

ANTHC Rural Alaska Monitoring Program (RAMP): Assessing, Monitoring, and Adapting to Emerging Environmental Human and Wildlife Health Threats

Presented to:

EPA Tribal STAR Grant Review

Raleigh-Durham, NC

9/20/16

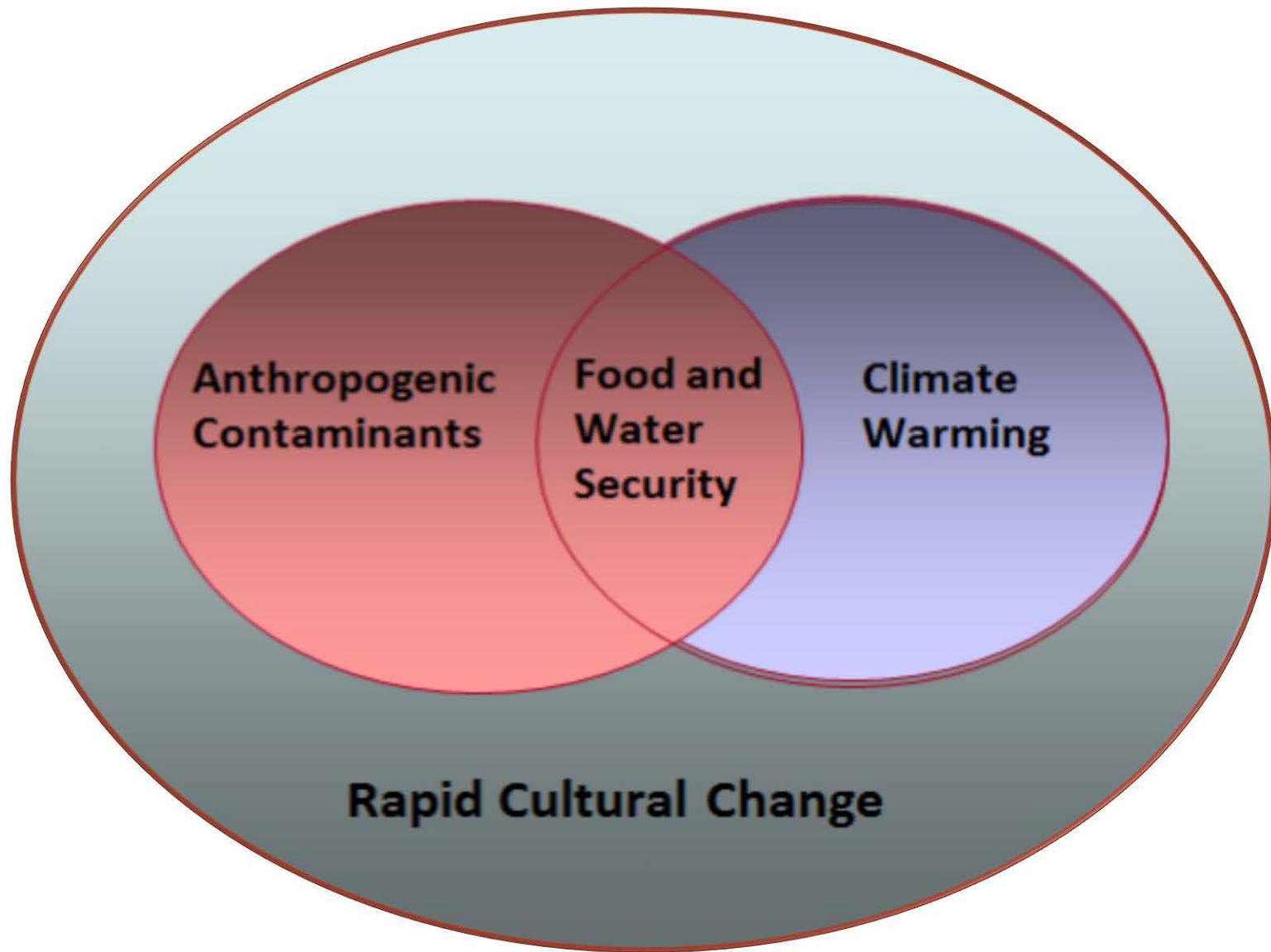
Presented by:

**James Berner, MD – Senior Director for Science
Department of Community Environment & Health
Division of Community Health, ANTHC**



ANTHC Rural Alaska Monitoring Project (RAMP)

