

# The consumer response to mesopelagic fed salmon

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The consumer response to mesopelagic fed salmon

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**Abstract:**

In this study the consumer response towards mesopelagic fed salmon was investigated. A survey was conducted. The respondents were presented with information about using the mesopelagic zone to produce salmon feed. Two frames were applied to the information supplied to the respondents, differing in several key phrases. One frame oriented towards using the mesopelagic zone, the fishing frame, and another frame oriented towards protecting the mesopelagic zone, the environmental frame. The respondents were then presented with a dichotomous choice (DC) question, having to choose between regular fed salmon at a bid of € 5.00 or mesopelagic fed salmon at a bid of € 4.00/5.00/6.00. Each respondent would get one of these bids, creating a total of 6 different versions of the survey. Afterwards, open questions were asked to obtain insight in the underlying ideas respondents had for the choice they made. Then several Likert scale questions were asked to discover if there are certain traits regarded as more important for respondents that would be willing to purchase mesopelagic fed salmon. No connection was found between the framing of the survey and the choice for either type of salmon, there was a connection found between the size of the bid and salmon choice. Environmental reasons in favour of protecting the mesopelagic zone were most often reported, with financial reasons being second to that. No discernible characteristics were found for people choosing mesopelagic fed salmon.

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## 1 Introduction

The UN expects a world population close to 10 billion people in 2050 (Nations, 2019). A growth in the world population also means a growth in the demand for food. It is a challenge to feed such a large number of people in a sustainable way, in particular the supply of dietary protein will be problematic. That is because livestock cultivation is one of the main ways proteins are supplied to people. In the forms of pork, beef, dairy, and poultry. This sector has been associated with numerous sustainability concerns. There are concerns, among others, around animal welfare, environmental damages from farming and human health (Anomaly, 2014).

One alternative to livestock for dietary protein intake is fish. In 2020, fish accounted for 7% of the globally consumed protein (FAO, 2020). One of the major issues with eating fish, is that a large quantity is obtained from fishing. This has especially recently led to overfishing in numerous areas (FAO, 2020). In 1990 90% of all fish stocks was still considered on a biologically sustainable level, whilst in 2017 this level has declined to were only 65.8% of fish stocks is considered as biologically sustainable (FAO, 2020).

Fish may also be obtained from aquaculture. Aquaculture is the cultivation of fish in a body of water. This sector has a lot of potential to be able to feed the world population. Aquaculture is an emerging industry with a production growth of 527% from 1990 to 2018 (FAO, 2020). Costello et al. (2020) expect seafood production to increase from 59 Mt to about 80-103 Mt of food in 2050. This shows the potential for seafood to help feed the world in 2050.

Fish and in particular fatty fish can also provide numerous health benefits for humans. Fatty fish are high in the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Fish is one of the most important sources for these specific fatty acids. These fatty acids are associated with health benefits such as a lower blood pressure and a decrease in heart disease (Toppe, n.d.). It is therefore also recommended by the Dutch council of health (Dutch= gezondheidsraad) to consume one portion of fat fish per week (Voedingscentrum, 2021). One fish high in fatty acids is Salmon. Salmon is one of the major species cultivated in value terms, only second to white leg shrimp (Cai, Zhou, Yan, Lucente, & Lagana, 2019).

In several forms of aquaculture there is heavy dependence on wild catches for producing fish. That is because cultured fish species require protein to grow. The dependence on wild catches is no different for salmon aquaculture. The existing market for salmon feed can be characterized as volatile, and recent shortages have caused spikes in the prices for fish meal (Hodar, Vasava, Mahavadiya, & Joshi, 2020; Shepherd, Monroig, & Tocher, 2017). Alternative sources of salmon feed would bring more stability to the market for salmon feed (Shepherd et al., 2017).

One alternative source of salmon feed may be provided by fish in the mesopelagic zone. This zone has been relatively unaffected by fishing effort. The mesopelagic zone is the zone in the ocean that starts at a depth of about 200 meters until a depth of about 1000 meter (del Giorgio & Duarte, 2002). The amount of fish biomass in this layer is estimated to be within a range of 9-19.5 gigatons, this equals 100 times the annual catch of fisheries (Hidalgo & Browman, 2019).

However, consumer acceptance of mesopelagic fed salmon can potentially be an issue. In the past there have been instances in which consumer acceptance of a new food technology provided to be problematic, one example of this is the acceptance of genetically modified foods (GMOs) (Fortin & Renton, 2003). Since it is unclear what the environmental effects will be from fishing in the mesopelagic zone, fish fed with mesopelagic species may be undesirable for consumers. Especially since consumers tend to care about the environmental effects of their seafood consumption (Whitmarsh & Wattage, 2006).

Therefore, the focus of this research is on the consumer attitudes surrounding mesopelagic fed salmon. The framing of research done regarding the mesopelagic zone and consumer attitudes is important to consider, as consumers tend to have low knowledge about this ecological area or the deep sea environment in general (Ankamah-Yeboah, Xuan, Hynes, & Armstrong, 2020; Kaikkonen & van Putten, 2021). In any survey design it is likely that there will be an effect of framing, however when respondents may have little previous experience, the potential effects of framing are heightened (Gyrd-Hansen, Jensen, & Kjaer, 2014). These considerations are included in the experimental design. The following research objective will be addressed in this work, through answering several research questions.

### **Objective**

This research aims to investigate how much framing influences the economic value consumers attach to cultured salmon fed with mesopelagic fish compared to salmon fed with a standard diet.

**Research Question 1:** How much does the framing of the information supplied affect the consumers' willingness to pay for mesopelagic fed salmon?

**Research Question 2:** How does the framing of the experiment impact how consumers view mesopelagic fed salmon?

**Research Question 3:** What are the characteristics of a consumer who is willing to purchase mesopelagic fed salmon?

## 2 Context

### 2.1 The mesopelagic zone

The mesopelagic zone refers to a vertical layer in the ocean which starts at a depth of 200 meters and goes until a 1000 meters deep (del Giorgio & Duarte, 2002). This zone is home to the largest daily migration on Earth. Several species of fish and plankton move every night to the surface, travelling 100s of meters to do so. At sunrise these species go back to the depths of the ocean (Martin et al., 2020).

One of the most important features of the mesopelagic zone is the marine carbon pump, also called the biological pump (Martin et al., 2020). This process allows the ocean to store atmospheric carbon. This process involves complex interactions between the organisms living in the mesopelagic zone, dissolved nutrients, atmospheric carbon and other environmental factors. The carbon captured from the atmosphere gets stored in the ocean (DeVries, Primeau, & Deutsch, 2012). Without this mechanism the CO<sub>2</sub> levels in the atmosphere would be 50% higher (Cavan, Laurenceau-Cornec, Bressac, & Boyd, 2019).

There is still a lot unknown about the mesopelagic zone and the carbon pump. This missing information makes it difficult to anticipate how future developments will impact the mesopelagic zone. For instance, there is little information regarding which exact species dwell in the mesopelagic zone, information regarding the metabolic rates of these fish species, there is a lot unknown about the food web interactions that occur, and there is also a lot of information not known about the functioning of the carbon pump (Martin et al., 2020; Robinson et al., 2010).

The lack of knowledge about the inner workings of this zone is problematic seeing as there are emerging threats to the functioning of this ecological area (Martin et al., 2020). Global warming may influence life in the mesopelagic negatively as changes of a physical-chemical nature may occur such as changes in dissolved oxygen concentration or larger oceanographic effects that can impact the mesopelagic zone (Robinson et al., 2010). Sea floor mining is another threat to the mesopelagic zone (Martin et al., 2020). Interest in sea floor mining has been rising over the past 50 years, as it is becoming more economically viable (Christiansen, Denda, & Christiansen, 2020). Sea floor mining is expected to affect the ecological area in several ways. For instance, through smothering local fauna or by introducing nutrients in nutrient poor systems (Jones, Amon, & Chapman, 2018). Thirdly, overfishing might influence mesopelagic species (Robinson et al., 2010). Many species that suffer from overfishing are species high in the food chain (Robinson et al., 2010). Some of these species may consume mesopelagic species. Decreasing levels of top predators can have the effect that prey animals can explode in population; it causes a ripple effect through the food chain.

The mesopelagic zone may also present opportunities for new fisheries. The total biomass of this zone may vary between 2- 19.5 giga tones according to recent estimates (Hidalgo & Browman, 2019). Some of the fish species in the mesopelagic zone are interesting for human consumption and aquaculture. Species fished from the mesopelagic zone have sufficient nutritional quality to serve as both food for human consumption, and as feed for the aquaculture sector. An analysis done by Alvheim, Kjelleevold, Strand, Sanden, and Wiech (2020) of mesopelagic species obtained from a trawl in a Norwegian Fjord has shown that mesopelagic species are dense in micronutrients, and thus might be able to help provide food security over the globe. In particular the species glacier lanternfish (*Benthoosema glaciale*) and silvery lightfish, also called Mueller's pearlside (*Maurolicus muelleri*) are dense in nutrients (Alvheim et al., 2020). These species are rich in omega 3 fatty acids and have a micronutrient density comparable to fish that is already commonly consumed like Atlantic salmon or Atlantic cod (Alvheim et al., 2020). A high lipid content makes both *M. Muelleri* and *B. Glaciale* particularly suitable for aquaculture. A lipid content of around 30% dry mass was found for *B. Glaciale* and for *M. Muelleri* a lipid content ranging around 40-55% of dry mass was found (Olsen et al., 2020).

