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Internship Report UNEP: The Effects of Climate Change in Arctic Zones

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UNEP
The effects of climate change in Arctic zones

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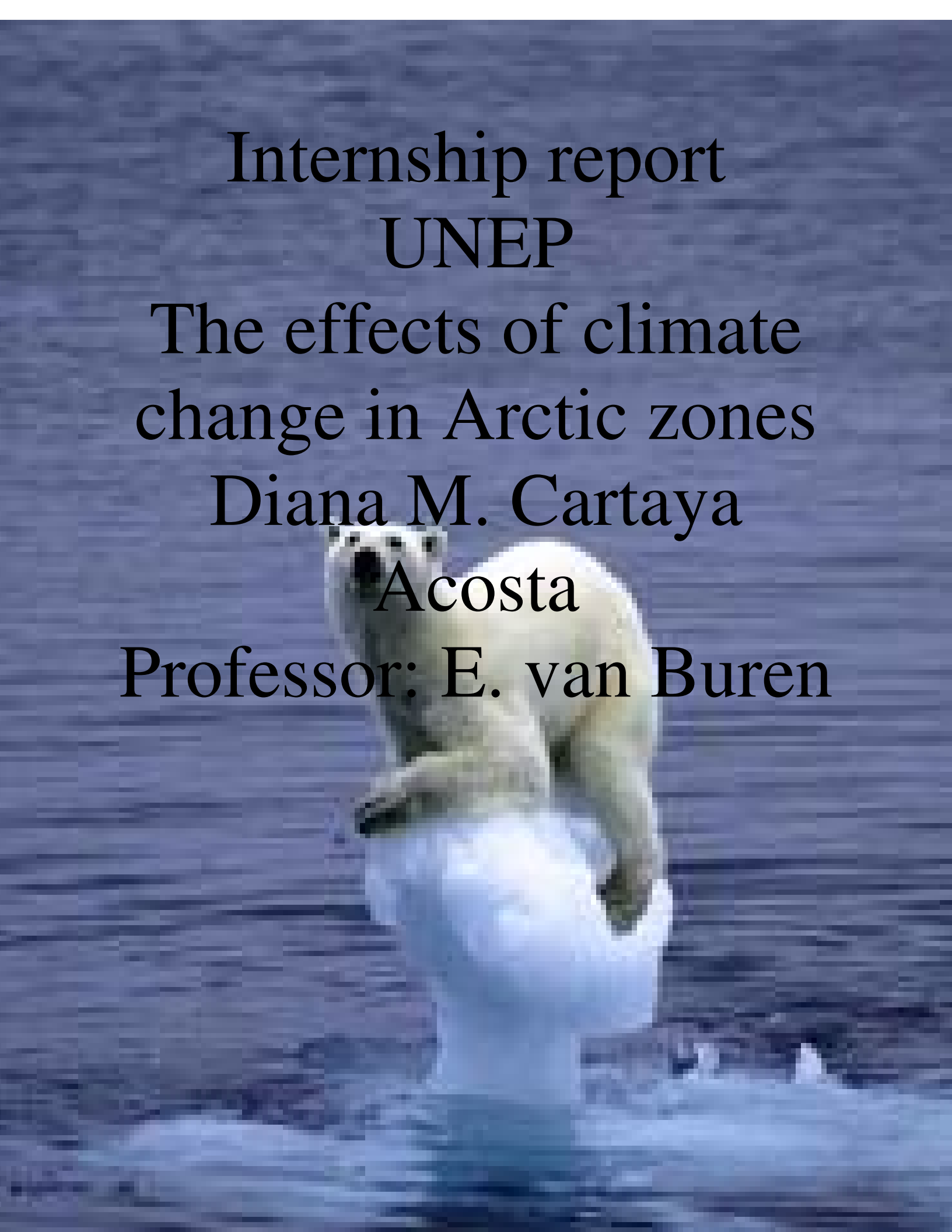

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Introduction

Climate change or the significant alteration of major weather pattern distributions around the planet over long time periods, is one of the most significant phenomena currently affecting our planet.Arctic as one of the most sensitive zones in terms of damaged it is by climate change effects.The consequences of the many representations of climate change are distributed in a geographically unequal manner, therefore it is a global major concern to target and mitigate related issues that are already directly affecting several populations.

Even tough geographically distinct and distant populations are likely to face climate change related catastrophes at different rates, many of the consequence will be somewhat detrimental for all, due to our interdependent global economy. Indeed, climate change's most noticeable representation, which is global warming, is undeniably caused by human's economic activity. Certain facts related to climate change and global warming are strikingly alarming and they support the research in my internship report. Most economic activities that constitute the base of international economic ties are currently producing necessity and luxury consumer goods to supply an excessive amount of population. Therefore, as counterproductive as it is, sustainability is not always amongst the first goals of producers. Although plenty of institutions report yearly about the consequences of these type of behavior, there is still a widespread lack of concern about properly using natural resources. It is a fact that because of human overpopulation and the massive consumption/misuse of natural resources we are destined to face gradually worsening consequences related to climate change. However, concerning environmental authorities and organizations constantly have to verify sustainability reports to avoid greenwashing.

Within the framework of the UN, environmental issues related to the causes and effects of climate change are of particular significance due to their imminent cost to present and future generations. UNEP is the agency working directly on the convergence between environmental scientific data and its implications to international policy implementation. Within UNEP, interns currently focus on the pre-negotiation for the Rio+20 Conference to be hold later this year and where climate change will also be a central theme. Consequently, taking into account interdisciplinary aspects, such as Ecological Anthropology, Environmental Health and Climate Ecology, I intend to evaluate scientific data providing evidence of the true human and nonhuman animals health effects of climate change in Arctic Zones. Not only does climate change affect the physical ecosystem of biomes, but it changes cultural patterns, people adaptation techniques for survival and results in new natural population control. New pest species and diseases could re-appear as a result to environmental stresses, which could also limit humans ability to adapt to possible future environmental conditions. Moreover, I will evaluate how are this concerns addressed in UNEP's precautionary policy approach and which are the current mitigation techniques approved/recommended by the agency. Climate change is a serious matter that ought to be placed among our generation's top prioritized concerns.

