INSTALLATION FOR IN SITU MONITORING THE QUALITY OF HABITAT OF AQUATIC ORGANISMS

FIELD OF THE INVENTION

The present invention relates to early warning systems for monitoring coastal water quality, and more particularly, it relates to a portable submersible apparatus for in situ monitoring the quality of habitat of aquatic organisms, or for in situ detecting lethal and sublethal pollution in inland or sea water.

BACKGROUND OF THE INVENTION

A good understanding of the coastal ecosystems and the monitoring of water quality have become essential to the success of any aquaculture program. Therefore, in recent years there have been several proposals developed for monitoring the quality of water at fish rearing installations and around natural shellfish habitats to ensure a healthy condition of the cultivated species.

Although these systems were developed primarily for the aquaculture industry, other applications include: the provision for an early warning of the onset of toxic bloom events that affect seafood crops designated for human consumption; the detection of pollution at point-source discharges around industrial operations such as pulp & paper; and the detection of pollution and sediment re-suspension during offshore oil & gas operations and marine construction projects.

In a first example of the prior art systems, the U.S. Pat. No. 4,626,992, issued on Dec. 2, 1986 to J. Greaves; R. S. Wilson; and E. H. Smith, discloses a water quality early warning system wherein aquatic organisms are placed in monitoring tanks and are exposed to the water from a selected source. These organisms are observed by cameras. A computer and software are used for analysing the organisms' movements and for comparing the observed movements with the set of prediction parameters. When the organisms' observed movements do not correspond to the predicted parameters, a warning message is generated. Other apparatus for monitoring the behaviour of fish in a fish tank using a camera and an image analysis software are also disclosed in U.S. Pat. No. 4,888,703 issued on Dec. 19, 1989 to K. Baba et al., and in U.S. Pat. No. 5,222,458 issued on Jun. 29, 1993 to J. H. C. Pippy.

Another example of the water quality monitoring systems of the prior art using a fish tank is described in the U.S. Pat. No. 4,723,511, issued on Feb. 9, 1988 to A. J. Solman and G. P. Evans. In the described system, the behaviour of fish is monitored by measuring the voltage from a pair of electrodes mounted in the fish tank in which water to be monitored is circulated. This system monitors a small oscillating voltage which is produced by the fish in ventilation. A rise in ventilation frequency or an increase in the frequency of abnormal behaviour such as coughing is indicative of the contaminated water.

In that respect, a method and a processor for interpreting the ventilation frequency of fish and for generating an alarm when the ventilation frequency reaches a threshold value is disclosed in U.S. Pat. No. 5,469,144, issued on Nov. 21, 1995 to P. Gradzki, M. Kaynor, and D. Gruber.

A further system for monitoring the quality of water in situ is disclosed in U.S. Pat. No. 4,744,331, issued on May 17, 1988 to D. E. Whiffin. The system uses cameras mounted in a sea pen for monitoring the weight gain and diseases in fish retained in the sea pen. The cameras in this installation

are controllable from a remote location, by an operator using a monitor screen and a control panel.

Most water quality monitoring systems of the prior art rely on the behaviour of fish confined in a fish tank or in a floating enclosure. In the case of the fish tank systems, the monitoring of water quality relies on discrete field sampling followed by laboratory analysis. In the case of the fish pen installation, the equipment is complex, expensive and the image analyses are better interpreted by marine biologists. Furthermore, the fish specimens in both cases are monitored while moving about in a restrained mode, and therefore, a certain deviation factor must be considered when defining a normal behaviour.

Therefore, it is believed that there is still an important market demand for a portable monitoring apparatus, which is reliable, relatively inexpensive, which can be transported and deployed using a small boat; which can be interpreted by a fish farmer having little knowledge of an aquatic organism behaviour when the organism is under stress, and most importantly, which can be used for monitoring in situ, one or more aquatic organisms in a true natural environment.

SUMMARY OF THE INVENTION

In the present invention, however, there is provided an installation for in situ monitoring the quality of a habitat of aquatic organisms with minimal disturbance to the aquatic organisms. In a first aspect of the present invention, the installation of the present invention uses invertebrate sentinel species such as mussels, clams and scallops. These species are somewhat passive animals and are easily observable. Furthermore it has been found that bivalve behaviour reliably reflects water quality. Individual or a sock of bivalves are suspended on a substrate that mimics their natural habitat. They are allowed to settle along the sock with their byssus threads, and no sensors are mounted to their shells. The bivalves may also be attached with glue or ear-hung on ropes or nylon strips.

The installation of the present invention comprises broadly, a buoy, a mooring and a portable monitoring apparatus comprising: a framework having an upper end connected to the buoy and a lower end connected to the mooring. There is also provided a camera attached to the framework. The camera is adapted for underwater operation and has data storage capabilities for registering a number of images. An instrument enclosure is also attached to the framework, and contains a variety of instruments relative to characteristics of the body of water, and a power supply battery for operating the instruments during a nominal test period. The monitoring apparatus further has a support structure mounted on the framework and extending in front of the camera. The support structure comprises rotary retainers retaining the aquatic organism specimen in front of the camera.

The installation of the present invention can be deployed in the form of an inexpensive mooring in situ, such that the test animals are in their natural environment. The specimens are monitored by the underwater camera, and both normal and stressed behaviour patterns are established and recorded. For example, the behavioural factors observed on bivalve specimens generally include various filtering modes, that is: a bivalve which is not pumping; open but not feeding; feeding; or severely stressed.

Other behavioural indicators generally considered to determine behavioural indices include events such as the number of clapping of the valves together to clear irritants particles from the mantle cavity per hour; the amount of