

## **Performance of a Mass Marking Technique, SE-Mark™ (Calcein), on Post-Larval Longfin Smelt (*Spirinchus thaleichthys*)**

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We tested the performance of a SE-MARK (calcein) for marking Longfin Smelt (LFS), a state-listed, threatened species, for potential use in mark-recapture experiments. Calcein is a non-toxic, fluorochrome [chemical] that can be used in live finfish. Calcein-marked tissue is easily visible when viewed under 495/500 nm wavelength light.

Post-larval LFS (mean fork length= 33 mm) produced from wild brood fish were spawned and reared at the UC Davis Fish Conservation and Culture Laboratory (FCCL). A 125mg/L bath mixture of calcein and source water was prepared and the post-larval LFS were exposed to the bath for 1 hour. Mark retention was monitored and scored immediately following calcein exposure and at intervals up to 90 days post-marking. Due to the sensitive nature of the test organism, only deceased subjects were evaluated for mark retention. Immediate and 24 hour mortality in marked groups were compared with control groups to determine if excess mortality occurred as a result of calcein exposure. Marks were graded or scored according to the U.S. Fish and Wildlife Service's Investigational New Animal Drug (INAD) program protocols. Easily visible marks were observed and the mark method shows promise for use in LFS. However, larval LFS rearing and mortality were highly variable, ranging from 0% - 45%. Therefore, before calcein can be used for mass marking with this species, the rearing methods need further research and improvement.

### **Keywords:**

### **Poster Topic**

Species and Communities - Sensitive Species

## **A Comprehensive Protocol for Monitoring Ridgway's Rail Population Trends in the San Francisco Estuary**

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The California Ridgway's Rail, found throughout the San Francisco Estuary, is a federally-listed endangered species requiring effective monitoring to support its recovery, alongside tidal marsh restoration and enhancement efforts. Unfortunately, because of different survey methods, biologists are not able to easily extract information on population trends, management actions, or response to restoration. Additionally, variance is introduced by the use of disparate survey methods and the results may not be reliable. Broadcasting marsh bird vocalizations has been shown to generally increase detection probability for most marsh bird species. The Standardized North American Marsh Bird Monitoring Protocol has been adopted by many federal, state and local organizations across the U.S. Using the National protocol as a framework, Point Blue Conservation Science in partnership with the USFWS, pursued the identification and promotion of an efficient method for surveying and analyzing secretive marsh bird populations throughout the Estuary, employing the broadcast of two species, Ridgway's and Black Rail. In order to maintain consistency, and to ensure no biases with the previous 11-year dataset, a pilot study was initially conducted. By pairing survey protocols and using appropriate statistical methods, it was determined that the switch to a call broadcast protocol could be accounted for in the data. This site-specific protocol was implemented by the USFWS, Point Blue, and other partners for the 2017 season. Coordination among partners, including appropriate statistical analysis and reporting, as outlined in the protocol, is essential for monitoring and recovery of the rail population. As marsh restoration moves forward, successful adaptive management actions must account for rail population responses, which can be best analyzed annually from a centralized, standardized monitoring data management system, as implemented with the Site-specific Protocol for Monitoring Marsh Birds in San Francisco Bay.

**Keywords:** Ridgway's Rail, sensitive species, tidal marsh restoration, monitoring, protocol

**Poster Topic** Species and Communities - Sensitive Species

## **Biogeography and Habitat Dynamics of Bank Swallows on the Sacramento River**

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The Sacramento River corridor provides nesting habitat for the largest documented meta-population of breeding Bank Swallows in California. The species depends specifically on river processes (erosion, deposition, channel migration) which renew its nesting substrate, steep riverbanks of friable soils, on a nearly annual basis. These river processes have been impacted by flow impairment from dams, disconnection of floodplains, and flood control measures such as bank stabilization, resulting in declines in the Bank Swallow population and other wildlife taxa. Several significant data gaps exist which impede progress on implementing habitat restoration for the species. While Bank Swallow population surveys have been conducted along the Sacramento River since 1986 by natural resource agencies, clear and quantitative identification and spatial mapping of suitable nesting substrate (e.g. soil characteristics) is lacking. Further, the efficacy of bank restoration in creating usable Bank Swallow habitat remains untested. Using a maximum entropy modeling approach, we describe the spatial variability of suitable soil characteristics using the location of Bank Swallow colonies along the Sacramento and Feather River. Further, we present empirical data on the response of Bank Swallows at locations where bank stabilization no longer persists. Given the importance of Sacramento River habitats in the context of other continental habitat resources and the large meta-population using these resources, Federal endangered species protections may be warranted. Bank restoration efforts aimed at addressing Bank Swallow recovery should consider soil characteristics and river meander potential. Entities focused on the broader implementation of environmental policy, river restoration, and environmental risk reduction benefit significantly from an improved understanding of Bank Swallow habitat and its relationship with riverine geomorphic process.

