Reconditioning Kelt Steelhead: A Novel Management Strategy for Populations in Low Abundance.

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Abstract

We reconditioned steelhead kelts in short- and long-term programs in a five-year study. Short-term reconditioned kelts were fed for approximately 3-11 weeks, transported around Columbia River hydroelectric facilities and released, with natural rearing and gonad rematuration occurring in the ocean. In long-term reconditioning, kelts were reared for 6-10 months then released locally. Survival to release for short-term reconditioning ranged from 69-93% and averaged 79%. Post-release survival and return of short-term kelts ranged from 1-9% with returning "ocean-reared" kelts showing an average weight gain of 46%. Survival to release for long-term reconditioning ranged from 19-62% and averaged 36% with captive-reared kelts showing an average weight gain of 38%. Short- and long-term reconditioned steelhead kelts represented 2-11% of the annual spawning escapement from 2001 to 2005 compared to a repeat spawning rate of 1.6% from the literature. Radio telemetry results demonstrated success in migrating to the estuary (short-term) and locating spawning grounds and constructing redds (long-term).

Introduction and Methods

Columbia River steelhead are iteroparous (able to spawn multiple times). Hockersmith et al. (1995) documented average incidence of natural iteroparity of about 1.6% for Yakima River steelhead from 1989-1993. However, major dams affect their survival as post-spawned steelhead (kelts) attempt to migrate downstream for a return trip to the ocean (Wertheimer and Evans 2005). Therefore, a novel approach to effectively increase abundance and productivity of steelhead populations is to capitalize on their inherent iteroparity by artificially reconditioning kelts. Reconditioning is the practice of capturing, holding, and feeding post-spawned salmon or steelhead in an artificial rearing environment for the purpose of regeneration of gonads for repeat spawning.

Fig 1. Reconditioned kelts feeding in tanks at Prosser Hatchery.

The Yakama Nation, in cooperation with the Columbia River Inter-Tribal Fish Commission, is managing a reconditioning project aimed at increasing the survival and potential repeat spawning rates of Yakima River steelhead kelts. The questions we addressed in the initial phase of this project, conducted from 2001 through 2005, were:

1. What feed types result in growth and re-maturation of gonads when rearing kelt steelhead in a captive environment?
2. Do captive kelts grow and survive?
3. Is abundance of potential repeat spawners better enhanced by a short- or long-term reconditioning program?
4. Do short-term kelts migrate successfully through the lower Columbia River?
5. Do long-term reconditioned kelts migrate to the spawning grounds?

To address these questions, wild steelhead kelts from the Yakima River were captured during their emigration past Prosser Dam and through the Chandler irrigation canal (Fig 2 and 3). These kelts were held in circular tanks at Prosser Hatchery. The short-term program was conducted from 2002 to 2005 while the long-term program was from 2001 to 2005. Short-term program fish were held and fed for three to eleven weeks, then trucked around mainstem irrigation and hydroelectric facilities and released below Bonneville Dam to continue the reconditioning process on their own. Long-term program kelts were reconditioned for about 6-10 months at the Prosser Hatchery, and released at Mabton in late November or early December concurrent with the return of the natural spawning run. This allowed reconditioned kelts to naturally select their spawning location, timing, and mates. We recorded condition factor, coloration, length, weight, and gonad maturation status of all kelts at collection, release, and for some individuals, at subsequent recapture at Prosser and/or Roza Dams. All fish were implanted with passive integrated transponder (PIT) tags and some were implanted with radio tags to facilitate monitoring and evaluation objectives.

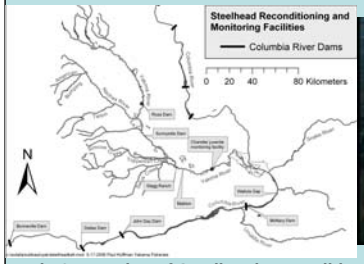
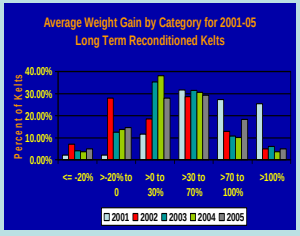


Fig 2. Location of Steelhead Reconditioning and Monitoring Facilities and Fig 3. Downstream view of Yakima R. at Prosser Dam and Chandler Canal.

