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Acoustic Study on the Spatial Distribution of Dosidicus Gigas in the Equatorial Waters of the Central and Eastern Pacific

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Abstract

Dosidicus gigas is an important oceanic cephalopod resource. Its resources increase significantly, so its resource development is increasing. Highly anticipated. In 2004 and 2011, Chinese fishing boats reached an output of more than 200,000 tons. The output in 2013 reached 261,000 tons. At present, the number of fishing boats in operation has stabilized at more than 100. The results of resource development. In order to scientifically, reasonably and sustainably develop Dosidicus gigas resources in the equatorial waters of the Central and Eastern Pacific Ocean, this article use resource acoustic assessment methods to initially explore the spatial distribution characteristics of Dosidicus gigas in the waters.

Keywords

Dosidicus Gigas; Fishery; Acoustic.

1. Introduction

Dosidicus gigas (Figure 1) is an important oceanic cephalopod resource. It is widely distributed in the eastern Pacific Ocean (Figure 2). It is a short-lived species with a general life span of 1 to 2 years; it is extremely reproductive. It is one of the largest individuals in the world of cephalopods [1]. In the entire marine ecosystem, the squid is an important part of the food web. It is not only a predator of relatively low-trophic species such as sardines, mackerel, and saury, but also important for high-trophic species such as tuna, sharks, and sperm whales. Food sources [2-3]. Dolphinfish is also a typical ecological opportunist: With the decline of resources of traditional economic species due to overfishing, the pressure on predation of Dolphinfish is reduced, and the pressure of ecological competition is eased. Its resources increase significantly, so its resource development is increasing. Highly anticipated.

Before the 1990s, there was less development of global squid resources. After the 1990s, countries such as Japan and South Korea joined in, and the production of squid increased sharply [4-5]. In 2014, the production of squid even reached More than 1.16 million tons (Figure 3). my country’s development and utilization of the resources of Dolphinfish was relatively late. It was only in 2001 that professional squid fishing boats were organized to explore the resources of Dolphinfish in the waters of Peru, and an output of 17,800 tons was obtained. After that, the scale of operations continued to expand. It has become an important target for my country's ocean squid fishing fishery.

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According to statistics, in 2004 and 2011, Chinese fishing boats reached an output of more than 200,000 tons. The output in 2013 reached 261,000 tons[6-8]. At present, the number of fishing boats in operation has stabilized at more than 100. The results of resource development.

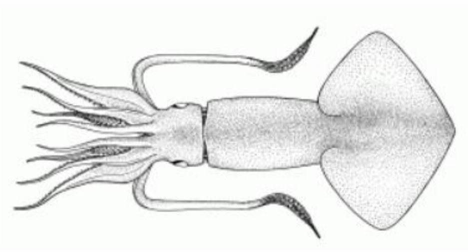

Figure 1 Dosidicus gigas

Figure 2 Distribution map of Dosidicus gigas

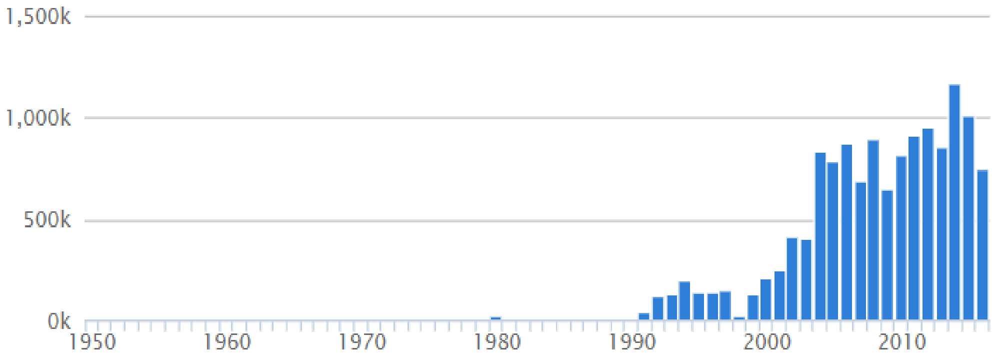

Figure 3 Statistics of total resource development of Dosidicus gigas

In order to scientifically, reasonably and sustainably develop Dosidicus gigas resources in the equatorial waters of the Central and Eastern Pacific Ocean, this exploratory and catching project team tried to use resource acoustic assessment methods to initially explore the spatial distribution characteristics of Dosidicus gigas in the waters.

