

# Research and Prospect of Fishery Resource Survey Technology

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## ABSTRACT

At present, the sustainable utilization of fishery resources has become a hot topic in the study of fishery sustainable development, and it is also an important research content in the theory and practice of sustainable development. In the 21st century, in addition to climate change and other factors, a large number of artificial Marine economic activities have caused great damage to the ecological environment of the habitat of fishery resources. At present, the protection of fishery resources is imminent, and to protect fishery resources, we need to conduct a good survey of existing fish. Based on the survey technology of fish resources, this paper introduces the traditional survey technology and modern fish resources survey technology in detail, analyzes the existing problems and countermeasures, and provides reference for the study of fish resources survey.

## KEYWORDS

Sustainable development of fisheries; Fishery resources; Technique of investigation.

## 1. INTRODUCTION

Fish is the oldest vertebrate and the most important ecological group in the Marine biological community. There are about 15,000 known Marine fish species in the world[1]. In the Marine ecosystem, different fish are at different food chain levels, which are important links in the process of energy flow in the Marine ecosystem. They regulate each other with other biological populations, determine the formation of spawning ground and the complement mechanism of population, and play a very important role in the structure, diversity and stability of the Marine ecosystem. Fishery resources are an important part of natural resources. It is not only one of the important sources of human food, but also provides employment, economic benefits and social welfare for people engaged in fishing activities. In 2020, the fishing yield of Marine fish reached 6 487 763t[2], and in 2019, the fishing yield was 6 828 817t[3]. The fishing yield of Marine fish in 2020 showed a downward trend compared with 2019. Global fish stocks are facing serious decline and threats due to human overfishing, pollution and climate change. Therefore, how to carry out effective fish resource survey is very important for the protection and management of this precious natural resource.

Since the 1960s, with the development of society and the rapid increase of population, the demand for aquatic products has been gradually enhanced, and the fishing intensity has been increasing. In particular, due to the rapid improvement of fishing and production technology caused by scientific and technological progress, the modernization of fishing vessels, nets and fishing exploration

equipment, the rapid development of industrial and agricultural production, and the aggravation of environmental pollution, offshore fishery resources and traditional fishing objects have been in decline worldwide one after another[4-6]. Especially in the 21st century, in addition to overfishing, climate change and other factors, land reclamation, a large number of Marine engineering projects and Marine economic activities have caused great damage to the ecological environment of the habitat of fishery resources. Environmental pollution caused by the acceleration of urbanization and the development of industry, agriculture and aquaculture has also caused many coastal and offshore fishery resources to be in a dangerous situation of obvious decline or even exhaustion. Therefore, in the era of Marine development and rapid development of Marine economy, facing the strategy of ecological civilization construction, it is particularly important to adhere to the concept of ecological priority and green development, realize the modernization of harmonious coexistence between man and nature, and realize the balanced development of Marine development and biological resources protection.

## **2. FISHERY RESOURCE SURVEY TECHNOLOGY**

Fish resource survey refers to the use of appropriate observation and sampling methods in selected target water areas on a timely basis to obtain information and samples of resource elements such as species composition, quantity distribution, community structure, and biological characteristics. The data and samples of relevant physical, chemical and biological environmental elements were obtained simultaneously, as well as the sample analysis and identification, data collation and analysis, resource assessment, etc., and the whole process of writing the survey report. Fish resource survey technology includes traditional survey technology and modern survey technology. The traditional survey technology generally adopts trawl survey, while the modern survey technology adopts sonar survey, remote sensing technology and DNA analysis technology.

