Looking at Noise

Human Ecological Issues when Assessing the Impact of Seismic Surveys Effects on Oceanic Whales

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Abstract:

This thesis introduces different issues regarding the impact of anthropogenic sound pollution on oceanic cetaceans (whales). It involves looking at the problems of anthropocentrism and the notion of Umwelt when trying to assess the well-being of a western culturally important species, and the relationship between that species and the industrialization of the ocean. The thesis is specifically focusing on seismic surveys conducted when prospecting for submarine reserves of natural gas and oil. Six semi-structured interviews have been made with professionally active individuals who have different expertise experience regarding the issue. Material from interviews have been intertwined with secondary data in the field of research to address human ecological aspects of the problems when assessing seismic surveys impact on oceanic cetaceans. The thesis aims to work as an introductory component for further human ecological research in the field of research of seismic surveys impact on oceanic cetaceans.

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Keywords: Airguns, Cetaceans, Anthropocentrism, Anthropogenic noise, Marine noise pollution, Marine sound pollution, Seismic surveys, Uexküll, Umwelt, Whales.

Figure 1: Airplane flying close to a residential area in London, England. “Aircraft pass close to Myrtle Avenue every 2 minutes when 27L is in use, so getting shots like this is easy” (Pingstone 2004).

“Just imagine doing it with humans, if you just watched them from on high and tried to figure out what they found disturbing or not, you would say *‘Oh look, there is these really loud airports. But look, there is a bunch of humans living around the airport! Therefore they are not disturbed by airports.'* In fact they are *very* disturbed by airports but the housing is cheaper there so they have to live there.”

Lindy Weilgart, the 13th November, 2015, via Skype.

“Forever unknowable behind all of the worlds it produces,
the subject— Nature—conceals itself.”

Jakob von Uexküll, *A Foray Into The Worlds Of Animals And Humans* (2010: 135).

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1. Introduction

As I began investigating this field of research concerning cetaceans (that is, whales), noise[1] pollution[2] and human ecology, my focus shifted many times. What had started as a crusade to find the hidden reason to mass strandings of whales came to be about how sound pollution in the ocean is assessed scientifically. I looked at how people that might have the most powerful evidential statements saw the issue being regarded and managed. The people I thought of were the scientific researchers and professionally involved people in industrialized countries. By using scientific methods of assessing environmental health they are seen as representatives of the 'truth' in the matter.

Figure 1 on page 3 is a photography of an airplane flying close to a residential area close to Heathrow airport in London, England (Pingstone 2004). In my interview with biologist Lindy Weilgart she reflected on how marine noise pollution would be understood if it were assessed the same way for whales as it is for humans. There are apparent differences in how noise pollution is defined depending on if it is cetaceans or humans that are at risk. For humans, all noise is thought to have some kind of harmful impact, even though some people might like that impact personally. For whales it is assessed more relative. But the greatest problem with defining if a sound[3] is harmful or disturbing for whales is of course the problem of communication. Whales cannot explain to humans how anthropogenic noise impacts their life. That is why this thesis will focus on the narrowness of the human perspective, the theory of Umwelt and anthropocentrism.

1.1 Scope of research & limitations

I have chosen to focus on the cetaceans inhabiting the oceans. I am not focusing on one specific species, but instead on a general perspective of all oceanic cetaceans. This includes species from both the suborders toothed whales *(Odontoceti)* and baleen whales *(Mysticeti)* (Klinowska, 1991). Even though dolphins and porpoises usually are not referred to by those names outside the scientific community, they are a part of the infraorder whales *(Cetacea)* (ibid.). The analysis will be from a

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1 Noise is "a sound, especially one that is loud or unpleasant or that causes disturbance" (Cucknell, Boisseau & Moscrop 2015: 10). Also "an undesirable component that obscures a wanted signal" (Cucknell, Boisseau & Moscrop 2015: 14).

2 Sound pollution and noise pollution can be seen as two interchangeable words when regarding marine acoustic pollution. As all marine sound pollution could possibly be disturbing for cetaceans, it has very similar, negative meaning as noise pollution have. But since the terms are used by different authors and informants in different ways, I have chosen to write what the source in question have chosen.

3 Sound "is a perceptual product of acoustical energy impinging on our body and hearing organs" (Stocker 2013: 69). Also "a signal designed to transfer information (be it biological or geophysical)" (Cucknell, Boisseau & Moscrop 2015: 14).

relatively general perspective, focusing on the broader understanding of cetaceans in relation to human produced (henceforth mentioned as anthropogenic) ocean noise. Cetaceans have a special symbolism in modern Western society (Kalland 2009). When cetaceans are put in an environmental or conservation driven agenda, they often represent the sufferers of detrimental environmental effects caused by human industrial society, and can therefore be used as an important tool to promote environmental political engagement (ibid.).

In this thesis the background setting will be the environmental downsides to using anthropogenic industrial sound when prospecting for oil and gas in submarine localities. I mainly focus on the effects of airguns, an anthropogenic seismic technology used when prospecting for fossil fuels, on oceanic cetaceans. Although the problem of assessing the impact is my chosen aim, I will not fully present current scientific evidence for this. The scope of research is also a consequence of the field of research's current situation, as there is an ongoing process of establishing an understanding for oceanic bioacoustics[4]. But it is also because I was more interested in the process of assessing the impact than the impact itself. Analyzing the issues regarding professional assessments of seismic surveys effect on oceanic whales through Jacob von Uexküll's theory of Umwelt, and anthropocentrism will be the theoretical framework for this thesis..

This thesis does not involve aspects of the issue regarding national and international ocean and its laws and regulations. The ocean will in this thesis be viewed as one entity. I will only look at the industrial use of the ocean. Even though my chosen topic is through seismic surveys impact, a great deal of my work will revolve around all sorts of ocean noise as literature in the subject is limited.

1.2 Purpose

In this thesis I will explore some of the possible reasons to the field of research's understanding of cetaceans by connecting the natural sciences involved in this field of research with human ecology. My purpose with this thesis is foremost to argue why a widening of the field of research is necessary, as it currently is mostly interdisciplinary between fields in the natural sciences but would be benefitted by incorporating human ecological perspectives and research. As a human ecologist you assess environmental problems both from the ecological and the political realms. You

[4] Bioacoustics is "a cross-disciplinary science, which investigates sound production and reception in animals, including man, the biological acoustically-borne information transfer and its propagation in elastic media" (Laboratory of Applied Bio-Acoustics 2015).

incorporate aspects of the individual spheres, the cultural and the environmental as indicators to analyze current phenomenons (Hornborg 2010: 211-212). The perspective of human ecology can give this issue new angles of understanding it, and maybe even create new ideas to solve the problems.

By narrowing my analysis to oceanic cetaceans and the impact of seismic surveys I wish to help the interdisciplinary work of assessing this issue in a more holistic perspective. I hope to help encourage the field of research to experiment with human ecological approaches to this issue, or somewhat help to conduct more premeditated research in terms of understanding human centered perspectives. As Katz concludes, "Dependence on the system is the one inescapable truth that ecology teaches us, and we must use this truth as the basis of moral judgements concerning living organisms and nature" (Katz 2000: 22-23). Human civilization lives inside the Earth's ecosystem, a fact which Katz demands common sense to be based on when valuing life and environment. Current western environmental assessments are usually managed from scientific results or indicators. I suggest that an ecological mentality regarding the issue of noise pollution needs to include the limitations of a human perspective, which in this thesis will be shown to affect the assessments of the field.

1.3 Research questions

To fulfill the purpose of my thesis I have phrased the questions I wish to answer as the following:

When assessing seismic surveys impact on oceanic cetaceans, which problems does working professionals in the field experience?
Which aspects of anthropocentrism and the theory of Umwelt affects these assessments?

1.4 Outline

The second chapter will introduce the interdisciplinary basis which my analysis is founded upon. It starts with introducing noise pollution, followed by a brief presentation of cetaceans and their relation to sound, followed by summarizing how seismic surveys are conducted and lastly there is a section about how cetaceans are affected by seismic testing. The third chapter explains my chosen methodology, starting by explaining my chosen methodological framework, then presenting my

material. In section 3.3, I present my procedure of collecting and analyzing data and in section 3.4 I briefly explain some aspects of this thesis regarding reflexivity and ethics. Chapter four presents my chosen theoretical framework. I proceed to my analysis in chapter five where I start by addressing relevant aspects of assessing impact of seismic surveys on oceanic cetaceans. Section two presents cetaceans' value in industrial societies, section three presents issues regarding human understanding of another species and lastly section four presents how uncertainties affect the assessment. Chapter 6 concludes this thesis.

2. Introducing the interdisciplinary scientific basis

To have a better idea of the interdisciplinary field of research that this thesis has emerged from, I will shortly present relevant facts involving noise pollution, cetaceans and their relation to their soundscape[5], a very brief technical overview of how seismic testing works, and an introduction to the impact of seismic surveys on oceanic cetaceans soundscape. This is to give the reader a slight comprehension of what the field of research consists of, so we can focus on the less basic and more problematic understanding of the issue in the Analysis chapter.

2.1 Noise pollution

Underwater life in the ocean has for long been alien for modern Western humans, understood through cultural myths and symbols. The industrial and technological advancements have now created new terrains for humans to 'discover'. The industrialization of oceans is orchestrated in accordance with economic ideas of necessary resource extraction to ensure global markets' expansion, and this development will only continue to expand through oceanic terrain (Frisk 2012 & Listening To The Deep Ocean Environment 2015). Sound levels have risen in the oceans for "the past few decades" and ambient noise[6] levels have risen by 12 dB in some areas (Boyd et al 2011:176). This estimated increase has only accounted for sound produced by shipping activities, and Boyd et al. stress how other exploitations of the ocean, such as fishing industry, oil and gas prospecting and extraction as well as renewable energy initiatives have increased their impact during the same time period (ibid). International Ocean Noise Coalition (2013) states that in some ocean areas, noise levels have increased twofold each decade for the last 60 years.

