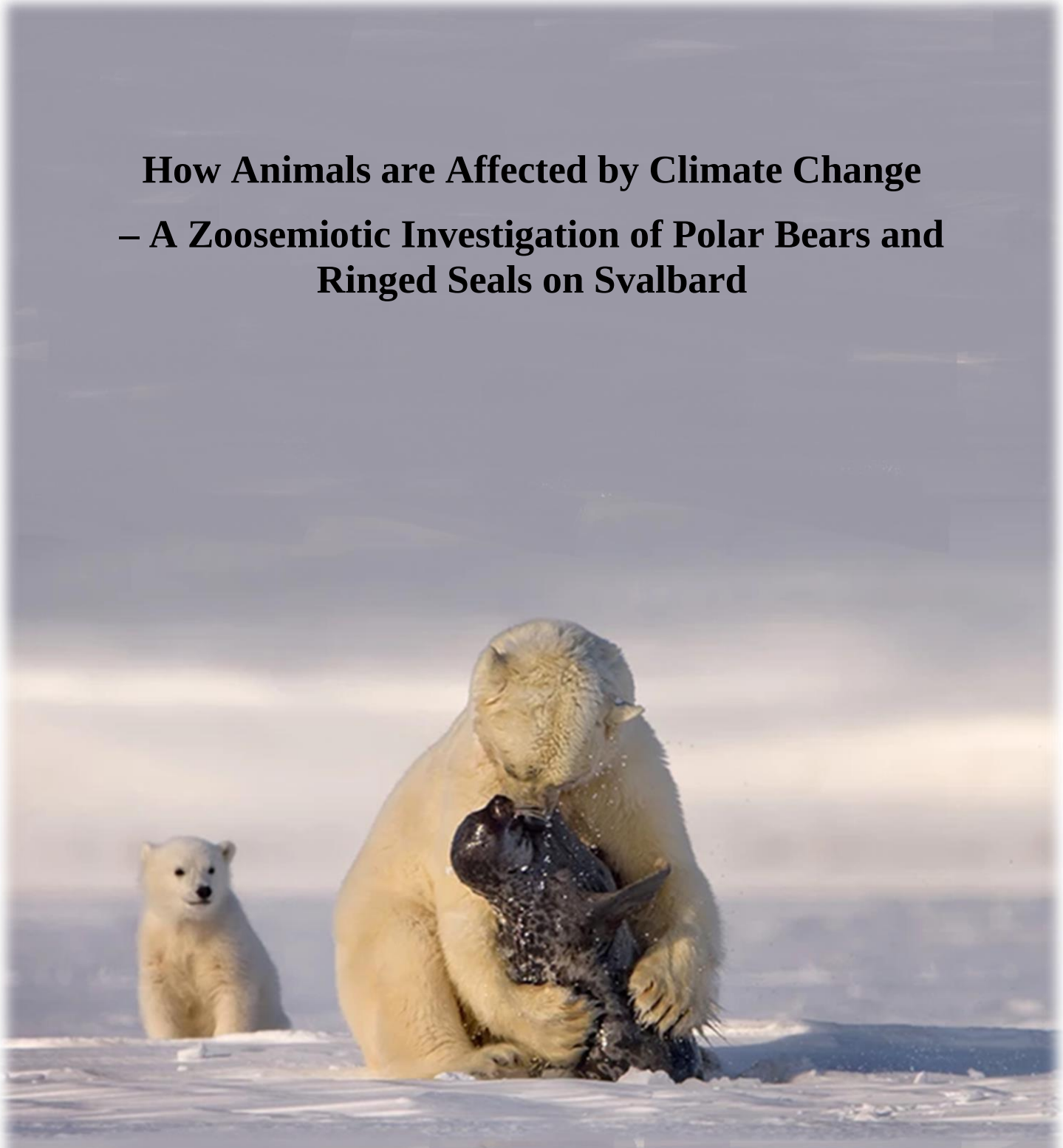
How Animals are Affected by Climate Change
– A Zoosemiotic Investigation of Polar Bears and Ringed Seals on Svalbard



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Master's thesis in Energy, Environment and Society
University of Stavanger
Spring 2019

UNIVERSITY OF STAVANGER

MASTER DEGREE IN

Energy, Environment and Society

MASTER THESIS

CANDIDATE NUMBER: 4037

SEMESTER: Spring 2019

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SUPERVISOR: Professor Morten Tønnessen

MASTER THESIS TITLE: How Animals are Affected by Climate Change - A Zoosemiotic Investigation of Polar Bears and Ringed Seals on Svalbard

SUBJECT WORDS/KEY WORDS: Arctic; Svalbard; Polar bear; Ringed seal; Climate change; Biodiversity; Ecosystem; Zoosemiotics; Umwelt; Functional cycle; Phenomenal fields; Umwelt transition; Ontological map; The tripartite umwelt model

PAGE NUMBER: 96

STAVANGER 14.06.19 Ida Tingvik Bertelsen

DATE/YEAR

Abstract

The purpose of the thesis is to examine the affect climate change has on polar bears and ringed seals subjective world. Climate change is affecting the world negatively in many ways. Biodiversity is essential for all life on our planet and to achieve a sustainable development. There has already been talk about a possible sixth mass extinction if we keep treating our planet like we do today. Despite not having the most important role in the ecosystem, polar bears have become a symbol not only for Arctic but for climate change globally – affecting our understanding of climate change and its effect on biodiversity and thus the decisions taken in among policy and conservation work. Polar bears and ringed seals as other arctic mammals are also driven to the edge of their natural habitat, having no place to "run". The situation on Svalbard is unique as it is one of the places on planet earth where climate change is most significant as it happens more than twice as fast as the rest of the world.

This thesis provides a zoosemiotics analysis of the effect of climate change on polar bears and ringed seals in Svalbard. Zoosemiotics and Umwelt theory enables us to investigate the subjective world of polar bears and ringed seals, how they communicate, and how climate change is changing their relationship. It gives a holistic approach to the challenges faced by polar bears and ringed seals as it connect the changes related to biology, but also examine how human representation of polar bears affect our perception which ultimately can affect what actions we take when it comes to climate change and consequently affect polar bears and other species subjective world.

Keywords: Arctic; Svalbard; Polar bear; Ringed seal; Climate change; Biodiversity; Ecosystem; Zoosemiotics; Umwelt; Functional cycle; Phenomenal fields; Umwelt transition; Ontological map; The tripartite umwelt model

Front page picture: taken by wildlife photographer Roie Galitz on Svalbard, showing a polar bear that has just caught a ringed seal. The picture is used with permission from the photographer for this master thesis (©Roie Galitz 2019).

Acknowledgement

I would first like to thank my supervisor Professor Morten Tønnessen for inspiration and helpful comments. Furthermore, I would like to thank Dag Vongraven, Heli Routti and Kit Kovacs from the Norwegian Polar Institute for using their free time to participate in interviews, giving me much interesting facts that were of great help for my thesis. Finally, I would like to thank my family and friends for supporting me through the process. Without you this would not been possible.

Table of Content

List of Figures

List of Tables

Glossary

Term	Definition
Biodiversity	the variety of living organisms which include all plant- and animal species (Bradley, 2012; WWF, 2018a).
Ecosystem	a community of all living organisms including their relationships and interaction between them and their environment (Bradley, 2012; WWF, 2018a). “Can be small - like a puddle, larger - like a forest, or encompass the entire biosphere, that is, the part of the Earth (soil, water, air) where living organisms can exist” (Semb-Johansson, 2018, author’s translation).
Sustainable development	“development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987: 43).

1.0 Introduction

Everything is connected on our planet and in our nature. All species are adapting to the environment they are living in and adapted to, and dependent on other species they are living with. If we are losing species it can have large impact on the planet. Although many species and the planet as a whole are incredible at adapting to changes and losses, there have already been five mass extinction. The world has moved on despite the majority of species have been driven to extinction. One mass extinction has open up for new life-forms to emerge. What has changed now is that is no longer the nature changing the course, it is one species – humans. Scientists are talking about a sixth mass extinction that may be the fastest in Earth's history (McCallum, 2015).

There is consensus among scientists that there is a rapid change in climate due to human activities or so-called anthropogenic climate change (Oreskes, 2004). Human impact on the planet can be seen everywhere, but evidence of anthropogenic climate change is especially notable in the Arctic where global warming approximately happens twice as fast than the rest of the world. In Svalbard, a Norwegian archipelago located between Norway and the North Pole, global warming happens at an even faster pace than in the rest of the Arctic (Norsk Polarinstitutt, n.d. b; Sysselmannen, 2016b). Climate change has large impact on many animals and ice-dependent marine mammals are some of the most impacted animals. While animals from southern regions are observed further and further north as the temperature increase, these animals have already reached their edge having no other places to go.

This thesis will examine the polar bear and the ringed seal on Svalbard. The reason these animals are chosen is that they are some of the animals most affected by anthropogenic climate change.

> Ringed seals rely on sea ice as a platform for hauling out, reproduction and moulting. Polar bears rely on seasonal ice to hunt seals but also to mate and pregnant females to den. (…) The polar bear appears to be among the most sensitive Arctic marine mammal species to climate change, primarily due to its reliance on sea ice and specialized feeding (Routti, Jenssen & Tartu, 2018: 356).

The polar bear has also become a flagship species or "poster species" for not only what is happening in the Arctic, but also for climate change in general (Harvey et al., 2018; WWF, n.d.). More importantly the polar bear is what is called an 'umbrella species' which will say

that many other species are connected to the polar bear. By protecting the polar bear many other species can be protected. The polar bear is on top of the food chain and can thereby say much about the problems and challenges in the marine and arctic environment. The ringed seal is another animal affected by climate change and is closely connected to the polar bear. Polar bears are dependent on the seals because the ringed seal is their primary prey. The polar bear can thereby affect the seal population which further can affect the fish population which the seal is dependent on. Their relationship is also important for others, such as the Arctic fox because it feed on the leftover carcasses of the seal which the polar bear has killed (WWF, 2018b, n.d.). In short, these two species are noticing the change in climate and together have a large role in the ecosystem.

Since the 1990s tourism has also increased much on Svalbard both by planes and cruise ships (Statistisk sentralbyrå, 2016). Many of them coming in the hope of seeing a polar bear.

> One of the best ways to get a close-up Arctic experience are by cruises, and climate change is an important reason for why cruise tourism is being possible in the Arctic. Earth's climate is going to large changes and one crucial consequence is that the sea ice thickness is decreasing which make the Arctic more accessible than before (Stewart, Dawson & Johnston, 2015). Arctic cruise tourism is increasing and among the most popular destinations in the Arctic is Svalbard. Paradoxically to portray global warming and climate change, pictures of starving polar bears and pictures of polar bears on melting icebergs are commonly used. People come because this can be their last chance to see it, some call it "last chance tourism" or "doom tourism" (Lück, Maher & Stewart, 2010 in Bertelsen, 2018).

Climate change therefore increases the amount of tourism and can affect the polar bear, the ringed seal and their habitat more negatively.

Previous research on animals and climate change has been lacking an interdisciplinary approach. Natural scientists (biologists) and social scientists have not been working much together. This is not only bad; much good research of specific "pieces of a system" have resulted in understanding of these systems. There are many examples of natural science research on climate change and animals, but it is also necessary to encourage interdisciplinary. One way to approach a problem that connects different disciplines can be through zoosemiotics where the concept "Umwelt" is in focus. Zoosemiotics is a research

field between biological sciences and humanities due to roots in zoology and semiotics. Zoosemiotics emphasis the subjectivity of animals and examine their relationships and communication. Umwelt theory can also be applied to describe human-animal relations (Maran et al., 2016). Therefore, the affect climate change has on animals, specifically on polar bears and ringed seals will be investigated through a zoosemiotic investigation where the concept "umwelt" is in focus. This may give another perspective to a large challenge and short the gap between natural science and social science.

1.1 Problem and Research questions

Global climate change has already had observable large consequences on the environment, but there has been a lack of studies on the effect climate change has on animals, especially arctic marine animals. Animals living at high altitude, such as the polar bear and the ringed seal, are affected particularly hard. These animals are important to our ecosystem and paradoxically climate change make Arctic more accessible, and the polar bear as a poster species creates more interests and increased human activity which creates new interactions that can have negative impact. There have been previous studies on marine mammals in the Arctic and climate change, however, much more can be done especially since there is a lack of interdisciplinary research.

The focus in this study will be:

> *What is the life world (Umwelt) of polar bears and ringed seals on Svalbard like, and how do they change due to climate change, tourism and other human activities on Svalbard?*

Based on the information above there will also be several sub-questions that need to be answered:

- How can zoosemiotics contribute to a better understanding on animals and climate change?
- How does climate change affect polar bears and ringed seals, and what effect will it have on a larger scale for the environment and biodiversity?
    - How has climate change changed the relationship between polar bears and ringed seals?

    - Does climate change affect how polar bears behave and communicate together, and does it change their relationship towards humans?
- How are climate change and tourism on Svalbard connected?
    - Have polar bears behaviour changed due to increased tourism? Have this affected people's perception of polar bears and can this have negative affect on polar bears and their habitat?

Svalbard has already experienced the effect on climate change, and climate change also influences tourism. What make Svalbard special in the Arctic is that it is easy to travel to. The government wanted to increase tourism as there was much potential in Svalbard as an exotic Arctic adventure at the same time as this could create more jobs and stability for the local community (Ministry of Justice and Public Security, 2016). Therefore, both flights and cruises to Svalbard have increased making Svalbard a popular destination for tourists seeking an Arctic adventure. Large cruise vessels and expedition cruises have increased rapidly as the sea ice is decreasing making passage to different places easier and more available for longer time. As polar bears and ringed seals are experiencing climate change on their bodies, human activities are also increasing due to more tourism and less ice making it possible to travel to places which earlier were isolated (Sysselmannen, 2006). One can question if tourism makes it worse for animals that already are threatened by climate change. Are the challenges polar bears and ringed seals facing then a climate problem, a tourist problem, or both? Will polar bears become more encroaching towards human settlement and does it change the animal-human relation, and can it therefore be more normal to see polar bears be killed or moved due to more encounters and conflict between polar bears and humans? Do this make the polar bears change their behaviour, and will this make it more challenging for a species that already is threatened with so many obstacles?

In order to answer the problem above, the research questions will be examined using an abductive research strategy. Abductive research strategy can be used to answer both what and why questions (Blaikie, 2010; Neuman, 2014). Abduction is "an approach to theorizing in which several alternative frameworks are applied to data and theory, which are redescribed in each and evaluated" (Neuman, 2014: 114). Zoosemiotics will here be used as a theoretical analytical framework which is described below. The data collected, academic literature and interviews, will be examined through the lens of zoosemiotics as zoosemiotics also can be

used in both biological science and humanities (Maran et al., 2016). “In zoosemiotics, abduction is not only a useful method of reasoning, but quite often the only one available” (Martinelli, 2010: 171).

1.2 Structure of Thesis

The next chapter will present information of the method used to answer the questions asked in this thesis. In addition, there will be a brief discussion of the validity and reliability of this method. Chapter 3 will provide some general background information about climate change and biodiversity and its relevance to Svalbard before giving a context to the situation of polar bears and ringed seals on Svalbard in chapter 3.4. The role of pollution and tourism will also be examined. Next, chapter 4 will provide an overview of the theoretical approach which will be used to answer the problem and research questions presented in chapter 1.2. Theories and models from zoosemiotics and Umwelt theory will be explained to better understand the discussion and analysis in chapter 5. Finally, chapter 6 will provide conclusions based on the discussion and analysis.

2.0 Methods

This chapter will present the scientific methods used in order to answer the problem presented in chapter 1.1. Furthermore, the validity and reliability of these methods will be discussed.

This master thesis uses a mixed method because there is used both qualitative and quantitative literature in addition to interviews as source. There was done a content analysis where zoosemiotics was used as a tool to interpret the data in order to answer the research questions discussed in chapter 1.1. Both secondary data and primary data was collected. Data collected from the literature was supplemented with information from the conducted interviews. Present studies and data were collected through scientific databases as part of the literature review. This was to find out what type of research had already been conducted and get an overview of the challenges polar bears and ringed seals are facing due to climate change, and check if there is consensus in the literature. This was mainly natural science literature and also contained quantitative research. Primary data was collected through interviews. Obtaining other types of primary data, for example through observation was impossible because of educational background and time limitations, but conducting interviews with experts in relevant fields of research can give the necessary data to analyse. The people interviewed are mentioned in chapter 2.2. The interviews can expand and validate the interpretations gained through the collection of secondary sources. As mentioned earlier there will be an abductive approach and there will be done a content analysis of the data in chapter 5.0 Analysing and Discussion. "In a content analysis study, you gather and analyse the content of text" (Neuman, 2014: 371). The analytical process of the data about polar bears and ringed seals on Svalbard supplemented with interviews will be done through a zoosemiotics framework.

2.1 Literature Review

That climate change has many impacts on Earth's natural system, has been well documented. There is among other a clear correlation between global warming and reduced ice in the Arctic. It is clearly documented that sea ice is retreating by using satellite and other recording such as ice charts from several countries. This makes it possible to make predictions on future changes. For example, a recent report by Hansen-Bauer et al. (2019) concludes that even with low emission there are predicted to be increased temperature affecting precipitation, sea ice, glaciers and more on Svalbard. Reports on the state of ecosystems and biodiversity on our planet, among other both WWF and UNs most recently report concludes that nature and

biodiversity are decreasing at an alarming rate due to human activities (Diaz et al., 2019; WWF, 2018a). It is also documented that Arctic, and especially Svalbard, is one of the most vulnerable places to climate change which also will affect the animals living.

Much of the literature used about the situation for polar bears and ringed seals on Svalbard is from the Norwegian Polar Institute and of researchers working there as this is where most of the studies on Svalbard are done. One limitation to the data on Svalbard is that there are limited data on polar bear and ringed seal population, due to the scope of such a project/monitoring and limited resources. Other projects, of more or less importance, will often be prioritized. In 2014 scientists on the Polar Bear Specialist Group (PBSG) meeting reported that there are not sufficient data on the status for nine of the polar bear populations, but for the other, six were stable, three were declining and one was increasing (Polar Bear International, n.d.). This has made many climate change sceptics write about how climate change is exaggerated focusing on the one increasing population and the three stable populations. Many climate change sceptics, but also articles in media, have referred to Susan Crockford's blog "Polar Bear Science". She claims to be an expert on polar bears and oppose the scientific consensus saying polar bears are not in trouble, although she has not conducted any research or published peer-reviewed literature on the topic (Harvey et al., 2018).

However, the growing number of scientific research reports agree that polar bears have adapted to many changes for thousands of years, but the intense anthropogenic climate change now threatens the future of both polar bears and ringed seals. The most extensive threat and change is the melting sea ice. Sea ice diminish and thereby it limits the access to seal, their main source of food. This is documented by some of the leading experts on Arctic environment, polar bears and ringed seals (see among others Aars, Andersen & Kovacs, 2005; Andersen & Aars, 2007; Andersen, Kovac & Lydersen, 2018; Derocher et al., 2013; IUCN, 2015; IUCN Red List, 2018; Lowry, 2016; Lydersen et al., 2014; Prop et al., 2015; Routti et al., 2019). Articles from other parts of the Arctic, such as Alaska and Canada were also studied as these can provide insight on how it will be/is on Svalbard where there is lacking data from Svalbard.

Although there are several examples of research as mentioned above, several studies also indicate there is a lack of studies on the effect climate change has on arctic marine animals. Furthermore, research on polar bears and ringed seals examined from a zoosemiotic perspective is not done earlier. Zoosemiotics is "new" compared to many other perspectives, but it is a rising field (see Maran et al., 2016; Maran, Martinelli & Turovski, 2011; Martinelli,

2010). Theory and models from Uexküll and later developed further by Friedrich Brock and Morten Tønnessen could be connected with the facts from the natural science and biology literature on polar bears and ringed seals (see Brock, 1939; Tønnessen, 2009, 2011a, 2011b, 2012; Uexküll, 2010). Such research can contribute to identifying how animals make sense out of each other and their environment, and also the relationship between animals and humans and see how climate change affect this.

2.2 Individual semi-structured interviews

Interviews can be a potential source for new data that is not accessed or mentioned in collected literature. It can also ensure the quality of my understanding. The interviews were semi-structured. They were structured with different topics and questions, but also open for the interviewee to come with information, topics and interpretation that were not thought about beforehand. This can give important information and/or ideas that one can examine later that one would not get with a structured interview. It was important to have semi-structured interviews because the different people interviewed had different fields of expertise and therefore different questions were asked. It made it possible to be prepared beforehand and have the opportunity to change and add questions. An interview guide with topics and questions was made together with an information letter (see Appendix 1, 2 and 3) that explained the theme, the purpose and how the interviews would be done and how the information would be treated afterwards. Before contacting potential people to interview a notification form was submitted to NSD (The Data Protection Services) and approved according to the new regulations from 2018 (see Appendix 4).

It was important that the potential participants contacted had first-hand experience on Svalbard and were involved in fieldwork related to the impact's climate change/human activities have on polar bears and ringed seals and/or conservation work on Svalbard. All the people that were contacted were showing up in many peer-reviewed papers found when doing literature research. In total three people were interviewed by skype and phone calls. Six people were contacted, but some of them were out doing field work for longer periods. Two of the interviewed had also periods where they were out doing field work. Skype and phone calls made it possible to conduct an interview as it fitted the participant as it was difficult to find days to meet all at the same time and it was challenging and time consuming to travel much back and forward. It also made it possible to be in contact with them after the interview

when new questions and information appeared. Because there were semi-structured interviews of a limited amount of people it was not necessary to categorise and analyse the data through a program.

The interviews were recorded with a digital voice recorder and notes were taken of the important points. This made it easier to have a normal conversation, at the same time as one did not miss any of the information. Approximately 45 minutes were used for each interviewed. After completion the interviews were transcribed. These are the people who were interviewed:

Name	**Occupation and workplace**
Dag Vongraven	Senior advisor at Norwegian Polar Institute and chairman of the IUCN SSC Polar Bear Specialist Group
Heli Routti	Research scientist in ecotoxicology at Norwegian Polar Institute
Kit M. Kovacs	Marine biologist at the Norwegian Polar Institute

Dag Vongraven has study zoology and is a senior advisor at Norwegian Polar Institute and is the current chairman of the IUCN SSC Polar Bear Specialist Group. “The IUCN SSC Polar Bear Specialist Group has a mission to coordinate, synthesize, and distribute scientific information necessary to guide the long-term viability of polar bears and their habitats” (IUCN SSC Polar Bear Specialist Group, 2017). He has also started on a PH.D. project on polar bear monitoring and politics, and has earlier done research on other marine mammals than the polar bears, such as the ringed seals and whales. In the interview general information from the literature was discussed to ensure that the literature was understood correctly. The situation for other polar bear populations than Svalbard was talked about as Vongraven also has much knowledge about all the different polar bear sub-populations as he is the current chairman of the IUCN SSC Polar Bear Specialist Group. Especially polar bears in Churchill, Canada were discussed as this is one of the places polar bears have been researched the most and because there are more human settlement and tourism directly connected to polar bear. the similarities and differences with Svalbard could be discussed.

