

Movement Patterns and Site Fidelity of Small Striped Bass in the San Francisco Estuary Watershed

Cynthia Le Doux-Bloom, Animal Biology Graduate Group, UC Davis, cledouxbloom@ucdavis.edu

Beth M. Wrege, NOAA Fisheries, Sacramento, CA, beth.wrege@noaa.gov

Michael Johnson, Center for Watershed Sciences, UC Davis, mbjohnson@ucdavis.edu

Serge Doroshov, Animal Science Department, UC Davis, sidoroshov@ucdavis.edu

J. Jeff Isely, NOAA, Southeast Fisheries Science Center, jeff.isely@noaa.gov

Small striped bass (n=99; mean fork length= 285 mm) movement and site fidelity within the San Francisco Estuary watershed were assessed using acoustic telemetry. Ninety-nine fish were surgically implanted with acoustic transmitters in June and July 2010 and tracked via stationary receiver (n=300) through October 31, 2011. Fish were tagged on the American (n=11), Sacramento (n=22), and San Joaquin rivers (n=33), the Sacramento Ship Channel (n=15), and Three Mile Slough (n=18).

A common feature was their progressive migration from rivers and sloughs into bays during summer and from bays to sloughs and rivers in the late fall and winter. On average, fish moved greater distances in early summer and early fall. Tidal surfing frequently occurred between the lower and upper sections of San Pablo Strait in summer and Carquinez Strait in the fall and winter. Tidal surfing also occurred between shoals and channels (Kimball Island and Antioch). Preliminary analyses indicate that fish repeatedly select the same migratory routes regardless of season. Route selection was correlated with tidal movement and appears related to flow conditions. Movement timing appears related to schooling behavior. Fish stationed at or near specific locations usually arrived and departed at similar times.

Keywords: striped bass; biotelemetry; movement patterns; San Francisco Estuary Watershed

Poster Cluster Title: Use of Biotelemetry to Assess Behavior and Survival of Fishes in the San Francisco Estuary Watershed 1

Use of San Francisco Bay Habitat by Tagged Special-Status and Recreationally Important Fishes

Thomas Keegan, ECORP Consulting, Inc., tkeegan@ecorpconsulting.com

Renee Spenst, Ducks Unlimited, Inc., rspenst@ducks.org

Philip Sandstrom, UC Davis, psandstrom@ucdavis.edu

The intent of this project was to identify and track fish tagged by any and all investigators (with permission) associated with the California Fish Tagging Consortium, and that were detected on receiver arrays deployed in the South Bay. species tagged include special-status Chinook salmon, steelhead, and green sturgeon, and recreationally important tagged species include striped bass and white sturgeon. The purpose of this Project is 1) to assess the utilization of the South Bay by fish produced in northern San Francisco Bay and Delta, including the Sacramento and San Joaquin river systems, 2) assess the utilization of restored South Bay Salt Pond tidal marsh habitats by those fish species tagged by California Fish Tagging Consortium investigators; and, 3) to determine the regional effectiveness of tidal restoration efforts on these species.

Nine acoustic (VEMCO) receivers were deployed as a gate array along the Dumbarton Railroad Bridge. In addition, six receivers were installed strategically within several newly restored tidal marsh units associated with Alviso Slough and the Island Ponds, and in Coyote Creek to document entrance of any tagged fish into the units, and residency time in the vicinity of each receiver/unit.

Keywords: South San Francisco Bay, salt pond, fish distribution, Dumbarton, Alviso,

Poster Cluster Title: Use of Biotelemetry to Assess Behavior and Survival of Fishes in the San Francisco Estuary Watershed 2

Smolt Behavior in the Sacramento River at a Levee Repair Site

Phil Sandstrom*, University of California Davis, ptsandstrom@ucdavis.edu

David Smith, ERDC Cognitive Ecology & Ecohydraulics Team, David.L.Smith@usace.army.mil