Frisk concludes that the whole field of research involving anthropogenic noise in marine environments has received more attention from the scientific world and civil society in what he defines as "recent years" (Frisk 2012:1). He draws the conclusion that since especially marine mammals depend on the soundscape as their most important tool for communication, eating, and finding their way, any shifts in this soundscape has an effect on their well-being (ibid.). Frisk reports that the ambient noise has increased in the Northeastern Pacific Ocean between 1950 and

5 Soundscape: the sum of all sounds in a specific environment, where "perception of the soundscape for each animal will vary depending on its hearing abilities" (DOSITS 2015a).

6 Ambient noise is "the background din of the sea", including all sources of noise, both anthropogenic and 'natural', which I construe as all noise not made by direct or indirect human activity (Frisk 2012:1)

2007 with circa 19 decibels[7] (ibid.). On the website of the international research program 'Listening to The Deep Ocean Environment' (LIDO) they argue that research about the impact of anthropogenic sounds on marine mammals and the marine ecosystem is warrant the present concern it has got, and conclude that the present body of data in the issue makes the scientific community's and public attention justified (Listening to The Deep Ocean Environment 2015).

2.2 Cetaceans and their acoustic world

As mentioned earlier there are two living suborders of cetaceans, which had evolved to their current adaption approximately 10 to 12 million years ago (Klinowska 1991:5). Although proper scientific base is still missing, it is suggested that cetaceans have a vital role in marine ecosystems (O'Shea 2006). Due to, among other factors, the different species' diverse ways of foraging, optimal evolutionary adaption and because of the massive and huge biomass consumption they have, the roles of cetaceans in different marine ecosystems is of great importance (ibid.). Cetacean use of sound is the most efficient solution to the communicative and navigational difficulties in the water medium, explained through evolutionary proof that their ancestors evolved from terrestrial mammals to marine life around 50 million years ago (Jasny 2005). Both hearing and sound producing is a highly developed sense in cetaceans, and is essential for their survival, but scientific research to date has still many blind spots (ibid). Many cetaceans have come to use the property of low-frequency sound being able to propagate over large distances, and evolved suiting communication tools (Jasny 2005). Some of these sounds are more researched. For example, the males of the humpback whale (*Megaptera novaeangliae*), create a mating song so complex that scientists suggests it contains information about reproductive fitness and location (ibid.: 2). Cetaceans along with all other marine mammals have evolved an ear with wider hearing ranges than among most terrestrial mammals (Cucknell, Boisseau & Moscrop 2015: 48). There are evidence for cetaceans having the fastest processing capability of all mammals regarding auditory and signal processing, and they use three times more neurons to their hearing capacity than any other animal (ibid).

[7] Decibels (dB): A unit used for measuring a mediums sound level regarding its power or intensity (Cucknell, Boisseau & Moscrop 2015: 10). The unit uses a logarithmic scale, functioning in the way that a 10 dB increase is ten times more intense (Jasny 2005:4; Cummings & Brandon 2004:10). Intensity is not equivalent to the experienced loudness, as loudness is desensitized with heightened intensity (ibid.). Loudness is a subjective concept based on an individual's auditory perception, and as frequencies have an irregular increase of perceived loudness (DOSITS 2015b). As decibel is calculated through comparing two different pressures, a reference pressure is necessary, which will have been measured in a medium (ibid. 2015c). To have the same reference pressure when calculating, scientists have decided that in water the reference pressure is 1 microPascal (μPa) and in air it is 20 microPascals (DOSITS 2015c). Therefore, estimations of decibels in air and water is not the same (ibid.).

Stocker (2013: 103-116) differentiates toothed and baleen whales from each other through their ways of feeding. Toothed whales are hunters, and baleen whales are foragers (ibid.). This corresponds to the two suborders different ways of using sound (ibid.). While toothed whales mostly use high frequency sound suited for pursuing their more fast moving prey and for communicating with other hunters close by, baleen whales use lower frequencies to be able to communicate longer distances as the sound travels longer in those frequencies (ibid). Stocker (2013: 103-116) suggests that the more direct use of low frequency sound is not connected to feeding, but instead of baleen whales informing each other of promising feeding grounds. How most cetaceans use sound more detailed is still quite unknown, as there are only ten species with thoroughly researched audiograms of their vocalizations (Cucknell, Boisseau & Moscrop 2015: 48). The recorded whales have all been held captive, and they represent the suborder toothed whales (ibid.).

The suborder baleen whales have plates called baleen instead of teeth, which they use as a filter to gather fish or krill by sieving water masses (Klinowska, 1991). Many baleen whales migrate great distances between tropical waters in the winter months and polar waters in the summertime (ibid.). Usually baleen whales live in smaller groups, with occasional gatherings with other social groups (ibid.). Research indicates that baleen whales have great longevity (O'Shea and Odell 2008). Researchers estimated in the year of 1993 an Alaskan bowhead whale (*Balaena mysticetus*) to be between 100 to 130 years; and in 1995 there was the last sighting of a North Atlantic right whale (*Eubalaena glacialis*) that had been photographed the first time in 1935, then already an adult (ibid.). Because of their big size and high mobility, baleen whales are far less researched with regard to their use of sound (Cummings & Brandon 2004). There are indications that they most commonly produce low-frequency sounds, few of which are exceeding 10 kHz[8] (Cucknell, Boisseau & Moscrop 2015: 51). Baleen whales generally hear sounds of frequencies as low as 20 Hz and at the highest between 20 to 30 kHz (ibid.).

As the name suggests, all toothed whales have teeth but with different characteristics fitting their diet (Klinowska 1991). Many species of toothed whales have been documented using echo-localization, vocalizing high-frequency pulsing sound to forage and orient themselves (ibid.).Toothed whales come in a variety of sizes and habitat varies both in size and geographical

[8] Hertz (Hz): "The frequency of sound waves is measured in the number of pulses or cycles per second, or hertz (Hz)" (Cummings & Brandon 2004: 8). The lower the frequency, the longer the sound can travel as it is more difficult to absorb long wave lengths (Stocker 2013: 74,76).

location (ibid.). Their social worlds are also very diverse; some species' whales live alone most of their life while some join groups on occasion; others live in schools of more than hundred individuals or smaller groups which flock at times (ibid.). O'Shea and Odell (2008) refer to documentation of the bottlenosed dolphin (*Tursiops truncatus*) becoming older than 50 years; and sperm whales (*Physeter catodon*), the biggest known toothed whale, reaching between 65 and 80 years of age. Toothed whales seem to use sounds which most frequently lie in the ranges of a few hundreds of Hz to several tens of kHz (Cucknell, Boisseau & Moscrop 2015: 49). Echolocation, also called biosonar, is over 100 kHz (ibid.). Their hearing range is best between 200 Hz and 100 KHz (ibid.).

2.3 Seismic surveys and airguns

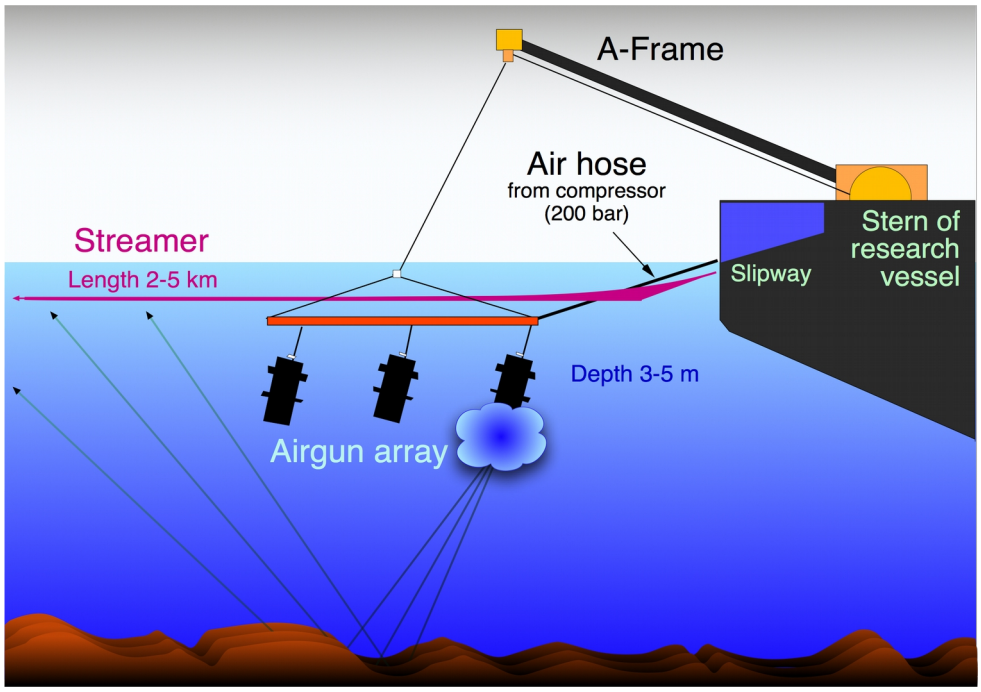

Figure 2: Diagram of setup of seismic research vessel conducting a seismic survey (Grobe 2007).

Anthropogenic sound is the best available technique to use when gathering information on the ocean's seabed and its submarine resources (Listening To The Deep Ocean Environment 2015). The most common method using sound to map the resources under the seafloor is through seismic surveys, and when done off-shore it mostly involves airguns and hydrophones (DOSITS 2015d; British Columbia Ministry of Energy and Mine 2003). Through the use of airguns a loud sound pulse is sent out, which releases highly pressured air in the direction of the seabed, and when the

sound that has been reflected back from underneath the seabed hydrophones can process the sound characteristics to locate submarine resources (DOSITS 2015d). The seismic survey is conducted by towing an array of airguns followed by hydrophones (called streamers) behind a moving research vessel, scanning the submarine geophysical structure for deposits of oil and gas (ibid.; DOSITS 2015e). Figure 2 shows an example of how the mentioned parts of a seismic vessel can be arranged when conducting a survey (Grobe 2007). Sound frequencies from airguns are usually in the range of 10 -500 Hz, but minor high frequency sound is also produced, which makes airguns considered to be a broad-band sound source (DOSITS 2015d; DOSITS 2015e; Cummings & Brandon 2004). They differ in sizes, and thus the impact of the sounds created, but the bigger models can create sound intensities up to 232 decibel at a one meter distance (DOSITS 2015d; DOSITS 2015e).

