Southern Resident Killer Whales Contaminants and Health

NOAA FISHERIES
Northwest Fisheries Science Center

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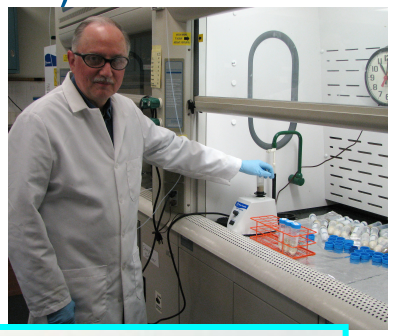
40+ years of toxics research at NWFSC

Environmental Chemistry

- Method Development
  - Toxic chemicals (industrial, agricultural, pharmaceuticals)
  - Lipids (dietary and non-dietary Fas, lipid classes)
  - Stable isotope ratios (carbon and nitrogen)
  - Biological measures (steroids and bile acids in fish)
- Monitoring Studies
  - Various species
  - Geographical and temporal trends
- Health Assessments
  - Baseline studies
  - Disease studies
  - Oil spill studies
- Feeding ecology

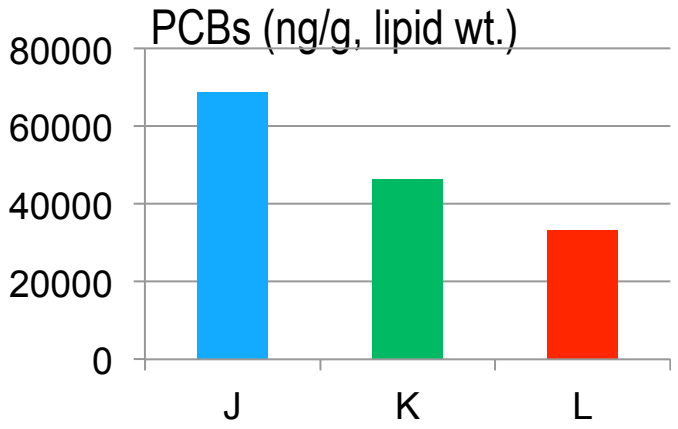


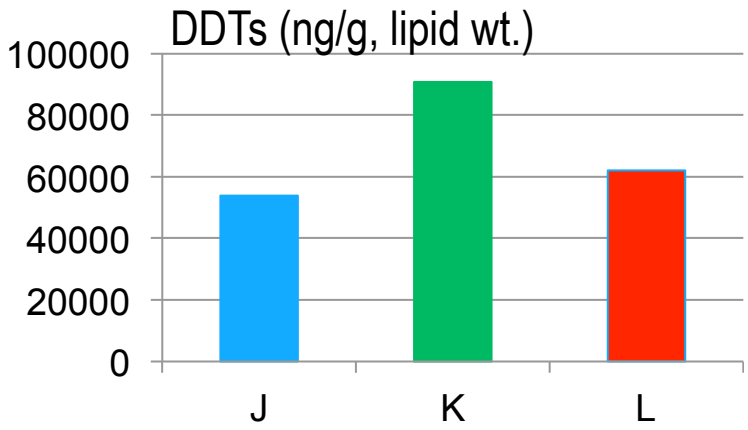
MMPA – Marine Mammal Health & Stranding Response Program - NMFS lead for toxics

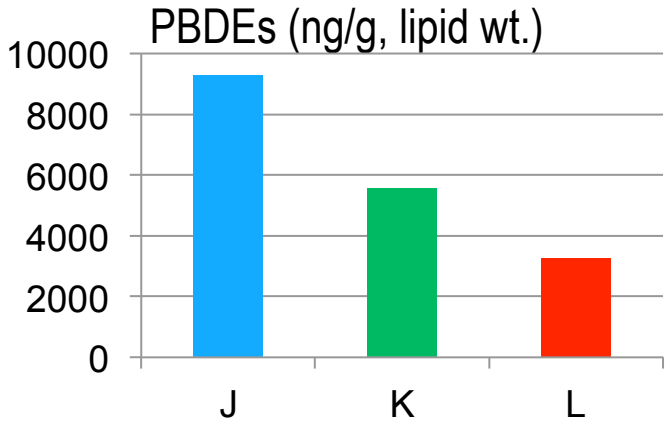
- Address deficiencies in data quantity and quality
- Refines methods and approaches for relating exposure and specific biological effects
- Improves the dissemination of the information

