Marine heatwaves in the northern California current: Impacts on early marine steelhead diet composition, morphology and potential survival

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Abstract

Juvenile steelhead (Oncorhynchus mykiss) enter the northern California Current from the Columbia River and Northwest coastal rivers and include several populations listed under the US Endangered Species Act. Columbia River steelhead that migrated into the ocean between 2014-20 have returned as adults in the lowest numbers in the last 25-yrs. Ocean sea surface temperatures (SST) have almost continually been above average during this time period, and both spring Chinook salmon and steelhead adult salmon returns are negatively correlated with elevated SST. Marine heat waves (MHW) are classified as areas where the ocean temperature is warmer than usual for an extended period of time for the location and time of year, and the majority of the juvenile steelhead range has been in a MHW during their early marine phase. NOAA/OSU's juvenile salmon ocean ecosystem survey (JSOES) has occurred since 1998 and was initially in May, June, and September. Due to funding constraints, the May survey changed in 2015 (no surveys in 2013-14) to target the location of where juvenile yearling Chinook salmon are typically in the marine environment, which is more inshore of where juvenile steelhead are located on average. With potentially less juvenile steelhead being sampled, we compare patterns of size, condition, and diets relative to ocean conditions between juvenile steelhead and yearling Chinook salmon. Juvenile steelhead are typically thinner in May when yearling Chinook salmon are, and show a negative correlation with their adult returns when this occurs. Several yearling Chinook salmon stocks have significant size shifts between cooler and warmer ocean conditions, but steelhead did not. Juvenile steelhead were eating similar prey, with some exceptions, but in different amounts, and as such, their diet composition was significantly different from yearling Chinook salmon caught at similar locations. They both show changes in diet composition between cold and warm ocean conditions. Yearling spring Chinook salmon condition and trophic habits could be used to predict metrics of juvenile steelhead in their marine environment, although due to their declining populations, it would be important to have directed marine surveys of steelhead earlier in May and further offshore.