“One Health” Perspectives on Environmental Contaminants in *Subsistence* Foods of Alaska

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One Health

• John Blake described this in the context of the proposed veterinary training program in collaboration with CSU.
• Involves high latitude sustainable agricultural & subsistence hunting, fishing and gathering.
• In the Arctic - easy to tie human and animal health together

One Health
Repeat John’s Message

• One Health is dedicated to improving the lives of all species—human and animal—through the integration of human medicine, veterinary medicine and environmental science.
Subsistence & Agriculture

Community hunter, gatherer, fisher = Community farmer/rancher

• Providers of nutrition! Raw materials (food & fiber).

• **Community based food security** enhanced when they team up: hunter, gatherer, fisher and **FARMER/RANCHER**.

*We need to do better in making these connections.*
Subsistence & Agriculture

• Focus on “food”
  ...not on how it’s harvested or by what specific group.

• Locally produced regardless of wildness or agricultural-ness.

• It’s a continuum and not discrete – hatcheries are salmon “ranching” reindeer herds on huge tundra systems, etc. (agric species sharing habitat with wild species!)
Sustainable Agriculture

• Key for local security in food availability and socioeconomics.
• Cost effectiveness only a portion of the formula.
• Including local “wild” or ranch type systems broadens view – environmental contaminants and so called “natural” toxins cross these systems (same ecological pathways).
• Involves same habitat! Similar management and ecosystem concerns (sustainable).
One Health

All linked via food production, distribution, utilization, quality and safety in a sustainable manner.
Calvin Schwabe’s “One Medicine”

- Circa 1960’s - Another conceptual model that combined general medicine of humans, domestic and free-living animals
- Precursor to current “One Health” paradigm.

Zinsstag et al. (2011)
One Health

• Advocating an interdisciplinary approach to health science

• A worldwide strategy for expanding interdisciplinary collaborations and communications

  in all aspects of health care for humans, animals, and the environment.
Inter-Disciplinary!!

Human Health
Animal Health
Ecosystem Health

Infectious Agents
Toxicology
Nutrition
Etc.
Infectious Agents

**Brucella**

- crosses Alaska cervids regardless of “ag” or wild designation (e.g., *Rangifer, Alces*)
- found in bison
- History of exposure (serology) and disease in humans (just like other carnivores!) in AK.

Infectious Agents

**Influenza**

- huge potential impact on large and small scale poultry.
- *Biotransport* via wild avian species
- “flyways” are transboundary & transoceanic!
- Obviously transmissible to mammals, including humans.
Toxicants/Toxins

• **Toxic plants** – climate change and human disrupted systems.

• **Where are we heading in the Arctic?**
  – Expertise & surveillance gap?
  – Assume same toxicity with related plants down south? Is that justified?
  – Ongoing *subclinical* impacts? Yet significant on production and economics?
  – Areas of research, CE and outreach needed? Can the DVM profession help?
Toxicants/Toxins

• **Harmful algal blooms** – marine/freshwater; increasing occurrence. Includes deadly drinking water for livestock, inedible seafood,…

• **Mycotoxins/endophyte toxins** – grasses and mushrooms key forage.

• **Industrial inputs** – chronic low level, catastrophic spills

• **Arctic** – atmospheric transport (Hg, PCBs). Important for fish and fish based food webs. Important for some subsistence species.
Cadmium (Cd)

• General concern for all herbivores regardless of agricultural or wild status.
• Enters (sub)arctic food web for reindeer/caribou & other herbivores.
• This is a potentially shared concern between hunters, herders, and farmers.
• Occurs naturally in the environment.
• Industrial sources, too.
Cadmium

- **Occurs naturally**: exposure to Cd reflects regional and local differences in the type of rocks/soil in area.
- **Industrial sources**: smelting, production of Cd-plated metal, nickel-Cd batteries, pigment and plastic stabilizers, & mining of Cu, Pb and Zn.
- **Long-range atmospheric transport** can distribute Cd to other places in the environment.
- **Lichens and some other plants absorb Cd directly from air** and pass it on to animals.
Trends in Cd and Hg Caribou Kidneys Northwest Territories

- Measure Cd in caribou herds across the NWT Territories.
- Cd in the NWT environment comes from both natural and industrial sources.
- Enter food chain - vegetation is eaten by herbivores then accumulate in caribou liver and kidneys.
Ongoing monitoring to ensure that caribou remains a safe, healthy food source.