Both these species do fulfil several functions within the ecosystem, such as being a food source for larger marine predators, such as sharks, sea turtles and marine mammals (Naito et al., 2013). Research done on northern elephant seals has shown that these species will dive to the depths of the mesopelagic zone to forage for food, often consuming small fish species (Naito et al., 2013). These species also play a role in the functioning of the biological carbon pump. That is through their daily migration patterns where they move hundreds of meters vertically through the water column every day to feed (Froese, n.d.; Kristoffersen & Gro Veia Salvanes, 2009).

## 2.2 Mesopelagic fishery

There has been research done on the possibility of a mesopelagic fishery in several areas. One such research was done by Prellezo (2018) on the possibility of a mesopelagic fishery in the Bay of Biscay. This research concluded that a mesopelagic fishery was not yet economically viable. However, Prellezo (2018) notes that there is potential for a mesopelagic fishery considering recent policy changes. This conclusion was shared by Grimaldo et al. (2020) who notes that selective trawls are necessary to more effectively target mesopelagic species. Another work of research done by Paoletti, Nielsen, Sparrevohn, Bastardie, and Vastenhoud (2021) explored if a mesopelagic fishery can be economically viable. By their predictions, a mesopelagic fishery would have a high break-even profit. This is due to increases in fuel cost, the need for modifications of the fishing gear, investments in new fishing vessels and modifications to the catch processing on-board. The authors identified the need for fishing trips beyond 5 days as one of the main limitations.

More ecological data will be required to give a more accurate and inclusive assessment of the potential for a mesopelagic fishery (Grimaldo et al., 2020). There are several difficulties with obtaining the data necessary for a mesopelagic fishery. One is the presence of scattering layers; these layers make it much harder to adequately perform acoustic sampling. Another factor that makes things more difficult is trawl avoidance, meaning that a significant portion of fish is not caught by trawl sampling (Grimaldo et al., 2020). This can be attributed to the used mesh sizes as well as that mesopelagic species are good swimmers (Grimaldo et al., 2020). One thing to note is that the main fish species in the mesopelagic zone, *B. Glaciale* and for *M. Muelleri* have shown large variability in their distribution across space and time as well as seasonal differences (Grimaldo et al., 2020). This seems to be in line with their daily migratory patterns (Grimaldo et al., 2020). Making them more difficult to locate and catch.

Some research has been done regarding the exact composition of the mesopelagic layer. Olsen et al. (2020) obtained samples for trawl hauls done by three separate transect cruises. These samples were analysed for lipid content and composition of fatty acids, for crude protein and trace elements and heavy metals. The authors note that for the case of Norway, studies have shown the composition of the mesopelagic layer to contain varying quantities of fish such as *B. Glaciale* and for *M. Muelleri* (Olsen et al., 2020). Also, species like krill, jellyfish and shrimp will occur in these layers. This would lead to catches varying in species and thus create variation in the nutrients that may be obtained per catch. The authors found for trawls within the fjords of Bergen a high occurrence of *P. periphylla* or helmet jellyfish (Olsen et al., 2020). The other species found are predominately mesopelagic fish, like Mueller's pearlside, some pelagic shrimps and krill. Glacier lanternfish occurred in smaller amounts than the aforementioned species (Olsen et al., 2020).

### 2.3 Aquaculture

In several forms of aquaculture there is heavy dependence on wild catches for producing fish. That is because cultured fish species require protein to grow. This protein is added to fish feed as fishmeal and fish oil (Naylor et al., 2021). The production of fish meal and fish oil is one of the reasons the aquaculture industry is scrutinized as the fish meal and fish oil is often obtained from wild catches. This could mean that an expansion in aquaculture will drive overfishing (Naylor et al., 2000). This phenomenon can also be referred to as the fish meal trap (Asche & Bjørndal, 2011). One example of this dependence on wild catches is the crustacean and finfish aquaculture sector. This sector needs wild catches to supply key nutrients in aquafeed (Tacon, 2004). Some often used species for the production of fish feed are blue whiting, mackerel, anchovies and capelin (Péron, François Mittaine, & Le Gallic, 2010).

Furthermore, wild catches are also used to supply the fatty acids and lipids in fish feed in the form of fish oil. It is possible to replace fish meal with for instance protein from soy, however this may not be done indefinitely as that would impede on the health of the cultured fish and be the cause of slow growth (Naylor et al., 2021; Webster, 2002). That



is due to the protein in fish meal having a different amino acid composition than protein obtained from other sources (Webster, 2002). For fatty fish to get a high fat content, the feed for these types of fish should be high in fat as well (Webster, 2002). For these types of species, the quality of the fat in the feed will determine how nutritious the fish will become (Webster, 2002). The irreplaceability of wild catches can mean that an expansion in aquaculture will drive overfishing (Naylor et al., 2000). This phenomenon is also referred to as the fish meal trap (Asche & Bjørndal, 2011).

## 2.4 Salmon aquaculture

To supply the required protein and fatty acids for salmon growth, fish meal and fish oil is used in salmon feed. Salmon aquaculture depends on wild catches for its supply of fish meal and fish oil. Salmon feed should contain high quality oil with a low melting point. These fats will allow the salmon to become healthy and nutrient dense (Webster, 2002). In terms of fish meal salmon has requirements for the amino acids that need to be present in the feed, these are Arginine, Lysine and Methionine (Webster, 2002). Feed which uses capelin, herring and anchovy as protein sources are much better digested than feed that uses soy for its protein (Webster, 2002). This allows for better uptake of the available amino acids, thus healthier salmon. This shows the dependence on fish-based feed for salmon aquaculture. Olsen et al. (2020) expands upon the need for high quality fish oil in salmon feed, the authors note that several problems persist when using plant protein. One of these problems is that inflammation and the malabsorption of nutrients may occur when using highly processed plant-based protein (Olsen et al., 2020). Furthermore, plant oil usage has been associated with lower levels of omega 3 fatty acids and lower levels of EPA and DHA in the final product. These lower levels make salmon a less suitable source of these fats, making it harder for humans to obtain these fats (Olsen et al., 2020).

In recent years the salmon aquaculture industry has been successful in partially replacing marine protein with plant protein. An analysis done by Ytrestøyl, Aas, and Åsgård (2015) found that the feed composition has already undergone a significant amount of changes since the 1990s. Ytrestøyl et al. (2015) examined the origin of the ingredients used in feed for salmon aquaculture in Norway, using data from several major feed production companies. They found that in 1990 65.4% and 24.0% of the feed were marine protein and marine oil respectively, compared to 18.3% and 10.9% in 2013 (Ytrestøyl et al., 2015). In this time period a large portion of the marine ingredients have been replaced with plant protein and plant oil (Ytrestøyl et al., 2015). Additionally, Aas, Ytrestøyl, and Åsgård (2019) examined the Norwegian feed industry. The authors found that for 2016 25% of ingredients for salmon feed had a marine origin.

Ytrestøyl et al. (2015) writes that one often used metric in feed efficiency is the fish in/fish out ratio (FIFO). In this metric the amount of fish oil and fish meal used to create 1 kg of farmed fish is expressed. This is not always measured in kilograms. This FIFO ratio can be found by examining how much fish meal and fish oil is produced from

foraged fish (Ytrestøyl et al., 2015). The amount of fish meal produced from forage fish is more or less constant, whilst the amount of fish oil that is obtained will vary depending on the fat content per species (Ytrestøyl et al., 2015). FIFO ratios may be greatly increased when using fish species that are more fat by nature (Ytrestøyl et al., 2015).

Salmon aquaculture tends to have a high FIFO. Bendiksen, Johnsen, Olsen, and Jobling (2011) did a feed trial to examine different compositions of fish meal and fish oil for salmon feed. In a feeding trial different compositions of feed are given to different groups, and then the subsequent growth is measured. The authors note that when performing calculations often the FIFO ratios are used (Fish in, fish out). It is important to account for the fact that small pelagic fish species contain both FM and FO (Bendiksen et al., 2011). Taking this into account is important to prevent double counting. If not accounted for, FIFO would be higher. The authors note that Fish oil availability will be a more major limiting factor in the expansion of salmon aquaculture. The authors calculated that 3-3.6 kg of raw fish was necessary to cause a gain of 1 kg in salmon biomass (Bendiksen et al., 2011). As mentioned before, *M. Muelleri* and *B. glaciale* are high in fat content. This would make these fish species particularly useful to produce salmon feed. The FIFO ratio would be lower for these species as a lower number is needed to produce the oil that is necessary to produce 1 kg of salmon.

## 2.5 Consumer concerns when purchasing seafood

There have been Contingent valuation studies conducted on the consumer attitude towards seafood. These studies have shown what consumers value about seafood and what they are subsequently willing to pay for these attributes. One example is a study in Norway in which consumers were given a choice experiment (Olesen, Alfnes, Røra, & Kolstad, 2010). One option was regular salmon whilst the other option was organic salmon. The authors found a willingness to pay of about 2 Euros per kilo, or 15%, for organic salmon as a price premium on top of regular salmon prices (Olesen et al., 2010). Whitmarsh and Wattage (2006) found using an open-ended willingness to pay format a price premium of on average 22% for salmon that only had half the nutrient discharge compared to standard produced salmon. This was a study for Scottish consumers, showing that these consumers value a low environmental impact of their salmon consumption. Research by Bronnmann and Asche (2017) has shown that for German consumers environmental concerns surrounding the purchases of salmon play an important role.

