ARCTIC PERMITS NEWSLETTER

United States Environmental Protection Agency Region 10

Oil and gas exploration air and water permits

Summer 2011

What is Happening

Air Permits

- EPA's air program is preparing to propose re-issuing draft revised air permits for Shell *Discoverer* oil and gas exploration in the Beaufort and Chukchi Seas. We are also preparing to propose issuing draft air permits for Shell *Kulluk* oil and gas exploration in the Beaufort Sea and for ConocoPhillips oil and gas exploration in the Chukchi Sea.
- We expect to propose the draft permits for public comment starting in July with the Shell *Discoverer* draft revised air permits.

Water Permits

- EPA's water program is preparing to propose reissuing wastewater general permits for oil and gas exploration in the Beaufort Sea and Chukchi Sea. We expect the draft general permits will be available for public comment in September.

Sharing information

- Before public comment periods begin later this summer and fall, EPA air and water programs are visiting Kaktovik and Barrow on June 15-17 to share early information about the draft permits.

Early Information Meetings - Air Permits

June 15 (Kaktovik)	Learn about the air permits for Shell and ConocoPhillips

Early Information Meetings - Air and Water Permits

June 16 – 17 (Barrow)	Learn about the air permits and the exploration general permits

Public Comment Period - Air Permits

Public Comment: July 1–Aug 1 **Public Hearing:** late July (Barrow)	Comment on draft Shell *Discoverer* air permits

Public comment period - Air Permits

Public Comment: mid July – Sept **Public Hearing:** August (Barrow, Anchorage)	Comment on draft Shell *Kulluk* and ConocoPhillips air permits

Public comment period - Water Permits

Public Comment: September –October **Information Meetings and Public Hearings:** October	Comment on draft exploration general permits

- Find air and water permit updates at: **http://yosemite.epa.gov/R10/AIRPAGE.NSF/Permits/ocsap/**

Air permits

Shell *Discoverer*: Expect public comment period to begin in early July

In March and April 2010 EPA issued air quality permits for Shell *Discoverer* oil and gas exploration in the Beaufort Sea and Chukchi Sea. EPA's Environmental Appeals Board remanded these air permits in December 2010, with additional Orders in February and March 2011. EPA is revising the Shell *Discoverer* air permits for public comment in early July.

Because the Shell *Discoverer* drill ship and fleet will emit more than 250 tons of air pollutants a year, it is considered a major emission source under the Prevention of Significant Deterioration (PSD) air permit program. Major emission sources under the PSD permit program must comply with the National Ambient Air Quality Standards, PSD increments and visibility requirements, and install Best Available Control Technologies.

Shell plans to drill up to 6 wells in the Chukchi Sea in the 2012 and 2013 seasons. Shell's drilling locations in the Chukchi Sea range in distance from 78–162 miles from Wainwright, 92–129 miles from Point Lay, and 140–230 miles from Barrow. Shell plans to drill 4 wells in the Beaufort Sea in the 2012 season. Shell's drilling locations in the Beaufort Sea range in distance from 16–23 miles from shore.

Shell *Kulluk*: Expect public comment period to begin in mid-July

Shell has applied for combined minor New Source Review and Title V air permits to operate the *Kulluk* drill rig and support fleet for oil and gas exploration in the Beaufort Sea. Shell proposes to limit their air pollutant emissions to less than 250 tons per year to avoid the need for a PSD permit. A minor New Source Review permit will cover Shell's air pollutant emissions within 25 miles of the state's seaward boundary and a Title V permit will cover Shell's air pollutant emissions beyond 25 miles. In Alaska the state seaward boundary is generally 3 miles off shore.

Shell plans to drill multiple exploration wells in the Beaufort Sea beginning in the 2012 season. Shell proposes to use the *Kulluk* to explore at the same locations proposed for the *Discoverer* drill ship in the Beaufort Sea, plus additional well sites (within Shell leased blocks and blocks leased to other operators in the Beaufort). Shell's application is incomplete; EPA is awaiting additional information while we draft the permit.

ConocoPhillips: Expect public comment period to begin in mid-July

Conoco has applied for a Title V part 71 air permit to operate a jack-up drill rig and support fleet for oil and gas exploration in the Chukchi Sea. Conoco proposes to limit air pollutant emissions to less than 250 tons per year to avoid the need for a PSD permit. Because the emissions are less than 250 tons per year and the exploration is beyond 25 miles of the state's seaward boundary, a Title V permit applies.

Conoco plans to drill multiple exploration wells in the Devil's Paw prospect of the Chukchi Sea Lease Sale 193 beginning in the 2013 season. Conoco's drilling locations range in distance from 70–90 miles from the North Slope, 115–140 miles from Wainwright, and 80–100 miles from Point Lay. EPA is working on the draft permit.

Water permits

Exploration general permits: Expect public comment period to begin in September

EPA is preparing to reissue the National Pollutant Discharge Elimination System (NPDES) general permits for oil and gas exploration wastewater discharges in the Beaufort Sea and Chukchi Sea. The Beaufort Sea exploration general permit will authorize wastewater discharges within leases in state and federal waters in the Beaufort Sea. The Chukchi Sea exploration general permit will authorize wastewater discharges only within federal waters in the Chukchi Sea. EPA plans to reissue the draft Chukchi Sea and Beaufort Sea exploration general permits for public comment beginning in September.

Find exploration permit updates at: **http://yosemite.epa.gov/r10/water.nsf/npdes+permits/arctic-gp**

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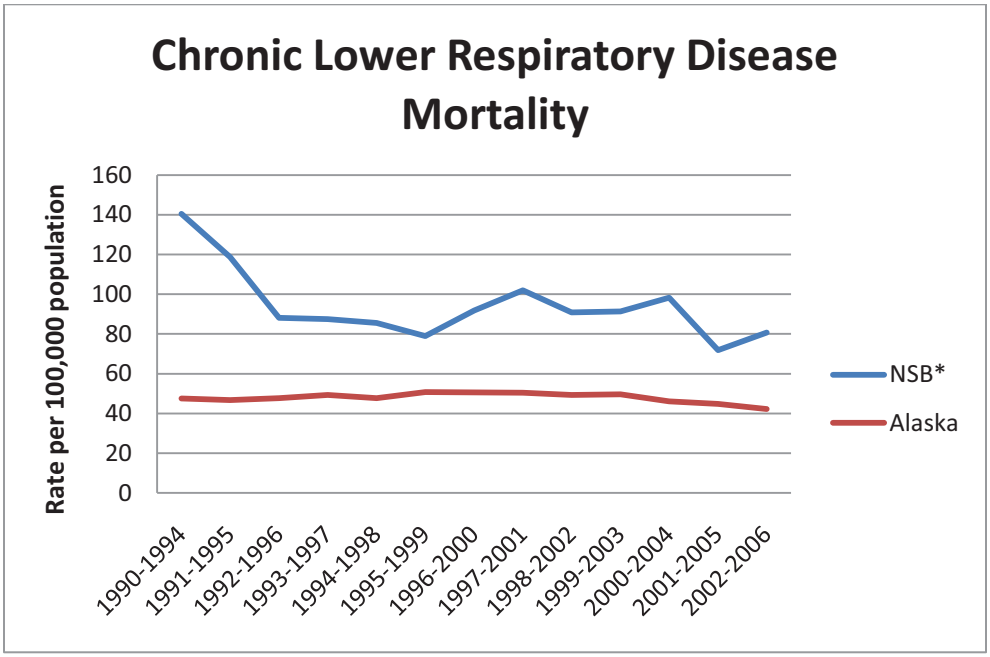
Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)

EPA's air and water permits, once issued, do not provide authorization to drill. EPA's permits only ensure compliance with air and water quality regulations, when and if drilling commences. BOEMRE is the federal agency that provides authorization to drill.

Find out more about BOEMRE in Alaska at: **http://alaska.boemre.gov/**.

