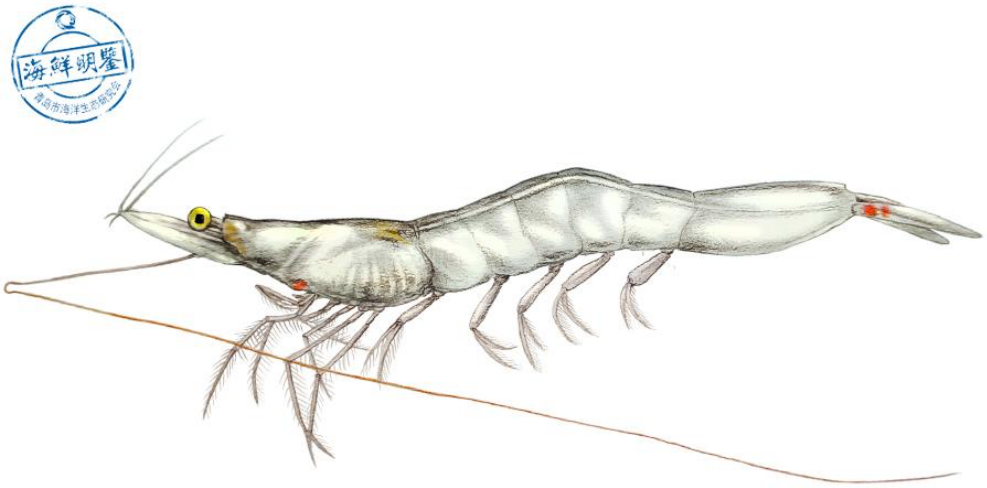
China Sustainable Seafood Assessment (CSSA)

Fishery



Acetes chinensis
Stow Net Fishery

CSSA Team

December 2023

Statement

In the assessment of all species, the China Sustainable Seafood Assessment (CSSA) team will strictly follow the assessment criteria and refer to the latest, impartial and objective scientific data. Common sources of reference for evaluation data include literature review, official materials, objective and unbiased media reports, data obtained from field research, and expert interviews. Inevitably, many fisheries face the problem of lacking robust data, and some data are not publicly available, which may affect the assessment results to some extent. The CSSA team is committed to carrying out the assessment and evaluation of the species objectively and impartially, basing on respecting objective facts, making maximum use of open data, and relying on rigorous scrutiny of experts. The results of the species assessment do not represent the opinion of any particular expert, scholar, etc.. The CSSA team has the right to the final interpretation of the assessment results.

Content

Introduction

China is the world's largest fishing country, and also has a large consumer market for aquatic products. The food choices we make determine the present and future of our marine and freshwater ecosystems. In order to cultivate a new generation of responsible seafood foodies, Qingdao Marine Conservation Society (QMCS) has launched the China Sustainable Seafood Assessment (CSSA) project to customize scientific and interesting sustainable seafood consumption guides for domestic consumers. We hope that by raising public awareness and promoting changes in consumer behavior, we can use the power of the market to force industrial transformation and make a lasting contribution to the continuous improvement of the health of China's marine and freshwater ecosystem.

Executive Summary

The Northern Mauxia Shrimp (*Acetes chinensis*) is a species indigenous to China, distributed along the Chinese coast, with the Bohai Sea region yielding the highest production. Main production areas include Liaoning, Shandong, Hebei, Jiangsu, Zhejiang, and Fujian provinces, with no aquaculture currently practiced.

Research on the biomass of Northern Mauxia Shrimp in China is limited. However, regional level assessments and capture volume suggest that the population is in good status, supported by its high fecundity and biannual spawning pattern. Annual production exceeds 300,000 tons in China, primarily harvested using stow net along coastal areas. These nets exhibit high selectivity, posing limited bycatch to other marine species and habitat impact.

Northern Mauxia Shrimp primarily feed on plankton and organic debris, serving as crucial prey for economically valuable species such as silver pomfret (*Pampus argenteus*), small yellow croaker (*Larimichthys polyactis*), and largehead hairtail (*Trichiurus japonicus*). Therefore, managing this fishery requires considering its role in the ecosystem.

China's management of the Northern Mauxia Shrimp fishery involves measures like summer fishing moratorium, bottom trawl exclusion zones, and total allowable catch pilots. The pilots initiated in Haizhou Bay, Jiangsu Province, since 2020 have expanded to other provinces like Shandong and Liaoning.

