



## Briefing on Greenland

Concerning IWC 64, Agenda Item 7.3 Aboriginal Subsistence Whaling Catch Limits and Agenda Item 18.11 Health Issues

### Background

Greenland Home Rule authority took full responsibility for the health sector in Greenland in 1993. Since 2010, this responsibility has been taken over by the Self Rule Authority. The same year Greenland established an institute for research in human health. The institute is located at the Centre for Human Health Education under the Ministry of Health.

The Kingdom of Denmark Strategy for the Arctic 2011-2020 notes the risk, that in particular long-range transported slow degrading problematic chemical substances pose to the environment and biodiversity in the Arctic, and commits to ensure monitoring and study of persistent organic pollutants (POPs), mercury, oil, particulates and other pollution to which the Arctic populations and ecosystems are exposed.

AMAP (The Arctic Monitoring program) was established in 1991 with the purpose to implement components of the Arctic Environmental Protection Strategy (AEPS). As part of the monitoring program AMAP has since 1994 collected information about how the people living in the Arctic region is being impacted by environmental contaminants. A part of this work has been research into contaminants found in the blood and tissue from the people living in the different regions of the Arctic. The research related to Greenland is analysed by the Centre for Arctic Environmental Medicine at the University of Aarhus, Denmark.

### PCB and DDT

The focus of the AMAP study<sup>1</sup> has been on women aged 18-49. For people living in Greenland and Faroe Islands, marine mammals including whales are part of the diet, while people in Iceland and northern Norway especially eat fish. These differences are clearly reflected in

the results of the studies and in regions where marine mammals are consumed a high content was found.

*Table (Miljøgifte i Groenland, 2007). Concentrations of polychlorinated biphenyls (PCB) and DDT (dichloro-diphenyl-trichlorethane) inng /g fatty tissue.*

Region	DDT	PCB
Northeast Greenland	1.720	4.325
Northwest Greenland	600	1.045
Southwest Greenland	265	360
Faroe Islands	600	1.050
Denmark	155	210
Finmark (Northern Norway)	100	150
Iceland	150	300

The Primary Health Care Centre in Greenland in 2005 noted that a rapid increase in prevalence of diabetes among Greenlanders has been observed, and that it is 2.5-3 times more prevalent among adults in Greenland compared to Danes. Further to that a higher risk for diabetes is also seen among children.<sup>2</sup>

Research in Faroe Islands where more than 700 people aged 70-74 were clinical examined shows, that people with type diabetes 2 tended to have higher PCB concentrations and a higher past intake of traditional food (including meat and other parts of pilot whales) especially during childhood and adolescence. The study further concluded that impaired insulin secretion appears to constitute an important part of the type 2 diabetes pathogenesis associated with exposure to the PCB's<sup>3</sup>.

1 Miljøgifte i Groenland, Aarhus Universitet, 2007

2 **Children's health in Greenland; interdisciplinary efforts necessary.** Henning Sloth Pedersen, MD, PhD, District medical officer, Primary Health Care Center, Nuuk, Greenland. Presentation at the Nordic Seminar, June 2nd 2005, Reykjavik, Iceland  
3 2011: Grandjean P, Henriksen JE, Choi AL, Petersen MS, Dalgaard C, Nielsen F, Weihe P  
**Marine food pollutants as a risk factor for hypoinsulinemia and type 2 diabetes.** Epidemiology. 2011 May; 22(3):410-7.

## Mercury

An estimated 90% of the mercury (Hg) found in the Arctic wildlife is of anthropogenic origin, where the main sources are associated with the burning of fossil fuels, in particular coal. The mercury in the Greenland nature derives from burning of such fossils in Europe and as far away as Asia. The Danish Environmental Research Institute has estimated that 200 tons of mercury each year ends up in the snow coverage in Greenland, and from there it is taken by the melting water into the surrounding sea. It is feared that the pollution will increase by 25% in 2020 compared to 2005, if nothing is done to change the development. In recent years more mercury has been found in 20% of the studied sea mammals.<sup>4</sup>

For humans the Tolerable Weekly Intake (TWI) of mercury according to WHO is 1,6 µg/kg body weight, whereas that of the U.S. Environmental Protection Agency is 0.7 microgram/kg body weight.

