Willingness to Pay for Preventing an Oil Spill in Vestfjorden: The Role of Use versus Non-Use Values

Ingrid Egeland & Ingrid Nilsen Frøystein

Master's Thesis
Faculty of Social Sciences, UIS Business School

Universitetet
i Stavanger

Universitetet
i Stavanger

FACULTY OF SOCIAL SCIENCES,
UIS BUSINESS SCHOOL

MASTER'S THESIS

STUDY PROGRAM:	THESIS IS WRITTEN IN THE FOLLOWING SPECIALIZATION/SUBJECT:
Business Administration - Master of Science	Economic Analysis IS THE ASSIGNMENT CONFIDENTIAL? (**NB**! Use the red form for confidential theses)

TITLE:

Willingness to Pay for Preventing an Oil Spill in Vestfjorden: The Role of Use versus Non-Use Values

AUTHOR(S)		SUPERVISOR:
Student number:	Name:	Gorm Kipperberg
227649 …………………	Ingrid Egeland ……………………………………	
220979 …………………	Ingrid Nilsen Frøystein ……………………………………	

ACKNOWLEDGE RECEIPT OF 2 BOUND COPIES OF THESIS

Stavanger, ……/…… 2016 Signature administration:……………………………

Abstract

In this study the values that could be lost if an environmental damage occurs in Vestfjorden are estimated. The overall research question is: “What is the willingness to pay for preventing an oil spill in Vestfjorden?”. The idea is that this might give indications on how people value the region’s environment and their current economic and recreational use of it. Focus is further on identifying the use and non-use components of the potential losses. In other words, a goal is to learn what parts of these that are related to use of the Vestfjorden area and not.

The Contingent Valuation Method is applied in order to investigate this. The data is taken from an Internet administered survey conducted in 2013, for which a sample from the Norwegian population was stratified on county level. The respondents were asked if they were willing or not to pay a proposed sum of money to avoid a constructed environmental damage in Vestfjorden. There were questions concerning recreational usage of the area, and others to detect various potential effects on the subject in focus.

Average annual willingness to pay per household in a 10-year period is estimated to be between 1304 and 1359 NOK. Total values that could be lost if an environmental damage occurred in the Vestfjorden area is calculated at 28.6 billion NOK. There is a high degree of uncertainty surrounding these numbers. The non-use component makes up the largest part of the potential losses. This means that many Norwegians who are not defined as users of the area want to pay for preserving it. The result indicates that Vestfjorden is of national importance. Various demographic and other variables seem to affect how individuals value the region.

The study was planned and implemented according to recommendations for the Contingent Valuation Method. Most of the explanatory variables that are included in the analyses have the expected estimated coefficients. The value estimates resembles the ones found in other researches. Together, this indicates that the results from the study are reliable and valid.

Preface

This Master's Thesis concludes our Master's Degrees in Business Administration at the University of Stavanger. We have chosen Economics as our specialization, and the thesis is written within the field of Environmental and Resource Economics.

By estimating what values that could be lost if an oil spill occurs in Vestfjorden, we wanted to make an academic contribution to the debate concerning whether or not such industry should be allowed there. We think the Contingent Valuation Method is an interesting approach to issues like this.

The process of working on this study has been interesting and challenging. We have had the possibility to use knowledge and insights we have gained throughout our education in new ways. We have also learned a lot about new subjects.

A special thank you is directed to our supervisor Gorm Kipperberg. He always kept an open door. We had many interesting conversations with him, and received constructive feedback. His interest for the subject of the study inspired us. We also want to thank our family and friends for moral support. Further, they have contributed with insights, guidance and critical questions concerning this thesis.

University of Stavanger
June 2016

Ingrid Egeland and Ingrid Nilsen Frøystein

Table of Contents

List of Equations

List of Figures

List of Tables

1 Introduction

Norway is a maritime nation. The sea and coast have characterized the development of the society and shaped much of the people's identity. The ocean holds great environmental values and resources. Norwegian trade and economy are strongly linked to it, with activities related to shipping, fisheries, tourism, aquaculture and petroleum (Meld. St. nr. 20 (2014-2015), 2015, p. 5). Coastal areas are also important for peoples' recreation. Conflicts of interest might arise as a consequence of the various applications. It is therefore interesting and important to investigate how sea and coastal resources should be used.

Oil and gas production have particularly high risks involved. The short-term consequences of an accident in this sector are often severe (Lindhjem, Magnussen, & Navrud, 2014), and some effects are long lasting. As seen from the Exxon-Valdez, the Prestige and the Deepwater Horizon accidents, nature, animal and bird life might be damaged from oil spills. Recreational areas could end up less attractive and jobs put at risk. These and other consequences might lead to stress and illness among humans in the affected regions. The mentioned accidents also disturbed people who neither lived in nor had been to the damaged areas. This shows that oil spills might cause both use and non-use value losses.

Most Norwegians know about the Vestfjorden area. Many have been there, and even more have seen it on photographs and TV. It is an area that many appreciate and are proud of. To a great share of the population it might be important to avoid environmental damages in Vestfjorden. This study seeks to estimate the values that could be lost if an oil spill occurred in the area. Material damages on ships and equipment are ignored, and focus is worth to the population. In an economic sense, the welfare loss is the amount the affected persons are willing to reduce their income with to avoid or reduce the constructed environmental damage (Lindhjem et al., 2014). The overall research question is: "What is the willingness to pay for preventing an oil spill in Vestfjorden?". Three specific research questions are developed in order to investigate this.

The first is: "How important are use versus non-use components of total willingness to pay for preventing an oil spill in the Vestfjorden area?". The goal is to identify what parts of the value of avoiding environmental damage that are related to use of it and not. Residents and people who have visited the area are considered as users, whereas non-users are the ones who have never been there. The former group is expected to appreciate it more than others.

Specific research question number 2 is the following: “How important is option value in the non-use component of willingness to pay for preventing an oil spill in the Vestfjorden area?”. If people derive option values from the region, planning to visit is expected to increase the perceived value of it. This is a component of the non-use values. Many Norwegians might want to maintain the option to go to the area and enjoy a nature free from environmental damage.

Lastly, the third specific research question is: “What factors affect use values, non-use values and total willingness to pay for preventing oil spill in the Vestfjorden area?” There are several variables that can have an impact on these. Both demographic and other factors are expected to affect peoples’ preferences for preserving the Vestfjorden area.

The Contingent Valuation (CV) Method is applied in order to investigate the research questions. Respondents are presented constructed oil spill scenarios in Vestfjorden, and are asked if they want to pay a certain amount to avoid an environmental damage there. It is assumed that peoples’ preferences may be expressed through utility functions, and that they seek to maximize their well-being. A further supposition is that environmental amenities can add value to humans.

The study follows a descriptive research design. A cross-sectional analysis is conducted based on quantitative methods. A sample of the Norwegian population is examined through an Internet administered survey conducted in 2013, and the data collected is analyzed using the binary logistic regression method. Ultimately, the goal is to be able to draw some general conclusions.

The thesis starts with a background section in chapter 2, followed by a review of the theory and methods that will be used in the third section. In chapter 4 the study design is presented, followed by an overview of the results from the survey in the fifth chapter. The theory and the empirical findings are tied together in a discussion on the research questions in the sixth section. Finally, the thesis ends with a conclusion in chapter 7, which includes a brief summary of the findings of the study.

2 Background

2.1 The Vestfjorden Area

Vestfjorden is located in Nordland County in the north of Norway. It is an coastal area that is about 155 km long and 80 km at it's widest (Store Norske Leksikon, 2009). Vestfjorden is surrounded by land in near all directions. There are a lot of islands in various sizes in Lofoten in the northwest, and towards east and south there is mainland. Further, there are many islets and shears in Vestfjorden. Kabelvåg, Svolvær, Lødingen and Bodø are some of the most important villages and towns in the area.

The areas surrounding Vestfjorden are world known for the spectacular nature. The contrasts between the steep mountains and deep fjords are outstanding. There are long, sandy beaches and the ocean has a characteristic blue color. The often-occurring northern light and midnight sun contribute in making the area special. These are some of the features that attract thousands of Norwegian and foreign tourists to the Vestfjorden area each year. The beautiful surroundings are also important for locals' recreation.

There are widespread possibilities when it comes to activities to take on in the Vestfjorden area. Due to its diverse appearance it is a great place to combine relaxation with experiencing new things. In the summer hiking, kayaking and diving are popular. During the winter months many people go skiing. Mountain climbing and ocean safaris are examples of all year round activities. Thus, there might be ways in which everyone has the possibility to recharge in the Vestfjorden area.

One of the world's largest deep-sea coral reefs is located outside the coast of Røst, which is the outermost of the Lofoten Islands. A great amount of plankton grows in Vestfjorden (WWF Norway, 2015). These features make the area an important habitat for many types of fish, birds and marine mammals. Europe's largest Puffins colony hatches on mountainsides at the tip of Lofoten, and there are also a lot of Guillemots and Kittiwakes (WWF Norway, 2015). The world's largest cod stock travels from the Barents sea and uses Vestfjorden as a spawning area. Many of the mentioned species are vulnerable and could be hurt if changes in their surroundings were to occur.

There are great fishing possibilities in Vestfjorden, especially in the period from January to April due to the cod spawning. Industries related to catching and processing of fish have been of great importance in the area for hundreds of years. Historical villages with Fishing Huts, originally called “Rorbu” in Norwegian, stand as a proof of this. Still, many people make a living out of the great resources that exist in the ocean, and anglers come from all over to fish in the area. The stockfish that is produced out of cod from Lofoten is perceived to be among the best in the world.

2.2 Oil Production in Vestfjorden

Norwegian oil production has mainly been located far away from the coastline. This is partly due to large discoveries in such areas and to avoid potential conflicts that might arise concerning other industries and peoples’ interests (Olsen, 2009). Recently, areas closer to the shore has been examined, and seismic results indicate that there could be several large reservoirs of oil and gas also there (Olsen, 2009). The Petroleum industry considers the continental shelf outside Lofoten-Vesterålen to be among the most interesting areas.

There is an ongoing public debate concerning whether or not oil production should be set up in the areas surrounding Vestfjorden. Arguments in favor of such activities are related to the possibility of new jobs and contribution to The Government Pension Fund Global. On the other side, many people worry about the possible environmental consequences of the business. Risk of blow-outs and pollution derive from offshore petroleum drilling, production and transportation (Knol & Arbo, 2014). In 2001 the Norwegian government prohibited all oil and gas activities in the Lofoten area, and required a consequence assessment before reopening.

The weather in the Northern Norway is shifting, and can be harsh from time to time. Winter storms with strong winds, pouring rain and big waves are not unusual. There are a lot of darkness and risk of ice in large parts of the year (Knol & Arbo, 2014). All this might represent risks for a potential oil industry in Vestfjorden. In the worst case, platforms could be damaged and tankers run aground. Lack of infrastructure and thereby long response time could be a challenge if an accident occurred there.

Overall, Norway has a relatively well-developed emergency response system to deal with oil spills along its coast (Knol & Arbo, 2014). Oil companies have the primary responsibility for dealing with acute pollution closest to the source. Further, different roles are defined for private, municipal and state actors. The Norwegian Coastal Administration is in charge of implementing preventive measures to reduce the risk of accidents causing oil spills (Lindhjem et al., 2014). Several international agreements concerning avoiding such events are also in place. Further, the technology used in clean up processes is under continuous improvement.

2.3 Previous Large Oil Spills

There have been several significant oil spills in different parts of the world. Focus in this thesis is on three of the most known ones. These are the Exxon-Valdez, the Prestige and the Deepwater Horizon accidents. Experiences from these might help in getting an understanding of the impacts an oil spill could have if it occurred in the Vestfjorden area. Consequences related to the environment, other industries and people in general are relevant. Information on how these oils spills were handled is valuable, and it is interesting to see if the cleanup mechanisms worked.

2.3.1 The Exxon-Valdez Accident

The Exxon-Valdez accident took place in March 1989. An American supertanker changed its route because of an iceberg, and ran aground on Bligh Reef in Alaska's Prince William Sound. Consequentially, about 350 000 tons of crude oil leaked from it (Carson et al., 2003). Strong winds and high sea spread the spill over large areas, and eventually it covered thousand miles of shoreline. The accident was declared to be a manmade accident, because there were many serious violations of rules and procedures (Haycox, 2012). It was stated that the change in course should have been avoided, and that the vessel instead should have been slowed down.

The oil spill led to mass mortality among sea otters and harbor seals and an unprecedented number of seabird deaths in the pristine Prince William Sound. Also many other types of fish, mammals and plants were affected negatively. There were two native villages in the area whose residents depended on harvest of the water's resources (Haycox, 2012). These peoples' livelihood and environmental values was seriously damaged. The accident led to emotional, psychological and economic tragedy among people in the affected areas. Alcohol, drugs, spousal abuse and related problems flourished.

Many argue that the company, federal and state authorities responses' to the Exxon-Valdez accident were failures, and that this resulted in more severe consequences. There was great confusion concerning who had the responsibility for the clean up process, and no coordinated plan was followed. In addition critical equipment like oil containment booms were scarce (Haycox, 2012). There was no clear definition of what a clean area actually was. The process of mitigating the oil lasted throughout the summer of 1989, and was continued in the summers of the two following years. Thousands of local residents from nearby communities and outsiders were hired to participate in the cleaning. In the aftermath is seemed like the job was not done sufficiently thoroughly. Oil was still found in the mid and lower intertidal zones twenty years after the accident (Haycox, 2012).

2.3.2 The Prestige Accident

The oil tanker Prestige suffered a serious accident outside the coast of Spain in November 2002 (Loureiro, Loomis, & Vázquez, 2009). Engine power was lost, and the ship drifted further on without any clear direction. On the sixth day after the accident it was divided in two during a storm, and sank to the bottom of the ocean. The ship leaked about 60 000 tons of oil. Multiple smaller spills arrived at the seashore in waves, and this extended the adverse negative effects in time (Loureiro et al., 2009). The event is considered to be the most serious environmental accident that has ever occurred in Spanish waters.

1300 km of coastline was polluted as a consequence of the accident, and the Northern parts of Portugal and Spain and Southern France were affected. (Loureiro et al., 2009). The coastal zones of Galicia were soiled the most, an area that supports a great number of human settlements economically and culturally linked to the sea (Loureiro, Ribas, López, & Ojea, 2006). Catching fish and extracting shellfish resources are crucial activities for many communities in the area. After the Prestige accident these industries were shut down for about a year. Also tourism was affected negatively. According to Loureiro et al. (2006) the number of total visitors in Galicia decreased considerably right after the accident. Several protected areas and national parks were damaged by the oil spill. Various estimates reveal that the number of birds that died may be around 100 000, and a great amount of mammals like whales, dolphins and turtles were also hurt and killed.

The cleanup process lasted for several months after the Prestige accident. A main problem was that little equipment and qualified personnel were available. This made a quick and effective response across such a large area difficult (Loureiro et al., 2009). By the summer time of 2003, almost a year after the tanker sank, most of the beaches were clean again (Loureiro & Loomis, 2012). Further, a complex extraction operation took place in mid 2004, emptying the tanker for the remaining oil. Cleanup efforts continued until December 2004.

2.3.3 The Deepwater Horizon Accident

The Deepwater Horizon accident occurred in April 2010 outside Louisiana in the Gulf of Mexico. An explosion that killed 11 workers and left another 17 seriously injured, caused a rig to burn and sink. The well on the ocean floor was open and leaking for about 3 months. As a consequence, large areas of ocean surface, islands and beaches were covered in oil. In total, nearly 700 000 tons of crude oil was released into the waters (Kling, Phaneuf, & Zhao, 2012). This makes the accident the biggest of such spills in history (Cleveland, Hogan, & Saundry, 2010).

The oil hydrocarbons spilled and the chemical dispersants used in the aftermath of the disaster affected many types of organisms negatively (Alvarez, Larkin, Whitehead, & Haab, 2014). Fishing was prohibited for long periods in the States of Alabama, Mississippi and Louisiana (Palinkas, 2012). This resulted in losses in commercial fishing revenue. The economic impact on tourism in the region was believed to be even greater. The federal government banned offshore drilling for about half a year after the accident. This jeopardized the jobs of 58 000 oil industry workers and 260 000 others who worked in related businesses in Louisiana alone (Palinkas, 2012). The oil spill resulted in damage both to the region's physical and social environments. People experienced anxiety and uncertainty over their future.

The state of Louisiana built a sand barrel construction that surrounded wide areas of barrier islands and wetlands. The general idea was to collect the oil behind these walls. A report designed by the Obama Administration revealed that the cleanup process was able to cover only 25% of the spill (Cleveland et al., 2010). The same portion of oil was naturally dissolved and 24% was distributed or spread over wide areas in the Gulf waters. It was assumed that the last part of it was either on or just below the ocean surface, washed on shore, collected on land or buried in the sand.

2.4 Application of the Contingent Valuation Method

According to Carson et al. (2004) S. V. Ciriacy-Wantrup laid out the conceptual foundations for the Contingent Valuation (CV) Method in 1947. Robert Davis was the author of the first academic application of it, which was a paper published in "Natural Resources Journal" in 1963 (Carson et al., 2003). At the time of the Exxon-Valdez accident in 1989 quite few articles concerning CV were published, but today there exist a lot of literature on it (Kling et al., 2012). Richard T. Carson has written the book "Contingent Valuation": a comprehensive bibliography and history", where he lists over 7500 such studies conducted in 130 countries spanning over 50 years (Carson, 2012a).

There are strong opinions both in favor of and against the method. The academic community is split when it comes to whether it is a useful approach, but it seems like many agree on that it is better to have some numbers than none (Kling et al., 2012). There have been great progresses concerning the method since the 1980s. These are mainly related to design and implementation of surveys and interpretation of results. But there are high costs associated with conducting a CV study where all recommendations for the method are accounted for.

The approach is applied on many issues, such as transportation, health, culture, education and marketing (Hanemann, 1994). A typical purpose is to measure potential welfare losses or gains from political proposals. It is often of interest to see how these will affect different groups of people. The CV Method is regularly applied in order to calculate the total costs of different types of accidents that affect the environment. Internationally, the estimates obtained have been widely accepted as a basis for legal prosecutions since the 1980s (Portney, 1994).

There have been few CV studies in Norway (Lindhjem et al., 2014). A consequence of this is that amenities and services related to it are considered in an arbitrary way. Thus, decisions affecting the environment based on traditional cost-benefit analyses may be taken with incomplete and inaccurate information. A relevant example from a Norwegian setting is the building of enormous power poles throughout the Hardanger area. This was chosen over the alternative of installing a submarine cable. The great resistance towards this indicates that the Norwegian authorities did not incorporate the total values of the affected area (Lindhjem et al., 2014).

2.4.1 The Contingent Valuation Method and The Exxon-Valdez Accident

A recognized study conducted after the Exxon-Valdez accident is ”Contingent Valuation and Lost Passive Use: Damages from the Exxon-Valdez Oil Spill”. Carson et al. (2003) applied the method in order to assess the consequences of the big accident of 1989. Focus was losses caused to the US’ population. Households in the affected areas were excluded in order to isolate non-use components of these. In face-to-face interviews the damages caused by the oil spill were described. The respondents were asked if they were willing or not to pay a specific amount to avoid a similar accident in the area in the future. Maximizing the likelihood function under the assumption of a Weibull distribution yielded an estimate of $97 for the mean WTP (Carson et al., 2003). Aggregate lost non-use values were calculated by multiplying this with the number of households in the population. The original study reported an estimate of $2.8 billion 1990 dollars as the lower bound (Carson et al., 2003). This was used as a starting point in the lawsuits that followed after the accident. Great progress has been made since the report when it comes to estimating WTP distributions. Updated numbers indicate that total lost non-use values from the Exxon-Valdez accident may actually be around $7.19 billion (Carson et al., 2003).

2.4.2 The Contingent Valuation Method and The Prestige Accident

Loureiro et al. (2009) estimated the environmental losses caused by the Prestige oil spill by applying the CV method. They investigated both the use and non-use components of these. It was the first such type of study conducted in Europe. Focus was on losses for the whole Spanish society. Face-to-face interviews were carried out in the period between March and

September 2006 (Loureiro et al., 2009). By using a parametric approach, the researchers found that respondents in the sample were willing to pay about €40.5 per household to avoid a similar future oil spill in Spain. By multiplying this estimate with the number of households, the value of the total environmental losses was found to be around €574 million.