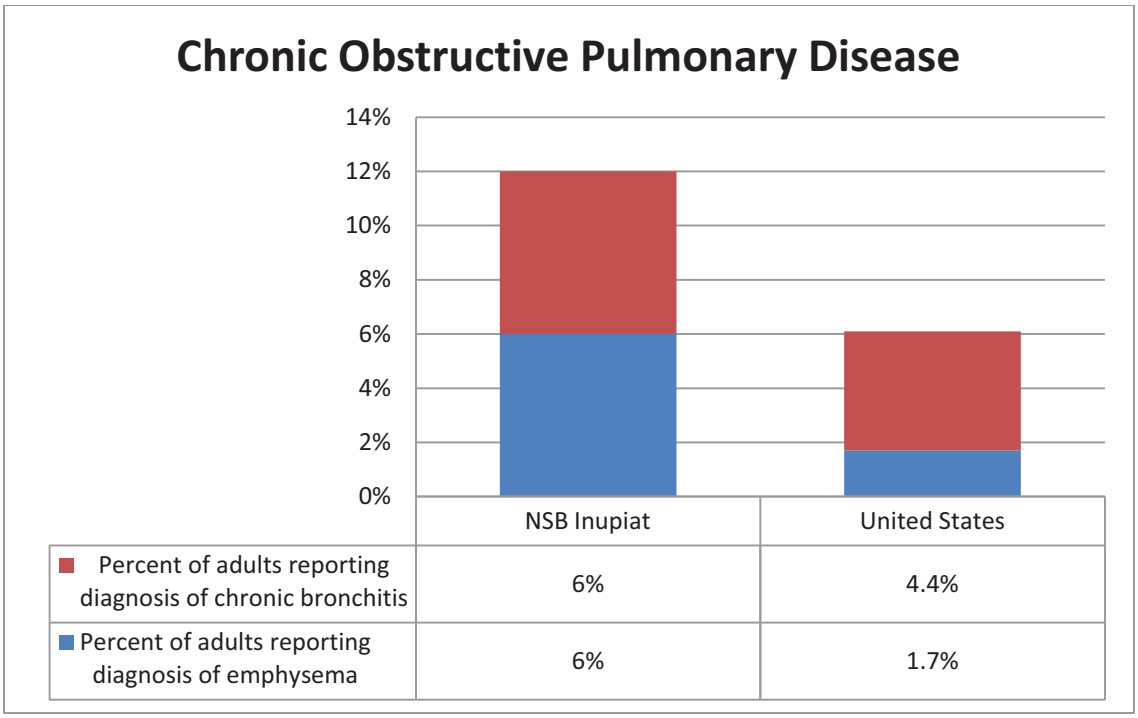
Chronic lower respiratory disease: Chronic lower respiratory disease (CLRD) and chronic lung disease are general terms that describe a number of respiratory ailments that involve irreversible damage to the lungs and reduced lung function. The most common form in adults is chronic obstructive pulmonary disease (COPD), a disease which includes both emphysema and chronic bronchitis. In this country, COPD is primarily due to cigarette smoking, although environmental and genetic factors also play a role. Also included in this general category are less common diseases such as bronchiectasis and cystic fibrosis. Data on chronic respiratory disease are limited in Alaska.

CLRD emerged as a leading cause of death in the NSB in the mid-1980'S and has been the 5th leading cause of death for most years since 1990 in the borough. Mortality rates from CLRD remain almost twice statewide rates. Statewide, COPD death rates are higher among Alaska Natives than among whites.



Source: Alaska Bureau of Vital Statistics
Age-adjusted to 2000 US Census standard population

Inupiat in the NSB appear to report COPD at higher rates than do non-institutionalized U.S. adults. The data from the two surveys illustrated below are not adjusted for age differences in the population, and the survey methodologies were substantially different. These prevalence data are self-reported, thus subject to the biases and inaccuracies inherent in self-reported data. Thus, comparisons must be made with caution. The data do, however, suggest a higher prevalence of COPD in NSB Inupiat, compared with national prevalence estimates.



NSB data source: Survey of Living Conditions in the Arctic (Inupiat aged 16 and over, told by a health professional that they have emphysema, chronic bronchitis)
US data source: Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2008 (non-institutionalized adults, ever diagnosed with emphysema, diagnosed with chronic bronchitis in the past year)

In the statewide analysis of CHAP practice, chronic lung disease accounted for 25% of all lung problems assessed in NSB village clinics. Overall, the pattern of lung problems seen in NSB villages was similar to statewide data within the Alaska Native rural health system. (Golnick, 2009)

Hospitalization for pneumonia is far more common among those with chronic lung disease than among those without. At Samuel Simmonds Memorial Hospital, pneumonia and exacerbation of COPD were the first and second most common admitting diagnosis (other than childbirth) (NPIRS).

Chronic lower respiratory disease among children: Chronic lower respiratory disease in rural Alaskan children and has been studied primarily in the Yukon-Kuskokwim Delta. In one study, an estimated 21.5% of Alaska Native children in the Yukon-Kuskokwim Delta region experienced chronic productive cough without asthma diagnosis or symptoms. Similar studies have not been conducted in the NSB.

NSB census data

FACTORS INFLUENCING ASTHMA AND OTHER LOWER RESPIRATORY PROBLEMS:

Asthma: The causes of asthma are not completely understood. Children who have had a severe viral pneumonia as infants, particularly from respiratory syncitial virus (RSV), are more likely to experience asthma (Thomsen, 2009) during childhood. Children living in poverty are more likely to experience

asthma than children who are not poor. This increased risk is likely conferred by a number of factors associated with poverty. Numerous environmental factors are known to trigger asthma symptoms:

- Indoor air quality: Exposures to tobacco and other types of smoke are known triggers for exacerbations of asthma symptoms, and they are associated with other forms of chronic lung disease, particularly emphysema. NSB smoking in household question
- Outdoor air quality: Children living in proximity to roadways have more symptoms, decreased lung function, more hospitalizations, increased incidence of asthma (Asthma in Alaska 2007 Report). This association with traffic density is thought to be due to increased exposure to a number of components of vehicle exhaust, as well as increased aeresolization of dust and silt. Evidence suggests that course particulate matter such as dust is associated with increased outpatient visits and quick-relief asthma medication use among children. (Chimonas 2006) See physical environment section
- Viral respiratory infections, such as colds and flu, are frequent triggers of asthma exacerbations
- Molds, pollen, animal dander, and other allergens can trigger asthma symptoms in susceptible persons

Chronic lung disease: By far the most important risk factor for chronic lower respiratory disease in the US is smoking. In the US, COPD is associated with history of cigarette smoking in 80-90% of cases (Wise 2007). Thus, the high rates of COPD and mortality from chronic lung disease are not surprising given the high rates of tobacco smoking in the NSB, discussed earlier.

Recurrent and severe lower respiratory infections during infancy and childhood also increase the risk of developing certain types of chronic lung disease and reduced lung function. Indoor and outdoor air pollution, dust and chemicals in the workplace, and second-hand tobacco smoke also play a role in the development of chronic lung disease. In more developed countries, these environmental factors may contribute between 10 and 30% of the disease burden of COPD (Pruss-Ustun 2006). Air quality data are very limited in the NSB.

Alaska Bureau of Vital Statistics (ABVS): http://www.hss.state.ak.us/dph/bvs/data/default.htm

Survey of Living Conditions in the Arctic (SLiCA):
http://www.iser.uaa.alaska.edu/projects/Living_Conditions/index.htm

Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2008. Data accessed on-line through DCD Faststats A to Z at http://www.cdc.gov/nchs/fastats

Golnick CL. Alaska Community Health Aide/Practitioner Clinical Practice Description http://www.akchap.org/Essential%20CHAP%20Docs/Temp_docs/CHAP%20Clinical%20Practice%201209Golnick.pdf

Asthma in Alaska 2007 Report: A Report on the Burden of Asthma in Alaska. Mary Ellen Gordian and Brian Saylor. Institute for Circumpolar Health Studies, University of Anchorage. Accessed on-line at http://www.ichs.uaa.alaska.edu/research/reports/asthma_burden_2007.pdf

Chimonas MR, Gessner BD. "Airborne particulate matter from primarily geologic, non-industrial sources at levels below national Ambient Air Quality Standards is associated with outpatient visits for asthma and quick-relief medication prescriptions among children less than 20 years old enrolled in Medicaid in Anchorage, Alaska." *Environmental Research* 102 (2007) 397-404.

