastal northern California streams and concluded that winter habitat was critically important, recommending adding substantial amounts of large wood to increase pool habitats, improve stream shelter in high winter flows, and reconnect the stream to floodplain habitats. Beaver impoundments also increase winter habitat, and whereas large woody debris may be associated with coho salmon smolt production (SPP) of 6-15 individuals, SPP per beaver dam ranges from 527 to 1,174 fish, indicating that promotion of beaver populations may have an 80-fold more positive impact (Pollock et al. 2004). Salmon from Alaska to Oregon have clearly evolved in sympatry with beaver and these anadromous fish ascend coastal streams with beaver dams, the latter often overtopped or breached by high winter flows. Coho salmon can jump dams as high as 2 meters (Bryant 1984, Powers and Orsborn 1986). Gard (1961) showed that rainbow trout (*Oncorhynchus mykiss*) can also cross beaver dams and in both directions, with some accounts of trout crossing a series of 14 dams (Pollock et al. 2003). Hood (2012) reported that beaver dams tripled juvenile Chinook salmon (*Oncorhynchus tshawytscha*) survival in brackish tidal marshes in the Skagit River delta of Puget Sound. Today California's coastal beaver are widely regarded as the non-native survivors of twentieth century translocations, and when they cause flooding problems or fell trees, depredation permits are often provided. Understanding beaver as native to coastal ecosystems may impact this decision-making.

Based on the results of our study, coupled with the recent evidence of historic beaver in the Sierra Nevada (James and Lanman 2012, Lanman et al. 2012), and the long-established nativity of beaver to the Central Valley, the Colorado River and California's northern rivers (Tappe 1942, Grinnell et al. 1937), we conclude that the historic range of beaver included most of California, except the streamless portions of the southern deserts (Figure 4). We consider the historic presence of beaver in the perennial streams in California's deserts (e.g., the Mojave River) unverified, but highly probable, given their current presence in these systems (Lovich 2012) and the historic and current presence of beaver in similar desert streams in Arizona (Allen 1895).

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## LITERATURE CITED

- ALLEN, J. A., AND W. W. PRICE. 1895. On a collection of mammals from Arizona and Mexico, made by Mr. W. W. Price, with field notes by the collector. *Bulletin of the American Museum of Natural History* 7:193-258.
- ALVAREZ, J. A. 2007. Natural history notes. *Rana draytonii* (California red-legged frog). Association with beaver. *Herpetological Review* 37:339-340.
- ALVAREZ, J. A., M. A. SHEA, AND S. M. FOSTER. 2013. Natural history notes. *Rana draytonii* (California red-legged frog). Association with beaver. *Herpetological Review* 44:127-128.
- ANDERSON, C. B., G. M. PASTUR, M. V. LENCINAS, P. K. WALLEM, M. C. MOORMAN, AND A. D. ROSEMOND. 2009. Do introduced North American beavers *Castor canadensis* engineer differently in southern South America? An overview with implications for restoration. *Mammal Review* 39:33-52.
- ANDERTON, A. J. 1988. The language of the Kitanemuks of California. Ph.D. Dissertation, University of California, Los Angeles, USA.
- ANONYMOUS. 1950. Beaver live trapping and transplantation. California Department of Fish and Game, Sacramento, California, USA.
- APPLEGATE, R. B. 2007. Samala English dictionary. Santa Ynez Band of Chumash Indians, Santa Ynez, California, USA.
- ASARIAN, E. 2013. Beaver mapper. Online map of beaver distribution in California and Oregon [Internet]. Riverbend Sciences, Eureka, California, USA. Available from: <http://www.riverbendsci.com/projects/beavers>
- ATKINSON, A. J., B. S. YANG, R. N. FISHER, E. ERVIN, T. J. CASE, N. SCOTT, AND H. B. SHAFFER. 2003. MCB Camp Pendleton arroyo toad monitoring protocol. Western Ecological Research Center, United States Geological Survey, Sacramento, California, USA.

- AUBRY, K., K. S. MCKELVEY, AND J. P. COPELAND. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. *Journal of Wildlife Management* 71:2147-2158.
