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Acoustic Monitoring of Fish Escape in Cage

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Abstract

In the far-reaching aquaculture, it is very common that the netting is damaged, the cage is deformed, and a large number of aquaculture fish escape. In this case, it is necessary to strengthen the research on related supporting technologies, improve the construction of the supporting service system of the industrial chain, explore new means to ensure aquaculture safety, and conquer key engineering technologies. Using fishery acoustics technology and satellite communication technology, the fish density around the cage can be monitored continuously for a long time. In case of abnormal situation, the alarm can be given quickly, and the loss of fish escape can be effectively prevented, and the safety of cage culture can be guaranteed.

Keywords

Acoustic; Fish Escape; Sea Cage.

1. Introduction

To stimulate the vitality of Marine economy and activate the potential of Marine development has become the most dazzling hotspot in current fishery research. The Outline of the National Program for Medium - and Long-term Scientific and Technological Development (2006-2020) clearly states that "we should focus on developing Marine ecology and environment monitoring technologies and equipment, and strengthen research on Marine ecology and environmental protection technologies". Accordingly, the state proposes to build a smart ocean system: based on a perfect Marine information collection and transmission system, supported by the establishment of an independent, safe and controllable Marine cloud environment, to tap new demands and create new values, so as to achieve the goal of healthy, scientific and sustainable development of the Marine economy.

2. Far-reaching Marine Culture

Under the premise of severe overfishing situation of fishery resources and limited development space of offshore aquaculture, it is an important option to develop a far-reaching new space for Marine aquaculture to guarantee the strategic demand of food protein supply for Chinese people. A large number of far-reaching Marine aquaculture projects are developing rapidly: Lingshui, Hainan, started to build a deep and far-sea intelligent aquaculture fishery in 2018, with a working water depth of 55 meters and resistance to a class 17 typhoon. Each fishery cage equipment is 75 meters high, 120 meters in diameter, the whole aquaculture water body is 250,000 cubic meters, equivalent to 200 standard swimming pools, only the net clothing area is equivalent to 7 football fields, each fishery annual production of finished fish 6000 tons, equivalent to 500-600 traditional offshore deep water cage standard total production.

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In June 2017, the world's first semi-submersible large-scale intelligent fishery and aquaculture platform "Ocean Fishery No.1" was successfully built by China Shipbuilding Industry Corporation and delivered to Norway's Salma Group for use. With a total height of 69 meters (equivalent to a 23-story building) and a diameter of 110 meters, it can withstand a class 12 typhoon and has a designed service life of 25 years. It is equipped with the world's most advanced intelligent salmon breeding system, automated support system and high-end deep-sea operation and management system. Only 3 to 7 people can operate the entire platform. It can raise 1.5 million fish every year, and the mortality rate is less than 2%.

3. The Challenge

However, far-reaching Marine mariculture faces many challenges. Natural high sea state has become a major objective factor affecting Marine aquaculture. The coastal conditions of China are more complex than those of many other countries. 60% of the world's typhoons are concentrated in the southeast coast of China, which is extremely unfavorable to far-reaching mariculture in China. It is very easy because of a variety of objective environmental effects caused by damage to the net, cage deformation, aquaculture fish escape in large numbers. In this situation, we should strengthen the research of related technology, perfect the construction of industrial chain service system, explore new means to ensure the safety of aquaculture, conquer the key engineering technologies, and promote aquaculture industry to the "deep blue".

4. Discussion

In order to simulate the escape of fish under the condition of cage damage in natural sea area, a small cage that can be manually controlled is set up in the large cage, and the acoustic monitoring is carried out by using the satellite communication fish finder buoy to understand the characteristics of acoustic signals detected by the fish finder in the process of fish escape. The satellite communication fish finder buoy detects the whole process of fish escape in the cage, and the numerical changes of acoustic signals are the key reference for setting the alarm threshold, which is the key to reduce the economic loss of fish escape.

In this paper, we summarized the density of wild fish in cage culture area under natural conditions and set the alarm threshold of satellite communication fish finder buoy combined with acoustic signals detected by fish finder.

In order to facilitate the normal use in practice, the sensitivity of the buoy can be set as "extremely sensitive", "very sensitive", "general sensitive", "slightly sensitive", "sensitive" five levels, corresponding to five alarm thresholds, for practitioners to adjust at will. Under natural conditions, a large number of wild fish will also gather in the cage aquaculture area. Under their influence, the maximum acoustic signal detected by the satellite communication fish detector buoy is the lowest alarm threshold value, which is the key to prevent frequent false alarm of the buoy.

In specific research, we have done the following work: in regard to the development of fishery electronic technology hardware, straight to the fishery related technology development, the fishery supervision and developed in the recent years with the black box, the miniaturization of the nets to subsidence recorder, file type discharge electronic signs, underwater cages measurement system, which has the function of fishing explore small floating buoy help fishing or scientific research with instruments and equipment, etc. Good at the development and application of low power instruments. The buoy technology directly related to this project, has accumulated experience in the development of small floating buoys, has the ability to develop high latitude buoy technology.

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In terms of software development, we have carried out a number of high-tech research projects for the purpose of fishery applications, and have presided over or undertaken a number of national major research projects and technical breakthroughs. Has developed a series of Marine fishery application software systems with independent intellectual property rights (North Pacific squid fishery fishery prediction system, ocean Tuna fishery fishery analysis and rapid prediction system, etc.), with the ability to develop large-scale software. In terms of hardware and software coordination, the miniaturized data reading program of netting settlement recorder, the 3D display and automatic measurement system of underwater cage measurement system, and the upper computer software of small floating buoy with fishing function are developed. The software can automatically receive and store the data, display the buoy position in real time on the chart, analyze and display the fishing and exploration data, and has the function of two-way communication with the buoy. Have the software development technology foundation of the project.

In terms of hardware development, the laboratory has spectrometer, network analyzer, oscilloscope, signal generator, adjustable power supply and other instruments and equipment, with the hardware conditions to carry out the research of electronic instruments.

In terms of software development, the laboratory has licensed commercial geographic information system software ArcGIS, remote sensing image analysis software ENVI/IDL4.0, SQL server2000 database management system, scientific computing matlab and other software.

The fishery acoustics technology and satellite communication technology are used to continuously monitor the fish density in the sea area around the cage for a long time, and alert the police immediately when any abnormal situation is found, so as to effectively prevent the loss of fish escaping and ensure the safety of cage culture.

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