There has also been research done on which attributes of seafood are valued by consumers. One such research was about the willingness to pay for sustainable seafood that is produced in Europe by Zander and Feucht (2018). 8 different European countries were examined and a willingness to pay varying between 7% and 20% was found depending on attribute and country. The chosen countries were Finland, France, Germany, Ireland, Italy, Poland, Spain and the UK (Zander & Feucht, 2018). This was done by asking people how much they would typically spend totally on fish and then they

were asked if they would agree to pay a price premium ranging between 100% to 200% for those fish having an extra attribute. Examples of these attributes are, fish being produced sustainably, or in accordance with organic standards, within the respondent's region or in Europe (Zander & Feucht, 2018). For most attributes the average willingness to pay of all countries combined would be around 12% (Zander & Feucht, 2018). Hicks, Pivarnik, and McDermott (2008) researched consumer perceptions about seafood in the United States. The authors used a multitude of statements to see what perceptions around seafood persists and identified several factors that people use to help make decisions what seafood to purchase. Some attributes of seafood, ranked in decreasing order of importance, quality of the seafood, safe handling practices, preparation, storage, the health benefits, and contaminants are main decision factors (Hicks et al., 2008). Eco-labels are often used as a method to distinguish between products and can be used to allow consumers to 'vote with their wallet' for the products with the necessary attributes that these consumers support (Gutierrez & Thornton, 2014). This allows the consumer to gain some insight in the different production methods used to create a product and the consumer can then choose what sort of attributes they support. Vitale et al. (2020) highlights the importance of environmental features related to a person's income. Vitale et al. (2020) researched the willingness to pay of consumers for seafood with an eco-label in Italy. A willingness to pay of about 16 to 24% was found for seafood products containing an eco-label (Vitale et al., 2020).

In general consumers prefer seafood obtained from fishing opposed to seafood obtained from aquaculture. An online questionnaire conducted in Italy found that consumers have a preference of wild caught aquatic food over farmed aquatic food (Pulcini, Franceschini, Buttazzoni, Giannetti, & Capoccioni, 2020). Wild caught food is favoured because it is viewed as healthier and tasting better (Pulcini et al., 2020). This conclusion was shared by other researchers (Verbeke, Sioen, Brunsø, De Henauw, & Van Camp, 2007).

### 3 Conceptual framework.

#### 3.1 Consumer acceptance of novel a food technology

In the past there have been instances in which consumer acceptance of a new technology provided to be problematic. One example is the acceptance of genetically modified foods, also referred to as GMO. Fortin and Renton (2003) examined if consumer attitudes would become more favourable to the idea of GMO when provided with more information about the benefits of these types of products. The authors found that with additional information the consumers tended to still have negative views. With GMOs in particular, consumers can be rigid in their negative point of view, GMOs even have the nickname 'Frankenstein' foods (Fortin & Renton, 2003). Negative attitudes surrounding a novel food technology can hinder further growth of this technology. Based on these cases in the past it can be important to examine consumer acceptance.

Another instance of an emerging food technology that has differing amounts of consumer acceptance is cultured meat. While still in its infancy, research examining stated acceptance of this technology found mixed results (Siegrist & Hartmann, 2020). There are several factors influencing people's acceptance to novel food technologies, these include trust in the food industry, framing of novel foods, the perceived 'naturalness' of a new product (Siegrist & Hartmann, 2020). These factors all contribute to consumer acceptance. Siegrist and Hartmann (2020) found that a possible way to create a higher acceptance of novel food technologies is by accounting for consumer perceptions during development and when a novel food technology is introduced. There are instances of Genetically modified food that is acceptance, one example is golden rice (Siegrist & Hartmann, 2020).

#### 3.2 Framing

Through the years there has been research done on the topic of framing in surveys. One famous example is the Asian disease framing experiment done by Tversky and Kahneman (1981). In this experiment, the respondents were divided into two groups and both groups given a dilemma of two types of medicine and asked to pick one of these to save a number of people from a disease. Group 1 received the following choice, presented in a survival format, this is quoted from Tversky and Kahneman (1981).

*'If Program A is adopted, 200 people will be saved.'*

*'If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved.'* (p.453)

In the end 72% of people chose for program A and 28% of people chose program B. The second group was presented with the following choice, presented in a mortality format, this is quoted from Tversky and Kahneman (1981).

*'If Program C is adopted 400 people will die.'*

*'If Program D is adopted there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.'* (p.453)

Which had 22% of people choosing program C and 78% of people chose program D. In their research they showed that the phrasing of a question would lead to different outcomes, undermining the theory of rational choice (Tversky & Kahneman, 1981). Predominantly risk adverse behaviour was observed when the dilemma was framed as gain. When the dilemmas were framed as a loss, predominantly risk-seeking behaviour was observed (Tversky & Kahneman, 1981).

An example of how framing may be incorporated into a survey is given by Galesic and Tourangeau (2007). In their survey questions were asked relating to sexual harassment in the workplace, prior to the questions being asked one group was informed that the questions were sponsored by a feminist group whilst the other group was informed through a more 'neutral frame' saying it was sponsored by a research institute (Galesic & Tourangeau, 2007). The authors kept the sentence structure the same, only differing in the nouns.

Another example of the implementation of framing is given by Cucchiara, Kwon, and Ha (2015). The authors researched the effects of the framing of a message to how consumers would respond to organic seafood. They found that when consumers had already a high familiarity with organic food, the effects of a positive frame on a consumer's intention to purchase was not as pronounced. For the more involved consumers a negative frame did have a more significant effect than a positive frame on the purchase intention. In general, a positively framed message had a more significant effect than a negatively framed message in convincing consumers to purchase organic good. The framing was also applied through giving different groups of respondents a different piece of information in which the sentence structure was kept the same, but several nouns differed between the versions.

### 3.3 Contingent valuation method

The contingent valuation method (CVM) is a stated preference method (Boardman, Greenberg, Vining, & Weimer, 2018). This method is useful for determining people's preferences when behavioural data is not available. Such as when dealing with hypothetical markets or with non-market goods, CV is the most common method used for these scenarios (Boardman et al., 2018). Through this method a willingness to pay is obtained for the good that is being valued.

One example of CVM is a Dichotomous Choice (DC) experiment. In this type of experiment a respondent is given a bid for a good and is then asked if they are willing to pay that amount for the good or not, meaning that the respondent has a binary choice. Not all respondents would receive the same offer, multiple bids of differing amounts are used. From the answers a willingness to pay (WTP) can then be determined (Boardman et al., 2018).

This method has been under criticism by some authors (Venkatachalam, 2004). There are multiple aspects on which the criticism is focussed. One aspect is the validity of results obtained from CVM (Venkatachalam, 2004). This concerns the ability of the CVM to estimate the actual economic value for individuals in the survey. Another aspect on which CVM has received critique is the reliability of the method. To be a reliable method, different measurements should be able to obtain the same WTP. In addition, changes in value of that product should be able to be observed upon repeated measurement (Venkatachalam, 2004). Furthermore, there is also some criticism regarding biases that may occur in this type of research. One example being starting point bias (Venkatachalam, 2004).

## 4 Materials and Methods

In order to answer the research questions identified in the introduction, a survey was conducted. In this chapter I will first clarify the steps that went into the design of this survey. Secondly, I will explain how the methodology was executed. Thirdly, I will explain how the survey data was analysed. The full survey is included in appendix A.

### 4.1 Survey design

The chapter will detail the design of the survey. The order in which each element is presented is also the order in which these were included in the survey. The survey was translated into Dutch after the design was complete.

#### 4.1.1 Survey Introduction

The survey starts with a short introduction explaining the purpose of the survey with the additional note that ensures the reader that the information obtained through the survey is treated anonymously and that the answers will be treated confidentially. Furthermore, the respondents were told that there are no right or wrong answers, to allow the respondents to answer freely.

Following the introduction of the survey, some fundamental information about aquaculture and the mesopelagic zone was provided. This was done to ensure that the respondents filling in the survey had some sort of idea about aquaculture and the mesopelagic zone. After that the framing utilized in this work is applied to the information given about the mesopelagic zone. This is fundamental to be able to answer all three research questions.

The most applicable demographic questions were inspired by Fontanella (2021). These questions aim to gain insight in the characteristics of the respondents. These questions may also be used to verify if there was a large bias in the people that filled in the survey. With one of the main purposes to verify if the survey can be an adequate representation of society. The selected questions were used to verify the respondents age, month of birth, nationality, gender, and highest education level. The month of birth was included as this allows a distribution of the survey between the respondents. One of the main considerations was to avoid asking too much personal information as that might influence a respondent's willingness to continue with the survey.

#### 4.1.2 Framing

The following section of the survey was the framed information. Two different types of frames were applied by slightly modifying the background information about the mesopelagic zone that was presented to the respondents to measure the degree of

influence that is exerted by each frame. Different responses to later questions after exposure to one of the two frames can indicate a sensitivity towards framing. Each respondent did receive one of the two frames.

The different frames were applied through supplying a piece of background information and changing a number of words between the two frames that will be used. The approach is similar to that used by Cucchiara et al. (2015), in which they test the effect of various frames on willingness to pay for organic salmon.

One frame that was utilized in this work is called the 'environmental frame'. This frame intends to use words that have an environmentally positive association. The reason for choosing this frame is that previous research towards consumer attitudes surrounding aquaculture finds that environmental concerns around aquaculture tend to play a large role. For this frame it was necessary to find words with a strong environmental association. To find these words the website of the WWF was consulted (WWF, n.d.). This is an organisation that values environmental protection. From this website several words and phrases were obtained to inspire the words chosen for this frame. Some words and phrases used by this organisation are: 'treasured wildlife', 'spectacular ecosystems' and 'an array of biodiversity' (WWF, n.d.). The following piece of information was given to the respondents who received the environmental frame, the words and phrases that are different for this version are made bold.