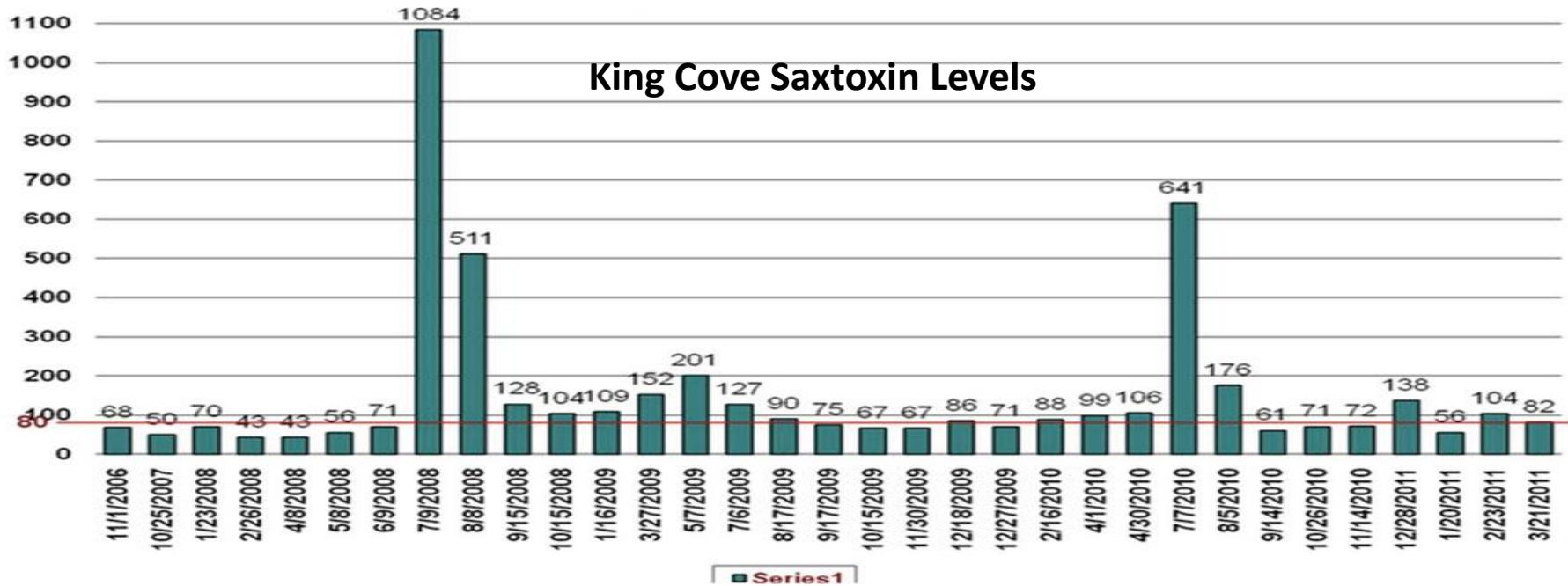
- The ANTHC RAMP is designed to monitor the Bering Strait region's climate-impacted human and wildlife environmental health threats.
- The RAMP is made possible by an EPA STAR grant. The RAMP monitors the known environmental health threats, detects emerging threats, and monitors trends.
- RAMP uses a "One Health" framework, which assumes that all parts of the ecosystem, and environment, are related, and affected by changes in any other part.
- The perspective of the monitoring is to focus on food and water security in rural Alaska, which is illustrated in the next slide, where the interaction of Arctic warming, man-made contaminants, and disease-causing organisms interact to form the threats to food and water security.



RAMP Monitoring Elements:

- Antibodies in land and sea mammal blood collected by soaking filter paper in hunter-killed animals, that show exposure to diseases that can infect both animals and humans, (zoonotic diseases).
- In the future, this blood will be able to be tested for contaminants, as well.
- Stomach and intestinal contents of sea mammals to test for the toxins of harmful algal blooms (HABs) saxitoxin (paralytic shellfish poisoning) and domoic acid(amnesic shellfish poisoning).
- Test ticks and mosquitos for the bacteria that cause the tularemia infection, a zoonotic disease of beavers, muskrats and rabbits, that has moved north as the tree line has moved north.
- Tests on local fresh water sources for the presence of mercury from Asian power plants, and melting permafrost, and the presence of HABs that can occur in fresh water, when it warms, and melting permafrost can release nitrogen and phosphorus into the water.

