Toxic contaminant patterns in Chinook salmon and southern resident killer whales provide insights into whale foraging habitat

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Comparison of contaminant patterns in southern resident killer whales and their prey suggests spatial segregation of whale pods in their foraging habitats.

Knowledge of the diet and foraging habitats of endangered southern resident killer whales (SRKW; Orcinus orca) is necessary to define and protect their critical habitat, but such information is lacking for this highly mobile species. SRKW spend much of the summer foraging in the Salish Sea where they feed primarily on Pacific salmon (especially Chinook, Oncorhynchus tshawytscha), based on observed feeding events (Ford and Ellis 2006, Hanson et al. 2010) and analysis of whale fecal material (Ford et al. 2016). The coastal distribution of SRKW outside of the summer months is known to extend south to Pt. Reyes, California but their preferred foraging habitats are unknown.

Persistent organic pollutants (POPs) can serve as chemical tracers to infer foraging habitats of marine species. Marine environments have distinct POP patterns based on historic inputs, and animals foraging for extended periods of time can accumulate POPs in proportion to their availability in those environments. We used multi-dimensional scaling to analyze the relative proportions of polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), dichlorodiphenyltrichloroethane (DDTs), and hexachlorobenzene (HCB), hereafter referred to as POPs fingerprints, in whole-body Chinook salmon from known marine distributions and foraging habitats along the west coast of North America. The POPs fingerprints from chinook were compared with POPs fingerprints in blubber samples of SRKW to infer SRKW foraging habitats.

The relative abundance of four POP classes in Chinook salmon populations revealed unique chemical fingerprints consistent with their known marine distribution, confirming that POP patterns can be used as chemical tracers that reflect time spent foraging in specific marine regions. We observed higher levels of DDTs compared to other POPs in Chinook populations originating from California that migrate northward and feed off the coast of California and Oregon (Weitkamp 2010), reflecting greater historical use of DDT in California. Likewise, higher concentrations of PCBs and PBDEs were observed in salmon that reside in Puget Sound, where the pelagic food web has elevated concentrations of these contaminants relative to the other regions of the west coast (West et al. 2008, O’Neill et al. 2009). A comparison of POPs fingerprints of three pods of SRKW and Chinook salmon populations (Figure) revealed that J pod whales overlapped most with salmon from Puget Sound and the Columbia River, suggesting that J pod foraged substantially in habitats used by these salmon populations (i.e., a more northerly distribution, along the Oregon coast northward to the west coast of Vancouver Island). In contrast, fingerprints of K and L pod whales overlapped more with those of salmon from California and the Columbia River, indicating they spend a substantial portion of time foraging in habitats frequented by these salmon populations (i.e., a more southerly distribution, along the coastal waters of northern California and the Oregon coast). Collectively, these data suggest that SRKW foraged in coastal waters from the northern coast of California, northward to the west coast of Vancouver Island, as well as in the Salish Sea, but that J pod was spatially segregated from K and L pods in their foraging habitats.

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REFERENCES