### **2.1. Traditional survey techniques**

Currently, trawling is one of the most commonly used survey methods and is commonly used in shallow seas and estuarine areas. This method assesses the abundance of fish stocks by capturing a large number of fish samples by towing, as well as recording the type and quantity of the catch. Hou Jianghua[7] et al. 's investigation of bottom trawl in Fujian coastal area found that bottom trawl is one of the main fishing methods in this area, but there are also problems such as overfishing and ecological environment destruction. Wang Shuanglong[8] et al. evaluated the accuracy and reliability of gillnet survey data in the East China Sea, and the results showed that the gillnet survey data had high accuracy and reliability, which provided important support for fishery resource management. Li Huiyu[9] et al., in order to quantitatively clarify the scientific basis for the damage of fishery resources caused by electric fishing, analyzed and compared the differences in catch composition and fishing efficiency between electric pulse shrimp trawl (electric trap) and control shrimp trawl (control trap) through the parallel trawl synchronous experiment conducted in the offshore waters of the northern East China Sea from July 1 to 7, 2019. The results showed that catch composition and catch rate were significantly different among different fishing gear and at day and night. The results showed that electric trapping could effectively improve fishing efficiency, especially at night. However, the catch was still dominated by bottom fish and crabs, while the proportion of shrimp, the main target species, was very low, and the target selectivity was poor. The results showed that catch composition and catch rate were significantly different among different fishing gear and at day and night. The results showed that electric trapping could effectively improve fishing efficiency, especially at night. However, the catch was still dominated by bottom fish and crabs, while the proportion of shrimp, the main target species, was very low, and the target selectivity was poor. Experimental bottom trawl fishing by Tiano JC[10] et al. found resilience in macrofauna but vulnerability of epifauna and juveniles in the Friesland Front. In this study, Using side-scan sonar, high-definition underwater video,

sediment profile images, and box core sampling after conventional beam trawls and box core sampling after electric pulse trawls from southern North Sea habitats, we analyzed the benthic impacts of two in situ fishery disturbance experiments and found that trawls may favor deep-burrowing animals but remove surface macrobenchers.

## **2.2. Modern survey techniques**

### **2.2.1. Acoustic survey**

In recent years, acoustic techniques have been widely used to assess fish abundance and spatial distribution. Multi-frequency sonar technology can be used to locate fish clusters and estimate fish abundance, such as Marine fish and freshwater fish. Acoustic assessment is a new high technology which is being developed and improved gradually in the fishery resources research. Since its introduction, it has been successfully applied to the Marine, river and lake fishery resources survey in our country. From 2002 to August 2006, Zhang Xin [11] and Tan Xicchang [12] respectively conducted underwater acoustic detection of Qinghai Lake with fish finder, and evaluated and analyzed the annual resource quantity and spatio-temporal distribution characteristics of *G. carp* in Qinghai Lake, while more scholars applied acoustic assessment methods to lake fishery resource investigation. Jia Chunyan et al.[13] used an echo-detector (EY60,200 khz) to detect the fish resources in Eastern Dongting Lake in Hunan Province, and studied the spatio-temporal distribution characteristics of fish in Eastern Dongting Lake for the first time. The growth of fish resources in Eastern Dongting Lake will provide data basis for the protection and rational utilization of fishery resources in Eastern Dongting Lake after the fishing ban. Song Dan[14] et al. investigated the spatio-temporal dynamics and resources of fish communities in Jingpo Lake by combining multi-mesh composite gillnet survey and underwater acoustic detection. According to the results of underwater acoustic detection and gillnet survey, the problem of miniaturization of catch in Jingpo Lake was prominent, and the fish resources showed a declining trend. The irrational use of fishery resources is the main factor causing the decline of Jingpo Lake fish resources. Therefore, it is recommended to strengthen the management of natural fishing, strictly control the quantity and specifications of fishing, ensure the natural proliferation of fish resources, and combine the pollution prevention and control of Mudan River basin, improve fish habitat environment and other fish habitat restoration measures to promote the recovery of fish resources.

### **2.2.2. Environmental DNA technology**

Environmental DNA technology is a method of using DNA present in the environment to identify species. This method can effectively detect various biological community information by collecting environmental samples such as water, soil or air without directly collecting specimens. Environmental DNA technology is more and more widely used in fishery resource survey because of its advantages of simple operation, more economical and affordable, and no need for fishing or damage to organisms [15]. Environmental DNA macrobarcoding is an environmentally friendly and reliable assessment method, which can be integrated into existing surveys to better understand fish diversity in the estuary. Jiang Peiwan et al. [16] used environmental DNA macrobarcoding and bottom trawl to study fish diversity in the Pearl River estuary, and compared the two methods. Bottom trawl-based surveys failed to collect most species detected by environmental DNA macrobarcoding, which was shown to be an environmentally sound and reliable assessment method that can be incorporated into existing surveys to better understand estuary-fish diversity. Aiming at the application of environmental DNA analysis technology in fishery resource survey, Takahara T[17] et al. collected samples from different water areas such as rivers, lakes and oceans, screened species-specific DNA sequences of fish, analyzed them by PCR amplification and sequencing, and obtained the composition and quantity of fish communities in each sample. The results showed that environmental DNA technology could be used as a rapid, accurate and non-invasive method to survey fish stocks. Rodofili et al. [18] used environmental DNA technology to investigate the salmon breeding pool, determined the stocking

density of salmon by detecting the presence of salmon DNA in the water body, and assessed the survival rate of salmon in the breeding pool. The results showed that environmental DNA technology could effectively monitor the ecological status of salmon in the breeding pool. It has the advantages of high efficiency, precision and reliability.

