



Indicating sustainable salmon farming: The case of the new Norwegian aquaculture management scheme

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ABSTRACT

Norway, the world's leader in the production and export of farmed Atlantic salmon, recently established a new management regime with a view to promoting substantial long-term growth in the industry. The government stated plainly, however, that the industry would have to be environmentally sustainable. The determination would be made through the use of indicators, but only one indicator would go into effect as the new regime was instituted: the amount of salmon lice (*Lepeophtheirus salmonis*) on wild salmon. This paper asks why this one, lone variable was selected. Using policy documents, the draft white paper outlining the new management plan sent out for comment by the government and the responses made by key stakeholders to the draft plan, this paper argues that the selection of this one indicator was overdetermined. Many factors contributed to the selection, including the government's fundamental decision to expand production, the momentum of Norwegian policy development, how the draft white paper defined and discussed environmental sustainability, the criteria established for acceptable indicators and the specifics of the proposed management plan. These had a political effect: For these reasons and more, no solid block of stakeholders emerged to press unambiguously for additional indicators at the start of the scheme, merited or not. This study also demonstrates the difficulties presented by a public debate on a management plan such as this.

1. Introduction

Norway, the world's leader in the production and export of farmed Atlantic salmon, recently established a new management regime with a view to promoting substantial long-term growth in the industry. The government stated plainly, however, that the industry would have to be environmentally sustainable. To put its new management plan into effect, production areas would be established along the coast. State authorities would evaluate the environmental condition of each production area, and rate it using a "traffic-light" system. Each area would be given a green, yellow or red "light" indicating whether growth would be allowed, production could be maintained at existing levels or the amount of farmed fish in the area would have to be reduced. The determination would be made through the use of indicators applied at the level of the production area. Such a large industry might pose several threats to the environment, but only one environmental indicator would go into effect as the new regime was instituted: a measure of the exposure of wild salmon to salmon lice (*Lepeophtheirus salmonis*) [1]. Why was the plan initiated with this one, lone indicator?

Using indicators to steer policy decisions is a common approach to the management of natural resources. Choosing such indicators is a deliberate act designed to reach politically chosen targets. Choosing environmental indicators as management indicators mixes political and practical issues with scientific ones. The selection of indicators to measure qualities such as environmental sustainability is at its root a scientific issue, but seldom simple. For example, both "environment" and "sustainable" are broad concepts; indicator selection depends on how these are defined and what elements are selected for measurement [2–4]. Policy objectives require choices among these. In addition, scientific indicators can be and have been chosen for non-scientific reasons [5–7] such as cost effectiveness. Indicators linked to policy also have a role in communicating information about decisions to the public [8,9]. Ideally, they should work to build confidence and trust in policy decisions among the many actors involved in governance [6,10]. The choice of indicators is accordingly extremely important in a policy context.

This article sets aside the science and offers a political analysis of the selection of the single indicator for the Norwegian traffic light system,

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arguing that the selection is rooted in previous policy, practical issues and politics, specifically the lack of unified pressure beyond the salmon aquaculture industry to include other indicators at the start of the new scheme. First, it looks at how the government framed its policy and defined “environmental sustainability” in the draft white paper (DWP) that outlined the proposal for the new management plan that was sent out for public comment. Second, it places the plan and the selection of indicators in the Norwegian policy context. Third, it uses comments submitted by stakeholders on the DWP that outlined the proposed new management regime to map support for the indicator that was adopted (the exposure of wild salmon to salmon lice) and compare it to support for another popular candidate indicator that was not adopted, escapes of farmed salmon. Fifty-seven organizations, agencies, groups and other actors made formal, written comments on the DWP. Along the way, the paper delves into the way various respondents addressed the discussion and illustrates the difficulties of the participation of even fairly well-informed public actors in policy decisions.

This article finds that the outcome of the process was over-determined. First, the government’s decision to expand production and the arc of Norwegian policy development created the framework within which the hearing round took place, which effectively set the boundaries of acceptable discussion in the hearing round. Second, the DWP effectively channeled discussion to the consideration of just a few potential indicators. It had a very vague definition of “environmental sustainability” and lacked a substantial discussion of sustainability goals and standards; this and previous policy decisions generated a focus on the industry’s impact on wild salmon. The DWP further narrowed the discussion about indicators by declaring some issues irrelevant and by acknowledging the need for others but deferring their development to some non-specified time in the future. Third, the criteria set by the government made it particularly difficult to select an indicator within the framework of the production-area based management program. For these reasons and more, no solid block of stakeholders emerged to press unambiguously for additional indicators at the start of the scheme, merited or not. This is particularly true of potential indicators associated with escapes of farmed salmon. This study also demonstrates the difficulties presented by a public debate on a management plan such as this: the bar for meaningful participation is fairly high, requiring a sophisticated understanding of the science and policy history in addition to the politics of the issue.

2. Environmental sustainability and indicators

The broad policy objective of the proposed new management scheme was “environmental sustainability”. Implementing a concept like this as policy, however, requires a more precise definition than that. The words “environment” and “sustainable” can be variously defined [2,11–13]. With the rise of widely-embraced concepts such as ecosystem-based management coinciding with growing awareness of the growing pressures on ocean systems, a multitude of indicators for various aspects of the marine environment have emerged. A plethora of suites or indices of indicators have been developed to measure marine ecosystem “health” and biodiversity [3,4,14–17]. These join broader sets of goals and indicators such as those developed in association with the European Union’s Water Framework Directive and the Marine Strategy Framework directive and any number of Sustainable Development Indicators (SDIs) [5]. All of these are means not just of gauging the status of ecosystems or biodiversity or environmental conditions but also of detecting trends in these. It would seem that decision-makers would be spoiled for choice with respect to sustainability indicators.

“Sustainability” is the policy objective of maintaining the marine environment at some level of functioning that can endure over time, but the term is notoriously vague [12,18–23]. It is, for example, common to distinguish between a “strong” and a “weak” version [2,24,25]. Since the topic is usually discussed in connection with the impacts of human activities on natural systems, the sustainability discussion is about how

much impact on natural systems can and should be allowed and to what end. “Sustainability” takes on concrete meaning through the specification of dimensions and standards that include notions of tolerance and risk levels, and these inevitably include decisions about trade-offs [7, 26–28].

The selection of policy indicators then should grow out of the basic science about natural systems, but with reference to what human activities are to be monitored and what ecosystem services need to be maintained and at what level. Beyond scientific criteria such as the “construct” validity of the indicator (whether the indicator captures what it is meant to), reliability and how accepted it is by the scientific community, practical considerations must be a part of the mix, such as how cost-effective the indicator is whether capacity exists to deploy it [1,29]. Because of the role indicators are supposed to play in the decision-making process, it is helpful if indicators are easy to understand and utilize, or they may be simply set aside [14]. In practice however, indicators have sometimes been chosen for reasons that have less to do with science and more to do with ease, convenience and high and low politics [5,14,27,30]

There is broad agreement that marine management, for example as operationalized by the ecosystem-based approach, should be inclusive, involving “stakeholders” in the decision-making process [31–34]. Involving stakeholders should result in better policy but it should also result in more legitimate policy. Indicators convey information not only to decisionmakers but to other relevant actors. The rationale for their selection and the ease by which the indicator is understood by stakeholders will inevitably have a role to play in building confidence and trust. Understanding how indicators are selected and why can reassure stakeholders who may suspect, with or without reason, that politics has played a role in indicator selection. This suspicion may arise in particular when indicators are tied to policy decisions, as is the case with the new Norwegian salmon aquaculture plan.

A good set of indicators for environmental impacts would seem particularly important for Norway, which hosts the production of over half of the world’s farmed Atlantic salmon [35], [p. 36] and will now be increasing that production. Open cage marine aquaculture of salmon introduces a substantial biomass into Norwegian waters. At the end of 2017, there were roughly 403 million salmon held in all Norwegian farms (about 792 thousand metric tons) compared to the roughly 530 thousand wild salmon that returned to Norwegian waters that year¹ [36, 37], [p. 3]. The farming of Atlantic salmon may affect the environment in many ways along its life-cycle, and, while all of these should be included in a complete assessment of its environmental impacts, our focus here is limited to potential impacts of open-cage farming in marine waters – which is also the focus of the DWP and subsequent discussions. In Norway and elsewhere, a series of potential impacts from the salmon aquaculture industry are routinely recognized and discussed [36, 38–41]. Wild stocks, including but not limited to anadromous fish, can be affected by diseases, parasites and the therapeutants (including antibiotics and chemicals) used to prevent or respond to outbreaks of these [42]. Continued use of such treatments can create the problem of resistance that will affect other species and other industries. Wild anadromous fish, including salmon and trout, are particularly at risk from parasites and disease and, with respect to salmon, genetic impacts from escaped farmed salmon [36,39]. The ecosystem can be affected by emissions of pollution and effluents from feeding and feces, containing nutrients such as nitrogen and phosphorous, including the depositing of sediment rich in nutrients and detritus on the sea floor under cages. Such nutrients can stimulate algae and bring on eutrophication problems. Metals can be introduced through, for example, copper-based anti-foulants or in feed. The behavior of wild species may be affected by the presence of the cages and the fish feed introduced into the ecosystem.

¹ Returning salmon are reported as the number of individuals, rather than in tons. See Anon. 2018.

The need for vast amounts of feed can have an impact far beyond Norway by affecting wild fish harvested for the fishmeal and fish oil used as ingredients [43].

In Norway, the industry is closely monitored at the farm site, and it is also the case that the importance of each of these potential impacts varies by country context. In Norway, for example, fish are vaccinated and antibiotic use is not a major concern [42]. However, as Norway's Inspector General/Riksrevisjonen pointed out, what has been lacking (among other things) in Norway is the evaluation of cumulative burdens (*den samlede belastningen*) of the industry in an "expanded area" [44], [p. 107]. In a country that has embraced an ecosystem approach to management [45], such an expanded area should relate to the ecosystem. Atlantic salmon aquaculture remains controversial, even in Norway [46]. Indicators that address a comprehensive suite of these potential problems could also have political communication and trust-building functions.

