

**EVALUATING ADMIXTURE WITHIN THE UPPER-COLUMBIA
RIVER SPRING CHINOOK (*ONCORHYNCHUS TSHAWYTSCHA*)
EVOLUTIONARILY SIGNIFICANT UNIT: PROVIDING A
SCIENTIFIC BASIS FOR FUTURE MANAGEMENT AND RESEARCH**

Chris Beasley
Columbia River Inter-Tribal Fish Commission
729 NE Oregon, Suite 200
Portland, OR 97232
(503) 731-1265
(503) 235-4228 (facsimile)
beac@critfc.org

Shawn R. Narum
Columbia River Inter-Tribal Fish Commission

John Whiteaker
Columbia River Inter-Tribal Fish Commission

André Talbot
Columbia River Inter-Tribal Fish Commission

Doug Hatch
Columbia River Inter-Tribal Fish Commission

Madison Powell
University of Idaho Center for Salmonid Species at Risk

EXTENDED ABSTRACT ONLY- DO NOT CITE

Abstract

From 1939 to 1943 during construction of the Grand Coulee Dam (rkm 960), all chinook salmon destined for the upper 1000 km of the Columbia River were intercepted at Rock Island Dam (rkm 730). Captured adults and/or their progeny were outplanted throughout the upper-Columbia in tributaries below the Grand Coulee Dam (Chapman *et al.*, 1995).

Winthrop National Fish Hatchery (located in the Methow River Basin North-Central Washington State) propagated spring chinook salmon from the Rock Island Dam trapping program from 1941 to 1962. Winthrop Hatchery resumed operation in 1976 and the facility was stocked primarily with spring chinook salmon from the Carson National Fish Hatchery, where broodstock was derived by capturing spring chinook salmon at the Bonneville Dam (the lowermost Columbia River Dam, rkm 235). Since 1984, the majority of the Winthrop Hatchery broodstock was collected from adults returning directly to that facility (Chapman *et al.* 1995).

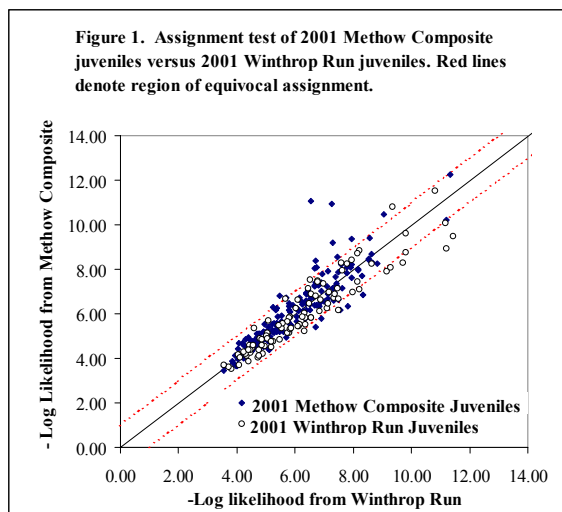
In 1992, the Methow State Fish Hatchery, located approximately 0.5 km upstream from the Winthrop Hatchery, began separate propagation of three stocks of spring chinook salmon from the Methow Basin; the Twisp River, the Chewuch River, and the mainstem Methow (Bartlett and Bugert, 1994). The goal of the Methow Hatchery is production of ESA-listed spring chinook salmon to aid in recovery. Few natural-origin spawners, and low adult returns in 1996 prompted managers to capture all adult spring chinook salmon at the nearest mainstem Columbia River dam (Wells Dam, rkm 830). Elemental scale analysis was used to assign unmarked adults to the appropriate broodstock, but an assignment threshold of only 60% was used to assign many of the unmarked adults. Subsequent to 1996, the Chewuch and mainstem Methow broodstock were merged to form the Methow Composite stock, due to chronically low returns.

