USING ACCLIMATION PONDS IN THE REARING OF SALMON[62]

Introduction

Acclimation ponds are frequently used in Pacific Northwest anadromous salmonid hatchery programs to redistribute adult salmon and steelhead returns. A literature review indicates that coho salmon, spring Chinook salmon and steelhead home to acclimation locations, but not fall Chinook salmon released as sub-yearlings (Slatick et al 1988; Vander Haegen and Doty 1995; Castle et al. 2002). Because returning adult fish often spawn near acclimation ponds, some conservation programs use acclimation ponds to increase spawning in under seeded areas. In harvest programs, homing to acclimation ponds can help managers by allowing returning adult fish to be removed before the fish spawn, important in the genetic management of wild fish.

Many acclimation ponds provide a more natural rearing environment, including aquatic macrophytes and dirt bottoms, and produce fish with increased post-release survivals (Tipping 1998; Tipping 2001). Acclimation ponds also allow smolt release directly at the site, which may decrease smolt travel times compared to trucked releases (Dawley et al.1977; Harza 1998; Tipping et al.1995; Tipping and Byrne 1996), and reduce the time that hatchery smolts prey on or compete with wild fish.

Homing to Acclimation Ponds

The homing ability of salmon and steelhead to natal areas has long been recognized. This ability has been shown to be heavily influenced by olfactory responses to chemical characteristics of natal waters (Brannon et al. 1984) and may also be genetically influenced (McIsaac and Quinn 1988). Imprinting appears to occur when fish undergo smoltification and emigration (Dittman et al. 1996).

The practice of outplanting smolts from hatcheries is being increasingly scrutinized due to the potential genetic damage to wild fish caused by straying of returning hatchery adults. Homing to acclimation ponds provides managers with the opportunity to remove adult hatchery fish before they spawn naturally.

Coho

Slatick et al. (1988) reported that most Columbia River coho salmon imprinted for 48 hours demonstrated a positive homing response to their point of release, be it a hatchery or upper or lower river release site. Vander Haegen and Doty (1995) analyzed the homing of coho salmon from Washington state hatcheries and found that similar rates of straying were observed for

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hatchery coho released on-station and wild coho. However, the stray rate increased for coho transported and released in-basin.

Fall Chinook

Slatick et al. (1988) found that fish released from Columbia River hatcheries generally homed back to those hatcheries. However, homing of adults to a mid-river site where juveniles had been imprinted for 9–44 days was considered poor. The majority of these fish strayed to the hatchery of origin and elsewhere. Quinn et al. (1991) reported that straying of fall Chinook in the lower Columbia River ranged from 8–19.3%. Vander Haegen and Doty (1995) reported that in-basin and out-of-basin releases resulted in more adult strays than on-station releases.

Spring Chinook

Castle et al. (2002) found that subyearling spring Chinook homed to the North Fork Nooksack River at a slightly higher rate than transported fish when acclimated to a pond on a North Fork tributary (Deadhorse Creek) (Table 1).

Table 1.Adult return distribution of spring Chinook salmon on the Nooksack River with and without use of an acclimation pond on a tributary of the North Fork Nooksack Rive (note that the hatchery is located relatively low on the North Fork).

		Recovery Location			
Year	Release strategy	North Fork	Middle Fork	Hatchery	South Fork
1996	Acclimated	61.1%	1.0%	36.3%	1.5%
	Unacclimated	54.4%	2.0%	41.1%	2.5%
1997	Acclimated	80.2%	0.0%	12.5%	7.3%
	Unacclimated	68.7%	12.1%	16.6%	2.6%
Mean	Acclimated	70.7%	0.5%	24.4%	4.4%
	Unacclimated	61.6%	7.1%	28.9%	2.6%

Steelhead

Kenaston et al. (2001) found no difference in homing rates between steelhead that were acclimated for 30 days in portable raceways and those trucked from a hatchery and directly released. They concluded that acclimation of juvenile steelhead is not necessary to achieve a high rate of homing to a release site. Slatick et al. (1988) reported that for the Columbia River, indigenous stocks of adult steelhead showed a high fidelity of return rates to the release site, but non-indigenous stocks did not. On rivers with an upstream hatchery, adult return distribution may be minimally affected by downstream smolt releases. Slaney et al. (1993) found small but significant release-site fidelity differences, but also observed substantial dispersal of lower-river-released fish to the upper river near the rearing hatchery. Tipping and Hillson (2002) found that adult return distributions from downstream smolt releases were only slightly changed for winter steelhead, while summer steelhead were unaffected.