In conclusion, the fishing method for Chinese Northern Mauxia Shrimp fishery demonstrates high selectivity and minimal impact on marine habitats. At the same time, systematic resource surveys and ecosystem-based management are warranted. The CSSA rates the Chinese Northern Mauxia Shrimp fishery as "Green" - overall sustainability is good, and consumption is recommended.

Northern Mauxia Shrimp

Acetes chinensis

Recommend

Species Profile

The Northern Mauxia Shrimp (*Acetes chinensis*) belongs to the family Sergestidae. Known for its rapid growth, short life cycle, robust reproductive capacity, and limited swimming ability, the Northern Mauxia Shrimp plays a vital ecological role as part of the zooplankton community. It thrives within a temperature range of 11 to 25°C and a salinity range of 30 to 32‰. The species exhibits both daily vertical migration and horizontal movement across seasons. Endemic to China, it is distributed along the entire Chinese coast, with the highest abundance observed along the Bohai Sea coast while Liaoning, Shandong, Hebei, Jiangsu, Zhejiang, and Fujian province being the major production area.

The Northern Mauxia Shrimp prefers shallow coastal regions with sandy or muddy substrates. It exhibits low trophic level and rapid maturation, capable of reproducing twice annually. As a primary prey for many economically valuable marine species, its population has surged due to declining fishery resources.

In the Bohai Sea, Northern Mauxia Shrimp typically migrate to shallow coastal waters from mid to late March, peaking from April to May. Spawning occurs between May and July, followed by a migration to deeper waters (approximately 30 meters) for wintering by late November.

In the southern seas, from mid-February to early April, Northern Mauxia Shrimp mature as coastal water temperatures rise. They migrate northward from deepwater wintering areas, progressively moving towards estuaries and bays for spawning. The peak spawning season is from April to May. Sexual maturity of the juvenile is achieved in August and September, initiating mating and reproduction, with each female carrying approximately 2000 eggs. The biological description highlights that the Northern Mauxia Shrimp undergoes two spawning seasons annually, resulting in two generations. The alternation of generations and distribution of Northern Mauxia Shrimp in China are illustrated in the diagram below.

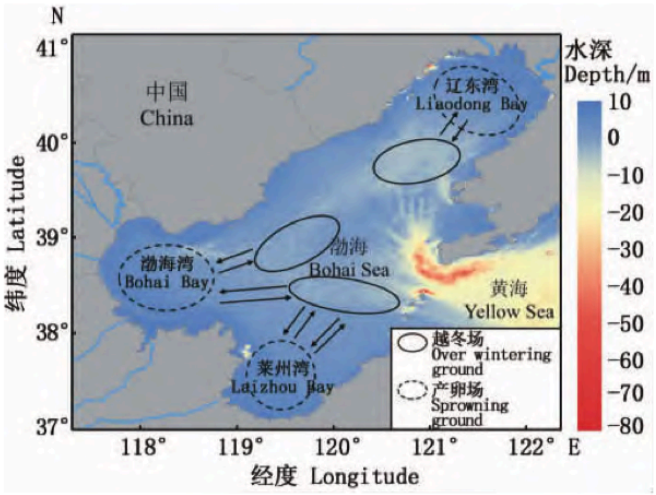


Fig. 1 Overwintering and spawning grounds of Acetes chinensis in the Bohai Sea[2]