Southern Resident Killer Whales – Contaminants

Contaminant Exposure Variation Among Pods





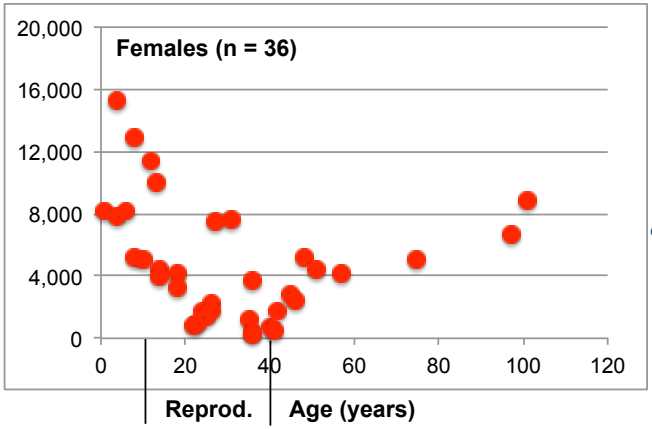


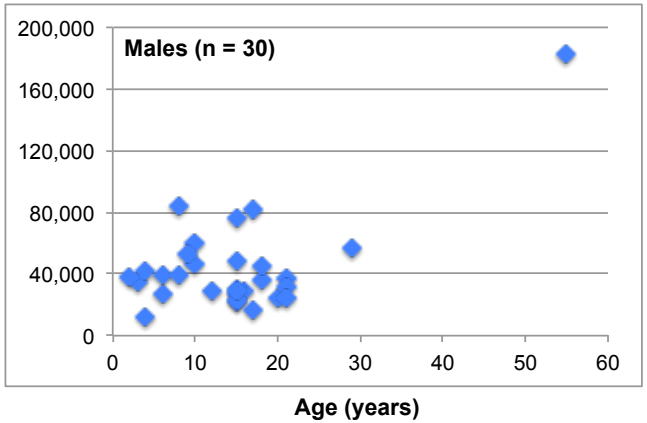
- Highest PCBs and PBDEs J pod whales
- Highest DDT levels in K pod animals
- Suggests differences in feeding ecology

Influence of Age and Sex on Exposure

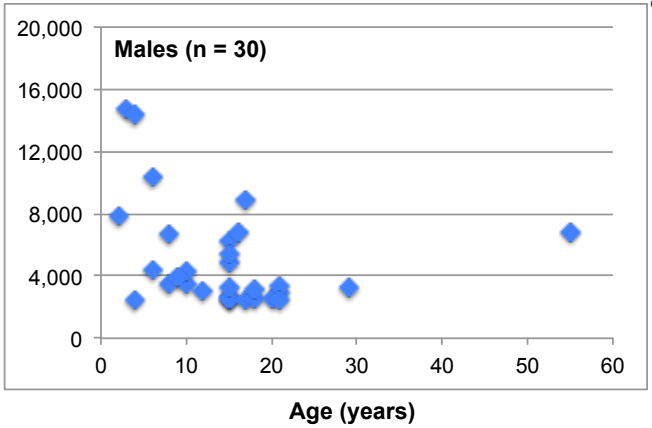
PCBs (ng/g, lipid wt.)

PBDEs (ng/g, lipid wt.)





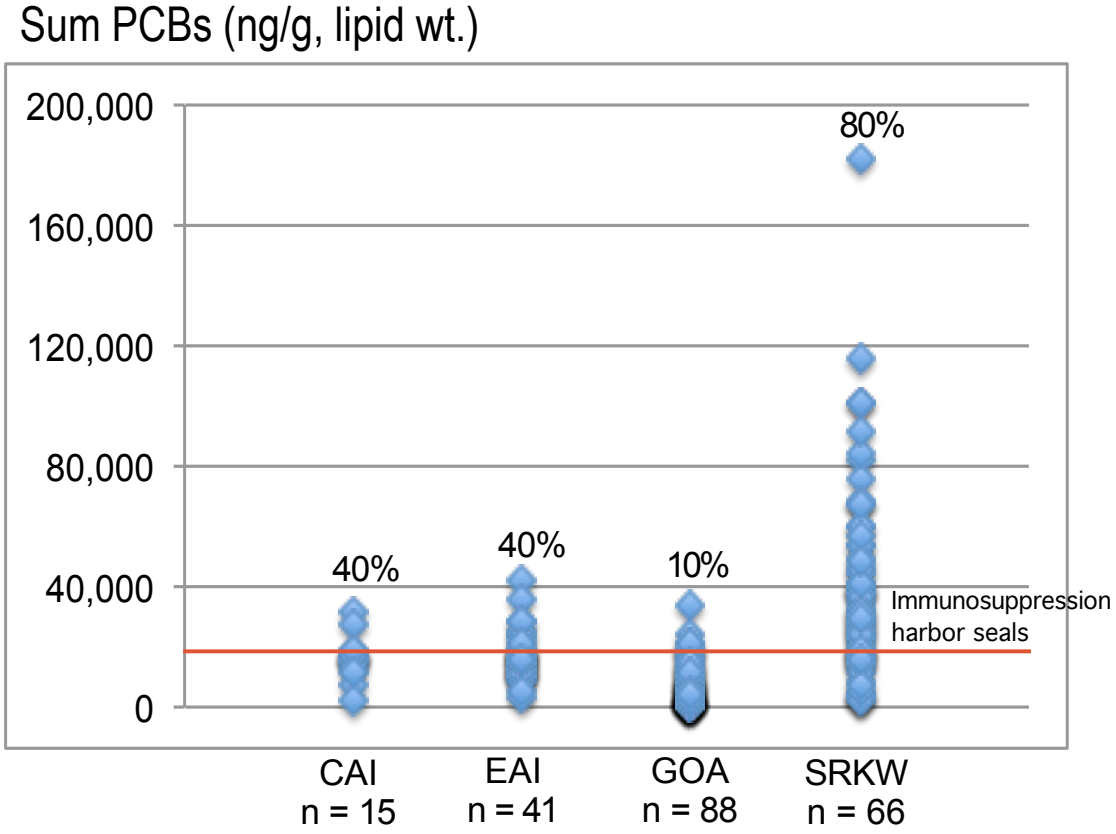
Age (years)



