**Stress-Induced Delayed Mortality in Juvenile In-River and Barged Chinook Salmon Outmigrating through the Columbia River Hydropower System**

Frank Loge
University of California Davis

Various methods have been developed to mitigate effects of the Federal Columbia River Power System (FCRPS) on juvenile salmon migrating through the Columbia River Basin. In this study, we found barged hatchery-reared Snake River spring/summer Chinook salmon were less susceptible to infectious diseases than fish with an in-river outmigration life-history, suggesting that the FCRPS imposes a level of stress that adversely impacts the health of in-river smolts, and barging mitigates that stress. In addition, we found that the hatchery of origin affected disease susceptibility, with significant differences observed between hatcheries in the disease susceptibility of barged fish but not fish with an in-river life-history. We hypothesize that the less fit in-river fish were culled prior to reaching Bonneville Dam, thereby eliminating differences in disease susceptibility between hatcheries within in-river fish, whereas barged fish are culled in the estuary after release.

Through the application of a dose-structured population dynamic model, we show that chemical (both in the river and estuary) and in-river (e.g., dams and/or predation) stressors influence host-susceptibility, increasing the mean force of infection (defined as the per capita acquisition rate of infection) by a factor of 2.2 and 1.6, respectively. Using *Listonella anguillarum* as a model pathogen, non-chemical in-river and chemical stressors contribute equally to a cumulative incidence of delayed disease-induced mortalities in Chinook salmon that range from 3 to 18% for estuary residence times of 30 to 120 days, respectively. Mitigation of environmental stressors that increase host-susceptibility could represent a significant component in future management strategies to recover listed stocks.

Physical, chemical, and biological characteristics of the smolts were evaluated to provide an ecological context within which to evaluate underlying mechanisms associated with disease susceptibility. Trends in whole-body lipid and chemical concentrations supported the differential disease susceptibility between barged and in-river fish. In contrast to these measures that would suggest barged fish are as fit, if not more, than in-river outmigrants, we found that barged fish had a greater mortality rate in the laboratory prior to disease challenge. If the incidence of mortality observed in the laboratory is any indication of what takes place during outmigration, a significant fraction of barged fish may suffer disease-related deaths shortly after release into the estuary. The collective results suggest that barging may help to mitigate the adverse health effects of the FCRPS on Snake River spring/summer Chinook salmon, but the fate of barged fish in the estuary and ocean may depend on their health status shortly after entering the river system (e.g., prior to barging).