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Northwest
Region

PBDEs and Killer Whales in Puget Sound



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July 23, 2013

All photos taken by the
NWFSO under a permit.

Background on Southern Resident (SR) Killer Whales

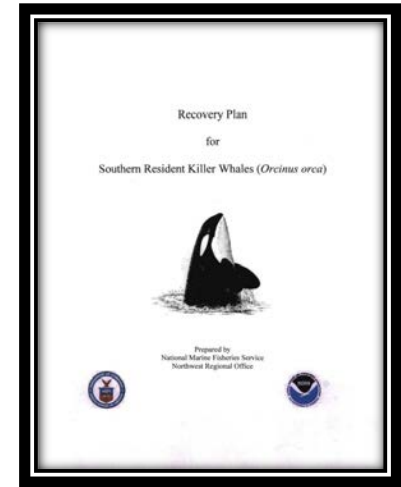
- ▶ SR killer whales have all been individually identified from photo-ID (this provides info on age, sex, population size)
- ▶ Population consists of 3 pods: J, K, and L.
- ▶ Pods consist of matriline. Typically, males and females do not disperse from their matriline.
- ▶ Females give birth on average every 5 yrs (first calf occurring between 12–16 yrs of age)
- ▶ Males typically live about 30 years (max= 50–60 yrs), females typically live into their 50s (max= 80–90 yrs).

SR Killer Whale Status

SRs Listed as Endangered under ESA in Nov 2005

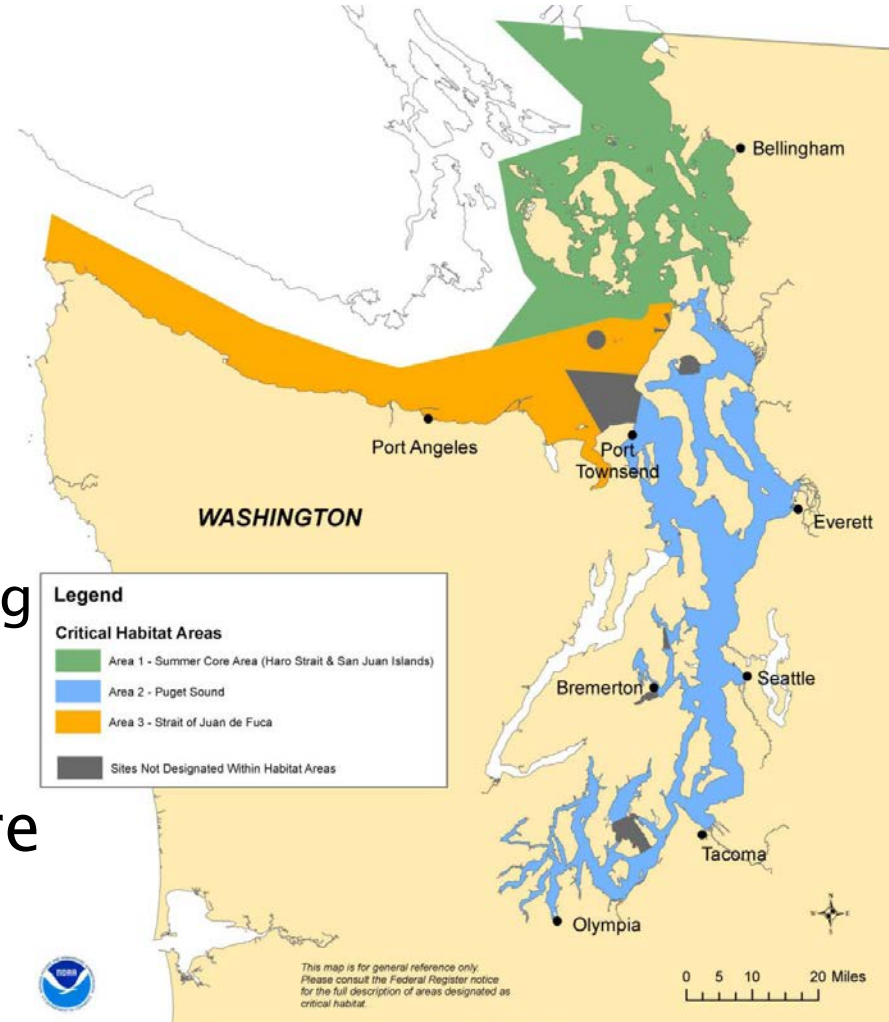
Risk Factors:

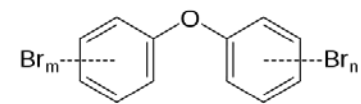
- Reduced Quality and Quantity of Prey (Salmon)
- Contaminants (persistent bioaccumulative toxics, PBTs)
- Disturbance from Vessels and Sound
- Oil spills
- Small Population Size
- Disease



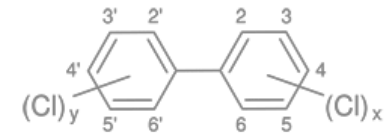
Distribution and Critical Habitat

- ▶ Range extends from SE Alaska to California
- ▶ Critical Habitat Nov 2006
 - Essential Features: water quality, prey (sufficient quality, quantity & availability), passage to support migration & foraging
- ▶ ~ 2,560 square miles (6,630 sq. km) 112 square miles (291 sq. km) excluded

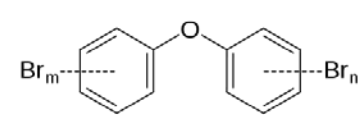




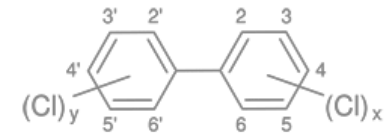
Background: PBDEs



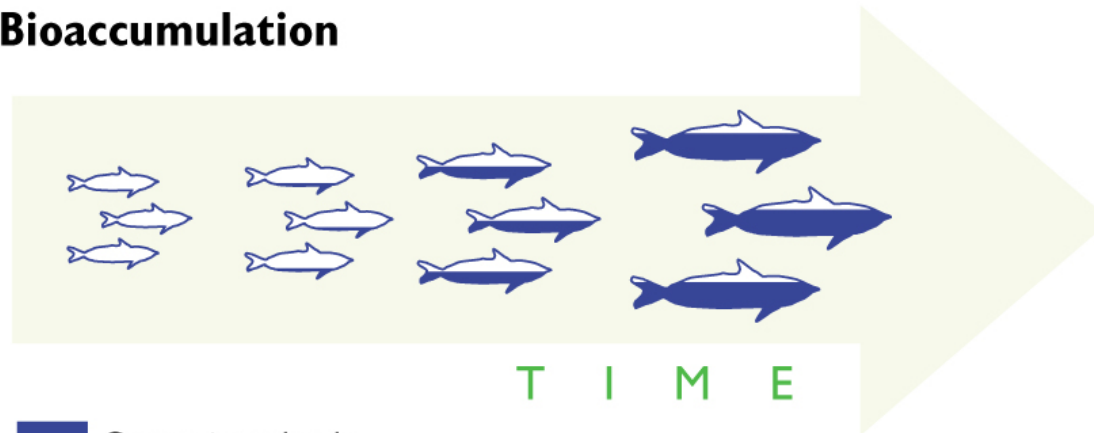
- PBDEs are used as additive flame retardants since 1970s
 - Textiles, plastics, electronics, polyurethane foams, etc.
- Similar in structure & mode of action as PCBs: persistent, bioaccumulative and toxic (PBT)–endocrine disruptors
- Washington's PBDE Law (RCW 70.76) placed restrictions on the use of PBDEs in products sold in WA.



Background: PBDEs



Bioaccumulation



Contaminant levels



Contaminant levels

Biomagnification

- PBDEs are found in significant amounts in wastewater discharge (~ 25–38% of total PBDE loading into Puget Sound is from wastewater discharge)
- Primary route of exposure to whales is through diet
- Storage occurs primarily in blubber

