Finny Merchandise: The Atlantic Cod (*Gadus morhua*) Trade in Gold Rush–Era San Francisco, California

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During California's Gold Rush of 1849–1855, thousands of miners rushed to San Francisco, Sacramento, and elsewhere throughout northern California, creating a significant demand for food. Here we investigate the role of Atlantic cod (*Gadus morhua*) and Pacific cod (*G. macrocephalus*) during the Gold Rush era using historical records, ancient DNA, and vertebral morphology in the cod assemblage recovered from Thompson's Cove (CA-SFR-186H), a Gold Rush–era site in San Francisco. From the 18 cod bones recovered from Thompson's Cove, our analysis of five specimens for ancient DNA indicates that Atlantic cod were imported during the 1850s, likely as a (largely) deboned, dried and salted product from the East Coast of the United States. Curiously, while locally available in very deep waters off the California coast, Pacific cod were minimally fished during the 1850s and became abundantly available in the 1860s after an Alaska-based fishery developed.

Key words: Cod, *Gadus morhua*, *Gadus microcephalus*, Gold Rush, San Francisco, ancient DNA, zooarchaeology

During the first year of California's Gold Rush (1848–1849), the small town of Yerba Buena (later renamed San Francisco) experienced an influx of people and grew from approximately 800 residents to well over 20,000 (Bancroft 1888:158; Soulé et al. 1854:244). Opportunistic argonauts traveled from distant locations to California, including large numbers from the East Coast of the United States. The overwhelming effect of this population movement is clearly reflected in historical accounts and the Gold Rush archaeological record—San Francisco's new population was hungry (Conrad et al. 2015a; Davis 1889; Delgado 1996, 2009; Holliday 1981; Lotchin 1974; Taylor 1868). The influx of migrants resulted in new food-based economic demands which the small community of Yerba Buena and northern California could not readily satisfy based on limited local crop and domestic animal availability during the late 1840s and

early 1850s (Bancroft 1888; Soulé et al. 1854; Stine 1980). Demand for food quickly led to the creation of a wild game market, exhaustion of locally available wild animals, and the wholesale importation of animals and other food products into this region from around the world. Noteworthy importations included Galapagos tortoises (*Chelonoidis* sp.), green sea turtles (*Chelonia mydas*), kangaroos, and Eastern (or Atlantic) oysters (*Crassostrea virginica*) to San Francisco during the 1850s (Conrad 2017; Conrad and Pastron 2014; Conrad et al. 2015a, 2015b, 2018). The epicures of Gold Rush-era San Francisco also consumed a wide variety of local and imported fishes and other seafood, a clear necessity during this time: herring, sardine, salmon, lobster, mackerel, clam, scallop, shrimp, anchovy, and even swordfish, are documented in early import records (*Daily Alta California* 1850b, 1850c, 1850e, 1850f, 1850g, 1850h, 1850i, 1851a, 1851b).¹ An April 5, 1851, account describes this well (Johnston 1964:133):

The fish market that adorns Long Wharf is becoming ornamental as well as useful. In extent, and in the variety of the finny merchandise displayed, it already rivals those of the Atlantic cities. Every description of animal that inhabits our bay may be found spread out on the boards, and so active are their captors, the fishermen, that multitudes of them are yet alive and capable of taking their last look and flopping finally on the famous Long Wharf. Besides a tempting show of salmon and innumerable others of the fish species, are here to be viewed a number of amphibious delicacies, such as turtles, lobsters, crabs, and at times also, scant representatives of the oyster and clam beds, which may assert, are all sufficiently plenty at many points along our coast, and even in the waters of San Francisco bay. This latter idea, by the way, is worthy of fathoming. If so be there are “oysters and clams” in our bay, would it not pay to introduce our citizens to the flavor? However, the fish market on Long Wharf is worthy of examination.

While historical records support a wide diversity of fish and seafood importation into San Francisco, archaeological records are less clear. Gold Rush sites from San Francisco and the Bay Area typically do not have evidence supporting this wholesale import of fish and seafood (Conrad et al. 2015a; Figure 1). Instead, animal remains at these sites tend to be dominated by domesticates, including cattle, pigs, sheep, and chickens; commonly hunted wild game (e.g., deer, elk, ducks/geese); and local fishes (e.g., salmon, steelhead, sturgeon, rockfish; Christenson 1989; Conrad et al. 2015a; Hattori and Kosta 1990; Pastron and Beevers 2003; Praetzelis 2017; Stine 1980; Valente 2012).

Based on these records, we investigate the use of cod (*Gadus* sp.) at Thompson’s Cove, and the implications of the cod trade during the mid-nineteenth century. Historical accounts (Collins 1892) indicate that numerous Atlantic cod (*Gadus morhua*) were imported into San Francisco during the Gold Rush, but current archaeological records do not support the presence of this fish during the late 1840s to 1850s. In addition, although *G. morhua* were fished for centuries in the northern Atlantic prior to the onset of California’s Gold Rush, Pacific cod (*G. macrocephalus*) were apparently not utilized in California, based on current zooarchaeological and ethnohistoric data (Gobalet et al. 2004; Mackovjak 2019; Scofield 1954). Pacific cod, however, were exploited by the Native peoples of the Pacific Northwest (Butler and Campbell 2004; McKechnie and Moss 2016; Moss 2011; Tushingham and Christiansen 2015). Although cod are present at Thompson’s Cove, previous morphological analyses (Conrad et al. 2015a) did not distinguish between Pacific or Atlantic cod based on skeletal elements because of the lack of comparative skeletons of both species. Now, with appropriate comparative skeletal and ancient

DNA analysis we examine the species of cod present in Gold Rush–era San Francisco and the relationship between cod and broader fish consumption during this time.

