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Acoustics Research Progress on Characteristics of Jellyfish Aggregation

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Abstract

Jellyfish blooming threatens the safety of coastal industrial and personal safety. In recent years, ocean eutrophication, ocean engineering, global warming and other factors have combined to create a more serious situation. Traditional studies on the ecological behavior characteristics of jellyfish mainly rely on the methods of net fishing and visual observation. The use of acoustic technology for the acoustic monitoring of jellyfish has been applied in Europe, the United States, Japan, South Korea and other countries, showing good observation effect and application potential in the study of resource assessment and kinematic law.

Keywords

Jellyfish; Behavior; Acoustic.

1. Introduction

Jellyfish blooms are common Marine ecological disasters worldwide, which not only bring economic losses to fisheries and tourism, but also threaten coastal industrial safety and personal safety. In recent years, factors such as ocean eutrophication, ocean engineering and global warming have combined to cause a more serious situation.

To study the drift and aggregation mechanism, monitoring and early warning system of jellyfish, and understand the aggregation rules and ecological habits of jellyfish, it is necessary to explore new technical solutions on the current basis, improve the jellyfish monitoring technology and three-dimensional business monitoring system, and develop the early warning mode of jellyfish flourishing.

2. Traditional Studies and Acoustics Research

Traditional studies on the ecological behavior characteristics of jellyfish mainly rely on nettling survey [1-4] and visual observation methods [5-6] to study the distribution and resource changes of jellyfish through the results of nettling or visual observation. The advantages of this method are unified sampling methods, easy to operate, and intuitive reflection of the plane distribution characteristics of jellyfish. However, the disadvantage is the lack of more intuitive judgment and analysis data on the swimming, clustering and vertical movement of jellyfish under water. In view of this situation, new technologies such as acoustic technology, satellite remote sensing, underwater imaging [7] and aerial imaging [8] have also been applied to jellyfish monitoring and investigation, and great progress has been made in various aspects [9].

The use of acoustic technology for resource monitoring of jellyfish has been applied in fishery developed countries such as Europe, America, Japan and South Korea, showing good

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observation effect and application potential in resource assessment, kinematic law and other studies.

Since more than 95% of jellyfish is water, the acoustic target intensity of jellyfish is obviously weaker than that of fish. The contraction frequency of jellyfish's umbrella diameter, the orientation of jellyfish in water and the biological characteristics of jellyfish themselves will all affect the acoustic scattering intensity [12,14]. Some other jellyfish, ctenophores, sea squirts and other glial zooplankton that coexist with jellyfish, as well as other non-glial zooplankton, may contribute to the acoustic target intensity and affect the accuracy of jellyfish acoustic signal identification [15], which are the difficulties of jellyfish acoustic monitoring and investigation.

3. Specific Examples from the Study

Brierley et al. [10] used scientific fish finder and multi-frequency observation technology combined with net sampling to continuously assess the resources of golden medusa and multi-siphon medusa in Namibian waters of Africa for many times. It is also recommended that the dB difference or MVBS difference technology [11], which is usually used to distinguish the echo images of zooplankton and fish, be used to distinguish jellyfish from economic fish. The model relationship between the individual target intensity and the umbrella diameter of the two jellyfish was established at multiple detection frequencies, and it was concluded that the umbrella diameter and the target intensity of the two jellyfish were positively correlated. The target intensity of the two jellyfish at four frequencies of 18, 38, 120 and 200 kHz was compared and analyzed [12-13]. The measurements were successfully used to assess jellyfish resources in the southeastern Atlantic Ocean.

Mutlu et al. [14] used the double-beam echo detection system (detection frequency 120 kHz and 200 kHz) to measure the target intensity of sea moon jellyfish in the Black Sea. Regression analysis was used to establish the model relationship between the target intensity of sea moon jellyfish and umbrella diameter and wet weight.

Hirose respectively using the method of the Born approximation model (Distorted wave Born approximation) [15] and the experimental method for sand stung in Japanese waters monomer acoustic scattering characteristics are studied, The model relationship between the target intensity and biological characteristics of sand jellyfish at multiple detection frequencies was established [16], and the acoustic scattering characteristic values of white chardonsia and sea moon jellyfish were also measured. The results showed that the three jellyfish had different acoustic scattering characteristics at the same detection frequency.