3. Background

In 2012, a study by a working group created by the Royal Norwegian Science Society (Kongelige Norske Videnskabers Selskab, DKNVS) and the Norwegian Technical Science Academy (Norges Tekniske Vitenskapsakademi, NTVA) concluded that the salmon and salmonid farming industry would likely expand five-fold by 2050. Over time, the prediction in this report, "Value Creation Based on Productive Seas in 2050" (*Verdiskaping basert på produktive hav i 2050, VBPH*) [47], became a national goal. Although the shift may have begun with the previous Labor-party dominated government, the conservative-right coalition government of Norway (elected 2013 and reestablished with minor adjustments since) explicitly embraced this report, adopted a growth-friendly attitude, and looked for a five-fold expansion in the industry [48,49]. At the same time, the government stated that the industry should be environmentally sustainable.

In 2014 the Norwegian government began laying the groundwork for the expansion of the industry. After a round of public meetings, the government published a draft white paper in November of that year [50]. The "høringsnotat" (here translated as "draft white paper" or DWP) entitled "Draft white paper for the Parliament on growth in Norwegian salmon and sea trout aquaculture" (*Høringsnotat – melding til Stortinget om vekst i norsk lakse-og ørretoppdrett*) [1] proposed three alternative frameworks for the expansion of the industry: 1) continuing the current system of allocation rounds with objective criteria to be determined at each round, 2) a fixed annual growth rate, or 3) a system based on production areas governed by "action rules" [1], [p. 5]. While the DWP formally introduced the three options as equally viable paths, the language used and the space given in the document to each alternative suggested that the government favored the third option. This preference was recognized by many of the responding groups, and most of the subsequent discussion focused on aspects of this third option.

The third alternative, "production areas with action rules", (*produksjonsområder with handlingsregler*) divided the Norwegian coast into 11 production areas (PAs), with the specification of the areas based on models of how particles (organic matter or pathogens) spread along the coast. Environmental indicators would establish whether the industry in a given area would be allowed to grow, using a traffic light system: PAs would be evaluated as green (low effect on the environment, growth permitted), yellow (moderate effect, no expansion allowed) or red (high impact, production should be reduced) [1], [p. 48]. Growth might occur by increasing the maximum allowable biomass (*Maksimalt Tillatt Biomasse*, MTB) at existing sites or through the issuing of new permits.

The DWP marked a departure in Norwegian salmon aquaculture management, but the policy arc is a long one in Norway. The creation of large production areas was innovative, but this proposal built on the recommendations of an earlier study, "Effective and sustainable use of area in the aquaculture industry" (*Eksperutvalg oppnevnt av fiskeri-og kystdepartementet*, 2011). The selection and discussion of specific

environmental indicators has roots in a longer policy process. Norway has hosted salmon aquaculture since the 1970s and farm sites in marine areas (and elsewhere) are subject to a battery of public regulations that include a wide variety of standards and indicators. The creation of PAs, however, introduced the need for indicators that would measure cumulative impacts at area rather than farm scale.

The selection of status indicators was a critical aspect of establishing the environmental sustainability of the industry in each PA. The DWP offered a brief presentation of several possible effects that indicators might monitor – disease and the impacts of treatments for disease, pollution and effluents, and escapes of farmed salmon – but proposed to initiate the management scheme using just one indicator for conditions at the level of the production area: salmon lice. While the DWP expressed the intention to develop indicators for a range of pollutants in the future, the government argued that no effective indicators for these were available for use at the PA level; these would have to be developed. While escapes of farmed salmon were recognized to be a problem for wild stocks, the government proposed to tackle that problem in another way; by fishing escaped farm fish out of local waterways. The DWP explicitly asked for feedback on the question of indicator selection [1], [pp. 43, 46].

While the salmon lice level was chosen as an indicator for the health of the ecosystem because of its effects on wild salmon, the number of lice on wild stocks would not be directly monitored. Impact on wild salmon would be determined using a model developed by the Institute for Marine Research: Measures of lice at farm sites (reported by aquaculture companies) would be entered into this "contagion model", which included factors such as current, temperature, and salinity. The model would then provide an assessment of the risk that the reported lice levels in the production area represented to wild salmon. The traffic light system would award a green light to areas where the risk to wild fish was estimated to mean less than 10% added mortality from exposure to salmon lice, a yellow light to areas with an added mortality of 10–30% and a red light to a projected added mortality of over 30% [1], [p. 48]. The production areas were designed using physical oceanographic analyses that tracked currents and other conditions that would affect the spread of salmon lice larvae and other contagions [51].

3.1. Wild Atlantic Salmon in Norway and focus on salmon lice and escapes

The focus on wild salmon is in part the outcome of a long history of Norwegian policy.

The Atlantic salmon (*Salmo salar*) is a distinct species of salmon. It is found naturally in the rivers and waters of Northern Europe and North America. Once plentiful throughout the region, the species has declined in recent decades. Norway has a relatively large number of wild salmon stocks and is an important reservoir for the genetic diversity for the species. About one-third of wild stocks of Atlantic salmon breed in Norway [52], [p. 4] and Norway has the single largest remaining wild stock [53]. Even so, a Norwegian government document noted in 2006 that wild stocks had disappeared from about 45 Norwegian rivers, and that about a quarter to a third of the stocks in the remaining 401 rivers were threatened or vulnerable ("*truede eller sårbare*") [54], [p. 6, 52, p. 4].

Preserving these stocks has been an important objective for many Norwegian governments. The law on salmon and freshwater fish (*lakse-og inlandsfiskeoven*, 1992, as amended in 2009) committed the government to managing stocks so as to ensure their survival and a harvestable surplus [55]. These general concerns and goals lay behind, among other things, the 2003 establishment of national salmon fjords and rivers. The Ministry for Fisheries and Coast's 2009 White Paper *Strategy for an Environmentally Sustainable Marine Aquaculture Industry* confirmed the policy established by the 2006/7 White Paper (*On the Protection of Wild Salmon and the Establishment of National Salmon Rivers and Salmon Fjords* [52]). The "Quality Norm for Wild Salmon", with

sub-norms relating to harvestable surplus and genetic integrity, was adopted as a Royal Resolution in 2013 [56].

The Norwegian Environmental Agency, which is tasked with the job of the management of wild Atlantic Salmon, and relevant governmental commissions attribute the broad reduction in Atlantic salmon stocks to increasingly difficult conditions that Atlantic salmon experience at sea, including a suite of factors associated with climate change as well as competition with other species for food, predation, fisheries by-catch and marine parasites and disease [41,57]. Conditions at sea are beyond the ability of coastal states to control. Norway and other Atlantic salmon states, however, are committed to the strategy of maximizing the number of individuals that set out to sea [57].

That is no easy task, for there are many threats to wild salmon stocks that lie within national boundaries. In 2014, The Norwegian Scientific Advisory Committee for Atlantic Salmon identified and assessed several of these. Acid rain, use of rivers for hydropower, the parasite *Gyrodactylus salaris*, and changes in habitat were among those with the greatest potential impact but were then judged to be under control or stabilized. Additional significant but then lesser threats included infections and disease originating from aquaculture and other human activity, pollution, runoff from agriculture, mining activity, and predation.

Two serious threats, however, stood out: escaped farm fish and salmon lice [41], [pp. 95–107]; The Advisory Committee characterized both as “non-stabilized threat[s] to stocks”, meaning that they were judged to have a strong impact and a high likelihood of causing further serious damage [41], [p. 108]. This information was available at the time the DWP was circulated [58], [p. 54], [59], [p. 1], [41], [pp. 88–89]. Other contemporary studies agreed with the seriousness of these threats [38,39].

The 2014 assessment reflected long-term concern regarding the effects of escaped farmed salmon and salmon lice. The “Strategy for an environmentally sustainable aquaculture industry,” adopted as policy by the Labor-Party dominated government in 2009, identified five areas of concern about the industry, three of which are directly related to the survival of wild salmon: genetic impacts and escaped farmed salmon, pollution and effluents, and disease (including parasites) [52], [p. 2].² Several of those responding to the DWP referred back to this list in framing their responses to the DWP. The 2013 White Paper 22, “World’s Foremost Seafood Country” (*Verdens Fremste Sjømatnasjon*) also endorsed both salmon lice and escapes as “warning indicators” [60], [pp. 122–123]. If wild salmon were to serve as the canary in the mine, it is understandable that the discussion would focus on salmon lice and escapes, with a secondary focus on pollution and effluents.

3.2. The adopted plan

The final white paper came out in 2015 and officially adopted alternative 3 [49]. The new management system went into effect October 15, 2017. It divides the coast into 13 rather than 11 PAs, after a revised analysis by the Institute for Marine Research indicated that this increased number of PAs would be compatible with environmental objectives while allowing for more nuance in decision-making [51,61]. The lice indicator was the only indicator available at the launch of the plan. The first assessment resulted in a green light for eight of the 13 PAs; three were given a yellow light and two a red light. Green light areas have already been awarded a minimum of two percent growth; the rules allow for salmon aquaculture operators in yellow- and red-light PAs to apply for exemptions from the rules. Requests for exemptions were under consideration at the time of writing [62]. Fig. 1 shows the production areas and with the first traffic-light passements.