THE GOLD RUSH–ERA ATLANTIC COD TRADE AND FISH EXPLOITATION

During and prior to the California Gold Rush, maritime passengers suffered from a lack of fresh foods on long voyages. Passengers often complained about the poor quality and repetitiveness of salted and dried meats and hard tack, which remained preserved but were bland and lacked adequate nutrients (Delgado 1996; Pomfret 1954). Commonly, these salted meats included beef and pork, but records also indicate the use of salted cod (Figure 2), either as a primary maritime staple or an imported market item (Lewis 1949). As an example, on February 19, 1850, the ship *Carthage* arrived in San Francisco with a full cargo of building materials and food products, including “codfish” (*Daily Alta California* 1850a). Even prior to the onset of the Gold Rush, in 1848, newspaper records document the import of “Cod Fish” into San Francisco (*The Californian* 1848). A US fisheries report summarized this Gold Rush era by stating that prior to 1863, all cod imported to California was “of the salt-cured” form, derived from Atlantic stocks; these salted fish were transported “across the Isthmus” (of Panama) or around Cape Horn to San Francisco at great cost and often were damaged or spoiled (Collins 1892; Mackovjak 2019:31–32). A review of newspaper accounts supports this record and indicates that at least 38 vessels arrived in San Francisco between December 1849 and December 1852—the height of the Gold Rush—importing 1,228 boxes, 382 drums (i.e., wooden barrels) and 100 half drums, 190 cases, 70 casks, 28 large casks (or “hhds”), 89 tubs, 49 barrels, and 12 half barrels of “codfish,” along with 18 kegs of “codfish tongues” and 22 boxes of “cod liver oil” (Table 1). For the 1,228 boxes of codfish alone, assuming a conversion of ~70–140 lb of fish per box (see Waterman 1969), this suggests at a minimum between 85,960 and 171,920 lb of cod were imported during 1849–1852. These vessels sailed from home ports in the Atlantic, including Boston, New Bedford, New Haven, and New York; New Orleans; and several vessels from England, Australia, and elsewhere (Table 1), suggesting the large demand for imported foodstuffs resulted in Atlantic cod arriving from both primary (e.g., Boston) and secondary (e.g., Australia) maritime codfish markets.

Newspaper accounts are also supported by company correspondence dating from this period. For example, a letter of May 15, 1855, from a commercial mercantile house in San Francisco makes note of written correspondence with an associate in Sydney, Australia, about the possibility of importing various items, including cod: “Codfish we see quoted very low. This is a delicate article, but if you find it perfect and dry, with no appearance of moisture whatever, fish white & good, free from strong smell & could ship by a dry vessel in a dry place, it would probably come good and command 6.2–7.2 cts. on arrival” (Crosby & Dibblee 1855).

Oddly, although these written accounts document an abundance of cod imported into San Francisco during the Gold Rush, archaeological records present a different story. Gold Rush sites in San Francisco and the Bay Area tend to be represented by local fishes, or fishes brought into the city from the California coast or the Sacramento–San Joaquin delta (Conrad et al. 2015a; Table 2). For cod, the earliest Gold Rush archaeological evidence occurs at Thompson’s Cove and a site in Sacramento, the Golden Eagle Hotel (Praetzelis et al. 1980; Schulz 1980). These physical records are notably rare.

For example, at the Hoff Store site, which burned in the fire dated to May 3–4, 1851, in downtown San Francisco, zooarchaeological and artifact evidence support the importation of packaged or “salt-pork,” canned oysters, and sardines (Hattori and Kosta 1990), the only fish. At a comparable warehouse site at 343 Sansome Street, which also burned in the fire, the majority

of faunal remains represented domesticated species—cattle (*Bos taurus*), pig (*Sus scrofa*), sheep/goat (*Ovis aries/Capra hircus*)—and other wild game (Christenson 1989). Fish bones were also noted, but not identified. This pattern continues: excavation of a pre/early Gold Rush–era well/privy adjacent to Portsmouth Square in San Francisco’s Chinatown resulted in one specimen identified as the locally available surfperch (Embiotocidae), along with goose and/or duck, cattle, and pig specimens (Valente 2012). Faunal remains from Gold Rush–era features in San Francisco’s Mission District indicate that of the 1,124 skeletal elements recovered, cattle, sheep, and pig represent nearly 50% of the identified assemblage (Pastron and Beevers 2003). The remaining specimens from these features include birds as well as unidentified mammalian and fish elements.

At Thompson’s Cove (CA-SFR-186H), a Gold Rush archaeological site located near North Beach in San Francisco (Pastron and Bruner 2014), the faunal assemblage is represented by at least 50 species and more than 8,000 skeletal elements, but domesticates, including cattle, pig, sheep, and goat, dominate the assemblage (see tables 3, 14, and 17 in Conrad et al. 2015a). In Feature 7, which dates to the early 1850s, cattle, sheep and pigs represent 64% (number of identified specimens [NISP; Lyman 2008] = 826/1293) of the assemblage—a common trend for Gold Rush–era archaeological sites. Additional non-native species found throughout this site include a single chestnut cowrie shell (*Cypraea spadicea*), California margin shell (*Volvarina taeniolata*)—both of which were likely carried as tokens or gifts—two Galapagos tortoise humeri fragments, a green sea turtle phalanx, and several turkey (*Meleagris gallopavo*) elements. Diversity among the molluscs, birds, and fishes also provided important insights into Gold Rush diets at Thompson’s Cove, but these organisms were largely limited to locally available species except for 18 cod vertebral elements previously identified to the genus *Gadus* (Table 3).

In particular, specimens from Thompson’s Cove indicated exploitation of native fishes, including Sacramento pikeminnow (*Ptychocheilus grandis*) and Sacramento sucker (*Castostomus occidentalis*), from the inland freshwaters of California, providing further support that the consumption of fishes was not restricted to importation of exotic species from distant localities. Sturgeon (*Acipenser* sp.), salmon (*Oncorhynchus* sp./*Oncorhynchus tshawytscha*), and Pacific tomcod (*Microgadus proximus*) also occur at the site and were likely sourced from the San Francisco Bay itself.

A Gold Rush site in downtown Sacramento provides a second case for the presence of cod in northern California during the 1850s. At the Golden Eagle Hotel site, fish specimens recovered from three features dating to 1856 and 1866–1878 suggest exploitation of locally available fishes from inland freshwaters, the San Francisco Bay, and the California coast, and cod (not designated to species; Praetzel et al. 1980; Schulz 1980, 1984; Table 2). Sacramento perch (*Archoplites interruptus*), thicktail chub (*Gila crassicauda*), steelhead, sturgeon, and other fishes were consumed at the Golden Eagle Hotel at that time, but the only fish which consistently appeared in all three features at the site was cod. The zooarchaeologist who made the cod identifications was unable to distinguish between Atlantic and Pacific cod but noted that either imported Atlantic cod or post-1863 imported Pacific cod may be present.

Appearance of archaeological cod bones in 1850s contexts in San Francisco and Sacramento strongly suggests the presence of imported Atlantic cod during this era based on historical documentation, but the presence of cod bones from 1860s–1870s contexts at the Golden Eagle Hotel may also indicate that Pacific cod was consumed during this era. This is also supported by additional later nineteenth-century zooarchaeological cod data from San Francisco, Stockton, San Jose, and Woodland, California (Gobalet 2006, 2014; Schulz 1984). For example,

fish specimens recovered from two household contexts in downtown San Francisco, dating to the 1870s and 1880s, indicate the presence of rockfishes (*Sebastes* sp.), sand sole (*Psettichthys melanostictus*), sockeye salmon (*Oncorhynchus nerka*), and apparently, Pacific cod (St. Clair and Dobkin 2003; Table 2). However, these Pacific cod specimens were not analyzed using ancient DNA, and it is unclear which morphological features distinguished these Pacific cod specimens from Atlantic cod.