PBTs in Killer Whale Prey



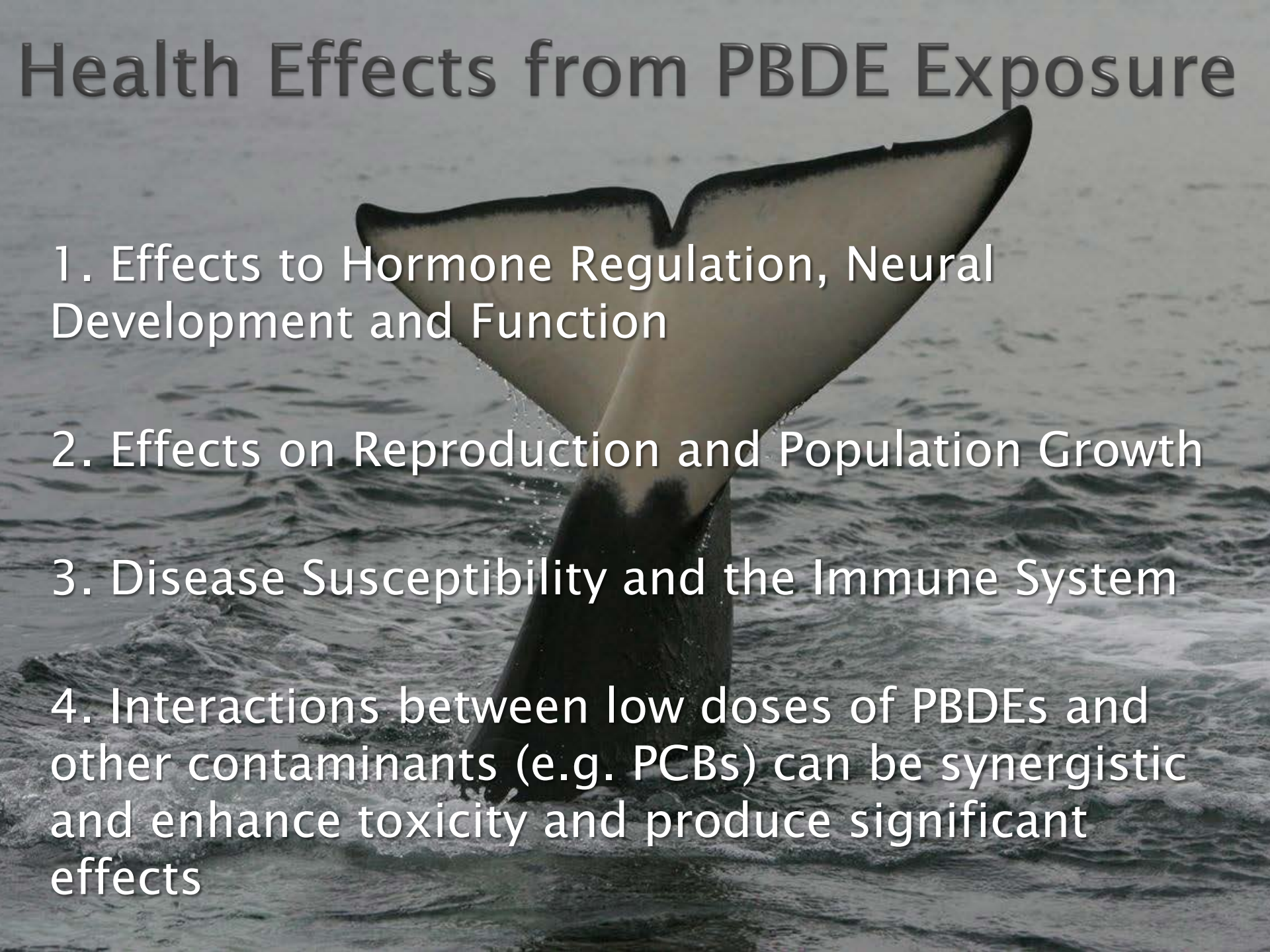
- Adult salmon accumulate the majority ($> 96\%$) of PBTs while feeding in the marine environment
- Observed levels of PBTs in adult Pacific salmon appears to be primarily determined by geographic proximity to contaminated marine environments (and contaminated prey).
- Chinook salmon generally have higher concentrations of PBTs than other Pacific salmon species.
- Highest PCBs and PBDEs concentrations were observed in fish from Puget Sound.

PBTs in SR killer whales



- ▶ Females can offload their body burdens to their calves.
- ▶ SR killer whales have high total PCBs that exceed health-effects thresholds. Juveniles have PCB blubber concentrations that were 2 to 3.6 times higher than the threshold.
- ▶ PBDEs 10X above levels that may cause endocrine disruption in gray seals.

Health Effects from PBDE Exposure



1. Effects to Hormone Regulation, Neural Development and Function
2. Effects on Reproduction and Population Growth
3. Disease Susceptibility and the Immune System
4. Interactions between low doses of PBDEs and other contaminants (e.g. PCBs) can be synergistic and enhance toxicity and produce significant effects

Health Effects from PBDE Exposure

A photograph of a whale's tail fluke emerging from the ocean surface. The fluke is dark on the outside and lighter on the inside, with a distinct V-shape. The water is dark and choppy, with white foam at the base of the tail.

5. Nutritional stress may act synergistically with high contaminant burdens in the whales and result in contaminant-induced adverse health effects or higher mortality rates

6. Highest risk = calves and adult male killer whales