- AYBES, C., AND D. W. YALDEN. 1995. Place-name evidence for the former distribution and status of wolves and beavers in Britain. *Mammal Review* 25:201-227.
- BANCROFT, H. H. 1886. Albatross, log-book of a voyage to the northwest coast in the years 1809-1812, kept by Wm. Gale, MS in history of California: 1801-1824. A. L. Bancroft and Company, San Francisco, California, USA.
- BARROWS, H. D., AND W. WOLFSKILL. 1902. The pioneer. *Annual Publication of the Historical Society of Southern California and of the Pioneers of Los Angeles County* 5:287-294.
- BAUMHOFF, M. A. 1958. California Athabaskan groups. *Anthropological Records* 16:172.
- BEIDLEMAN, R. G. 2006. California's frontier naturalists. University of California Press, Berkeley, USA.
- BENNYHOFF, J. A. 1986. The Emeryville Site (CA-ALA-309) viewed 93 years later. A new look at some old sites. *Archives of California Prehistory* 6:65-74.
- BETTINGER, R. L. 2010. Cultural ecology. Abstracts of the 32nd Great Basin Anthropological Conference, October 20-23, Layton, Utah.
- BLOK, G. K. 1933. The Russian colonies in California: a Russian version. California Indian Library Collections, California State Library, Sacramento, USA.
- BOCKSTOCE, J. R. 2005. The opening of the maritime fur trade at Bering Strait: Americans and Russians meet the Kanhigmiut in Kotzebue Sound. American Philosophical Society, Philadelphia, Pennsylvania, USA.
- BOLTON, H. E., AND F. PALOU. 1930. Palou's account of the founding of San Francisco, 1776. Pages 383-406 in H. E. Bolton, editor. *Anza's California expeditions. Volume 3.* University of California Press, Berkeley, USA.
- BOLTON, H. E., AND P. FONT. 1930. Diary of an expedition to Monterey by way of the Colorado River 1775-1776. Pages 1-534 in H. E. Bolton, editor. *Anza's California expeditions. Volume 4.* University of California Press, Berkeley, USA.
- BROUGHTON, J. M. 1995. Resource depression and intensification during the late Holocene, San Francisco Bay: evidence from the Emeryville Shellmound vertebrate fauna. Ph.D. Dissertation, University of Washington, Seattle, USA.
- BRYANT, M. D. 1984. The role of beaver dams as coho salmon habitat in southeast Alaska streams. Pages 183-192 in J. M. Walton and D. B. Houston, editors. *Proceedings, Olympic Wild Fish Conferences.* Peninsula College, Fisheries Technology Program, Port Angeles, Washington, USA.
- CDFG (CALIFORNIA DEPARTMENT OF FISH AND GAME. CALIFORNIA INTERAGENCY WILDLIFE TASK GROUP). 2005. California wildlife habitat relationships version 8.1 personal computer program. California Department of Fish and Game, Sacramento, USA.
- CHRISTOPHER, S. V. 2004. Introduced predator effects on a threatened anuran. Ph.D. Dissertation, University of California, Santa Barbara, USA.
- COAN, E. 1982. James Graham Cooper, pioneer western naturalist. University Press Idaho, Moscow, Idaho, USA.
- COOPER, E. E. 2007. Beaver ecology on the West Copper River Delta, Alaska. M.S. Thesis, Oregon State University, Corvallis, USA.
- COPE, C. R. 1985. The mammalian fauna of the Emeryville Shellmound, CA-ALA 309. M.S. Thesis, Sonoma State University, Rohnert Park, California, USA.

- CORNEY, P., AND W. D. ALEXANDER. 1896. Voyages in the northern Pacific: narrative of several trading voyages from 1813 to 1818, between the northwest coast of America, the Hawaiian Islands and China, with a description of the Russian establishments on the northwest coast, interesting early account of Kamehameha's realm; manners and customs of the people, etc. and sketch of a cruise in the service of the independents of South America in 1819. Thos. G. Thrum, Publisher, Honolulu, Hawaii, USA.