Loureiro and Loomis conducted another CV study in 2012 following the Prestige accident. They sought to find citizens of Spain, UK and Austria's WTP for avoiding a similar future oil spill in Spain. The goal was to estimate the losses in non-use values caused to people in these countries by the accident. UK had experienced several oil spills before. Austria was selected as a baseline scenario exclusively for the valuation of non-use values, as this country does not have sea (Loureiro & Loomis, 2012). An online survey was conducted in May 2009, where a program with different measures to protect against a future oil spill in Spain was presented. The respondents were asked if they wanted to pay different specific associated costs or not. The Spanish population was found to have higher WTPs than the others, with an estimate of €124.4. Also people in UK and Austria turned out to have significant positive numbers, of €80.9 and €89.1, respectively. The results indicate that an oil spill like the Prestige might cause non-use value losses to people over wide areas and across borders.

2.4.3 The Contingent Valuation Method and The Deepwater Horizon Accident

According to Petrolia (2014) there have been developed few economic estimates of the losses caused by the Deepwater Horizon oil spill. He writes that this might be because of little funding allocated to such types of studies. CV approaches to valuing the consequences of the accident are probably currently being worked on.

Alvarez et al. (2014) conducted a Revealed Preference study where they looked at non-market recreational fishing losses from the accident. They developed a series of random utility models of site choice by saltwater anglers in the Southeast US. By using mixed logit approaches and estimating different monetary compensation measures for various types of anglers, they accounted for heterogeneity in preferences. The authors found that the losses were around $ 585 million. WTP for oil spill avoidance in affected areas varied greatly between different units in the target population.

2.5 Identification of Use and Non-Use Values

The distinction between use and non-use values has been a growing subject in the economic literature. Today it is widely accepted that an area might consist of components related to both the former and the latter (Eom & Larson, 2006). Efforts to disaggregate the two types of values have shown to be problematic (Carson, 2000). Non-market valuation methods have been developed and refined in order to better do this. Now, there exist several studies that aim to identify use and non-use values using various methods. Some of the approaches are reviewed in this section.

2.5.1 Eom and Larson (2006)

Eom and Larson (2006) studied the total value of an improvement in the water quality of the Man Kyong River (MKR) basin in South Korea. The authors combined Revealed Preference (RP) and Stated Preference (SP) data by simultaneously looking at the recreational usage the area and WTP for water quality improvement. The former only contains information about the use value of MKR, while the latter provide inputs that help estimate both this and non-use value parameters. In other words, preferences for environmental quality are expressed both in the individual's behavior and in statements of valuation. Because parameters related to the first are obtained, decomposition of WTP is possible. The result is a complete characterization of the individual valuation of the water quality change (Eom & Larson, 2006). Mean WTP per individual was estimated to be $26.56. The component related to use constituted 62% of this, and non-use 38%.

2.5.2 Loureiro, Loomis and Vázquez (2009)

As previously mentioned, Loureiro et al. (2009) estimated Spanish households' mean WTP for avoiding a similar oil spill in the country as the Prestige. They used a parametric approach called the Logit Model, as their WTP responses come from a dichotomous choice question. The dependent variable is the log of odds ratio of an affirmative response over a negative one to the main question in focus (Loureiro et al., 2009). The estimated coefficients indicate how the various explanatory variables affect it, all else equal. The significance levels of them reveal whether these seem to be real relationships or not. Mean WTP is calculated as the sum of products of the means of the explanatory variables multiplied by their associated coefficients. The researchers found that this number was higher for participants who had visited or lived in the affected area compared to others. The former had a mean WTP for avoiding another oil spill in Spain of €228.28, while the others' was €27.92. This might be interpreted as that there are positive values related to use of the area.

2.5.3 Wattage and Mardle (2008)

The article "Total Economic Value of Wetland Conservation in Sri Lanka Identifying Use and Non-Use Values" presents another example of how such types of values may be differentiated. CV is conducted in order to measure the stakeholders' WTP for the conserving area (Wattage & Mardle, 2008). The Analytic Hierarchy Process was applied in order to separate the two types of values. It involves making paired comparisons of different attributes of the area that are related to use and non-use values. The qualities are placed on opposite sides of a scale, with the value 1 in the middle and 9 on each extremity. One point on this is to be chosen by each respondent. A high number indicates that the respondent think an attribute is more important than the other. Preferences of individuals towards criteria relating to non-use values indicates their relative importance (Wattage & Mardle, 2008). Ten paired comparisons were made. The points allocated to the different types of use and non-use related attributes were summed. Wattage and Mardle found that it seems like that the latter contributes to about 45% of the overall value of the area.

3 Theory and Method

3.1 Utility Maximization

For the purpose on non-market valuation, Freeman III (2004, p. 11) state that two properties of preferences are important. These are non-satiation and substitutability. The former refers to that a bundle with a larger quantity of an element will be preferred to a smaller one, all else equal. Substitutability means that if an individual is compensated accurately he might be willing to change his consumption from one bundle to another. In other words, he may be indifferent between goods if the quantities of them are right. Thus, trade-off ratios between goods are established (Freeman III, 2004, p. 11).

Peoples' preferences can be presented by utility functions if the two types of properties mentioned above are satisfied. Such expressions specify how the well-being of individuals depends on consumption of different elements. $U(X, Q)$ is an example of an utility function, where X and Q are the bundles of goods in focus. The former may be a vector representing a combination of various entities that are traded in markets, such that $X = (x_1, x_2, \dots, x_n)$. In the same way $Q = (q_1, q_2, \dots, q_n)$ may involve non-market goods.

A general assumption is that individuals seek to maximize their utility given the available budget. Non-market goods typically do not have direct prices related to them. It is therefore the costs of the goods in bundle X that is most relevant. These can be given by $P = (p_1, p_2, \dots, p_n)$. The available income is y, and the level of non-market goods, Q, is fixed at Q^0. Utility maximization can then be expressed as in equation 1.

Equation 1: Utility Maximization Problem

$$\max U(X, Q) \;\; s.t. \;\; P * X \leq y, \qquad Q = Q^0$$

3.2 Willingness to Pay

Calculating people's Willingness to Pay (WTP) is a quick and easy way to assign a monetary amount to a specific good that do not have an associated price (Griffin, 2011). The resulting number can be considered as the maximum sum a person would be willing to offer for an item (Martín-Fernández et al., 2010). Most recreational sites in Norway are free to visit. By estimating WTP for preserving them, knowledge on what values that could be lost if an environmental damage occurred might be obtained.

WTP is also referred to as compensating surplus. When studying a potential environmental improvement it is the maximum sum of money the individual would be willing to contribute with, rather than do without it (Freeman III, 2004, p. 12). Thus, this concept is relevant when individuals do not have a certain good. In this study WTP is what avoiding environmental damage in Vestfjorden is worth to a unit of the population. WTP is constrained by income, meaning that an individual cannot contribute with a higher amount than what he earns. The first expression in equation 2 presents the state before measures to protect against oil spills are introduced. The latter is the one after, where a compensating measure, C, is included. The basic idea behind it is that if a person gives up this with the changes, then he is back at his original utility (Flores, 2004, p. 30).

Equation 2: Compensating Welfare Measure

$$v(P^0, Q^0, y^o) = v(P^1, Q^1, y^1 - C)$$

It is possible to obtain information on how the WTP for environmental goods varies with the respondents' characteristics (Carson & Hanemann, 2005, p. 826). Relevant literature identifies tree main categories of variables. The first set of factors is demographic data such as age, gender and number of members in the household (Jones, Malesios, & Botetzagias, 2009). Next are economic ones, including individuals' income. The final category is individuals' attitudes regarding environmental goods being valued.

3.3 Willingness to Accept

Another way of pricing non-market goods is measuring peoples' Willingness to Accept (WTA). This is also called the equivalent surplus. The concept is relevant when people already have a good. When considering an environmental improvement it is the minimum sum of money an individual would require to voluntarily forgo it (Flores, 2004, p. 30). In other words, in order to let go of measures to protect against oil spills, a unit of the population would require compensation. WTA has, unlike WTP, no upper limit. This follows logically because it is not the individual who has to pay for a change. The equivalent welfare measure is shown in equation 3. The left side of if represents the utility before a change, while the right side is the one after. E refers to the additional income a person would need with the initial conditions to obtain the same utility as before the change (Flores, 2004, p. 30).

Equation 3: Equivalent Welfare Measure

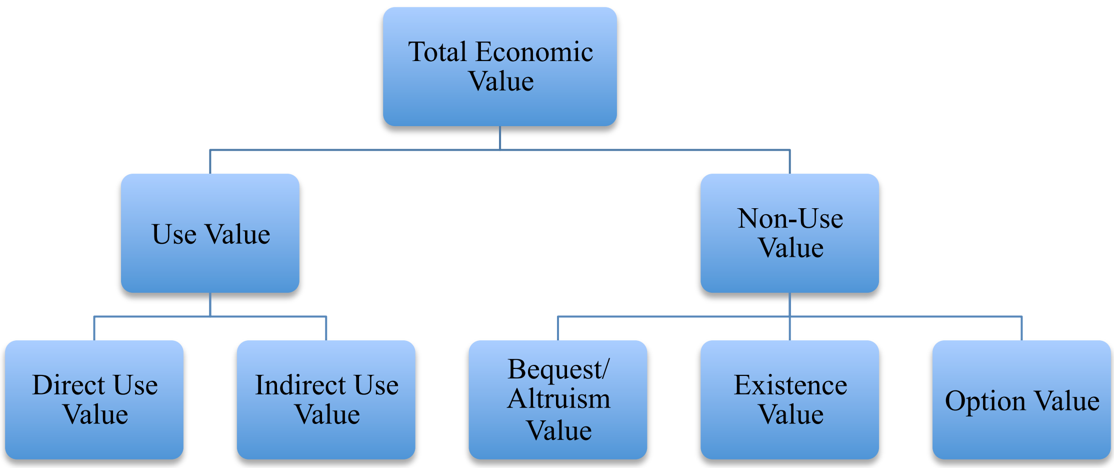
$$v(P^0, Q^0, y^o + E) = v(P^1, Q^1, y^1)$$

3.4 Total Economic Value

According to Freeman III (2004, pp. 9-10) the economic value of an item is a measure of its contribution to human well-being. This means that it is judged based on whether it makes people better off or not. Goods and services that can be bought in markets are typically included in analysis of economic value (Freeman III, 2004, p. 10). So are peoples' time and public goods provided by governments. Environmental amenities may also enhance individuals' well-being.

The total economic value people put on the environment consists of both use and non-use value (Baker & Ruting, 2014, p. 12). The former is related to demand behavior, while the latter is the part of the total value that will not be found in this. Use value includes direct use, and the activities of the fishing and agriculture industries are examples of this. People hold indirect values for the services provided by species and ecosystems. This includes clean air, pollination and water cycling. According to Baker and Ruting (2014, p. 12), non-use value consists of components arising from altruism or bequest and existence. The former is related to knowing that an area may provide pleasure to others. People might want to protect an area because they believe that for example their children will use the area at some point. Existence value is based on that a place can be important to a person by simply just existing, even if he think that neither he nor his descendants will ever visit it. Further, option value and quasi-option values are related to that it might be important to people to maintain the possibility to visit and experience an area in the future. Carson and Hanemann (2005, p. 862) write that these are components of non-use values. Others argue that option value should be classified as use value, as it concerns future use (Marre et al., 2015). The different types of values are illustrated in figure 1.

Figure 1: Classification of Environmental Values



3.5 Valuation of the Environment

To determine worth in monetary value to the public, economists typically look to information about people's preferences (Carson et al., 2004, p. 2). Valuing the direct use of the environment is often straightforward. As an example, fish is sold in the market place with prices. Indirect use and non-use values, on the other hand, are harder to identify. Non-market valuation techniques are useful tools for finding these. There are two main types of such methods. These are Revealed Preference and Stated Preference (Baker & Ruting, 2014, p. 5). In addition, various combinations of them are often applied.

3.6 Revealed Preference Methods

Revealed Preference (RP) Methods are used to identify utility functions, and thus, use value (Perman, Yue, Common, Maddison, & McGilvray, 2011, p. 413). They are based on observing what choices and actions people actually take on. There are four commonly used RP Methods. These are the Travel Cost Method, the Hedonic Price Method, Defensive Behavior Methods and Damage Cost Methods (Boyle, 2004, p. 259). The former one is applied in order to value recreational usage of the environment (Parsons, 2004, p. 269). Hedonic models are generally property value models. They are primarily used to uncover households' WTP for an estate near an environmental amenity or away from such an disamenity (Boyle, 2004, p. 259). Defensive Behavior and Damage Cost Methods are normally used when identifying health effect values of pollution. The first of these are based on the expenditures people are willing to pay for reducing exposure, whereas the second measure the resource costs caused by environmental contamination (Boyle, 2004, p. 259).

3.7 Stated Preference Methods

Stated Preference (SP) methods measures both use and non-use values (Eom & Larson, 2006). Peoples' hypothetical behaviors are examined. This means that focus is on what they say that they would do in specific scenarios. The approach is based on answers to carefully worded survey questions (Brown, 2004, p. 99). This gives the analyst control over the alternatives presented and the circumstances by which they are framed (Carson et al., 2004, p. 3). Indicators on how people are expected to react might then be estimated. The choices made by survey respondents are analyzed in a similar manner as the one made by consumers in actual markets (Carson, 2000). The most commonly used SP approaches are the Attribute-Based Method, Paired Comparison and Contingent Valuation. The two first seek to estimate preference orderings among several goods at once (Brown, 2004, p. 101). TheAttribute-Based Method builds on the traits of the items, while when applying Paired Comparison the goods themselves are in focus.

3.8 Contingent Valuation

The CV Method aims to get people to reveal or construct preferences as an answer to the economic problem they face through direct questions (Lindhjem et al., 2014). It often involves asking a representative sample of the population about their WTP or WTA for a environmental good (Perman et al., 2011, p. 415). The simplest and most commonly used CV question format is that the respondent is offered a binary choice between two alternatives. One of these is a status quo policy while the other is an alternative. The latter typically has higher costs associated with it. When it comes to the issue of whether or not measures to protect against oil spills should be put in place, the reference alternative is when it is not. (Lindhjem et al., 2014). Random assignment of cost numbers to respondents allows the researcher to trace out the distribution of the WTP for the good (Carson, 2000).

3.9 Reliability & Validity

The CV Method is sometimes being criticized, and concerns are mainly related to the reliability and the validity of the survey results. The former involves that administering the same questionnaire to a different sample or the same set of respondents at a later date should yield similar results (Perman et al., 2011, p. 423). A common way to measure reliability is the test-retest reliability of scale (Pallant, 2013, p. 6). Validity is related to whether or not the obtained estimates actually are able to predict something about the concept in focus. Reliability is a necessary condition for Validity (Loomis, 1989).

According to Perman et al. (2011, p. 423) there is usually no entirely satisfactory way of validating the results. But three approaches are often suggested. These are to investigate the Criterion, Construct, and Content Validity (Brown, 2004, p. 104). The former can be examined by comparing the CV results with actual market prices (Perman et al., 2011, p. 423). But this may not be possible, as the reason for computing such surveys typically is that prices of environmental goods are missing. Construct Validity refers to whether the observed measures relate to others predicted by theory. This can be done in two different ways. The estimates may be compared with the ones obtained in other studies. Another approach is to investigate whether various influences on the respondents' WTP correspond to expectations. The Content Validity looks at the quality of the survey being used. Examples are whether there is a clear description of the item being valued and if it is likely that the payment is reasonable for the respondents (Brown, 2004, p. 104).

3.10 Problems in Contingent Valuation

In the literature, several potential problems that might arise in CV studies are discussed. The report of the NOAA panel led by the famous economists Robert Solow and Kenneth Arrow is often cited. Some of the most common issues are reviewed in this section. These can be minimized by careful survey design and testing. Using a good and accurate questionnaire is important (Perman et al., 2011, p. 424).

A concern of the NOAA panel was missing information in surveys. If CV studies are to elicit useful information about WTP, respondents must understand exactly what it is they are being asked to value (Arrow et al., 1993). It is crucial that they get enough information to make an informed decision, without being overwhelmed by it (Carson, 2000). The environmental good should be clearly defined and explained. Otherwise, respondents might be uncertain of what they are asked to pay for. The participants must accept the scenario presented when formulating their responses.

It is important that respondents believe the survey to be consequential, both in terms of affecting the provision of the good and creating a binding payment commitment (Kling et al., 2012). According to Carson and Groves (2007) consequential survey questions meet the two criteria of the respondents believing that their responses potentially can influence the decision makers' actions and that the respondents need to care about what the outcomes of those actions might be. If this is the case, the survey questions can be interpreted in economic terms. This means that agents should respond to the survey in such a way as to maximize their expected welfare. Whether the goal of consequentiality is reached in a research relies upon the realism of the scenarios presented. This depends on both how they are presented and the contents of them.

Warm-glow effect might arise in situations where a respondent derives satisfaction from making a symbolic commitment to a cause (Perman et al., 2011, p. 425). According to Dibona (1992) several studies indicate that many respondents in CV surveys are not valuing a specific resource or damage, instead they are making a statement about their feelings for the environment in general. Such behavior may stem from a desire to impress the interviewer. Problems with warm-glow are more severe when WTA is estimated rather than WTP (Kahneman & Knetsch, 1992). An example is when respondents are asked how much compensation they need to accept contamination in an area.

Hypothetical bias is one of the main problems in CV studies. It is the error that occurs when survey questions do not elicit responses consistent with actual behavior (Champ & Bishop, 2001). Arrow et al. (1993) refer to the problem as absence of a meaningful budget constraint, as contingent donations typically overestimate actual ones. Incentive compatibility can help against the potential skewness. A CV survey design that has this characteristic is one that not gives respondents incentives to answer strategically (Lindhjem et al., 2014). In order to achieve this, it is typically best to present only one amount to each respondent when asking if they are willing to pay or not. This reflects the types of decisions individuals make on a daily basis (Carson & Groves, 2007). Cheap talk and a follow-up question concerning how sure the respondents are about their answer should be included (Carson, 2000).

Arrow et al. (1993) claim that some of the empirical results produced by such CV studies are inconsistent with assumptions of rational choices. Higher cost should for example lead to lower demand. In other words, the percentage favoring a project should fall as the randomly assigned cost of the project increases (Carson, 2000). Further, the WTP estimates from CV studies should increase with the scope of the good being provided. Thus, respondents ought to be sensitive to the scale of the project presented to them.

3.11 Combinations of Revealed Preference and Stated Preference Methods

When considering the choice of valuation method, researchers have traditionally seen the RP and SP approaches as substitutes (Whitehead, Pattanayak, Van Houtven, & Gelso, 2008). Today it is generally well-appreciated that both of them have strengths and weaknesses (Eom & Larson, 2006). This has led economists working on non-market valuation problems to turn increasingly to the use of combinations of them. Joint estimation provides the opportunity to both estimate actual recreation demand and contingent WTP models. The result is more structure for parameter estimation and that both sources of information are used more efficiently (Eom & Larson, 2006). An example is that by combining historical RP data with SP estimates on future responses, changes in participation due to environmental changes might be better understood (Whitehead et al., 2008). The validity of SP data might be determined by comparing the estimates obtained when using both approaches.

3.12 Specific Research Questions

The parent goal of the study is to investigate what avoiding environmental damage from an oil spill in Vestfjorden is worth to the Norwegian population. This might indicate what values that could be lost if such an accident occurred in the area. Specific research questions are developed based on the overall one, the background information and the presented theory and methods. These are listed in table 1.

Table 1: Specific Research Questions

Number	Specific Research Question
1	How important are use versus non-use components of total willingness to pay for preventing an oil spill in the Vestfjorden area?
2	How important is option value in the non-use component of willingness to pay for preventing an oil spill in the Vestfjorden area?
3	What factors affect use values, non-use values and total willingness to pay for preventing an oil spill in the Vestfjorden area?

The purpose of the first specific research question is to look closer at how important the two components of the total value of preserving the Vestfjorden area are. In other words, what parts of the potential losses caused by an oil spill that are related to the use of it and not are going to be investigated. Users are defined to be people who live in or have visited the area. These are expected to value Vestfjorden higher than others. As previously mentioned, both users and non-users may hold non-use values from an area. This is expected to be an important component of the WTP for avoiding an oil spill in Vestfjorden. The reason is that many people know and are proud of the area. As stated in the Background section, it is a region with a special environment and various natural resources.