Helli Routti is working as a research scientist in ecotoxicology at Norwegian Polar Institute working mainly on contaminant levels and its effects on arctic mammals such as polar bears and seals by among other taking blood and tissue samples. Additionally, she does research on changes in bodily conditions and diet. The interview with Heli Routti focused on different

types of pollution and how pollution is connected to human activities and climate change, and what affect this have on polar bears and ringed seals on Svalbard.

Kit M. Kovacs is a marine biologist working for the Norwegian Polar Institute where she leads the biodiversity research group, and works part time at the University Centre of Svalbard. Her field of study is marine mammals and she works on all the Arctic seals, whales, polar bears, and also do some penguin work. She does applied ecology, such as population surveys, food web studies and more. This interview was more directed towards polar bears and ringed seals biology and the many effects climate change had on Svalbard and how this affect polar bears and ringed seals, the food web and the ecosystem as a whole.

The information from the interviews are used as a supplementary source in the text and there will not be done an own analysis on the interviews in themselves. Information from the interviews in the thesis are written with the letter "I" in front of their name to show when the information is from the interviews: (I-Kovacs, 2019), (I-Routti, 2019) and (I-Vongraven, 2019).

2.3 Validity and Reliability

Because it is used a framework/theory (zoosemiotics and umwelt theory) in abduction research to analyse the data from both literature and interviews, there are not necessarily one conclusion for the problem. The problem can be studied from different angles and it is often about how good you are at arguing your point. This can challenge the reliability and validity as there can be different interpretations of the same problem (Blaikie, 2010; Neuman, 2014). Therefore, it is important to have clear research questions and clearly definitions and explanation of concepts and theories used. By using different methods, combining peer-reviewed literature and interviews, it contributes to secure both the validity and reliability. Finding consensus in the peer-reviewed literature show there are reliability and validity in their studies. The interview questions did not give much room for personal opinion not based on facts, although there can always be interpretations or misunderstandings of what is said. To avoid this a couple of the questions were asked to all the participants in the interviews. The interview also ended with a summary to confirm that there were no misunderstandings between the interviewer and interviewee. Interviewing experts contribute to validate the data found in the literature.

3.0 Background

In order to answer the problem presented in chapter 1.1 it is necessary to start with an introduction of climate change and biodiversity and then examine the situation on Svalbard closer. Furthermore, this chapter will provide facts from published literature on polar bears and ringed seals and how climate change and other human activities are affecting them on Svalbard.

3.1 Climate Change

There have always been natural variations in world's climate and humans have to a greater or lesser extent impacted the environment since human history began. Humans like all other species are a part of nature, but no species have had such a large impact on the planet as humans have (Steffen, Grinevald, Crutzen & McNeill, 2011; WWF, 2018a). The last decades there have been growing concerns for the environmental impacts happening, such as increased greenhouse gas emissions and air pollution, global warming, depletion of natural resources and deforestation, and growing concern about the energy supply and loss of biodiversity. This has made the concept of sustainability become a highly important concept. Many of the challenges we face appear to only recently started, but in reality it is antecedents from earlier choices and exploitations from humans (Steffen et al., 2011; World Commission on Environment and Development, 1987; WWF, 2018a).

The discovery and exploitation of fossil fuels during the Industrial Evolution in Great Britain in the 1700s led to a rapid increase in energy consumption. It spread to other parts of Europe and North America. Fossil fuel made it possible for humanity to undertake new activities. From 1950 there was an explosion in growth in socio-economic trends better known as the Great Acceleration (see Figure 1) (Steffen et al., 2011). Resources from nature have made it possible for human dominance, and the standard of living have increased as a result of the Great Acceleration and have had many benefits for human societies. However, this also have negative effects on Earth's natural systems. Among other resulting in a rapid increase of greenhouse gas emissions and resource depletion. There has been a rapid increase of CO2 emission into the atmosphere, so high that human influence was visible and beyond natural variability (Steffen et al., 2011; WWF, 2018a).

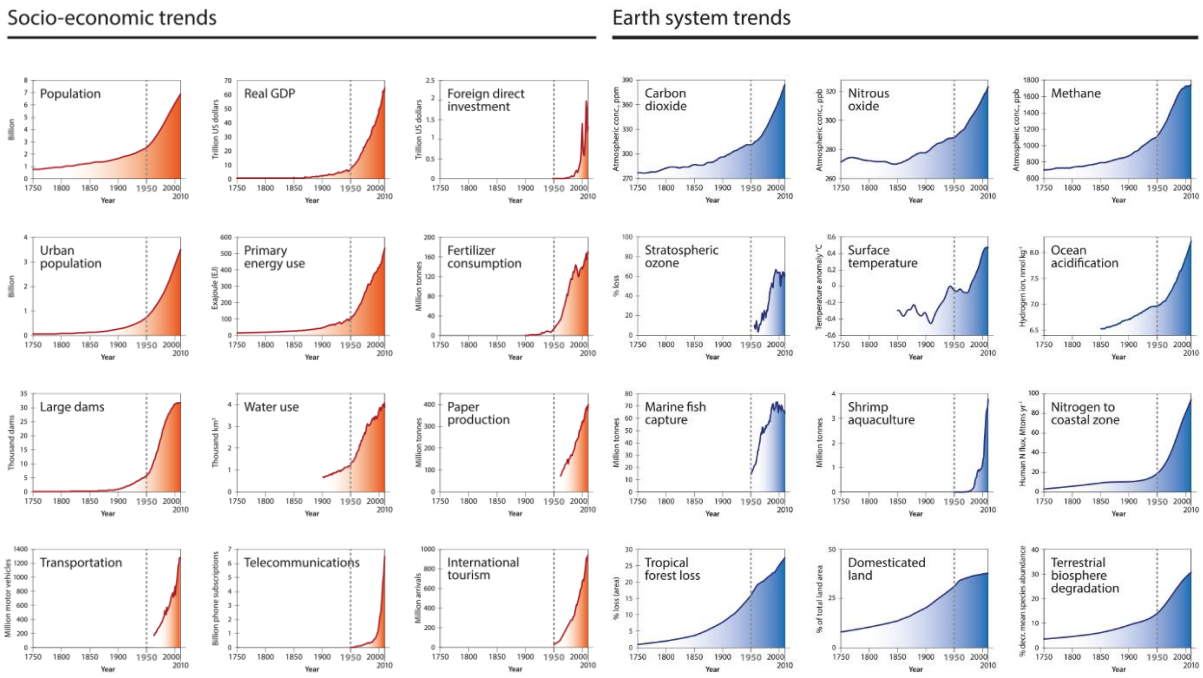

Figure 1 *The Great Acceleration. Since the beginning of the Industrial Revolution there has been an increasing rate of human activities which had and still have positive socio-economic consequences. However, after the explosion of growth in the 1950s human activities interference with Earth's life support system was significant (Steffen et al., 2011).*

Confronting these challenges have made us aware of how profound human impact have been and still are to our planet, so much that several scientists recommend that the Anthropocene, the age of humanity, should officially be recognised as a new geological epoch. Many experts argue that huge increase of CO2 emissions together with economic growth and increase in resource use and waste from humans are threatening the resilience of Earth systems, and thereby affects the stability of our current epoch, the 12,000 year-old Holocene (Hamilton, 2017; Hughes, 2006; Steffen et al., 2011; Steffen et al., 2015). There is a broad scientific consensus that humans and human development are a key component to the changes on the Earth system. A report from the Intergovernmental Panel on Climate Change (IPCC) stated that greenhouse gas emissions caused by human activities creates climate change (Solomon, 2007). Naomi Oreskes (2004) which analysed 928 peer-reviewed articles, claimed that other scientific literature generally had similar statements as the report from IPCC. Climate change as a result of humanity's exploitation, pollution and consumption, has changed landscape and to extinction of several birds and mammals (Bray, 2010; Oreskes, 2004).

The concept of planetary boundaries introduced by Rockström and colleagues recognizes that there are nine processes which are being modified by human actions. The planetary boundaries framework "aims to define a safe operating space for human societies to develop

and thrive, based on our evolving understanding of the functioning and resilience of the Earth system" (Steffen et al., 2015: 737). The approach is based more or less on returning the earth system to the Holocene. Analyses suggest that at least three of them are already crossed beyond the safe operating space. One of them are loss of biosphere integrity, the destruction of ecosystem and biodiversity (Steffen et al., 2015; Steffen et al., 2011; WWF, 2018a).

3.2 Biodiversity

Our planet is unique because of the existence of life, and diversity is the most unique feature of life. There are around 7.7 billion people on the planet today and an estimate of almost 9 million types of species on Earth (Henry & Tubiana, 2018). The species estimations on Earth were earlier much more unprecise, counting between 3-100 million species, today it is estimated to be approximately 8.7 million species – this cover eukaryotes (animals, plants and fungi). However, the majority has not been identified, only around 1.7-1.8 million living species have been named and recorded (May & Nee, 1995; Mora, Tittensor, Adl, Simpson & Worm, 2011). Loss of biological diversity will alter the functioning of ecosystems. To avoid major climate disturbances the temperature must be kept under 1.5-2 ℃ above pre-industrial level (Barras, 2015; Henry & Tubiana, 2018).

Human pressure and anthropogenic climate change have taken its toll on our planet and can be seen on many different levels. "Nature and biodiversity are disappearing at an alarming rate" (WWF, 2018A: 10). Although evolutionary responses have been documented in some species, climate change and especially increasing temperatures have significant impacts on animals and plants making them more vulnerable and many species have already gone extinct due to recent climate change. This is documented in several scientific papers (see Pacifici et al., 2017; Parmesan, 2006; Root et al., 2002). "Of the 8,300 animal breeds known, 8 per cent are extinct and 22 per cent are at risk of extinction" (United Nation Development Programme, 2018). According to a recent report from World Wildlife Fund there has been a decline of 60% in species population sizes in 44 years, between 1970 and 2014 (WWF, 2018a). 26 000 species are threatened with extinction whereas 25% of mammals are threatened according to the IUCN Red List (2018). The number may not sound large compared to how many species there are, but this is an estimated number of only the recorded species. Many of the species we know little or nothing about are most likely threatened, and we do not know which role they play in our ecosystems. According to the Global Assessment Report on Biodiversity and

Ecosystem Services from 2019, species are to a much greater extent threatened now than before by extinction due to human activities. “An average of around 25 per cent of species in assessed animal and plant groups are threatened, suggesting that around 1 million species already face extinction, many within decades, unless action is taken to reduce the intensity of drivers of biodiversity loss” (Diaz et al., 2019: 3). Within wild species the genetic diversity has since the mid-19th century declined with as much as 1 % per decade. Already more than a third of all marine mammals are threatened (Diaz et al., 2019).

Animals and biodiversity are important parts of our ecosystem because “biodiversity has been described as the ‘infrastructure’ that supports all life on Earth” (WWF, 2018a: 110). Each species plays a role in our ecosystem and loss of biodiversity can affect the dynamics and functioning of ecosystems. For example, the eradication of the wolf in Inner Mongolia affected the landscape and turned grassland into sandy desert. The wolf used to roam the steppe and fed on antelope that where grazing. The grass fixed the soil and when the wolfs disappeared more antelopes were grazing turning the landscape into sandy soil (Henry & Tubiana, 2018). “Biodiversity is required to maintain the ‘multi-functionality’ of ecosystems” (Bradley et al., 2012: 62). Biodiversity increase the stability of ecosystem functions and resistance to climate change (see Bello et al., 2015; Bradley et al., 2012; Isbell et al., 2015). Consequently, the intensifying of climate change increases the value of nature and biodiversity since it is essential for the planet and for human societies to cope. Many species can slow down climate change, therefore we are depended on them to reach the two-degree target from the Paris agreement. Climate change has many different levels, but mitigation and adaptation have little focus on biodiversity compared to other solutions to slow down climate change. Although, biodiversity is both a part of the sustainability goals number 14 *Life below water* and goal 15 *Life on land* in addition to the *2011-2020 Strategic Plan of the Convention on Biological Diversity* (CBD) being adopted, limited process has been made (Moreno, Watson, Venter, & Possingham, n.d.; Tittensor et al., 2014).

Biocapacity and The Ecological Footprint can illustrate human pressure on the planet. Biocapacity is the ability for the planet’s ecosystems such as land areas and oceans to renew themselves by absorbing materials such as CO_2 emissions and produce renewable resources. The Ecological Footprint conceived by Mathis Wackernagel and William Rees measures how much nature we have and how much nature we use to make us understand the impact we have on our planet and help improve sustainability. By comparing the consumption of humanity and Earth’s regenerative capacity, The Ecological Footprint track human demand on the

biosphere (Galli, Wackernagel, Iha & Lazarus, 2014; WWF, 2012; WWF, 2018a). The last decades humanity's Ecological Footprint have exceeded Earth's biocapacity. In 2008 it exceeded by more than 50% of Earth's biocapacity (WWF, 2012). It is clear that biodiversity is threatened by climate change, and it is especially noticeable in the Arctic where almost every ecosystem shows marked shifts according to Parmesan (2006).

3.3 Svalbard and Climate Change

It is known that increase of greenhouse gases (GHG) into the atmosphere due to human activity will cause climate change, and Arctic is especially sensitive. Climate and changes in climate can vary from region to region and year to year. This can make it more challenging to understand to what degree it is natural variabilities and to what degree change happens due to anthropogenic activities. Consequently, making reliable projecting for the future is difficult (Arctic Monitoring and Assessment Programme, 2003). Although small changes with temperature rise of 1-2 degrees the past 10 000 years had impacts on humans and Earth's ecosystems, this period is considered stable. It is nothing compared to the anthropogenic changed we see in the twentieth century (Steffen et al., 2011).

Evidence of anthropogenic climate change is especially notable in the Arctic. It is one of the places in the world where the consequences of climate change are clearest. The climate in the Arctic has experienced large varieties from year to year both in wind, temperature and precipitation due to climate change (Sysselmannen, 2016b). The Arctic experiences the most rapid increase in temperature, particularly in the autumn-winter season the temperature has increased much. Ice melting, rise of sea-level and permafrost melting are expected to accelerate affecting vegetation and promote further erosion (Arctic Monitoring and Assessment Programme, 2003). Global warming happens approximately twice as fast in the Arctic than the rest of the world (Norsk Polarinstitutt, n.d. b).

Svalbard, an archipelago located in the Arctic ocean between Norway and the North Pole, is unique due to its location and climate. "Svalbard and the surrounding ocean are considerably milder, wetter and cloudier than the average for the latitude" (Hanssen-Bauer et al., 2019: 23) due to the atmospheric low pressure centre that forms between Iceland and southern Greenland, called the Icelandic low, which dominates the wind circulation and transport atmospheric heat and moisture together with The West Spitsbergen Current (Rafferty, 2012). Furthermore, global warming happens at an even faster pace in Svalbard than in the rest of

Arctic. Svalbard was an archipelago in the ice, now the ice is disappearing and much of the year it is open water (Norsk Polarinstitutt, n.d. b; Sysselmannen, 2016b).

The land areas at Svalbard had an estimated average temperature at -8.7 °C in the years 1971-2000. On Svalbard the temperatures have increased after year 2000. The last 30 years the temperature average has increased by 1.5 °C from what it was in the reference period 1971-2000, and an increase of 3-5 °C has been observed from 1971 to 2017, most notable in the inner fjords (Hanssen-Bauer et al., 2019). According to Hanssen-Bauer et al. (2019) the temperature will continue to rise according to all projections. On a global scale there has been an increased by about 0.8 °C since the 1880, where two-thirds of the warming has occurred since 1975 (Hansen, Ruedy, Sato & Lo, 2010). Figure 2 illustrate the temperature difference between Svalbard Airport, Longyearbyen and on a global scale.

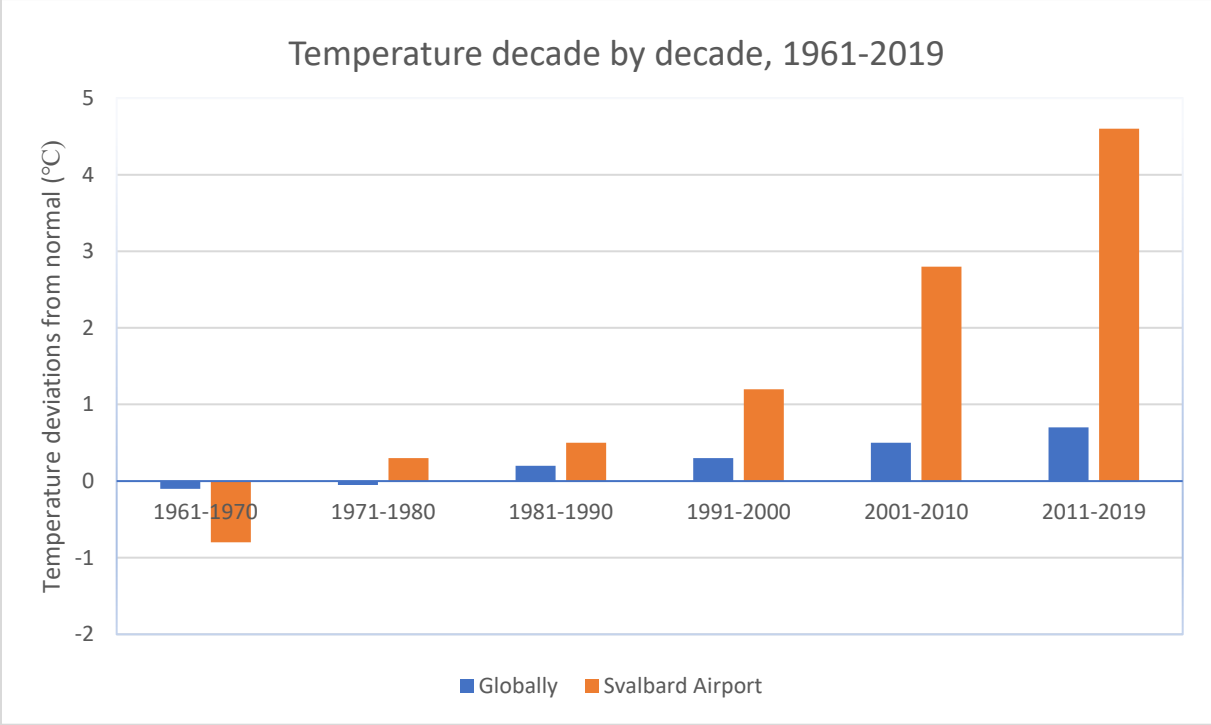

Figure 2 *Temperature deviations globally and at Svalbard Airport. This illustrate how the temperature is changing more rapidly in Svalbard than the rest of the world (Hanssen-Bauer, 2019; Holm 2019).*

The warming in Svalbard has been especially strong in the winter the last two decades with an increase of 2-3◦C per decade at Svalbard Airport, see figure 3 (Førland, Benestad, Hanssen-Bauer, Haugen, & Skaugen, 2011).

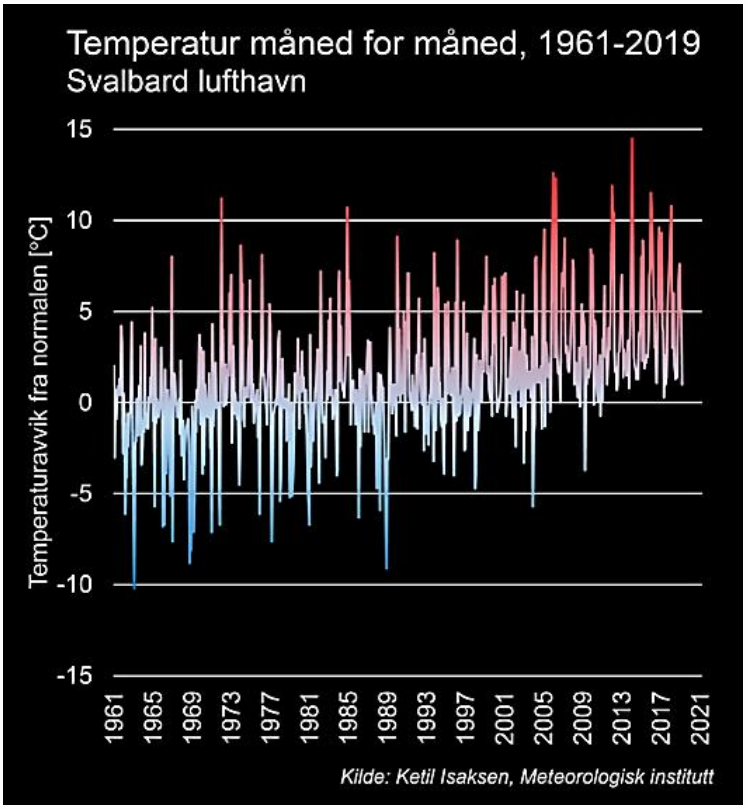

Figure 3 *Temperature month by month from 1961-2019 at Svalbard Airport (Holm, 2019).*

Furthermore, there has been an increase in storms, which contribute to heat transport up to the Arctic. This also contributes to an increase in contaminants from northern industrial regions being transported to the Arctic because of an increase in precipitation. The wind transport contaminants directly to the Arctic from a timescale as short as days. It can also be transported over longer terms, as much as months or years through a series of jumps, for example through re-volatilising during summer warming (Arctic Monitoring and Assessment Programme, 2003).

In the report by Hanssen-Bauer et al., (2019) they use three different scenarios to predict the climate in Svalbard in the future:

Scenario 1: “Business as usual”; high emissions.

Scenario 2: Reduction after 2014; medium emissions

Scenario 3: Drastic cuts from 2020; low emissions

All of the three different scenarios project an increase in temperature, from about 3-10 °C from 1971-2000 to 2071-2100, however, due to regional pattern in the sea ice retreat it is expected to be large variations within the Svalbard area. Reduced sea ice in the fjords increases the temperature especially in the winter. Sea ice is an important component of the climate system in the Arctic and its high albedo protects the Earth surface to heat up by reflecting the solar radiation instead of it being absorbed by the oceans. The prevalence of sea ice has decreased by 10 percent the last 20-30 years (Hanssen-Bauer, 2019; Sysselmannen, 2016b). Figure 4 and 5 show how much of the sea ice has declined each year from 1979 to 2018 in April, the month with most ice, and September, the month with the least amount of ice (MOSJ, 2019b).