**Student Award Competition:** Yes

**Keywords:** riparian, riprap, species conservation

**Poster Topic** Species and Communities - Sensitive Species

## Fitness of Cultured Delta Smelt in the Wild

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The fitness of cultured Delta Smelt in the wild has drawn more attention than ever before since there is an increased interest in their resilience due to the continued decline of wild Delta Smelt. The UC Davis Fish Conservation and Culture Laboratory conducted a study to look at the resilience of cultured Delta Smelt in an environment that mimics the wild. A total of 526 adult Delta Smelt (at 297 days post hatch) were released into a large trough (total volume of 12,870L with a cultural volume of 5,604L) with raw water pumped from the California Aqueduct located at the end of Clifton Court Forebay. The fish not only experienced natural water conditions, but could also feed on any food available in the raw water. The trial started on December 5<sup>th</sup>, 2016, and their survival was 82% (88% if sampled fish excluded) on May 2<sup>nd</sup>, 2017, which was Day 148 of the study. The condition factor of fish dropped 0.26 for the first 98 days but bounced back to -0.04 on Day 140. This may have been caused by the various food types and their abundance in the water source. Gut content of fish was collected for further identification and analyses. As the water temperature increased, so did the mortality, especially at temperatures higher than 20°C. On June 20<sup>th</sup>, Day 197 of the study, a severe heat wave led to a water temperature higher than 27°C for several days, which caused a huge loss of fish and concluded the study. Fifteen fish survived at the end of the study, which was much less than the estimated survival (278) based on the corpses found. Predators found sneaking into the trough may have led to the low recovery rate.

**Keywords:** Delta Smelt, resilience, food, condition factor, temperature, predator

**Poster Topic** Species and Communities - Sensitive Species

## Longfin Smelt Distribution: Abundance and Evidence of Spawning in San Francisco Bay Tributaries

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Historic Surveys conducted as part of monitoring programs have shown evidence suggesting Longfin Smelt may utilize tributaries in North Bay and South Bay as spawning and larval rearing habitat predominantly during high outflow years; however, the frequency and magnitude of the contribution of tributary spawning to adult abundance and year class strength is currently unknown. In January 2015, we began sampling tributaries to the San Francisco Bay Estuary to document the distribution and relative abundance of adults, larvae, and juvenile recruits. In four tributaries, (Napa River, Sonoma Creek, Petaluma River, and Coyote Creek) adults were sampled using an otter trawl monthly, while larvae were sampled using a replica of California Department of Fish and Wildlife's Smelt Larval Survey sled. In 2016 and 2017, we included the 20-mm net in the North Bay tributaries to document juvenile distribution and abundance. Larval and juvenile Longfin Smelt were found in low densities in the North Bay tributaries in 2015 and 2016, however; no larvae or juveniles were found in South Bay tributaries. In 2017 however, with a significant increase in fresh water input, larger numbers of Longfin Smelt were found in all North Bay tributaries, San Pablo Bay, Central Bay and juveniles were also found in South Bay tributaries. Adults have been more abundant in South Bay tributaries than the North Bay suggesting this area may operate as a sink to the population in drought periods. Larval life stages were found predominantly in lower salinity habitats than juveniles and adults, and few Longfin Smelt were found in the North Bay or South Bay when water temperatures exceeded 18 °C. These data suggest Longfin Smelt spawned in North Bay tributaries during this drought period as well as during a wet year and at least some individuals are found outside of the existing monitoring range.

**Student Award Competition:** Yes

**Keywords:** Longfin Smelt, Restoration, Ecology, Larval Fish, Spawning Habitat

**Poster Topic** Species and Communities - Sensitive Species

## Evaluation of Oyster Shell Enhancement on Western Snowy Plover Breeding Success

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The Pacific Coast population of the western snowy plover (*Charadrius nivosus nivosus*; plover) is listed as a federally threatened species under the U.S. Endangered Species Act. The population has experienced poor reproductive success as a result of anthropogenic habitat loss, fragmentation, and high predation pressure. Plovers in the South San Francisco Bay use dry salt evaporation ponds and wildlife-managed ponds to breed and winter. However, the South Bay Salt Pond Restoration Project aims to restore up to 6,110 hectares of this habitat back to native tidal marsh which will require plovers to breed in smaller areas and in higher densities. In order to recover this species in such unique conditions, remaining pond habitat can be enhanced using oyster shells which may provide camouflage for breeding plovers, thereby possibly decreasing predation. This study evaluated the effect of oyster shell enhancement on plover breeding success by comparing nesting density, nest success, and brood behavior between enhanced and non-enhanced areas. Plovers selected to nest in enhanced areas which created higher nesting densities compared to non-enhanced areas. However, nest success and survival over time did not increase with enhancement. Predation by common raven substantially limited nest success during study years, suggesting that enhancement may not effectively prevent nest predation by intelligent generalist species. Brood behavior was also affected by enhancement, though highly correlated with the location of optimal foraging habitat. It is likely that oyster shell enhancement will improve plover nesting success only if predator populations are concurrently controlled. Ultimately, plovers may benefit from the application of oyster shells as it attracts nesting effort, and may be strategically used by resource managers.

**Keywords:** plover, recovery, threatened, habitat enhancement, breeding, nesting, success

**Poster Topic** Species and Communities - Sensitive Species