## Methylmercury

Mostly the focus has been on the presence of mercury in diet coming from marine sources, whereas methylmercury (MeHg) is far more toxic. Most monitoring data discussed relates to measurements of total Hg (THg) and not MeHg. Further to that it has been found that the percentage of THg, which is actually MeHg varies from species to species, and tissue to tissue, with muscles generally containing mostly MeHg and organs such as liver and kidney containing mostly less toxic inorganic forms of Hg<sup>5</sup>.

There has been some speculation that increases in the temperature of the sea water might lead to an increase in the marine methylation rate. A study by Booth and Zeller modelled climate changes impacts on Hg concentrations in fish and pilot whales in the Faroe Islands marine ecosystem and the result showed that increases in water temperature of 0.4 and 1.0 degrees C might result in average MeHg increases of between 1.7% and 4.4% respectively.<sup>6</sup>

Methylmercury intake by consumers of marine life in Greenland has been found to vary with the season. For West Greenlanders individual MeHg intakes of 66 microgram/day were estimated in spring and 42 microgram/day in autumn. This is a high intake, and one which exceeds the European Food safety Authority's TDI (total daily intake) of 0.23 µg/kg body weight/day and the U.S. EPA reference dose of 0.1 µg/kg body weight /day<sup>7</sup>.

## Humans and mercury contamination

### The Faroese example

In Faroe Islands the high mercury intake over time is due to almost entirely a single food item, the pilot whale.

Studies in the 1980s and 1990s showed that high mercury exposure in children born to mothers eating pilot whale meat could be linked to small, but significant delays in brain development (language, attention and memory) that persisted throughout childhood. In 1998, the Faroese authorities issued a guidance to the public recommending that pilot whale liver and kidney should never be eaten, and that adults should only eat muscle(meat) once or twice a month, while women who were pregnant, planning to become pregnant, or breast feeding – should not be eating it at all. In 2008, it was recommended that pilot whale should no longer be used for human consumption. Pregnant women in Faroe Islands have clearly followed the advice to avoid pilot whale in their diet, as there has been an almost eight-fold fall in blood mercury levels over the past two decades (1986-2009).<sup>8</sup>

Cohort studies of the Faroe Islands showed that there are serious health risks for adults consuming pilot whale meat of hypertension, arteriosclerosis, type 2 diabetes and hypoinsulinemia. In addition contaminants in the whales appears to increase the risk of developing Parkinson's disease.<sup>9</sup>

4 AMAP Assessment 2011: Mercury in the Arctic. AMAP, Oslo, 2011

5 AMAP 2011

6 Booth S, Zeller D 2005. Mercury, Food Webs, and Marine Mammals: Implications of Diet and Climate Change for Human Health. *Environ Health Perspect* 113:521-526. <http://dx.doi.org/10.1289/ehp.7603>

7 AMAP 2009

8 AMAP Assessment 2011: Mercury in the Arctic, Oslo, 2011

9 Weihe and Grandjean 2012, Cohort studies of Faroese children concerning potential adverse health effects after the mothers' exposure to marine contaminants during pregnancy. *Acta Veterinaria Scandinavica* 2012, 54 (Suppl 1)

## Greenland

Guidelines for safe levels of mercury in blood have been established in Canada and the United States of America. By using these safe level limits the AMAP report from 2011 concludes that the proportion of mothers and women of childbearing age with blood mercury concentrations exceeding the guidelines has decreased across the Arctic during the recent years. However blood mercury concentrations in over 90% of women of child-bearing age in some areas of Greenland still exceed the guideline levels. Despite this and the positive effect that the warnings by the Faroese Authorities has had on the Faroese population, the Greenland authorities have to this date not issued such guidance to the public.

The AMAP study concluded in relation to Greenland that most of the contaminants are found in liver, kidney and blubber and by not eating these parts of marine mammals or by shifting to fish or land mammals such as muskox or reindeer it is possible to reduce the intake of contaminants to a level below the international recommended maximum level of intake. However in relation to intake of meat and muscles from marine mammals the daily intake of methyl mercury may still exceed the recommended maximum level even though liver, kidney and blubber are excluded.<sup>10</sup> See the table below.