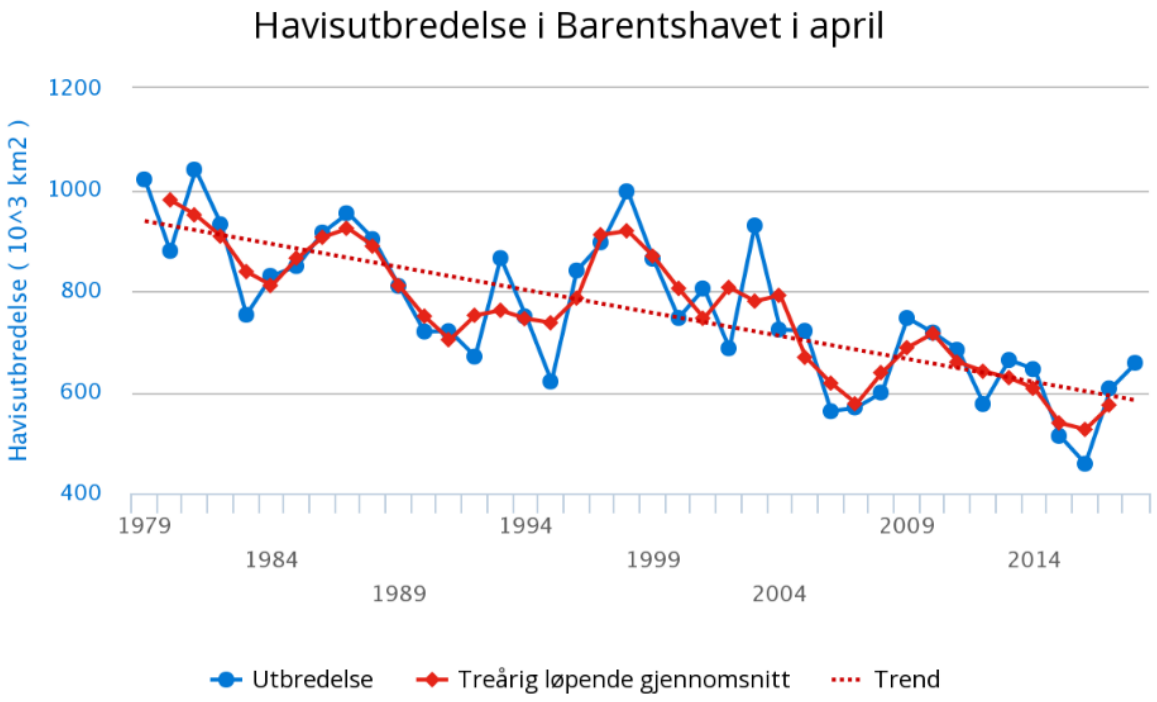

***Figure 4**: Sea ice in the Barents Sea in April. April is the month with the least amount of ice on Svalbard. The blue line shows the difference from each year, the red line shows the three-year average and the dotted red line show the trend (MOSJ, 2019b).*

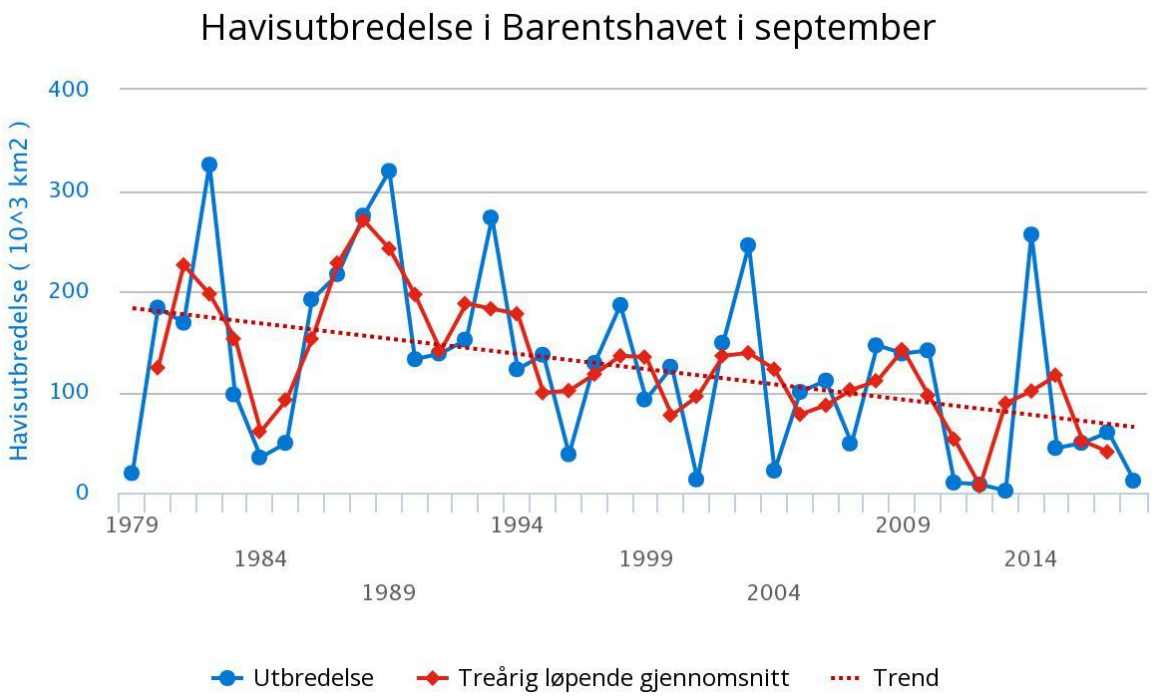

***Figure 5**: Sea ice in the Barents Sea in September. September is the month with most ice on Svalbard. The blue line shows the difference from each year, the red line shows the three-year average and the dotted red line show the trend (MOSJ, 2019b).*

Additionally, the thickness of the sea ice has decreased significantly (Hanssen-Bauer, 2019; Sysselmannen, 2016b). In the Arctic Basin "from 2000-2012 the thinning of the ice was about 0.58 m per decade" (Hanssen-Bauer, 2019: 135). If it continues the surroundings around the North Pole will in the summer be free of ice within this century (Aars, Andersen & Kovac, 2005).

In areas where there have been a reduction of sea ice, the albedo is reduced leading to higher absorption of solar radiation which increase the atmospheric warming.

> The albedo effect says how much sun get reflected on different surfaces. The Arctic which is largely cover by ice and snow reflects much more sun than the ocean, and thereby has higher albedo effect. When the ice then melts the ocean increases and makes the global warming increase even faster (Serreze, 2008; Sivle, 2018 in Bertelsen, 2018).

There are natural variabilities, but there is anthropogenic warming which imply that the warm period will be even warmer. Recent changes in the pattern of the large-scale atmospheric processes which control the climate on Svalbard brings warm Atlantic water (see figure 6). Even during the winter warm water arrives into the fjords. This has stopped sea ice from

forming, and large areas of water are ice-free in the west and north of Svalbard. The inflowing water coming to Svalbard has been especially high after around 2000 (Hanssen-Bauer et al., 2019). The reduction of sea ice has "likely lead to more wind-generated upward mixing of warm and saline Atlantic Water from about 200 m depth, preventing formation of sea ice" (Hanssen-Bauer, 2019: 127). The increased temperature after year 2000 is a consequence of the retreat of sea ice, and higher sea temperatures will also be an important factor in the future (Hanssen-Bauer et al., 2019).

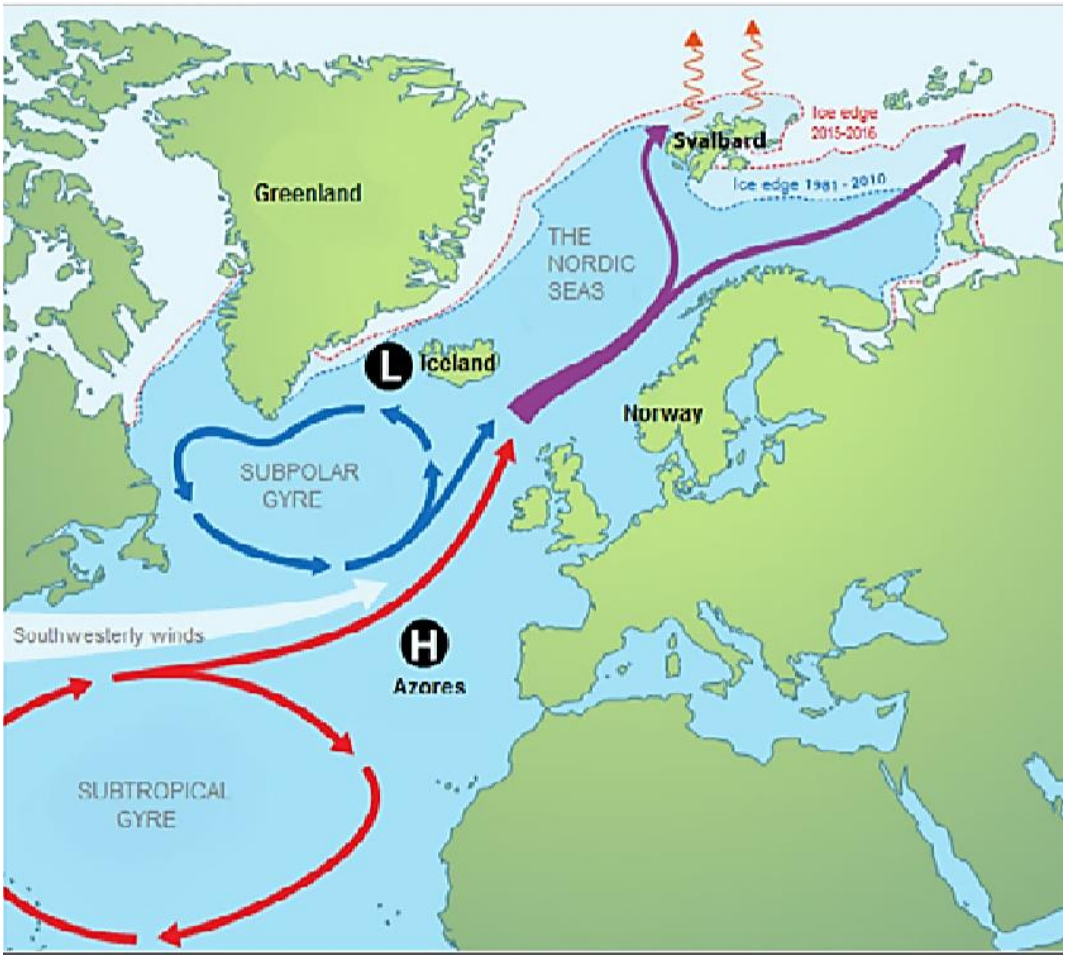

Figure 6: *Climate Change Svalbard – "Variable atmospheric forcing and oceanographic circulation contributing to changes in temperatures and sea ice extent around Svalbard" (Hanssen-Bauer et al., 2019: 130).*

The largest increase is in the winter and more of the snow falls as rain decreasing the number of frost days. As a consequence of the increased air temperature the snow season in Svalbard has decreased with 20 days from 1958-2017 according to Hanssen-Bauer et al. (2019). Since snow cover is dependent on temperature and precipitation, it is an important indicator for climate change. For scenario 1 and 2 the number of days of snow and snow cover will be

further reduced. This is due to the predicted change in temperature and precipitation. The winter season will therefore start later and end earlier. However, there is predicted an increase of precipitation that most likely will increase the snow storage at higher latitude where the temperature is lower (Hanssen-Bauer et al., 2019).

This will also affect glaciers on Svalbard. "A glacier forms when snow accumulates over time, turns to ice, and begins to flow outwards and downwards under the pressure of its own weight" (The National Snow and Ice Data Center, 2019). A glacier therefore responds dynamically to environmental conditions. Since almost 60% of Svalbard's land area is covered by glaciers, higher temperature will have serious consequences for Svalbard. Higher temperatures have caused more melting and calving of the glaciers on Svalbard. Satellite observations have complemented on-ground monitoring since the 1970s, revealing changes in mass balance, flow velocity, thermal regime and frontal displacement. An overall observed retreat is accompanied by increased calving rates of sea-terminating glacier (Grove, 1987; Jackson & Ragulina, 2014). "An average glacier area reduction of 7% was estimated from the period 1961-1990 to the 2000s. The glacier area was reduced in all regions. This loss of glacier mass and area is changing the landscape and contributing to sea-level rise" (Hanssen-Bauer et al., 2019: 11). The glaciers on Svalbard are expected to continue losing mass (Hanssen-Bauer et al., 2019).

15% of the glaciers on Svalbard are tidewater glaciers which are glaciers "whose fronts terminate in seawater. While their number is small, more than 60% of the total glacier ice area flows end in a tidewater glacier" (Hanssen-Bauer, 2019: 38). Tidewater glaciers are important for the ocean circulation and for the ecosystems and "entrainment ensures a continuous resupply of intermediate depth waters, including zooplankton and nutrients, to the glacier front area" (Hanssen-Bauer et al., 2019: 103) making the front of the glaciers important feeding area for marine mammals. Tidewater glaciers are not good climate change indicator because it is not possible yet to accurately forecast front retreat as a result of climate change since they have their own cycles of advance and retreat, making them more unstable as indicator. However, historic data can be used which was done in the report by Hanssen-Bauer et al. (2019), illustrating that several glaciers have retreated, and future warming will cause the number of tidewater glaciers to decline. This will impact the circulation in the fjords which gives implication for the fjord ecosystem and less nutrients will affect the bird and marine mammal populations negatively (Hanssen-Bauer et al., 2019; Lydersen et al., 2014).

It is clear that "increasing concentrations of greenhouse gases in the atmosphere are the primary underlying cause of the warming observed over the last 50 years" in Arctic (Hanssen-Bauer et al., 2019: 54). It is still too early to know which of the three emissions scenarios that are most realistic in the future (Hanssen-Bauer, 2019). Nonetheless, areas with extreme climates such as polar regions like Svalbard are experiencing severe changes in weather events and temperature changes and the effects of these changes can often be complex and unpredictable (WWF, 2018a).

> Different species, and even different populations of the same species, can display very different responses. The response can depend greatly upon the nature of the threat, the resilience of the species, their geographic location and the presence/absence of other closely related species (WWF, 2018a: 80).

However, it is clear that the effect of climate change and then especially the melting of ice has and will have dramatic consequences for animal wildlife, and sea-ice dependent Artic species are already struggling due to loss of habitat. While other animals have the opportunity to move further north in accordance with warmer temperature, arctic animals such as the polar bear and ringed seal are already on the edge of their geographical limit (Parmesan, 2006).

3.4 Polar Bears and Ringed Seals

Today it is often said to be more polar bears than people living on Svalbard. According to Statistisk sentralbyrå (2019) there are just below 2300 people living on Svalbard. The number of 3000 polar bears is often used in media and by travel agencies/tourism promotors. However, the number of polar bears is more likely to be approximately 1000 on Svalbard. The population of polar bears on Svalbard is a part of the Barents Sea subpopulation which also include the Russian archipelago Franz Josef Land. A survey conducted in 2004 estimated this population to be 2650 (between 1900-3600) polar bears. A survey from 2015 from Svalbard alone estimated just under 1000 polar bears (Durner, Laidre & York, 2018). However, it is difficult to say an exact number because of the limited data, and the two surveys are incomparable. Additionally, polar bears can travel long distances, crossing borders.

Until 1973 Svalbard was a dangerous place for polar bears. Polar bears could be hunted in many ways, for example with guns, poison and set-gun trap, many which wounded them or killed only the mother leaving the cub(s) alone. Polar bear skins were in demand and much

money was paid to get the skins. In the 1950s wealthy hunters paid to do safari hunts (Amundsen, 2014; MOSJ, 2019c). The catch intensity was increasing, and the methods became more efficient. From 1870-1973 a total of 30 231 polar bears were captured, most hunted and killed, a few were taken alive (MOSJ, 2019c). The polar bear taken alive were cubs that were brought to different zoos in Europe. The hunting on polar bears had serious impact on the population. There were growing resistance to polar bear hunting and especially the use of set-guns. In September 1970 it became forbidden to use set-guns and to shoot mothers with cubs and take cubs alive. Around 1973 the polar bear population at Svalbard was in danger of extinction. The same year it became forbidden to hunt polar bears when the International Agreement on the Conservation of Polar Bears which regulates commercial hunting was signed in Oslo by the five nations which have polar bear populations. Although there is lack of data to compare the population size, it is believed that after this agreement the population on Svalbard recovered considerably (Aars, Andersen & Kovacs, 2005; Agreement on the Conservation of Polar Bears, 1973; Amundsen, 2014; MOSJ, 2019c). There are also different local laws and regulations. Svalbard has the Svalbard Environmental Protection act which have regulations to harvesting, travel and tourisms, camping and to protect the environment which include polar bears and their habitat (Svalbardmiljøloven, 2001). However, still today polar

Polar Bear (Ursus maritimus)

Geographic range: Ice-covered waters of the circumpolar Arctic

Populations: 19 subpopulations in Canada, Greenland, Norway (Svalbard), Russia and United States. Occasionally individuals have reached Iceland.

Current population: Worldwide 22 000 - 31 000. Barents Sea population 1900-3600. Svalbard 1000.

Weight: 150-800 kg

Size: 180-260 cm

Lifespan: 25-30 years

Diet: Carnivores – primary prey are ringed seals. They also hunt other types of seals, walruses, sea birds and their eggs, small mammals and fish.

Reproduction: Females are 5-6 years when they get their first cubs. They breed yearly from March to June and 1-4 (average: 2) cubs are born which they stay with for 2 ½-3 years. One of the lowest reproductive rates of mammals with only up to five litters during their lifetime.

Threats: Anthropogenic and natural climate change. Additionally, an emerging threat is the "resource exploration and development in the Arctic along with increased ice-breaking and shipping" (Wiig et al., 2015: 10).

Conservation measures: The International Agreement on the Conservation of Polar Bears (1973). The Svalbard Environmental Protection Act (2002, revised 2012).

Conservation status: Vulnerable (IUCN red list). However, the status varies from country to country. Svalbard: Vulnerable.

(Source: Durner, Laidre & York, 2018; Gunderson, 2009; Norsk Polarinstitutt, n.d. a; Wiig et al., 2015; WWF, 2019)

bears globally and on Svalbard are listed as “vulnerable” on the IUCN Red List meaning polar bears have a high risk of extinction in the wild (Wiig et al., 2015). Globally, polar bears are predicted to decline by more than 30 % by 2050 (IUCN, 2015). “Organisations such as Polar Bears International predict that, without action on climate change and stopping sea ice loss, the bears could be gone by 2100, with 2/3 gone by 2050” (Merskin, 2018: 139).

Today, on the other hand, polar bears experience other threats than human hunting. Climate change can end up becoming, or already is, a much more comprehensive challenge for polar bears. Before 1973 the population size of polar bears was below the carrying capacity because of the excess hunting which means that the population on Svalbard still can increase (I-Kovacs, 2019). Carrying capacity is the maximum number of a biological species that can live in a certain area over a longer period of time, which depends on the access of food, shelter, water and other necessities for the certain species (IUCN SSC Polar Bear Specialist Group, n.d.). Despite that the polar bear population can have a positive development on Svalbard because of the excessive hunting earlier, the carrying capacity have decreased drastically today because of climate change (I-Vongraven, 2019). Polar bears are marine mammals dependent on sea ice to travel on for hunting and to find denning areas. When the ice disappears, it causes reduced food intake, increased energy consumption and more fasting for polar bears according to the Intergovernmental Panel on Climate Change’s report (Larsen et al., 2014). This can affect differently on polar bears since polar bears on Svalbard can be divided into two groups. There are coastal polar bears which stay in mainland Svalbard all year, also during the summer when there is lack of ice. However, most polar bears in the Barents Sea population migrate east toward north-east Barents Sea. Nevertheless, both groups depend on the sea ice to hunt ringed seals (I-Routti, 2019).

Polar bears can almost eat everything, but seal and especially ringed seals are their main prey and therefore most of the hunting they do is on the sea ice. They feed up for the summer and fall, however higher temperature and less ice create longer period of time where the polar bear has less food. In periods of less ice- or ice-free periods polar bears can use more time on hunting to get the same amount of energy. Seals are difficult to find since they are also dependent on sea ice to survive. Less seals means that polar bears are forced to land and need to look for alternative food sources such as bird eggs, vegetation and reindeer (carcasses or injured reindeer). It has been observed that polar bears have hunted reindeer, however, reindeer can be difficult to hunt because polar bears can get overheated and die of heat stroke

if it run at high speed for long time (Aars, Andersen & Kovacs, 2005; Stempniewicz, Kidawa, Barcikowski & Iliszko, 2013).

Prop et al. (2015) suggest that climate change has increased the impact polar bears have on bird populations. Observations during almost 40 summers done in four locations on Svalbard and one in Greenland illustrates how global warming have affected polar bears and forced them more on land due to changed ice conditions and made them hunt for birds and bird eggs as an alternative food source on land. The species it concerned were common eider, barnacle goose and glaucous gull (Prop et al., 2015). They "propose that the increased number of bears on land predating on bird nests is due to the lack of sea ice on which bears can hunt seals in summer" (Prop et al., 2015: 8). They found out that the "length of sea ice season dropped over the years, on average by 3.5 days/year" (Prop et al., 2015: 4) and the "start of the ice-free season advanced by 2.0 days/year" (Prop et al., 2015: 5). There has been an increase from the 1970/80s to present of the amount of days polar bears are presence in summer. In the summer from 1980 to 2000, polar bears were occasionally seen, but from 2000s and onwards they became regular visitors in the summer. The number increased by 15% each year. Although there were high predation rates the number of nests in the colony remained relatively stable which most likely is related to birds arriving from other places. They see a possible linkage to the increased movements to terrestrial habitats and the sea ice reduction (Prop et al., 2015). This exemplifies how climate change can contribute to behavioural changes and affect other parts of the Arctic biodiversity.

In the summer and autumn there have been observed three instances of killing and cannibalism of polar bears in Svalbard. There have been reported several observations of this in Canada and Greenland, however the three observations on Svalbard are different as all the adult males appeared to be in good physical conditions. However, earlier studies of ringed seals illustrate that they move north on Svalbard where they are not as accessible to bears. The study suggests that less sea ice and decreasing number of seals available can make young polar bears males a prey for adult males. As a result of climate change the decreasing ice and decreasing amount of seal together with increasing ships that go closer into the dissolving ice, the frequency may increase (Stirling & Ross, 2011).

When sea ice retreats in the spring and summer, there are less sea ice which means less seals. Some polar bears can be trapped on land where they can have months with starvation. There are increasing examples of polar bears that have decline of body conditions and some also die of starvation although polar bears can survive as much as eight months without eating, losing

approximately 0,5% of their body mass each day (Aars, Andersen & Kovacs, 2005; Routti, Jenssen & Tartu, 2018). More time abstaining from food can mean more polar bears dying of starvation as a result of climate change. With less ice it is necessary to find alternative food sources. Polar bears can smell food from a long distance and can also be attracted by human food and waste. When bears have no other options, they can become bolder in approaching people and thereby increased the likelihood for confrontations with humans and the risk of bears being hurt or killed increase (Clark, van Beest & Brook, 2012; I-Kovac, 2019).

Polar bears need fat to build up fat reserves for the winter. Annually an adult polar bear needs to kill 50 to 75 seals to meet its energy requirement and to stay warm in the winter (Aars, Andersen & Kovacs, 2005). Especially for the females it is important. The consequence for females is that they are in poorer condition when they are pregnant and thereby get less cubs. As the temperature increase more snow comes as rain, and females are dependent on large volume of snow to dig their dens. There have been born less cubs in the eastern part of Svalbard in the years when the weather has been mild. It is unclear how it affects the Barents Sea population because some polar bears can find denning areas other places, such as Frans Josef land. However, polar bears need to adapt their behaviour since the ice is melting. Researchers have observed polar bears swim for several days to find a den, up to 300 km. This is energy-intensive, and the female may not manage to give birth. If cubs are born, they are often born smaller, and both mother and cubs will struggle more to survive. Although they can swim long distances for many hours they can suffer from exhaustion. If the swimming is too much, they need to choose to den or not, and if they choose to, they may need to walk for an even longer distance on land to find appropriate denning areas (Aars, Andersen & Kovacs, 2015; Norsk Polarinstitutt, n.d. a).

