State of Washington

Department of Fish and Wildlife

Southern Resident Killer Whale Executive Order Immediate Action Report

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Executive Summary

Following the decline of the Southern Resident Killer Whale population, Governor Jay Inslee signed Executive Order 18-02. The purpose of this report is to respond to the Governor's request for Washington Department of Fish and Wildlife (WDFW) to investigate the potential of hatchery feed as a contributing source of Polychlorinated biphenyls (PCBs) found in Southern Resident Killer Whales.

Research indicates that hatchery feed is not a significant source of PCB contamination in adult Chinook salmon that originated from WDFW hatcheries. Hatchery feed contains low concentrations of PCBs. In addition, juvenile salmonids have trace amounts of PCBs through maternal transfer. Most (96% – 99%) of the PCBs in adult salmonids is acquired in the marine environment in which they migrate and live.

The amount of PCBs in adult salmon that is acquired in the freshwater environment, including hatcheries, varies from approximately 1% in undeveloped rivers to 4% in developed river where outmigrating juvenile fish acquire more PCBs. Hatchery feed is estimated to contribute a maximum of 1% of the PCBs measured in adult Chinook from Puget Sound that originated in hatcheries.

WDFW is actively engaged with researchers, other government agencies and fish feed manufacturers to identify detectable PCBs in fish feed and will pursue alternative feed options that contain the lowest concentration of PCBs when feasible and cost-effective to do so.

Introduction

In Executive Order 18-02, *Southern Resident Killer Whale Recovery and Task Force,* Washington Department of Fish and Wildlife (WDFW) was asked to conduct the following immediate action to benefit Southern Resident Killer Whales.

"WDFW—By April 30, 2018, explore options and develop a proposal to alter fish food used in state hatcheries to limit the amount of Polychlorinated Biphenyls (PCBs) in Southern Resident prey."

The following report will:

1. Assess the contribution of PCBs in hatchery feed to adult Chinook Salmon;
2. Summarize the Current PCBs concentrations in hatchery feed; and
3. Outline available alternatives for PCB reduced feed

Exposure to high levels of persistent organic pollutants (POPs), especially polychlorinated biphenyls (PCBs) is one of several factors that currently pose a risk to the viability of Southern Resident killer whales (NMFS 2008).

Background

Adult killer whales are primarily exposed to POPs through the ingestion of prey. POPs present in the marine food webs are biomagnified up the food web to Southern Resident killer whales (Figure 1), reaching concentrations high enough to potentially impair their health. Chinook salmon, particularly populations from Puget Sound and Harrison Lake (Fraser River), are likely a significant source of contaminants like PCBs to Southern Residents, given their importance as prey, and their elevated PCBs levels compared to other salmonids (Mongillo et al. 2016).

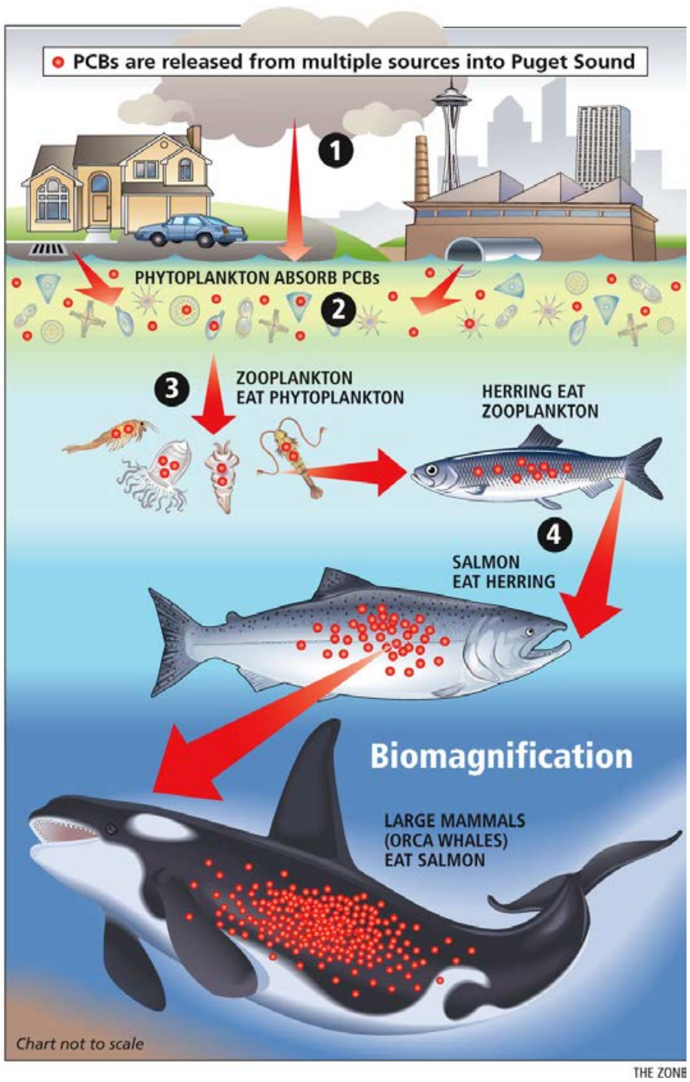

Figure 1. Conceptual drawing detailing the bio-magnification of PCBs through the marine food web, from zooplankton, to Pacific herring, to salmon and resident killer whales.

