The making of a louse - constructing governmental technology for sustainable aquaculture.

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Abstract

Salmon production, and aquaculture in general, entails certain environmental risks that must be managed and controlled. In Norway, as in other aquaculture-producing countries, governments seek means of improving the industry and encouraging sustainable conduct. In Norwegian aquaculture regulation, the salmon louse has become an important indicator and regulatory instrument – a governmental technology. The louse is a proxy for the environmental impact of the industry and as a governmental technology, it is used to regulate and incite behavior. In this paper, we draw on results from both interviews and an analysis of responses to a consultation round for a governmental White Paper proposing new means for regulating the growth of the aquaculture industry. Based on these results, we investigate the becoming of the salmon louse as a regulatory instrument, and how this is perceived among relevant stakeholders. The political significance of the salmon louse serves to illuminate how a governmental technology is created to instill control from a distance. The history of how the salmon louse has become a governable object additionally elucidates disagreements and uncertainties surrounding modern salmon farming and demonstrates that the creation of governmental technologies persists in the face of resistance.

Keywords: *aquaculture, governmental technology, policy, indicator use, qualitative analysis*

Introduction

During the past 50 years aquaculture has gone from being a relatively insignificant food source to surpassing that of wild fisheries (FAO in Garlock et al., 2019). The aquaculture industry currently produces 47% of the total global fish production (FAO, 2018). Production of Atlantic salmon is in comparison to the production of carp and tilapia of less volume. However, Norway, being the largest producer of farmed salmon, still rates among the top ten aquaculture producing nations (Garlock et al., 2019). Salmon production in Norway also had the fastest growth rate (7%) among developed countries in the last decade and the 16th fastest growth rate among the major producing nations (Garlock et al., 2019). While beneficial physical conditions, such as a lengthy coastline providing sheltered conditions, biological, and technological innovations, can account for much of the success of the salmon industry in Norway, good governance structures and regulatory frameworks are also an important reason (Osmundsen, Almklov, & Tveterås, 2017). The stability and quality of the regulatory environment for the aquaculture industry has in former research been seen as linked to technology adoption (Kumar, Engle, & Tucker, 2018), and possibilities for expansion (Young et al., 2019). The shape and form of public regulation has a strong influence on how the aquaculture industry develops. It is therefore important to increase our understanding of how different regulatory systems and instruments perform.

In Norwegian aquaculture regulation, the salmon louse, *Lepeophteirus salmonis*, has since 2009[1] been central to the public regulation of salmon aquaculture in Norway. Increased attention to the salmon louse is related to the growth of the industry, alongside greater awareness of how lice infection may have negative consequences for wild salmon. During the same period, there has been increased pressure for greater control with the industry (Olsen and Osmundsen, 2017). In public debate, it is foremost the environmental impact of salmon production that is seen as a risk (Olsen and Osmundsen, 2017; Osmundsen and Olsen, 2017), and this is where the impact of salmon lice on wild salmonids takes centre stage[2] (Misund, 2019). Salmon lice are deemed one of the biggest threats to wild salmon in Norway (Thorstad and Finstad, 2018). Indeed, this tiny louse has the most significant economic impact of any parasite in salmon aquaculture (Costello, 2006), instigating multi-million dollar commercial

[1] The Salmon Lice Directive came into force in August 2009.
[2] A search in Norwegian media archives (Atekst) revealed that salmon lice was mentioned in three media pieces in 1986, 186 pieces in 2006 and 4,494 pieces in 2015.

losses (Abolofia et al., 2017). The requirement for frequent lice counts is perceived as demanding within the industry owing to resources and costs(Thorvaldsen, Frank, & Sunde, 2019). Nevertheless, lice counts are very important since reported lice numbers may have severe implications for day-to-day production, as well as for companies' production licences. Emphasis on lice is demanding for the fish itself and for the staff, as strict delousing regulations requires more operations on the farm, causing reduced welfare for the fish, and a higher risk for unsafe operations that may lead to both escapes and possible harm to personnel (Holen et al., 2018).

The problem is considered so severe that salmon louse as an indicator now permeates most of Norwegian public regulations concerning aquaculture. The political significance of this tiny louse is thus impressive, persisting in the face of heavy resistance and disagreement among public and private stakeholders alike. In this paper, the development of how the salmon louse becomes a regulatory instrument – a governmental technology- to control the aquaculture industry is discussed. In addition to constituting a parasite that threatens the salmon industry, public authorities view the louse as an objective and reliable indicator regarding human impacts on nature. Regulation of sustainability often relies on measurable parameters, and the salmon louse is easily counted and communicated. Indeed, a number serves as a point of reference: something that is transferable and easy to compare, a potential yardstick holding industrial actors accountable. However, as the empirical data for this paper demonstrates, in order to become a governmental technology, the salmon louse must be transformed and defined in ways that both simplifies and reduces the uncertainty regarding its causes and consequences. This, in turn has implications for the salmon industry as well as for legitimising public regulation and control of the aquaculture industry.