The second specific research question seeks to explore how important the option value is. As stated in the Theory and Method section, this is a component of the non-use values. It is interesting to check whether people who never have been to the area want to preserve it for future visits. Many Norwegians might want to maintain the option to go to the area and enjoy a nature free from environmental damage later on in life.

Lastly, the third specific research question concerns what factors that affect the use values, non-use values and total WTP for preventing an oil spill in the Vestfjorden area. There are several objects that may have an impact on these. Examples are different demographic and other interesting variables.

4 Study Design

The study has a descriptive research design. The main purposes of these are typically to explore relationships between different variables. Describing characteristics of certain groups is also an often-stated goal of descriptive studies (Churchill & Iacobucci, 2010). This might for example be for marketing purposes or to learn how different types of people will react to policy changes. Descriptive studies are quite rigid, and objectives of all questions must be formulated before they are carried out. What types of analysis that are going to be conducted should be clear (Churchill & Iacobucci, 2010).

The data collection builds on the principles of cross-sectional studies. Such data are widely used in economics and other social sciences (Wooldridge, 2014, p. 6). Cross-sectional studies are carried out over a short time period, and focus is on the present. This means that it is not possible to capture changes over time. A cross-sectional data set consists of a sample of individuals, households, firms, cities, countries or other units (Wooldridge, 2014, p. 5). Thus, there might be great variety among these types of data sets. The goal of cross-sectional studies is often to capture different aspects of social life, including population characteristics and interaction (Blaikie, 2010, pp. 201-202).

The study uses quantitative methods. An important advantage of this is the possibility of examining many units of a population using relatively little resources. The goal is not necessarily to acquire depth knowledge about the subject, but rather to get a clearer picture of what different phenomenon look like. When using quantitative methods the research is often more standardized than with qualitative approaches (Befring, 2015). A downside related to this is a low degree of flexibility, but an advantage is better control with the research. The collected data is assigned numbers, and is often described and analyzed using statistical methods.

4.1 Survey

Survey data are examined in this study. It is the most widely used information gathering method in the social sciences. When surveys are conducted, large samples of persons are faced with a set of questions. An interviewer may ask these or let the respondents go through the questionnaire by themselves. Data in this study were collected through an Internet administered survey conducted in early 2013. The professional data collection firm NORSTAT carried it out, on behalf of the University of Stavanger. The fact that secondary data is used has both its positive and negative sides. It is time and cost saving, but there might be some mismatches between the information that was collected and what is wanted in this particular study. The latter is due to that it was gathered with other purposes and research questions in mind.

The goal of the survey design process was to develop an instrument able to analyze the value people put on environmental goods that are important for the tourism industry. More precisely, the researchers wanted to explore the Norwegian population's preferences and WTP for avoiding environmental damages of different severities caused by oil spills. Focus was directed towards the Vestfjorden area. This was to avoid the strong opinions and attitudes that many people have towards allowing oil production in Lofoten and Vesterålen, which in turn could bias the results. A similar reasoning explains why shipping accidents were featured instead of oilrigs and other installations. The Norwegian population was examined because they have the highest knowledge about it and would be most affected if Vestfjorden were to be damaged by an oil spill. Many live in the area, and even more have visited or want to do so. Furthermore, it is the Norwegian households who would have to contribute financially through if measure against oil related accidents were to be introduced.

The survey was designed in cooperation with test and expert panels. A lot of pre testing was conducted and focus groups were used extensively in order to optimize it. Lindhjem et al. (2014) carried out a pilot study where they used the valuation instrument. They found that people were able to understand descriptions of various environmental damages, and to give reasonable estimates of their welfare losses related to oil spills. The valuation instrument seemed to be valid, and it looked like non-use values of the Vestfjorden area were important.

The survey design was improved based on experiences from all parts of the development process.

The valuation experiment was created such that the price to pay for measures to protect against oil spills was increased income taxes. The respondents were asked if their households were willing to pay a randomly assigned sum between 100 and 2500 NOK annually in a 10-year period. The presented amounts varied between different participants. Based on the answers on the first question, they were faced with a second valuation scenario. This study only examines the responses on the first WTP query. In other words, a dichotomous choice question approach is chosen. As previously mentioned, this is most in line with incentive compatibility. Thus, the probably of hypothetical bias is minimized.

Four oil spill scenarios of various severities were developed based on experiences from previous oil spills, expert and stakeholder workshops. The scopes are small, medium, large and very large. Damages related to birds, fish, seals and coastal zones were described. This was because it turned out that these were what most people cared about. The medium and large oil spill scenarios were shown to 200 respondents each, 500 were presented the small one and 501 the very large. Each participant was only faced with one of these. This study does not focus on the scope of potential environmental damages. Instead, WTP estimates for an average oil spill are calculated. The importance of scope was emphasized by the NOAA panel, but there has been less focus on it the last years (Carson, 2012b).

4.2 Questionnaire

The questionnaire starts with a warm-up section. Focus is on parts of the demographic information. The respondents are then asked to state how important they think various community tasks are. Examples are reducing green house gas emissions, building new roads and improving the care for the elderly.

Then the theme of the survey is presented. There is a map showing the three northernmost counties in Norway, where the area in focus is highlighted[1]. The participants are first asked about their visitation to Nordland, Troms and Finnmark during the last 12 months, before the

[1] This is given in Appendix 1.

same questions are given regarding the Vestfjorden area. Examples are whether or not the respondents have ever been in the regions, how many times and days they have been there the last year and if they think that their household will go there in the future.

Further, a more detailed map of Vestfjorden is provided[2]. Information on the diverse nature, and the rich animal and bird life in the area is given, along with pictures of various species[3]. In addition illustrations of several recreational activities that one can take on in the area are presented[4]. A table lists the current environmental state of the area and consequences of oil spill of the four different severities[5]. In order to make it more understandable it has a traffic light design. The color green is the current state, yellow represents a small environmental damage and red is a very large one. A map illustrating how oil spills of various severities may spread beyond the sea and along the coast in the Vestfjorden area is also presented[6].

It is stated that shipping accidents often causes oil spills. Information on the environmental consequences of such events is given. These include that oil will float on the ocean surface, and might drift onshore. After some time it may blend in the water. An oil spill will therefore affect how nice it is to swim, be in boats, take walks and do other types of activities on land or by the sea, in a period. The respondents are told that this type of accident can affect animal and bird life along the coast. Illustrations of possible damages are given.[7] About half of the respondents are shown pictures of damaged fish and seal.

Information about that The Norwegian Coastal Administration (Kystverket) is considering introducing several initiatives to strengthen the oil spill protection preparedness in Vestfjorden is given. These are both measures that make a shipping accident less likely, and that minimizes spread of oil if it occurs. Examples of these are given, and one of them is introducing digital traffic monitoring. The respondents are informed about that potential measures will be financed through increased income tax for all households.

[2] This is given in Appendix 2.
[3] These are given in Appendix 3.
[4] These are given in Appendix 4.
[5] This is given in Appendix 5.
[6] This is given in Appendix 6.
[7] These are given in Appendixes 7 and 8.

A text in the questionnaire states that without preventive measures an oil spill will happen in Vestfjorden during the next 10 years. Initiatives to protect against environmental damages in the area will be implemented if the majority of the Norwegian population agrees to contribute financially. Then the WTP question is given. A map illustrating the concrete scope is presented along with it[8]. Then the respondents are asked how certain they are about their answer, on a scale from 1 to 10. Several reasons for why they said yes or now are suggested, and the participant are asked to choose up to 3 of these.

In the end there are some further questions concerning demographic background information on the respondents and their households. Then there is a comment box where the persons are urged to write what they think about the survey.

One question was presented on each page, and it was possible to navigate between the different ones as needed. Categories to choose from when answering were predefined, which makes the data analyses easier. Some of the variables were measured by using Likert scales.

4.3 Hypotheses

Several hypotheses are formulated based on the specific research questions and the available survey data. These are given in table 2. These will be investigated through the analyzes in the study.

Table 2: Hypotheses

Hypothesis number	Hypothesis
Hypothesis 1	People who live in or have visited the Vestfjorden area value it higher than others.
Hypothesis 2	There are significant non-use values related to the Vestfjorden area.
Hypothesis 3	Option value constitutes an important part of the non-use value component of willingness to pay.
Hypothesis 4	Willingness to pay varies systematically with observable demographic characteristics of the sample population.

[8] These are given in Appendixes 9-12.

The first hypothesis suggests that living in or having visited the Vestfjorden area increases the perceived value of it. Residents would be directly affected if an oil spill occurred in the area. Having visited and experienced a place in own person might account for a part of the WTP for preserving it.

Hypothesis 2 states that there are significant non-use values related to the Vestfjorden area. If this is the case, other components than direct and indirect use of it are important. Non-use values might consist of option, altruism or bequest and existence portions. If the hypothesis is indicated to be true, the area would seem to be of national importance.

The third hypothesis suggests that option value constitutes an important part of the non-use component of WTP. This means that planning to visit the Vestfjorden area increases a person's perceived value of it. People who wish to see the spectacular fjords and landscape might have a higher WTP for protecting the area from oil spill than others.

Hypothesis 4 concerns whether different observable demographic variables affect the WTP for avoiding an oil spill in Vestfjorden. The literature suggests that there might be several significant relationships. Females are often found to be more concerned with environmental issues than men, and therefore more willing to pay for such measures (Seip & Strand, 1992). There is a growing awareness of the importance of climate politics in younger generations. A higher age is therefore expected to be associated with a lower WTP. This is also in line with the assumptions of Seip and Strand (1992). Further, there is typically a positive relationship between educational level and interest in issues as the one in focus. According to Jones et al. (2009) wage level among the respondents influence their acceptance to pay. People with higher income have a stronger purchasing power, and is expected to want more protection against oil spills as long as this is a normal good.

4.4 Variables

The different variables that are included in the analyzes are listed in table 3. These are chosen based on the formulated hypotheses and the available dataset. Most of them are coded as dummy variables, indicating that a respondent either has a characteristic or not. Others are continuous over some intervals.

Table 3: Variables

Variable Name	Description
VOTE	1 if answer on WTP question is affirmative, 0 otherwise.
BID	Amount the respondent was presented.
USE	1 if the respondent lives in or has visited the Vestfjorden area, 0 otherwise.
RES	1 if the respondent is a resident in the Vestfjorden area, 0 otherwise.
VIS	1 if the respondent has visited Vestfjorden area, 0 otherwise.
FEM	1 if female, 0 otherwise.
AGE	Respondent's age.
UNI	1 if highest education level is a University degree, 0 otherwise.
MINC	1 if the household's income is between 500 001 and 1 000 000 NOK, 0 otherwise.
HINC	1 if the household's income is 1 000 001 NOK or higher, 0 otherwise.
PLANV	1 if respondent plan to visit the Vestfjorden area, 0 otherwise.
EORG	1 if member of an environmental organization, 0 otherwise.
LCOAST	1 if respondent lives near a coastal area, 0 otherwise.
OPP	1 if respondent is opponent of oil production in the coastal areas outside Lofoten and Vesterålen, 0 otherwise.
PROT	1 if respondent think that increasing the oil spill protection readiness along the coast is important, 0 otherwise.
RGAS	1 if respondent thinks that reducing green house gas emissions is important, 0 otherwise.
TGOV	1 if respondent trust that elected people prioritizes according to what is best for the community, 0 otherwise.
BPAY	1 if respondent think it is likely that the household will have to pay an increased income tax if measures to protect against oil spill in Vestfjorden are introduced, 0 otherwise.
UINFO	1 if respondent think it is likely that the authorities will use the information gathered in the survey when deciding on whether to introduce measures to protect against oil spill in Vestfjorden, 0 otherwise.
SURE	1 if respondent is sure about the answer on the WTP question, 0 otherwise.

VOTE is the dependent variable. It indicates whether or not a respondent states that his household is willing to pay a specific amount in increased income taxes every year in a 10-year period to avoid an environmental damage of a certain severity in Vestfjorden. A person that wants to contribute with a higher amount is more likely to answer affirmative on the question. BID specifies the proposed annual sum of money.

The use value component is sought estimated through looking at people who live in or have visited Vestfjorden's WTP. The additional sum arising from presence of variables related to this might indicate the size of the portion. Both a combined use variable and separate ones that refers to whether a participant live in or have visited the area are included in the analyzes. These are USE, RES, and VIS, respectively.

All other independent variables are expected to affect the non-use component of the total worth of the area. The option value is explored by looking at the variable that indicate whether or not a respondent plan to visit Vestfjorden in the future, PLANV. A positive coefficient implies that this accounts for a part of the non-use values. The demographic characteristics gender (FEM), age (AGE), educational level (UNI) and income (MINC and HINC) are included in the analyses. Also other interesting variables might affect the non-use components of the WTP for avoiding oil spill in Vestfjorden, like if they are members of an environmental organization (EORG), whether or not they live close to a coastal area (LCOAST) and if they are opponents of oil production in Lofoten and Vesterålen (OPP). Whether or not they think it is important to increase the oil spill protection along the coast (PROT), if they think it is important to reduce green house gas emissions (RGAS) and whether or not they trust that elected people prioritize according to what is best for the community (TGOV) are also taken in as independent variables. The basic idea is that adding the mentioned variables might modify the estimates that are obtained in the regression.

Lastly, three variables are considered in order to help check the validity and reliability of the results. These are whether or not the respondents believe that taxes will increase in order to finance measures to protect against oil spills (BPAY), if they think that the information that is gathered in the survey will be used (UINFO) and how sure they are about their answer on the WTP question (SURE). As previously mentioned, consequentiality is important in CV studies. The two first of these variables are included with respect to this fact. Unsure respondents have typically higher hypothetical bias, and it is therefore interesting to check if the participants are in this group or not.

4.5 Empirical Strategy

4.5.1 Statistical Methods

4.5.1.1 Binary Logistic Regression

The WTP data is analyzed using a parametric approach. Binary Logistic Regression is conducted in order to reveal underlying relationships between a dependent variable and the explanatory ones. The goal is to explore how the last ones affect the first, all else equal. In this study an expression for the probability of saying yes to pay for measures to protect against oil spills in Vestfjorden is going to be estimated. Binary Logistic Regression is similar to the linear type in the way that it attempts to fit a line to the data (Sainani, 2014). But because there are only two possible values for the dependent variable, this is not straightforward. Transforming the outcome to a logit is a way in which to deal with this. This may be plotted against any independent variable to obtain a line presenting the relationship between them. The connection between the logit and the probability of the outcome is $logit = ln\frac{p}{1-p}$. Logistic regression is estimated by maximizing the likelihood function.

4.5.1.2 Estimation Model

Adopted from (Hanemann, 1984), U_1 is utility level of a person that wants to pay for and gets protection against environmental damages from oil spills, while U_0 represents the opposite. These might be expressed as the functions $U_1 = U\ (1, y, s)$ and $U_0 = U\ (0, y, s)$. The numbers 1 and 0 illustrate whether or not an individual gets access to the good. y represents income and s is other observable attributes that might affect his preferences. It is assumed that the respondents know their own utility functions, while the researcher does not. To the latter, these are given as $V(j, y, s) + e_j$. This is a random variable with a probability distribution where V is the mean and e_j as a stochastic error term. The latter represents unobservable characteristics. An individual will answer affirmative on the WTP question if this gives him a higher expected utility than otherwise. This may be written as: $V(1, y - A, s) + e_0 \geq V(0, y, s) + e_1$ where A is the amount he has to pay. To the researcher a person's answer on the WTP question is a random variable with a probability distribution given as shown in equation 4.

Equation 4. Probability Distribution

$$P_1 = \mathrm{Pr(Individual\ Willing\ to\ Pay)} = \mathrm{Pr}(\mathrm{V}(1, \mathrm{y} - \mathrm{A}, \mathrm{s}) + e_0 \geq \mathrm{V}(0, \mathrm{y}, \mathrm{s}) + e_1)$$

$$P_0 = \mathrm{Pr(Individual\ Not\ Willing\ to\ Pay)} = 1 - P_1$$

The simplest version of the model to be estimated is given in equation 5. The dependent variable is the natural logarithm of the probability of getting an affirmative response on the WTP question. BID is the amount he is faced with and α is a constant that reflects the value of protection. The symbol β_{BID} is a coefficient that specifies how much the dependent variable changes when BID deviates by one unit.

Equation 5: A Basic Regression Model

$$\ln\left(\frac{yes}{(1 - yes)}\right) = \alpha + \beta_{BID}BID$$

The model can be developed in different ways. An example of this is given in equation 6. The dummy variable USE indicates if the respondents live in or have visited the area. FEM, AGE, UNI, MINC and HINC are included as control variables. In the next chapter both equation 5 and 6 will be estimated, along with other specifications.

Equation 6: An Expanded Regression Model

$$\ln\left(\frac{yes}{1 - yes}\right) = \alpha + \beta_{BID}BID + \beta_{USE}USE + \beta_{FEM}FEM + \beta_{AGE}AGE + \beta_{UNI}UNI + \beta_{MINC}MINC + \beta_{HINC}HINC$$

4.5.1.3 Goodness-of-Fit Measures

The percent correctly predicted is a goodness-of-fit measure (Wooldridge, 2014, p. 205). It gives an overview of how well the predicted y represents the actual y across all observations. There are four possible outcomes on each pair. When both are zero or one, the correct prediction is made. If they differ, it is not. The percentage correctly predicted is the share of times when the estimated y equals the actual ones. In addition to this there are also various pseudo R^2 measures for binary responses (Wooldridge, 2014, p. 466). These give indications on how much of the variation in the y-variable that the model accounts for. Cox-Snell is an example of a R^2 measure.

4.5.1.4 Multicollinearity

Multicollinearity can be a problem in multiple regression models. This is a term that refers to high correlation among the independent variables (Wooldridge, 2014, p. 576). There is no absolute number from which one can conclude that this is an issue. But a typical assumption is that there might be multicollinearity when the correlation coefficient is close to 1 (Wooldridge, 2014, p. 83). In a model with this the independent variables might not fully capture the underlying factors that explain the concept in focus. On the other side, excluding to many of them might weaken the explanatory power of the model. This is often referred to as Omitted Variable Bias. The Variance Inflation Factor (VIF) can give indications on whether or not there are problems related to multicollinearity. Often 10 is chosen as a cut-off value (Wooldridge, 2014, p. 86). In other words, the VIFs should be lower than this.

4.5.1.5 Calculation of WTP

The approach for calculating WTP from Loureiro et al. (2009) is adapted in this study. The formula for doing so is shown in equation 7. The negative of the coefficient divides the constant obtained from the regression.

Equation 7: Calculation of WTP

$$\widehat{WTP} = \frac{\hat{\alpha}}{-\hat{\beta}_{BID}}$$

The approach for calculating mean WTP in the model presented in equation 6 is explained in equation 8. The upper term consists of the constant and all but one of the obtained coefficients multiplied by the mean values of the associated variables. The negative of the estimated coefficient of BID divides this. The resulting number may be interpreted as the monetized average value a person in the sample's household put on the environmental losses that could occur in Vestfjorden. If the sample is representative of the target population, aggregate WTP is simply mean or median WTP multiplied by N, the number of observational units (Perman et al., 2011, p. 423). This gives indications on what avoiding oil spill in Vestfjorden is worth.

Equation 8: Calculation of Mean WTP

$$\overline{WTP} = \frac{(\hat{\alpha} + \hat{\beta}_{USE}\overline{USE} + \hat{\beta}_{FEM}\overline{FEM} + \hat{\beta}_{AGE}\overline{AGE} + \hat{\beta}_{UNI}\overline{UNI} + \hat{\beta}_{MINC}\overline{MINC} + \hat{\beta}_{HINC}\overline{HINC})}{-\hat{\beta}_{BID}}$$

Individual WTP in the model from equation 6 can be calculated as shown in equation 9. The obtained coefficients are multiplied with each individual's value on the explanatory variables.

Equation 9: Calculation of Individual WTP

$$WTP_i = \frac{(\hat{\alpha} + \hat{\beta}_{USE}USE_i + \hat{\beta}_{FEM}FEM_i + \hat{\beta}_{AGE}AGE_i + \hat{\beta}_{UNI}UNI_i + \hat{\beta}_{MINC}MINC_i + \hat{\beta}_{HINC}HINC_i)}{-\hat{\beta}_{BID}}, \quad i = 1,2,\dots,N$$

4.5.1.6 Calculation of Use and Non-Use Values

The WTP estimates can be divided into use value and non-use value components. In this study the former are identified as shown in equation 10. The estimated coefficient related to use of the Vestfjorden area is multiplied by the mean value of the variable. The negative of the estimated BID coefficient divides this.

