WG3. EXERCISE IN AQUACULTURE

During the course of the project, members of WG3 discussed the application of exercise in aquaculture. In addition, WG3 organised two industry workshops, in Rotterdam (2015) and Dubrovnik (2017), to open up a dialog with the aquaculture industry and policy makers. The following is a summary of discussions in these meetings.
The results of the discussions in the WG and the workshops will be summarised in two reviews that are now in preparation, one aimed for the scientific literature which will be prepared in collaboration with WG1 and the other one aimed more at introducing the results of the project to industry and policy makers.

Questionnaires

The working group conducted a questionnaire to gather input from fish farmers and policy makers. The main objective of the questionnaire was to (1) Hear opinions of fish farmers and others who are involved in aquaculture about the importance of swimming exercise for aquaculture fish; (2) Get information on the practical control of currents in aquaculture facilities; (3) Assess the potential for increasing production with strategic use of water current (4) Gauge the interest of fish farmers to participate in research projects related to water current in rearing units. The answers suggest, that most fish farmers are aware of the benefits of swimming exercise for aquaculture fish. Most respondents thought that swimming exercise would be beneficial for fish and could improve growth performance. Fish farmers regulate current to facilitate cleaning of tanks and to create a better rearing environment for the fish with reference to swimming speed and feed distribution. However, not all land based fish farms allow current to be regulated. Most farmers regulate the current based on intuition rather than direct measurements and only few have equipment in their farms to measure current. Instead, they rely on cues such as the orientation of the fish towards the current. Some respondents thought that they could increase their production capacity with the correct choice of current velocity. The majority of the respondents were ready to participate in a research projects on swimming exercise.

Research on swimming exercise in aquaculture and gaps in knowledge

For the past four years, about ten papers have been published annually in peer reviewed journals on the effects of swimming exercise or swimming behaviour of aquaculture fish. Furthermore, the number of papers published each year on the subject has progressively increased during this period. Some of these papers are written by members in the FITFISH action. The workshops organised by WG3 have also given a good overview of current research in this field.
A number of studies focus primarily on how swimming activity affects the physiology of aquaculture fish. As a result, our understanding of the processes involved is increasing. Recent and current studies on the effect of swimming exercise on gene expression will also contribute to our understanding of the subject. However, further understanding is still required on how swimming exercise affects the growth of fish and other traits that are important to aquaculture. The review that is in preparation by WG1 and WG3 will shed further light on this.
Most of the published studies have addressed the effect of exercise on growth of different species. This has been studied most extensively in salmonids and there, we have the most complete picture of the beneficial effects of swimming. Much less is known about other species. The capacity of fish to swim depends on size and environmental factors such as temperature and oxygen levels and this information is required to define the optimum swimming regimes. There is still some work to be done on this in salmonids and more so for most other European aquaculture species. It is also important to address issues pertaining to the effect of exercise at different developmental stages, e.g. do exercise regimes during juvenile stages affect subsequent growth of fish. Most studies have tested short term effects of exercise but less is known about effects over the entire production cycle. Thus, although information is slowly gathering on the effects of swimming exercise on fish, there is still a significant gap in our knowledge of the field. Other effects of swimming exercise on important production parameters, such as muscle

structure and flesh quality, have also been studied. Furthermore, there are some interesting results coming from studies on the effects of swimming exercise on sexual maturation, stress, disease resistance and welfare although, further research is also required in this area.

Perhaps the most important gap in our knowledge is on how swimming exercise affects the nutritional requirements of aquaculture fish. Increased exercise may elevate the energy requirements of the fish and it is important to study how feeds should be formulated for exercising fish.

It is relatively easy to regulate current velocity within circular tanks and thus control the swimming velocity of fish. However, this is more difficult in ponds or raceways. Movement of water in net cages depends on tidal currents and, therefore, placement of cages gives some opportunities to regulate the current to which the fish are exposed. Recent work has attempted to assess the sustainable swimming speed of aquaculture salmon to explore the possibilities of exploiting higher currents in exposed locations to improve performance and welfare of fish in cages. It may also be possible to develop methods to induce swimming activity of fish in cages independent of current. Experiments have been conducted using light cues and on-going studies using robotic fish to affect the swimming activity of larger groups of fish may could open interesting possibilities.

Implementation of swimming exercise in aquaculture

The broad background of the working group and those who attended the workshops created a strong forum for discussing the implementation of swimming exercise in aquaculture. At present, swimming exercise is most relevant for land based aquaculture in tanks. The engineering of circular tanks is currently primarily aimed at ensuring even distribution of water quality and efficient cleaning of tanks while the effects on swimming exercise have been given less consideration. However, the current velocity required for removing waste from tanks may be similar to the velocities required for inducing optimum swimming speed of aquaculture fish with regards to growth, welfare and production performance. The implementation of swimming exercise in other rearing systems such as ponds or cages is more complicated although recent and on-going work may open up new possibilities in this area.