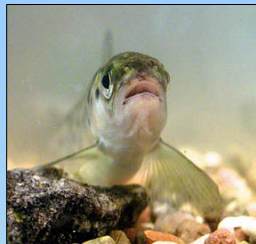


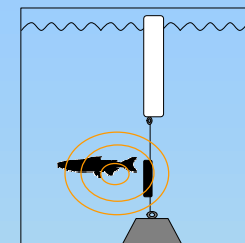
Hydroacoustic Telemetry and the Distribution of Salmonid Smolts in San Francisco Bay

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Abstract

Information on the temporal and spatial distribution of Federally listed juvenile Chinook salmon and steelhead in San Francisco Bay is needed for assessing potential impacts to these species from dredging activities. Currently, work windows are used that limit dredging activities to periods of time when listed salmonids are thought to be absent from the Bay. Through the use of hydroacoustic telemetry, we hope to increase our knowledge of juvenile salmon migration behavior to better manage dredging operations. Through a collaborative multi-agency effort, Chinook salmon and steelhead smolts implanted with ultrasonic tags are being released each year during the winter months of 2007-2009. As the smolts outmigrate, they are detected by strategically located hydrophones to better define migratory routes and transit times. Based on data available to date, the mean travel time between Rio Vista and Golden Gate bridges was about 20 and 41 days for Chinook salmon and steelhead, respectively. Mean residence time at the San Pablo Bay Dredge Material Disposal Site was 70 and 2.5 minutes for Chinook salmon and steelhead respectively. Fish of both species tended to use deeper areas around the Richmond San Rafael Bridge rather than the shallower portions. A substantial proportion of the tagged populations of both species traveled over one dredged material placement site.



Typical Listening Station

Objectives

- Estimate transit times through the San Francisco Estuary.
- Measure residence times in areas of interest.
- Identify spatial trends in migratory pathways.
- Determine the suitability of telemetry for tracking migrating smolts.

Background

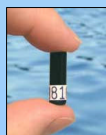
Impacts to salmonid smolts from dredging activities include: the redistribution of pollutants and/or release of contaminants which may result in chronic or acute toxicity; burial of bottom-dwelling organisms which may reduce feeding opportunities for rearing juvenile salmon; or re-suspension of sediment particles which could interfere with visual foraging, abrade gill tissues, or interfere with migration. This study does not overlap with the timing of dredging activities but rather examines the *potential* exposure of smolts to dredging impacts.

Methods

We acquired late-fall run Chinook salmon and steelhead smolts from the Coleman National Fish Hatchery in Anderson, CA, transported the fish to the Center for Aquatic Biology and Aquaculture in Davis, CA, and held them in tanks for one week before the surgeries commenced. We tagged ten individuals of each species each week, beginning on January 17 and ending on February 9. We anesthetized each individual fish, made a 10mm incision into the ventral side of the fish anterior to the pelvic girdle, and implanted a sterilized, individually-coded, VEMCO V7 (Chinook) or V9 (steelhead) ultrasonic transmitter tag into the peritoneal cavity. The incision was closed with two simple interrupted sutures. After a holding period of five days, we transported the fish to Rio Vista, California and released them into the Sacramento River. Untagged Chinook (90) and steelhead (90) were released along with the tagged fish to serve as a screen against release predation. A total of 49 tagged fish of each species was released. Tagged fish that swam within the range of VEMCO VR2 monitors were detected. Detected fish ID codes and date and time of detections were downloaded from the monitors for data analysis.



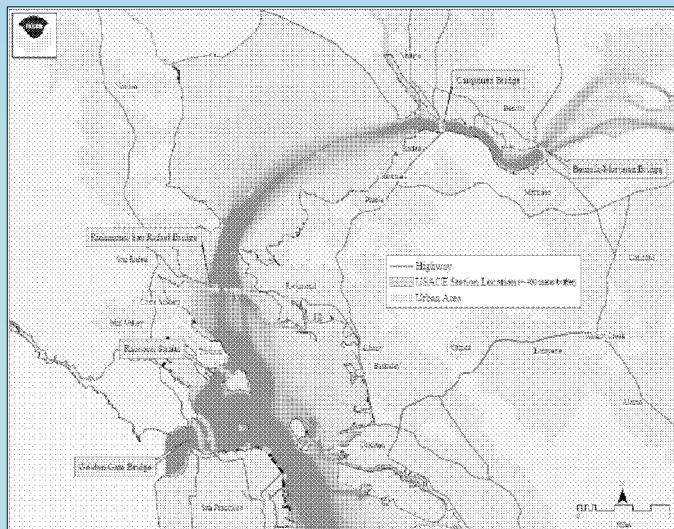
Fish Surgery



V7 Transmitter



VR2 Acoustic Receiver



Conclusions

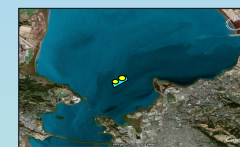
Acoustic telemetry can be a useful tool for examining fine and broad scale fish movements and residence time in San Francisco Bay. Chinook salmon and steelhead differ in their transit and residence times. Despite the temporal differences between species, there appears to be some overlap in migratory habitat.

Future Work

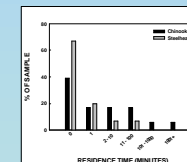
We would: monitor more dredging and disposal sites; evaluate the role of environmental factors; and release more tagged fish.

Results to Date

Data analysis only completed for one-quarter of the first year's work.



Monitor Locations at Dredged Material Disposal Site in San Pablo Bay

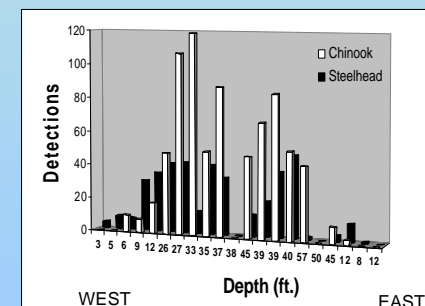


Approximately 40% of Chinook salmon and 70% of steelhead detected up and downstream of the disposal site were not detected at the dredged material disposal site. Approximately 54% detected Chinook stayed between 1 and 100 minutes. Approximately 35% detected steelhead stayed a minute or less.

	Chinook Salmon		Steelhead	
	Mean (s.e.) hrs	n	Mean (s.e.) hrs	n
Rio Vista - Carquinez	436 (50.6)	18	932 (161)	19
Carquinez-Richmond	59.2 (15.0)	14	23.5 (6.44)	14
Richmond-Golden Gate	15.8 (7.85)	10	33.8 (3.32)	11
Richmond - Golden Gate w/out "outlier"	266 (251)	11	NA	

Transit times between monitor arrays on the various bridges.

¹One Chinook "outlier" took 2772 hours to transit from Richmond to the Golden Gate.



Listening Curtain at the Richmond San Rafael Bridge

The number of tag detections give an indication of residence time and transit routes under the Richmond San Rafael Bridge. Fish seem to pass where the water is deeper.