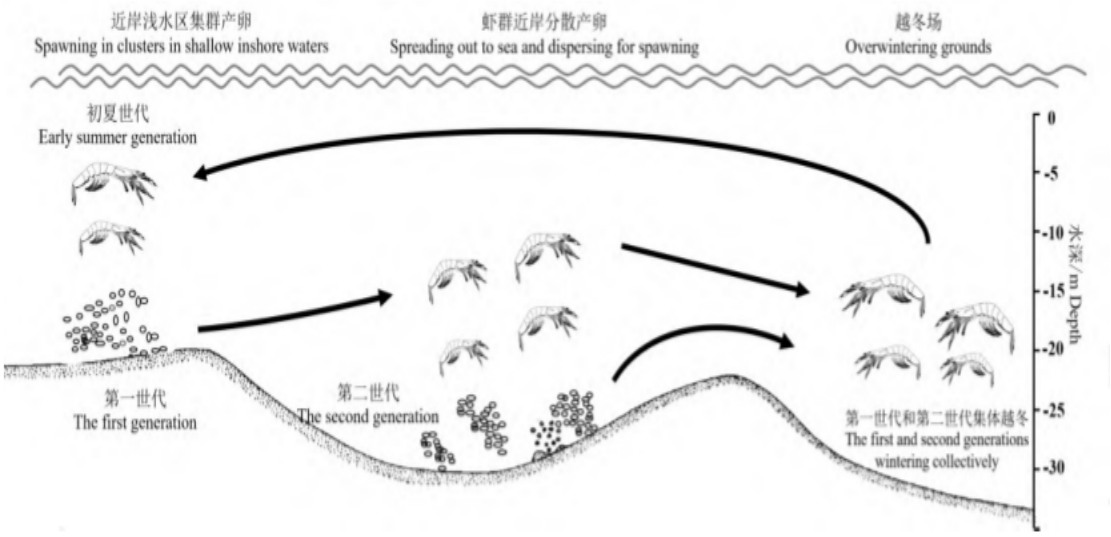


Fig.2 Generation alternation of Acetes chinensis[2]

FULL ASSESSMENT

Criterion 1: Impact on Target Species

Status of resources

Since the 1950s, the yield of Northern Mauxia Shrimp in China has experienced a steady increase, peaking at 720,000 tons in 2006. However, there has been a significant decline since then, with the yield dropping to 425,000 tons in 2018.[5] Despite this trend, research on the assessment of Northern Mauxia Shrimp resources in China has been limited.

In a study by Wu et al. (2023) focusing on Haizhou Bay, an assessment of the exploitation rate (E) of Northern Mauxia Shrimp resources was conducted for 2020 and 2021. The results suggested that the resources of Northern Mauxia Shrimp in Haizhou Bay have not been overexploited. [12]Furthermore, Chen et al. (2022) conducted comprehensive studies on the biological characteristics of Northern Mauxia Shrimp in both southern and northern Chinese seas. They found that the minimum sexual maturity body length is 18mm.[2] Research by Zhang indicated that the average individual fecundity of Northern Mauxia Shrimp in Bohai Bay and Laizhou Bay of 4,222 eggs. Interestingly, the closely related species, *Aectes japonicus*, has a lower fecundity of only 500 to 4,000 eggs, suggesting the robust reproductive capacity of the Northern Mauxia Shrimp, which in together with the twice-a-year spawning pattern contribute to the replenishment of its resources, indicating the sustainability of its population.[15] Thus, based on available information, it can be inferred that the status of Northern Mauxia Shrimp resources in China remains favorable.

Fishing level

The fishing yield of Northern Mauxia Shrimp in China has undergone three phases over the years. Initially, from 1958 to 1990, there was a slow growth during which the yield increased from $12*10^4$ tons to $21*10^4$ tons. Following this, there was a rapid increase period, with the yield reaching a

historical peak of $72*10^4$ tons in 2006. However, in recent years, there has been a slow decline, with the yield stabilizing between $35*10^4$ to $45*10^4$ tons.[2]

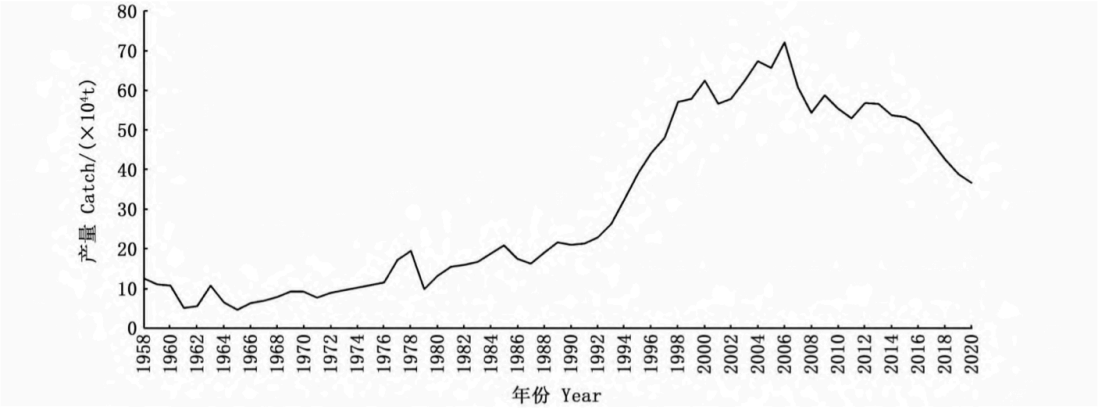


Fig. 3 The coastal catch of Acetes chinensis in China during 1958 —2020[2]

Northern Mauxia Shrimp is a species that holds limited economic value and is primarily utilized as feed or processed into dried products for consumption. Its fishing season is short and concentrated, making its fishing relatively simple. Over the past decade, the catch has remained relatively stable, ranging from $40*10^4$ to $50*10^4$ tons annually, with the highest production reaching $57*10^4$ tons in a year. However, in the past three years, there has been a slight decline, with production falling below $40*10^4$ tons in 2021, reaching $36.7*10^4$ tons.

