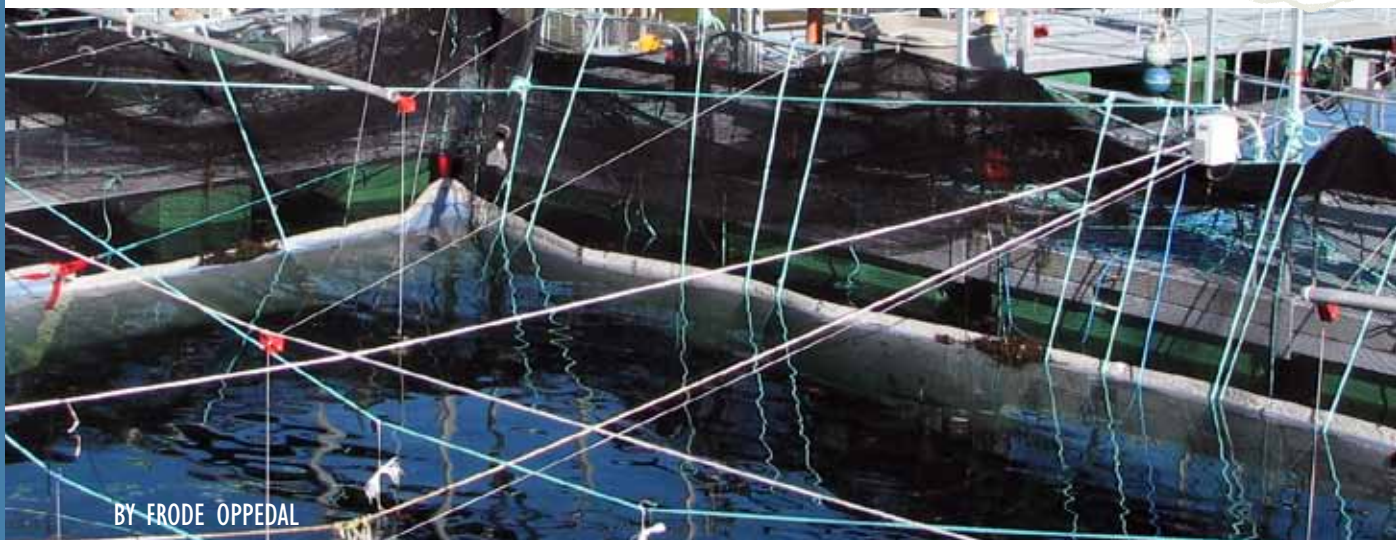


Salmon attempt to avoid delousing agent



BY FRODE OPPEDAL

Bath treatments are often used to control sea lice on large farmed salmon. This involves putting a tarpaulin skirt or bag around the cage, and mixing the therapeutant into the water in which the fish are confined. New studies have shown that it is difficult to keep the fish inside the treated volume of water in the large cages used at modern fish farms. When using a tarpaulin skirt, it is therefore advisable to raise the bottom of the cage up to the skirt.

A CRITICAL MOMENT IN THE PRODUCTION PROCESS

Sea lice represent a threat to sustainable salmon farming in Norway. The challenge is to keep the level of mature sea lice on farmed salmon so low that wild salmon do not suffer from excessive levels of larval lice in the sea.

The most common method for delousing large salmon in cages is to limit the volume of water near the sea surface using several tarpaulin skirts, before adding a therapeutant for 30–40 minutes. Unfortunately there are mixed reports on the efficacy of this kind of treatment in the large, and to some extent unmanageable, cages used at modern fish farms.

Sea lice that survive the process due to receiving inadequate doses of therapeutant may increase the rate at which resistance to the therapeutant develops. Because delousing is a critical phase of the salmon production process, several studies have looked at salmon behaviour, and the environment in the cage, during bath treatments using skirts. The aim has been to find ways of improving treatment procedures, as well as to assess the use of tarpaulin skirts for bath treatments from an animal welfare perspective.

STUDIES IN SMALL AND LARGE CAGES

Studies in small-scale, easy-to-handle research cages with normal fish densities have looked at how salmon behaviour responds to tarpaulin skirts (control) and a combination of tarpaulin skirts and therapeutant. By using echo sounders and underwater cameras, we have been able to observe how deep the salmon swim, what the fish densities are in the various areas

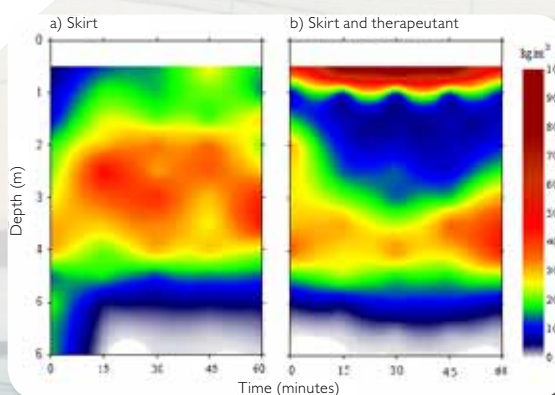
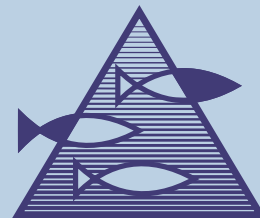


Figure 1
Fish density (a) without and (b) with therapeutant when using a tarpaulin skirt to a depth of six metres in a 12x12 metre cage, with a four metre deep cage bottom after raising, and an estimated density of 40 kg/m³. Without the therapeutant, the fish distribute themselves evenly within the cage (20–50 kg/m³), but when the therapeutant is added, the salmon try to swim towards the sea surface or the bottom of the cage.