- COX, J. J., D. S. MAEHR, AND J. L. LARKIN. 2002. The biogeography of faunal place names in the United States. *Conservation Biology* 16:1143-1150.
- DALE, H. C., W. J. ASHLEY, J. S. SMITH, AND H. G. ROGERS. 1918. The Ashley-Smith explorations and the discovery of a central route to the Pacific. Arthur H. Clark Publishing, Cleveland, Ohio, USA.
- DOLIN, E. J. 2010. Fur, fortune, and empire: the epic history of the fur trade in America. W. W. Norton and Company, New York, USA.
- DUHAUT-CILLY, A. B. 1834. A voyage to California, the Sandwich Islands, and around the world in the years, 1826–1829. Translated by A. Fruge, and N. Harlow. University of California Press, Berkeley, USA.
- DURHAM, D. L. 1998. California's geographic names: a gazetteer of historic and modern names of the state. Word Dancer Press, Sanger, California, USA.
- DURHAM, D. L. 2001. Durham's place names of San Diego County. Word Dancer Press, Sanger, California, USA.
- DYMYTRSHYN, B., AND E. A. P. CROWNHART-VAUGHN. 1976. Colonial Russian America: Kyrill T. Khlebnikov's Reports, 1817–1832. Oregon Historical Society, Portland, USA.
- FARNHAM, T. J. 1849. Life, adventures and travels in California. Nafish and Cornish, New York, USA.
- FARRIS, G., AND C. P. T. LAPLACE. 2006. Visit of Cyrille Pierre Theodore Laplace to Fort Ross and Bodega Bay in August 1839. Fort Ross Interpretive Association, Jenner, California, USA.
- FINCH, D. M., AND S. H. STOLESON. 2000. Status, ecology, and conservation of the southwestern willow flycatcher. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station General Technical Report RMRS-GTR-60. Ogden, Utah, USA.
- FOSTER, G. M. 1944. A summary of Yuki culture. *University of California Anthropological Records* 5:155-244.
- GALLAGHER, S. P., S. THOMPSON, AND D. W. WRIGHT. 2012. Identifying factors limiting coho salmon to inform stream restoration in coastal northern California. *California Fish and Game* 98:185-201.
- GARCES, F. T. H., AND E. COUES. 1900. On the trail of a Spanish pioneer: the diary and itinerary of Francisco Garces (missionary priest) in his travels throughout Sonora, Arizona, and California, 1775–1776 Vol. I and II. F. P. Harper, New York, USA.
- GARD, R. 1961. Effects of beaver on trout in Sagehen Creek, California. *Journal of Wildlife Management* 25:221-242.
- GIBSON, J. R. 2000. Otter skins, Boston ships, and China goods: the maritime fur trade of the northwest coast, 1785–1841. McGill-Queen's University Press, Montreal, Quebec, Canada.
- GILMAN, C. H. 1901. Autobiography and reminiscences of Charles H. Gilman, deceased, 1901. *Autobiographies and Reminiscences of California Pioneers* 6:38-41. The Society for California Pioneers, San Francisco, California, USA.



- GOODE, R. U. 1903. Historical topo maps, San Diego County, Map Number 1. U. S. Coast and Geodetic Survey [Internet]. David Bloom website [cited 27 May 2013]. Available from: <http://www.muststayawake.com/SDAG/MapTopoList.html>
- GRAVES, C. L. 1964. An early San Diego physician: David Hoffman. San Diego Historical Society Quarterly 10:1-3.
- GRINNELL, J., J. S. DIXON, AND J. M. LINDSALE. 1937. Fur-bearing mammals of California: their natural history, systematic status, and relations to man. University of California Press, Berkeley, USA.
- GROSSINGER, R. 2012. Napa Valley historical ecology atlas: exploring a hidden landscape of transformation and resilience. University of California Press, Berkeley, USA.
- GUDDÉ, E. G., AND W. BRIGHT. 2004. California place names: the origin and etymology of current geographical names. Fourth edition. University of California Press, Berkeley, USA.
