Assessment report of the effectiveness of closure in the Yellow Sea

Xiujuan Shan, Qiang Wu, Na Li

Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences

Mid-summer fishing closure system is one of the most comprehensive protection measures that has the widest coverage, the largest impact, the largest number of fishing fishermen involved, the most important management tasks, and the most substantial effectiveness in Chinese fishery resources management. The effectiveness of mid-summer fishing closure system directly determines the sustainable development of fishery resources to a certain extent. The evaluation of the effectiveness of mid-summer fishing closure system is a very important research content of YSLME-II phase. This report analyzed the development of the mid-summer fishing closure system in China, and analyzed the difference of fishery resources in the Yellow Sea before and after the mid-summer fishing closure in recent years, and analyzed the impact of the mid-summer fishing closure system on abundance of fishery resources, so as to provide a basis for the joint conservation of fishery resources in the Yellow Sea.

1 Background

The Yellow Sea and the East China Sea are waters with rich fishery resources and the highest productivity in China Seas. Their capture exceeds 50% of the total capture of the whole country. Some important fishery resources have been affected, such as largehead hairtail fish and small yellow croaker, which are becoming smaller, younger and more sexually precocious year by year. In order to prevent the further deterioration of marine fishery resources and eventually achieve the goal of restoring fishery resources, the Yellow Sea and the East China Sea began to fully implement the summer fishing closure in 1995. In 1995, the Ministry of Agriculture (now the Ministry of Agriculture and Rural Affairs) revised the original mid-summer fishing closure system, redefined a new mid-summer fishing closure system, and specified specific no-fishing periods, no-fishing zones and prohibited nets. In 1998, the Ministry of Agriculture began to implement a new mid-summer fishing closure system. After the adjustment, the mid-summer fishing closure period was extended

from two months to three months and the range was expanded. In 2000, the mid-summer fishing closure system was implemented across the country. The Ministry of Agriculture has decided to postpone the starting and ending time of the mid-summer fishing closure period in the Yellow Sea, East China Sea and South China Sea for 12 hours to facilitate fishermen's production and fishery suspension management since 2000. In 2003, the Ministry of Agriculture made appropriate adjustments to the mid-summer fishing closure time and types of fishing operations in some areas of the Yellow Sea and East China Sea, and continued to implement the original regulations in other areas. In 2005, according to mid-summer fishing closure system from the Ministry of Agriculture, the Bohai Sea mid-summer fishing closure time and types of fishing operations were adjusted. Since 2006, the fishing closure for shrimp trawling has been adjusted. In 2007, all the light-seine operations in the East China Sea were included in the fishing closure. In January 2017, Bureau of Fisheries of the Ministry of Agriculture and Rural Affairs issued the "most strict fishing closure system in history", and the mid-summer fishing closures in the Bohai Sea and the Yellow Sea start earlier from June 1 to May 1. For waters of the Bohai Sea and the Yellow Sea in north of 35°latitude, it starts from May 1 at 12 p.m. to September 1 at 12 p.m.; for waters in south of 35°N, it starts from May 1 at 12 p.m. to September 16 at 12 p.m. (Fig.1).