Bering and Chukchi Sea HAB Studies



% Positive for DA:

Max conc ng/g:

% Positive for SXT:

Max conc ng/g:

- Walrus 40% (6,457)
- Bearded Seals 26% (47.8)
- Ribbon Seals 24% (6.6)
- Ringed Seals 19% (126.6)
- Spotted Seals 1% (39.9)

- Walrus 27% (240)
- Bearded Seals 14% (14.8)
- Ribbon Seals 0% (NA)
- Ringed Seals 14% (172)
- Spotted Seals 1% (3.1)

DA = Domoic Acid

SXT = Saxitoxin

Fig. 1. Locations where algal toxins were detected in stranded (s) and harvested (h) marine mammals. Red images represent species positive for domoic acid (DA) and purple images represent species positive for saxitoxin (STX). Marine mammal species are listed as follows: (A) humpback whales, (B) bowhead whales, (C) beluga whales, (D) harbor porpoises, (E) northern fur seals, (F) Steller sea lions, (G) harbor seals, (H) ringed seals, (I) bearded seals, (J) spotted seals, (K) ribbon seals, (L) Pacific walruses and (M) northern sea otters.



Harmful Algal Blooms; HAB toxin levels in walrus from St. Lawrence Island (SLI)

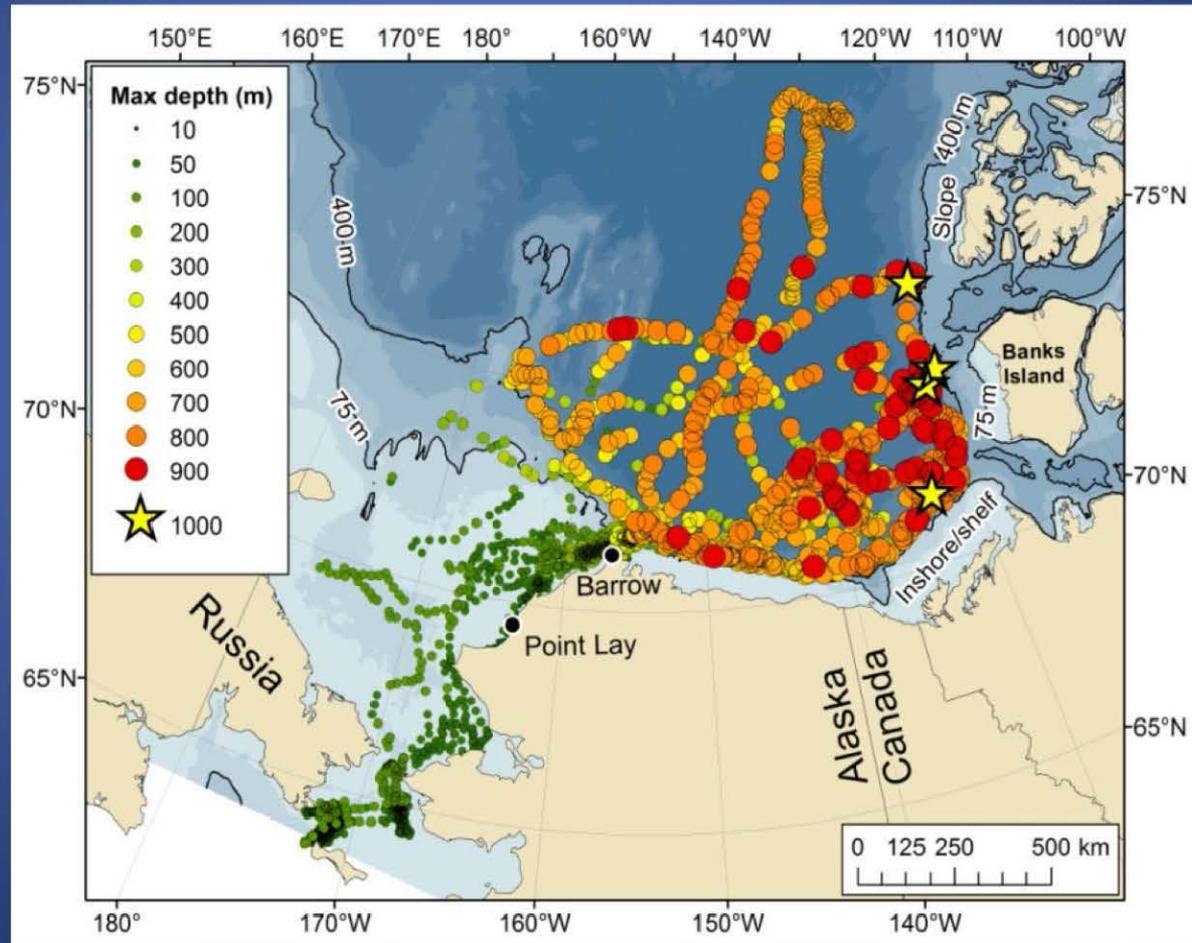
- GI contents on 97 walrus harvested 2014-2015 were tested for domoic acid, 46 were positive, range -6,457 ppb.
- GI contents on 44 were tested for saxitoxin, range 6-1,162 ppb
- GI contents on 31 walrus harvested in the spring hunt on SLI were tested for domoic acid, 12 were positive, range 0.6-19.6 ppb
- All 31 were tested for saxitoxin, 10 were positive, range 3.8-81.1 ppb.



