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Attitudes toward aquaculture in Ireland and Norway

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Abstract

Around the world, there is a growing emphasis on developing the aquaculture industry in an environmentally, economically and socially sustainable manner and this is the case also in Norway and Ireland. The impact of aquaculture on the environment is currently evaluated by the use of a set of indicators focusing mainly on physical and chemical parameters, while to date social acceptance has not been integrated fully into aquaculture sustainability evaluation. With this in mind, this paper examines the public attitudes of the Irish and Norwegian general public to marine aquaculture. Both countries have long coastlines, a significant aquaculture industry and a strong emphasis on public participation in decision-making. The results indicate that both the Norwegian and Irish public recognise the potential of aquaculture to create opportunities for employment in coastal areas but opinion is much more divided on some of the more controversial impacts of aquaculture on the marine environment. The results would also suggest that the Norwegian general public may be better informed on issues related to aquaculture development.

Acknowledgement

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Introduction

It is generally accepted that wild capture fisheries will not be able to produce high enough yields in the future for an ever expanding population. Aquaculture on the other hand has been the fastest growing food production sector over the past 20 years. The expansion of the sector however has raised a number of concerns for the public. Chief among these concerns has been the issues of sea lice on farmed fish, the use of antibiotics, the sourcing of fish feed, waste accumulation on the seafloor and the potential impacts of escaped farm fish on wild stocks (van Osch et al., 2017). While these same concerns are felt across many societies, the industry has not expanded at the same rate in what should be similar environmental conditions. Take for example the case of Ireland, Scotland and Norway where salmon production currently stands at approximately 16,000, 162,000 and 1,310,000 tonnes respectively. What explains these widely diverse production levels? In this paper we explore the attitudes of the public towards aquaculture and salmon farming in Norway and Ireland in light of difference in fish farming activity in the two countries.

According to figures from the 'BIM Annual aquaculture Survey (BIM, 2017), Ireland produced 44,000 tonnes of farmed seafood in total in 2016 of which the majority were engaged in shellfish aquaculture. Farmed salmon comes second to shellfish output in volume and value. Salmon farming in Ireland declined from a peak in production of 23,000 tonnes in 2001 to a low of 13,000 tonnes in 2005 (Grealis et al., 2017). The most recent data from the BIM survey indicates a gradual increase in production to 16,300 tonnes in 2016 (BIM, 2017). A National Strategic Plan for Sustainable Aquaculture Development (NSPSAD) sets out a target of achieving production levels, for all aquaculture sub-sectors, at or near previous historic maxima simultaneously. This equates to a relatively modest target of just 25,000 tonnes for farmed salmon annually.

In contrast, aquaculture and related industries contribute substantially to the economy of Norway with farmed salmon being one of the main export commodities from the country (FAO, 2017). Just over 90% per cent of Norwegian aquaculture production in 2015 was reared salmon. In total, 1.31 million tonnes of salmon were produced in Norway in 2015. According to a recent Earnest and Young (EY) report the output and export value of salmon farming has doubled since 2006 (EY, 2016). The key driver of this growth has been the increase in the price of salmon, following the decline in salmon harvest volumes in Norway and Chile in 2015. However, while the industry experienced record high revenue levels, profitability in the industry was down due to the rise in operating costs, which according to the EY report was mainly driven by the increasing challenges with sea lice and diseases. The Norwegian Government presented a White Paper to the Norwegian Parliament on growth in the Norwegian salmon farming industry in 2015. The White paper proposes a new monitoring system that would use the industry's environmental impact as the main factor to determine future growth in the salmon farming industry. In particular, sea lice impact on wild populations would be used as a key indicator when determining whether a production area is suited for growth or not.

This new approach being adopted by the Norwegian government demonstrates the increasingly important link between perceived environmental impact and consumers' and societies willingness to accept and/or consume a product (Johnston et al., 2008,

Yip, 2012; Martínez-Espiñeira et al., 2016). Previous research has also shown public attitudes toward aquaculture is largely determined by what the public believe or understand in terms environmental impact – understanding that is often driven by the media and vested interest groups rather than scientific facts (Schlag, 2010, Whitmarsh and Palmieri, 2011, Katranidis et al., 2013, Backer et al., 2014 and Alexander et al., 2016). Two recent studies examining the public attitudes towards the marine environment across a number of European countries found that aquaculture was generally seen to be less harmful than other threats such as industrial pollution, litter and climate change (Potts et al., 2011, Hynes et al. 2015).

A number of studies in the Irish and Norwegian case have also previously examined societal attitudes to aquaculture. In 2015 the Irish Farmers Association commissioned an opinion poll on aquaculture (IFA, 2015). The objective of this opinion poll was to gather data on concerns, perceptions and information sources for the Irish public on the industry and to compare it to a similar opinion poll conducted by the IFA in 2008. The study found, amongst other things that increasing acceptance of possible fish farms in a person's area was driven by a significant lift in thinking about job creation amongst the public and that the reasons given for being against possible fish farms in their local area suggested the need for a communication programme to help people understand the issues better. In the Norwegian case, Alexander et al. (2016) conducted a small scale internet based study (500 observations) of the Norwegian general public's perceptions of aquaculture in general and integrated multi-tropic aquaculture in particular as part of a broader cross country analysis. Elsewhere, Chu et al. (2010) examined how different stakeholder perceptions in the USA and Norway contribute to the likelihood that an agent is willing to support aquaculture expansion in those countries. In a more recent study, the content, positions, and producers of debate contributions in nine Norwegian newspapers in order to shed light on the public debate on aquaculture and its environmental credentials (Olsen and Osmundsen 2017; Osmundsen and Olsen 2017).

Interestingly, Rudd et al. (2011) found that the controversy relating to the environmental impacts of salmon farming may be more of a concern amongst academics and non-government organisations than amongst consumers. Having said this, a positive consumers' willingness to pay has been identified in several studies for salmon produced in a more environmentally friendly manner (Whitmarsh and Wattage, 2006, Barrington et al., 2010, Yip et al. 2017, van Osch et al. 2017). Also, in earlier research, Whitmarsh and Palmieri (2011) found that public attitudes towards the future of the salmon farming industry in Scotland were a function of the weights people attached to the beneficial effects of industry expansion (e.g. job creation) as against the perceived negative effects associated with environmental degradation. Their survey of the general public also found significant regional variations in attitudes towards salmon farming in Scotland.