*Table (Miljøgiftte i Groenland, 2007) daily intake of food from marine mammals by participants in the study living in Disko Bay region, and the estimated intake of heavy metals. The recommended TDI is in microgram /day/person weighing 60 kg.*

	Meal incl. liver, kidney and blubber	Meal excl. liver, kidney and blubber	Percentage decrease in intake	FAO/WHO's TDI
Meal in g/day	256	194	24	
Heavy metals (microgram/day)				
Cadmium	346	24	93	60
Mercury	66	37	44	43
Methyl mercury	54	37	31	14
Selen	127	71	44	400

<sup>10</sup> Miljøgiftte i Groenland, Aarhus Universitet, 2007

During the UN Mercury negotiations in 2011, the Environment Advisor to ICC ( Inuit Circumpolar Conference) Greenland Parnuna Egede in a press release explained about the ongoing meeting and noted among other things, that in October 2011 long term studies from Canada had shown, that foetus which have been exposed to mercury while still in the uterus had a reduced intellectual function and difficulties to concentrate when they were at the age of 11 years. That had led Nunavik in Canada to recommend that women in the reproductive age and pregnant women should reduce their intake of beluga. Ms. Egede continues in the press release to reflect "this is thought-provoking as research has shown, that in some places in Greenland we find the highest levels of mercury in human blood"<sup>11</sup>

### RESEARCH ON WILD ANIMALS

According to the CAFF (Conservation of Arctic Flora and Fauna) report<sup>12</sup> many POPs reach high levels in polar bears and it is noted that recent studies suggest that these pollutants impact the endocrine system, immune system, and subsequent reproductive success of polar bears.

In 2010 NERI (Danish National Research Institute) examined brains from about fifty polar bears and ringed seals from Greenland and pilot whales from Faroe Islands. They found 0.26 microgram of mercury per gram wet weight in the medulla oblongata of polar bears. Furthermore in brains from Eastern Greenland polar bears damaging effects to the brain neurotransmitters were found. The researchers are to continue their work covering also brains of narwhals. The 0.26 microgram is low, as the estimated level so far where wild animal are affected is 20 microgram mercury per gram brain tissue.

<sup>11</sup> Sermitsiaq 08-12-2011

<sup>12</sup> Arctic Biodiversity Trends 2010 – Selected indicators of change. CAFF International Secretariat, Akureyri, Iceland. May 2010

## Persistent organic pollutants (POPs)

In recent decades AMAP and others have focussed more and more on the risk to human health posed by POPs.

*Table (Miljøgifte i Groenland, 2007) daily intake of food from marine mammals by participants in the study living in Disko Bay region, and the estimated intake of POPs. The recommended TDI is in microgram /day/person weighing 60 kg.*

	Meal incl. liver, kidney and blubber	Meal excl. liver, kidney and blubber	Percentage decrease in intake	FAO/WHO's TDI
Meal in g/day	256,0	194,0	24	
POP's microgram/day				
PCB	23,0	2,5	89	18
DDT	32,0	2,9	91	1.200
Chlordanes	18,0	1,8	90	3
HCH	3,7	0,4	90	18
Chlorbenzenes	3,5	0,6	84	16
Dieldrin	8,0	0,7	92	6
Toxafen	30,0	10,0	66	12

The AMAP study related to POPs concluded in relation to Greenland, that most of the contaminants are found in liver, kidney and blubber and by not eating these parts of marine mammals or by shifting to fish or land mammals as muskox or reindeer it is possible to reduce the intake of contaminants to a level below the international recommended maximum level of intake.

### Human reproduction and POP's

Focus of much recent research in Greenland has been on how POPs influence on the human reproductive system. Utero exposure to POPs has been studied and it was concluded, that POPs may reduce birth weight and gestational age of newborns however, new insights as to why results vary across studies were not apparent.<sup>13</sup> Another study concluded that the risk of fetal loss may increase at higher levels of CB-153 and p,p'-DDE exposure, although lack of dose response and inconsistencies between countries did not allow for firm conclusions.<sup>14</sup>

13 **2010:** Bogdan J Wojtyniak; Daniel Rabczenko; Bo A G Jönsson; Valentyna Zvezday; Henning S Pedersen; Lars Rylander; Gunnar Toft; Jan K Ludwicki; Katarzyna Góralczyk; Anna Lesovaya; et al. **Association of maternal serum concentrations of 2,2', 4,4',5,5'-hexachlorobiphenyl (CB-153) and 1,1-dichloro-2,2-bis (p-chlorophenyl)-ethylene (p,p'-DDE) levels with birth weight, gestational age and preterm births in Inuit and European populations.** Environmental health: a global access science source 2010;9():56.