Drawing on neo-Foucauldian and constructivist perspectives, this article explores disagreement and resistance towards establishing the salmon louse as a governmental technology in Norwegian aquaculture, and discusses the possible implications of such a process.

Theoretical background

Constructionist perspectives of risk, which highlight historic, social and cultural contexts, are useful for understanding why the salmon louse has become such an important representative of sustainability in the Norwegian aquaculture industry. The types of risk subjected to public regulation have changed over time. To illustrate this point, Beck (1992) uses the term *risk society* to describe a global society where the risks associated with modernisation, created by humans through science and technology, are placed in focus. In the risk society, environmental risks stand out. Accordingly, salmon lice and farmed salmon are perceived as anthropogenic threats to wild salmon. In environmental discourse, the louse is not merely an indicator, but becomes a symbol of the potentially dangerous and unsustainable aspects of aquaculture. Moreover, given that nature is not directly accessible, it must be represented through specific governable objects. These objects are constructed through symbolic representations of components and processes in an ecosystem (Johnsen et al., 2014). Thus, although some outcomes can be measured and monitored directly, indicators are employed to ascertain the condition of something through measuring something else that is easier to measure (Amundsen & Osmundsen, 2018; Kongsvik, Almklov, & Fenstad, 2010; Osmundsen et al., 2020). The louse represents the environmental consequences of aquaculture and serves to create specific intervention mechanisms for governance because it can be measured, quantified, and modelled (Hersoug, 2015). Indeed, it is an indicator that serves as a governmental technology.

Risk management via institutions is closely linked to accountability, responsibility, and expectations to reduce the risks in question (Power, 2007). Organisations must act in ways that fulfil these expectations by demonstrating accountability (Johnsen et al., 2014). Governmentality, as Foucault (1991) defined it, is about understanding how to enable 'the conduct to conduct'. That is, how does government enable control at a distance without applying the use of direct or immediate force? Technologies of government, as Rose and Miller (1992) argue, tie together the responsibility of individuals and their freedom to pursue a prescribed and standardised target. The governmentality framework provides a set of characteristics that allows us to understand how such technologies or objects are established, as well as their implications for instilling control and power (Dean, 2010; Miller and Rose, 1990; Rose and Miller, 1992). Therefore, the central question of governmentality is by what means are governments able to instill control and predictable conduct in society (or, pertaining to this paper, foster sustainable conduct)? Part of the answer is to alter the subjectivities of actors, which means to give the governing subjects motivation to self-regulate. Motivation arises from having received the responsibility to comply, and the threat of sanctions if not. The focus of compliance is a defined and recognised object: a governable object. Such an object must be rendered knowable, not merely as an object in itself, but as an object 'that can be governed through decentered, self-regulating means' (Rydin, 2007:611).

The construction of governable objects, as ‘concrete devices for managing and directing reality’ (MacKinnon, 2000:296) can be quite varied, but often involve techniques of counting and calculation. In the realm of aquaculture, the louse can be seen as a representative of human impact on nature, and in order to perform associated inspections and control compliance, authorities need an indicator that is easily measurable. Given that the louse is visible and countable, it is an excellent candidate. As Miller (2001) eloquently argues, what is counted usually counts, which may help to explain the overwhelming focus on the salmon louse and the considerable efforts made by the industry to control infestations. To govern by numbers means to apply the logic of accountancy to the realm of public management, and thus the ability to translate diverse and complex processes into a single figure. As stated in the White Paper fortifying salmon louse as an indicator for regulating aquaculture production in Norway: 'In simplifying complicated conditions, an indicator should provide a clear signal on the status or change in status' (Fiskeridepartementet, 2015).

Indicators like governmental technologies and governable objects have multiple purposes and serve different interests. Both within organisations and in regulation from public authorities, control is sought by auditing a delimited number of parameters, usually quantitative (Amundsen & Osmundsen, 2019). Although qualitative reports may contain more information, they are vulnerable to suspicions of bias; in contrast, measurements and numbers convey a reassuring 'mechanical objectivity' and methodological transparency (Porter, 1996). Standardised measures and indicators are mobile across contexts, facilitate commensurability (Espeland and Stevens, 1998) and reduce transaction costs in a global economy (Busch, 2000, 2011). When employed in regulation, indicators must be standardised in order to create fair and transparent competition (Almklov et al., 2014). Indicators may serve to bridge knowledge gaps and help construct a web of commonly shared norms, conventions, and rules across different policy arenas (Guston, 1999; Jasanoff, 1987) thus creating consensus between actors regarding their usability. However, more often than not resistance exists towards such processes (Rydin, 2007). Indeed, Strassheim & Kettunen (2014:260) highlight how the construction of a governable object constitutes a result of 'an intensive and complex struggle for political and epistemic authority on both sides: science as well as policy'.