Another problem is that with less ice polar bears will become more isolated and thereby the degree of genetic differentiation between the population can decrease and thereby increase the danger for extinction (Aars, Andersen & Kovacs, 2005).

When the ice melt is not only the hunting grounds for the polar bear that disappear, the ringed seal, polar bears main prey, is dependent on ice. Ringed seals are more dependent on ice than polar bears. Despite the ringed seal being negatively impacted as their habitat is being destroyed and their reproduction rate will be affected negatively as the ice melts due to climate change, the ringed seal is listed as “least concern” on the IUCN Red List meaning there it a relatively low risk of extinction. However, some of the subspecies are assessed separately, where one is assessed as “vulnerable” and another “endangered” (Lowry, 2016).

On Svalbard there is lack of monitoring on the ringed seal, and therefore uncertain how large the population is, but a report by Andersen, Kovacs & Lydersen (2018) concludes that is likely to be tens of thousands ringed seals on Svalbard. Ringed seals on Svalbard are also harvested, but it is unlikely to impact the population since it is less than 100 seals annually (Andersen, Kovacs & Lydersen, 2018). Despite the large population, the trend in declining sea ice is a clear threat to the population on Svalbard and the population is likely to be declining (Norsk Polarinstitutt, n.d. c). Data from Andersen, Kovacs and Lydersen (2018) also suggest that pregnancy rate, and survival of young animals are low, but "not unexpected, given that there has been 11 years (since 2006) with markedly reduced ice cover in west coast fjords" (Andersen, Kovacs & Lydersen, 2018: 14). Up until 2005 there was status quo when it comes to sea ice. In 2006 west coast and north coast had no sea ice and it has not recovered since. When there is no ice for seals to be on, it is also impossible to count them (I-Kovacs, 2019).

Ringed Seal (Pusa hispida)

Geographic range: Ice-covered waters of the northern hemisphere.

Populations: Five subspecies. Wide-ranging in the Northern Hemisphere.

Current population: Worldwide likely more than 3 million**.** Svalbard likely to be tens of thousands.

Weight: 50-100 kg

Size: 100-160 cm

Lifespan: can be up to 45-50 years (average 40 years).

Diet: Carnivore – fish, but also invertebrates.

Reproduction: Females reach sexual maturity at age 3-7 and give birth to one pup in the early spring which is cared for approximately six weeks.

Predator: Polar bears are most important. Additionally, killer whales and walruses.

Threats: Climate change. Other threats depend on location and population, for example; boating, tourism, net fishing and pollution/contaminants (but falling levels in the seals due to restriction of use).

Conservation measures: "Protected by a variety of laws and quotas in different parts of their range, but even within Europe the legal provisions are not always being fully implemented in domestic law" (Lowry, 2016: 7). In Svalbard all marine mammals are included in the Svalbard Environmental Protection Act.

Conservation status: Least concern (IUCN Red list).

(*Source: Andersen, Kovacs & Lydersen, 2018; Lowry, 2016; National Geographic, n.d.; Norsk Polarinstitutt, n.d. c).*

The preferred breeding habitats for ringed seals on Svalbard is deep in the fjords where ice calved from the glacier fronts have frozen into the land-fast sea ice. These glaciers fronts are also important feeding areas because of zooplankton being trapped here. Zooplankton attracts fish and they again are attracting marine mammals such as the ringed seal which also make it an important hunting area for

polar bears. The algae in the ice and water are the foundation of the rich plant kingdom here. It makes the Polar Seas to the most productive in the world. If the ice melts, krill and other crustaceans which are crucial sources of fat will disappear affecting the whole food chain – also the largest animals (Hanssen-Bauer, 2019; Lydersen et al., 2014).

Ringed seals need very specific ice and snow conditions. The mother makes a cave in the snow over a breathing hole in the ice (see figure 7). This is made in the snowdrift which is created when snow is drifting on old cracked ice to protect the pups against predators. They therefore need both the ice and a certain amount of snow. Lack of snow and shallow snow cover makes it easier for polar bears to destroy the snow caves. Lack of snow, more warm weather and precipitation coming as rain can also make the cave collapse killing the pup or leave it visible and vulnerable for predation. Lack of ice can also force the mother to give birth on the ice making the pups an easy prey for among others polar bears. Consequently, bad years make it harder for seal pups to survive – among these pups the mortality is high, and less pups are born (Lowry, 2016; Lydersen et al., 2014).

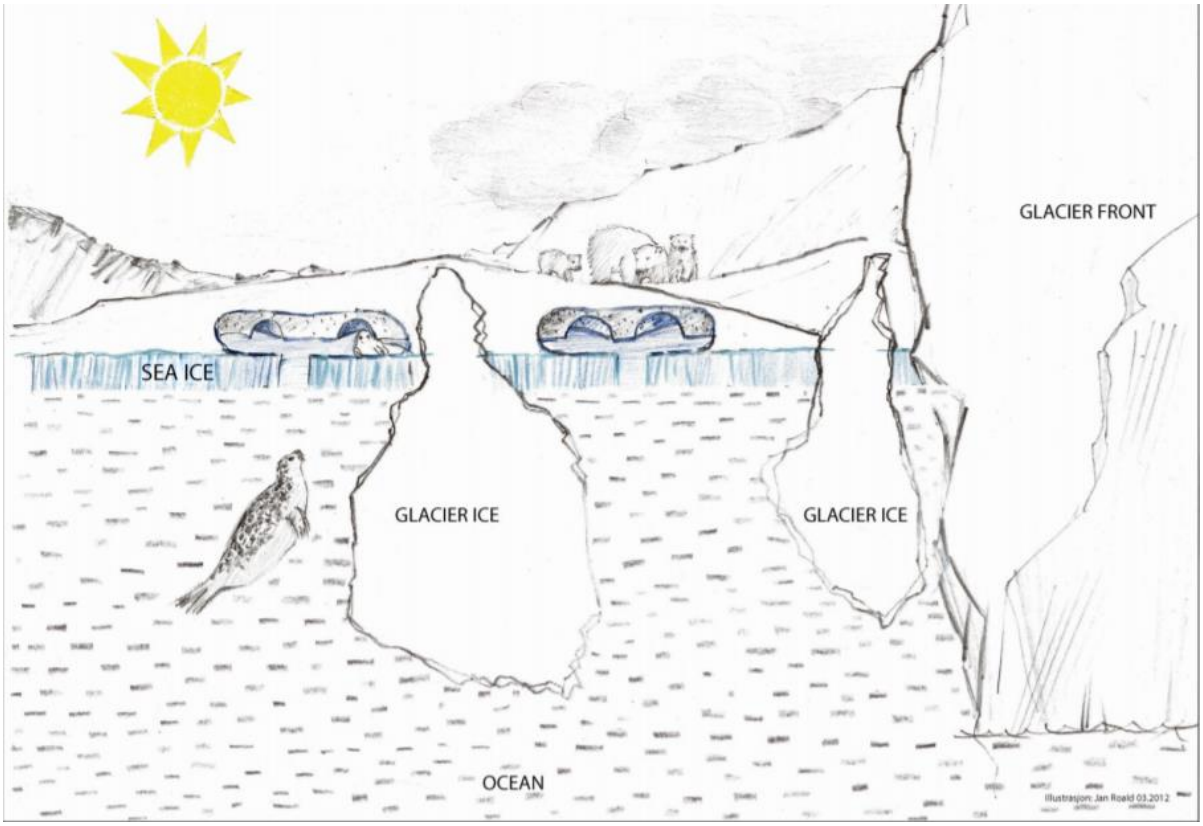

Figure 7 *The important role of tidewater glaciers for marine mammals. Tidal glaciers attract many species, including ringed seals and polar bears for hunting/feeding and denning. If snow, glaciers ice and tidal glaciers are disappearing seals and polar bears will struggle to find suitable feeding/hunting and denning areas (Lydersen et al., 2014).*

Ice platforms are also important when they go through their annual moulting, where they shed and replace their hair and outer layers of their skin. During this process they eat little and since warm temperatures are ideal it is better to spend the time resting on the ice and not in the water. If there is no ice, they use glacier pieces. This has been the case for several years. It is recorded that polar bears manage to hunt ringed seals on the glacier ice pieces by diving a distance from the seal and jump out of the water with great speed (Lydersen et al., 2014). If the ice disappear the ringed seals have no place to rest and then no place for the polar bear to hunt. "The lack of spring ice in front of glaciers in the fjords of western Spitsbergen during the last decade has likely resulted in near-zero production of ringed seals" (Lydersen et al., 2014: 469). It is clear that predicted global warming will make glaciers continue to decrease and marine areas close to tidal glacier are important for all marine life and will potentially have cascading effects through the whole marine ecosystem in Arctic (Lydersen et al., 2014).

3.5 Pollution

Although the Arctic is far away from industrial areas, anthropogenic chemicals are found in many of the Arctic mammals. Polar bear is one of the most polluted animals in the world because polar bears are on top of the food chain (see figure 8). Luckily, polar bears can handle high levels of contaminants. Most other species would die if they had the same amount of contaminants as polar bears have. Much of the released contaminants are "fat-loving", so polar bears get much contaminants through their ringed seal diet. Food from the ocean in general have more contaminants as much of it come into the water where it can be for a long time. There are also found more pollutants in polar bears on Svalbard than the rest of the Arctic. Pollutants are transported by natural processes such as water and air, and due to Svalbard's geographical position there are many "transport routes". Pollutants can be spread quickly, through airflows it can take days or even hours, while ocean currents can take as much as years (Miljøstatus, n.d.; Routti, Jenssen & Tartu, 2018; I-Routti, 2019; Stockholm Convention, 2008a).

One of the most problematic environmental contaminants in Arctic are Persistent Organic Pollutants, better known as POPs. They are released into the environment due to human activities the last decades. When they are released into the environment they will remain for a long period of time as they have a slow decomposition. Although many of the pollutants have

been banned, they will still be in the environment for a long time after (Routti, Jenssen & Tartu, 2018; I-Routti, 2019; Stockholm Convention, 2008b).

> POPs are readily absorbed in fatty tissue, where concentrations can become magnified by up to 70,000 times the background levels. Fish, predatory birds, mammals, and humans are high up the food chain and so absorb the greatest concentrations. When they travel, the POPs travel with them. As a result (…) POPs can be found in people and animals living in regions such as the Arctic, thousands of kilometres from any major POPs source (Stockholm Convention, 2008b).

The main compounds found in ringed seals are PCBs which is one sort of POPs and are ceased to be used in 2025. Nonetheless, PCBs are ten times higher in polar bear tissues than in ringed seals since polar bears are on top of the food chain. PCBs are used to among electrical utilities and paint (Routti, Jenssen & Tartu, 2018; Stockholm Convention, 2018a). The Arctic marine mammals are endemic which means that they exist only in one geographic area. Both polar bears and ringed seals are key species in the Arctic ecosystem. Changes in one species will affect the food web and thereby affect the whole Arctic ecosystem (I-Kovacs, 2019).

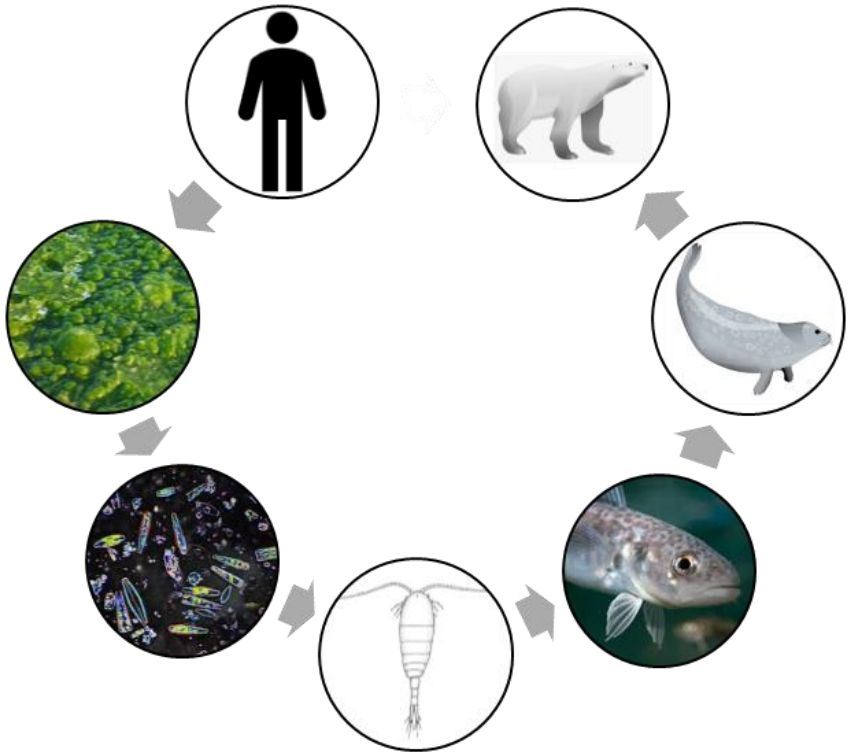

Figure 8 *Arctic Food Web. As most pollution end up in the ocean, marine species are particularly exposed for pollution. The higher a species is in the food web the more contaminants the species have which make polar bears one of the most polluted species on the planet. Chemicals and pollution of human origin end up in the ocean affecting the food web from bottom to top illustrated in the picture: Algae → Diatoms → Copepods → Fish (Polar cod) → Ringed Seals → Polar Bear (Author's figure).*

Climate change will most likely increase the negative effects as it "is likely to affect transport, secondary emissions, food web structures, body condition influenced by changes in food availability, as well as movement patterns of polar bears. All of these factors may subsequently affect contaminant concentrations in polar bears" (Rouuti et al., 2019: 1077). When glaciers and ice melts pollutants that have been stored in the ice reach the ocean. Thereby more environmental toxin reaches the environment and the animals living there. More contaminants come through "fat-rich" diet. Consequently, more contaminants are in polar bears that are on the ice eating ringed seals and less in bears that eat land-based food. This does not mean that land-based diet is better, as it is less rich of fat and other nutrients. Pollutants in the bear are stored in their fat. In periods with less sea ice polar bears can have long period with no or a small amount of food – the fasting period will be longer due to loss of sea ice. "Prolonged fasting due to climate-induced ice loss and resultant lowered prey availability that will result in fasting, or dietary changes will cause levels of POPs to exceed thresholds levels (Routti, Jenssen & Tartu, 2018: 356-357). When they lose their body fat, contaminants are transported into their blood, and important organs such as their liver and brain. The skinnier the bear is the higher concentration of pollution there is. Limited access to food, reproduction, moulting and migration leads to loss of body mass and thereby increasing the levels of contaminants. High concentration of pollutants can affect vital functions such as the immune system response, it can interfere with their hormones and their reproductive systems (Aars, Andersen & Kovacs, 2005; Miljøstatus, n.d.; Routti, 2015; Routti, Jenssen & Tartu, 2018). It can also affect cub survival as mothers transfer pollutants to their offspring causing higher concentrations in the cubs (Routti et al., 2019).

The major source of the contaminants found in polar bears and ringed seals are from industrialised parts of the world. However, another source is also tourism where emissions from cruise ships are a potential source (Miljøstatus, n.d.). Increased ship-traffic to Svalbard can contribute to more pollutions and diseases that can affect marine mammals. "Discharge of ballast water from ships containing biological materials, including algae, animals, viruses and bacteria into the Svalbard region can be a source for the transfer of diseases and introduced species to the ecosystem" (Jensen, Aars, Lydersen, Kovacs & Åsbakk, 2010: 605).

3.6 Tourism

Tourism on Svalbard have increased, earlier it was hunting of polar bears that made people travel from far away to come to Svalbard, now people have switched their hunting gear with cameras and come to the archipelago far north by both planes and cruise ships. Less ice and longer period of ice-free periods make it easier for ships to come. Before the 1990s there was barely any organised tourism. Tourism on Svalbard was one of the focus areas in the white papers no. 50 (1990-1991). It was decided to give more focus on tourism and regulate it more. Tourism could create many new jobs in Longyearbyen and Svalbard since it connected many businesses within sale, activities, information, transport, food, hotel and more (Ministry of Industry, 1991). The amount of flight passengers has increased moderately from 128 067 in 2006 to 166 477 in 2015, an increase of 38 410 flight passenger after nine years (Ministry of Justice and Public Security, 2016). However, how many of the flight passengers to Svalbard are travelling on holiday is unclear. Overnight stays at hotels have increased more than four times, from 32 695 in 1995 to 150 898 in 2017, where most of them traveling on holiday, as much as 103 986 (MOSJ, 2018).

Increasing numbers are also seen in the amount of cruise ships and cruise ships passengers. Arctic cruise tourism on Svalbard started as early as 1891, however the volume was small in the beginning. In the beginning of 1990, there were among 15 000-18 000 passengers per year (Sysselmannen, 2006). The last 10-15 years the popularity of Svalbard as a cruise destination has only increased, both large cruise ships and smaller expedition cruise vessels. In 2018 there were as many as 45 900 cruise passengers (MOSJ, 2019a). More ships and larger ships are arriving (MOSJ, 2019a). A cruise ship arriving the summer of 2018 had almost 6000 people on board (Kjøllesdal, 2018). Many people come first of all in hope of seeing a polar bear, and one of the best ways to have a chance to see one is by expedition cruises which are increasing in popularity. Sarah Auffret was AECOs (Association of Arctic Expedition Cruise Operators) environmental agent, pointed out that although there is no guarantee to see a polar bear, many tourists are so eager to see one that a ship can stay at the same place for two days in the hope of spotting a polar bear walking past (S. Auffret, personal communication, July 3, 2018). These cruises are going along the coast for a couple of days to a couple of weeks, having everything from 10 to 200 people on board. Most of the trips include daily disembarkations to make the tourists experience the nature and history of Svalbard. This has increased the number of landing sits, many which rarely or never were visited by tourists earlier. In 2017

there were 217 landing sites outside the settlement and Isfjorden. In 1993 on the other hand, there were only 53 landing sites (MOSJ, 2019a; Sysselmannen, 2006).

Tourism was the focus also in the two next white papers about Svalbard stating that the tourism industry had become an important part of the business. This has been of further focus in white paper no. 32 (2015-2016) where it says "the Government wants to facilitate the further development of the tourism industry, it is an overriding goal that Svalbard should be one of the world's best managed wilderness areas and the best-preserved high-arctic destination in the world" (Ministry of Justice and Public Security, 2016: 81, author's translation).

Different measures have been done such as the establishing of Association of Arctic Expedition Tour Operators (AECO) in 2003 by eight cruise operators dedicated to managing sustainable tourism in the Arctic. When they were established a set of guidelines for among other visitors, clean seas, biosecurity and wildlife were created. These guidelines help their members meet the demands set by the government, and also inspired Visit Svalbard and Svalbard Cruise Network making the Longyearbyen Community Guidelines (AECO, n.d.). The heavy oil ban on ships arriving Svalbard from 2007 was also in 2015 expanded to several other protected areas (Sysselmannen 2016b). Many of these implementations made the destination of Svalbard one of top 100 global destinations in 2016 (Sustainable Destinations TOP100, 2016).

The goal according to the white paper is to be the best-preserved wilderness area and many laws and regulations have been implemented on Svalbard to protect both human artefacts, plants and animals, however, this may be more challenging with more people and climate change (Sysselmannen, 2016a). "Arctic are being utilized more than ever for tourism. Visitors are going further afield than ever before, undertaking a more diverse range of activities, and their impacts are becoming more widespread" (Lück et al., 2010: 20). As the tourism sector is increasing both in amount, cruise ships and new landing sites, so can the impact on the environment grow; damaging vegetation, creating noise and pollution. Figure 9 illustrate the connection between tourism and climate change.

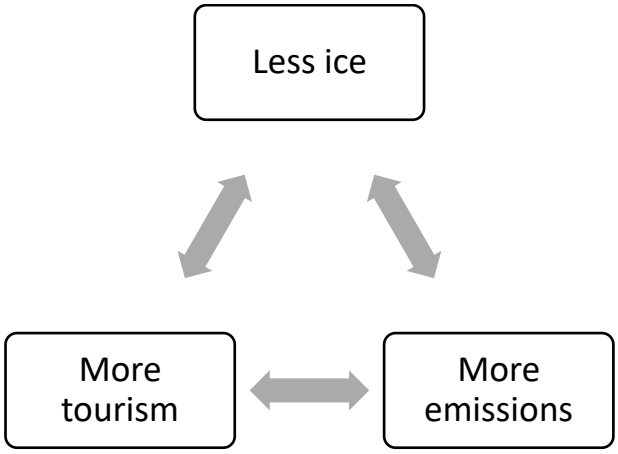

Figure 9 The relationship between tourism and climate change. *When the ice melts there are more opportunities for cruise tourism and shipping activity – increasing the tourism and human activity on Svalbard. As there are more activities there will be more emissions although there are strict regulations (Lowry, 2016). Oil drilling in the Arctic areas are also increasingly discussed. In Norway, Lofoten, Vesterålen and Senja are heated subjected and politicians are still open for the possibility to drill far north – which make a possible accident a potential disaster for the Arctic ecosystem (Author's figure).*

> Oil pollution, pollution through wastewater and garbage, air pollution, ballast water, physical damage from cruise ship activities, wildlife disturbance, degradation of vegetation, historical sites and geological sites are some of the things WWF mentions in their report about the environmental risk linked to cruise tourism on Svalbard (WWF, 2004). Different kind of waste and wastewater from cruise ships, emissions to the air, and noise that can give disturbances in the ecosystem can happen on a regular basis. Accidents such as oil spill will be rarer, but at the same time it can have severe impacts (Evenset & Christensen, 2011). Stronger winds and changes in climate can affect the ships traffic and make the consequences even worse (Sysselmannen, 2016b in Bertelsen, 2018).

An oil spill can give long-lasting effects and be severe for marine mammals (Sysselmannen 2016b) and "an increase in human-created noise in the arctic environment could cause marine mammals, including Ringed Seals, to abandon areas" (Lowry, 2016: 7). Because seals use low-frequency sounds below water to find food and communicate, human-created noise can travel under water and disturb these behaviours. Human activities can lead to an alteration of contaminant pathways. Sea that is clear of ice will encourage more tourism, shipping and other industrial activities. This can bring contaminants and increase the risk of oil leakages, and thereby led to an alteration of contaminant pathways (AMAP, 2003).

As human activity and travelling on Svalbard are increasing, snowmobiles will increase as this a popular way of transport. A study by Andersen and Aars (2007) on the effect

snowmobiles have on polar bears, concluded that the effects were dramatically. Polar bears reacted on disturbance from snowmobiles from a long distance and fled long distances away from the areas. A few bears were bold and stayed in touristified areas, but most bears were scared and left the area (I-Kovacs, 2019).

