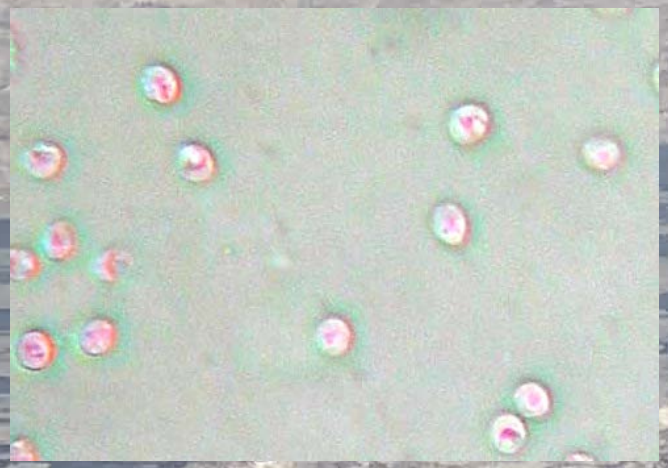
Microbial threats currently at the interface of humans, animals, and the Arctic environment



Dr Emily Jenkins
Professor, Veterinary Microbiology
University of Saskatchewan
Affiliate of the Canadian Wildlife Health Cooperative
Associate of School of Public Health

Photo credit Kayla Buhler

Microbial risk analysis framework

- Risk assessment
  - **Hazard identification: what's there?**
  - Hazard characterization: what does it do? (pathogenicity)
  - **Exposure assessment: probability of survival and exposure?**
  - Risk characterization: overall (and relative) probability and severity, knowledge gaps and level of certainty
- Risk management: what can we do about it?
- Risk communication: who needs to know about it, and how?

Zoonoses currently in the Arctic

Bacteria

- Anthrax
- *Bartonella*
- *Brucella*
- *Clostridium*
- Leptospirosis
- Lyme Disease
- *Mycobacterium*
- *Salmonella*
- Tularemia

