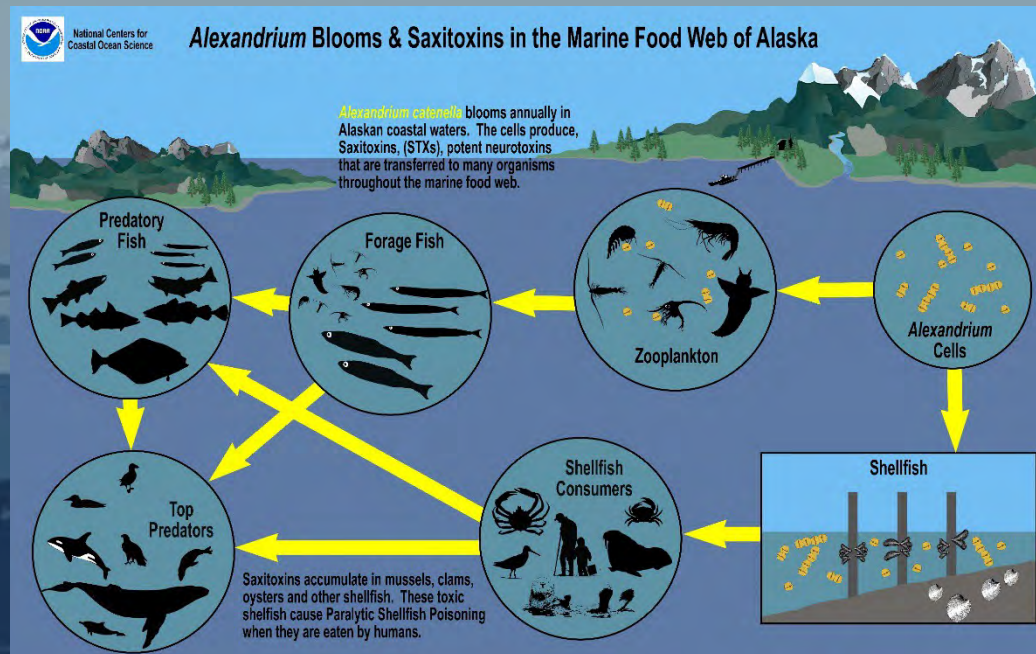


# Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of Coastal Alaska

Bruce Wright  
Knik Tribe of Alaska



Steve Kibler  
NOAA/NOS/NCCOS  
Beaufort Laboratory

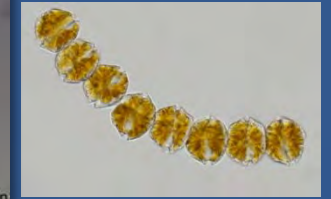
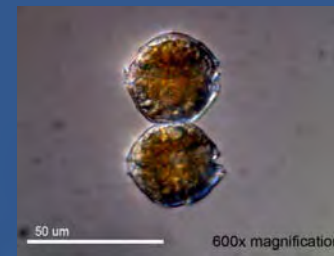
Xiuning Du  
Oregon State University

Rob Campbell  
Prince William Sound Science Center  
Rose Matsui, Chris Guo & Coowe Walker  
Kachemak Bay NERR

Kris Holderied & Dominic Hondolero  
NOAA Kasitsna Bay Lab

Julie Matweyou  
University of Alaska Fairbanks/AK Sea Grant

# Paralytic Shellfish Poisoning (PSP) in Alaska



*Alexandrium catenella*

## PSP Toxins (PSTs)

Saxitoxins (STXs)

Mussels, clams, oysters, crabs

## Symptoms

Nausea, vomiting, diarrhea

Headaches, tingling, numbness

Paralysis, death

## FDA Advisory Limit

80  $\mu\text{g}$  STX 100  $\text{g}^{-1}$

(800 ng STX  $\text{g}^{-1}$ )