2.4 Seismic surveys interference with cetacean soundscapes

There are no proper scientific base to prove direct detrimental damage on cetaceans from seismic surveys (Cummings & Brandon 2004). Reasons for this could be how the vessels are moving while the airguns are shot and how noise gradually is built up to the desired level, which lessen the impact of the noise as whales have a chance to react and for example swim away from the sound source (ibid.). But less direct impact is more researched within the field. Ender et. al. (2014) argue that seismic testing along with vessel noise can mask echolocation signals and deteriorate foraging abilities for cetaceans. Jasny refers to a metaphor proper for humans to relate to, of how there is a "continuous fog that is shrinking the sensory range of marine animals" (Jasny 2005: 5). Cummings and Brandon (2004: 8) stress how not only the intensity of airguns (the decibel), but also which frequencies it uses creates the loudness and harm done by the sound. And how the acoustic impact varies between different species as they have different ways to apprehend their surroundings (ibid.). Since larger whales use relatively low frequencies to communicate, which lies in close range to the ones airguns use, they are inclined to be more affected by the sound (ibid.). Acoustic masking is one example of an impact on their soundscape, where sounds lying in the near frequencies have to compete in intensity to be heard best (Cummings & Brandon 2004: 8). As baleen whales are bigger and also use lower frequencies to communicate long distances, which also is crucial for them to have good chances to find enough food, acoustic masking could be a serious issue (ibid.; Stocker 2013: 103-116). Jasny (2005) suggests that airguns can drown out cetacean calls for distances of over 25, 900 square kilometers. Tyack (2008) gives examples of how several marine mammals, including cetacean species, have altered their calling behavior because of the changed marine soundscape.

Another implication for cetaceans is how they and other marine animals have an “acoustic impedance very close to water”, as most living creatures consists of a high percentage of water (Cummings & Brandon 2004:21). Sound therefore travels in another way in cetaceans than it does in humans, as we use sound in the medium of air where densities of body and medium is less alike (ibid.). Cummings and Brandon therefore imagine that sound is sensed more bodily by whales than the same sound would be sensed in the air medium (ibid.). This could have consequences to how cetaceans experience airguns, as it is not a natural sound in their soundscape, especially in regard to sound pattern and intensity.

Rossi-Santos (2015: 185) discusses the importance of soundscapes for animals to understand their surroundings, where the background noises contain information of the larger area the animals is inhabiting, while the foreground sounds gives a more immediate understanding of the closer surroundings. The ecology of marine soundscapes is being threatened by human activities, which will affect marine species (ibid. 2015).

3. Methods and materials

This chapter will present my chosen method which have shaped my thesis work. I will start with a section of my use of theory supporting my methodology, then continue to introduce my material and informants. The third section will explain the procedure of collecting and analyzing data. The fourth section will comment on my chosen methods.

3.1 Methodological Framework

Flowerdew writes that "knowledge is multiple and situated" (Flowerdew 2005: 28). Even so, when perceiving the issue of anthropogenic noise pollution's impact of oceanic cetaceans, there is a certain epistemology. As humans cannot communicate properly with the whales, we have to settle for the human perception of the problem. In this thesis the chosen humans are those with professional experience within the field of research, and those who have written the literature I have found useful. I have used Edmund Husserl's ideas as a basis to understand this issue (Alvesson & Sköldberg 2008). Phenomenology has been utilized as a guiding theory for understanding the way human perception affects the assessment of the issue. Phenomenology essentially opposes the traditional natural science view of the world, where subjectivity is separate from the objective reality which the natural science explores (Alvesson & Sköldberg 2008: 165-168). The lived experience creates what Husserl called a persons "Lebenswelt", their lifeworld (ibid.). A hermeneutical approach to phenomenology has been useful for explaining the way Umwelt and anthropocentrism are blinding other perspectives and how this blindness is reproduced. The hermeneutical approach values the parts of a context and the greater context as interdependent for understanding the idea (Alvesson & Sköldberg 2008:189-280) The method using this concept is called the hermeneutical circle, which as a method can be seen as a spiral which the scientist moves through successively and repeatedly understanding parts of the idea to understanding the wholeness, developing the understanding further (ibid.). These methods have helped the process of directing and analyzing my chosen data.

3.2 Material

For this thesis I have used scientific literature and conducted semi-structured interviews. I have used literature mostly from Lund University's and Copenhagen University's library services. Most literature in the field I have found is from Canada, USA or Europe. As there is not much written about the human ecological perspective in terms of marine noise pollution from seismic surveys, I

saw it fitting to collect my own data. My semi-structured interviews have created the focus for this body of work, and also set its limits when trying to find interesting themes within the collected data. I have used material from six persons involved in the phenomenon. Below is a brief introduction to all informants and a presentation of how the interviews were conducted. They will be incorporated in the analysis (Chapter 5).

Farrah Khan
Arctic campaigner for Greenpeace Canada focusing on preventing fossil fuel extraction in the Arctic ocean. The last 1,5 years she has been collaborating with the Inuit community of the hamlet Clyde River, Kanngiqtugaapik, in the north of Canada. The community fear the effects of seismic testings on marine life and their traditional way of life. I conducted a semi-structured Skype interview which lasted for about one hour (the 13th of November 2015).

Sune Scheller
Arctic campaigner for Greenpeace Nordic and has for more than a year studied the issue of seismic testing's environmental impacts. In 2015 he participated in a research project with Greenpeace ship Arctic Sunrise. The aim was to document seismic testing in the Greenlandic sea. I conducted a semi-structured physical interview which lasted for about one hour (the 9th of November 2015) at Greenpeace Denmark's office in Copenhagen.

Michael Stocker
Sound engineer with a special focus on ocean bio-acoustics. He has been involved in the issue regarding the health of marine habitats since the beginning of 1990. He is helping with translating the issue to a more easily understood version, so that the engaged public easier can become involved. He currently resides in California, USA. I conducted a semi-structured Skype interview which lasted for about one hour (the 12th of November 2015). I will also refer to a book by Stocker, called *Hear Where We Are: Sound, Ecology, and Sense of Place* (2013), which explores the value of bioacoustics.

Jakob Tougaard
Senior researcher in the Department of Bioscience at Aarhus University in Denmark. His main research interest is the biology of marine mammals, and he is trying to bridge the science of underwater acoustics and marine mammal biology. I conducted a semi-structured Skype interview which lasted for about 50 minutes (the 10th of November 2015).

Magnus Wahlberg
Associate Professor at the Department of Biology at the University of Southern Denmark, focusing on bioacoustics of aquatic animals. I conducted a semi-structured Skype interview which lasted for about one hour (the 9th of November 2015).

Lindy Weilgart
Canadian biologist working with the effects of underwater noise on cetaceans, focusing on commenting and reviewing environmental assessments and other documents regarding policies and management in the issue. She has been professionally involved since 1993. I conducted a semi-structured Skype interview which lasted for about one hour and 15 minutes (the 13th of November 2015). I will also refer to an article Weilgart has co-written together with biologist Hal Whitehead and bioethicist Lucie Wade called "Conflict of Interest in Research on Anthropogenic Noise and Marine Mammals: Does Funding Bias Conclusions?" (Wade, Whitehead and Weilgart 2009).

3.3 Procedure
I will now present how my research process was planned and accomplished. Two sections will follow; the first revolves around collecting data while the second is how these data were analyzed and utilized.

3.3.1 Data collection
To investigate my research question I had to read a great deal of different literature in the fields of natural science to understand how the issue of marine sound pollution can be perceived. The social scientific literature directly connected to my thesis was more difficult to find, as this is a relatively new field of research. There is a great deal of literature about marine mammals and their habitat, yet not enough about the subject of effects from seismic surveys on cetaceans. This is why parts of my data analysis are connected to literature focusing on the broader issue of all kinds of marine noise pollution.

As Yngve Ryd states: "The white spots one do not find in the literature, but through consorting with competent people" (Ryd 2010: 244, my translation). As I have been focusing on the human perspective of an issue which relatively few people have knowledge about, I have chosen to conduct my own qualitative research. I conducted six interviews. The number of participants in my

qualitative research was premeditated as a way to come closer to the different experiences of the field of research. I have conducted one physical semi-structured interview and five online semi-structured interviews using the video-communication program Skype. This kind of interview was preferred since my informants were internationally scattered (cf. Deakin & Wakefield, 2014: 606). Deakin and Wakefield (ibid: 607-609) state that online interviews often is preferred by informants, as it is often more time efficient and creates a sense of control for the informant, as they can easily leave the conversation if wanted. Also in my initial contact with the first informant I contacted, he (Michael Stocker) requested this form of interview, as he also saw it as the most time-efficient[9]. One particular downside to online video-communication was the limited social context the interview took place within. This made the less verbal aspects of the interview more difficult to be of use.

As Ryen (2004: 44-47) writes, one must consider having enough focus when defining themes and questions for one's interview guide, but also incorporate the possibilities for unexpected scenarios. In Appendix 1 I present how my interview guides were organized. There were variations and always more specific questions to particular informants, but I regard the appendix to serve as a general example. During the interviews I adapted the questions to what the informant seemed to have knowledge and reflections about and interest in. Afterwards I made transcripts of the interviews which the informants had the chance to give feedback to or approve before I used them in my work. As the theme of the interviews has been about issues concerning natural science that I lack full understanding of, I thought it was important to make a practical dialogue possible with the informants after the interview. The feedback also functioned as a way to keep my interpretations of the interviews in alignment with the informant's experience. I chose my informants through purposive sampling as my qualitative method revolved around people with experience in the issue of seismic surveys impact on cetaceans. (On this method, see Cloke et al. 2004: 145). Three informants were found through "snowballing" sampling, asking scientists I had contacted of people within the bioacoustic field of research they could recommend. But as the purpose of the interviews was to understand different perspectives of the issue the sampling method was abandoned as I was afraid that the opinions of my informants could be too like-minded. Thereafter I researched the contemporary literature and environmental initiatives to find informants which I thought would have knowledge of the issue in different ways.

