Operational Welfare Indicators for Salmon

Dr Lars Helge Stien
Institute of Marine Research, Norway

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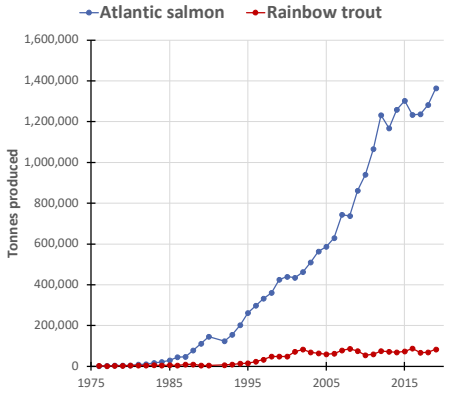
Has been a booming industry in Norway

Norway produced more than 1.4 million tones of salmon and rainbow trout in 2019.

Estimated value of nearly 6.5 billion Euro



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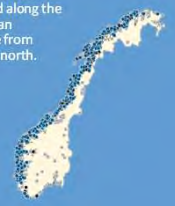
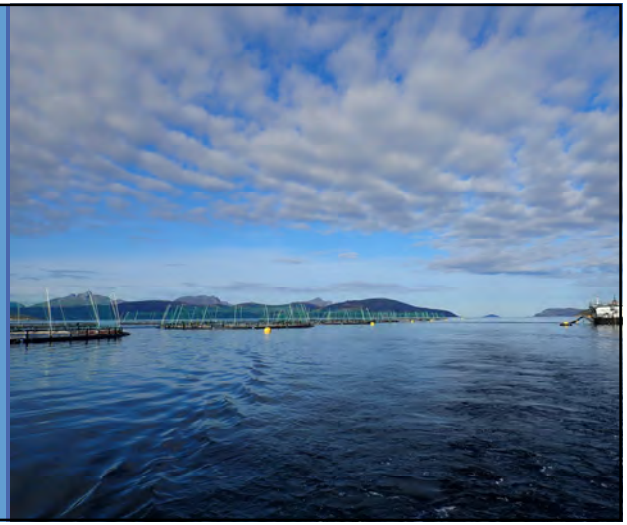
Based on open sea cages

Salmon farms are scattered along the Norwegian coastline from south to north.





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Low level of control

Feed particles, feces and other metabolites emanating from the fish are removed by the natural water current at the location, which also replenishes the cage with new fresh oxygen saturated water.

But outside pathogens have also free access to the sea cage.

Pictures shows salmon being attacked by sea lice (*Caligus elongatus*)

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Can be very difficult to assess fish welfare in a sea cage

Welfare indicators are measurements and observations that say something about the welfare status of the fish.

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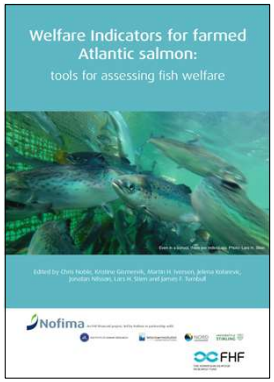
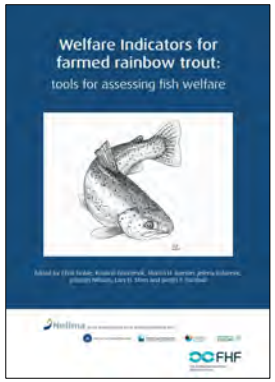
The FISHWELL handbooks for Atlantic salmon and Rainbow trout





Can be downloaded from https://nofima.no/en/fishwell/

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Operational Welfare Indicators

Results from projects: FISHWELL (FHF: 901157), LAKSVEL (FHF: 901554), CROWDMONITOR (FHF: 901595), AND TRIPVEL.
Collaborations with Nofima, Norwegian Veterinary Institute, Nord University, University of Stirling, Norway Royal Salmon , Marin Helse AS ,...