Svalbard is a hotspot for polar bear tourism, and thereby at risk of becoming a hotspot for human-polar bear conflict. 132 polar bears have been killed after polar bears were protected in 1973, that means 2,93 polar bears have been killed on average each year. These bears are killed in self-defence, because of safety reasons and because of protection of property. Furthermore, four people have been killed in polar bear attack on Svalbard after 1973 (MOSJ, 2019c). At this point it is only speculation if the effects of climate change contribute to more human-polar bear conflicts because of lacking data. However, more activity and less ice does increase the chance of polar bears and humans to meet. Already in Alaska and Canada there are data concluding there is a rise of human-polar bears conflicts. Polar bears are coming closer to human settlement in the look for food. Unlike Canada and Alaska, Svalbard has few and tiny settlements compared to the polar bears territory and may not experience the same degree of conflicts unless the tourist sector will continue to increase in the future (Clark, van Beest & Brook, 2012; I-Vongraven, 2019).

4.0 Theory

This master project will look at theoretical and analytical approaches that aid to analyse the change in animals due to climate change. The project will use several concepts and theories from zoosemiotics and umwelt theory; functional cycle, phenomenal fields, umwelt transition and ontological maps.

4.1 Zoosemiotics

Zoosemiotics is a "new" research field compared to many other research fields. It is associated with Thomas A. Sebeok and his semiotic studies on animals in the 1960s. Zoosemiotics is a research field between biological sciences and humanities (Maran et al., 2011; Martinelli, 2010). It is "the study of signification, communication and representation within and across animals" (Maran et al., 2011: 1). It can look at it intraspecific, that is within one single animal species or interspecific where one look at the semiosis occurring between different species. Interspecific can be between prey/predator and animal/human. The primary focus in zoosemiotics is semiosis. Semiosis "is any sign action or sign process or, (…) the process in which something is a sign to some organism" (Martinelli, 2010: 265). Zoosemiotics can be used to study the relationship between both polar bears and ringed seals and between polar bears and humans. Zoosemiotics can be divided in three different focuses which often go hand in hand: signification, communication and representation. While the receiver is the only subject in semiosis in signification, the meaning is produced by the sender only in representation. In communication, on the other hand, both sender and receiver are part of the semiosis. Communication and signification are more related to biology while representation is more related to humanities (Maran et al., 2011; Martinelli, 2010). This thesis will look at a mix of these three.

Signification examine the way animals make sense of each other and their environment and is more relevant to ecology. It is when semiosis and meaning is explored by the receiver of the message (Maran al., 2011; Martinelli, 2010). In this case both how polar bears make sense of each other, their environment, and the interaction between polar bears and ringed seals. Polar bears and ringed seal have a predator-prey relationship. While a polar bear associates the seal with food, the ringed seal associates the polar bear with danger and need to escape.

Anthropogenic environmental change and other human activities can affect their behaviour and how their lifeworld evolves. Here *anthrozoosemiotics* can also be studied, that is the interaction between humans and other animals. This is where the question about increased tourism versus ecological change due to climate change can be studied (Maran al., 2011; Martinelli, 2010).

Communication is the process where "a sign is coded and transmitted from a sender to a receiver" (Martinelli, 2010: 1). Communication can be both intraspecific and interspecific. Both the sender and the receiver are here part of the semiosis, unlike signification and representation. This can be exchanged, understood or misunderstood (Martinelli, 2010). For example, can a polar bear make different growls communicating anger or to give a warning for example in defence of food, also a polar bear can slowly approach another bear eating and have a nose to nose greeting to ask for food (Polar Bear International, 2019).

Representation studies how the animal makes sense. "The meaning is produced first and foremost by the sender of the message" (Marinelli, 2010: 261). It often looks at how animals are portrayed, this can be in for example fairy tales and myths (Maran al., 2011; Martinelli, 2010). The polar bear for example has become a poster species for climate change. This has been a large part of why people want to travel to Svalbard. It can be the last chance to see it, not necessary thinking of how this can interrupt and affect a species (Lück, Maher & Stewart, 2010).

These three can be explained through Umwelt theory, and different model will be used to examine their signification and communication (see models of functional cycle, phenomenal fields, Umwelt transition and Ontological map), and also representation by examining how polar bears are represented in among media (see mediated and conceptual umwelt in the tripartite model). This will be discussed in chapter 5. There are risks of interpreting animals wrongly, and this is something zoosemiotics are aware of. Humans are neither the receiver nor can code the message. No code is fully understood by humans. It is therefore important to get the fact correct on the biology and contact expert on this field, this is more written in detail in the method section, chapter 2.

4.2 Umwelt theory

An important part of zoosemiotics is “umwelt”. The German word umwelt translates to environment, but biologist Jakob von Uexküll formulated it as much more complex:

> The starting assumption is that the environment inhabited by an organism is not merely the actual environmental niche, but is a larger not purely physical “environment”, of which the niche is just a part, that is perceivable and meaningful in its entirety only from the perspective of that particular organism (Martinelli, 2010: 291).

Uexküll gives the example with a flower’s many meanings. For a girl it become a decoration, for an ant it is a path to reach food and for a cow it is food (Uexküll, 1982). Uexküll has been one of the most influential persons in zoosemiotics together with Sebeok (Martinelli, 2010). Uexkül is today recognised as a zoosemiotician although he died before the term started to be used (Maran et al., 2016).

Umwelt theory can be used to analyse the changing relationship between animals and their environment. It was created to examine animals in their own semiotic world and not exclusively from a human world. It is about examining the animal’s umwelt, how they experience the world, their subjective lifeworld (Maran et al., 2016). The perspective from a prey (the ringed seal) and enemy (the polar bear). Umwelt includes all the aspects that are meaningful for the world of the particular subject. Thus, the concept unites all the processes of semiotic (Kull, 1998). To write about a species umwelt some knowledge about the underlying biology of the species is needed (Maran et al., 2016). “Uexküll’s concept of umwelt provides zoosemiotics with its fundamental principle that any animal lives, perceives, acts, and communicates in its own subjective world”, but we need to “be aware that our perception and understanding of animals are biased by our own umwelt structure” (Maran et al, 2016: 14). There are indirect methods such as umwelt mapping where knowledge about for example animal’s ecology and way of living is taken into account to create a hypothesis about the content and structure of its umwelt. In umwelt analysis it is possible to map with four basic functional cycles. The four basic functional cycles are related to food, enemies, medium and partner. This also makes it possible to compare different Umwelten and how climate change affects species by examine how their Umwelt is changing (Umwelt Transition) (Maran et al., 2016; Tønnessen, 2009).

4.2.1. Functional cycle

Jakob von Uexküll introduced the concept of functional cycle (see figure 10) which is a schema describing the connection between a subject and an object and how they "are interconnected with each other and form an orderly whole" (Uexküll, 2010: 49). Although the functional cycle divide between subject and object, it does not say how the object react, only the subject. However, the functional cycle can be used both ways and "allows for analyses of the different relations that animals have with the objects in their environments, with other animals of the same or different species, and between animals and humans" (Maran et al., 2016: 15). Functional cycles

> do not usually disappear but develop towards more complicated ones. Thus, it is very improbable that a functional circle once created will disappear; in the course of contradictions met by organisms, these circles are augmented by new elements, made more complex, but still retain their old content. This is why the living conditions of mammal-like reptiles (synapsids, p. 116) can explain some features of their much later descendants (Kull, 1998: 307).

How they interact have much to do with their senses to do, and their environment (medium), that will say "a circular process of recognition and action going on between inside and outside of an organism" (Emmeche, Kull & Stjernfeldt, 2002: 28).

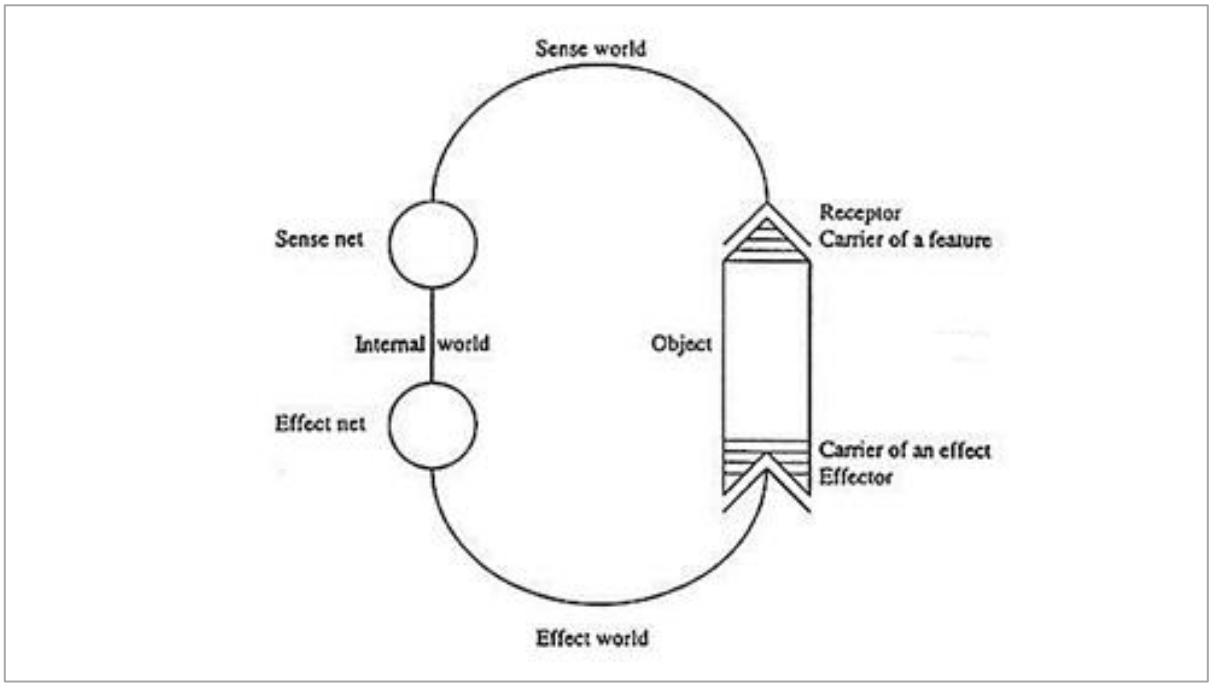

Figure 10 *Functional cycle (Hedaa & Törnroos, 2007).*

A functional cycle has many individual processes and always includes recognition (Kull,1998). In figure 10 receptor is the sensory organs the subject uses, such as smell and the effecters are the activity organs (Uexküll, 2010). Sense world is what the subject's sensory experience, for example, when the categorial perception recognize that the object is food. Categorial perception is the same as

> perceiving in terms of categories, i.e. recognizing objects of perception by aligning them to already familiar categories of objects (…) categorical perception is performed whenever an Umwelt carrier, i.e., a being operating in functional cycles, recognizes an object in its Umwelt as belonging to a specific category of objects which makes a difference in its life (e.g., something 'edible', 'threatening') (Tønnessen, 2009: 56).

The internal world consists of sense net and effect net which are the nervous system – affecting what signals are sent out to the body and muscles. Effect world is how the subject acts because of the senses, for example walk, jump, attack (Uexküll, 2010). Uexküll is known for the example of the tick's Umwelt where he describes the tick as a subject and the mammal as an object (see table 2). Every sensing that causes an act is a new functional cycle. Uexküll describes three different cycles for the tick which has been simplified in the table below. Three functional cycles or reflects happen after each other. First the tick, which is both blind and deaf, needs to recognise the mammal, then access it and finally find the correct place to drill to find food. A categorial perception is performed when the tick recognizes the object mammal as something edible. When the tick has eaten, it lays its eggs and dies. (Uexküll, 2010).

Table 1 *Umwelt of the tick and its functional cycles.*

	Functional cycle 1	**Functional cycle 2**	**Functional cycle 3**
Sense used	Smell	Tactile	Tactile
Object – what is sensed	Butyric acid	Collision with mammal	Body heat
Sign of	Mammal	Success	Skin
Action	Release legs and falls	Running about	Boring membrane
Purpose	Hit the mammal	Find a place to drill	Blood=food

Mammals such as polar bears, ringed seals and humans have a much more complicated life process and Umwelt than the tick. The tick is reacting the same when a mammal is passing by and does not care about much other than eating and laying eggs as it then has fulfilled its "meaning of life" (Uexküll, 2010). While a functional cycle represents one action, Umwelt is

> related to that of contrapuntal ecological relations (…) and represents the behavioural and perceptual repertoire of a living being (...) and a functional cycle an action-directed and alert, momentary Umwelt; a contrapuntal relation subsists between the Umwelt carrier and each of its Umwelt objects (…) which it actively relates to (Tønnessen, 2009: 55-56).

Contrapuntal relations imply that there are mutually meaningful relationships as their behaviour is adjusted to other species. For example, ringed seal as a the main prey for polar bears is an object in their Umwelt by escaping or being eaten, and for the ringed seal, the polar bear perishes as an umwelt object in by being outrun or by death, causing their whole umwelt to collapse (Maran et al., 2016). Therefore "an animal's behaviour and perception can never be studied in strict isolation, but rather in light of ecological relations that can explain the origin and development of both animal behaviour and perception" (Maran et al., 2016: 157). This is also why an ontological map is of importance which will be described in chapter 4.2.2. Their Umwelt can be described by four phenomenal fields. A polar bear for example can choose differently depending on each situation unlike the tick that automatically react to the mammal in the same way, illustrated by the three functional cycle in table 1. How a species reacts depends greatly on how species "experience" each other and how the environment they are a part of is, and therefore also how their environment is changing – all of which affect their umwelt and functional cycles.

4.2.2 Phenomenal fields, Umwelt transition and Ontological map

Phenomenal fields were developed by Friedrich Brock and illustrate umwelt by four phenomenal fields (functional cycles): food, partner (includes both sexual and social partner as elaborated by Tønnessen in Maran et al., 2016), enemy and medium (environment), all of which are important for a subject's Umwelt (see figure 11). All four aspects contribute to determine what a species perceives, how the species is acting and its perception of the world. This illustrates the important interactions the species has, at the same time recognising its

subjectivity and its ability to learn and adapt when change is happening (Brock, 1939; Tønnessen, 2009).

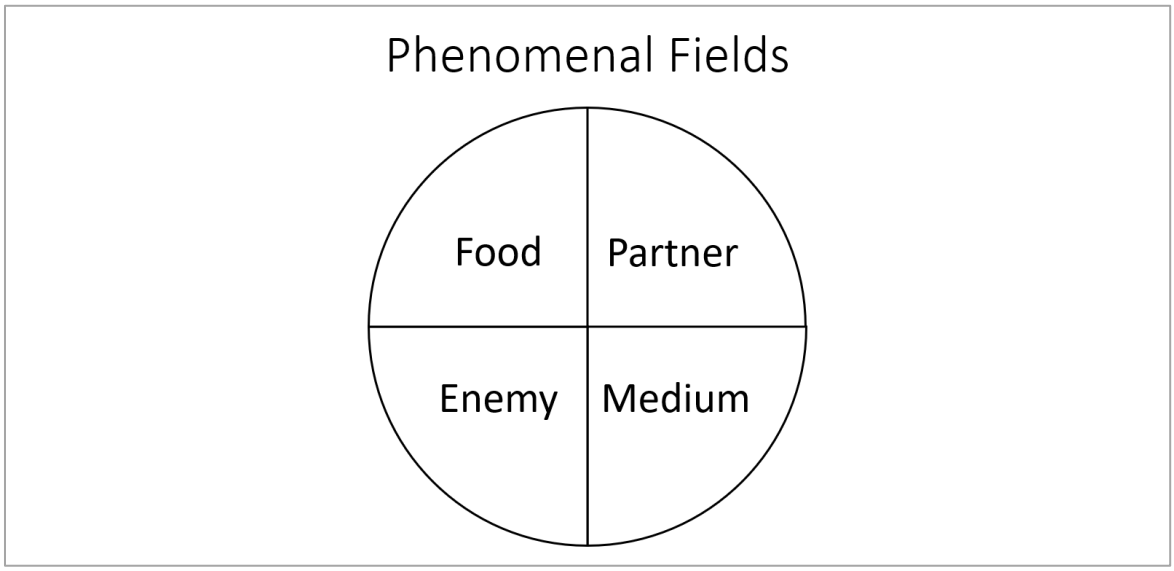

Figure 11 *Phenomenal fields (Author's figure).*

Connecting the subjective species with its environment, show their many interactions and their significant ecological relationships, which further can be illustrated in what Morten Tønnessen call an ontological map. The ontological map is illustrated with the species centred in the middle with different coloured lines, signifying their functional relationship to their significant social and ecological relations (see figure 12). The categories are the same as Uexküll's four main functional cycles. Many relationships, how a subject species appear and is perceived is more complicated than categorising only as partner or food. An enemy can just as well be a partner (Tønnessen, 2011a).

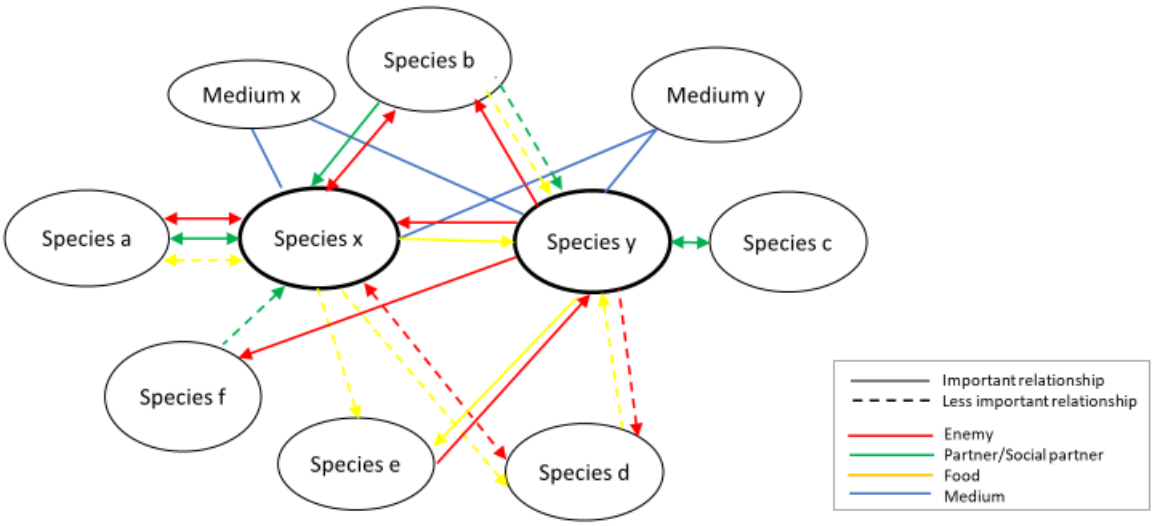

Figure 12 *Ontological map (Author's figure).*

The four phenomenal fields for a species can be described over time, and climate change will affect these fields, consequently affecting their relationships. This will change their Umwelt – creating an *umwelt transition* as they have to adapt to climate change. Morten Tønnessen has developed the concept Umwelt transition, "an Uexkülliaan notion of environmental change" which is defined as "a lasting, systematic change within the life cycle of a being considered from an ontogenetic (individual), phylogenetic (population-, species-) or cultural perspective, from one typical appearance of its Umwelt to another" (Tønnessen, 2009: 49). Umwelt transition can be illustrated by placing the four main phenomenal fields before the specific change next to another set of phenomenal fields after the specific change to compare. If the Umwelt is remaining similar there has been stability, if not, the has been changes that have affected the species relationship – where they either have managed to adapt or struggle to adapt (Tønnessen, 2011b). Because of climate change many species need to adapt to new physical environment to survive as their natural conditions are changing. To examine how polar bears and ringed seals have been affected by climate change we can examine how their Umwelt is changing. This is illustrated in chapter 5. But, it is not only climate change that affect a transition, other elements affect such as laws, for example the law prohibiting polar bear hunting.

4.2.3 The tripartite umwelt model

A fourth model, the tripartite model (see figure 13), illustrate three aspects of umwelt: the core umwelt, the mediated umwelt and the conceptual umwelt. While the functional cycle and phenomenal fields are part of the core umwelt this model is "able to distinguish between Umwelt objects as encountered, Umwelt objects as anticipated and Umwelt objects as conceptualised" (Tønnessen, 2011b: 37).

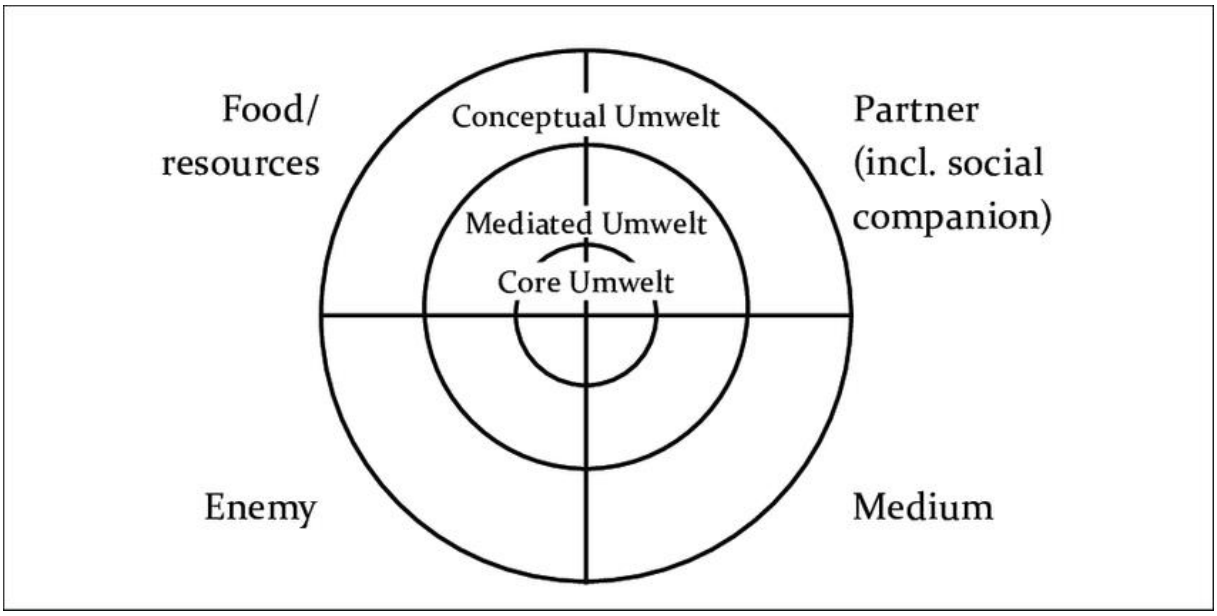

Figure 13 *The tripartite umwelt model. "The tripartite model of the umwelt, combined with Uexküll's four main functional cycles in partly generalised form" (Tønnessen, 2012: 50).*

The core umwelt is where a species interacts directly with others (umwelt objects) - the phenomenal fields described above. The mediated umwelt is where

> umwelt objects are encountered indirectly by way of some mediation, for example, memory, fantasy, and, in the human case, modern media. (…) The conceptual umwelt is the aspect of umwelt in which one navigates among umwelt objects in terms of predicative reasoning in general or human language in particular (Tønnessen, 2012: 49-50).

Here the functional meaning of umwelt objects is established linguistically, but not all animals are subjected for it. The conceptual umwelt is grounded in the core and mediated umwelt. Tønnessen uses the example of perceptually embedded concept of "wall" and "mouse" to describe a conceptual umwelt object. Hearing movements inside a wall and the

memory we have of a mouse can give the association of disgust “ew!” and thereby lead to a behavioural response (Tønnessen, 2012).