- GUSTAITIS, R. 1995. San Francisco Bay shoreline guide. University of California Press, Berkeley, USA.
- HALL, J. G. 1966. *Castor canadensis subauratus* [Internet]. California Academy of Sciences Mammalogy Collection Database catalog number CAS MAM 24780 [cited 2013 Apr 13]. Available from: <http://researcharchive.calacademy.org/research/bmammals/MamColl/index.asp?xAction=getrec&CollectionObjectID=163916>
- HALLEY, D., F. ROSELL, AND A. SAVELJEV. 2012. Population and distribution of Eurasian beaver (*Castor fiber*). Baltic Forestry 18:168-175.
- HALLEY, D. J., I. TEURLINGS, H. WELSH, AND C. TAYLOR. 2013. Distribution and patterns of spread of recolonising Eurasian beavers (*Castor fiber* Linnaeus 1758) in fragmented habitat, Agdenes peninsula, Norway. Fauna Norvegica 32:1-12.
- HARRINGTON, J. P. 1981. The papers of John Peabody Harrington in the Smithsonian Institution. A collection on Native American history and languages. Prepared in the National Anthropological Archives, Department of Anthropology, National Museum of Natural History, Washington, D.C., USA.
- HEIZER, R. F. 1974. The Coastanoan Indians. The Indian culture from the mouth of the Sacramento River, south to Monterey and inland past the Salinas River. Local History Studies Volume 18. California History Center, De Anza College, Cupertino, California, USA.
- HENSLEY, A. L. 1946. A progress report on beaver management in California. California Fish and Game 32:87-99.
- HILL, J. J. 1923. Ewing Young in the fur trade of the far Southwest, 1822-1834. Oregon Historical Society 24:1-35.
- HOFFMAN, D. B. 1864. Sanitary report — new San Diego barracks, California. San Francisco Medical Press VI(XVI):145-158.
- HOOD, W. G. 2012. Beaver in tidal marshes: dam effects on low-tide channel pools and fish use of estuarine habitat. Wetlands 32:401-410.
- HORNUNG, J. 1916. Letter from John Hornung to Joseph Grinnell. Museum of Vertebrate Zoology, Berkeley, California, USA.
- HOWELL, A. B. 1923. The mammal collections of North America. Journal of Mammalogy 4:113-120.
- JAMES, C. D., AND R. B. LANMAN. 2012. Novel physical evidence that beaver were historically native to the Sierra Nevada. California Fish and Game 98:129-132.

- JONES, C. G., J. H. LAWTON, AND M. SHACHAK. 1994. Organisms as ecosystem engineers. *Oikos* 69:373-386.
- KOSTROMITINOV, P., AND F. P. VON WRANGELL. 1974. Notes on the Indians in Upper California. Pages 7-18 in F. H. Stross and R. F. Heizer, editors. *Ethnographic observations on the Coast Miwok and Pomo by Contre-Admiral F. P. Von Wrangell and P. Kostromitinov of the Russian Colony Ross, 1839*. Publications of the University of California Archaeological Research Facility, Berkeley, USA.
- KRAMER, N., E. E. WOHL, AND D. L. HARRY. 2012. Using ground penetrating radar to 'unearth' buried beaver dams. *Geology* 40:43-46.
- KROEBER, A. 1919. *Handbook of Indians of California*. (Reprint of Smithsonian Institution, Bureau of American Ethnology, Bulletin No. 78). Courier Dover Publications, Mineola, New York, USA.
- LANMAN, R. B., H. PERRYMAN, B. DOLMAN, AND C. D. JAMES. 2012. The historical range of beaver in the Sierra Nevada: a review of the evidence. *California Fish and Game* 98:65-80.
- LEE, G., AND S. HORNE. 1978. The Painted Rock Site (SBa-502 and SBa-526): Sapaksi, the House of the Sun. *The Journal of California Anthropology* 5:216-224.
- LEVULETT, V. 1985. The prehistory of southwestern Humboldt County: a study of coastal archaeological sites in the King Range National Conservation Area. Ph.D. Dissertation, University of California, Davis, USA.