Zoonotic Disease Antibody Studies

Zoonotic	Diseases
<i>Toxoplasmosis</i>	<i>6 – 10% Caribou ≈ 50% of harbor seals</i>
<i>Trichnosis</i>	<i>Very common in polar bear, walrus</i>
<i>Brucellosis</i>	<i>10. - 25% Caribou</i>
<i>Tularemia</i>	<i>Northward movement -beaver, muskrat, snowshoe hare, ticks; it can also be water-borne, and is carried by mosquitoes, ticks</i>
<i>Q-Fever (coxiella burnetti)</i>	<i>75% Northern Fur Seals similar prevalence in Stellar Sea Lions on St. Paul Island 25-30% Caribou</i>

Beluga Dive Data (Citta et al. In press.)



Tracks of satellite-tagged belugas 1998-2008

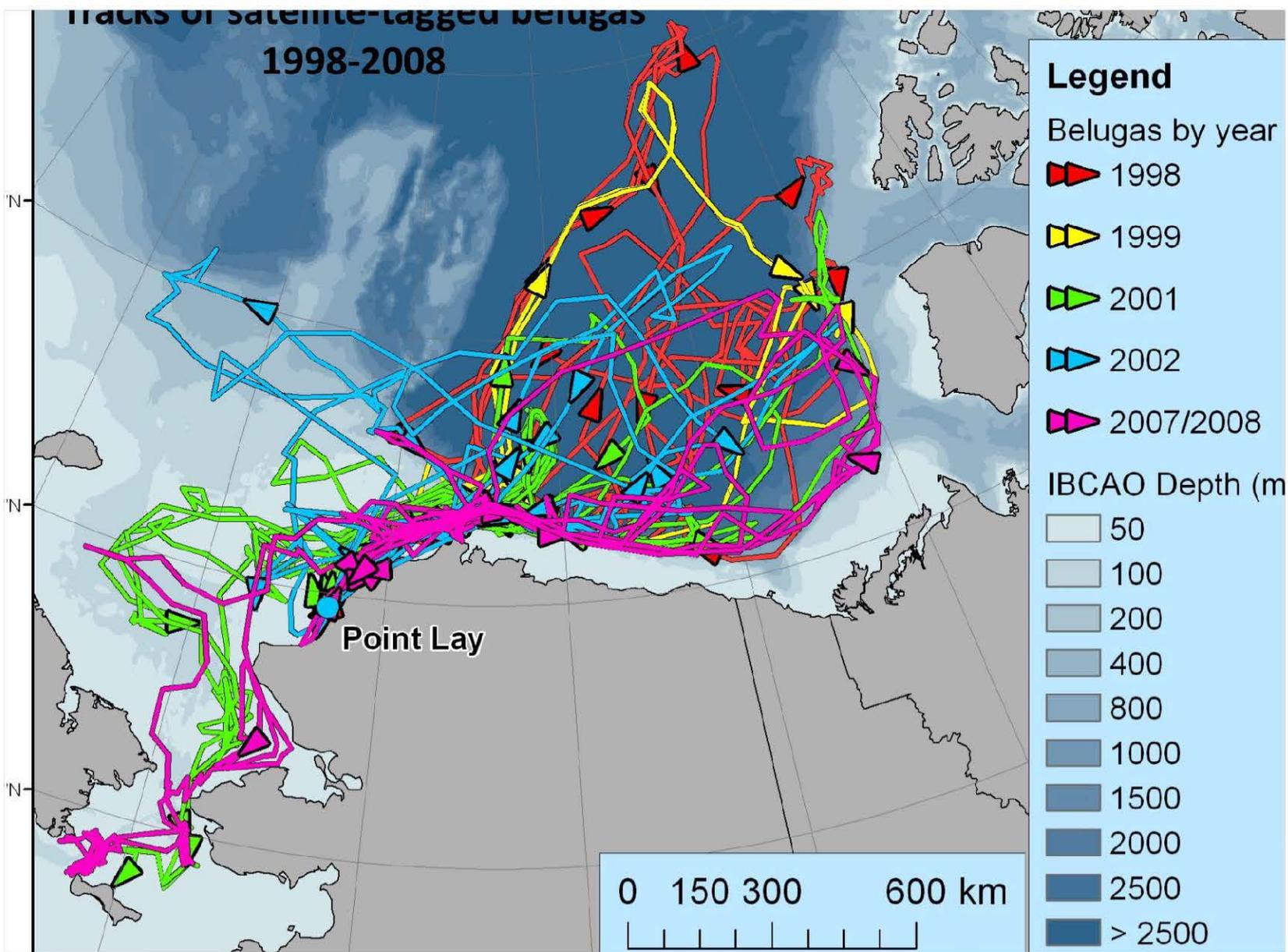




Photo: Mike Brubaker

Zoonotic Disease in Sea Mammals

Walrus

6/151 positive for leptospira bratislova

1/151 positive for toxoplasma gondii

7/151 positive for marine brucella

Bearded seal

13/81 positive for marine brucella

Leptospirosis and toxoplasma all negative

Ringed seal

