



IWAP IV

Fourth International Workshop on Arctic Parasitology

1st - 4th June 2010

A wide-angle photograph of a coastal landscape in Svalbard, Norway. The foreground shows a calm body of water with a small, dark boat in the middle ground. The background is dominated by a range of rugged, snow-capped mountains under a pale, overcast sky. The overall scene is serene and captures the natural beauty of the Arctic region.

Longyearbyen
Svalbard, Norway

Abstracts from the Fourth International Workshop on
Arctic Parasitology
IWAP-IV

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Topic: Zoonoses

Epidemiology and public health significance of parasitic zoonoses in northern Canada

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Parasitic zoonoses (i.e. *Trichinella*, *Toxoplasma*, *Echinococcus*, *Diphyllobothrium*, and *Giardia*) may have greater public health significance in northern and indigenous communities in Canada than in the general population. Residents of these communities may be at greater risk of exposure to parasitic zoonoses due to practices of harvesting and consuming wildlife, inadequate water and sewage treatment, and free-ranging dog populations with little access to veterinary care. Challenges in determining the burden of human disease associated with parasitic zoonoses include lack of surveillance, limited medical and laboratory infrastructure for detection and genetic characterization of parasitic zoonoses, and the subclinical and chronic nature of these zoonotic infections. We describe recent investigations into the prevalence, diversity, and public health significance of parasitic zoonoses in dogs in northern and indigenous communities in Canada, including ascarid roundworms, *Echinococcus granulosus* (*E. canadensis*), *Diphyllobothrium* sp., and zoonotic genotype A *Giardia*. As well, we describe recent genetic characterization of endemic and introduced strains of *E. multilocularis* in Canada, and the significance of these findings for public health. Our goals are to develop diagnostic and research capacity in conjunction with international collaborators, to support initiatives in delivery of veterinary services to local communities, and to provide evidence-based inputs for public health personnel, wildlife managers, and policy makers. Ongoing research includes determining the significance of genetic diversity of parasitic zoonoses for public and wildlife health, and developing baselines and predictive models for the impact of landscape and climate change on the complex ecology of parasitic zoonoses in vulnerable northern ecosystems.

Engaging Northern communities in the monitoring of country foods for Anisakidae nematodes.

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This project deals with nematodes from the Anisakidae family, which are parasites that can be transmitted to humans by eating raw or partially cooked fish. Larvae of these parasites are common in several species of invertebrates, marine fish, cetaceans and pinnipeds. These parasites are found worldwide, including in Atlantic Canadian waters, however; data on Anisakidae in Arctic Canada is limited. Certain members of this family, such as *Pseudoterranova decipiens* and *Anisakis simplex*, can cause disease in humans, including stomach and intestinal ulcers, and in some cases, allergic reactions. The zoonotic disease risk is of particular concern in Northern communities, as traditional methods of preparing country food often include eating raw, dried or fermented meat. The distribution of meat among community members could also pose a serious food safety risk when the disease status of the food remains unknown.

To better inform Northern communities of their potential food safety risks from these parasites, it is necessary to determine the parasites' prevalence and distribution in the Arctic. To this end, a project is being conducted in Nunatsiavut, Nunavik and Nunavut, where traditional local hunters submit samples from their hunts to the local lab for analysis; local residents have been trained in the laboratory techniques.

Preliminary data indicate the presence of Anisakidae nematodes in traditionally-consumed fish and marine mammals from Nain (Nunatisavut) to Arviat, and Nunavut. Identified species include *Pseudoterranova decipiens*, *Anisakis simplex*, *Contracaecum osculatum* and *Hysterothylacium aduncum*. The presence of adult nematodes in beluga and ringed seals from Hudson Bay indicates that these animals are definitive hosts, and are thus capable of maintaining infection transmission in the marine food web via fecal contamination of the marine environment. Statistical modeling will determine risk factors for parasite burden in marine mammals and fish, and subsequently which are of greater concern for human consumption.