Internship

The United Nations Environment Program was created in 1972 by the UN General Assembly as one of the main outcomes of the Stockholm Human Environment Conference held earlier that year. It was established to coordinate and promote environment related activities in the UN. Its objective are to develop and integrated approach to the planning and management of development, ensuring triple bottom line

benefits as well as to promote scientific and technological development on environmental issues, especially in developing countries, where financial and educational assistance is more needed. My role as an intern at this institution is to attend relevant conferences and producing daily reports about negotiations and existing panel recommendations and dialogues. Reports submitted by interns to the Office Programmer form part of a larger document weekly sent to Mr. Achim Steiner, UNEP's Executive director to inform him of events taking place in UNEP's New York Division. One of UNEP's greatest concerns is to mitigate climate change effects in Arctic zones, which is the main theme of my Internship report, especially because of the agency's role on the Rio+20 Conference on Sustainable Development, to be hold in June. The main role of this Conference is to address issues related to unsustainable development related practices and to find innovative mitigation techniques involving international cooperation.

Climate Ecology/Environmental Policy

Arctic ecosystems probably date back to the mid [1]Pleistocene. It's temperature boundary line is at about 10C during the warmest months. Although the flora and fauna currently found in the arctic are likely to have evolved in highland areas of central Asia and the Rocky Mountains and slowly colonized the tundra. The tundra is the most common type of vegetation in the northern borders of the Arctic, consisting on treeless extremely cold landscapes. Summers in this area are cool and short with [2]extensive daylight time. In the Antarctic the environment is even more threatening to life for only 10, 350 square kilometers of a total of 14.24 million square kilometers are suitable for

[1] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology
[2] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology

sustaining life. The only types of life in this part of the planet are: lichens, fungi, mosses and tiny flies. The limits of the arctic vary, depending on the point of reference taken: botanical or climatological. Moreover, with the expected 3C degrees temperature rise at the end of the century, permafrost "the greatest limiting factor" is likely to disappear, allowing forests to extend into current tundra regions. The [3]subarctic boreal coniferous forest or taiga is, combined with tundra, the largest ecotone in the world with more than 134000km. This ecotone is composed by somewhat differentiated types of vegetation such as dwarf trees, cottongrass-tussock and sedge-moss meadow tundra, mosses, lichens, bushes and polar deserts. The vegetation, which rarely passes knee heigh, absorbs all the water that defrosts in the summer, not allowing draining. Consequently, below the vegetation the land remains frozen and impermeable to plant roots. Tundra soils contain high accumulation of peaty organic matter due to a slow plant material decomposition. This impermeability enables most of the carbon to be sequestered and prevents it from being exposed to the atmosphere.

The ecological importance of the Arctic is based on the several ecosystem services it provides, some of which are the basic life conditions of many species. Cold temperatures prevent snow from melting, which reduces the increase of sea ice and prevents the [4]greenland ice sheet from expanding. Cold temperatures regulate the expansion of the cryosphere. Atmospheric cooling causes decrease in summertime sea ice melting, which entails a decrease of summertime open water. This regulation process then regulates sea rise levels as well as the natural clockwise flowing of cold

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[3] Tundra, http://www.blueplanetbiomes.org/tundra.htm

[4] Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

water currents southwards. Because of the large amount of snow, the [5]albedo effect causes an increase in solar reflexion and sun's energy absorbtion. This chain processes then lead to a rise in ocean cooling, which helps solidify the multi-year ice layer formation. These ice layers have played a huge role in greenhouse gases sequestration for millions of years. Recent studies show that although with climate change the manipulation of [6]nonacidic tundra with nitrogen and phosphorus did not increase, in acid tundra, biomass has increased. Nonacidic tundra, [7](soil pH 3-4) occurs primarily on older landscapes, and moist non-acidic tundra (soil pH 6-7), exists mostly on landscapes with a more recent history of glaciation and has higher graminoid and forb abundance and lower woody shrub abundance than acidic tundra. Both types of tundra have a significant ecological importance. Since they are mostly treeless, they cool down the warm air coming from the Tropics in the summer, sending in southwards to the Equator. Therefore they play a very important role in air current patterns. Moreover, the tundra provides a secure layer to the permaprost (layer of ice that remains frozen year round) and its vegetation is a main part of the caribou, reindeer and other animals which live in tundra biomes. During the [8]Arctic's short summers, this layer growths at a very fast pace due to the long daytime length. This rapid plant growth is quite beneficial to migrating birds and the overall development of all animals in the area. However, given the slow plant succession through seasons, plant erosion is quite hard to control in the

[5] Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic, 26

[6] Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic,30.

[7] Hobbie,S.E.(2004) Litter decomposition in moist acidic and non acidic tundra with different glacial histories

[8] Correl, Robert W. (2005)Arctic Climate Impact Assessment (ACIA)

area, reason why animals including the musk ox, foxes, etc must migrate very often through the tundra-taiga ecological patch. Individual animals in the region also play an important role in determining soil temperature, vegetation abundance and thaw depth. The boom of the [9]small lemming, for instance, indicates that as the main year round active herbivore of the area, the vegetation is not as abundant. However, as summer arrives and predators cause a decrease in the lemming population, plants grow faster and the predator's population decrease.

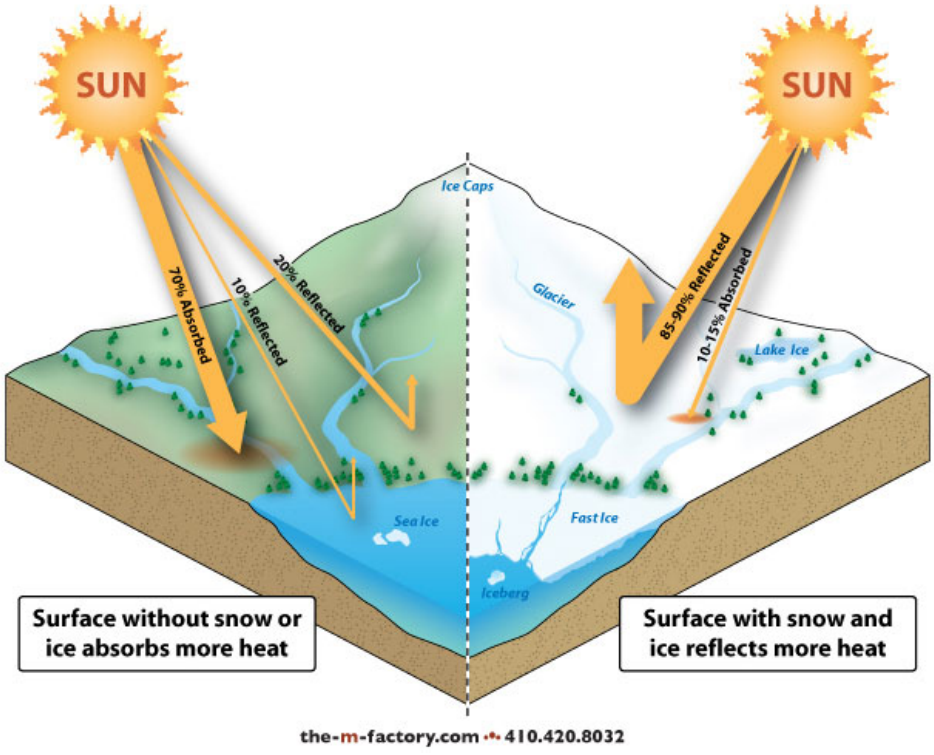
[9] Tundra, http://www.blueplanetbiomes.org/tundra.htm

