Population Composition, Migration Timing, and Harvest of Columbia River Chinook Salmon in Late Summer and Fall

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Abstract.—We used radiotelemetry to evaluate population composition, run timing, and reservoir harvest patterns for adult Columbia River fall-run Chinook salmon Oncorhynchus tshawytscha. Chinook salmon (n = 5,886) were collected at Bonneville Dam during August–October over 7 years. We selected for upriver bright (URB) populations en route to interior basin spawning sites because these groups are priority populations for both fisheries and conservation efforts. Run composition varied within and among years, but in all years a relatively large percentage of the earliest migrants returned to upper Columbia River sites and the majority of late-run fish returned to the Columbia River Hanford Reach. Deschutes, Yakima, and Snake River populations typically constituted small (<20%) but relatively constant proportions of the run throughout each migration season. Population-specific migration timing distributions indicated modest but persistent timing differences among populations, particularly for Hanford Reach and upper Columbia River populations. Annual reported reservoir harvest estimates ranged from 12% to 26%. Harvest rates varied seasonally within years, from relatively low mean rates (<11%) for fish tagged early and late in migrations to peak rates of over 25% for those tagged in late August and early September. These patterns suggest that it may be possible to increase harvest of abundant populations and reduce harvest of some vulnerable populations by adjusting the timing of fisheries. In addition, there was evidence that larger fish were harvested at higher rates and that mean fish size differed among populations. The combined results improve our understanding of the Columbia River URB fall Chinook salmon run and should help in refining harvest and escapement management plans.

Mixed-stock fisheries for Pacific salmon Oncorhynchus spp., defined as the harvest of adults before they have segregated to their natal streams, pose a persistent management challenge to balance protection of less-productive and vulnerable populations with efforts to maximize sustainable harvest of robust populations (Ricker and Smith 1975; Collie et al. 1990; Knudsen 2000; Newell et al. 2007). Balancing these competing objectives for Columbia River fall-run Chinook salmon O. tshawytscha is especially problematic. First, the run is a diverse assemblage of wild and hatchery populations, including some federally protected wild fish. Second, the aggregate population is exposed to a variety of mixed-stock fisheries in multiple management jurisdictions. These range from Alaskan and Canadian ocean fisheries to in-river commercial, tribal, and sport fisheries (Waples et al. 1991; Myers et al. 1998). Ocean harvest of Columbia River salmon is regulated by the 1985 Pacific Salmon Treaty (USA–Canada) and the Pacific Fisheries Management Council, whereas in-river harvest is subject to federal, state, commercial, and tribal rules. Additional regulatory requirements for the run stem from the U.S. v. Oregon agreement and its associated biological opinion (NMFS 2008; U.S. v. Oregon 2008). In this multi-tiered management structure, it is often difficult to develop and assess strategies to protect threatened populations.

Alternative paradigms contribute to the current difficulty related to managing Columbia River fall Chinook salmon. A stock-based paradigm was developed first and evolved as a harvest management approach in which stocks are classified into units based on geographic region and adult run timing. The second paradigm is based on evolutionarily significant units (ESUs), a more biologically based system in which groups are delineated based on differences in ecological or genetic diversity (Waples 1995). The ESUs may contain a hierarchy of distinct Chinook salmon populations that are reproductively isolated from conspecific populations. The ESU approach was developed coastwide for Chinook salmon and other anadromous salmonids under the U.S. Endangered Species Act in an effort to protect the evolutionary legacy of each species (e.g., Good et al. 2005). For a