14 **2010:** Gunnar Toft; Ane M Thulstrup; Bo A Jönsson; Henning S Pedersen; Jan K Ludwicki; Valentyna Zvezday; Jens P Bonde: **Fetal loss and maternal serum levels of 2,2',4,4',5,5'-hexachlorobiphenyl (CB-153) and 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (p,p'-DDE) exposure: a cohort study in Greenland and two European populations.** Environmental health : a global access science source 2010;9():22.

POPs may in addition interfere with male reproductive function without major impact on fertility. The data from this study do not provide direct evidence for endocrine disruption; hence it is recommended that other mechanisms should also be considered.<sup>15</sup> Within Greenland the sperm cell concentration appears to be similar in different regions a study concluded, but sperm cell motility tends to be lower in men from the east coast. This may be related to the higher organochlorine exposure level previously demonstrated in this population.<sup>16</sup> POP may affect both the female and male reproductive system in animals as well as in humans. The overall results of a study created a somewhat ambiguous pattern, but give some support to the idea that dietary POP exposure might be harmful for couple fertility.<sup>17</sup>

15 **2008:** Jens Peter Bonde; Gunnar Toft; Lars Rylander; Anna Rignell-Hydbom; Aleksander Giwercman; Marcello Spano; Gian Carlo Manicardi; Davide Bizzaro; Jan K Ludwicki; Valentina Zvyezday; et al.

**Fertility and markers of male reproductive function in Inuit and European populations spanning large contrasts in blood levels of persistent organochlorines.** Environmental health perspectives 2008;116(3):269-77.

16 2004: Gunnar Toft; Henning Sloth Pedersen; Jens Peter Bonde: **Semen quality in Greenland.** International journal of circumpolar health 2004;63 Suppl 2():174-8.

17 2006: A Axmon; A-M Thulstrup; A Rignell-Hydbom; H S Pedersen; V Zvyezday; J K Ludwicki; B A G Jönsson; G Toft; J-P Bonde; L Hagmar  
Time to pregnancy as a function of male and female serum concentrations of 2,2',4,4',5,5'-hexachlorobiphenyl (CB-153) and 1,1-dichloro-2,2-bis (p-chlorophenyl)-ethylene (p,p'-DDE). Human reproduction (Oxford, England) 2006;21(3):657-65.

Recent studies indicate that POPs may contribute to sex ratio changes in offspring of exposed populations. A study indicates that POP exposure might be involved in changing the proportion of ejaculated Y-bearing spermatozoa in human populations. It was concluded that inter country differences, with different exposure situations and doses, may contribute to varying Y:X chromosome ratios.<sup>18</sup>

POPs exposure may have a negative impact on reproductive function in particular in relation to the reproductive hormone production. The study concluded that Gonadotropin levels and SHBG (sex hormone-binding globulin) seem to be affected by POP exposure, but the pattern of endocrine response is the subject of considerable geographic variation<sup>19</sup>.

### **Diet and value of traditional food versus the risk of contamination**

On the General Assembly of ICC (Inuit Circumpolar Conference) in 2010 the participating medical officer from Greenland asked why 80-90% of food is imported to Greenland. He added that he has for many years been monitoring the pollution by heavy metals in the animals hunted in the arctic. According to the results it is recommended that pregnant women and women wishing to have children sometime in future refrains from eating marine mammals such as seals and whales as they contain mercury and other heavy metals and intake leads to a risk to the intelligence and the ability to reproduce. However instead of importing the western food he encourages the sustainable approach and to use local foods such as fish, reindeer, lamb and vegetables from southern Greenland so that these become main part of the diet. He adds that there is sufficient opportunity to produce these items so as to feed the population in Greenland.<sup>20</sup>

Gert Mulvad, Centre for Primary Health Care, Nuuk, at a NAMMCO expert meeting in 2007 noted that the proportion of marine mammals, fish and birds in the diet varies throughout Greenland according to the region and the village. Each town has a different diet from the others. Greenland has gone through a nutritional transition where the diet has moved from being of local origin to come mainly from western imported products. On average in Greenland 75% of the calorie intake today comes from imported food and 25% from local food.<sup>21</sup>

