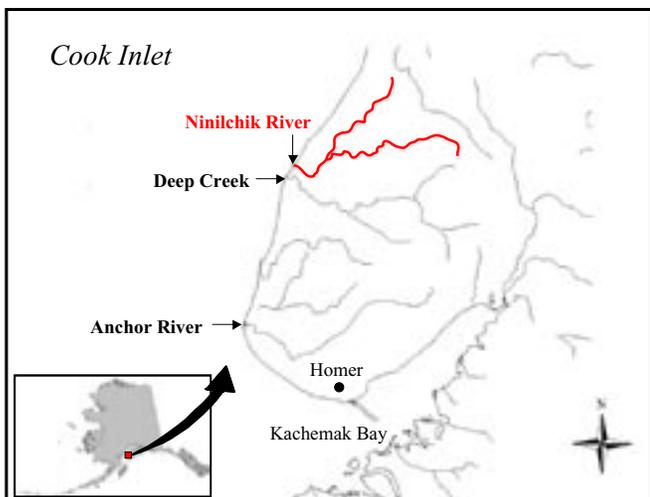


# Archival and Acoustic Tags Explore Steelhead Marine Migration



## Background

The Census of Marine Life (CoML) is a ten-year program to assess and explain the diversity, distribution, and abundance of marine organisms in the oceans. Initially, several pilot projects will be conducted to explore specific concepts of the CoML and provide guidance for the full CoML research program. The Pacific Ocean Salmon Tracking project (POST) is a CoML pilot project aimed at testing methods of tracking salmon populations on the continental shelf and in the open waters of the North Pacific Ocean using electronic tags and acoustic arrays.

The U.S. Geological Survey, Alaska Science Center is initiating one of three pilot studies within the POST. Archival and sonic tags will be used to describe the distribution of salmon as they leave the freshwater environment and range into the open North Pacific Ocean. Along with related studies in California and British Columbia, this study will serve as a means to test new technologies



and refine methods before they are applied to salmon populations throughout the North Pacific.

Tagging juvenile salmon with archival and acoustic tags is not currently feasible due to the large tag size relative to the small size of juvenile salmon. As a result, use of these tags in Pacific salmon is limited to fish that have already spent several months at sea. Steelhead (*Oncorhynchus mykiss*), unlike other

Pacific salmon, are iteroparous meaning that they do not die after spawning. As a result, adult fish capable of carrying archival and acoustic tags can be captured after spawning and tagged.

Therefore, tagging steelhead with acoustic and archival tags provides the opportunity to monitor migration to the ocean, through the marine environment, and ultimately back to freshwater on subsequent spawning migrations. The data from the acoustic tags provide detailed information concerning movements of fish at a local scale such as time spent near the mouth of the stream and direction of travel as fish leave the near-shore area. Data from the archival tags will provide a larger scale analysis of movements throughout the ocean for individual fish in marine habitats.

## Study Area

The Ninilchik River is located on the Kenai Peninsula, Alaska and drains into Cook Inlet that connects to the Pacific Ocean. Approximately 450 emigrating steelhead pass through the weir annually during May and June. An impassible fish

weir is located 6.5 km upstream from Cook Inlet and all adult steelhead returning to sea after spawning pass through the weir's fish trap, where they are counted and released downstream. Surviving steelhead generally return to the Ninilchik River to spawn after 15-16 months at sea.

## Methods

### Tagging

The USGS operated the Ninilchik River weir from May through June of 2002 and 2003 to capture and tag out-migrating steelhead kelts. Archival and acoustic tags were surgically implanted and tagged fish were also implanted with PIT tags. PIT tags were used as a secondary mark to enhance



Ninilchik River fish weir

identification and re-capture of returning tagged steelhead. The average measurements for all tagged steelhead were 653 mm fork length and 2.31 kg. Adult steelhead were tagged with V8SC coded acoustic pingers manufactured by VEMCO (Shad Bay, Nova Scotia, Canada). The cylindrical acoustic tags are 30 mm long and 9 mm in diameter. Unlike conventional acoustic tags that transmit a single ping, coded acoustic tags transmit a burst of 6 pings followed by an off time interval. The burst of 6 pings encodes an identification number



Lotek LTD\_1110 Archival Tag



Surgically implanting acoustic and archival tags

that can be decoded by a receiver and stored into non-volatile memory. LTD\_2410 and LTD\_1110 archival tags (LOTEK Marine Technologies) were implanted in steelhead kelts. The tubular archival tags are 33 mm long by 11 mm in diameter and are equipped with an external light stalk. The LTD\_2410 archival tags record temperature, pressure, and ambient light for 24 months. LTD\_1110 tags record pressure and temperature only.

