



Operational Welfare Indicators for Sea Bream and Sea Bass




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Welfare Indicators for farmed Atlantic salmon: tools for assessing fish welfare




Even in a school, there are individuals. Photo: Lars H. Stien

Edited by Chris Noble, Kristine Gismervik, Martin H. Iversen, Jelena Kolarevic, Jonatan Nilsson, Lars H. Stien and James F. Turnbull

Nofima An FHF Research project, led by Nofima in partnership with:
 NORWAY UNIVERSITY OF LIFE SCIENCES, NORSK LUSKOLEGJISKE INSTITUTT, NORD UNIV, UNIVERSITY OF STIRLING

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THE NORWEGIAN LEISURE RESEARCH FUND

Welfare Indicators for farmed rainbow trout: tools for assessing fish welfare



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FISH FROM GREECE

Mediterranean Fish Welfare: Guide to good practices and assessment indicators

M. Pavlidis & A. Samaras, 2020

HAAPO HELLENIC AQUACULTURE PRODUCERS ORGANIZATION

FISH FROM GREECE Mediterranean Fish Welfare

Aim of the Welfare Guide

To compile an operational guide for personnel and those involved in mariculture, so that they can carry out tasks in line with current scientific knowledge on the welfare of farmed fish and well-established farming knowhow

Production phases

- ❖ Broodstockmanagement
- ❖ Pre-growing
- ❖ Juvenile transport
- ❖ On-growing
- ❖ Harvest

Processes

- ❖ Grading, transportation
- ❖ Sampling to monitor growth and health
- ❖ Administering veterinary treatments
- ❖ Diving work
- ❖ Feeding

Classifying Welfare Indicators

**Indirect or
Environmental**

Biologicals



Photo: <https://www.marine.ie>

Operational

**Laboratory-
based**

Available OWIs

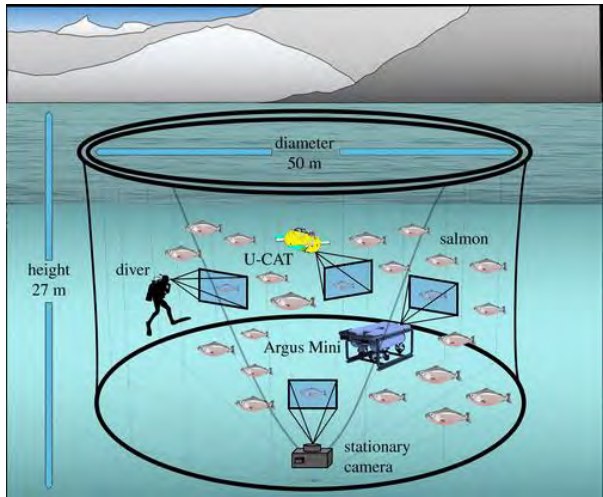
Stock based

Individual based

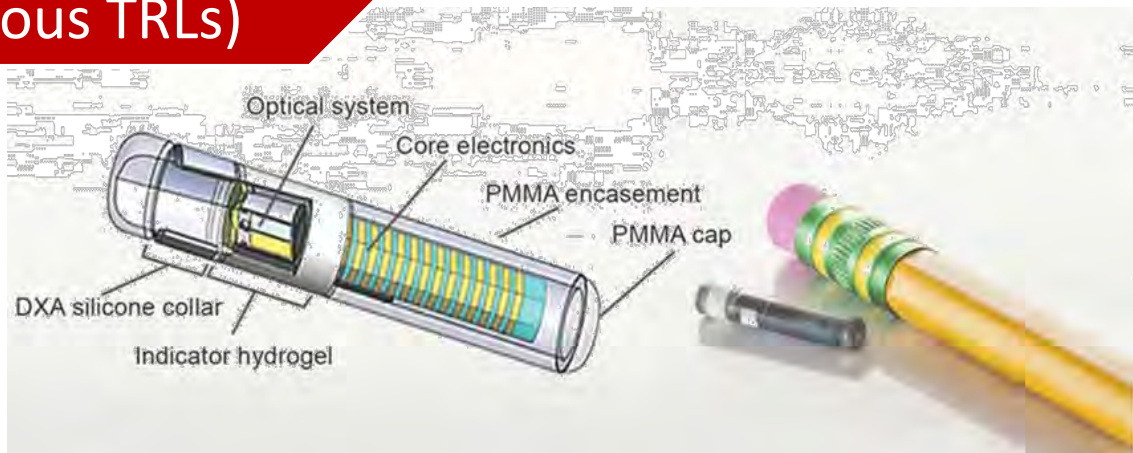
Available LabWIs

Available /not commonly used

Under development (various TRLs)