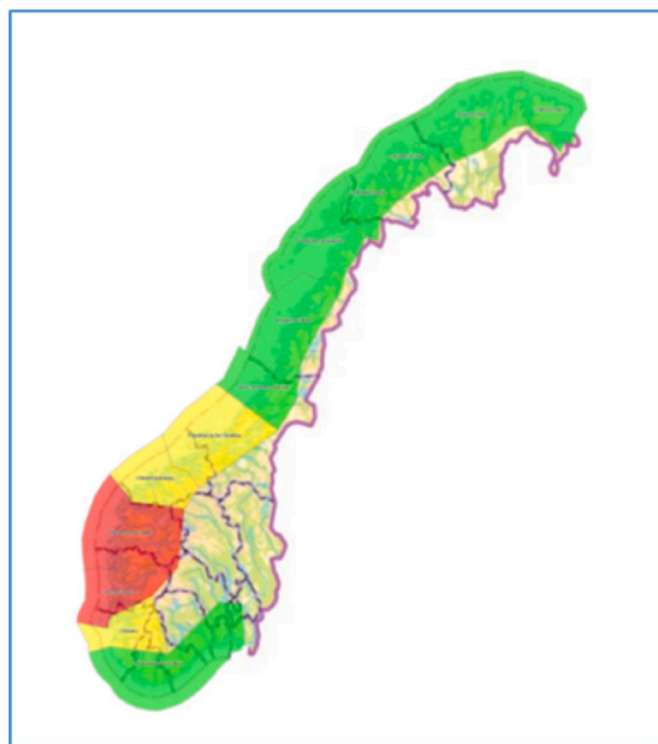


Fig. 1. Salmon aquaculture production areas along the coast of Norway. Two areas have been colored red to indicate that the total aquaculture biomass should be reduced in those areas. Yellow indicates it should remain at existing levels; green indicates that growth can occur. Source: Fiskeridirktoratet. Generated February 20, 2019 from <https://kart.fiskeridir.no/share/5d8a92f44301>. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

4. The actors: a snapshot of the salmon aquaculture and other industries

Salmon farming is an important industry for Norway. Although the industry has had its ups and downs, it has been very dynamic and, as we will see, much is expected of it in the future. In 2014, the country produced over half (1.26) of the 2.33 million metric tons (tonnes) of Atlantic salmon produced in the world. Production of Atlantic salmon, as measured in tonnes of such fish slaughtered for food, increased again in 2015 (just before the new management plan was implemented), but it declined the following year, before starting to increase again [63]. The value of produced Norwegian salmon has, however, continued to rise: The first-hand sales value of farmed salmon increased by 2.5% from 2016 to 2017, and in 2017 had doubled in value compared to 2012 [64]. In 2016, Norwegian exports of farmed Atlantic salmon were worth 61.3 billion Norwegian Kroner (NOK) (about 7 billion US Dollars, USD) and reached 90 countries. Excluding gas and oil, they accounted for 16% of the value of Norwegian exports [65]. The industry is spread all along the coast of Norway, but is least in evidence in the warmer waters of the very south and has been moving to the north, now the largest producer by value [66].

The government considers the seafood industry, and especially the dynamic aquaculture sector, to be a national priority. The selection of this sector is rooted in the report and hearing process connected to the “A knowledge-based Norway” (*Et kunnsapsbasert Norge*) project [1,67] which in turn is based on the “business cluster” approach made famous by Michael Porter [68] and Paul Krugman [69]. The project report identified the seafood industry along with off-shore industry (oil and gas) and the maritime (shipping) sectors as one of the three “super clusters” in the country [1], [p. 9], and the government has built on this.

² The other two issues related to the use of space/area and feed resources.

The government sees vibrant salmon aquaculture as a value-creating industry that will benefit the coast. It also sees the industry as an element of “what the country will live from” once the oil and gas sector declines:

The Norwegian economy has come to a turning point where oil will no longer have the same position in the future as the motor of our economic growth. We need new industries and new jobs in existing industries to secure the welfare of coming generations. The aquaculture industry is a part of Norway’s future [49], [p. 7].

The two economic sectors that are most directly competitive with the salmon aquaculture industry are the fishing industry, which shares dependence on the ecosystem and competes for space in marine areas, and the riverbank owners and professional fishers of wild salmon and trout who depend on resources many believe are threatened by the industry [39–41,46,70]. The marine capture fishery is large and diverse and economically important to Norway. The total value of all marine fish caught in 2017 (including the famous cod fishery) increased by 50% compared to 2007 to about 18.6 billion NOK (about 2 billion USD) [71]. The number of fulltime fishers, however, has declined dramatically since 2000 (from 14.6 thousand to about 1.1 thousand) [72]. This industry is also spread along the coast of Norway, although the most fish (of the greatest value) are landed in the west coast counties of Møre and Romsdal and Rogaland, and the northern counties of Nordland, Troms and Finnmark³ [73].

There has long been both commercial and recreational/tourism fishing on wild salmon (and trout) in the fjords and in the rivers. The value of these are difficult to determine but are undoubtedly lower than those connected to the farmed salmon industry or to the fishing industry. Most sea fisheries for salmon are today hobbies. The Norwegian Environmental Agency estimates the sales value of this fishery at about 20 million NOK or just over two million USD [74] and describes the economic significance of the professional fishery as “modest” (*beskjeden*) [75]. Most sea fishing takes place along the coasts of south-west Norway, in mid Norway (Trøndelag) and in the northernmost county (Finnmark) where it has special significance for the indigenous Sea Sami population [76,77].

Recreational and tourist fishing for Atlantic salmon takes place in the rivers, and is a business run by the riverbank owners who control access. Rural residents sell fishing licenses to recreational fishers, frequently as a part of a package of diversified economic activities [78,79]. Nearly 100 000 salmon were caught and killed in Norwegian rivers in 2017; additionally, almost 26 000 were caught in rivers and released [80] and 73 000 were caught at sea [81]. The organization *Redd Villaksen* estimates the revenues from the wild salmon (and trout) recreational fishing and tourist business to be 1.3 billion NOK (about 148 million USD) spread among many stakeholders and benefitting 100 000 anglers [82]. Again, the rivers of Trøndelag and Northern Norway (especially Finnmark) produce the most catches [80].

5. The data and methods

This paper is a political analysis of the consultation process that the government used to establish the new policy. It rests upon an analysis of how the government framed the issues, the reactions of key stakeholders to the government’s framing and proposals, and the support for various indicators from key stakeholders. The DWP is here taken to represent the government’s views on policy goals and indicators. The authors first evaluated the presentation of environmental sustainability as presented in the DWP, and how the DWP structured the request for feedback on the proposed plan, including indicators. In order to gauge the position on

indicators of the most relevant stakeholders, comments on the proposed management plan were examined. The Ministry of Trade, Industry and Fisheries issued the DWP in November 2014 and invited a large group of agencies, institutions and groups to comment. The written responses to the DWP provide a snapshot of views held by key actors at the time, including views on the proposed indicators. While many of these stakeholders have published several studies, statements and other documents over many years, the assumption here is that the responses to the 2014 DWP captured the arguments that these actors felt to be most important to put forward at that moment. All responses were produced at roughly the same time (between November 2014 and January 2015) in response to a substantial change in the management scheme (which should have motivated comment submission), and all are reacting to the same document. This produces a set of comparable comments.

Those submitting comments were asked to address several aspects of the plans, including which management alternative they preferred (DWP p. 42), how production areas should be organized and what size they should be (pp. 43, 52) and how permits should be distributed (p. 43). While all of these are important and turn out to be difficult to disentangle from the question of indicators, this article focuses in particular on the government’s request for feedback on the proposed indicators (pp. 43 and 46).

The government received 58 comments on the DWP, but one submission (from the Justice Department) simply stated that the respondent had no comment, so the number of meaningful responses was 57. This includes some key management agencies (The Directorate of Fisheries, The Norwegian Food Safety Authority, The Norwegian Environmental Agency, The Norwegian Veterinary Institute), specialized research institutions (Institute for Marine Research, NOFIMA), environmental organizations and associations related to the fishery for wild Atlantic salmon. A selection of municipal governments, county governors and county governments also responded. All of these had roles in deciding and implementing aquaculture policy. Municipal governments decide upon the siting of grow-out pens along the coast. At the time of the DWP, county governors, who are appointed by the government, had extensive roles in regional environmental affairs, including the role of assessing how aquaculture facilities could conflict with regional and national interests. They also issued permits for emissions from aquaculture sites [83].⁴ County governments, which are popularly elected, had at the time responsibility for distributing aquaculture concessions, channeling aquaculture industry reactions to municipal coastal zone planning, and for making impact assessments [84]. [Table 1], below, provides a complete of the list of the actors and organizations that commented in this hearing round.

The responses are fairly representative of the relevant stakeholders with respect to the Norwegian salmon aquaculture industry. Examination of a selection of key hearings about farmed and wild salmon between 2003 and up to and including the 2014 hearing round (10 hearings, including both invited and responding stakeholders) indicates that most of the usual stakeholders (those were invited to comment or who did comment 5 times or more in the 2003–14 period) were among the 57 who commented on the draft white paper. There were some noteworthy exceptions, however. The ministries associated with finance, justice, trade, administrative affairs and municipalities did not comment as they frequently do.⁵ Government agencies associated with innovation and competitiveness did not contribute (Innovation Norway and the Competition Authority), nor did some business associations (such as the Norwegian Financial Services Association). Fewer county governments and county governors responded than expected given the importance of the industry and its presence along most of the coast of Norway. Perhaps most surprising is the absence of the Norwegian Water

³ All county and municipality names used here are those that applied at the time of the DWP. Since then, several counties and municipalities have been combined and names have changed.

⁴ Some functions have since been moved to the elected county government.

⁵ Some government agencies are missing from the 2014 list because they have been renamed or merged with other agencies.

Table 1
Respondents to the Draft White Paper.^a

Respondent	Category Total
Governmental Bodies	20 (21)
State Level: ministries and agencies	6 (7)
The Norwegian Environmental Agency (Miljødirektoratet)	
Norwegian Food Safety Authority (Mattilsynet)	
Ministry of Justice and Public Security (Justis- og beredskapsdepartementet) (statement of no comment)	
The Government Pension Fund (Folketrygdfondet)	
Directorate of Fisheries (Fiskeridirektoratet)	
Institute for Marine Research (Havforskningsinstituttet)	
Norwegian Veterinary Institute (Veterinærinstituttet)	
County Governments (Fylkeskommune, elected locally)	5
Finnmark	
Møre og Romsdal	
Nordland	
Sogn og Fjordane	
Troms	
County Governors (Fylkesmannen, appointed by the government)	4
Hordaland	
Nordland	
Rogaland	
Sør-Trøndelag	
Municipalities (city or local governments)	2
Alta	
Hammerfest	
Association of Municipalities	1
Network of Fjord and Coastal Municipalities (Nettverk fjord- og kystkommuner)	
Sami Parliament of Norway (Sametinget, ST)	1
Aquaculture companies and seafood companies	7
Alsaker Fjordbruk AS	
Bremnes Seashore A/S	
Cermaq	
Coast Seafood A/S	
Grieg Seafood ASA	
Marine Harvest (now known as MOWI)	
Salmar	
Industry associations (aquaculture or with strong aquaculture components)	6
The National Association of Fishery and Aquaculture Businesses (FHL - Fiskeri- og Havbruksnæringens landsforening)	
Hardanger Fjord Association (Hardangerfjordlauget)	
Norwegian Seafood Association (NSL - Norske Sjømatbedrifters Landsforening)	
Salmon Group (locally owned aquaculture businesses)	
Confederation of Norwegian Enterprise - Nordland (Joint submission by the Nordland, Troms and Svalbard, and Finnmark chapters)	
Norwegian Industry (Norsk Industri)	
Producers of closed facilities, and equipment and services providers	5
Akva Design	
Brilliant Buildings (Byggutengrenser)	
Fishfarming Innovation AS	
Pharmaceutical Industry (Legemiddelindustrien)	
NORCEM AS (Cement)	
Fishing Industry	3
Norwegian Coastal Fishers' Union – Service Office (Norges Kystfiskarlag - Kystfiskarlagets Servicekontor AS)	
Norwegian Fishers' Union (Norges Fiskarlag)	
Nordland Fishers' Union (Nordland Fylkes Fiskarlag)	
Labor	5
The Norwegian Veterinary Association (Den Norske Veterinærforening)	
Norwegian Union of Municipal and General Employees (Fagforbundet)	

