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Utilization and Management of Small Fishery Population Resources in Coastal and Offshore Areas of China

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Abstract There are numerous types of living resources in coastal and offshore areas of China. In recent years, both the population type and quantity structure have significant changes, and the stock of small fishery population resources is increasing. This population is precious protein resource. It is urgent to study how to take prompt and effective fishing and take full advantage of processing, utilization and management. Traditional utilization methods are limited by many factors. The utilization efficiency is extremely low. The feed conversion rate of some mariculture fishes with fresh small trash fishes as feeds is even as low as 0.2. Innovative production and management organization model with aquatic enterprises as leaders greatly increases the utilization efficiency of small fish resources with the aid of marine processing mother ship. In order to further accelerate developing and utilizing small fishery population resources in coastal and offshore areas, China should launch survey and utilization researches of small fishery population resources in coastal and offshore areas, formulate practical and feasible laws, regulations and policies, actively encourage and support autonomous innovative management mode of enterprises, and promote effective utilization and management of coastal and offshore fishery resources.

Key words Fishery population resources, Coastal and offshore areas, Small fishery population resources, Utilization and management

1 Introduction

Proper protection and effective utilization of marine living resources are inevitable choice for realizing sustainable development of human beings in the 21st century. As a county with large population but insufficient per capita land resources, China should actively develop marine living resources. Constantly and effectively developing marine fishery is an effective approach following the trend of international marine development and reasonably utilizing marine living resources. Besides, it is also a requirement of times and strategic choice for satisfying increasing demands of people for safe animal protein, ensuring current demand of national food security, and also the need for transforming fishery economic growth way.

2 Analysis on current situations of small fishery population resources in coastal and offshore areas

There are numerous types of living resources in coastal and offshore areas of China. The offshore including intertidal belt and 15 m isobath neritic areas is sea areas with numerous and high density of marine living resources. There are more than 10 000 marine plants (including 1 820 types of algae) and 12 500 marine animals. The average annual biological yield is up to 3 020 t/km^2. However, China's traditional marine fishery fishing products are mainly large living resource population in upper part of the marine biological chain, such as *Spanish mackerel*, conger eel, hairtail, pagrosomus major, larimichthys polyactis, and mackerel scad.

However, since the 1980s, due to constant rapid development of China's marine fishery, majority fishery resources in coastal and offshore areas are excessively utilized. This leads to excessive utilization and even decline of traditional fishing fishery resource population. Due to constant decline in stock of traditional economic fish resource population, total fishing amount and the quality of individual catches directly available for people are increasingly declining. As a result, production cost of fishing fishery is rising, while the economic benefit is dropping. This restricts constant growth of fishermen's income to a certain extent.

In recent two decades, the implementation of summer closed fishing, double control system, and dual transformation of marine fishermen has slowed down quantity of traditional economic fish resource population in coastal and offshore areas, but the trend is not reversed fundamentally. As a result, small living resource population with short life cycle in the middle part of the food chain is rapidly increasing, such as Spratelloides gracilis, anchovy and acetes. An anchovy is a small, common salt-water forage fish of the family *Engraulidae*, and there are 8 species of anchovy widely distributed in northwest Pacific Ocean, New Zealand, Australia, India, east coast Africa, and coastal area of south Africa, with annual yield more than 20 million tons. The yield in South America, EU, and Asia accounts for more than 80% of global yield. *Spratelloides gracilis* and acete are widely distributed in coastal and offshore areas of China, and they have short life cycle (generally 1 - 2 years) and have feature of collective migration. However, these fishery resources are small and difficult to preserve and are perishable. *Spratelloides gracilis* also known as *Engraulis japonius*, *elanostictus*, and *Etrumeus teres*, is small fish used as fishing bait, especially in skipjack tuna-fishing. It is valued as food in Japan, where it is known as *kibinago*. These can be eaten raw, as sashimi, or cooked, as whitebait. *Spratelloides gracilis* is widely distributed in East China Sea and Huanghai Sea and Bohai Sea, and the resource volume is up to 3×10^6 tons.

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According to ecological balance condition of marine living resource population, with decline of stock of population in upper part of food chain, the stock of small and short life fishes such as *Spratelloides gracilis* and acete will increase significantly. Such living resource population has high ability of regeneration and resource restoration, and high nutritive value and safe and convenient eating. However, without timely fishing and adequate processing and utilization, they will die out with ending of their life cycle, leading to huge waste of precious resources. China should learn successful experience of Japan, South Korea and Taiwan in utilization of offshore and coastal fishery population resources.

3 Significance of moderately developing and utilizing coastal and offshore small fishery population resources

Since it still takes a long time to realize effective control and scientific evaluation of reducing fishing intensity and enhancement and release through artificial interference to restore the stock of traditional economic fish resource population in upper part of the food chain, it is necessary to carry out study and implementation effective development and utilization. Just like all countries concentrating on effectively developing and utilizing rich Euphausia superba resources, China also should accelerate launching effective utilization and development activities of small fishery living resources in coastal and offshore areas.

Although China has the tradition of using small marine products (such as anchovy and dried small shrimps or salted products), due to limitation of warehousing, transportation, freshkeeping and processing technologies and facilities, only limited offshore fishery resources are directly enjoyed by human beings. More related resources are used for feeds or baits. Therefore, the conversion rate of animal protein is low, the conversion cost is high, and resource utilization benefit is low. According to statistics of related data, the feed conversion rate of some marine fishes with small fishes as feeds is as low as 0.2.