9 Michael Stocker, e-mail conversation of how to conduct interview, 11th of September 2015.

3.3.2 Data analysis

For understanding the whole phenomenon regarding marine noise pollution, especially involving oceanic whales and seismic surveys, the hermeneutical circle has been useful to the analysis of both existing literature and analyzing data from interviews.

As this area of research is fairly new, I have not found any helpful 'literary canon' to create a basic understanding of the issue. My thesis is interdisciplinary, which means that I have been reviewing research from many different academic disciplines and themes. This has made my research less in-depth than desired, as time has made me prioritize a brief understanding of the different disciplines involved in the thesis. Using triangulation, the analysis of different data has become easier and helped shape the scope of the research. Triangulation is the method of using different methods of analyzing material to more accurately distinguish a phenomenon (Alvesson & Sköldberg 2008: 179). Through coding the literature and interviews, in several rounds, I have made this thesis.

3.4 Reflexivity and ethics

Reflexivity is the method to reflect over the premises of one's own thinking, observing and use of language (Alvesson & Sköldberg 2008: 487). As Habermas concludes, "the production of knowledge is never neutral but rather always linked to particular social interest" (Habermas quoted in Cloke 2004: 309). From a human ecological perspective, I think it is appropriate to state my own background to understand my interest in this thesis. My interest is how anthropogenic impact is understood from a scientifically normative perspective. I have a background of environmental political activism and have always preferred vegetarian food. I come from an ethnic white middle-class hetero-normative home with parents with leftist political views. For myself to raise my awareness of my experienced Lebenswelt has helped me explain my own social interests, and to be aware of these has helped my analysis of data.

As the qualitative work of this thesis has been within a very specialized group of people, all people with respected professional positions, I have regarded my role as an interviewer as less dominant than in it can be in other contexts. All informants have also been from western countries, which also made the interviews easier to conduct because we had relatively similar socio-cultural backgrounds.

A great deal of the funding of marine mammal research is from actual noise polluters, a fact which will be presented further in chapter 5.4. The extracting industry and the U.S. Navy fund most research on anthropogenic marine noise; more specifically does the U.S. Navy fund 70% of marine mammal science in USA and 50% worldwide (Wade, Whitehead & Weilgart 2009). In the

beginning of my research, I tried to acquire funding information for all the read research, but this was so time consuming that I chose to leave this aspect from my analysis.

4. Theoretical framework

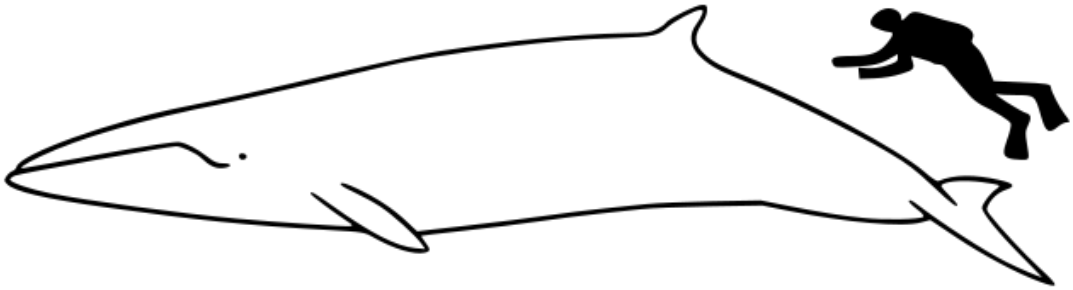

Figure 3: A size comparison of a Minke whale and a human (Huh 2006).

When humans attempt to understand the impact that anthropogenic noise has on oceanic cetaceans, there is one big problem: we cannot communicate with whales in the same manner as we can with humans. We do not use our senses in the same way, and we do not live in the same medium; we are separated in water and air. Humans are we, whales are them. Figure 3 presents an image of a minke whale (*Balaenoptera acutorostrata*) and its size relative to a human scuba diver (Huh 2006). The image tells us many things but what I think is most interesting is that we so often need these kinds of pictures to get an understanding of things. We need to relate them to ourselves, in this case our size to understand the whale's size. The human is dressed in diving equipment and is interested in the whale, but alien in the whale's environment.

I will now introduce my theoretic framework, consisting of two central theories. I will start with the Theory of Umwelt, and follow with anthropocentrism.

4.1 Umwelt

The term 'Umwelt' was presented in its current conceptual meaning by biologist Jakob von Uexküll in the beginning of the twentieth century (Hornborg 2001). The word in itself means 'environment' in German (Oxford Dictionaries). The idea suggests that each living organism has its own experience of the world, and that this shapes its perspective (Uexküll 2010).

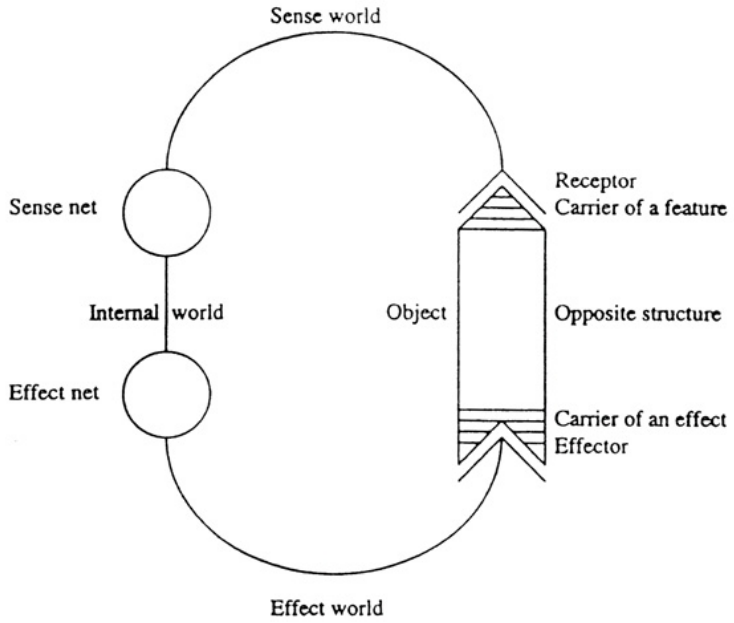

Figure 4: The functional cycle from Uexküll's book *A Foray into the Worlds of Animals and Humans* (Uexküll Wirkkreis 2008).

In figure 4 Uexküll demonstrates how an Umwelt comes into form with the "functional cycle" (Uexküll Wirkkreis 2008). Everything possible to sense for an organism creates its 'sense world', and through this biological sensibility the organism interprets it internally into the world it uses and produces, its 'effect world' (Uexküll 2010). The effect world has objects with meaning for the organism, which can be used because it can be sensed (ibid.). The Umwelt created is thus related to the organism's biological structure which is adapted to its environment (Uexküll 2010). An organism´s environment is in accordance with its ability to create an understanding, and effect, from its senses (ibid.). That is without the lived experience, you cannot presume that specific experience. It is not clear to me if Uexküll values organisms of the same species to understand each other better than organisms from different species. But as his argument is founded on the use of senses to process your surrounding, which organisms from the same species have more similar, I will understand Umwelt from the point of view that even though organisms from the same speciesdo not have the same Umwelt, they are usually more similar than the Umwelts of organisms from different species. As the human species is different from all cetaceans, there is an especially big problem in the human assessment of their Umwelts. All cetaceans are not the same species, but humans have the same problem of understanding all cetacean species if you apply the theory of Umwelt. As soundscapes are a part of their Umwelt, this problem is relevant for this thesis. Umwelt offers the idea that all animals, humans included, live in different worlds (Uexküll 2010). One could say that the theory of Umwelt suggests the same kind of empathy for the different Umwelts as humans do to

humans different cultures.

Deely (2014: 12) suggests that there is a hidden material world behind the sensory dimension that all organisms use to interpret and value their material environment, but we are all limited to our own internal and subjective perceptive skill. Uexküll (2010:197) share a similar thought, but goes the opposite direction, claiming since there are only perceptions of the world there is no objective world underneath.

Deely (2014) introduces Edmund Husserl's concept 'Lebenswelt', which compared to Umwelt is suggested to be a solemnly human perspective:

> Other animals can and do form mind-dependent relations, and have to create their Umwelt. But they do so without any direct awareness of the relations formed. A direct awareness of relation in its proper being as suprasubjective requires a cognitive power that does not require a sensible dimension – quantified matter – in its direct object of apprehension, and that is precisely where and how human understanding includes but transcends animal estimation. That is precisely where and how the line is drawn between Umwelt as generically animal and Lebenswelt as the specifically human form (or transform) of Umwelt (Deely 2014:30).

Humans have the ability to transcend from only using perceptions to understand our lifeworld; as humans we can also use our cognitive self-awareness and create new perspectives (ibid.). Lebenswelt is the perfect remedy when stricken with the claustrophobia of the limiting perspective possible for human intelligence. I see this as interesting, as it is symmetrical to the vision of human kind's never ending possibilities, and our current technocratic and profit driven Lebenswelt. Yet Uexküll to some extent emphasizes the human species' advantage compared to other species of "being able to broaden the compass of inborn human nature" (Uexküll 2010:199). Uexküll writes how the human being is able to use tools which to some extent broadens our Sensory worlds and in extension our Effect worlds (ibid.). This implies that the human Umwelt actually can be broadened, but only as much as our tools permits us. Uexküll (2010: 207) states that our tools will always be able to be refined and developed, but they will always be done so within the possibilities of our Umwelt.

Uexküll disputed Herbert Spencer's view on evolution: "It is hardly a matter of the survival of the fittest, but rather, of the survival of the normal in the interests of an unchanging further existence of the species" (Uexküll 2010: 185). I interpret Uexküll to oppose the hallmark of nature's law as a

constant mechanical contest, and suggests instead one big entity of nature where the parts of the sum is equally important ecological components. There is an order and a meaning beyond what humans cognitively can comprehend, which is progressing without internal competition (Uexküll 2010). He explains further:

> Only the knowledge that everything in Nature is created according to its meaning and that all environments are composed into the world-score opens up a path leading out of the confines of one's own environment (Uexküll 2010: 200).

