



Work with fish welfare in hatcheries



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Content

1. Introduction.....	4
2. About the production of smolt.....	4
3.1 Conduct of the study	5
The interviews	6
3.2 Analytical approach.....	7
4. Findings from the interview study.....	8
4.1 Material infrastructure and technology	8
4.2 Formal structure	10
4.3 Culture and knowledge.....	12
4.4 Interactions and work processes.....	14
4.5 Social relations	15
5. Suggestions for best practice	16
5.1 Adapt the production.....	16
5.2 Understand and make use of existing information	16
5.3 Use specialized operators in a robust organization.....	17
5.4 A critical and strong fish health team	17
5.6 Dialogue with other organizations and the authorities	17
5.7 Fish welfare competence for all.....	17
6. Concluding remarks.....	17
7. References	18

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Summary

This report describes findings from a qualitative study of incentives for fish welfare in hatcheries. This is part of a research project funded by the The Norwegian Animal Protection Alliance's Research Fund *Incentives for fish welfare in juvenile fish production*. The study is a collaboration between the Veterinary Institute and NTNU Social Research and was completed in 2020.

We have interviewed 18 people who are involved in smolt production in Norwegian fish farming companies. The topics for the interviews are incentives for work that promotes fish welfare, including knowledge and organizational support.

The results show that incentives are e.g. how the organization facilitates the use and development of competence, collaboration, production plans with room for biological variation, and contact with regulatory developers.

There are many practical and biological knowledge gaps. This study has suggested some practicalities that hatcheries should consider introducing to promote fish welfare:

- Customize production
- Use and understand the information they have
- Use especially competent operators in a robust organization
- A critical and strong fish health team
- A present management
- Dialogue with other organizations and the authorities
- Fish welfare competence for all

Running a biological production requires fish welfare competence and a production system adjusted to the biology.

Thanks to Kristina Josefin Sundnes (student) for transcribing, and to the participants for helpful reflections and for generous sharing of knowledge!

1. Introduction

This report shows how some fish hatcheries work with welfare today, and culminates in proposals for best practice to promote fish welfare. Animal welfare in farmed fish has received increasing attention in recent years. The mortality in farmed fish at sea is a concern for both fish farmers and the society. In comparison, there has been little attention paid to welfare and mortality in hatcheries, although the mortality is higher in this part of the production. In 2018, the total number of dead fish in hatcheries was 60.6 million individuals, while the total number of dead fish in the sea phase was 52.7 million (Directorate of Fisheries). The financial losses associated with poor welfare and mortality in seawater farms is higher than in hatcheries, and might be one of the reasons why the focus on the welfare and mortality in seawater phase is more common.

Research on fish welfare in hatcheries has mainly revolved around water quality and fish health (for example NIVA: VK 1999-2006, Adams et al., 2007 and Kolarevic et al, 2014). In a study where employees in hatcheries were interviewed about how they work to improve welfare and productivity, it came stated that the employees considered that their routines were given by the design of the facility. They had few opportunities to change e.g. when the eggs is placed in the hatchery due to the facility and the managements wishes (Størkersen, Jakobsen & Schiefloe, 2018).

In 2019, the project Animal Welfare in the hatchery production (SMÅFISKVEL) put the spotlight on fish welfare in hatcheries. In this project, analyzed mortality figures reported to The Norwegian Food Safety Authority and a survey was also conducted. The project found large differences in mortality between hatcheries, which indicates room for improvement for many (Tørud et al., 2019).

As for any production of animals, there is a dynamic interaction between the risk of events that causes reduced welfare and mortality, investment in the control of such incidents, and the related incentives as the decision maker meets (Rich, 2007). Previous research shows that it is time to shed light on incentives to be able to promote welfare, such as knowledge and organizational support. Through in-depth interviews of various personnel groups involved in Norwegian hatcheries, we have examined incentives to improve fish welfare in hatcheries. Based on the interviews, we describe some suggestions for «best practices» that can improve the welfare of juvenile fish.

The industry is described in Chapter 2, the method in Chapter 3, and the findings in the study in Chapter 4. Chapter 5 consists of proposals for aspects that can be included in a «best practice» for hatchery management.

2. About the production of smolt

Fish farming in Norway is defined as industry. The first part of the production takes place in freshwater hatcheries on land, where the juvenile salmon stay until smoltification. The second part of the production takes part at seawater farms, where the salmon grows until slaughter.

It`s important to remember that the production is based on live animals, even though the process is industrialized. The fish must be in focus continuously. This balance between the industrial operation and animal husbandry is possible when “all” production parameters can be controlled. New hatcheries (many with RAS - Recirculating Aquaculture Systems), have systems that allow them to control light and temperature. This makes them independent of seasonal variations. This makes it possible to have control of the growth and makes the production more predictable. However, it does require knowledge and precise limits for water quality parameters. These requirements for specific water quality will change during the production cycle. The regulations do not set any limits for water quality. The FISHWELL handbook contains a number of recommendations and a background knowledge in addition to recommended welfare indicators (Noble et al, 2018).

