

“One ear to the ground”: Using isotopic analysis of otoliths to investigate the life history of Delta Smelt.

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The Delta Smelt (*Hypomesus transpacificus*) is rapidly approaching extinction in the wild. This small, euryhaline fish is endemic to the tidal fresh and brackish waters of the San Francisco Bay Estuary (SFE). Extensive studies over the last decade have shown that this fish exhibits a diverse life history of both resident and migratory phenotypes within a genetically homogenous population, but the details of this life history remain unclear. We investigated the life history diversity utilizing the microchemistry of otoliths (“ear bones”) from fish collected during monitoring surveys in the Fall of 2011 and Spring of 2012, the last abundant year-class. Otoliths consist of calcium carbonate and accrete continuously throughout the life of a fish. Consequently, they can provide a life-long archive of physiological and environmental conditions that a fish has experienced. <sup>87</sup>Sr/<sup>86</sup>Sr ratios and new statistical analyses (Discrete Wavelet Transformations) were used to reconstruct and cluster changes in salinity habitats throughout the lifetime of a fish. Delta Smelt exhibited three unique life history trajectories; residency (completing the lifecycle) in freshwater, residency in brackish water, and a migratory life history with changes in freshwater and brackish water use. Migratory fish could be further resolved into three contingents that can be characterized with a combination of three life history attributes; natal origin, adult rearing habitat and ontogenetic transition from fresh water to brackish water in the early life. This previously undescribed complex life history diversity provides Delta Smelt a diverse portfolio of behavioral phenotypes that may facilitate resilience within its dynamic and unpredictable estuarine environment. Understanding how management of freshwater flows affects fish with different life histories is paramount for conserving this endangered species.