Uexküll is describing the ecosystem functions of the Earth, and when one understands the concept of ecosystems one can start to understand other organisms (ibid.). It is a humble approach, which incorporates both uncertainties and scientific facts regarding the environment. Hornborg (2001) mentions how Uexküll's theory of Umwelt is considered too close to traditional cultures animistic cosmologies, and how that has made his work less important for scientific research regarding ecology. Hornborg has found the Uexküllian Umwelt interesting when discussing ecological concepts. He states:

> Each organism and species exists by virtue of its capacity to perceive and interpret the world around it. An ecosystem is not a machine, where the various components mindlessly fulfil[l] their functions as a reflection of the external mind of the engineer (Hornborg 2001:125).

Sensing and interpreting one's surroundings is crucial for all living beings, and ecosystems are made out of organisms that function in accordance with their perceived reality (ibid.). Hornborg (2001) suggests perceiving ecological crisis as arising from communication issues. This point of view would help us to regain some empathy for the unknown implications of the industrialization of the ocean, and could be useful when regarding the theory of Umwelt's relation to marine noise pollution.

Using the concept of Umwelt in this thesis is suitable for answering the research question**.** The emphasis on an ecological assessment of human environments, where conventional ideas of understanding is not the prime objective, would be an interesting starting point for managing the materialistic profit-driven industrialization of the oceans.

4.2 Anthropocentrism

The idea of anthropocentrism has been debated and motivated in Western societies since antiquity, but the term as it is used today emerged from environmental movements in the 1960's (Wolloch 2009). Smythe argues that anthropocentrism "is utilitarian – our relationship to nature is driven by our need for resources for survival, and, more recently, for comfort and convenience" (Smythe 2014: 146). Anthropocentrsim is a perspective, where nature is regarded through a filter of what is instrumental to humans (ibid.). Smythe (2014) presents three supporting notions creating this utilitarian mode of regarding the environment: the righteousness of human control over nature, the perception of nature as a resource that should be utilized, and that people are not a part of nature. I would argue that anthropocentrism does not only mean that humans are situated in a two-dimensional center of all things, there is also a third dimension. We can look at the rest of nature from above, creating an overview. Human superiority means that we can assess and use nature efficiently for our own sake (Lovejoy 1961).

Like Uexküll, Smythe (2014) stresses limits to human abilities and how uncertainties are something we should acknowledge and incorporate in human culture. For developing a truly ecologically sustainable human culture she suggests:

> [A] path that recognizes the limits of human technology, competence, and understanding not just for the sake of recognition, but because in doing [so] we reclaim other aspects of our nature (Smythe 2014: 152).

Smythe sees anthropocentric perspectives containing components that need to be addressed to develop a deeper relationship to nature (ibid.). By regarding the world as something not always expanding, we would have a chance to restore this relationship to something ecologically sensible (Smythe 2014).

In arguing why extinction of species is wrong, Persson (2006) uses the concept of 'anthropocentric instrumentalism': how other species have or can have a purpose for human kind. Persson (2006: 9-11) uses the term 'anthropocentric instrumentalism' instead of anthropocentrism, as he believes that animals also can have an intristic value for humans, a value that is not instrumental. The problem is the uncertainty in defining what actually has an anthropocentric instrumental value and how to prioritize (ibid. 2006). There is also the dimension of how transformative a resource can be for human use (Persson 2006: 30-53), for example fossil fuel or even cetaceans. Modern industrial societies are inside economic systems which are adapted to certain kind of values, where the resources that can be transferred to monetary value the most cost-efficiently usually is most

valuable (ibid. 2006). It seems as if direct and short term gains easily are prioritized, for example when extracting and capitalizing on fossil fuels. Hildebrand (2004) gives an example of anthropocentrism when mentioning how military submarines have been developed to become extremely silent, as that is their purpose as protectors of the nations, and makes this an indication of how little humans care about consequences if they are not directly affecting ourselves and our current goals. When it is not directly connected to our more imminent needs, mitigation of ocean noise is not prioritized.

I want to investigate how anthropocentrism is expressed when assessing seismic surveys impact on oceanic cetaceans, and how the human expertise motivates it. It is important to raise human self-awareness when regarding environmental problems to a wider perspective, where the anthropocentric aspects are integrated in analyses.

5. Analysis

Using the chosen theoretical framework, this chapter will develop different aspects of the answer to my research question. These different aspects I regard as the most important for introducing this issue when connected to the chosen theoretical framework. I will start by problematizing how seismic surveys impact on oceanic cetaceans is determined and defined through anthropocentrism and Umwelt, focusing on what knowledge is legitimate and how the temporal dimensions affects the same assessments and definitions. Next section, section 5.2, will introduce the value cetaceans have to the industrialized society and how it is connected to the theoretical framework. Section 5.3 will develop the perspective of how humans and different cetaceans do not share similar bodily and environmental experiences. Lastly, section 5.4 will address issues regarding uncertainties, focusing on how the human bias, and the idea of cetaceans' role in ecosystems and the idea of ecosystems affect the field of research.

5.1 The process of assessing anthropogenic impact

There are conflicting perspectives of how to define anthropogenic ocean noise as a serious ocean pollutant. I have interviewed scientist Jakob Tougaard, who is researching the effects of noise on marine mammals. He raised the problem in our interview:

> … if you google a little bit about seismic surveys and whales it is very very difficult to get a good understanding of what is actually going on. Some sources will tell you that this is no problem at all, other sources will tell you this is the end to all life in the oceans and then you can find all positions in between.

Tougaard regards the public information of the impact of seismic surveys on cetaceans as being very varied and confusing, and this is mirrored in what can be found when investigating the issue through popular methods online. Baumann-Pickering (2014) sees the research on anthropogenic marine sound as being motivated by assessing *if* human activities harm or interrupt marine animals. This kind of hesitant approach affects the field of research in ways I present in the following section.

5.1.1 Scientific research's definition of impact

Even though there are uncertainties of determining the harm of seismic surveys, the general issue of noise pollution has become a popular scientific topic (Frisk 2012). Not all informants thought the

current level of concern is valid its attention. Biologist Magnus Wahlberg states: “In the end it is all about priorities; is this what we should focus on or is it something else?” Wahlberg calls himself a “skeptical professional” in regard to this issue and sees a problem with how noise pollution is prioritized. He is currently more interested in investigating fishing equipment and by-catch in the fishing industry but claims sound pollution is prioritized. Marine mammal researcher Jakob Tougaard, like Wahlberg working in Denmark, raises a similar point. Tougaard thinks one explanation to the trend could be that noise is more convenient to focus environmental legislation and research on than by-catch, when talking about harbour porpoises (*Phocoena phocoena*), the only frequent cetacean in Danish waters. On the other side of the Atlantic ocean, bioacoustician Michael Stocker has another view of the problem, highlighting the uncertainties in assessing ecosystem health of the ocean. When talking about how anthropogenic activities in U.S. waters is authorized, he explains how seismic companies have to estimate the action’s consequences quantitatively when applying for legal approval. But the quantitative information is lacking regarding these consequences. Thus, it is more difficult to assess the graveness of the issue. Stocker states: “The fact of the matter is that it is a huge system and when you start damaging it to that level, you might not be able to immediately see the consequences”. It seems as if the results from different analytical dimensions and methods confuse the way to conclude impact. This confusion can be sensed in the field, especially as cetaceans are relatively out of reach (Ender et al. 2014). Research on cetaceans can be particularly tedious, expensive and logistically difficult, a fact which creates a “knowledge gap” regarding population numbers, distribution and behavior (ibid.: 1). There is a strong tradition in scientific research to never claim something as ‘true’ unless it is very likely from the evidential data, which generally is known as “the scientific bias towards false negatives” (Persson 2006:77). This can stagnate research, since the spectrum between ‘false’ and ‘true’ statements becomes very wide (ibid. 2006). As Persson concludes, “if the scientific community does not want to exclaim something as true, it does not necessarily mean that it is false” (Persson 2006: 75). In this area of research, regarding finding effects on cetaceans by seismic surveys, assessments made through hypothesis testing seems to be an issue. When I ask biologist Lindy Weilgart of her opinion on how seismic surveys affect cetaceans, she stresses the importance of how difficult it is to find scientifically valid effects. “The ocean is not a controlled laboratory”, she says. Regarding hypothesis testing she states:

> You have to have overwhelming evidence; you have to be 95 % certain to conclude that there is an impact on the environment. […] It is set up so that you would need overwhelming evidence that the environment was hurt[...]. Our bars should be much lower than that. If there is indication that there is

> environmental damage, it should count for something. The trouble with that, especially regarding whales, is that their life spans are so long so that there is this lag effect. […]It is a problem that the effect may not show up for quite some time. So if you are going to wait until all the evidence is in and it is *so* strong and *so* overwhelming, *it will be too late.*

Weilgart states that to be 95% sure that something has a negative effect, especially regarding the environment, is neither a safe nor proper method when assessing cetacean health. When studying effects on an animal with such a long lifespan she argues that you cannot wait until you have the conventionally appropriate amount of statistical evidence. Further, she suggests that for creating a proper scientific baseline, researchers would need five years of sampling before and after a conducted seismic survey. But from the way seismic surveys are able to be planned and conducted today, it is limited to a much shorter time spectrum, a fact which Weilgart see as something making it difficult to create reliable and strong statistical data.

To know what can be defined as a consequence one might need to leave the safe haven of trusting the human Umwelt to be able to more accurately define another animal's reaction towards its sensed environment. Cummings and Brandon use a relatively Uexküllian approach when assessing seismic surveys impact on marine animals:

> To appreciate the ways that powerful human sounds (which saturate large areas of the ocean with powerful acoustical energy) may affect the finely-tuned and integrated acoustic and tactile senses of water creatures will require us to step outside the frameworks of our own perceptual systems. It is natural that our scientific inquiries are based in what we know, yet it is important to remember that to understand other creatures with very different perceptual skills, we will need to expand the horizons of our inquiry
> (Cummings & Brandon 2004: 22).