Further complicating inferences on historical cod import, and the zooarchaeological record of cod, is a striking 1853 newspaper record from Redding, California. The November 19, 1853, record notes, “Halibut, codfish, mackerel and Sardines are said to be abundant in the ocean, near the Northwest of our State. A vessel arrived at San Francisco a few days since from a fishing cruise, with seven hundred *codfish*” (*Shasta Courier* 1853f, emphasis added). Comparison with San Francisco newspapers confirms this account—on November 8, 1853 (eight days prior), the schooner *Queen of the West* landed from a “fishing cruise” with 700 “fish” (*Daily Alta California* 1853e). This record cannot confirm that Pacific cod were fished and imported to San Francisco in 1853, but it is nonetheless significant. Although the bulk of Pacific cod fishing from San Francisco began in 1863, Pacific cod fishing may have begun 10 years earlier, during the Gold Rush.

Other newspaper accounts provide further support for this reinterpretation of the Pacific cod fishery record. On September 19, 1854 the *Sacramento Daily Union*, in an article titled “Pacific Fisheries,” noted that cod and halibut are plentiful and sell in northern California markets at high prices while being “found farther . . . northward . . . in the neighborhood of Townsend Harbor, Port Orford, and off Vancouver’s [*sic*] and Queen Charlotte’s Island.” The *Daily Alta California* reported on September 22, 1855, that west-northwest of Cape Classet (Washington), “codfish can be caught in quantities” and that the cutter *Jefferson Davis* caught 300 cod “at Seattles [*sic*].” This record also noted that “some of our enterprising Cape Codmen should bestir themselves, and take advantage of the opportunity thus offered of making a handsome business, as the fish are in the greatest abundance and can be easily taken” (*Daily Alta California* 1855). Finally, a May 14, 1857, article titled “Pacific Codfish” in the *San Joaquin Republican* noted:

It appears, at last, that Cape Cod is likely to have a rival in Steilacoom [Washington], and Puget sound. We have seen, says a San Francisco paper, some samples from the latter region, and tasted them also, in our market. The fish is not so large as the eastern, but exceedingly well cured and sweet. The supply of the raw material is said to be inexhaustible, and the cured fish can be afforded here at the reasonable price of three to four cents per pound.

Clearly, these records reinforce the need to reanalyze the Thompson’s Cove cod to determine their species, and thus the route of import into the city during the Gold Rush.

BACKGROUND AND METHODS

Thompson’s Cove

Cod at Thompson’s Cove occurred in three features: 25 (NISP = 10; minimum number of individuals [MNI; Lyman 2008] = 1), 15 (NISP = 2; MNI = 1), and 7 (NISP = 6; MNI = 1; Conrad et al. 2015a; Pastron and Bruner 2014; see the latter reference for site-specific feature information). These features all date to between the late 1840s and 1853. *Gadus* specimens from the site are solely vertebral elements: six complete caudal vertebrae, seven partial vertebrae, and

five neural spines (Table 3). Kenneth W. Gobalet (KWG) based his identifications on the morphological differences in the vertebrae of *G. macrocephalus* and *G. morhua* in the osteological collection of the Ichthyology Department, California Academy of Sciences, Golden Gate Park, San Francisco.

Sediments from these three features were water-screened through 3.2 mm (1/8 inch) mesh in the laboratory and account for the majority (NISP=3,002/3,024 including scales) of all fish specimens recovered from the site (Conrad et al. 2015a). Feature 3/31/37 also received bulk sediment water-screening, but only a single fish bone was identified in this context and is not a cod. This is in sharp contrast to Feature 15, for example, which resulted in the identification of 575 fish bones and 1,385 scales using similar screening and laboratory processing. At Thompson's Cove this pattern is significant since all other features, as well as fish specimens, were either hand-collected during excavation or retrieved in 6.4 mm (1/4 inch) mesh in the field (note: cod at the Golden Eagle Hotel was recovered in both 3.2 mm and 6.4 mm mesh; Schulz 1980).

Cod Processing and Taphonomy

Based on historical records, following capture, the cod are taken to the mother ship or the shore, where they were bled, the head and viscera removed, and the anterior three-fifths of the vertebral column removed. This leaves caudal vertebrae in place when the salting process begins (Cobb 1916:56–57; Hittell 1882:343; Kurlansky 1997:103, 118; Mackovjak 2019:122–25; van Klaveren and Legendre 1965). Therefore, given the historical record of importing Atlantic cod into California, the finding of only caudal vertebrae, or vertebral fragments, in the archaeological assemblage from Thompson's Cove is significant because it is consistent with these descriptions of cod processing (see additional discussions in Amundsen et al. 2005; Barrett 1997; Orton et al. 2014). One would anticipate finding caudal vertebrae at an archaeological site containing imported salted cod, and based on these descriptions, we anticipate that the cod remains found at Thompson's Cove are from Atlantic cod, even with historical references suggesting the possibility of early Pacific cod fishing during this time. Unfortunately, the lack of skeletal element descriptions for the cod from the Golden Eagle Hotel preclude us from determining if these remains represent specimens from dried, salted cod. Taphonomic analysis of the cod vertebrae and fragments from Thompson's Cove failed to identify any evidence of cut marks or other post-processing features (e.g., Schroth 1996).

Ancient DNA

Given the successful amplification of DNA in archaeological cod specimens (e.g., Star et al. 2017), in this analysis we selected five cod vertebrae from Thompson's Cove for ancient DNA (aDNA) analysis for species identification. These specimens are from Features 25 ($n = 4$) and 15 ($n = 1$). All pre-polymerase chain reaction (PCR) activities were conducted at the Laboratories of Molecular Anthropology and Microbiome Research (LMAMR; lmamr.org) at the University of Oklahoma. This facility is a dedicated workspace for processing aged, degraded, and/or LCN (low copy number) DNA samples. The lab takes precautions to minimize and monitor the introduction of contaminants.

DNA was extracted from ~41.2 to 55.8 mg subsamples of vertebrae removed from sample numbers 107, 108, 111, 113, and 870. Each subsample was submerged in 6% (w/v) sodium hypochlorite (NaOCl) for 4 minutes, after which the NaOCl was poured off (Barta et al. 2013). The samples were submerged and rinsed with DNA-free water twice, then transferred to 1.5 mL tubes, with 500 μ L of 0.5 M ethylenediaminetetraacetic acid (EDTA) added to each of the tubes. The same volume of EDTA was added to a sixth 1.5 mL tube to serve as an extraction

negative control. The set of six tubes was gently rocked at room temperature on a nutator for >48 hours.

DNA was then extracted following Kemp et al. (2014). First, 90 µl of proteinase K were added to the samples and incubated at 65°C for 3 hours. Then the samples were centrifuged at 15,000 rpm for 1 minute to pellet any remaining bone or dirt matter. The liquid was then transferred into new 2 mL tubes while avoiding co-transfer of the pelleted matter. Aliquots of 750 µl of “resin” (2.5% celite in 6M guanidine HCl) and 250 µl of 6M guanidine HCl were added to the tubes, which were then vortexed numerous times over a 3-minute period.