Spratelloides gracilis is small and has high nutritional composition. However, it is extremely perishable and difficult to keep fresh because fishing ships are free from freezing and processing facilities. The catches are used only as fish powder and breeding feeds. The price is less than 0.1 yuan/kg, leading to huge waste of precious food resources. Besides, *Spratelloides gracilis* has high requirement for sea water temperature. Its relative Engraulis japonius swims from south to north or from east to west and spawns in coastal areas of China. After three times of incubation, ova grow along with Kuroshio. One month later, they grow to 25 mm long. In May to September, they enter the peak yielding period in Zhejiang, Shandong and Liaoning provinces. However, at this time, East Sea, Huanghai Sea and Bohai Sea enter the summer closed fishing season, leaving fishermen greatly disappointed alone. Marine processing ships also get no fishes for processing. Fishermen lose great opportunity of effectively utilizing small fishery resources and the opportunity of increasing income. Fish processing enterprises lose the opportunity of processing and increasing added value of aquatic products, utilization rate, and fishery economic benefits.

In recent years, aquatic product enterprises in Zhejiang and Fujian coastal areas have established economic cooperative organizations according to changes of fishery resources and effective utilization of small fishery resource population in coastal and offshore areas of foreign countries through voluntary combination, autonomous management, and cooperative multi-win. They have opened up an effective path for sustainable income growth and effective resource utilization through exploiting and utilizing automatic processing lines, freezing and refrigerating and rescuing facilities in marine processing ships, and development and utilization of small fishery resources in coastal and offshore areas. Aquatic product processing enterprises directly use advanced processing technologies and facilities. Then, fishes caught will complete concentrating, cleaning, classification, cooking, drying, packaging, warehousing, and transportation in controllable scope. The directly edible rate is close to 100%, ensuring freshness and quality of fishes and shrimps. Processing product quality is completely controllable and traceable, realizing integrated operation of production, processing and sales. This increases added value of products and economic benefits of enterprises.

4 Recommendations for developing and utilizing coastal and offshore small fishery population resources

Scientific, reasonable and effective utilization of small fishery resources can directly provide considerable quantity of fish foods with rich protein, and also can indirectly save natural resources such as land, water, baits, increase income of fishermen, and promote sustainable development of fishery production. Thus, it is of profound ecological, economic and social significance. In line with these, we come up with following recommendations.

4.1 Launching survey and utilization researches about small fishery population resources in coastal and offshore areas as soon as possible According to changes and current situations of coastal and offshore fishery resources in China, fishery administrative service divisions should organize relevant industry, university and research institutions as soon as possible to launch survey of small fishery resources. Systematic and scientific researches include stock distribution, biological characteristics, resource stock, reproduction ability, resource utilization situation of fishery resource population. Besides, it is recommended to make scientific evaluation on available utilization volume of small fishes, provide scientific basis for formulating development plan, and learn successful experience of Taiwan in utilization of coastal and offshore fishery resources, in the hope of providing more scientific and reasonable improvement schemes for utilization of offshore and coastal fishery resources.

4.2 Formulating and improving practical and feasible laws, regulations and policies Under the premise of ensuring effective utilization of coastal and offshore marine living resources and sustainable development of fishery production, it is recommended

to make scientific and renewable management rules and regulations on types, fishing sea areas, fishing time, fishing quantity, fishing tools and methods, access system, and supervision methods, and make revision and improvement of prohibition boundary and season of fishing. On this basis, it is recommended to further detail provisions of fishing prohibition areas and moratorium according to population characteristics of various types of living resources, fishing objects and methods, allow fishermen and related fishing ships use fishing tools and methods with specific functions in certain period and sea areas, and implement specialized fishing permit system, so as to comprehensively increase utilization efficiency of marine living resource population, provide higher quality and more foods with animal protein, increase fishery efficiency, and income of fishermen.

4.3 Actively encouraging and supporting enterprises to carry out autonomous innovation and management Relying on modern market system, through voluntary combination, autonomous management, and cooperative multi-win of fishery economic organizations, aquatic product enterprises in offshore and coastal areas of Zhejiang and Fujian provinces lead development direction of small fishery resources in coastal and offshore areas of China. Therefore, China should provide energetic support in policies and management systems, to make such new management mode bring into play wider model effect, increase added value of small fishery resource products, promote increase of fishermen's income, and provide safe and healthy aquatic products for both domestic and foreign consumers with higher quality protein.

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building commercial circulation industry and modern logistics industry (especially agricultural cold chain logistics industry), it is necessary to understand and make full use of government support policies for agriculture, and strive for the policy and financial support of government at all levels. Firstly, it is necessary to urge municipal and district governments to strengthen the regulation and guidance on cold chain logistics industry, make regional plan and support key chain logistics companies based on characteristics of cold chain industry. Secondly, it is necessary to strive for tax support from all levels of government, promote the construction of agricultural product distribution service system, accelerate the circulation of agricultural products, ensure the safety of agricultural products in circulation, reduce losses during circulation of agricultural products, lower the early investment pressure of companies, and decrease the circulation costs of agricultural products.

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