The Arctic is by far, the most sensitive biome to climate change effects, given its structural dependency to constant cooling-warming patterns which initiate reactive chain of events that maintain ecological stability. The albedo effect or the common measure of snow reflectivity is quite significant in this case. Fresh snow, as well as snow covered sea, may have an albedo of more than [10]80%, meaning that they reflect that amount of the sun's energy back to the atmosphere. The ecosystem function of this high reflexivity is to maintain stable cold temperatures. If temperatures continue to rise due to climate change, the snow will melt, exposing darker surfaces such as [11]evergreen spruce, pine canopy and ocean water, which reflect less than 10% of the sun's energy each. As a consequence, the overall temperature has a tendency to rise. Coherently, the expected

[10] Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

[11] Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

temperature rise for the next [12]100 years in the Arctic is of 6C and 12C for arctic winters (AECO). In cooler periods, the Arctic ‘s strong surface winds have a clock-wise current in the western Arctic that allows Atlantic water at bay. This Cool Phase is considered positive because it allows an even distribution of layers of fresh, cold insulating water; which restrains ice melting. On the other hand, the current Warm Phase, due to climate change, is significantly changing the Arctic Ocean. Present [13]wind and ocean currents have caused a 20% higher amount of warmer water into the Arctic than the norm. Moreover, the layer of cold water that insulates sea ice from the Atlantic has greatly thinned in the last decade by around 4 feet.



[12] Sommerkorn, Martin Climate Change in the Arctic: how to manage in times of rapid change
[13] Sommerkorn, Martin Climate Change in the Arctic: how to manage in times of rapid change

Further current effects of climate change in the Arctic include the dramatic loss of summer sea ice, reason why [14]experts predict that the what we know as Arctic is likely to more northward by 2040. Boreal forests, which have accumulated carbon for thousand of years are now threatened by wildfires and climate change, which implies that more harmful gasses could be in released to the atmosphere. Over the last 50 years, the temperature rise in the Arctic has risen more than [15]1C, taking into account the average winter temperature has also risen about 3C. Because of the imminent temperature rise, thaw periods are likely to be longer, which will harm the impermeability of the Arctic soil, contributing to the emission of further greenhouse gases. However, skeptics argue that this temperature rise could also extend growing periods and enhance carbon sequestration in boreal forests. Moreover, a [16]three-fold increase of mass loss was reported from 2004-2006 compared to 2002-2004 (Bently et al 2007). This mass loss contributes to sea level rise, as explained in 2007 assessments to the Greenland Ice Sheet. The GIS has had a 4 fold upward contribution to sea level rise since 2004, compared to 2005 results (Chen et. al 2006). This level rise could cause humanitarian emergencies to Arctic populations.

According to the [17]UN Millennium Ecosystem Assessment and the IPCC, which gathers the most outstanding scientific and verifiable international research in the subject, climate change and its most clear representation, global warming, are unequivocally tied to human activities. Climate change is the failed or dysfunctional

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[14] Berman et al. (2005) Millenium Ecosystem Assessment: Polar System

[15] Sommerkorn, Martin Climate Change in the Arctic: how to manage in times of rapid change

[16] Sommerkorn, Martin Climate Change in the Arctic: how to manage in times of rapid change

[17] Berman et al. (2005) Millenium Ecosystem Assessment: Polar System
IPCC Fourth Assessment Report

ecological stability of natural ecosystems due to human activity. If this had not been the case, long term weather patterns throughout regions would change as well, but not so drastically over a relatively short period of time. The re-appointed [18]Secretary General Ban-ki Moon even assured the existence of "scientific consensus regarding the quickening and threatening pace of human-induced climate change." Both the Millennium Ecosystem Assessment and the IPCC 2001 reports confirm that the greatest temperature rise ever observed started in mid-20th century; which correlates to humans increasing emission of carbon dioxide, methane, nitrous oxide and other greenhouse gases to the atmosphere. During [19]pre-Industrial times, levels of carbon dioxide were approximately 280 parts per million (ppm) but have now risen to 386 ppm and are rising by about 2-3 ppm more every year. Example in the Arctic. The IPCC report further explains that by examining the concentration of greenhouse gases in ice cores going back 10000 years, the rise is inarguably high right from the start of the industrial era. Scientists also assure that from 1750 and on, the effects of human activity has had 5 times more impact than the sun's output fluctuations. Achim Steiner, the [20]Executive Director of UNEP even said in that the 007 IPCC report "removed the question mark behind the debate on whether climate change has anything to do with human activity on this planet." There the updated UNEP material to be presented in the Rio+20 Conference and approved by the IPCC; considers human induced climate change as "very likely" reason why their current focus in to conduct relevant assessments leading to effective policies. Not only is climate change human induced, but it is, as indicated in

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[18] IPCC Fourth Assessment Report
[19] Berman et al. (2005) Millenium Ecosystem Assessment: Polar System
IPCC Fourth Assessment Report
[20] IPCC Fourth Assessment Report

the Kyoto Protocol(1995) legally bind to developed countries, which have the highest emission rates in the world.

However, when referring to biome stability, there is limited frame to which scientists can refer to, due to nature's tendency to change over time. Natural, man induced reasons or a combination of both can drastically change the weather patterns and economic value of any biome. Ecological stability, or persistent patterns in an ecosystem that prevail for extended periods of time, is only a subjective term, reason why there are still a political opposition to climate change. According to some scientists [21](the minority) current modeling systems to determine average temperature changes in the past compared to a posteriori results, are not totally credible, but only partially. Most mathematical models are set with the belief that temperature rise can only have an average ranging from [22]1.5 to 4.5 C. This means that there is 10% chance that the actual equilibrium warming caused by doubled atmospheric CO_2 is somewhat outside that range. Although current models are very good at determining large scale changes, some mathematical and physical weaknesses still remain. This scientific skepticism has arisen due to worries about the potential socio-economic disruptions and cost that mainstream IPCC approved climate change facts could have and wether it would really imply real consequences.