Zoonotic pathogens in marine mammal meat: a risk assessment of transmission to humans

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Knowledge on the occurrence of zoonotic pathogens in marine mammals and their potential health risk to human consumers is limited. Norway participates in commercial hunting of minke whales (*Balaenoptera acutorostrata*), and harp (*Phoca groenlandica*) and hooded seals (*Cystophora cristata*). Products are available through food stores and restaurants. Meat inspection is generally minimal, being based on organoleptic evaluation, spot-tests of hygiene indicator organisms and possibly a few infectious agents (bacteria). Harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals are also hunted in Norway, and for these, as with other game species, no meat control is performed.

The Panel on Biological Hazards of the Norwegian Scientific Committee for Food Safety has addressed this lack of knowledge by undertaking a self-initiated risk assessment of human pathogens in marine mammals. As well as various species of bacteria and different viruses, the potentially zoonotic parasites considered of interest are: *Cryptosporidium* spp., *Giardia duodenalis*, *Toxoplasma gondii*, and *Trichinella* spp.

The literature on occurrence of these parasites in marine mammals, reports of outbreaks, and epidemiological studies has been reviewed. Although transmission of either *Toxoplasma gondii* or *Trichinella* spp. to humans by ingestion of their transmission stages in the meat of marine mammals of interest seems unlikely, this infection route cannot be excluded. There are few available data on *Cryptosporidium* in marine mammals, and no reports of it occurring among species of relevance to Norway. *Giardia*, in contrast, has been detected in all the relevant seal species, and also some whale species, but there are no data available from minke whales. Marine mammals have been speculated to be important reservoirs of *Giardia*, however we suggest that transmission of *Giardia* or *Cryptosporidium* may be as likely to occur due to onboard contamination of seal/whale meat, via contaminated water or from infected humans, as from infected seals or whales.

Topic: Emerging Diseases

Setaria tundra, an emerging parasite of reindeer, and an outbreak it caused in Finland in 2003-2006

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Recent Finnish studies have revealed an array of filarioid nematodes and associated diseases to be emerging in northern ungulates. Infections attributable to a species of *Setaria* appear to have emerged in Scandinavian reindeer in 1973 associated with an outbreak of peritonitis and mass mortality.

In Finland, the latest outbreak of peritonitis connected with poor body condition and peritonitis in reindeer calves started in 2003 causing economical losses. Adult nematodes inhabit the peritoneal cavity of reindeer and produce microfilariae in to the host's blood circulation. The life span of the adult *S. tundra* female is at least 14 months. Microfilariae get with the blood meal into the intermediate mosquito (Culicidae) host. Microfilariae penetrate the gut of the mosquito. The development to the infective stage is temperature dependent and takes about two weeks at 21°C (mean). Mosquitoes, particularly *Aedes* spp. play an important role in the transmission of *S. tundra*.

Ivermectin has good efficacy against adult *S. tundra* nematodes and circulating smf, and therefore there is an obligation to treat heavily infected reindeer calves with ivermectin by injection for animal welfare reasons. At the population level, massive antiparasitic treatment with ivermectin can reduce the number of carriers among reindeer population, but could not prevent the emergence of the *S. tundra* outbreak in new areas.

Warm summers apparently promote transmission and the genesis of disease outbreaks by favouring the development of *S. tundra* in its mosquito vectors, by improving the rate of mosquito development and reducing their mortality from frost, and finally, by forcing reindeer to stay in herds on mosquito-rich wetlands. Based on the evidence in present studies indicate that *S. tundra* can act as a significant pathogen in reindeer. The putative relationship between climate change and a vector-borne disease identified indicates the potential and obvious threats to the individual and population health of arctic ungulates.