## Effects

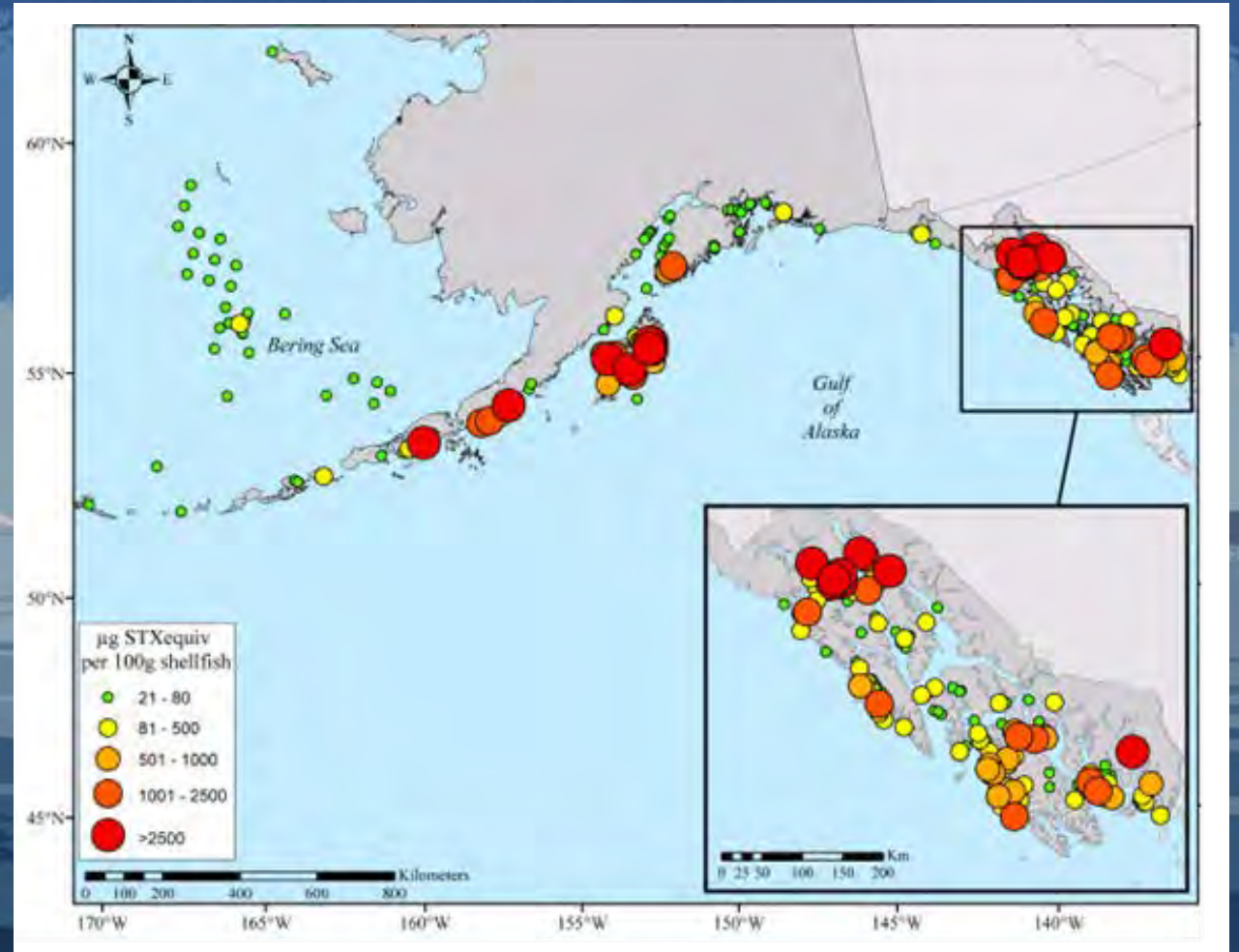
Human illness

Shellfishing closures

Barrier to shellfish farming

Seafood marketing impacts

Effect on marine biota



# PSTs in Marine Food Webs

## Phytoplankton grazers

Small and large copepods  
Ciliates, rotifers, heterotrophic dinoflagellates  
Fish and invertebrate larvae



## Trophic transfer of PSTs

Crabs & sea Stars  
Predacious zooplankton  
Zooplanktivorous fish  
Shrimp & other invertebrates  
Seabirds  
Marine mammals



# Algal toxins were detected in 13 species marine mammals from Southeast Alaska to the Arctic Ocean during 2004 to 2013



- A Humpback whales (s)
- B Bowhead whales (h)
- C Beluga whales (s)
- D Harbor porpoises (s)
- E Northern fur seals (s)
- F Steller sea lions (s)
- G Harbor seals (s)
- H Ringed seals (h)
- I Bearded seals (h)
- J Spotted seals (h)
- K Ribbon seals (h)
- L Pacific walruses (h)
- M Northern sea otters (s)

