# HIGH RATES OF PRECOCIOUS MALE MATURATION IN A SPRING CHINOOK SALMON SUPPLEMENTATION PROGRAM:

# CAUSES, CONSEQUENCES, AND POTENTIAL SOLUTIONS

Donald A. Larsen
Integrative Fish Biology Program, Northwest Fisheries Science Center,
National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle,
Washington 98112, USA
Phone (206) 860-3462, FAX (206) 860-3467, e-mail: don.larsen@noaa.gov

Brian R. Beckman, Kathleen A. Cooper, Jon T. Dickey, Penny Swanson, and
Walton W. Dickhoff
Integrative Fish Biology Program, Northwest Fisheries Science Center

**EXTENDED ABSTRACT ONLY – DO NOT CITE**

Throughout the Pacific Northwest of the United States "supplementation" hatchery strategies are being employed in attempts to rebuild native stocks and also augment fisheries. Successful supplementation relies on improving the post release survival of hatchery salmon while reducing potential negative genetic and ecological impacts on wild fish. Although in practice definitions vary, a supplementation hatchery may be defined as a rearing facility to breed and propagate a stock of fish with genetic resources equivalent to the native stock, and with the full ability to return to reproduce naturally in its native habitat (Flagg and Nash 1999). These projects generally utilize production hatchery rearing methods with juvenile releases occurring at acclimation sites to provide homing to target areas. In some programs no returning adults are taken in to the hatchery as broodstock for subsequent generations but rather allowed to spawn naturally in the wild to minimize adverse genetic impacts.

Supplementation hatcheries have the potential benefits of reducing short-term risk of extinction, speeding recovery, reseeding vacant habitat, and increasing harvest opportunity. However, much controversy and uncertainty surrounds the use of these "experimental" facilities and, to date, little information is available regarding the performance of supplemented fish and their progeny in the natural environment.

The Yakima River Spring Chinook Salmon Supplementation Project in Washington State is currently the most extensive test of supplementation hatchery principles. Over the past four years we have conducted research to characterize the physiology and development of naturally-reared wild and hatchery-reared spring chinook salmon (*Oncorhynchus tshawytscha*) in the Yakima River Basin. Fish were sampled at the main hatchery in the town of Cle Elum, at remote acclimation sites, and at downstream dams during spring smolt migration. During these studies the maturational state of all fish was characterized using visual and histological analysis, measurement of plasma 11-ketotestosterone levels, and gonadosomatic index. These analyses revealed that approximately 50% of the hatchery-reared males from this program were undergoing precocious maturation at 1+ years of age and the majority of these fish, but not all, were residualizing in the upper Yakima River basin throughout the summer.

Many species of male salmonids display phenotypic plasticity in their age of sexual maturation. Two age classes of precocious males exist in spring (stream-type) chinook salmon: sub-yearling (0-age precocious parr) and yearling (1+ year-old parr, also commonly referred to as "minijacks"). The incidence of precocious maturation in naturally rearing stocks of spring chinook salmon is poorly characterized, but believed to be less than 5% (Gebhards 1960). Age of maturation in salmon is influenced by genetic, biotic, and abiotic factors (Power 1986) including energy stores (whole body lipid), size and/or growth rate at specific times of year (Silverstein et al. 1998; Shearer and Swanson 2000). Studies in spring chinook salmon have shown that male maturation is physiologically initiated in the fall, approximately 10 months prior to autumn maturation (Silverstein et al. 1998; Shearer and Swanson, 2000). In precociously developing males external characteristics of maturation (olive pigmentation, deep body shape, and dark fin margins) as well as very large white gonads typical of the later stages of maturation may not be evident until mid-summer prior to autumn spawning. These more obvious signs of early maturity often escape detection since most spring chinook hatcheries release fish in March and April, which may explain, in part, why this issue has historically received only modest attention.

Precocious maturation represents a natural life-history strategy for the Yakima and other spring chinook populations, but the hatchery environment may be potentiating this developmental pathway beyond natural levels. Alterations in the normal life-history composition of salmon populations are undesirable in supplementation as well as production hatcheries. An uncharacteristically high incidence of precocious male maturation may result in loss of potential returning anadromous adults, biasing of male/female sex ratios, and negative genetic and ecological impacts on wild populations and other native species. These impacts may include increased straying, predation, and competition with native fish species and other stocks for limited resources and habitat.

In recent laboratory studies we, and others, have found that modulation of growth rate at specific times of the year can reduce the incidence of precocious maturation. This talk will close by describing growth rate modulation studies currently being conducted at the Yakima River Cle Elum Hatchery to potentially reduce early male maturation to levels similar to their wild cohorts.

**References**

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