Trichinella and *Toxoplasma* in Svalbard

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The history of *Trichinella* is long in Svalbard and other arctic regions, and the parasite (*Trichinella* spp.) is well known from important arctic marine and terrestrial species such as polar bear, walrus and arctic fox. Another important zoonotic parasite, *Toxoplasma gondii*, was demonstrated in the arctic more recently and is shown to be widespread in the Svalbard ecosystem. The presentation will give an overview of the two parasites related to what has been published on prevalence in different animal species and briefly discuss possible transmission ways for the parasites.

Echinococcus surveillance in Norway

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Dogs and cats currently wishing to enter Norway from the European Union (EU), with the exception of animals from Sweden, Finland, the United Kingdom and Ireland, must be treated for the zoonotic tapeworm *Echinococcus multilocularis*. The EU required the Norwegian authorities to provide evidence for their presumed *E. multilocularis* free status in order to maintain this obligatory treatment regime beyond 2007. In 2006 the National Veterinary Institute (NVI) in Oslo began to systematically collect faeces from red foxes (*Vulpes vulpes*) shot during the licensed hunting season. At the same time, faecal material from foxes that had been examined at the NVI between 2002-2005, and that had been stored frozen, were also examined. These 329 "historic" faecal samples were screened using a copro-ELISA at the University of Zürich and then those that tested copro-antigen positive were examined using a multiplex PCR technique. The fox samples collected in 2006-2007 (482 foxes), 2007-2008 (426 foxes) and in 2008-2009 (396 foxes) were examined using the same multiplex PCR, as carried out in Switzerland, on pooled faecal samples subsequent to a modified egg isolation technique. Hunters were invited to participate based on the list of registered fox hunters (Statistics Norway) and received a small remuneration for their efforts. Each hunter submitted a standardised form, recording pertinent information about the fox, along with the faecal sample.

To date 1633 red fox faecal samples have been examined. None of these have tested positive by PCR for *E. multilocularis*. Foxes were collected from throughout the country, the distribution based proportionately on the hunting statistics for each county. These results therefore indicate that *E. multilocularis* is not present in mainland Norway. Annual surveillance will be necessary to ensure the continued absence of this zoonotic parasite from all regions of the country. The obligatory treatment of dogs and cats is now permitted until early 2012, before the EU will once again reconsider this derogation from the legislation.

Topic: The Marine Environment

Parasitological survey in Antarctic pinnipeds

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Marine mammals are regarded as good bioindicators of environmental changes. However, the information available about the health status of the Antarctic marine mammals is very limited. In addition, human derived activities such as tourism and global warming could be compromising these populations. The aim of our ongoing study is to evaluate the health status of Antarctic pinnipeds from the South Shetland Islands and Antarctic Peninsula. As a part of this study we are carrying out an investigation on the presence of parasites in phocids: Weddell seals (*Leptonychotes weddelli*), Southern elephant seals (*Mirounga leonina*), Crabeater seals (*Lobodon carcinophagus*) and Leopard seals (*Hydrurga leptonyx*), and otarids: Antarctic fur seals (*Arctocephalus gazella*). The determination of their presence and frequency would enable the assessment of the health status of these animal populations. In addition, some of these parasites are zoonotic and could contribute to evaluate the impact of the increasing human activity in the Antarctic continent. Faecal (366) and blood (134) samples were collected from these animals during austral summers 2006, 2007 and 2010. The results obtained up to date show that these animals present high infection rates by gastrointestinal parasites some of which are currently being identified. Comparatively, presence of parasites is higher in Weddell and Southern elephant seals than in Antarctic fur seals. Regarding the groups of parasites identified, digestive (Anisakidae: *Pseudoterranova* spp.) and respiratory (Filaroididae) nematodes have been observed in all marine mammals analysed, except Leopard seal. Cestodes (Diphyllobothriidae) are only detected in Weddell and Leopard seals whereas acantocephalans (*Corynosoma* spp.) are only found in elephant seals. The presence of protozoan parasites is very low. Regarding systemic parasites, antibodies against *T. gondii* have been found in elephant seals.

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Red vent syndrome - a new disease in Atlantic salmon (*Salmo salar*) in the North Atlantic Ocean.