Equation 10: Estimation of Use Value

$$Use\ value = \frac{\hat{\beta}_{USE}\overline{USE}}{-\hat{\beta}_{BID}}$$

The non-use values are found by subtracting the use value from the total value, as shown in equation 11.

Equation 11: Estimation of Non-Use Value

$$Non\ use\ value = Total\ value - Use\ value$$

4.5.1.7 Confidence Intervals for WTP, Use and Non-Use Value Estimates

There is statistical uncertainty related to the regression results, and therefore also the WTP estimates (Bliemer & Rose, 2013). Confidence intervals (CI) are often developed to in order to increase peoples' faith in them. Without this it is difficult to conclude whether different functional forms or estimation methods generate statistically significant differences for the calculated values (Park, Loomis, & Creel, 1991). The need to develop CI around benefit estimates is of policy relevance as well. Such measures provide a range of likely values for the population parameter instead of just one point (Wooldridge, 2014, p. 114). If random samples were obtained over and over again, the population parameter would lie in the interval for 95% of them when a CI on that level is used.

According to Bliemer and Rose (2013) the Krinsky & Robb (K&R) and the Delta Methods are the two main approaches for determination of CIs for WTP measures. It seems like by using the former, potential problems with the latter are often avoided. But there are many pitfalls related to it, and therefore many seem to agree that the Delta method is a good approximation (Bliemer & Rose, 2013). The approach is based on a first-order Taylor series transformation. The maximum likelihood estimates for the unknown parameters will be asymptotically normally distributed, with a mean corresponding to the true values (Powell, 2007). A function of them will have the same type of distribution. By using the Delta Method one can estimate the variance of this expression. This is explained in equation 12. Each of the explanatory variables has associated variations that have to be accounted for, and in addition there is covariance between them (Powell, 2007). The former is presented in the left part of the equation, and the latter in the right one. Similar approaches are applied in order to find the variance related to the calculated use and non-use value components.

Equation 12: Calculation of Variance of a WTP Estimate

$$var(\widehat{WTP}) = var\left[\frac{\left(\alpha + \hat{\beta}_{USE}\overline{USE} + \hat{\beta}_{FEM}\overline{FEM} + \hat{\beta}_{AGE}\overline{AGE} + \hat{\beta}_{UNI}\overline{UNI} + \hat{\beta}_{MINC}\overline{MINC} + \hat{\beta}_{HINC}\overline{HINC}\right)}{-\hat{\beta}_{BID}}\right]$$

$$= \sum_{i=1}^{n} var(X_i)\left[\frac{\partial\widehat{WTP}}{\partial X_i}\right]^2 + 2\sum_{i=1}^{n}\sum_{j=1}^{n} cov(X_{i,}X_j)\left[\frac{\partial\widehat{WTP}}{\partial X_i}\right]\left[\frac{\partial\widehat{WTP}}{\partial X_j}\right]$$

A CI for a WTP estimate can be calculated as presented in equation 13. The standard error is an approximation of the unknown standard deviation, and is the square root of the estimated variance. The resulting CI will be symmetrical by definition. Carson and Czajkowski (2013) argue this is one of the problems with the Delta Method, as the distribution of the WTP ratio variable may be asymmetric. CIs for the use and non-use value estimates are found in the same way.

Equation 13: Calculation of Confidence Intervals for a WTP Estimate

$$\widehat{WTP} \pm t_{1-\frac{\alpha}{2}} se(\widehat{WTP})$$

4.5.1.8 Purchasing Power Parity

The WTP estimates obtained in this study will be compared with the ones calculated after the Exxon-Valdez and Prestige accidents. Empirical research indicate that large price discrepancies between countries that trade with each other decreases over time. This is because it is not sustainable that one can profit on buying a good where it is cheap and re-sell it in more expensive places. Purchasing Power Parity (PPP) indicates that prices and exchange rates in the long run will be adjusted. This means that a good will cost the same both home and abroad when measuring in a common currency (Steigum, 2004, p. 209). When this phenomenon is present, the growth in the exchange rate equals the difference between the inflation rates in the two countries (Steigum, 2004, p. 210). Because of the continuous developments, the estimated numbers from the previous oil spill will have to be adjusted for inflation and currency.

4.5.2 Hypotheses Testing Plan

Hypothesis 1: "People who live in or have visited the Vestfjorden area value it higher than others."

This hypothesis can be formulated with parameters in the following way:

H_0: $\beta_{USE} \leq 0$
H_1: $\beta_{USE} > 0$

B_{USE} shows how much living in or having visited the Vestfjorden area affect the probability of saying yes to pay for measures to protect against an oil spill there, all else equal. The hypotheses can be examined by looking at the sign and the significance of its estimated coefficient. If it is significantly larger than zero, the null hypothesis might be rejected. This could indicate that the proposition is accurate.

Further, also the following, separate hypotheses tests might be conducted:

H_0: $\beta_{RES} \leq 0$
H_1: $\beta_{RES} > 0$

H_0: $\beta_{VIS} \leq 0$
H_1: $\beta_{VIS} > 0$

β_{RES} refers to how much the dependent variable deviates when a person lives in Vestfjorden. β_{VIS} is related to whether a participant has visited the area or not. These might provide further useful insights what concerns the hypothesis in focus. If the test result suggests that the null hypothesis in the first of these sets might be rejected, it would seem like residents appreciate the Vestfjorden area higher than others. Likewise, it is indicated that people who have visited the region value it more if the obtained coefficient related to this is positive and significant.

Hypothesis 2: "There are significant non-use values related to the Vestfjorden area."

The hypothesis can be explored by looking at the size of the calculated non-use values. The estimate will be compared with the total values of the area. If the non-use component seems to constitute an important part of these, the proposed hypothesis might be accurate.

Hypothesis 3: "Option value constitutes an important part of the non-use value component of willingness to pay."

First and foremost, it might be interesting to look at the regression coefficient related to if a respondent plan to visit the Vestfjorden area in the future. The hypothesis shown under can be conducted in order to investigate whether this has a positive effect on the WTP for avoiding an oil spill there. If the estimated coefficient turns out to be significant at a chosen level, the null hypothesis might be rejected. This would indicate that there are option values related to the Vestfjorden area.

H_0: $\beta_{PLANV} \leq 0$
H_1: $\beta_{PLANV} > 0$

Whether or not this constitutes an important part of the non-use value component of WTP can be explored by looking the relative size of it. The hypothesis is indicated to be true if the former make up a large part of the latter.

Hypothesis 4: "Willingness to pay varies systematically with observable demographic characteristics of the sample population."

The following type of hypothesis test might be formulated for each of the demographic variables:

H_0: $\beta_k = 0$
H_1: $\beta_k \neq 0$

β_k shows how much the predicted probability of saying yes to paying for measures to protect against oil spill changes when the variable *k* has the value 1 rather than 0. If there is no relationship the coefficient will take on the latter value, otherwise it will be positive or negative. By looking at the significance level of the estimated coefficient it is possible to check this. If this is lower than a chosen level the null hypotheses might be rejected. This would indicate that WTP varies systematically with a specific observable demographic characteristic of the sample population.

5 Results

5.1 The Sample

The sample consists of 1401 respondents. The size of the sample and the fact that it was gathered by a professional survey agency increases the probability of it being representative of the Norwegian population. The sample is stratified on county level. This means that the population was divided into smaller groups, before units from these were randomly selected for participation. Every questionnaire was completed in a satisfactory manner. In other words, there are no missing answers. Not all respondents were faced with all of the questions. Based on previous ones, some were not relevant to certain individuals. An example of this is if a respondent stated that he had not been to Nordland, Troms or Finnmark, he was not later asked if he had visited the Vestfjorden area. Such system-missing answers were coded to 0 when dummy variables were created. Responses in the categories “do not know” and “no answer” was treated in the same way. This procedure was employed by Carson et al. in 2003, and is one element in making the WTP estimates conservative. Some respondents expressed that they felt that the survey was too long. Consequences of this might be that they did not carefully consider all of the questions, or that they answered neutrally to some of them. Additional possible sources of errors could be that the questions are unclear, respondents’ haste or that they did not want to give the information that was demanded. The data that was gathered was analyzed using the statistical software program SPSS.

5.2 Descriptive Statistics

Figure 2 illustrates the share of affirmative answers to the WTP question. 57% of the participants expressed that they were willing to pay the amount they were presented. In other words, over half of them are willing to contribute financially to prevent environmental damages in the area.

Figure 2: % Positive and Negative Responses to the WTP Question

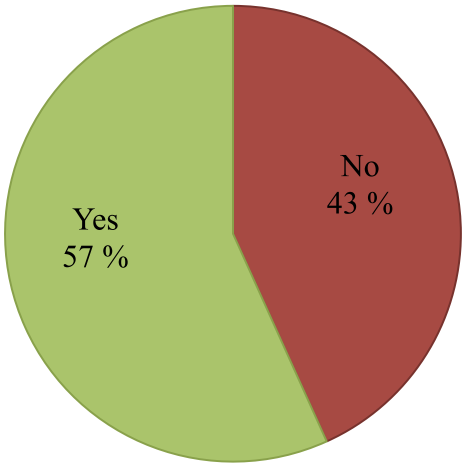


Table 4 shows how many of the respondents that were presented the different BID amounts. The numbers of positive and negative answers on the WTP question are also given.

Table 4: Distribution of Responses to the WTP Question

BID Amount (NOK)	# No	# Yes	Total
100	36	164	200
300	64	137	201
500	83	117	200
700	84	116	200
900	81	102	183
1100	11	6	17
1400	17	10	27
1500	101	73	174
2500	129	70	199

The percent of affirmative responses per BID amount is illustrated in figure 3. The majority said yes to pay the amounts between 100 and 900 NOK. Overall, the former gets smaller when the latter increases. From 1100 to 1500 NOK there is a slight raise. Relatively few participants were presented the amounts 1100 and 1400 NOK, and this result should therefore be considered with some caution.

Figure 3: % Affirmative Responses per BID Amount (NOK)

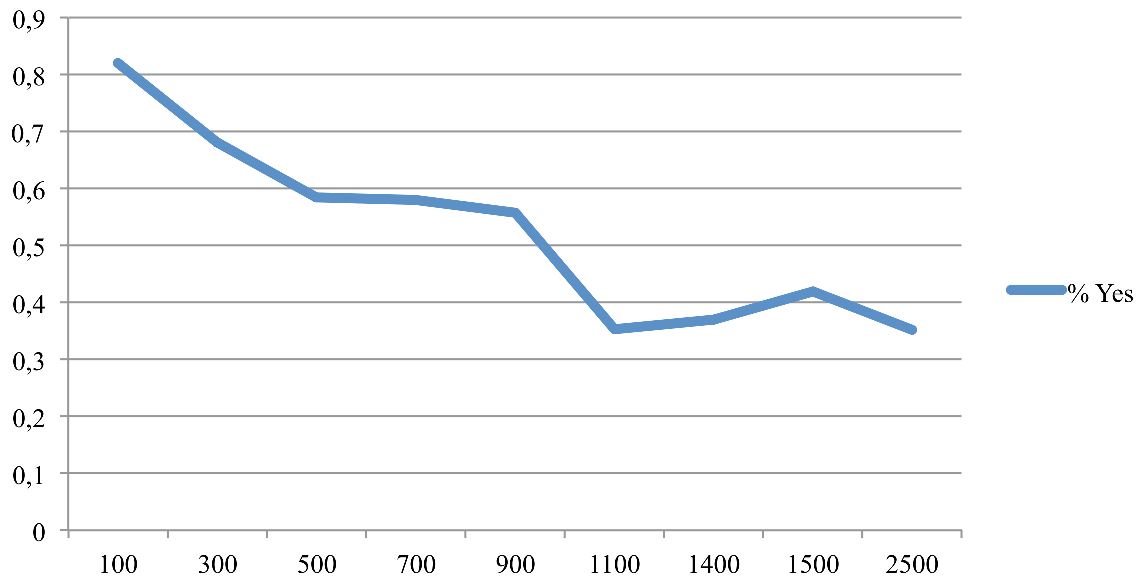


Table 5 provides descriptive statistics for the variables[9]. The means, standard deviations, minimum and maximum values of both the dependent and the independent ones are presented.

Table 5: Descriptive Statistics

Variable Name	Mean	St.Dev.	Min	Max
VOTE	0.56745	0.49561	0	1
BID	927.90864	764.74960	100	2500
USE	0.45396	0.49805	0	1
RES	0.01784	0.13243	0	1
VIS	0.43612	0.49608	0	1
FEM	0.50892	0.50010	0	1
AGE	46.37893	15.82416	17	79
UNI	0.58530	0.49285	0	1
MINC	0.40828	0.49169	0	1
HINC	0.15703	0.36396	0	1
PLANV	0.43540	0.49599	0	1
EORG	0.06495	0.24653	0	1
LCOAST	0.79729	0.40216	0	1
OPP	0.32691	0.46925	0	1
PROT	0.69308	0.37609	0	1
RGAS	0.69272	0.38029	0	1
TGOV	0.17773	0.38242	0	1
BPAY	0.31870	0.40484	0	1
UINFO	0.15525	0.30588	0	1
SURE	0.81299	0.39006	0	1

Few of the respondents in the sample live in Vestfjorden, but many have visited the area or plan to do so. Both genders are somewhat equally represented. The average age is 46, while the youngest participant was 17 and the oldest 79 years old. A slight majority of the respondents have an university degree. Many are in the medium income group and some in the high income one.

[9] The numbers are abbreviated.

5.3 Analyzes

5.3.1 Regressions

Two sets consisting of five logit regressions each where VOTE is the dependent variable are conducted. The estimates obtained are given in table 6 and 7. The variable USE is included in the first set, whereas in the second one VIS and RES are applied instead. Model 1 only includes BID as an explanatory variable. The variables indicating use of Vestfjorden are taken into account in the next one. In the third model the demographic variables FEM, AGE, UNI, MINC and HINC are included. Other interesting variables are taken into consideration in the following regression. These are PLANV, EORG, LCOAST, OPP, PROT, RGAS, and TGOV. The last model includes BPAY, UINFO and SURE.

Table 6: Regression Estimates, Set 1[10]

Constant/Explanatory Variable	Estimated Coefficient (Standard Error)				
	Model 1	Model 2	Model 3	Model 4	Model 5
α	0.96524*** (0.08992)	0.82546*** (0.10288)	0.61685*** (0.21539)	-0.56358** (0.27139)	-1.72561*** (0.31937)
BID	-0.00074*** (0.00008)	-0.00074*** (0.00008)	-0.00076*** (0.00008)	-0.00086*** (0.00008)	-0.00081*** (0.00009)
USE		0.30624** (0.11308)	0.44073*** (0.12551)	0.27517* (0.14403)	0.27069* (0.15039)
FEM			0.55199*** (0.11728)	0.34868** (0.12658)	0.45809*** (0.13257)
AGE			-0.00658* (0.00385)	-0.01118** (0.00429)	-0.01165** (0.00448)
UNI			0.19033 (0.11920)	0.06823 (0.12792)	0.07409 (0.13282)
MINC			0.12354 (0.12653)	0.16343 (0.13482)	0.14221 (0.14034)
HINC			0.22907 (0.17330)	0.21492 (0.18605)	0.16057 (0.19375)
PLANV				0.11640 (0.13596)	-0.00896 (0.14244)
EORG				0.65633** (0.29038)	0.66148** (0.30587)
LCOAST				0.40456** (0.15045)	0.36893** (0.15643)
OPP				0.95978*** (0.14369)	0.98022*** (0.14939)
PROT				0.39318** (0.18056)	0.24636 (0.18910)
RGAS				0.93459*** (0.17586)	0.98178*** (0.18392)
TGOV				0.64166*** (0.16327)	0.56671*** (0.17207)
BPAY					-0.03254 (0.15831)
UINFO					0.99766*** (0.22711)
SURE					1.39628*** (0.16668)

[10] The numbers are abbreviated.
*** Significant on 1% level, ** Significant on 5% level, * Significant on 10% level.

Table 7: Regression Estimates, Set 2[11]

Constant/Explanatory Variable	Estimated Coefficient (Standard Error)				
	Model 1	Model 2	Model 3	Model 4	Model 5
α	0.96524*** (0.08992)	0.82987*** (0.10301)	0.60597*** (0.21579)	-0.57856** (0.27196)	-1.78160*** (0.32164)
BID	-0.00074*** (0.00008)	-0.00074*** (0.00008)	-0.00076*** (0.00008)	-0.00086*** (0.00008)	-0.00082*** (0.00009)
RES		0.82901* (0.46052)	0.91122** (0.45932)	0.72954 (0.47011)	1.16231** (0.51522)
VIS		0.28619* (0.11427)	0.41759*** (0.12722)	0.23900 (0.14822)	0.20491 (0.15455)
FEM			0.55036*** (0.11732)	0.34747** (0.12663)	0.45649*** (0.13277)
AGE			-0.00627 (0.00386)	-0.01070** (0.00431)	-0.01078** (0.00450)
UNI			0.19428 (0.11932)	0.07102 (0.12801)	0.08126 (0.13297)
MINC			0.12525 (0.12660)	0.16436 (0.13488)	0.14590 (0.14059)
HINC			0.23260 (0.17347)	0.21437 (0.18615)	0.16020 (0.19398)
PLANV				0.14591 (0.13895)	0.04208 (0.14525)
EORG				0.65204** (0.29049)	0.66098** (0.30710)
LCOAST				0.39349** (0.15079)	0.34823** (0.15699)
OPP				0.95333*** (0.14381)	0.97111*** (0.14962)
PROT				0.39051** (0.18065)	0.24037 (0.18916)
RGAS				0.93763*** (0.17593)	0.99297*** (0.18430)
TGOV				0.64240*** (0.16321)	0.56593*** (0.17212)
BPAY					-0.03886 (0.15852)
UINFO					0.99000*** (0.22758)
SURE					1.43192*** (0.16849)

[11] The numbers are abbreviated.
*** Significant on 1% level, ** Significant on 5% level, * Significant on 10% level.

The tables reveal that the estimated values of the constant decrease and eventually get negative, as the models get bigger. This indicates that the included variables together have a positive effect on WTP. The fact that nearly all of them have positive estimated coefficients supports this theory. When more explanatory variables are included, the standard errors increase. This implies that the effect of the constant term varies more between individuals in more comprehensive models.

The coefficient of BID is significantly negative on 1% level in all the models. The value of it varies from -0.00074 to -0.00086, and are in other words quite stable. The result indicates that if a respondent is presented a higher amount, he is less likely to answer affirmative on the WTP question than otherwise, all else equal. The standard errors of the variable are low and similar in all models.

The variables indicating whether a respondent has used the Vestfjorden area have positive estimated coefficients in every model. Nearly all of them are statistically significant. The estimated effect of PLANV is positive in all models except for one, but it is not significant. The regression results suggest that some of the demographic variables changes the probability of saying yes to pay for measures to protect against oil spill. The implications of these variables are further discussed in the Hypotheses Testing section.

It seems like EORG, OPP and RGAS make a person more likely to answer affirmative on the question in focus. The coefficient related to first of these is estimated be around 0.66. The others seem to vary in the intervals 0.96 to 0.98, and 0.93 to 0.99, respectively. Also respondents who trust that elected people prioritize according to what is best for the community, TGOV, have a higher probability of being positive to increasing taxes. The estimated coefficient varies between 0.57 and 0.64, and is significant on 1% level in all models. It is also indicated that people who live near a coastal area, LCOAST, are more likely to say yes. The value varies between 0.35 and 0.41, and is significant. PROT seems to have a positive effect on the dependent variable, but it is only statistically significant in model 4 in both of the sets. The estimated coefficient is between 0.24 and 0.39. Standard errors of EORG are high, while for the other variables these are quite low and stable.

UINFO and SURE have significant positive effects on the dependent variable. The estimated coefficients are 0.99 and between 1.39 and 1.43, respectively. Thus, if a participant believes that the information he provides will be used or he is sure about his answer, he is more likely to respond affirmatively. BPAY has a negative sign in both sets, but this is not statistically significant. The value of the coefficient is -0,03. The standard errors of the second variable are higher than the others'.