The creation of governmental technologies additionally rests on mechanisms of exclusion and selectivity, here most notably modes of blackboxing (Callon, 1986; Latour, 1999) and over-simplification (Scott, 1998). Blackboxing is a social process where complexities are rendered invisible and obscure to give way for the production of objectivity. As Porter (1996:27) explains, black boxes are *artificial entities that are treated as units*; what we see is the input and output, whereas the inside remains agreed and accepted pieces of knowledge that are rarely examined. In turn, over-simplification pertains to the narrowing of vision, thereby bringing into focus certain limited aspects of an otherwise complex reality. The aspect in focus is thus rendered legible and makes the phenomenon more susceptible to measurement and calculation (Scott, 1998). However, this also entails that certain issues are prioritised over others.

Materials and methods

Empirical setting

Governmental control with the aquaculture industry was earlier based on control with production volumes, first with feed quotas, next by delimiting the production permitted in volumes, and today through Maximum Allowed Biomass (MAB) (Hersoug and Hovland, 2014; Hersoug et al., 2019). Environmental concerns have continuously been emphasised in regulation, but primarily through control with operations.

The salmon louse existed long before fish farming was introduced, and was known to cause wounds and discomfort in wild salmon. However, as salmon aquaculture production increased in terms of volume, salmon lice infestations increased too. This represents a problem for both farmed and wild salmon, but the main aim of specifying and regulating lice on farmed salmon is to protect wild salmonids. Fewer lice in aquaculture pens result in lower infection pressure on passing wild salmonids.

The concentration of lice in aquaculture facilities has been shown to affect and infest passing wild salmon and trout, but there is disagreement regarding the strength of the correlation between lice levels in aquaculture pens and the mortality of wild salmonids. Karlsen et al. (2016) have summarised the knowledge gaps concerning the relationship between salmon lice and wild salmonids, concluding that knowledge is medium or bad for a number of key issues pertinent to applying salmon lice as an indicator for regulation. Even though Thorstad and Finstad (2018) subsequently demonstrated that salmon lice are very likely to have a population effect on wild salmonids, disagreements and uncertainties have led to protests against the role of salmon lice as a governmental technology.[3]

In 2009, the Salmon Lice Directive was passed in order to regulate the infestation levels of lice in aquaculture pens in Norway. The directive specifies how salmon lice should be counted, how treatments against lice should be conducted, and the authority of the Food Safety Authority in controlling and sanctioning breeches. It further specifies how counts

[3] See for instance - http://ilaks.no/risikabelt-lakse-eksperiment/ [in Norwegian]

should be undertaken and when, on which pens, and how many fish.[4] The Food Safety Authority can reduce production on sites that display long-term problems with lice. Accordingly, since 2015, 41 sites have been instructed to reduce production. Since 2009, the directive has been modified several times, in particular towards specifying an increasingly strict number of lice permitted. Salmon lice issues prevented the authorities from issuing ordinary aquaculture licences between 2009 and 2013, despite the government's significant ambitions for growth in the aquaculture industry. In 2013, so-called green licences[5] were issued with special requirements calling for stricter control against salmon lice and escapees, and introducing a stricter limit for lice (0.25 level and 0.1 level). With the announcement of development licences in 2015, the salmon louse was once again made the centre of attention. These licences promote technological innovations that could combat lice and escapees. Companies with these special purpose licences can later transform them into a regular licence in exchange for a fixed price.

In 2014, the White Paper to the Storting (Fiskeridepartementet, 2015) proposed new means of regulating growth in the aquaculture industry, again based on lice numbers as an indicator. The Directorate of Fisheries, which has the authority to grant permits and MAB, was now to rely on lice numbers and modelled effects on wild salmon in order to regulate production volumes in the Norwegian salmon industry. In the new system, where the production sites across Norway are divided into 13 production areas, lice numbers are the sole indicator[6] to permit or deny production growth, measured in MAB affecting all sites in the same production area. Each area receives a green, yellow or red light towards production growth based on an estimate of 'salmon lice induced mortality on wild fish'. Companies can be offered an increase in MAB if their area receives a green light, or as an exception, individual sites with extremely low lice numbers may also be offered an increase. In sum, the specific lice levels applicable to sites and companies vary extensively (across geographical areas, types of licences, and seasonal variations) and constitute a complicated system to regulate and control.