Pruss-Ustun A, Corvalan C, "Preventing Disease through Healthy Environments: Towards an estimate of the environmental burden of disease.": World Health Organization, 2006. http://www.who.int/quantifying_ehimpacts/publications/preventingdisease/en/

Indian Health Service National Patient Information and Reporting System/National Data Warehouse (NPIRS/NDW), Department of Health and Human Services, Indian Health Services: http://www.ihs.gov/CIO/DataQuality/warehouse/

Wise RA, Tashkin DP. Preventing chronic obstructive pulmonary disease: what is known and what needs to be done to make a difference to the patient? Am J Med 2007;120:S14–S22.

Attachment 8
AEWC & ICAS

Volume 112, Issue 1, Pages 7-13
(January 1998)

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Alaska Native Cancer epidemiology in the Arctic

RJ Bowerman, Dr

Accepted 5 September 1997.

ABSTRACT
ABSTRACT + REFS
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Abstract

Cancer incidence and its possible relation to environmental contaminants, including radiation, continues to be a perceived health threat for the arctic-dwelling Alaska Native (Inupiat Eskimo) people despite the lack of a direct link to high-dose exposure. To better understand this concern, all known malignancies diagnosed in this population (n = 177) in three consecutive eight-year periods (1971–1994) were evaluated.

The most recent average incidence rate (age-adjusted to world standard population) of 315 per 100 000 (95% confidence interval, CI = 248–382) represents a 33% surge (albeit non-significant) in Alaska Native cancer incidence over the initial period studied. The male rate 366 (95% CI = 266–466) for the same period exceeds the female rate 258 (95% CI = 169–347) by 42%. Two patterns of cancer incidence are seen at the village level. One, a 24 y upward trend found in the villages of Barrow, Point Hope and Kaktovik (combined rate of increase significant [P = 0.047]) associated with lung cancer; and the other, a stable trend over the past 16 y, associated with colon and rectal cancer. Lung cancer is the predominant cancer by site and is primarily a male disease. The recent male lung cancer incidence rate of 137 (95% CI = 73–201) exceeds the female rate by greater than five times. Total lung cancer cases are primarily confined to four villages where the incidence significantly (P = 0.0043) exceeds the remaining population. The major female cancers are colon/rectal and breast with cancer of the cervix virtually eliminated. Breast cancer is found primarily in two villages where its excess is significant (P = 0.025).

Inupiat Eskimo cancer epidemiology is unique, differing from both the Alaska Native and other Circumpolar populations. At present, this uniqueness cannot be explained by an overt environmental contaminant exposure. Although tobacco very likely plays a central role, it by itself cannot fully explain the extremely high male lung cancer rate and why only specific villages are affected. Genetic predisposition and environmental factors may play a synergistic role as cofactors. A cooperative investigative effort with the Inupiat population is indicated and may go a long way in reducing cancer concern in the region.

Keywords: Alaska, arctic regions, cancer epidemiology, environmental pollution, lung cancer, native Americans

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Chronic Lower Respiratory Disease Mortality

	1990-1994	1991-1995	1992-1996	1993-1997	1994-1998	1995-1999	1996-2000	1997-2001	1998-2002	1999-2003	2000-2004	2001-2005	2002-2006
NSB*	140.4	118.7	88.2	87.4	85.6	78.9	91.8	101.9	90.9	91.4	98.3	71.9	80.7
Alaska	47.5	46.7	47.7	49.3	47.7	50.8	50.6	50.4	49.3	49.7	46.1	44.8	42.2

Rates are age-adjusted to 2000 Census US standard population, expressed per 100,000 population

Source: Alaska Bureau of Vital Statistics

*NSB rates calculated based on fewer than 20 events and must be interpreted with caution

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Health Profiles for North Slope[1], Alaska, and the U.S.

2002-2004

	Number of Events	Rate[3]	Alaska Events	Alaska Rate	U.S. Rate[6]
Mortality Statistics[2]					
All Causes	109	1029.0	9261	792.9	801.0
Cancer (C00-C97)	25	251.9	2167	186.8	184.6
Lung Cancer (C33-C34)	11	110.0*	638	55.1	52.9
Diseases of the Heart (I00-I09, I11, I13, I20-I51)	15	185.8*	1842	174.0	217.5
Coronary Heart Disease (Ischemic) (I20-I25)	5	**	1225	112.7	150.5
Cerebrovascular Disease (Stroke) (I60-I69)	6	**	512	55.8	50.0
Chronic Lower Respiratory Disease (J40-J47)	8	**	426	44.2	41.8
Diabetes (E10-E14)	0	0.0	280	23.9	24.4
Homicide (U01-U02, X85-Y09, Y871)	4	**	131	6.5	5.6
Suicide (U03, X60-X84, Y870)	8	**	410	21.6	10.7
Teen Suicides (15-19)	2	**	55	34.2	
Unintentional Injuries (V01-X59, Y85-Y86)	12	83.8*	982	56.5	36.6
Motor Vehicle Accidents[4]	8	**	346	18.9	14.8
Birth Statistics					
Births to Residents	499	23.0	30366	15.6	14.0
Fertility (15-44)	499	109.5	30366	72.1	66.3
Teen Births (15-19)	97	88.1	3193	41.1	41.2
Young Teen Births (15-17)	32	45.5	923	19.1	22.1
Prenatal Care Statistics[5]					
First Trimester Care	318	66.9	23270	80.6	83.9
Adequate Prenatal Care	165	35.3	17398	64.9	
Birth Outcomes[5]					
Pre-term Delivery	72	14.5	3160	10.5	12.5
Low Birth Weight	27	5.5	1787	5.9	8.1
Infant Statistics					
Infant Mortality	5	**	194	6.4	6.8

[1] Borough or Census Area

[2] Age-Adjusted rates are per 100,000 U.S. year 2000 standard population.

[3] Rates based on fewer than 10 occurrences are not reported.

[4] V02-V04,V090,V092,V12-V14,V190-V192,V194-V196,V20-V79,V803-V805,V810-V811,V820-V821,V83-V86,V870-V878,V880-V888

[5] Birth statistics for these outcomes are percents, not rates.

[6] US year 2004 rates are preliminary.

* Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution.

** Rates based on fewer than 10 occurrences are not reported.

The Alaska Bureau of Vital Statistics

EcoHealth 4, 500–513, 2007
DOI: 10.1007/s10393-007-0132-2

ECOHEALTH

Special Feature: Indigenous Perspectives

Original Contribution

Inupiat Health and Proposed Alaskan Oil Development: Results of the First Integrated Health Impact Assessment/ Environmental Impact Statement for Proposed Oil Development on Alaska's North Slope

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Abstract: We report on the first Health Impact Assessment (HIA) for proposed oil and gas development in Alaska's North Slope region. Public health is not generally analyzed in the Environmental Impact Statement (EIS) process in the U.S. We conducted an HIA for proposed oil development within the National Petroleum Reserve - Alaska in response to growing concerns among North Slope Inupiat communities regarding the potential impacts of regional industrial expansion on their health and culture. We employed a qualitative HIA methodology, involving a combination of stakeholder input, literature review, and qualitative analysis, through which we identified potential health effects. The possible health outcomes identified include increases in diabetes and related metabolic conditions as a result of dietary change; rising rates of substance abuse, domestic violence, and suicide; increased injury rates; more frequent asthma exacerbations; and increased exposure to organic pollutant, including carcinogens and endocrine disruptors. There are also potential benefits, including funding for infrastructure and health care; increased employment and income; and continued funding of existing infrastructure. Based on these findings, we recommend a series of public health mitigation measures. This project represents the first formal effort to include a systematic assessment of public health within the U.S. EIS process. The inclusion of public health concerns within an EIS may offer an important and underutilized avenue through which to argue for environmental management strategies that focus on public health, and may offer communities a stronger voice in the EIS process.