Kang et al. [17] measured the target intensity of sand stings in Korean waters by using a scientific fish finder (detection frequency 38 kHz and 120 kHz), established a model relationship between the umbrella diameter of single sand stings and the target intensity, and found that the target intensity of sand stings increased linearly with the increase of umbrella diameter at two detection frequencies. The effect of jellyfish shrimp symbiotic with sand jellyfish on the acoustic target intensity of sand jellyfish is small and negligible, and it is suggested that the results of these determinations can be applied to the acoustic survey of jellyfish to assess the distribution and biomass of sand jellyfish.

Robertis et al. [18] used the field measurement method to measure the acoustic target intensity of the coffee golden jellyfish in the Chukchi Sea and the Arctic region of the North Pacific Ocean, and analyzed the acoustic target intensity of the coffee golden jellyfish at 38 K Hz and 120 kHz frequencies.

Graham et al. [19] used scientific fish finder to study four species of bowl jellyfish in the eastern Pacific Ocean off California: In this study, we evaluated the resources of sea moon medusa, Sea rhubarb medusa, Pacific golden medusa and fried egg medusa, and compared the individual scattering characteristics of sea medusa at five different frequencies (18, 38, 70, 120 and 200 K

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Hz) using the field method and the Bourne approximate model method, respectively. When using the field measurement method, two different threshold Settings were used for the acoustic images of the two frequencies. The lower threshold of jellyfish detection at 38 K Hz detection frequency was -80 dB, and the lower threshold of jellyfish detection at 200 kHz detection frequency was -85 dB.

Gorbatenko et al. [20] used the scientific fish detector (detection frequency 38 K Hz and 120 kHz) to carry out multi-frequency acoustic observation and assessment of the jellyfish in the western shelf waters of Kamchatka Peninsula and the jellyfish resources in the eastern shelf waters of the Sea of Okhotsk. Analyzed the chardonnay jellyfish and jellyfish outbreaks of golden season, coffee through multiple frequency acoustic image contrast and found that chardonnay golden jellyfish jellyfish and coffee in terms of vertical space distribution and movement characteristics are showed huge differences, in combination with nets after sampling, the author further on the behavior and jellyfish jellyfish feeding zooplankton outbreaks of pollock spawning grounds were studied, the influence of The superiority of multi-frequency acoustic observation technique for glial plankton observation and resource assessment is further emphasized.

Tomohiko et al. [21] compared the differences between the acoustic image characteristics of small and medium-sized fish and jellyfish in the echo images of scientific fish finder: the echo image of jellyfish is usually approximately round, while the echo image of fish is usually crescent or wavy [22].

Han et al. [23] used high-resolution imaging sonar to monitor the abundance and spatial distribution of sea moon jellyfish in salt lake waters of Honjo District near the coast of Japan. According to high-resolution sonar images, qualitative and quantitative analysis was carried out on jellyfish with a diameter of 4.1cm to 19.6cm(average 13.1cm). Moreover, the total average density of jellyfish obtained by this method was 3.3 times higher than that obtained by the traditional netting method. It was concluded that the traditional netting method may underestimate the amount of jellyfish resources. Using high resolution imaging sonar survey jellyfish, even in low visibility of the water, can also provide the similar video quality of underwater acoustic image, though the jellyfish's acoustic image is clear, no fish but can be by the outline of the medusa itself, water features such as location and gonads jellyfish and fish effectively identified, combined with the results of our survey, This method is an accurate method to investigate the abundance and distribution of jellyfish in shallow waters [23].

4. Discussion

Overall, the acoustic characteristics, to distinguish the jellyfish jellyfish and other species, acoustic method, related research are sufficient, the methods of ship, fixed-point fish finder, to monitoring and investigation and assessment of biomass of jellyfish, combined with the actual situation, the applications of acoustic technology to our country the jellyfish survey and evaluation, natural ecological habit research, focus on water jellyfish in the dynamic monitoring and early warning, It has practical significance.

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