# Contaminants reveal spatial segregation of sub-adult Chinook salmon residing and feeding in Puget Sound

Sandie O'Neill[1], Andrea Carey[1], Robert Fisk[1], Mariko Langness[1], Laurie Niewolny[2], Gina Ylitalo[3], James West[1]

1. WDFW TBiOS; 2. Ecology; 3. NOAA NWFSC

Contact: Sandie O'Neill, sandra.oneill@dfw.wa.gov, 360-902-2666

https://wdfw.wa.gov/conservation/research/projects/marine_toxics/

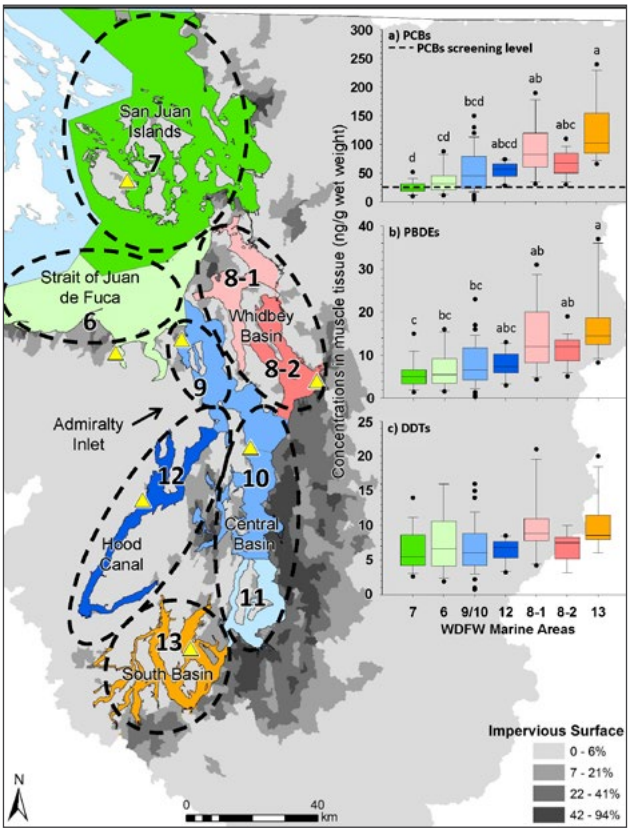
- **Polychlorinated biphenyls (PCBs) in resident Chinook salmon exceeded the DOH screening level for human consumption in all Puget Sound basins and were highest in South Basin.**
- **Chinook salmon have distinct contaminant patterns associated with catch locations, indicating segregated populations with limited feeding distributions.**

Adult salmon accumulate most of their body burdens of persistent organic pollutants (POPs) while feeding in marine habitats, where they also acquire most of their body mass. Although the majority of Chinook salmon originating from Puget Sound migrate to the Pacific Ocean to feed and grow, approximately one third reside in the Salish Sea for much of their marine rearing phase (Chamberlin et al., 2011; O'Neill & West, 2009). Here, they are exposed to POPs through their diet, including Pacific herring and other pelagic fishes, which are highly contaminated in Puget Sound (West et al., 2008, 2011). Resident Chinook salmon are targeted by recreational anglers, potentially putting these fishermen at increased risk of contaminant exposure. In addition, Chinook are the primary food source of the Southern Resident Killer Whales (SRKWs), and thus a major source of toxic chemicals to these endangered whales (Cullon et al., 2009; Mongillo et al., 2016; O'Neill & West, 2009). The objectives of this study were to determine whether contaminant concentrations in resident Chinook varied among marine basins and whether anglers targeting these salmon are at risk of contaminant exposure.

We measured POPs in resident Chinook salmon collected from various WDFW Marine Areas (MAs), roughly representative of Puget Sound basins, in the late fall, winter, and spring of 2016 and 2017, outside the typical migration timing for ocean-returning adults. Chinook samples were donated by anglers participating in fishing derbies or collected from a test fishery. Skinless muscle tissue was collected from behind the fish's head and analyzed for PCBs, polybrominated diphenyl ethers (PBDEs), and dichlorodiphenyltrichloroethanes (DDTs).