Results and Plan

Hatchery Contribution to PCBs

Hatchery rearing is a potential exposure pathway for juvenile salmon, as PCBs have been measured in hatchery feed and fish. Meador et al. (2010) reported Chinook salmon collected from WDFW's Soos Creek Hatchery had mean PCB concentration ranging from 10 – 50 ng/g (nanongrams-per-gram or parts-per-billion) wet weight. Johnson et al. 2010 reported similar concentrations of PCBs in juvenile Chinook salmon from eight Oregon hatcheries, mean concentration of 14 ng/g wet weight, ranging from 7.3 ng/g wet weight in fish from Cowlitz Hatchery to 58 ng/g wet weight in fish from Priest Rapids Hatchery. Furthermore, Johnson et al. (2010) estimated that for hatchery origin fish, the proportion of PCBs in outmigrant juvenile Chinook salmon were found to be lower from hatchery rearing than amounts that were absorbed during the time fish spent in freshwater. Johnson et al. (2010) conclude that the Columbia River was a more important source of PCB contamination than are the hatcheries because PCB exposure levels in hatchery Chinook salmon were lower than those in field collected juvenile fall Chinook salmon of hatchery origin from the lower Columbia River.

Although hatchery feed is a potential source of PCBs to juvenile Chinook salmon, PCBs in adult Chinook salmon are accumulated primarily in saltwater habitats in which they reside and feed, rather than freshwater habitats (O'Neill and West 2009; Cullon et al. 2009). For example, comparing body burdens in returning adult Chinook salmon to out-migrant smolts O'Neill and West (2009), documented adult Chinook salmon that had migrated as subyearlings from the Duwamish River, the most highly PCB contaminated river draining into Puget Sound, accumulated the vast majority (96%) of PCBs during their marine life history phase. The remaining 4% of the adult body burden was accumulated in the freshwater life history phase, including hatchery rearing. Based on the PCBs concentrations reported for hatchery Chinook salmon released in to the Duwamish River (Meador et al. 2010), we estimated that approximately 1% of the total PCB body burden in adult Chinook salmon was accumulated from hatchery feed and the remaining 3% was accumulated in the river (Figure 2). Moreover, most Chinook salmon from Puget Sound would accumulate far less PCBs during their freshwater life history phase compared to fish from the Duwamish River, as other rivers have less contaminated juvenile salmon than the Duwamish River (Johnson et al. 2007, O'Neill et al. 2015). In less developed rivers, the percent of PCB in adult salmon of hatchery origin that was accumulated in the freshwater life history phase, including hatchery rearing, would 1% or less. Similarly, Cullon et al. 2009 estimated that for all stocks of Chinook salmon they samples in the Georgia Basin and Puget Sound, 97% to 99% of the POPs in all were originated during their time at sea.

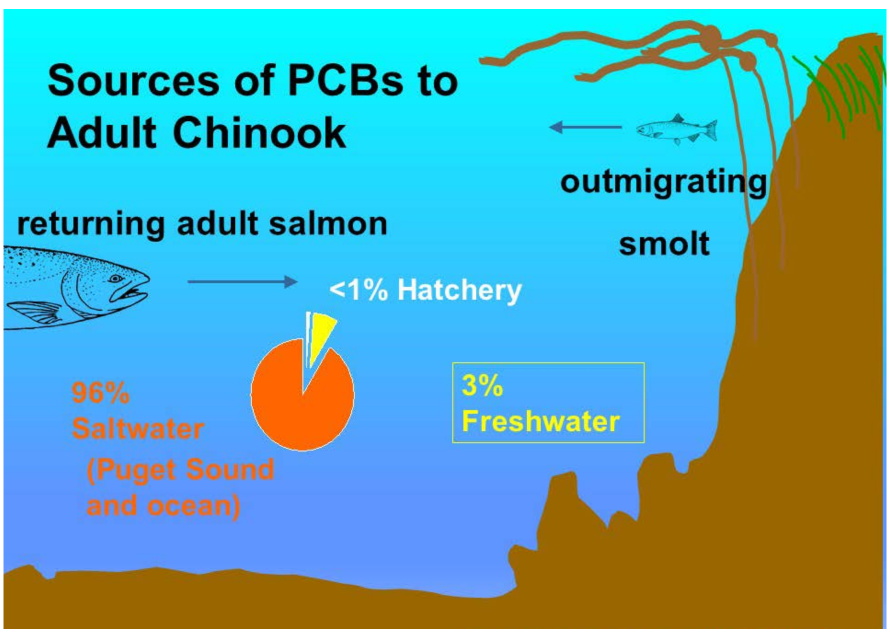

Figure 2. Proportion of PCBs in adult Chinook salmon that are accumulated while feeding in saltwater and river habitats and from hatchery feed (modified from O'Neill and West 2009). Estimates are based on average body burden in fish from the Soos Creek Hatchery, the most PCB contaminated smolts (95th percentile for body burden) migrating out of the Duwamish River, and average PCB body burdens in returning adults. In less developed rivers, the contribution from hatcheries would be the same but the contribution from freshwater would be less.