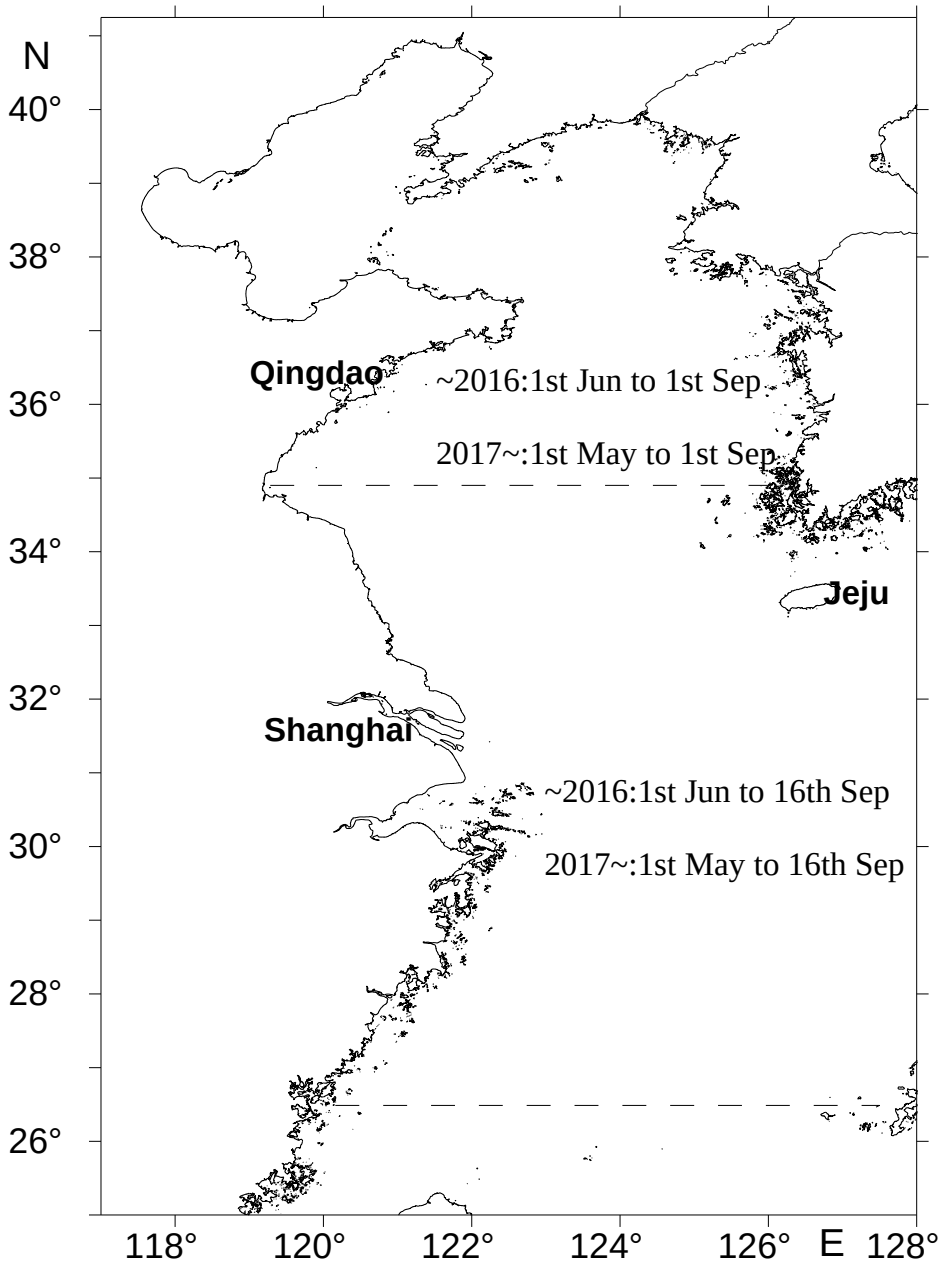


Fig.1 Amendment of the mid-summer fishing closure system in China Seas

2 Relationship between the mid-summer fishing closure and the abundance of fishery resources

To assess the effect of the adjusted mid-summer fishing closure system on the conservation and management of fishery resources in the Yellow Sea, this report is based on the survey data of bottom trawl fishery survey in Yellow Sea conducted by Yellow Sea Fisheries Research Institute of the Chinese Academy of Fishery Sciences. The survey site distribution is shown in Fig.2. The results of the survey in 2017 and the same period of 2015-2016 were compared to evaluate the conservation effect of the mid-summer fishing closure system adjustment on fishery resources in the Yellow Sea.