Brian Mulvey, U.S. Army Corps of Engineers, brian.m.mulvey@usace.gov.mil

Since 2010 more than 1000 smolts and four species of predators have been implanted with acoustic tags to study their two dimensional movements in relation to a levee repair site located at RM 85.6. Repair work on this levee began in June of 2006 and made use of more than 80,000 tons of materials. The study primarily focused on juvenile late-fall Chinook, however juvenile steelhead trout were also monitored. Only a handful of predators were implanted with acoustic tags, however our objective with these individuals was to characterize a difference in behavior and movement patterns relative to the tracks of smolts. Two-dimensional track data was used to calibrate a Eulerian Lagrangian Agent Method model. In 2010/2011 season of study positions of smolts were consistently higher in the river channel with the lowest proportion of overall positions calculated occurring along the levee repair site. Also two-dimensional tracks from smolts were highly directional, 91.4% of smolts with more than 5 bearing calculated were found to have a Rayleigh test $p < 0.05$. Average movement rates within the study site were 0.8 m/s. We observed no significant difference in the transit times of smolts near (within 20m) the levee repair site (00:15:25) versus further away individuals (00:14:31) (t-test: $t=0.61$ $df=174$ $p=0.27$). A single smallmouth bass was tagged in 2010/2011, however the behaviors and movements rates of this individual were drastically different than those of the observed juvenile salmonids. The movement rates of the observed predator were lower than of the Chinook (t-test: $t=-42.9$ $df=5994$ $P < 0.01$) and bearings were bimodal primarily showing lateral movement (Rao's Test: $U=223.9$ $p < 0.01$).

Keywords: chinook salmon, Steelhead trout, predators, telemetry, levee repair, fish tracks

Poster Cluster Title: Use of Biotelemetry to Assess Behavior and Survival of Fishes in the San Francisco Estuary Watershed 3

Survival, Movement, and Route Selection of Steelhead Trout in the Sacramento River

Phil Sandstrom*, University of California Davis, ptsandstrom@ucdavis.edu
Arnold Ammann, National Marine Fisheries Service, arnold.ammann@noaa.gov
Cyril Michel, National Marine Fisheries Service, cyril.michel@noaa.gov
Gabe Singer, University of California Davis, gpsinger@ucdavis.edu
Steven Lindley, National Marine Fisheries Service, Steven.Lindley@noaa.gov
Bruce MacFarlane, National Marine Fisheries Service, bruce.macfarlane@noaa.gov
Peter Klimley, University of California Davis, apklimley@ucdavis.edu

We studied the survival and outmigration patterns of natural and hatchery juvenile steelhead trout throughout the Central Valley. A large-scale array deployed and maintained by the California Fish Tracking Consortium was used to monitor acoustically-tagged smolts as they migrated past receiver locations. Hatchery steelhead trout were monitored from 2006-2011 while natural fish were monitored from 2008-2010. In both 2008/2009 and 2009/10 the timing of outmigration of naturally-produced steelhead occurred later in the year than for hatchery smolts. The transit time of natural steelhead from the Sacramento River to the Golden Gate was faster for both years with less variability. However, under higher flow conditions in 2009/2010, we observed shorter transit times with a decreased range or variability compared to the prior year. The hatchery steelhead trout which successfully navigated from the Sacramento River to the Golden Gate had average movement rates of 2-45 km/d. By contrast, the natural smolts migrated at average rates of 32-52 km/d. Once steelhead reach the Delta, they take one of the following migration routes: Steamboat, Sutter, and Miner Sloughs (western routes), Georgiana and the Delta Cross Channel (interior Delta), or the mainstem Sacramento River. The highest proportion of fish follow the mainstem Sacramento River, while the next highest proportion enter Georgiana Slough. We observed relatively high survival rates in all routes for hatchery fish over 5 years except in Sutter Slough, which had consistently low survival rates (0-0.45). Our data also revealed that natural steelhead had high survival rates through all routes regardless of year.

Keywords: Steelhead trout, survival, route selection, movement rates, telemetry, and salmonids

Poster Cluster Title: Use of Biotelemetry to Assess Behavior and Survival of Fishes in the San Francisco Estuary Watershed 4