**Potential effects of climate change on the high seas life history**

**and ecology of steelhead in the North Pacific Ocean**

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Human-caused changes in climate are expected to affect key physical and biological drivers of natural variation in the high seas life history and ecology of steelhead (Myers and Mantua 2013). In their natural oceanic habitats, steelhead migrate and feed in near-surface (epipelagic) and surface (neustonic) layers, where sea surface temperature (SST) and salinity are key physical factors influencing seasonal patterns of horizontal distribution. Modeled changes in future SSTs in summer due to greenhouse warming indicate a substantial northward shift and east–west contraction in high seas thermal habitats of steelhead by the end of the 21st Century (Abdul-Aziz et al. 2011). Projected changes would eliminate most or all of the current summer rearing habitat of North American-origin juvenile (ocean age 0) steelhead in the Gulf of Alaska, as well as a substantial portion of the trans-North Pacific summer rearing habitat of immature and maturing inland summer-run steelhead populations of the Snake River Basin. Changes in SSTs related to the extreme 1997 El Niño coincided with a large decrease in squid, which are preferred prey, in the summer diets of steelhead in the Gulf of Alaska (Atcheson et al. 2012a). The decrease in dietary squid was even larger in the central Subarctic North Pacific, where steelhead compete for food with abundant stocks of Russian pink salmon. Recent decades have brought record high levels of pink salmon abundance throughout most of the North Pacific region, supporting the idea that late 20th century warming of the North Pacific Ocean and salmon rivers of the Pacific Rim was beneficial to pink salmon. Modeled growth potential of steelhead under future SST scenarios showed reduced growth as temperatures warm beyond the optimum growth temperature for a given feeding rate and body mass of steelhead (Atcheson et al. 2012b). The combined reduction in physiological maximum feeding rate and increasing metabolic costs prevent any potential increases in steelhead feeding rate or energetic prey quality from sustaining historical growth rates. The resulting growth decline might become a strong selective force in shifting the geographic distribution of steelhead in the ocean and perhaps in freshwater. For example, as temperatures warm in the Bering Sea conditions may become more favorable for steelhead in eastern Kamchatka and western Alaska streams, regions that currently host only resident rainbow trout. Important topics for future evaluations of potential climate-change effects on high seas steelhead include population-specific responses, hatchery-wild steelhead interactions, ocean acidification, and marine pollution.

**References**

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