7/24 positive for marine brucella

8/19 positive for leptospira bratislava.

1/13 positive for toxoplasma gondii

Brucella Preliminary Results (harbor seals)

Serum results:

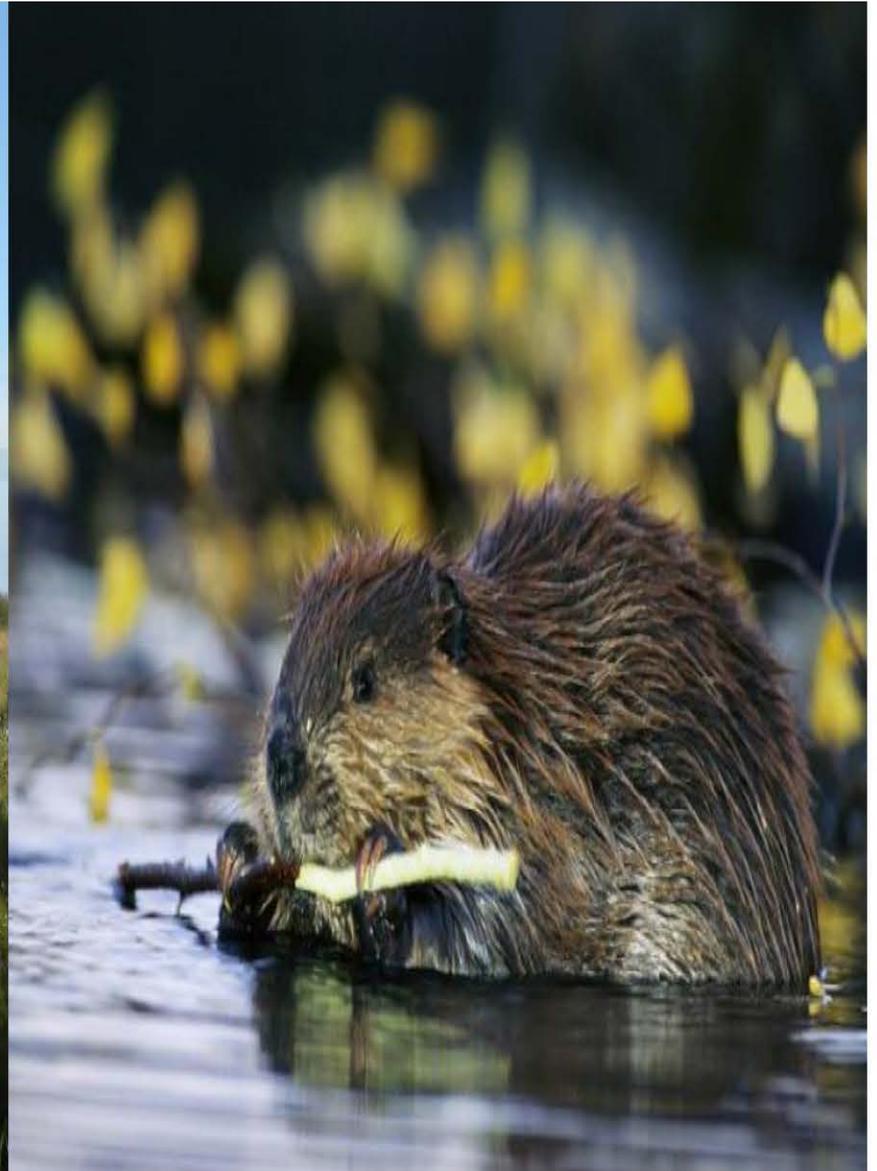
- 13 positives on card, 9 positives on card and plate, 4 card positives not reactors on plate test.
- One false positive (on plate not card) which was not included in filter paper samples.
- Serum is used as our gold standard test.
- Card Test: Serum showed 13 positives of which eluate only detected 4 of 13 while the **concentrated eluate detected 8 of 13** (7 negative controls remained so).
- Plate Test: Serum showed 9 positives of which eluate only detected 3 of 9 while the **concentrated eluate detected 5 of 9** (9 negative controls remained so).
- Thus, our preliminary results indicating that the reconstitution method enhances Brucella serum antibody detection and can now be applied more widely on FP samples.