While the oldest representations, through pictures and text, of polar bear were based on real observation of their environment and behaviour, portraying them in their natural environment and as a potential danger, polar bears have later become more anthropomorphised and fairy tale-like (Olaussen, 2015). The increasingly popularity of using polar bears in advertisement for different products and as symbol of climate change is not only positive for the real polar bear as it is portrayed unrealistically becoming more of a fictional character (Merskin, 2018; Olaussen, 2015). This will be elaborated in chapter 5.4.

5.0 Analysis and Discussion

In this chapter the theory and models in the previous chapter will be used to analyse how polar bears and ringed seals are affected by climate change.

5.1 Functional cycle – Polar bear, Ringed seal and Human

Our five main senses are important for our umwelt. It is one way of comparing us with other species and to understand other species and how we experience our subjective world, and how our umwelten are similarly and/or differently from each other. Table 2 compare polar bears, ringed seals and humans the five main senses. For polar bear the smell is the best sense, while seals have excellent hearing and we humans use our eyes as our primary sense.

__Table 2__: Comparison of polar bears, ringed seals and humans five main senses.

	Polar Bears	Ringed Seals	Humans
Smell	Excellent	Good	Ok
Hearing	Good/Excellent	Excellent	Good
Eyesight	Good	Good, but aquatic adapted eyes	Primary sense
Tactile (touch)	Unclear	Through their whiskers	Good
Taste	Unclear	Unclear	Good/excellent

Polar bears have an excellent sense of smell because of their large olfactory bulb in their brain which is much larger than humans. They can smell food from more than 1 km away and smell a seal under snow. Seals have a good smell, but not as good as polar bears. They can use their smell to detect predators such as polar bears, but they also use it to recognise their pup. In the water they keep the nostrils shut. Humans sense of smell is inferior compared to other animals, but it is important to us among other because it is connected to our sense of taste. We can detect five basic tastes: sweet, sour, bitter, salty and umami. Polar bears specialise in Arctic marine mammals and especially in arctic seals, but can eat almost anything, but not everything is equally nutritious or good for them. Therefore, it is difficult to say how

important taste is for them. How taste is and how taste receptors function for marine mammals are still poorly understood (I-Kovacs, 2019; Togunov, Derocher & Lunn, 2017).

Polar bears vision is good, although they are a bit short-sighted. They use their nose much more than their eyes, opposite of humans; we use our vision to find where the smell is from and use our vision as our primary sense. Ringed seals have aquatic adapted eyes, making their lens circular so that the eye is resistant under water and the pupils expand to let in as much light as possible under water. At the same time, they must function on air, but they are not highly adapted for sight on air. They therefore have a very good vision under water, much better than humans, however they are a bit short sighted in air and they have a little blue-green colour differentiation (I-Kovacs, 2019).

Ringed seals hearing is excellent both in water and in air. Both in the breeding season and for female and their pup's communication, different grunts and growls can be important way of communicating. They can also detect low-frequency sounds below water. This helps them communicate and find food. Polar bears hearing is good and compared to humans they actually have a wider range of frequencies and can detect sounds from long distances away, almost as long as 5 km (Andersen & Aars, 2007; I-Kovacs, 2019; Polar Bear International, 2019).

The tactile sense is more unclear which happens by direct body contact or by producing vibrations (Martinelli, 2010). For ringed seals their whiskers are important to detect fish. Even in the most difficult waters their whiskers manage to detect fish. It is more unclear for polar bears how the tactile sense work – although it is observed polar bears using both their paws, tongue and nose to touch and interact with things. As mentioned earlier polar bears can communicate by having a nose to nose greeting to ask for something, for example food (Andersen & Aars, 2007; I-Kovacs, 2019; Polar Bear International, 2019).

Functional cycle can be used to explain animal communication and how they use their senses to interact with each other. They have their own subjective world, and how subject and different objects are interconnected with each other can be illustrated in the functional cycle (see figure 14 and 15).

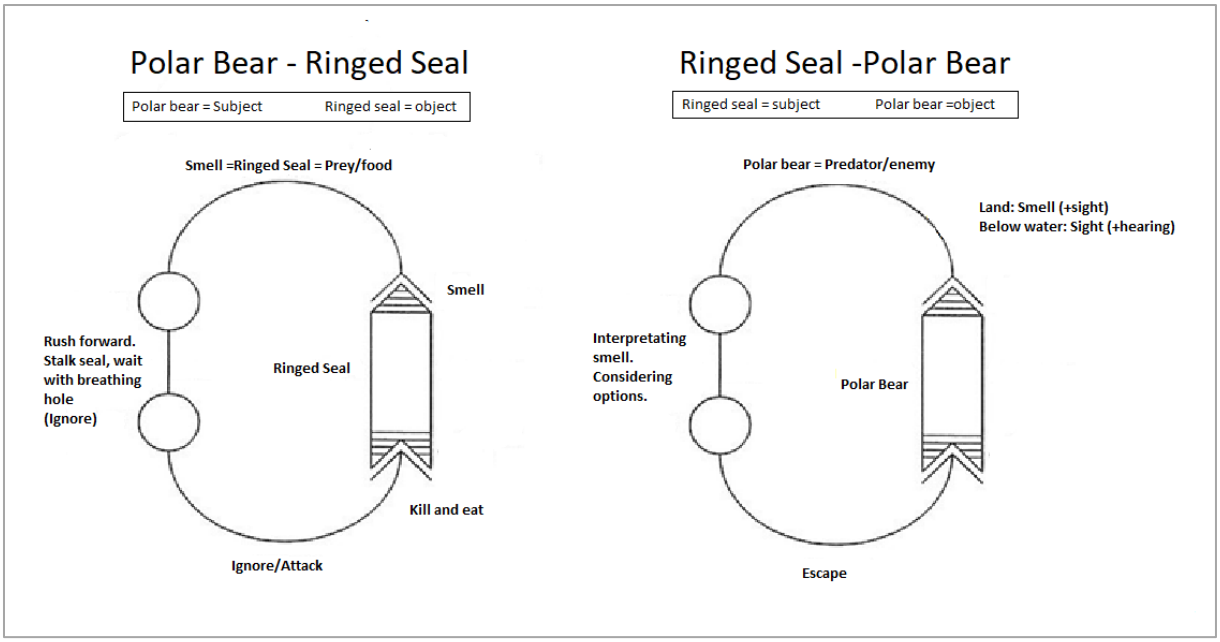

Figure 14 *Functional cycle of polar bear-ringed seal and ringed seal-polar bear (Author's figure).*

When polar bear smells ringed seal and recognises it as food a categorial perception happens and triggers physical and behavioural responses. Polar bears can hunt in different ways. They can smell seals pups under the lairs of snow and target them, or they can stalk seals by swimming close enough to seals hauling on the ice and undetected ambush them. However, the most common strategy, up to 90%, is still hunting. Still hunting is when a polar bear is waiting close to a breathing hole for the seal to appear. This is also the most successful way to hunt. Although the ringed seal needs to come up to breath approximately every 15 minutes, they also can make up to 15 holes making it a possible long wait for the polar bear. They can wait for hours, even up to days to catch the ringed seal although it has a really powerful sense of smell. When the seal surfaces the bear stuns the seal with its front paws and bites its neck to drag it onshore (Leahy, 2018; Pagano et al., 2018).

Ringed seals, on the other hand, associate polar bears with enemy and danger. To not become polar bear food, they have a technique where they blow bubbles up their breathing holes. They do this to trick the polar bear into thinking the seal will surface, so that the seal can detect the polar bear. If there is a polar bear the seal can swim up to a new breathing hole (Freitas, Kovacs, Ims, Fedak & Lydersenet, 2008; National Geographic, n.d.).

Polar bears relationship to humans are a bit more ambivalent (see figure 15). As ringed seal signifies prey and food, not all polar bears have had encounters with humans or little experience, not knowing quite what it is. Unlike most other animals, polar bears do not automatically fear humans. Noises from humans and human activity can frighten bears, make them leave the area, as mention in the example with snowmobiles. But polar bears are curious animals with no natural predators and therefor rarely fear humans. Polar bear shows signs of curiosity by moving slowly with frequent stop sniffing the air trying to catch the scent of humans. If humans are far away polar bears can choose to ignore them, but if they are hungry or just curious, they can move closer, and can eventually attack to kill although they under normal circumstances do not hunt humans. This can also happen if a bear is surprised at close range. Then the bear can show signs of feeling threatened or agitated by making different signs such as stomping on its feet, growling, hissing, panting, taking their ears back and lowering their head (I-Kovacs, 2019; Nunavut Department of Environment, 2007; I-Vongraven, 2019).

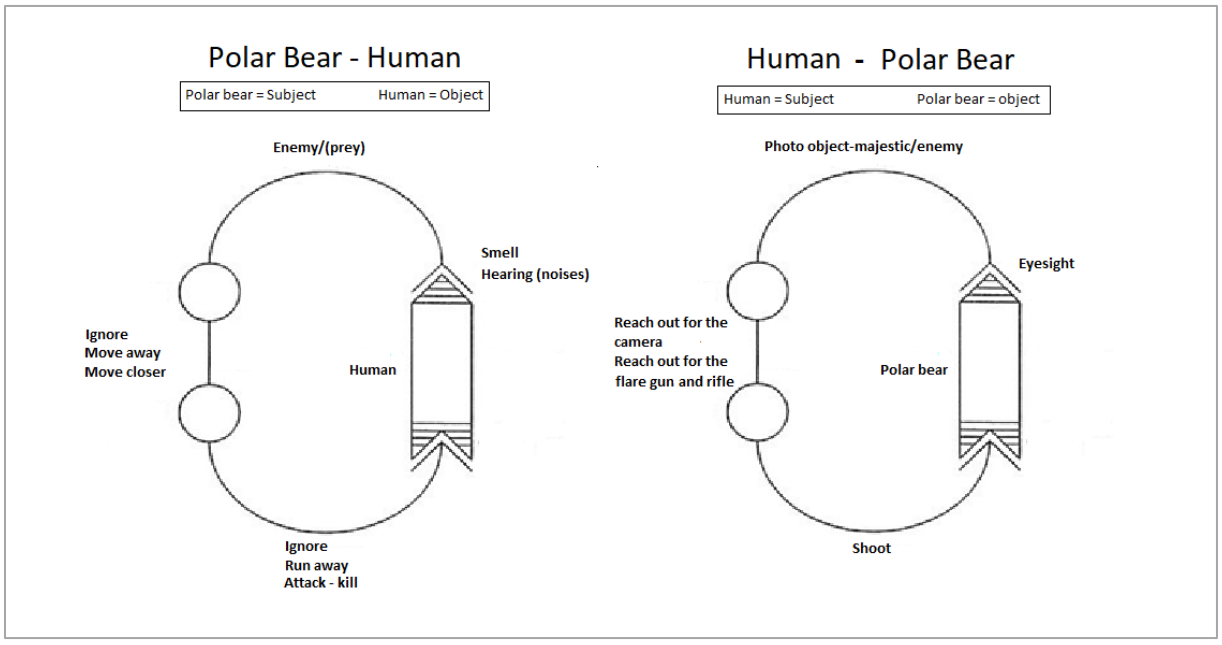

Figure 15 *Functional cycle of polar bear-human and human-polar bear (Author's figure).*

Sometimes groups of people (researchers, students, people hiking) try to avoid polar bears, but many people have travel from far away in the hope to see a polar bear. If one sees a polar bear, depending on the distance, one end up "shooting". "Shoot" here have two meanings; either you shoot to get a picture of the animal or you shoot to scare, and if needed to kill in

self-defence. There are always some precautions, a group should always be equipped with flare gun(s) and rifle(s). The flare gun (and making much noise in general) is used to scare a polar bear if it is close, but not all polar bears are running away. If a bear come closer showing signs to attack one shoot with the rifle. Tourists usually travel in groups with guides which know how to behave and explain this to the tourists. But as there are someone responsible for the security most people relax just waiting for the perfect picture, not thinking about how fearless, strong and dangerous polar bears are (Aars, Andersen & Kovacs, 2005; Clark, van Beest & Brook, 2012)

5.2 Polar bears and Ringed seals Umwelten and Umwelt transition

The functional cycles or phenomenal fields of food, partner, enemy and medium provide a way to compare polar bears and ringed seals Umwelten, illustrated in figure 16.

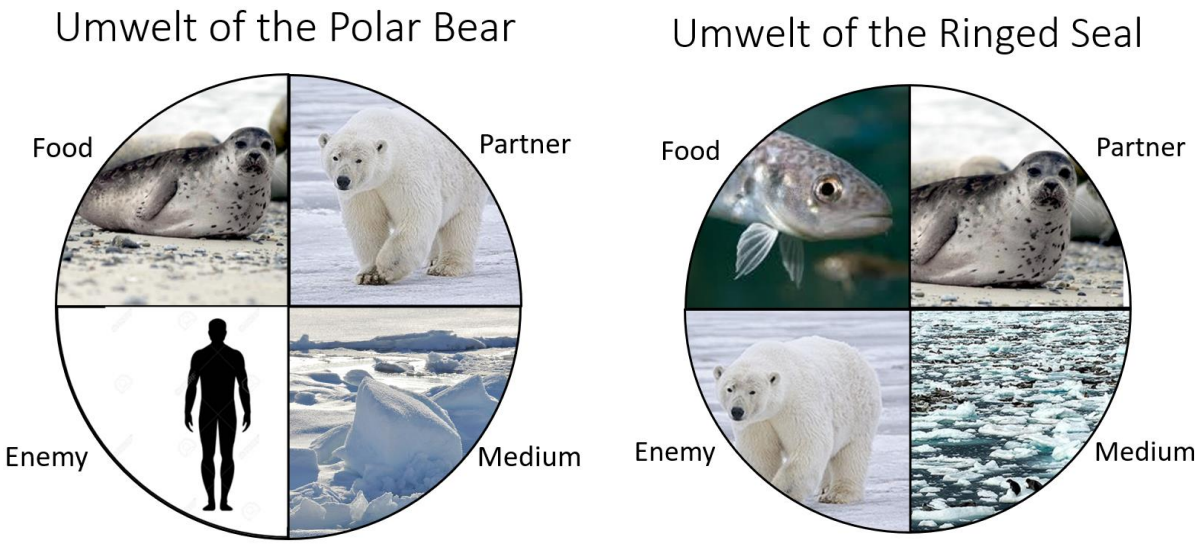

Figure 16 *Umwelt of the polar bear and Umwelt of the ringed seal (Author's figure).*

Figure 16 illustrates the polar bear and ringed seal's umwelt. All the Arctic marine mammals are highly specialised, and all base-affiliated in association with sea-ice. Just losing ice means you are losing your primary habitat. "Sea ice is used as a platform for nearly all aspects of the life history of Arctic marine mammals" (Routti, Jenssen & Tartu, 2018: 356) and as the ice is decreasing rapidly both polar bears and ringed seals environment and umwelt are changing dramatically.

Umwelt Transition – Polar Bear

"Historically harvesting was the primary threat to polar bears" (Derocher et al., 2013: 368). Before the International Agreement on the Conservation of Polar Bears from 1973 the only enemy polar bears had were humans. It is only in Canada hunting of polar bears is permitted in some cases because of indigenous people. This is because they have long culture and tradition for hunting polar bears as polar bears are an important species providing among other economic and nutritional resources (Durner, Laidre & York, 2018). Thereby, hunting is not a challenge for polar bears on Svalbard where they are fully protected. The way humans still are polar bears enemy on Svalbard is through anthropogenic climate change – polar bears biggest threat.

Increasing tourism and other human activities increase the potential for negative interactions (Dundre, Laidre & York, 2018). Unlike places such as Canada, there are not much data showing more conflicts between humans and polar bears on Svalbard. This is most likely due to small and few settlements on Svalbard. Polar bears on Svalbard have much "room to play on" (I-Kovacs, 2019; I-Vongraven, 2019). However, as mentioned earlier, humans do affect polar bears through for example snowmobile activity, scaring them away from areas (Andersen & Aars, 2007). Furthermore, pollution from human activities can have dramatically effects on polar bear's body conditions and survival (Routti et al., 2019). Polar bears do not always show any fright of humans, but humans are the only one that can be categorised as polar bears enemy, except other polar bears. Other polar bears can become a bigger threat now as the available food is decreasing (Stirling & Ross, 2011).

The motivation for a polar bear to kill depends on the animal in front of them. Killing ringed seals are – at no surprise – for food. Killing a polar bear, on the other hand is more complex. An adult male bear can kill a polar bear cub because it wants to mate with the female. The same can happen if a bear is competing with another adult polar bear over a female with or without cubs. There are also examples where females are not involved but two adults are competing and one of them end up killing another and the bear has been eaten of (cannibalism) (Stirling & Ross, 2011).

However, there is still no data confirming that there are more conflicts between humans and polar bears on Svalbard, resulting to polar bears being shot and killed. Neither is there evidence that cannibalism between polar bears are a more normal phenomenon because of climate change, but climate change force polar bears to adapt and find new sources for food

and the problem is that it is hard to get enough nutrients. Stirling and Ross (2011) believe it can be more normal with cannibalism in the future, as it is the way to get enough food and nutrients. Figure 17 illustrates the umwelt transition of polar bear on Svalbard. When human hunting polar bears earlier were their only enemy, other polar bears are a potential increasing threat and humans through anthropogenic climate change and increasing tourism and activities can affect polar bears. But, it is still unclear how much as there are not enough data to conclude, but some studies have been done.

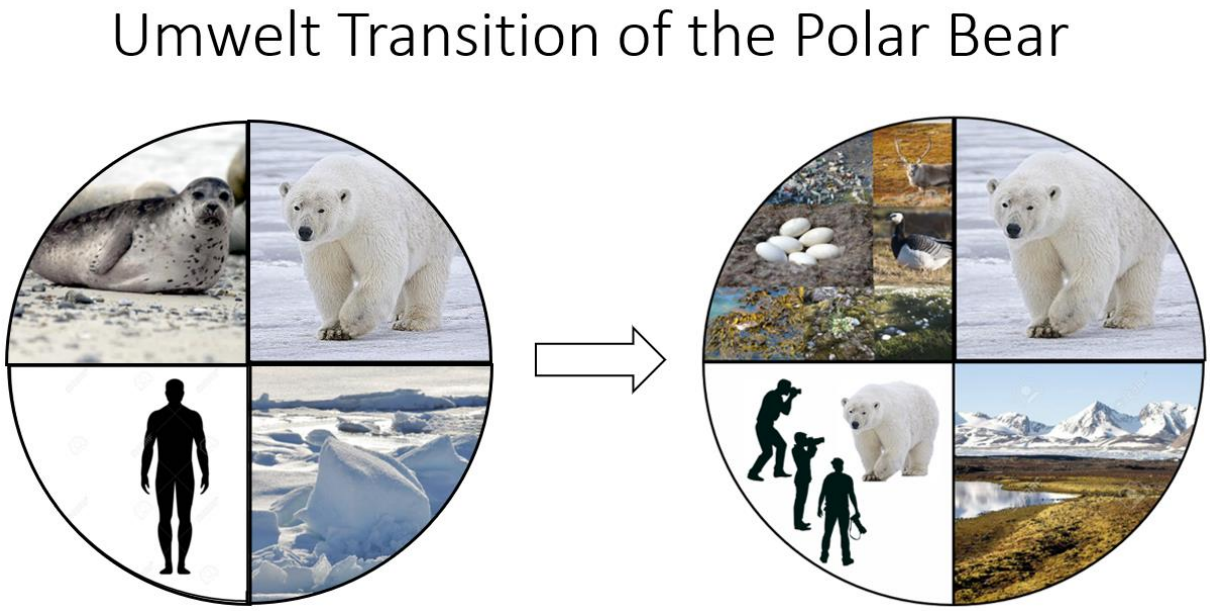

Figure 17 *Umwelt transition of the polar bear on Svalbard. As the ice melts and precipitation comes as rain and not snow, polar bears need to adapt. Their diet is one of the most dramatic change. The lack of ringed seals (and the difficulty to hunt the ones that are) forces polar bears to look for alternative food such as reindeer, birds and bird eggs, vegetation and kelp – which also have made polar bears changed their hunting practices. In some cases they can be attracted to human garbage. Human was earlier a threat because of the excessive hunting, now they are a threat through anthropogenic climate change and tourism, and polar bears are speculated to be an increasing threat as there a less food available (Author's figure).*

Wind can disturb both the transmission of sound and smell. Polar bear can detect sounds from a distance of almost 5 km. It is uncertain how often polar bears are disturbed and fleeing away from human noises (Andersen & Aars, 2007)

> We believe that potential reactions of polar bears are often not detected by humans since bears react before they are within our eyesight. This may mean that bears are unintentionally displaced from important feeding areas. It also may indicate that reaction distances and patterns of bears habituated to tourists or photographs may provide a false impression regarding disturbance (Andersen & Aars, 2007: 504).

Although polar bears can move long distances and can easily move if there are disturbances in the area, some individuals have a small home range where they can have a small-scale movement, for example long distances within a certain area such as a fjord. Polar bears living in small home range are vulnerable for disturbance in these areas (Andersen & Aars, 2007). More human activities, and especially increasing tourism can in the long run have negative impact on polar bears habitat and affect their behaviour. In the study by Andersen & Aars (2007) some polar bears still-hunting were observed leaving the ringed seals breathing holes as a result of vehicles. Disturbances have most negative effects on females and cubs, and as it is common for polar bears to take refuge in water when they are startled, it can affect their body conditions and give much stress as they need to swim in open water and thereby also affect their chance for survival. Andersen and Aas (2007) conclude that "repeated disturbance leading to running and interrupted hunting could result in increased energetic stress on the animals. Further, in extreme situations, overheating from running could lead to death of the animal" (Andersen & Aas, 2007: 506). The increasing tourism in Arctic makes it important to know more how wildlife and marine mammals get affected by tourism, but these studies are demanding, and these types of studies can also disturb the mammals studied (Andersen & Aas, 2007; I-Vongraven, 2019).

Another dramatic effect of climate change is the change in food access. Although polar bears are omnivore, both polar bears and ringed seals are categorised as carnivores as their natural diet is meat-based. However, polar bears meat-free diet will increase as a result of climate change. As the ice melts ringed seals are getting more and more concentrated directly in front of tidal glaciers in much smaller territory. Fish prefer colder water coming from tidal glaciers, which give seals much and easily accessible food. The problem for polar bears is that there is no ice for them to stand on and hunt ringed seal. Before there were chunks of glacier ice frozen into first year fast ice, like ice platforms, through much of the summer. Now there is still glacier ice because the ice is calving, which is very difficult for polar bears to hunt on even if the seal hauls out on them. They tend to be small and tippy. It is hard for polar bears to get close enough and there are no breathing holes to wait by, which is their normal hunting strategy; waiting at breathing hole and catch the seal as it comes up for air. It has also been more difficult for polar bears to access the seals denning areas (I-Kovacs, 2019; MOSJ, 2019c).