In SMÅFISKVEL, it was reported that the smallest fish had the highest mortality (Tørud et al., 2019). This is related to the first-feeding period which is a vulnerable phase. No differences were found in mortality related to farm size. In SMÅFISKVEL's study, it was stated that welfare was a topic at regular meetings among the employees and most thought they benefited from participating in fish welfare courses required by regulations. However, there were some cases where the management would provide unrealistic production plans and the hatchery staff felt bound by something that was impossible. There were also found huge differences in limits for density and temperatures in the production. The facilities' own limits were not necessarily within the recommended limits. There were huge differences in the practice regarding planned destruction of fry. Such conditions affect the fish welfare. SMÅFISKVEL showed that even though fish welfare is in focus at the hatcheries, the practices are very different. So is the perception of what good fish welfare is.

Both salmon and rainbow trout are robust species that can adapt to an intensive production. New research shows that rapid growth in the freshwater phase is not necessarily followed by the same growth rate in the seawater phase (Frisk et al. 2020). A successful smoltification is essential not only for survival, but also for the welfare by ensuring the best possible transition to the sea. Therefore, it is a requirement in the Aquaculture Operations Regulations that "Adequate smoltification of anadromous fish to be released into seawater shall be documented through suitable tests, if such tests exist (Aquaculture Operations Regulations § 26, third paragraph, authors translation).

Organization of personnel varies between the companies, and so do job descriptions. In this report we use the following terms:

Operator	Responsible for the daily care of the fish, the biological aspects
Technician	Responsible for the technical parts at the facility
Operations Manager	Responsible manager at the hatchery, large facilities may have one biological and one technical operations manager
Coordinator	For larger companies with more than one hatchery, responsible for coordination of production and e.g. health controls
Fish health personnel	Veterinarian or fish health biologist in charge of fish health and welfare
Top manager / central management	Management of the fish farming company, where the hatchery is one of several units

3. The study

This study is an interview study that is analyzed and presented in the dimensions of the pentagon model (Figure 1).

3.1 Conduct of the study

The aim of these interviews was to find incentives to promote fish welfare for the various hatcheries. The data collection has followed research ethics guidelines and has been approved by the Norwegian centre for research data (NSD).

The selection

In this study, we have interviewed people at different levels in several companies, and both newer and older hatcheries. The hatcheries produce salmon smolt. We have interviewed operators, operations managers and technical staff. In addition, we interviewed coordinators, regional managers, and top management, as the study in the SMÅFISKVEL project showed perceptions that some hatcheries were not equipped for the production determined by the top management.

We recruited the interviewees in a wide range of Norwegian fish farming companies with hatcheries. Employees in different positions from six companies participated. 18 interviews were conducted. All six

companies had both freshwater and seawater production, but not all had production of eggs within the company.

The interviews

18 confidential semi-structural research interviews of one to two hours duration were conducted as video meetings or by phone in the summer of 2020. The fact that everything took place anonymously meant that we gained insight into both what was perceived as positive and negative.

The interviews were based on an interview guide, which was a checklist to ensure that we went through the same subjects in all interviews. Adjustments were made according to what level the person we interviewed worked at, as operator, operations manager, hatchery coordinator, technical staff or senior management. The questions were about process and decisions, care of the fish, competence, tasks that take care of fish welfare, how the organization assesses the work with fish welfare, personal incentives, and finally thoughts on society, regulations and supervision.

The researchers took thorough notes during the interviews. Audio recordings were made in 16 of the 18 interviews, and four of the audio recordings were fully transcribed. The quotations in Chapter 4 are taken from notes and transcripts. To maintain anonymity, we have not added a position or other identifications to the citations.

Considerations during the interviews

The study of mortality in SMÅFISKVEL showed that some hatcheries had the highest mortality for several years in a row and another group had low mortality for several years in a row. However, a small qualitative study is not suitable for finding causal relationships between incentives / motivation / working methods and mortality.

Because this is a small qualitative interview study, it would not be possible to compare welfare as a cause of differences in mortality. The interviewees were therefore not recruited based on mortality in the production.

We did not interview a representative sample of interviewees, but interviewed those who volunteered to talk with us. Since our goal is to find incentives for working with fish welfare and to find recommendations for the best practice, it has been useful to get answers from those who are particularly motivated for fish welfare work. However, this study does not provide answers on the connection between the efforts in working with welfare and mortality.

This report describes the opinions of the people we have interviewed. In cases where the interviews revealed opinions that do not agree with research, this was discussed during the interview and is not referred to in this report.

Expected utility value

This study, including discussions and dissemination of the findings in this report can contribute to:

- Increased focus on the intrinsic value of juvenile fish, regardless of economic value, both for producers, at the public and among consumers.
- Increased motivation among producers of juvenile fish to improve the welfare in their facilities.
- Better welfare of juvenile fish by identifying knowledge gaps and suggestions on «best practice» to achieve better welfare in hatcheries.
- Increased focus on the problem of high mortality in hatcheries among fish farmers, researchers, decision makers and authorities.