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[4] According to the Salmon Lice Directive, §6, lice are to be counted at least every seventh day with temperatures equivalent to or above 4°C, and at least every fourteenth day with temperatures below 4°C. At any time, there should be fewer than 0.5 grown females on average per fish in an aquaculture facility (§8). When a facility has more than three pens, the lice from a selection of fish from at least half of the pens should be counted each time, so that all pens are included in two consecutive counts. If the facility has three pens or fewer, lice on a selection from all pens should be counted each time. From 1 June to 31 January, counts should be conducted on 10 randomly selected fish, and from 1 February to 31 May on 20 fish. Lice should be counted and categorised in three stages: female adult, pre-adult and chalimus. The average number is calculated based on the number in each stage from all fish examined, divided by the total number of fish examined.

[5] So-called 'green licences' are permits announced by the Norwegian government in 2013, with conditions promoting a higher environmental standard than before, e.g. limiting the threshold for lice numbers and medical treatments.

[6] To be more precise, the modelled mortality of wild salmonids based on numbers of lice in aquaculture facilities and local dispersion patterns. For further information: http://www.imr.no/lakseluskart/html/lakseluskart.html In the White Paper, it was foreseen that louse as an indicator would be coupled with other indicators, but this has yet to occur.

Materials

The material for this article is a document analysis of responses to the consultation round for the White Paper (Fiskeridepartementet, 2015) proposing a new system for regulating growth in the salmon farming industry in Norway, an interview study with industry representatives, scientists and governmental agencies, and available public material (White Papers, official statistics, and policy papers).

The analysis of responses to the consultation round on the White Paper includes 56 responses from different stakeholder groups. Of these, 20 came from industry actors (both aquaculture and other industries), 15 from non-governmental organisations (NGOs), nine from governmental agencies, eight from municipalities and counties, and four from research institutes. With the aim of discussing the development of the salmon louse as a governable technology, as well as the disagreement and resistance that exists regarding this development, the responses were read and categorised. Statements regarding salmon louse as an indicator and suggestions for other indicators were noted. Other statements concerning the consequences of using the salmon louse as an indicator were also recorded, especially pertaining to the consequences for the regulatory system and expressed uncertainties linked to the indicator itself.

The material also consists of qualitative interviews with industry and public administrators in Norway, where the scope was the potential to improve existing regulatory mechanisms and systems. This includes 53 interviews, each lasting approximately one and a half to two hours. These comprise interviews with 25 aquaculture companies (22 fish farms and three service companies or veterinaries) and 28 representatives from public authorities: (Food Safety Authorities, Directorate of Fisheries, County Governor (Climate and Environmental Department) and Counties and Municipalities. The starting point of the interviews was to study public aquaculture regulation aimed at sustainable growth, in light of current policy strategies, day-to-day regulation, and the increased focus on sustainability issues. Semi-structured interview guides were prepared to ensure that all relevant topics were covered, while at the same time allowing for follow-up questions on topics raised by the informants. The interview guides were prepared for each group of respondents allowing for questions adapted to each while maintaining comparability in types of questions and topics. After a short introduction about the background of the respondent, the interviews' main topics concerned the respondents' experience and perception of public regulation of the aquaculture industry, availability of up-to-date knowledge and information, collaboration and dialogue between public regulators and industry, and finally the main challenges facing the industry and the extent of sustainability of aquaculture production. All of the interviews were recorded, transcribed, and anonymised.

The transcribed interviews have been re-read for the purpose of this article, and the transcripts coded in categories identifying statements regarding the role of salmon lice in public regulation, regulatory frameworks and praxis, and impact and effect of regulation. The coded transcripts were compared across respondent groups (public authorities and industry), and within each group, to identify similarities and differences between respondents. To explore the salmon louse as a governmental technology and the resistance towards it, the results presented in this article focus on the discourse of regulation and sustainability in the aquaculture industry, especially regarding how our respondents frame lice, and the role of lice in characterising challenges in aquaculture. Furthermore, we also present the respondents' understandings and perceptions of the salmon louse as an indicator for sustainability.

Results

Below we report on findings from our material highlighting the characteristics of the salmon louse being established as a governmental technology, as well as resistance to this process.

1. Expanding governmental control: establishing a proxy for environmental impact

Historically, salmon lice have not always been viewed as a problem, as a statement from one of the respondents from the aquaculture industry reveals:

"*Catching wild salmon in Norwegian rivers with salmon lice was once considered a sign of quality and freshness. If the wild salmon had lice when caught, it was viewed as a strong individual that had travelled up the river so fast that the lice had not had time to be washed off*" (Industry, 101).

However, considering the scale of salmon production today, the salmon louse is viewed as a severe environmental problem. This is also reflected in the responses to the White Paper, most of which express a need and willingness to develop improved environmental control, as well as agreement that the salmon louse constitutes a good indicator of the environmental impact from salmon production. However, several responses underline the fact that self-reported lice numbers by the industry might not be trustworthy and that applying lice as the sole indicator is too narrow an approach. Moreover, some responses express disagreement with the relevance of the salmon louse as a proxy for environmental impact. For instance, the Norwegian Seafood Federation, which represents 600 companies in the seafood industry, argues against using salmon louse as a proxy for environmental impact, holding that the scientific foundation for asserting that there is a strong correlation between mortality in emigrating wild salmon and infestation levels of lice in aquaculture facilities has not been proven. On the other hand, they do support the use of lice for controlling growth in the industry, as this may induce increased motivation to control infestation levels and have a positive impact on animal welfare.

