Investigating Survival and Migration Patterns of Steelhead Kelts along the Oregon Coast Using Pop-Up Satellite Archival Tags

2025 Pilot Study Report

Ryan Sollee and Matthew Thornton, Directors, The Wilderness Calling Conservation Initiative (TWCCI)

Kevin Fraley, Fisheries Ecologist, Wildlife Conservation Society

Abstract

Steelhead (*Oncorynchus mykiss*) are an extremely important species economically and ecologically. Thousands of anglers from around the world, and from local communities, visit the Pacific Northwest region annually to fish for steelhead. In Oregon, hundreds of fishing guides earn a living by taking clients out to realize their dream of catching one of these fish. This translates to significant tourism dollars coming into the state. Historically, steelhead were also important subsistence food and a cultural pillar for Native Oregonian tribes. Unfortunately, a sharp decline in steelhead numbers in Oregon has been observed over the past 50 years. Despite the decline, much of steelhead life history, and the factors that contribute to lower abundances, remain a mystery.

Steelhead are unique salmonids that have the potential to spawn and return to the ocean, at which point they are referred to as “kelts.” They can spawn and return to the ocean up to 5 times in their life, which makes the potential spawning output for each individual steelhead more prolific than that of other salmon species, which spawn only one time before dying. The freshwater life history of steelhead has been studied extensively, however the saltwater portion of their life history is under-studied, and may be different across regions (e,g, Alaska vs. Oregon populations). To address the scarcity of knowledge for Oregon populations, we are employing Pop Up Satellite Archival Tags (PSATs) to study the migration patterns and behavior of steelhead kelts from the Nestucca and Nehalem Rivers, two of the premier coastal fishing rivers in Oregon. In 2025, the first year of a planned multi-year effort, we attached seven PSATs to ocean-migrating kelts to track their post-spawning survival, collect information on saltwater migration routes, and assess water temperature and depth occupancy.

While PSATs have been used to track oceanic movements extensively in Alaska, to our knowledge they have not been deployed successfully on fish in Oregon. Therefore, the data that we have collected in 2025, and will continue to collect as part of our multi-year study, is novel and invaluable for characterizing the life histories of these populations, in the context of a pressing conservation need.

Results from the 2025 PSAT tagging pilot study indicated that kelt mortality was high during the post-spawning outmigration phase, as five of the seven tagged fish did not survive to reach saltwater. This high mortality rate may be due to natural post-spawning senescence or predation by riverine and estuarine fish-eating animals such as river otter, osprey, bald eagle, harbor seals, or sea lions. It is unlikely that fish handling or effects from PSAT tagging contributed to mortality, because tags are attached externally (minimally invasive), tagging procedure is rapid (accomplished in minutes), and tagging personnel were expert fish handlers, but procedures will be reviewed for optimization for subsequent tagging seasons.

Of the two fish that entered saltwater, one appeared to have expired from unknown predation almost immediately, with the tag drifting approximately 30 km south. The final fish swam out into the Pacific Ocean for more than 20 days, traveling a minimum distance of 364 km in the northwest direction into an area of 2590 m water depth. The tag subsequently released from this fish early due to mortality or predation, and data was transmitted. Depth and water temperature occupancy data indicated the fish undertook dives >170 m and spent time in water from 7 - 13 degrees C. Average swim depth was 2.8 m, and average water temperature occupied was 9.6 C. Compared to the at-sea behavior of steelhead tagged with PSATs from the Situk River and Prince of Wales Island, Alaska, our Nehalem River fish exhibited deeper dives, with only 7% of Situk River fish and 11% of Prince of Wales Island kelts diving past 100 m to a maximum of 134 m. Our Nehalem River fish occupied similar water temperature ranges as those in the Alaska studies (4 - 17 C across the two Alaska studies).

Overall, the high mortality rate of tagged steelhead kelts indicates a mortality bottleneck in the freshwater outmigration/estuarine entrance phase that could be targeted by conservation action to improve long-term survival of individual fish and assist in boosting abundance (e.g., facilitate protected transportation of kelts from spawning grounds to a location in the ocean to reduce post-spawning mortality). Given this preliminary information and our plans to continue our study for the next 5-10 years we will be able to fill in the knowledge gaps that exist in the ocean life history portion of Oregon steelhead , which will undoubtedly represent vital knowledge to inform conservation efforts for the species.