

Stress affects reproduction

Tom Pottinger is a fish ecophysiologicalist at the Centre for Ecology and Hydrology (CEH) in Lancaster, UK. His research focuses on understanding how fish cope with, and respond to, adverse alterations in their environment.

Further information:
<http://www.ceh.ac.uk/StaffWebPages/TomPottinger.html>
Contact:
tgp@ceh.ac.uk

When an animal is faced by something that is potentially life-threatening, a “stress” response will be triggered. That is to say, rapid hormonal, respiratory, metabolic and behavioural changes will take place that increase the chances of the animal surviving the threat. This response is common to all vertebrates in their natural environment, including fish.

In the aquaculture environment fish may develop stress-related problems. One of the reasons for this is that, in comparison to other farmed animals like sheep, pigs and cattle, **most farmed fish species are essentially undomesticated** (although one exception to this generalisation may be the carp which has been farmed for millennia). Consequently, farmed fish may “over react” to events that are in actual fact harmless, as if they were a potential threat. When you consider the husbandry practices that are a necessary part of large-scale fish production

it's clear that the farm environment can be a potentially stressful one for fish. **Fish can be confronted with all sorts of physical, chemical and social stressors, such as handling, grading, transport and veterinary treatment, as well as possible longer-term deteriorations in water quality and overstocking.** While



Removing eggs for artificial fertilisation

for the most part not damaging in themselves, the inappropriate activation of the stress response that results from exposure to frequent or intermittent disturbance can result in a decline in the growth and condition of fish, and an increase in the frequency of disease outbreaks.

It is true that a vigilant farmer would quickly become aware of such problems and take steps to eliminate or reduce the source of the problems. However, more subtle adverse effects of stress can occur, and these may not be so easily detected. **In particular, the reproductive system is a sensitive target for stress-induced changes.** In functional terms, considering that the purpose of the stress response is to enhance the chances of survival during challenging events, this makes sense. Under duress, the fish's chances of survival will be enhanced if all non-essential activities are shut down and resources re-allocated appropriately.



Sorting fish

So what does this mean? It means that the reproductive performance of a farmed fish can be significantly affected if it is exposed to continuous, or repeated short-term, stressors during the reproductive period. We know that exposure to stressful factors can delay ovulation and reduce egg size in female trout and reduce sperm count in males, it can reduce the size and survival of offspring, increase developmental abnormalities and cause resorption of the eggs in the ovary. In fact, what's happening is that the presence of cortisol, otherwise known as the "stress hormone", reduces the levels of sex hormones (estrogens and androgens) and key pituitary hormones (gonadotrophins) in male and female fish, this has knock-on effects on the building-blocks of reproduction.

What can be done to ensure that the performance of valuable broodstock is not impaired by stress? Clearly, welfare is of

paramount importance, and broodstock should be held in optimal environments with as little disturbance as possible. Some attention should be paid to the behavioural characteristics of the species to ensure that social stress is not inadvertently a factor - for example by not holding fish at too high or too low a density, or inappropriately as single or mixed sex groups. **In the longer term research initiatives, such as the EU-funded AQUAFIRST programme, are underway to develop lines of fish that are more tolerant of the aquaculture environment.** This will be achieved by exploiting selective breeding strategies to reduce stress responsiveness. This strategy will in effect accelerate the domestication of these valuable resources and lead to improved productivity coupled with a positive welfare outcome.