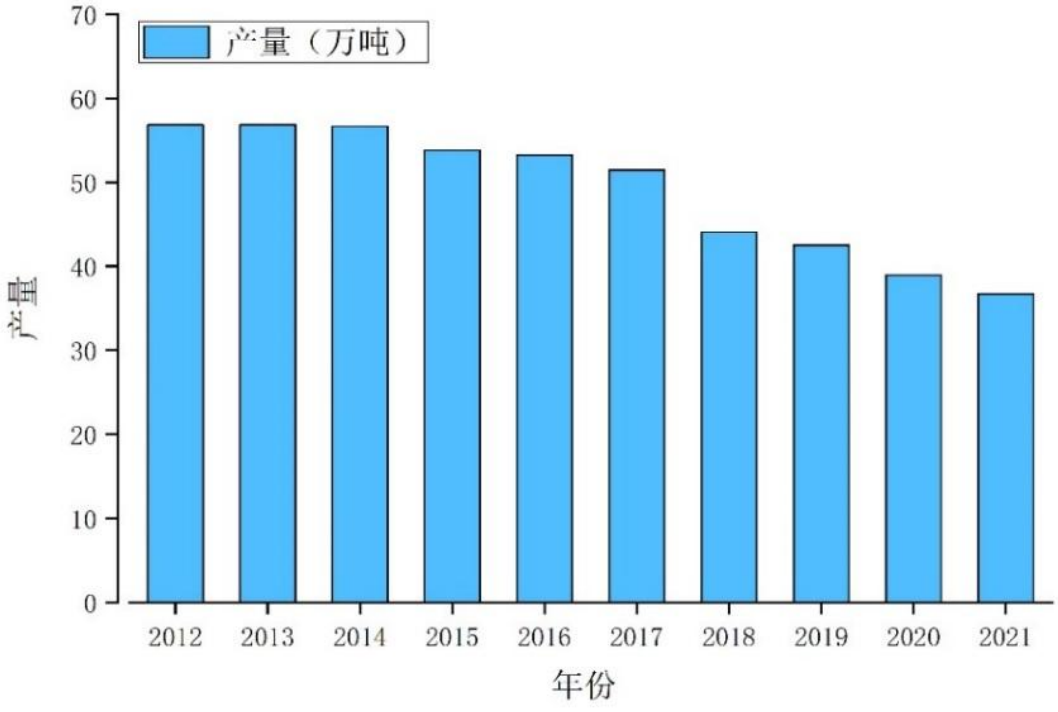


Fig 4. The annual catch variation of Acetes chinensis in China during 2012-2021 [10]

The distribution of Northern Mauxia Shrimp production varies unevenly among coastal provinces in China. According to 2021 data, Zhejiang had the highest production volume, reaching $15.2*10^4$ tons, accounting for nearly half of the national total. Following Zhejiang are Shandong, Fujian, Guangdong, Jiangsu, and others. Overall, Northern Mauxia Shrimp distribution is relatively scattered. The

Zhoushan fishing ground along the coast of Zhejiang is a central fishing ground.