Table 1 (continued)

Respondent	Category Total
Norwegian Union of Food, Beverage and Allied Workers (Norsk Nærings- og Nytelsesmiddelarbeiderforbund)	
Norwegian Confederation of Trade Unions -National organization (LO - Landsorganisasjon Norge)	
The Norwegian Society of Graduate Technical and Scientific Professionals (Tekna)	
Riverbank owners, salmon-focused groups, and hunting and fishing interests	5
Alta Salmon Fishing Interest Association (Alta Laksefiskeri Interessentselskap)	
Norwegian Federation of Hunters and Anglers (Norges Jeger- og Fiskeriforbund)	
Norwegian Salmon Rivers (Norske Lakseelver)	
SalmonCamera (wild salmon and trout interest organization)	
Sogn Council for Wild Salmon (Sogn Villaksråd)	
Environmental NGOS (ENGOS)	5
Bellona	
Nature & Youth and Friends of the Earth, Norway (Natur og Ungdom og Naturvernforbundet)	
Friends of the Earth, Norway, Hitra-Frøya Chapter (Naturvernforbundet Hitra-Frøya)	
Friends of the Earth, Norway, West Finnmark Chapter (Naturvernforbundet Vest-Finnmark Lokallag)	
WWF-Norway	
Research	2
Norwegian Institute for Nature Research (Norsk Institutt for naturforskning)	
NOFIMA (Applied research in fields of fisheries, aquaculture and food research)	
(Total Responses)	(58)
Total without Ministry of Justice and Public Security	57

^a All county and municipality names used here are those which applied at the time of the DWP. Since then, several counties and municipalities have been combined and names have changed.

Resources and Energy Directorate (NVE), a governmental body that oversees the usage of Norwegian waterways and the Norwegian Institute for Water Research (NIVA), Norway's leading institution on water-related questions. Both usually participate in such hearings.

The business community is strongly represented among the respondents, and the salmon aquaculture and associated industries are well represented. The large number of responses by individual firms is unusual in the history of these hearings. The government proposed a significant change in management, and actors whose interests were involved took care to respond to the government's proposal.

All the responses are available on the website of the Norwegian government (available at: <https://www.regjeringen.no/no/dokumenter/horing-melding-til-stortinget-om-vekst-i-norsk-lakse-og-orretoppdrett/id2076332/>).⁶ However, a list of all responses with a direct link to each document is presented in the Appendix. All documents submitted were closely read by the authors. They coded the passages relevant to the indicators in question, and then, in a second cycle of coding, clustered the responses taking similar positions. Grouping like responses proved to be extremely challenging because of the complexity of the issues involved and because of the nuances of the responses. Tables of the coded responses are provided at each section. Page numbers are provided for specific statements or positions; these refer to the relevant responses.

⁶ Last accessed on 9 June 2019.

6. The findings

6.1. Definition of environmental sustainability and indicator criteria

It is important here to pause and point out that the Norwegian salmon aquaculture industry is closely monitored along many environmental (and other) dimensions at the level of the farm site. These are addressed by the Regulations on the operation of aquaculture facilities (*Forskrift om drift av akvakulturanlegg*). Norway also subscribes to ecosystem-based management [85] and is applying the European Union's Water Framework Directive [86]. However, as noted, the government now sought to add indicators for industry impact at the production area level [87], [pp. 13–19]. But the indicators were also to serve as “action rules”: the government would make decisions about whether the industry would be allowed to increase production based on these. The choice of indicators had therefore direct relevance to interest groups.

In stating the importance of environmental sustainability to the government's plan, the DWP stated the following:

With today's prevailing production technology, nature will always set the premise for how the aquaculture industry can operate and the extent to which it can operate. Growth in the Norwegian aquaculture industry must be sustainable. This means that the further development of the industry will also take place so that *the structure, function and productivity of nature are preserved*, among other things as a basis for safeguarding future generations' opportunities to meet their needs [1], [p. 10] (*our translation and emphasis*).

The quote above defines “environmental sustainability” as the “structure, function and productivity of nature”. There is, however, no further discussion as to what this might mean and accordingly, it is unclear exactly what dimensions of the “structure, function and productivity of nature” should be measured. Besides a brief mention of the EU Water Framework Directive, the relationship to other standards and indicators relating to marine, coastal or river management is not mentioned in the DWP.

However, the government did specify other characteristics of the indicators it sought: An indicator “must be able to reflect the status within a production area with respect to the current environmental impact and the effect must relate to the amount of production, so that changes in capacity would result in changes in the environmental impact [1], [pp. 6, 40]. It should also “reflect the status of a geographical area of a certain stretch” in order to “capture the sum of the effects from all of the production sites in the area that make a real impact on the area” [1], [p. 40]. This meant: 1) that a prospective indicator would not be acceptable unless there was a direct causal link – not between the *presence* of salmon aquaculture and some effect, but between the *capacity* of present salmon aquaculture and the effect – and 2) that if the factor caused irreversible changes, then it would not be relevant for such a system [1], [p. 6].

The DWP discussed four categories of possible indicators: disease and use of medications, escapees, pollution and effluents and lice, but discussed at length only two: pollution/effluents, and salmon lice. However, it stated that “emissions from the aquaculture industry are not today considered to be an environmental problem” [1], [p. 45]. In addition, it noted that environmental authorities were [then] engaged in updating the water pollution regulations and the implementation of the EU Water Framework Directive, and that this work would most likely address any problems, although it was unclear how that work would be connected to the new management plan. Even so, it agreed that “work to develop an indicator that might fit into the action rule system should be

started” [1], [p. 45]. No timeframe for the development of PA-level indicators for effluents or pollution was given, nor was it stated what emissions should be included.⁷ Escaped farmed salmon were to be dealt with separately. That is, action was to be taken but the number of escapees was not adopted as an indicator or as a part of an action rule [1], [p. 24].

The one indicator that would go into effect with the establishment of the new scheme was one for salmon lice. In effect, by selecting this indicator, the government proposed the condition of wild salmon stocks as a key indicator for the health of the ecosystem. Following this logic shifts the discussion to the question of the status of wild Atlantic salmon. Lice are not the only threat to wild stocks of salmon, as many official documents and studies available at the time made clear [38,41]. These sources clearly acknowledged that escapees of farmed salmon represented one of the most important threats to wild salmon stocks. This part of the paper examines why an indicator for salmon lice was adopted but not an indicator related to escaped farmed salmon.

6.2. Lice and support for alternative 3

The DWP was clear that the incidence of salmon lice was a serious environmental threat from farmed salmon; the importance of the salmon lice challenge was largely taken as given in the hearing round. 40 of 57 submissions mentioned the word “lus/lakselus” – many of them only cursorily. Most took the seriousness of the threat as a given, and most submissions agreed that lice should be considered when making decisions about growth. However, some salmon aquaculture industry actors (e.g. *Salmar*, *Marine Harvest* – now known as *MOWI*) did challenge the scientific basis for using salmon lice as an indicator of environmental impact by challenging the (well-established) assertion that the lice situation for wild salmon was aquaculture-related. *The National Association of Fishery and Aquaculture Businesses*, in particular, did this at length – and even stated that “the Ministry's premise for the need for an action rule to regulate future growth has no scientific validity” (p. 21). The environmental group *Bellona* made similar claims, and *Nordland County Government* also expressed some skepticism about the significance of “aquaculture lice”.⁸ A few submissions delved into the matter: The research institutions *IMR* (which developed the suggested salmon lice indicator) and *NINA* both relayed the science behind the premise that salmon lice from farmed salmon represent an existential threat to wild salmon, and clearly supported this conclusion.

Other discussions about lice mostly concerned the regulations: How lice levels would be monitored, and how many lice would be allowed. *The Norwegian Seafood Association*, for example, was very critical of the lower level that was suggested and argued against any maximum lice “quota” at the PA-level (p. 7). They argued, in other words, not only for keeping the higher limit but also against any “politically determined lice level.” This latter sentiment was echoed by *The National Association of Fishery and Aquaculture Businesses* (p. 2), the corporation *Cermaq* (p. 1), and (for different reasons) by environmental/wild-salmon interests such as *WWF* (p. 7) and *Norwegian Salmon Rivers* (p. 12). When not directed at the science or the regulations, attention paid to lice mostly had to do with delousing methods. The fishing industry (*Norwegian Fishers' Union* and *Nordland Fishers' Union*) focused their lice comments not on environmental damage of lice to wild salmon, but rather on the damage done to other marine species by lice *treatments* – *Norwegian Fishers' Union* (p. 3) even questioned the appropriateness of contemporaneous lice limits (implying that they might be too strict) and asked that future delousing strategies consider the “risk to marine species”. That is to say, they were concerned that the efforts taken to meet the standard set would

⁷ Although the DWP implies (p. 6) that nutrients (*næringsalter*) would be included.

⁸ “Fylkesråden kan ikke se at en slik sammenheng er påvist klart nok til at lakselus kan brukes som indikator” (*Nordland County Government*, p. 6).

endanger other wild stocks. Among the responses there were also scattered concerns about other delousing methods: injuries to salmon from mechanical delousing, and very high mortality rates among “cleaner fish”. A major concern was development of resistance to anti-lice agents among salmon lice. *The Norwegian Veterinary Institute* (p. 2) described this as “one of the biggest threats to sustainable production”, and wanted it incorporated into the new growth regulations.