Current policies to mitigate the effects of climate change in Arctic regions try to focus on the general most worrisome related effects throughout the biome. Consequently, single communities might not experience as many short term benefits as others, depending on their locality and overall socio-political influences. Indigenous

[21] Wolfon, R. Scheider S.H (2002) Understanding Climate Change
[22] Wolfon, R. Scheider S.H (2002) Understanding Climate Change

peoples, who have the [23]smallest footprint in the planet, are the most damaged from given their direct dependency and use of ecosystem services. Reverting this pattern, is one of the main goals of the Kyoto Protocol. Current policies have more differentiated responsibilities in terms of the environment, those who consume and pollute the most, should lead mitigation practices. Contributions to climate change mitigation by Indigenous populations include their sustainable production and consumption, their resilience to monocrop plantations and their actions against oil and mineral gas extractions in their land. Indigenous communities favor hunting and gathering and use renewable/recyclable resources. Indigenous peoples in the Arctic, as well as those in other biomes, believe that treaties such as the Protocol are not sufficient to ensure implementation techniques, especially since the UN did not take them into account until very recently. Mitigation policies targeting all Arctic populations include [24]Emissions Trading (ET) which allows developed nations to earn and trade emissions credits through domestic or international projects under the responsibility of an authorizing country. The Joint Implementation (JI) is another mechanism under the Kyoto protocol framework that enables Annex 1 countries to offset their emissions cut by funding emissions-reducing projects in other countries in the same category. This type of investment is very typical of Arctic countries. Likewise, the Clean Development Mechanism (CDM) works the same as the previous policy but only with projects in developing countries. Denmark, Finland and Norway currently rely on this allowance to meet their quota. Climate change mitigation policies in the Arctic include tax incentives

[23] IPCC Fourth Assessment Report

[24] UN Framework Convention on Climate Change: The Mechanisms of the Kyoto Protocol IPCC Fourth Assessment Report

and to businesses and individuals installing renewable energy devices or for switching to energy efficient transportation means. Because most countries within the biome are highly energy dependent due to their overall use of mining, oil and gas, pulp and paper as economic activities, there is a tremendous focus on technology based mitigation. Moreover, there is an increase use of nuclear power plants and carbon capture/storage techniques. [25]On the other hand, Russia, barely proposes any green initiative and out of all countries in the Arctic Sweden is the only one which green performance classifies as "good" in the Germanwatch Climate Change Performance Index 2008. This index contains the CO2 emission patterns of al countries as well and compares the results each country's previous results per capita. This results entail that there will be no likely near future increase in emission reduction if we take into account that there are more than 40 different indigenous communities in this biome.

The environmental science behind the effects of climate change in the Arctic, shows that there is an interconnection between the effects visible in this biome, and those likely to take place in warmer areas. The Earth is a single unit formed by a chain of interdependent reactions. The Arctic's [26]ecological response to recent climate change have been growing stronger since the 1980s. According to scientific records, [27]by 1989, sea level pressure starting dropping so fast due to thawing that it led to the creation of a strong cyclonic atmospheric circulation. The Arctic Oscillation (AO) is the most used index to determine which of the two existing atmospheric patterns is dominant for given

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[25]UN Framework Convention on Climate Change: The Mechanisms of the Kyoto Protocol IPCC Fourth Assessment Report

[26] Correl, Robert W. (2005)Arctic Climate Impact Assessment (ACIA)

[27] E. Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

period of time. The dominant AO is determined by factors such as sea ice, atmospheric and oceanic accumulated data. During negative AO regimes (anticyclonic) the wind speed and winter temperatures are lower, therefore sea ice layers and overall coverage are thicker which allows water to freshen more rapidly. This regime was present in the Arctic before the 1980s, but due to human induced climate change, the present pattern is cyclonic or positive AO. This pattern is characterized by increased sea ice and warmer, high salinity water transport to the Arctic, which causes apertures in ice layers and allows heat accumulation. As a consequence, the thawing period is extended and ice layers thin. This is the current state of Arctic zones. This effects have as a whole contributed to pushing the [28]"cryosphere to a tipping point", perpetuating the acceleration of fast ice melting. At the same time, damages to the cryosphere and the permafrost have increased substantiality, therefore precipitations and river discharge into the ocean. All of these changes have caused [29]"A shift from the Lomonosov Ridge to the Mendeleyev Ridge of the front separating Atlantic and Pacific water masses, a weakening and deflection of the Transpolar Drift, a weakening and shrinking of the Beaufort Gyre, a intensification and thickening of the Arctic Ocean Boundary Current, and a significant redirection of the shallow Arctic Ocean outflow entering the North Atlantic." This means that the life of Arctic specific species, such as the polar bear, with its almost carnivorous lifestyle as well the life of other predators such as seals and species such as the lemming are threatened due to the relocation or population density decrease of their main food sources. Habitat loss leads to food source decrease.

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[28] The Encyclopedia of EarthState of the Arctic Report

[29] E. Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

According to the most recent [30]scientific assessments in Arctic zones have raised very serious concerns about the future local and the global effects of the Arctic's response to future climate change. Contrary to popular believe, some scientific evidence points that there is a risk of abrupt change in climate patterns, meaning that the Arctic could cool down very fast in the future. This hypothesis highlights that the current state in which ice melting increases the amount of freshwater discharge, could inhibit [31]NADW formation, leading to a slow water circulation pattern that could reduce heat accumulation in the Arctic. NADW or [32]North Atlantic Deep Water, have drifted southwards in recent decades and their future is quite tied to climate change consequences to LSW (Labrador Sea Water) which plays a central role in converting warm water into cool water, reason why it currently dominates NADW. The decrease of winter storm activity and freshwater transported into the LSW has reduced its depth in less than 1000m causing it to become warmer and saltier. Because LSW is especially sensitive to greenhouse gases emissions and its related to the freshening of water, its is the center of attention in terms of what could happen to the Arctic in the future. As climate change increases the supply of the fresh water by increasing ice thawing and precipitation rates, it becomes harder to predict what will happen in the future. Furthermore, it is difficult to predict how a reduction of oceanic heat would affect the current conditions of the cryosphere. There is an urgent need to develop further modeling systems to combat natural and man induced climate change.