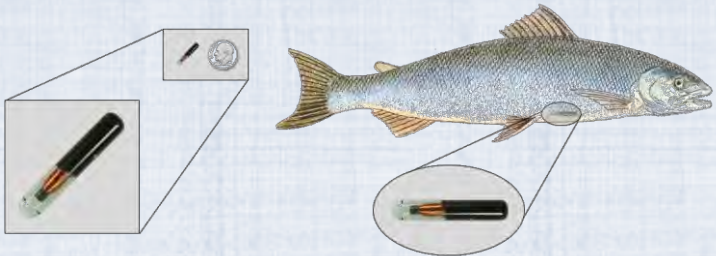


<https://royalsocietypublishing.org/doi/10.1098/rsos.191220>



Broodstock Welfare Challenges

1. Tagging



<https://www.uidevices.com>

2. Sexing

(stripping/biopsy)

- ✓ Anaesthesia
- ✓ Social context
- ✓ Sex ratio

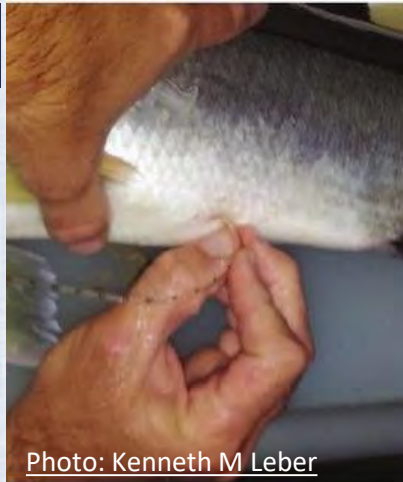


Photo: Kenneth M Leber

3. Spawning induction

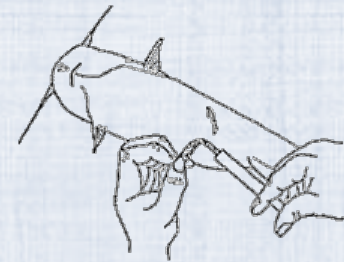


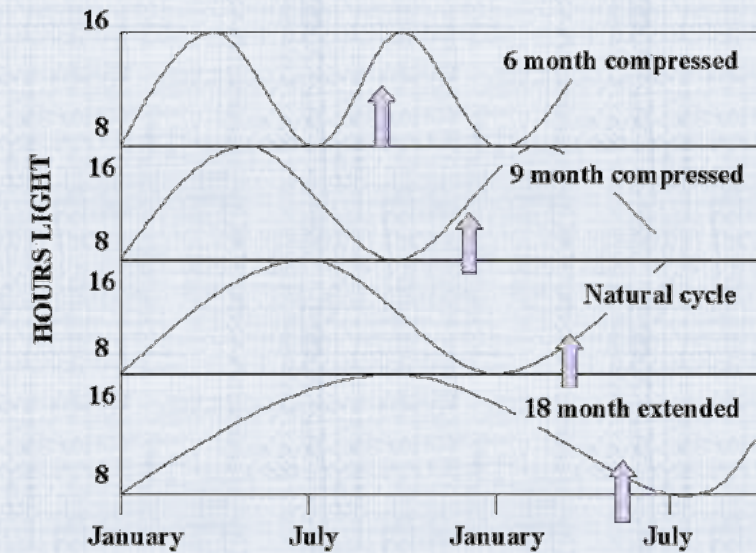
Figure 2



Figure 3

<http://www.seagrants.umn.edu/>

4. All year-round egg production



Broodstock OWIs

Environmental	Biological	
	Stock indicators	Individual indicators
Oxygen	Mortality	Health
Temperature	Appetite	Injuries
Salinity	Growth	Sexual maturation
pH	Behaviour	Spawning
Stocking density		Egg & sperm quality
Lighting		
Turbidity		