Promega Wizard® Minicolumns were attached to 3 mL luer-lok syringe barrels (with the plungers removed) and placed on a vacuum manifold. Three milliliters of DNA-free ddH₂O was pulled across the columns, followed by the resin mixture. Then, 3 mL of 80% (v/v) isopropanol was pulled across the columns to rinse the silica pelleted on the minicolumns. The columns were placed in 1.5 mL tubes and centrifuged at 10,000 rpm for 2 minutes to remove excess isopropanol. The columns were placed in new 1.5 mL tubes, and the old tubes discarded. Fifty microliters of 65°C DNA-free molecular water was added to the columns, followed by a waiting period of 3 minutes. Tubes were then centrifuged at 10,000 rpm for 30 seconds. An additional 50 µl of 65°C DNA-free molecular grade water was added to the tubes and centrifuged at 10,000 rpm for 30 seconds, following another 3-minute wait, resulting in 100 µl of extracted DNA.

DNA extracts were tested for the presence of PCR inhibitors following Kemp et al. (2014) using ancient turkey DNA as a positive control (Kemp et al. 2017). Surprisingly, although the inhibition test indicated the five sample eluates to be “inhibited,” they still amplified under normal PCR conditions, indicating that the extracts did not contain sufficient inhibitors to prevent successful amplification of the samples.

Primers were designed to amplify a 193 base pair (bp) region of the mitochondrial Cytochrome b gene, spanning nucleotide positions (nps) 14522 to 14714 relative to the Atlantic cod full mitochondrial DNA (mtDNA) reference sequence (GenBank accession: KX267089.1). The primer sequences are as follows: CodF 5'-AGACAGCCTTCTCATCCG-3' and CodR 5'-ATTACTAAAAGGAAAAGGACAA-3'. The amplicons produced with these primers contain a 153 bp sequence that serves as a barcode to identify samples as either Atlantic cod or Pacific cod, with nine mutational differences consistently occurring between the two species.

PCRs were conducted with two different polymerases: Omni KlenTaq LA (DNA Polymerase Technology) and Platinum Taq (Invitrogen). In the case of the former, 15 µl PCRs were prepared with 1× Omni KlenTaq Reaction Buffer (including a final concentration of 3.5 mM MgCl₂), 0.32 mM dNTPs, 0.24 µM of each primer, 0.3 U of Omni KlenTaq LA polymerase, and 1.5 µl of template DNA. PCR cycling conditions consisted of (1) a 3-minute hold at 94°C; (2) 60 cycles of 15-second holds at 94°C, 56°C, and 68°C; and (3) a 3-minute hold at 68°C. Fifteen microliter PCRs were also prepared with 1× Platinum Taq Reaction Buffer, 0.32 mM dNTPs, 1.5 mM MgCl₂, 0.24 µM of each primer, 1 U of Platinum Taq, and 1.5 µl of template DNA. PCR cycling conditions were (1) a 3-minute hold each at 94°C, 56°C, and 72°C; (2) 60 cycles of 15-second holds at 94°C; and (3) a 3-minute hold at 72°C. PCRs were conducted with both full-concentration DNA eluates and their 1:10 dilutions. PCR negatives accompanied each batch of amplifications to monitor for potential contamination.

Two microliters of PCR product were separated on a 2% agarose gels, stained with GelRed, and viewed under ultraviolet light to confirm amplification. Amplicons were sequenced at the Biology Core Molecular Lab at the University of Oklahoma.

Under the above described conditions, results were obtained for all but one sample (870).

This sample may have failed to amplify because it does not belong to the genus *Gadus*. To control for this possibility, we employed primers for generalized fish species identification using a 148 bp sequence of the 12S mitochondrial genome (Jordan et al. 2010). The reverse primer originally described by Jordan and colleagues was in the wrong orientation. Corrected here, the primers we used were: “OST12S-F” 5’-GCTTAAACCCAAAGGACTTG-3’ and “OST12S-R” 5’-CTACACCTCGACCTGACGTT-3’. Fifteen microliter PCRs were conducted as described above using Platinum Taq with an annealing temperature of 55°C for this primer set. Amplicons were sequenced at the Biology Core Molecular Lab at the University of Oklahoma.

RESULTS

Using comparative Pacific and Atlantic cod skeletons, KWG identified the cod vertebrae as Atlantic cod. In Pacific cod, there is a gap between the edge of the centrum and the base of the neural and hemal arches that is lacking in the Atlantic cod caudal vertebrae (Figure 3). These differences were corroborated by ancient DNA analysis.

All sequences were aligned to the Atlantic cod mitochondrial DNA reference sequence (GenBank accession: KX267089.1) with Sequencher v 5.4.6. Four of the five samples (107, 108, 111, and 113), all from Feature 25, were identified as Atlantic cod based on amplification with primers Cod F/R. Species identification was confirmed for each of these specimens from four amplifications each (Table 4). The fifth sample (870) from Feature 15 did not amplify with the Cod F/R primers and was identifiable only to the genus (*Gadus*) using primers OST12S-F/R. None of the extraction or PCR negatives revealed the presence of cod mtDNA. Furthermore, the sequences produced with the Cod F/R primers exclude samples 107, 108, 111, and 113 from being walleye pollock (*Gadus chalcogrammus*), which inhabits the North Pacific and is genetically distinct from both Atlantic and Pacific cod.

DISCUSSION

Identification of Atlantic cod in Gold Rush–era deposits from San Francisco supports the role of global maritime trade in 1850s northern California. Our study confirms the importing of Atlantic cod into San Francisco during this period but leaves several questions unanswered. Here, we focus on contextualizing the presence of Atlantic cod at Thompson’s Cove within the (1) broader record of Pacific cod fisheries during the nineteenth century, (2) demand for food experienced during the Gold Rush, (3) transition between Atlantic cod importation and Pacific cod fishing during the 1860s and later, and (4) identification of cod in nineteenth-century California.

Based on current archaeological and ethnohistoric evidence, prior to the Gold Rush in 1848–1849, there was no commercial fishery of Pacific cod in California, although Alaska Natives, First Nations, and Native Americans fished cod for millennia prior to this period (see Butler and Campbell 2004; McKechnie and Moss 2016; Moss 2011). Recently, Tushingham and Christiansen (2015) noted the presence of unidentified “gadids” in far southern Oregon at the precontact midden of Tcetxo (35-CU-42), and in Humboldt Bay, in northern California, at the precontact village of Manila (CA-HUM-321), dating to between 1,300–1,500 and 1,800–2,000 years ago, respectively. This may suggest that while the bulk of precontact Pacific cod fishing occurred in the Pacific Northwest and in southeastern Alaska, Indigenous fishers also exploited gadids in northern California and southern Oregon, possibly by AD 700—but this inference is tenuous. For example, a major summary of the Native American fisheries in California identified no evidence for the exploitation of cod (Gobalet et al. 2004). Further identification and analysis of these gadid specimens is required to confirm their identification and provide insight into the exploitation and/or trade of these fish prior to the arrival of Spanish colonials, Russians, and Anglo-Americans into northern California.

