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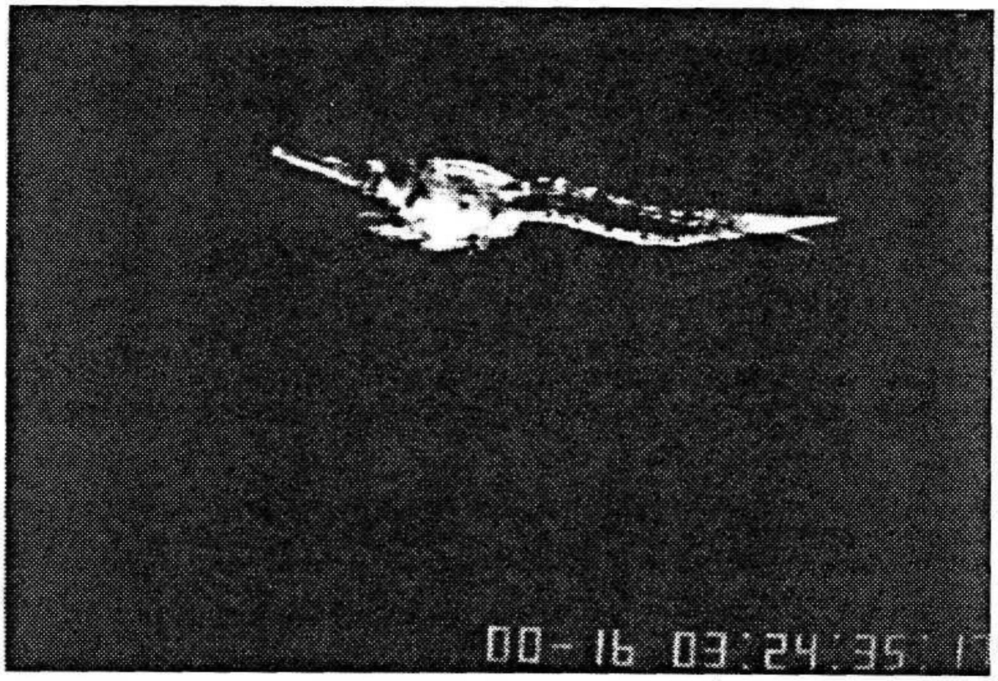

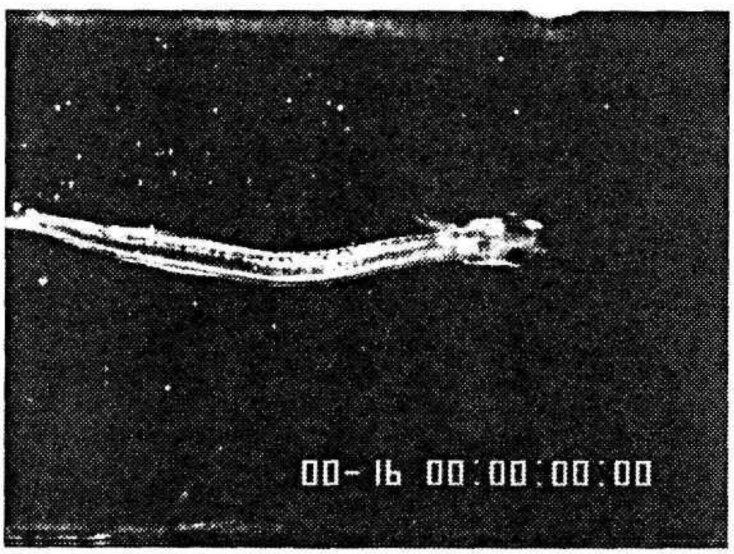

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DEVELOPMENT OF AN UNDERWATER VIDEO SYSTEM FOR RECORDING OF ICHTHYOPLANKTON AND ZOOPLANKTON

by

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ABSTRACT

Our working group is developing an underwater video system for continuous recording of ichthyo- and zooplankton. The system is integrated in the cod end of standard plankton nets used for horizontal and vertical hauls. Images of organisms are transmitted to the ship-board unit together with CTD and oxygen data. The high spatial resolution of the system allows the testing of several hypotheses on the small-scale distribution of zooplankton and on the mortality of ichthyoplankton. Experiments in the laboratory resulted in sharp video images of zooplankton organisms which passed the measuring chamber at speeds of up to 3.5 m/s. In situ experiments are planned for the end of 1990.

Introduction

Traditional methods for horizontal sampling of zooplankton and ichthyoplankton have a spatial resolution of several hundreds of meters. The Longhurst-Hardy-Plankton-Recorder achieves a theoretical resolution of about 15 m (HAURY 1976). The resolution of vertical hauls is restricted to several meters. The testing of hypotheses on small-scale distribution of zooplankton and on the mortality of ichthyoplankton (cf. ROTHSCHILD 1986) demands still higher resolutions.

Direct recording of plankton in situ distribution by underwater video would be the ideal solution. This, however, is not feasable because of the small size of organisms and their low concentration per volume water. Our idea is therefore to place a video system at the entrance of the cod end of standard plankton nets (Fig. 1) that can continuously record plankton organisms including ichthyoplankton together with their prey and predators.

