

ABSTRACT

HATCHERY REFORM: REDUCING RISK OF CUMULATIVE IMPACT OF HATCHERY ORIGIN FISH ON NATURAL ORIGIN FISH IN THE COLUMBIA RIVER ESTUARY WHILE INCREASING HATCHERY MARINE SURVIVAL

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There is a strong consensus that estuaries are important in terms of providing rearing habitat for growth, potential refuge from predation and a physiological transition before emigrating to the higher salinity in the marine environment (Quinn 2005, Thorpe 1994). Unfortunately, the Columbia River (CR) estuary has suffered a major loss of shallow water rearing habitat in the past century. This loss of habitat has been documented by Bottom et al. 2005 in their excellent treatment of the role of the CR estuary in the Decline and Recovery of Pacific Salmon in which they point out that the loss of wetland habitat since 1870 has been a major factor in the capacity of the estuary to support juvenile salmon. It is estimated that 77% of tidal marshes and 62% of swamps which existed before 1870 have been lost. The diking and filling of marshes and swamps have reduced the surface area by 20% (Bottom et al. 2005). These changes in the CR estuary in terms of habitat loss are likely to have the biggest impact on the capacity to support juvenile salmon however, the impact of habitat loss in the CR estuary in terms of salmonid carrying capacity is unknown (Bottom et al 2005). More specifically, it has been established that subyearling Chinook and chum are species that use the CR estuary more than other species. Chinook are found in the estuary in every month of the year but were most abundant from May to September whereas chum fry are found in the estuary from March to June (Bottom et al. 1983, Dawley et al. 1986, McCabe et al. 1986). These two species, subyearling Chinook and chum salmon, show a preference for shallow water marsh and swamp habitat. Given the limited habitat in the CR estuary this sets the stage for the impact of more abundant hatchery origin fish (HOF) on their natural origin fish (NOF) counterparts in terms of spatial and temporal overlap of habitat. Based on actual smolt release data from 2007 that was reported in the Mitchell Act DEIS 86% of the salmonid smolts or approximately 108 million that reach the estuary are HOF. Of these 52% are fall Chinook, 20% are spring Chinook, 18% are coho, 9% are steelhead and 1% are chum salmon. The number of NOF to reach the estuary were estimated by a habitat based modeling effort, also part of the Mitchell Act DEIS, to be 14% (17.8 million) of the overall total number of smolts which were composed of 47% fall Chinook, 28% chum, 13 % spring Chinook, 7% steelhead and 4% coho. Given the larger numbers of HOF the risks of ecological interactions (competition, predation and disease transfer) are greater based upon limited estuary habitat. One method used to illustrate the risk of larger numbers of hatchery fish compared to natural origin smolts in the estuary is to calculate a simple density metric in an effort to quantify the effect. Both intraspecific and interspecific interactions have been quantified in this manner. Since the CR estuary in contemporary times is much smaller than historically it tends to exacerbate the impact of spatial and temporal overlap between HOF and NOF. One aspect of control over risk is in the temporal component since most hatchery fish are released from April and May and to

a lesser extent in June. A number of authors have suggested staggering releases of HOF. Perhaps a viable release strategy would involve sequencing the hatchery release with the availability of the marine prey base as was originally proposed and implemented by the Japanese in their chum salmon program and subsequently used in Alaska. In other words, hatchery release timing could be based upon the peak availability of the zooplankton populations in the nearshore marine environment. There is a strong data base from NOAA Fisheries biweekly oceanographic zooplankton sampling off Newport, OR that could be used as a predictor of salmonid prey availability. More specifically, smolt releases could be timed based on the abundance of zooplankton prey rather than the current arbitrary release dates in April and May. It is a testable working hypothesis that better marine survival would result from biologically timed releases based upon salmonid prey abundance which could improve hatchery performance in the spirit of hatchery reform while reducing the risk of cumulative impact of HOF on NOF from intraspecific and interspecific ecological interactions in the Columbia River estuary.