Preliminary Conclusion:

- Centrifugally based concentrating (reconstitution) methods can enhance detection of *Brucella* specific antibodies from serum soaked filter paper of harbor seals.
- With these encouraging data we will progress with additional samples.
- We point out that care in selecting the actual assay to use is important!

Hueffer, K., S.M. Gende and T.M. O'Hara. 2013. **Assay dependence of Brucella antibody prevalence in a declining Alaskan harbor seal (*Phoca vitulina*) population.** Acta Veterinaria Scandinavica 55:2 (January) doi:10.1186/1751-0147-55-2

Northward Movement of New Species



Mosquito Sampling Results

- We report on preliminary *Francisella* detection data in mosquito samples as part of the Rural Alaska Monitoring Project (RAMP).
- Mosquitoes collected in rural western Alaska as a teaching research opportunity for undergraduate students (three students have benefited from active learning in the laboratory on this project).
- To date, established **three real time quantitative PCR methods** at UAF: detect DNA of three *Francisella* genes (*lpnA2*, *fopA*, and *iQFt1*).
- Assays have average detection limits of 36, 825 and 2680 genome copies per reaction for *lpnA2*, *iQFt1*, and *fopA*, respectively.
- Based on these findings we will screen mosquito pools of five mosquitoes per pool with the most sensitive assay (*lpnA2*) and confirm positive samples with the other assays.
- To date, **9 pools out of 56 total pools** (5 mosquitoes per pool) have consistently tested positive for *lpnA2*.