Helminths

- *Baylisascaris*
- *Echinococcus*
- *Trichinella*

Prions

- Chronic Wasting Disease

Protozoa

- *Cryptosporidium*
- *Giardia*
- *Toxoplasma*

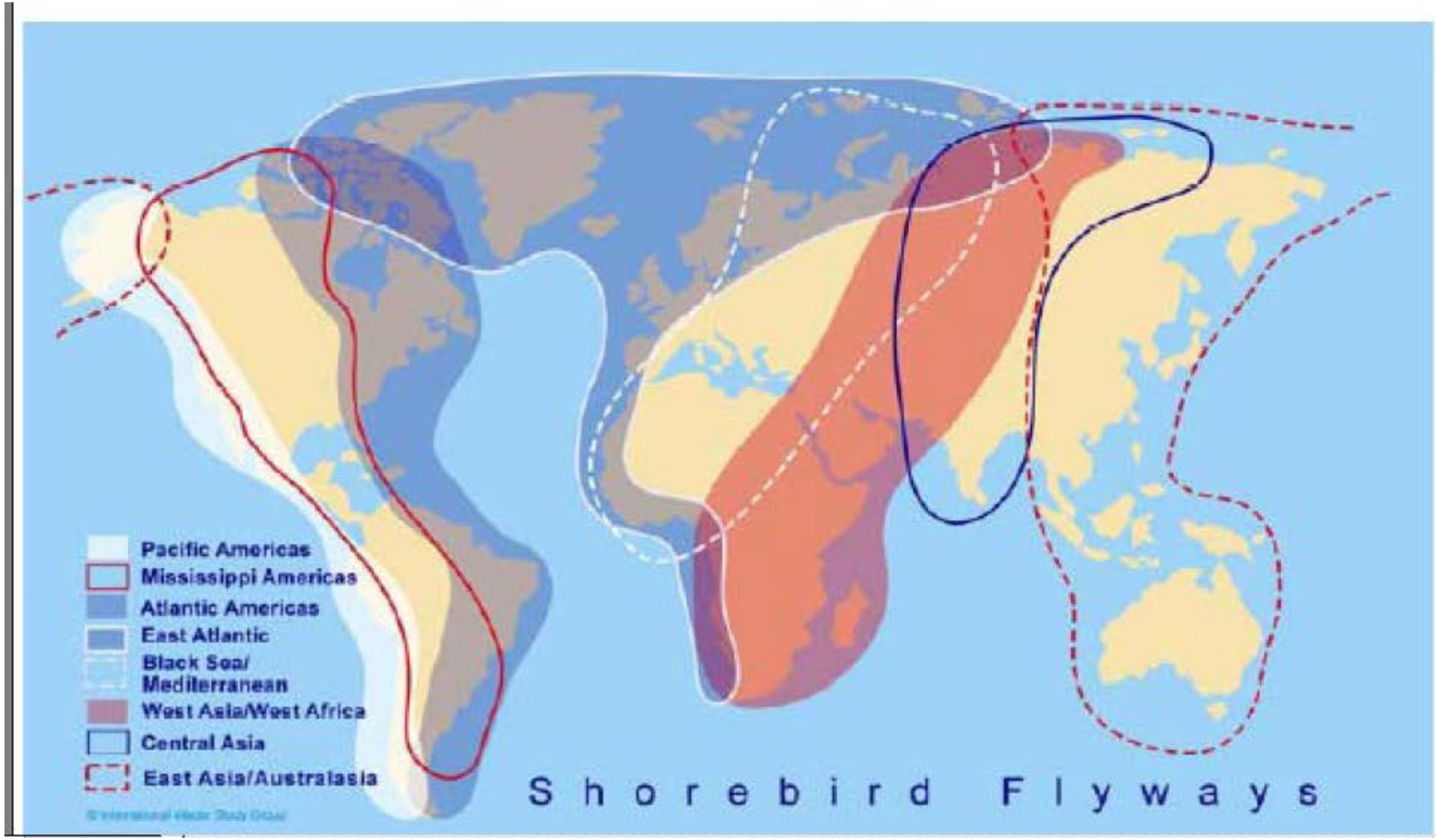
Viruses

- California Serogroup Viruses
- Hanta/Puumala
- Hepatitis E
- Influenza
- Pox viruses
- Rabies
- Tick Borne Encephalitis

Knowledge Gaps for Hazard Identification

- Major gaps in surveillance, especially wildlife, limit ability to definitively determine what is currently there
- Even if we know what's there now, what HAS been there?
  - Beringia!
- Seasonal presence in migratory wildlife (re-introduced every spring)
- It's a moving target

Flyways – seasonal introductions



Stroud et al., 2005, courtesy Anna Birmingham

So what Arctic zoonoses are tough?

- Bacteria: spore forming bacteria, *Mycobacterium* spp.
- Parasites: protozoan cysts/oocysts, some helminth eggs
- Prions: Transmissible Spongiform Encephalopathies, spontaneous
- Viruses: naked (non-enveloped) viruses; pox viruses

So what can we rule out?

- Vector borne diseases
- Obligate intracellular pathogens (some exceptions)
- Many viruses (very dependent on host cell infrastructure)
- Highly host specific diseases

Tough Zoonoses in the Arctic

Prions
- **Chronic Wasting Disease**

Bacteria
- **Anthrax**
- *Bartonella*
- *Brucella*
- ***Clostridium***
- Leptospirosis
- Lyme Disease
- ***Mycobacterium***
- *Salmonella*
- Tularemia

Protozoa
- ***Cryptosporidium***
- ***Giardia***
- ***Toxoplasma***

Helminths
- *Baylisascaris*
- ***Echinococcus***
- ***Trichinella***

Viruses
- California Serogroup Viruses
- Hanta/Puumala
- **Hepatitis E**
- Influenza
- **Pox viruses**
- Rabies
- Tick Borne Encephalitis