**Kathi Lefebvre et al. (2015, 2016)**

**Ringed Seal**  
 12.7  $\mu\text{g } 100\text{g}^{-1}$   
 (feces)

**Bowhead Whale**  
 35.9  $\mu\text{g } 100\text{g}^{-1}$   
 (feces)

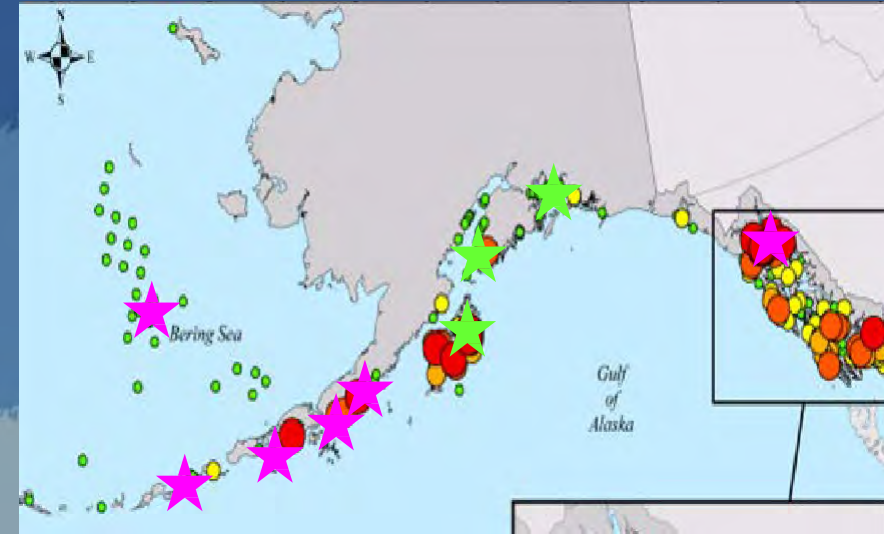
**Pacific Walrus**  
 645.7  $\mu\text{g } 100\text{g}^{-1}$   
 (stom. cont.)

Data & map by: Kathi Lefebvre, Su Kim & Damon Holzer, December 2015.

## ★ NPRB 1801: PSTs in the Marine Food Webs of Southcentral and Southwest Alaska.

### Objectives

- Develop STX screening and analysis capacity
- Characterize *Alexandrium* blooms & phytoplankton community
- Assess trophic transfer of STXs to zooplankton community
- PSTs in forage fish
- PSTs in commercially important predatory fish species Digestive organs, liver, kidney, muscle, roe
- Assess potential risks to Higher level consumers, human health, seafood industry



## ★ Knik Tribe: PSTs in Lower Cook Inlet, the AK Peninsula, Aleutian & Pribilof Islands.

### Objectives

- PSTs in forage fish
- PSTs in Salmon Digestive organs, liver, kidney, muscle, roe
- Invertebrates Urchins, Sea Stars, Chitons, Limpets
- Risks to human health, higher level consumers



# Collection & Analysis

## Collection

Phytoplankton	Surface samples, Net tows
Bivalves	Intertidal collection, docks, pilings, cages
Zooplankton	Net tows
Forage fishes	Beach seine, cast net, trawls, (stomachs)
Predatory Fishes	Sport catch, set net, fish processors
Other Invertebrates	Subsistence harvest