3.2 Analytical approach

In order to present and analyze the empirical material, it was necessary to create a certain structure in the data material. An analytical model developed by Schiefloe (2017), Schiefloe and Vikland (2006) gives us opportunity to look at the organizational context as consisting of five different dimensions: Structure, technology, culture, relationships and interaction. These five dimensions can be used as analytical pegs for the interview data and shows how organizational aspects, such as incentives to take care of fish welfare, is affected by several factors in the organization and by individuals with different backgrounds and experience.

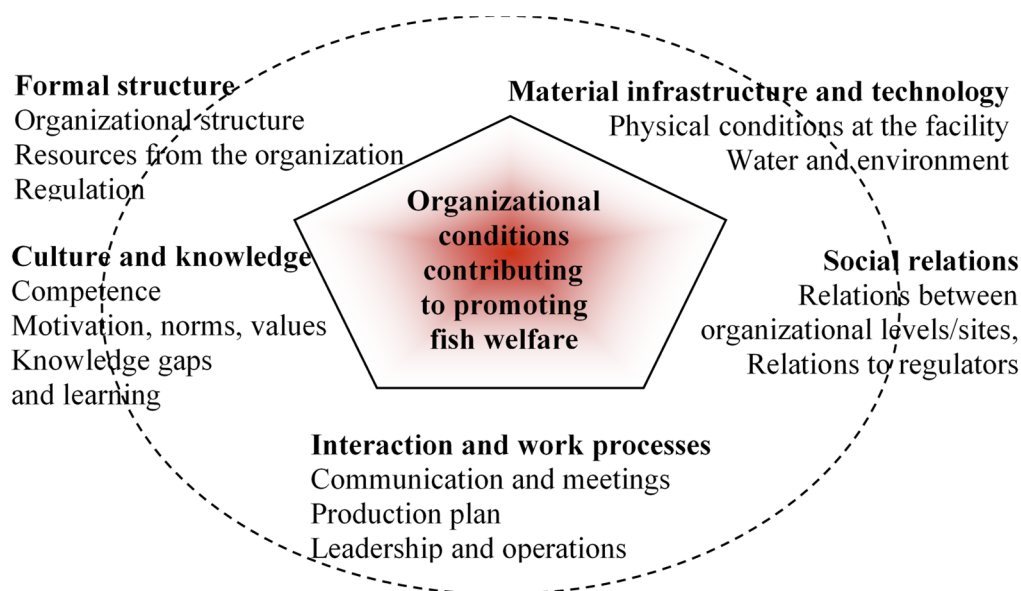


Figure 1. The Pentagon model for holistic organizational analysis (Schiefloe, 2017).

Materiality: In most workplaces, the technological dimension is of great importance. The facilities' design, facilitation, aids and other equipment are examples of conditions that are about technology.

Formal structure: All organizations have some formal structures that form a framework for the work carried out in the organization, and these are often formally adopted by the management of the company. Structural conditions can be how departments are structured and responsibilities distributed, working hours, salaries, regulations, contracts, position instructions, objectives and routines.

Culture and knowledge: Values, attitudes and competence are often referred to by a collective term as culture (Schiefloe 2003). For example, hiking stories and personal experiences will be part of this. Otherwise, norms, attitudes, knowledge, understanding, manners and training are examples of cultural organizational conditions.

Interaction and work processes: Interaction is an important part of the organizational context, which is often forgotten. For example, processes related to decisions can be important. Organizational interaction is for example: communication, working methods, collaboration, dependencies, and leadership.

Social relations: Relationships are a lasting and experienced connection between two or more individuals (Schiefloe 2003). For example, social networks can serve as sources of information and exchange of experience. Social relations are created by professional conversations and meetings, chatting during work or at a party. Friendships, social networks, collegial relationships, professional differences, and trust are examples of relational conditions in organizations.

The five dimensions: These analytical dimensions illuminate a holistic organizational context. Applied to the issue that is relevant here, it shows how promoting fish welfare is a result of several factors in the

organization. By analyzing what our interviewees tell us about their own incentives, one can use these five dimensions to look at how different conditions of importance for fish welfare are linked and how they can possibly be improved.

The different conditions are part of the same organizational whole and are linked to each other and influence each other. The dotted line around Figure 1 indicates this. By decomposing it organizational whole as in the figure, you get an overview of the parts and the variation in the data material, at the same time as one sees the whole and the interplay between the conditions in the dimensions. Thus, one can choose which conditions one wants to illuminate and which ones one wants to ignore.

By such a decomposition of the whole, one will encounter challenges with the placement of the findings into each of the five dimensions. Most observations about fish welfare in hatchery production contains elements that can be placed under several of the organizational dimensions. The location of finds and quotes are based on judgment and can be discussed.

These organizational dimensions are used in the next chapter to categorize and analyze the data material. In this way, it becomes clear that the incentives for promoting fish welfare come from several parts the organization.

4. Findings from the interview study

In this chapter, we arrange the interview descriptions under the five organizational dimensions (Figure 1), which shows how promoting fish welfare is a result of many factors in the organization.