*"Fishing companies are now considering to produce fish feed from fish caught in the mesopelagic zone. The mesopelagic zone lies between 200m and 1000m deep. This part of the ocean has not yet been fished, and therefore is a relatively **pristine ecosystem**. It contains a lot of **interesting wildlife**. Fishing in this part of the ocean to produce fish feed will help to reduce pressure on other ecosystems, but it is not clear what the effects of fishing will be on the mesopelagic zone itself. The fish that live in this zone **are part of some spectacular ecosystems**. This part of the ocean can be used **to conserve biodiversity**."*

The other frame that was used in the survey is called the 'fishing frame'. This frame aims to highlight the opportunities that stem from the mesopelagic zone for the fishery industry. This frame is chosen as it represents a more opposite side of the 'environmental frame'. The words chosen for this frame represent the opportunities that the mesopelagic zone brings. One of the reason this frame is chosen is because of the potential of the mesopelagic zone in terms of available biomass. Words used in this frame have been obtained from organisations that favour fishing and can be classified as being fisher friendly. One such organisation is The National Federation of Fishermen's Organisations (NFFO) (nffo, 2021). News articles from the NFFO website have been read and analysed to find certain specific phrases that can be used for the fishing frame. On this website several phrases such as: 'fishing grounds', 'marine development' and 'marine space' are used, these phrases have been used as inspiration for this part of the framing (nffo, 2021). The following piece of information was given to the respondents who received the fishing frame, the words and phrases that are different for this version are made bold.



*"Fishing companies are now considering to produce fish feed from fish caught in the mesopelagic zone. The mesopelagic zone lies between 200m and 1000m deep. This part of the ocean has not yet been fished, and therefore is a relatively **unused resource**. It contains a lot of **fish biomass**. Fishing in this part of the ocean to produce fish feed will help to reduce pressure on other ecosystems, but it is not clear what the effects of fishing will be on the mesopelagic zone itself. The fish that live in this zone **offer great opportunities for marine development**. This part of the ocean can be used **as an alternative source of food for human systems**."*

#### 4.1.3 Contingent Valuation question

Following the provided information in which the framing is included, the respondent was presented with a choice between purchasing salmon produced with standard fish feed or purchasing salmon produced with mesopelagic fish feed. This was done to answer research question 1. The choice the respondents had to make was framed as that the respondents would be having guests over and that these guests would like to eat salmon. This choice was made to increase the inclusivity of the survey and gain insights about the attitudes and views that respondents who did not consume salmon themselves have. There was a third option given which was for the people who would never purchase farmed salmon.

Each choice was accompanied by a bid. The salmon produced with standard feed was set at € 5.00 for a 250-gram salmon filet. This price was based upon the price used on the website of a large Dutch supermarket chain, the Jumbo (Jumbo, n.d.). Salmon fed with mesopelagic feed was given a different price depending on the version of the survey the respondent had. The price for mesopelagic-fed salmon was given as €4.00, €5.00 or €6.00 for a 250-gram salmon filet. Each respondent is only given one of these bids, this means that additional versions of the survey are created. The combination of the number of frames (2) and the number of bids (3) means that there are 6 unique versions of the survey. Utilizing different bids for different respondents in this fashion is often referred to as a Dichotomous Choice (DC) experiment (Boardman et al., 2018). Here the question that was in the survey:

*"Suppose that you are having guests over who really like salmon. Now you are standing in the supermarket and you can choose between farmed salmon fed with regular fish feed, or farmed salmon fed with fish feed from the mesopelagic zone. Which one would you choose? Remember there are no good or bad answers.*

- 1. A 250 gram filet of farmed salmon fed with fish feed made from a wild fish species such as anchovy or blue whiting at price € 5,00*
- 2. A 250 gram filet of farmed salmon fed with fish feed made from mesopelagic fish at price € 4,00/5,00/6,00*
- 3. Under no circumstance would I purchase farmed salmon."*

To allocate each respondent to one of the versions, each respondent was asked in which month that respondent was born. This question was included in the earlier section along with the demographic questions. The respondents answer to this question would then generate the rest of the survey. The pairing between each month of birth and the subsequent frame and bid is seen in table 1.

**Table 1: Pairing of Month of Birth, Frame and Bid**

<b>Month of Birth</b>	<b>Frame</b>	<b>Bid for Mesopelagic fed salmon (€)</b>
<b>January or February</b>	Environmental	4.00
<b>March or April</b>	Fishing	5.00
<b>May or June</b>	Environmental	6.00
<b>July or August</b>	Fishing	4.00
<b>September or October</b>	Environmental	5.00
<b>November or December</b>	Fishing	6.00

#### 4.1.4 Follow up questions

In the following section three open questions were asked. This was done to answer the second research question. The open questions were used to gain insight in the reasons why people would choose for the specific type of salmon in the contingent valuation question and what additional information consumers want to have to make that decision. Furthermore, the open question allowed this research to gain insight in the most fundamental ideas people have about the mesopelagic zone.

In the following section several statements are used. Respondents are then asked to note if they agree or disagree with these statements on a 5-point Likert scale. Information relating to the design of the questions on a Likert scale was obtained from Hotjar (2021). Further information regarding the design and nature of a Likert scale was obtained from websites (Bhandari, 2020; SurveyMonkey, n.d.; Toor, 2020). The purpose of these statements is to evaluate if the framing has an effect. Two out of four statements are given here:

*"The fish that live in the mesopelagic zone present a good opportunity for food production"*

*"The mesopelagic zone should be protected from fishing"*

In the section after that the respondents were asked additional background questions. These are about the respondent's prior knowledge and salmon eating and purchasing behaviour. The reason for including these questions at this stage is because at this point

of the survey the concepts are introduced. For the background questions a 5-point Likert scale was used to maintain consistency in the survey.

The final section of the survey is used to answer the third research question. These questions were only asked if the respondent consumed salmon themselves. This consideration was made because these respondents would have experience with salmon and therefore be able to rely on their previous knowledge to answer these questions. Consumers were asked to rate how important a certain attribute is when purchasing salmon. This was asked for several attributes on a 5-point Likert scale. These attributes may be referred to as decision factors for the rest of this work.

## 4.2 Survey execution

The website [kobotoolbox.org](http://kobotoolbox.org) was utilized to create the survey (Kobotoolbox, n.d.). This website contains open source and free software for users to help collect data in the field. Prior to the full survey execution, a trial survey was conducted among 12 respondents. In this trial survey respondents were asked to fill in the survey and give feedback on their understanding and the functionality of the survey. Respondents to the trial survey were given the opportunity to share feedback with the researcher.

To obtain respondents for the survey flyers were delivered in people's mailboxes in both Ede and Bennekom. The survey was conducted in the last week of December 2021 and the first two weeks of January 2022. In total 2970 flyers were delivered in people's mailboxes.

These flyers contained a sentence to explain what the purpose of the flyer was. And a second sentence on the flyer explained how people could reach the survey. This was either via a link which people would need to enter in a web browser or via a QR code which could be scanned with a mobile device and would then lead respondents to the survey.

## 4.3 Data analyses

The data was analysed using R and Microsoft Excel. The first step was displaying the descriptive statistics into several tables.

The first analysis done was to examine if the framing had effect. The statements were used to evaluate the effect of framing for this analysis. The responses to these questions were simplified from 5 categories to 3 categories, in which the 4 and 5 answers were merged into one category and the 1 and 2 answers were merged into one category. That was done to increase the robustness of this work and to have a stronger difference between categories. A chi square test for independence was done comparing the framing against the answers given to these statements.

The analysis of the Contingent valuation question was subsequently done. In a complete DC experiment, the willingness to pay of all consumers would be determined by having several numbers of bids, for instance 7, and pairing this with the choices made by the consumers (Boardman et al., 2018). Through this method a willingness to pay would then be determined. This could not be done for this research. For this work it was first evaluated through a chi square test for independence if the framing had an effect on the choice made for mesopelagic or regular fed salmon. Afterwards a chi square test for independence was used to test if there was a correlation between bid size and the choice made by respondents.

Analyses of the open questions was done by the creating subcategories in which the responses were organised, as described by Cho (n.d.). This was done by first reading through the data to obtain an idea what sort of answers were given to these questions. The answers were then subdivided into categories. All answers that did not fit into one category were reevaluated to see if there was need to create a different category. For answers that could belong in multiple categories, a consideration was made based upon the most prevalent point made by the person. The responses to the first open question were then split by both frame and bid in a separate table. This was not done for the second and third open questions, as a high number of respondents did not answer those questions.

Analysis of the decision factors was done only for the respondents that received the €5.00 for mesopelagic fed salmon and regardless of frame. This choice was made because these respondents did not have different bids for their salmon which means that the difference in price could not influence their choice. Analyses was done through performing a chi square test for independence multiple times. The test was only done on decision factors were 80% of the expected results were 5 or higher, as this is a requirement for this test ("Chi-Square Test of Independence," 2022).

## 5 Results

In total 2970 flyers were delivered in mailboxes. These flyers lead to a total of 192 responses, meaning a response rate of 6.5%. It was observed that differences in response rate occur between different neighbourhoods.

### 5.1 Descriptive statistics

The demographic composition of the sample may be observed in Table 2. The age group that was the least represented was the group 20 years and younger with 6.8% of responses belonging to that group, whilst the group most represented was the group between 21 and 30 years old with 23.4% of responses. For the education category, HBO was the most common level of education with 41.7% of respondents belonging to that category, this was followed by MBO, University and High School which were all around the response level of 18%. There was an even distribution between men and women in the sample. Nearly all respondents had a Dutch nationality, that being 98.9% of respondents, this table can be seen in Appendix B.