Pre-growing Welfare Challenges

A. Production Systems

Flow-through indoor tanks



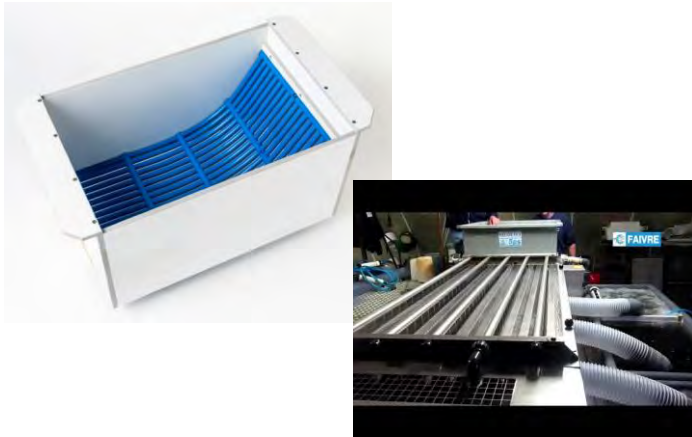
Recirculating Aquaculture System



Pre-growing Welfare Challenges

B. Operations

1. Grading



2. Counting



3. Vaccination



Pre-growing Welfare Challenges

B. Operations

4. Transportation



- Crowding
- Confinement
- Netting
- Air exposure



- Novel tank
- Social stress
- Water change
- Transportation



- Crowding
- Confinement
- Netting
- Novel tank
- Social stress

Pre-growing OWIs

Environmental

Biological

Stock indicators

Individual indicators

Oxygen

Mortality

Health

Temperature

Appetite

Injuries

Salinity

Growth

Respiration rate

pH

Behaviour

Stocking density

Lighting

Turbidity

On-growing OWIs



Environmental

Biological

Stock indicators

Individual indicators

Oxygen

Mortality

Health

Temperature

Appetite

Injuries

Salinity

Growth

Respiration rate

pH

Behaviour

Haematocrit and haemoglobin

Stocking density

Plasma glucose & lactate

Lighting

Turbidity

Follow up

	1	2	3
Eye haemorrhage	Minor haemorrhages	Larger haemorrhages, or traumatic injury	Large haemorrhages / traumatic injury. Eye may be ruptured
Exophthalmia	Eye protruding a little	Moderate eye protrusion	Major eye protrusion
Opercular damage	Operculum only partly covering gills	Operculum absent on one of the gills (gill exposed)	Both opercula absent (both gills exposed)
Snout damage	Minor wound on snout (either jaw)	Moderate wound and broken skin on snout	Large deep and extensive wound. Can cover the whole head
Upper jaw deformity	Suspected malformation	Distinct malformation	Major malformation, jaw pointing backwards
Lower jaw deformity	Suspected malformation	Distinct malformation	Major malformation, jaw pointing backwards

	1	2	3
Emaciation	Potentially emaciated	Emaciated	Extremely emaciated
Vertebral deformity	Signs of deformed spine	Clearly visible spinal deformity (e.g. short tail)	Extreme deformity
Skin haemorrhages	Minor haemorrhaging, often on the belly of the fish	Large area of haemorrhaging, often coupled with scale loss	Significant bleeding, often with severe scale loss, wounds and skin edema
Lesions / wounds ¹	One small wound (< 10 pence piece) ¹ ; subcutaneous tissue intact (no muscle visible)	Several small wounds	Large, severe wounds, muscle often exposed (≥ 10 pence piece)
Scale loss	Loss of individual scales	Small areas of scale loss (< 10% of the fish)	Large areas of scale loss (≥ 10% of the fish)
Sea lice infection	Light infection	0.05 - 0.08 pre-adult or adult lice cm ² of fish skin	≥ 0.08 pre-adult or adult lice cm ² of fish skin

Development of a **morphological scheme for classifying** key external morphological welfare indicators

Application of AI systems

Healed fin damage	Most of the fin remaining	Half of the fin remaining	Very little of the fin remaining
	Most of the fin remaining	Half of the fin remaining	Very little of the fin remaining
Active fin damage, splitting, haemorrhaging	Most of the fin remaining	Half of the fin remaining	Very little of the fin remaining
	Most of the fin remaining	Half of the fin remaining	Very little of the fin remaining

Figures: C. Noble et al., 2018

Harvesting – Humane Slaughter

***Asphyxia & chilling
in ice water slurry***





Electro-stunning



Thank you