In all interviews, we have asked what the interviewees put in the concept of fish welfare, and most have the same opinion:

Healthy and sound, good growth, feels good, optimal conditions.

Good water quality so the fish thrive, good survival, no outer flaws, good growth.

To have what it needs to feel as good as possible, avoid unnecessary stress, the right time for transfer to sea.

Freedom from suffering. Mortality and appetite are the outer edges. Low mortality overall, good appetite, sufficient access to water.

The interviewees were asked to describe the fish welfare in their facility on a scale from 1-5 where 5 is best. One answered 5. One answered 3 because his/her hatchery was in a rebuilding phase. The rest answered 4.

4.1 Material infrastructure and technology

Physical conditions at the facility

The interviews show that fish welfare is affected by the hatchery's physical construction and its potential for biosecurity and stability of water quality. RAS facilities are challenging since the biofilter must be well functioning and stable for it to be good for the fish. Some take the filter down for maintenance once a year, while others keep it going as long as it goes well. Since infectious disease probably is the single factor that leads to the greatest welfare challenges for the fish, biosecurity measures are important in welfare context.

Lack of water is the root to much suffering.

Many differences in both size and age of the facilities were included in the study. Many of the facilities are large and technically very complicated. Everything in the facility has to function to provide stable and safe conditions for the fish. Much of the infrastructure is hidden in the ground, making maintenance and improvements difficult. While separated units for groups of fish within a hatchery today is seen as essential, older facilities and facilities that are rebuilt are rarely able to separate their units. Physically separated units are, however, no guarantee for units to be sanitary separated. The personnel tell that they try to communicate to managers the importance of keeping groups of fish separated in different sanitary units even though it from a financial point of view is tempting to make full use of the tank capacity.

The facility becomes what you make of it.

Those who were interviewed describe major improvements in terms of transport of fish within the facility and upon delivery to the wellboat (for live fish transportation to the slaughterhouse). The transport takes place through pipe systems so that the fish are the shortest possible time out of the water and the operators do not have to handle the fish. They consider it positive for fish welfare due to less stressful handling of fish. Less handling of the fish also does the job easier for the personnel. However, transportation systems can be difficult to clean and disinfect. In addition, there are aerators, vaccination machines and pumps that are seemingly built without thought of cleaning and disinfection. Cleaning and disinfection also take time. A large part of the interviewees underline that their production plans are too tight and do not include sufficient time for cleaning and preparations between fish groups. See more about the work with production plans in chapter 4.4.

Parameters and values

According to new regulations, all hatcheries must set their own limits and goals for the production. Earlier prescriptive regulations recommended specific limits. Most of the hatcheries included in this study have limits that are stricter than the previously recommended limits, except for temperature. Previously, 12°C was set as the highest temperature in first-feeding to reduce e.g. the occurrence of vertebral deformities. Among those interviewed, the lowest maximum limit in first-feeding now is 11,5°C and the highest maximum limit 14°C. In farms with seasonally independent production with the possibility for down-regulation of the temperature, the goal was a maximum 2-degree difference between the water in the hatchery and the seawater at sea transfer.

The growth is monitored almost continuously. Rapid growth might become a problem in some hatcheries due to high temperatures. This might challenge the capacity at the hatchery (this is related to production plans, see chapter 4.4). The fish are scored several times during the production period for welfare indicators such as operculum shortening, skin lesions, fin damages, nephrocalcinosis and HSS. Those we interviewed had not reflected over what is an acceptable level of the welfare indicators. Currently, a standard for this is lacking. The FISHWELL handbook (Noble et al, 2018) provides a professional background for the development of welfare indicators and examples of scoring. There is a need for further studies recommending a practical use of welfare scores. The quote below is somewhat rewritten, but shows what many of the breeders wish for:

We dream of delivering a robust smolt.

In the interviews, different methods are mentioned as strategies to smoltify the fish: smolt feed, light in combination with smolt feed. Some told they use only light in parts of the production, while others use salt habituation. ATP-ase tests, smolt timer and chloride tests are used. The chloride test measures the fish's ability to tolerate seawater. This is an old method which is quite laborious, but which the hatchery can perform themselves. Several of those interviewed use this test, as it seems safer than modern tests. The hatcheries benchmark themselves on both survival in their production and survival the first 90 days after sea transfer. The best value here was at a hatchery with 3 % reported mortality after first-feeding and 99.2 % survival after sea transfer.

4.2 Formal structure

Organizational structure

How the facilities are organized depend on the size of the production, but also on where the employees live and what competence they have.

The studied hatcheries organize the work in varied ways. Some practice specialization, others generalization: In the interviews, there are different opinions about whether each of employee should be able to handle all tasks in most units, or whether they should be specialized in one unit. Most of the operators interviewed, prefer to stay within one unit. That way they become well acquainted with their fish and could react earlier if something changes. The weakness of such organization is if someone gets sick and others must do their task. Also, the person who is on call must have a good overview of all units in the hatchery.

I have discussed how to do this with the employees in the hatchery. They work shifts. If it's best that each one follows one unit. However, there's something about logistics, if someone is sick, you want everyone to be equally good at everything.