5.3.1.1 Goodness-of-Fit Measures

Two Goodness-of-fit measures for all the models are listed in table 8 and 9. Overall, Percent Correctly Predicted increases, as more explanatory variables are included. In the last regressions it is above 73%. Cox Snell R^2 indicates that the largest models explain about 25% of the variation in VOTE.

Table 8: Goodness-of-fit Measures, Set 1

Goodness-of-fit	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Correctly Predicted	63.5	62.8	64.5	70.0	73.4
Cox Snell R^2	0.071	0,076	0.096	0.195	0.249

Table 9: Goodness-of-fit Measures, Set 2

Goodness-of-fit	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Correctly Predicted	63.5	62.8	64.4	69.8	73.0
Cox Snell R^2	0.071	0.077	0.097	0.195	0.251

5.3.1.2 Multicollinearity

The correlation matrixes indicate that there are no strong relationships between the explanatory variables.[12] The VIFs are also inspected in order to check this. The highest value is 1.4, while most of them are just above 1. Together this indicates that there are not multicollinearity issues within the dataset.

[12] Correlation matrixes are given in Appendixes 13-21.

5.3.2 WTP Estimates

Based on the regression results, mean, mean individual and median individual WTP are estimated. These are given in tables 10 and 11. The former ranges from 1304.38 to 1358.59 NOK in different models, and the second measure is quite similar as this. Median individual WTP varies somewhat more, from 1115.49 to 1379.7. Overall, the 3 estimates are quite similar within all specifications. This indicates that they are robust.

The standard errors and CIs for mean WTP is calculated in all models[13]. The former vary from 240.88 to 949.48 NOK, and increases when more variables are included. This is as expected, because more variation is accounted for. Resulting from this, CIs get wider in larger models. Overall they are broader in set 2 compared to in set 1. This is largely due to the high standard error of the variable RES. The CIs vary from the ranges [832.26, 1776.50] to [-506.28, 3215.68].

Table 10: Estimated Mean, Mean Individual and Median Individual WTP, Set 1

	Model 1	Model 2	Model 3	Model 4	Model 5
Mean WTP	1304.38 (240.88) [832.26, 1776.50]	1307.85 (220.18) [876.29, 1739.42]	1306.61 (345.43) [629.58, 1983.65]	1311.87 (440.46) [448.57, 2175.16]	1358.59 (584.12) [213.71, 2503.47]
Mean Individual WTP	1304.38	1303.35	1303.26	1307.28	1359.98
Median Individual WTP	1304.38	1115.49	1311.04	1257.11	1374.43

[13] The standard errors are given in the parentheses. 95% CIs are given in the square brackets.

Table 11: Estimated Mean, Mean Individual and Median Individual WTP, Set 2

	Model 1	Model 2	Model 3	Model 4	Model 5
Mean WTP	1304.38 (240.88) [832.26, 1776.50]	1310.10 (572.87) [187.27, 2432.93]	1309.23 (660.11) [15.42, 2603.05]	1309.67 (587.46) [158.25, 2461.09]	1354.70 (949.48) [-506.28, 3215.68]
Mean Individual WTP	1304.38	1310.10	1309.23	1310.71	1353.63
Median Individual WTP	1304.38	1121.45	1315.04	1262.42	1379.70

Figure 4 and 5 illustrate the distribution of individual WTPs in model 5 in the first and second regressions sets, respectively. Both of them are quite symmetrical, and resemble normal distributions. As previously mentioned, this indicates that using the Delta Method in order to estimate the variance and CIs for the WTP estimates is unproblematic. The high standard deviations compared to the means reveal heterogeneous preferences. In other words, there are large differences in what people are willing to pay for avoiding an oil spill in Vestfjorden. As can be seen from the figures, some of the predicted estimates are below zero. This may seem strange, as protecting the area is expected to be a good. But some individuals might fear that jobs could be lost if measures were implemented, or have others reasons why they do not want them. All negative WTPs could be forced to be on or above zero if another type of specification was used.

Figure 4: Distribution of Individual WTP, Set 1 Model 5

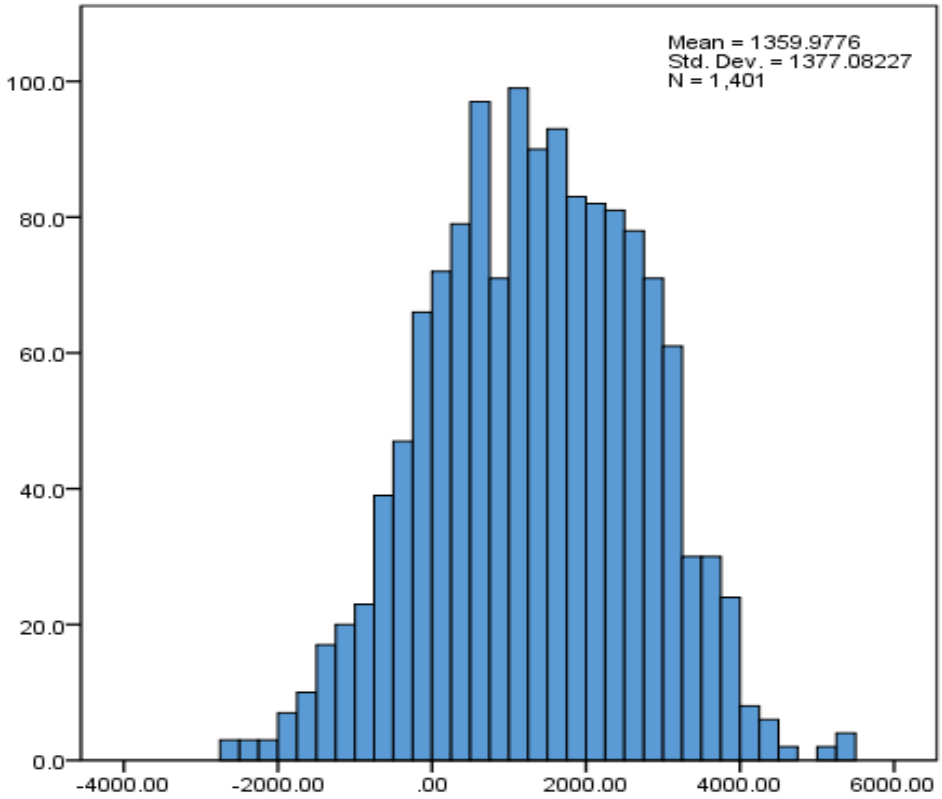
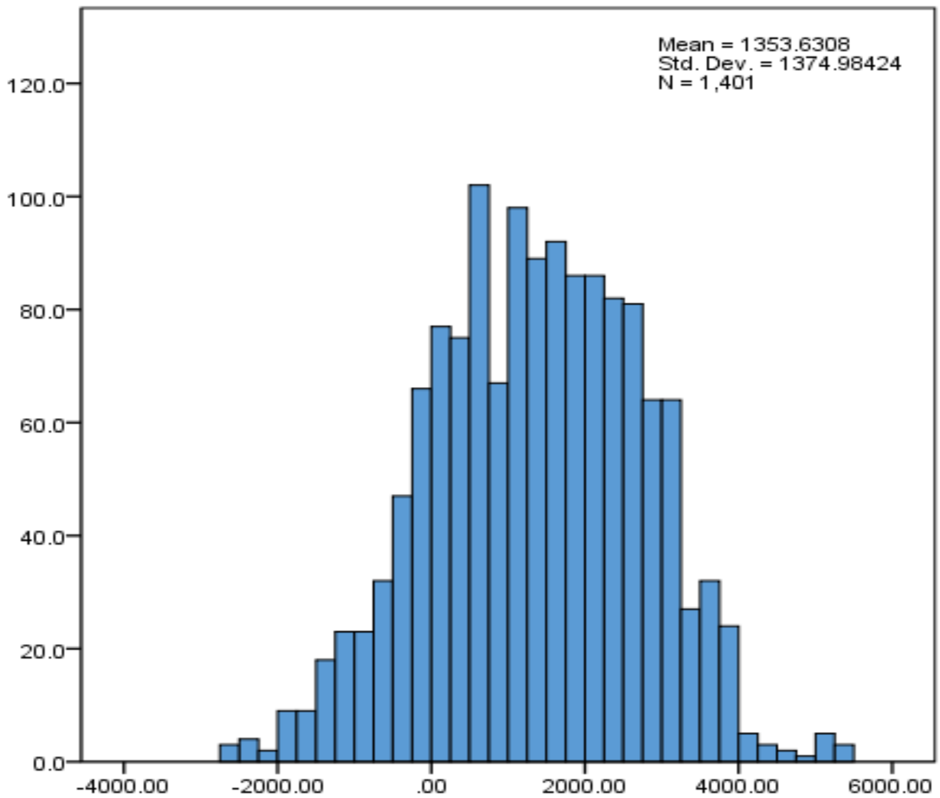


Figure 5: Distribution of Individual WTP, Set 2 Model 5



5.3.3 Use and Non-Use Values

Use and non-use values are calculated based on the estimates of mean WTP[14]. The resulting numbers are given in tables 12 and 13[15]. The latter are much larger than the former in all models. Estimated non-use values vary from 1042.67 to 1220.3. When users are studied as a homogenous group, the values related to this are calculated to be between 145.77 and 263.94 NOK in different specifications. On average, residency in the Vestfjorden area contributes less to the total values than having visited. The first of these is estimated to be between 15.12 and 25.32, and the second in the range of 109.08 and 239.63 NOK.

The non-use value estimates obtained in the two regression sets have similar standard errors, and thus, width of CIs. The former are between 233.74 and 569.66 NOK, and the latter vary from the ranges [633.32, 1579.58] to [90.51, 2323.57]. The use variable from the first regression set have estimated standard errors from 46.25 and 78.35, and CIs between [55.12, 236.42] and [110.37, 417.51]. RES has, as previously mentioned, a high variation. Estimates of the standard errors are between 399.38 and 732.07 NOK. As a consequence, CIs of the use value related to being a resident are very wide, and varies from [-767.65, 797.90] to [-1409.53, 1460.16]. There is less uncertainty related to VIS. The standard errors go from 41.12 to 75.12, and the CIs are between [28.49, 189.66] and [92.39, 386.86].

Table 12: Use and Non-Use Values, Set 1

	Model 1	Model 2	Model 3	Model 4	Model 5
Mean WTP/Total Value	1304.38	1307.85	1306.61	1311.87	1358.59
Use $Value_{USE}$		188.51	263.94	145.77	151.54
		(50.76)	(78.35)	(46.25)	(52.90)
		[89.03, 288,00]	[110.37, 417.51]	[55.12, 236.42]	[47.87, 255.22]
Non-Use Value		1119,34	1042,67	1166,10	1207,04
		(233.83)	(283.51)	(424.03)	(569.66)
		[611.03, 1577.65]	[486.99, 1598.36]	[334.99, 1997.20]	[90.51, 2323.57]

[14] The standard errors are given in the parentheses. 95% CIs are given in the square brackets.
[15] The calculations are given in Appendixes 22-29.

Table 13: Use and Non-Use Values, Set 2

	Model 1	Model 2	Model 3	Model 4	Model 5
Mean WTP/Total Value	1304.38	1310.10	1309.23	1309.67	1354.70
Use Value$_{RES}$		19.99	21.39	15.12	25.32
		(517.51)	(553.13)	(399.38)	(732.07)
		[-845.66, 1034.31]	[-1062.75, 1105.54]	[-767.65, 797.90]	[-1409.53, 1460.16]
Use Value$_{VIS}$		168.67	239.63	121.09	109.08
		(48.23)	(75.12)	(43.28)	(41.12)
		[74.13, 263.20]	[92.39, 386.86]	[36.26, 205.93]	[28.49, 189.66]
Non-Use Value		1121.45	1048.21	1173.45	1220.30
		(233.74)	(313.31)	(421.37)	(565.42)
		[663.32, 1579.58]	[434.13, 1662.29]	[347.56, 1999.34]	[112.08, 2328.53]

5.3.4 Hypotheses Testing

Hypothesis 1: ”People who live in or have visited the Vestfjorden area value it higher than others.”

H_0: $\beta_{USE} \leq 0$
H_1: $\beta_{USE} > 0$

The coefficient related to use of Vestfjorden is significantly positive in all the models. It varies from 0.27 to 0.44. This indicates that if a person lives in or has visited the area he is more likely to be willing to pay an increased annual tax amount in a 10-year period for avoiding an environmental damage there. In other words, he has a higher WTP for preserving the area than others, all else equal. The standard errors are between 0.11 and 0.15, and they increase as more explanatory variables are included in the regression models. Summarized, it seems like the null hypothesis might be rejected.

H_0: $\beta_{RES} \leq 0$
H_1: $\beta_{RES} > 0$

Residency seems to have a very positive impact on the dependent variable. The obtained coefficients vary between 0.73 and 1.16, but the associated standard errors are very high. This implies that the estimates are quite uncertain, and that the effect of being a resident varies across individuals. The effect on the probability of answering affirmative on the WTP question is significant in model 2, 3 and 5. In other words, the results indicate that the null hypothesis may be rejected. If this is the case, people who live in the Vestfjorden area seem to value it higher than others.

H_0: $\beta_{VIS} \leq 0$
H_1: $\beta_{VIS} > 0$

The estimated coefficients related to whether a person has visited Vestfjorden vary between 0.20 and 0.42, and the standard errors are relatively low. This means that having this characteristic seems to increase WTP for avoiding an oil spill in Vestfjorden. The effect is only significant in model 2 and 3. It is therefore uncertain whether or not the null hypothesis can be rejected.

Overall, it seems like the first hypothesis of the study might be accurate. This implies that people who live in or have visited the Vestfjorden area value it higher than others.

Hypothesis 2: "There are significant non-use values related to the Vestfjorden area."

Non-use values are large in all the models. In the fifth specification in the first set this component is estimated to be 1207, while total values are calculated at 1359 NOK. From the last model in the second set it follows that non-use values are 1220, while the summarized number is 1354 NOK. Thus, these constitute 88 and 90% of the total values in the mentioned set ups, respectively. Similar proportions are also calculated from the other models. This indicates that the hypothesis is true, that there are significant non-use values related to the Vestfjorden area.

Hypothesis 3: "Option value constitutes an important part of the non-use value component of willingness to pay."

H_0: $\beta_{PLANV} \leq 0$
H_1: $\beta_{PLANV} > 0$

The estimated coefficient of PLANV is positive in model 4, but negative in the fifth model in set 1. The numbers are 0.12 and -0.01, respectively. For set 2 the coefficient is positive in both models, at 0.15 and 0.04. The obtained standard errors are between 0.14 and 0.15. This indicates that there is some variation in the effect of planning to visit Vestfjorden on the WTP. Neither of the estimated coefficients is statistically significant on any level. Thus, it does not seem like option value constitutes an important part of the non-use value component of willingness to pay. This implies that the hypothesis is not accurate.

Hypothesis 4: "Willingness to pay varies systematically with observable demographic characteristics of the sample population."

H_0: $\beta_k = 0$

H_1: $\beta_k \neq 0$

The regression results indicate that being a female and the age of the respondent have significant effects on the WTP for avoiding an environmental damage in Vestfjorden. The estimated coefficients of the former vary between 0.35 and 0.55, and the standard errors are between 0.12 and 0.13. This means that a female is expected to have a higher WTP than men, all else equal. The coefficient of AGE is estimated to be approximately -0,01, with very low variation related to it. This implies that the effect of age on WTP is stable across individuals. The older a person is, the less likely he is to answer affirmative. The estimated coefficients of UNI vary between 0.07 and 0.19, and the standard errors are in the interval of 0.12 to 0.13. The variable is not statistically significant on any levels. Both MINC and HINC are found to have positive effects on WTP, with values ranging from 0.13 to 0.14 and 0.16 to 0.23, respectively. They have a bit higher standard errors than other explanatory variables. Neither of these is statistically significant.

Overall, WTP varies systematically with some of the observable demographic characteristics of the sample population. The null hypothesis cannot be rejected completely, but the alternative one might be somewhat accurate.

6 Discussion

Average annual WTP in a 10-year period for avoiding environmental damages from an oil spill in Vestfjorden is estimated to be just over 1300 NOK. Thus, the values that could be lost if an accident occurred is calculated at 13 000 NOK per household. The CIs are quite wide, and vary from about -500 to 3200, and 800 to 1800 NOK in different models. This means that there is a high degree of uncertainty related to the estimates. Given that there were around 2.2 million households in Norway at the time of the study (Statistisk Sentralbyrå, 2012), the size of total potential environmental losses for the whole population are expected to be around 28.6 billion NOK.

The positive signs of the coefficients related to use of Vestfjorden indicates that people derive values from this. “A good coastal area increases my experienced value of being on the coast” was in fact one of the three most chosen reasons for answering yes on the WTP question. Mean estimates of this component vary from 134 to 264 NOK in different models. Total use values that could be lost are therefore expected to be between 3 and 6 billion NOK. Also these numbers are uncertain. Overall, the numbers are quite similar in the regressions where living in the area and having visited are differentiated as when they are studied as one indicator. It seems like the latter constitutes a greater part of the average use values than the former. But residents are expected to have a higher probability of answering affirmative on the valuation question than people who have visited. Living close to a coastal area also increases peoples’ WTP for avoiding an environmental damage from oil spill in Vestfjorden. This variable may have some use or option value components, as this group might appreciate recreational places near the ocean higher than others.

Estimates of the non-use component of the WTP for preventing an environmental damage in Vestfjorden vary between about 1000 and 1200 NOK, with a high degree of uncertainty. The total values related to this are therefore calculated to be between 23 and 27 billion NOK. This means that more than 80% of the potential losses from an oil spill seems to be related to non-use. This is in line with Kling et al. (2012). They write that for pristine wilderness areas non-use may be the largest share of the total value. But the share is larger than what is found in other studies. Eom and Larson (2006) and Wattage and Mardle (2008) estimated it to be 38% and 45%, respectively. This is less than half of what this study predicts the non-use component to be. The result implies that people who have not been to the area greatly appreciate it. This indicates that the area is of great national importance.

It does not seem like planning to visit Vestfjorden increases WTP for avoiding an oil spill there. In other words, option value is not found to be an important part of the non-use component of the welfare losses that could occur. But as previously mentioned, the variable indicating whether a respondent lives close to a coastal area might have some implications for it. Further, there is made no differentiation between bequest or altruism and existence values in this study. But the large non-use component probably consists of both. In other words, it is expected that some want to preserve the area for future generations, while others wish to protect it for its' pure existence. This hypothesis is supported by the fact that "preserving the nature regardless of my own use" was the most commonly selected reason for answering affirmative on the WTP question.

The significantly negative sign of the estimated coefficient related to the amount implies that the probability of an affirmative answer decreases when it increases. This is in line with the prediction that higher cost associated with preventive measures in Vestfjorden should lead to lower demand for them. Further, the effects of being in a medium or high income class rather than a low one is positive on the WTP. But as previously mentioned, these effects are not significant. Together these things indicate that protecting the area from environmental damage caused by an oil spill is a normal good.

Members of environmental organizations, opponents of oil production in Lofoten/Vesterålen, and people who think reducing greenhouse gases emissions is important are more likely to say yes to pay for measures to protect against oil spills. This implies that people who are more concerned about the environment have higher WTPs. One of the most popular reasons for answering negatively on the valuation question was that the respondent thinks that ship owners and the shipping industry should pay for the measures. People might refuse to pay because they feel the responsibility lays on the ones that profit the most on the industry. Another common reason for saying no was that the level of taxation is already high enough. Champ and Bishop (2001) argue that in some cases voluntary donations might be more appropriate than to vote for higher taxes to finance various measures. The mentioned objects might cause problems with protest responses in the study. This phenomenon can bias the numbers upwards or downwards. However, these are usually included in estimations, because in actual polls they are accounted for. The approach contributes in making the estimates conservative.

Having trust in that elected people prioritize according to what is best for the community increases the probability of saying yes to paying. This is in line with what is reported in Lindhjem et al. (2014), who claims that several studies find that people typically do not want to pay for the environment because of their lack of trust in the government. The third most frequently chosen reason for answering negatively on the valuation question was in fact that the respondents do not trust that the money will be used for the right purpose.

