



# The escape of fish from Norwegian fish farms: Causes, risks and the influence of organisational aspects



Trine Thorvaldsen\*, Ingunn M. Holmen, Helene K. Moe

SINTEF Fisheries and Aquaculture, N-7465 Trondheim, Norway

## ARTICLE INFO

### Article history:

Received 22 December 2014

Received in revised form

15 January 2015

Accepted 19 January 2015

### Keywords:

Aquaculture

Escape of fish

Human error

Organisational aspects

## ABSTRACT

The escape of fish from fish farms is a problem for the Norwegian aquaculture industry. Following a decrease in structural equipment failures, human errors and human factors have been highlighted as one of the main challenges when it comes to preventing fish escape. This article identifies causes of previous accidents leading to fish escape, as well as risks of escape, focusing in particular on the organisation of work as well as the role of the workers at fish farms. It is apparent that operational managers and fish farmers have great responsibility when it comes to preventing escape. Severe consequences for individuals and companies if fish escape may lead to workers prioritizing the safety of the fish over their own safety. Accident causality is often complex. The term “human error” may be perceived as incriminating by employees, as it focuses on the individual and not the bigger picture.

© 2015 Elsevier Ltd. All rights reserved.

## 1. Introduction

In April 2013, during lice treatments of farmed salmon, around 13,000 salmon escaped from a Norwegian fish farm. The accident happened when a well boat moved fish from one net cage to another. Fish were pumped on board and transported to the new cage. While pumping the fish into the new net cage it soon became apparent that the net was put up incorrectly; with no physical barrier preventing the fish from swimming out into the sea. The company in question stated that the accident was caused by human error [1].

Escape of farmed fish is a challenge for the Norwegian aquaculture industry. Farmed salmon is seen as a threat to biodiversity because it disrupts wild salmon gene pools [2]. Consequently, escape of fish harms the reputation of the industry. As illustrated above, human error stands out as one of the main causes of escape in recent years. Following the introduction of formal regulations, workers may face severe sentences if found responsible. Fish farmers and operational managers thus have a great responsibility when it comes to preventing fish escape at farm sites.

The objective of this article is to identify causes for previous escape of fish, focusing in particular on organisational aspects and the role of workers at fish farms. This article aims to answer the following questions: “Which aspects contributed to earlier escape incidents and near incidents?” and “Do organisational aspects influence the risk of

fish escape? If so, how?” A descriptive approach provides knowledge specific to the Norwegian aquaculture industry that may help prevent fish escape in the future.

## 2. Norwegian aquaculture

Aquaculture is a leading export industry in Norway. In addition to providing food, it provides jobs and spin-off effects that are of great importance to the local and national economy. Currently about 4000–5000 people work in different parts of the industry. Marine industries are seen as essential for future value creation and employment, and aquaculture has been identified as the sector with the largest potential for growth [3–5].

The main species in Norwegian aquaculture are Atlantic salmon and trout. Fish are bred in net cages at fish farms along the coast. To ensure water quality and reduce impact of farm wastes, modern farm sites are located in partly sheltered areas away from the shore [6]. Fish are transported by well boats from land-based hatcheries to farm sites. They are kept in net cages until reaching desired weight. This usually takes around 18 months. Well boats then transport the fish back to land for slaughtering and further processing [5] before being distributed to the market.

The job of fish farmers is to look after the fish and take care of a range of daily tasks such as feeding and maintenance. In addition to this, they regularly perform more complex operations such as lice treatments and transfer of fish to and from net cages and well boats. Fish farmers thus have to handle fish, machinery, equipment and chemicals in challenging physical environments [7]. A recent

\* Corresponding author. Tel.: +4792422971.

E-mail address: [trine.thorvaldsen@sintef.no](mailto:trine.thorvaldsen@sintef.no) (T. Thorvaldsen).

study shows that the aquaculture industry is statistically one of the most dangerous occupations in Norway when it comes to occupational fatalities and accidents [8]. Similarly, a study based on Canadian aquaculture concludes that workers are exposed to several potentially serious occupational hazards [9].

Official statistics indicate that the majority of reported escapes from Norwegian fish farms in the period from September 2005 to December 2009 were caused by structural equipment failures. Studies show that previous escapes have also been linked to operational related failures, external factors and escapes from land-based facilities [6]. Transportation of fish is another part of the production process linked with escape [10].

A reduction in the number of escapes in the last decade has been linked to the introduction of a Norwegian technical standard (NS9415) in 2004 which contributed to the industry investing in better and safer technology [6]. Furthermore, authorities have argued that greater awareness about escape issues as well as better work practices have contributed to the decline in escape accidents [11].

Along with the decrease in structural equipment failures, the issue of human error and human factors has gained attention when it comes to preventing fish escape. The responsibility of fish farmers is also reflected in formal regulations.