While we could easily summarize remarks on salmon lice as an *issue*, summarizing the commenters’ views on salmon lice as an *indicator* was trickier because the question was inextricably connected to the new policy as a whole. We categorized views about lice as an indicator from the perspective of whether or not commenters were supportive of “alternative 3” as a package, that is, as a package that included the salmon lice indicator. This turned out to be complicated, even though most submissions explicitly addressed the question. Among other things, the discussions also became about the proposed level, which were in turn sometimes hung up in other aspects of the approach. The summary of respondents’ views is presented in Table 2, below.

We found that 10 submissions took no discernible position regarding “alternative 3”. Of the other 47, 21 were opposed: 9 argued that it was not strict enough, and 12 argued that it was too strict. Twenty-six submissions supported the policy to some extent – this encompasses any submission that expressed explicit support for alternative 3, including those that also made it clear that while the general approach was acceptable, the proposal was unacceptable to them in its current form.⁹ We took this approach because any submission – however hedged – asserting that “we support alternative 3” would be read as support by the Ministry. The final White Paper demonstrated this when it named 20 commenters¹⁰ from *all* sectors (“and others”) as saying that “a system based on an action rule and production areas is best suited to be the future growth regime” [49], [p. 41]. While sorting the submissions by their stance on alternative 3, we also recorded whether or not salmon lice from farmed salmon was seen as an environmental problem. The latter premise was broadly accepted, and many who accepted the problem description were to some extent supportive of alternative 3. With some exceptions, those who disputed the premise also dismissed the policy.

Of the 26 “supporters” of alternative 3, only three expressed something resembling *unconditional* support.¹¹ The most common attitude by far was what we call “hedged support” for the policy, while arguing that it would have to be made more restrictive (21 submissions). With the exception of the environmental organization *Bellona*, submissions in this category acknowledged the lice problem, either explicitly or (unambiguously) implicitly. *The Directorate of Fisheries* fell into this category – it clearly endorsed the alternative but contested (among other things) the Ministry’s descriptions of the environmental impact of delousing medicines as mostly related to individual localities. *The Directorate of Fisheries* (p. 5) argued that an impact was not in doubt, and not mainly related to individual localities. The Directorate also expressed concern about other pollution (such as copper), insisted that louse impact on sea trout must also be considered, and wanted stock losses to be included in the system. The *IMR*, which was central to the development of the policy and very supportive of it at first glance, was slightly more hedged than *The Directorate of Fisheries* on closer reading. Most other “hedged supporters” of alternative 3 who wanted a stricter

version were less confident in the policy alternative in its current form than were these two. An example from the other end of the “hedged support”-spectrum was the wild-salmon stakeholder organization *Norwegian Salmon Rivers*. It explicitly supported alternative 3 (p. 9) while also insisting that the final policy had to be far more comprehensive and should require significant *reductions* – under current conditions (pp. 3, 19).

Submissions that dismissed/downplayed the lice problem were uncommon among “hedged supporters”; among those who wanted a stricter version of the policy, it occurred only once (*Bellona*). Two submissions that expressed hedged support for alternative 3 were concerned that the policy proposal was too restrictive in its current form: *The Norwegian Seafood Association* and *Marine Harvest/MOWI*. *The Norwegian Seafood Association* did not dispute the Ministry’s description of the lice problem, and they endorsed the lice indicator – but opposed the suggested lowering of the lice limit (p. 2). *Marine Harvest/MOWI* denied responsibility for the lice impact on wild salmon (pp. 1, 7). For both, the main reason why they hedged their “support” was their objection to using production areas to regulate growth (an opposition to “collective punishment”).

Of the 21 submissions that “opposed” alternative 3, twelve argued that it was too restrictive of the industry. All but two of these¹² were themselves industry actors, and all but *Sogn og Fjordane County Government*¹³ either dismissed or downplayed the lice problem. *Sogn og Fjordane County Government* did not directly address the lice threat, either – but wanted more monitoring of salmon lice (p. 5). Their main reason for rejecting alternative 3 was concern about “collective punishment” (p. 1). While these submissions were broadly dismissive of the entire policy proposal, there was a noteworthy subcategory: *The National Association of Fishery and Aquaculture Businesses* unequivocally rejected both alternative 3 and “farmed salmon lice” as an environmental challenge, but they were still open to some form of a salmon lice indicator to regulate growth of the industry (p. 17). Three other industry actors expressed similar positions.

Nine submissions opposed the policy on environmental grounds. Most of these explicitly acknowledged the louse problem, and none directly dismissed it – though it is noteworthy that the most unambiguous “environmental opposition” to alternative 3 came from the fishing industry, where there was some ambiguity on the lice question. The other 6 submissions in the category all emphasized the lice challenge and protecting wild salmon, as well as pollution/effluents. They were also often difficult to distinguish from the “hedged support, stricter direction”-category.¹⁴ The County Governors posed a particular challenge: While all four expressed considerable skepticism, the opening lines of *The County Governor of Hordaland*’s submission sent a message of support. The policy proposal was described as “correct changes” to aquaculture management, and the submission explicitly supported “the principles from alternative 3 regarding indicators as an action rule for capacity adjustment” (p. 1).¹⁵ The next line asserted that the specific indicators suggested in the DWP were unsatisfactory, however, and the submission requested comprehensive changes that included (among others) stricter lice impact limits, expanding the lice indicator with a

¹² *Sogn og Fjordane County Government* and *Nordland County Government*.

¹³ *The Hardanger Fjord Association* did not address lice at all – but the submission was so overtly hostile to environmental regulation of the aquaculture industry that we read it as “implicit dismissal” of the lice problem.

¹⁴ *Friends of the Earth, Norway, West Finnmark Chapter* was a clear exception (in that it was easily classified as opposed); *NINA*, a partial one.

¹⁵ *The County Governor of Hordaland*, p. 1. Full quote, in our translation: “We perceive the suggestions from [the DWP] to be correct changes to the management of the aquaculture industry, where the principles of sustainability shall be a precondition for further growth in Norwegian salmon and trout aquaculture. We support the principles of alternative 3 in the hearing notes regarding the use of indicators as an action rule for capacity change. However, these must be changed to ensure adjustment before environmental damage.”

⁹ *The Norwegian Environmental Agency*, for example, while explicitly supportive, also stated that implementation of the new policy in its current version would most likely make things worse (p. 3).

¹⁰ This includes even the research institution *NINA* – with the qualification “initially combined with allocation rounds”. The inclusion is striking because *NINA* explicitly did not support alternative 3, but recommended a combination of the new and the current system (p. 4).

¹¹ They were *The Government Pension Fund*, *The Norwegian Union of Food, Beverage and Allied Workers*, and *The Norwegian Confederation of Trade Unions*.

Table 2
Support for alternative 3 (including lice indicator) Positions on “alternative 3”. * = borderline case. #: *The Norwegian Union of Municipal and General Employees* was hesitant to support the policy because of sustainability concerns – but they were mainly focused on social sustainability. (Darker field: Lice problem was downplayed/rejected)..

Positions	oppose (too lax)		hedged		“support”		hedged		oppose (too strict)		(No discernible position)	Total responses	
	Oppose	Oppose + open to indicator	“Alternative 3 is currently too lax”	Clear support	“Alternative 3 is currently too strict”	Oppose	Oppose + open to indicator						
Respondents	3***		10		1				*2		3	19	
Government	3***		10		1				*2		3	19	
<i>Subcategory</i>	National		5		1							6	
	County Governments		2						*1 (1)		1	5	
	County governors	3***	1									4	
	Municipalities		1								1	2	
	Association of municipalities										1	1	
Sami Parliament		1									1		
Aquaculture companies						1*		4		1	1	7	
Aquaculture ind. associations						1		2		3		6	
Closed facilities producers, equipment/service providers				1*							4	5	
Fishing industry	(1)	2*										3	
Labor		3*#		2								5	
Riverbank owners, hunting and recreational fishing groups	1*	4										5	
Environmental NGOs	1	2	1*								1	5	
Research Institutions	1											1	2
Totals	9		21		3		2		8		4	10	57

measure of medicine use, adding an escapes-indicator, and incorporating locally measured emissions of delousing agents, hydrogen peroxide, and copper into the policy. Because we used “explicit support” as a category touchstone, *The County Governor of Hordaland* was classified as a “hedged supporter” and the other 3 county governors as “opposed” – albeit tentatively.

In a mirror-image coding challenge, the research institution *NINA* was classified as “opposed” because it actively avoided supporting “alternative 3” by instead suggesting a concrete alternative. In the context of the salmon lice indicator, however, it was the “hedged supporter” *County Governor of Hordaland* that appeared most skeptical of the policy of these two; worrying that the louse impact would be “equally high, and too high, in all production areas” (p. 2). *NINA* thought that the proposed system could, at least, ameliorate the salmon lice situation (p. 5).

6.3. Escaped farmed salmon

Generally, those who discussed wild salmon stocks the most tended to agree that escapes of farmed salmon posed a threat to wild stocks. These include the *Norwegian Environmental Agency, NINA, Institute for Marine Research (IMR)* and the two largest wild-salmon interest groups, *Norwegian Salmon Rivers* and the *Norwegian Association of Hunters and Anglers*. The *IMR* was the most “hedged” in its phrasing, however. Forming the next tier of concern, judged by how much attention they devoted to wild salmon and its issues, were environmental organizations (*WWF, Nature & Youth and Friends of the Earth*), the *County Governor of Hordaland*, the *county government of Troms*, and a fishing and hunting and riverbank organization (*SalmonCamera*). These also agreed that escapes of farmed salmon are a threat to wild salmon. *Salmar* discussed wild stocks (pp. 5–6) but hardly discussed escapes; the *Directorate of Fisheries* (somewhat obliquely) seemed to accept that escaped farmed

salmon threaten wild stocks. On the other hand, *The National Association of Fishery and Aquaculture Businesses* submitted one of the longest responses but contested the significance of lice from aquaculture (e.g. pp 16–17; pp. 21–23) and dismissed escapes as an issue (p. 9).

It is in discussing how to deal with escapes within the context of the DWP that concerned actors diverge in their views on using escapes as some sort of indicator. The fracturing occurs because both the issues and the proposals are complex. The DWP contained several interlocking parts, and the position taken on escapes relates to positions taken on other issues.