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Red vent syndrome (RVS) in wild Atlantic salmon (*Salmo salar*) returning to rivers draining to the eastern part of the North Atlantic Ocean is associated to accumulations of the nematode *Anisakis simplex* in the vent area. RVS appears to be an emerging problem and has been diagnosed in several European countries. The disease and its occurrence will be described and causative factors will be discussed.

Topic: International Polar Year

Engaging communities in the monitoring of zoonoses for country food safety concerns in Canada.

Manon Simard, Andria Jones, Brett Elkin, Lorry Forbes, Alvin Gajadhar, Ted Leighton, Ole Nielson, Antoni Jerzy Rokicki

Zoonoses in Canadian Arctic country food is a concern because different methods of food preparation are used between regions, therefore, food safety concerns differ between northern communities. There is a need to understand wildlife and disease ecology, and potential public health risks from the consumption of contaminated game meats. Our goals related to parasites are: (1) establish the distribution of *Trichinella* sp, *Toxoplasma gondii*, Anisakidae worms, in traditional Northerner's food, (2) set-up laboratory facilities in Nunavik, Quebec, the Northwest Territories, and Nunatsiavut, Labrador, (3) train local people for wildlife sampling and diagnosis of the three parasitic diseases of interest, (4) develop/refine/validate simplified (field) diagnostic tests for *Toxoplasma gondii* and (5) develop a Canadian web-based database of Arctic wildlife diseases that can be accessed by all Northerners.

Over 200 fish and 109 marine mammals were tested for Anisakidae nematodes. Preliminary results show that *Anisakis simplex*, *Contracaecum osculatum*, *Pseudoterranova decipiens*, and *Hysterotylacium aduncum* were present in beluga, sculpin species, cod species, ringed seals, Arctic charr, Atlantic salmon and Atlantic white fish, but not in walrus. Six hundred and ninety Arctic mammals and birds were tested for the presence of *Trichinella* larvae. Infection was widespread among black and grizzly bears, wolves, foxes, cougars, wolverines and walrus. Beluga whales and seals were negative. Bird samples, primarily from geese, ptarmigans and a variety of raptors, were also negative for *Trichinella*. Only freeze-resistant species or genotypes of *Trichinella* (*T. nativa* and *Trichinella* T6) were detected.

A qPCR and a multi-species ELISA assays for *Toxoplasma* were also developed. additional. An absorbent filter paper method to collect blood under Arctic conditions for the diagnosis of *Toxoplasma gondii* was assessed in collaboration with the Circum Arctic Rangifer Monitoring and Assessment (CARMA) Network with good results. This will simplify blood collection under Arctic conditions and facilitate sample collection by hunters.

CircumArctic Rangifer Monitoring and Assessment Network - Building a Snapshot in Time for *Rangifer* Pathogens

Susan Kutz, Pat Curry, Nathan deBruyn, Ryan Brook, Julie Ducrocq, Danna Schock, Bryanne Hoar.

Supported by biologists in the Governments of Greenland, Yukon, NWT, Nunavut, and Makivik Corporation and the broader CircumArctic Rangifer Monitoring and Assessment Network.

Rangifer tarandus ssp. (caribou and reindeer), are keystone species across much of the Arctic and contribute substantially to the physical, spiritual, and economic health of northern communities. Recent dramatic population declines highlight the need to better understand factors that influence the health and resilience of this species. International Polar Year funding provided a unique opportunity to build a collaborative network of researchers, wildlife managers, and community members to explore *Rangifer* health. During IPY we combined scientific and local knowledge and expertise to investigate infectious diseases of *Rangifer* species across much of the Arctic. We developed various training materials and scientific techniques that aim to facilitate community-based and scientific monitoring of *Rangifer*. Training materials include health monitoring protocols, a hunter caribou sampling and disease training video, various *Rangifer* anatomy resources. Scientific techniques include validation of the use of filter paper for blood collection and molecular methods for non-invasive sampling of gastrointestinal parasites. We also worked closely with hunters to train them in caribou health sampling as well as to document their opinions on community-based caribou health monitoring. Finally, we did empirical laboratory and field studies to experimentally investigate the life history and impacts of parasites in caribou. We have produced an unprecedented snapshot in time of *Rangifer* health with pathogen profiles for several herds. Ongoing investigations are exploring how these pathogens may directly or indirectly influence caribou health now and under changing climatic regimes. Our integrated approach will greatly enhance our understanding of the multiple factors driving the rise and fall of caribou populations. Such an approach is vital in order to effectively predict population trajectories and implement appropriate management actions.