Cummings and Brandon suggest in the quote above that to understand the impact of "powerful human sounds" we need to implement a strategy which is more open and related to other species' ways of perceiving marine soundscapes and not only base research on what is already scientifically established facts (2004: 22). They want other species' lifeworlds to have more value in these scientific inquiries. The quote can also be related to Hornborg's (2001) statement of how communicative qualities of organisms in ecosystems are suggested to have great impact on ecosystem health. He refers to Uexküll's work where interaction between organisms, and the perception of their environment is as important to investigate as the quantitative data.
Farrah Khan, Arctic campaigner from Greenpeace Canada, has experienced that there is an uneven

value to different kind of knowledge within the field of research when cooperating with the Inuit community of Clyde River in Canada. She stated that the modern use of 'expertise knowledge' as an argumentation tool is being inflated in many circumstances, that you can find experts in all issues which can support your chosen claim. But not all kinds of knowledge are equally acknowledged as 'expertise knowledge'. From Khan's cooperation with the Inuit community and their skill of observing nature and habits of wildlife which has been passed down through generations, it is clear that noise effect on wildlife has been known for long. But the worries assessed through the use of traditional knowledge is not recognized by the Canadian government:

> When you are trying to convince governments to act on a certain issue because there is possible danger directed to a particular ecosystem they often want to see scientific studies and they want people that have many letters attached to their names, which is fine. But we need to think of our understanding of the world in a much more holistic way and in order to do that we should be looking to other sources as well. […] … we should not try and fit traditional knowledge into a box where it does not fit. We should instead incorporate traditional knowledge in its existing form into the realm of expertise we hold in high esteem.

Khan points to how the traditional knowledge has qualities that should be regarded as valid in the same capacity as the scientific knowledge. Khan describes the observant skills of the Inuit community, of how they live so close to the animals that they can predict their actions. She thinks it is important that more people know about this kind of expertise. This can be related to how the theory of Umwelt is limiting our human perception, and how still some aspects of the Umwelt humans can experience are not being recognized. The possibilities within the Umwelt humans can experience could be utilized easier if all senses involved in creating it would be regarded as important tools. I see the scientific assessment of what is reliable knowledge as not fully utilizing perceptive skills of the Umwelt that humans can experience. As Khan suggests, the Inuit community in this case can contribute with different knowledge, as they have traditions to observe nature that science does not.

5.1.2 A short-term perspective

In most of the literature included in the research for this thesis, the emphasis is on relatively short-termed effects on oceanic cetaceans are discussed. Cummings & Brandon (2004) raise a problem with how marine sound pollution seems to be assessed. Anthropogenic noise is seen as a problem only if the consequences on marine animals is so dramatic that they affect the population numbers in ways that could affect survival of the species, or if individuals of a species have suffered clear

physical harm (ibid.). According to these scientists the bar of when noise becomes hazardous is set too high, and discuss how the bar would have been set much lower if it was assessing the health of humans (Cummings & Brandon 2004: 2-3). Stocker uses a metaphor when explaining how the American industry approaches the uncertainties in the field of research influenced by market driven agendas. From a regulatory standpoint, "It is like driving a car towards a wall and not stopping until you hit the wall. 'Oh, I guess the wall is there!' When everybody has been telling you that." He thinks the way the regulation is put forward is influenced by the lack of broad spectra proof of negative correlation between cetaceans and seismic surveys. Stocker sees the industry prioritize the values of market economy over those of environmental health. Tougaard mentions how every time there is a request to expand human use of the environment there is a conflict between environment and the wishes of society:

> For the companies it is straight forward – they want to find oil and extract it. They also want to protect the environment, because it is bad business not to protect the environment. But it is not their primary concern. As for authorities that also want to extract oil because they want the money, they want the taxes and employment and all sorts of things. They also want to protect the environment, because it is also bad business not to protect the environment. But again it is not their primary concern.

Tougaard points out how the conflict boils down to priorities. If your "primary concern", as he defines it, is to accumulate economic capital as a company and/authority of a state, you will choose seismic surveys over cetaceans. You will do this even though you still want to protect the environment, as it is "bad business" not to. What Tougaard points out is how the subordination of environmental impact is a valid remark for actors involved in seismic surveys, which makes the same actors aware of them. But since the seismic surveys are still being considered more profitable than the environment, this is not seen as *that* bad business. This is an obvious example of how anthropocentrism is reproduced and argued for when regarding the use and value of natural resources. The more direct economic profit from natural resources is prioritized, as human industrial society is built upon human domination of nature.

Another temporally direct characteristic of the assessments is how cetacean's direct behavior is used to understand the issue. Weilgart explains how a common counter-argument from oil and gas companies of how seismic surveys might not be detrimental to cetaceans is that whales have been sighted close to operating seismic vessels. Weilgart argues that this argument is meaningless, since there are still so much we do not know about cetaceans. Their motivations to expose themselves to the noise from seismic testing are scientifically unknown and cannot be used as an argument. I regard the argument of oil and gas companies' as an illuminating example of the problems regarding

the theory of Umwelt, of how the occurrence of humans around a noise would mean that they are not harmed by the noise. But as Weilgart states, we do not know if this behavior can be linked to harmlessness. To use human behaviors to explain cetacean behavior is not only done by the oil and gas companies. Weilgart answers the counter-argument by exemplifying how humans expose themselves to risks, for example to be windsurfing while there are hurricanes or going to loud concerts, and how that does not mean that those activities are safe. Both Wahlberg and Weilgart put the example in a context; Wahlberg says that the drive to find food often is so much stronger than the drive to stay away from noise. Weilgart puts the cetaceans situation in the reality of human society:

> Just imagine doing it with humans, if you just watch them from on high and try to figure out what they found disturbing or not, you would say '*Oh look, there is these really loud airports, but look there is bunch of humans living around the airport. Therefore they are not disturbed by airports*.' In fact they are *very* disturbed by airports but the housing is cheaper there so they have to live there.

Turning the counter-argument on its head, Weilgart stresses the importance of from which perspective you see the issue. Weilgart is trying to move outside the human Umwelt and analyze the uncertainties of anthropocentrism. Therefore my theoretical framework seems important for the still developing assessment of seismic surveys impact on cetacean health.

5.2 Cetaceans' value for humans

To understand how oceanic cetaceans is seen we need to investigate how industrial human culture values them as material and immaterial resources. Historically, cetaceans have been an important part of the human diet and as an economical resource in other ways, for oil and ivory in particular, but industrial countries have now replaced the nutritional value and to some extent the economical value with a less material (Kalland 2009). In the case of the Inuit community Farrah Khan is cooperating with in Canada, whales are a vital part of their daily sustenance, as the ocean is their only option for food in that climate. Farrah Khan thinks one of the reasons for the recurring theme of whales being viewed as majestic creatures is that humans rarely see them, which makes them elusive for humans. Kalland (2009) suggests that cetaceans have become an important environmental symbol, a symbol indicating the anthropogenic harm done to nature by modern society. The symbolic value is now the greatest force used when advocating the ethics of cetacean conservation (ibid.). Through a number of arguments Kalland is explaining the creation of what he

calls the “Superwhale”, the generalized and combined image of all different positive characteristics and functions of cetaceans worldwide creating a unique and special empathic sentiment towards cetaceans (Kalland 2009: 28-46).
Milton (2002) investigates an ecological approach to emotions that embraces the emotional value of the environment as a tool for humans which is most helpful when discussing sustainability and rational mitigation of environmental issues. She also points out science’s “assumed independence from emotional bias” and its “supposed impartiality” which creates eminent political power (Milton 2002:136). Although the sentimental value of whales can mobilize against the industry, arguments are weakened by the non-quantitative value emotions inhabit. Stocker and arctic campaigner for Greenpeace Nordic, Sune Scheller, give examples of fish and marine larvae that also are affected by seismic surveys, but if used as an environmental symbol it will not have the same reactionary public response that whales will have.

Kalland is explaining how whales have become seen as the “humans of the ocean”, and therefore becoming an increasingly important emotional symbol in western societies (Kalland 2009:19). This is a clear example of the phenomenon anthropomorphism, which metaphorically uses human culture to relate to cetaceans (ibid.). This means, for example, to apply human cultural traits to cetaceans to understand their behavior (Kalland 2009:1-27). This was exemplified earlier in section 5.1.2 when the prevalence of whales close to operating seismic vessel implied that cetaceans were not harmed by the noise produced. Both noise producers and scientists used anthropomorphism to explain the occurrence for their own agendas. Anthropomorphism can be seen as both a result of Umwelt and anthropocentrism. It is a tool to discern the surrounding organisms’ Umwelt using anthropocentric methods. Stocker uses the anthropomorphic traits of cetaceans to explain why humans attach a certain symbolism to whales. He gives their high consciousness, their care for their young and old and their complex social networks as examples of anthropomorphism. Weilgart suspects that the initial focus on cetaceans, when marine noise pollution was first noticed as an environmental problem, could be linked to the public’s prioritized interest for them over other marine organisms, even though most marine life is dependent on acoustics.

Rendell & Whitehead have suggested that cetaceans could have had culture in the same meaning as humans have, if regarding culture according to “Boesch’s concept of culture as a dynamic process reaching different complexities, and Slater’s call for a taxonomy of cultures” (Rendell & Whitehead 2001: 369). But impediments from living in the marine environment could be a reason for the less materialistic approach cetacean species’ culture possess (ibid.). “Thus, cetacean culture may be akin

to the information economy: more mental than material" (Rendell & Whitehead 2001: 369). To compare cetacean culture to have characteristics similar to the human information economy is very interesting. I consider the information economy in western society to be valued as something highly intelligently developed, almost something that has ascended standard conditions of living and invoked a paradigm shift. It can in some ways be connected to Deely's (2014: 30) thought of Lebenswelt as a 'humans-only club'. That cetaceans could be considered to have gone through this kind of advancement is trying to see them in their Umwelt yet still use anthropocentric anthropomorphism to value them.

The value of cetaceans in industrial societies today is rather intangible, immaterial, as the known material value has become less important. It seems as the developed symbolism for cetaceans in industrialized societies have been a part of shaping this research field. Perhaps with time the use of cetaceans for humanity will be extended outside both the Uexküllian and anthropocentrically locked views and transcend to ways of understanding the environment in more spacious perceptions.

5.3 Differences

I will in this section explore relevant issues regarding the sheer fact that humans and cetaceans live in very different Umwelts, and how anthropocentrism impact the human understanding of cetaceans. The first section will be about the more bodily different experience, and the second section will explain the varied conditions when inhabiting the elements of water or air.