Based on evidence from late-precontact/early-contact fishing in the San Francisco Bay area, Native American communities caught and consumed a variety of fishes (Broughton 1997; Broughton et al. 2015; Gobalet 2020; Gobalet et al. 2004; Voss 2008). Many of these same fishes were exploited from the San Francisco Bay during the Spanish and Mexican periods preceding the Gold Rush (e.g., Voss 2008). Early-contact fishing has been documented at the Russian colony of Fort Ross (ca. 1812–1841) in Sonoma County, California (north of San Francisco), where Native Alaskan (Chugach and Kodiak Island Alutiiq) and Native Californian (Kashaya Pomo, Southern Pomo, and Coastal Miwok) peoples lived together but used different techniques (hook and line vs. intertidal capture, by hand), and none exploited cod (Gobalet 1997; Lightfoot et al. 1997). Since cod inhabit deep-water habitats off the California coast (Love 2011), the limited or nonexistent demand for Pacific cod prior to and during the Gold Rush may be a result of the inaccessibility of Pacific cod.

Pacific cod are found several hundred feet below the surface in marine waters off California and were presumably difficult to fish and access by Native peoples and later colonists. Gold Rush-era descriptions of wild game often cite the delicious, large, and abundant local fishes, but cod were never mentioned as a local product (Bancroft 1888:191; Davis 1889:227; Soulé et al. 1854:146, 148, 360, 546–47; Taylor 1868:222). The single 1853 newspaper record indicating fishing of Pacific cod off the northwest coast of California identified in this study (*Shasta Courier* 1853f) is intriguing and may indicate small-scale, market-level cod fishing during the Gold Rush, but it is not currently supported by zooarchaeological records. For example, several 1850s newspapers indicate the presence of schooner-based fishing cruises which returned large catches to San Francisco. On January 29, 1852, the *Mount Vernon* landed from a “fishing cruise” with 600 fish; the *Orleans* landed 300 fish on May 7, 1852; the *J.W. Brown* landed 1,000 fish from Catalina Island (Channel Islands) on January 24, 1853; the *Odd Fellow* landed 1,100 fish from Drake’s Bay (Marin County, California) and the *J.W. Brown* landed 800 fish, both on February 8, 1853; and the *Bay State* landed 1,000 fish on May 27, 1853 (*Daily Alta California* 1852a, 1852b, 1853a, 1853b, 1853d). These records are not exhaustive, nor do they indicate specific fishes caught and landed. Instead, they suggest that the Gold Rush populace fished, in some instances, for Pacific cod.

In general, the large-scale Pacific cod fishery developed in the early 1860s (Mackovjak 2019; Scofield 1954). Traditionally, the earliest cited record of a Pacific cod catch entering San Francisco occurred in 1863. When this Pacific cod fishery began, schooners sailed to Alaska and the coast of Russia to catch Pacific cod where the fish were cleaned and salted aboard vessels, then returned to the San Francisco Bay area for repacking and/or consumption (Clemens and Wilby 1961; Cobb 1916; Collins 1892; Hart 1973; Love 2011; Mackovjak 2019; Scofield 1954). Therefore, the identification of Atlantic cod within 1850s Gold Rush deposits in San Francisco, and possibly Sacramento based on *Gadus* bones dating to 1856, is significant. Why are non-native cod present in this archaeological record when, presumably, there was an abundance of native fish available to the local population? This is a complex question involving aspects of colonization, Gold Rush prejudice, lack of traditional knowledge (or engagement), and more. For the purposes of our study, the basic demand for food during the Gold Rush, and the influence and connectivity of San Francisco to global maritime trade economies, helps explain this evidence.

During the early Gold Rush, historical accounts describe a tumultuous period of activity. A pattern that appears in many of these records is the enormous demand for food that began in 1849 and continued for several years, until approximately 1853 (Bancroft 1888; Davis 1889;

Soulé et al. 1854; Taylor 1868). So many gold-seekers arrived in 1849 that San Francisco's domestic and newly established import food markets became heavily lopsided, with enormous demand but little supply, especially in domesticated plants and animals. A wild game market quickly emerged, and it included native fishes (Stine 1980), but this supply did not resolve widespread food scarcity. Entrepreneurial gold miners and merchants within and outside of California devised several solutions to answer the demand for food, including importation of foodstuffs from markets both near and far from San Francisco—an easily established trade given San Francisco's influence on global maritime trade (Delgado 2009). For example, native Pacific oysters (*Ostrea lurida*), which were quickly overexploited in the San Francisco Bay area, were subsequently imported from far northern California, Oregon, and Washington (Conrad et al. 2015b). Imports also included massive quantities of marine bird eggs from the Farallon Islands (Ainley and Lewis 1974; Doughty 1971), exotic Galapagos tortoises (Conrad and Pastron 2014; Conrad et al. 2015a), green sea turtles (Conrad et al. 2018), and in some cases, “green peas, halibut, green corn, [and] codfish” (*Daily Alta California* 1850a, emphasis added). Beginning as early as 1848–1849, San Francisco newspaper records document the import of cod (see Table 1). Simmons, Hutchinson & Co. advertised “2,000 lbs cod fish” on September 6, 1849, while the vessel *Columbia* advertised “50 boxes of dried cod fish” on December 10, 1850; “50,000 pounds in drums” was for sale at Bradshaw & Co. on May 25, 1853 (Figure 4), and “40 drums [of] codfish” was for sale at Arrington & Co. on March 12, 1854 (*Daily Alta California* 1849, 1850d, 1853c, 1854).

Since long-term ice storage and refrigeration was not available on maritime vessels during the Gold Rush era, it is not surprising that historical accounts describe the import of “dried” cod or “drums” of cod. By the 1850s, New England fisheries in the United States nearly perfected the craft of catching, drying, and salting Atlantic cod (Figure 2; Kurlansky 1997). In fact, New England mariners, commonly the captains and crews of vessels transporting individuals to the goldfields, found salted cod to be delectable, often in stark contrast to the opinion held by their passengers. A passenger traveling on the bark *Canton* en route to San Francisco in 1849 wrote, “While writing this the Steward has just passed me with a tubful of this filthy and rotten codfish, which some of the beauties [crew] prefer and call a treat!” (Lewis 1949:109–10). A similar grievance was written by Samuel Upham while traveling to San Francisco on the brig *Osceola* in 1849. Discussing the captain's treatment of the steerage passengers during meals, he wrote, “He is a sea-tyrant, and totally unfit to command a passenger vessel. The dinner for the steerage passengers to-day consisted of *boiled codfish and hard tack*—all told!” (emphasis in original; Upham 1878:48).