Keywords: Inuit, Environmental Impact Statement, Health Impact Assessment, National Environmental Policy Act, human health

INTRODUCTION

This article describes the initial results of the first Health Impact Assessment (HIA) undertaken for oil and gas development on Alaska's North Slope. This work also represents the first formal effort to undertake an HIA within the legal framework of the National Environmental Policy Act (NEPA), the statute that established the Environmental Impact Statement (EIS) process and which forms the foundation of environmental regulation in the U.S. The inclusion of a broad, systematic analysis of health within a

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National Center For Environmental Research

Research Project Search

NCER Research Project Search

Risks to Northern Alaskan Inupiat: Assessing Potential Effects of Oil Contamination on Subsistence Lifestyles, Health, and Nutrition

EPA Grant Number: R831045
Title: Risks to Northern Alaskan Inupiat: Assessing Potential Effects of Oil Contamination on Subsistence Lifestyles, Health, and Nutrition
Investigators: Wetzel, Dana L. , Hepa, Taqulik , O'Hara, Todd M. , Reynolds, John E. , Willetto, Carla
Institution: **Mote Marine Laboratory**
EPA Project Officer: Fields, Nigel
Project Period: August 1, 2003 through July 1, 2006
Project Amount: $437,399
RFA: Lifestyle and Cultural Practices of Tribal Populations and Risks from Toxic Substances in the Environment (2002)
Research Category: Health Effects , Environmental Justice

Description:

Scientists have focused on potential effects of toxic substances on Native populations with subsistence lifestyles in the Arctic. Risks from toxicant exposures range from direct health hazards to changes in lifestyle that may impair nutrition and health. Petroleum hydrocarbons may enter the Arctic environment in a variety of ways. Oil and gas production in the Arctic occurs at a high level and may increase. Petroleum can enter humans through species that form a major part of the Inupiat diet in northern Alaska. In Barrow, 75% of Inupiat households consume bowhead whale (*Balaena mysticetus*), and nearly 50% consume bearded seals (*Erignathus barbatus*). Marine mammals are exposed to petroleum directly or through their diet and may metabolically transform petroleum-related compounds. Based on toxicological properties, polycyclic aromatic hydrocarbons (PAHs) in the human diet should be investigated. Limited information is available on the extent to which: a) species eaten by the Inupiat are exposed to and contaminated by petroleum; b) contamination may cause Inupiat households to avoid eating traditional foods; and c) handling and preparation of foods affect levels of ingested PAHs.

Objective:

Our proposal involves Inupiat leaders and diverse scientists to: a) characterize levels of PAHs in a range of tissues from bowhead whales and bearded seals; b) characterize PAH levels in meat and other food items following their handling and preparation for consumption; c) document "traditional biomarkers" (e.g., odors) that Native hunters and field scientists use to accept or reject tissues for consumption following harvest; d) assess chemical or histological assays that could serve as low cost biomarkers of exposure; e) use published information and results of this study to develop a risk assessment model incorporating *both* health risks associated with ingestion of petroleum-related compounds and cultural and nutritional risks related to avoidance of certain foods; and f) develop outreach and public awareness programs to inform residents in northern Alaska of issues, potential consequences, and options.

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Approach:

We will acquire specimen materials from bowhead whales and bearded seals taken during the subsistence harvest. At harvest, traditional observations and traditional knowledge will be recorded regarding perceptions of the quality of the meat and organs. Samples will be analyzed using gas chromatography-mass spectrometry for various PAHs. In addition, samples of meat and blubber will be marked and re-analyzed following a six-month storage period and preparation in traditional ways. Biochemical, metabolic, and histological assays will assess exposure of free-ranging whales and seals. Once a risk assessment model is developed and evaluated, appropriate Native spokespersons will work with the scientists to develop and disseminate information to towns and villages about risks associated with oil-related pollution and consumption of whale and seal meat.

Expected Results:

The unusual combination of traditional knowledge, powerful scientific analyses, and integrative modeling, will permit our development of outreach tools and messages, delivered by appropriate Native spokespersons, to empower Alaskan Inupiats with insights and information that will allow them to choose options to reduce their risk from PAH exposure and to maintain good nutrition and health.

Supplemental Keywords:

human health; indicators; community-based; environmental chemistry; zoology; toxicology; North Slope, AK; food processing. , HUMAN HEALTH, Geographic Area, Scientific Discipline, Health, Risk Assessments, Health Risk Assessment, Exposure, Ecology and Ecosystems, State, toxic environmental contaminants, human health risk, biomarker based exposure inference, dietary exposure, petroleum waste, PAH, Inupiat, human exposure

Last updated on Thursday, December 11, 2003.
http://cfpub1.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/6318
Print As-Is

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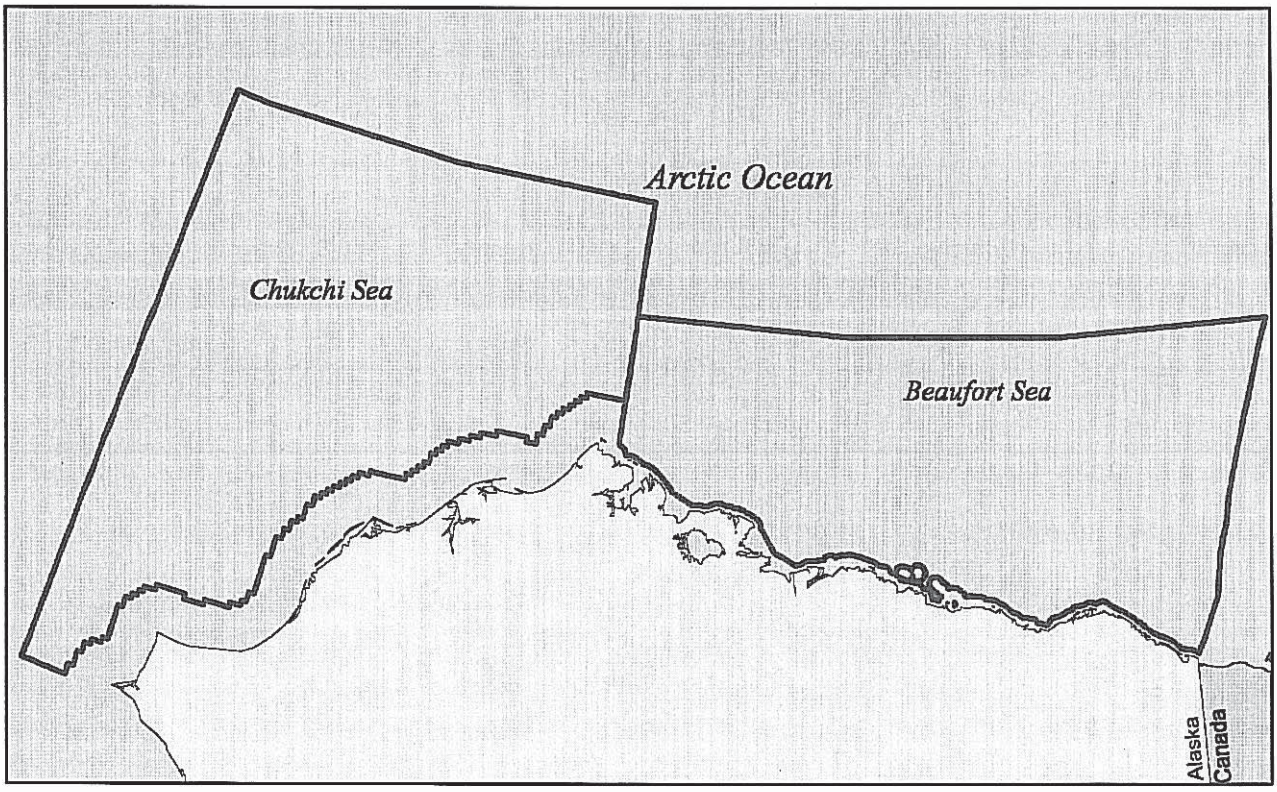
Alaska Outer Continental Shelf