The results from the pilot study revealed an annual mean WTP of 1559 NOK in a 10-year period per household for avoiding oil spill in Lofoten (Lindhjem et al., 2014). This is somewhat higher than what this research predicts, but it overlaps with the CIs. First and foremost, the pilot study looked at peoples' preferences for preserving Lofoten instead of Vestfjorden. Most people better know of the former area, and more focus has historically been directed towards it in media. Further, only 751 respondents were examined instead of 1401. A smaller sample may account for some of the variation. In addition, the valuation question was designed somewhat differently. Instead of a yes/no answer, the respondent could choose a number between 0 and 15 000 NOK on a non-linear scale. Typically, payment cards like this can have problems with respondents centering their answers on round numbers and middle columns (Lindhjem et al., 2014).

Mean WTP per household, as a one-time payment, for avoiding a similar oil spill as the Exxon-Valdez in Alaska was estimated to be $97.18 (Carson et al., 2003). The Consumer Price Index for US in January 1990 was 127.400, while in the middle of 2013 it was 233.504 (McMahon, 2016). Based on this, the increase is calculated at 183%. The estimated WTP is multiplied by the percentage change in CPI. This number is turned into NOK by using the exchange rate from June 2013, which was 5.869 (Norges Bank, 2016a). Mean WTP for avoiding a similar oil spill as the Exxon-Valdez is calculated at around 1070 NOK. This is quite similar, but somewhat lower, than what is found when looking at the WTPs for protecting the Vestfjorden area. As previously mentioned, the research conducted after the Exxon-Valdez accident only studied losses of US' households outside the affected area. Thus, only non-use values were in focus. This study takes both components into account when estimating what avoiding a future oil spill is worth.

Mean WTP per household, as a one-time payment, for avoiding a similar accident as the Prestige in Spain was estimated to be €40.51 (Loureiro et al., 2009). According to numbers obtained from Reuters, the Spanish CPI for January 2006 was 87.548, and for June 2013 it was 104.329. Following this, the percentage change is calculated to be 119%. The exchange rate between NOK and Euro was 7.7394 in June 2013 (Norges Bank, 2016b). Mean WTP is calculated to be 380 NOK. This can be considered somewhat low compared to the other estimates. The study did account for losses related to both use and non-use. But the Prestige oil spill was much smaller than the Exxon-Valdez accident.

The large portion of non-use values that is found illustrates the importance of examining the accurate population when estimating potential losses from an oil spill. In this study respondents from all parts of Norway are included, not only the ones that would be directly affected if an environmental damage occurred. One of the most popular reasons for answering affirmative on the WTP question was that for the participant's household it is worth paying the proposed price for avoiding the described environmental damage. In other words, the benefits of this exceed the costs for the surveyed respondents. Which peoples' values that should count is an important issue, and is one of the main concerns related to environmental cost-benefit analyzes. According to Hanemann (1994), economists have no special competence to judge this.

Different interests should be taken into account when assessments concerning whether or not oil exploration and production should be allowed in Vestfjorden are done. Depopulation is a problem in the Vestfjorden region, as in large parts of Northern Norway. The industry might generate many new jobs, and be a remedy against this. But the results from the study indicate that large values could be lost if an environmental damage occurred in the Vestfjorden area. According to the report "Indeks Nordland" from 2015, the county is predicted to have high growth even without the industry, with aquaculture being the most important contributor (Johansen & Lysvold, 2015).

It is important that decisions concerning environmental resources are efficient and well informed. All choices have opportunity costs, and having more of something means having less of others. A relevant question posed by Hanemann (1994) is whether everything can and should be quantified. In situations with little information, a lot of uncertainty, and big and complex consequences it might be difficult to gather it all in one number. A common critique towards using the CV Method when evaluating various projects is that too many pass costs-benefits tests. According to Lindhjem et al. (2014), focus on this is often exaggerated. When political suggestions are evaluated using this approach they are only on a planning stage, and all proposals will not actually be implemented. A project should be compared with alternative ways in which to solve a specific problem. A competitor to the CV approach may be expert assessments. But Hanemann (1994) argue that people themselves are the ones that know how they value things, and therefore, are the relevant experts. Even though the CV Method has its shortcomings, it seems to be the only approach capable of shredding light on potentially important values (Portney, 1994).

The data might be somewhat outdated, as peoples' values and beliefs may have changed from the time of the survey. This is not believed to have a large impact on the results, as there have not been any significant changes in the Vestfjorden area after 2013. The questions concerning visitation to the Vestfjorden area focuses on the previous 12 months. People might not remember this accurately. Especially if the number of visits is high, stating the correct information could be difficult. Further, when people are asked about a payment that goes over several years, they might discount it individually. This could be a problem in this study, as the valuation question focuses on an annual amount that is to be paid over a 10-year period.

The questionnaire used in this thesis contains a lot of information regarding where the oil spill would occur, of which size, and how the plant and animal life could be affected. It specifies that an oil spill typically affects the environment along the coast and in the ocean in a narrow time span and in a limited geographical area (Lindhjem et al., 2014). This is important to emphasize in questionnaires used in CV studies that aim to measure the costs of such accidents. Otherwise WTP might be overestimated. But as previously mentioned, even in the most information rich surveys participants cannot be forced to accept the information and proceed by using it (Arrow et al., 1993). In other words, there is no guarantee for that the respondents actually have internalized the inputs they were given.

Relatively few of the respondents stated that they believed that the information gathered in the survey would be used when decisions on the issue are made. Nor many of them said they thought that income taxes would increase in the next 10 years in order to finance measures to protect against oil spills in Vestfjorden. These findings indicate that the respondents do not believe the survey to be consequential. This might be problematic, in terms of interpreting the results in an economic sense. But the regression coefficients related to these variables have the expected signs. If an individual believes that the information will be used, he is expected to have a higher probability of saying yes to paying. A respondent who thinks that taxes will increase is predicted to be less likely to pay.

The NOAA panel recommended use of face-to-face interviews in CV studies, but according to Lindhjem et al. (2014) use of Internet does not seem to produce significantly different or biased estimates compared to this. The fact that the survey was administrated through the Internet decreases the probability of warm-glow effects and other interviewer effects. Estimation of WTP instead of WTA also underpins this. However, the respondents may have exaggerated their valuation in hope of being “good citizens”, in order to help get more protection against oil spills in Vestfjorden.

Several measures were implemented in order to minimize hypothetical bias in the study. The impact of these treatments will be explored in future work. About half of the respondents were given cheap talks before answering the WTP question. They were reminded about that if their household would have to pay more in income taxes, less money would be available for other things. Likewise, if the government were to use tax income on measures to protect against oil spills in Vestfjorden, it would have less to spend on other community tasks. The respondents also received a follow-up question asking how certain they were about their answer. Research done by Champ and Bishop (2001) showed that individuals who are less certain about their willingness to donate, are less likely to actually make a donation. In other words, unsure respondents may have higher hypothetical bias (Loureiro et al., 2009). Most of the participants in this study claimed that they were certain about their answer on the WTP question.

Overall, the survey follows the guidelines presented in the NOAA panel report and other relevant literature. Most of the coefficients of the explanatory variables have the expected signs, and the value estimates resembles the ones found in other researches. Altogether, this indicates that the results are reliable and valid.

7 Conclusion

The goal of this study was to develop estimates of the values that could be lost if an environmental damage caused by an oil spill occurred in Vestfjorden. Focus was further on identifying the use and non-use components of these. Hopefully it can be a useful contribution to the public debate concerning whether or not oil exploration and production should be allowed in the area. When making such decisions it is important that all relevant cost and benefits are taken into consideration.

A Contingent Valuation (CV) study was conducted in 2013, where a sample from the Norwegian population was surveyed. Oil spill scenarios were developed based on experiences from previous oil spills, expert and stakeholder workshops. Damages related to birds, fish, seals and coastal zones were described. The respondents were asked if they wanted to pay a proposed sum of money in increased income taxes to avoid an environmental damage of a specific severity. It is assumed that peoples' preferences may be expressed through utility functions, and that they seek to maximize their well-being. A further supposition is that environmental amenities can add value to humans.

Average annual willingness to pay (WTP) per household over a 10-year period for avoiding an oil spill in Vestfjorden vary between 1304 and 1359 NOK. This means that people want to reduce their income with around 13 000 NOK per household to avoid the constructed environmental damages. Total values that could be lost are calculated at 28.6 billion NOK. There is high uncertainty related to the estimates. Respondents who have used the area are more likely to answer affirmative on the valuation question than others. Residents are expected to have higher WTPs than visitors. The non-use component constitutes over 80% of the total values connected to Vestfjorden, and this means that the area is of national importance. In other words, many Norwegians appreciate and are proud of it.

The results indicate that option value is not an important part of the potential losses from an oil spill. This implies that planning to visit Vestfjorden do not increase the perceived value of the area. Females are more likely to be willing to say yes than males, and age has a negative effect on the dependent variable. This means that an older person is expected to have a lower

WTP for avoiding an environmental damage in Vestfjorden than a younger one. Various other variables also seem to influence how a person values the area.

CV is a debated method, mainly because of its nature of observing hypothetical behavior. The literature leans towards that is better to have some estimates that none. The results from this study seem to be valid and reliable. But further research is needed, to investigate this more closely. It may for example be useful to implement a new survey, and check if the estimates obtained resemble the ones from this research. Conducting an experiment where focus is on whether or not WTP differ if respondents believe that they have to pay immediately instead of in the future may also be valuable.

8 References

Alvarez, S., Larkin, S. L., Whitehead, J. C., & Haab, T. (2014). A revealed preference approach to valuing non-market recreational fishing losses from the Deepwater Horizon oil spill. *Journal of environmental management, 145*, 199-209. doi:10.1016/j.jenvman.2014.06.031

Arrow, K., Solow, R., Portney, P. R., Leamer, E. E., Radner, R., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation. *Federal Register, 58*(10), 4601-4614.

Baker, R., & Ruting, B. (2014). Environmental policy analysis: a guide to non-market valuation. *Productivity Commission Staff Working Paper, Canberra*. Retrieved from

Befring, E. (2015, 27.04). Kvantitativ metode. Retrieved from https://www.etikkom.no/FBIB/Introduksjon/Metoder-og-tilnarminger/Kvantitativ-metode/

Blaikie, N. (2010). *Designing social research : the logic of anticipation* (2nd ed.). Cambridge: Polity Press.

Bliemer, M. C. J., & Rose, J. M. (2013). Confidence intervals of willingness-to-pay for random coefficient logit models. *Transportation Research Part B, 58*, 199-214. doi:10.1016/j.trb.2013.09.010

Boyle, K. J. (2004). Introduction to Revealed Preference Methods. In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), *A Primer on Nonmarket Valuation* (pp. 259-267). Netherlands: Kluwer Academic Publishers.

Brown, T. C. (2004). Introduction to Stated Preferences. In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), *A Primer in Nonmarket Valuation* (pp. 99-110). Netherlands: Kluwer Academic Publishers.

Carson, R. T. (2000). Contingent valuation: a user's guide. *Environmental science & technology, 34*(8), 1413-1418. doi:10.1021/es990728j

Carson, R. T. (2012a). *Contingent Valuation: A Comprehensive Bibliography and History*: Edward Elgar Publishing.

Carson, R. T. (2012b). Contingent Valuation: A Practical Alternative when Prices Aren't Available. *Journal of Economic Perspectives, 26*(4), 27-42. doi:10.1257/jep.26.4.27

Carson, R. T., Conaway, M. B., Hanemann, W. M., Krosnick, J. A., Mitchell, R. C., & Presser, S. (2004). *Valuing oil spill prevention : a case study of California's central coast* (Vol. 5). Dordrecht: Kluwer Academic.

Carson, R. T., & Czajkowski, M. (2013). *A new baseline model for estimating willingness to pay from discrete choice models.* Paper presented at the International choice modelling conference, Sydney.

Carson, R. T., & Groves, T. (2007). Incentive and informational properties of preference questions. *Environmental Resourse Economics, 37*(1), 181-210. doi:10.1007/s10640-007-9124-5

Carson, R. T., & Hanemann, W. M. (2005). Contingent valuation. In K.-G. Mäler & J. R. Vincent (Eds.), Handbook of Environmental Economics: Valuation of Environmental Changes (Vol. 2, pp. 821-936). Amsterdam: North-Holland. doi:10.1016/S1574-0099(05)02017-6

Carson, R. T., Mitchell, R. C., Hanemann, W. M., Kopp, R. J., Presser, S., & Ruud, P. A. (2003). Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill. *The Official Journal of the European Association of Environmental and Resource Economists, 25*(3), 257-286. doi:10.1023/A:1024486702104

Champ, P. A., & Bishop, R. C. (2001). Donation payment mechanisms and contingent valuation: An empirical study of hypothetical bias. *Environ. Resour. Econ., 19*(4), 383-402. doi:10.1023/A:1011604818385

Churchill, G. A., & Iacobucci, D. (2010). *Marketing research: methodological foundations* (10th ed.). Canada: South-Western Cengage Learning.

Cleveland, C., Hogan, C. M., & Saundry, P. (2010). Deepwater Horizon oil spill. *The Encyclopedia of Earth*.

Dibona, C. J. (1992). Assessing environmental damage. *Issues in Science and Technology, 9*(1), 50-54.

Eom, Y.-S., & Larson, D. M. (2006). Improving environmental valuation estimates through consistent use of revealed and stated preference information. *Journal of Environmental Economics and Management, 52*(1), 501-516. doi:10.1016/j.jeem.2005.11.001

Flores, N. E. (2004). Conceptual Framework for Nonmarket Valuation. In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), *A Primer on Nonmarket Valuation* (pp. 27-58). Netherlands: Kluwer Academic Publishers.

Freeman III, M. A. (2004). Economic Valuation: What and Why? In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), *A Primer in Nonmarket Valuation* (pp. 1-25). Netherlands: Kluwer Academic Publishers.

Griffin, R. (2011). Willingness to pay. *Training Journal*, 27-30.

Hanemann, W. M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. *American Journal of Agricultural Economics, 66*(3), 332-341. doi:10.2307/1240800

Hanemann, W. M. (1994). Valuing the Environment Through Contingent Valuation. *Journal of Economic Perspectives, 8*(4), 19-43. doi:10.1257/jep.8.4.19

Haycox, S. (2012). "Fetched Up": Unlearned Lessons from the Exxon Valdez. *Journal of American History, 99*(1), 219-228. doi:10.1093/jahist/jas050

Johansen, A. D., & Lysvold, S. (2015, 01.14.2015). Indeks Nordland: – Veksten fortsetter, selv uten olje. *NRK Nordland*. Retrieved from https://www.nrk.no/nordland/indeks-nordland_-_veksten-fortsetter_-selv-uten-olje-1.12150305

Jones, N., Malesios, C., & Botetzagias, I. (2009). The Influence of Social Capital on Willingness to Pay for the Environment Among European Citizens. *European Societies, 11*(4), 511-530. doi:10.1080/14616690802624168

Kahneman, D., & Knetsch, J. L. (1992). Valuing public goods: The purchase of moral satisfaction. *Journal of Environmental Economics and Management, 22*(1), 57-70. doi:10.1016/0095-0696(92)90019-S

Kling, C. L., Phaneuf, D. J., & Zhao, J. (2012). From Exxon to BP: Has Some Number Become Better than No Number. *Journal of Economic Perspectives, 26*(4), 3-26. doi:10.1257/jep.26.4.3

Knol, M., & Arbo, P. (2014). Oil spill response in the Arctic: Norwegian experiences and future perspectives. *Marine Policy, 50*, 171-177. doi:10.1016/j.marpol.2014.06.003

Lindhjem, H., Magnussen, K., & Navrud, S. (2014). Verdsetting av velferdstap ved oljeutslipp fra skip – Fra storm til smulere farvann (?). *Samfunnsøkonomen, 128*(6), 25-39.

Loomis, J. B. (1989). Test-retest reliability of the contingent valuation method: a comparison of general population and visitor response. *American Journal of Agricultural Economics, 71*(1), 76-84. doi:10.2307/1241776

Loureiro, M. L., & Loomis, J. B. (2012). International Public Preferences and Provision of Public Goods: Assessment of Passive Use Values in Large Oil Spills. *Environmental & Resource Economics, 56*(4), 521-534. doi:10.1007/s10640-012-9556-4

Loureiro, M. L., Loomis, J. B., & Vázquez, M. X. (2009). Economic Valuation of Environmental Damages due to the Prestige Oil Spill in Spain. *The Official Journal of the European Association of Environmental and Resource Economists, 44*(4), 537-553. doi:10.1007/s10640-009-9300-x

Loureiro, M. L., Ribas, A., López, E., & Ojea, E. (2006). Estimated costs and admissible claims linked to the Prestige oil spill. *Ecological Economics, 59*(1), 48-63. doi:10.1016/j.ecolecon.2005.10.001

Marre, J.-B., Brander, L., Thebaud, O., Boncoeur, J., Pascoe, S., Coglan, L., & Pascal, N. (2015). Non-market use and non-use values for preserving ecosystem services over time: A choice experiment application to coral reef ecosystems in New Caledonia. *Ocean and Coastal Management, 105*, 1-14. doi:10.1016/j.ocecoaman.2014.12.010

Martín-Fernández, J., del Cura-González, M. I., Gómez-Gascón, T., Oliva-Moreno, J., Domínguez-Bidagor, J., Beamud-Lagos, M., & Pérez-Rivas, F. J. (2010). Differences between willingness to pay and willingness to accept for visits by a family physician: A contingent valuation study. *BMC Public Health, 10*, 236-236. doi:10.1186/1471-2458-10-236

McMahon, T. (2016). Historical Consumer Price Index (CPI-U) Data. Retrieved from http://inflationdata.com/Inflation/Consumer_Price_Index/HistoricalCPI.aspx?reloaded=true

Meld. St. nr. 20 (2014-2015). (2015). Oppdatering av forvaltningsplanen for Barentshavet og havområdene utenfor Lofoten med oppdatert beregning av iskanten.

Norges Bank. (2016a). Valutakurs for Amerikanske Dollar (USD). Retrieved from http://www.norges-bank.no/Statistikk/Valutakurser/valuta/USD/

Norges Bank. (2016b). Valutakurs for Euro (EUR). Retrieved from http://www.norges-bank.no/Statistikk/Valutakurser/valuta/EUR/

Olsen, E. (2009). Oljeboring i Kystnære områder. *Kyst og havbruksrapport*, 76-77.

Palinkas, L. A. (2012). A Conceptual Framework for Understanding the Mental Health Impacts of Oil Spills: Lessons from the Exxon Valdez Oil Spill. *Interpersonal and Biological Processes, 75*(3), 203-222. doi:10.1521/psyc.2012.75.3.203

Pallant, J. (2013). *SPSS survival manual : a step by step guide to data analysis using IBM SPSS* (5th ed.). Maidenhead: McGraw-Hill.

Park, T., Loomis, J. B., & Creel, M. (1991). Confidence intervals for evaluating benefits estimates from dichotomous choice contingent valuation studies. *Land Economics, 67*(1), 64-73.

Parsons, G. R. (2004). The Travel Cost Model. In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), *A Primer on Nonmarket Valuation* (pp. 269-329). Netherlands: Kluwer Academic Publishers.

Perman, R., Yue, M., Common, M., Maddison, D., & McGilvray, J. (2011). *Natural resource and environmental economics* (4th ed.). Harlow: Pearson.

Petrolia, D. R. (2014). What have we learned from the Deepwater Horizon Disaster? An economist's perspective. *Journal of Ocean and Coastal Economics, 2014*(1), 1-26. doi:10.15351/2373-8456.1002

Portney, P. R. (1994). The Contingent Valuation Debate: Why Economists Should Care. *Journal of Economic Perspectives, 8*(4), 3-17. doi:10.1257/jep.8.4.3

Powell, L. A. (2007). Approximating variance of demographic parameters using the delta method: a reference for avian biologists. *The Condor, 109*(4), 949-954. doi:10.1650/0010-5422(2007)109[949:AVODPU]2.0.CO;2

Sainani, K. L. (2014). Logistic Regression. *PM&R, 6*(12), 1157-1162. doi:10.1016/j.pmrj.2014.10.006

Seip, K., & Strand, J. (1992). Willingness to pay for environmental goods in Norway: A contingent valuation study with real payment. *The Official Journal of the European Association of Environmental and Resource Economists, 2*(1), 91-106. doi:10.1007/BF00324691

Statistisk Sentralbyrå. (2012). Folke- og boligtellingen, husholdninger. Retrieved from http://www.ssb.no/befolkning/statistikker/fobhushold

Steigum, E. (2004). *Moderne makroøkonomi*. Oslo: Gyldendal akademisk.