- LEWIS, O. 1943. The quest for Qual-a-wa-loo [Humboldt Bay]: a collection of diaries and historical notes pertaining to the early discoveries of the area now known as Humboldt County, California. Holmes Book Company, Oakland, California, USA.
- LEWIS PUBLISHING COMPANY. 1889. *An illustrated history of Sonoma County, California*. Containing a history of the county of Sonoma from the earliest period of its occupancy to the present time. The Lewis Publishing Company, Chicago, Illinois, USA.
- LOOMIS, L. M. 1901. The paroquet auklet in California. *Auk* 18:104.
- LONGCORE, T., C. RICH, AND D. MULLER-SCHWARZE. 2007. Management by assertion: beavers and songbirds at Lake Skinner (Riverside County, California). *Environmental Management* 39:460-471.
- LOVICH, J. 2012. Western Pond Turtle - *Clemmys marmorata* [internet]. Western Ecological Research Center, Department of Biology, University of California, Riverside, California. 1-8 [cited 2013 June]. Available from: [http://www.blm.gov/ca/pdfs/cdd\\_pdfs/clemmys1.PDF](http://www.blm.gov/ca/pdfs/cdd_pdfs/clemmys1.PDF)
- LUTHIN, H. W. 2002. *Surviving through the days: translation of native California stories and songs*. University of California Press, Berkeley, USA.
- LYNN, A. V., AND B. GLADING. 1949. Beaver transplanting. Federal Aid in Wildlife Restoration Project 34-D-2. Final report. California Department Fish and Game, Sacramento, USA.
- MACGREGOR, B. A. 1976. *The centennial history of Newark*. Newark Days Bicentennial Committee, Newark, California, USA.
- MALONEY, A. B. 1940. Camp sites of Jedediah Smith on the Oregon coast. *Oregon Historical Quarterly* 41:304-323.
- MALONEY, A. B. 1943. John Work of the Hudson's Bay Company— leader of the California Brigade of 1832-33. *California Historical Society* 22:96-109.



- MALONEY, A. B., AND J. WORK. 1943. Fur brigade to the Bonaventura: John Work's California Expedition of 1832-33 for the Hudson's Bay Company. *California Historical Society Quarterly* 22:323-348.
- MALONEY, A. AND J. WORK. 1944. Fur Brigade to the Bonaventura: John Work's California Expedition of 1832-33 for the Hudson's Bay Company. *California Historical Society* 23:19-40.
- MEHAFFY, C., AND B. MEHAFFY. 1999. Revised and expanded cruising guide to San Francisco Bay. Paradise Cay Publications, Arcata, California, USA.
- MERRIAM, C. H. 1979. Indian names for plants and animals among Californian and other western North American tribes. Ballena Press, Socorro, New Mexico, USA.
- MOREJOHN, G. V. 1969. Evidence of river otter feeding on freshwater mussels and range extension. *California Fish and Game* 55:83-85.
- MORGAN, L. H. 1868. The American beaver and his works. J. B. Lippincott and Company, Philadelphia, Pennsylvania, USA.
- MULLER-SCHWARZE, D., AND L. SUN. 2003. The beaver: natural history of a wetlands engineer. Cornell University Press, Ithaca, New York, USA.
- MUNRO, P., N. BROWN, AND J. G. CRAWFORD. 1992. A Mojave dictionary. University of California, Los Angeles, Occasional Papers in Linguistics, No. 10.
- NAIMAN, R. J., C. A. JOHNSTON, AND J. C. KELLEY. 1988. Alteration of North American streams by beaver. *BioScience* 38:753-762.
- NUNIS, D. B. 1968a. Michel Laframboise. Page 159 in L. R. Hafen, editor. The mountain men and the fur trade of the far West. Volume 5. A. H. Clark Company, Glendale, California, USA.
- NUNIS, D. B. 1968b. The Hudson's Bay Company's first fur brigade to the Sacramento Valley: Alexander McLeod's 1829 hunt. Sacramento Book Collectors Club, Fair Oaks, California, USA.
