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Sustainable Leadership

Climate Change Impacts on National Fish Hatcheries

U.S. Fish and Wildlife Service's (FWS) National Fish Hatchery System (NFHS) was established in 1871 by Congress to conserve fishery resources for future generations. The first Federal fish hatchery was established in 1872, known as the Baird Hatchery on the McCloud River in California. The FWS's mission has always been to "work with others to conserve, protect and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people" (U.S. Fish and Wildlife Service, 2013). Since the creation of NFHS, it has established hatcheries, laboratories, and research centers all over the United States and as of 2013, there were over seventy facilities. The focus of NFHS is the culture and distribution of fish, mussels and other aquatic species that are federally listed as threatened and endangered (U.S. Fish and Wildlife Service, 2013). NFHS also works to restore declining or depleted fish stocks and other aquatic species in hopes to prevent more listings on the Endangered Species Act (U.S. Fish and Wildlife, 2015). They work respectively with Native American tribes to enhance tribal fisheries to ensure availability of food. NFHS provides a place of interest for visitors and chances for aquatic education while also making significant contributions to recreational, commercial, and tribal fisheries in lakes, streams, and marine environments across the United States by propagating and releasing millions of fish species (U.S. Fish and Wildlife Service, 2013)

Currently, there are 155 fish and 88 mussel species listed under the Endangered Species Act in the United States. Between 1898 and 2006, 39 species and 18 subspecies of fish were declared extinct in North America and researchers estimate that an additional 53-86 species of freshwater fish may be extinct by 2050 (U.S. Fish and Wildlife, 2015). Due to human activities such as agricultural, urban and transportation development, pollution discharge, and construction of dams, the nation's water resources are becoming degraded. In addition to human activities, climate change is posing a great threat to water supplies by changing precipitation patterns and increasing water temperatures, especially in the western and southwestern parts of the United States. Native aquatic species are already stressed and additional changes may be too much for some species, such as the eastern brook trout, which rely on clean, cold water to survive (U.S. Fish and Wildlife, 2015). Salmonids (salmon, trout, and whitefish) are an ecologically and economically vital group of fish that are greatly influenced by climate change. Increases in stream temperatures will influence the distribution of salmonid populations because they require cold water and invasions of nonnative species will also fragment their habitats, influencing the size and genetic makeup of a population (Roberts, Fausch, Peterson, & Hooten, 2013). The NFHS in the Pacific Northwest annually produces and releases over 60 million juvenile Pacific salmonids (Hanson & Ostrand, 2011).

Fish hatcheries can produce a large number of fish that are of adequate size and condition by being able to control and modify rearing conditions such as water temperature, rearing densities, rations and rearing schedules (Hanson & Peterson, 2014). Hatcheries can be less costly and more convenient than large-scale habitat restorations. Managers can regulate environmental conditions and fish growth by managing the flow of water, altering the water temperature,

changing the size of rearing containers or densities, and controlling rations or diet composition (Hanson & Peterson, 2014).

Climate change will have a major impact on water temperature and hydrology of local watersheds that supply hatcheries' water and changes in the natural environment can affect the water quality and quantity (Hanson & Peterson, 2014). Hatcheries will also have to compete with the need of water by a growing population. In some areas like the Northwest, increased winter temperatures along with increased rain fall will prevent the accumulation of snowpack and can cause high surface flows and potential flooding during the fall and winter (Hanson & Ostrand, 2011). Hatcheries and facilities that draw water from streams might suffer from lower water availability in the summer months due to variations in surface flow. An increase in flooding and frequency of forest fires could possibly damage hatchery infrastructure. Hatcheries near the coast could see damage from sea level rise, due to volume expansion because of higher temperatures, and salt water intrusion. Heat waves and severe droughts are expected to intensify and will greatly influence water quality and availability (Hanson & Peterson, 2014). Agriculture will suffer greatly from droughts and more water will have to be pulled from river systems to compensate during the growing season. As water temperatures increase, chillers will be needed in the hatcheries. Rearing techniques will need to change to compensate for increased growth rates from warmer waters. Managers will need to either decrease food rations, which may affect fish conditions and health, or produce less fish due to increased biomass, which means releasing fewer fish that are larger and can eat more. Hatcheries will need to use chillers to control temperature increases during summer months or reduce fish growth in other months to compensate for the increases during summer (Hanson & Peterson, 2014). Wild populations of fish will be greatly affected by climatic changes. Hatcheries will need to continue monitoring of

genetic and phenotypic similarities between wild and reared fish to prevent outbreeding depression causing reduced fitness of the wild populations (Hanson & Ostrand, 2011).

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Questions for Research:

- Temperature related diseases impacts are already occurring in the summer- what happens with increased temperatures? Can fish in hatcheries evolve to defend themselves against this in the wild?
- Increased temps, increased bacteria- How does this effect the people working in the hatcheries?
- Increase in temp increases growth but may be offset with increased salinity reducing growth?
- Fish habitats will shift- researchers will have to be mindful of this when releasing new fish?

- How do fish hatcheries work? How are they operated and maintained? What are the daily responsibilities of them?