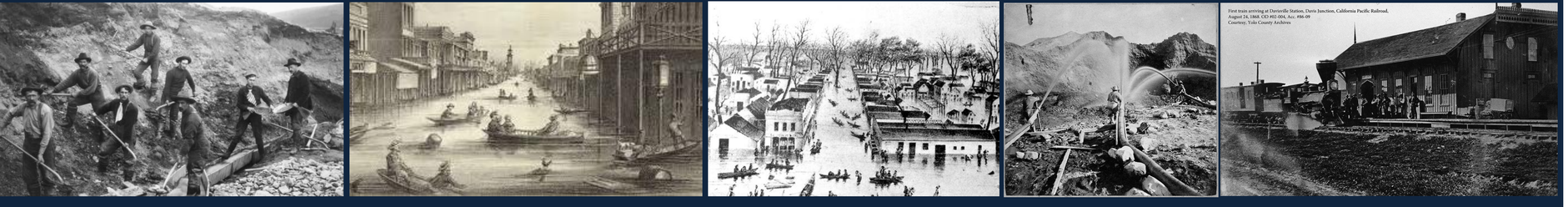

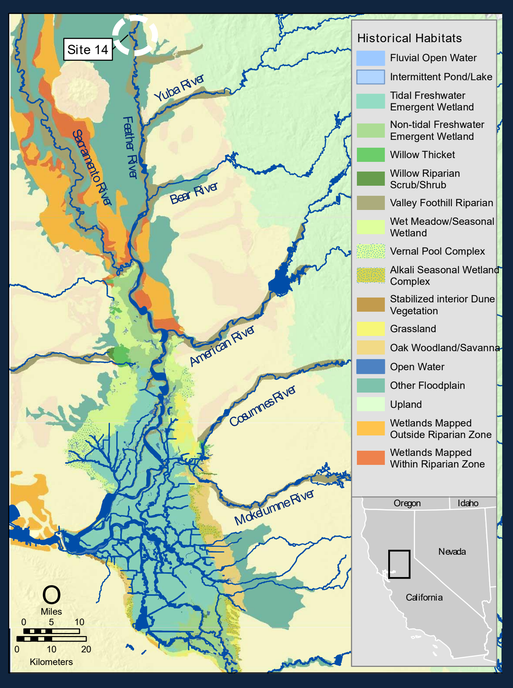

Figure 1. Maidu Village (1800-1850) in the historic landscape.

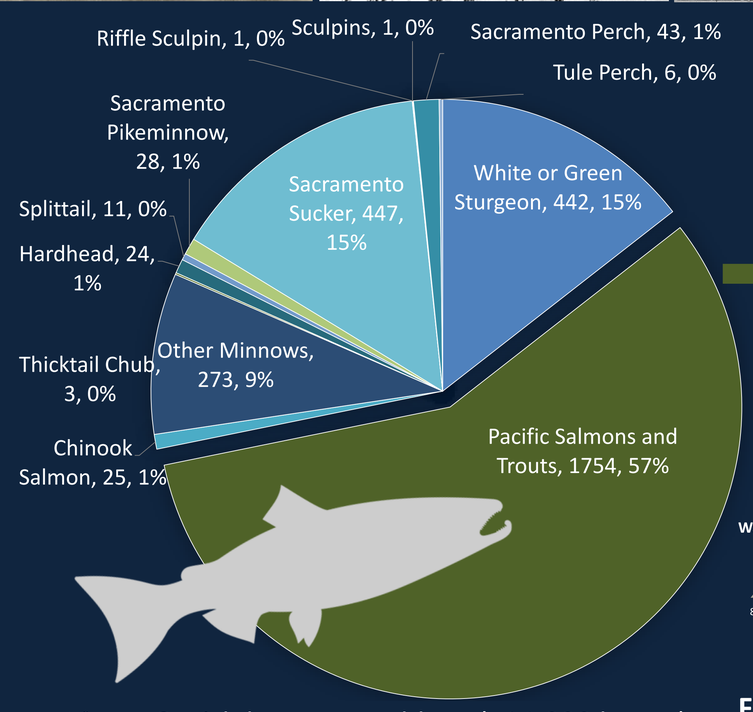

Figure 2. Fish bone assemblage (>14,000 bones) from Site 14 on the lower Feather River. Otoliths found in food waste.