- OGDEN, A. 1932. The Californias in Spain's Pacific otter trade, 1775-1779. *Pacific Historical Review* 1:444-469.
- OGDEN, P. S., AND T. C. ELLIOT. 1910. The Peter Skene Ogden journals. *The Quarterly of the Oregon Historical Society* 11:201-222.
- ORLOFF, S. 1988. Present distribution of ringtails in California. *California Fish and Game* 74:196-202.
- OSBORN, H. F. 1910. Forty-first annual report of the American Museum of Natural History. Irving Press, New York, USA.
- PHOEBE HEARST MUSEUM OF ANTHROPOLOGY. 2013. Tobacco sack and beaver tail shaman's rain-making kit [Internet]. Catalog Number 1-84664 [cited 27 May 2013]. Available from: <http://pahma.berkeley.edu/delphi/modules/browser/details.php?onum=1-84664>
- POLLOCK, M. M., R. J. NAIMAN, H. E. ERICKSON, C. A. JOHNSTON, J. PASTOR, AND G. PINAY. 1994. Beaver as engineers: influences on biotic and abiotic characteristics of drainage basins. Pages 117-126 in C. G. Jones and J. H. Lawton, editors. Linking species to ecosystems. Chapman and Hall, New York, USA.
- POLLOCK, M. M., M. HEIM, AND D. WERNER. 2003. Hydrologic and geomorphic effects of beaver dams and their influence on fishes. Pages 213-234 in S. V. Gregory, K. L. Boyer, and A. M. Gurnell, editors. The ecology and management of wood in world rivers. American Fisheries Society, Bethesda, Maryland.

- POLLOCK, M. M., G. R. PRESS, T. J. BEECHIE. 2004. The importance of beaver ponds to coho salmon production in the Stillaguamish River Basin, Washington, USA. *North American Journal of Fisheries Management* 24:749-760.
- POLLOCK, M., T. BEECHIE, AND C. JORDAN. 2007. Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River Basin, eastern Oregon. *Earth Surface Processes and Landforms* 32:1174-1185.
- POWERS, S. 1877. *Tribes of California*. University of California Press, Berkeley, USA.
- POWERS, P. D., J. F. ORSBORN. 1985. New concepts in fish ladder design: analysis of barriers to upstream fish migration, Volume IV of IV; Investigation of the physical and biological conditions affecting fish passage success at culverts and waterfalls. Final Report, Project No. 198201400. Bonneville Power Administration, Portland, Oregon, USA.
- PRESCOTT, H. S. 1922. Letter to Museum Vertebrate Zoology Director J. Grinnell. Museum of Vertebrate Zoology Collection of Historical Correspondence, Drawer I. Berkeley, California, USA.
- ROSELL, F., O. BOZSER, P. COLLEN, AND H. PARKER. 2005. Ecological impact of beavers *Castor fibre* and *Castor canadensis* and their ability to modify ecosystems. *Mammal Review* 35:248-276.
- SACRAMENTO DAILY UNION. 1881. Pacific Coast items. Sacramento Daily Union [internet]. California Digital Newspaper Collection; [cited 26 February 2013]. Available from: <http://cdnc.ucr.edu/cgi-bin/cdnc?a=d&d=SDU18810226.2.58&srpos=19&e=-02-1880--02-1882--en--20-SDU-1--txt-txIN-beavers----->
- SAN DIEGO UNION. 1889. Brief mention [internet]. San Diego Union-Tribune Archives [cited 27 May 2013]. Available from: <http://www.utsandiego.com/union-tribune-archives/>
- SCHMIDT, R. H. 1991. Gray wolves in California: their presence and absence. *California Fish and Game* 77:79-85.
- SCHWARTZ, M. K., K. B. AUBRY, K. S. MCKELVEY, K. L. SCHWARTZ, K. L. PILGRIM, J. P. COPELAND, J. R. SQUIRES, R. M. INMAN, S. M. WISELY, AND L. F. RUGGIERO. 2007. Inferring geographic isolation of wolverines in California using historical DNA. *Journal of Wildlife Management* 71:2170-2179.