All hatcheries have employees on call 24-hour in case of emergencies. Since it requires great insight and experience, not everyone is involved in this on-call duty. There come great responsibilities with being on-call. Those who has call duties often work a 12/9-scheme, i.e. work continuously for twelve days and are at home for nine.

Some of the hatcheries structure all the work in shifts, so the employees do not have to live close to the farm. Such schemes make it possible to commute when the company provides satisfactory living conditions. Such shifts also require "overlap meetings" or "shift change meetings" to maintain continuity.

Resources from the parent organization

All interviewees in this study is employed in a large company that produce salmon both at the hatchery and and in seawater. The interviewees see an advantage in that their hatchery is part of a larger organization, but this also gives the central management an influence on how the production in the hatchery takes place. Ideally, the central managements provide resources to the hatchery, enabling the operational personnel to promote fish welfare.

Everyone must have a relation to fish welfare.

Profitability: Many of the interviewees emphasize that good fish welfare is financially profitable, and that the public urges for good fish welfare. Healthy fish and good fish welfare leads to good growth and low mortality. Hence, they believe its twice the profitability to invest in fish welfare. They describe that central management expects the greatest possible production and can be ignorant to that can give success at a hatchery. From time to time, employees at hatcheries may experience central management as an opponent of fish welfare because management is optimistic about the number of smolt possible to produce based on tank volume etc. In several interviews, frustration emerges over goals and production plans, since water volume, water quality, temperature and other infrastructure in the hatchery is crucial to the results. However, representatives from the management experience that compliance of external requirements (like regulation) is expensive, so they need the highest possible earnings and high production. This affects the degree of freedom for the operations managers at the hatcheries, and can slow down the development of the fish welfare work.

Procedures - formal descriptions of tasks - exist in all the companies in this study. Opinions of key procedures vary. Many are happy with their procedures. Some procedures serve as textbooks and instructions for use. Standardized procedures across units in large companies can lead to too general procedures.

Procedures must be adapted to each individual facility.

In many interviews, it appears that the employees use a regulated internal control system (*IK-Akvakultur*) to register tasks and report nonconformities. They express that this system provides an overview of fish welfare.

Procedures provide the opportunity to report discrepancies and thus bring about improvements.

Procedures mustn't stand in the way for development and improvement.

Bonuses: In some companies, those who produce the best smolt are rewarded. In the interviews it appears that this promotes extra efforts from the personnel. Some companies also reward employees who (independent of position) come up with good suggestions for improvements in production.

Regulations

The hatchery personnel have many reporting tasks, also external to the authorities. The personnel have many stories about too much reporting. For example, they find it frustrating when representatives from the authorities do not find reported data, but asks the farm to submit data again before inspections.

Double reporting should not occur, but it does.

The amount of data reported is large. If it is to be reported, it must be in such a way that the authorities become more knowledge-based.

Function-based rules are perceived as a challenge. The regulations include terms such as "justifiable", "shall be suitable from the point of view of animal welfare ", and that the amount and quality of water "shall be such that the fish have good living conditions". The interviewees tell that these kinds of goals are demanding to fulfill. However, the fish farming companies' describe their own requirements as stricter than the regulations' requirements. Although it is difficult to set such goals, several of the interviewees see the benefit of this work. For example, it can have an influence on production plans: When regulations are vague, company-specific goals can teach top management what is important for fish welfare.

Top management makes production plans. The operations manager is involved, but his point of view is often not heard - he doesn't get help from the regulations, and get tired of fighting against them.

A regulatory requirement is fish welfare courses. To ensure fish welfare competence for those who work with the fish it's mandatory to attend fish welfare courses every five years. This subject is constantly evolving and the understanding of animal welfare will change in line with the development of knowledge. The view of the fish welfare courses was very varied among the interviewees. Some think it is a good repetition of already learned knowledge, others that there is too much talk about diseases and too little discussion about how to improve welfare.

Fish welfare courses should be a discussion arena where positive measures are discussed.

Recruitment

Many of the Norwegian hatcheries are located in remote areas, so recruiting personnel with the right competence can be a challenge. Some interviewees describe that the local community must be attractive for families. One company manager interviewed is active in politics, since the industry needs good roads, accessibility, schools, and preschools.

The government wants the profit from the aquaculture industry, but they don't want to build roads.

While some aquaculture companies struggle to recruit suitable candidates, other companies rarely need to be active in their recruitment, as candidates present themselves asking for a job. Since the hatcheries today are large and complicated, both specialists and generalists are required. The interviewees had different opinions on whether it was important to recruit local candidates or candidates with special competence. On the one hand, specialized candidates without local belonging might not want to stay long at the remote hatchery, so some companies prefer local and more stable candidates. On the other hand, local attachment is not necessarily better than bringing in people with another knowledge and other perspectives. Although they may only stay a couple of years, they could add a lot to the business. By ignoring local belonging when hiring, one can also get hold of personnel who actually become a part of the local community and would like to stay.