This paper adds to the above literature by providing an in-depth analysis of the knowledge and variation in the attitudes to aquaculture in Norway and Ireland as found in a comprehensive survey of the general public in both countries. The current plans to expand aquaculture and invest in the sector in both countries, coupled with EU policy goals to expand the food we produce from EU waters while at the same time protect marine ecosystems, means that uncovering evidence related to the attitudes of the general public for aquaculture production should lead to a deeper

understanding of the priorities present across different groups in Irish and Norwegian societies. It should also highlight potential conflicts of interests. In what follows the methods section describes the data collection approach and provides a general outline of the survey instrument. The results section then presents the descriptive statistics for the sample and an analysis of the observed attitudes to aquaculture in both countries. The final section concludes by discussing the implications of the results for the aquaculture industry in both countries.

Methods

Study Design

Data for the analysis was collected via a nationwide survey conducted in both Ireland and Norway over a 3 month period from April to June in 2016. Only respondents aged 18 years or older were interviewed in both countries. The interviews resulted in 859 complete Irish surveys and 1001 Norwegian surveys. The sampling method employed in each country was different. In the Irish case a quota controlled sampling procedure was followed to ensure that the survey was nationally representative for the population aged 18 years and above. The quotas used were based on known population distribution figures for age, sex and region of residence taken from the Irish National Census of Population, 2011. Survey collection was through face to face interviews at the respondents' homes.

In Norway, telephone interviews were carried out rather than door to door surveying due to cost and time constraints. In this case, representative sampling weights based on Census of Population statistics for Norway were used in the analysis to insure that the interviewed sample is representative of the national population. Due to the different interview collection method a small number of questions were asked using a different format in both countries. The responses analysed in this paper are however based on the same question format unless otherwise stated.

Pilot testing of the survey instruments was conducted in the months prior to the main survey. Along with observations from earlier focus group discussions, results from the pilots were used to refine the questions asked in the main surveys. In the final survey instrument, respondents were asked a series of questions related to their attitudes toward the marine environment and aquaculture and their fish eating habits. A number of socio-demographic questions were also asked related to age, gender, marital status, occupation, working status, income, number of persons in household and education. Finally, a contingent valuation method (CVM) based question was asked of respondents that examined the Norwegian and Irish public's willingness to pay a premium for sustainably farmed salmon¹.

Respondents were probed on their awareness and concerns in relation to fish farming using a series of Likert scale questions. These questions provided a series of statements or posed a question that the respondents were asked to provide a response to on a 1 to 5 scale. For example, respondents were asked how important they thought salmon fish farms were to the livelihood of their local community. They were then asked to answer on a scale of 1 to 5 where 1 is not at all important and 5 is extremely important. Similarly respondents were asked to what extent a number of issues such

¹ The response to the CVM question is not analysed here as we just concentrate on the attitudes to aquaculture in this paper. The CVM analysis is reported in Hynes et al. (2017).

as climate change, over fishing, etc. pose a threat to the marine environment. They were asked to answer on a scale of 1 to 5 where 1 was ‘Does not pose any threat’ and 5 was ‘Poses a severe threat’.

Data were analysed using STATA 14. Descriptive statistics were used to report percentages, means and standard deviations. Excel was used to develop all the comparative figures. We also estimate a simple logit model for each sample, where the log odds of considering the environmental credentials of farmed salmon when going shopping is modelled as a linear combination of a number of socio-demographic characteristics.

Results

The summary statistics for both the Norwegian and Irish samples are shown in table 1. Both samples provide similar statistics in terms of age, gender and household composition. There is a higher percentage of individuals in full-time third level education in the Norwegian sample (26%) than in the Irish one (6%). This reflects an overestimation of students for the Norwegian sample where according to census figures 15% of the total population are currently in third level education. The average household income recorded in the samples would also suggest that there are higher household incomes on average recorded in the Norwegian sample than observed in the population in general. The opposite is the case for the Irish sample with the sample average being approximately €10,000 less than officially reported figures from the Irish Central Statistics office.

The summary statistics would also suggest that respondents in Norway use the coast more than their Irish counterparts for recreation. Finally over 50% of the sample from Norway were from a non-urban location compared to 38% in the Irish case. In order to deal with possible biases in the Norwegian sample the Norwegian statistics due to the sampling process used, the analysis of responses have been adjusted based on sampling weights derived from the Census of Population statistics for Norway.

Table 1 Summary statistics for the Irish and Norwegian Samples

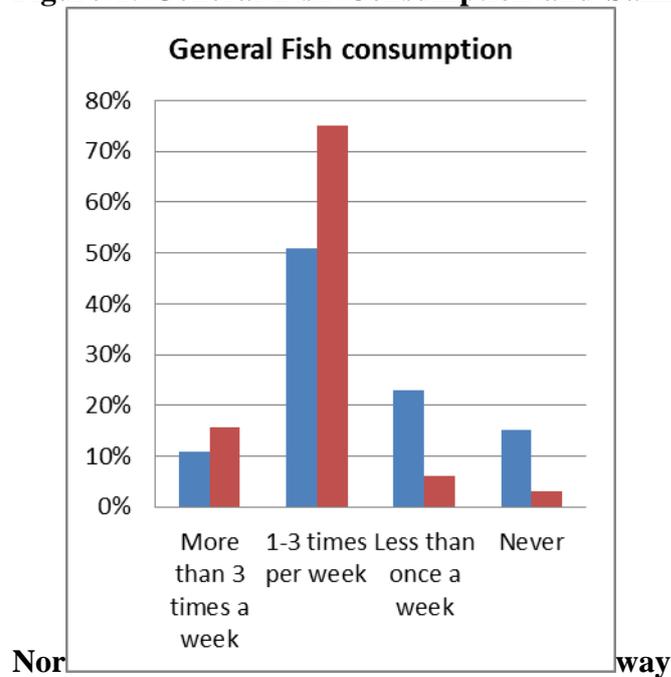
Variable	Ireland	Norway
	Mean (S.D)	Mean (S.D.)
Employed (dummy,0,1)	0.55 (0.50)	0.61 (0.49)
Student (dummy,0,1)	0.06 (0.23)	0.26 (0.44)
Retired (dummy,0,1)	0.18 (0.38)	0.10 (0.30)
Female (dummy,0,1)	0.52 (0.50)	0.43 (0.50)
Age	46.22 (16.65)	49.57 (18.00)
Rural Dweller (dummy,0,1)	0.38 (0.44)	0.57 (0.49)
Number of persons in household	3.03 (1.37)	2.60 (1.33)
Eats fish at least once on a weekly basis (dummy,0,1)	0.62 (0.49)	0.91 (0.23)
Respondent believes that there are farms in local area (dummy,0,1)	0.04 (0.18)	0.26 (0.44)
Partakes in coastal recreation activity more than 10 times per year (dummy,0,1)	0.29 (0.45)	0.48 (0.50)
	32,185	
Annual Gross Household Income (€)	(17,156)	77,766 (27,276)