Store Norske Leksikon. (2009). Vestfjorden. Retrieved from https://snl.no/Vestfjorden

Wattage, P., & Mardle, S. (2008). Total economic value of wetland conservation in Sri Lanka identifying use and non-use values. *Wetlands Ecology and Management, 16*(5), 359-369. doi:10.1007/s11273-007-9073-3

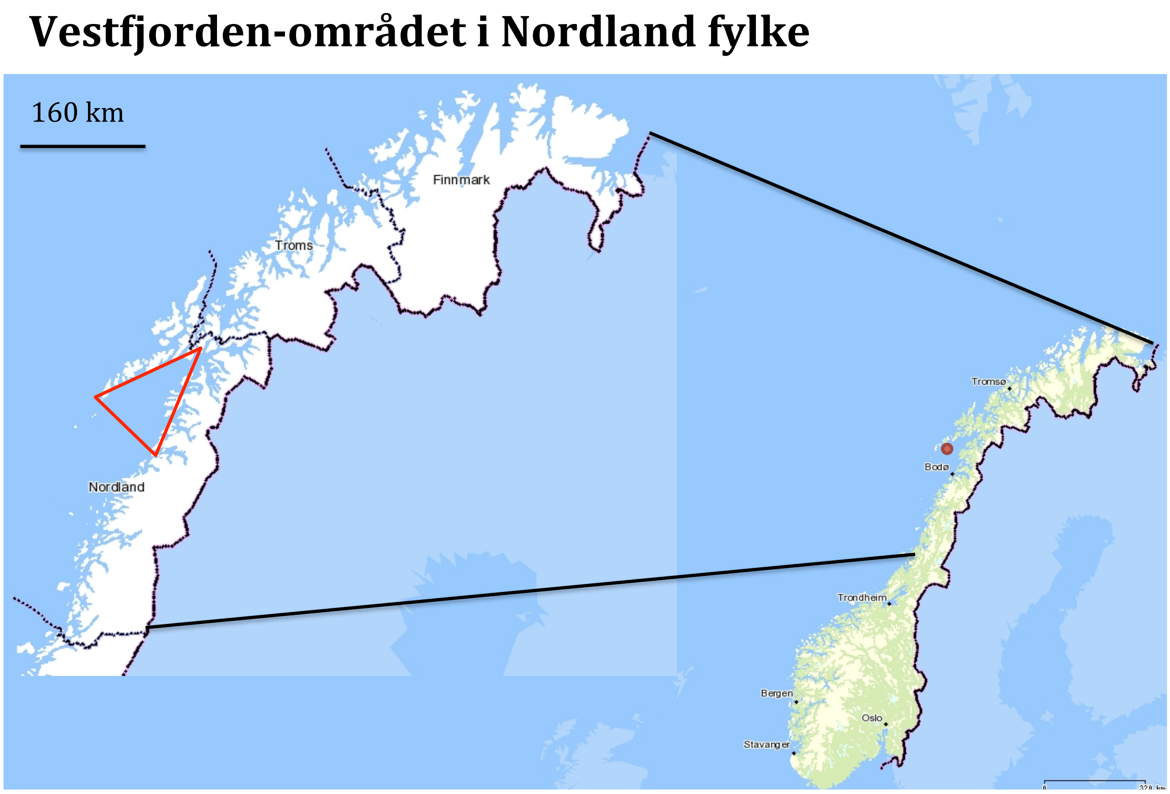
Whitehead, J. C., Pattanayak, S. K., Van Houtven, G. L., & Gelso, B. R. (2008). Combining Revealed and Stated Preference Data to Estimate the Nonmarket Value of Ecological Services: An Assessment of the State of the Science. *Journal of Economic Surveys, 22*(5), 872-908. doi:10.1111/j.1467-6419.2008.00552.x

Wooldridge, J. M. (2014). *Introduction to Econometrics* (5th ed.). Hampshire: Course Technology, Cengage Learning.

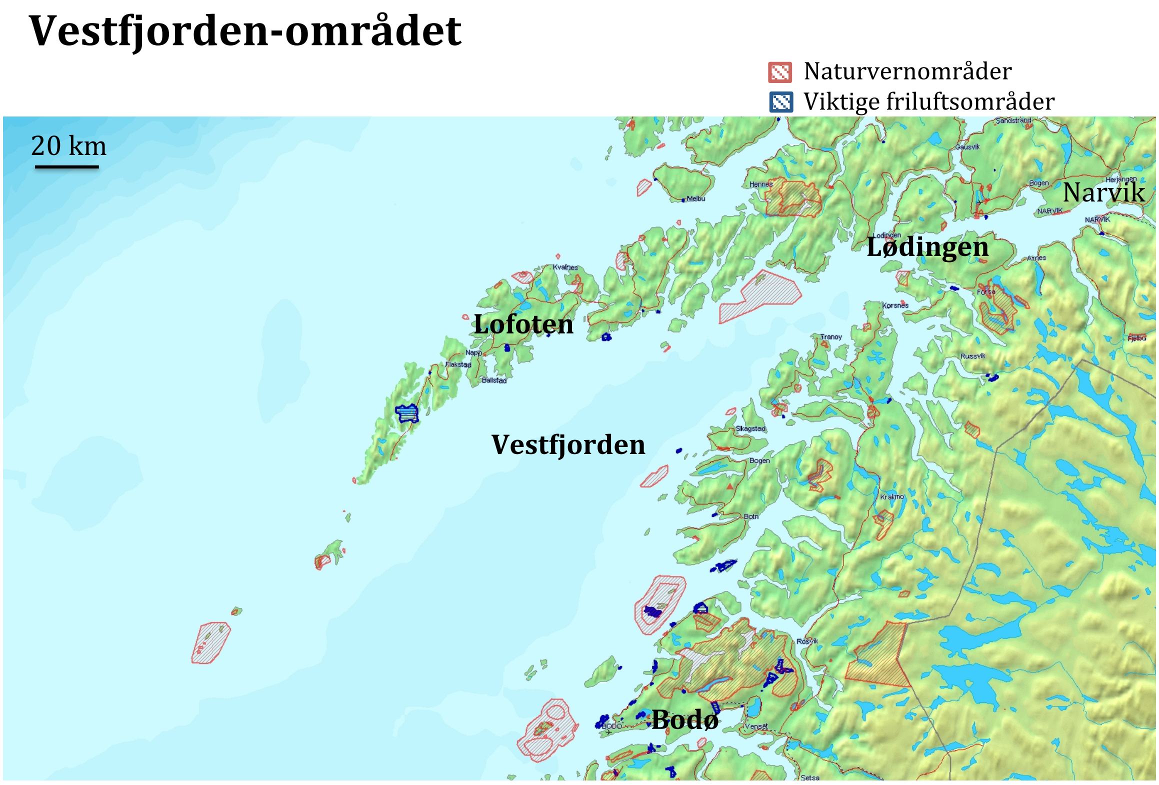
WWF Norway. (2015). Lofoten, Vesterålen og Senjas sårbare natur. Retrieved from http://www.wwf.no/dette_jobber_med/hav_og_kyst/oljefritt_lovese/dyrelivet_i_lofoten__vesteralen_og_senja/

9 Appendixes

Appendix 1: Map of the 3 Northernmost Counties in Norway



Appendix 2: Map of the Vestfjorden Area



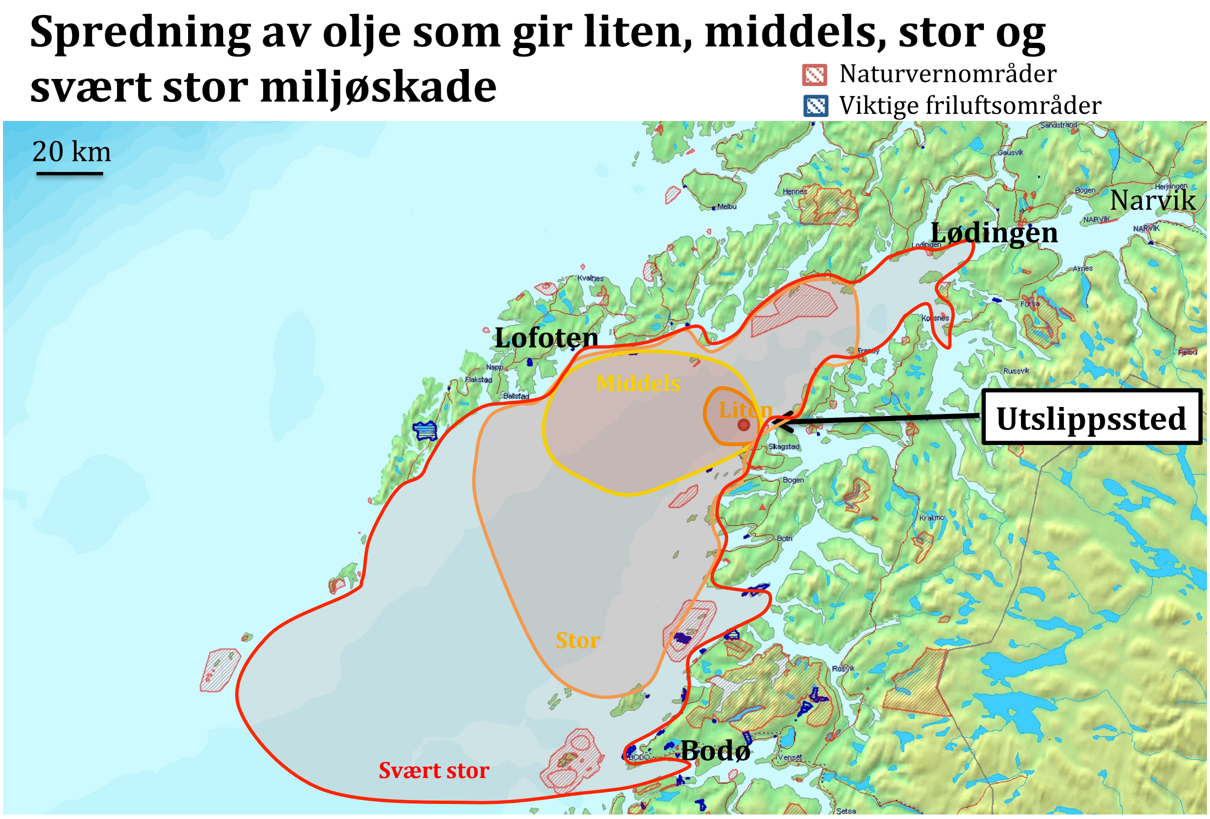
Appendix 3: Species That Live in Vestfjorden

Appendix 4: Recreational Activities in Vestfjorden

Appendix 5: Table with Explanations of the Current Environmental State of the Area and How the Environment Could be Affected if an Oil Spills of Different Severities Occurs

	Dagens tilstand	Liten miljøskade	Middels miljøskade	Stor miljøskade	Svært stor miljøskade
Skade på fugl					
	Området er viktig hekke-, trekk- og overvintringsområde for sjøfugl. Har vært nedgang i sjøfugl siste år, men bestander i hovedsak i god forfatning	Fuglebestandene i hovedsak i god forfatning I alt 1500 døde fugl	Lomvi lokalt utrydningstruet Øvrige bestander tilbake til normalt etter 1 år I alt 15 000 døde fugl	Bestanden av krykkje og lomvi lokalt utrydningstruet Øvrige bestander tilbake til normalt etter 2 år I alt 50 000 døde fugl	Bestanden av krykkje og lomvi utrydningstruet i Norge Øvrige bestander tilbake til normalt etter 4 år I alt 120 000 døde fugl
Skade på sel					
	Området er viktig for sel. Selbestandene i god forfatning	Selbestandene i god forfatning I alt 30 døde sel	Selbestandene i god forfatning I alt 100 døde sel	Bestanden av selarten steinkobbe lokalt utrydningstruet I alt 500 døde sel	Bestanden av selarten steinkobbe utrydningstruet i Norge Øvrige arter tilbake til normalt etter 4 år I alt 1000 døde sel
Skade på kystsone					
	Rikt ravinelandskap og dypvanns koraller Området er viktig for rekreasjon og friluftsliv for fastboende og tilreisende	5 km kystsone bestående av *svaberg og strender* tilsølt med olje Påvirker landbasert og vannbasert friluftsliv Berørte områder kan brukes som normalt etter 6 måneder	30 km kystsone bestående av *svaberg og strender tilsølt med* olje Påvirker landbasert og vannbasert friluftsliv Berørte områder kan brukes som normalt etter 1 år	150 km kystsone bestående av *svaberg og strender* tilsølt med olje Påvirker landbasert og vannbasert friluftsliv Berørte områder kan brukes som normalt etter 3 år	400 km kystsone bestående av *svaberg og strender* og fiskevær tilsølt med olje Påvirker landbasert og vannbasert friluftsliv Berørte områder kan brukes som normalt etter 5 år
Skade på annet liv i sjøen					
	Området er viktig gyte- og internasjonalt viktig oppvekst- og beiteområde for flere fiskeslag.	Kan høstes som før Trygt å spise sjømat Gyte- og oppvekstområder for fisk ikke påvirket	Kan høstes som før Trygt å spise sjømat Gyte- og oppvekstområder for fisk tilbake til normalt etter 1 år	Fisk, skalldyr, skjell og tang bør ikke spises før 3 år etter utslippet Gyte- og oppvekstområder for fisk tilbake til normalt etter 3 år	Fisk, skaldyr, skjell og tang bør ikke spises før 5 år etter utslippet Gyte- og oppvekstområder for fisk tilbake til normalt etter 5 år

Appendix 6: A Map illustrating How a Small, Medium, Large and Very Large Oil Spill May Spread Geographically

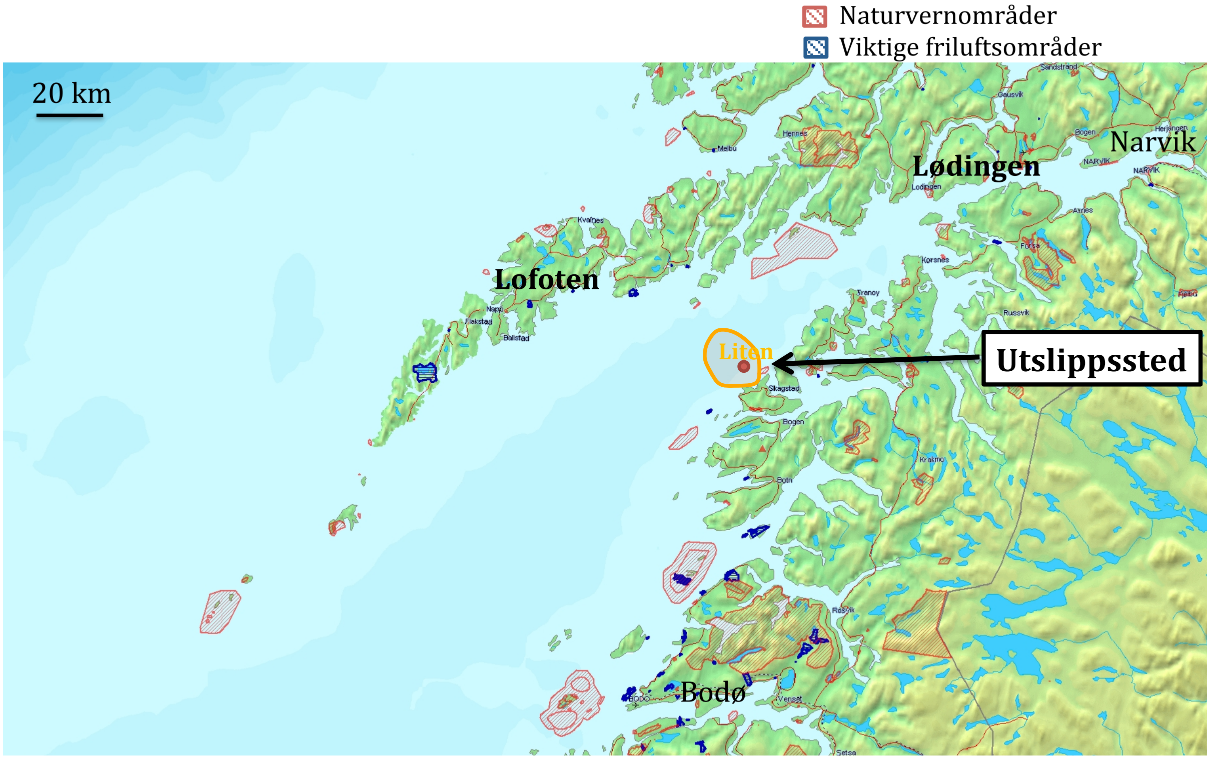


Appendix 7: Illustrations of Potential Environmental Damages from Oil Spills, With Seal and Sea Bird

Appendix 8: : Illustrations of Potential Environmental Damages from Oil Spills, Without Seal and Sea Bird

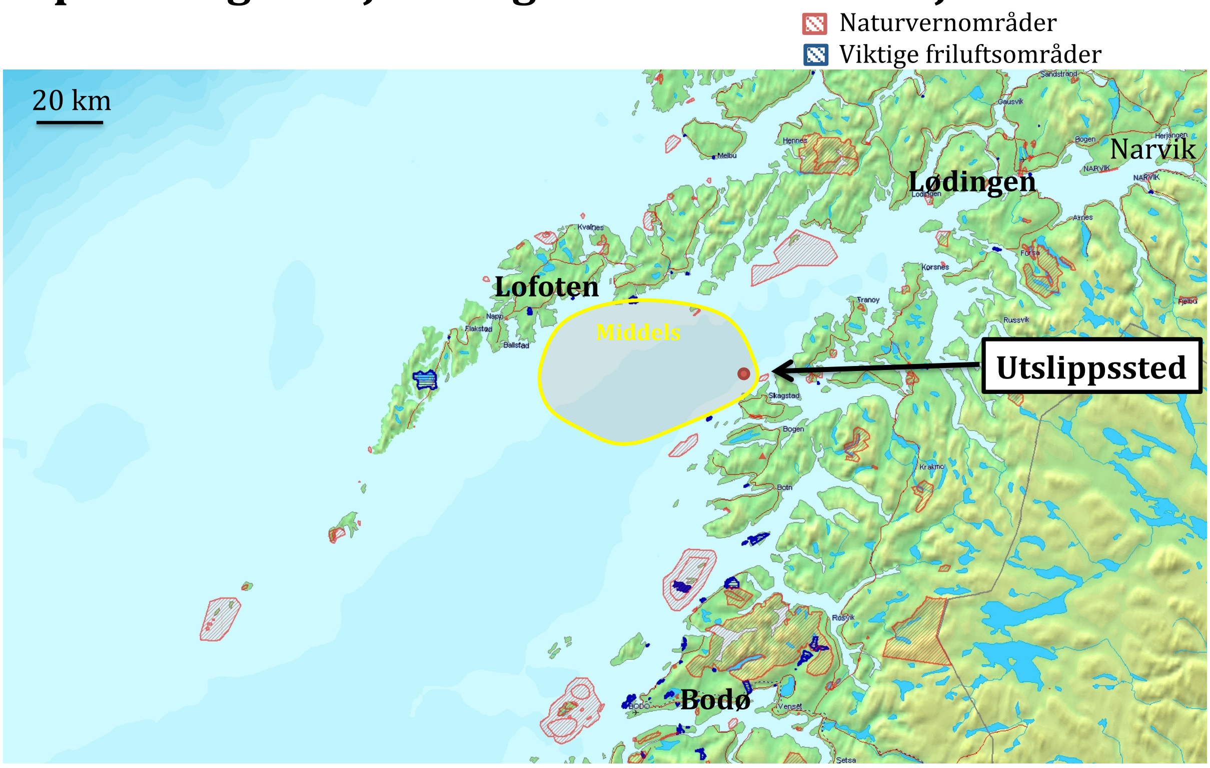
Appendix 9: A Map illustrating How a Small Oil Spill May Spread Geographically

