The Research Review of Target Acoustic Characteristics in Acoustics Survey on the Biological Resources in the Southern Ocean

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Abstract

In order to improve the accuracy of the survey results of the Antarctic krill and other biological resources in the Southern Ocean, it is very important to identify plankton among copepods, polychaetes, jellyfish, and pteropoda in the investigation and study. This paper discusses the status of the research of target acoustic characteristics in acoustics survey on the biological resources in the Southern Ocean. A feasible research method was discussed: during the Antarctic expedition, high-speed collectors are used, biological samples are collected, while scientific sonar are working. A detailed study is conducted on the structure of the acoustic survey data and the corresponding biological community. Pool experiments were conducted simultaneously to accurately measure and study the acoustic characteristics of important biological species. The prospects for future research are also looked into.

Keywords

Antarctic krill; Acoustic survey;Biological Resources;scientific sonar.

1. Introduction

The investigation and assessment of the Antarctic Antarctic krill and other biological resources in the Southern Ocean is of great significance for understanding the ecological environment of the Southern Ocean and developing and utilizing the Antarctic biological resources. Previous survey results showed that plankton, copepods, polychaetes, jellyfish and other species of plankton are widely distributed in the waters where Antarctic krill are distributed. However, in the past data processing, these species could not be identified. Affected the scientific nature of Antarctic krill resource assessment results.

The relationship between target intensities of plankton species assessed by Antarctic krill and impacting Antarctic krill resources and body length was studied by pool measurements, acoustic surveys and biological sampling to understand the acoustic image of these species at different survey frequencies. The relevant characteristics, and strive to grasp the different characteristics of different biological species acoustic image, the acoustic data post-processing target recognition modeling was introduced into the post-processing process of the Southern Ocean biological resources acoustic survey data, which is very useful for improving the accuracy of the survey results. necessary.

2. Research status

Due to the importance of Antarctic krill in the ecological and fisheries development of the Southern Ocean, the research on the distribution, resource, and life history of Antarctic krill began in the 1920s. The most eye-catching is that The CCAMLR (the Commission for the Conservation of Antarctic Marine Living Resources) organizes several countries and multiple survey ships to conduct in-depth surveys of the extensive sea areas of the Southern Ocean at regular intervals. According to the results

of the survey, each annual fishing operation area will be established. When the catch of fishing vessels participating in the development of the resources of the fishery is about to reach this limit, monitoring the CCAMLR of each fishing vessel operating in the Southern Ocean will close the relevant fishing grounds, thereby protecting the fishery resources and ensuring its sustainable development potential. The role.

The most recent large-scale survey was conducted in January-February 2000 [1]. There were four survey ships from Japan, Russia, the United Kingdom, and the United States. It was also the largest ever survey of biological resources in the Southern Ocean. The survey was conducted mainly in the 48-zone waters near the Antarctic Peninsula. This survey established a rare example for the Southern Ocean biological resources acoustic survey in terms of the meticulousness of survey methods and the stringency of data quality management, and established standards that could be relied on in survey methods.

In the identification of Antarctic krill species and the study of target intensity, Wiebe, PH [2] used a combination of scientific fish finder and biological sampling to study the characteristics of the Antarctic krill acoustic image and found that the water depth was in the range of 0-250 m. The reflection intensity Sv per unit volume at an operating frequency of 120 kHz differs by 2-16 dB from 38 kHz. The relationship between acoustic target strength and body length of Antarctic krill is:

$$TS(L) = -127.45 + 34.85\log 10L + 10\log 10(kf/k120kHz). \tag{1}$$

In the formula:

TS (L) is the target intensity of single Antarctic krill (dB re. $1m^2$);

L is the body length (mm) of Antarctic krill;

k is the wave number ratio ($2\pi f/c$);

f is the transducer operating frequency (kHz);

c is the speed of sound (m/s).