The following quotation from an aquaculture company summarises the disagreements:

"*And the regulations, they are based on knowledge that we see as insufficient. It is the interaction between aquaculture and wild fish that is the reason we handle it the way we do. Just last year the Norwegian Institute for Nature Research stated, on our commission, that the knowledge we have today about the interaction between wild fish and aquaculture is not good enough. There are big knowledge gaps that need to be filled, and we probably have more such areas. If you ask someone who is an expert on handling parasites the answer will be that the regime we have today is completely wrong*" (Industry, 102).

This respondent echoes the concern voiced by both respondents in interviews and responses to the White Paper: the salmon louse is important in assessing environmental impact, but provides only part of the full picture, and several knowledge gaps remain.

2. Moving towards self- regulation and sanctions

Establishing the louse as a governmental technology means to incorporate the indicator as part of public authorities' mandate to sanction non-compliance, and to motivate industrial players to comply.

In the responses to the White Paper, concern for how the salmon louse is to be incorporated into the existing mandates of the various public authorities responsible for regulating aquaculture is voiced. The Directorate of Fisheries and the Food Safety Authority both claim that the new production area regime based on louse as an indicator will be complex and difficult to administer, and that responsibilities between the various agencies might be obscured. One of the industrial actors echoes these concerns, arguing that the proposed changes may disrupt the former division between industrial policy as a political domain and environmental or biological expertise. Several of the industrial actors recommend that awarding licences and production growth should continue to be based on price alone, and that lice and other environmental issues should be regulated through inspections (and sanctions) of day-to-day operations. In an interview, a respondent from the Food Safety Authority expressed concern about the unilateral focus on lice. In the new production area system, the louse is the sole indicator for growth, yet indicators for the health and welfare of farmed salmon are neglected.

The handling of the lice problem is also relevant for the County Governors, who are responsible for issuing discharge permits in the different counties. County Governors are increasingly concerned about discharge from delousing medication, but also consider the sharing of responsibilities across different public authorities a difficult task. As stated by one respondent:

"*It's a bit strange that there are two public authorities that deal with pollution. The Food Safety Authority gives permission for the use of environmentally harmful substances and discharge, meaning delousing medication, without involvement from us [County Governor]. In our legal framework there are few contradictions. They work with lice and delousing medication hoping that a better handling of it will come, because veterinary authorities evaluate disease, but perhaps they haven't considered the effects outside of the pen*" (Public agency, 202).

The responses also reflect disagreement as to the sanctioning of non-compliance, and argue against establishing production areas based on collective sanctions, i.e. all producers in one area may risk reduced MAB if one producer fails to comply. What is referred to as collective sanctions in a production area receives considerable attention from the industrial actors in their responses to the White Paper, as well as from some of the counties. Indeed, a respondent from an aquaculture company states:

"*The traffic light system is collective punishment; a whole area can get reduced biomass because of one producer who does not follow the regulations, and who doesn't have control with his production. The individual companies should have to reduce their production. That is what they do now. And that is the right way to do it*" (Industry, 103).

A few of the public agencies also voice their disagreements with the collective sanction. For instance, one county argues that the Food Safety Authority already has the mandate to reduce biomass at a site level, and warns against a production area system based on collective sanctions.

3. Rendering the louse knowable and governable

Science has provided knowledge that has rendered the salmon louse knowable, and enabled the transformation of the salmon louse into an indicator that fish farmers can count and authorities can control and measure. During the past 10 years, knowledge about the salmon louse has increased, and models and tools to enable decision support and statistical overviews have been developed.

On the other hand, several of our respondents question the scientific foundation and the conclusion that has been drawn. As one of the respondents from an aquaculture company states:

"*The current lice situation… I am very uncertain of both the lice situation and the escaped farmed fish in the rivers. It has never been discussed. It has just been concluded that both have an impact on the wild stock. But all experiments show that perhaps it does not have such a large impact on the stocks. So, we have the Norwegian Food Safety Authority… and the authorities just implemented lice and escapes as absolute things. Because of… something I don't… I feel this discussion has never been open, in a way. It has just… The conclusions have just been made"* (Industry, 105).

Respondents from public agencies also acknowledge the importance of more knowledge about the issue. As stated by a public administrator: "*There is a need for more information regarding lice because the media and society in general focuses more on it*" (Public agency, 202). Even though the louse is at centre stage in the regulation of aquaculture, more knowledge is required.