Cd in NWT caribou not of safety concern; it’s a healthy, safe food choice for northern people.
Cadmium

"The World Health Organization recommends the cadmium intake should not exceed 72 mg per day or 26,280 mg per year. The average caribou kidney weights 250 g wet wt (...). Given the mean cadmium level 42.6 mg per gram and the mean water content is 77% (of Bluenose caribou kidneys), an individual would have to consume 10.64 entire kidneys per year in order to exceed the recommended level. Subsistence hunters do not harvest the average caribou; they harvest young animals. Conservatively, we suggest that hunters realistically harvest animals -6 years of age and therefore would have to consume 13.2 entire kidneys per year in order to exceed the recommended level. An average family of five would harvest six to eight caribou annually for subsistence purposes. Assuming all kidneys were available and in their entirety that would provide 16 kidneys for five individuals for annual consumption."

(Later and Nagy 2000)
Cadmium

*Seem a bit complicated?!*

No offense to these (my) colleagues!

Toxicologists
(veterinary and public health)

DVMs

Extension Specialists

Producers

Hunters

Game Managers

We need to work together!
Not all good news

• Monitoring moose in the NWT: An advisory was issued for moose in the southern Mackenzie Mountains (Deh Cho region, 2009).

• Elevated cadmium in liver and kidney of mountain moose harvested in the southern Mackenzie Mountains.
PUBLIC HEALTH ADVISORY

Limit consumption of Moose Organs from the Southern Mackenzie Mountains in the Dehcho, due to high cadmium levels

February 10, 2009 – The Chief Medical Health Officer has issued a notice recommending that people limit the quantity of liver and kidneys eaten from mountain moose harvested in the southern Mackenzie Mountains within the Dehcho region. Moose harvested in the Mackenzie and Liard valleys have lower levels of cadmium, and the recommended guidelines for consumption are higher than for moose harvested from the southern Mackenzie Mountains.

Moose liver and kidney organs collected from the southern Mackenzie Mountains, the Mackenzie and Liard Valleys, were tested as part of a wildlife monitoring program, and some animals were found to have elevated levels of cadmium.

Levels of cadmium in the MEAT of both valley and mountain moose are very low, and moose MEAT remains a very healthy food choice.

The Recommended Maximum Weekly Intakes (RMWI) were provided based on the Provisional Tolerable Weekly Intake (PTWI) of 7 ug/kg bw/week.

The RMWI for the kidney and liver of valley moose is 16 and 154 g/week, respectively. This amounts to consumption of approximately one serving of valley moose kidney every two months, or one serving of valley moose liver per week.

As indicated, the mountain moose have much higher cadmium levels. The RMWI for consumption of kidney and liver from these animals is approximately 2 and 14 g/week, respectively. This would amount to a recommendation that only one serving of mountain moose liver every three months could be consumed. It is recommended that no kidneys from these animals be consumed, due to the significantly higher cadmium levels.

For more information, contact:
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http://www.enr.gov.nt.ca/_live/pages/wpPages/hunting_moose.aspx
Cadmium, Lead, Mercury & 137 Cesium in Caribou of Northern Québec

- Cd - Levels exceeded tolerance thresholds for human consumption in nearly all kidney samples and in nearly half the liver samples.
- Mean total Hg - concentrations exceeding consumption thresholds in most kidney samples and nearly half the liver samples.
- Pb - few samples exceeded consumption thresholds.
- For most tissues, the three metals showed regional differences; the western region consistently showing higher values. Remember, there are local differences in what metals occur.
- Mean level of 137Cs - never exceeded the acceptable limit for human consumption
Levels of Cadmium, Lead, Mercury and 137 Caesium in Caribou (*Rangifer tarandus*) Tissues from Northern Québec
Robillard et al. 2002
Radioisotopes

- *General concern for all herbivores* regardless of agricultural or wild status.
- Similar concern for this 2nd class of chemicals.
- Cesium 137 similar pathways as Cd but accumulates in muscle (“meat”). Potassium analog.
- Strontium 90 – accumulates in bone. Calcium analog.
- Repeated releases cause great alarm.
- Impact of Chernobyl accident well known.
Livestock

• Will arctic/subarctic livestock need to face these Cd and/or radioisotope issues?
  – Condemned organ meats or carcasses?
  – Perception of food quality/safety?

• Maybe not:
  – Harvest young animals
  – Muscle meat primary product (Cd)
  – Supplemented feeding
  – Managed grazing
Livestock

• But maybe so...
  - Using same regions that are naturally high in certain elements.
  - Using same regions subjected to atmospheric and biological transport of contaminants and pathogens.
  - Similar physiology of some livestock and free-ranging species.
One Health

Human Health

More people
radioisotopes
Habitat change

More people
Ag producers
managers

More people
Habitat change

More people
Ag producers

contaminants
Climate change

Hunters
Biomedical professionals

pathogens
In Conclusion
One Health: Toxicology

- Toxicologists
  (veterinary and public health)
- DVMs
- Extension Specialists
- Producers
- Hunters
- Game Managers

Requires us to work together!