JL Watkins et al. [3] studied the 120 kHz and 38 kHz acoustic images of the South Georgia Island Scientific Fish Finder (SIMRAD EK500) in 1996. The difference between the average volume backscattering strength of the Antarctic krill was 2 to 12 dB, and the south pole of the sampling network. The krill samples corresponded well (regression $\Delta MVBS=0.94$, r2=0.99). The sampling network port area used in this study was 8 m2, and the trawl velocity was 1 to 1.3 m/s.

Based on the above studies, Conti, SG [4] et al. studied the acoustic mapping characteristics of Antarctic krill in tri-band scientific fish finder (38, 120, 200 kHz), and also proposed SDWBA on the target intensity of Antarctic krill. model:

$$TS(kL) = A\left[\frac{\log_{10}(BkL)}{BkL}\right]^{C} + D(kL)^6 + E(kL)^5 + F(kL)^4 + G(kL)^3 + H(kL)^2 + I(kL) + J + 20\log_{10}\left(\frac{L}{L_0}\right) \tag{2}$$

This formula is a simplified SDWBA model formula given by CCAMLR in 2009. When kL is less than 200, the average error is less than 2.18 dB. k is the wave number ($k=2\pi/\lambda$); L is the length of the krill body in m. The relevant parameters are shown in Table 1:

Table 1. SDWBA Model Formula Parameters.

	N（11°，4°）
A	6.6455874521e+00-2.3282404324e+01i
B	1.2790907635e-01-3.7077142547e-02i
C	4.4631814583e-01-2.0095900992e-01i
D	-1.1920959143e-11
E	7.4232471162e-09
F	-1.7391623556e-06

G	1.8632719837e-04
H	-8.6746521481e-03
I	1.3214087326e-01
J	-8.1337937326e+01
L0	38.35e-003

This model is the target strength model now specified by CCAMLR and is now the most widely used.

In addition, there are also related researches in China, such as Yang Quan [5], who used the lighting nets and scientific fish finder to collect the biological and acoustic data of the squid from April to May 2011 in the sea area of the Nansha Islands and calculated the squid's The length and the empirical formula of the field target intensity were explored, and the investigation method combining acoustics with the light shade net was explored as the basic method for the South China Sea to carry out the assessment of the resource size of the Squid.

3. Research Methods

Although a large number of studies have been conducted on the target intensity of Antarctic krill, there is not only the presence of Antarctic krill, but also a large number of plankton, such as copepods, polychaetes, jellyfish, and pteropoda, and their target strength and body. The long-term relationship and related characteristics of acoustic images in different survey frequencies are also worthy of in-depth study, and this kind of research is closely related to the scientific nature of the acoustic survey results of Antarctic krill resources. This is the urgent need to solve the problem of investigation and assessment of biological resources in the Southern Ocean.

A feasible research method is to use a high-speed collector to drag the operation and collect biological samples while conducting an acoustic investigation of the scientific fish-finder during the Antarctic expedition. A detailed study was conducted on the structure of the acoustic survey data and the corresponding biological community. Pool experiments were conducted simultaneously to accurately measure and study the acoustic characteristics of important biological species. By analyzing the distribution and population structure of target organisms such as Antarctic krill, copepods, polychaetes, and Pteropods, the relationship between target intensity and body length was studied using field-target intensity measurement. Based on the survey results, a program was written in the software for fishery resources hydroacoustic investigation and processing to realize the initial identification of the acoustic image, which provided a theoretical basis for the future investigation of biological resources acoustics.

4. Outlook

Aiming at the interrelationship between biological and acoustic data in the survey of biological resources in the Southern Ocean, the aim is to grasp the different characteristics of acoustic maps of different biological species, and to incorporate acoustic data post-processing target recognition modeling into the post-processing of acoustic data of biological resources in the Southern Ocean. In order to promote the further development of acoustic investigation of biological resources in the Southern Ocean, it provides theoretical support for a deeper understanding of the Southern Ocean ecosystem and better sustainable development and utilization of biological resources in the Southern Ocean.

Acknowledgements

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