Workshop

Topic: Zoonoses - Arctic parasites and Food security

***Trichinella* infection in Greenland: Regional variation in a humans and reservoir animals.**

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Introduction: Outbreaks of human trichinellosis from consumption of game meat are frequent in Greenland. Epidemiological studies have been scarce and this study aimed to compare the presence of *Trichinella* antibodies in historical and recent human blood sera to evaluate temporal and spatial variations. In Greenland, previous studies have reported *Trichinella* in (*Phoca hispida*) (0.06%) bearded seals (*Erignathus barbatus*) (0.8%). An experimental study has demonstrated that grey seals (*Halichoerus grypus*) are highly susceptible to infection with *Trichinella nativa*. The present study aimed to determine the prevalence of *Trichinella* in the four seal species hunted and eaten by Greenlandic Inuit: ringed seal (*Phoca hispida*), harp seal (*Phoca groenlandica*), hooded seal (*Cystophora cristata*), and bearded seal (*Erignathus barbatus*) and to type any recovered specimens by molecular tools. Additionally, a serological assay was evaluated on the material.

Methods: Human blood samples were collected from Nuuk, Upernavik, Qaanaaq, and Ammassalik municipalities during two periods, 1979-1981 and 1998-2004. Samples were initially screened for *Trichinella*-specific IgG antibodies by ELISA and by immunoblot as a confirmatory test. To assess the background exposure level of *Trichinella* infection in game from different parts of Greenland, muscle tissue from sled dogs, which are generally fed offal from game, were collected from Sisimiut, Ilulissat, Qaanaaq, and Ammassalik municipalities and analyzed for the presence of *Trichinella* muscle larvae. Muscle samples from four seal species, hooded seal (*Cystophora cristata*), harp seal (*Phoca groenlandica*), ringed seal (*Phoca hispida*), and bearded seal (*Erignathus barbatus*) were collected from Greenland between 1982 and 2004. Muscle juices from the samples were tested by ELISA using two different antigens to detect *Trichinella* antibodies in muscle fluid, and by HCl-pepsin digestion to detect muscle larvae. Positive samples from the ELISA were examined further by Western blot.

Results: The prevalence of infected dogs gradually increased from south to north (Sisimiut (2.5%) and Ammassalik (14%) to Ilulissat (23%) and Qaanaaq (67%)). *Trichinella* larvae were recovered from a total of six seals from two species; 0.16% of ringed seals and 2.3% of hooded seals. All muscle larvae recovered were examined by multiplex-PCR. In general, the DNA of the recovered larvae was poorly preserved due to the long storage times of the muscle samples. One sample from a ringed seal confirmed infection with *Trichinella nativa*. The serological examination of the muscle fluid samples detected positives among ringed seals, harp seals, and hooded seals. The human seroprevalence was high in communities depending on game meat consumption but decreased in all municipalities over the 20-year study period.

Conclusion: It was concluded that the temporal variation likely reflected an increase in the consumption of imported food in relation to traditional food in the southernmost larger towns, and that the geographical variation in *Trichinella* prevalence in sled dogs and humans was consistent with consumption of game meat. The low grade infection in the seals most likely only pose a limited risk for clinical disease, but may explain a high level of sero-positivity in the native population consuming seal meat.