The health situation in Norwegian aquaculture 2018. Welfare concerns over the use of new technologies

The Health Situation in Norwegian Aquaculture 2018 is the sixteenth in an annual series of fish health Reports. It contains a risk evaluation of the health situation in Norwegian aquaculture — predominantly as it relates to Atlantic salmon as this is their most numerously farmed species — with 1,253,000 tonnes of salmon being produced in 2018 (rainbow trout are the second with 64,000 tonnes produced).

The Report is split into 12 sections, which variously detail changes in risk of infection, fish welfare, viral bacterial and fungal diseases of salmonids, parasitic infections and miscellaneous health problems in farmed salmonids and the health situation in wild salmonids. Other sections include the health situation in cleaner fish — for which numbers stocked have continued to show a sharp rise (up 18 million from 2017 to 55 million individuals in 2018) — and farmed marine fish (other than salmonids). The Report flags up some serious concerns regarding the use of new technologies and the impact they have had on fish health and welfare.

The sentiment and approach of this Report is perhaps best outlined in the opening paragraphs of the section on fish welfare. This argues that if fish welfare is to be a priority in Norwegian aquaculture there needs to be a change in both attitude and practice, such that farmed fish are treated as individuals with specific requirements. It is currently common within the Norwegian industry to use a term 'svinn' relating to fish loss that is more widely used in other industries to refer to non-sentient/inanimate product loss. To avoid obscuring costs to welfare, the authors of the Report call for a conscious move towards discussion of fish as individuals, and not biomass, and for the use of language that talks of mortality and loss — in line with existing Norwegian legislation that recognises that individual fish have an intrinsic value independent of any financial value. The Report then proceeds to adopt this approach in the rest of the areas it discusses.

The first section, on changes in risk of infection, provides an overview of developments and areas of concern in the aquaculture industry important for fish health. In 2018, 53 million salmon were reported as lost to the industry, the majority due to deaths caused by infectious disease or injury (87.2%). Significant regional differences exist in fish lost, indicating regional variation in disease and infection — and this variation is detailed in the later sections on specific diseases. A smaller percentage of fish were lost due to rejection on grounds of quality (6.6%) or other causes (6%). This latter category includes deaths (3.2 million) due to routine management and treatment procedures, such as salmon louse control (of which more later).

The Report highlights the transport of live fish, both smolts and harvest-ready fish, as a significant risk factor for the spread of disease. This is because latent infection can be hard to detect and diseased fish may be introduced into previously healthy populations. Infection can also be picked up during transport, from the well-boats used to move the fish, although better disinfection of boats, and of the influent and effluent water which may contain marine pathogens, has led to a reduced risk of spreading disease.

The use of enclosed land-based recirculation systems (RAS), is increasing in popularity and now form the majority of new juvenile production systems for salmon. These systems recirculate the water through the system and offer the opportunity to reduce exposure of the fish farmed in them to pathogens and provide a more stable aquatic environment. Good biosecurity is key to the successful operation of these systems as any disease introduced into these systems will be recirculated through them and can be hard to eradicate and cause high levels of mortality. Infections enter such systems via introduced roe or fish or via the water source. Water quality is also of prime importance and the Report highlights increased levels of CO_2 and H_2S as particularly problematic in seawater systems and systems with low replacement of water where they can cause acute mortality events. High CO_2 levels, which have been reported to be up to 30 mg L^{-1}, have been linked to calcium deposition in the kidneys (nephrocalcinosis) which can affect kidney function and salt balance and result in reduced fish welfare and increased mortality.

Enclosed or partly enclosed sea-based systems are also being developed, that aim to establish a more secure barrier between the enclosed captive fish and the marine environment. The primary driver for their adoption is to avoid and/or reduce the settlement of salmon lice on the farmed fish. They are also expected to reduce fish loss due to escape. As with the land-based recirculation systems, water quality is important and this is influenced by water volume, current speed, temperature, biomass and feeding. The Report indicates that there is much still to be learnt about such issues for such systems to operate securely and for fish welfare to be protected.

Section three addresses fish welfare and gives more detail about the specific welfare challenges of the different production systems and management and treatment procedures, especially those relating to the control of salmon lice, where the welfare concerns are significant.

Despite improvements in technology and management, the Report states that mortality in the industry remains high, although the time when fish die has changed. Previously, runting — where a fish stops growing and becomes emaciated after transfer to the sea — was a significant problem but losses due to runting were reduced in 2018. Instead, larger fish are dying at higher frequency. The Report puts this down to the increased adoption of non-medicinal treatments to control salmon lice — specifically thermal and mechanical treatments.