**Table 2: Demographic characteristics of the sample.** *The number of respondents belonging to each category is given along with the percentage of responses belonging to that category. These are the demographics of the total sample, regardless of frame or bid.*

Age	Number	Percentages (%)
20 Year or younger	13	6.8
Between 21 and 30	45	23.4
Between 31 and 40	19	9.9
Between 41 and 50	17	8.9
Between 51 and 60	39	20.3
Between 61 and 70	36	18.8
71 years and older	21	10.9
No Answer	2	1.0
<b>Total</b>	<b>192</b>	<b>100.0</b>
<b>Education</b>		
Elementary School	2	1.0
Middelbare school	34	17.7
MBO	37	19.3
HBO	80	41.7
University	38	19.8
No Answer	1	0.5
<b>Total</b>	<b>192</b>	<b>100.0</b>
<b>Gender</b>		
Man	95	49.5
Woman	95	49.5
Other	2	1.0
<b>Total</b>	<b>192</b>	<b>100.0</b>

Respondents' prior knowledge about both aquaculture and the mesopelagic zone was asked. The results from these questions can be seen in table 3. The mean knowledge about the mesopelagic zone and aquaculture was 1.38 and 1.82 respectively.

**Table 3: Answers to the background questions for aquaculture and the mesopelagic zone.** Consumers were asked to rate their knowledge on a scale from 1 to 5, with 1 being nothing and 5 being equivalent to being an expert.

How much you think you know about:	Mean	Median	Standard Deviation
Aquaculture	1.82	2	0.80
Mesopelagic zone	1.38	1	0.63

In table 4 the salmon purchase frequency and the salmon consumption among respondents may be viewed. It should be noted that salmon is not often purchased, with a total of  $11.5+31.3+19.3= 62.1\%$  of respondents purchasing salmon once a month or less. In total 80.7% of respondents consume salmon.

**Table 4: Salmon purchase frequency and Salmon consumption.**

How often do you or your household purchase salmon?	Number	Percentages (%)
Never	22	11.5
Less than once a month	60	31.3
Once a month	37	19.3
More than once a month but not weekly	54	28.1
Once a week or more	16	8.3
No answer	3	1.6
<b>Total</b>	<b>192</b>	<b>100.0</b>
Do you yourself eat salmon?		
Yes	155	80.7
No, I don't like salmon	22	11.5
No, I am a vegetarian or vegan	8	4.2
No, I have a different reason.	4	2.1
No answer	3	1.6
<b>Total</b>	<b>192</b>	<b>100</b>

## 5.2 The effects of framing

The effect of framing was evaluated using several statements with answers on a 1-5 scale. For each statement a chi square test of independence was conducted. In table 5 the input for the test is visible for the first statement: "We should expand fish farming to meet rising demands for seafood". The results of the test for this statement were  $X^2(2, N=184) = 3.76, P = 0.15$ . At an  $\alpha = 0.05$  there is failure to reject the null hypothesis. There is no correlation between the framing and this statement.

**Table 5: The answers to the question: We should expand fish farming to meet rising demands for seafood.** The question that was asked: "Please answer how much you agree or disagree with the following statements. In which 1 is completely disagreeing and 5 is completely agreeing." During analyses the answers were simplified in 3 categories.

Frames	4 and 5	3	1 and 2
<b>Environmental</b>	27	25	31
<b>Fishing</b>	47	23	31

The same procedure was followed for the statement "The fish that live in the mesopelagic zone present a good opportunity for food production". The input table is visible in appendix B. The results were that  $X^2(2, N=183) = 4.61, P = 0.10$ . At  $\alpha = 0.05$  there is failure to reject the null hypothesis. There is no correlation between the framing and this statement.

The same procedure was followed for the statement "my consumption has an impact on the environment". The input table is visible in the appendix B. The results were that  $X^2(2, N=188) = 2.91, P = 0.23$ . At  $\alpha = 0.05$  there is failure to reject the null hypothesis. There is no correlation between the framing and this statement.

The same procedure was followed for the statement "The mesopelagic zone should be protected from fishing". The input table is visible in table 6. The results were that  $X^2(2, N=183) = 7.93, P = 0.02$ . At  $\alpha = 0.05$  the null hypothesis is rejected. In this case, there is a correlation between the framing and the answers to this statement.

**Table 6: The answers to the question: The mesopelagic zone should be protected from fishing.** The question that was asked: "Please answer how much you agree or disagree with the following statements. In which 1 is completely disagreeing and 5 is completely agreeing." During analyses the answers were simplified in 3 categories.

Frames	4 and 5	3	1 and 2
<b>Environmental</b>	57	18	8
<b>Fishing</b>	48	36	16

So, it was found that framing correlates with answers to the statement "The mesopelagic zone should be protected from fishing".

### 5.3 Contingent valuation question

The responses by the people that received the environmental frame are shown in table 7. In total 89 people received the environmental frame. Acceptance of mesopelagic fed salmon was highest for the group that received the € 4.00 bid, with that being 55.6%.

**Table 7: Answers from the respondents that received the environmental frame.** The table shows the number of people accepting the bid for mesopelagic fed salmon, those rejecting mesopelagic fed salmon, thus choosing regular fed salmon. The people that would choose the third option that they would never purchase farmed salmon are also displayed.

Bid Mesopelagic (€)	Number of responses	Accepted	Rejected	Third option	Acceptance Rate (%)
4.00	24	10	8	5	55.6
5.00	26	6	15	5	28.6
6.00	39	5	26	7	16.1

The responses by the people that received the fishing frame are shown in table 8. In total 103 people received this frame. The acceptance rate was highest for the group that received the € 4.00 bid, with that being 64.3%. For the € 5.00 bid 14 people choose the third option, highest for across all bids and both frames.

**Table 8: Answers from the respondents that received the fishing frame.** The table shows the number of people accepting the bid for mesopelagic fed salmon, those rejecting mesopelagic fed salmon, thus choosing regular fed salmon. and the people that would choose the third option that they would never purchase farmed salmon are also displayed.

Bid Mesopelagic (€)	Number of responses	Accepted	Rejected	Third option	Acceptance Rate (%)
4.00	30	18	10	2	64.3
5.00	45	14	17	14	45.2
6.00	28	4	20	4	16.7

The effect of framing on the acceptance of mesopelagic fed salmon was evaluated for the valuation question. A chi square test of independence was done for each bid. The input for the test for the tests is visible in table 9.



**Table 9: Input for the chi square test of independence examining the correlation between frame and choice for all three bids.** The bids are for mesopelagic fed salmon, accepting the bid means that mesopelagic fed salmon was chosen while rejecting the bid means that regular fed salmon was chosen.

<b>4.00</b>	<b>Environmental</b>	<b>Fishing</b>
<b>Bid accepted</b>	10	18
<b>Bid rejected</b>	8	10
<b>5.00</b>	<b>Environmental</b>	<b>Fishing</b>
<b>Bid accepted</b>	6	14
<b>Bid rejected</b>	15	17
<b>6.00</b>	<b>Environmental</b>	<b>Fishing</b>
<b>Bid accepted</b>	5	4
<b>Bid rejected</b>	26	20

At a bid of € 4.00 the results of the chi square test of independence were  $X^2(1, N=46) = 0.35, P = 0.55$ . At  $\alpha = 0.05$  there is failure to reject the null hypothesis. No correlation can be found between the framing and choice for the bid of € 4.00.

At a bid of € 5.00 the results of the chi square test of independence were  $X^2(1, N=52) = 1.46, P = 0.23$ . At  $\alpha = 0.05$  there is failure to reject the null hypothesis. No correlation can be found between the framing and choice for the bid of € 5.00.

At a bid of € 6.00 the results of the chi square test of independence were  $X^2(1, N=55) = 0.003, P = 0.96$ . At  $\alpha = 0.05$  there is failure to reject the null hypothesis. No correlation can be found between the framing and choice for the bid of € 6.00.

The possible relation between choice and bid size was then investigated. The input for the test is visible in table 10. These tests investigate the possibility of a relation between the size of the bid and choice. This test is conducted irrespective of frame.

**Table 10: Input for Chi square test of independence between the choice for mesopelagic fed salmon and bid size.** Rejecting mesopelagic fed salmon means that regular fed salmon was chosen.

<b>Bid for Mesopelagic fed salmon</b>	<b>Accepted</b>	<b>Rejected</b>
<b>Bid 4.00</b>	28	18
<b>Bid 5.00</b>	20	32
<b>Bid for Mesopelagic fed salmon</b>	<b>Accepted</b>	<b>Rejected</b>
<b>Bid 5.00</b>	20	32
<b>Bid 6.00</b>	9	46
<b>Bid for Mesopelagic fed salmon</b>	<b>Accepted</b>	<b>Rejected</b>
<b>Bid 4.00</b>	28	18
<b>Bid 6.00</b>	9	46

For the chi squared test between Bid 4.00 and 5.00 the results were  $X^2(1, N=98) = 4.90$   $P = 0.03$ . At  $\alpha = 0.05$  the null hypothesis is rejected. For bid 5.00 and 6.00 the results were  $X^2(1, N=107) = 6.60$   $P = 0.01$ . At  $\alpha = 0.05$  the null hypothesis is rejected. For bid 4.00 and 6.00 the results were  $X^2(1, N=101) = 21.4$   $P = 4E-06$ . At  $\alpha = 0.05$  the null hypothesis is rejected. In every scenario correlation between bid size and choice is found.

#### 5.4 Results from the open questions

The answers given to the first open question utilized in this survey may be seen in table 11. Most respondents' answers were related to protecting the mesopelagic zone from fishery, with 59 answers belonging to this category. That is 30.7% of total responses. The second category that has the most answers is the category relating to financial reasons with 45 responses. That is 23.4% of total responses. It should be noted that financial reasons are only given for bids where there is a difference in price. This is logical as for these reasons there is a possibility of choosing based on price. To see the breakdown per bid and frame for the first open question, table 12 should be consulted.