Some fish farmers claim that the amounts of lice currently in Norwegian fish farms are the same as 30 years ago. Some also argue that they scarcely experience lice on their fish, because the prevalence of infestations varies geographically. As stated by one respondent:

"*We do not have an animal welfare issue with salmon lice in Norway. Perhaps some areas have it from time to time. But we have zero, we almost never have any lice on our fish. So, we are using up the active medication available on something we do not know why we are doing. It might be that we are doing the right thing, but I don't think we are quite sure*" (Industry, 101).

The respondent highlights how geographical variation is ignored when the coordinated use of delousing medication is enforced in areas with several fish farms. Another respondent claims:

"*When you look at the industry, you have a lice crisis in Trøndelag [...]. But the whole industry is viewed as having a lice crisis. Last time we had a challenge [of lice] in this region was in 2009. That was seven years ago. And still... you are treated as if you have a crisis*" (Industry, 104). There is disagreement among our respondents as to whether or not the Norwegian salmon industry as a whole is experiencing augmented numbers of lice, and there is also disagreement within the industry as to the significance of the problem and how it should be combated.

This debate is echoed in responses to the White Paper: claims are made that the proposed salmon louse indicator is both too weak and too strict, and the disagreements range from how robust it is to what it actually represents. This concerns how the number of lice comes to be, and what level of lice numbers should lead to measures by the farmer or public agencies. Responses also highlight a concern that reducing the number of lice permissible will lead to more delousing operations, thus causing stress, high mortality, reduced growth, and a weakened immune system in salmon. Delousing operations may also represent a risk for the personnel and cause damage to net pens (hence causing escapes). The respondents therefore claim that there is a high cost, both for the fish and for the staff, of reducing lice infestations. Several responses (such as by research institutes) call for indicators to measure the use of medication, with the purpose of motivating the industry to apply non-medical methods against salmon lice. Most responses from the industry acknowledge the importance of using the salmon louse as an indicator, but additionally question the scientific foundation for concluding that salmon lice have a population effect on wild salmonids. Several of the NGOs' responses to the White Paper also emphasise the need to improve the scientific foundation for applying the salmon louse as an indicator and seek additional indicators. Moreover, some of the environmental NGOs conclude that compliance with the indicator should not lead to increased biomass.

One of the research institutes responsible for developing the distribution model for salmon louse, the Institute for Marine Research, acknowledges the need for more knowledge and warns against the threshold value suggested by the White Paper, but concurs with the use of the salmon louse as an indicator.

4. Translating salmon counts into routinised modes of action

Since 2009, counting salmon lice has constituted a routine aspect of operating a fish farm, and as the permissible level of lice has diminished, the number of delousing operations has increased. Several of the responses to the White Paper question how, by whom, and where (i.e. in a pen, on a site, or in a production area) lice should be counted. An issue that is frequently raised pertains to whether counting by the producers themselves can be reliable, as the potential exists to game the system. Both responses to the White Paper and interviews reveal concerns about the dilemmas involved in handling the farmed fish at increasingly lower levels of lice.

Additional delousing operations have unintentional consequences, including the augmented transportation of fish increasing the possibility of transmitting diseases and reducing fish welfare. As a respondent from the Directorate of Fisheries explains: "*There are some who think that one has been too strict on regulating lice levels, and that it has brought more problems than solutions*" (Public agency, 203). Certain dilemmas are involved, as combating lice with delousing medication is understood to affect the marine environment, especially crustaceans. Moreover, physical handling of the farmed salmon when delousing is harmful and stressful, and being reared into well boats for delousing causes wounds that may weaken their immune system. As the following statement from a respondent at the Directorate of Fisheries concerned with fish welfare illustrates:

"*If you have two million fish at one fish farm, and you have a loss of 20 per cent, or you have a mortality of 20 per cent, 400,000 fish disappear. It is not a pretty picture. There is something about natural mortality rate in fish that you can't put 1,000 fish in the ocean and expect that 1,000 fish will make it no matter how well you treat them, really. But 20 per cent and more, that's not good. No, the fish are handled a lot more. They are handled too much. In and out of well boats, lice treatments and stressing, perhaps moving*" (Public agency, 204).

Furthermore, respondents from the county administration are sceptical of the emphasis on lice, especially in the media:

"An optimal environment is the safest way to avoid disease. Stress causes disease. Delousing on low occurrences of lice also causes stress, especially if you use hydrogen peroxide and need to delouse in a well boat. We have received comments from the veterinary inspector that this is not justifiable for animal health. But society has made some conditions here... The media and society in general do not have professional insight into this... but there is no room for discussion. You do not get your message across and few dare to try" (Public Agency, 205).

