

## **Insight on the use of shelters and their effect on the welfare of rainbow trout in organic aquaculture**

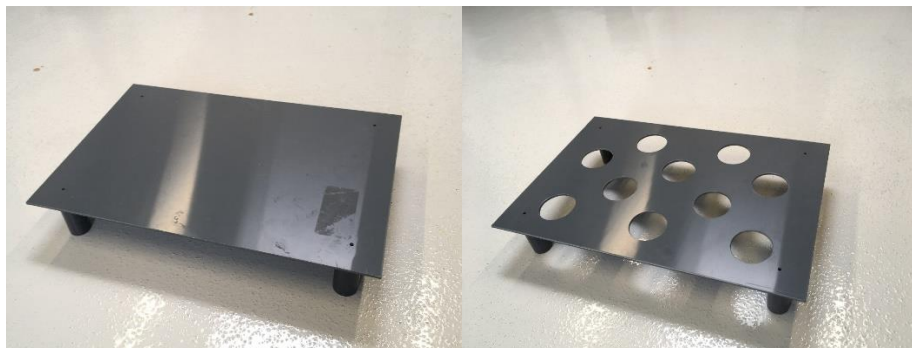
**The use of shelters for promoting fish welfare in organic aquaculture has been tested in organic rainbow trout as part of the Shelterfish project.**

Most fish-rearing facilities in aquaculture consist of barren tanks where environmental complexity is very low. This has raised concerns about the welfare of fish in captivity and different kinds of environmental enrichment have been tested as potential strategies to promote the welfare of captive fish. Most animals display some kind of shelter-seeking behavior to get away from situations or events they prefer to avoid. In this regard, providing shelters to the fish is a kind of enrichment that has shown promising effects on fish welfare, particularly in fish released for restocking purposes. Use of shelters is uncommon in aquaculture, maybe because data about their effect is still scarce and available data show contradictory effects on fish growth performance when shelters are available in the rearing units. In addition, submerged structures can result in more complicated cleaning routines in a fish farm.

One of the aims of the Shelterfish project was to test whether simple shelters, easy to produce, install and remove, might have similar beneficial effects for fish welfare in aquaculture as observed before for fish used for re-stocking. Different trials were performed with fish to test their ability to grow, resist stress and keep good health conditions in the presence or absence of shelters.

### **Effects after shelter presence as juveniles**

Simple shelters were designed in the form of PVC flat screens, which were allocated at the bottom of fish rearing units, separated 10 cm from the floor. Two types of shelters were used: a full screen, and a partial, perforated screen. The presence of shelters was first evaluated by exposing trout juveniles of around 15 g to the shelters. The fish grew in the presence or absence of shelters until they reached around 55 g. During this period, the growth performance, external lesions (in fins, eyes, operculum, snout and skin), and the ability of the fish to resist stressful procedures (such as handling or reduced water level) were evaluated. The behavior of the fish around the shelter was also observed during this period. By the end of the trials, the fish in the sheltered rearing units had developed a clear shelter-seeking behavior when exposed to disturbance, all the fish hiding together under the sheltered area. Furthermore, the shelters had a protective effect on fish external lesions, total damage to the fins were reduced > 10 % when compared to fish growing with no shelters. The presence of shelters did not affect the mortality rates, growth performance and the ability of the fish to cope with stress.



### **Effects from earlier stages**

During early stages of development, fish nervous system is very sensitive to external events and what fish experience during early life is known to affect the future behavior and stress sensitivity of the animals. Therefore, in a second set of trials, trout fry were exposed to shelters at an earlier stage. Fish were introduced to the shelters when they were 1.5 g and were kept in the enriched units until they reached 55 g. Mortality, growth and condition factor of the fish were not affected by the shelters, neither were differences found between sheltered and control fish in terms of external injuries. Fish that were grown with shelters showed a stress response of higher magnitude after acute stress, but were equally able than control fish to deal with repeated stress.

### **Early life and shelters. Any effect on the forthcoming life of the fish?**

After living for four months in the presence of shelters, those were removed, and the ability of fish to compete with control fish, never exposed to the shelters, was evaluated. Both groups were allocated together in the same tanks. After several weeks, growth performance and stress resilience was tested and was seen to be similar for both control and previously-sheltered fish. Previously-sheltered fish showed a lower ability to compete for food in conditions of restricted feeding, but this effect tended to disappear when the period of adaptation to the absence of shelters was increased.

### **Conclusions**

Altogether, the results of the trials in the Shelterfish project showed that fish have a clear preference for shelter use and that shelters had no negative effects on the fish growth performance. These results alone can be considered positive for fish welfare, since animal preference is an important welfare aspect. However, effects on external lesions and general health were modest, and the ability of the fish to deal with stress was not altered. There is likely room for optimization in the use of shelters and other types of enrichment for increasing the welfare of farmed fish. In the particular case of the use of shelters for salmonid farming, shelter effects seem to depend on many different factors and there is a need for further research to optimize their use in terms of shelter type, sheltering extent and timing for its application during the fish life cycle. Ongoing Shelterfish trials directly on a fish organic farm will further contribute to that research effort.