Spredning av olje som gir liten miljøskade



Appendix 10: A Map illustrating How a Medium Oil Spill May Spread Geographically

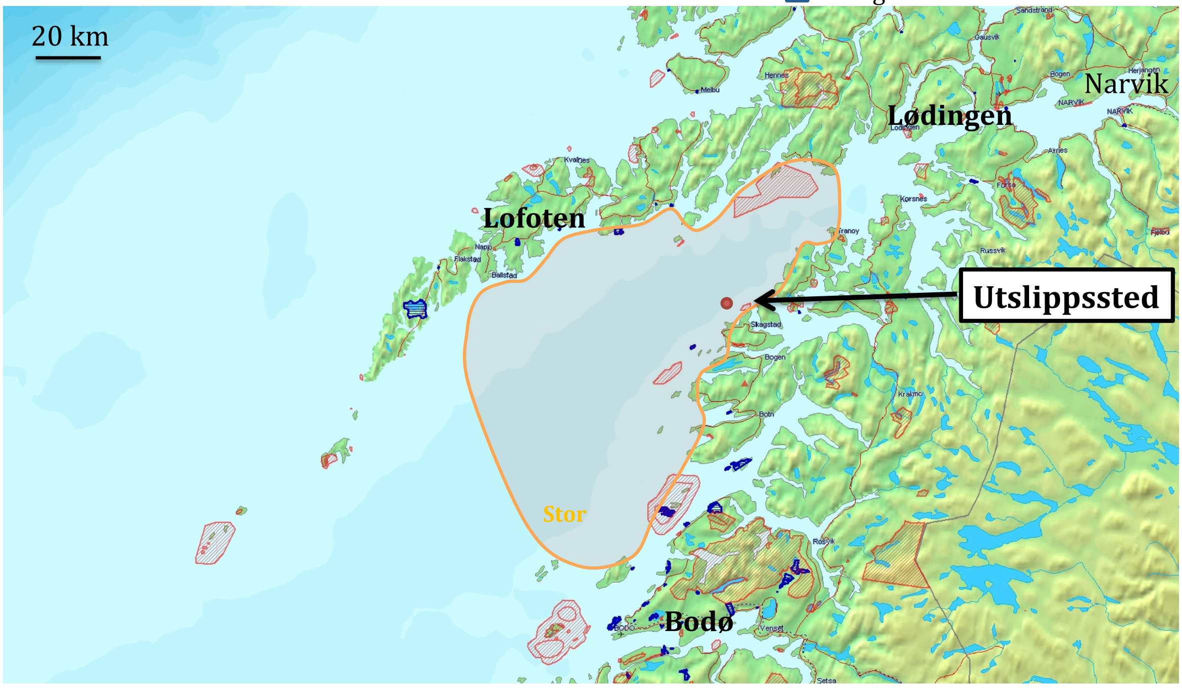
Spredning av olje som gir middels stor miljøskade



Appendix 11: A Map illustrating How a Large Oil Spill May Spread Geographically

Spredning av olje som gir stor miljøskade

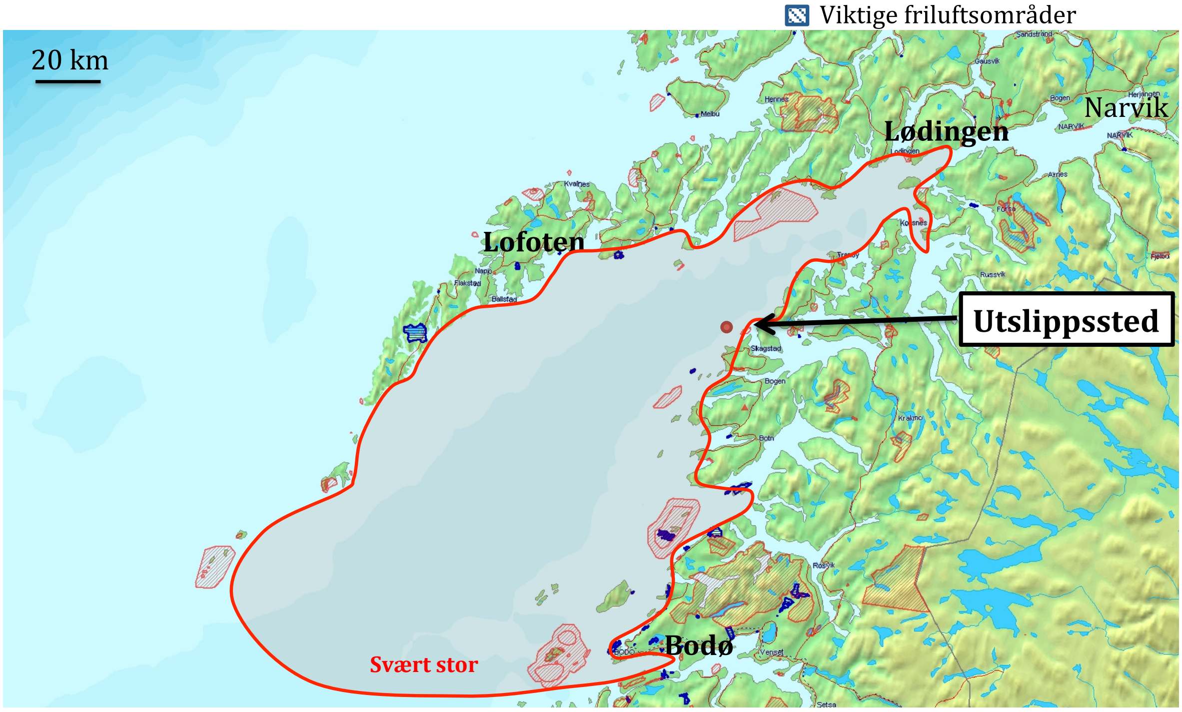
Naturvernområder
Viktige friluftsområder



Appendix 12: A Map illustrating How a Very Large Oil Spill May Spread Geographically

Spredning av olje som gir svært stor miljøskade

Naturvernområder
Viktige friluftsområder



Correlation Matrixes, Regression Set 1

Appendix 13: Model 1

	α	BID
α	1.000	
BID	-0.782	1.000

Appendix 14: Model 2

	α	BID	USE
α	1.000		
BID	-0.682	1.000	
USE	-0.482	-0.006	1.000

Appendix 15: Model 3

	α	BID	USE	FEM	AGE	UNI	MINC	HINC
α	1.000							
BID	-0.314	1.000						
USE	0.032	-0.024	1.000					
FEM	-0.329	-0.071	0.169	1.000				
AGE	-0.734	0.034	-0.348	0.008	1.000			
UNI	-0.212	-0.035	-0.136	-0.039	0.005	1.000		
MINC	-0.204	-0.034	0.01	0.148	-0.088	-0.117	1.000	
HINC	-0.147	-0.021	0.016	0.083	-0.018	-0.215	0.372	1.000

Appendix 16: Model 4

	α	BID	USE	FEM	AGE	UNI	MINC	HINC	PLANV	EORG	LCOAST	OPP	PROT	RGAS	TGOV
α	1.000														
BID	-0.188	1.000													
USE	0.078	-0.017	1.000												
FEM	-0.253	-0.05	0.125	1.000											
AGE	-0.565	0.56	-0.339	-0.008	1.000										
UNI	-0.151	-0.022	-0.095	-0.027	-0.002	1.000									
MINC	-0.167	-0.044	0.032	0.129	-0.075	-0.114	1.000								
HINC	-0.097	-0.016	0.038	0.065	-0.011	-0.205	0,374	1.000							
PLANV	-0,088	0,009	-0,356	0,043	0,092	-0,09	-0,038	-0,074	1.000						
EORG	-0,031	-0,017	0,023	0,015	0,001	-0,031	0,018	-0,007	-0,027	1.000					
LCOAST	-0,382	-0,099	-0,029	0,024	-0,006	-0,045	-0,016	-0,048	-0,052	0,047	1.000				
OPP	0,045	-0,127	-0,051	-0,076	-0,046	-0,055	0,038	0,066	-0,082	-0,106	0,002	1.000			
PROT	-0,114	-0,015	-0,019	0,097	-0,255	0,063	-0,061	-0,026	-0,065	0,008	-0,012	-0,071	1.000		
RGAS	-0,256	-0,085	0,065	-0,153	0,053	-0,057	0,063	0,011	-0,016	-0,052	0,016	-0,122	-0,341	1.000	
TGOV	-0,116	-0,016	0,002	-0,012	-0,049	0,057	-0,048	-0,043	-0,034	0,022	0,039	0,142	0,079	-0,029	1.000

Appendix 17: Model 5

	α	BID	USE	FEM	AGE	UNI	MINC	HINC	PLANV	EORG	LCOAST	OPP	PROT	RGAS	TGOV	BPAY	UINFO	SURE
α	1.000																	
BID	-0.193	1.000																
USE	0.079	-0.012	1.000															
FEM	-0.273	-0.033	0.124	1.000														
AGE	-0.493	0.059	-0.341	-0.016	1.000													
UNI	-0.150	-0.021	-0.081	-0.016	-0.009	1.000												
MINC	-0.142	-0.043	0.027	0.133	-0.070	-0.110	1.000											
HINC	-0.077	-0.019	0.030	0.055	-0.008	-0.203	0.375	1.000										
PLANV	-0.055	0.012	-0.361	0.030	0.089	-0.093	-0.040	-0.074	1.000									
EORG	-0.029	-0.021	0.025	0.010	0.001	-0.039	0.017	-0.005	-0.030	1.000								
LCOAST	-0.344	-0.083	-0.026	0.026	0.007	-0.036	-0.019	-0.049	-0.058	0.044	1.000							
OPP	0.024	-0.113	-0.054	-0.071	-0.043	-0.043	0.037	0.070	-0.092	-0.092	-0.005	1.000						
PROT	-0.054	-0.017	-0.023	0.091	-0.251	0.067	-0.062	-0.031	-0.055	0.002	-0.013	-0.067	1.000					
RGAS	-0.258	-0.069	0.056	-0.144	0.049	-0.055	0.056	0.013	-0.013	-0.053	0.010	-0.131	-0.360	1.000				
TGOV	-0.114	-0.002	0.008	-0.006	-0.050	0.060	-0.052	-0.046	-0.028	0.028	0.036	0.130	0.071	-0.023	1.000			
BPAY	-0.182	0.071	-0.029	0.032	0.015	0.019	-0.008	0.024	0.043	0.000	0.024	-0.030	-0.066	0.083	0.070	1.000		
UINFO	-0.077	-0.016	0.012	0.068	0.004	0.000	0.011	-0.015	-0.098	-0.003	0.007	0.068	0.008	-0.038	-0.069	-0.147	1.000	
SURE	-0.406	-0.010	0.000	0.087	-0.033	0.013	-0.013	-0.019	-0.050	0.018	-0.018	0.029	-0.076	0.079	0.010	-0.045	0.033	1.000

Correlation Matrixes, Regression Set 2

Appendix 18: Model 2

	α	BID	RES	VIS
α	1.000			
BID	-0.683	1.000		
RES	-0.076	-0.064	1.000	
VIS	-0.483	-0.002	0.108	1.000

Appendix 19: Model 3

	α	BID	RES	VIS	FEM	AGE	UNI	MINC	HINC
α	1.000								
BID	-0.31	1.000							
RES	-0.03	-0.067	1.000						
VIS	0.039	-0.014	0.115	1.000					
FEM	-0.329	-0.07	0.034	0.167	1.000				
AGE	-0.735	0.03	-0.028	-0.354	0.008	1.000			
UNI	-0.213	-0.038	-0.009	-0.14	-0.039	0.008	1.000		
MINC	-0.204	-0.034	0.018	0.008	0.148	-0.087	-0.117	1.000	
HINC	-0.148	-0.022	0.025	0.013	0.083	-0.017	-0.214	0.372	1.000

Appendix 20: Model 4

	α	BID	RES	VIS	FEM	AGE	UNI	MINC	HINC	PLANV	EORG	LCOAST	OPP	PROT	RGAS	TGOV
α	1.000															
BID	-0.184	1.000														
RES	-0.027	-0.053	1.000													
VIS	0.088	-0.004	0.081	1.000												
FEM	-0.252	-0.05	0.03	0.123	1.000											
AGE	-0.567	0.05	-0.003	-0.352	-0.008	1.000										
UNI	-0.153	-0.023	-0.008	-0.097	-0.026	0.001	1.000									
MINC	-0.166	-0.045	0.021	0.03	0.129	-0.075	-0.114	1.000								
HINC	-0.097	-0.015	0.012	0.038	0.065	-0.012	-0.204	0.374	1.000							
PLANV	-0.097	-0.002	0.08	-0.388	0.041	0.111	-0.084	-0.037	-0.073	1.000						
EORG	-0.03	-0.015	-0.004	0.025	0.014	-0.001	-0.031	0.018	-0.008	-0.029	1.000					
LCOAST	-0.376	-0.095	-0.074	-0.012	0.024	-0.013	-0.047	-0.016	-0.047	-0.065	0.048	1.000				
OPP	0.046	-0.125	-0.054	-0.042	-0.076	-0.049	-0.056	0.039	0.066	-0.087	-0.105	0.005	1.000			
PROT	-0.114	-0.014	-0.017	-0.016	0.097	-0.254	0.063	-0.061	-0.026	-0.066	0.007	-0.011	-0.071	1.000		
RGAS	-0.257	-0.085	0.039	0.058	-0.153	0.056	-0.057	0.062	0.011	-0.011	-0.052	0.015	-0.123	-0.341	1.000	
TGOV	-0.117	-0.016	0.003	-0.001	-0.013	-0.047	0.057	-0.048	-0.043	-0.031	0.022	0.038	0.142	0.079	-0.029	1.000

Appendix 21: Model 5

	α	BID	VIS	RES	FEM	AGE	UNI	MINC	HINC	PLANV	EORG	LCOAST	OPP	PROT	RGAS	TGOV	BPAY	UINFO	SURE
α	1.000																		
BID	-0.181	1.000																	
VIS	0.098	0.004	1.000																
RES	-0.081	-0.068	0.067	1.000															
FEM	-0.271	-0.037	0.120	0.029	1.000														
AGE	-0.497	0.049	-0.353	-0.001	-0.016	1.000													
UNI	-0.153	-0.023	-0.086	0.001	-0.013	-0.007	1.000												
MINC	-0.142	-0.044	0.025	0.031	0.132	-0.068	-0.111	1.000											
HINC	-0.079	-0.018	0.031	0.014	0.056	-0.008	-0.200	0.375	1.000										
PLANV	-0.071	0.000	-0.389	0.071	0.030	0.107	-0.085	-0.039	-0.075	1.000									
EORG	-0.029	-0.018	0.025	0.013	0.008	0.001	-0.038	0.017	-0.007	-0.030	1.000								
LCOAST	-0.335	-0.078	-0.011	-0.074	0.025	0.001	-0.038	-0.019	-0.048	-0.069	0.043	1.000							
OPP	0.026	-0.113	-0.050	-0.045	-0.073	-0.045	-0.044	0.039	0.070	-0.094	-0.090	-0.004	1.000						
PROT	-0.053	-0.016	-0.017	-0.017	0.092	-0.252	0.066	-0.062	-0.032	-0.058	0.000	-0.011	-0.067	1.000					
RGAS	-0.262	-0.072	0.044	0.055	-0.144	0.054	-0.054	0.057	0.016	-0.005	-0.051	0.007	-0.133	-0.359	1.000				
TGOV	-0.112	-0.003	0.004	-0.004	-0.009	-0.049	0.060	-0.053	-0.046	-0.025	0.027	0.034	0.131	0.071	-0.023	1.000			
BPAY	-0.180	0.071	-0.024	-0.030	0.033	0.013	0.018	-0.008	0.024	0.039	-0.001	0.026	-0.031	-0.064	0.082	0.072	1.000		
UINFO	-0.076	-0.014	0.015	-0.004	0.066	0.004	0.001	0.011	-0.017	-0.100	-0.001	0.008	0.068	0.007	-0.037	-0.071	-0.150	1.000	
SURE	-0.416	-0.019	-0.027	0.134	0.086	-0.021	0.018	-0.010	-0.017	-0.027	0.019	-0.025	0.028	-0.075	0.085	0.009	-0.047	0.033	1.000

Calculations of WTPs, Use and Non-Use Values, Set 1

Appendix 22: Calculation of WTP, Use and Non-Use Value, Model 2

$$WTP = 1307.8695$$

$$Use\ value = \frac{\hat{\beta}_{USE} * \bar{x}_{USE}}{-\hat{\beta}_{BID}} = \frac{0.30624 * 0.4540}{-(-0{,}00074)} = 188.5307$$

$$Non\ use\ value = 1307.8695 - 188.5307 = 1119.3388$$

Appendix 23: Calculation of WTP, Use and Non-Use Value, Model 3

$$WTP = 1306.6162$$

$$Use\ value = \frac{\hat{\beta}_{USE} * \bar{x}_{USE}}{-\hat{\beta}_{BID}} = \frac{0.44073 * 0.4540}{-(-0{,}00076)} = 263.9626$$

$$Non\ use\ value = 1306.6162 - 263.9626 = 1042.6536$$

Appendix 24: Calculation of Use and Non-Use Value, Model 4

$$WTP = 1311.8679$$

$$Use\ value = \frac{\hat{\beta}_{USE} * \bar{x}_{USE}}{-\hat{\beta}_{BID}} = \frac{0.27157 * 0.4540}{-(-0{,}00086)} = 145.7846$$

$$Non\ use\ value = 1311.8679 - 145.7846 = 1166.0833$$

Appendix 25: Calculation of WTP, Use and Non-Use Value, Model 5

$$WTP = 1358.5387$$

$$Use\ value = \frac{\hat{\beta}_{USE} * \bar{x}_{USE}}{-\hat{\beta}_{BID}} = \frac{0.27069 * 0.4540}{-(-0{,}00081)} = 151.5576$$

$$Non\ use\ value = 1358.5387 - 151.5576 = 1206.9811$$

Calculations of WTPs, Use and Non-Use Values, Set 2

Appendix 26: Calculation of WTP, Use and Non-Use Value, Model 2

$$WTP = 1310.0457$$

$$Use\ value\ RES = \frac{\hat{\beta}_{RES} * \ \bar{x}_{RES}}{-\ \hat{\beta}_{BID}} = \frac{0.82901 * 0.0178}{-\ (-0{,}00074)} = 19.9411$$

$$Use\ value\ VIS = \frac{\hat{\beta}_{VIS} * \ \bar{x}_{VIS}}{-\ \hat{\beta}_{BID}} = \frac{0.28619 * 0.4361}{-\ (-0{,}00074)} = 168.6587$$

$$Non\ use\ value = \ 1310.0457 - 168.6587 \ - \ 19.9411 = 1121.4459$$

Appendix 27: Calculation of WTP, Use and Non-Use Value, Model 3

$$WTP = 1309.1488$$

$$Use\ value\ RES = \frac{\hat{\beta}_{RES} * \ \bar{x}_{RES}}{-\ \hat{\beta}_{BID}} = \frac{0.91122 * 0.0178}{-\ (-0{,}00076)} = 21.3417$$

$$Use\ value\ VIS = \frac{\hat{\beta}_{VIS} * \ \bar{x}_{VIS}}{-\ \hat{\beta}_{BID}} = \frac{0.41759 * 0.4361}{-\ (-0{,}00076)} = 239.6197$$

$$Non\ use\ value = \ 1309.1488 - 239.6197 \ - \ 21.3417 = 1048.1873$$

Appendix 28: Calculation of WTP, Use and Non-Use Value, Model 4

$$WTP = 1309.6110$$

$$Use\ value\ RES = \frac{\hat{\beta}_{RES} * \ \bar{x}_{RES}}{-\ \hat{\beta}_{BID}} = \frac{0.72954 * 0.0178}{-\ (-0{,}00086)} = 15.0867$$

$$Use\ value\ VIS = \frac{\hat{\beta}_{VIS} * \ \bar{x}_{VIS}}{-\ \hat{\beta}_{BID}} = \frac{0.23900 * 0.4361}{-\ (-0{,}00086)} = 121.0891$$

$$Non\ use\ value = \ 1309.6110 - 121.0891 - \ 15.0867 = 1173.4353$$

Appendix 29: Calculation of WTP, Use and Non-Use Value, Model 5

$$WTP = 1354.5743$$

$$Use\ value\ RES = \frac{\hat{\beta}_{RES} * \ \bar{x}_{RES}}{-\ \hat{\beta}_{BID}} = \frac{1.16231 * 0.0178}{-\ (-0,00082)} = 25.2538$$

$$Use\ value\ VIS = \frac{\hat{\beta}_{VIS} * \ \bar{x}_{VIS}}{-\ \hat{\beta}_{BID}} = \frac{0.20491 * 0.4361}{-\ (-0,00082)} = 109.0749$$

$$Non\ use\ value = \ 1354.5743 - 109.0749 - \ 25.2538 = 1220.2456$$