

Interception of a PIT-Tagged Columbia River Basin Steelhead in the Central North Pacific Ocean

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Abstract

Steelhead, Chinook and coho salmon, and piscivorous birds caught during the summer, 2008, research operations of the R/V *Wakatake maru* were screened for the presence of a passive integrated transponder (PIT) tag using a hand-held detector. One PIT-tagged steelhead was found from among the 329 fish and 68 seabirds scanned. The steelhead was tagged in April, 2006, as a smolt in the Snake River of the Columbia River Basin, USA. This PIT tag detection demonstrates the feasibility of scanning immature and maturing salmonids during on-deck processing operations of high seas salmonid research cruises. The routine use of a PIT tag detector during high-seas cruises holds the potential to generate new information from tag detections of wild and hatchery fish, which could significantly increase our knowledge of the ocean distribution of steelhead, and other salmon that originate from areas where fish are routinely PIT-tagged prior to or during their freshwater out-migration.

Introduction

The passive integrated transponder (PIT) tag is an electronic radio frequency identification device (RFID), approximately 12mm long and 2 mm in diameter. In the Columbia River Basin of the Northwest United States, PIT tags are used extensively to monitor the movement of juvenile and adult salmonid populations. The PIT tag is embedded internally in the fish, usually in the visceral cavity of the fish near the pelvic area. The unique PIT tag code can be benignly detected while inside the fish by using an external transceiver, eliminating the need to destructively remove the tag from the fish to retrieve the tag code. Since 1987, more than 21.75 million fish (predominately Chinook salmon and steelhead) have been tagged and then remotely monitored as the fish move through the juvenile and adult fish bypass facilities at the numerous hydroelectric dams in the Columbia and Snake rivers. Because Columbia River Basin fisheries management and research entities PIT-tag salmonids in significant numbers, detection of PIT-tagged fish during NPAFC-related high-seas research activities provides an opportunity to gather information on the ocean ranges of salmonids from this area, and to potentially acquire more information on growth and survival of individual fish as they return to freshwater. The research survey area of the R/V *Wakatake maru* occurred within the known range of steelhead originating from the Columbia River Basin (e.g., Myers et al. 1996, Myers et al. 2005, Celewycz 2007), so we considered it likely that steelhead caught during the cruise might have an embedded PIT tag. Our goal was to determine if PIT tags could be detected during routine, on-deck fish processing operations during the survey.

Methods

The salmon survey area of the R/V *Wakatake maru* was located in the central North Pacific and Bering Sea in the vicinity of 180° longitude (Fig. 1). A surface longline was used for the live-capture of salmonids for tagging with high-seas disk tags and data storage tags. A research gillnet was used outside the US Exclusive Economic Zone (EEZ) for capture of fish for biological data and tissue collection to monitor stock condition (Fukuwaka et al. 2008).

Steelhead and Chinook and coho salmon caught live on the longline were measured for length, and a fish scale sample was collected from each fish. Then the fish were tagged with disk tags, and scanned for the presence of a PIT tag before being returned to the sea. All steelhead, Chinook and coho mortalities from gillnet catches were scanned during routine processing on deck. In addition, piscivorous birds that could not be released alive were scanned for PIT tags. Birds were scanned because a PIT tag originally inserted in a Columbia Basin steelhead smolt was detected two years later in a sooty shearwater chick in New Zealand, indicating that birds may ingest a juvenile PIT-tagged fish, or consume fish offal that contains a PIT tag, and retain the tag in their crop for an extended period of time (http://php.ptagis.org:80/wiki/index.php/Titi_Recovery).

During this survey we scanned for PIT tags using a Pocket Reader *EX*[®] hand-held transceiver manufactured by the Destron Fearing Corporation (Figs 2-4). Prior to each fishing operation, a reference PIT tag was scanned to confirm the detector was working correctly. To ensure the scanner was within the detection range of the tag, fish were scanned by placing the detector in direct contact with the fish's skin and then the scanner was moved in a wavy pattern from head to tail on both sides of the fish's body.