Cutaneous Tularemia



Datum

Sidfot

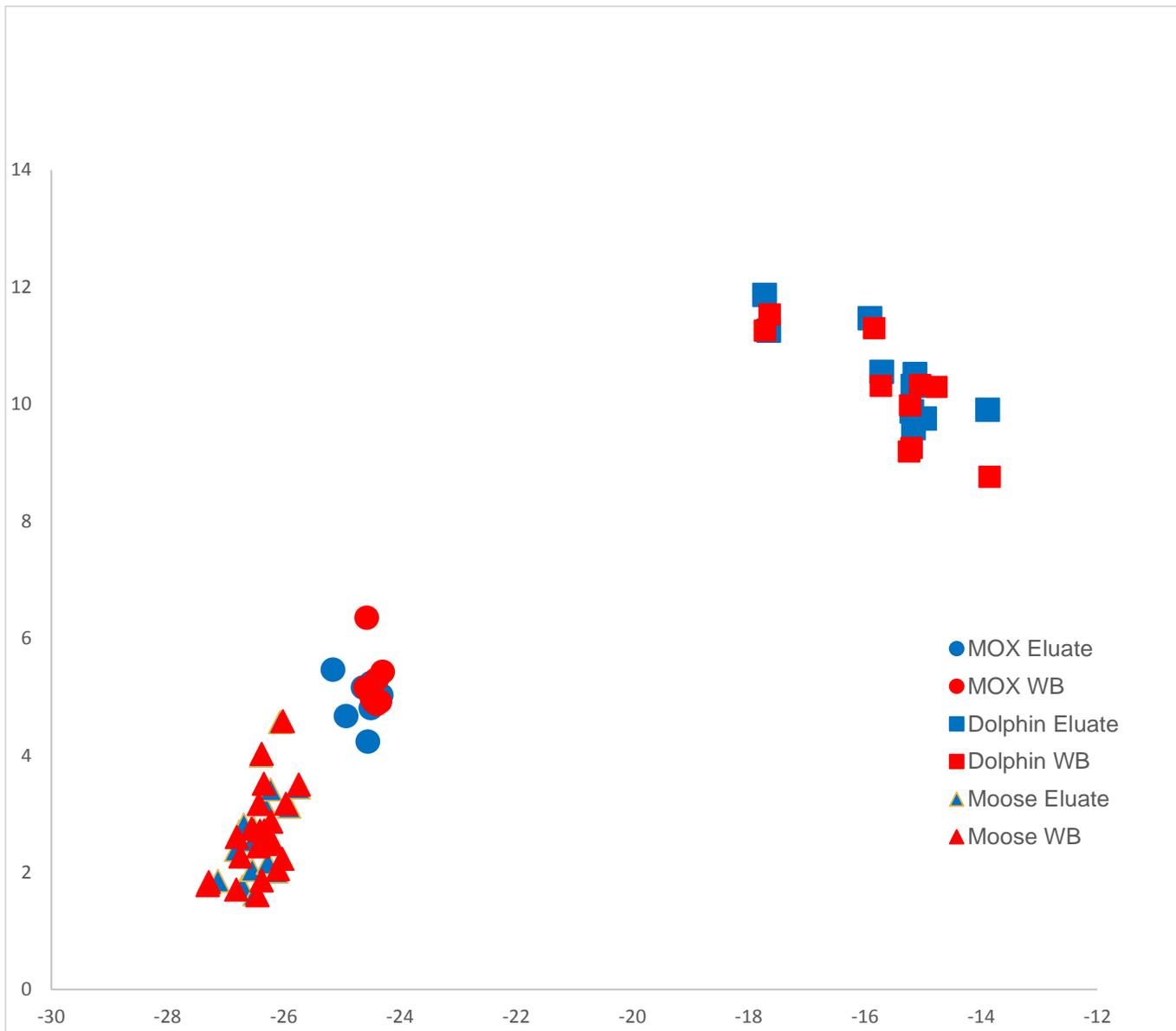
8

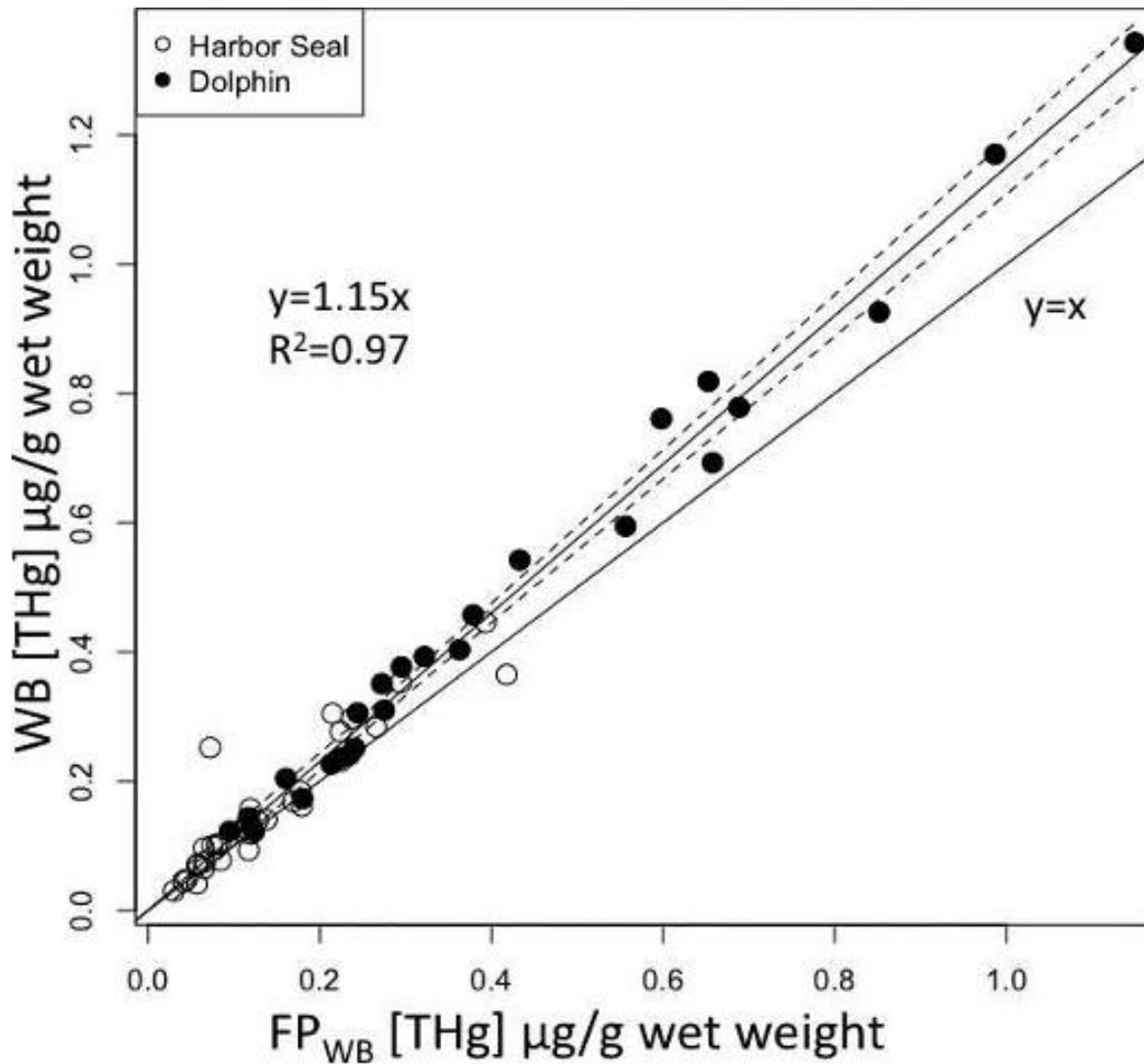
Photo by Dr. Maria Furbar, Umea, Sweden

Use of Blood Soaked FPs for Chemical Feeding Ecology Assessment

- We assessed C and N stable isotopes (SIs) in three species (bottlenose dolphins, moose and musk ox) to determine if blood soaked filter paper (FP) was amenable to assess C and N SIs.
- Dolphins represent our marine high trophic level strict carnivore and show no significant difference in mean $\delta^{15}\text{N}$ ($p=0.157$) and mean $\delta^{13}\text{C}$ ($p=0.339$) values when compared between the freeze dried filter paper (FP) eluate and freeze dried whole blood.
- Musk ox show no significant difference in mean $\delta^{15}\text{N}$ ($p=0.072$). However, a significant difference for mean $\delta^{13}\text{C}$ ($p=0.040$) was noted when compared between the freeze dried FP eluate and freeze dried whole blood. For musk ox the absolute (0.2109 for $\delta^{13}\text{C}$) and % difference (0.86 for $\delta^{13}\text{C}$) were relatively small indicating a negligible biological significance. We conclude the results from FP eluate and whole blood are comparable.
- Moose show no significant difference in mean $\delta^{15}\text{N}$ ($p=0.717$) and mean $\delta^{13}\text{C}$ ($p=0.141$) values when compared between the freeze dried filter paper (FP) eluate and freeze dried whole blood.
- Figures (next slide) display direct comparisons of FP eluate to whole blood for C and N SIs for each animal.
- under preparation: manuscript to be led by Megan Templeton (former graduate student) with assistance from O'Hara and Castellini that will involve other colleagues who are species specific experts and provided needed samples and data.

$\delta^{15}\text{N}$





Thus, in combination with our published results (Hansen et al., 2014) we can use FP technology to conduct chemical feeding ecology of contaminants (the example here is Hg in harbor seal and dolphin blood).