## Analysis

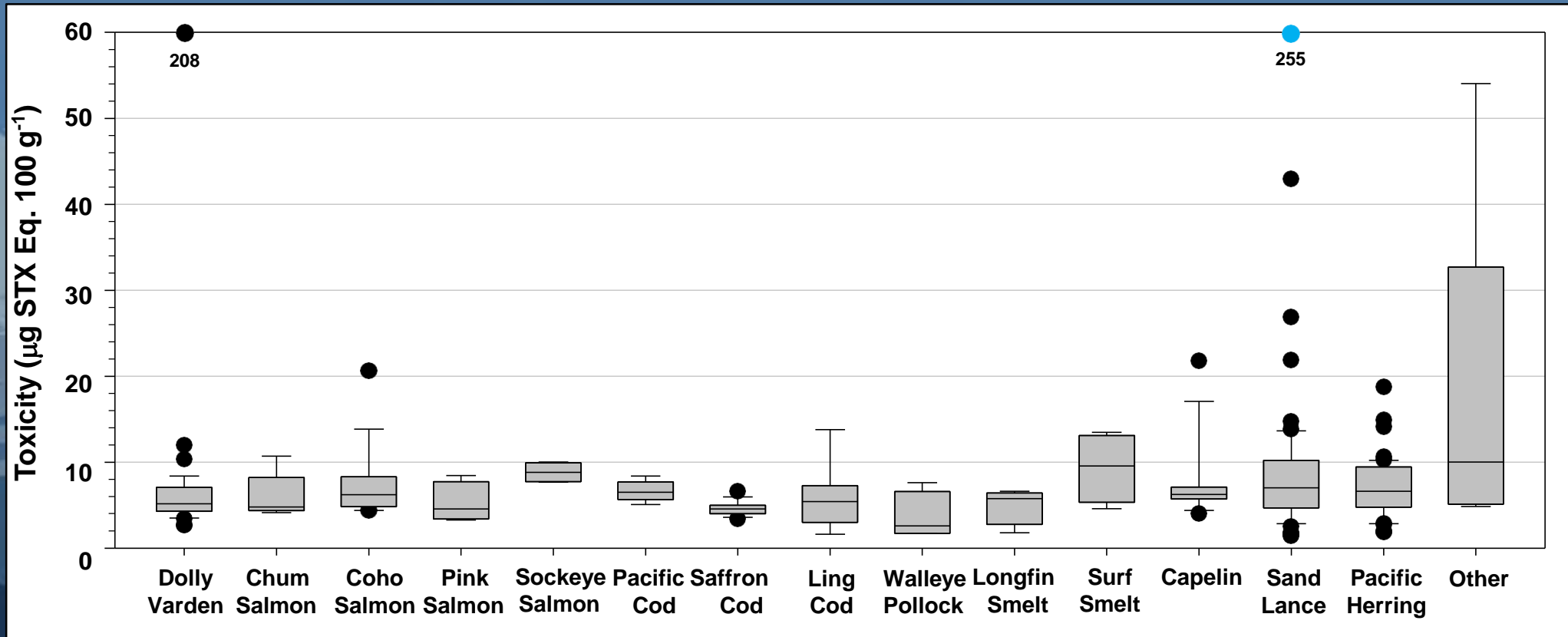
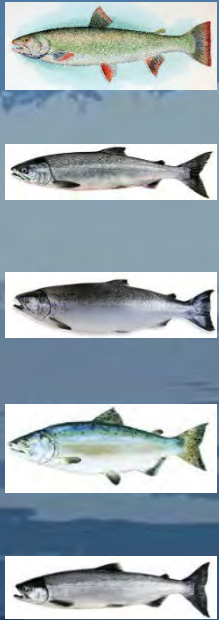
ELISA Screening	Threshold of 10 $\mu\text{g STX Eq. } 100\text{g}^{-1}$
HPLC Follow-up	>10 $\mu\text{g STX Eq. } 100\text{g}^{-1}$



# Forage Fish

## 249 Analyzed

**<10  $\mu\text{g STX Eq. } 100 \text{ g}^{-1}$**       **84.3%**  
**10-20  $\mu\text{g STX Eq. } 100 \text{ g}^{-1}$**       **12.9%**  
**>20  $\mu\text{g STX Eq. } 100 \text{ g}^{-1}$**       **2.8%**