When a PIT tag was detected, the displayed tag code (in decimal format) was manually copied into a notebook, as well as automatically stored in the memory of the scanner. The PIT tag codes of fish marked and released in the Columbia River Basin are reported in hexadecimal format in the PIT Tag Information System database (PTAGIS 2008) maintained by the Pacific States Marine Fisheries Commission. For each tagged fish, the database correlates the PIT tag code with the species, run, origin (hatchery or wild), length and weight of the fish, and information about when and where the fish was tagged and released. PIT tag detectors installed in the juvenile fish bypass systems at federal hydroelectric dams and other sites throughout the Basin automatically record and report the detection time and location as the juvenile PIT-tagged fish moves downstream. Information on every PIT tag mark/recovery event is updated in the PTAGIS database as soon as it is received, and is then immediately available on-line from the PTAGIS Web Portal (<http://www.ptagis.org/ptagis>).

Results and Discussion

One PIT tag was detected in the 329 fish (237 coho, 68 Chinook salmon and 24 steelhead) and 68 seabirds (shearwaters, murre, northern fulmar, and tufted and horned puffins) that were scanned. The PIT tag (decimal code 985120030555799, hexadecimal code 3D9.1BF260EE97) was detected in a steelhead caught during a longline fishing operation on June 14, 2008 at 42.067°N, 179.950°W (Fig. 1). The PIT tag was detected after high seas disk tags (NA0008, LL6008, MM3008) had been placed on a plastic cinch strap and inserted in the dorsal muscle, just anterior to the dorsal fin. After the PIT tag code was recorded, the fish was returned to the sea.

The PIT tag code identified the fish as a summer-run steelhead originating from one of five hatcheries located above Lower Granite Dam on the Snake River, USA (Table 1). In 2006, more than 7.7 million steelhead were released from these five hatcheries, located in the upper Snake River sub-basin (FPC 2008). The steelhead was PIT-tagged as a smolt on April 23, 2006,

when it was collected in the smolt bypass facility at Lower Granite Dam. The dam is located at Snake River kilometer 173, a total of 695 river kilometers from the mouth of the Columbia River. On April 24, 2006, the fish was placed on a barge and transported down the Snake and Columbia rivers and released the following evening 5 km from the mouth of the Columbia River. The fish was one of 29,200 steelhead and 16,200 Chinook salmon PIT-tagged and transported to the Columbia River Estuary in 2006 as part of a study to evaluate alternative release locations for barge-transported fish. More than 346,000 steelhead in the Columbia River Basin were PIT-tagged for various studies during 2006, comprising slightly more than 17% of the 2 million fish PIT-tagged that year.

The great circle distance between the release site at the Columbia River mouth and high seas recovery site where the fish was disk-tagged and released is approximately 4390 km. The scale collected from this steelhead indicated that at the time of disk tagging the fish was age-1.2, with a freshwater pattern typical of a hatchery fish (Davis and Light 1985, Bernard and Myers 1996). Information relating to the detection of this steelhead in the ocean has been recorded in the PTAGIS database. This information can be retrieved using the Complete Tag History interactive report from the PTAGIS Web Portal.

The recovery of this fish confirms it survived not only the transportation by barge to the Columbia River Estuary, but also survived an additional two years as it migrated to the central North Pacific. We hope it survived its capture and disk tagging on the R/V *Wakatake maru* and will be detected again on its return to the Columbia River. This PIT tag detection demonstrates the feasibility of scanning immature and maturing salmonids during on-deck processing operations of high seas research cruises, and how these interceptions can provide additional information from tag detections of wild and hatchery fish that originate from areas where fish are routinely PIT-tagged during their freshwater out-migration. This information could significantly increase our knowledge of the ocean distribution of steelhead, as well as Chinook and coho salmon.