A dietary study in 2007 concludes that the change to more western fare was found to be negative resulting in less adequate nutrient coverage but at the same time lower contaminant load<sup>22</sup>. A study covering dietary composition and contaminants in north Greenland, in the 1970s and 2004 concluded that the consumption of locally produced food has decreased to a present average of about 20% in Greenland during the last 30 years, and this has led to a reduction in the daily intake of contaminants. However, the concentrations of contaminants in local food items have not decreased, except for PCB and Lead. Therefore, it has been recommended that the consumption of local products is not increased beyond the present level, until the level of contaminants is reduced to a safer level.<sup>23</sup>

18 **2006:** Tarmo Tiido; Anna Rignell-Hydbom; Bo A G Jönsson; Yvonne Lundberg Giwercman; Henning S Pedersen; Bogdan Wojtyniak; Jan K Ludwicki; Vladimir Lesovoy; Valentyna Zvezdaj; Marcello Spano; et al.

**Impact of PCB and p,p'-DDE contaminants on human sperm Y:X chromosome ratio: studies in three European populations and the Inuit population in Greenland.** Environmental health perspectives 2006;114(5):718-24.

19 **2006:** Aleksander H Giwercman; Anna Rignell-Hydbom; Gunnar Toft; Lars Rylander; Lars Hagmar; Christian Lindh; Henning S Pedersen; Jan K Ludwicki; Vladimir Lesovoy; Maryna Shvets; et al.

**Reproductive hormone levels in men exposed to persistent organohalogen pollutants: a study of inuit and three European cohorts.**

Environmental health perspectives 2006;114(9):1348-53.

20 Sermitsiaq 01-07-2010

21 NAMMCO report from expert meeting on potential positive health effects of consuming whale and seal oil, 3 October 2007.

22 **2007:** Bente Deutch; Jørn Dyerberg; Henning Sloth Pedersen; Ejner Aschlund; Jens C Hansen  
**Traditional and modern Greenlandic food - dietary composition, nutrients and contaminants.** The Science of the total environment 2007;384(1-3):106-19.

23 **2006:** Bente Deutch; Jørn Dyerberg; Henning Sloth Pedersen; Gert Asmund; Per Møller; Jens C Hansen  
**Dietary composition and contaminants in north Greenland, in the 1970s and 2004.** The Science of the total environment 2006;370(2-3):372-81.

## Conclusion and recommendation

Greenland has in recent years with the acceptance of IWC<sup>24</sup> been taking two additional species of whales under ASW<sup>25</sup> quota allowance; since 2008 bowhead whales (2/ per year) and since 2010 humpbacks (9 /year). These two species are taken in addition to a total quota of 190 Minke whales and 10 Fin whales. The two new species have been asked for, in particular because of their thick layer of blubber. In 2012, the ASW quotas for Greenland are to be renewed and not only has Greenland asked for an increase in humpbacks to 10/year but also an increase from 10 to 19 of Fin whales, which means an additional amount of 75 tons of whale products.

In 2010 and 2011, Greenland has taken only 5 Fin whales out of a quota of 10. Greenland should be encouraged to first use the current quota before asking for an increase.

Taking also the amount of meat from about 3,000 small cetaceans caught per year, mainly Beluga, Narwhal and Harbour Porpoise, into consideration makes the stated need highly questionable.

Based on the available information and research at hand Greenland should however be encouraged to follow the example of Faroe Islands and Nunavik and without delay issue guidance

<sup>24</sup> International Whaling Commission

<sup>25</sup> Aboriginal Subsistence Whaling

women who are pregnant, planning to become pregnant, or breast feeding in particular, to avoid eating marine mammals, but also to the public in general as human diseases associated with contamination levels in cetacean products can be found in other population and age groups.

Arctic communities have a right to know what threats they may be facing when consuming seriously polluted food. Local governments, along with international organizations, bear the responsibility of empowering isolated communities and individuals to make informed decisions about their own lives and health. Simultaneously, these same bodies must attempt to reduce the dangers currently facing beluga and narwhal populations from pollutants, environmental degradation and overutilization.

The people and wildlife of the Arctic are paying a high price for the industrialized world's use of pesticides, PCBs, mercury, nuclear energy, and certain technologies. Any attempts to mitigate a potential health crisis among people in the Arctic and their environment should begin with public notification of the various potential threats. In addition, health authorities in the Arctic should reconsider the risks and benefits of consumption of whale products and the resulting diet recommendations.