science summary

Environment Agency

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Development of a fish counting system for fish passes

Summary SC050022/SR1

A new method for counting fish as they move through a fish pass is published in a report by the Environment Agency. An accompanying manual explains how to record underwater video images and use them to monitor fish. The method can be used to assess the effectiveness of a fish pass or existing fish counter, as well as estimating returning stock of salmon and trout.

The report, *Development of a fish counting system for fish passes* outlines a new method to monitor and count fish as they travel through a fish pass or channel. The method will be useful to owners and managers of fish passes, who must provide evidence that a pass is working effectively to be granted regulatory approval. To date, this has proved expensive and technically difficult. The Environment Agency approves fish passes under the Environment Act 1995, via a Fish Pass Panel through which all applications for new builds, alterations of existing passes and final approvals are dealt with. This report describes a simple and cost-effective method to gather data for the approval process, along with the equipment necessary to carry out video counting.

After developing the monitoring method, this project assessed its performance on a range of test sites and drew up an instruction manual for its operation, *Using video images for fisheries monitoring*.

Five sites representing a broad range of fish pass types were chosen for the trials. Camera, lighting and image recording equipment were deployed at each site, to identify the optimum arrangement to produce the best fish images. The resulting video output was used to evaluate three computer-based image analysis systems for detecting fish from video images. Two of these significantly outperformed the third in terms of detection rate for fish and time taken for an analyst to obtain a fish count.

One of these, Fishtick, is a commercially available motion detection system, where the analyst is presented with a stream of video clips which can be tagged individually to data. The other, DVMD, based on commercially available hardware used in the security industry, tracks targets and automatically counts objects as they pass through a camera field. These two approaches were tested at the trial sites.

Using Fishtick, 24 hours of data could be reviewed and analysed in 15 minutes with a detection rate of 90 per cent. Extrapolated for a whole year, a verified fish count could be obtained from 13 days of staff time.

The more automated approach of DVMD required an analyst to verify the automatic output. Though this had similar detection rates to Fishtick, the time taken to obtain a count could be four times as long. However, in applications with very few false counts, the time to produce a count of fish may be quicker than Fishtick.

The project generated the following results:

- A fish counting system costing less than £5,000 suitable for fish passes and narrow channels.
- A manual for using underwater cameras, lighting and image analysis to monitor fish.
- Standard designs for the fish exit of a fish pass for the routine use of video monitoring equipment.
- An automated motion detection system for fish, which meets Environment Agency requirements.
- An automated image analysis system for counting fish, based on commercially available hardware.
- A statistical model for improving the accuracy and precision of fish counts using an automated motion detection or image analysis system.

The video counting method reported here was relatively cheap to build, install and maintain and demonstrated its ability to produce reliable results with modest use of staff time. The technique could be used to validate existing fish counters (resistivity, infrared, acoustic) or as a stand-alone counting system. It could also be used as a primary fish counting tool to estimate returning stock of salmon and trout in rivers.

The method is suitable for any natural or manmade channel, fish pass, bypass, or water intake that is a maximum of two metres wide and two metres deep. Sections of weir face may also be suitable.

The accompanying manual, *Using video images for fisheries monitoring,* details the equipment and methods required to record underwater video images and to use them to monitor and count fish. It describes the arrangement of cameras, lighting, image recording equipment, motion detection and image analysis software for a variety of applications for monitoring fish. Case studies, specifications, diagrams, step-by-step instructions and contact details are also given in the manual, to help users design their own monitoring systems and build or order equipment such as LED or infrared lighting, low-powered digital video recorders, fuel cells and outdoor housing for power supplies.

As a consequence of this study, facilities for video monitoring are being installed on the River Mersey to monitor the return of salmon to the river, to help decide whether to open up more of the river to salmon. Louds Mill weir on the River Frome is being refurbished to incorporate a video monitoring system, to assess the effectiveness of a gauging weir at passing fish. New fish passes on the River Yealm in Plymouth and River Ely in Cardiff are being installed with video fish counting systems. Video fish counters are being used on existing resistivity counters on the rivers Tamar and Fowey to assist in routine validation. The Department of Transport for the Isle of Man is installing a Fishtick system at a tidal barrage in Peel harbour.

This summary relates to information from Science Project SC050022/SR1, reported in detail in the following output(s):-

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