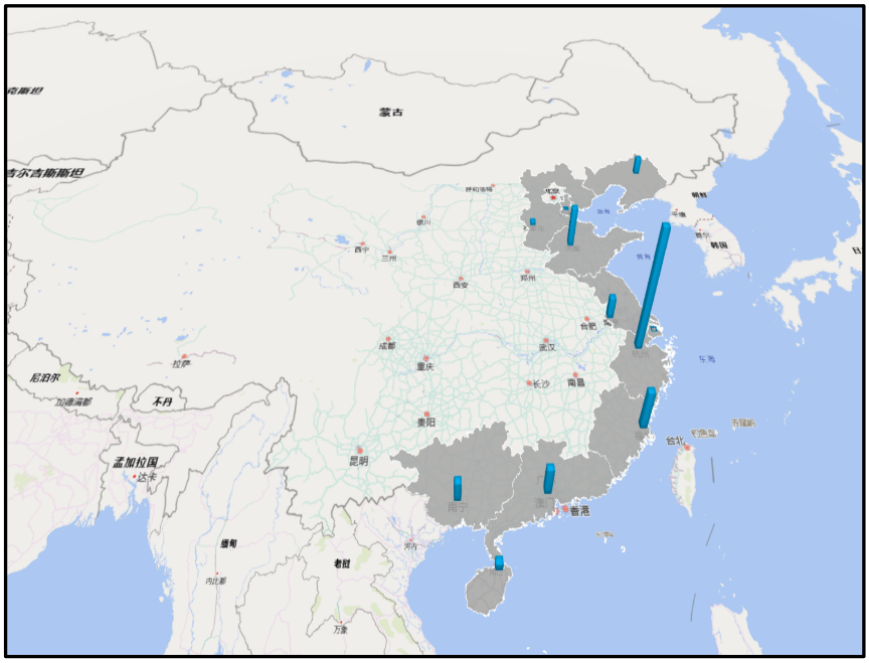


Fig 5. The production of Acetes chinensis of each coastal province in China in 2021[10]

Criterion 2: Impact on Non-target Species

Bycatch of other concurrently harvested species and Threatened, Endangered, Protected (ETP) species

The stow net exhibits high selectivity towards Northern Mauxia Shrimp, with Northern Mauxia Shrimp accounting for over 95% in the catch. [16]In Northern Mauxia Shrimp stow nets, there may be a small amount of bycatch of other species, such as *Benthosema pterotum*. Due to the fact that the juvenile of large yellow croaker (*Larimichthys crocea*), feed on Mauxia Shrimp as bait, they may be inadvertently caught in the fishery. Large yellow croaker is listed as critically endangered (CR) by IUCN due to its poor status in the wild. Given large yellow croakers' strong habitat selectivity, factors such as temperature, salinity, current, sediment, and bait are crucial environmental elements. Therefore, it is possible to avoid conducting Northern Mauxia Shrimp stow net operations in the same area during the large yellow croaker spawning and migration season, thereby minimizing or reducing bycatch as much as possible.

Criterion 3: Control Impact on Ecosystem

The effect of fishing gear

The primary method used for catching Northern Mauxia Shrimp is through the use of stow nets. The technical requirements for operation of Mauxia Shrimp stow nets are not demanding. Larger fishing vessels with stow net can catch Northern Mauxia Shrimp highly efficiently and selectively. Stow net fishing also offers advantages such as high mobility, rapid relocation of fishing grounds, and timely pursuit of fish schools. Additionally, compared to other fishing methods like trawling, stow net fishing has lower fuel consumption and has a relatively minor impact on the marine habitats, largely avoiding

damage to the seabed substrate.

In the past, one major issue of stow net fishery was the significant bycatch of juvenile species, leading to the depletion of fishery resources. However, with technological improvements, fishing vessels are now equipped with advanced fish finders, coupled with fishers' extensive fishing experience, the identification of target species has become highly accurate. As a result, the selectivity of stow net operations for Northern Mauxia Shrimp is generally high, with Mauxia Shrimp accounting for over 95% of the catch in most cases. Therefore, the fishery has minimal risk on the bycatch issue.[16]

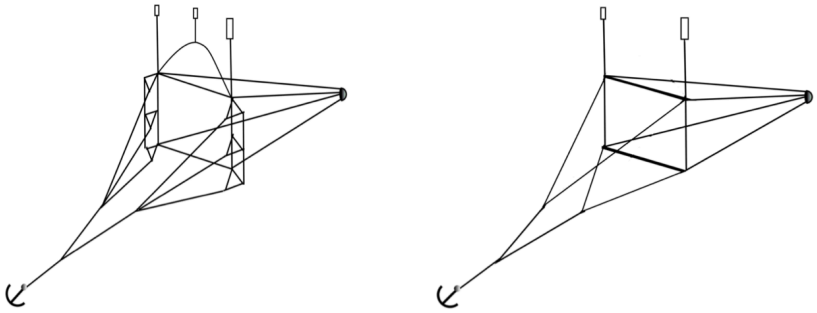


Fig 6. Diagram of common stow net structure in China's coastal fishery[11]

Ecosystem-based fisheries management

Northern Mauxia Shrimp are characterized by their small size and limited swimming ability, making them susceptible to drifting with ocean currents. Their reproduction and growth are influenced by various environmental factors such as water temperature, and salinity. Therefore, changes in the marine environment significantly influence the management of Northern Mauxia Shrimp resources and fishing activities.

