Improving salmon's success in the wild and aquaculture

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Picture of smolt in the laboratory.

Have you ever been stressed and forgot what you were doing? Chronic mild stress may explain why many salmon don´t return to our rivers and why 20% of salmon production is lost every year.

Chronic mild stressors, such as a bad working environment, marital problems or sleepless nights with small children, are well known to cause learning and memory problems.

Researchers at Uni Research AS have shown that the same is true for salmon. This type of stress is very difficult to detect by traditional means. Often not until it is too late! Whether salmon are transferred from rearing tanks to sea-cages in aquaculture or are migrating from freshwater to the sea, their ability to learn and adapt rapidly to the new environments will dictate their future success.

The research team in the Integrative Fish Biology group at Uni Research AS has been establishing new ways to evaluate the salmon´s mental robustness, the ability to react and learn quickly in a new environment, before its too late. They recently showed that salmon exposed to poor water quality were poorer learners and that markers in the brain can show the fish have experienced chronic mild stress (Grassie et al 2013).

Identifying environmental situations that cause chronic mild stress will improve fish welfare and reduce losses in fish aquaculture. In addition, these researchers have shown that the same tools can be applied to improve the restoration of our salmon populations. A recent article by Ebbesson and co-workers in *The Proceedings of the Royal Society*, shows that raising fish in an environment with "furniture" improves their learning ability (Salvanes et al 2013).

These data demonstrate that alternative rearing strategies for restoration fish need to be found. These types of studies will provide new welfare indicators for the evaluation of welfare and aid in determining stress thresholds that can provide an optimal welfare and improved production. Together these physiological and mental robustness indicators will provide important information in the evaluation of the fishes robustness towards future challenges.

Fish welfare

Previously, a homeostatic-based definition of welfare postulated a negative linear relationship between stress and welfare, stability and no threats to homeostasis means the best welfare. In recent years, a new concept of welfare based on allostasis suggests an inverted U-shaped relationship, where both too little or too much stress gives poor welfare (Korte et al., 2007).

The allostasis concept is an important model to discriminate between normal adaptive stress responses and situations leading to poor animal welfare. Good animal welfare is characterized by a broad predictive physiological, cognitive, and behavioural capacity to anticipate and respond to environmental challenges in a way that matches the environmental demands (McEwen and Wingfield 2003, 2010).

Reducing these capacities leads to a mismatch between the response required by the actual conditions and the actual responses activated by animal, limiting the ability to experience good welfare. Understanding how the mediators of allostasis and coping ability are affected by stress level will give us a better understanding about the regulation of fish welfare.

Recent studies in fish have demonstrated that previous environmental experiences, whether negative (Grassie et al 2013) or positive (Salvanes et al 2013) provide learning and memory-based mechanisms to efficiently deal with environmental challenges, integrating physiological stress and cognitive abilities (Ebbesson et al 2013).

More information: Salvanes, A. et al. 2013. Environmental enrichment promotes neural plasticity and cognitive ability in fish, *Proc R Soc B* 280: 20131331. DOI: 10.1098/rspb.2013.1331

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