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[30] Correl, Robert W. (2005)Arctic Climate Impact Assessment (ACIA)

[31] E. Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

[32] E. Greene, Charles H, et al. (2008) Arctic Climate Change And Its Impacts On The Ecology Of The North Atlantic

Environmental Health/Epidemiology

Given the Arctic's sensitivity to environmental changes, variations to the physical ecosystem also imply that its interactive sub-unities will be damaged to some extent as well. An ecosystem is a dynamic functioning unit composed of plants, microorganisms and non living components, therefore, if one of these factors is not properly addressed when referring to climate change, then it becomes impossible to completely understand the dimension of these issue. The linkage between human wellbeing and the overall ecosystem activity is known as [33]"ecosystem services" and these include provisioning as well as regulating, supporting and cultural services, without which human life in any biome would not be possible. Because we are so dependent on the flow of these activities for our well being, it is assumed that on top of these components, health and security are the central focus of all wellbeing preconditions. The dangers of climate change effects are not only related to variations in the physical environment and the geographical redistribution or possible disappearance of biomes; this phenomena has also been linked to high incidences of infectious diseases in affected zones.

It is inevitable to accept that climate change has had drastic consequences in Arctic zones, in which seven countries are included, such as Canada, Finland,

[33] IPCC Fourth Assessment Report

Greenland, Norway, Russia, Sweden, and the United States (Alaska only), although Iceland is also sometimes added. As climate change shrinks and destroys habitats and the concentration of wildlife throughout the Arctic, it also affects the usual [34]movement of people, animals, vectors and pathogens. All of these factors are important drivers for the emergence of infectious diseases. Although current [35]climate ecology data show that Arctic temperatures have risen by a small amount of numbers in the past 50 years, ordinarily insignificant temperature changes, can drastically change the pathogen epizootiology. Moreover, because of the [36]biotic uniformity of northern regions, the occurrence of certain organisms which cause zoonotic diseases is general throughout the Arctic. There are many factors influencing the incidence of diseases in the Arctic, especially those activities which alter the landscape and change the existing landscape-people-animal-parasite relationship. Development related activities, including renewable and non renewable resource exploitation. Renewable resources are [37]living resources which can restock themselves, such as trees and absorb solar radiation via photosynthesis. However, if they are harvested at a much higher pace than they can replenish themselves, then they will eventually ran out. On the other hand, non renewable resources are only available in finite amounts and are nor replenished after used or depletion. These include minerals and fossil fuels among others. In the Arctic any disturbance to biodiversity takes a long time to recover because cold temperatures slow down the growing process. Moreover, since water sources are limited because a high percentage of them are frozen, they are not available to plants for growth. This

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[34] Kutz Susan J. et al. (2004) "Emerging Parasitic Infection in Arctic Ungulates"
[35] Kutz Susan J. et al. (2004) "Emerging Parasitic Infection in Arctic Ungulates"
[36] Rausch, Robert L. (1968) Zoonotic diseases in the Changing Arctic
[37] Resources: Natural Capital

pattern of slow growth used to also control the propagation of diseases among humans and animals in the Arctic. However, in recent years, oil (a non renewable resource) extraction has become one of the most important activities for international economy as well as one of the most noticeable causes of human induced climate change. [38]Consequently, as oil prices rise, the Arctic has turned into one of the possible targets for extraction, leading to further movement of wildlife, as well as further intrusion of people and domestic animals.

However, because emerging diseases are mainly associated to template or tropical zones, there is a lack of integrated long term data on health issues affecting directly humans in the Arctic or polar animals, which as a part of the food chain, are one of the main disease transmitters to humans. The Arctic's past overall level of coldness, which inhibits the propagation of bacterial diseases by shortening their growth and reproduction cycle. As [39]Achim Steiner in the preface of the UNEP 2011 Year Book, "Next year at Rio +20, governments need to urgently address the gap between science and how to form a decisive response as part of an overall package that finally aligns the economic pillar of sustainable development with the social and environmental ones." For a long time, environmental health was not one of the top concerns of neither scientists nor governments. Although nowadays that approach to environmental issues is different, in order to detect changes in health issues taking climate change as a reference point, scientists need baseline data to assist comparisons. However, this data is limited, especially in terms of epidemiology and the biological effect of toxicants for people and humans in the Arctic. In short, there are studies on the consequences of

[38] Kutz Susan J. et al. (2004) "Emerging Parasitic Infection in Arctic Ungulates
[39] UNEP Year Book Emerging Issues In Our Global Environment 2011

direct effects of climate change but there are almost no studies relating [40]"health parameters to infectious agents or population level effects." It is known that the loss of the sea ice platform is causing loss of substrate for preys, an increasing amount of drownings and strandings from exhaustion as well as changes in movement and distributions. Likewise, strandings and hypothermia cases amongst animals consumed by people have increased due to exhaustion caused by severe weather patterns. However, not all causes of disease in animals are as direct. Indirect causes of diseases or presence of abnormalities include changes in host-pathogen associations. Moreover, changes in the prey base/food web as well as increased human activity. This increases the [41]density of hosts per habitat, which also contributes to the apparition of high density-linked diseases. Climate change can cause alterations in infectious disease transmission by contributing to host density variations and movement patterns, which can alter pathogen transmission rates. Moreover, what scientists call "relax overwintering" may increase the survival of pathogens that would otherwise freeze. Also, given the biome's structural change, host species are likely to vary in range extension and be more susceptible to diseases due to changes in their diet or toxic components.

Infectious diseases are those which can be transmitted to others by means of either direct or indirect contact. When referring to climate change related infectious diseases, scientists mean that these are increasing their incidence due to the drastic climatic conditions taking place in the Arctic. The development of [42]helminth parasites,

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[40] Burek, Kathy A. et al (2008) Effects Of Climate Change On Arctic Marine Mammal Health
[41] Burek, Kathy A. et al (2008) Effects Of Climate Change On Arctic Marine Mammal Health
[42] Kutz Susan J. et al. (2004) "Emerging Parasitic Infection in Arctic Ungulates"

and transmission of vector borne pathogens, are closely linked to climatic conditions and consequently tightly constrained by the length and quality of the “growing season’’ in the Arctic. Because snow is melting so rapidly and temperatures will have an increasing tendency to rise, tundra ecosystems will be exposed to direct sunlight for a longer period, which might expend growing seasons. That effect could ease the spread of diseases around biomes faster, given that parasite and bacterial infections are transmitted by pathogens that are sensitive to temperature, rainfall and humidity. A humidity rise can increase vector’s metabolic rate whereas rainfall is fundamental to bloodfeeding vectors because the immature larval and pupal stages are aquatic or semi-aquatic. Higher frequencies of rain can increase the presence and size of pathogens.The increase in sea level due to fast thawing as well as higher sea surface temperature may cause higher incidence of [43]water borne infections and toxin related illnesses. These include cholera and shellfish poisoning. Mosquito borne diseases including [44]malaria, dengue and viral encephalitis are some of the most sensitive to