Research Needs:

- Consider standardizing zoonotic antibody testing for a panel of circumpolar infections found in a circumpolar distribution.
- Consider establishing a network of rural hunters willing to obtain filter paper blood on harvested mammals, to track trends in zoonotic and contaminant exposure, and establish a circumpolar archive of specimens.
- Continue testing of appropriate sea mammal matrices for HAB toxins. HPLC investigation of saxitoxin forms in ice seals in the different parts of the Arctic to see if the toxin is being formed by the same plankton species in all Arctic regions.
- Begin investigations of effects of HABs on sea mammal genes.

PLANS FOR THIS YEAR:

- More samples of land and sea mammals for zoonotic disease exposure, metals and HAB toxins.
- More sampling of mosquitos, ticks and local water, from any community that wants to now more about these.
- Increase public and provider awareness about signs of HAB toxin exposure, and risk reduction from zoonotic exposure.
- Discuss sampling ice seal and /or walrus stomach tissue for tissue samples, to begin investigation of effects of HAB toxin on sea mammals, to better understand the influence they may have on sea mammal foraging behavior.

CREDITS:

- The RAMP Study, was supported by a generous grant from the US EPA, and the enthusiastic support and participation of the residents of the Bering Strait, the Kawerak Corporation, the Norton Sound Health Corporation and the efforts of Anahma Shannon, Environmental Coordinator for the Kawerak Corporation.
- The collaboration of scientists at the Alaska Department of Fish and Game, NOAA, CDC, and partners at the University of Alaska Fairbanks, Wildlife Toxicology Laboratory.
- The success of the RAMP, would not have been possible without the cheerful, skilled advocacy, technical assistance and oversight of Dr. Cynthia McOliver, the EPA Project Officer.