### Tag Recovery

The Ninilchik River weir was operated during the spring of 2004 with the intention of capturing steelhead previously tagged with acoustic and archival tags during the 2002 and 2003 field seasons. Recovery efforts consisted of capturing emigrating steelhead in a downstream trap. Captured steelhead were individually netted, scanned for PIT tags and visually inspected for sutures, scars, or protruding light stalks. Steelhead with sutures and/or surgical scars but no PIT tags were scanned with a metal detector to determine tag retention and location. If no PIT tag was detected and no tag was identified by the metal detector, it was assumed the fish expelled both tags and



Archival tag #01560 recovered on May 26, 2004.

was released. Archival tags were surgically removed and the fish were released. Length, weight and scale samples were taken from steelhead retaining tags.

### Results and Preliminary Data

From May 18–June 30, 2004, 416 emigrating steelhead (244 female and 172 male) were individually examined for tags at the Ninilchik River weir and sixteen previously tagged steelhead were recovered. Three fish retained archival tags (2 LTD\_1110, 1 LTD\_2410, LOTEK), five were acoustic

Tag Type	Year Released	Date of Recapture	Sex	Identified by
acoustic	2002	5/22/04	f	sutures
acoustic	2002	5/23/04	f	sutures
expelled	unknown	5/23/04	f	sutures
archival	2002	5/24/04	f	PIT tag, sutures, light stalk
expelled	unknown	5/24/04	f	sutures
acoustic	2002	5/24/04	f	sutures
expelled	unknown	5/26/04	f	sutures
archival	2002	5/26/04	m	sutures, scars, light stalk
expelled	unknown	5/26/04	f	scars
acoustic	2002	5/27/04	f	PIT tag and sutures
acoustic	2002	5/29/04	m	PIT tag and sutures
archival	2002	6/1/04	f	light stalk
expelled	unknown	6/7/04	f	scars
expelled	unknown	6/7/04	f	sutures
expelled	unknown	6/7/04	m	sutures
expelled	unknown	6/8/04	f	sutures

Table 1. Recovery information for acoustic and archival tagged steelhead released into Ninilchik River during 2002-2003.

tagged and 8 expelled all tags (Table 1). We recovered 11% (1:9) of archival LTD\_2410, 8% (2:25) of archival LTD\_1110, and 10% (5:50) of acoustic tags from the 2002 release. All tags recovered in 2004 were released in 2002. Of the 16 recovered steelhead, 81% (13:16) expelled their PIT tags. It is unknown whether the eight fish that expelled both tags were released in 2002 or 2003. No tags implanted during 2002 were recovered in 2003 and no tags implanted in 2003 were recovered in 2004, suggesting the eight fish that expelled their tags were released 2002. Given the success of recovering fish tagged during the 2002 field season in 2004, it is likely that several of the 33 LTD\_2410 archival tags implanted in 2003 will be recovered in 2005.

Pressure (depth) and temperature data were successfully downloaded from the two LTD\_1110 tags recovered. Figures 1 and 2 show temperature and depth data from archival tag #01560 implanted in a female steelhead on 9 June 2002 and recovered on 26 May 2004. The LTD\_2400 tag was corrupted and no data were downloaded. It is not known what caused the LTD\_2400 malfunction.

This study is a demonstration project to test concepts and techniques for the Census of Marine Life. Specifically, this project will demonstrate the feasibility of the

archival and acoustic tag use on one species with the highest likelihood of success, and generate high profile results that can be quickly published. Progress and final reports concerning methods and application of technology will be prepared. Manuscripts for peer-reviewed publication in scientific journals are in process. We anticipate one publication concerning near-shore movements of steelhead kelts returning to the ocean (acoustic tagging) and a second publication describing migration and environment in the open ocean (archival tags).