- Highest PCBs and DDTs in oldest male, senescent females
- Highest PBDE levels in young whales

Eastern North Pacific resident killer whales PCB threshold comparison

- 80% of SRKW sampled males and females above threshold value immunosuppression in harbor seals
- Other resident ENP killer whale populations 10-40% of whale sampled above the PCB threshold
- Does not indicate cause of population decline but does indicate potential health risk



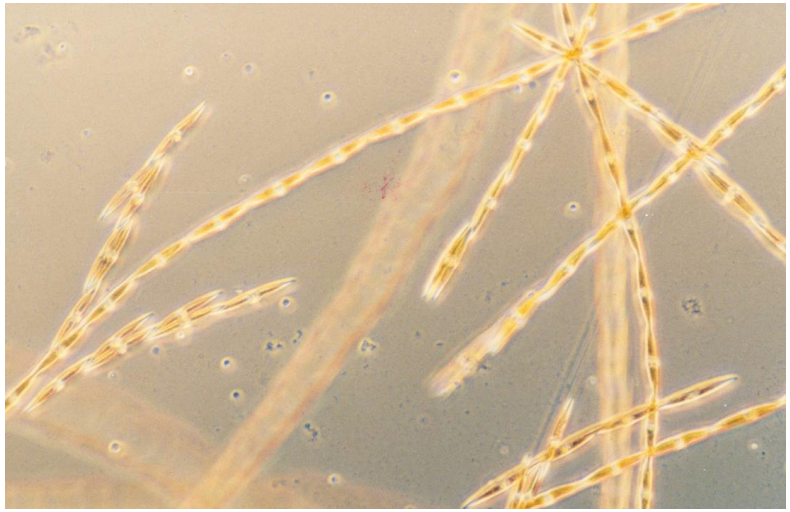
Other SRKW contaminant-related studies

- Investigation of relationships of fecal reproductive and stress steroids and persistent organic pollutants (Lundin/Wasser)
- Determine maternal POPs transfer rates using public display killer whales (NWFSC)
- Chemical tracer analyses of potential prey to describe feeding range and likely prey (NWFSC/WDFW)
- Collect baseline data in feces/blubber for petroleum-related hydrocarbons (NWFSC/WCRO/Lundin/Wasser)

Southern resident killer whales – health studies

Evaluating the threat of domoic acid biotoxin

- Dosed salmon with DA to assess exposure risk to SRKWs
  - Coho salmon excrete DA via the kidneys and bile but can store DA for up to one week (Lefebvre *et al.* 2007)
- In future, will model duration of time until SRKWs, consuming salmon during a bloom, accumulate acute and lethal doses of DA
  - SRKW prey energy requirements (Noren 2011)
  - Pacific salmon energy content (O'Neill *et al.* 2014)
  - Salmon DA tissue concentrations (Lefebvre *et al.* 2007)
  - SRKW acute and lethal dose thresholds (based on CA sea lion model, Bejarano *et al.* 2007)



Breath Samples
Pathogenic Microbes & Antibiotic Resistant Bacteria

56 microbial genera

37 bacterial (7 pathogenic)

19 fungal (1 pathogenic)

Bacteria	Fungi
Burkholderia sp.	*Aspergillus* sp.
Pseudomonas sp.	
Rothia dentocariosa	
Salmonella enterica Heidelberg	
Staphylococcus cohnii cohnii	
Staphylococcous warneri	
Stenotrophomonas sp.	
Vibrio alginolyticus	

- Culture of breath vs. sea surface microlayer (SML) showed whales were likely source of microbes
- Eight known human pathogens found; 7 bacterial and 1 fungal
- Resistance to antibiotics were readily detected among bacteria cultured from breath and SML
- Pathogenic & antibiotic resistant bacteria inhabit respiratory system of free-ranging whales

Summary

- SRKW are at risk of health effects from toxic POPs
- Harmful algal biotoxin exposure via prey may also pose risk to SRKW
- Respiratory system of SRKW inhabited by a wide range of microbes, including pathogenic and antibiotic resistant bacteria

Southern Resident Killer Whale Health Workshop

- 2-day workshop that included NOAA and subject-matter experts
- Development of 5-year strategic plan (2016-2020) with the following top priorities
    - Build effective toolbox (e.g., develop centralized database, standardize sampling & health assessment protocols, telemetry, photogrammetry, stranding investigations)
    - Track animals of interest & continue studies related to prey and body condition
    - Use case-reference studies to identify risks to reproduction and survival