In the same vein, a respondent from the industry explains the consequences of the regulations: "*What we are in the middle of now – a lice discussion – the way the regulations demand that we handle lice in situations in periods where there is a big risk related to mortality for example, is not sustainable*" (Industry, 102). The potential effects of combating lice (whether via medication or technology) on the environment, wild salmonids, and farmed fish constitute the centre of attention for many of the stakeholders' discussions, especially those in the industry.

5. Standardising louse counts across time and space and disciplining through naming and shaming

While louse counts have been routine operations on salmon farms since 2009, it was through the publication of a so-called "lice list" that the public authorities (Food Safety Authority) in 2015 increased the pressure to comply. Lice counts from individual farms along the coast were thus compared and publicly announced three times a year, naming and shaming those who had exceeded the permitted numbers of lice for a longer period of time and who had been given a warning or decision to reduce biomass. Standardising louse counts across time and space, and naming and shaming those who do not comply is viewed as a way to "discipline" the industry into compliance, as explained by a respondent from the Food Safety Authority: "*It works like self-discipline, because it is not OK to end up on that list, with poorer results than your neighbour*. *We will not see any improvement unless somebody feels that it is a bit uncomfortable*" (Public agency, 320).

However, the industry perceives the publication of the lice list as unnecessary and claims that it will have negative consequences for public opinion:

"*Many politicians still believe that the industry has a problem with lice because we are unwilling, and if the industry is willing to put enough money into the machine we will remove all lice. […] This is a total lack of knowledge. And of course, this [perception] does not improve when researchers claim they have the solution. We face the same challenge with the vendors saying "we can kill the lice. We have the solution". All of this information from actors around the industry, with their own agendas, contributes to this misconception of the situation*" (Industry, 305).

The standardisation of lice numbers across time and space, and the publication of lice numbers are not considered in the White Paper, and few of the responses thus reveal perspectives on the matter. Nevertheless, a couple of responses indicate how the causes of infestations may be external to the farm. One of the producers argues that companies with large sites will influence the level of lice in a production area more than companies with smaller sites, due to their greater biomass. The response points to the fact that although counts are conducted in individual pens and farms, the causes of infestations may actually be neighbouring farms and currents. Standardising counts across time and space is thus deemed problematic.

Discussion

The results of this article illustrate resistance and disagreement regarding the establishment of the salmon louse as a governmental technology in Norwegian aquaculture. To become a governmental technology, the louse needs to be rendered knowable, an object that can be governed through decentred self-regulating means (Rose and Miller, 1992). This necessitates consensus regarding what the louse represents – a threat to wild salmonids – and reliance on the counts made by fish farmers. Through the White Paper, the government suggested boosting the industry's motivation to reduce lice infestations by linking low levels to promises of increased growth in production, and the threat of sanctions (such as reduced biomass) where the industry fails to comply. While the results demonstrate that most stakeholders consider the salmon louse important in assessing environmental impact, there is widespread concern that the indicator is only partial and that knowledge gaps need to be filled. Industrial actors and public authorities also argue against the introduction of collective sanctions, as well as against obscuring divisions between different public authorities and their respective mandates. The findings show that there are disagreements regarding the degree of impact on wild salmonids, whether the lice infestations are equally problematic at all sites and geographical areas, and the robustness of the indicator. Another characteristic of the salmon louse as a governmental technology is to translate lice counts into routinised modes of action (Hersoug, 2015; Rose and Miller, 1992). Industrial actors and public authorities, among others, voice concern over the dilemmas involved in treating salmon at low levels of lice infestations, which they perceive as undermining fish welfare (and even causing mortality), encourage gaming the system through reporting lower levels of lice than is the case, and increased escapes due to a higher frequency on operations.

The final characteristic of establishing a governmental technology is to standardise louse counts across time and space, and to encourage self-discipline through naming and shaming (Rydin, 2007). The standardised lice counts and publicly available indicator trends have a clear normative directionality that stimulate improved performance, and encourage self-discipline. The 'naming and shaming' of the industry through publicly available lice data seeks to influence behaviour and enables comparisons to be made across time and space. There are divergent opinions as to the consequences of publishing the names of the sites that exceed lice numbers, and a few of the responses to the White Paper voice disagreement regarding the standardisation of lice counts.

The salmon louse as a governmental technology apparently lacks the capacity to create consensus among stakeholders. The political career of the louse has persisted despite disagreement and resistance from various stakeholders. Strassheim and Kettunen (2014) describe a similar trajectory when investigating the scientific approval of facts through intensive and complex struggles for epistemic authority. They find that this especially applies to circumstances where it is difficult to validate knowledge, akin to the situation in aquaculture (Osmundsen et al., 2017).

The results demonstrate resistance to the political career of the salmon louse as a governmental technology. The process is characterised by disagreements between those who emphasise that knowledge gaps and uncertainties must be filled before refining the system, and those who hold that the knowledge is sufficient and will be improved by installing the system. As such, the application of the louse as a governmental technology can be seen as part of an intention to improve the regulatory framework and a means to attain knowledge.