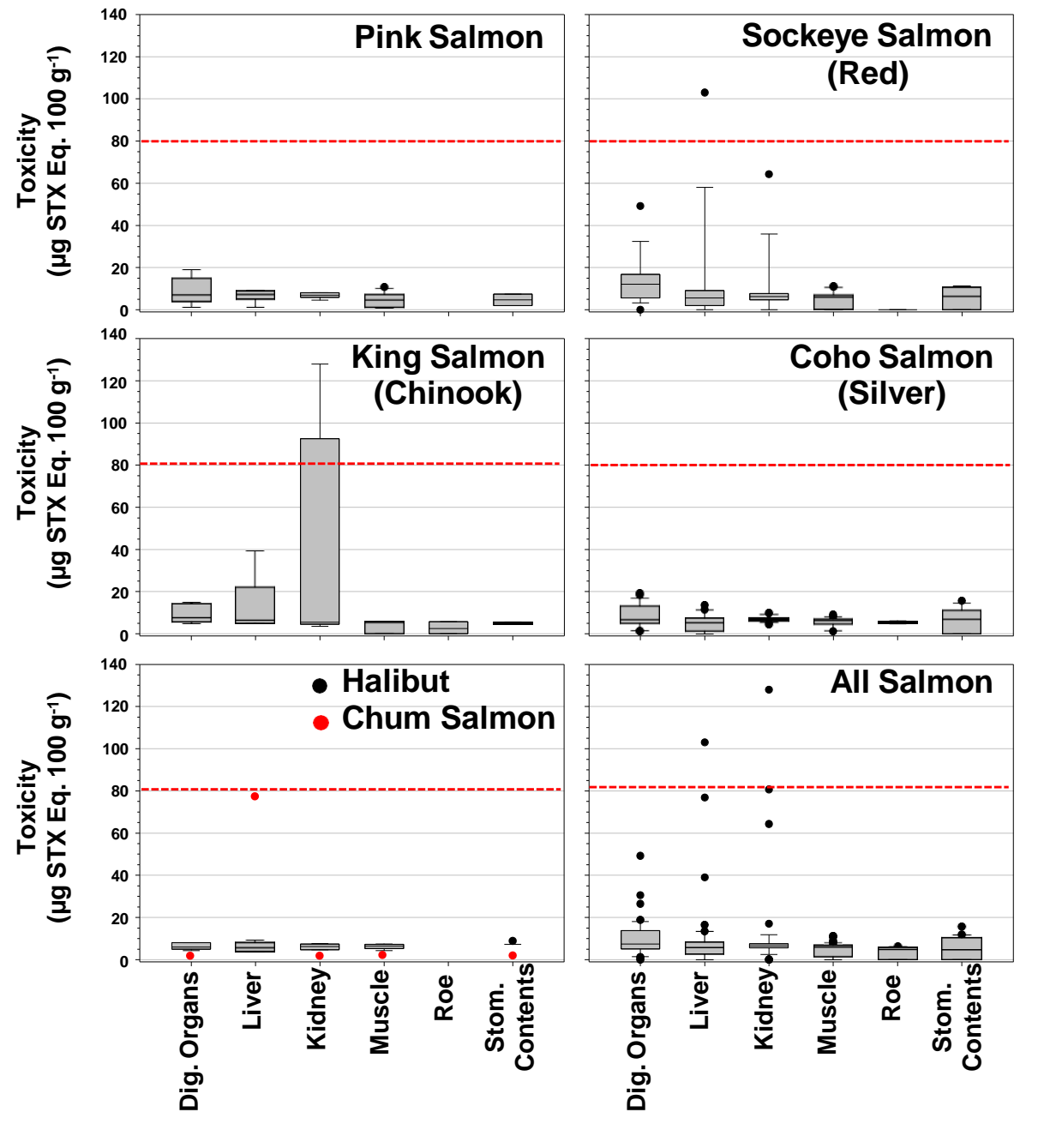


# Predatory Fish

## Salmon & Halibut

### 73 Analyzed

- Digestive Organs
- Liver
- Kidney
- Muscle
- Roe
- Stomach contents





# Summary

## Overall

Toxins in plankton, juvenile and forage fishes, predatory fish  
Highly variable in time & space  
Widespread low level toxicity in fish  
Commensurate with *Alexandrium* bloom intensity

## Salmon & Halibut

PSTs in digestive tract, excretory organs  
Very low in muscle meat & gonads

- Very low human health risk
- Little economic threat to seafood industry
- Higher risks to predators

Samples during intense *Alexandrium* blooms?

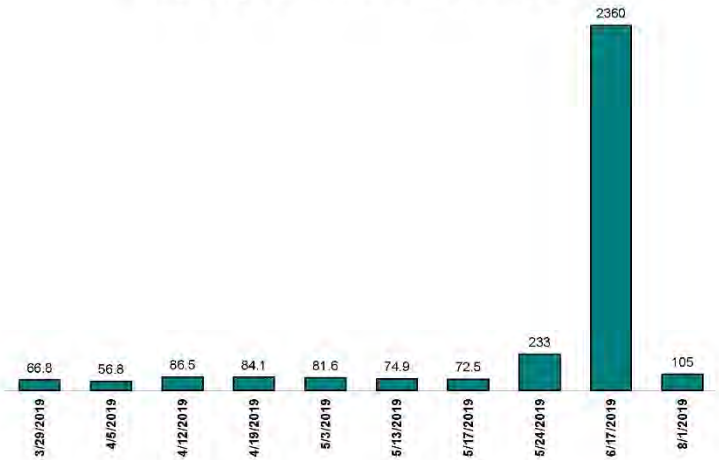
What's worse? Higher toxin levels vs. higher incidence in fish?

Upper limit to body burden?