5.3.1 Individuals

Even though the human ear can detect frequencies between 20 Hz to 20 kHz, and airguns emit noise with a frequency range of below 1 kHz, there is no use to apply this fact to understand different cetaceans use of sound as we use sound differently (Cummings & Brandon 2004). In my interviews this fact seemed only to be able to be used for indications, but not to understand cetaceans relation to sound. Something interesting is the perspective of how one cannot relate to another animal's sensed world, and how this may not be species specific. When I ask Tougaard about how he thinks a cetacean experiences airguns, he answers:

> It is very very difficult to imagine how it must be to be a dolphin, but it is not really more difficult than trying to imagine how it would be to be a cow. We really cannot imagine much else than being ourselves, we have difficulties trying to understand how it would be to be another human.

Tougaard problematizes the thought of being able to imagine being another animal, as well as imagining being another human. Scheller's answer was similar: "… how it is perceived, for an individual whether it is a human or a marine mammal, is impossible to say something about." Scheller refers to indications of how the noise can be perceived, giving examples of comparing frequencies that seismic surveys and the animals use or how some research show heightened stress hormones in individuals which would indicate a negative response to the noise. When involved in assessing impact from seismic surveys on cetaceans' soundscape, it seems as Tougaard and Scheller have similar thoughts connected to the theory of Umwelt. They are both trying to understand the other Umwelts which marine mammals experience.

But some differences can be more difficult to remember to take account for when assessing noise pollution's effect on cetaceans. In my interview with Stocker he mentioned the advanced neuroplasticity of *Homo Sapiens'*, and how it is "our greatest trait as a species, because we can adapt very fast to new situations". Cetaceans have had longer time to adapt to their surroundings, and now those surroundings are changing faster than they are able to adapt because of human environmental impact (Kalland 2009: 28-46). "If we start putting our priorities of neuroplasticity and rapid adaptation on to other species that do not have that characteristic of course they are going to fail", Stocker says. He raises the point of anthropomorphism in this statement, how humans take human traits and assumes other species have similar characteristics. As mentioned in section 5.2, this can be explained by the human Umwelt combined with anthropocentric narrowness perceiving the world from human standards: a human perspective that can have detrimental effects on other species.

5.3.2 Different mediums

The different conditions for living and inhabiting an environment affect the way we relate to our surroundings, which can become an issue when working professionals try to relate to other living organisms. Stocker (2013: 60) compares marine animals use of sound to how terrestrial animals use optics, both preferred senses are related to the medium which the animals inhabit. Sound also travels five times faster in water than in air, which is great when sunlight and along with that the perceptive orientation only reaches a few hundred feet down from the ocean surface (Jasny 2005; Stocker 2013: 103-115) The density of water has a much more dynamic and heterogeneous response to physical changes, which gives sound and noise a much more diverse seascape to move

through (Stocker 2013: 103-115). This have aquatic animals adapted to use and translate, which helps them understand their surroundings (ibid.). Also, organisms have greater access to the three dimensional world to move through, when the earth's gravity is less present in the medium of water than in air (Stocker 2013: 103-115).

Sound propagation, how sound travels, in ocean water is different from sound propagation in air. In the water medium it is much more diverse. Ocean water differs in water depth, in what kind of topography the seafloor is composed of, salinity and water temperature (Cummings & Brandon 2004:3). Stocker explains the complexity of the ocean soundscape:

> There are many properties of water that engender sensual realms outside of our perceptual grasp. Water is not as homogeneous as air; it has density and pressure gradients that vary widely with turbidity, turbulence, salinity, temperature, and depth. You might imagine an underwater environment as a rich mélange of blending densities produced by the motions of eddies, currents, and tides. These swirling nuances of density affect the transmission of acoustical energy in water, giving aquatic animals cues to the current flows, temperature, and chemical characteristics of their surroundings expressed in its dynamic acoustic qualities (Stocker 2013:110).

The water medium has many qualities that cannot be analyzed through the visual perception (ibid.). Through listening to the ocean medium with its different characteristics, information useful to marine animals can be understood (ibid.:110-111).

An important part of the two different mediums is how they work at their intersection. The interface of air and ocean works as a sound barrier, making sound from each element less strong (Hildebrand 2004). This is an important factor for why humans do not understand the underwater soundscape; we do not get affected directly by it (ibid.). Humans do not hear the sound we create under water as strongly as if we were in the water. And neither do our auditory organs function like those of cetaceans. Regarding the theory of Umwelt, it is important to understand the different sensory worlds humans and different cetaceans inhabit. This affects our way of evaluating noise, as we could easily regard noise from a human sensory perspective, where it is less of a crucial navigational tool than it is to cetaceans.
Wahlberg does not share this view, he sees a reason to why sound in water is seem so magical is because we do not know the marine animals sounds as well as we do with terrestrial, where most animals have been reported and established.

> But, the problem under water is that the whole thing seems so magical, since we have no experience of it, so when we listen under water it sounds very odd and spooky. [...] it must be something intelligent in that, right? But when we analyze it, it is not more intelligent than a blackbird. There is a male trying to reach a female, end of story. But it sounds different and we think it sounds very cool. Because it is something we do not hear normally.

The unknown sounds of marine life are thus to be to be valued more intelligent because they are mysterious to humans. He continues to conclude how he thinks sound used in air and water are fundamentally the same but what differs is human knowledge and experience of the mediums. He points out how much sound we make in air, and even though more of it is regulated, humans do not care so much about the reactions of the terrestrial animals. While I do not have as much scientific knowledge as Wahlberg has in the field of marine mammals bioacoustics, I cannot help regarding his thoughts as locked in his own Umwelt. As my other sources do accentuate the role of air and water as mediums creating different conditions to communicate in, I must regard Wahlberg to disregard the different modes of using mediums and senses, and consequently the theory of Umwelt.

5.4 Uncertainties

When Umwelt works in combination with anthropocentrism, it is difficult to perceive the uncertainties of the scientific understanding of anthropogenic noise pollution. As this thesis focuses on the flaws of having a human perspective when assessing my selected issue, I will now present how the relevant and important uncertainties within the field of research are understood by informants and the field of research itself.

5.4.1 Bias creates uncertainties

I will now present how the bias of funding by different actors within the field of research impact the assessments of the issue. Connected to the problems of creating certainty in the scientific understanding of the issue, is how research is orchestrated. Wade, Whitehead and Weilgart states in their article of how funding bias the field of research of anthropogenic noise effects on marine mammals, and write that “the U.S. Navy, whose sonars[10] kill marine mammals, provides

[10] Sonar sound has a wider frequency range than seismic surveys have, as well as a greater propagation and more powerful decibel, which should make its impact on cetaceans greater (British Columbia Ministry of Energy and Mine 2003). There is scientific evidence for sonar sound to be causing cetacean strandings, especially of beaked whales *(Ziphius cavirostris)* (Boyd et al. 2011).

approximately 50% of the funds for marine mammal research worldwide" (Wade, Whitehead & Weilgart 2009: 320). They chose six reviews which they thought represented the field of research's current situation according to where funding came from and how reviews are orchestrated in the subject, and where all reviews had intentions of providing valuable information to help public policies being managed (Wade, Whitehead & Weilgart 2009). These were analyzed along with the primary research papers in those reviews to get an understanding of the current research procedures that seem to have been fueled by the mass mortalities of cetaceans when militaries have used mid-frequency sonar (ibid.). They found a disproportionate relationship between the funding the U.S. military is giving to the field of research and the acknowledgment of this funding in the actual literature; acted through funding agencies with no apparent connection in their name to them (Wade, Whitehead & Weilgart 2009). This was regarded to consciously impact the general assessment of marine mammal noise research when hiding their mark on biased research (ibid). They saw an apparent pattern of how all different funders influenced their funded reviews and primary research papers, although the military and oil and gas companies funding were so much larger that the conservation groups bias towards always concluding environmental impact in their funded research could be seen as a leveler, since their financial power are so much smaller (Wade, Whitehead & Weilgart 2009). The authors state that "the conclusions of the research favour the interests of the sponsor" (Wade, Whitehead and Weilgart 2009: 326). These political motives produce a general distrust to the field of research's assessments and weakens the management and policy work regarding noise pollution (ibid. 2009).

In an interview Weilgart explains her thought on the structural bias, how the noise polluters are mainly funding the research is appropriate, but their control over the research is not:

> Clearly the funder would want to have results that show that there is not a problem, […] As a noise producer, that is what they want to hear.[…] But, again, it creeps in in very subtle ways; about how you design a project, what questions you look at. There is all sorts of ways every step of the way that your bias can affect your results.[…] Bias is inherent in humans, there is always bias. We are not machines.

The complexity of the structural bias is apparent to Weilgart, how the funding creates specific obvious wishes with the research, which can be more or less incorporated in the research process and result. She also makes a point of how difficult it is to not have bias, how it is inherent in humans. Weilgart regards this problem as larger than in many other areas of research, as the funding so often is from a noise producer. Tougaard sees bias due to who have funded the research to be

visible everywhere, but considering that the oil and gas industry is a very important one with so much money so that their bias could be more visible.

Regarding Greenpeace influencing their researchers assessments through their funding, Khan does not want to define it as exaggerating: “One way of looking at it is to say that we are focusing too strongly on the environmental impacts but another way is to say, well if we do not do it who will do it?” Weilgart views the influence by environmental groups as a small effect on the general perspective: “People say environmental groups fund research too and that counterbalances it. Well it does not, because the amounts are so different. Environmental groups are penniless compared to oil companies.”

The perspective of the individual scientists is also of concern for shaping this problem, as their job security is tightly knit with funding. Weilgart states that even though the funding from noise producers does not usually fund the scientists salary, they fund their research projects:

> And the research is critical to a scientist’s career. So that makes a huge impact. If they can not find funding [...] they are not going to be able to hold on to their position unless they have tenure and sometimes not even then. It is a crucial part of the life of an academic scientist to be able to have funded research.

