Climate Change and Health of Arctic Marine Mammals

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Health vs. Disease

- Immune status
- Environment
- Toxicants
- Pathogens
- Body Condition
## Possible Direct Effects

<table>
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<th>DIRECT</th>
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<td>Downward: Sea ice platform</td>
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<td>Upward: Incidence of severe weather</td>
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<td>▲‘s infectious disease transmission</td>
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<td>▲‘s In toxicant pathways</td>
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<td>▲‘s in predator-prey relationships</td>
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<td>Negative anthropogenic effects</td>
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Infectious disease - Host Density

• Density dependent diseases
  • Morbilliviruses
  • Many parasites
  • Influenza, etc.

• Frequency dependent

USFWS-MMM; G. Sheffield
Host or vector range expansion

- Some infectious diseases have carriers
- Morbillivirus example:

Grey seal (*Halichoerus grypus*)

Harp seals (*Phoca groenlandicus*)
Norbert Rosing
Goldstein et al PDV in Northern Sea otters in the Pacific. 2009

Sea Ice Index from the National Snow and Ice Data Center
Since 1998, 11 introductions of different serotypes in Europe

Culicoides sp.
Increased survival of pathogens

• “Climate influences pathogen distribution, and weather influences the timing of disease outbreaks” (Dobson and Carper 1993)

Figure 3. Number of Patients with *Vibrio parahaemolyticus* Infection Associated with Oysters from Farm A, According to the Harvest Date, and Mean Daily Water Temperatures at Farm A.

During the harvesting of oysters in Prince William Sound, Alaska, in 2004, the lowest temperature associated with the onset of illness in any of the 51 patients was 15.3°C, on July 27. The dashed line denotes the theorized threshold temperature (15.0°C) for the risk of *V. parahaemolyticus* illness from the consumption of oysters. Temperatures in May never exceeded 12.2°C. Farm A was closed on July 28, 2004.

Toxicants / HABs

- Harmful algal blooms (HABS)
- Evidence that they are worldwide
- Changes in water temperature
- Micronutrients
- Salinity
- Mortality events in marine mammals

Alexandrium catenella produces a suite of toxins responsible for paralytic shellfish poisoning symptoms.
Unusual Mortality Event 2011

Photo by J. Herreman

Photo by T. Fishbach

NMFS MMHSRP permit number: 932-1905-00/MA-009526
Reported locations of illness in northern marine mammals
(ringed seals, spotted seals, bearded seals, walruses)
July to November 2011

Map: ANTHC - Center for Climate and Health
As of November 10, 2011

Courtesy of Michael Brubaker
Multifactorial process

Pathogen candidates:
- Viruses
- Mycoplasmas; S. phocae
- Abnormalities in molt
  - Endocrine disruption
  - Nutritional factors
  - Climate change factors
    - Loss of sea ice
    - Algal bloom
What's the plan?

- Need Baselines
- Health parameters
- Identity, prevalence and intensity of pathogens
- Relationship to environmental factors
- Integrated with demographic data on marine mammals
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