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Fish Welfare in Swiss Aquaculture

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Key words
aquaculture, fish welfare, ontology, semantic data models, welfare assessment

Aim of the study
The project includes the development of a model to measure animal welfare on Swiss fish farms and fish farms. The aim is to develop a software-based application that allows individualised documentation for fish farmers and provides researchers with a standardised methodology to assess fish welfare.

Material and methods
First, an ontology of general fish welfare was created with semantic data modelling to link needs, i.e. fundamental requirements for welfare, and parameters, i.e. quantifiable aspects of welfare. Parameters at the basis of an applicable model must be relevant for welfare, have practicable assessment methods and deliver reliable results. Based on these three criteria, 80 parameters were chosen from the ontology and incorporated into a mathematical model. This model, named MyFishCheck, allows the evaluation of these parameters in five distinct welfare-related modules: farm management, water quality, fish group behaviour, fish external appearance and fish internal appearance, thereby yielding five individual module grades. The grades, numerical values from 0 to 1, categorise fish welfare from critical, poor, acceptable to good. The model represents an improvement to current fish welfare assessment in terms of comprehensiveness, applicability and developability.

Results and significance
Using semantic data modelling for fish welfare assessment proved to be advantageous. First, the approach imposed little constraints on the nature of parameters and thus, allowed for the inclusion of diverse aspects of fish welfare. Second, the concept of the ontology enabled the digital management of the complex topic. Third, the graphical representation of the ontology intuitively depicted relevant parameters, which allowed for a justified omission of parameters and a desired reduction of complexity. Further, the use of the concept of allostasis, which was the theoretical basis for the mathematical calculation provided two main advantages. First, the severity of stressors, i.e. the intensity, the duration and the frequency of the inflicted stress can be incorporated into the parameter intervals and translated to parameters scores. Second, the algorithm developed was based on the mean of scores and accounted for the cumulative nature of the allostatic loads. Together this represented a successful translation of a holistic concept into applicable and practicable protocols, an approach that is crucial for a methodological and objective assessment of fish welfare.

The model developed allows for the exchange of parameters and the adaptation of the intervals. This feature will enable the model to be tailored to particular aspects known to alter relevant husbandry conditions and their assessment, e.g. fish species, live stages, selection line, level of domestication and husbandry system and procedures, or the field of application, e.g. fish farms, fisheries, or scientific laboratories. The normalisation in the calculation, done by a division by the weighted mean within the modules, allows the model to function even if not all parameters are assessed. This enables the model to be spontaneously customised to a certain extent. This makes the model flexible and purpose-oriented.

The MyFishCheck model allows researchers to assess fish welfare based on the full model in a standardised and efficient way. This enables representative surveys of the whole industry, evaluations of measures across farms and verifications of theoretical ideas or lab trials in practice. Initial tests on six different farms showed that the model is indeed applicable on different fish species, different aquaculture systems and different locations. In addition, the available MS Excel version of the model facilitates its use in science.
Furthermore, the model allows fish farmers to perform regular controls based on a customised version of the model as part of their quality control management. This enables the documentation of on-farm welfare standards, the tracking of improvements and the tracing of problems. During the testing, the model reliably produced lower module grades where parameters showed negative effects on welfare. Additionally, the MyFishCheck app enables the user to perform these single-point evaluations more conveniently and to store, evaluate and compare past assessments.

Altogether, the model and its software application combine the advantages of previous fish welfare assessment attempts while improving on their shortcomings. MyFishCheck is comprehensive, applicable and developable, and will serve today's industry while assisting future advancements for the common goal of better fish welfare in aquaculture.

Publications, posters and presentations
Paper: "MyFishCheck: A model to assess fish welfare in aquaculture", in submission

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