

Trans. Am. Fish. Soc., In press, 2009

Reproductive Abnormalities in Trout from Western U.S. National Parks

Adam R. Schwindt^a Michael L. Kent^a, Luke K. Ackerman^b, Staci L. Massey Simonich^{b,c}, Dixon H. Landers^d, Tamara Blett^e & Carl B. Schreck^f

^aDepartment of Microbiology, 220 Nash Hall, Oregon State University, Corvallis, Oregon 97331. ^bDepartment of Chemistry, 153 Gilbert Hall, Oregon State University, Corvallis, Oregon 97331. ^cDepartment of Environmental and Molecular Toxicology, 1007 Agricultural Life Sciences, Oregon State University, Corvallis, Oregon 97331. ^dU.S. EPA, National Health and Environmental Effects Research Laboratory, Western Ecology Division, 200 SW 35th Street, Corvallis, Oregon 97333. ^eU.S. National Park Service, Air Resources Division, P.O. Box 25287, Denver, Colorado 80225. ^fU.S. Geological Survey, Oregon Cooperative Fish & Wildlife Research Unit & 22 Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, 23 Oregon 97331.

Reproductive disruption is well-documented in polluted areas such as below sewage treatment plants, but not in ecologically protected environments such as national parks. In a majority of sub-alpine lakes sampled in Rocky Mountain and Glacier National Parks, we observed intersex male cutthroat trout *Oncorhynchus clarkii* and brook trout *Salvelinus fontinalis* at frequencies of 9-33%. Intersex, one form of reproductive disruption, is the presence of both male and female reproductive structures in the same animal. Male cutthroat trout, rainbow trout *O. mykiss*, and brook trout from these parks also produced elevated levels of the estrogen-responsive protein vitellogenin, another indicator of reproductive disruption. We did not find reproductive abnormalities in national parks of the Sierra Nevada, Cascades, Olympics, Brooks, or Alaska ranges. To determine if gonad abnormalities were evident in mountain ecosystems before the production of organic pollutants, we sampled various species of the family Salmonidae collected from the pre-organic pollutant era (pre-1930s). In these museum collections, we observed intersex male greenback cutthroat trout *O. c. stomias* collected in the late 1800s from Twin Lakes, Colorado, in the Rocky Mountains. Our results suggest that reproductive disruption is occurring in some national parks. The abnormalities were observed in remote, high elevation locations, suggesting that they might have resulted from airborne contaminants. Our observation of intersex greenback cutthroat from the late 1800s suggests that organic pollutants are not the only factors inducing reproductive disruption. The causes and population level consequences of reproductive disruption in these lakes remain to be determined.