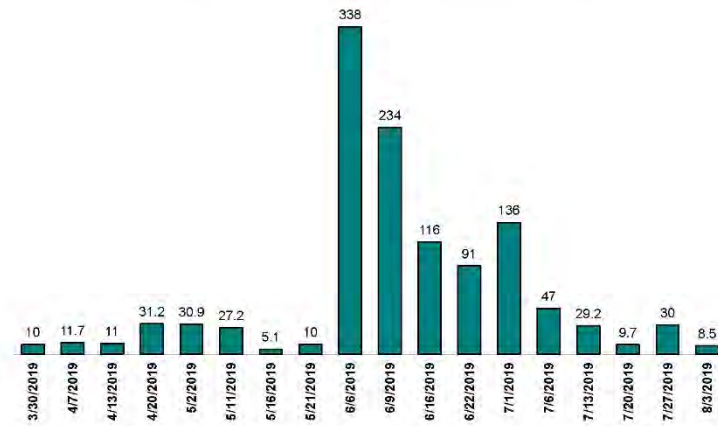
Effect on fish?



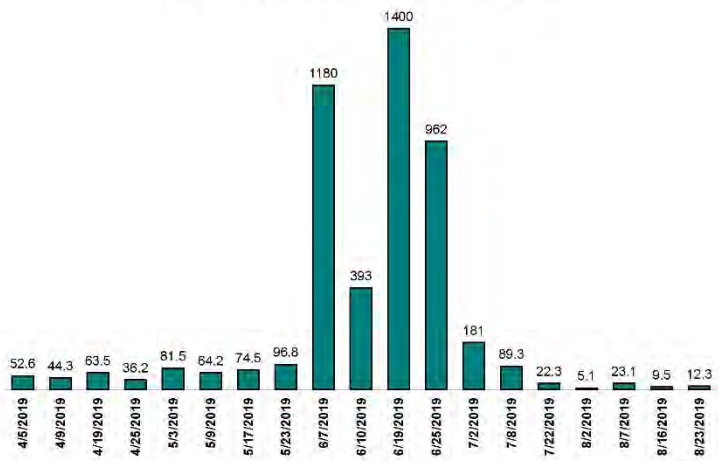
Chignik Lagoon, Alaska Mussels PSP Results 2019



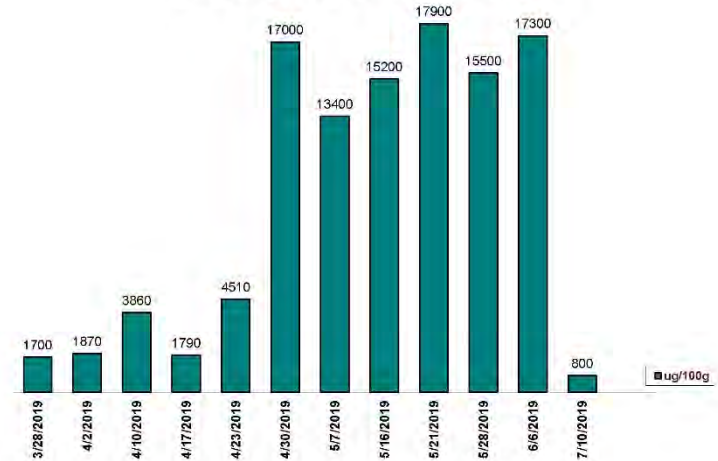
Auke Bay, Juneau, Alaska Mussels PSP Results 2019



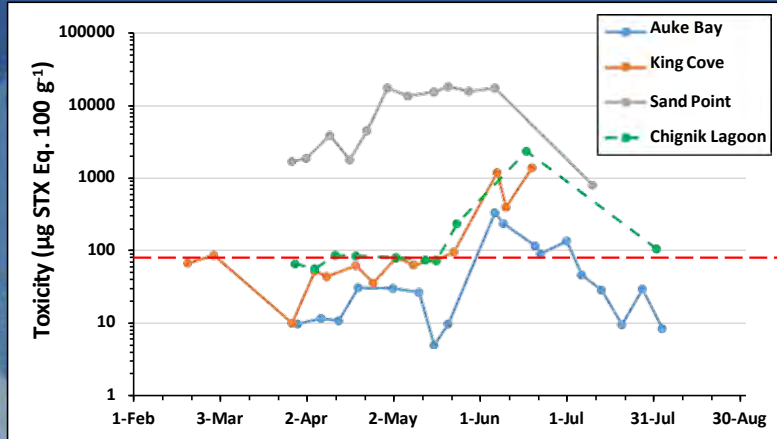
King Cove, Alaska Mussels PSP Results 2019



Sand Point, Alaska Mussels PSP Results 2019



# 2019 data



Shellfish toxicity