I wouldn't only hire locals. I think it's important not to look blindly whether someone might only stay for a short time, because you never know. I thought that I'd only stay here briefly. Maybe you overlook someone like that. (...) I would probably hire specialists, because it's detailed work. And you have to follow up over time, you may not notice what you should when walking around. And the more you know about a thing, the more you see that you don't know, and the more you immerse yourself in it.

4.3 Culture and knowledge

Competence and training

Those interviewed in the study have great variation in background, whether they are operators, operations managers or higher up in the system. Some have "stumbled" into the industry, others started in a summer job that never ended. Several say that they had planned for a job in the aquaculture industry, but not necessarily at hatcheries. Some have planned an educational course to obtain a trade certificate. Everyone employed as an operator is given the opportunity to obtain a trade certificate. A background from terrestrial livestock farming is seen as a useful experience in terms of respect for the individual animal and related responsibilities. The interviewees also tell that their companies are positive employees receiving further education all the way up to university level. Thus, it is possible to start as a summer substitute and later become an operator or production manager.

New employees learn from their co-workers. The interviews show that hands-on training is included in the companies' training systems for new employees. The large companies function internally as a knowledge bank. Training in seeing and reading the fish is experience-based. This is also one of the reasons why of the interviewees many prefer to specialize in one unit of the hatchery.

The fish health service is a very important source of knowledge. In all the interviews, the competence and the commitment of fish health personnel is highlighted as positive for fish welfare. Still there is variations in how much benefit the individual employee sees in the visit from the fish health service. If the fish health personnel have tight schedules only giving room for the mandatory tasks, there will be little time for counseling the other personnel. Some fish health personnel are involved in operations in the hatchery and decisions about operating conditions, and will have a greater role in counseling. In decisions, they usually speak for fish welfare against other values. One interviewee noted that not all fish health personnel have the strength to stand against the management. Where fish health personnel have a strong team behind them, they also experience that it is easier to convey knowledge about the fish and influence decisions in the company.

People who work with fish health should be trained to stand for what is professionally correct. The management does not attend fish welfare courses, but we [the fish health personnel in the company] have discussed having one for them.

Between the hatcheries represented by the personnel in the study, it varies how much the personnel groups interact. There are differences in how much the technicians participate in the care of the fish.

However, every hatchery involved in the study has their own technical staff who are responsible for daily maintenance and follow-up of the technical.

Raising awareness is very important. You get in a routine, and then it's easy to forget to stop if you're in a hurry. You have a busy day. (...) I find that the more you work with others in the organization, they become more aware and it becomes easier for them to get in touch.

Motivation

The interviewees say that incentives to promote fish welfare in their work can come both from within oneself, from colleagues within and outside the organization, from management and through knowledge. Your own conscience is important when it comes to go on when times are hard. Fish farming is an animal husbandry, and growing up with animals or practice from working with livestock on land is described as a good and natural platform for welfare work. Many say that an important motivation is the desire to see the egg become a strong and good smolt.

A nice lamb or a nice smolt. It's such an indescribable feeling when I know that it is going well. It does not always do that, but that is what we strive for.

Although several of the interviewees express that they prefer to work in only one special unit, they were keen to be involved in the entire production. The use of twelve-week production plans, give information for contextual insight and increases the understanding of the entire production process. The interviews show that responsibility and interesting tasks promote the desire to learn more. The interviewees get stronger ownership and greater job satisfaction through participation in experiments aiming for improved fish welfare. The feeling of ownership, "my fish", "my facility", etc. increases their motivation to constantly improve.

Those who work with the fish are proud of the work they do and want recognition for it. They do not necessarily feel that top management see them even if they visit at the hatchery. At some hatcheries it is paid less to biological responsibilities than technical responsibilities. Some describe that it may have a negative influence on the motivation that technology is valued higher than biology.

Knowledge gaps

Important for fish welfare, is knowledge on how to develop robust fish that do well both in the hatchery and in the sea. The interviews show both biological and practical knowledge gaps. Many conditions that apply to biology are still unknown, difficult to control, or it is not known how conditions may affect each other. Light is mostly used continuously in production, but there is little knowledge about color and intensity of the light and how it affects the fish. Most knowledge is experience-based. When it comes to water velocity there is little knowledge of what the fish prefers. How constant temperature throughout the hatchery phase affects the fish is also uncertain, and how it affects the performance when transferred to the sea. Hemorrhagic smolt syndrome (HSS) and kidney calcification have been problems for over twenty years and the reasons are still unknown. Many of the conditions that affect the practical work of obtaining robust smolts are not scientifically proven, but the interviews point to some organizational issues that can be problematic or beneficial for fish welfare in hatcheries. The lack of implementation of research results is also an important topic highlighted in the interviews. The companies have a lot of information about egg, space, disease, treatments, etc., both in the hatchery phase and the sea phase - but the interviewees see no systematic use of it. Much of the production seems random.

We have a new and good hatchery that's easy to operate. It also depends on the employees and the production plan, but [...]. Sometimes it goes badly and other times it goes well, I believe there isn't that big a difference.