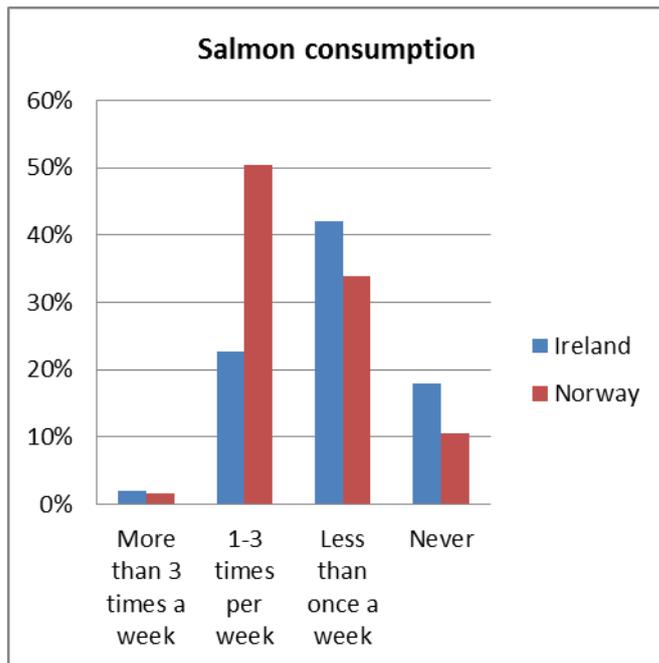
Fish Consumption

As can be seen table 1, 62% of the Irish sample indicated that they eat fish at least once a week compared to 91% in Norway. Figure 1 breaks down the fish consumption patterns of both populations further. Sixteen percent of Norwegians and 10% of Irish consume fish more than 3 times per week while 75% of Norwegians and 51% of Irish indicated that they consumed fish between 1 and 3 times per week. Perhaps the greatest difference between the populations is in relation to the proportion who indicate that they never eat fish; 15% in Ireland compared to just 3% in Norway.

A similar patten can be seen for salmon consumption in the second part of figure 1. It is interesting to note that 10% of the Norwegian population indicate that they never eat salmon where as it was only 3% for any fish. The frequency of consumption for Norwegians and Irish per week is also significantly less for salmon than fish in general indicating that both populations would appear to consume a variety of fish. Fifty two percent of Norwegians consume salmon at least once per week compared to 25% in the Irish case.

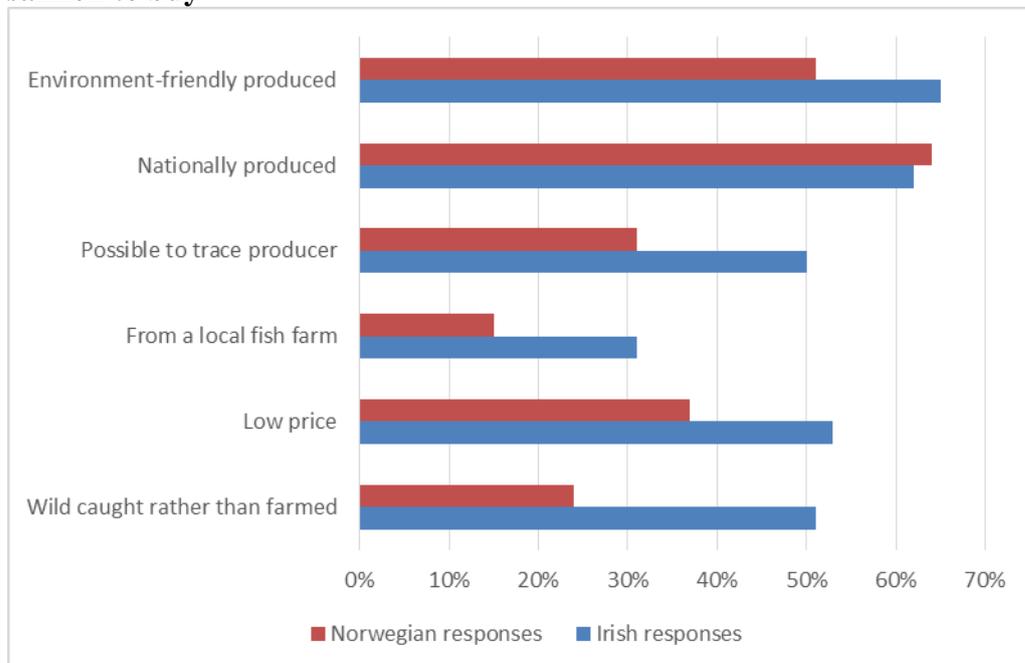
Figure 1. General Fish Consumption and Salmon Consumption in Ireland and





Respondents were also asked about their reasons for eating fish. Although the responses are not directly comparable due to differences in how the question were presented², taste was indicated as the most important reason for eating fish with health benefits a close second in both surveys. In the Norwegian case, only 1% of respondents indicated that price was the most important reason for them to consume fish.

Figure 2. Aspects considered important or very important when choosing which salmon to buy



² In the Norwegian case respondents were asked to choose the most important reason for consuming fish from a list that included health benefits, taste, easy access to fish products and price. In the Irish case respondents could choose multiple reasons from the same list rather than a single option as in the Norwegian case.

* A score of 4-5 on a 5 point scale where 1 means it is not at all important and 5 means it is very important

Next, those respondents that indicated that they did eat salmon (574 in the Irish case, 866 in the Norwegian case) were asked what aspects of the salmon product they considered important when choosing to buy salmon. As shown in figure 2, for Norwegians, that the salmon was produced in Norwegian waters was the aspect considered important or very important by the most respondents. Second and third most important were that it was produced in an environmentally friendly manner and that it commanded a low price, respectively. In the Irish case the top two most ranked attributes were a reversal of the Norwegian's first and second ranked attributes – first and second most important aspects were that it was produced in an environmentally friendly manner and that the salmon was produced in Irish waters, respectively.