There are less polar bears hunting in front of glacier and more doing other kind of hunting. Despite this, the population on Svalbard is likely to have a positive development for a short

time. This is not because they are having a good time, but the polar bear population on Svalbard was taken down to such a tiny number that there are still a lot of food compared to the tiny size of the polar bear population although the food is declining. However, this will reverse and the carrying capacity will exceed because of climate change (I-Kovacs, 2019; MOSJ, 2019c). The land-based (terrestrial) polar bears therefore go on land to find alternative food – nonpreferred prey. Birds, eggs and reindeer have become a part of their diet. This do not give the same energy as ringed seal, and the bears need to find more to get the right amount of energy - "a bear would spend more energy chasing than the actual energy value of the prey it will consume" (Routti, Jenssen & Tartu, 2018: 356). If they also need to travel more to access food, they will lose more weight and muscles which lower the likeliness for hunting success (Leahy, 2018). One studied from the Beaufort Sea showed that polar bears have greater energy demand than previous believed. This also can explain why polar bears prefer still-hunting (Pagano et al., 2018). If they do not have access to ringed seals, many polar bears can use more energy than they consume as they have a high metabolism, where many are in risk of starvation.

Kelp and vegetation have also become a part of their diet. It is unclear if it is just a stomach filler or if they are searching for a specific nutrient that they are not getting any longer when they do not eat seals. Ringed seals are also rich on fat and omega-3 which make polar bears cholesterol level drop. How a new diet affects their cholesterol level is uncertain (I-Kovacs, 2019). Another problem is that their new prey such as reindeer also start to struggle to find food as the climate is changing. When the precipitation come as rain, it often freezes on the ground covering plants and vegetation making it difficult to find food which can affect the reindeer population (Heggberget, Gaare & Ball, 2002).

"This sea ice cover decline is likely to lead to qualitative and/or quantitative diet changed for a number of species, as a consequence of phenological mismatches between predator/prey distribution" (Routti, Jenssen & Tartu, 2018: 355). Ultimately, it can have dramatically consequences on the whole food chain and ecosystem. Polar bears are highly adaptable to change as one see that they find alternative ways of hunting and alternative food. On the other hand, polar bears are extremely vulnerable as they are almost completely reliable on one prey species, the ringed seal.

Umwelt Transition – Ringed Seal

Ringed seals have changed their behaviour dramatically with the collapse of sea-ice on Svalbard, now living in a quite different world than earlier (see figure 18). The ringed seals do two stretch, like the polar bears do. Some of them stay in-shore all year-round others go off-shore (Freitas et al., 2008; I-Kovacs, 2019).

The "off-shore seals" are still going off-shore, but when they go off-shore they behaviour differently. They travel to the summer sea-ice that they used to occupy, but they need to travel much further. They are not doing area restricted search because it does not look like they find food concentrations like they used to do before. They used to do a lot of diving right under the ice and they are not doing that anymore because there is less prey immediately under the ice presumably because the ice is much more broken. As a result, they are moving more around, swimming longer, diving for longer and deeper, and they are resting less on the surface. It cost much more to get food. The group on shore are staying in-shore all the time. They have always liked the glacier fronts and tidewater glaciers, but now they are there all the time in much tighter territories trying to keep their diet, polar cod which are found in these areas (Hamilton, Lydersen, Ims & Kovacs, 2015; I-Kovacs, 2019).

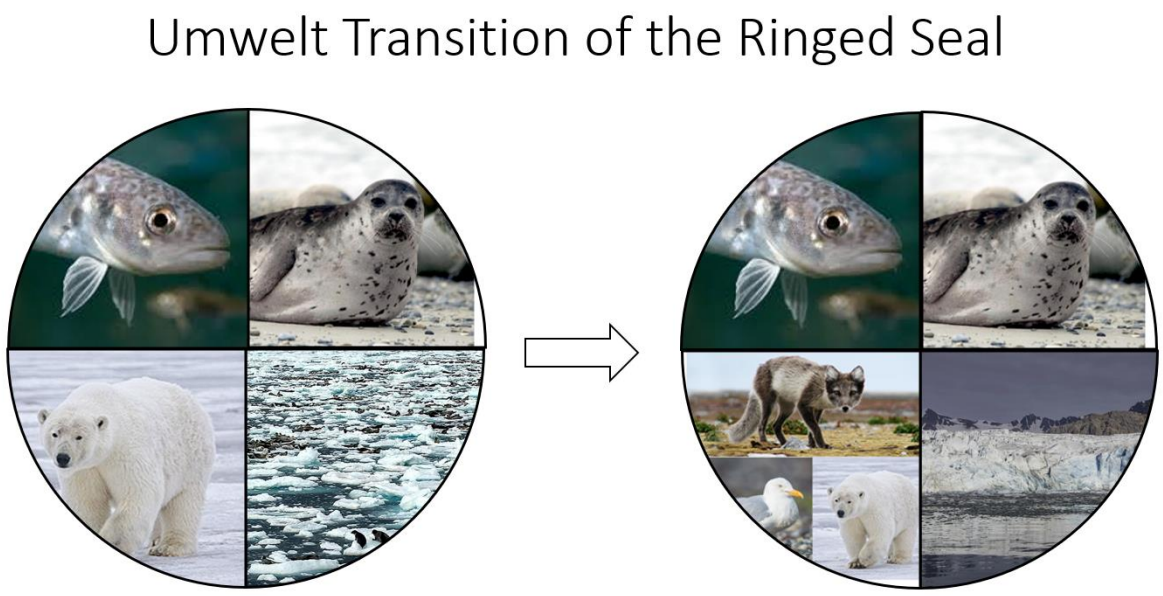

Figure 18 *Umwelt transition of the ringed seal on Svalbard. The lack of snow and ice have created smaller area of territory and affects both the mortality rate for ringed seals pups as they get more enemies. Dramatically, this led to the reproduction rate being close to zero. This can have dramatic effects on the ecosystem as a whole (Author's figure).*

The main prey for ringed seal is polar cod, and they also eat different decapods and amphipods. As a consequence of climate change there is a movement of temperate species north. There is a lot of what is classified as invasive species (I-Kovacs, 2019). For example, fifteen alien invertebrate species introduced via imported soil have settled in Svalbard (IPBES, 2018). But also, species such as mackerel, halibut, herring and Atlantic cod are coming up in the fjords of Svalbard, that 10-15 years ago you would never have thought would be there (I-Kovacs, 2019). The whole food web is changing dramatically. As they still have enough food it does not look like it affects them, however, new plankton species and fishes can change the food web and the ecosystem as everything is connected (illustrated in figure 8).

The lack of proper snow gives an advantage for the polar bears. Ringed seals pups become an easy prey when they are not in a den but born in open air. However, the lack of ice challenge both the polar bears hunt and gives problems for ringed seals to give birth. Because of the lack of ice there are many problems when it comes to giving birth to pups. As there is no snow to protect their pups, the mortality is high. “In many areas we see nothing but red splashes on the limited ice available, because there isn’t snow cover to make the lair the ringed seal normally would use. So, even glaucous gull, big birds, are killing baby ringed seals because they are born on the surface” (I-Kovacs, 2019). As the ice disappear polar bears are not the only enemy; birds and Arctic foxes see the opportunity to feed on seal pups laying on the open ice, not protected by snow. When the ice melts seals do not give birth at all. It is never observed a ringed seal that go to land to give birth. There has been reproductive failure since 2006. Despite polar bears having trouble hunting adult ringed seals and although there is no proper estimation measurement, it is clear that high mortality rate and only a few areas where there is retained ice and enough snow (where there is some reproduction), impact the population negatively (I-Kovacs, 2019).

A normal cycle for ringed seals is that they go down about 1/3 or more of their body mass every spring because they reproduce. When they do not breed pups, they do not lose all that weight. Ringed seals are opportunistic, that means that they take in as much food as they can all the time. Less seals means more food. Consequently, their body mass is higher than normal which is a problem for their health. Consequently, there are fewer of them, and they are not reproducing (I-Kovacs, 2019.

5.3 Why are polar bears and ringed seals important?

Why are these animals important at all? Looking at the food web algae and plankton are more important – for what is happening with them will affect the whole system. Nevertheless, polar bears (and ringed seals) are important in the system, in that they are our systems drivers having a top-down control on the ecosystem, if you pull one of the out of the system, it often causes unbalance and changes that you never would predicted. The polar bear has a function although not the most important in the ecosystem as the attention given to it (I-Kovacs, 2019; I-Vongraven, 2019). The relationship between polar bears and ringed seals are vital to maintaining the balance between the two species, but also for the rest of the Arctic species and ecosystem, see figure 19. For example, polar bears and arctic foxes have a commensalism relationship, a one-sided symbiotic relationship, which mean that one species benefits from the relationships while the other does not get affected. Some arctic foxes follow polar bears to feed on the leftover food after polar bears hunt (Lee, 2018).

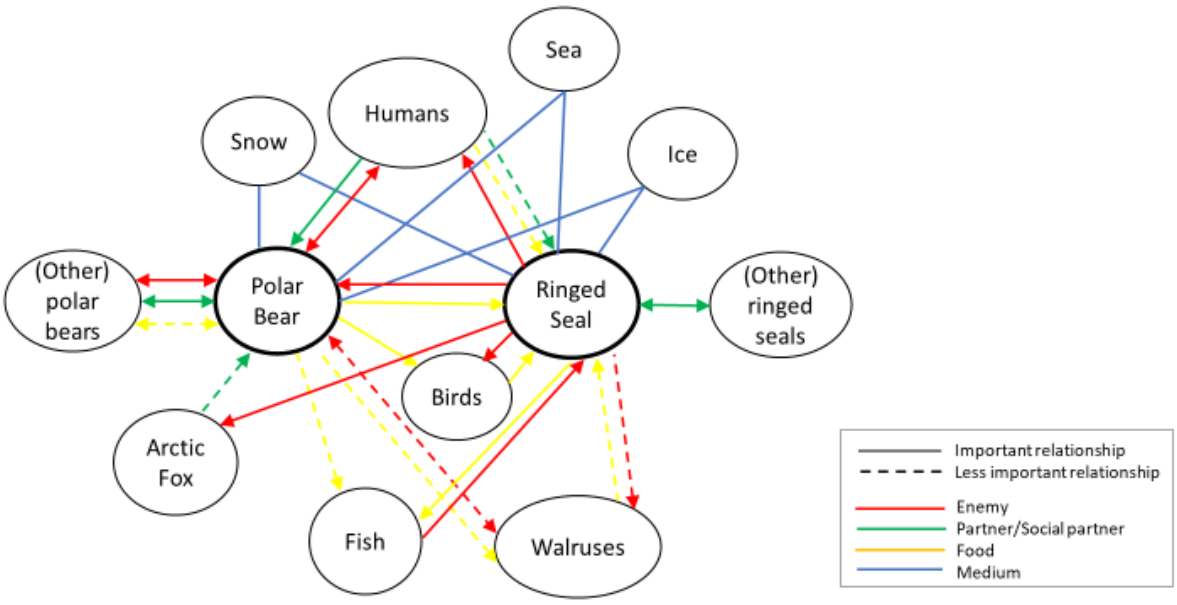

Figure 19 *Ontological map of polar bears and ringed seals relationships (Author's figure).*

Many of polar bears and ringed seals relations and connections have changed as both snow, ice and sea have changed. For example, birds (glaucous gull) and ringed seals were earlier not much connected, but now they have become an enemy for ringed seal pups. Some relationships can be of many different types; another polar bear can be both an enemy, partner

and food (but less important). As figure 19 illustrate not all relationships are of same importance. Although there are examples of polar bears, usually adult males hunting walruses (most likely when there are lack of food), walruses are also large predator that can be a threat for polar bears, and therefore the two species usually avoid each other. If a polar bear goes after a walrus, it is usually desperate for food. To have a chance to kill an adult walrus it must be weak/sick according to Jon Aars in an interview for national geographic (Gibbens, 2018).

In the ecosystem the role of the ringed seal is more important because more species are dependent on the seal for example for food. Polar bears are the top carnivore of Arctic and the leftover of killed animals after polar bears are often food for other animals such as the arctic fox. Also, for humans' polar bears have become "flagship species". A flagship species is a "popular charismatic species that serve as symbols to stimulate conservation awareness and action locally, nationally, regionally or globally" (IUCN, n.d.: 29). Polar bears have become an ambassador or icon for climate change in Arctic as well as a symbol of climate change globally. "By focusing on, and achieving conservation of that species, the status of many other species which share its habitat – or are vulnerable to the same threats - may also be improved" (WWF, n.d.).

These animals can be said to define Arctic, and if we cannot take care of these big charismatic animals, how can we take care of smaller, obscure and less well-known species? It is not just the polar bear and the ringed seal or another species that have problems, but the whole ecosystem and the entire planet (I-Kovacs, 2019; I-Vongraven, 2019). Both being a symbol of climate change and their majestic appearance have made them to the largest "attraction" for tourists coming to Svalbard. "Considering the global attention paid to polar bears, managers will be forced to respond to sudden changes in environmental conditions that negatively affect polar bears" (Derocher et al., 2013: 373)

Interestingly, we care about them because we are "alike". Although at first thought humans are very different from polar bears and ringed seal, we also have much in common. Polar bears, ringed seals and humans are all mammals, which make it easier for us to compare us with each other and connect with them, more than with other types of species such as insects. While humans live in terrestrial habitat and ringed seals is considered aquatic, polar bears are a mix of the two. Terrestrial landscape is also important and polar bears are the least aquatic of all marine mammals. The more shared bio-behavioural traits we share with another species, the more humans are valuing them (Batt, 2009). Human attitude toward animals are more positive the more the species are alike, and this can as mentioned earlier have positive effects

on other species. The way we portray animals can be of help for them, but it can also be problematic.

5.4 Representation of the polar bear

For a long time, there has been a fascination of polar bears. Historically, in painting and pictures polar bears symbolised the unknown, unpredictable and dangerous. The illustrations were of aggressive polar bears and could illustrate fights between polar bears and humans. Most of the stories and illustrations were based on real observations of polar bears and their natural environment and natural behaviour (Olaussen, 2015). There was a true fascination for the Arctic as an exotic place with harsh conditions for people. It became a symbol of the unknown land (Merskin, 2018; Olaussen, 2015). In the late 1700th, early 1800th the focus was on the sublime (and fearsome) and the beauty. The Arctic and the polar bear in this massive unknown landscape captured this. Instead of heroizing the expedition or romanticizing the polar bears the raw brutality in the Arctic was in focus (Olaussen, 2018). Later many expeditions to the Artic brought polar bears to the mainland. Many polar bears cubs were brought to zoos and polar bears which were shot were often taxidermized and brought to museums. Today most museums and zoos have a polar bear in their animal collection (Merskin, 2018). Polar bear rugs were popular as a trophy, and many associate polar bear rugs with women as many women with hardly any clothes, many of them celebrities, posed on pictures with a polar bear rug (Merskin, 2018; Olaussen, 2015).

Gradually, there have been a disconnection "between the symbolic polar bear, representations of the bears in media and popular culture, and the potential effects of human cultural mediation on our understanding of other species" (Merskin, 2018: 137). Most people have never encountered a polar bear, but most people have a relationship to the "white bear". Thus, most people cannot place the polar bear in their core Umwelt, but rather in their mediated Umwelt and conceptualised Umwelt (Tønnessen, 2011b). Our idea of the polar bear (and other wild animals such as the ringed seal) are influenced by what we have heard, read and seen, which we do most from representations in the media. Polar bears have been used in many campaign and commercials the last decades. Unlike other predator species like wolfs, lions and bears which have been portrayed as powerful and fierce, polar bear have been portrayed as cuddly and gentle animals (Merskin, 2018). "A real polar bear walks in the line

between who we perceive him or her to be and the realities of his/her lived experience" (Merskin, 2018: 139).

> Polar bears are considered charismatic mega fauna, i.e. those species who have popular appeal because of their size, inviting appearance, large ears and eyes are "cute cuddly, majestic or furry", with otherwise positive qualities known as neoteny. (…) a shortened nose, big eyes, a disproportionally large head, and round and soft body features paired with playfulness or curiosity turns us all gooey inside. This cuteness triggers the release of hormones that stimulate pleasure centers in the brain in humans that encourage nurturing and protection" (Merskin, 2018: 146).

In the conceptual Umwelt of humans, polar bears are likely a positive Umwelt object. Polar bears are used in much marketing and merchandising for different products such as stuffed toys, movies, and beverage (Merskin, 2018). For example, the Coca-Cola Polar Bear has become a familiar face in Coca-Cola advertisement campaigns. Commercials, both posters and animated video clip, together with stuffed animals and a human size mascot have been used. These anthropomorphic polar bears do not show many of their natural behaviour. Among other they show families with a mother, a father and children, and polar bears and seals are friends. The Coca-Cola company have earned much money on the Coca-Cola Polar Bear, but have also started to work together with WWF to conserve world's water resources and has raised several million dollar for polar bears (Merskin, 2018; Moyer & Nemer, 2016).

Because polar bears today are a flagship-species – a symbol of climate change, polar bears do not longer symbolise the unknown and dangerous, but instead have become the image of the threatened both in campaigns for animal and environmental protection organizations and in people's consciousness (Olaussen, 2015). Polar bears have also been used to marketing travel destinations. For example, Visit Norway title the destination of Svalbard with "The realm of the polar bear" (VisitNorway, 2019). Polar bears have become an attraction for "last chance tourism" (Lück, Maher & Stewart, 2010; Merskin, 2018). This has become popular as polar bears have "become the most evocative species in the media showing the struggle to survive in a changing environment" (Merskin, 2018: 148). We all associate polar bears with climate change. To communicate the issue of climate change to a broader public, polar bears have been used as the "face" of climate change. Anthropomorphized bears were commonly used to get the public to emotionally relate to them and thereby identify themselves with polar bears. There was much focus on the family lives of polar bears and pictures of them displaying "emotions". Connecting them with climate change connects them with being in danger which

evoke feelings; they are vulnerable, cannot take care of themselves and it is up to humans to save them (Born, 2018; Merskin, 2018). “The polar bears become “charismatic victims”, romanticized, anthropomorphized, in need for human help and, therefore, deprived of agency” (Born, 2018: 11).

Today commercials also use climate change as a way to sell their products. For example Nissan used a polar bear to sell Nissan leaf, an electric car (see figure 20). They end the commercial saying: “100% electric, innovation for the planet, innovation for all”. The description of the video also says:

> “Seeing its arctic home melting away, a lone polar bear begins its great journey to seek out the cause of global warming. Along the way, the polar bear witnessed pollution and finally finds a man who is trying to make the world a better place to live by driving a 100% electric, zero emission Nissan LEAF car. This causes the bear to give him a hug, thanking him for his action (NissanMalaysia, 2012).

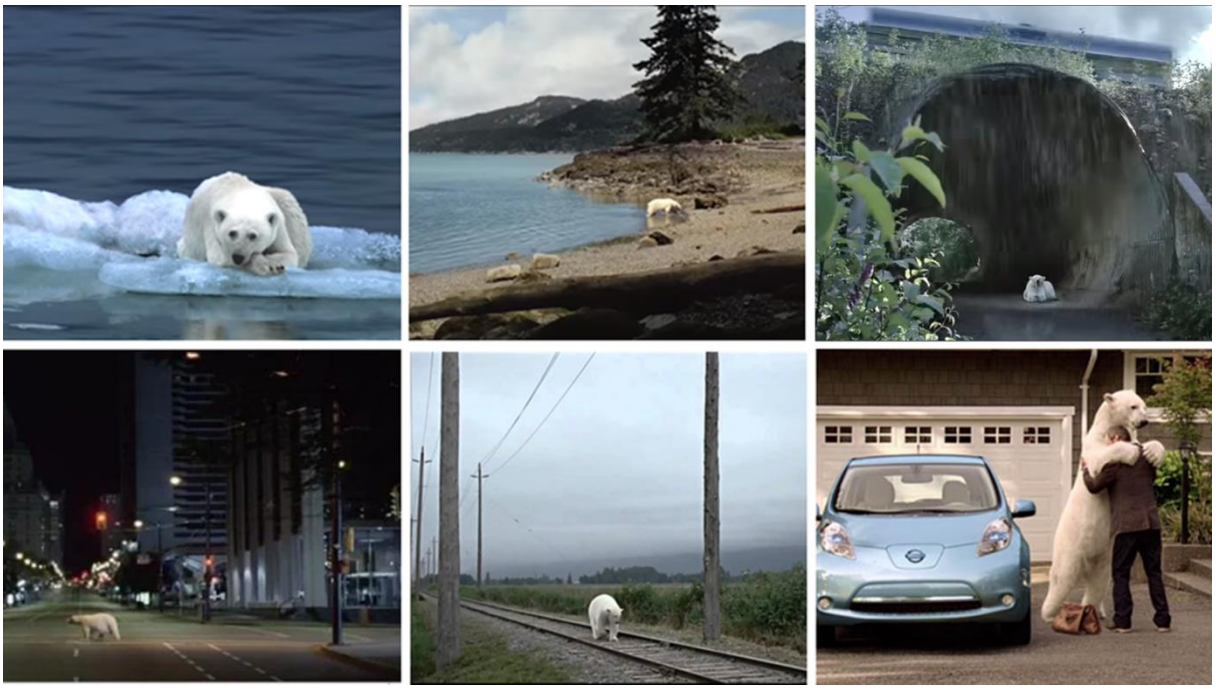

Figure 20 *Nissan Leaf Commercial. Screenshots from the Nissan Leaf commercial (NissanMalaysia, 2012).*

There has been criticism for focusing on one single species because the public are losing sight of the overall issue (Born, 2018). In 2009 it was proposed by IUCN to add ten new species to share the “burden” with polar bears. The ringed seal together with nine other species were

later added to the IUCN climate change flagship species. The goal is that several charismatic animals can attract public attention, both to the species but most of all to the overall challenge - climate change (Barua, Root-Bernstein, Ladle & Jepson, 2011; Merskin, 2018). “A whole fleet of flagships would have an even greater effect” (Barua et al., 2011: 431). But other species such as the ringed seal do not have the same commercial value as polar bears have (Merskin, 2018). Furthermore, what we know about polar bears come mostly from the media. Corporations and organisations often have an overly positive representations of polar bears, looking happy and humanized. Although, Coca-Cola cooperates with WWF their commercial of happy polar bears drinking with family and friend, which include several types of species which in reality are their prey, gives a false image. All the inaccurate information can result to a sense that they are less endangered than they in reality are (Merskin, 2018).

> research shows that using bears, or other wildlife to advertise products can have the opposite effect than intended on their conservation: “Academic research of marketing unsurprisingly shows that the more abstract and anthropomorphized an animal character is, the less consumers think about the real animal and its natural context” (Engelhard, 2017, p. 212)” (Merskin, 2018: 152).

While representations of polar bears earlier were based on their natural environment and behaviour, the increasingly advertisements of products using polar bears have made them a harmless and fuzzy teddy bear. The real polar bear is portrayed unrealistically becoming more of a fictional character, and we are not valuing the real polar bear. How humans think and believe also affect their lives and what kind of actions we take. All the attention polar bears have gotten can therefore have opposite effects and affect other species.