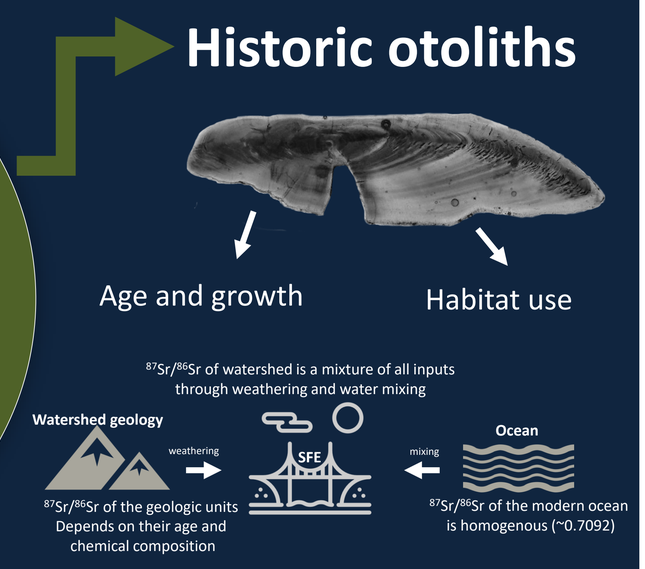

Figure 3. Strontium isotope ratios can be used to reconstruct the environmental history of fish. $^{87}Sr/^{86}Sr$ varies between watersheds based on the age and composition of the geology. In the San Francisco Estuary the $^{87}Sr/^{86}Sr$ values reflect the mixing of freshwater inputs and the Pacific Ocean.

Historic otoliths can provide a long-term view of Chinook Salmon life history changes

Figure 4. Modern wild salmon on the Feather River returned at younger ages and exhibited a truncated age structure (age-2 and age-3), while their historic counterparts generally returned as age-3 and age-4 and exhibited a broader age distribution.

Figure 5. In modern salmon a significant shift from wild-spawned to hatchery-origin fish on the lower Feather River, particularly after the 2008-09 stock collapse was observed. The natal origins and rearing behaviors of the historic salmon have a ~25% contribution of fish rearing outside of the lower Feather River.

Figure 6. Life history reconstructions of a modern Feather River salmon and a prehistoric Feather River salmon. An offset is visible for the juvenile to adult phase in the prehistoric salmon otolith, indicating use of Delta to low salinity habitats with significant strontium isotopic variation, in contrast to the modern salmon which shows a stable oceanic strontium isotope signal throughout most of its adult life.

Reconstructing ancient salmon life history strategies to support modern conservation

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Introduction

Chinook salmon (*Oncorhynchus tshawytscha*) populations in California are in decline due to the combined effects of habitat degradation, water diversions, and shifting climate regimes. Effective salmon conservation and management relies on understanding their life history diversity and ability to adapt to environmental change. Monitoring efforts and geochemical tools have provided crucial insights into modern salmon population dynamics and behavior in California. However, these data were collected only after significant population declines and extirpation from a large fraction of their historic habitat.

Methods

Otoliths are a powerful archive of age, growth, and chemical composition of the surrounding water. In particular, strontium isotopes ($^{87}Sr/^{86}Sr$) in otoliths are a well-established tool in fish ecology for the retrospective determination of life history and origin.

We used adult salmon otoliths (fish ear stones) from the lower Feather River to reconstruct juvenile and adult life history metrics, and compare patterns among modern (2002-2010, n=755) and historic (~1840 CE, n=49) populations.

Specifically, we investigated the age and size of fall-run salmon when they returned to freshwater and reconstructed their natal origins and juvenile/adult rearing behaviors.

Implications/Future Work

The natal origins and rearing behaviors of the historic population suggests that a diverse range of habitats were used, and that variable life history strategies were successful on the lower Feather River.

This study represents the first step towards unlocking the potential for historic fish bones to provide unique insights into California's past salmon populations and to apply this knowledge to guide future salmon conservation, management, and recovery.

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