As can be seen from figure 2 where exactly in national waters (From a local farm) the salmon is farmed is far less important than the fact that it is at least farmed somewhere in national waters. This preference for nationally produced farmed fish was also seen by van Osch et al. (2017). It is interesting to note that over half of Irish respondents indicated that whether the salmon was wild caught rather than farmed was an aspect they considered important or very important compared to just 24% in the Norwegian case. This may indicate that the Norwegian population are much happier to consume farmed fish compared to the Irish. Traceability is also a significantly greater concern for the Irish respondent compared to the Norwegian.

Table 2. Logit model estimating the likelihood of considering the environmental credentials of farmed salmon when purchasing

	Ireland		Norway	
Employed	0.555	(0.261)	0.187	(0.197)
Female	0.552**	(0.232)	0.441***	(0.145)
Age	-0.151***	(0.050)	0.022	(0.028)
Age Squared	0.002***	(0.001)	-0.001	(0.001)
Number of persons in household	0.112	(0.096)	0.005	(0.063)
Eats fish at least once on a weekly basis	0.206	(0.257)	0.178	(0.308)
Respondent believes that sea lice from fish farms has significant impact on wild stocks	0.833***	(0.272)	0.552***	(0.167)
Ln (Annual Gross Income)	0.192	(0.219)	-0.146	(0.243)
Constant	1.501	(2.400)	0.589	(2.562)
Log likelihood	-253		-576	
Wald or LR chi2(8)	27.5		26.1	
AIC	524		1171	
BIC	563		1214	
Observations	574		866	

Standard errors in parenthesis. *** indicates significance at 1%, ** indicates significance at 5%, * indicates significance at 10%.

We also estimated a simple logit model for each sample, where the log odds of considering the environmental credentials of farmed salmon when purchasing is modelled as a linear combination of a number of socio-demographic characteristics as shown in table 2. If a respondent indicated that an environmentally friendly production process was an important or very important aspect of the product when

they were considering buying salmon then the dependent variable is given a value of 1 and 0 otherwise. In both country models, the likelihood ratio chi-squared statistics (Wald chi squared statistic in Norwegian case) indicate that the models as a whole fits significantly better than models with no predictors. It would appear that being employed, female, younger and believing that sea lice from fish farms has a significant impact on wild stocks and positively influences the likelihood of considering the environmental credentials of farmed salmon when going shopping in the Irish case. In the Norwegian case being female and believing that sea lice from fish farms has an impact on wild stocks are the only variables that are statistically significant.

Aquaculture awareness

Respondent were asked if they were aware of fish farms in their local area. Only 4% of Irish respondent believed that there were farms in their local area compared to 26% in the Norwegian sample. Those that said they were aware of fish farms in their local area were also asked how important do you think that the salmon fish farms are to the livelihood of your local community. In the Irish case 56% of this sub-sample indicated that they thought it was important or very important compared to 33% in the Norwegian case. This is not surprising given that where these farms do exist in the Irish case they are often in remote locations with limited opportunities for other forms of employment whereas in the Norwegian case they will often be a wider range of other employment options especially in the oil and fisheries sectors.

Only 2.5% of Norwegians believed that aquaculture in some way hindered their use of the coast compared to 11% in Ireland. Given the low levels of development of the sector in Ireland 11% seems like a high response rate and may indicate a more negative attitude to aquaculture generally in the Irish case. Given the importance of the industry in the respective economies it was not surprising to find that Norwegians also had a greater knowledge when it came to the different forms of aquaculture production. In response to the question 'Have you ever heard of Land-Based Closed Containment fish farms?' only 18% of Irish respondent gave a positive response compared to 58% in the Norwegian case. While not as significant a difference across the two surveys, a greater proportion of Norwegian (20%) were also familiar with the concept or technique referred to as Integrated Multi Tropic Aquaculture (IMTA). Only 5% of Irish respondents indicated they knew what IMTA was. This latter finding is also in line with that found by Alexandra et al. (2016).

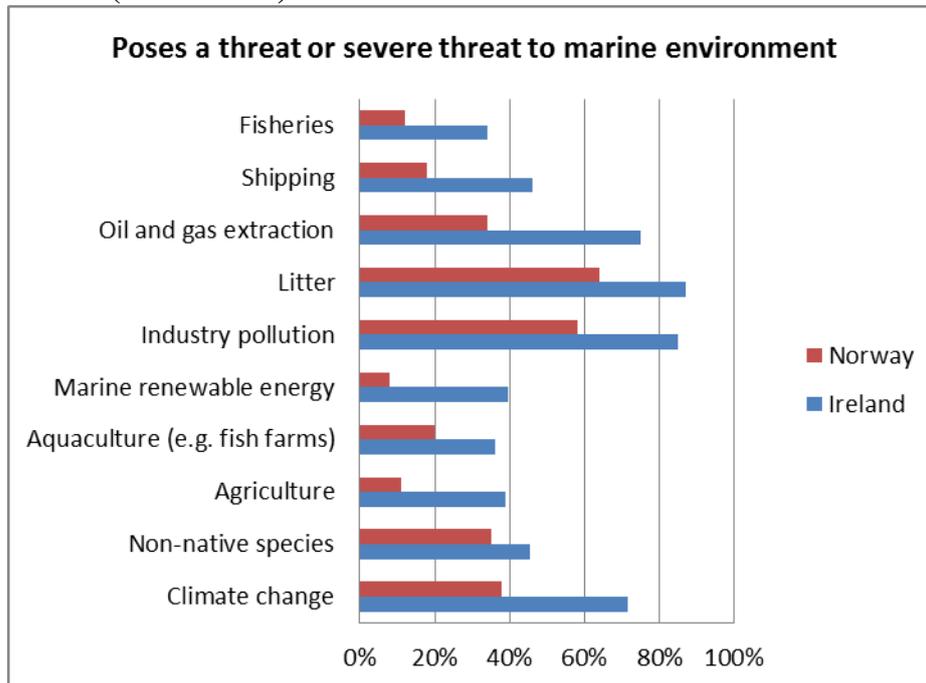
Attitudes towards Aquaculture and Salmon Farming

Respondents were also asked a series of question that examined their attitudes to aquaculture and to salmon farming in particular. Firstly, in a similar question to Potts et al. (2011) and Hynes et al. (2014), respondents were asked to indicate how much of a threat different sectors and issues posed for Ireland's and Norway's marine environments (see figure 3). Similar to these previous studies, the factors that were deemed to be the most of a threat in both countries were litter followed by industry pollution.

