Toxic contaminants pose a threat to early marine survival of Chinook salmon from Puget Sound

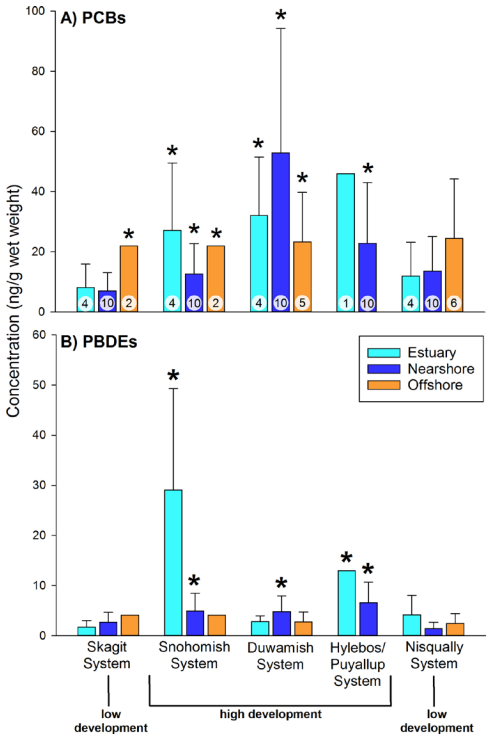
Andrea Carey[1], Jennifer Lanksbury[1], Laurie Niewolny[1], Gina Ylitalo[2], Lyndal Johnson[2], James West[1], Sandra O'Neill[1]

1. Washington Department of Fish and Wildlife; 2. NOAA, Northwest Fisheries Science Center

- A third of juvenile Chinook salmon migrating through Puget Sound estuary, nearshore and offshore habitats accumulated contaminant concentrations high enough to impair their health.

Human development and urbanization of Puget Sound over the past 100 years has led to the loss and modification of salmonid habitat, and has resulted in inputs of toxic contaminants and impairment of water quality (Meador et al. 2014). Salmonids may be exposed to contaminants in fresh, estuarine, and marine waters (Cullon et al. 2009; O'Neill and West 2009); however, the health and ultimately the marine survival of juveniles migrating from freshwater into Puget Sound en route to the Pacific Ocean are more likely to be reduced by contaminant exposure as this life stage also undergoes tremendous physiological stress associated with smolting. Juvenile Chinook salmon are especially vulnerable to contaminant exposure because they spend considerably more time than other salmonid species feeding in estuaries (Quinn 2005) where contaminant inputs may be quite high. This study was designed to provide a synoptic assessment of contaminant exposure for major populations of Puget Sound juvenile Chinook salmon as they migrate from freshwater to marine habitats.

Fish were sampled in spring and summer of 2013 from five major Puget Sound river systems and three associated marine basins in Puget Sound. In each river system, sampling sites included locations in the lower estuary and adjacent nearshore marine shorelines, while the offshore marine basins included Whidbey, Central, and South Basins. Whole-body juvenile Chinook were analyzed for persistent organic pollutants, including polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and several organochlorine pesticides.



The mean concentrations (+95% confidence intervals) of PCBs (A) and PBDEs (B) measured in juvenile Chinook salmon whole bodies. The star indicates some or all samples exceeded the adverse effects threshold for that contaminant. Sample sizes are in located within the bars of Figure A.

Approximately one third of the juvenile Chinook salmon sampled from estuary, nearshore marine, and offshore habitats of Puget Sound had contaminant concentrations associated with adverse effects (O'Neill et al. 2015). These effects include reduction in growth and disease resistance, and altered hormone and protein levels. Most levels of PCBs and PBDEs measured in salmon from the more developed Snohomish, Green/Duwamish, and Hylebos/Puyallup river systems were high enough to potentially cause these adverse effects. Furthermore, PCBs and PBDEs from these highly developed river systems and other sources are reaching less developed offshore habitats where juvenile Chinook salmon may feed for several months, as evidenced by the higher total mass of these contaminants in their bodies. Moreover, juvenile Chinook salmon migrating from rivers to the offshore habitat of the Whidbey and Central Basins accumulated substantial PCB concentrations, sometimes high enough to potentially impair their health.

Building on these results, WDFW is currently expanding and modifying the sampling design to provide better estimates of contaminant exposure in juvenile Chinook salmon for all populations from each of the major river systems in Puget Sound. This new study will help identify areas where salmon may be at risk of contaminant exposure so that appropriate toxics reduction activities can be implemented.

For more information: Andrea Carey, andrea.carey@dfw.wa.gov http://wdfw.wa.gov/conservation/research/projects/marine_toxics/index.html

RECOMMENDED CITATION

Carey, A.J., Lanksbury, J.A., Niewolny, L.A., Ylitalo, G.M., Johnson, L., West, J.E., and O'Neill, S.M. (2017) Toxic contaminants pose a threat to early marine survival of Chinook salmon from Puget Sound. p. 15 In 2016 Salish Sea Toxics Monitoring Review: A Selection of Research. Edited by C.A. James, J. Lanksbury, D. Lester, S. O'Neill, T. Roberts, C. Sullivan, J. West. Puget Sound Ecosystem Monitoring Program. Tacoma, WA. 68 pp; https://www.eopugetsound.org/sites/default/files/features/resources/PSEMP_2016_ToxicsSynthesis%202017.05.09.pdf

REFERENCES

Cullon, D.L., Yunker, M.B., Alleyne, C., Dangerfield, N.J., O'Neill, S., Whiticar, M.J. and Ross, P.S. (2009) Persistent organic pollutants in Chinook salmon (Oncorhynchus tshawytscha): implications for resident killer whales of British Columbia and adjacent waters. Environmental Toxicology and Chemistry 28(1), 148-161.

Meador, J.P. (2014) Do chemically contaminated river estuaries in Puget Sound (Washington, USA) affect the survival rate of hatchery-reared Chinook salmon? Canadian Journal of Fisheries and Aquatic Sciences 71(1), 162-180.

O'Neill, S., Carey, A.J., Lanksbury, J.A., Niewolny, L.A., Ylitalo, G., Johnson, L., and West J.E. (2015) Toxic contaminants in juvenile Chinook salmon (Oncorhynchus tshawytscha) migrating through estuary, nearshore and offshore habitats of Puget Sound. Washington Department of Fish and Wildlife, Olympia, WA.

O'Neill, S.M. and West, J.E. (2009) Marine distribution, life history traits, and the accumulation of polychlorinated biphenyls in Chinook salmon from Puget Sound, Washington. Transactions of the American Fisheries Society 138(3), 616-632.

Quinn, T. (2005) The behavior and ecology of Pacific salmon and trout. American Fisheries Society, Bethesda, Md.