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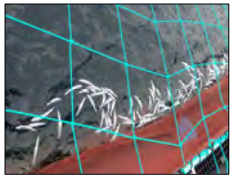
Welfare indicators

Input WIs

The fish

Outcome WIs



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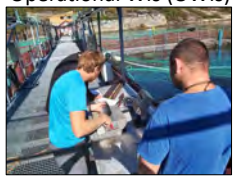
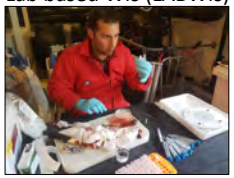
Welfare indicators

Operational WIs (OWIs)



Lab based WIs (LABWIs)



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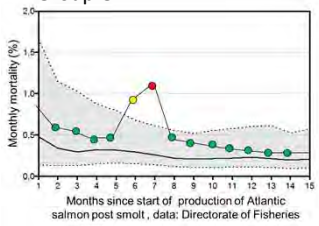
Outcome OWIs

Group OWI



Individual OWI

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Example of a group-based outcome OWI

Abnormal behaviour: The populations aggregate in the surface, standing against the current.

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Example of a group-based outcome OWI

Illustration of different levels of crowding intensity during surface monitoring of behaviour according to the RSPCA and Mejdell et al.

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Individual based outcome OWIs

Typical based on sampling of individual fish, looking for early signs of disease, deformations or damage from handling.

Moritella viscosa

Deformation

Damage from handling

Different interests

- Fish farmers want to have a welfare assessment system that is easy and fast to use.
- Fish health personnel want a system that gives detailed information that they can use to diagnose the fish.
- All want a system that can identify deteriorating welfare conditions before they become detrimental to the fish, and there still is time to perform mitigating measures.

Framework for Welfare Monitoring

Framework for utilizing different Operational Welfare Indicators (OWIs) and Laboratory-based Welfare Indicators (LABWIs) in an on-farm welfare assessment.

Level 1 Daily management

Input OWIs Basic observations of feeding and rearing environment

Outcome OWIs Basic observations of fish behaviour, appearance and mortality

Not enough information

Level 2 When level 1 outcome OWIs are compromised

Input OWIs Detailed assessment of water environment, rearing practices etc.

Outcome OWIs Detailed assessment of compromised fish and blood and faecal samples (LABWIs)

Not enough information

Level 3 When level 2 outcome OWIs are compromised Expert personnel needed

Input WIs Technical analysis of the rearing system, identifying pathogens in system (LABWIs)

Outcome WIs Fish health diagnosis, blood and tissue samples (LABWIs)

Outcome Welfare schema level 1

- Developed to be used on the fish sampled in connection with the obligatory weekly lice counts at Norwegian salmon farms.
- Easy and fast to use.
- All indicators are scored according to a 0–3 scale: (0) No or very minor damage, (1) minor damage (2) clear damage, and (3) extreme.

OWI - Skin haemorrhage

1

2

3

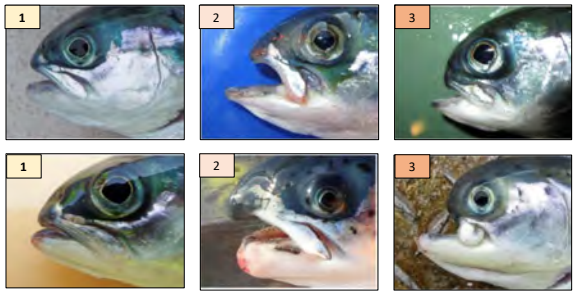
Outcome Welfare schema level 1

- Developed to be used on the fish sampled in connection with the obligatory weekly lice counts at Norwegian salmon farms.
- Easy and fast to use.
- All indicators are scored according to a 0–3 scale: (0) No or very minor damage, (1) minor damage (2) clear damage, and (3) extreme.

Scoring rules:

0	=	No or very minor damage / defect
1	=	Minor damage / defect
2	=	Clear damage/defect
3	=	Extreme - reason for culling

OWI – Upper jaw deformation



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Outcome OWIs from FISHWELL

- Examples of outcome-based OWIs based on the appearance of individual fish from the FISHWELL-handbooks for Atlantic salmon and Rainbow trout