[43] Patz JA et al.(1996) Global Climate Change and emerging infectious diseases
[44] Patz JA et al.(1996) Global Climate Change and emerging infectious diseases

climate change. Climate change can shift the vector's geographic range and directly affect the transmission of diseases by shortening the pathogen incubation period and increasing its reproductive and biting rates.Temperature rises increase host susceptibility and increase pathogen survival rate and population size. Pathogens that have always survived in the Arctic have evolved to be fit even under harsh environmental conditions, the problem is that the total number of infective larvae that spread parasitic diseases are starting to reproduce faster and infecting animals and people in earlier dates than decades ago, given temperature rises. However, [45]climate

change is not the only determinant for the transmission of diseases, human migration patterns, the assumption of Western lifestyles, changes in human immune system, damage to health infrastructures as well as malnutrition due to human activities and climate change stresses on agriculture are also factors linked to diseases.

[45] Patz JA et al.(1996) Global Climate Change and emerging infectious diseases

Some diseases that are common in arctic areas include [46]rabies, trichinellosis (transmitted by eating raw meat), hydatid diseases (both cystic and alveolar), tularemia, and brucellosis are among the most prevalent zoonoses in the Arctic, and knowledge of them is most complete. Zoonotic diseases are those that can be transmitted among species, therefore, their incidence in humans is mostly caused by eating or being in direct contact with infected animals. The incidence of zoonotic diseases in humans is determined by biological, ecological and human induced (socio-economic) determinants. Changes in dietary habits, new transportation means (planes and cars) and the increasing use of commodities that allow people to live in more remote areas increase the opportunity of [47]pathogen dissemination across the Arctic as well as the introduction of exotic ones.

However, climate change affects both the distribution of the parasites that contribute to the spreading of this diseases and the rates at which they occur. Moreover, it permits the emergence of infectious diseases that used to be more likely associated to warmer areas, including the tropics. Disruptions in the operation of [48]water supply and sewage facilities increase the possibility of water borne vector diseases which lead to intestinal infections. Parasitic diseases that have been proven to be climate change related include Giardiasis, [49]Cryptosporidiosis, Echinococcosis multilocularis and Toxoplasmosis. These are all...Bacterial diseases emerging in the Arctic are Lyme borreliosis, Relapsing fever, Tularemia, Multi-resistant Staphylococcus

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[46] Rausch, Robert L. (1968) Zoonotic diseases in the Changing Arctic
[47] Rausch, Robert L. (1968) Zoonotic diseases in the Changing Arctic
[48] Evengård, Brigitta and Sauerborn, Rainer (2009). Climate change influences infectious diseases both in the Arctic and the tropics: joining the dots
[49] Evengård, Brigitta and Sauerborn, Rainer (2009). Climate change influences infectious diseases both in the Arctic and the tropics: joining the dots

aureus, Haemophilus influenza, Streptococcus pneumoniae and Mycobacterium tuberculosis. The only proven rickettsia pathogen disease in Arctic biomes is the Mediterranean spotted fever. Virus triggered diseases, include [50]Nephropathia epidemica (Puumala virus), Tick-borne encephalitis, Russian summer and spring encephalitis, West Nile fever, Chikungunya, Dengue fever, Rabies and Hepatitis A. Climatic factors such as mild winters and the early arrival of spring have caused that a disease such as TBE is now spread throughout the Arctic due to the proliferation of the Ixodes ricinus further north. There are some vectors that used that although more commonly in the tropics are increasingly starting to rise in incidence in the Arctic. These include mosquitoes such as the Anopheles, Culex and Aedes which cause malaria, West Nile virus, Dengue virus and Chikungunya virus, respectively. Also Ticks, including [51]Ixodes ricinus, Dermacentor reticulates, Hyalomma marginatum and Rhipecephalus sanguineus) transmit Borrelia burgdoferi (leading to Lyme borreliosis), TBE virus (TBE-encephalitis), Tularaemia franciscella (tularaemia), Coxiella burnetii (Q-fever), Bunyaviridae viruses (Crimean-Congo haemorrhagic fever), Rickettsia conorii (Mediterranean-spotted fever. Moreover Sandflies (Phlebotominae) transmit Leishmania donovani and Leishmania infantum.

In the past, infectious diseases in the Arctic were mainly associated to indigenous populations given the fact that their survival activities require further direct contact with the wilderness. However, due to the rise of industrialization, which unraveled globalization and the creation of polluting socio-economic activities tied to

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[50] Evengård, Brigitta and Sauerborn, Rainer (2009). Climate change influences infectious diseases both in the Arctic and the tropics: joining the dots

[51] Evengård, Brigitta and Sauerborn, Rainer (2009). Climate change influences infectious diseases both in the Arctic and the tropics: joining the dots

development; these diseases are now more spread amongst the general population. The incidence of these diseases is decreasing within aboriginal communities but rising within non aboriginal people. An interesting case study of how diseases typical in tropical zones are now present in Arctic regions is that of [52]Malaria in indigenous Swedish people. The last of these cases was reported in the 1930s however, scientists fear that temperature rises could cause this disease to reappear in the Arctic and move its northern limits, given the current locally transmitted cases of Malaria in Italy. Another shocking case study is that of the Nile West Virus in Canada. NWV a flavivirus maintained in the bird-mosquito transmission cycle, was first reported in Canada in 2001. The [53]virus is known to affect a wide range of birds with secondary transmission to mammals and humans. This virus becomes active in the spring, when birds migrate to northern areas and dormant vectors resume their life cycle. These mosquitoes become infected with the virus by feeding on returning birds. On the other hand, previously infected mosquitoes can infect returning birds as well. This infection cycle increases the amount of infected species and causes further transmission to mammals and humans. Since the arrival of this disease to Canada it has mostly affected the country's southern areas, however, due to climate change, the range of virus carrying species is likely to shift and move upwards. Another case is that of tularemia. Tularemia is

[52] Evengård, Brigitta and Sauerborn, Rainer (2009). Climate change influences infectious diseases both in the Arctic and the tropics: joining the dots

