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Heart rate loggers as a tool to identify and quantify detrimental stressors in aquaculture

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European whitefish (*Coregonus lavaretus*) has been suggested as a suitable candidate for further expansion of aquaculture in northern Europe. Whitefish are, however, highly sensitive to stress. Farmers report that it is difficult to directly translate farm practices from other salmonid species, as the whitefish respond to stressful events with reduced feed intake and even loss of equilibrium.

To better understand the effects of environmental and anthropogenic stressors on whitefish, we surgically instrumented 20 whitefish with heart rate loggers before releasing them back into a commercial sea cage together with 3000 conspecifics. We recorded heart rate and related that to common farming practices events occurring during a period of 3 weeks. During the last 2 days of the study period, the fish were exposed to a series of farming practises related to the harvest of the fish (e.g., crowding, brailing, well-boat transport and CO₂ stunning). To validate the stress responses during these days, a sub-sample of 100 fish were sampled for plasma cortisol

The results show that the repeated stress induced by subsequent interfering farming practises had a cumulative effect as heart rate peaked at ~35 beats min⁻¹ above resting heart rate following the combination of crowding, brailing and transportation. Interestingly, we also found a clear increase in heart rate 18 days after the whitefish had been released back into the sea cages, which coincided with a second net cage containing rainbow trout being transported into the bay and anchored close to the whitefish cage at this time. With rainbow trout in their vicinity, the heart rate of the whitefish never recovered but remained significantly elevated by 10-15 beats min⁻¹ above resting hear rate, indicating sustained elevated stress levels. Collectively our results show how heart rate can be used to continuously monitor stress responses of fish during normal aquaculture practices.

Keywords: Stress, Heart rate, Biologger, Whitefish