Executive Summary

Plasticity and adaptation in life histories allow populations to persist in fluctuating environments. Steelhead exhibit a remarkable range of life histories, yet continue to decline in abundance throughout California. The research proposed here will examine (through models, laboratory experiments, and field work) the hypothesis that alteration of the amount of water flow and the temporal pattern of its delivery in a watershed impact the life history trajectory selected by juvenile steelhead. Alteration of the complex linkage between life history strategies and survival potentially contributes to the continuing decline of steelhead populations. The mechanism underlying a particular trajectory is presumed to be an interacting function of growth rates, body condition, and the temporal pattern of changes in these attributes during the first year of life. Growth opportunity is likely to be greatly modified by changes in water flow, primarily through accompanying changes in temperature, available habitat, and food delivery in the form of drifting invertebrates. We will use a three-pronged approach of laboratory, field, and modeling studies to investigate the environmental factors that determine life history transitions and pathways for age-0 steelhead, how these patterns vary across different populations and watersheds, how modification in flow regimes impacts growth opportunity and subsequent life history decisions, and how these life history transitions affect population dynamics. Laboratory experiments will examine the timing of decision windows that set an individual on one of three pathways: emigration at age-1, continued residence in freshwater prior to emigration, or early maturation. Central Valley and central California coast populations will be used to assess population differences in growth responses and selected trajectories. Field studies will focus on the seasonal variability in environmental factors for age-0 steelhead in four watersheds, two in the Central Valley and two on the central California coast. Physical parameters of temperature and flow rates, and biological parameters of food availability and competitor density will be monitored throughout a three year time period. Growth rates will be measured in tagged fish to evaluate correspondence with expectations based on environmental factors. Data from lab and field studies will be incorporated into life cycle and population models of California steelhead. Results of all three approaches will be used to develop predictive models of life history consequences under varying environmental conditions and water policy decisions. These scenarios will be valuable in assessing the implications of different water management regimes for continued persistence of steelhead populations in freshwater ecosystems of the Central Valley and other California regions. . Our work will thus focus on CalFed priority topic areas of ecological processes and their relationship to water management and key species and water operations and biological resources. Furthermore, our work will provide tools and data to help achieve the CVPIA Section 3406(b)1 objective of doubling populations of naturally produced salmonids.