This evidence suggests that the cod imported to San Francisco during the Gold Rush, and ultimately deposited at Thompson's Cove, and likely the Golden Eagle Hotel in Sacramento, resulted from shipping salted Atlantic cod to northern California, possibly from New England (see also Collins 1892). Regardless of the consumer's taste or desire, codfish clearly represented a foodstuffs necessity during this time. Genetic and morphological identification of Atlantic cod in this study, the historical record of food shortages, import of foodstuffs, connection of San Francisco to global maritime markets (Delgado 2009), the North Atlantic cod fishery (Kurlansky 1997), and the presence of Atlantic cod caudal vertebrae at Thompson's Cove (Table 3)—a common signature of dried, salted cod—all support this argument.

Confirmation of Atlantic cod being deposited in 1850s San Francisco helps contextualize the role and demand of food in facilitating San Francisco's influence on global maritime markets during this era, but it leaves significant questions unanswered. Once the Pacific cod fishery

began in 1863, did the importation of Atlantic cod end? If not, how were Pacific and Atlantic cod viewed and consumed within socioeconomic markets in northern California? And, how does this record influence—or how is it influenced by—zooarchaeological cod data from the later nineteenth century (e.g., identifying cod based on their temporal affiliation)? Although these questions require additional research, a cursory examination of later nineteenth-century zooarchaeological and historical records is suggestive: Atlantic cod continued to be imported alongside Pacific cod, but these species become differentiated in local markets.

On September 18, 1863, Captain Mathew Turner arrived in San Francisco with 15 tons of Pacific codfish, fished from the Gulf of Tartary, Alaska (*Daily Alta California* 1863b, 1863c). This radically altered the cod market in San Francisco and the greater Pacific (Mackovjak 2019) by facilitating the import of massive quantities of cod into the city and the creation of an export market for codfish from San Francisco to global markets. As the *Daily Alta California* (1853c) wrote of Turner's arrival:

A part of her cargo is a new importation for California, being nothing less than fifteen tons of codfish. . . . They are somewhat smaller than the Newfoundland codfish, but resemble those taken on the coast of Labrador, and are in every respect equal to the best found in Atlantic waters.

Yet, even prior to this event, codfish in San Francisco appear to be differentiated in markets based on their origin—something that did not occur during the Gold Rush. For example, on March 13, 1863, an advertisement for the salesroom of Jones & Bendixen indicated that “15 drums Isthmus Codfish” were for sale (*Daily Alta California* 1863a). The cargo of the *Electra* direct from Hamburg, on July 26, 1870, also included numerous cases of “desiccated codfish,” a term not previously associated with cod in local markets, and presumably indicating Atlantic cod (*Daily Alta California* 1870). S.L. Jones & Co. (a continuation of Jones & Bendixen) also advertised “15 drums Eastern Codfish” on October 24, 1871 (*Daily Alta California* 1871). These records suggest the establishment of distinct codfish markets, and an advertisement from April 3, 1868 highlights this well (Figure 5). In this advertisement, “eastern” and “Pacific” codfish were sold together, but identified separately for consumers; this occurred after the Gold Rush ended and during the era of large-scale Pacific cod fishing.

Zooarchaeological records from northern California also appear to support this historical record (Figure 6). While this sample is small and is not exhaustive—representing only ten distinct archaeological deposits—it suggests that Pacific cod enter the zooarchaeological record during the 1870s, but this record lacks critical confirmation from aDNA analysis. The only confirmed Atlantic cod thus far occurs at Thompson's Cove during the Gold Rush, but multiple sites exhibit cod bones with unclear speciation (i.e., *Gadus* and *gadidae*). These data on cod bones do not distinguish between Atlantic and Pacific cod, but they are nonetheless important. For example, the skeletal elemental representation of 22 cod bones from San Francisco sites dating to between 1870 and 1899 is clearly suggestive of Pacific cod exploitation based on the wide diversity of elements present (William Self and Associates 2019): caudal vertebrae (NISP = 12), cleithra (NISP = 3), supracleithra (NISP = 2), basioccipital (NISP = 1), quadrate (NISP = 1), branchiostegal rays (NISP = 2), and unidentified vertebra (NISP = 1). Because these are cranial and pectoral elements, they could not have been prepared as described above for preserved Atlantic cod; instead, they were likely from freshly caught cod, stored on ice and shipped from

Alaska to California (see also discussions in Amundsen et al. 2005; Barrett 1997; Orton et al. 2014).

It is intriguing to note that codfish appear in zooarchaeological collections far distant from northern California, suggesting multiple avenues of cod import and transportation during the nineteenth and early twentieth centuries. For example, research at a central Nevada mining community dating to the late nineteenth/early twentieth centuries identified a single Atlantic cod bone in an American Chinese occupation context, and 14 Atlantic cod bones from a Euroamerican restaurant context (Simons 1999). Excavations at a late-nineteenth/early-twentieth-century residence in north-central Nevada also identified a single *Gadus* sp. bone (Wiley and Ross-Hauer 2017). Archaeological investigations recovered six *Gadus* vertebrae from similar dated contexts in Tucson, Arizona (KWG, personal communication).

Finally, while we identified a morphological approach for distinguishing Atlantic and Pacific cod in zooarchaeological assemblages from nineteenth-century California, studies of fish collections from this era clearly require use of aDNA and more thorough development and examination of *Gadus* sp. comparative morphology for identification purposes. This approach would broadly benefit cod identification, as well as that of other fishes—for example, the possible presence of sockeye salmon in 1870s–1880s San Francisco (see Table 2). It would also provide insights into past species diversity for the now extinct thicktail chub from 1860s–1870s Sacramento (see Table 2). Future studies should focus on rigorously examining Atlantic and Pacific cod morphology and applying aDNA analyses to confirm species presence or absence in archaeological sites. The 87 elements reported as *G. microcephalus* from 1870s–1880s San Francisco (Table 2) should be reexamined with aDNA to confirm their origin. Future work is especially relevant since Pacific cod likely entered Gold Rush–era diets, in small quantities, as early as 1853. As this research occurs in northern California and elsewhere in the American West, exploring the relationship between Atlantic cod importation, the Pacific cod fishery, northern California fish markets, consumerism, and epicureanism will prove fruitful for clarifying this record.