Less than 40% and 20% of Irish and Norwegian respondents, respectively considered aquaculture as posing a threat or severe threat to the marine environment and only approximately 34% and 12% of respondents in Ireland and Norway, respectively, felt that fishing posed any significant threat. An analysis of the statistical difference in the

response to the perceived threat from aquaculture across a number of socio-demographic characteristics indicated that retired individuals and those with a sea view in the Norwegian case are more likely to perceive aquaculture as a threat or severe threat to the marine environment (at 5% level of significance). Being female and having fish farms in your locality meant that the respondents were also more likely to perceive aquaculture as a threat or severe threat to the marine environment but only at 10% level of significance.

Figure 3. Rankings of perceived threats to the marine environment by the Irish Public. Scores shown as percentage of responses rated as ‘threat or severe threat’ (score of 4-5).



* A score of 4-5 on a 5 point scale where 1 means it poses no threat and 5 means it poses a significant threat.

In the Irish case, those with a third level education were found to be less likely to perceive aquaculture as a threat or severe threat to the marine environment while those who believed that there was fish farms in their locality were more likely to perceive aquaculture as a threat or severe threat to the marine environment. Those with a sea view in the Irish case are also more likely to perceive aquaculture as a threat or severe threat to the marine environment but only at 10% level of significance. No statistical difference in attitude towards the perceived threat of aquaculture was found in either population across the rural urban divide or for age, employed or being a student.

It is somewhat surprising that aquaculture and fishing do not rank higher as perceived threats given the significant media coverage often given to these sectors impact on the marine environment (Olsen and Osmundsen, 2017). As pointed out by Hynes et al. (2014) these results may reflect the fact that the public generally do not see first-hand aquaculture or fishing activity, which happens on the water, whereas they do see litter on the beaches and the spread of industry on the coasts. Also the issue of litter in our oceans and micro-plastics in our seafood is a topic that has been given increasing

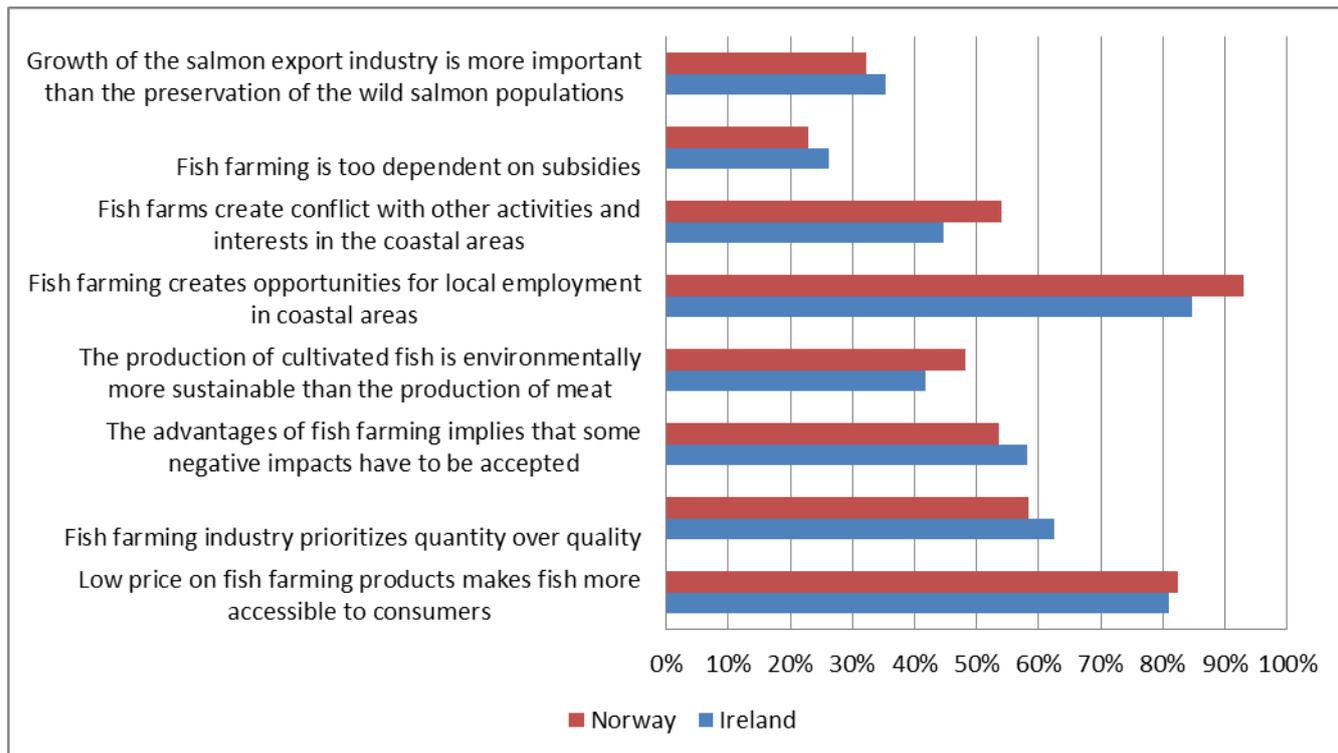
coverage in both academia and the media over the last number of years (Lusher et al. 2013; Wright et al. 2013) . The Norwegian media monitor *Retriver* shows that Norwegian newspapers already has used the term ‘plastics in the ocean’ (plast i havet) three times more in 2017 than in 2016.

Respondents were also given a series of statements related to fish farming and asked on a Likert scale of 1 to 5 how strongly they agreed or disagreed with them. The percentage of respondents that agreed or strongly agreed (score 4 or 5) to each of the statements are shown in figure 4. Interestingly, there was no statistically significant difference in the ratings across the Irish and Norwegian samples. The statement that found the most agreement across the samples was ‘fish farming creates opportunities for local employment in coastal areas’ (85% and 93% of Irish and Norwegians agreeing or strongly agreeing with this statement). The statement that found the least agreement in both samples was ‘fish farming is too dependent on subsidies’ (26% and 23% of Irish and Norwegians agreeing or strongly agreeing with this statement, respectively).