Northern Mauxia Shrimp are omnivorous species, feeding on phytoplankton, zooplankton (such as copepods and larval bivalves), and organic detritus. Diatoms, a type of phytoplankton, are a major component of their diet. Furthermore, Northern Mauxia Shrimp serve as the primary food source for various economically important fish species in China's coastal waters. In the Bohai Sea, silver pomfret (*Pampus argenteus*), small yellow croaker (*Larimichthys polyactis*), and red eel goby (*Odontamblyopus rubicundus*) rely heavily on Northern Mauxia Shrimp throughout the year. In the Yellow Sea, species like *Thryssa kammalensis*, *Thryssa mystax*, Chinese tapertail anchovy (*Coilia nasus*), and half-fin anchovy (*Setipinna taty*) depend on Northern Mauxia Shrimp for 30% to 100% of their diet. In the northern part of the East China Sea, during the summer and autumn seasons, species like spinyhead croaker (*Collichthys lucidus*) and Bombay Duck (*Harpadon nehereus*) predominantly feed on Northern Mauxia Shrimp, while *Ilisha elongata* relies on them during autumn. In the waters near the Maan Islands, small yellow croaker primarily feed on Northern Mauxia Shrimp throughout the year. In the northern part of the South China Sea, round scad (*Decapterus maruadsi*) and Japanese jack mackerel (*Trachurus japonicus*) rely on Northern Mauxia Shrimp as their main food source throughout the year, while largehead hairtail (*Trichiurus japonicus*) prefers them during winter. Reports indicate that *Noctiluca scintillans*, not only competes with Mauxia Shrimp for food but also consumes large quantities of Mauxia Shrimp eggs and larvae. Therefore, fluctuations in Northern Mauxia Shrimp populations also affect the abundance of many economically important fish species.

Based on the principles of ecosystem-based fisheries management, it is imperative to not only focus on the target species but also consider the broader components and functions of the ecosystem in fisheries management practices.[3] Ecosystem-based fisheries management represents a more comprehensive approach to resource management. However, in China, fisheries management predominantly relies on total catch and input controls, with limited implementation of measures for conserving and managing fisheries resources at the ecosystem level. The Northern Mauxia Shrimp, occupying a lower trophic level in the marine ecosystem, plays a crucial role in connecting different levels of the food chain. It influences the biomass of marine planktonic species, while simultaneously sustaining the populations of numerous high economic value species. Therefore, in managing fisheries for such species, it is crucial to adopt a holistic perspective and incorporate the dynamics of species interactions into management frameworks. Consequently, CSSA advocates for the comprehensive consideration of various factors, including the prey-predation relationship, when developing management plans for Northern Mauxia Shrimp fisheries.

Criterion 4: Management and Implementation

Fishery management plans for target species

In 1955, the State Council issued the "Order on the Prohibition of Trawling in the Bohai Sea, Yellow Sea, and East China Sea by Motorized Trawlers," which established a non-trawling zone line consisting of 17 reference points. It stipulated that motorized trawlers equipped with propellers and fishing gear intended for bottom-dwelling aquatic animals (excluding sailboat fishing vessels) were not allowed to operate within the non-trawling zone line. The zone line was extended in 1957 and 1980, resulting in the national non-trawling zone line for motorized trawling fishing vessels comprising 40 reference points. Starting in 1981, all motorized bottom trawling fishing vessels were prohibited from operating within the aforementioned non-trawling zone line.

Since 1995, to conserve the spawning fisheries resources in summer, the East China Sea region has implemented a comprehensive fishing ban on trawling and canvas stow nets in July and August, gradually extending to the entire Chinese coastline. Currently, the summer fishing ban has become one of the fundamental fisheries management measures in China, covering major fishing operations and adjusting the timing, types, and scope of fishing bans according to the actual situation each year.

In December 2012, the Ministry of Agriculture announced the designation of the sixth batch of National Aquatic Germplasm Reserves. Among them, the Wudi Northern Mauxia Shrimp National Aquatic Germplasm Reserve in Shandong Province was included. Characterized by a high density of Northern Mauxia shrimp population, the establishment of this Reserve plays a significant role in protecting the key habitats and natural germplasm resources of Northern Mauxia Shrimp.[14]

According to the "Notice of the Ministry of Agriculture and Rural Affairs on the Special Fishing Permit and Supporting Service Arrangements for Special Economic Species During the Summer Fishing Moratorium in 2020," the designated pilot area for total allowable catch (TAC) fishing of Northern Mauxia shrimp is in the waters of Lianyungang, Jiangsu Province. The specified fishing period was from June 15th to July 15th, 2020. The operational area falled within the coordinates of 34°40’N to 34°50’N and 119°40’E to 120°10’E. The total catch quota was set at 5,000 tons, with a restriction on the number of licensed fishing vessels, capped at 100. The catch must be landed at the designated fishing port. Fishing vessels targeting Northern Mauxia shrimp must meet certain specifications: a

length of not less than 24 meters and a main engine power of not less than 110 kW. The permitted gear is stow net. Fishing vessels seeking special permits must have no records of illegal fishing.[8]In 2021, the TAC fishing pilot program for Northern Mauxia shrimp was expanded to other provinces including Liaoning and Shandong.