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Table 1. Location and biological information for a PIT-tagged steelhead detected and released with high-seas disk tags during salmon research operations of R/V *Wakatake maru* in the central North Pacific Ocean during June, 2008 (Fukuwaka et al. 2008). A. The steelhead was originally collected in the Lower Granite Dam fish passage facility where it was PIT-tagged, then transported by barge to the Columbia River estuary, 5 km upstream of the river mouth, and released. B. The steelhead was tagged with high seas disk tags, the PIT tag was detected, and the fish was returned to the ocean.

A. PIT-Tag Release Site.

PIT Tag Code	Location	Latitude	Longitude	Date	FL (mm)	Life History Stage	Population	Comment
3D9.1BF260EE97 (hexadecimal)	Tagging: Lower Granite Dam	46.661°N	117.438°W	April 23, 2006	198	smolt	Snake River, hatchery, summer-run	PIT tagged at the Lower Granite Dam Fish Bypass, Snake River, Washington, barged to within 5 km of Columbia River mouth and released.
985120030555799 (decimal)	Release: Columbia River mouth	46.255°N	124.058°W	April 25, 2006				

B. High Seas Disk Tag Release and PIT Tag Interception Site.

PIT tag Code (hexadecimal)	High Seas Disk Tags	Latitude	Longitude	Date	FL (mm)	Life History Stage	Age
3D9.1BF260EE97	NA0008, LL6008, MM3008	42.067°N	179.950°W	June 14, 2008	776	Immature, or maturing adult	1.2

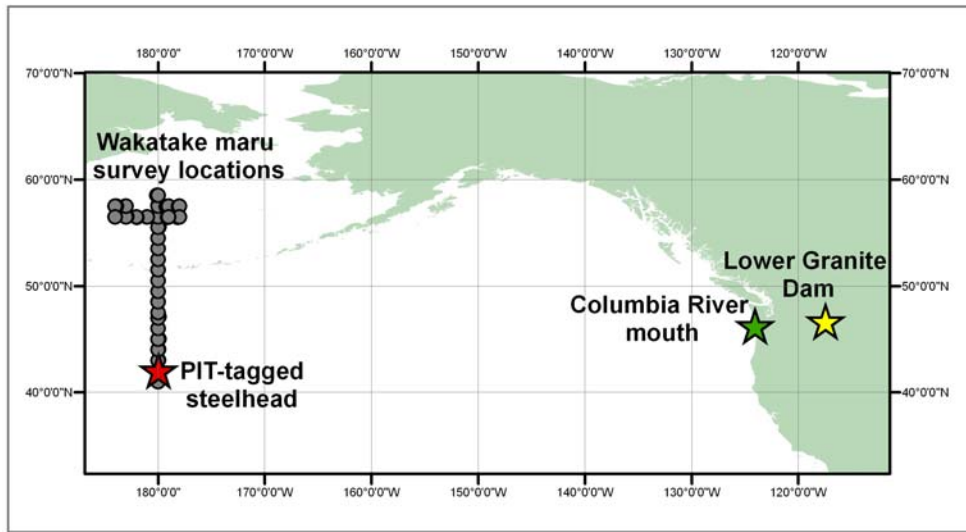


Figure. 1. Location (42.067°N, 179.950°W) in the central North Pacific Ocean that a PIT-tagged steelhead, age-1.2, was intercepted during the 2008 salmon research cruise of the R/V *Wakatake maru*. This steelhead was PIT-tagged on April 23, 2006 at the Lower Granite Dam, located on the Snake River near Pullman, WA, USA. The tagged smolt was transported by barge downstream to the Columbia River estuary and released 5 km from the River's mouth.



Figure 2. Screening a high-seas tagged steelhead for the presence of a PIT tag using a hand-held detector on the deck of the R/V *Wakatake maru*, June-July, 2008. The detector is held directly against the fish's skin and waved over the body from head to tail.



Figure 3. The detector is used to scan both sides of the steelhead's body.



Figure 4. M. Atcheson screens a salmon caught by gillnet before sample processing.