The implications

There are at least four implications of the salmon louse as a governmental technology. First, in order to become an indicator, disagreements and uncertainties must be concealed through processes of blackboxing (Callon, 1986; Latour, 1999; Porter, 1996). All the reservations, guesswork, judgments, decisions, uncertainties, and inconsistencies that enabled the salmon louse to become an indicator of environmental impact are obscured; hence the number is portrayed as neutral and objective. Indeed, public authorities and others present and discuss numbers of lice as a neutral fact and provide a skewed impression to the public of what the indicator represents. Certainly, an impression is created that lice counts represent routine operations that are not susceptible to creative gaming or bias. An impression is also made that even though medical treatments against lice should be limited, other measures such as cleaner fish and technological solutions are readily available. Such measures have negative consequences for fish welfare, causing stress and mortality (Holen et al., 2018), also for the cleaner fish (e.g. lumpsuckers), and are not as effective and available as one would think. Thus, our respondents have revealed the disagreements and uncertainties that the salmon louse as a governmental technology entail.

Second, blackboxing serves to position responsibilities and power. The aquaculture industry bears much of the responsibility for severe lice numbers, but the predominance of the salmon louse as an indicator also conceals numerous complex relationships between cause and effect. When these are obscured, the industry additionally holds responsibility for conditions and circumstances beyond their control and influence, even though these are better managed through a combination of private and public regulation (Osmundsen et al., 2017). Furthermore, controlling lice has become a collective responsibility, as augmented lice numbers in production areas include several fish farms that are measured and sanctioned. Establishing the louse as a governmental technology affords power to some and responsibilities to others. Given that the salmon louse represents accepted/unaccepted environmental impact, the Directorate of Fisheries now has the power to reduce MAB in production areas where lice numbers are too high. In contrast, such a sanction was only available to the Food Safety Authority at the site-level in the past.

An indicator by its nature constitutes a simplified representation of reality (Kongsvik et al., 2010). Indeed, although the salmon louse has become a star with tremendous power in the regulation of aquaculture, it can only say something about a tiny piece of a complex reality. The third implication of relying too much on one indicator is that the focus on the louse becomes so narrow that other issues are placed outside of focus. Both industry and regulators spend considerable time and effort counting and controlling lice, whereas important issues such as diseases and other parasites receive less attention. Furthermore, by placing such an emphasis on local externalities of aquaculture production, important broader scale impacts of the industry are, to a large degree, not addressed (Amundsen, Gauteplass, & Bailey, 2019).

The fourth and final implication is that the importance of controlling the louse is so paramount to the industry that all energy is expended in this task. This includes most technological, biological, and managerial innovations and investments that are currently made, resulting in less effort applied to other issues. The aquaculture industry views the louse as a threat to its environmental credibility and reputation (Vilde Steiro Amundsen, Gauteplass, & Bailey, 2019). It is therefore important for the industry that they are seen to take the problem seriously, following regulations and implementing measures to combat salmon lice, in spite of the negative consequences of such efforts. Negative and unintended consequences can be increased transportation of fish augmenting the transmission of diseases and reducing fish welfare, the use (and subsequent death) of cleaner fish, and the stress and deterioration of welfare among salmon due to treatment.

The White Paper also discusses the use of other indicators, and while the responses are mixed, the conclusion was that other indicators must wait until more knowledge has been attained. Several issues besides lice may well become candidates for governable objects and indicators for sustainability, including mortality rates and losses, use of medication, escape of fish, discharge, parasites and viruses, fish behaviour (e.g. welfare and stress), and fish growth (i.e. food intake). Indicators that represent these issues are being used to guide management strategies and to report on environmental impacts, but they have not become governable objects to the same extent as the salmon louse. Based on the argument presented in this paper, this may be because none are precise enough or as easily countable. However, in the future, such indicators may also be included as governmental technology in the same manner.

Concluding remarks

In the salmon farming industry in Norway, the salmon louse has been called upon to encourage responsible rearing of salmon, to improve decision-making, to reduce environmental impacts, and ultimately, if combated, to promote production growth in the industry. In spite of resistance and an intense struggle for political and epistemic authority, the salmon louse has persevered as an indicator, and today permeates the Norwegian regulation of aquaculture. As a protagonist in the public administration of aquaculture, the salmon louse represents the environmental consequences of salmon production: it protects the wild salmon, serves as a yardstick for public regulators, and enables the industry to demonstrate accountability. The louse is thus plastic enough to serve as a common reference for seemingly contradictory positions regarding aquaculture, despite the lack of consensus. A question that only time will answer is whether this should be seen as governmental craftsmanship, allowing for control from a distance, or simply a failure to create consensus among the numerous stakeholders concerned with the role of aquaculture production.

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