Fisheries management system

China's current fisheries management primarily relies on measures such as summer fishing moratorium, non-trawling zone lines, and aquatic germplasm reserves to control fishing intensity and alleviate fishing pressure. While these initiatives have yielded some initial outcomes, they have not effectively addressed the overarching goal of resource recovery. China's fisheries management system faces several key deficiencies:

1. Inadequate data reporting and monitoring of fishery catches, leading to a lack of fishery-dependent species biomass assessment and monitoring.
2. Low gear selectivity resulting in a high proportion of non-target species and economically valuable species' juveniles in the catch, with limited information available to evaluate associated impacts.
3. The substantial catch of low trophic level species may have significant ecosystem impacts, but relevant information for assessing these impacts is lacking.
4. Absence of specific management plans tailored to individual species, beyond general measures like summer fishing moratorium and non-trawling zones.

Moreover, China's nearshore areas typically feature mixed fisheries involving multiple species. Challenges in designing and implementing quota-based fishing management systems arise due to incomplete regulations, lack of vessel and catch volume data, and the absence of an effective fisheries monitoring system.

To address these challenges, it is imperative to not only reinforce enforcement of existing management measures but also to:

- Strictly limit the use of destructive fishing gear and practices.
- Crack down on three-no fishing vessels (fishing vessels without licenses, vessel names or proof of being on a port registry).
- Improve gear selectivity to reduce bycatch.
- Strictly implement minimum mesh sizes and minimum catch sizes to protect juveniles.

Additionally, there is a pressing need to develop comprehensive fish catch monitoring systems, design and implement ecosystem-based management approaches, and integrate species-specific fishing management plannings into the existing management framework. These efforts are crucial for establishing a robust and effective fisheries management system in China.

Acknowledgement

The CSSA team sincerely thanks Prof. Jiang Keji and his team at East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences for providing scientific and professional support for this report.

Reference

[1] 安丽娜, 王磊, 黄浩, 等. 大亚湾西部海域中国毛虾种群动态变化及其对环境要素的响应[J]. 应用海洋学学报, 2021, 40(3): 403-412. AN L N, WANG L, HUANG H, et al. Population dynamics of Acetes chinensis and its response to environmental factors in western Daya Bay[J]. Journal of Applied Oceanography, 2021, 40(3): 403-412.

[2] 陈立婧,杨帆,仲霞铭,宋大德,李国东,康中杰,熊瑛.中国毛虾生活史研究进展[J].上海海洋大学学报,2022,31(5):1032-1040. CHEN Lijing, YANG Fan, ZHONG Xiaming, SONG Dade, LI Guodong, KANG Zhongjie, XIONG Ying. Review of the life history of Acetes chinensis[J]. Journal of Shanghai Ocean University,2022,31(5):1032-1040.

[3] 褚晓琳.基于生态系统的东海渔业管理研究[J].资源科学, 2010(4):6.DOI:CNKI:SUN:ZRZY.0.2010-04-006. Xiao-lin, C. (2010). Ecosystem-Based Management of Fishery Resources in the East China Sea. Resources Science.

[4] 黄长江, 董巧香, 林俊达. 全球变化对海洋渔业的影响及对策[J]. 应用海洋学学报, 1999, 4(4): 481-494. HUANG C J, DONG Q X, LIN J D. Impact of global change on marine fisheries and countermeasures[J]. Journal of Applied Oceanography, 1999, 4(4): 481-494.

[5] 李国东, 仲霞铭, 熊瑛, 龚海翔, 汤建华, 施金金, 吴磊. 2021. 基于北斗船位数据的渔业信息解译与应用研究——以中国毛虾限额捕捞管理为例[J]. 海洋与湖沼, 52(3): 746-753. LI Guo-Dong, ZHONG Xia-Ming, XIONG Ying, GONG Hai-Xiang, TANG Jian-Hua, SHI Jin-Jin, WU Lei. 2021. INTERPRETATION AND APPLICATION OF FISHERY INFORMATION BASED ON BEIDOU POSITION DATA: A CASE STUDY OF TACS PILOT PROJECT OF ACETES CHINENSIS[J]. Oceanologia et Limnologia Sinica, 52(3): 746-753.