OCS EIS/EA
MMS 2008-0055

Beaufort Sea and Chukchi Sea Planning Areas
Oil and Gas Lease Sales 209, 212, 217, and 221

Draft Environmental
Impact Statement

Volume I
Chapters 1 through 4.3



MMS U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

Food insecurity is defined by the U.S. Department of Agriculture (USDA) as not having "enough food to fully meet basic needs at all times" (Rosso and Weill, 2006). The basic definition of food insecurity used by the USDA does not refer to the source of food (Lambden et al., 2006). A more severe form of food insecurity is "food insecurity with hunger (defined by the USDA as "the uneasy or painful sensation caused by lack of food") (Rosso and Weill, 2006). The prevalence of food insecurity in the NSB or specific villages is not known. Because of the importance of subsistence foods to the nutritional system of North Slope communities, food security depends on access to traditional foods as well as economic resources. The estimation of food insecurity rates in Arctic subsistence communities is complicated by the fact that most standardized measures are not designed to account for subsistence harvests and food sharing. On the other hand, data from Canadian Inuit communities found extraordinarily high rates of food insecurity, up to 84% in one study (Boult, 2004). An ADF&G survey of selected villages in the NWAB, on the other hand, found that 60 % of residents in villages surveyed were food-secure, and 12% were food insecure (roughly 25% were classified as "marginal" (Magdanz 2008, unpublished data). A recent survey under the BRFSS program found that over 20% of rural Alaskans are food insecure, as compared with 12% in urban areas.

Food insecurity is associated with a wide range of health problems. Because food-insecure families typically restrict the range of foods purchased to only the most affordable sources of calories, nutritional deficiencies are more common. Because inexpensive foods often are higher in saturated fats and simple sugars, several studies have found, somewhat paradoxically, a higher prevalence of obesity and diabetes in food-insecure people. Studies also have demonstrated that food-insecure individuals are more likely to report poor overall health and to have psychological symptoms such as depression and anxiety (Lambden et al., 2006; Vozoris and Tarasuk, 2003).

3.4.5.2.5. Noncommunicable and Chronic Disease. This is a large category of diseases, many of which are increasing in prevalence in Alaskan Native communities. Diseases in this category that will be discussed here include diabetes, high blood pressure, and related metabolic disorders (a group of disorders that often share related pathophysiology and are termed "metabolic syndrome"); vascular disease; chronic lung diseases; endocrine disorders such as thyroid disease, and cancer.

Diabetes, Hypertension, and Metabolic Syndrome. Type II diabetes, high blood pressure (hypertension), dyslipidemia (often referred to as "high cholesterol"), and obesity are increasingly prevalent in Arctic indigenous people, including Alaskan Natives (Naylor et al., 2003; Murphy et al., 1997). These disorders are among the most important risk factors for a number of leading causes of disability and mortality nationwide, including cardiovascular disease, strokes, renal failure, and peripheral vascular disease. These problems frequently coexist in individuals, and likely share similar pathophysiologic origins.

These problems represent a new phenomenon in Arctic indigenous populations. Based on incomplete data, it appears that they were extremely rare prior to the 1960s (Naylor et al., 2003), but they are now increasing quite rapidly (Alaska Native Medical Center, 2008). The subsistence diet is the most important protective factor against these problems; numerous studies have demonstrated that this transition has been caused by a transition to market foods and an increasingly sedentary lifestyle (Adler et al 1996; Murphy et al., 1995; Ebbesson et al., 1999; Bjerregaard et al., 2004).

In the NSB, rates of diabetes in Alaska Natives are still low compared with other regions of the state, but have begun to increase rapidly. The diabetes program at ANTHC tracks regional rates of diabetes; the current prevalence of diabetes in NSB Alaskan Natives (BSU) as of 2006 was 22/1,000 (compared with 40/1,000 for all Alaskan Natives, and 78/1,000 for the general U.S. population). Between 1990 and 2006, however, diabetes rates in the BSU increased by 126%, compared with 114% for all Alaskan Natives (Alaska Native Medical Center, 2008). The regional prevalence of high blood pressure and dyslipidemias

has not been calculated, although these rates could potentially be calculated through the ASNA RPMS electronic database.

Cardiovascular and Cerebrovascular Disease. Cardiovascular disease and cerebrovascular disease (strokes) are among the most important causes of death and disability in the U.S. Risk factors include diabetes, high blood pressure, dyslipidemias, smoking, depression, and family history (genetic predisposition). While rates in the NSB are somewhat lower than U.S. and Alaska Statewide rates, cardiovascular disease is still the third leading cause of death in the North Slope region. Rates of cardiovascular disease mortality have been decreasing in the NSB, mirroring Statewide and national trends. The explanation for this is not known but could correlate with improvements in risk-factor modification through medical and public health efforts (Cooper et al., 2000).

Chronic Lung Disease. Chronic lung disease is a spectrum of disorders including chronic obstructive pulmonary disease (COPD), asthma, and chronic bronchitis. Risk factors for these problems include smoking, air pollution, poor indoor air quality, and possibly severe pulmonary infections in early childhood; numerous studies have also demonstrated that "socioeconomic position," as measured by factors such as income level and educational attainment, has a direct effect on severity of and mortality from pulmonary disease (O'Neill et al., 2003).

There was a 192% increase in mortality rates for COPD between 1979 and 2003; between 1999 and 2003, the BSU had the highest mortality rate COPD of any region in the State (130/100,000 compared 68.8/100,000 for all Alaskan Natives (Day, Provost, and Lanier, 2006). Rates of pediatric asthma in the NSB reported in one paper (by asthma diagnosis or medication use) was 6.6%, compared with 3.5% in the Nome area, 12 % in the Bethel service area, and 7.0% in the NWAB service area (Gessner and Neeno, 2005).

Residents in Nuiqsut have complained that local gas flaring at the Alpine facility has led to increased respiratory problems in the village. One brief unpublished review examined rates of asthma and other lung problems including lower respiratory tract infections (such as pneumonia) in Nuiqsut compared with a control village, and found differences only in the 10-19 age group and in the number of clinic visits for asthma (Serstad and Jenkerson, 2003). Health care providers interviewed for this study noted that an apparent increase in respiratory problems may have correlated with increased traffic on the roads leading to increased dust, although the study findings did not support nor conclusively refute this hypothesis.

Smoking rates in the NSB are high. According to a regional analysis of BRFSS data from 2005-2007, 44% of North Slope residents currently reported being smokers, compared to a Statewide rate of 23% (ADHHS, unpublished data). In the SLiCA North Slope sample, 61% reported smoking daily (Poppel et al., 2007).

Historical data are not available for comparison, but accounts suggest that the high smoking rates in rural Alaskan Native communities are a long-standing problem. Income and educational status are strong predictors of smoking rates. Lower income and less education are two of the most powerful risk factors for smoking in the U.S. (Centers for Disease Control and Prevention, 2007).

Indoor air quality also has been suspected as a cause of increasing rates of chronic lung disease in the Arctic. An unanticipated consequence of modern, highly insulated housing in remote Iñupiat villages has been decreased ventilation. One recent study in Canadian Inuit villages noted that ventilation in these houses was poor, and CO_2 levels were higher than recommended (Kovesi et al., 2007). It is not known whether these study results can be generalized to NSB housing.

Air pollution is another important cause of and exacerbating factor for chronic pulmonary disease (EPA, 2006a; Ostro et al., 2006). One study traced emissions from Prudhoe Bay as far west as Barrow (Jaffe et al., 1995). On the other hand, at present the Beaufort and Chukchi sea areas are classified as attainment areas under the Clean Air Act. However, current information on air quality in the North Slope is based primarily on modeling, and is limited by the scarcity of monitoring sites (2 sites on land in the entire region), lack of monitoring data for fine particulates (PM 2.5), and lack of monitoring for HAP because of reporting exemptions for oil and gas producers. According to ADEC (2007):

> Currently no data has been collected to document if the substantial amount of pollution emitted on the North Slope, although not in violation of air standards, may be having a significant cumulative effect on this area.