Many believe that if the provided information were unitedly analyzed, they would be able to show, for example, the benefit of planning with extra space for the fry. Most interviewees express a desire to prove that fish welfare can be profitable.

Knowledge of those in production and the economics of the production. So that one understands that welfare and profit go hand in hand. Good production planning and development of the hatcheries as well.

4.4 Interactions and work processes

Communication and meetings

In the interviews it is described that good teamwork requires good communication, between all personnel, including top managers, operations managers, and operators, including technical teams. This communication is practiced slightly different from hatchery to hatchery.

Communication between hatchery and sea site is important. Everyone interviewee underlined a pride in handing over nice and healthy fish to the next unit or to the sea site. Feedback from the sea site when things are going well with the smolt is inspiring. Unfortunately, the feedback often comes when the fish is not doing so good after sea transfer, while feedback often lacks when things go well.

Close contact with sea sites and visits both ways.

Meetings between personnel are seen as invaluable. During the interview period, there has been a special situation with strict control measures - not just for the fish, but also for the people. Covid-19 has changed meetings and communication.

It's sad not to lunch together.

Something is lost when we don't gather for operating meetings.

Too little social and too little sharing of what happens in the operation.

The corona situation has provided extra challenges for the operations manager, who has had to pay more attention to the communication and the sharing of information since not all employees cannot meet each other at work.

The interviewees reveal that a positive consequence of the Covid-19 is that more employees have had time for online courses.

Production plan

An operations manager emphasizes that the best communication is through clear plans, accessible to all. The production plan for a hatchery shows, among other things, how much egg/fish you want to have in each unit and each production, and the number of productions per year. In many organizations, central management makes the plan, based on input from the hatchery. Although the operations managers participate in the meetings where production plans are made, there is great variation in how much they influence how many smolt they are to produce and at what time. Even if the operations manager is involved when the production plan is made, it can be difficult to convince the top management that a production with live animals will be variable. This dilemma is similar to the dilemma the personnel experience in building and rebuilding processes: Decisions are not always made with the best for the fish in mind. Most operations managers and fish health personnel have stories about planning situations where fish health competence where not heard early enough in the planning.

There should be a representative of fish health present when something is to be built that is going to house biology. If it was a requirement, they wouldn't have to argue to be heard!

The interviews show that many operators and managers experience a production plan that is too tight. Many says they have had problems with mortality because the production plan is too intensive. Most interviewees are concerned that the production is not adapted to the hatchery. There are too many fish to ensure good fish welfare, and too short time between cycles to safeguard biological differences and biosecurity.

Even very small deviations from the production plan can lead to a domino effect throughout the hatchery. Some believes that their production plan requires a larger facility, but acknowledges that if they rebuilt the hatchery, they would probably upscale the production and have the same problem over again. Stories from start-up of new hatcheries show that it is not common to start carefully enough. The hatchery personnel have rarely had time to get to know the facility and solved the first problems before they are expected to reach the planned production capacity.

Things must be given a chance - Rome wasn't built in a day.

The facilities that are controlled by top management rather than fish health competence are described as struggling to get the best out of the production. A common problem is plans for a production that is larger than the capacity of the hatchery. Fish welfare becomes impossible and one must try to do the best out of the situation. The interviewees describe that some hatcheries add up to 25 % more egg than the smolt capacity - then healthy and good fish must be destroyed. This puts a strain on those who have provided good care for the fish.

"Too good to go" is discarded.

From the operators, we heard that top management focus on red and black numbers, and not how operations could be improved. Those at the top see a less granulated picture and can thus more easily look at theoretical production possibilities. However, in the interviews a top manager also explained that the production intensity had become too high, and wanted to take a step back and focus on a less intensive production in the hatchery phase to get a stronger fish with faster growth at sea.

Leadership at the hatchery

There may be one or more operations managers at the hatchery depending on the size of the production and the complexity of the hatchery. Usually there is a biological and a technical manager. The operator interviewees want a management that is clear on what is expected of them. They also want the management to understand them and show respect for the work. Mortality affects the operators, who can get sad and angry - the operations manager must be able to handle that. Good fish welfare provides better working conditions.

Happy and healthy fish give happy and healthy people.

A statement that is repeated by all operators is: in order for the fish to be well, everyone who works with the fish must thrive and have a good time. The managers at the hatcheries therefore place great emphasis on well-being, that everyone should feel included and have the opportunity to make suggestions for improvements in work routines. In the interviews of operators, it was evident that good operations managers influence the employees.

4.5 Social relations

Relations between hatcheries and central management

There are large differences in how far the interviewed operators are from their companies' top management. Some companies have a strict hierarchical system, while other have a flat structure. The number of management levels varies with the size of the companies. Large companies have the advantage that there is a lot of knowledge within the system, but it can also be a disadvantage that those who ultimately make the decisions are far away from the actual production. Flat structure does not mean that

the operator's wishes or proposals always are accepted. However, the feeling of being heard is nevertheless an important incentive for promoting fish welfare.