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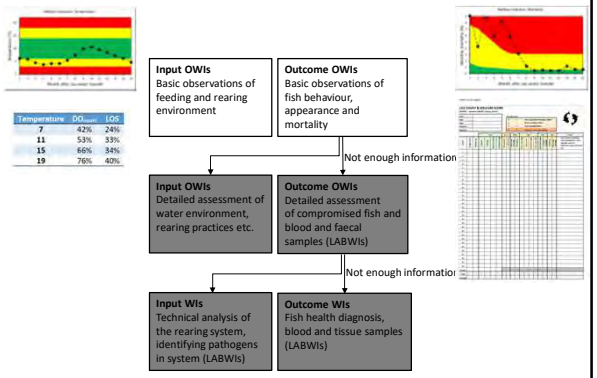
Framework for Welfare Monitoring Level 1

Daily management: Basic observations



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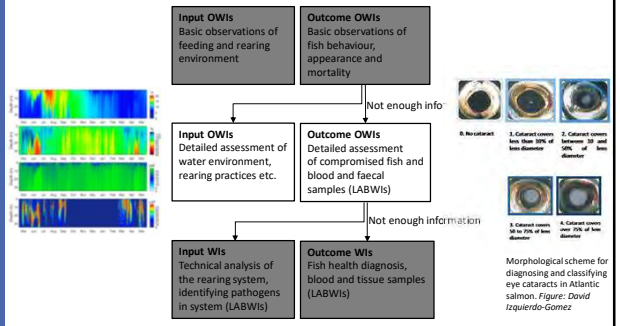
Framework for Welfare Monitoring Level 2

When level 1 outcome OWIs are compromised



Morphological scheme for diagnosing and classifying eye cataracts in Atlantic salmon. *Figure: David Izquierdo-Gomez*

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Framework for Welfare Monitoring Level 3

When level 2 outcome OWIs are compromised Expert personnel needed

Input OWIs
Basic observations of feeding and rearing environment

Outcome OWIs
Basic observations of fish behaviour, appearance and mortality

Not enough information

Input OWIs
Detailed assessment of water environment, rearing practices etc.

Outcome OWIs
Detailed assessment of compromised fish and blood and faecal samples (LABWIs)

Not enough information

Input WIs
Technical analysis of the rearing system, identifying pathogens in system (LABWIs)

Outcome WIs
Fish health diagnosis, blood and tissue samples (LABWIs)

The Speilberg Scale for intra-abdominal lesions after intraperitoneal vaccination of Atlantic salmon. Figure: Lars Speilberg

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Framework for Welfare Monitoring

Return to Level 1 when enough information.

Level 1

Level 2

Level 3

Enough information

Input OWIs
Basic observations of feeding and rearing environment

Outcome OWIs
Basic observations of fish behaviour, appearance and mortality

Not enough information

Input OWIs
Detailed assessment of water environment, rearing practices etc.

Outcome OWIs
Detailed assessment of compromised fish and blood and faecal samples (LABWIs)

Not enough information

Input WIs
Technical analysis of the rearing system, identifying pathogens in system (LABWIs)

Outcome WIs
Fish health diagnosis, blood and tissue samples (LABWIs)

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Framework for Welfare Monitoring

Framework for utilizing different Operational Welfare Indicators (OWIs) and Laboratory-based Welfare Indicators (LABWIs) in an on-farm welfare assessment.

Level 1

Level 2

Level 3

Enough information

Input OWIs
Basic observations of feeding and rearing environment

Outcome OWIs
Basic observations of fish behaviour, appearance and mortality

Not enough information

Input OWIs
Detailed assessment of water environment, rearing practices etc.

Outcome OWIs
Detailed assessment of compromised fish and blood and faecal samples (LABWIs)

Not enough information

Input WIs
Technical analysis of the rearing system, identifying pathogens in system (LABWIs)

Outcome WIs
Fish health diagnosis, blood and tissue samples (LABWIs)

Fish farm personnel

Fish health personnel or technical expert

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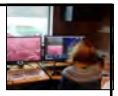
Framework for Welfare Monitoring

Framework for utilizing different Operational Welfare Indicators (OWIs) and Laboratory-based Welfare Indicators (LABWIs) in an on-farm welfare assessment.



Level 1

Level 2

Level 3

Enough information

Input OWIs
Basic observations of feeding and rearing environment

Outcome OWIs
Basic observations of fish behaviour, appearance and mortality

Not enough information

Input OWIs
Detailed assessment of water environment, rearing practices etc.