ADEC (2007) further notes that:

> Air monitoring data is limited on the North Slope, especially in the NPR-A. Existing air monitoring data is collected by the oil companies as part of their air permit requirements and monitoring is not performed at locations several hundred miles downwind of the facilities. While North Slope air quality data has not shown violations of the National Ambient Air Quality Standards (NAAQS) near the facilities, concerns exist about the ability of older air quality models to predict deposition given the North Slope's strong atmospheric stability, complex high latitude atmospheric chemistry, the secondary formation of pollutants trapped in mid to long distance transport, and deposition of air pollutants which can accumulate in the soil and vegetation.

Because of the current data gaps, it is not possible to determine with confidence the potential contribution of existing oil and gas emissions to baseline levels of respiratory illness in the NSB region, although it is certain that air pollution would be only one of several important contributors.

Cancer. Cancer is now the leading cause of death in the NSB and BSU (and for Alaskan Natives Statewide), and it has become a matter of great concern to NSB communities. Residents have testified to increasingly common tumors in fish and game and have voiced strong concerns regarding the possibility that subsistence resources have been or will be contaminated by local activities. Exacerbating these concerns, the rate of cancer in the BSU has increased over recent decades. Cancer mortality increased from 273/100,000 in 1979-1983, to 362/100,000 in 1999-2003, a 33% increase. By comparison, cancer mortality in U.S. whites decreased from 203/100,000 to 193/100,000 over the same time period, whereas rates in the NWAB and Norton Sound also increased. The BSU had the highest incidence of cancer of any region (579/100,000, compared with 554 in the Anchorage Service Unit, 425 in the Kotzebue Service Unit, and 479/100,000 in the Norton Sound Service Unit. than (Lanier et al., 2006). Lung cancer is the most common type of cancer (41%), followed by colorectal (32%), breast (15%), stomach (10%), and prostate (7%). Each type of cancer has somewhat different known risk factors (discussed below).

Lung cancer of the variety most commonly seen in Alaskan Natives is highly associated with tobacco smoke. Thus, the high rates of smoking documented on the North Slope are one identified risk factor for lung cancer. Radon gas exposure also is a risk factor in some areas of Alaska and, nationwide, it is thought to be the second leading cause of lung cancer behind smoking tobacco (EPA, 1993). Radon levels in Alaska generally are low, although elevated levels have been measured during EPA surveys of homes in some parts of the Interior, Southcentral, and Southeast, Alaska. Permafrost and some Arctic building construction practices, such as pilings, effectively eliminate the radon risk in some areas (AMAP, 1998). Other risk factors for lung cancer include industrial exposure to asbestos, uranium, arsenic, nickel, and chromium.

Colorectal cancer has known genetic risk factors, in addition to family history. The prevalence of the genetic risk factors in Alaskan Natives is not known. Cigarette smoking is a known risk factor, and recent studies have

suggested that increased insulin levels associated with sedentary lifestyle and consumption of high sugar diets also are risk factors for colon cancer.

Breast cancer has several known risk factors, including genetics, use of estrogen-progesterone hormone-replacement therapy, obesity, and consumption of four or more alcoholic drinks daily.

Prostate cancer has increased in Alaskan Native men but remains less frequent than the general U.S. population. Known risk factors include age and possibly a diet high in animal fat.

Stomach cancer is far more frequent in Alaskan Natives and, unlike the U.S. population in whom the incidence is decreasing, the rate among Alaskan Natives has remained stable. The major known risk factor for this cancer is infection with the bacteria *Helicobacter pylori,* which causes a chronic infection in the lining of the stomach. This infection is present in 85% of Alaskan Native adults who live in rural Alaska (Parkinson et al., 2000), and may contribute to the disparity in this cancer.

Evaluation of the question of whether and to what degree environmental contaminants produced by oil and gas activities in the region may contribute to the high cancer rates on the North Slope is complicated by reporting exemptions that limit the availability of data on the types and amounts of carcinogens produced by North Slope oil and gas activities; by the lack of routine and ongoing monitoring of locally-produced carcinogens in air, water, and subsistence foods; by the concentration of some pollutants in the Arctic from worldwide sources; and by a lack of dietary data to allow a more quantitative evaluation of exposure to various dietary sources of contaminants. The NSB has maintained an extensive program of monitoring and testing subsistence resources for contaminants. The results have been encouraging, in that to date, the levels of contaminants such as PCBs (organic pollutants not typically associated in high quantities with modern oil and gas operations) in subsistence foods have been substantially lower than those reported in similar resources in Canada and Greenland. One study compared PCBs in subsistence foods harvested on the North Slope to levels of PCBs in foods purchased in local stores, and made the point that there is no available food source that prevents exposure to organic pollutants altogether (O'Hara et al., 2005). The Alaska Department of Health also has summarized data on PCBs and mercury in subsistence foods, and concluded with a strong recommendation that people continue eating subsistence foods because, given the relatively low levels of contaminants present, the health benefits clearly outweigh the risks (ADHSS, 2004a,b). A 1999 report by the Alaska Native Health Board, *Alaska Pollution Issues*, assessed the risks from radionuclides, persistent organic pollutants, heavy metals, PCBs, dioxins, and furans, and concluded that the "benefits of a traditional food diet far outweigh the relative risks posed by the consumption of small amounts of contaminants in traditional foods" (Alaska Native Health Board, 1999). To date, there has been no risk assessment completed to evaluate cancer risk from contaminants produced by oil and gas operations on the North Slope. The ATSDR completed a risk assessment for exposure to PCBs and DDT (not contaminants generally associated with contemporary oil and gas operations) in fish in the Colville River, and found no evidence of a significant health risk (ATSDR, 2003), but this report is not generalizable to other contaminants and sources throughout the region. Thus, although there are data available suggesting that for certain organic pollutants the risks to human health from consuming wild foods harvested in the region remain low, the data are not exhaustive in terms of the subsistence species tested and the spectrum of contaminants that might be present.

3.4.5.2.6. Infectious Diseases.

Respiratory Infections. Respiratory infections are highly prevalent in the NSB and certain other rural regions of Alaska, as compared with the general Alaska and U.S. populations. Respiratory infections were the leading outpatient diagnosis and the third leading hospital discharge diagnosis for Alaskan Natives in the region between 2001 and 2004; the second leading hospital discharge diagnosis was COPD and, in general, a large proportion of hospitalizations for this diagnosis are associated with respiratory

infections (Alaska Area Indian Health Service, 2008). The hospital discharge rate for NSB residents hospitalized in a major referral center (Anchorage or Fairbanks) for respiratory infections in 2001-2005 was 51/10,000, compared with 24.8/10,000 for Norton Sound residents, and 24.7/10,000 for NWAB residents.

The high prevalence of respiratory infections in Alaskan Natives has been the subject of several studies. Two recent studies found a significantly higher prevalence of respiratory infections in villages without access to an adequate supply of running water (Hennessey et al., 2008; Gessner, 2008). Other studies have shown particularly high rates of lower respiratory infections in infants and children in at least one rural Alaska region (Singleton et al., 2006).

The high rate of chronic lung problems (COPD, asthma) is important to consider when evaluating the effect of respiratory infections, because people with chronic lung disease are more likely to develop severe complications of respiratory infections than the general population.

The contribution of existing oil and gas operations to rates of respiratory infections has not been studied. In theory, exposure to a wider range of infections could occur in areas where there is widespread mixing of nonresident workers from outside the region and village residents. There are no data available regarding the frequency of respiratory illnesses among nonresident workers.

Gastrointestinal. No data are available regarding the prevalence of severe diarrheal infections in the NSB.

Skin Infections. Serious skin infections (cellulitis, abscesses) are caused by bacteria, most commonly *Staph. aureus* and *Strep pyogenes*. There is an increasing prevalence of antibiotic-resistant staph infections (MRSA) in Alaska, a very concerning problem. The prevalence of MRSA infection in the NSB has not been calculated. As in the case of respiratory illness, adequate water supply and sanitation are documented as important determinants of the rate of serious skin infections (Hennessey et al., 2008).