[53] West Nile virus in the context of climate change Infectious Diseases and Immunization Committee

Mitigation and control practices include increased disease surveillance, the use of geographically based data systems and integrated modeling systems. However very few scientist feel comfortable modeling [54]infectious diseases, especially given their relationship with climate change. Scientists lack sufficient data to link agriculture and meteorology for multi-sectoral analysis which demonstrates existing difficulties between knowledge and knowledge-based actions at a global level. Currently, this type of modeling have not been used by the [55]Arctic Climate Impact Assessment (ACIA). Furthermore, scientists and public health experts are experiencing issues with the validation of early warning and surveillance systems as well as with the development and evaluation of evidence-based adaptation strategies. For instance, modeling systems based on temperature rise show that the incidence of tick borne [56]Lyme borreliosis might increase in Northern Canada, where is currently unusual. However, how accurate this predictions are is uncertain due to lack of integrated research on the topic. There currently exist several mechanisms to mitigate the effects of climate change in Circumpolar regions. The International Circumpolar Surveillance is a multinational mechanism that includes all countries with territory in the Arctic to assist governments and public health institutions in the process of controlling infectious diseases. The working groups of these mechanism as well as its several partnering agencies focus mainly on climate change linked invasive bacterial diseases. The [57]ICS

[54] Evengård, Brigitta and Sauerborn, Rainer (2009). Climate change influences infectious diseases both in the Arctic and the tropics: joining the dots
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capitalizes on existing surveillance systems providing standardized laboratory and epidemiological data on infectious diseases. Although there is a still a long way in terms of data collection and international collaboration to combat these diseases, ICS currently plays a central role in the process of making climate change related diseases a global priority.

Ecological anthropology

Given the Arctic's sensitivity to climate change effects, communities which have inhabited this area for centuries are the most likely to suffer from the direct effects of linked environmental distresses. Although indigenous peoples in the Arctic have always been portrayed as functioning in a stable manner with the environment for long periods of time research demonstrates that human occupation throughout this biome is characterized by [58]disruptions, shifting cultural traditions, and ecological/demographic shocks. Ethno-historic evidence from the [59]seventeenth and eighteenth centuries prove that there were plenty of famines, epidemics and ecological disasters. However, due to their extreme adaptation abilities which are in part a result of cultural and socialization patterns, allowed them to be the only hunter-gathering based populations which have not decreased in number from European contact. Traditional community dynamics throughout the Arctic show a tendency toward "territorial expansion, maximum resource utilization and high birthrates" which has allowed them to balance their population

[58] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology
[59] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology

losses at a somewhat stable rate. Their traditional [60]sexual norms, diet, socialization patterns and overall lifestyles have mostly depended on specific resources that are currently threatened due to the effects of human induced climate change. Regardless of the resilience of indigenous communities in the Arctic, the fast pace of industrialization and human induced climate change have caused a tremendous imbalance to their traditional lifestyles and adaptation possibilities. Industrialization has caused major intrusion to traditional indigenous lifestyles and it has also contributed to the spreading of germs, pollution and western lifestyles amongst communities. On top of these factors, industrialization is clearly linked to the emission of greenhouse gases to the atmosphere, causing severe climate pattern alterations to indigenous habitat. Indigenous communities are currently facing greater dangers than it could be possibly estimated given their exclusion from mainstream scientific research until very recently, the poor implementation of existing protection laws and their lack of participation in policy procedures that affect them.

Indigenous peoples have contributed the least to climate change. Their ancestral traditions are based on adapting to existing environmental conditions rather than to changing the environment to their benefit. Indigenous peoples knowledge is primarily based on the way they understand how to use natural resources in a sustainable manner. Their diet consisted mostly of caribou, seal, walrus and fish. Because they needed the different nutrients each of these animals offered to survive in such harsh environmental conditions, there was a high interdependence between coastal

[60] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology

[61](Taremiut) and inland (Nuunamiut) communities. From meat, Inuit obtained proteins, vitaminK and B complex vitamins which derive from enzyme proteins. On the other hand, inland communities obtained oil fish as well as [62]A and D vitamins and vitamin derived from marine mammals by trading with the Inuit. Their main intake of vitamin C was obtained through eating caribou rumen filled with undigested plant material. Arctic communities managed to have diets that ensured the well-being of the community in unlikely manners. They consumed about[63] 2% carbohydrates per day, which is associated with glucose homeostasis. Moreover, their high phosphorus and low calcium diets are linked to bone loss and abnormal calcium homeostasis. However, the high fat content of their diet was mostly unsaturated, which avoided cholesterol and wight issues amongst populations. Industrialization caused the switch from traditional diets to Western-like ones. There are plenty of negative cultural change related to industrialization and westernization. The increase in commodities caused by foreign moving and dispersal throughout the Arctic have resulted in several social changes. These include the end of the [64]subsistence based hunting economy, sedentarization and wage employment. Moreover, foreign professionals are hired for skilled works now available in the Arctic, therefore indigenous people face a high level of disemployment. Furthermore, concentration in villages has caused their abandonment by indigenous peoples, who currently live in government planned buildings with improperly

[61] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology
[62]Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology
[63] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology
[64]Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology

[65]humidified heat stoves, are now more susceptible to respiratory diseases and arctic hysteria. However, industrialization has enable them to make better use of their patterns of light and darkness. The twenty-four hour rhythm Moreover, the introduction of milk has stabilized their calcium intake. However, practices related to industrialization, are often more suitable to areas with non Arctic light and darkness pattern.

For centuries Arctic communities have made effective use of animals. A practice central to the lives of Arctic indigenous peoples was hunting. Inland adaptation was based on caribou hunting, until in the [66]1950s the introduction of new weapons caused a drastic reduction of herds due to overhunting. New population flows to the Arctic underestimated the environmental know of indigenous peoples, who consider the cyclical nature of caribou population fluctuations. The reindeer also played a central role in their existences not only because its meat but due to the fact that reindeer herding was one of the most effective ways to move around in the inland tundra zone. However, [67]ocean fauna has aways been more significant to human in the Arctic than land fauna including ring and barbed seals as well as whales (bowhead, beluga, white).They all provide several raw materials for cold adaptation such as leather to make boots, coats, sinew thread and mittens. Their religion was essentially animalistic, focus on environmental features having supernatural powers. Animal and human corpses had the same value to them. They believed that by performing [68]rituals (dividing maritime and land animals) the spirits of the animals would return in new bodies to be hunted

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[65]Hotez, Perez J. (2010) Neglected Infections of Poverty among the Indigenous Peoples of the Arctic

[66]Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology

[67]Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology

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again. Likewise, killing more animals than they could possibly consume, displeased the spirits. In summer, people used to live in sealskin tents made out of the skin of several animals. Tents for larger kins required about [69]60 sins each.The dark tone and the texture of the sealskin absorbed solar energy and since they were double layered, they provided a comfortable temperature. During the winter, several communities built [70]subterranean stone houses with sealskin insides in secure hillside spots.