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of the cage and whether all individuals behave the same. Similar observations have been made during bath treatments in commercial cages with circumferences of 157 metres and volumes of up to 70,000 cubic metres. Those cages may contain between 120,000 and 200,000 fish.

SALMON ATTEMPT TO AVOID THE THERAPEUTANT

In the control cage, the salmon were evenly distributed (Figure 1a), whereas they chose to swim towards the sea surface or the bottom of the cage after the therapeutant was added (Figure 1b). It appears that the salmon attempted to avoid the therapeutant. In the large, commercial cages, the bottom of the cage was not pulled up, so the salmon chose to swim away from the treated volume of water, and to crowd more closely together under the edge of the skirt (Figure 2). The concentration of therapeutant in the water below the tarpaulin skirt is probably minimal in comparison to inside it, which means that the lice on those fish were most likely exposed to very low doses of therapeutant.

ESSENTIAL TO RAISE THE BOTTOM OF THE CAGE DURING BATH TREATMENT

Based on these observations, it appears that some aspects of current practice are unsatisfactory, and that a number of improvements to treatment procedures should be proposed. Most importantly,

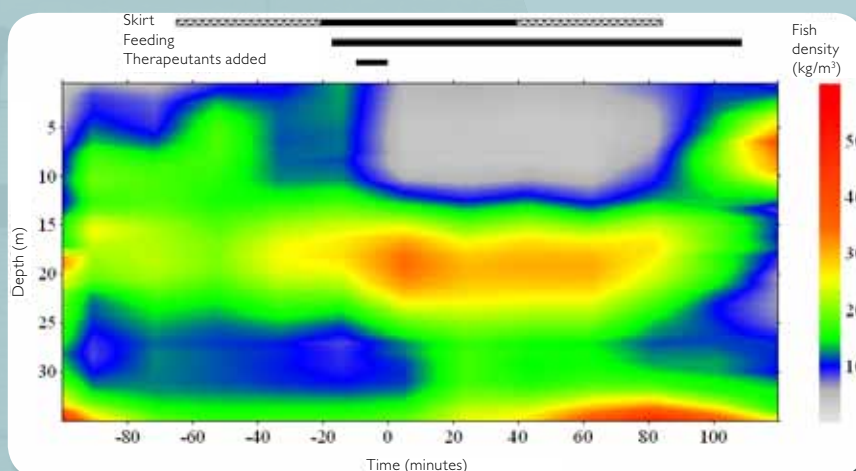
the bottom of the cage must be raised to the level of the lower edge of the tarpaulin skirt in order to ensure that the salmon, and any lice on them, remain within the treated volume of water. Starving the fish for a few days, before feeding them in conjunction with delousing, so as to attract them to the sea surface, does not appear to be an adequate way of getting them into area containing therapeutant (Figure 2). For most salmon, the urge to avoid the delousing agent appears stronger than their desire to eat, even after two days without food.

If a large number of sea lice are exposed to low doses of therapeutant they will not die, and the delousing process fails. An even more serious long-term effect is that this will make the lice less sensitive to the therapeutant. Eventually they will become resistant, making it very difficult to delouse salmon in the future.

A similar problem arose in the 1990s, when sea lice became resistant to the delousing agent used at the time, and new agents with different active ingredients had to be developed. However, developing new delousing agents takes time, and in the meantime we must minimise the rate at which resistance develops by optimising delousing techniques.

Figure 2

Fish density during delousing in a commercial circular cage with a circumference of 157 metres and a depth of approx. 35 metres. The total biomass in the cage was 999 tonnes, giving an estimated fish density of approx. 15 kg/m³. The tarpaulin skirts (two 90-metre long, 15-metre deep skirts) are closed when the time line for the skirt is solid black, whilst the positioning and removal of the skirt is marked xxxx. The salmon were starved for two days, and feeding started seven minutes before the addition of the therapeutant. We can see that feeding has a slight tendency to attract fish to the surface. When the therapeutant is added, the salmon disappear from the volume of water within the tarpaulin skirts, and there are hardly any left (only 1–5 kg/m³) by the time the addition of the therapeutant has been completed (time = 0 minutes). The salmon mainly remain below the skirt at densities of 20–40 kg/m³ throughout the delousing process. Once the skirts are removed, the salmon return, making use of the whole volume of the cage in a similar way to prior to the addition of the therapeutant.



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