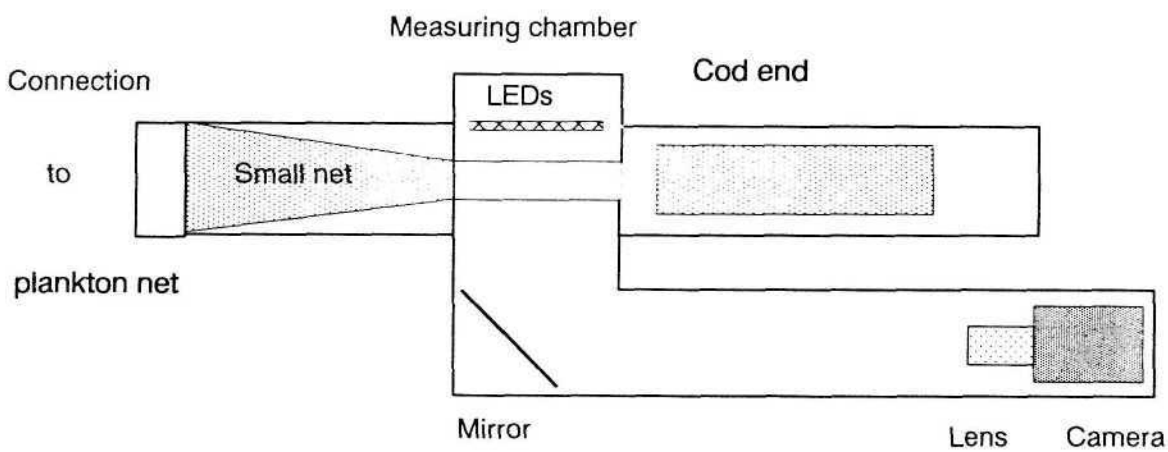

Figure 1: Schematic drawing of video unit for implementation in cod end of plankton nets.

The resolution of the system is limited only by net characteristics such as flow profile in the net, clogging and smearing, i.e., the different residence times of organisms within the net (PIPE et al. 1981; SMITH et al. 1969). Experiments with optimized plankton nets indicate that this bias can be kept small. In experiments with dead zooplankton, more than 95 % of the animals passed directly into the cod end (WILLIAMS et al. 1983).

The aim of our project is to develop two video-based plankton recording devices: a ZOOPLANKTON PROFILER for vertical hauls and organisms of 0.05 to 5 mm size, and an ICHTHYOPLANKTON RECORDER for horizontal tows at a speed of up to 6 knots for organisms of 0.5 to 30 mm size. Sharp images of the organisms entering the cod end of the net together with environmental data (CTD, oxygen) are transferred in real time to a ship-board unit where they are displayed on a monitor and stored on a video recorder. Thus they are easily accessible for a subsequent semi-automated image analysis.

The Video System

We used a sensitive CCD-camera (30 dB S/N at 30 millilux) with a resolution of 384 * 256 pixels and a 90 mm macro lens. Tank experiments by BLENDERMANN (1969) indicate that water velocity in the cod end of plankton nets is about the same as the towing speed, i.e., usually 0.5 m/s for vertical hauls and 1.5 to 3 m/s for horizontal tows. To avoid blur caused by motion, organisms are illuminated by an LED strobe light (wave length 660 nm) of 50 flashes per second (video norm) with an exposure time of 0.5 to 2.5 us per flash. This results in 50 individual images per second. Depending on magnification and water velocity in the measuring chamber, images overlap or have gaps in between. For a visual field of 20 * 15 mm^2 and a velocity of 1 m/s, the images form a continuous band.

Laboratory experiments

The first aim of our project was to obtain sharp video images of small plankton organisms that pass at high speed through a measuring chamber of 15 * 15 mm^2 diameter. We had to balance the diverging requirements of high resolution, sufficient depth of field, sufficient light, and very short exposure time. We tested the system in the laboratory with copepods, cladocerans, mysids, and fish larvae. A backlight illumination technique gave best results in displaying the transparent organisms. Sharp images were obtained for object velocities of up to 3.5 m/s (= 7 knots) (see video prints on cover).

Outlook

The video system has been integrated in the cod end of a "Nackthai" (NELLEN and HEMPEL 1969) for horizontal tows, and similar gear is currently being built for vertical hauls. We hope to be able to present first in-situ results during the presentation of this paper at the ICES meeting in October 1990.

Acknowledgements

The project is funded by the Federal Ministry for Research and Technology (MFU05972) within the EUROMAR programme. Thanks are due to Dr. V. Kachel of the Max-Planck-Institut fur Biochemie for advice and good cooperation within the programme.

References

BLENDERMANN, W. 1969. Windkanalmessungen an einem Planktonnet/.. Bericht fuer das Institut fuer Hydrobiologie und Fischereiwissenschaft der Universitaet Hamburg.

HAURY, L.R. 1973. Sampling bias of a Longhurst- Hardy plankton recorder. Limnology and Oceanography 18: 500-506

NELLEN, W., G. HEMPEL 1969. Comparisons of the fishing efficiency of the Gulf III sampler "Hai" and a modified sampler "Nackthai". Ber. Dt. Wiss. Komm. Meeresforsch. 20: 141-154

PIPE, R.K., S.H. COOMBS, K.R. CLARKE 1981. On the sample validity of the Longhurst-Hardy Plankton Recorder for fish eggs and larvae. J. Plankt. Res. 3(4): 675-684

ROTHSCHILD, B.J. 1986. Dynamics of marine fish populations. Harvard Univ. Press, Cambridge (USA): 277 pp.

SMITH, P.E., R.C. COUNTS, R.I. CLUTTER 1969. Changes in filtering efficiency of plankton nets due to clogging under tow. J.Cons. perm.int.Explor.Mer 32(2): 232-248

WILLIAMS, R., N.R. COLLINS, D.V.P. CONWAY 1983. The double LHPR system, a high speed micro- and macroplankton sampler. Deep- Sea Research 30(3A): 331-342 •