CONCLUSIONS

San Francisco was undoubtedly an exhilarating and exhausting place to inhabit during the Gold Rush. Notably, rampant fires would destroy the city, rain and mud would consume entire horse-drawn carts, thousands of dollars' worth of gold dust would be gambled multiple times each night, there was an overabundance of guns and alcohol, and a continual search for shelter and food (Bancroft 1888; Soulé et al. 1854). Demand for food led to the importation of a variety of plant and animal products. Some of these faunas included oysters, marine-bird eggs, kangaroos, Galapagos tortoises, green sea turtles, and now, based on traditional morphological analysis, ancient DNA evidence, and insights from the historical record, Atlantic cod. Our research indicates that Atlantic cod was imported to San Francisco, likely dried and salted, during the Gold Rush era. We believe this is the earliest established physical record of Atlantic cod importation into the San Francisco Bay area, but it is surely not the only or the last. Although large-scale Pacific cod fisheries began in the 1860s when vessels traveled to Alaska for their catch, at least several records suggest that small-scale fishing operations were already exploiting Pacific cod stocks as early as 1853. These records provide new, significant insight into the global record of animal exploitation, human migration, and cod trade during the mid-nineteenth century in San Francisco.

NOTES

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1. Newspaper articles were accessed online from the California Digital Newspaper Collection (CDNC), Center for Bibliographic Studies and Research, University of California, Riverside. The collection can be searched at <http://cdnc.ucr.edu>.

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Figure 1. The location of select archaeological sites discussed in text, including Thompson's Cove (CA-SFR-186H). The shaded area represents the approximate extent of the original Yerba Buena Cove during the onset of the Gold Rush in 1848-1849. A: 35-CU-42 (Tushingham and Christiansen 2015), B: HUM-321 (Tushingham and Christiansen 2015), C: Golden Eagle Hotel/Cronin's Oyster Saloon (Schulz 1980), D: Woodland Opera House (Schulz 1984), E: Fort Ross (Lightfoot et al. 1997), F: Thompson's Cove (this study), G: The Hoff Store (Hattori and Kosta 1990), H: 343 Sansome Street (Christenson 1989), I: North Beach Campus (Valente 2012), J: 110 The Embarcadero (Praetzellis 2017) and K: 343 Fremont Street (Praetzellis 2015).

Figure 2. "Drying Codfish in Flake Yard at Gloucester Massachusetts" ca. 1899 by Charles H. Stevenson. Historic photograph courtesy of the University of Washington, Freshwater and Marine Image Bank (#38918).

Figure 3. (A) Caudal vertebra (sample 107) from an Atlantic cod at Thompson's Cove (CA-SFR-186H) analyzed in this study and (B) Pacific cod caudal vertebra from a contemporary comparative collection, courtesy of Dr. Gabriel M. Sanchez, Department of Anthropology, Michigan State University. Note the differential attachment of the neural and hemal arch bases to the caudal edge of the centrum (see arrows).

BRADSHAW & CO., Corner California and Battery streets, offer for sale—

SPERM CANDLES—100 boxes;
SALT—443 bags Liverpool salt;
SYRUP—70 bbls N Y steam refined;
SAGO—3000 lbs, in cases of 34 lbs;
TAPIOCA—3000 lbs, in tins;
ARROWROOT—3000 lbs, in tins;
CASSIA—2000 lbs, in mats;
CLOVES—1000 lbs, in bbls;
ALSPICE—1000 lbs whole a'spice;
SALMON—50,000 lbs smoked and pickled;
CODFISH—50,000 lbs in drums, 100 lb and 50 lb boxes;
MACKEREL—50 half bbls No. 1;

Together with a general assortment of
**GROCERIES, PROVISIONS, WINES, LIQUORS, ALE
 AND PORTER, &c.**

my25-7ls

BRADSHAW & CO.
 cor California and Battery sts.

Figure 4. An advertisement for “codfish” at Bradshaw & Co. from the May 25, 1853, *Daily Alta California*. This seller was located on the corner of California and Battery streets, approximately five blocks south/southeast of the Thompson’s Cove archaeological site. Source: California Digital Newspaper Collection, Center for Bibliographic Studies and Research, University of California, Riverside, <http://cdnc.ucr.edu>.

CODFISH! CODFISH!

50 DRUMS EASTERN CODFISH.
 50 drums Eastern Hake.
 500 bundles Pacific Codfish.
 For sale in lots to suit by

BENJ. BRADY,
 103 California street, S. W. cor. Davis, up stairs.
 P. S.—Can be seen at Eagle Warehouse, corner of
 Davis and Pine streets.

mh17-2p m

Figure 5. An advertisement for “Codfish! Codfish!” at Benjamin Brady from the April 3, 1868, *Daily Alta California*. This seller was located at 103 California Street. Source: California Digital Newspaper Collection, Center for Bibliographic Studies and Research, University of California, Riverside, <http://cdnc.ucr.edu>.

Figure 6. Cod bone abundance (NISP) and taxonomic identifications from sites in northern California. Data sources: Late 1840s–1853 (Thompson’s Cove, this study), 1856 (Gold Eagle Hotel; Schulz 1980), 1866–1878 (Cronin’s Oyster Saloon; Schulz 1980), ~1870s (Gobalet 2014), 1870–1880 (St. Clair and Dobkin 2003), 1884 (Schulz 1984), 1870–1899 (William Self Associates 2013, 2019) and ~1890s (KWG, unpublished laboratory notes). Note, all non-aDNA identifications are aggregated into *Gadus sp.* given uncertainty in their original identifications. For the data and script associated with this figure, see <https://doi.org/10.17605/OSF.IO/WCJD3>

Table 1. Cod importation records from the *Daily Alta California* between December 1848 and December 1852. For all *Daily Alta California* newspapers available in the California Digital Newspaper Collection (<https://cdnc.ucr.edu/>) we reviewed and digitized “Shipping Intelligence” and “Importation” records to identify shipments of cod into San Francisco.