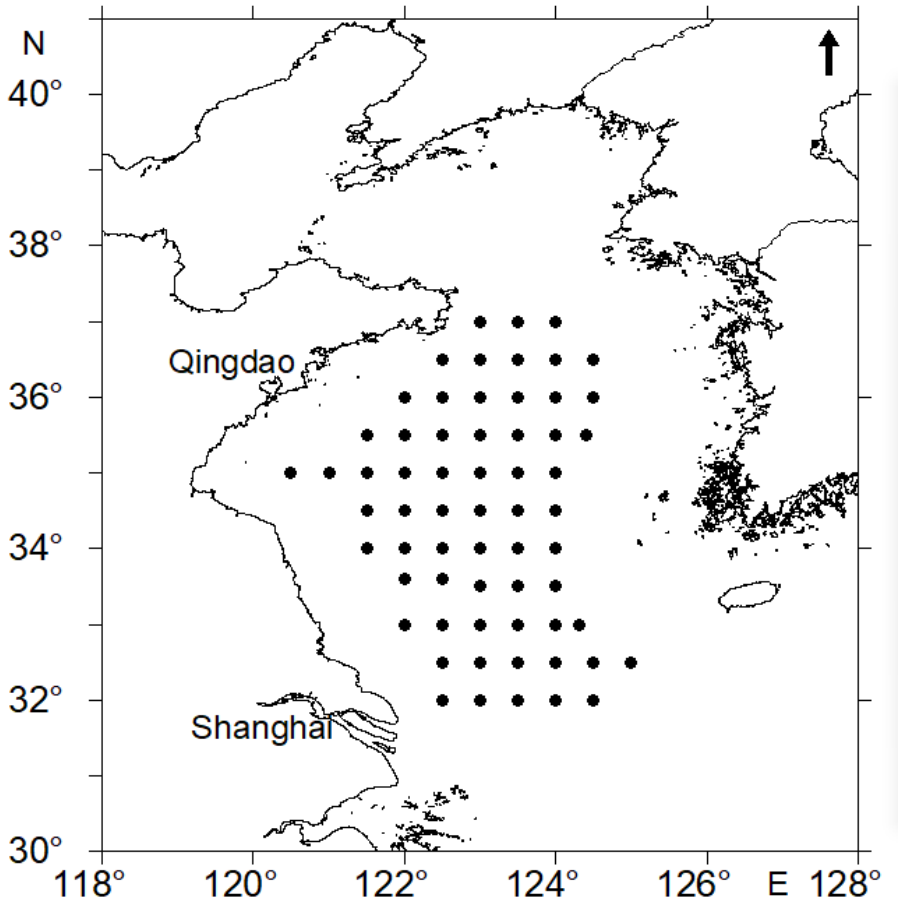
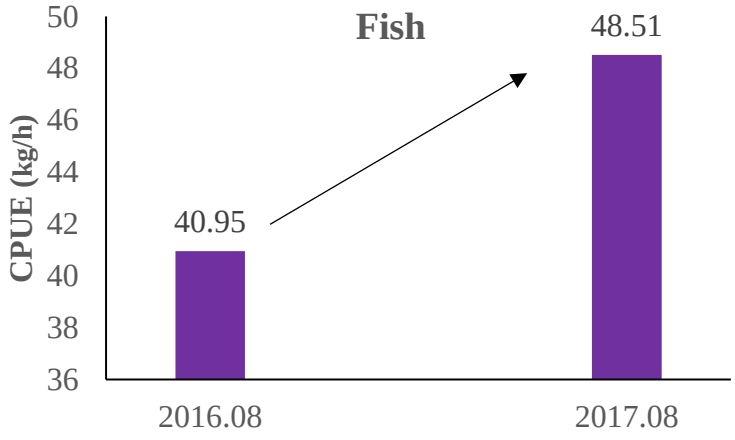
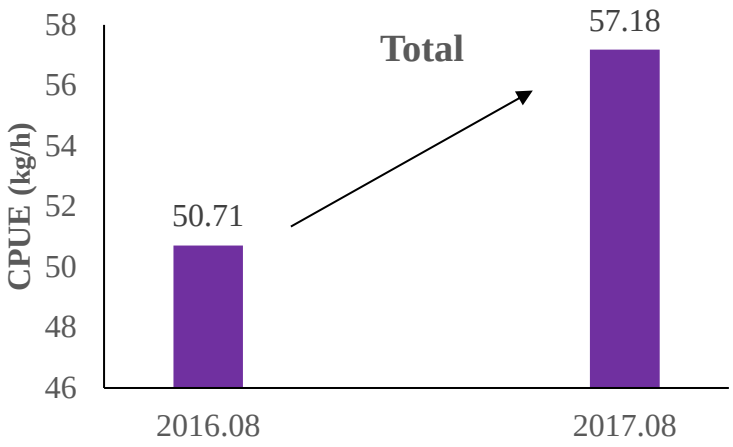