Perhaps the greatest negative consequence of industrialization processes for indigenous peoples is the acceleration of climate change induced effects. Climate change is a major outcome of unsustainable activities, power concentration and increasing individualism, thus the most politically underrepresented communities are those paying the higher cost of it. Oil and natural gas extraction in Arctic zones has caused an increasing amount of coastal erosion which alongside sea level rise and an increasing amount of storms have led plenty of communities to move out. Damages become exponentially increase given that more than [71]85% of Alaska indigenous communities are coastal. Moreover, [72]thinning sea ice makes hunting activities more dangerous and changing permafrost patterns alter run-off circulation pattern. Likewise, while maritime hunting has become more difficult due to a northern shift of species such as seals and fish due to sea level rise, some other animals communities rely on have nearly disappeared. Plenty of villages have experienced increase flooding during winter, due to lack of shoreline ice that used to prevent water from spreading inland.

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[69] Moran, Emilio F. (2009) Human Adaptability: An Introduction to Ecological Anthropology
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Increasingly stronger winds and floods have often times destroyed the infrastructure of many villages situated near by riverbanks and coastlines.

Fishing, a [73]traditional economic activity for Arctic indigenous populations is now threatened because temperature rises cause mountain and glacial snow melting which causes riverbanks to rise. These shallow waters these effects provoke, negatively impact fish populations and increase the amount of new marine species entering the Arctic and causing new [74]diseases. Moreover, the reduced amount of species that currently live in the Arctic have changed their migration routed due to climate change effects.Unpredictable weather patterns and the entry of new species of plants and animals could also threaten the traditional knowledge of indigenous communities, for they have not had prior interaction with them. Furthermore, unusual rain during winters freeze the food available for caribou and other species, which consequently die. Another issue which is currently quite taboo is the [75]"sovereignty of indigenous peoples"ice melting might completely open the Northwest passage and consequently allow new populations to move in. An interesting case study is herding in the [76]Saami culture of Northern Norway, Finland, Sweden and Russia, who first noticed climate change effects in the 1980s. Herding, an activity of high significance to the [77]Saami culture is also in danger due to extreme rains in areas where only snow landscapes predominated. If herders could no longer operate, the Saami would lose a central part of their cultural wisdom. Due to all of these changes, the accuracy of the traditional

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knowledge of indigenous peoples has decreased while decades ago they were able to predict weather patterns quite successfully.

However, regardless of the obvious damages caused by climate change to these communities, they are excluded from negotiations under the [78]UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol as well as from subsequent discussions at national and global levels. Although some communities have become

somewhat Westernized, indigenous communities are largely known to depend on natural resources, therefore when these are harmed, they are the most directly affected people. Under the UN framework there is an urgent need to reinforce government cooperation to mediate between indigenous peoples and the private/industrial sector as well as to enforce public monitoring to identify existing problems and find solutions. Despite the work of the UN by hosting the UNPFII meetings every year, there are plenty

[78] Corpus-Tauli, Victoria (2009) Guide on Climate Change and Indigenous Peoples

of issues related to climate change effects and indigenous issues that remain poorly addressed. Mitigation and equal multinational cooperation are essential to solving these issues. Market based mitigation mechanisms (CDM, ET, JI) are not enough to solve these issues given the persistent discrimination and disadvantaged indigenous peoples face. Current projects directly involving indigenous leaders and targeting specific issues faced by each community would be a better organized manner to mitigate problems derived from climate change. Not only does climate change damage their physical surroundings, but also their right to self determination, food, clean water and so on. Because they were previously excluded from discussions and negotiation about issues taking place at their region, the process of integrating them to policy dialogues has not been achieved yet. The [79]UNPFII works as the most effective UN mechanism to enforce policy making and ensure partnerships with UNEP, UNDP and other UN agency as well as private sector institutions. However, further commitment from governments and the private sector are necessary to achieve further results.

Conclusions

This new pattern of climate change infectious diseases tends to be nonlinear and complex due to its convergence with other important factors such as healthcare, human immune response, human behavior (including land use) drug resilience and so on. However, research shows that the incidence of specific pathogens, such as salmonella, are directly related to temperature increase. However, parasitism is not the only stress contributing to human and animal health deterioration in Arctic regions, the existence of poor habitats, severe weather events, predation competition, development related

[79] UNPFII DPPD Indigenous Issues

activities and land disturbances are quite significant factors as well. Over the last 100 millennia, humans have developed an increasingly fast succession of environmental and cultural changes including [80]"dispersal, tool-making, patterns of social cohesion, agriculture, urbanism, sea faring and latterly industrialization." All of these have somewhat shaped new patterns of diseases and death in many areas. Although [81]The World Commission on Environment referred to sustainable development for the first time in the late 1980s it was not until 2001 that the IPCC firmed up its conclusion that there were diseases influenced by human induced climate change. Therefore, most research on the subject has been conducted after that date. In the Arctic, where the atmosphere is warming twice as fast as in the rest of the world, there are at least 400,000 indigenous peoples. However, even tough they are the most affected by climate change, highly exposed to diseases and losing their traditional cultures, we are all bound to suffer from these effects to some extent. Therefore, current conditions in the Arctic should not be taken lightly, they must be immediately addressed by all countries. Current environmental effects caused by human induced climate change such as excessive ice thawing, sea level rise, unusual raining patterns, species migration pattern changes and so on have a global effect that cannot be ignored. Arctic species population is decreasing and new species are starting to live in northern regions due to temperature rise. Political mechanisms to ensure proper care of Arctic regions include plenty of market mechanism that help mitigate the effects of climate change. However, more commitment from the private sector, governments and UN mechanisms are needed to ensure proper policy implementation. Although the pace of these effects

[80] P.Martens, A.J McMichaels, Environmental Change,Climate and Health
[81] P.Martens, A.J McMichaels, Environmental Change,Climate and Health

appear more rapidly in the Arctic than in other zones of the planet, ecosystems function as an interconnected web, therefore, it is our global responsibility to mitigate the effects of climate change.

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