These results are not surprising given that over 99% of the final weight of Chinook salmon is achieved in saltwater (Quinn 2005), and consequently the adult body burdens of PCBs are accumulated while Chinook salmon are feeding in saltwater habitats. As detailed by O'Neill and West (2009), on a per-gram basis, the average PCB concentration (ng/g) in subyearling Chinook salmon smolts migrating out of the Duwamish River was more than three times that in adults returning to the river. However, the estimated PCB body burden in adults was almost 170 times higher than that in smolts because adults weighed almost 600 times more than did smolts. Although yearlings spend more time feeding in rivers, the vast majority of their final adult body weight is also acquired in saltwater. **Consequently, the majority of PCB accumulation would occur in the marine environment, regardless of juvenile life history, or hatchery rearing.**

Current PCBs in Fish Feed

Concentrations of PCBs measured in feed from salmon hatcheries in the northwest ranged from <1 (ng/g) (Maule 2007) to 90 ng/g (Easton et al, 2002; Hites et al. 2004). Maule et al. (2007) reported that for U.S. Fish and Wildlife Service hatcheries, PCB concentrations in feed ranged from <1–11 ng/g wet weight. In a study of contaminants in hatchery feed of eight salmon hatcheries from Oregon, Johnson et al. (2010) reported PCBs in feed ranged from 5.3 ng/g wet weight in feed from Washougal Hatchery to 25 ng/g wet weight in feed from Little White Salmon Hatchery. Similarly low concentrations were measured for feed in salmon hatcheries from British Columbia (Kelly et al. 2008). Somewhat higher PCB concentrations (in the range of 30–90 ng/g wet weight for some samples) were reported in commercial feed samples analyzed in earlier studies by Easton et al. (2002) and Hites et al. (2004).

More recently, Department of Ecology conducted an unpublished study which obtained fish feed results for 24 samples taken from hatcheries located in Washington State (discrete/grab samples). Samples were detected in the range of about 3 to 30 ng/g total PCBs. This data compares with previous studies at Ecology. Three sets of samples are the same product but collected at different hatcheries and all sets had different manufacture dates. Two sets were variable between products and one set had reported totals closer in range (Turnbull 2018).

In addition, Turnbull (2018) sampled an insect meal supplemented fish feed. The product contains insect meal in place of some of the fish meal in the product but the product still contains fish meal (information on how much insect meal is used was not provided by company due to proprietary information). The sample showed detected results lower in the range but no conclusions can be drawn from one sample of one product because of the variability of results shown among the same product in other product types with different manufacture dates/lots.

Options for Lowering or Reducing PCBs in Feed

Hatchery fish feed is generally comprised of fish meal that already contains PCBs at low levels. At this time WDFW is not aware of fish feed manufacturers that produce PCB free feed.

WDFW is continually seeking fish feed options that utilize alternative protein sources, within potentially lower PCB concentrations than fish based feeds currently used. Potential alternative protein feed sources include insect, poultry, and algae based feeds. While alternate options may be available, many of the manufacturers that produce alternative proteins do not currently test for PCB levels in their feeds.

Sources have also proven to be cost prohibitive. In addition, these feed manufacturers do not have the capacity to produce feed on a scale that is required to support WDFW hatchery needs.

Plan for Reducing PCBs in Fish Feed

WDFW will continue investigate alternative fish feed proteins and work with researchers, other government agencies and feed manufacturers to identify the levels of total PCBs in the raw materials/source ingredients used in the fish feed like insect meal, fish meal, fish oil etc. In addition, WDFW will work with feed manufacturers to compare composite samples of insect meal supplement fish feed to composite samples of regular fish feed over time in order to determine if insect meal supplemented fish feed contributes to lower PCB levels in fish feed (Turnbull 2018).

Conclusion

WDFW is aware that hatchery fish feed contains PCBs; however, hatchery feed contributes up to a maximum of 1% of PCBs in adult Chinook salmon released from WDFW hatcheries. The majority of PCBs in adult Chinook salmon accumulate from food sources during their life stage in the marine environment.

RCW 39.26.280 directs agencies to establish preferential purchasing for products that do not contain PCBs, including fish feed.

Washington Department of Fish and Wildlife will continue to investigate and review PCBs in fish feed as additional findings become available, and seek reasonable options for lowering amounts of PCBs in fish feed.

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