There seems to be a certain indirect bias which can be addressed or hidden when regarding funding, and this can be done for different purpose. If what Weilgart said is true, that bias is inherent in all humans, then there is a problem to how the field of research’s funding functions. Could these kinds of bias also relate to an anthropocentric perspective? If the field of research could be partially controlled by noise polluters, would not the understanding of other animals be connected to what is anthropocentrically useful? Bias from funding is seen as a problem. In section 5.1.2 Tougaard mentioned how it is bad business for the noise polluters not to acknowledge their environmental impact, which according to the massive funding they give to the field of research could be seen as a way to control how the impact of noise pollution is assessed. I regard the uncertain results that noise polluters help create, and the undermining of scientific credibility of the field of research, help to prolong the process of assessing seismic surveys impact on oceanic cetaceans. This is clearly in favor of the noise polluters, which gets more time to exploit oil and natural gas reserves.

5.4.2 Uncertainties when assessing cetaceans through their ecosystems

When trying to assess seismic testing's effect on oceanic cetaceans, there is many uncertainties because of the lacking understanding of ecosystem functions and health. I will in this section address how these uncertainties can be linked to the theoretical framework.
An important component of the current understanding of ecosystems, and thus the importance of biodiversity, is the fact that there is a lot of data still lacking (Persson 2006). The uncertainty in the understanding of ecosystems is a crucial part in how we manage them (ibid.).

The symbolism of whales in industrialized societies can help encourage research revolving ecosystem functions. As presented earlier in section 5.2, whales are seen as the true inhabitants of the ocean, and as anthropomorphic tendencies also create an image of them being like humans, their rights to the ocean become of great importance for many people (Kalland 2009: 28-46). Kalland compares this to how aboriginal regions is prohibited from white people using it in certain ways, as if cetaceans long history of living sustainably in the ocean should give them rights to it (ibid.). This argument can be used more or less consciously when looking at the functions of whales in ecosystems. Even though the functions of different cetaceans are relatively unknown, it seems as if the anthropomorphic value on whales is accentuated by uncertainty. When the theory of Umwelt and anthropocentrism results in anthropomorphism to handle uncertainties, this is an illuminating example of what can happen.

But the scientific tradition has also shifted its way of approaching the ocean. Rose, Janiger, Parsons and Stachowitsch (2011) state that there has been a paradigm shift in research regarding anthropogenic impacts on marine environments. Through bibliometric analysis of cetacean research they state that the contemporary field of research focuses on assessing ecosystem health and those systems organisms' health (ibid.). This development presents a field of research with many uncertainties, with many conclusions confiding in future research where data collecting methods will be more valid (Rose et. al. 2011). This I find especially clear in the literature I have read regarding seismic surveys and oceanic cetaceans; there is generally one or another kind of uncertainty affecting the result and conclusion and as Rose et. al. (2011) suggest, there is much faith to future research and methods. Persson (2006: 53-95) mentions this development as well when discussing scientific understanding of the value of biodiversity. There is now an idea of ecosystems as dynamic and complex "where chaos and unpredictability are endemic, with stability and predictability the exception" (Maher 1999-2000 cited by Persson 2006: 53). The thought about ecosystems has changed, and analysis of ecosystems when trying to assess the importance of

biodiversity has the pattern of being uncertain and intricate (Persson 2006: 53-95). In this regard the field of research has begun developing towards a less anthropocentric approach. Admitting that there is a still hidden coherence in nature is to admit that the world around the human species should not only be utilized through human needs. The world might actually have many *different* needs.

As the logic behind ecosystem functions and the importance of biodiversity have become the center of attention in scientific research regarding anthropogenic impacts on marine environments, there is a realization of how little of this logic that is known (Persson 2006; Rose et. al. 2011). When combined with the field of research's focus on quantifiable data mentioned in section 5.1 there will be clear limitations to what will be scientifically visible effects from seismic surveys' noise pollution. Hornborg raises a point of how "mainstream biology" reproduces the image "of nature as an assemblage of objects" (Hornborg 2001:123). This high value on materialism he suggests is created from "an accommodation to the demands of an economic and technological establishment concerned with the management and control of natural systems" (Hornborg 2001:122). As economic and technological ideologies have interest in "natural systems" they affect the position of biology when viewing those same natural systems, and the procedures and modes of analysis (ibid.). This perception is interesting when regarding anthropogenic sound pollution, and how seismic surveys are a consequence of industrial society's use of natural systems; of natural resources.

Another thought regarding the effect of seismic testing is how the sound is a temporary noise polluter, which makes the effect on cetaceans also temporary. "The nature has that joyful quality that it very quickly recover when conditions get better again", Wahlberg states. Stocker mentions a similar argument which he opposes. Related to the argument of prevalence of whales where seismic surveys are being conducted, there is an argument of how seismic surveys has been conducted in some places for 20 years and there are still whales in those habitats. He says:

> Well, there are a lot of whales around but it is not just about how many marbles you have in the jar, that is not the issue. The issue is what these animals roles are in a larger ecosystem. And what is eroding as a consequence of that? And a lot of those systems are way too complex for us simple-minded humans to understand.

When speaking to Weilgart she compares the environmental assessments with how harm prevention is used in human medical procedures, where there is no interest to see how much they can push the health of the patient, as the medical treatment focuses on the best outcome possible. She suggests a

similar perspective should be implemented when assessing environmental health.
It seems as the assessments works within an anthropocentric perspective, where it works as an extension of assessing human health. The anthropocentric perspective focuses on human health through environmental assessments. And if the noise pollution's impact is not defined as detrimental in scientifically quantifiable measures, as section 5.1 discussed, it is not threatening to humans.

Cetaceans are highest up in the oceans' food chain and as some cetaceans migrate large distances, they have a great impact on ecosystems functioning properly, yet there is still little known about them (Merkens 2013). Merkens suggests that, "To better understand our world, and the effect humans have on it, it is essential for us to better understand cetaceans" (Merkens 2013: 1). And even if ecosystems would manage without certain species of cetaceans, or if cetaceans would not be so indispensable as some believe, we will probably always have uncertainty as a part of research which makes it important to incorporate it into our assessments (Persson 2006). Persson points out how we have no way of knowing future life on Earth's conditions and use of resources, and therefore we can not know for certain which species to exploit obliviously, since something industrialized societies see as useless now can have a completely other value in other contexts (ibid.).

To address seismic surveys impact on oceanic cetaceans within the context of ecosystems highlights the many uncertainties of the understanding of cetaceans, ecosystems and the human future. Uncertainties is a natural component when accepting the theory of Umwelt, as all beings are captured in their own sensed and functioned world (Uexküll 2010). This thesis theoretical framework is important for developing a broader understanding of cetacean health in the context of the industrialization of the ocean.

6. Conclusion

By assessing seismic testings impact on oceanic cetaceans, I have presented epistemological issues within the field of research to be limiting its possible development. The traditional use of statistical evidence is halting the process of assessing seismic surveys effect on cetaceans. Also, it seems as if the current short-term focus from both noise polluters and researchers might stagnate the research, as the impact is assessed within a narrow context. Further there is a problem regarding the emotional-political value of cetaceans to industrial societies. The less material use of whales have made them a symbol for a transcended nature, which in turn is a symbol for the human responsibility towards the ocean and environment. There are also problems in how humans can relate to cetaceans, without relating through anthropomorphic methods. Differences between lived experiences and environments also enhance the difficulties in understanding their use of soundscapes. Noise polluters have financial influence in how and what research is conducted, which seem to be creating difficulties in assessing noise pollution and also affecting the credibility of the research field's scientific ethos. Finally, the many uncertainties connected to the research of cetaceans and how ecology and ecosystem functions should be used in context of cetacean health makes the situation more complex.

Even though all informants for this thesis recognized the inability to fully understand cetacean's relation to sound, they still did not always admit it. The anthropocentrism is in other ways more tangible than the theory of Umwelt, but more difficult to manage within the industrial societies' profit driven preconditions. Noise polluters also benefit from an uncertain field of research, and an anthropocentric agenda drives the seismic surveys to continue as long as fossil fuel is an attractive commodity.

The interdisciplinary complexity of this issue should be treated with a similarly complex mode of understanding it, instead of the typical scientific traditions of the disciplines involved. I think that approaching how knowledge is produced in this field would be an important tool for understanding many of the issues this thesis discussed. As this work had the purpose of introducing human ecological perspectives in the issue, I hope future human ecological explorations will follow. I would especially like to see more of how definitions of anthropogenic impact is established and controlled, and how noise polluters affect the production of knowledge.

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Appendix 1

Interview guide

This is a general summary of how interview guides for this research were orchestrated. Questions and themes differed among interviews, depending on the informant's seeming interest in certain themes and my background research of their previous professional experience and work. Individual questions are not a part of this summary.

Introduction:

- Formalities.
- Introduce research theme and purpose.
- Explain how the interview will be used.
- Confirm consent to being recorded and offer the choice to be anonymous.

Tell me about your professional experience of the issue.

Starting questions:

- How do you regard airguns affecting cetaceans?
  - What do you know about how other scientists think about this?
- Which problems do you see with understanding the soundscape of cetaceans?
- With your professional knowledge, how do you think cetaceans experience airguns?

The professional role:

- How does a scientist's or professionally involved person's job security affect the research?
- Does a scientist's or professionally involved person's attitude to seismic surveys affect the research? If so, how?
- How does funding and salary affect what research projects that is created?
- Have you found traditional ecological knowledge useful for your research, and if so: how?

Problems/phenomenons within the field:

  - What are the effects of this?
- Which effects does uncertainties and the lack of data have on your work?
- Is there a focus on short-term effects in the field of research, and if so: why?
- What are the effects of uncertainties and the lack of data on the field of research?

The bigger picture:

- What role or impact do humans have on the marine ecosystems?
- Has this issue been given appropriate attention? Why? How?
- How do you define the precautionary principle and what meaning does it have to the assessment of this issue?
- When dealing with uncertainties and conservation issues, I have read about the precautionary principle and how there is a scientific bias towards false negatives. Is this apparent in the seismic surveys and the effect on cetaceans?
- How do different actors involved in the issue affect the creation of a scientific baseline?
- Can you see any common interpretations of the phenomena outside the field of research?
- What is so special with whales?

Finishing the conversation:

- Thank you.
- Inform of option to give feedback to transcript.
- Confirm if wanting to be anonymous or not.