**Table 11: The answers to the first open question: "Please elaborate why you chose this option for the previous question".** The answers given to the question were categorized using a tag. *Environ No Meso* = the answer was related to the environment and was negative regarding the usage of the mesopelagic zone. *Money* = answer relates to price or financial aspects. *No reason* = if no answer was given. *Preference* = answer relates to someone's eating preference. *Environ ProMeso* = answer was related to the environment and was positive towards potential use of the mesopelagic zone. *Lack of information* = answers which noted some lack of information. *AntiAqua* = answer was negative towards aquaculture specifically.

Category	Number	Percentage (%)
Environ No Meso	59	30.7
Money	45	23.4
No reason	29	15.1
Preference	28	14.6
Environ ProMeso	17	8.9
Lack of information	9	4.7
AntiAqua	5	2.6
<b>Total</b>	<b>192</b>	<b>100</b>

Examples of responses per category can be seen in appendix B. The first category "Environ No Meso" represents answers that are negative about using the mesopelagic zone and contain some sort of a reference towards the environment. Answers in this category often contain phrases that express concerns regarding possible environmental damages from exploiting the mesopelagic zone or concerns that fishing in this zone would cause a more damage compared to fishing in areas that have already experienced fishing. Furthermore, the untouched nature of the mesopelagic zone is often mentioned in these answers. In the category "Money" all answers directly related financial information are included. In this category most answers include a mention of the price or a mention of the cheaper option.

In the category "preference" all answers directly related to eating preference are included. The respondents in this category often would not eat salmon due to eating preference or due to being vegetarian or vegan. In the category "Environ ProMeso" all answers that relate to the environment and are open to using the mesopelagic zone to produce salmon feed are included. These answers often noted that an advantage was that pressure could be taken from other ecosystems by using the mesopelagic zone or its advantages for the population of blue whiting or anchovies. In the category "Lack of information" most answers that are included noted that a lack of information was the primary reason for choosing an option. In the category "AntiAqua" the people that reported not eating farmed fish specifically because it is farmed fish are included.

In table 12 a breakdown of the answers given to the first open question can be seen subdivided into bid and frame. In this table it can be clearly seen that financial reasons, those in the 'money' category, are only reported in cases where there is a difference in the bid for mesopelagic fed salmon and regular fed salmon. In total  $8+10+13+14 = 45$  responses were given in the 'money' category. If that is divided by the total responses in those categories, which is  $24+39+30+28 = 121$ , then 37.2% is reached. This means that when it is logical for a respondent to give "money" as a reason, it is done in 37.2% of cases. It should be noted that the "Environ No Meso" category for the fishing frame at bid € 6.00 only has three responses which is much lower than for the other bids.

**Table 12: The answers to the first open question: "Please elaborate why you chose this option for the previous question" per bid and per frame.** The answers given to the question were categorized using a tag. Environ No Meso= the answer was related to the environment and was negative regarding the usage of the mesopelagic zone. Money = answer relates to price or financial aspects. No reason= if no answer was given. Preference = answer relates to someone's eating preference. Environ ProMeso = answer was related to the environment and was positive towards potential use of the mesopelagic zone. Lack of information = answers which noted some lack of information. AntiAqua = answer was negative towards aquaculture specifically.

<b>Environmental</b>	<b>Bid</b>			<b>Fishing</b>	<b>Bid</b>		
<b>Category</b>	€ 4.00	€ 5.00	€ 6.00	<b>Category</b>	€ 4.00	€ 5.00	€ 6.00
<b>Lack of information</b>	0	1	0	<b>Lack of information</b>	2	3	3
<b>Preference</b>	7	5	6	<b>Preference</b>	2	6	2
<b>Environ No Meso</b>	6	13	14	<b>Environ No Meso</b>	8	15	3
<b>Environ ProMeso</b>	0	3	3	<b>Environ ProMeso</b>	1	7	3
<b>Money</b>	8	0	10	<b>Money</b>	13	0	14
<b>AntiAqua</b>	0	0	1	<b>AntiAqua</b>	1	2	1
<b>No reason</b>	3	4	5	<b>No reason</b>	3	12	2
<b>Total</b>	24	26	39	<b>Total</b>	30	45	28

The answers to the second option question can be seen in table 13. Most respondents did not answer this question, with 63.5% not answering to this question. The most often reported additional information people would require was concerning the environmental effects, with 25.5% of answers belonging to this category. The “Environ effects” category includes all answers that mention an environmental effect. Often mentioned in answers was the need for knowledge about the long-term environmental effects and concerns that the problem of overfishing would simply be moved to a new area. The “Misc” category was for answers that were classified as miscellaneous. This broad category concerns many different answers that would only occur once. In total 6.3% of answers belonged to the “Misc” category. In appendix B examples of each category may be viewed.

**Table 13: The answers to the second open question: “If you are uncertain about the decision you made, what sort of additional information would you need to make a better decision?”** The answers given to the question were categorized using a tag. No reason= if no answer was given. Environ effects = if the answer indicated that more information regarding the environmental effects was necessary. Misc = A miscellaneous category for all reasons that did not belong in other categories. Aquaculture = answers that noted that more information about aquaculture should be necessary. Taste = answers relating to the taste of salmon.

<b>Category</b>	<b>Number</b>	<b>Percentage (%)</b>
No reason	122	63.5
Environ Effects	49	25.5
Misc	12	6.3
Aquaculture	7	3.6
Taste	2	1.0
<b>Total</b>	<b>192</b>	<b>100.0</b>

The answers to the third open question are reported in table 14. Most respondents did not answer this question, with 45.8% of respondents not answering to this question. After that the most reported category was “Don’t Touch” with 22.4% of answers belonging to this category. This category includes all answers that are against usage of the mesopelagic zone. Responses in this category do not leave room for potentially using the mesopelagic zone. The second most reported category was the “Unknown” category, with 20.3% of responses. This category is for all answers in which it was mentioned a lack of knowledge about the mesopelagic zone or a lack of knowledge if the mesopelagic zone can be used. In appendix B examples of each category may be viewed.

**Table 14: The answers to the third open question: "Do you have additional thoughts on the mesopelagic zone?"** The answers given to the question were categorized using a tag. No reason = if no answer was given. Don't Touch = if the response indicates that the mesopelagic zone should not be used. Unknown = answers that noted the lack of information about this zone. Potential Use = answers that indicate a potential for using the mesopelagic zone.

Category	Number	Percentage (%)
No reason	88	45.8
Dont Touch	43	22.4
Unknown	39	20.3
Potential Use	22	11.5
<b>Total</b>	<b>192</b>	<b>100.0</b>

### 5.5 Decision factor and choice

The questions were only answered by the respondents that answered yes to the question: "Do you yourself eat salmon?", which can be seen in table 4. In total 155 or 80.7% of respondents answered yes to this question.

Answers given to the Likert scale questions regarding the importance of several attributes when purchasing salmon are given in table 15 for the fishing frame and in table 16 for the environmental frame. Differences between the two frames for these questions were minor. For both frames freshness and product quality had the highest mean scores. The lowest mean scores were attributed to the country of origin and whether the salmon was organic or not, this is the case for both frames.

**Table 15: Answers for the fishing frame to the question "Please answer how important the following attributes are when you purchase salmon. 1 is not important, and a 5 is very important".** Only respondents that eat salmon answered these questions.

Attribute	Mean	Median	Standard deviation
Price	3.4	3	1.03
Sustainability	3.5	4	0.89
Freshness	4.2	4	0.78
Country of origin	2.8	3	1.25
Product quality	4.2	4	0.73
Organic or not	2.7	3	1.30
Presence of an ecolabel	3.7	4	1.20
Animal welfare	3.5	4	1.13
Fished or farmed	3	3	1.21

**Table 16: Answers for the environmental frame to the question "Please answer how important the following attributes are when you purchase salmon. 1 is not important, and a 5 is very important". Only respondents that eat salmon answered these questions.**

Attribute	Mean	Median	Standard deviation
Price	3.5	4	0.92
Sustainability	3.7	4	0.84
Freshness	4.4	4.5	0.73
Country of origin	2.8	3	1.11
Product quality	4.4	4.5	0.60
Organic or not	2.8	3	1.10
Presence of an ecolabel	3.6	4	1.23
Animal welfare	3.6	4	1.15
Fished or farmed	3	3	1.18

Analysis was then performed by using a chi square test of independence. This was done for each decision factor to see if there is a correlation between a decision factor and choice for regular or mesopelagic fed salmon. These tests were done on the respondents in this research that received the €5.00 bid for mesopelagic fed salmon and regardless of frame. As it was shown that frame did not impact a respondent's choice.

In table 17 the input for the chi square test of independence for the price attribute is shown. The results were  $\chi^2(1, N=44) = 3.5$   $P = 0.06$ . At  $\alpha = 0.05$  there is failure to reject the null hypothesis. There is no correlation between the choice and this decision factor.

**Table 17: Answer to the question "Please answer how important the following attributes are when you purchase salmon. 1 is not important, and a 5 is very important.", for the price attribute. During analyses the answers were simplified in which the 4 and 5 answers were combined and 1,2 and 3 were combined into a category.**

Price	4,5	1,2,3
Regular	10	15
Meso	13	6

The same procedure was followed for all other decision factors. In appendix C the input table may be observed. In table 18 each result from the chi square test of independence can be seen. At an  $\alpha = 0.05$  there is failure to reject the null hypothesis for every decision factor. For the decision factors "Freshness", "Country of origin", "Product quality" and "Organic or not" no chi square test of independence was performed. As for these decision factors 80% of expected values did not reach the threshold value of 5, which is required ("Chi-Square Test of Independence," 2022).