Despite the historical homogenization, as well as historical and recent stock transfers, the National Marine Fisheries Service (NMFS) identified several groups of upper-Columbia River spring chinook salmon as members of the Upper Columbia River Spring Chinook Salmon Evolutionarily Significant Unit (ESU; NOAA, 1999). Within the Methow River Basin, the NMFS included natural-origin spring chinook salmon as well as spring chinook salmon from the Twisp River and Methow Composite broodstocks propagated at the Methow Hatchery. The Winthrop Hatchery (Winthrop Run) broodstock was not included

in the ESU. Following the listing decision, managers began replacing production at the Winthrop Hatchery with Methow Composite broodstock. Following this decision, favorable environmental conditions resulted in near-record runs of spring chinook salmon in 2000 and 2001. Managers were faced with the decision of destroying “surplus” Winthrop Run adults, or allowing them to spawn naturally.

Development of a restoration approach using the appropriate lineages of spring chinook salmon requires resolution of the genetic production base within the Methow River Basin. The goal of this study was to determine the composition of the Methow River Basin production base, the degree of divergence between the Methow Composite and Winthrop Run broodstocks, and to determine the degree of divergence between the propagated stocks and the naturally spawning spring chinook salmon aggregates in the Methow River Basin.

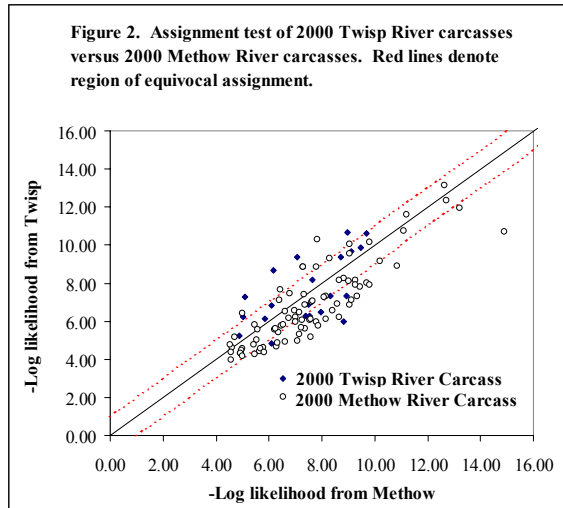
Amplification of seven polymorphic microsatellite loci from 536 spring chinook salmon from the Methow Basin revealed high levels of admixture between stocks. While slight statistical significance among sample groups (less than temporal variance) was exhibited in pairwise F_{ST} between Methow Composite (listed) and Winthrop Run



(non-listed) hatchery stocks, F_{IS} , assignment tests (using Doh; <http://www.biology.ualberta.ca/jbrzusto/doh.php>; Figure 1), and phylogenies indicate low divergence and likely homogenization. The highest level of divergence was observed between spawning ground carcasses (primarily of hatchery origin) and adult returns to Methow hatcheries with an average F_{ST} of 0.079, $p < 0.0001$. Distribution of rare alleles suggests that divergence

between spawning ground and hatchery samples may result from the contribution of stray fish to natural production. In addition, despite management as separate stocks, we were unable to genetically distinguish between natural spawning aggregates in the Twisp and Methow Rivers using an assignment test (Figure 2).

Our findings suggest that the Winthrop Run stock



has contributed substantially to both the Methow Composite stock, as well as naturally spawning spring chinook salmon aggregates throughout the Methow Basin. In addition, the lack of strong genetic divergence between the Winthrop Run stock and the naturally spawning spring chinook salmon aggregates in the Methow Basin suggests that the Winthrop Run stock has received reciprocal gene flow from natural spawners. Although data are limited (with only 18 Twisp River carcass samples), our findings do not support management of the Twisp and Methow River aggregates as separate populations. Finally, our interpretation of the genetic data is supported by coded wire tag recoveries and hatchery records, which confirm the potential for both substantial exchanges between the Methow Composite and Twisp River stocks, as well as substantial contribution in the Methow mainstem and to the Methow composite by Winthrop Run adults.

Literature Cited

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