### 2.2.3. Remote sensing technology

Marine environment is a necessary condition for the survival and activities of Marine fish. The change of each environmental parameter will have an important impact on the distribution, migration, movement and clustering of Marine fish and other Marine animals. For Marine fisheries, the application of remote sensing to explore this response relationship and using this relationship to analyze the real-time remote sensing data can predict the geographical distribution of fish and understand its population characteristics, which has practical significance for fishery production and management. Marine mammals are facing multiple threats such as global climate change, bycatch, and vessel collisions, and in this context, more frequent and extensive spatial surveys are needed for abundance and distribution studies to inform conservation efforts, with researchers increasingly using satellite and drone imagery for surveys [19]. Chen Xuedong [20] et al. analyzed the effects on the growth, migration and habitat of bigeye tuna by using multi-source satellite data, such as sea surface temperature, chlorophyll concentration and sea surface height, in order to accurately predict the fishing ground of bigeye tuna in this area. The results showed that satellite remote sensing technology could effectively monitor Marine environmental changes and provide important reference for the conservation and management of bigeye tuna resources. Zhang Jiazze [21] et al. reviewed the research on fishery application based on remote sensing technology. Satellite remote sensing data, such as sea surface temperature, chlorophyll concentration, and sea surface height, can be used to monitor Marine environmental changes and predict fish distribution, abundance, and seasonal migration. At the same time, remote sensing technology can also be used in fishery resource assessment, fishery management and fishery disaster monitoring. The literature summarizes and analyzes case studies of fisheries applications based on remote sensing technologies around the world, and suggests directions and challenges for future research.

## 3. EXISTING PROBLEMS AND PROSPECTS

At present, there are still many problems in fish resource survey technology. In traditional trawl survey techniques, the trawl is prone to capture non-target species, including endangered animals and other species in protected areas, which may cause negative impacts on ecosystems. Trawling disturbs and destroys seafloor habitats and undermines the integrity of Marine ecosystems; Trawl surveys can accidentally injure and kill many Marine mammals, including whales, dolphins and sea lions; Due to the high secrecy of trawl operations, it is difficult to accurately assess the actual catch of various fish in a specific area when investigating, which may lead to overfishing [22]. The problems existing in fish acoustic survey include the complex and variable underwater environment, the complex and diverse ecological behaviors of fish, the limited detection depth and resolution of sonar, and the different frequencies and characteristics of sounds produced by different types of fish [23]. In addition, the propagation path of sound waves in water is affected by hydrology, topography and other factors, which may cause signal distortion or reflection interference [24].

Although a large number of researchers have used remote sensing technology to extract and analyze the spatial distribution of fish in coastal waters, most of these studies are still based on local scale or focus on a single type of extraction method, and few studies have analyzed the spatial distribution of different types in the whole country. In the research of high-resolution image extraction, most researchers conduct extraction research based on pixel classification methods, but the accuracy of classification results is low, resulting in insufficient accuracy in boundary monitoring, area statistics, and analysis of spatial distribution characteristics in coastal waters. Therefore, it has become a major research trend to use higher temporal resolution images to conduct large-scale surveys of coastal

waters, and at the same time to use sub-meter images to accurately extract coastal waters at local scale, which has important research and application value.

## 4. SUMMARY

In this review, we introduced the main techniques and their applications for fish resource survey at home and abroad, and discussed the effects of different techniques in practical application, so as to provide reference for researchers in related fields. Through the introduction and comparison of different fish stock survey techniques, the actual survey work can be better guided and optimized, and its accuracy and efficiency can be improved. At the same time, it also helps to strengthen the understanding of the protection and management of fish resources and promote the sustainable development of fisheries.

## CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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