PROJECT: BARRIER
PARTNERS: Nofima, CreateView
CONTACT: Christian Karlsen
(christian.karlsen@nofima.no)

CtrlAQUA

Wound types and regeneration

A major step towards successful production of Atlantic salmon in closed and semi-closed containment system (CCS, S-CCS) is knowledge about how these systems affect the diversity, prevalence and load of microparasites (viruses, bacteria, protozoan parasites, and fungi) in comparison with existing knowledge from open production systems. Will change in the culture system (e.g. S-CCS with water intake at large depths) lead to introduction of new microparasites not found in open production systems?

HYPOTHESIS:

The healing progression of physical or mechanical induced wounds depends on the wound's severity and type.

DURATION: 2021 - 2022

FISH SIZE TESTED: 400-600 g

SALINITY TESTED: Salt water

WATER TEMPERATURE: 10 °C

HIGHLIGHTS:

Wound healing progression after 5 weeks.

Healing progression between wound types is shown in Figure 1.

- Scale loss initiates re-epithelialization with rapid migrating skin keratocyte cells that cover and seal the surface after hours restoring the barrier function. The blood osmotic balance is restored after less than 2 days when fish suffer a skin area scale loss of ~10%, as shown in Figure 1. Healing of the tissue takes longer time. By week 5 at 10 °C, appearance is similar to the control with developed scales and structured epithelial layer with a high number of mucosal cells.
- Superficial wounds (scales are scraped off, also removing the outer skin structures completely, while leaving the dermis intact) have a longer recovery time. After 5 weeks, a gel like substrate is still filling the wound. Epidermis is sealed with a thick layer of keratocytes. Skin tissue layers are regenerating, display pigmentation, and starts developing scales. The epidermal surface has a high number of mucosal cells.
- Deep wounds (induced by punch biopsy tool) are after 5 weeks noticeable with dark coloration at the wound edges on the dorsal side. Ventral wounds appear more contracted. Restructuring of the tissue is on-going but the thickness of the epidermal layer is dominating. The epidermal layer has a high number of mucosal cells.

RECOMMENDATION:

- Knowing the healing progression of different wound types when injuries occur is valuable. This can be used to estimate a time frame for healing, if the tissue recovers and restore, or if activities such as e.g., handling or necessary treatments may increase the risk of recurrence and add to further damage.
- Wound healing progression depends on the severity of damage (Figure 1). After 5

weeks at 10 °C, scale loss area was in the final remodelling stage, superficial wounds were closed but only starting to develop scales, and deep wounds were still in inflammation with active tissue formation.

- It is expected that at higher temperatures healing progression is faster, while lower temperatures lengthen the healing time.

The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

READ MORE:

- Deliverable D3.1/BARRIER/2022

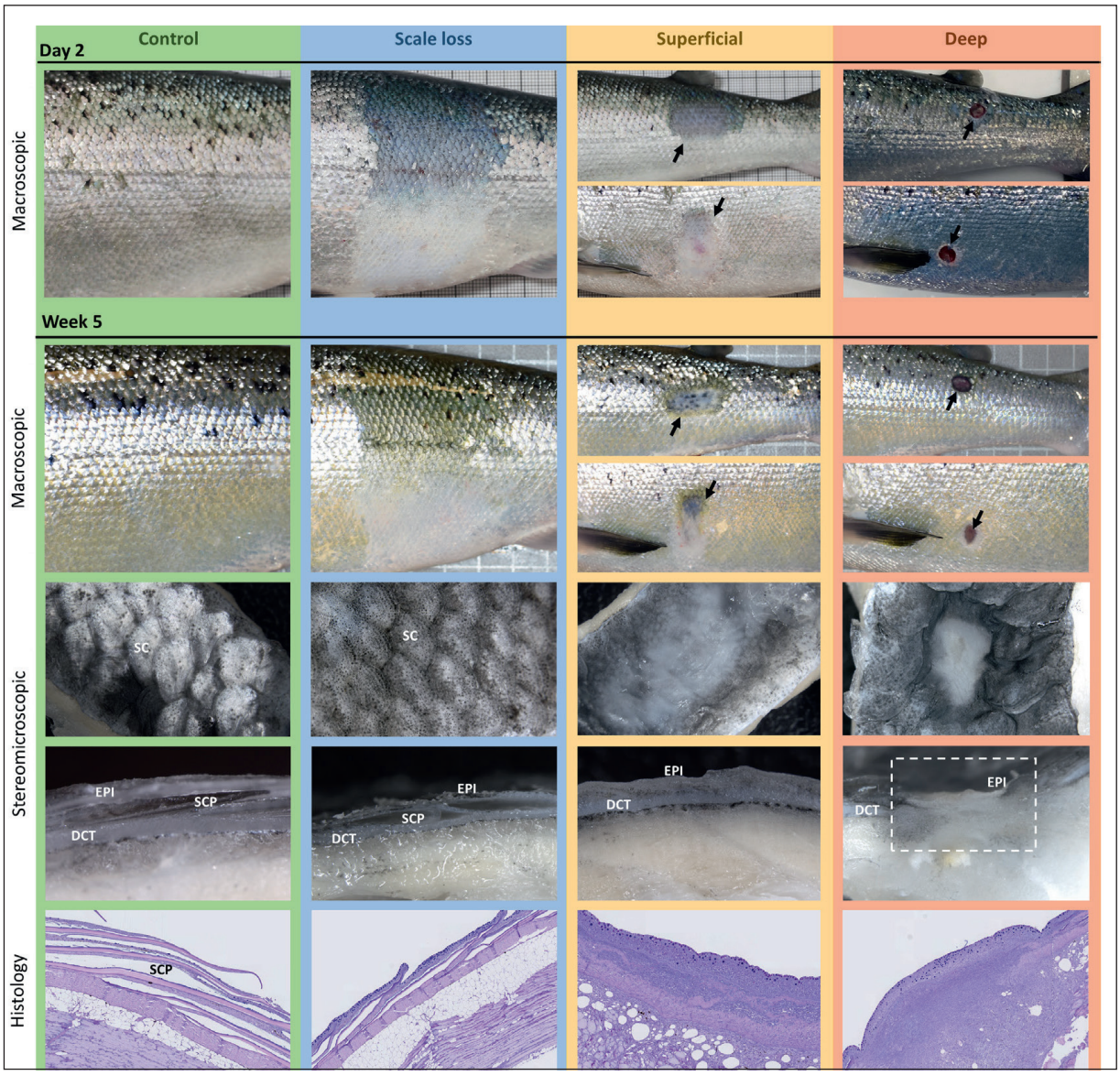

Figure 1. Wound healing progression, in salt water at 10 °C, between wound types shown by visual appearance, close up of the surface, by vertical sagittal cut followed by histological sections of the different wound types. The general wound healing cascade includes re-epithelialization, inflammation, granulation tissue formation and tissue remodeling.