Fig.2 Survey site map

Compared with 2016, the mid-summer fishing closure period in the waters of the Yellow Sea was extended by one month in 2017, and the abundance of fish resources was significantly increased. The abundance index of fish resources increased from 40.95kg/h in August 2016 to 48.51kg/h in August 2017. The overall fishery resource abundance also showed an increasing trend, with the resource abundance index increasing from 50.71kg/h in August 2016 to 57.18kg/h in August 2017 (Fig. 3).



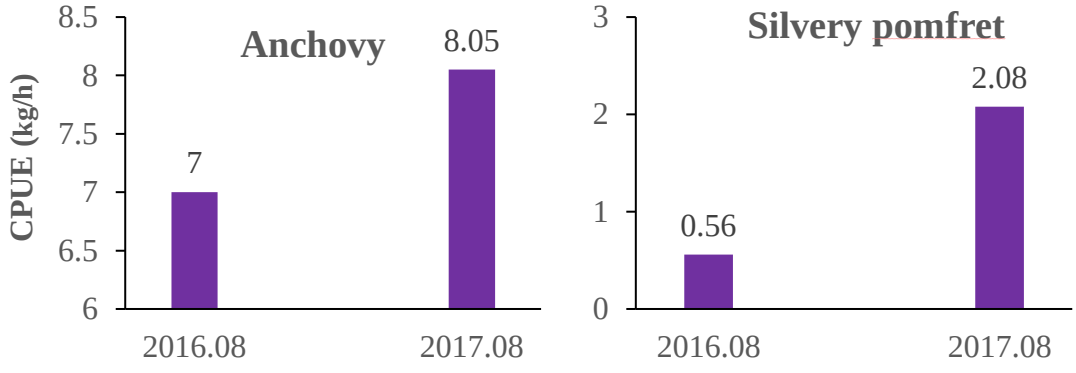
（a）



（b）

Fig.3 Changes of fish CPUE (a) and total CPUE (b) in the Yellow Sea

Compared with 2016, the abundance of resources for some major economic species also had increase trends in 2017. Anchovy abundance index increased from 7 kg/h in 2016 to 8.05 kg/h in 2017, silvery pomfret abundance index increased from 0.56 kg/h in 2016 to 2.08 kg/h in 2017, the snailfish abundance index increased from 6.57 kg/h in 2016 to 7.17 kg/h in 2017, pacific cod abundance index increased from 1.81 kg/h in 2016 to 2.31 kg/h in 2017,goosefish abundance index increased from 2.67 kg/h in 2016 to 4.2 kg/h in 2017, swimming crab abundance index increased from 1.86 kg/h in 2016 to 3.95 kg/h in 2017 (fig.4).