6.0 Conclusion

There is consensus that the change in climate we see today is not only natural varieties but effects of anthropogenic activities. Climate change will have dramatic effects on biodiversity which gives us healthy ecosystems we all are dependent of, not only to thrive but to survive. Arctic is one of the most vulnerable places on the planet and Svalbard is unique due to its location. Global warming happens twice as fast in Arctic than the rest of the planet and even faster on Svalbard. Arctic and their species, especially the polar bear, have become a symbol for climate change and the extensive challenge our planet is facing. The Arctic is important because the sea is cooling down the polar regions and balance the temperatures on the planet as whole as the ice and snow reflects the sun's radiation back to space. Without the ice more of the sun's energy is absorbed into the ocean accelerating global warming and changing climate patterns. The Arctic marine ecosystem is important for the global biodiversity, having many important species from algae to polar bears. If one species disappears it can have cascading effects on the ecosystem and key species can go extinct.

One of the species on our planet that experiences the changes the most is the polar bear. All the Arctic marine mammals are highly specialised, and all base-affiliated in association with sea-ice. Just losing ice means you are losing your primary habitat. Because polar bears are on top of the food web it can also signal what problems other animals have and the challenges the planet is facing. How polar bears main prey, the ringed seal is affected by climate change will affect the lives of polar bears enormously and the balance in the Arctic ecosystem.

Zoosemiotics and umwelt theory can contribute to a holistic understanding. It focuses on four parts: enemy, partner, food and medium, all of which are essential for an animal life world and therefore illustrate all the aspects of how they are affected by climate change. How they are affected can easily be illustrated through Umwelt transition (see figure 21 and 22).

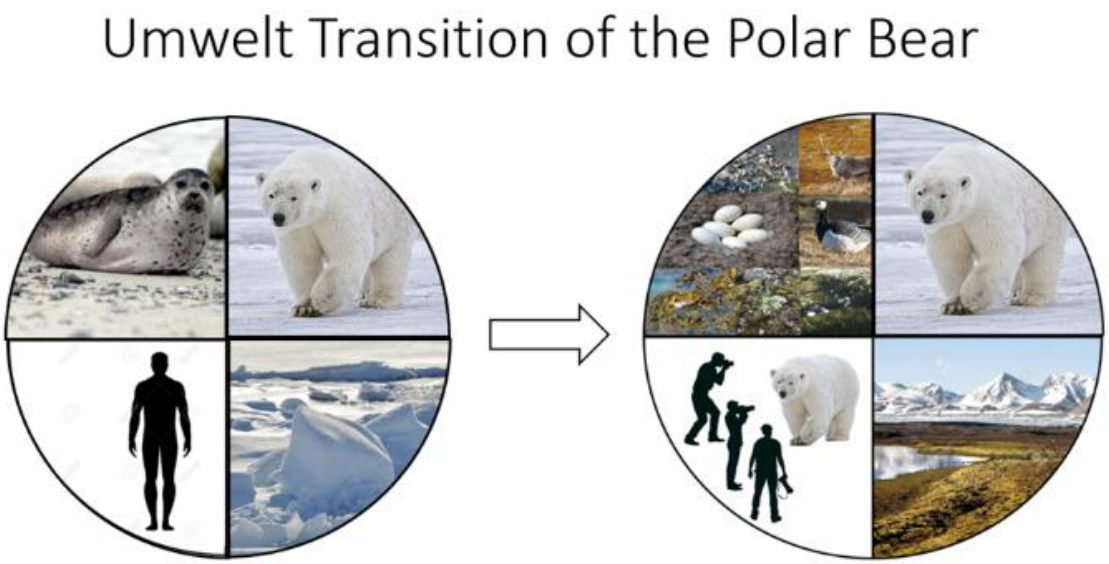

Figure 21 *Umwelt transition of the polar bear (Author's figure).*

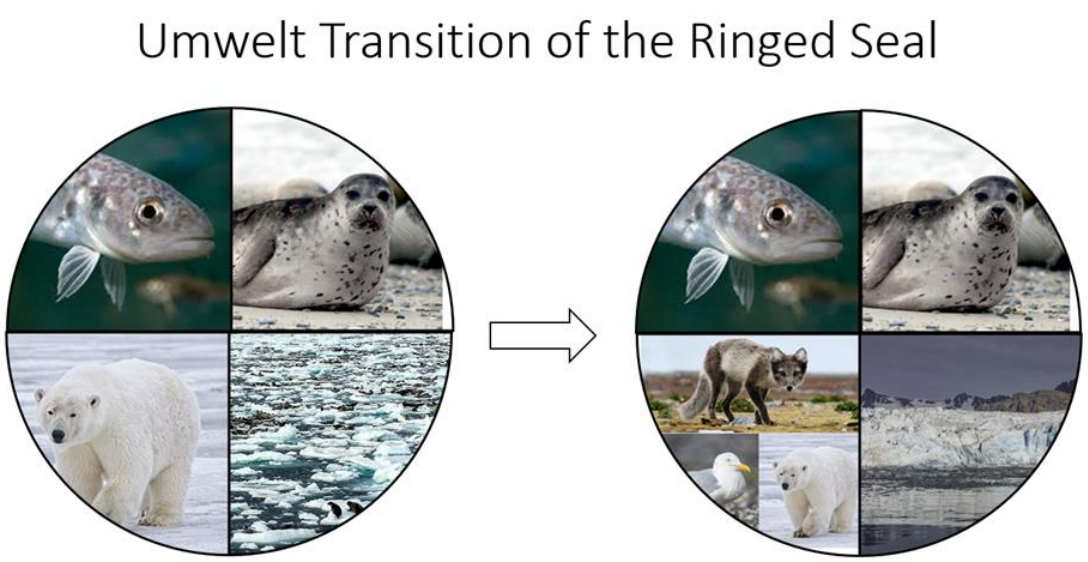

Figure 22 *Umwelt transition of the ringed seal (Author's figure).*

Their medium is changing rapidly. Both polar bears and ringed seals are marine mammal's dependent on ice and snow to hunt and reproduce. Without it they will not survive. When the sea ice is disappearing, and precipitation comes as snow and not rain ringed seals must give birth directly on the ice not protecting their pups. This make them an easy prey for polar bears, but also for arctic foxes and glaucous gull, species that earlier did not hunt them. Despite seal pups consequently become an easy prey for polar bears, they usually hunt adult seals which have more fat. But less ice makes the seals move further and tight up to the

glaciers where it can be difficult for polar bears to reach them. They are also hauling out on ice, but the ice from the glaciers are calving and they are small and tippy making it hard for polar bears to hunt. The lack of ice and snow makes the reproduction rate of ringed seals decreasing rapidly. Consequently, polar bears need to find alternative food sources (reindeer, birds, eggs and vegetation) which does not give the same amount of fat and nutrients needed for a polar bear. They also need to move more to find enough food, which also is the case for some of the ringed seals. Polar bears are naturally using much energy and as they prefer still-hunting on ringed seals, this change in hunting technique can make them use more energy than they consume. A potential way of getting the right amount can be through cannibalism. Although researcher mentioned this as a potential effect of climate change, it is still a poorly understood and more research is needed.

Climate change have made it possible for more tourism, and more tourists are traveling in polar bears habitat. The shrinking ice have made Svalbard easier to travel to by boat and because polar bears have become a flagship species and an attraction for "last chance tourism", tourists arriving by both plane and boat have increased rapidly. Research conclude that polar bears are disturbed by human noise. This can stress them and make them run away from their areas where they usually hunt. Also ringed seals get disturb by noises under water, and more human activities can disturb them and affect their behaviour. As their habitat is shrinking it can have dramatic effects on their lives and survival. Research from other parts of the Arctic have already concluded that there have been more human-polar bear conflicts as a result of climate change and increasing activities by humans as both polar bears are looking for alternative food sources close to human settlements and more people visit more places to see polar bears. In the future this may also be the case on Svalbard, but there is still needed to do much more research on the relationship between tourism and its effects on polar bears and ringed seals before one can conclude. Svalbard has many strict regulations and work closely with the tourist industry, but at the same time as the goal is to be one of the world's best managed wilderness areas, they plan to further develop the tourist industry. It can be questioned if this is realistic. Furthermore, emissions from industrialised parts of the world, and potentially emissions from cruise ships, creates pollution which can change the food web structure, body conditions and movement pattern for species. Climate change will also release more pollution as some are stored in the ice.

Umwelt theory also focus on the representation of the species. It is almost impossible to think about polar bears and not think about climate change. Many pictures of polar bears on drifting

ice or polar bears starving have frequently been used in media and by environmental organisations. Although polar bears are starving, the situation is more complicated than media often portray it. Polar bears are also strong and highly adaptable but faces several challenges and how climate change affect other species also affect polar bears as everything is connected. Through history we have regarded the polar bear as a monster, a commodity, a trophy and status symbol, a favourite in the zoo, a vulnerable teddy bear and a victim of climate change. Polar bears have the perfect appearance to reach out to people's emotions and have been used widely in merchandising. Their commercial value has helped many companies sell their products. Polar bears are given human traits and put in a "friendly role" portrayed as happy and kind. All this attention together with inaccurate information can give the wrong understanding of the species and their situation. It can have the opposite effect than intended. The real polar bear in its natural context is replaced with a fantasy bear and the whole ecosystem and species that are connected can be forgotten. At the same time the increased attention and popularity of the polar bear can make people's attention go to the Arctic and thereby affect what is being done for the whole ecosystem and eventually contribute to a more sustainable world.

In this thesis some smaller modifications were done of the models to make the theory more applicable for analysing the research questions. By using pictures in the models of phenomenal fields and umwelt transition it gives a clearer presentation of how polar bears and ringed seals communicate and how climate affect them and their life world (Umwelt). In the ontological map it was important to not only illustrate the different types (enemy, food, medium and partner) of relationships polar bears and ringed seal have, but also how important they are. By illustrating the more important relationship with a solid line and less important with a dotted line it can clarify the connection climate change has. For example, walruses are a potential food source only if there are lack of food which climate change have made an increasingly problem. In a "perfect world" polar bears and walruses would avoid each other, but now (although of less importance) they have a connection. Another example is ringed seals and glaucous gull. A ringed seal and a glaucous gull did not normally have any relationship, but climate change have made the bird an enemy for ringed seals pups which earlier was not the case. These lines can help illustrate the effects of climate change by showing relationships that have become more important or less important. This can also be used in combination with Umwelt transition in other research to illustrate other changes than climate change.

Because zoosemiotics are divided between three parts: signification, communication and representation, it allows for interdisciplinary research. If the thesis only examined literature (and interviews) from biology and natural science, one would miss the representation of polar bears. If only examining the representation one would miss the basic facts on how climate change affects polar bears and ringed seals. Zoosemiotics can contribute to a better understanding on animals and climate change as it gives a holistic approach. It consider both the biological dimension – how climate change affect polar bears and ringed seals behaviour and physiology as their habitat is changing, and human representation – what we think, believe and our decisions are based on what we believe and most of the information we receive are from media. Therefore, how animals (polar bears) or climate change are portrayed impact our decision. Decisions we do for conservation and for a more sustainable planet which ultimately will affect positively or negatively the animal (polar bears and ringed seals) and thereby the whole ecosystem and planet. The theory and methods can therefore be applicable for research on the effects of climate change on other animals than polar bears and ringed seals– contributing to both interdisciplinary research and to a more holistic approach on the subject. But it is always important to be aware of the biases as we can never fully understand another species life world.

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Forespørsel om å delta i intervju i forbindelse med masteroppgaven «How Animals are Affected by Climate Change – A Zoosemiotic Investigation of Polar Bears and Ringed Seals in Svalbard»

Formål

Jeg er masterstudent i energi, miljø og samfunn ved Universitetet i Stavanger og holder nå på med den avsluttende masteroppgaven. Temaet for oppgaven er dyr og klimaendringer, og jeg skal undersøke hvordan isbjørn og ringsel på Svalbard blir påvirket av klimaendringer gjennom et zoosemiotisk perspektiv.

Blant annet ønsker jeg å se nærmere på hvordan zoosemiotikk kan gi et annet perspektiv/forståelse på dyr og klimaendringer gjennom å studere nærmere blant annet: Hvordan klimaendringer påvirker oppførselen til isbjørnen og dermed hvordan forholdet mellom isbjørner-isbjørn, isbjørn-ringsel og isbjørn-mennesker har endret seg/endrer seg. Ønsker også se nærmere på hvordan klimaendringer og turisme er knyttet sammen i denne sammenheng.

Hvem er ansvarlig for forskningsprosjektet?

Universitet i Stavanger er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?

Jeg ønsker å intervjue eksperter (forskere og akademikere) på området som kan bidra til opplysninger om ringselen/isbjørnen/klimaendringer på Svalbard. Grunnet opplysninger om ulike dyrearter vil jeg kontakte flere eksperter.

Hva innebærer det for deg å delta?

Hvis du ønsker å delta på prosjektet innebærer det et intervju som vil ta deg ca. 1 time, og vi blir sammen enige om tid og sted. Det vil bli tatt lydopptak og notater fra intervjuet. Det er ønskelig å oppgi opplysninger om navn, yrke/utdannelse/arbeidssted i oppgaven.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake uten å oppgi noen grunn. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg. Dersom du trekker deg vil alle innsamlede data bli slettet.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Jeg vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Jeg behandler opplysningene i samsvar med personvernregelverket.

- Det vil kun være student og veileder som får tilgang på råmateriale for intervjuene.
- Intervju vil bli oppbevart på ekstern disk kun tilgjengelig for student.
- Deltakerne vil kunne gjenkjennes i publikasjonen. Dette gjelder navn, yrke/utdannelse/arbeidsted.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Oppgaven skal etter planen leveres 14.06.19 og prosjektet skal etter planen avsluttes senest 01.10.19 etter fullført sensurprosess. Intervjuopptak og skriftlige notater fra intervju vil bli slettet ved prosjektslutt.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg på forespørsel,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitet i Stavanger har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Student masteroppgave: Ida Tingvik Bertelsen | 977 31 052 | it.bertelsen@stud.uis.no.
- Veileder på masteroppgave: Professor Morten Tønnessen | 51 83 41 49 / 942 37 093 | morten.tonnessen@uis.no.
- Personvernombud for UiS Kjetil Dalseth: personvernombud@uis.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen
Ida Tingvik Bertelsen

Prosjektansvarlig (Veileder)

Masterstudent

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «How Animals are Affected by Climate Change – A Zoosemiotic Investigation of Polar Bears and Ringed Seals in Svalbard», og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta på intervju
- ☐ at opplysninger om meg (gjelder kun navn, yrke/utdannelse, arbeidssted) publiseres slik at jeg kan gjenkjennes

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 14.06.19

(Signert av prosjektdeltaker, dato)

Are you interested in taking part in the research project «How Animals are Affected by Climate Change – A Zoosemiotic Investigation of Polar Bears and Ringed Seals in Svalbard»?

This is an inquiry about participation in a research project where the main purpose is to examine how polar bears and ringed seals are affected by climate change. In this letter I will give you information about the purpose of the project and what your participation will involve.

Purpose of the project
I am a student taking my master in Energy, Environment and Society at the University of Stavanger. The theme for my master is animals and climate change, and I want to study how polar bears and ringed seals in Svalbard are affected by climate change through a zoosemiotic perspective.

Among other I want to look deeper into how zoosemiotic can give another perspective/understanding of animals and climate change by examining among other: How climate change affect the behaviour of the polar bear and thereby affect the relationship between polar bear-polar bear, polar bear-ringed seal and polar bear-humans. I also want to see how climate change and tourism are connected in this context.

Who is responsible for the research project?
The University of Stavanger is the institution responsible for the project.

Why are you being asked to participate?
I want to interview experts (scientists and academics) in the field that can contribute to information about the ringed seal/polar bear/climate change on Svalbard. Because I need information of several animal species, I wish to contact several experts.

What does participation involve for you?
If you want to participate in the project it implies an interview that will be approximately one hour, and together we agree on time and space. The interview will be sound recorded, and notes will be taken. It is desirable to provide information about your name, occupation/education/workplace in the assignment.

Participation is voluntary
Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data
I will only use your personal data for the purpose specified in this information letter. I will process your personal data in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- It is only the student and the supervisor that will get access to the interviews.
- The interviews will be stored on an external server only available for the student.
- Participants will be recognized in the publication by name, occupation/education/workplace.

What will happen to your personal data at the end of the research project?
The project is scheduled be handed in 14.06.19 and the end of the project is planned to latest end 01.10.19 after completing the censorship process. Interviews and written notes from the interview will be deleted at the end of the project.

Your rights
So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?
We will process your personal data based on your consent.

Based on an agreement with the University of Stavanger, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?
If you have questions about the project, or want to exercise your rights, contact:

- Student, Master Theis: Ida Tingvik Bertelsen | 977 31 052 | it.bertelsen@stud.uis.no.
- Supervisor/Project leader: Professor Morten Tønnessen | 51 83 41 49 / 942 37 093 | morten.tonnessen@uis.no.
- Our Data Protection Officer at UiS Kjetil Dalseth: personvernombud@uis.no
- NSD – The Norwegian Centre for Research Data AS, by email: (personverntjenester@nsd.no) or by telephone: +47 55 58 21 17.

Yours sincerely,
Ida Tingvik Bertelsen

Project Leader
(Researcher/supervisor)

Student

Consent form

I have received and understood information about the project «How Animals are Affected by Climate Change – A Zoosemiotic Investigation of Polar Bears and Ringed Seals in Svalbard», and have been given the opportunity to ask questions. I give consent:

- ☐ to participate in interview
- ☐ for information about me/myself (only name, occupation/education/workplace) to be published in a way that I can be recognised

I give consent for my personal data to be processed until the end date of the project, approx. 14.06.19

(Signed by participant, date)

Intervjuguide

Hvilke av spørsmålene som blir tatt opp i hvert enkelt intervju avhenger av intervjuobjektenes kompetanseområde. I og med at dette er semistrukturerte intervjuer til bruk i en pågående læringsprosess er det sannsynlig at noen av spørsmålene vil bli endret/presisert underveis i arbeidet. I tillegg vil hvert enkelt intervju bli preget av hvilke tema ekspertene bringer på bane og som bør følges opp under intervjuet.

Innledning – Ca. 5-10 minutter

- Uformell prat. Presenterer meg selv. Forklarer hva jeg studerer: hvordan isbjørnen og ringselen på Svalbard blir påvirket av klimaendringer fra et zoosemiotisk perspektiv.
- Forklarer hensikten med intervjuet (bakgrunn/formål) og informerer om hvordan intervjuet skal brukes i masteravhandlingen.
- Informasjonsskriv – Har de lest gjennom, får signert dokument.
- Har informanten noen spørsmål før vi starter?
- Start lydopptak
- Innhenter informasjon om navn, utdanning, yrke og arbeidsplass.

Tematiske spørsmål – Ca. 40-45 minutter

Svalbard og klimaendringer

- Hva er de største utfordringene når det kommer til klimaendringer på Svalbard slik du ser det?
- Hvor mye av havisen og isbreene har smeltet de siste årene?
- Har klimaendringene hatt store konsekvenser for dyrelivet?
    - Hvilke dyrearter blir mest påvirket?
- Fører klimaendringene til mer spredning av miljøgifter?

Isbjørn og ringsel

- Hva er den største utfordringen/trusselen for isbjørnen og ringselen på Svalbard?
- Hvorfor er isbjørnen og ringselen viktig?

- Når isbreene og havisen smelter hvordan påvirker det ringselen?
    - Hvor føder den ungene sine?
    - Hvor får en mat? – Forsvinner plankton?
    - Er det nedgang i bestanden?
    - Er det synlige fysiologiske endringer som for eksempel endring i kroppsstørrelse?
    - Hvordan påvirker klimaendringene ringselens sosiale relasjoner?
    - Har den endret atferd for å overleve som følge av klimaendringer?

- Hvordan påvirkes ringselen av miljøgifter?

- Isbjørnbestanden på Svalbard tok seg opp etter den ble fredet i 1973, men har klimaendringer hatt negativ påvirkning på bestanden i etterkant?
- Ser man endring i atferden til isbjørnen som følge av klimaendringer?
    - Hva spiser isbjørnen, og har kosten endret seg da det blir mindre is (mindre sel)? (alternative matkilder: fugleegg, mat ved/nær menneskelig beboelse)
    - Har jaktforholdene endret seg? Hvor ofte (prosent) er jakten til isbjørnen vellykket?
    - Er det flere isbjørner som ikke overlever fasten nå når det er lengre isfrie perioder?
    - Er det nye utfordringer med å finne steder å gå i hi?
    - Har fødselsraten blant isbjørner på Svalbard falt?
    - Hvordan påvirkes isbjørnens sosiale relasjoner av klimaendringene?
- Det er funnet miljøgifter i isbjørnen, høyere nivåer på Svalbard enn resten av Arktis – hvordan påvirker dette isbjørnen?
- Er det andre eller flere utfordringer for isbjørn på Svalbard enn ellers i Arktis?

Menneskers påvirkning

- Ser du en klar sammenheng mellom klimaendringer på Svalbard og økt turisme (i menneskelig tilstedeværelse og aktiviteter)?
    - Når isen smelter, har sesongen for cruise/båtturisme blitt lengre? Ser en i så fall konsekvenser av dette?
- Er det konkrete eksempler på hvordan den økte turismen påvirker isbjørnen, - og/eller ringselen?
- På hvilke måter er isbjørners/ringsels forhold til mennesker i endring, og hvorfor?
- Det at isbjørnen har fått så mye oppmerksomhet (blitt et symbol på klimaendringer) har det hatt positive eller negative ringvirkninger for isbjørnen? Hvordan?
    - Ser en mer interesse for isbjørnen? (flere som reiser til Svalbard for å få et glimt av isbjørnen)
    - Er det flere mennesker som blir nærgående fordi en ønsker å se isbjørnen?
    - Hvis isbjørnen har blitt mer nærgående i forhold til menneskelig befolkning på grunn av mat – hvilke konsekvenser får det for isbjørnen?
    - Går det utover andre dyrearter – får isbjørnen mer oppmerksomhet enn det andre dyrearter burde få?

Oppsummering – Ca. 5-10 minutter

- Går gjennom uttalelser - har jeg forstått deg riktig? Oppklarer eventuelle misforståelser.
- Er det noe du vil legge til?
- Noen spørsmål før vi avslutter?

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

How Animals are Affected by Climate Change – A Zoosemiotic Investigation of Polar Bears and Ringed Seals in Svalbard

Referansenummer

389129

Registrert

07.03.2019 av Ida Tingvik Bertelsen - it.bertelsen@stud.uis.no

Behandlingsansvarlig institusjon

Universitetet i Stavanger / Det samfunnsvitenskapelige fakultet / Institutt for medie-, kultur- og samfunnsfag

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Morten Tønnessen, morten.tonnessen@uis.no, tlf: 94237093

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Ida Tingvik Bertelsen, ida.tingvik@lyse.net, tlf: 97731052

Prosjektperiode

04.03.2019 - 01.10.2019

Status

03.04.2019 - Vurdert

Vurdering (1)

03.04.2019 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet 03.04.2019 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html

Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 01.10.2019.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke behandles til nye, uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og/eller rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Jørgen Wincentsen
Tlf. Personverntjenester: 55 58 21 17 (tast 1)