There is variation between the hatcheries in terms of how much leeway the local managers have. The interviews show that there is little time for good communication between operations managers and management higher up, poor communication may have led to the same error being done several times. Some operations managers feel that the top management does not have enough respect for the work that takes place in the hatcheries. In such companies, one experiences that an accident or loss is needed before bigger investments are made. In other companies, good arguments for better fish welfare can lead to such investments quickly.

Relations with the authorities

The aquaculture industry has many governmental agencies to deal with; several ministries, many directorates in addition to county municipalities and the county governor. The interviews describe that when these organs do not play on the same team, it can lead to delays and irritation.

We need a unified and not a fragmented government that contributes to a high cross-pressure.

It is mainly the management that meets the authorities. The operators and others at the hatchery mainly meets the authorities if they have problems and must notify the Norwegian Food Safety Authority. In the interviews, some stories are told about bad experiences, where the government representatives show little practical competence and little understanding of the work done at the hatcheries. Some also believe that the authorities are afraid of making mistakes, which makes them too strict and lead them to interpret the regulations different from the industry.

The Food Safety Authority often doesn't understand what's good fish welfare because they lack competence.

5. Suggestions for best practice

The results from the interviews show many factors that affect how fish welfare is promoted in the hatcheries. The study does not provide a complete recipe for achieving good fish welfare, but points to some measures that should be considered. These measures can be a starting point for a "best practice" to promote fish welfare in hatcheries.

5.1 Adapt the production

Goals and investments for the production should be calculated on the basis of biosecurity and fish welfare. This includes investments that facilitate the success of personnel that aims for fish welfare. For example, a stable and sufficient water supply with good water quality is important. Good production planning should consider that biology is not always completely streamlined. By providing the fish with enough space and providing slack between the productions, will contribute so as many egg grains as possible arrive at the dinner table.

5.2 Understand and make use of existing information

The organization should register important information, and use the information actively in planning of new operations. The quality system (IK-Akvakultur) must be used actively. Information about the sea phase - both good and bad results - should be easily accessible and communicated to the hatchery. Each production should be analyzed before new productions are planned. The opportunity to compare different fish groups and productions, conditions on land and how fish performs in the sea, can both improve the next production and increase the interest of the employees.

5.3 Use specialized operators in a robust organization

It is possible to achieve both specialization and a form of generalization among the staff. The organization may benefit from specialists, even if they stay a short time in the company. Also, there are measures to make the organization robust while developing cutting-edge expertise. For example, employees who are "permanent" in one unit can occasionally practice in all units to gain basic skills.

Coworker involvement is a way for the organization to get the most out of the personnel's qualities and special competence. Planning of all tasks, especially larger operations, should be done in collaboration with those who will carry out the tasks. Good animal husbandry involves collaboration by professional groups in both operations and management: production planners, investment managers, and the implementers. All personnel should be allowed to influence their own area of responsibility, especially routine tasks that can be optimized. Good suggestions for improvements can be rewarded - and implemented.

5.4 A critical and strong fish health team

Fish health personnel need space and resources to give advice both upwards and downwards in the organization. To have fish health personnel that argue for fish welfare, is a benefit for the company.. A good fish health team have and can further promote competence, good arguments and ability to influence.

5.5 Present management

The employees in hatcheries want managers who let them make improvements, in addition performing tasks. To provide incentives to work for fish welfare, management at all levels should emphasize fish welfare in procedures, compliance, training, recruitment and every operation. All fish welfare measures from employees should be implemented as far as possible. Managers who have created a team spirit among the operators at the hatchery often run smoother operations. The management and staff can together reflect on decisions that may be difficult for fish welfare. For example: When does an operation conflict with fish welfare, and what does it take to stop the operation?

5.6 Dialogue with other organizations and the authorities

Hatcheries should share their expertise on how to increase fish welfare between them. In addition, one sees that also the authorities may need updated knowledge about how the hatcheries work, so personnel at hatcheries can also offer practical information to the authorities.

5.7 Fish welfare competence for all

Knowledge about fish welfare is necessary for everyone with responsibility in areas that affect the fish, including those who make decisions related to construction, equipment, and production planning. Bureaucrats, top management, and financial personnel should all have a certain level of knowledge about fish welfare. Welfare knowledge can come from courses or education. The fish welfare courses should address production conditions, such as production planning, technology and handling the fish. The organization should ensure that personnel are up to date and can provide the knowledge, both upwards and downwards in the organization.

6. Concluding remarks

This study has shown that employees involved in hatchery production have many incentives to promote fish welfare. At the same time, the results show some organizational factors that work against fish welfare.

Fish farming is a biological production set in an industrial system. The findings show that goals and production plans are developed based on profit, and do not always take the biological conditions into count. This means that fish welfare can be perceived as being the opposite of achieving production goals.

Slack in production plans is a prerequisite for fish welfare in operations, and slack can thus also be profitable. If the production widens the margins and resources required in biological production, fish welfare may prove to be financially profitable.

Courses in fish welfare is a great resource where one should add learning objectives about organizational conditions that contributes to fish welfare. This study demonstrates that all employees in fish farming companies should attend such fish welfare courses.

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