**Table 18: Results from several chi square tests of independence examining correlation between the choice for mesopelagic fed salmon and a decision factor.** Certain tests could not be performed due to too few responses in those categories. These are marked in the table with "cannot be done".

<b>Decision Factor</b>	<b>Results</b>
<b>Price</b>	X2 (1, N=44) = 3.5 P = 0.06.
<b>Sustainability</b>	X2 (1, N=44) = 3.5 P = 0.06.
<b>Freshness</b>	Cannot be done
<b>Country of origin</b>	Cannot be done
<b>Product quality</b>	Cannot be done
<b>Organic or not</b>	Cannot be done
<b>presence of an Ecolabel</b>	X2 (1, N=43) = 1.1 P = 0.29.
<b>Animal welfare</b>	X2 (1, N=44) = 0.39 P = 0.53.
<b>Fished or farmed</b>	X2 (1, N=44) = 0.17 P = 0.68.

## 6 Discussion

### 6.1 Answering the research questions

**Research Question 1:** How much does the framing of the information supplied affect the consumers' willingness to pay for mesopelagic fed salmon?

It was found that the framing only affected the answers to the statement "The mesopelagic zone should be protected from fishing". No correlation between framing and the choice for mesopelagic salmon was found. A complete willingness to pay cannot be obtained in this work. However, a correlation that was found between bid size and choice does suggest that the respondent is sensitive towards the price.

**Research Question 2:** How does the framing of the experiment impact how consumers view mesopelagic fed salmon?

The exact effect of the framing could not be determined. Environmental reasons were often reported as an important indicator, with 30.7% of reasons being environmental and against usage of the mesopelagic zone. There was a group that had environmental reasons and was open to potentially using the mesopelagic zone, with that being 8.9% of respondents. Financial reasons were reported in 37.2% of cases were that was potentially applicable. Most respondents did not desire additional information, that group being 63.5% of all respondents to the second question. The group that did respond was mostly concerned about environmental effects, that being 25.5% of responses. Most people did not answer the third open question, that group being 45.8%. The largest group that answered the question was against using the mesopelagic zone, with that being 22.4% of responses. The third largest group noted that they had a lack of information about the mesopelagic zone with that being 20.3% of respondents.

**Research Question 3:** What are the characteristics of a consumer who is willing to purchase mesopelagic fed salmon?

No significant characteristics were found for consumers that wanted to purchase mesopelagic fed salmon.

The question remains if the mesopelagic zone is a suitable option to produce salmon feed. This research did not show a clear preference between mesopelagic fed and regular fed salmon. It was found that financial reasons are often important indicators for the choice of which salmon is bought. When looking at the results to the open questions, it might be the case that the people who were unresponsive to the second and third question were rather indifferent towards which salmon is chosen and mostly guided by price. This was also an often-reported reason for decision making at the first open question. This would mean that for this group it is important that mesopelagic fed salmon is competitive in terms of price with regular fed salmon. Environmental reasons and



environmental effects were often mentioned in answering the open questions. This shows that the environmental effects of consumption are an important topic to consider. Having insight in the environmental effects of a mesopelagic fishery and subsequently communicating these effects is likely going to be important for these types of consumers to be open towards mesopelagic fed salmon.

The group reporting environmental reasons indicates the people do care about this environment. This conclusion is also found by Kaikkonen and van Putten (2021). In their research the authors found that symbolic values shape how people care about the deep sea, and they found that consumers do care about human activities affecting the deep-sea area (Kaikkonen & van Putten, 2021).

## 6.2 Limitations and recommendations

This research has several limitations which should be considered when regarding the results. One fundamental limitation is the framing that is used and the lack of knowledge of the respondents. This research did not find that respondents had a high level of knowledge about aquaculture and the mesopelagic zone. Through the provided frames some respondents might be given their initial ideas about the mesopelagic zone and its potential use. The information included in the frames refers to the environment of the mesopelagic zone. This has likely influenced respondents, causing them to report environmental reasons for choosing their salmon. It is unclear if these respondents would still use environmental reasons if the framing of the experiment contained different information about the mesopelagic zone.

Another limitation is concerning the total number of responses. A higher number of responses would allow for additional statistical analyses and improve the robustness of the existing results. The effect of framing could be further researched on how it impacted the other questions in this survey. If a high number of responses is anticipated the experimental design could be modified to include more bids, this way a full dichotomous choice experiment can be conducted and a willingness to pay can be determined.

There were also some limitations regarding the survey design and distribution. In designing the survey several considerations and trade-offs had to be made. The survey was distributed around several neighbourhoods partly based upon the convenience of houses that were closer to each other. This means that sparsely populated areas were not included in the distribution area of the survey. This might have led to biases in the responses. For the example, 41.7% of respondents had an HBO education. Limitations in survey design were the results of trade-offs that were made between aspects like respondents' retention, length and complexity of the survey.

Future research towards the mesopelagic zone should focus on several things. Firstly, getting more insight in the environmental effects that would be caused by a mesopelagic fishery. This type of research can be used for future consumer studies as they would be able to provide a clearer picture to the consumer what the effects are of mesopelagic fed salmon. Secondly, information regarding the economic viability of a mesopelagic fishery can help indicate what the price of mesopelagic fed salmon might be. Regarding the consumer attitudes towards the mesopelagic zone, qualitative research to better understand the reasons consumers have for accepting or rejecting mesopelagic fed salmon can help identifying consumer concerns.

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## APPENDIX A

### Final version survey in English

#### Introduction

Hello, my name is Frank, and I am a student at Wageningen University. This survey is part of my master thesis that examines consumer attitudes towards fishing in the mesopelagic zone, which is one of the deeper layers of the ocean. There are no right or wrong answers, your opinion is what matters. This survey is anonymous and I will treat the results confidentially. You can also fill in this survey if you do not eat fish.

#### Socioeconomic information

1 What is your Age:

\* Less than 20 years old \* between 21 and 30 \* between 31 and 40 \* between 41 and 50  
\* Between 51 and 60 \* Between 61 and 70 \* 71 and above

2 What is your Month of birth?

\*January or February \*March or April \*May or June \*July or August \*September or October \*November or December

3 What is your Highest Education finished:

\*Primary school or lower \*High school \*MBO \*HBO \*University

4 What is your Nationality:

\*Dutch \*Other (please specify)

5 What is your Gender:

\*male \*female \*other \*prefer not to say

#### Background information and frame

(Both Versions)

The salmon that you buy in the supermarket can either come from fishing (wild salmon), or from fish farming using ponds or cages in the water (farmed salmon). Most likely it is the latter. Farmed salmon require feed that is partially made from other fish species such as anchovy or blue whiting. In other words, its production requires catching other wild species.

(Environmental Frame)

Fishing companies are now considering to produce fish feed from fish caught in the mesopelagic zone. The mesopelagic zone lies between 200m and 1000m deep. This part of the ocean has not yet been fished, and therefore is a relatively **pristine ecosystem**. It contains a lot of **interesting wildlife**. Fishing in this part of the ocean to produce fish feed will help to reduce pressure on other ecosystems, but it is not clear what the effects of fishing will be on the mesopelagic zone itself. The fish that live in this zone **are part of some spectacular ecosystems**. This part of the ocean can be used **to conserve biodiversity**.

(Fishing Frame)

Fishing companies are now considering to produce fish feed from fish caught in the mesopelagic zone. The mesopelagic zone lies between 200m and 1000m deep. This part of the ocean has not yet been fished, and therefore is a relatively **unused resource**. It contains a lot of **fish biomass**. Fishing in this part of the ocean to produce fish feed will help to reduce pressure on other ecosystems, but it is not clear what the effects of fishing will be on the mesopelagic zone itself. The fish that live in this zone **offer great opportunities for marine development**. This part of the ocean can be used **as an alternative source of food for human systems**.

### Question

Suppose that you are having guests over who really like salmon. Now you are standing in the supermarket and you can choose between farmed salmon fed with regular fish feed, or farmed salmon fed with fish feed from the mesopelagic zone. Which one would you choose? Remember there are no good or bad answers.

4. *A 250 gram filet of farmed salmon fed with fish feed made from a wild fish species such as anchovy or blue whiting at price 5,00 €*
5. *A 250 gram filet of farmed salmon fed with fish feed made from mesopelagic fish at price 5,00 € + Y*
6. *Under no circumstance would I purchase farmed salmon.*

(Y varies between these values: -1, 0,+1)

### Open questions

Please elaborate why you chose this option for the previous question.

.....

If you are uncertain about the decision you made, what sort of additional information would you need to make a better decision?

.....

Do you have additional thoughts on the mesopelagic zone?

.....

### Statements

*Please answer how much you agree or disagree with the following statements. In which 1 is completely disagreeing and 5 is completely agreeing. We should expand fish farming to meet rising demands for seafood*

The fish that live in the mesopelagic zone present a good opportunity for food production

The mesopelagic zone should be protected from fishing

my consumption has an impact on the environment



## Background questions

1 Please rate how much you think you know about fish farming between 1 and 5. 1 is having no knowledge and 5 is being an expert.

2 Please rate how much you think you know about the mesopelagic zone between 1 and 5. 1 is having no knowledge and 5 is being an expert.

3 How often do you or your household purchase salmon?

\*Once a week or more      \*More than once a month but not weekly  
\*Once a month              \*Less than once a month      \*Never

4 Do you yourself eat salmon?

\*Yes   \*No, I don't like salmon   \*No, I am a vegetarian   \*No, I am a vegan   No, I have a different reason.

## Questions ( Only if respondent eats salmon).

*Please answer how important the following attributes are when you purchase salmon. 1 is not important, and a 5 is very important. ( on a likert scale).*

Price

Sustainability

Freshness

Country of origin

Product quality

Organic or not

Presence of an ecolabel (for example MSC or ASC)

Animal Welfare

Fished or Farmed

*Open question*

I have other important attributes that I use to make a decision in the store, these are not listed above, namely

.....

