Sizing up the fish market

A new underwater camera technique for assessing fish will help commercial salmon farmers monitor the growth and welfare of their valuable stock and meet their customers' strict size requirements.

Salmon farming is big business. It's worth £150 million per annum to the UK, supports 6,500 jobs, 70% of them in the Scottish Highlands and Islands, and accounts for nearly 40% of all Scottish food exports. Not only has the UK demand for salmon more than trebled over the last decade – consumption has risen from 31,000 tonnes in 1992 to an estimated 94,500 tonnes in 2000 – but there's a healthy market for it in the US, Japan and other EU countries.

The vast majority of salmon destined for the table is farmed commercially in large sea cages off the Scottish coast. A cage 20m x 20m x 15m deep stocks on average 30,000 fish. Farmers quantify the fish in terms of biomass, or the total weight of fish in a cage. The supermarkets they sell to require the fish to be of a specific size; they won't accept smaller fish, or pay more for larger ones. A farmer, therefore, needs to monitor his stock regularly to ensure that individual fish are growing sufficiently and meeting their target size and weight.

However, current techniques for monitoring fish are not especially reliable, according to Dr Jeff Lines of Silsoe Research Institute, one of the UK's leading agricultural engineering research organisations whose work is largely funded by the Biotechnology and Biological Sciences Research Council. 'You can catch fish with a hand net, anaesthetise and weigh them, but you tend to get a poor and biased sample – only the greedier ones who happen to be near the surface, which aren't necessarily representative.'

The only commercial 'sizing frame' system currently available for measuring fish biomass, which reveals a fish's silhouette as it passes through and breaks a series of infra-red rays, delivers similarly unrepresentative data, not least because fish appear to avoid swimming through the frame.

Fishing for a solution

Eureka project E! 2446 Multifunction Sensor was born when Norwegian company Akvasmart, one of the world's leading suppliers of IT-based products and services for the aquaculture industry, asked Silsoe Research Institute to collaborate on developing a prototype stereo vision-based system which lowers cameras into the cage for a close-up view of the fish.

Just as the project was getting off the ground, though, a Canadian company launched their own stereo vision-based system which worked very much along the same principles, but which required the operator to sit and watch the fish

Team members collecting images on floating circular fish cages near Bodo (Northern Norway) and on Lock Fyne, Scotland

Preparing the cameras for lowering into the sea cage

Images courtesy of Silsoe Research Institute

coming past, press a button to capture the image and go over the images by hand. Akvasmart and the institute decided to use this existing system as a hardware platform which they could automate using their own specially developed software.

The system comprises of a pair of cameras set in a frame 18"– 24" apart, which can be lowered to any depth. The cameras capture a 3-D image of the fish and estimate its size by measuring a range of linear points (distance from nose to tail, from one fin to another etc), a method developed by another collaborator on the project, the Institute of Aquaculture in Stirling.

Much of the development work took place in a water tank at Silsoe, and when it came to testing the prototype in a sea cage visibility proved a major problem says Dr Lines: 'You get very strange lighting conditions under water – the images become very flat and the fish merge into one. We had to experiment with different camera positions to find out the optimum places to take images.'

Dr Lines and his team then tried out the equipment on location on Scottish and Norwegian fish farms, to the great interest of the farmers. 'I used to work in agricultural engineering R&D and whenever I took a prototype to a farm to test the attitude was always, what do we want that for?,' says Dr Lines. 'The fish farmers couldn't be more different – they always ask how soon they can have one. They recognise the need for and benefits of new technology, which makes it a wonderful industry to work in. It's a sector that's moving very rapidly, and is concerned enough about environmental and welfare issues to fund its own research.'

Multifunction Sensor's software is still being developed and refined to maximise other potential functions: monitoring sea lice infestations, for example, and the amount of fish food that goes uneaten, which can be an environmental hazard to the fauna and flora on the sea bed. Silsoe Research Institute is also working on a way of counting the number of fish in a cage, a facility which fish farmers would much appreciate. When the software technology is finalised, the product is sure to win an eager reception from the world's major fish farming markets.

Further information

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