Outcome OWIs
Detailed assessment of compromised fish and blood and faecal samples (LABWIs)

Not enough information

Input WIs
Technical analysis of the rearing system, identifying pathogens in system (LABWIs)

Outcome WIs
Fish health diagnosis, blood and tissue samples (LABWIs)

Near future: Auto-matic

Fish farm personnel

Fish health personnel or technical expert

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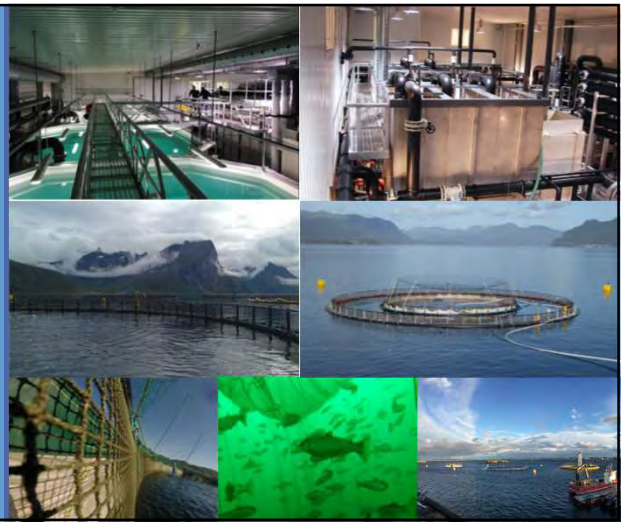
The FISHWELL handbooks for Atlantic salmon and Rainbow trout

Includes chapters discussing recommended WIs for different rearing systems and operations



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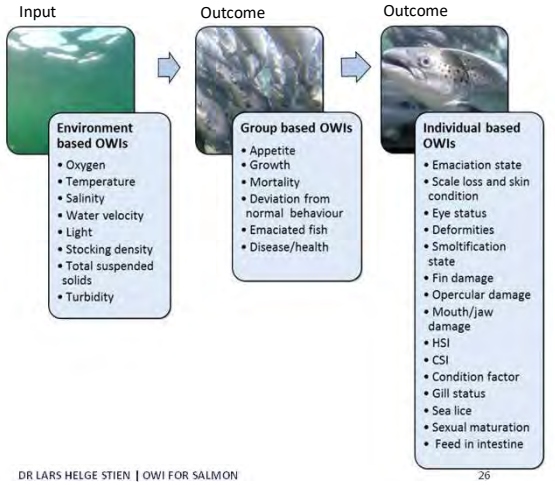
FISHWELL OWIs for salmon in sea cages

Includes chapters discussing recommended WIs for different rearing systems and operations



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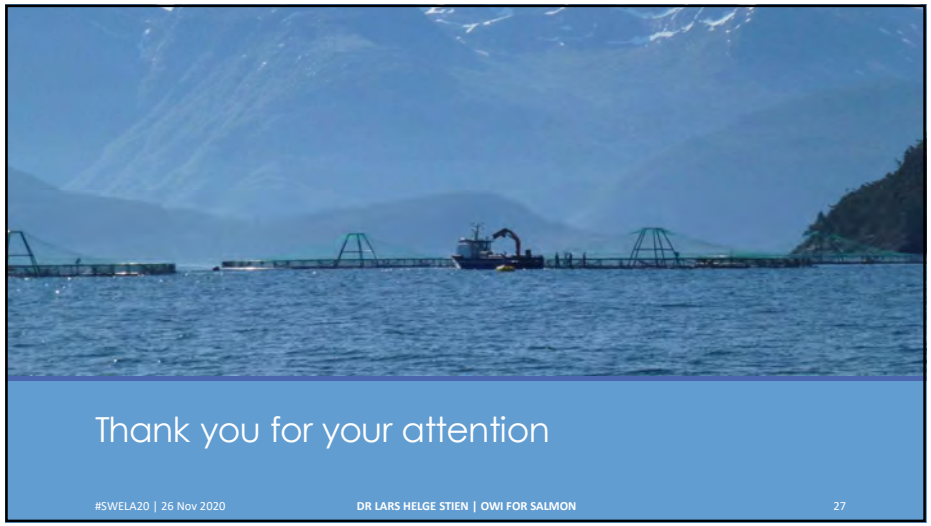

Thank you for your attention

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