Some of the more controversial statements presented to the respondents produced a more divided split in opinions. For example 58% of Irish and 54% of Norwegians agreed or strongly agreed with the statement ‘the advantages of fish farming implies that some negative impacts have to be accepted’ while 62% of Irish and 58% of Norwegians agreed or strongly agreed with the statement ‘fish farming industry prioritizes quantity over quality’. The environmental sustainability of fish farming could also be seen to be an important issue for respondents with only 35% and 32% of Irish and Norwegians agreeing or strongly agreeing, respectively with the statement ‘Growth of the salmon export industry is more important than the preservation of the wild salmon populations’.

While one might suspect that the responses to the statements might differ across the urban-rural divide, but the only statistically significant difference in opinions observed in either country in this regard was for the threat of oil and renewables in the Irish case (5% level of significance). Finally it is worth noting that just under half of respondents in each sample agreed with the statement that ‘the production of cultivated fish is environmentally more sustainable than the production of meat’. This is an interesting finding given that it has been shown that fish process energy more efficiently than farmed animals such as cattle and pigs and aquaculture also emits less phosphorous, nitrogen and greenhouse gases than livestock production (Duarte et al. 2009 and WorldFish Center, 2011).

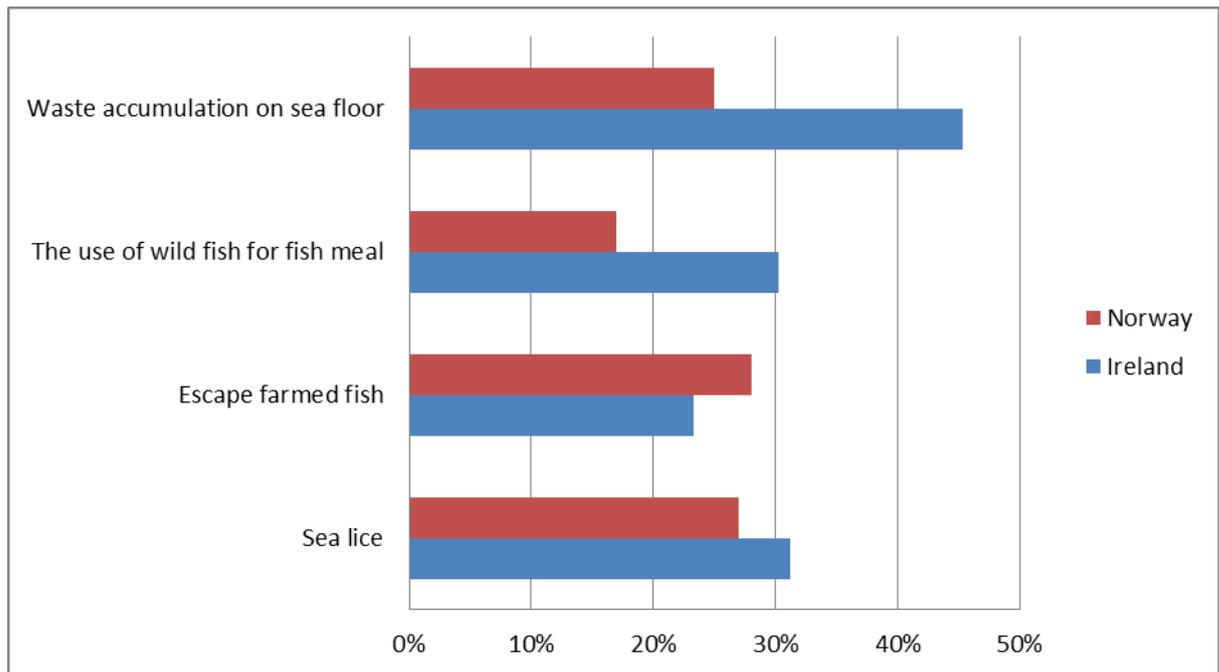
Figure 4. Opinions on fish farms. Scores shown as percentage of responses rated as ‘agree or strongly agree’*



*Score of 4 or 5, from a scale of 1 to 5 where 1 means strongly disagree and 5 is strongly agree.

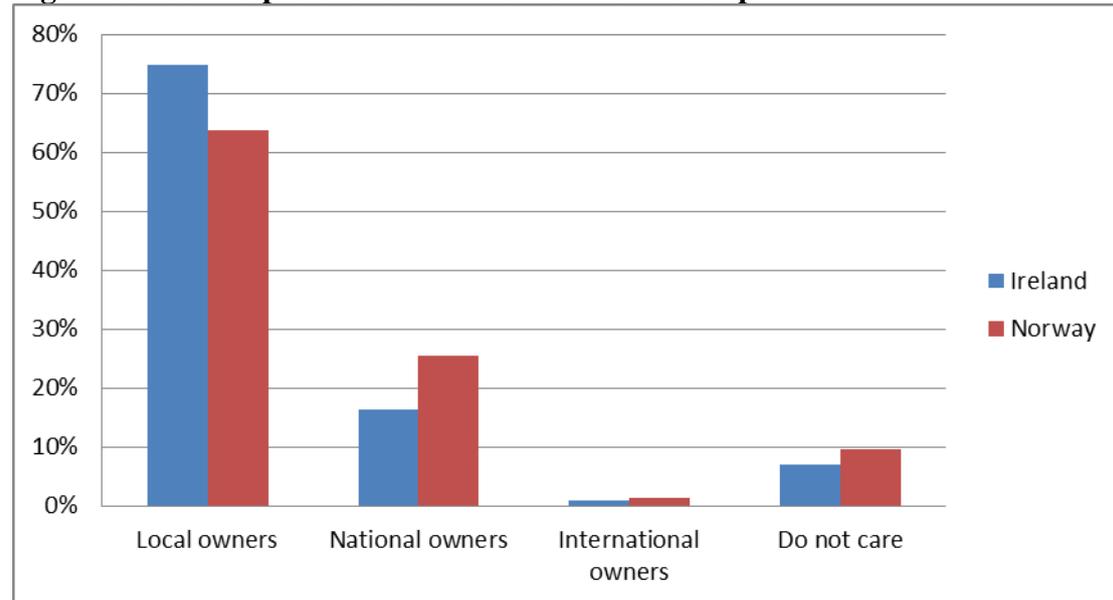
Respondents were next presented with a number of issues that have been associated with aquaculture and fish farming. The respondents were asked to what extent they thought each of these issues were having a negative impact on the environment. Figure 5 presents the percentage of responses who rate the impact of each issue on the environment as 'significant'. Surprisingly, just 31% of the Irish sample and 27% of the Norwegian sample felt that sea lice has a significant impact on the environment although this was the second most frequently ranked impact amongst the Norwegian respondents. If we add those who chose 'slight impact' as well then the percentages increase to 48% and 57% for Ireland and Norway, respectively. Waste accumulation on the sea floor was the most frequently ranked significant impact amongst Irish respondents (45% versus 25% in Norway) and this may be related to the strong opinion held by the Irish sample on the severe threat posed by litter and industrial waste in the marine environment observed earlier.