The production area premise was fundamental to the proposal and to views on escapes. It led to three broad discussions. The first revolved around impacts of escaped farmed salmon on wild salmon with reference to the production area. First, is there a clear relationship between the density of production in a production area (in terms of number of farms or density within cages) and the number of escaped farmed fish? If not, then a PA-level action rule would make little sense. Second, do escapees swim up rivers within the same production area as the farm from which they escaped? If not, then again, establishing an action rule concerning escapes at the PA level would make no sense. Third, should a single set of action rules be applied to all production areas? Some respondents pointed out that the impact of escaped farmed salmon varied according to the context: the stocks of some rivers were already in a precarious state; others were more robust. A rather small number of escaped fish would do greater damage to fragile stocks than a larger one would to more robust stocks (see for example the submission of the *Troms County Government*, p. 7).

Some groups concerned about wild salmon saw a weak or mediated relationship between the density of production in an area and the number of escapee (for example, *Salmon Camera*, p.4; the *Norwegian Hunters and Anglers' Association*, p. 4; and the *County Governor of Nordland*, pp. 2–3). Others argued for a strong (if not perfect) relationship (such as the *County Governors of Hordaland*, p. 2; and *Rogaland*, p. 3; *The Norwegian Environmental Agency*, p. 5; and *NINA*, p. 3). As for where escaped fish go, the *IMR* (p. 7) stated that escaped fish scatter and may (but do not necessarily) swim up the nearest river and *NINA* (p. 5) that escaped fish might swim up rivers both near and far from the escape site. The *County Governors of Rogaland* (p. 3) and *Nordland* (p. 3) and *Norwegian Salmon Rivers* (p. 10) among others insisted that there was a meaningful if not perfect relationship between escape site and presence in nearby rivers. *The Norwegian Environmental Agency* put the case strongly, stating that escaped fish do tend to enter nearby rivers, and that there was a clear relationship between the amount of production and the number of escaped fish (pp. 4–5). Aquaculture interest groups and companies tended to by-pass much discussion of the issue of escaped farmed salmon, confining their comments to simply agreeing with the DWP that no such indicator was necessary (for example *The National Association of Fishery and Aquaculture Businesses*, p. 2). *Salmar*, however, did agree with the DWP that there was “no correlation between the number of fish in the sea and the amount of escaped fish in the rivers” (p. 7).

The requirement that the action rule in the production area be a good indicator for the ecosystem but also relate to a factor which, if altered, would result in a clear change in the measured value¹⁶ – a requirement for a direct, linear relationship – was problematic for some. As the *County Governor of Nordland* pointed out, the relationship between a particular “burden” (*belastning*) and an environmental impact is not necessarily linear (p. 3). *The Norwegian Environmental Agency* (pp. 4–5) stressed the importance of thinking in terms of “combined impacts” on wild stocks, meaning that the effects of no single factor could be understood adequately in isolation. This in turn meant that decreasing the number of escapees might not have a directly measurable impact on wild salmon.

In addition, stopping escapes might not lead to a reversal of damage already done but would at least lessen some part of the burden on wild stocks. On the other hand, a fairly modest effect might still be highly significant for stressed stocks.

A related set of arguments about adopting escapes as a part of an action rule at the PA level was about the prospective fairness of such a rule. As was the case for the lice indicator, many respondents objected to a rule that would affect all producers in a given area regardless of whether a specific operator was to blame or not. As might be expected, salmon aquaculture companies in particular reacted against this idea, but they were not alone in this. Some local and regional governments and environmental organizations (such as the *County Governments of Nordland*, p. 8; and *Sogn og Fjordane*, p. 1; *Nature & Youth/Friends of the Earth, Norway*, p. 4; and *Friends of the Earth Norway – Hitra-Frøya Chapter*, p. 2) were concerned about collective judgements or wanted to be able to establish which operators were responsible for escaped fish. This discussion frequently led into a set of related discussions such as whether escaped fish could be traced back to individual farms and the feasibility of tagging fish. All in all, there was broad agreement that good operators should not be punished for the sloppy procedures of others, and this weakened support for escapes as an indicator for an action rule in the form prescribed by the government’s plan.

Because of the complexities of the government’s proposals and the issues relating to the condition of wild salmonids, it is difficult to state categorically whether respondents did or did not support inclusion of escapes as an “indicator” in a form that fit the government’s requirements. What does come through very clearly however is that those most concerned with wild stocks of salmonids supported some form of decisive preventative action with respect to escapes. An overview of respondents’ position is presented in [Table 3](#). For example, one of the non-governmental respondents most concerned with the effect of escapes on wild salmon stocks, *Norwegian Salmon Rivers*, agreed with the government “that escapes are not suitable for inclusion as an indicator to be used as a part of an action rule at the production area level” – but supported creating a decision rule that would apply at the level of the operator (concession level) (p. 10).¹⁷ Several others supported the general idea that escapes should be included in assessments about growth at the level of the operator or concession holder. A couple of respondents suggested that the proper level for such a rule might be the national level (*Norwegian Salmon Rivers*, p. 12; *NINA*, p. 1). *The Norwegian Veterinary Institute* (p. 1) wanted escapes to be folded into an indicator or indicators on fish loss (which would also include fish that died) as a condition for allowing growth, with such an indicator functioning at the operator level. *The Troms County Government* was firm in its position that escapes should be taken into account when making decisions about areas where rivers already had high percentages of farmed salmon mixed with wild stocks (p. 7). The three fishing organizations generally supported taking escapes into account in some way, but they had other primary concerns and did not spend much time on the issue in their submissions.

The proposal to “deal with escapes separately” meant that escaped fish that made their way to rivers would be removed or fished out of the river (*utfisking*). This proposal satisfied some who expressed concern about the effect of escapees on wild salmon. For example, the *Finnmark County Government* acknowledged escapes as a major problem and stated that they should be used as an environmental indicator (p. 1) but was also “positive” to the proposal that this be dealt with separately (p. 2)

¹⁷ «... støtter vi imidlertid at rømming er lite egnet som indikator for en handlingsregel på produksjonsnivå ... Vårt forslag er å innføre en handlingsregel på konsesjonsnivå» (p. 10).

¹⁶ « ... påvirkningen må henge sammen med produksjonsmengde, slik at endringer i kapasiteten reflekteres i endret miljøpåvirkning» (p. 3).

Table 3
Respondents' position on adopting "escapes" as some sort of "action rule" for decisions about growth.

Positions Respondents	Clearly for	Apparently for	Neutral, no comment, too ambiguous to categorize	Apparently against	Clearly against	Total Responses
Government	6	5	6		2	19
<i>Subcategory</i>						
National	1	1	2		2	6
County governments	1	2	2			5
County governors	2	2				4
Municipalities	1		1			2
Association of municipalities			1			1
Sami Parliament	1					1
Aquaculture and Seafood companies		1	1	1	4	7
Aquaculture industry associations			1	1	4	6
Producers of closed facilities, equipment and service providers			4		1	5
Fishing industry	2	1				3
Labor			4		1	5
Riverbank owners, hunting and recreational fishing groups	4	1				5
Environmental NGOs	2	3				5
Research Institutions	2					2
Totals	16	11	17	2	12	57

(see also *Salmon Camera*, p. 4).¹⁸ IMR also agreed that escapees were best handled separately – but added that if this were not done adequately, new measures would have to be taken (pp. 5,7). For those respondents not particularly focused on the wild salmon issue, such as *Norwegian Seafood Association* (p. 3), the “deal with separately” proposal simply took the escapes issue off the table, allowing them to assume (if they addressed the issue at all) that escapes would be dealt with. The environmental organization *Bellona* considered the fishing-out idea to be a positive contribution (p.5).

But the *Troms County Government* (p. 7) warned that fishing escaped farmed salmon out of rivers can be a difficult proposition and just not practical in some cases; and the *Finnmark County Government* (p. 2) wanted more study of the feasibility of this option. Some environmental (*Nature & Youth/Friends of the Earth, Norway* (p. 6); WWF (p. 5)) and salmon organizations (*Sogn Council for Wild Salmon* (p. 3); *Norwegian Salmon Rivers* (p. 4)) and a sprinkling of others (for example, *Nordland Fishers' Union* (p. 2); *Alta Municipality* (p. 1)) and the *County Governor of South Trøndelag* (p. 7) wanted a solution to the escape problem before any growth was to be allowed at all, some without a discussion of at what level this would apply or precisely what form this should take. *Bellona* did not want the “fishing out” of escaped fish to detract from the “zero vision” (no escapes goal) of earlier governments (p. 5). Some respondents referred explicitly to the precautionary approach (“*føre var-prinsippet*”) embedded in the Norwegian biodiversity law to support actions to prevent escapes.¹⁹

Those who were less focused on wild stocks had much less to say about whether escapes should be adopted as some sort of action rule/indicator. Those taking no discernible stand on the issue include some key actors such as *The Food Safety Authority* (unspecified indicators could be added to the production area proposal) (p. 4), major unions (although *Tekna*, the union most directly associated with the industry, actively opposed adopting escapes as an indicator) (p. 2), and the

Network of Fjord and Coastal Municipalities. Companies involved in providing closed facilities avoided addressing the question directly but argued that closed facilities were the way of the future.

The position of the salmon aquaculture industry was quite clear. Those firms and organizations that expressed a clear opinion on this point were opposed to an escapes-indicator, with only one company supporting some version of it. The outlier was *Cermaq* (p. 2), which wrote that a company's good prior history with reference to escapes should be taken into account in decisions about allowing the company to increase production. The aquaculture producers' association *The National Association of Fishery and Aquaculture Businesses* simply agreed with the government position against having such an indicator (p. 2), and most other industry actors expressed agreement in a similar fashion or just agreed with in general *The National Association of Fishery and Aquaculture Businesses*.²⁰ *Salmar* (p. 7) phrased its opposition in a more conciliatory way, stating that while it opposed escapes as an indicator, this was a problem that operators had to get under control anyway. The industry groups *the Norwegian Seafood Association*, *Norwegian Industry* and the *Nordland, Troms and Svalbard* and *Finnmark* chapters of the *Confederation of Norwegian Enterprises* (writing together) opposed adopting escapes as an indicator or action rule in any form. Few of these actors had much to say about the fate of wild salmon or the impact of escapes on them. *Alsaker Fjordbruk* (p. 5), however, actively questioned whether escaped fish actually represented a problem, and *The National Association of Fishery and Aquaculture Businesses* discounted both the number of escapees and escape incidents (p. 9).