Survival

The act of acclimating salmonids does not appear to enhance fish survival. Survival enhancements from acclimation ponds are probably due to the more natural rearing environment and/or trucking stress mollification. Kenaston et al. (2001) acclimated steelhead in portable raceways, similar to hatchery concrete raceways, and found no post-release survival enhancement over fish that were directly released into the same waters. Further, Kenaston et al. (2001) mentioned an ongoing evaluation of acclimated steelhead groups that showed no clear survival advantage. Using similar rearing raceways for acclimated and non-acclimated spring Chinook yearlings, Appleby et al. (2002) reported similar post-release survival for both groups. Acclimated subyearling spring Chinook in an asphalt bottom pond had lower survival than unacclimated fish on the Nooksack River (Castle et al. 2002).

Acclimation ponds with a more natural rearing environment have been shown to improve post-release survival of fish. Adult survival of hatchery sea-run cutthroat trout was doubled for fish reared in an acclimation-type semi-natural rearing pond versus a concrete raceway (Tipping 1998; Tipping 2001). The improved survivals may be associated with reduced rearing densities (Banks 1994; Ewing and Ewing 1995); possible cryptic coloration differences for pond-reared fish that helps them avoid predation (Donnelly and Whoriskey 1991; Maynard et al. 1996); increased exposure to natural feed that may help in post-release foraging ability (Savino et al. 1993; Maynard et al. 1996); and the acclimation process allowing trucking stress to be mollified prior to release (Specker and Schreck 1980; Schreck et al. 1989). Trucking stress was shown to reduce post-release survival in coho salmon by 20% (Johnson et al. 1990). However, for steelhead, no survival enhancement was observed for trucked smolts that were allowed to rest before release, suggesting that an acclimation pond for stress mollification would not benefit survival (Tipping 1998). In addition, steelhead and sea-run cutthroat reared in acclimation ponds have lower condition factors (measure of plumpness) than fish from raceways. This lower condition factor has been associated with improved survivals (Ewing et al. 1984; Tipping et al. 1995).

Duration of exposure to natural-type acclimation ponds appears to influence post-release survivals. Survival of sea-run cutthroat increased an average of 31% for fish placed in an acclimation pond for four to seven months prior to release, compared to fish exposed for one month prior to release (Tipping 2001). Importantly, fish exposed for even one month prior to release had 2.0 times better survival than fish reared in raceways; fish reared for four to seven months in acclimation ponds had 2.6 times better survival than fish reared in raceways.

Due to the large size and surface water source of many acclimation ponds, water temperatures within may fluctuate. Wagner (1974) found that hatchery steelhead smolts exposed to a variable temperature cycle emigrated in larger numbers than did those under constant temperature. Bjorn and Ringe (1984) reported that steelhead transferred to a pond with cold water (four to ten degrees centigrade) for two to three months prior to release had higher survivals than fish held in 15°C water until release. Wedemeyer (1982) showed that gill ATPase activity in coho salmon and steelhead could be markedly increased with a sudden temperature change. Temperature fluctuations were used to accelerate smolt development and downstream movement in yearling Chinook salmon (Muir et al. 1994). However, yearling spring Chinook that were acclimatized in the same rearing vessels from 10°C well water to four to ten degree centigrade surface water for three or six weeks prior to release had no survival enhancement (Appleby et al. 2002).

Smolt Travel Times

Although side-by-side comparison data are lacking, there is some evidence that outplanted smolts may have longer travel times compared to smolts from on-station releases. Mean travel time for ten groups of trucked steelhead smolts in one study was 2.9 km/day (Tipping and Byrne 1996), 1.6 km/day in another study (Tipping et al.1995) and 7.1 km/day in another instance (Pat Hulett, WDFW, personal communication). Meanwhile, travel times of steelhead released directly from a hatchery was 33 km/day in two studies (Dawley et al.1977; Harza 1998). Smolt emigration time is important because faster emigration reduces the time that hatchery smolts can compete and prey (Hawkins and Tipping 1999) on wild fish.

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