Figure 5. Aquaculture/fish farming impact on the environment. Scores shown as percentage of responses who rate impacts as 'significant'*



* A score of 5 on a 5 point scale where 1 means little impact and 5 means significant impact.

The use of wild fish as fish meal is also a much greater concern in Ireland (30%) compared to Norway (17%) while the impact of escaped farmed fish was the issue of greatest concern in Norway (28%) compared to Ireland where 23% ranked it as having a significant impact on the environment. While an opt out level of 'I don't understand this issue' was presented with each of the suggested impacts it was interesting to note that on average only approximately 10% chose the opt out option in the Norwegian case whereas in the Irish case 46% of the sample indicated they did not understand the sea lice issue enough to give a definitive answer. The opt-out response ranged from 20% to 33% in the Irish sample for the other issues. The IFA aquaculture poll in 2015 also found that issues surrounding fish farming were not very well understood by Irish citizens (IFA, 2016). This would suggest that the general public in Norway understand the issues surrounding the main impacts of fish farming on the marine environment much better than their Irish counterparts.

Figure 6. Public's preferences for fish farm ownership

Respondents were also asked who they would prefer to see own fish farms in their own national waters. Not surprisingly, the responses indicated that the more local the ownership the better. As can be seen from figure 6, local owners were the preference of 75% and 64% of respondents in Ireland and Norway respectively with a further 16% and 25% respectively expressing a preference of national level ownership. Only 1% of respondents in each country indicated that they would prefer to see international owners although approximately 10% in each case indicated that they did not care who owned the fish farms.

In a further question on who should be in charge of planning in coastal areas both Norwegian and Irish indicated preferences expressed in the descending order of local authorities, then national authorities and then regional authorities. The preference for national ahead of regional authority may be due to the fact that many respondents may not be able to identify who the regional authority might be in this case whereas they would be familiar with local planning authorities and the responsible national planning agencies and departments. Finally, a question asking respondents to indicate who they felt were the most capable of dealing with environmental challenges in coastal areas found that Irish respondents favoured local authorities again (62%) whereas the Norwegians felt that academic researchers were in the best position to deal with environmental challenges in coastal areas (46%).

Discussion and Conclusions

Aquaculture has increased rapidly over the past number of decades, and globally it plays a significant role in respect to employment and economic development in generally rural locations. It also has an increasing role in the provision of nutrition to an ever expanding global population (FAO 2012). Aquaculture is a major industry in Norway, second only in size to the oil industry. Aquaculture is also an industry that is seen to have significant potential for expansion in Ireland if issues surrounding licences can be solved. Internationally, both Irish and Norwegian aquaculture enjoys a good reputation. In both countries, however, the public debate surrounding salmon farm developments in particular can often be heated. In the Norwegian case the debate often surrounds the problems of escapees and sea lice while in the Irish case the

impact of lice on the wild stocks and the subsequent impacts on the important salmon angling sector is a key concern. The industry itself, on the other hand, claim that the problems are exaggerated and that the salmon produced are of high quality.

Ultimately, the environmental and economic sustainability of the sector, and having a social licence to operate, requires social acceptance. Public perceptions are therefore important for fish farm operators and institutions governing the aquaculture sector. In this paper, we provided insight into people's attitudes towards aquaculture and farmed salmon in both Norway and Ireland. It was interesting to note that aquaculture ranked lower in terms of it perceived threat to the marine environment compared to other industries such as oil and gas, shipping and general industrial pollution. Despite the observed negative perceptions of the aquaculture in some respects (e.g. between 55 and 65% in both countries agreed or strongly agreed with the statements 'fish farming industry prioritizes quantity over quality'), it seems to be valued by the public as a provider of economic and employment opportunities (between 85 and 95% of respondents in both countries agreed or strongly agreed with the statement 'Fish farming creates opportunities for local employment in coastal areas').

The media's attention towards the negative impacts of sea lice has been high in both Norway and Ireland in recent years. It was therefore surprising to see that the attitudes towards the impact of sea lice are not any more negative than attitudes towards the impacts from escapees and waste accumulation from farms. Nevertheless, the results are in line with previous research that has also shown that the social acceptability of aquaculture amongst the public is strongly linked to its perceived environmental impacts (Whitmarsh and Palmieri, 2011 and Backer et al., 2014).

The results presented here would suggest that the Irish have a more negative perception of aquaculture than their Norwegian counterparts; something that does not line up with the respective intensity of current aquaculture activity in both countries. Indeed it is noticeable that the Irish public tend to express higher levels of concern related to the general threats to the marine environment and the more specific environmental issues surrounding salmon farming. This tendency to express higher levels of concern amongst Irish respondents is something that has also been noticed in previous studies (Hynes et al, 2014 and Lavelle and Fahy, 2012). It would be interesting to also carry out the same survey as was conducted for this study in an area of each country where aquaculture is a dominant industry and a key employer. This would allow the researcher to assess whether the attitudes toward aquaculture of those living in these areas would differ from those observed here in the general populations.

It has been suggested that the public criticism to aquaculture development based mainly on suspected environmental impacts may be holding back development of the industry (Alexandera et al. 2016). This may in part explain the fact that even though the salmon farming industry in Norway is 84 times that of Ireland by volume, Norwegians are still significantly less likely to consider aquaculture as a severe threat to the marine environment compared to their Irish counterparts. They also have a lower probability than the Irish of agreeing to statements that indicate that fish farming impacts the environment through waste accumulation, sea lice, and the use of wild fish as feed.

The results here also suggest that the Irish may be less well informed than their Norwegian counterparts in relation to the different types of aquaculture production

techniques that are possible and in terms of the issues surrounding fish farm impacts. Relatively high numbers in the Irish sample indicated that they did not understand the issues well enough to indicate what impact issues such as sea lice or salmon escapees had on the marine environment. An obvious policy recommendation would therefore be for the development of a comprehensive communication programme to help people understand the issues surrounding fish farm developments and operations better. This may be easier said than done though given that even amongst scientists themselves there is considerable debate about the actual magnitude of some the impacts from fish farming on the marine environment.