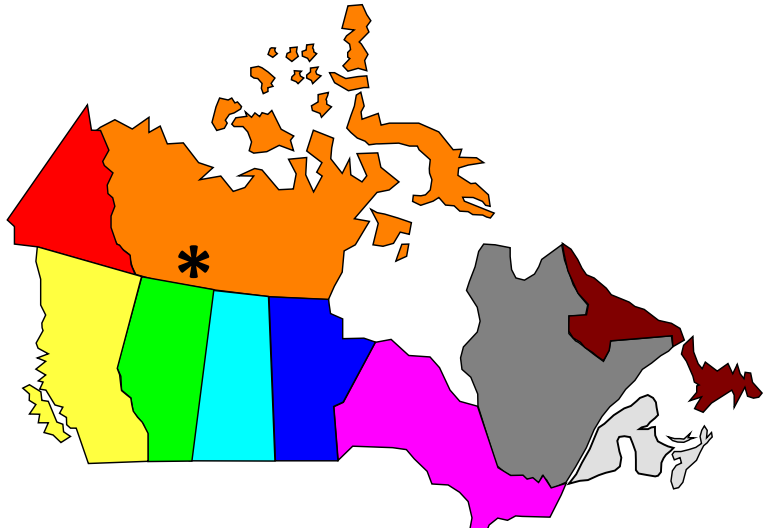
Bison in the Canadian North

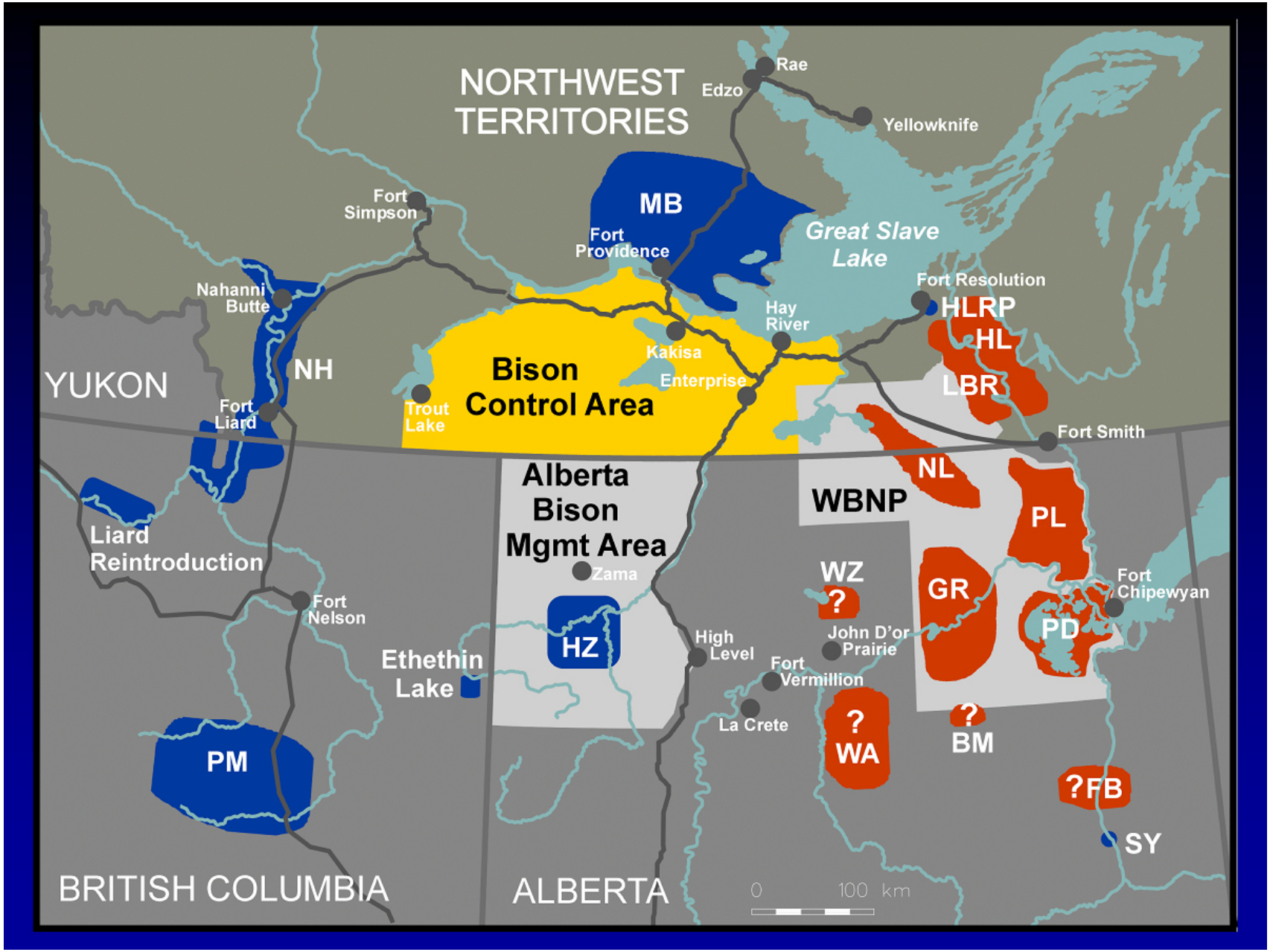
Source of:

Bacillus anthracis

Mycobacterium bovis

Brucella abortus



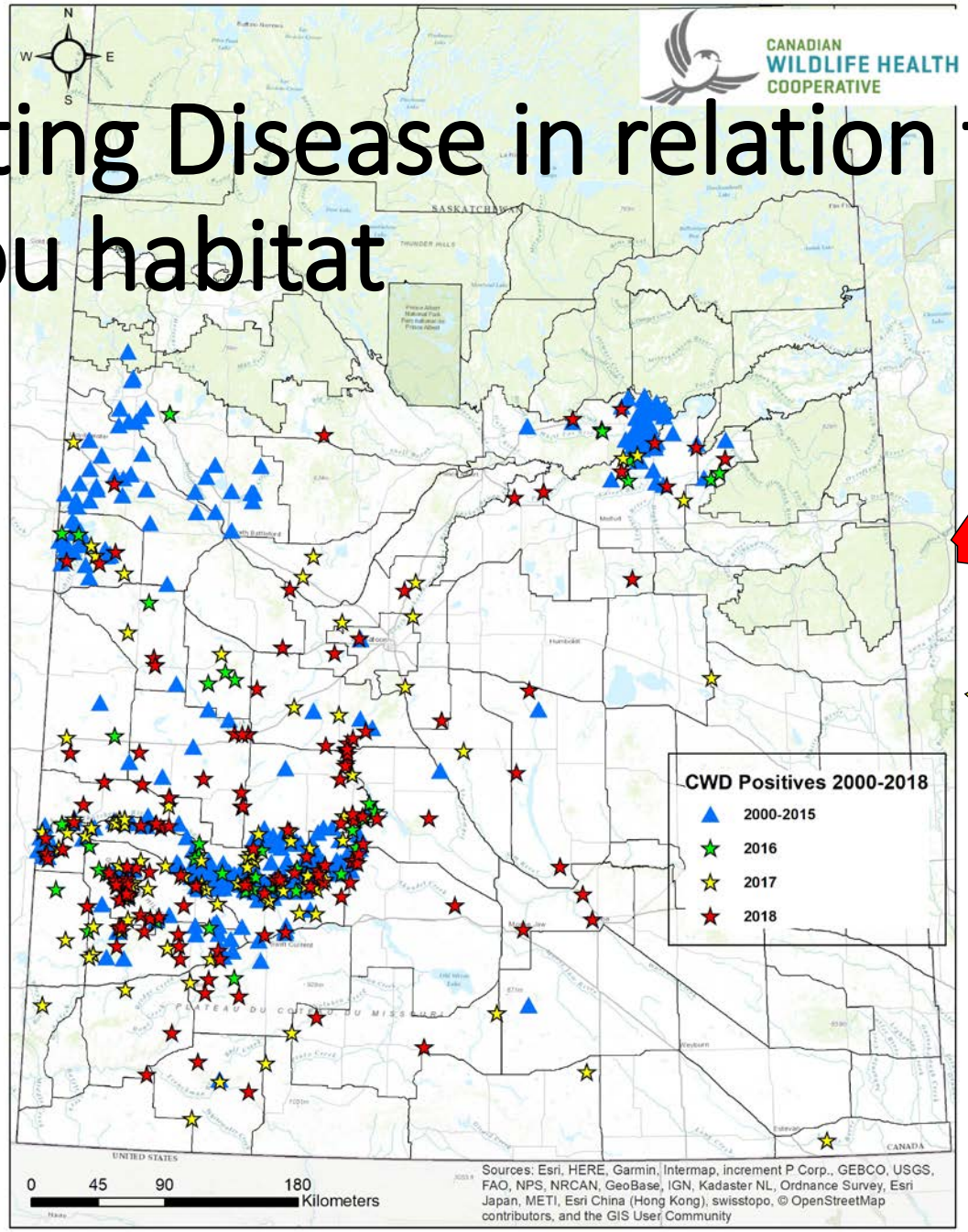


Map courtesy of Brett Elkin, Govt Northwest Territories

Chronic Wasting Disease in relation to boreal caribou habitat

Caused by prions

Photo credit Emilie Bouchard



Map courtesy of CWHC and Iga Stasiak

Eggs of *Echinococcus* spp.

Photo
S. Elmore

E. multilocularis

E. granulosus complex

Temperature (°C)	Survived (+) or killed (–) after periods indicated	References
–18	240 days: +	Veit *et al.* (30)
–27	54 days: +	Schiller (28)
–30	24 h: +	Colli and Williams (3)
–50	24 h: +	Colli and Williams (3)
–70	96 h: –	Blunt *et al.* (1)
–30	24 h: +	Colli and Williams (3)
–50	24 h: +	Colli and Williams (3)
–70	24 h: –	Colli and Williams (3)

Eckert et al., 2001, WHO/OIE Manual on Echinococcosis in Humans and Animals: a Public Health Problem of Global Concern

Needs for exposure assessment

- Actual microhabitat conditions
- Probability of survival
  - Environmental stages
  - Stages inside carcasses (carcass as cryoprotectant?)
- Probability of Transmission:
  - Host specificity (to people, or via bridging hosts)
  - Transmission routes (i.e. inhalation vs ingestion)
  - Minimum infectious dose

Gaps for exposure assessment

- Time spans in most empirical studies are not years- and we are talking decades, centuries…
- Most information is how to kill it, not keep it!
- Arctic adapted strains may have higher freeze tolerance than temperate and lab strains

Freeze-resistant larvae of *Trichinella nativa* survive years at -20℃

Photo credit Rajnish Sharma