The control of salmon lice has been an issue for salmon farmers since the 1970s. These crustacean salmonid fish parasites attach themselves to salmon in the later stages of

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their lifecycle and feed on skin, mucus and blood. While only a very few fish die due to salmon lice infection, if the burden of lice on an individual is high then they can pose a direct welfare challenge to the fish. Anaemia and open lesions may occur and these lesions may provide a point of entry for secondary infection. Over time, lice have become increasingly resistant to the chemicals used to control their numbers and so aquaculturists have moved towards other methods of control. In 2018, the Report identifies that it is now more common for Norwegian farmers to use preventative measures — such as reducing louse access to the salmon — and/or thermal, mechanical and biological means of control.

In that these treatments are effective for shorter periods, it means the salmon have to be handled and treated more frequently, which impacts negatively on fish welfare. Non-medicinal treatments lead to stress and increase the risk of physical injury and/or death. Indeed, the Report draws attention to the fact that thermal and mechanical treatments result in increased post-treatment mortality compared to medicinal or freshwater-based treatments. Further, the impact of such treatments is particularly marked on fish that are already suffering from poor health, eg infectious viral or bacterial disease.

Thermal delousing most commonly involves the transfer of fish to a warm water for 30 s, where the raised temperatures shock the lice and cause them to let go (exposure to cold water also seemingly has the same effect). The temperature of such baths is usually 29–34°C — dependent on sea-water temperature, level of infestation and treatment effect — and the Report indicates that such temperatures are painful to the fish. Indeed, salmon par and smolt exposed experimentally to temperatures of 30–33°C apparently die within 10 min, and wild salmon have been reported to die if exposed to temperatures of 29.5°C for extended periods. When asked the temperature normally used in thermal delousing, the Report indicates that over 80% of respondents used temperatures of between 31–34°C, with a few indicating that temperatures as high as 36°C had been recorded. Panic attacks are common when salmon encounter the warmed water, as the temperature differential experienced between seawater and treatment water is generally around 22°C. Treatment with warmed water has been linked with an increase in physical injuries to the salmon, including gill haemorrhage, scale and skin loss, degeneration of nasal epithelium and brain haemorrhage.

Mechanical delousing involves the physical flushing of lice from the skin of the salmon. This can occur through the use of water jets or turbulent water and by physical brushing. Injuries caused by such treatments include scale loss and skin lesions.

Both thermal and mechanical delousing also involve the crowding of fish prior to treatment and increased handling, which themselves represent a considerable welfare challenge. In addition to increased injuries, fish can also experience stressful changes in water quality, eg through falls in oxygen levels.

The Report is critical of the rapid uptake and use of such new technologies and calls for the impact on welfare to be better assessed before they are adopted more widely. The Report notes that it is compulsory in Norway to report serious welfare challenges to the Norwegian Food Safety Authority and during 2018 60% of the 1,036 reports received related to non-medicinal delousing treatments and handling — accounting for approximately one-third of all such treatments. The Report notes that this high figure is extremely concerning and states "Given the relatively common occurrence of acute mortality episodes in association with thermal delousing, there must be a considerable question mark over whether this method, as it is currently used, represents an acceptable means of treating fish in terms of fish welfare". Such is the concern that fish health personnel have advised against treatment using these systems on welfare grounds.

The Report addresses welfare issues related to another increasingly popular method of salmon louse control; the use of cleaner fish that are kept with the salmon and feed off lice infesting them. The majority of the 55 million cleaner fish used in 2018 were farm-produced lumpsuckers (40 million individuals) with wild-caught wrasse making up 13 million plus (farmed Ballan wrasse accounted for only 1.6 million individuals). Lumpsuckers are favoured because they actively remove lice at temperatures lower than wrasse species. They also have a shorter lifecycle than wrasse and are more easily raised in captivity. In addition, the use of farmed cleaner fish allows improved biosecurity as the introduction of wild-caught cleaner fish into aquaculture facilities may introduce infection/disease into the system.

The production and husbandry of the cleaner fish brings a new set of health and welfare challenges, not least as they relate to the species themselves. Lumpsuckers, for example, are susceptible to serious bacterial infections and the majority of antibiotic prescriptions were for this species (this contributed to a rise in antibiotic use in the Norwegian fish industry in 2018, but it still remains stable and relatively low — between 0.5 and 1.5 tonnes of active substance — despite increasing numbers of fish farmed). The transport of wild-caught wrasse to salmon farms can also result in high mortalities, with up to 40% being recorded during the process. Water quality during transport is also an issue as some wrasse species seem particularly sensitive.

Mortality and problems directly or indirectly associated with handling (particularly in association with transfer to sea and non-medicinal lice treatments), fin-rot, skin disease and bacterial diseases, such as atypical furunculosis and vibrosis, are the most significant health- and welfare-related challenges to the use of cleaner fish. Of these, post louse-treatment mortality, particularly following non-medicinal lice treatments and associated

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handling is the most important, with 100% mortality reported for some treatments. This is despite the introduction of legislation in 2018 that requires cleaner fish to be recaptured prior to delousing or harvest of salmon. In part, this is because of the difficulty of recapturing the cleaner fish. There are also issues as to what to do with recaptured cleaner fish as they pose an infection risk to any salmon they are rehoused with. The Report calls for a continued focus on increasing the knowledge of the health and welfare requirements of cleaner fish.