References

- Alexandera, K., S. Freeman, T. Potts (2016). Navigating uncertain waters: European public perceptions of integrated multi trophic aquaculture (IMTA). *Environmental Science & Policy* 61, 230–237.
- Bacher, K., A. Gordo, and E. Mikkelsen (2014). Stakeholders' perceptions of marine fish farming in Catalonia (Spain): A Q-methodology approach. *Aquaculture*, Volumes 424-425, Pages 78-85.
- Barrington, K., Ridler, N., Chopin, T., Robinson, S. and Robinson, B. (2010). Social aspects of the sustainability of integrated multi-trophic aquaculture. *Aquaculture International* 18(2): 201-211.
- BIM (2017). *The Business of Seafood 2016*. Bord Iascaigh Mhara Publication, Dublin.
- Chu, J., J. Anderson, F. Asche and L. Tudur (2010). Stakeholders' Perceptions of Aquaculture and Implications for its Future: A Comparison of the U.S.A. and Norway. *Marine Resource Economics*, 25(1), 61-76.
- Duarte, C., Holmer, M., Olsen, Y., Soto, D., Marbà, N., Guiu, J., Black, K. and Karakassis, I. (2009). Will the oceans help feed humanity? *BioScience*, 59(11), 967-976.
- EY (Ernest and Young) (2017). *The Norwegian Aquaculture Analysis 2016*, EY Report
- FAO (2017) National Aquaculture Sector Overview. Norway. National Aquaculture Sector Overview Fact Sheets. In: *FAO Fisheries and Aquaculture Department*. Rome. http://www.fao.org/fishery/countrysector/naso_norway/en
- FAO 2006, State of World Aquaculture 2006, FAO Fisheries Technical Paper. No. 500. Rome, FAO. 134p.
- FAO 2012, State of World Aquaculture 2006, FAO Fisheries Technical Paper. No. 500. Rome, FAO. 230p.
- Grealis, E., Hynes, S., O'Donoghue, C. Vega, A., van Osch, S. and Towmey, C. (2017). The economic impact of aquaculture expansion: An input-output approach, *Marine Policy*, 81, 29–36.
- Hynes, S., Norton, D. and Corless, R. (2014). Investigating societal attitudes towards the marine environment of Ireland. *Marine Policy*, 47: 57–65.
- Hynes, S., Skoland, K., Ravagnan, E., Gjerstad, B., Vatland Krøvel, A. (2017). An Irish and Norwegian comparative study of willingness to pay for sustainably produced farmed salmon. SEMRU Working paper No. 2.
- IFA (2016). Opinion poll on attitudes and information sources relating to Irish Aquaculture, Irish Farmers Association Report.

Johnston, R., Roheim, C., Joglekar, D. and Pomeroy, R. (2008). Estimating preferences for non-market attributes of aquaculture and sustainable seafood production: methods and empirical applications. *International Journal of Environmental Pollution*, 33 (4), 469–484.

Katranidis, S., Nitsi, E., Vakrou, A. 2003. Social acceptability of aquaculture development in coastal areas: the case of two Greek Islands. *Coastal Management*, 31: 37–53.

Lavelle, MJ. and Fahy, F. (2012) ConsEnSus lifestyle survey - Environmental concern results. [Available Online - <http://www.consensus.ie/wp/wp-content/uploads/2013/10/Environmental-Concern-survey-results.pdf> - Accessed 3rd September 2017]

[Lusher, AL., McHugh, M. and Thompson, R C. \(2013\) Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel. Vol. 67, Issues 1–2, pp 94-99](#)

Martinez-Espiñeira, R., Chopin, T., Robinson, S., Noce, A., Knowler, D. and W. Yip (2016). A contingent valuation of the biomitigation benefits of integrated multi-trophic aquaculture in Canada, *Aquaculture Economics & Management*, 20, 1-26.

Olsen, S, and Osmundsen, T. (2017). Media framing of aquaculture. *Marine Policy* 6, 76, 19-27.

Osmundsen, T. and Olsen, S. (2017). The imperishable controversy over aquaculture, *Marine Policy*, 76, 136-142.

Potts T., O’Higgins T., Mee L., Pita C. (2011). Public Perceptions of Europe’s Seas – A Policy Brief. EU FP7 KNOWSEAS Project. Available at: <http://www.knowseas.com/links-and-data/project-publications/Knowseas%20Marine%20Social%20Survey%20Final.pdf/view> (accessed 16/11/2016).

Rudd, M., Pelletier, N. and Tyedmers, P. (2011). *Aquaculture Economics and Management* 15(1), 18 – 45.

Schlag, A., 2010. Aquaculture: an emerging issue for public concern. *Journal of Risk Research*, 13(7), 829-844.

Whitmarsh, D. and Wattage P. (2006). Public attitudes towards the environmental impact of salmon aquaculture in Scotland. *European Environment* 16, 108-121.

Whitmarsh, D. and Palmieri, M. (2011). Consumer behaviour and environmental preferences: a case study of Scottish salmon aquaculture. *Aquaculture Research*, 2011, 42, 142-147.

WorldFish Center (2011). Blue Frontiers: Managing the environmental costs of aquaculture, Joint WorldFish Center and Conservation International Report. https://www.conservation.org/publications/documents/BlueFrontiers_aquaculture_report.pdf

Wright, S., Thompson, R. and Galloway, T. (2013). The physical impacts of microplastics on marine organisms: A review. *Environmental Pollution*, Vol. 178, pp. 483-492

van Osch, S., Hynes, S., O'Higgins, T., Hanley, N., Campbell, D., Freeman, S. (2017). Estimating the Irish public's willingness to pay for more sustainable salmon produced by integrated multi-trophic aquaculture. *Marine Policy*, 84, 220–227.

Yip, Winnie (2012). Assessing the willingness to pay in the Pacific Northwest for salmon produced by integrated Multi-Trophic Aquaculture. Master's thesis. Simon Fraser University. http://rem-main.rem.sfu.ca/theses/YipWinnie_2012_MRM530.pdf

Yip, W., Knowler, D. Haider, W. & Trenholm, R. (2017). Valuing the Willingness-to-Pay for Sustainable Seafood: Integrated Multi-trophic versus Closed Containment Aquaculture. *Canadian Journal of Agricultural Economics*. Vol. 65 (1), 93–117.