## APPENDIX B

**Table 19: Nationality of respondents**

Nationality	Number	Percentages (%)
Dutch	188	97.9
Different	4	2.1
<b>Total</b>	<b>192</b>	<b>100.0</b>

**Table 20: The answers to the question: The fish that live in the mesopelagic zone present a good opportunity for food production.** The question that was asked: "Please answer how much you agree or disagree with the following statements. In which 1 is completely disagreeing and 5 is completely agreeing." During analyses the answers were simplified in 3 categories.

Frames	4 and 5	3	1 and 2
<b>Environmental</b>	18	24	41
<b>Fishing</b>	31	35	34

$\chi^2 (2, N=183) = 4.61, P = 0.10.$

**Table 21: The answers to the question: my consumption has an impact on the environment** The question that was asked: "Please answer how much you agree or disagree with the following statements. During analyses the answers were simplified in 3 categories.

Frames	4 and 5	3	1 and 2
<b>Environmental</b>	61	16	9
<b>Fishing</b>	62	21	19

$\chi^2 (2, N=188) = 2.91, P = 0.23.$

**Table 22: The answers to the first open question: "Please elaborate why you chose this option for the previous question".** The answers given to the question were categorized using a tag. *Environ No Meso* = the answer was related to the environment and was negative regarding the usage of the mesopelagic zone. *Money* = answer relates to price or financial aspects. *No reason* = if no answer was given. *Preference* = answer relates to someone's eating preference. *Environ ProMeso* = answer was related to the environment and was positive towards potential use of the mesopelagic zone. *Lack of information* = answers which noted some lack of information. *AntiAqua* = answer was negative towards aquaculture specifically.

Open 1	Number	Example (Translated to English)	Example (Original)
<b>Environ No Meso</b>	59	Spare the mesopelagic zone. leave intact	Zuinig zijn op mesopelagische zone. ongeschonden laten
		I am concerned that fishing at that depth will cause even more damage to nature.	Ik ben bang dat het vissen op die diepte nog meer natuurschade gaat opleveren.
		In my opinion, there is already serious overfishing and I am concerned about what this will do in the unfished areas.	Naar mijn idee is er al sprake van ernstige overbevissing en ik maak mij zorgen over wat dit in de niet beviste gebieden nog verder zal aanrichten.
<b>Money</b>	45	I only buy based on price. I don't delve into where it comes from	Ik koop alleen op basis van prijs. Ik verdiep me niet in waar het vandaan
		Know too little about it and therefore choose the cheapest option	Weet er te weinig van en kies daarom voor de goedkoopste optie
		Cheaper. Groceries are already very expensive.	Goedkoper. Boodschappen zijn al heel duur.
<b>No reason</b>	29	-	-
<b>Preference</b>	28	I don't eat fish, so I wouldn't buy this for my guests.	Ik eet geen vis, en zou dit dus ook niet voor mijn gasten kopen.
		Farmed salmon is less tasty.	Gekweekte zalm is minder lekker.
		I don't eat fish	Ik eet geen vis
<b>Environ ProMeso</b>	17	Takes the pressure off the other ecosystems. The only thing is why I do have doubts; this can't be a definitive solution, eventually people will still make feed from whiting and anchovies	Haalt de druk weg van de andere ecosystemen. Het enige is waarom ik wel twijfel; ook dit kan geen definitieve oplossing zijn, uiteindelijk zal men alsnog voer maken van wijting en ansjovis
		I think it is important that wild fish remain such as anchovies, etc.	Ik vind het belangrijk dat er wilde vis blijft zoals ansjovis, enz.
		There seems to be a surplus in the mesopelagic zone. However, the effects should be closely monitored.	In de mesopelagische zone lijkt een overschot te zijn. Wel moeten de effecten goed gevolgd worden.
<b>Lack of information</b>	9	This is familiar, know nothing of effects of catching mesopelagic fish for fish food	Dit is vertrouwd, weet niets van effecten van vangst mesopelagische vis voor visvoer
		I wouldn't know what the benefits are specifically (taste improvement?).	Ik zou niet weten wat concreet de voordelen zijn (smaakverbetering?)
		Actually know too little about effect of fish in this zone to answer properly.	Weet eigenlijk te weinig van effect van vissen in deze zone om goed antwoord te geven.
<b>AntiAqua</b>	5	As long as there are fish for sale that swim in open water I'm not going to buy farmed fish	Zolang er vis te koop is die in open water zwemt ga ik geen gekweekte vis kopen
		After seeing a documentary about farmed fish, I only eat fish that has been fished.	Na het zien van een documentaire over kweekvis eet ik uitsluitend vis die gevestigd is.
		Because we buy the salmon from the	Omdat we de zalm bij de visboer kopen,

	fishmonger, it is not farmed	deze is niet gekweekt
<b>Total</b>	<b>192</b>	

**Table 23: The answers to the second open question: "If you are uncertain about the decision you made, what sort of additional information would you need to make a better decision?"** The answers given to the question were categorized using a tag. No reason= if no answer was given. Environ effects = if the answer indicated that more information regarding the environmental effects was necessary. Misc = A miscellaneous category for all reasons that did not belong in other categories. Aquaculture = answers that noted that more information about aquaculture should be necessary. Taste = answers relating to the taste of salmon.

Open 2	Number	Example (Translated to English)	Example (Original)
<b>No reason</b>	122	-	-
<b>Environ Effects</b>	49	What are the longer term effects of fishing in deeper sea layers Perhaps an assurance that this will actually be a long-term solution.	Wat zijn de effecten op langere termijn van vissen in diepere zeelagen Misschien een zekerheid dat dit daadwerkelijk een oplossing zal zijn op langer termijn.
<b>Misc</b>	12	I don't eat fish myself and never prepare it for others, so don't really feel the need to educate myself on this as a consumer either. Informatie over de eventuele nadelen van de beide opties.	Ik eet zelf geen vis en maak het ook nooit klaar voor anderen, dus heb ook niet echt de behoefte om me hier als consument over te laten voorlichten. Information on the possible disadvantages of the two options.
<b>Aquaculture</b>	7	Other than not buying it I would wonder if the feed for the salmon could not also be farmed I really don't know how salmon is farmed	Buiten dat ik het niet koop zou ik mij afvragen of het voer voor de zalm ook niet gekweekt kan worden Ik weet werkelijk niet hoe zalm wordt gekweekt
<b>Taste</b>	2	Is the taste better if so I would reconsider As described above, I would like to taste them both.	Is de smaak beter zoja dan zou ik heroverwegen Zoals hiervoor beschreven, zou ik ze beide willen proeven.
<b>Total</b>	<b>192</b>		

**Table 3: The answers to the third open question: "Do you have additional thoughts on the mesopelagic zone?"** The answers given to the question were categorized using a tag. No reason = if no answer was given. Don't Touch = if the response indicates that the mesopelagic zone should not be used. Unknown = answers that noted the lack of information about this zone. Potential Use = answers that indicate a potential for using the mesopelagic zone.

Open 3	Number		Example (Original)
<b>No reason</b>	88	-	-
<b>Dont Touch</b>	43	<i>"This zone should remain protected from fishing. There are already enough areas where fishing can be done."</i>	<i>Deze zone moet beschermd blijven tegen visserij. Er zijn al genoeg gebieden waar gevist kan worden .</i>
		<i>"I had never heard of it before, but mostly leave it alone I think now."</i>	<i>Ik had er nog nooit van gehoord, maar laat het vooral met rust denk ik nu.</i>
<b>Unknown</b>	39	<i>I have never heard of this zone.</i>	<i>Ik heb nog nooit van deze zone gehoord.</i>
		<i>I had never heard of this before, but maintain nature in the oceans.</i>	<i>Ik had hier nog nooit van gehoord, maar houdt de natuur in stand in de oceanen.</i>
<b>Potential Use</b>	22	<i>This tells me too little. If here without too much damage to the fish stock in that zone, then this is a good option .</i>	<i>Dit zegt mij te weinig. Als hier zonder al te veel schade voor de visstand in die zone, dan is dit een goede optie .</i>
		<i>It seems like a serious option to me because the size of oceans/deep seas is large</i>	<i>Het lijkt me een serieuze optie omdat de omvang van oceanen/diepzeeen groot is</i>
<b>Total</b>	<b>192</b>		

## APPENDIX C

**Table 25: Results and input for several chi square tests of independence examining correlation between the choice for mesopelagic fed salmon and a decision factor.** Certain tests could not be performed due to too few responses in those categories. These are marked in the table with "cannot be done".

<b>Price</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	10	15	X2 (1, N=44) = 3.5 P = 0.06.
Meso	13	6	
<b>Sustainability</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	10	15	X2 (1, N=44) = 3.5 P = 0.06.
Meso	13	6	
<b>Freshness</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	21	4	Cannot be done
Meso	16	3	
<b>Country of origin</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	4	21	Cannot be done
Meso	4	15	
<b>Product quality</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	23	2	Cannot be done
Meso	16	3	
<b>Organic or not</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	6	19	Cannot be done
Meso	5	14	
<b>Ecolaber presence</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	19	6	X2 (1, N=43) = 1.1 P = 0.29.
Meso	11	7	
<b>Animal welfare</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	18	7	X2 (1, N=44) = 0.39 P = 0.53.
Meso	12	7	
<b>Fished or farmed</b>	<b>4,5</b>	<b>1,2,3</b>	<b>Results</b>
Regular	8	17	X2 (1, N=44) = 0.17 P = 0.68.
Meso	5	14	