Results

The use of krill as a starter diet was associated with higher overall survival rates while the use of maintenance feed pellets appeared to increase rates of maturation. Kelts that received krill as a starter diet had an average survival rate of 45% compared to only 21% survival for kelts not exposed to krill. In the tank that received a diet of just krill, only 25% of surviving fish were classified as mature compared to an average of almost 60% for the three tanks receiving a maintenance diet of pellets. We used these results to establish a feeding regime for subsequent years. Short-term reconditioned kelts were fed a diet of krill for the duration (3-11 weeks) of their captivity. Long-term reconditioned fish were fed a combination of frozen krill for the first 2.5 months and unaltered Moore-Clarke pellets thereafter.

Short-term kelts were held for an average of 44 days before being trucked below Bonneville Dam for release, while long-term kelts were reconditioned for an average of 227 days prior to release. A substantial proportion (> 45%) of long-term program fish experienced a weight gain of 30% or more during the reconditioning process (Fig 4). The mean weight gain of 37.7% for long-term reconditioned kelts compared to a mean weight gain of 46.2% for six short-term reconditioned kelts which were recaptured at Prosser an average of 152 days after their release below Bonneville Dam. For short-term kelts, survival to release ranged from 69.3% to 93.4% and averaged 78.5% from 2002-2005, while survival to release for long-term kelts ranged from 18.9% to 62.4% and averaged 35.5% from 2001-2005 (Fig 5).



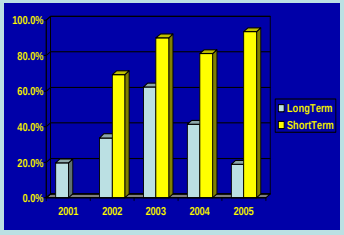


Fig 4 (L) Growth histogram for long-term kelts and Fig 5 (R) Percent of kelts surviving to release for short- and long-term reconditioning programs.

Assuming that short-term kelts returning to McNary Dam also returned to Prosser Dam, we estimate that short- and long-term reconditioned steelhead kelts represented 2.4% to 11.3% (average 6.8%) of the spawning escapement upstream of Prosser Dam annually from 2001 to 2005 (Fig 6). Radio telemetry data for 137 long-term program steelhead kelts reconditioned and released from 2001-2005 which had subsequent observations above Prosser Dam were analyzed and the last location of these fish was recorded. Approximately 30% of our final radio telemetry detections were observed in documented steelhead spawning areas of the Yakima Basin (Fig 7). A number of final detections near the mouths of two major spawning tributaries were attributed to dead batteries or failures in tags prior to these fish achieving their eventual spawning destinations. We were able to track and observe several fish constructing and guarding redds (Fig 8). In addition, several reconditioned kelts were later recaptured at Chandler with substantial weight loss observed, evidence of potential egg deposition.

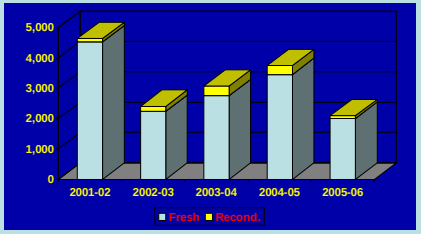


Fig 6. Number of "fresh" (steelhead migrating upstream for the first time) and reconditioned steelhead in Yakima R. returns, 2001-2006.

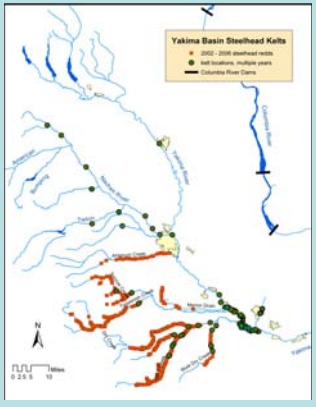


Fig 7 (L). Location of steelhead redds (red squares) and final radio telemetry locations for long-term reconditioned kelts (green dots) during the study. Fig 8 (below). Reconditioned Steelhead Female in process of constructing her redd in Satus Creek, April 1, 2002.

Conclusions

Based on the empirical results of this project to date, steelhead kelt reconditioning shows promise to assist restoration of imperiled wild steelhead populations in the Columbia River Basin. Short- and long-term reconditioning can be used to enhance post-spawn steelhead survival. The short-term approach is less invasive than long-term reconditioning, more cost efficient, and allows the fish to utilize benefits of the marine environment. Long-term reconditioning allows the release of a greater number of potential spawners, but is more expensive and presents more challenges in terms of fish culture and assuring spawning success for released fish. We are continuing to evaluate the costs and benefits of the different reconditioning programs. The key question of course, is whether reconditioned kelt steelhead were able to successfully spawn and reproduce once they were released to the natural environment. We are addressing this uncertainty more rigorously with additional research.

References

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