（a）　　（b）

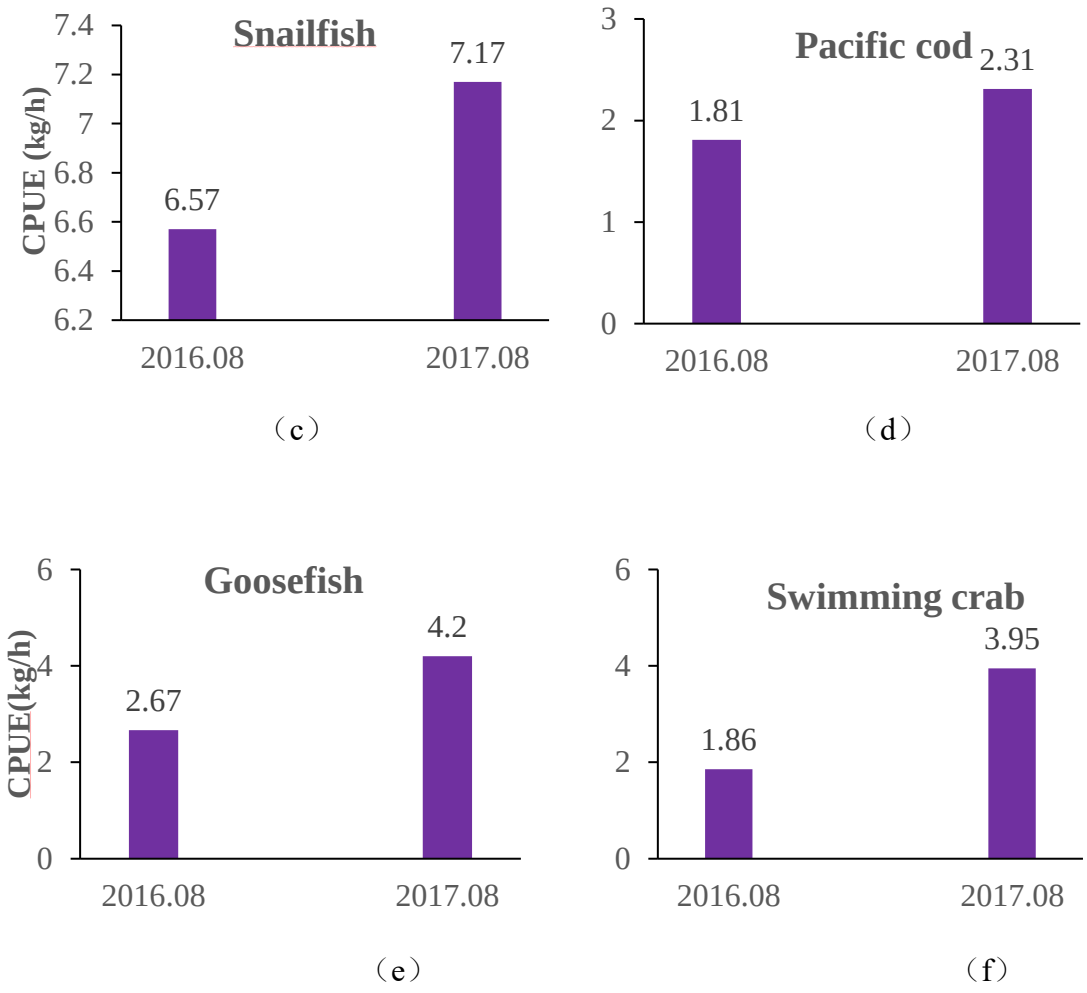


Fig.4 Changes in CPUE of major economic fish in the Yellow Sea

Compared with 2016, the mid-summer fishing closure period in the Yellow Sea area was extended by one month in 2017, and the abundance of both the overall fishery resources and the main economic fish resources showed obvious increasing trends.

3 The social benefits of the mid-summer fishing closure system

The mid-summer fishing closure system promotes the adjustment of the marine fishing industry and is conducive to the development and utilization of a variety of potential marine fishery resources. Because of fishing activity of trawling, stownet and other fishing boats are prohibited during the mid-summer fishing closure period, some of these fishing vessels are prompted to switch to light-seine or light-lift net fishing activity, to use pelagic fish resources such as mackerel and cephalopod resources, or switch to production of deep-water drift nets and fishing tackle in

distant-water to use fish resources such as polefish. The adjustment of fishing operation mode is conducive to balance the development of marine capture fishery. During mid-summer fishing closure period, fishing areas of mid-summer fishing closure zones can be restored, preparing for safety production in autumn-winter season. Also, the fishermen can participate in training course of fishery laws and regulations and training course of fishing techniques organized by local government, or can exchange fishing skills between companies of inter- or intra- provinces. As a result, the comprehensive quality of fishermen has been improved, and the proportion of licensed fishermen has been greatly increased, creating conditions for safe production, efficient fishing and compliance with fishery laws and regulations.

4 Conclusion

According to random sampling analysis, the alternate phenomenon of fishery resources is relatively obvious at present, with the increase of resources with low trophic level and short life cycle, which reflects the instability of the entire coastal fishery resource. If no effective conservation measures is taken, the sustainable development of marine fishery will be affected. Therefore, the implementation of mid-summer fishing closure system is imperative. As can be seen from the above results, the implementation effectiveness of mid-summer fishing closure system is very good, mainly reflected in the following aspects.

