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PROJECT MANAGEMENT

The project "Catch control in pelagic fish in Purse Seine" will develop better instruments, methods and tools for monitoring and visualizing shoal during catch. This can contribute to a better decision making during the fishing process.

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PROJECT FACTS:

Duration:	2017-2021
Project Manager:	Hanne Digre, SINTEF Ocean
Funding:	FHF, Institute of Marine Research and Directorate of Fisheries
Scope:	NOK 28 342 000
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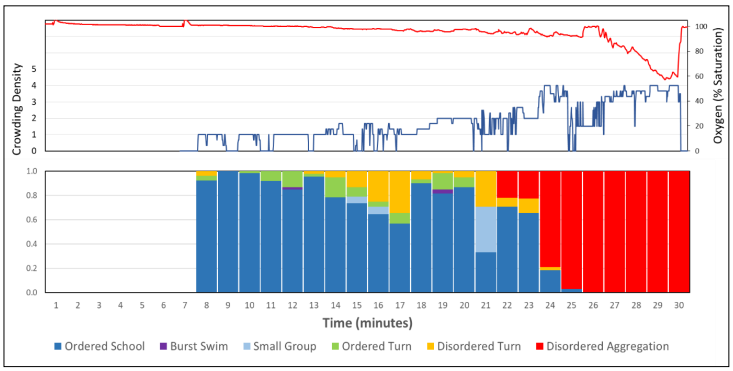
Monitoring stress in fish during capture in Purse Seines

The main objective of WP5 is to "*Develop indicators of stress and potential survival in commercial ring net fishing to help define limit values for unwanted catch release".* The stress response in fish is complex and variable. It is expressed at multiple biological levels: neurologically, hormonally, physiologically and behaviourally. Also, it is dependent on what is stressing the animal, and to what degree. Moreover, responses can vary between, and even within, individual fish. So, to be confident about our interpretation of the stress responses during different phases of the capture process, we must investigate different stress indicators simultaneously.

At the IMR laboratory facilities at Austevoll and on commercial fishing boats, we have been investigating the relationship between several potential stress indicators in mackerel (e.g. reflexes, behaviour, cortisol, lactate, skin colour, mortality and fillet quality) with known stressors during capture in purse seine (e.g. crowding, hypoxia). From this work we are beginning to define thresholds where these indicators show when it is safe to release unwanted catch, or where conditions are becoming so stressful that fillet quality in the landed catch may be affected. By combining and comparing different stress/welfare indicators we can develop a complete and more synergistic overview of the stress response in the affected fish. These indicator thresholds remain in development, but here we present a hypothetical example, based on real data, to show how this may work.

Figure 1 - Left: herring in an ordered school inside a purse seine during early hauling; and, right: herring becoming densely packed and disordered, close to the netting wall, late in the hauling phase.

PURSUE SEINE CATCH CONTROL



Stress/Welfare Status	2.0	2.0	2.0	2.0	2.0	2.0	1.8	1.8	1.8	1.8	2.0	1.8	1.8	1.8	1.8	1.3	1.3	1.5	1.3	1.0	0.3	0.3
Crowding	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1.5	1	1	0	0
Hypoxia	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Behaviour	2	2	2	2	2	2	2	1.5	1.5	1.5	1.5	2	1.5	1.5	1.5	1.5	1	1	1	1	0	0	0

Figure 2: crowding density (score), oxygen concentration (% saturation) in relation to observed behaviours in a retained catch during hauling. The table below shows a hypothetical Stress/Welfare Status score for the catch, based on an average of three individual stress indicator scores: Crowding, Hypoxia and Behaviour.

Work packages 2 (Catch Monitoring: Visualising the purse seine and catch) and 4 (Catch Monitoring: Characteristics and behaviour at the individual level) have been developing tools for monitoring various stress indicators and integrating these with other operational data. One of the main tools, the *Catch Monitoring Probe (CMP)*, has been used to collect data on behavioural responses in relation to the stressors: crowding and hypoxia. It has confirmed that crowding density increases, as expected, during the hauling process (figure 2), which becomes stressful when the crowding density is "High" (level 3) or more. In the table in figure 2, this is shown by a reduced crowding status score. "High" crowding initiates behavioural changes in the catch, which progresses from orderly, coordinated schooling behaviours to increasingly more disordered behaviours, which also reduces the behaviour score. The hypoxic stressor typically does not develop until after the school has become very crowded and disordered, when it drops below the "safe" threshold of 60% oxygen saturation. In this example, by taking an average of the three indicator scores, we can get a better overall indicator of the status of the catch, which suggests that the stress/welfare status of the catch is starting to be compromised from 24 minutes and become dangerously affected after 29 minutes.

In addition, using cameras placed at the discharge opening, observations have been made of the behaviour of slipped catches that demonstrate a similar progression from ordered to disordered behaviour over time. This suggests a link between the disordered behaviour at the discharge opening and the state of order of the catch within the net. To interpret the stress/welfare status of the catch during a slipping event, we will combine data on crowding, behaviour and oxygen concentrations in the catch, with crowding data behaviour at the discharge opening.

It proved impractical to get vitality and physiology samples from fish in the net during hauling and/or slipping, because mackerel easily evade our sampling net. For this reason, samples were taken from the pumped catch to provide some indication of what impact crowding and hypoxia during pumping had on vitality and physiology; working on the assumption that this would be representative of a worst-case scenario of crowding during a slipping event. This has also given us the opportunity to investigate the effects of conditions during pumping and storage in the RSW tanks on the catch stress/welfare status, and its potential implications for catch quality.

In conclusion, by combining different stress/welfare indicators we can make more confident inferences about the status of the catch in terms of its stress/welfare status. Over the course of the remainder of the project, data will be used to define indicator thresholds for a range of metrics, which can then be combined to give an overall indication of the stress/welfare status of the catch (e.g. figure 2). This information will be beneficial for promoting both the survival of the released unwanted catch and the quality of the retained catch.

Figure 3 – fillets from stressed mackerel showing "gaping" (in orange circles).

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