The obligation to prevent and limit escape of fish from aquaculture farm sites is described in the Regulations on fish farm operations (aquaculture operation regulations) from 2008. Regulations state that employees are expected to pay attention, conduct risk assessments and carry out systematic measures aimed at preventing escapes. All escape of fish must be reported to the authorities and to avoid future escape measures must be implemented. In regulations on internal control to fulfil the aquaculture legislation from 2005, specific demands are given regarding workers' skills and training. Furthermore, all companies are required to perform internal control to make sure regulations are being followed.

Fish escape may lead to substantial financial and legal consequences for companies and individual employees. This criminalization has been linked to a report on economic crime published in 2011 by the Økokrim, a division of the police fighting economic and environmental crime. The report designated fish escape as one of three main categories of Norwegian fisheries crime and stated that some companies fail to report and cover up escapes to avoid punishment.

Focus on fish escape impacts the reputation of the industry as a whole. Furthermore, increased media attention surrounding escapes has negatively impacted upon people who work in the industry [12].

### 3. Accidents and organisational aspects

This article focuses on human factors associated with fish escape. Human factors include a variety of factors that may influence people and their behaviour. For instance, a recent study from the offshore sector identifies several human factors related to organisation and personnel such as knowledge, experience, training, skills, communication, compliance with regulations, leadership, safety culture, and safety management systems [13].

In the aquaculture context human factors and human error are commonly used to describe operational-related failures. In the literature, human error has been defined as a generic term that encompasses all occasions in which a planned sequence of activities, mental or physical, fails to achieve the intended outcome [14].

Unsafe acts may be produced by organisational aspects because they influence work practice at all organisational levels [15,16]. A previous study focusing on personal safety in Norwegian aquaculture [12] applies an analytical model [17] that divides the organisational context into five dimensions. The dimensions

include formal structure and organisation, technology, culture and competence, relations and networks, and interaction and work processes. Safety is thus a result of several organisational aspects. Data analysis can show how these aspects are connected and how they can be improved. Findings in this study show that management rely on fish farmers to make operational safety decisions. Furthermore, fish farm workers are interested in doing the best job possible. Consequently, the safety of the fish is sometimes prioritized before the safety of the workers themselves.

Another study of the Norwegian aquaculture industry investigates the operational setting where fish farmers make their decisions. Certain constraints and criteria that impact the decision-process are identified and discussed [5]. The most important criteria for the fish farmers is keeping the fish healthy and alive, and preventing escape of fish. It is argued that time pressure related to keeping fish safe may lead to fast decisions with unwanted consequences. On the other hand, the necessity to perform certain operations to carefully protect the fish may help prevent accidents.

A recent study of accidents in Norwegian aquaculture argues that technical, human and organisational factors should be seen as complementary and encourages accident investigations to apply different perspectives to provide knowledge about accident mechanisms and the industry itself [8]. In this article, the main focus is on the organisational aspects and how they affect individual workers. This approach explores underlying causes and risk factors leading to fish escape.

### 4. Material and methods

Semi-structured interviews comprised the primary method of data collection [18]. All interviews were based on an interview guide covering the following topics: critical operations, previous escape incidents, near misses, decision-making/responsibility, safety management, training, co-operation and communication, equipment, and measures taken to prevent escapes. Open-ended questions such as: "Could you explain in your own words, what happened when the fish escaped from the farm site?", "How was the work at the farm site organised at the time of the accident?" and "What do you consider to have been the cause(s) of the escape incident(s)?" were asked.

Informants were selected based on one main criterion, namely, that they were employed in companies that had reported fish escape in the period from 2009 to 2012. An official registry of escape was used to identify relevant companies. To reflect the variations in the industry, informants working in companies belonging to different geographical regions, a selection of large and small companies as well as farm sites with different technology (plastic rings and steel constructions) were asked to participate. The majority of informants that were interviewed had been present at the farm site at the time of the accident. Those who had not been present were nonetheless volunteered by their companies as informants because they knew the details of the accident well. To reflect the totality of the operations and the risk involved researchers also conducted interviews with employees of well boat companies, service vessels and harvesting plants that had been involved in escape accidents. A total of 12 informants were interviewed. Some interviews were conducted by telephone and others in person.

In addition to the interviews, data from 33 non-compliance reports were examined and included in the analysis. The reports were made available to the researchers by the companies participating in the interviews. The information given in the reports provided more data regarding escapes and near-misses that added to interview findings.

A third data source was a two-day workshop focusing on critical operations and escape prevention. The workshop gathered

Download English Version:

<https://daneshyari.com/en/article/7490371>

Download Persian Version:

<https://daneshyari.com/article/7490371>

[Daneshyari.com](https://daneshyari.com)