

# **Climate Change and Infectious Diseases of Arctic Fauna**

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# Arctic Warming Will Challenge Species Ability to Adapt.

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# Impacts of Climate Change on Arctic Species

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- Significant declines of some species have occurred**
- Populations of others have increased**
- Ranges have also changed with the appearance of unusual species.**
- New migratory pathways may be established**
- Mixing of species has occurred**
- Species will be stressed!**

# Impact of Climate Change

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**These changes will alter the balance, distribution and occurrence of infectious disease agents.**

- Important subsistence species may be affected.**
- Arctic economies may be threatened (Alaska fisheries are a 1 \$ billion a year industry).**
- Infectious disease threats to humans may increase.**

# What Can Happen When Species is Exposed to New Disease Agent?

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- **Nothing – Natural immunity may be protective**
- **May be infected but may tolerate quite well – no symptoms no harm.**
- **May produce clinical disease**
- **May be very virulent because of no natural immunity. Cerebrospinal elaphostrongylosis in caribou**

# Climate Change – Arctic Species – Infectious Diseases – What do we know?

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- Not much – don't have good prevalence/incidence data
- Do have some surveillance data
- Factors related to climate change that influence disease occurrence are understood.
- What is known about disease occurrence + what we know about the factors that influence disease occurrence allows cautious projections for future disease patterns.

# **Climate Related Factors that Influence Infectious Diseases of Animals**

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- **Increasing Environmental Temperature**
- **Range Changes – mixing of species**
- **Human factors – domestic animals:  
livestock, domestic pets**

# **Disease Agents Favored by Increasing Environmental Temperature**

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**Disease agents that live outside a warm blooded host & are limited by environmental temperature.**

- **Parasites with stages in soil, water, cold blooded hosts,**
- **Cold sensitive bacteria that exist outside a host**
- **Pathogens transmitted by insect vectors.**



# Diseases Favored by Increased Temperatures

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## Terrestrial Parasitic Diseases:

- Arctic Canada - temperatures prior to 1997: muskox lungworm and sheep muscle worm took two years to develop
- After 1997 temperatures allow development in one year
- Result is that animals have greater parasite loads and more animals are infected.
- Warming could also favor range expansion of these parasites.

# Disease Agents Favored by Increasing Temperature and Precipitation

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Leptospirosis is a bacterial disease that lives in water. Canadian study showed warm, wet conditions increased rate of infection.

Lepto Serology studies in Alaska show exposures:

- 2% caribou
- 3% moose
- 5% grizzly bear
- 4% black bear

# Mosquito-borne Diseases

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**Insect-borne diseases are often limited by environmental temperature.**

**Many are tropical, some are temperate others exist in the Arctic.**

**Temperature is the major limiting factor in how far north insect-borne diseases occur.**

**Warming trends promote northern expansion of insect-borne diseases.**

# MOSQUITO-BORNE DISEASES IN ALASKA WILDLIFE

Virus	Zarnke 1983	Walters 1968-72
Jamestown Canyon*	Bison 89% Dall sheep 51%, snowshoe hare 43%	Caribou 20%
Snowshoe hare*	Bison 89% Dall sheep 41% snowshoe hare 65%	
Northway*	Bison 94% Dall sheep 84%, caribou 43% moose 78%	Moose 60% Bison 20% Bear 20%
Sindbas SIN		Bison 80%

# MOSQUITO-BORNE DISEASES IN ALASKA INFECTIOUS TO HUMANS

Virus	Zarnke 1983	Walters Alaska Natives 18 villages 1968-72	Stansfield USGS USFWS workers 1988
Jamestown Canyon JC	54%	17.6%	20.5%
Snowshoe hare SSH	42%	6.8%	13.6%
Northway NOR	14%	3.1%	3.9%
Klamath KLA	5%		3.4%

# **Insect-Borne Disease and Climate Change**

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## **Increasing temperature may:**

- **Shorten the incubation period insect-borne parasites need to become infectious.**
- **Increase number of insect generation cycles in a season.**
- **Bring more insect-borne diseases into the Arctic.**

# Expansion of Disease Agents through Host Range Changes

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- **Range changes are happening on a large scale. A review of 143 studies of 1500 species indicated 80% had shifted their ranges north.**
- **Shifts are likely to be greater in Polar Regions where the temperature increase is greater.**
- **When species move into other regions they are apt to bring their pathogens with them.**

# Diseases Favored by Range Changes

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- **Harp seals migrate to the high Arctic each summer.**
- **A study in Canada showed 83% harbored phocine distemper virus antibody. 50% carried Giardia parasites.**
- **Phocine distemper antibody was also found in ringed seals in the high Canadian Arctic and was highest in regions where ringed seals were in contact with harp seals.**
- **If climate change favors summer range expansion of harp seals more marine mammals may be exposed to their pathogens.**



# DISEASES OF DOMESTIC ANIMALS INTRODUCED INTO ARCTIC FAUNA

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# DISEASES OF DOMESTIC ANIMALS INTRODUCED INTO ARCTIC FAUNA

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- 1977 bison in the Delta Junction region were negative for parainfluenza 3 virus antibody
- 1984 PI 3 antibody appeared in bison after a cattle industry had developed in the region.
- *Giardia & Cryptosporidium* parasites infect many species and if they become established in migratory mammals such as caribou their range could expand considerably.
- Molecular characterization of *Cryptosporidium* from caribou in NW Alaska indicates this may have already occurred.

# Diseases from Domestic Pets

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- Serosurveys of lynx 1993-2001 in NW Canada & Alaska indicated exposure to feline parvovirus, feline infectious peritonitis virus and canine distemper virus.
- Feline parvovirus prevalence was higher in southern populations than in those farther north.
- The difference could reflect more exposure to domestic animals

# Diseases from Domestic Pets

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- Toxoplasmosis is a cause of mortality in southern sea otters, but not Alaska Sea Otters
- Recently a sea otter found injured in Resurrection Bay in Southcentral Alaska was diagnosed with Toxoplasmosis
- As more people and their domestic pets invade the Arctic and Subarctic, chances of exposure of wildlife to domestic animal diseases will increase.

# Summary

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- Climate change will have dramatic impacts on Arctic ecosystems
- Animal infectious diseases are integral elements of all ecosystems and will also be affected
- Some infectious diseases may decrease others increase
- Some may seriously impact important economic and subsistence species.
- Some of these diseases may also pose a threat to humans