Bloodborne and Sexually Transmitted Infections. This group of infections includes HIV, Hepatitis B, Hepatitis C, gonorrhea, Chlamydia, and syphilis. These are diseases transmitted either through blood or sexual contact. The prevalence of Hepatitis B and C in Alaska are not known with certainty (ADHSS, 2003). The prevalence of HIV in the Northern Region of Alaska appears to be substantially lower than prevalence in the general U.S. population (ADHSS, Section of Epidemiology, 2002, 2007).

Gonorrhea and Chlamydia are highly prevalent in rural Alaska. On the North Slope, the rate of Chlamydia was calculated to be 1,317/100,000, compared with 2,052/100,000 in the Statewide Alaskan Native population and 332/100,000 in the U.S. Gonorrhea rates in the North Slope are relatively low, 20/100,000, compared with 305/100,000 in Alaskan Natives Statewide, and 115/100,000 in the U.S.

The prevalence of blood-borne and sexually transmitted infections is related to rates of intravenous drug use, high-risk sexual behavior, number of sexual partners, and use of appropriate barrier contraceptives. An influx of nonresidents has the potential to change incidence and prevalence patterns of blood-borne and sexually transmitted infections through the mixing of high and low prevalence populations (International Finance Corp., 2007).

3.4.5.2.7. Maternal-Child Health. Important health disparities include an elevated rate of teen pregnancies and premature deliveries compared with the Alaska population. Premature birth has complex causes, which are incompletely understood. A number of potentially modifiable risk factors have been

Attachment 10
AEWC & ICAS

Traditional Knowledge
Environmental Protection Agency

Literature Review of North Slope Marine Traditional Knowledge

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and Lydia Agnasagga testified to the changes they have seen in the sea ice in the Chukchi Sea during their lifetime. They said,

> *The ice conditions were good in them old days, but right now we got limits even staying out on the ice because we don't fish till December and it will melt by the last part of May sometimes. One time we were whaling right from the beach. That was about five years ago, because the ice melt. That's the condition of the ice nowadays. I think it's due to global warming.* (Billy K. Nashoalook Sr. 2007 DEIS Seismic Wainwright)

> *Like I said earlier, in my days I remember people would be out more and they would be out on ice more, you know, more because there would be more solid ice. Nowadays they can't. They always have – because of the thin ice or something or whatever, you know, so many change in our ocean down there. That's why we never really meet our quotas nowadays. It all depends on how the ice conditions are. That's the way I see it, anyway, myself. It's not like the old days anymore. That's what I'm trying to say.* (Lydia Agnasagga Sr. 2007 DEIS Seismic Wainwright)

In addition to testimony regarding the changes in ice conditions, Wainwright residents also provided comments regarding the timing of seasonal hunting activities. During public testimony in 2007, George Agnasagga noted,

> *Most captains will go out to the ice the second week of April, and then they will stay out there right through May, and sometimes the second or third week of June, depending whether they got their quota or not. But most times it's second week of April through end of May most years.* (George Agnasagga Sr. 2007 DEIS Seismic Wainwright)

Subsistence Use Area Studies by Study Community

Subsistence use area studies are another source of TK as these data provide information about where resources are traditionally harvested and reflect the indigenous populations' intimate knowledge of their landscape. While use areas may change due to seasonal fluctuations and changes in resource availability, the general pattern remains consistent and is evidence of an accumulation of knowledge about where subsistence resources can be found during specific times of the year and in accessible areas. Within the reports of these studies is TK information from the respondents that is the basis for when, where, what, and how they harvest these resources. The following section briefly summarizes the available subsistence mapping studies for each study community. Subsistence use areas for resources that utilize the marine environment are the focus of the following discussion as they are mostly likely to be potentially affected by the offshore oil and gas exploration. These resources include marine mammals, fish, waterfowl (eiders and sea bird eggs), and marine invertebrates. Individual maps for terrestrial resources are not included because these resources are not the focus of this TK review.

Barrow

Barrow subsistence use area data related to the marine environment are available for lifetime to 1979, 1979-1983, 1987-1989, and 1997-2006 and are shown on Map 2 through Map 9. These maps include use areas for beluga, bowhead, polar bear, seal, walrus, fish, waterfowl, and marine invertebrates. These maps show that Barrow residents utilize both the Chukchi and Beaufort seas for their subsistence activities. From Barrow, their marine use areas extend 60 miles to the north (for seal; Map 5), as far east as Prudhoe Bay (also for seal), and as far west as the area near Kasegaluk Lagoon near Wainwright (bowhead and waterfowl; Map 3 and Map 8). While residents use the marine environment to harvest subsistence resources year round, the majority of offshore hunting activities occur from April through October (SRB&A 2010). The spring bowhead whale hunt occurs during April and May; eiders and seals are also harvested from the ice as needed or available during this time. Starting in June and continuing through August, residents focus on harvesting seals (ringed and bearded) and walrus in large offshore areas.

Eiders are also harvested during the summer and fall (from June through October) from shore and while hunting for marine mammals. The months of September and October are dedicated primarily to the fall bowhead whale hunt. Through the summer and fall months of June through November, Barrow harvesters set nets for various species of fish at coastal locations, including in Elson Lagoon. Some coastal ice fishing occurs during the winter months. While the majority of seal hunting occurs during the summer months, residents also target ringed seal on the ice throughout the winter months. Sources for the subsistence use area mapping studies, seasonal round, and their related TK include Pedersen (1979b), Braund and Burnham (1984), SRB&A and ISER (1993a), SRB&A (Unpublished-b), and SRB&A (2010).

Nuiqsut

Nuiqsut subsistence use area data related to the marine environment are available for lifetime to 1979, 1994-2003, and 1995-2006 and are shown on Map 10 through Map 15. These maps include use areas for bowhead, polar bear, seal, fish, and waterfowl. These six maps show Nuiqsut residents marine subsistence use areas extending over a large area of the Beaufort Sea. Residents have reported traveling up to 60 miles offshore to the north and as far east as Kaktovik for bowhead (Map 10). Use areas extend to the west to Cape Halkett (seal; Map 13). Nuiqsut offshore hunting activities occur primarily from May through October (SRB&A 2010). Once the ice breaks up in late May or early June, residents travel from their location on the Colville River delta to the ocean in search of ringed and bearded seals, as well as eider ducks. Seal and eider hunting continue throughout the summer until September. Nuiqsut only participates in a fall bowhead whale hunt, traveling to Cross Island during the month of September to harvest whales; residents sometimes stay at Cross Island into October. Arctic ciscoes are harvested as they migrate from the Beaufort Sea along the Colville River Delta in the months of October, November, and December. Broad whitefish are also harvested in nets near the mouths of Colville River and Fish Creek throughout the months of May through November, with the majority of broad whitefish harvests occurring during the month of July and while harvesting Arctic cisco in October. Sources for the subsistence use area mapping studies, seasonal round, and their related TK include Pedersen (1979b), Pedersen (1986), SRB&A (2003a), and SRB&A (2010).

Kaktovik

Kaktovik subsistence use area data related to the marine environment are available for lifetime to 1979 and 1995-2006 and are shown on Map 16 through Map 21. These maps include use areas for bowhead, polar bear, seal, walrus, fish, and waterfowl. The maximum distance for Kaktovik's reported offshore use is 35 miles (bowhead and walrus; Map 16 and Map 19). Along the coast, their use area extends as far east as the Mackenzie River Delta in Canada (waterfowl and fish; Map 20 and Map 21) and to the west as far as the Return Islands near the Kuparuk River Delta (waterfowl; Map 21). Because the community is located on an island in the Beaufort Sea, subsistence activities occur in the marine environment throughout the year. However, the majority of offshore hunting and fishing occurs from May through September (SRB&A 2010). Hunting for waterfowl (geese and eiders) begins as early as May and June primarily at inland locations; residents hunt waterfowl along the coast and on the barrier islands during the fall months of August and September. Ringed and bearded seal hunting also occurs during the spring, summer, and fall months of April through September, with the majority of activity occurring in July and August. Residents generally harvest walrus while looking for seals between July and September. Most offshore fishing activities occur during the summer; residents travel inland in the winter to harvest fish through the ice. Fish such as Arctic cisco, Arctic char/Dolly Varden, and broad whitefish are harvested in nets at various coastal locations starting in June and extending through September, with the vast majority of offshore fishing activities occurring in July and August. Like Nuiqsut, Kaktovik hunts bowhead whales almost exclusively during the fall month of September. Sources for the subsistence use area mapping studies, seasonal round, and their related TK include Pedersen (1979b), Pedersen and Linn (2005), and SRB&A (2010).