Vessel Type	Vessel Name	Import Type	Quantity	Date Imports Published	Vessel Origin	Days Sailed to San Francisco
barque	<i>Helen S. Paige</i>	boxes	25	June 14, 1850	Boston	210
schooner	<i>Lydia</i>	boxes	41	July 15, 1850	New York	135
ship	<i>Thos. W. Scars</i>	boxes	85	July 16, 1850	Boston	143
barque	<i>Archibald Gracie</i>	drums	20	July 19, 1850	Boston	148
barque	<i>Abagun</i>	drums	20	July 31, 1850	New York	180
brig	<i>Eliza Taylor</i>	drums	47	August 5, 1850	Boston	144
barque	<i>Cuba</i>	drums	10	August 15, 1850	Boston	150
brig	<i>Picard</i>	drums	28	September 18, 1850	New Haven	180
barque	<i>General Taylor</i>	boxes	55	October 9, 1850	Boston	165
barque	<i>Ellen Noyes</i>	boxes	10	October 11, 1850	Boston	165
brig	<i>Victoria</i>	tubs	36	November 16, 1850	Liverpool	190
ship	<i>Gerrone</i>	kegs ¹	18	November 18, 1850	New Bedford	197
ship	<i>Cariolanus</i>	boxes	100	November 19, 1850	New York	218
ship	<i>William H. Harbeck</i>	half barrels	12	November 25, 1850	New York	148
barque	<i>Juno</i>	boxes	50	November 26, 1850	Boston	213
schooner	<i>Mary Filkins</i>	boxes	300	December 3, 1850	New Orleans	238
barque	<i>Royal Sovereign</i>	tubs	20	January 7, 1851	Cardiff	204
barque	<i>Adelaide</i>	drums ²	60	February 5, 1851	Halifax	200
brig	<i>Dracut</i>	drums	6	April 2, 1851	Boston	160
ship	<i>John Gray</i>	barrels	20	April 5, 1851	Greenock	175
brig	<i>Acis</i>	tubs	33	April 21, 1851	Adelaide	93
barque	<i>Jessie Byrne</i>	barrels	29	May 23, 1851	Cork	147
barque	<i>Walter Claxton</i>	drums	25	June 14, 1851	Boston	155
barque	<i>Margaret Hugg</i>	pounds	300	July 1, 1851	Baltimore	182

brig	<i>Charran</i>	boxes	2	July 2, 1851	New Orleans	175
brig	<i>Mary Helen</i>	pounds	1000	July 16, 1851	Santa Barbara	17
clipper ship	<i>Witch of the Wave</i>	boxes ³	22	September 21, 1851	Boston	122
brig	<i>Wyandot</i>	cases	190	January 3, 1852	Honolulu	16
barque	<i>Ala</i>	boxes	100	July 5, 1852	Boston	155
		half drums	100			
		drums	25			
ship	<i>Eastern State</i>	drums	50	July 13, 1852	New York	150
ship	<i>Michael Angelo</i>	boxes	200	August 3, 1852	New York	148
clipper ship	<i>Statflordshire</i>	drums	61	August 14, 1852	Boston	101
ship	<i>Shooting Star</i>	boxes	60	August 18, 1852	Boston	105
ship	<i>David Cross</i>	casks	70	September 6, 1852	Valparaiso	79
clipper ship	<i>Sovereign of the Seas</i>	large cask	28	November 16, 1852	New York	103
clipper ship	<i>Southern Cross</i>	drums	30	November 29, 1852	Boston	153
clipper ship	<i>Onward</i>	boxes	150	December 2, 1852	Boston	120
clipper ship	<i>Syren</i>	boxes	50	December 24, 1852	New York	118

¹This shipment is of “codfish tongues”

²This shipment is of “dried codfish”

³This shipment is of “cod liver oil”

Table 2. Fish specimens recovered from several Gold Rush–era and later sites throughout San Francisco and Sacramento, California

Taxon	Common Name	Site:	Dates: 1840s– 1853	1840– 1857	1851 343 S.	1850– 1880	1852– 1857	1856 GEH	Mid- 1860s	1862– 1878	1866– 1878	1870s– 1880s
			TC	NBC		WLL	NDP		110	343 F.	COS	CFP
Rajiformes	Skates and rays (not bat ray)		1									
<i>Acipenser</i> sp.	White or green sturgeon		17								18	
<i>Archoplites interruptus</i>	Sacramento perch										213	
Clupeidae	Herring/Sardine		57									
	Scales		27									
<i>Clupea pallasii</i>	Pacific herring		2									
<i>Oncorhynchus</i> sp.	Pacific salmon and steelhead		21									
<i>Oncorhynchus nerka</i>	Sockeye salmon											1
<i>Oncorhynchus tshawytscha</i>	Chinook salmon		20					1	2		1	
Salmonidae	Trout and salmon								4			
Cyprinidae	Minnow/Carp		2									
<i>Ptychocheilus grandis</i>	Sacramento pikeminnow		11									
<i>Catostomus occidentalis</i>	Sacramento sucker		1									
<i>Gila crassicauda</i>	Thicktail chub										26	
<i>Gadus</i> sp.	Atlantic or Pacific cod		18					6			6	9
<i>Gadus macrocephalus</i>	Pacific cod											87
<i>Microgadus proximus</i>	Pacific tomcod		27									
Atheriniopsidae	New World Pacific silversides		314									
	Scales		1072									
<i>Atherinopsis californiensis</i>	Jacksmelt		26								7	
Scorpaenidae	Rockfishes										13	
<i>Sebastes</i> sp.	Rockfishes		19							2		30
	Scales		5									
Pleuronectiformes	Flatfish									5	2	
<i>Psettichthys melanostictus</i>	Sand sole											1
<i>Ophiodon elongatus</i>	Lingcod		1								12	
Sciaenidae	Drums and croakers		1									
<i>Atractoscion noblis</i>	White seabass										2	
Embiotocidae	Surfperches		13	1			X		2		4	
<i>Embiotoca</i> sp.	Black or striped surfperch		3									
<i>Scomber</i> sp.	Mackerel										3	
<i>Scomber japonicus</i>	Pacific chub mackerel		14						2			
Actinopterygii	Ray-finned fishes		456	1	45	49	X					178
	Scales		894									
Unidentified	Unidentified fish							1			99	9

Notes: X = present. TC = Thompson's Cove (Conrad et al. 2015a), NBC = North Beach Campus (Valente 2012), 343 S. = 343 Sansome Street (Christenson 1989), WLL = Wing Lee Laundry (Pastron and Beevers 2003), NDP = Notre Dame Plaza (Ambro 2003), GEH/COS = Golden Eagle Hotel/Cronin's Oyster Saloon (Schulz 1980), 110 = 110 The Embarcadero (Praetzellis 2017), 343 F. = 343 Fremont Street (Praetzellis 2015), CFP = Central Freeway Project (St. Clair and Dobkin 2003)

Table 3. Cod (*Gadus* sp.) specimens and elements from Thompson's Cove (CA-SFR-186H)

Element	Feature 25	Feature 15	Feature 7
Undetermined vertebral fragment	5		2
Caudal vertebrae	3	2	1
Neural spines	2		3

Table 4. Selected specimens, provenience, and results for ancient DNA analysis

Catalogue No.	Feature	Context	Specimen	Subsampled amount (mg)	aDNA Species
107	25	Courtyard-Area 4, Trench 1	Vertebra	41.2	<i>Gadus morhua</i>
108	25	Courtyard-Area 4, Trench 1	Caudal vertebra	55.8	<i>Gadus morhua</i>
111	25	Courtyard-Area 4, Trench 1	Vertebra	45.5	<i>Gadus morhua</i>
113	25	Courtyard-Area 4, Trench 1	Caudal vertebra	37.4	<i>Gadus morhua</i>
870	15	Quad H7 (East 1/2) North 16-32 East 47-53	Caudal vertebra	54.5	<i>Gadus</i> sp.