

Habitat Characteristics of the North Delta Arc

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The North Delta Arc refers to the suite of interconnected littoral and shallow water habitats along the northern rim of Suisun Bay and the Delta which wrap around the base of the Montezuma Hills. It includes Suisun Marsh, Sherman Lake, the Cache-Lindsey Slough Complex, and Liberty Island. These habitats tend to be more productive and more biologically diverse than other regions of the Delta. While multiple stressors have been implicated fish declines throughout the Estuary, there are multiple physical and trophic drivers that support fishes in the Arc, providing a slower rate of decline for a number of native species. These drivers include reticulate geomorphic structure, a bathymetric gradient extending from above to below sea level, complex residence times due to tidal exchange, and the influence of high net fresh water flows in adjacent channels. These conditions promote the essential needs of local fishes: they provide physical and hydrodynamic structure for habitat, trophic structure that supports multiple foraging strategies, and corridors for transit or recruitment among habitats. Comparisons with other regions of the Delta demonstrate that these conditions are not met throughout much of the ecosystem; the North Delta Arc is an exception.

Keywords: Native fishes, habitat, Cache-Lindsay Slough, Suisun Marsh, food webs, geomorphology

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The North Delta: A Cache of Native Fishes in the Upper San Francisco Estuary

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The northern Delta is presumed to provide refuge for fishes native to the upper San Francisco Estuary, and is often identified as a model ecosystem for regional restoration efforts. However, the species composition and community structure among these various habitats remains understudied. We conducted comprehensive electrofishing surveys throughout Lindsey and Cache Sloughs, Liberty Island and the Sacramento Deep Water Ship Channel in the spring of 2011. Using spatial analyses, we evaluated the distribution and abundance of fish species. On average, native species comprised 41% of catch-per-unit effort (CPUE). These results differ markedly from comparable electrofishing data collected in other regions of the Delta in the springs of 2009 and 2010, where native species represented only 5% and 7% of average CPUE, respectively. Tule perch and Sacramento sucker, the most abundant native species, occurred along shallow vegetated banks. Juvenile chinook salmon frequented nearshore habitats along channel corridors and backwater sloughs. Delta smelt occupied shallow open water habitat near exposed beaches and riprap banks, and along a submerged road in Liberty Island. These findings provide important data on the species occurrence and distribution in the northern Delta, which has implications for habitat restoration goals aimed at encouraging native fish populations in the Delta.

Keywords: Fish communities, native fishes, shallow water habitats, habitat restoration

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Larval and Juvenile Fishes of Liberty Island

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Liberty Island is a tidally influenced freshwater marsh that is hypothesized to provide important habitat to the early life stages of many fishes found within the Sacramento – San Joaquin River Delta, in particular, Delta smelt (*Hypomesus transpacificus*). The Stockton office of the U.S. Fish and Wildlife Service has been monitoring the fish communities inhabiting Liberty Island since the early 2000's, although not continuously. We looked at the occupancy and temporal distribution of delta smelt, splittail (*Pogonichthys macrolepidotus*), Chinook salmon (*Oncorhynchus tshawytscha*), and longfin smelt (*Spirinchus thaleichthys*) captured in our larval trawls and beach seines from 2010-2012. We used species specific hierarchical models to investigate the effects of water quality characteristics, hydrogeomorphology, spatial position within the wetland, and weather on juvenile and larval fish occupancy. The relative abundance estimates for most species were the highest in the spring; however delta smelt appear to be using the island year round. Based on model output, temperature influenced the occupancy probability for all species and gear type except larval delta smelt. In addition, results indicated that different water quality characteristics had unique effects on species. Splittail was our second most abundant species and was the only species modeled to show spatial preference within the island. Through our continued monitoring of Liberty Island we hope to gain a better understanding of the habitat use by native fishes within a restoring wetland and to inform future restoration efforts in the Cache Slough and Yolo Bypass areas.

Keywords: Liberty Island, beach seine, larval fish trawl, occupancy

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Some Like it Fresh: Evidence of Year-Round Freshwater Residence of Delta Smelt in the North Delta

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The north delta including Liberty Island, the Deep water Ship Channel and the Cache-Lindsey Slough complex has been identified as a critical area for the conservation of native fishes including the delta smelt. Increased focus on this area has suggests that delta smelt can reside year-round in this freshwater habitat, which is counter to the traditional understanding of the life history of this species. In this study we summarize the existing IEP monitoring data supporting freshwater residence for delta smelt and utilize otolith geochemistry to identify freshwater residence among a mixed stock of delta smelt collected during the Fall Midwater Trawl and Spring Kodiak Trawl Surveys.

IEP monitoring surveys during the past decade have observed at least some delta smelt in all seasons We examined a subsample of delta smelt from the Fall Midwater Trawl(1999,2000,2001,2005,2006,2007, & 2011) and Spring Kodiak Trawls(2002,2004,2005,2006) for the presence of freshwater resident delta smelt. Otolith data demonstrated resident freshwater fish in all years and surveys except Fall Midwater Trawl 2006. We observed the largest number of resident fish in the 2003 Spring Kodiak Trawl (n=32). A majority of resident fish were collected in the north delta beginning in November, and as far downstream as station 704 along the lower Sacramento River.

Conclusion/Relevance: Delta smelt can reside in freshwater habitats year round and forego movements into low salinity waters. This life history could have significant implications for the conservation and management of delta smelt.

Keywords: North Delta, Delta Smelt, Otolith

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Climate Change Effects on North Delta Fishes

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Problem: The North Delta is regarded as potential large-scale conservation habitat for native fishes but its characteristics will change as result of climate change. Can it persist as a refuge for native fishes when water temperatures will be increasingly warmer, tidal action will likely be muted, and outflows will be more variable (bigger floods, longer droughts)? Approach: Using twenty metrics, we evaluated the likely responses of native and alien fishes to climate change.

Results: Most populations of native fishes will decline, some to extinction, and most populations of alien fishes will increase or remain steady, if present trends continue.

Conclusions: The North Delta has considerable potential for management to mitigate for climate change effects on native fishes, including improving connectivity to other habitat areas both upstream and downstream, increasing habitat complexity, and improving flows through aquatic weed control and other measures. Studies are needed to more precisely determine habitat requirements of most species and how to provide for them under changing conditions.

Keywords: delta smelt, splittail, native fishes, alien fishes, Delta, hitch

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