Point Hope

Point Hope subsistence use area data related to the marine environment are available for lifetime to 1979 and 1979-1983 and are shown on Map 22 through Map 29. These maps include use areas for beluga, bowhead, polar bear, seal, walrus, fish, waterfowl, and marine invertebrates. These data show offshore use areas up to 17 miles from the coast for bearded seal and walrus (Map 25 and Map 26). The northern terminus of their offshore use areas is near Kukruk Creek (walrus; Map 26) and residents' southern documented offshore use area extends to Kivalina (seal; Map 25). Point Hope's marine harvest activities occur year round, although the majority of resources are harvested during the spring and summer (Braund and Burnham 1984). Point Hope's bowhead harvest occurs in the spring during late March or early April and into May. Bearded seal are harvested from May through July with spotted seal harvests occurring during the open water months and ringed seal harvests occurring primarily from November through March. June through July is the primary harvest season for walrus, while beluga are harvested anywhere from March through August, with the majority of harvests occurring in July. The majority of fishing in the marine environment occurs from June through August, although residents will also harvest cod near the point from December through February. Eider hunting occurs in the spring during whaling. Hunting for polar bear occurs primarily during January to April. Sources for the subsistence use area mapping studies, seasonal round, and their related TK include Pedersen (1979b) and Braund and Burnham (1984).

Point Lay

Point Lay subsistence use area data related to the marine environment are available for lifetime to 1979, 1979-1983, lifetime to 1987, and 1997-2006 and are shown on Map 30 through Map 36 These maps include use areas for beluga, polar bear, seal, walrus, fish, waterfowl, and marine invertebrates. Point Lay residents reported traveling as far as 25 miles offshore for walrus (Map 33). To the north, residents traveled as far as Nokotlek Point in Kasegaluk Lagoon for waterfowl and seal (Map 32 and Map 35). The southern terminus of Point Lay residents documented offshore use areas is to Cape Lisburn for seal (Map 32). Point Lay's seasonal round of harvest activities for the marine environment is reported in Braund and Burnham (1984). Beluga, an important resource for the community, is primarily harvested in July as the whales migrate north. Ringed seals are harvested earlier in the spring from April to June, with bearded seal hunting in June, and walrus hunting in June and July. Spotted seals are occasionally harvested during the summer. Eiders and other waterfowl are usually harvested in the spring, particularly during May. Marine fishing is conducted during July and August. Polar bears are only occasionally harvested during the winter. Sources for the subsistence use area mapping studies, seasonal round, and their related TK include Pedersen (1979b), Braund and Burnham (1984), Impact Assessment Inc. (1989), and SRB&A (Forthcoming).

Wainwright

Wainwright subsistence use area data related to the marine environment are available for lifetime to 1979, 1979-1983, 1988-1989, and 1997-2006 and are shown on Map 37 through Map 45 These maps include use areas for beluga, bowhead, polar bear, seal, walrus, fish, waterfowl, and marine invertebrates. Wainwright subsistence harvesters have reported traveling up to 42 miles offshore for seal and walrus (Map 40 and Map 41). Map 42 shows offshore use as far as 52 miles offshore but for marine mammals but the exact species targeted is unknown. Marine use areas extend to the north as far as Barrow (seal and waterfowl; Map 40 and Map 44) and as to south to Cape Sabine (seal; Map 40). Wainwright's utilizes the marine environment of the Chukchi sea throughout the year, however, similar to other coastal communities, most of their marine harvests occur during the spring and summer months (SRB&A and ISER 1993b). The bowhead whaling season begins in April and lasts into June depending on the ice conditions. Beluga can also be harvested during the bowhead whaling season and occasionally into the summer months. After the bowhead whaling season, residents harvest bearded seal during June and July, followed by walrus in July and August. Ringed seal are harvested primarily from April through July but

are also harvested in lesser quantities throughout the year including the winter months. Eider hunting occurs from May through July. Much of Wainwright's coastal fishing occurs during the summer months of July and August, particularly for salmon, Arctic char, Bering cisco, and sculpins. Harvest of smelt and saffron cod are an important marine activity that occur in Kuk lagoon mainly from January through March. Sources for the subsistence use area mapping studies, seasonal round, and their related TK include Pedersen (1979b), Nelson (Nelson 1981), Braund and Burnham (1984), SRB&A (Unpublished-b), SRB&A and ISER (1993b), and WTC and TNC (2008).

Harvest Studies by Study Community

Harvest studies are a fourth source of TK. These studies are one way of showing how traditional harvest practices that are based out of local TK are sustainable from year to year. The data show which species are the most important to a community's livelihood and the appropriate seasons for harvesting them. Within the reports of these studies is TK information from the respondents which is the basis for when, where, what, and how they harvest these resources. The following section briefly summarizes the available harvest studies for each study community with tables of harvest data and references to the studies from which additional TK information is available. Resources that utilize the marine environment are the focus of the following discussion as they are mostly likely to be potentially affected by the offshore oil and gas exploration. These resources include marine mammals, fish, waterfowl (eiders and sea bird eggs), and marine invertebrates. Individual harvest studies for terrestrial resources are not included because these resources are not the focus of this TK review.

Barrow

Barrow harvest data are available for 1987, 1988, 1989, 1992, 1995-1996, 1996-1997, 2000, 2001, and 2003 (Table 6 and Table 7). As shown in Table 6, marine mammals comprise over half of the community's yearly harvest. Table 7 shows that individual species of marine mammals harvested in Barrow include bearded seal, ringed seal, walrus, and bowhead. Polar bear, beluga, and spotted seal are also harvested but to a lesser extent. Marine and or migratory fish harvested by Barrow residents include Arctic char; Arctic and least cisco; Arctic cod; broad whitefish; chum, halibut, humpback, king, and silver salmon; rainbow smelt, arctic flounder, sculpin, and clams. Eiders are also harvested. Sources for this information as well as related TK include SRB&A and ISER (1993a), Fuller and George (1997), and Bacon, Hepa, Brower Jr., Pederson, Olemaun, George, and Corrigan (2009).

Nuiqsut

Nuiqsut harvest data are available for 1985, 1992, 1993, 1994-1995, 1995-1996, and 2000-2001 (Table 8 and Table 9). Marine mammals contribute between two percent (a year in which Nuiqsut did not harvest any bowhead) to 66 percent of the community's total harvest (Table 8). The top species that Nuiqsut harvests that are relevant to this review include whitefish, bowhead, bearded and ringed seals, Arctic char, and Arctic and least cisco (Table 9). Sources for this information as well as related TK include Pedersen (1995), Fuller and George (1997), Brower and Hepa (1998), Bacon et al. (2009), and ADF&G (2010).

Kaktovik

Kaktovik harvest data are available for the years 1985, 1986, 1992, 1994-1995, 2001, 2002, and 2002-2003 (Table 10, Table 11, and Table 12). In all but one study year (1985) shown on Table 10, marine mammals comprised nearly 60 percent or more of the community's total harvest. Residents did not harvest a bowhead in 1985, which explains the low percentage toward the total harvest of marine mammals for the year (Table 11). Species that utilize the Beaufort Sea and contribute the most to Kaktovik residents' harvests include bowhead, seal, Arctic char/dolly varden, whitefish, Arctic cisco, and polar bear (Table 11 and Table 12). Sources for this information as well as related TK include Fall and