A total of 27 respondents were very clear that the industry should not grow unless escapes were brought under better control or prevented altogether. Concern for the fate of wild salmon and concern for the impact of escapees on this species is clearly widespread among those respondents most concerned with wild salmon and the challenges they face. The fishing industry is very skeptical as well—all three fishing organizations supported taking action against escapes – although they seemed less concerned on the whole with wild salmon than with the fate of other wild stocks for which no indicators were proposed. The concerns of all of these fit poorly with the proposed structure and the requirements the government set for selection of an action rule or indicator. Those that made strong statements in favor of including an action rule on escapes usually dispensed with an attempt to fit such an indicator into the government's specifications or management plan.

¹⁸ “Finnmark fylkeskommune støtter ikke departementets syn på at det per dags dato kun er lus og utslipp som er best egnet som miljøindikator i en handlingsregel for kapasitetsendring. Fylkeskommunen mener at både medikamentbruk og rømming må være med som miljøindikator. Fylkeskommunen er følgelig positive til a utfordringen med rømming behandles særskilt i et eget løp” (p. 2).

¹⁹ *Friends of the Earth - Norway & Nature and Youth; Norwegian Federation of Hunters and Anglers; Norwegian Salmon Rivers; Troms Country Government; WWF and The Norwegian Environmental Agency.*

²⁰ For example, Bremnes Seashore, Grieg Seafood, Marine Harvest/MOWI.

7. Discussion

The DWP and the hearing submissions show there were several interlocking reasons why the government's proposed indicator (the level of lice on wild salmon), and no other, became a part of the plan as enacted. First, the policy history focused policy makers and respondents on a limited number of potential indicators within a very specific framework, that of the production area. Second, for several reasons, stakeholder responses did not combine to create enough pressure to change the proposal in any substantial way. Third, the government's requirement for indicators related to the ecosystem made it difficult for stakeholders to argue for other indicators. The complexity of the issue, the incorporation of indicators into a proposal for a new management plan, and the requirements imposed for indicators by the government fractured the positions taken by respondents. Fourth, the discussion of indicators became entwined in powerful narratives about fairness.

7.1. Policy momentum

The development of a "production area with indicators linked to action rules" framework was the result of previous study, the Expert Commission named by the then Ministry for Fisheries and the Coast. This commission included key figures from the key governmental bodies (Directorate of Fisheries, the Food Agency, the Veterinary Institute, the [then] Directorate of Nature Management, the Norwegian Coastal Administration, the Food Authority, the Ministry for Fisheries and the Coast, the Directorate for Climate and Pollution), the single most important marine research body (Institute for Marine Research), an independent researcher (from the College of Bodø) and two county governments from the most important salmon aquaculture areas (Hordaland and Sør-Trøndelag) [87], [p. 11]. This report, delivered without dissent in 2011, accordingly set the course of policy development. In other words, there was a clear bureaucratic momentum behind the PA system.

The momentum for this plan reflected but also intersected with the long-term debate about salmon aquaculture in Norway and the long trail of studies and policy documents on the topic. The legacy of the debate and of previous Norwegian policy to protect wild salmon ensured that the fate of wild salmon would be a major part of the discussion and become in effect the clearest indicator for the environmental sustainability of the salmon aquaculture industry. The majority of actors participating in this hearing round have been active in the debate for years and are undoubtedly both well acquainted with these studies and documents and socialized into this focus. Perhaps as a result, the fate of wild salmon became the sole operationalization of the health of the ecosystem; neither the DWP nor the ensuing debate discussed what preserving the structure, function and productivity of the ecosystem should mean in this context.

7.2. Stakeholder responses on lice and escapes

If the momentum of previous policy guaranteed that the fate of wild salmon would be a major indicator of environmental sustainability, why was it that one "non-stabilized" threat (lice) was formulated into an indicator and the second, escaped fish, was not? This is made more interesting by opposition from the key salmon aquaculture and fishing industries, albeit for very different reasons, to the adoption of an indicator for lice. Some of the most impassioned writing of the submissions comes from salmon aquaculture actors who argued that the farmed-wild salmon nexus was just wrong, and from the fishing industry that despaired that their warnings against the effects of treatments for lice went unheeded. Many other stakeholders, however, supported by earlier policy documents, supported adoption of an indicator for lice. An indicator for lice was the indicator for which there was the most understanding and support within the government's preferred Alternative 3. The final White Paper shows that the Ministry could and did interpret

the hearing round as broadly supportive of its plan. Without it, the government would have had to launch a plan that was purported to be environmentally sustainable without a single indicator of environmental sustainability. It could also be said that the lice problem was already a major problem for the industry, since lice impact farmed salmon as well as wild ones. Resources were already flowing into work on the problem. One way or the other, the industry was going to have to deal with the problem of lice.

With respect to escapes, there was little disagreement within the submitted responses that escaped farmed salmon represent a threat to wild salmon. There were, however, real differences of opinion among those most concerned with the fate of wild salmon as to whether escapes would work *as an indicator in the new system*. They disagreed about the relationship between the density of farmed salmon in the area and the number of escapees, about where escaped salmon went, and about the fairness of punishing all operators in the area for the sins of one or a few. Moreover, they offered practical solutions, such as to make an escape action-rule that worked at the concession level. Adopting such a solution would violate the government's criteria, including pitching indicators at the production area level. Adopting such a position in the submission, however, meant that real concern for escapes did not translate into support for escapes as an indicator and action rule at the PA level. In addition, some of the civil society stakeholders most concerned about the fate of wild salmon were willing to accept at least to some degree the idea of treating escapes separately (that is, not as an "indicator" or a part of an action rule), which meant at that time, accepting the strategy of fishing up escaped farmed salmon. All in all, there was not enough pressure from outside the government for the adoption of an escapes indicator as a part the preferred PA-indicator framework.

7.3. Pollution and effluents

The legacy of the debate/policy momentum – including the 2009 "Strategy for an environmentally sustainable aquaculture industry" – meant that potential indicators relating to pollution and effluents from the industry would have to be considered in some way. Stakeholder views on pollution and effluents could not be adequately covered here for reasons of space, but one point does rather jump out: the DWP assertion that an emissions-indicator would be developed and incorporated into the new growth policy appears to have had a pre-emptive, tempering effect on the expression of such concerns in many submissions. Some actors did raise emissions as a main concern, notably the fishing industry's concern with chemicals used to combat lice, but the DWP deferred this concern to the undefined future along with other potential effluents and pollution, including nutrients from feed and feces. For the most part, stakeholders external to the government tacitly accepted the statement that "emissions from aquaculture today are not considered to be an environmental problem" [1], [p. 45].

7.4. Formulation of indicator criteria

The government increased the threshold for adopting any indicator for salmon aquaculture that would double as an action rule by requiring a direct relationship between the amount of such aquaculture present and effects on the ecosystem (effectively operationalized as wild salmon) and by requiring that such an indicator relate to a condition that could be reversed. The directness of the connections between the amount of farmed salmon in a given production area, the number of escapees and the presence of escaped farmed salmon in the rivers of the PA from which they escaped became a major issue in the discussion of escapes, and generally weakened support for the inclusion of such an indicator.

Interestingly, "escapes" are not actually an indicator of the condition of an ecosystem or of the state of wild salmon as such; they are an agent of change. If an "indicator" of the impact of escapees on wild salmon were sought, it would make more logical sense to talk in terms of the

genetic impact of escapees. There was no proposal to do this, and one has the impression that this might be difficult. It would also raise the question as to what degree the genetic impact of farmed salmon on wild salmon can be reversed. This issue was not taken up in the DWP or in the responses.

7.5. Entanglement in the new management proposal

The authors found it impossible to focus this paper exclusively on the indicators. Those commenting on the government's choice of indicators had the same difficulty. As noted, the placement of any indicator in the PA system diffracted views on indicators. Political realities may have also intervened. Stakeholders who had wild-salmon concerns largely wanted to engage with the new policy framework, and paired their objections with proposed policy improvements. The Ministry interpreted this position as "support". Those who thought that the proposal was too restrictive were less likely to want to work within the policy framework, and outright opposition to alternative 3 was both more frequent and easier to categorize on the "industry-side" than on the "environment-side". Industry was perhaps more combative because it stood to gain ground anyway, since the government had already decided to increase production; pushing for a looser or no lice indicator had little potential cost and much potential gain. On the other hand, those who feared for wild salmon might have sought, at least in part, to temper the worse effects of a decision already made. The fishing industry was an exception to this; its representatives voiced the most uncompromising "environmental opposition" of the hearing round. Their main objections were unrelated to whether the new regulations could succeed in protecting wild salmonids – and would obviously not be ameliorated by a decision rule based on an indicator for lice alone.

7.6. Fairness

Perhaps the most interesting and potentially most consequential finding of this study is how often the issue of "fairness" came up. The most adamant objections to alternative 3 from the salmon aquaculture industry concerned the production area model, and what they saw as "collective punishment": good operators should not be punished for the poor performance of others. This was a potent argument; and concern for fairness was evident among a wide variety of stakeholders; it served to weaken support for an escapees-indicator. This is striking because such an argument could be used to oppose any PA-level indicator. Indeed, it would apply to any indicator, rule or legislation that sought to use the perspective of cumulative impacts on an area or ecosystem as a reason for limiting the contribution of any contributor within it.

7.7. Science and politics

Two issues underlay all of the discussion: science and politics. This paper has not delved into the science behind the selection of these indicators. This is too large a task to include here. Instead, it has reported on what some actors had to say about some of the science. The *National Association of Fishery and Aquaculture Businesses*, the most important industry spokesman, argued strongly against the connection between lice on farmed salmon and wild salmon. Other scientific questions debated include those about where escaped salmon swim, the effects of de-licensing treatments on wild stocks (such as shrimp), and about the feasibility of indicators for pollutants and effluents at the PA level. It is clear that the science of these questions is critical for an effective policy, and also that effective participation in such a policy debate requires much of non-specialists. Many non-scientists referred to the work of specialists embodied in national reports. It is for this reason that a very close reading of the responses of the Institute for Marine Research and the Directorate of Fisheries is important and their "hedged support" for the government's proposal so interesting; the clear opposition to not including an escapees indicator from the governmental agency charged

with the care of wild salmon (The Norwegian Environmental Agency) is striking.