(1) Major economic fish resources have been protected recently, and certain ecological benefits have been achieved, protecting the spawning population and the juvenile population. The closure of fishing in the summer season is the feeding period of major economic fish. At this period, the closure of the fishing areas ensures the spawning and hatching of major economic fish. During the closure, fishing gears and methods that severely damage young populations are restricted and the fishing intensity for young fish is reduced. Therefore, the mid-summer fishing closure system creates a good environment for fish growth and breeding. According to the investigation and analysis of fishery administrations in Yellow Sea, Bohai Sea and East China Sea, before and after the fishing closure period, the body length of juvenile largehead hairtail and small yellow croaker both increased by more than 8mm and gained about 10g.

(2) The yield, quality and production value of fishery catch were increased. According to relevant data, after three-years implementation of mid-summer fishing closure system in the Yellow Sea and the Bohai Sea, the yield of main economic species, such as large yellow croaker, small

yellow croaker, largehead hairtail, pomfret, Spanish mackerel, chub mackerel, sea eel, jellyfish, increased differently after fishing closure compared with before fishing closure. The yield of traditional high quality species, large yellow croaker, largehead hairtail, pomfret and cuttlefish increased by 42.87%, 63.04%, 82.54% and 52.97% respectively within three years after the closure of fishing in summer.

(3) During the mid-summer fishing closure period, fishing boats do not go out to sea, which saves a lot of labor, physical resources and financial resources. According to relevant data, there are 87,600 fishing boats in the Yellow Sea and the Bohai Sea regions, of which 78,200 are below 45kw, 7,200 are between 45kw and 148kw, and 2,200 are above 149kw. After the implementation of mid-summer fishing closure system, a pair of otter trawling boats with a capacity of more than 205kw can save 400,000 RMB (16%-18% of the total annual cost) in two months of fishing closure. A pair of fishing boats with 45-148kw can save 170,000 RMB; saving 14,000 RMB per 15-44kw fishing boat. Each 15kw fishing boat can save 8,000 RMB. It is estimated that the closure of fishing in the Yellow Sea will save hundreds of millions to over one billion RMB annually.

5 Advice

Although the current implementation of mid-summer fishing closure system in China has achieved great success, in order to achieve the long-term goal of sustainable utilization of fishery resources, it is necessary to further take various effective measures and constantly improve the current implementation of mid-summer fishing closure system. For example, (1) establishing a fishing closure for shrimp trawling. Shrimp are one year lived crustaceans, and the best time for their utilization is when they approach or reach sexual maturity stage, where they have the largest individual and the highest utilization value. Generally, they are protected for 2-3 months before the fishing season to make sure shrimp grows up and increase the abundance of recruitment, so as to obtain the best economic benefit; (2) implementing a special fishing license system. There are a huge number of fishing boats in the Yellow Sea and the East China Sea. Therefore, fishermen should not focus on a particular operation mode, it is recommended to conduct otter trawl, single trawl, shrimp trawl, stow net to establish special fishing license system, and these vessels are prohibited to change fishing gears and methods but during mid-summer fishing closure season part of them are allowed to switch to the light-seine, drift net, which can make full use of the potentially exploitable species such as mackerel; (3) accelerating the implementation of the total allowable catch (TAC)

system. We should actively create opportunities, from easy to difficult, to implement quota catch for major economic fishes that are fished mainly in autumn and winter. Advanced international fishery resource management system should be applied to China as soon as possible.

6 Future work

Effectiveness of current mid-summer fishing closure system is limited to one year closure, effectiveness and utilization. The increase of recruitment abundance by fishing closure usually will be fished in the same year, which is a short-term conservation behavior. In order to change the present state of marine fishery resources, which is difficult to improve, relevant scholars and fisheries managers should carry out more researches on how to improve the current mid-summer fishing closure system and implement it.

In the future, biological model, economic model and observation method should be combined to evaluate and study the effectiveness of fishing closure system thoroughly. For example, the B-H age group model assessment method is used to simulate the effect of fishery prohibition measures on the catch per unit recruitment and its economic value.