[6] 李淼, 许友伟, 孙铭帅, 等. 气候变化对海洋鱼类群落结构的影响研究进展[J]. 海洋科学, 2022, 46(7): 120-129.LI M, XU Y W, SUN M S, et al. Effects of climate change on marine fish community structures[J]. Marine Sciences, 2022, 46(7): 120-129.

[7] 李星颉, 戴健寿, 吴常文. 浙江北部沿岸海域的虾类资源[J]. 浙江水产学院学报, 1986, 12(1): 13-20+4. LI X J, DAI J S, WU C W. Shrimp resources in the coastal waters of northern Zhejiang[J]. Journal of Zhejiang Ocean University, 1986, 12(1): 13-20+4.

[8] 农业农村部. 农业农村部关于 2020 年伏季休渔期间特殊经济品种专项捕捞许可和捕捞辅助船配套服务安排的通告. 2020. https://www.gov.cn/zhengce/zhengceku/2020-05/07/content_5509581.htm. Ministry of Agriculture and Rural Affairs. (2020). Notice of the Ministry of Agriculture and Rural Affairs on the Special Fishing Permit and Supporting Service Arrangements for Special Economic Species During the Summer Fishing Moratorium in 2020.

[9] 农业农村部渔业渔政管理局, 全国水产技术推广总站, 中国水产学会. 1949~2020 中国 渔业统计年鉴[M]. 北京: 中国农业出版社, 1949-2020. Ministry of Agriculture and Rural Affairs of the People's Republic of China, National Fisheries Technology Extension Center, China Society of Fisheries.1949~2020 China fishery statistical yearbook[M]. Beijing: China Agriculture Press, 1949-2020.

[10] 农业农村部渔业渔政管理局, 全国水产技术推广总站, 中国水产学会. 2022 中国渔业统计年鉴 [M]. 中国农业出版社, 2022. China Agriculture Press. (2022). 2022 Chinese Fishery Statistical Yearbook.

[11] 王皓.浙江省沿海毛虾张网渔具研究[J].浙江海洋学院, 2015. Hao, W. (2015). Zhejiang coastal Acete Chinensis stow nets fishing gear and research. Zhejiang Ocean University.

[12] 吴晓睿, 宋大德, 熊瑛, 仲霞铭, 李纲, 杨帆, 康中杰, 李国东, 李冬佳, 施金金, 闫欣. 2023. 海州湾中国毛虾(Acetes chinensis)种群生物学特征和资源开发状态研究[J]. 海洋与湖沼, 54(2): 573-582. WU Xiao-Rui, SONG Da-De, XIONG Ying, ZHONG Xia-Ming, LI Gang, YANG Fan, KANG Zhong-Jie, LI Guo-Dong, LI Dong-Jia, SHI Jin-Jin, YAN Xin. 2023. POPULATION BIOLOGICAL CHARACTERISTICS AND EXPLOITATION STATUS OF ACETES CHINENSIS IN HAIZHOU BAY[J]. Oceanologia et Limnologia Sinica, 54(2): 573-582.

[13] 薛正锐. 渤海湾、莱州湾毛虾资源状况的初步分析[J]. 海洋湖沼通报, 1980,3(3): 51-56. XUE Z R. A Preliminary Study on the Natural Resources Conditions of the Actcscntsns in Bohai Bay and Laizhou Bay[J]. Transactions of Oceanology and Limnology, 1980, 3(3):51-56.

[14] 佚名.山东无棣毛虾入选国家级水产种质资源保护区[J].水产养殖，2013(2):1.DOI:CNKI:SUN:SCYZ.0.2013-02-032. Anonymous. Shandong Wudi Northern Mauxia shrimp selected as a national aquatic germplasm reserve[J]. Aquaculture, 2013(2):1. DOI:CNKI:SUN:SCYZ.0.2013-02-032.

[15] 张孟海. 渤海湾莱州湾毛虾渔业资源及当前生产中存在的主要问题[J]. 海洋渔业, 1990, 1(1): 14-16. ZHANG M H. Shrimp fishery resources and main problems in current production in Laizhou Bay, Bohai Bay[J]. Marine Fisheries, 1990, 1(1): 14-16.
[16] 郑基, 王陈, 王皓, 等. 东海区中国毛虾张网网具的优化设计[J]. 水产学报, 2015, 39(12):10.DOI:10.11964/jfc.20141209588. Zheng, J. (2015). Optimal design of Northern maoxia shrimp (Acete chinensis) stow net in coastal region of the East China Sea. Journal of Fisheries of China.