- SHIMKIN, D. B. 1947. Wind River Shoshone ethnogeography. *University of California Anthropological Records* 5:245-284.
- SIMPSON, G. 1847. *An overland journey round the world, during the years 1841 and 1842*. H. Colburn, London, England.
- SKINNER, J. E. 1962. *An historical review of the fish and wildlife resources of the San Francisco Bay area*. California Department of Fish and Game, Water Projects Branch, Sacramento, USA.
- SMITH, J. S., A. R. MCLEOD, AND M. S. SULLIVAN. 1934. *The travels of Jedediah Smith: a documentary outline including the journal of the great American pathfinder*. Fine Arts Press, Santa Ana, California, USA.
- STEIN, E. D., S. DARK, T. LONGCORE, R. GROSSINGER, N. HALL, AND M. BELAND. 2010. Historical ecology as a tool for assessing landscape change and wetland restoration priorities. *Wetlands* 30:589-601.
- TAPPE, D. T. 1942. The status of beavers in California. *California Department of Fish and Game, Game Bulletin* 3:1-59.
- THOMPSON, R. A. 1896. *The Russian settlement in California known as Fort Ross. Why the Russians came and why they left*. Sonoma Democrat Publishing Company, Santa Rosa, California, USA.

- TIMBROOK, J. 2007. Chumash ethnobotany: plant knowledge among the Chumash people of southern California. Santa Barbara Museum of Natural History, Santa Barbara, California, USA.
- TRUBODY, W. A., AND C. L. CAMP. 1937. William Alexander Trubody and the Overland Pioneers of 1847. *California Historical Society Quarterly* 16:122-143.
- TURNER, D. W., AND G. H. TURNER. 2010. Place names of Humboldt County, California: a compendium 1542-1992. Dennis W. and Gloria H. Turner, Eureka, California, USA.
- UHLE, M. 1907. The Emeryville Shellmound. *University of California Publications in American Archaeology and Ethnology* 7:1-106.
- U.S. FISH AND WILDLIFE SERVICE. 2005. Recovery plan for the tidewater goby (*Eucyclogobius newberryi*). U.S. Fish and Wildlife Service, Portland, Oregon, USA.
- VALLEJO, M. G., G. FARRIS, AND R. M. BEEBE. 2000. Report of a visit to Ft. Ross and Bodega Bay in April 1833. *California Mission Studies Association Occasional Paper* 4:1-32.
- WARES, A. C. 1968. A comparative study of Yuman consonantism. *Janua Linguarum, Series Practica* 57. Mouton Publishers, The Hague, Netherlands.
- WARNER, J. J. 1907. Reminiscences of early California — 1831 to 1846. *Southern California Quarterly* 7:176-193.
- WARNER, T. J. 1966. Peter Skene Ogden. Pages 222-223 in L. Hafen, editor. *The mountain men and the fur trade of the far West*. Volume 3. A. H. Clark Company, Glendale, California, USA.
- WIBERG, R. S. 1996. Archaeological excavations and burial removal at CA-ALA-483, CA-ALA-483 Extension, and CA-ALA-555, Pleasanton, Alameda County, California. Holman and Associates, San Francisco, California, USA.
- WIKIPEDIA CONTRIBUTORS. 2013. California fur rush [internet]. Wikipedia, the free encyclopedia; [cited 26 May 2013]. Available from: [http://en.wikipedia.org/wiki/California\\_Fur\\_Rush](http://en.wikipedia.org/wiki/California_Fur_Rush)
- WILBUR, M. E., AND E. D. DE MOFRAS. 1937. *Travels on the Pacific Coast: a report from California, Oregon and Alaska in 1841*. Fine Arts Press, Santa Ana, California, USA.
- WOOD, C. A. 1932. James Graham Cooper (1830–1902): a Pacific coast ornithologist. *Ibis* 74: 632-638.
- ZEINER, D. C., W. F. LAUDENSLAYER, JR., K. MAYER, AND M WHITE. 1990. *California's wildlife. Volume III: Mammals*. California Department of Fish and Game, Sacramento, USA.

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