2. Materials and methods

The acoustic assessment of biological resources is to use the scientific fish finder to emit sound waves vertically into the water body, and to understand the distribution of biological resources in the water body and its biomass through the analysis of echo signals. This method has the advantages of fast investigation speed, wide range, and no damage to resources. The acoustic instrument used in this investigation is SIMRAD EY60 Scientific Fish Finder (NORWAY). The scientific fishery detector can ensure all data collection and storage are automated; during the survey process, if operating parameters are not suitable for the current survey environment, the system will automatically give relevant prompts, and investigators can combine the prompts to quickly implement adjustments. Effectively guarantee the quality of survey data.

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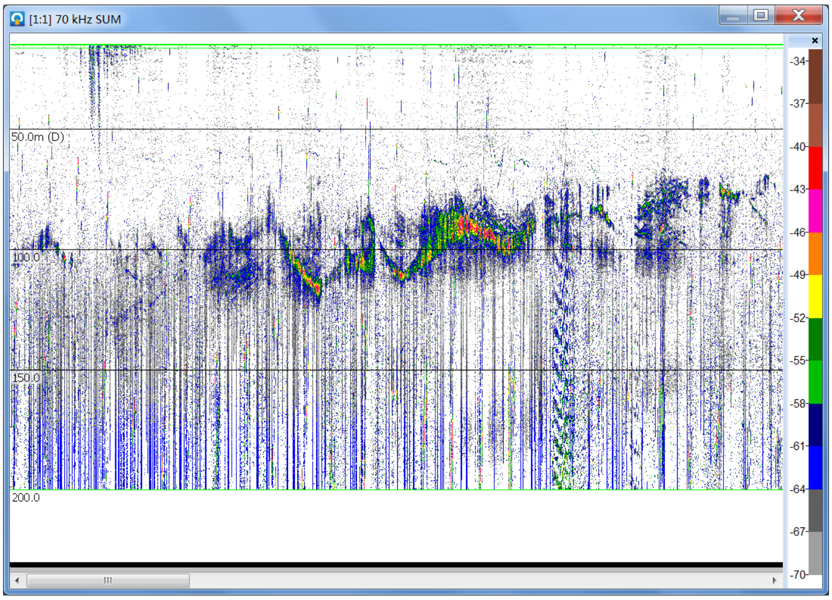

Figure 4 Acoustic image during the investigation

Before using the scientific fishing probe, the instrument should be calibrated. Due to the fact that this survey is always in open waters in the ocean and the wind and waves are relatively high, there are no good calibration conditions during the exploration and capture period of this year (2019-2020), so no calibration of the acoustic instruments has been implemented. Since none of the stations planned to be investigated has output and no valuable acoustic data has been collected, acoustic data is collected in areas with abundant production.

In terms of the time and scope of the survey, this resource acoustic survey was carried out when the ship was parked and the squid fishing machine was operating, that is, the hydroacoustic survey was carried out while the ship was parked and drifted. On the day of the hydroacoustic survey, lights were turned on at around 18 o'clock every night to trap the fish for 1.5 hours. During this period, the welded steel frame is extended out of the ship's side to support and protect the transducer and cables. Sink the transducer to a depth of 2 m, and fix it. The transducer frequency is 70 kHz. At 19:30, the transducer was switched on and the sound waves started to be sent, each lasting about 1 hour; a total of 9 site surveys were carried out, and the acoustic data collected totaled 2.4G. The site situation is as follows:

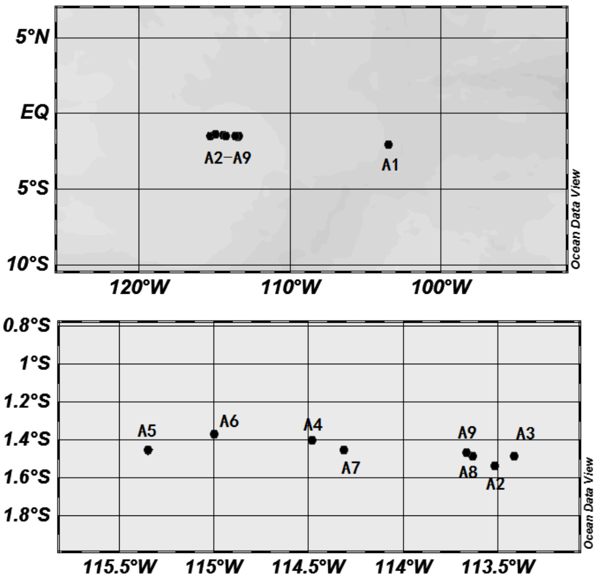

Figure 5 Acoustic survey site map

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Acoustic data processing uses the software ECHOVIEW specially used for biological resource underwater acoustic survey and analysis. The acoustic survey data was also affected by the noise generated by the host and depth sounder. The following countermeasures were taken in the processing:

(1) This survey uses the latest version of the acoustic data processing software ECHOVIEW 9.5 (MYRIAX, AUSTRILIA), in which a special background noise processing module has been updated, which is based on the research results of De Robertis and Higginbottom. Using it can remove a considerable part of the noise data, and its effect can be found quite obvious in use.

(2) Set up for the interference noise removal module in this processing. This module uses the different characteristics of interference noise and biological resource noise, and uses the matrix analysis function in the software to analyze, automatically identify and remove the noise, which effectively guarantees Improved data quality. In this treatment, combined with the biological sampling situation, the carcass length (ML) of the squid ranges from 13.6 to 29.3 cm. According to the research results of Kelly J Benoit-Bird [9], the target strength of squid The relationship between carcass length is

$$TS_{70kHz} = 20\log10ML-67.4$$

Among them, TS is the target strength and ML is the carcass length. According to the above empirical formula, the target intensity distribution of Dosidicus gigas in this study is between -44.73 and -38.06 decibels. According to this limitation, the target organism can be screened out well, and the scientificity of the analysis result can be ensured.

3. Results and discussion

3.1 Resource abundance distribution of Dosidicus gigas

Since this acoustic survey was carried out during the berthing of the survey ship, the corresponding results are mainly related to the biomass observed per unit time, using the cross-sectional scattering of biological resources detected in the unit time (1 h in this survey) The coefficient (Nautical Area Scattering Coefficient, NASC) is used to indicate that the larger the NASC value per unit time, the higher the resource abundance of the fish in the flight segment. After processing the data, the results are shown in the following table:

Table 1 Acoustic data processing results

Station	NASC	Time(h)	NASC/h
A1	300.95	1.62	186.15
A2	81.35	0.13	610.13
A3	592.28	1.35	438.73
A4	582.53	1.77	329.73
A5	938.12	2.47	380.32
A6	640.22	2.08	307.31
A7	91.63	0.27	343.61
A8	1483.67	2.17	684.77
A9	1359.80	2.28	595.53

From the analysis results, it can be seen that the NASC value per unit time is the highest for the A8 site, the A1 site is the lowest, and A3, A4, A5, A6, and A7. These five sites are not much different, all around 359.94 m2/nmi2. The three stations A2, A8, and A9 are obviously much higher in comparison, around 630.14 m2/nmi2. In terms of location, these three sites are also relatively similar.

3.2 Vertical distribution of Dosidicus gigas resources

The vertical distribution of Dosidicus gigas is mainly estimated by individual detection of acoustic data. In this study, the target intensity distribution of Dosidicus gigas ranges from -44.73 to -38.06 decibels. The results after target screening show that there are two main situations in the vertical distribution of Dosidicus gigas: one is that no obvious stratification can be seen. , The distribution is

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relatively discrete, such as stations A1, A3, and A9; the other is to be able to see obvious layered concentrated distribution, such as stations A4 and A8, the fish are concentrated at 40 m, 90 m, and 170 m. There are three water layers and two water layers of 50 m and 150 m, and the fish are concentrated in relatively deep water layers. At station A5, it can also be seen that the targets are concentrated near the 42 m water layer, the number of target organisms at 55-80 m is small, and the distribution below 80 m is relatively large. Site A6 is special, with a shallow depth of 110 m and less distribution, but more in deep water. Since the observation time of A2 and A7 is relatively short, no vertical distribution analysis is performed.

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