That leaves the politics of the issue. The political decision to allow the industry to expand was already made, as a number of commenters observed. The lack of adequate indicators for pollution and effluents and impact of escaped farmed salmon on wild salmon left the government with options other than to proceed without them. The scheme could have been substantially altered, abandoned or delayed. However, the government clearly favored the PA scheme and growth. This is a decision at the level of high politics, since the success of the industry is framed as of strategic importance to the country.

There is also a communication issue involved in this debate and this plays into the politics of the management scheme. The Norwegian government proclaimed as its goal a management plan for environmentally sustainable Norwegian salmon aquaculture. But this scheme went into operation with a single indicator for sustainability, which on the face of it, does not appear to be a scientifically plausible position. However, Norwegian aquaculture sites are already regulated at the farm and production site levels. Excluding consideration of that work in the formulation of a plan pitched at the PA level creates the impression that no other measures to protect the environment are being taken. That being said, there remains an inherent difficulty in combining farm or facility-level measures with measures intended to capture cumulative effects at the PA (or ecosystem) level. A related point is that Norway has also adopted an ecosystem approach to marine management as well as the EU Water Framework Directive. While the latter was mentioned, there was very little linkage of the salmon aquaculture management scheme to these efforts. Again, the launching of a management scheme with a single indicator/action rule communicates a simplistic view of the environment to the public. Combined with the clear commitment to growth, this invited broad skepticism.

8. Conclusion

Norway's proposal for a new management plan for salmon aquaculture was an important event in the long-term development of salmon policy. The hearing round for this proposal provided an occasion for the most interested parties to voice their views on this plan, and responses to the plan offered a chance to survey these views in a controlled fashion.

A key question about the resulting plan has been why salmon lice on wild salmon was selected as the one, lone variable to serve as an indicator of sustainability. The salmon aquaculture industry is clearly the most valuable and dynamic of the industries directly represented in this study and the government clearly favored it. That did not mean, however, that the industry got everything it wanted. Generally speaking, the industry did not want an indicator for lice or for escapees. We conclude that there were several interlocking factors that account for this outcome, including past policy momentum, the framing of the indicator within the new management plan, the lack of unambiguous and unified pressure from outside the government for other indicators, and the intervention of the fairness narrative.

The new system went into effect on October 15, 2017. The first appraisals of the new production areas have already been made and the government has made its first round of decisions about allowing growth. These first decisions confirm the fears expressed by many and confirm the pro-growth attitude of the government: in the two areas which were given a red light, the amount of farmed salmon was not reduced, and in one area coded yellow, growth was allowed [88].

Escapees have indeed been "handled separately" since the end of this round of hearings: a fund has been established to "fish out" the farmed salmon found in Norwegian rivers. This does nothing to prevent escapees to begin with, and it is hard to believe that all or even a significant number of escaped fish can be extracted in this way. In addition, this solution does little to protect the interests of anglers and riverbank owners for whom catching farmed fish is anathema. A great many of the wild-salmon focused respondents agreed that tagging farmed fish was

essential in both quickly identifying escaped fish and in identifying the site from which they escaped. As of yet, no such system is in place. Research is underway, however, into two other solutions: creating sterile farmed salmon and closed facilities, possibly on land, from which there would be no escape.

As a final observation, the analysis of these responses illustrates how difficult it is to put questions like these out for public comment. Those responding to the plan had to comment on many aspects and scenarios and arguing effectively required a good deal of knowledge on multiple issues. The proposal required that commenters take stands on science issues on which scientists may disagree. It is striking, however, how well informed many of the lay commenters are.

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CRedit authorship contribution statement

Jennifer L. Bailey: Conceptualization, Methodology, Validation, Investigation, Writing - original draft, Writing - review & editing, Visualization, Supervision, Funding acquisition. **Sigrid Sandve Eggeride:** Conceptualization, Methodology, Validation, Investigation, Writing - original draft, Writing - review & editing, Visualization.

Appendix. URL link to all submissions

Submissions in alphabetical order

- Alta Municipality**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/alta-kommune.pdf?uid=Alta_kommune
- Alta Salmon Fishing Interest Association**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/alta-laksefiskeri-interessentskap.pdf?uid=Alta_laksefiskeri_interessentskap
- AkvaDesign AS**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/akvadesign-as.pdf?uid=AkvaDesign_AS
- Alsaker Fjordbruk AS**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/alsaker-fjordbruk.pdf?uid=Alsaker_fjordbruk_AS
- Bellona**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/bellona.pdf?uid=Bellona>
- Bremnes Seashore AS**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/bremnes-seashore-as.pdf?uid=Bremnes_Seashore_AS
- Brilliant Buildings (Byggutengrenser)**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/byggutengrenser.pdf?uid=Byggutengrenser>
- Cermaq**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/cermaq.pdf?uid=Cermaq>
- Coast Seafood AS**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/coast-seafood.pdf?uid=Coast_seafood_AS
- Confederation of Norwegian Enterprise – Nordland (NHO Nordland)**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/naringslivets-hovedorganisasjon-nho.pdf?uid=Naringslivets_hovedorganisasjon
- Directorate of Fisheries (Fiskeridirektoratet)**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/fiskeridirektoratet.pdf?uid=Fiskeridirektoratet>
- Finnmark County Government**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/finnmark-fylkeskommune.pdf?uid=Finmark_fylkeskommune
- Fishfarming Innovation AS**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/fishfarming-innovation-as.pdf?uid=Fishfarming_Innovation_as
- Friends of the Earth, Norway, Hitra-Frøya Chapter**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/naturvernforbundet-hitra-froya-lokallag.pdf?uid=Naturvernforbundet_Hitra-Frøya
- Friends of the Earth, Norway, West Finnmark Chapter**
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- The Government Pension Fund (Folketrygdfondet)**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/folketrygdfondet.pdf?uid=Folketrygdfondet>
- Grieg Seafood ASA**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/grieg-seafood-asa.pdf?uid=GriegSeafoodASA>
- Hammerfest Municipality**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/hammerfest-kommune.pdf?uid=Hammerfest_kommune
- Hardanger Fjord Association**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/hardangerfjordlauget.pdf?uid=Hardangerfjordlauget>
- Hordaland County Governor**
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- Institute of Marine Research**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/havforskningsinstituttet—vedlegg-.pdf-11436609.pdf?uid=Havforskningsinstituttet_-_Vedlegg
- Ministry of Justice and Public Security (statement of no comment)**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/justis-og-beredskapsdepartement.pdf?uid=Justis_ogberedskapsdepartement
- Marine Harvest (now MOWI)**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/marine-harvest-asa.pdf?uid=Marine_Harvest
- Møre and Romsdal County Government**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/more-og-romsdal-fylkeskommune.pdf?uid=Møre_og_Romsdal_fylkeskommune
- The National Association of Fishery and Aquaculture Businesses (now Seafood Norway)**
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/fhl.pdf?uid=Fiskeri_og_havbruksnæringens_landsforening
- Nature & Youth and Friends of the Earth, Norway**
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/naturvernforbundet-natur-og-ungdom.pdf?uid=Naturvernforbundet>
- Network of Fjord and Coastal Municipalities**
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Nofima AS
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Norcem
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Nordland Fishers' Union
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Nordland County Government
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Nordland County Governor
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Norwegian Coastal Fishers' Union
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Norwegian Confederation of Trade Unions -National organization (LO) https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/landsorganisasjonen-i-norge-lo.pdf?uid=Landsorganisasjonen_i_Norge

The Norwegian Environmental Agency
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/miljodirektoratet.pdf?uid=Miljodirektoratet>

Norwegian Federation of Hunters and Anglers
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/norges-jeger-og-fiskerforbund.pdf?uid=Norges_Jeger-og_Fiskerforbund

Norwegian Fishers' Union
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Norwegian Food Safety Authority
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Norwegian Industry
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Norwegian Institute for Nature Research (NINA)
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Norwegian Salmon Rivers
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/norske-lakseelver.pdf?uid=Norske_Lakseelver

The Norwegian Seafood Association
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The Norwegian Society of Graduate Technical and Scientific Professionals (Tekna)
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/tekna.pdf?uid=Tekna>

Norwegian Union of Food, Beverage and Allied Workers
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/norsk-narings-og-nytellesmiddelearbeiderforbund.pdf?uid=Norsk_Narings-og_Nytelsesmiddelearbeiderforbund

Norwegian Union of Municipal and General Employees (Fagforbundet)
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/fagforbundet.pdf?uid=Fagforbundet>

The Norwegian Veterinary Association

https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/den-norske-veterinarforening.pdf?uid=Den_norske_veterinarforening

Norwegian Veterinary Institute (Veterinærinstituttet)
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/veterinarinstituttet.pdf?uid=Veterinærinstituttet>

Pharmaceutical Industry (Legemiddelindustrien)
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/legemiddelindustrien.pdf?uid=Legemiddelindustrien>

Rogaland County Governor
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/fylkesmannen-i-rogaland.pdf?uid=Fylkesmannen_i_Rogaland

Salmar ASA
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/salmar-asa.pdf?uid=SalMar_ASA

SalmonCamera
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/salmoncamera.pdf?uid=SalmonCamera>

Salmon Group
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/salmon-group.pdf?uid=Salmon_Group

Sami Parliament of Norway
<https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/sametinget.pdf?uid=Sametinget>

South Trøndelag County Governor
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/fylkesmannen-i-sor-trondelag.pdf?uid=Fylkesmannen_i_Sor-Trondelag

Sogn and Fjordane County Government
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/sogn-og-fjordane-fylkeskommune.pdf?uid=Sogn_og_Fjordane_fylkeskommune

Sogn Council for Wild Salmon (Sogn Villaksråd)
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/sogn-villaksrad.pdf?uid=Sogn_Villaksråd

Troms County Government
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/troms-fylkeskommune.pdf?uid=Troms_fylkeskommune

WWF Norway
https://www.regjeringen.no/contentassets/b2de95d503b842c599412de09d5c68b3/wwf.pdf?uid=_WWF-Norge

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.marpol.2020.103925>.

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