Amongst some of the other welfare challenges discussed in the welfare section are those relating to production of large smolts, water quality in juvenile salmon production and water quality in marine facilities.

In the sections on the various diseases and infections of farmed salmonids, detailed descriptions, control measures and breakdowns of the disease situation are given for the various diseases covered. Viral diseases are considered to have the greatest effect on fish welfare after salmon lice infestations. Cardiomyopathy syndrome (CMS) is the most important of these, followed by pancreas disease (PD). The Report raises the concern that recent research has indicated that CMS has the potential to transmit from parent to offspring. Amongst the other six diseases detailed are infectious salmon anaemia (ISA) and heart and skeletal muscle inflammation (HSMI).

For bacterial disease, the Report indicates that vaccination programmes against diseases such as vibriosis and furunculosis have brought the previously huge losses caused by these under control. Use of antibiotics to control such diseases remains low, both compared to previous use and to the increased levels of salmon production. Developing areas of health and welfare concern are winter ulcer — which presents as visible lesions on the flanks of fish caused by systemic infection by *Moritella viscosa* normally during the autumn and winter and which causes increased mortality and yersiniosis (or enteric redmouth diseases), a systemic disease caused by the bacterium *Yersinia ruckeri*. Stress caused by handling and thermal/physical delousing are thought to be important factors in outbreaks of yersiniosis.

This Report gives an excellent overview of the situation in Norway regarding farmed fish and should be of interest to anyone working in aquaculture and/or interested in fish welfare.

The Health Situation in Norwegian Aquaculture 2018 (February 2019). A4, 132 pages. Hjeltnes B, Bang-Jensen B, Bornø G, Haukaas A and Walde CS (eds). Norwegian Veterinary Institute report series nr 6b. Available online from: www.vetinst.no or https://www.vetinst.no/rapporter-og-publikasjoner/rapporter/2019/fish-health-report-2018/_/attachment/download/cdb0d230-03ee-44bb-a139-7b3df553ff84:1a35928cc7d96375db49c2fcd337524e37f437eb/Fish%20health%20report%202018%20eng-enkeltsider.pdf.

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Tourism and animal welfare

ABTA (a travel trade association for tour operators and travel agents within the UK) has recently published a Best Practice Guidance Manual for animals in tourism. ABTA consulted with stakeholders from around the world (industry experts, scientists, zoological organisations, and other non-governmental organisations) to produce the manual with the aim of encouraging suppliers of animal experiences and attractions to take into account animal welfare.

The manual consists of twelve sections. Sections 1 to 5 introduce the concept of animal welfare (based on the Five Freedoms and the Welfare Quality® criteria), discuss the ways in which animals may be used in tourism, and put forward minimum requirements and best practice. Section 6 goes on to describe what are considered to be unacceptable practices within the tourism industry (eg ostrich riding, crocodile wrestling and trophy hunting) and discouraged practices (eg feeding animals with live vertebrate prey, tethering birds of prey). Unacceptable practices are those which are known to be detrimental to animal welfare and should therefore not be offered for sale to customers. Sections 7 to 12 go on to cover: legal requirements — CITES; acquisition of animals; animal sanctuaries; protecting livelihoods; wildlife souvenirs; and volunteer tourism. The manual emphasises that animal welfare is best protected by working with and engaging local communities.

ABTA is the largest travel organisation in the UK and it hopes that by encouraging its members to subscribe to the manual that the standard of animal welfare across the tourism industry can be improved.

Global Welfare Guidance for Animals in Tourism: A Best Practice Guidance Manual (2019). A5, 67 pages. ABTA Animal Welfare Guidelines. ABTA The Travel Association. Available to download (free) online at: https://www.abta.com/industry-zone/abta-shop/abta-animal-welfare-guidelines.

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Updated Code of Practice for the welfare of pigs in England

Ten species-specific Codes of Recommendations for farmed animals have been published by the Department for Environment, Food and Rural Affairs (Defra). The Codes support legislation and guide owners and keepers in how best to care for their animals. However, some of the Codes are significantly out of date and do not reflect the latest scientific and veterinary knowledge or legislative changes. Consequently, Defra is in the process of updating the Codes and the latest update to be published is the Code of Practice for the Welfare of Pigs in England (Scotland, Wales and Northern Ireland each have their own codes of welfare).

The Code applies to all farmed pigs in England and is intended to help owners and keepers practice good standards of stockmanship — an essential prerequisite to

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