Contaminant concentrations and patterns in Chinook salmon varied by marine basin: PCBs and PBDEs were lowest in fish caught in the Strait of Juan de Fuca (SJF) and the San Juan Islands (SJIs) (MAs 6 & 7), intermediate in fish caught further into Puget Sound, south and east of Admiralty Inlet (MAs 9/10, 12, 8-1, 8-2,) and highest in fish caught in the South Basin (MA 13), furthest from the ocean (Figure). Concentrations of DDTs did not vary significantly among basins. Additionally, Chinook had distinct contaminant fingerprints associated with their catch locations (data not shown), indicating segregated populations with limited marine feeding distributions. Our results are consistent with acoustic telemetry studies that documented a high degree of basin fidelity with limited movements between resident Chinook caught and tagged in the SJIs and the Central Basin (Arostegui et al., 2017; Kagley et al., 2017).

People (and SRKWs and other top-level predators) consuming resident Chinook salmon caught in the SJIs and the SJF will be exposed to lower PCB and PBDE levels than those consuming fish from other areas of Puget Sound. However, concentrations of PCBs in virtually all fish from all basins exceeded the Washington Department of Health's (DOH) PCB screening value for human health (23 ng/g). In contrast, PBDEs and DDTs in fish in all basins were well below the human health screening values. Data from this study will be used by DOH to provide basin-specific fish consumption advice to protect human health in Puget Sound.




Concentrations of a) PCBs, b) PBDEs and c) DDTs (ng/g wet weight) measured in muscle tissue from Chinook salmon collected in eight WDFW Marine Areas (MAs). Similar letters signify MAs with no significant difference ($p > 0.05$). Puget Sound basins are circled with a dotted line and yellow triangles indicate where the Chinook salmon were landed during the fishing derbies and test fishery.

# RECOMMENDED CITATION

O'Neill, S.M., Carey, A.J., Fisk, R.J., Langness, M., Niewolny, L.A., Ylitalo, G.M., and West, J.E. (2019) Contaminants reveal spatial segregation of sub-adult Chinook salmon residing and feeding in Puget Sound. p. 25 in 2018 Salish Sea Toxics Monitoring Synthesis: A Selection of Research. Edited by C.A. James, R. Jordan, M. Langness, J. Lanksbury, D. Lester, S. O'Neill, K. Song, and C. Sullivan. Puget Sound Ecosystem Monitoring Program. Tacoma, WA. 88 pp: https://www.eopugetsound.org/articles/2018-salish-sea-toxics-monitoring-synthesis

# REFERENCES


Arostegui, M. C., Smith, J. M., Kagley, A. N., Spilsbury-Pucci, D., Fresh, K. L., & Quinn, T. P. (2017). Spatially Clustered Movement Patterns and Segregation of Subadult Chinook Salmon within the Salish Sea. Marine and Coastal Fisheries, 9(1), 1-12. doi:10.1080/1 9425120.2016.1249580

Chamberlin, J. W., Essington, T. E., Ferguson, J. W., & Quinn, T. P. (2011). The Influence of Hatchery Rearing Practices on Salmon Migratory Behavior: Is the Tendency of Chinook Salmon to Remain within Puget Sound Affected by Size and Date of Release? Transactions of the American Fisheries Society, 140(5), 1398-1408. doi:10.1080/00028487.2011.623993

Cullon, D. L., Yunker, M. B., Alleyne, C., Dangerfield, N. J., O'Neill, S., Whiticar, M. J., & 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. doi:10.1897/08-125.1

Kagley, A. N., Smith, J. M., Fresh, K. L., Frick, K. E., & Quinn, T. P. J. F. B. (2017). Residency, partial migration, and late egress of subadult Chinook salmon (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) in Puget Sound, Washington. 115(4), 544-556.

Mongillo, T. M., Ylitalo, G. M., Rhodes, L. D., O'Neill, S. M., Noren, D. P., & Hanson, M. B. (2016). Exposure to a mixture of toxic chemicals : implications for the health of endangered southern resident killer whales. doi:http://doi.org/10.7289/V5/TM-NWFSC-135

O'Neill, S. M., & 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. doi:10.1577/T08-003.1

West, J. E., Lanksbury, J. A., O'Neill, S. M., & Marshall, A. (2011). Control of Toxic Chemicals in Puget Sound Phase 3: Persistent Bioaccumulative and Toxic Contaminants in Pelagic Marine Fish Species from Puget Sound. Retrieved from Olympia, Washington: https://wdfw.wa.gov/publications/01362/

West, J. E., O'Neill, S. M., & Ylitalo, G. M. (2008). Spatial extent, magnitude, and patterns of persistent organochlorine pollutant in Pacific herring (Clupea pallasi) populations in the Puget Sound (USA) and Strait of Georgia (Canada). Science of The Total Environment, 394(2), 369-378. doi:https://doi.org/10.1016/j.scitotenv.2007.12.027s