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China Annual Report - Squid

People's Republic of China

Annual Report of China to the 2021 SPRFMO Scientific Committee, the Squid Jigging Fishery

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Summary

A total of 557 Chinese squid jigging vessels were recorded to operate in the Convention Area and caught 358 thousand tons of jumbo flying squid in 2020, but the actual number of active fishing vessels varied from 437 (the first week of January) to 557 (the last week of December). The estimated fishing days were 119,306 days and continued to increase comparing with the historical level. Catch rate is about 3.0 tones per fishing day, a rise of 7.1 percent over 2019. Two observers were designated to perform the observer program in 2020 with another five studying vessels. A total of 300 fishing days were observed and 21,683 squids were measured by observers on the sea in the 2020-2021 observer mission.

1 Description of Chinese Squid Jigging Fishery

The Chinese distant-water squid jigging fleet have targeted jumbo flying squid (*Dosidicus gigas*) since 2001 (Chen et al., 2008). The Chinese squid jigging vessels operate in the high seas of the South East Pacific. In general, small vessels with hand jiggers catch jumbo flying squid all year round, while the big vessels move to the South East Pacific from the southwestern Atlantic to catch jumbo flying in a few months of the year. In recently, East-central Pacific has become one of the main fishing grounds of the squid jiggers, and more vessels moved to the equator waters from the traditional fishing ground, high seas off Peru.

Twenty-two fishing vessels arrived at the international waters of the Southeast Pacific in 2001. The number of vessels increased to 119 in 2004 and then declined continuously in the following three years. In the past five years, the number of active squid jigging vessels is increasing and reached to 557 in 2020 (Table 1).

The number of active fishing vessels tends to change weekly in a calendar year. In

2016, the maximum number was 242, which occurred in December. 356 jigging vessels were reported to operate in the Convention Area in 2017, and the monthly maximum number varied from 180 (April) to 327 (November), however, in 2018, it changed from 192 in March to 373 in November. In 2019 the maximum occurred in the third week of December while the minimum number was 193, which occurred in the first week of January. In 2020 the number of active squid jiggers peaked in the last week, a total of 557 vessels operated in the high seas while the minimum number was 437, which occurred in the first week of 2020.

Annual total catches of the Chinese squid jigging fishery fluctuated widely in the first few years in the Southeast Pacific, but maintained at a higher level during the last five years. In 2020, 358 thousand tons of squid were caught.

Table 1 Number of vessels and annual catch of the Chinese squid jigging fisheries in the Southeast Pacific during 2016-2020

Year	Number of vessels	Catch in tons
2016	276	223,300
2017	356	296,100
2018	435	346,200
2019	503	305,700
2020	557	358,000

Table 2 Catch, effort and CPUE of the Chinese squid jigging fleet in the past five years

Year	Catch in tons	Fishing days	CPUE (tons/day-vessel)
2016	223,300	62,258	3.6
2017	296,100	75,655	3.9
2018	346,200	85,862	4.0
2019	305,700	111,343	2.8
2020	358,000	119,306	3.0

2 Catch, Effort and CPUE Summaries

Annual catch continued to grow and reached a higher level in 2014 and 2015, about 320 thousand tons, however, it fell to 223 thousand tons in 2016. Later it grew over and maintained about 300 thousand tons during the next three years. In 2020 annual catch was 358 thousand tons, the highest on record.

Fishing effort and CPUE during 2016-2020 are presented in Table 2. The estimated fishing days continued to grow with the increase of fishing vessels. Fishing days were 119,306 in 2020, up 4.5% compared to 2019. CPUE was relatively stable and fluctuated between 3.9 and 5.5 tons/day-vessel during 2014-2018, however it decreased to 2.8 tons/day-vessel in 2019. In 2020, estimated CPUE showed a small increase when compared to 2019.

The monthly catches and CPUEs over the period 2016-2020 are presented in Figures 2 and 3, respectively. Monthly catches curves in 2016 and 2017 showed a similar trend that they decreased in the first half-year and increased in the second half of the year. In 2018, monthly catch continued to grow basically and peaked in September, and then it started to decline month by month. In 2019 the monthly catch fluctuated more sharply than it in the last three years and showed two rise phases and decline phases. In 2020, catches in January, February, July and August were higher than that in the same period of previous years, thus monthly catch showed some downward trend. Moreover, catch in the fourth quarter of 2020 was lower than that of the previous four years.

Monthly CPUEs in the previous five years showed a U-shape curve and dropped to the lowest value in May, June, or July, and then recovered month by month, however, in 2018, the CPUE peaked in February, and had not started moving upward since September, but continued to fall with the catch. In 2019 monthly CPUE was highest in December, and it appeared a small peak in July. Three peaks were showed at the beginning year, at the middle and at the end of 2020, and the maximum occurred in July 2020.

Monthly catch or CPUE distributions in recent years are shown in Figures 4, 5, 6, and 7. The monthly geographical distributions showed that these fishing vessels operated in the high seas and moved back and forth between high seas off Peru and equator waters. The former was the main fishing grounds for the Chinese squid jigging fleet but been replaced by the latter since 2017. Furthermore, only a few vessels operated in the high seas off northern Chile. In 2020, the fishing vessels distributed form high seas

off Peru to the 120 degrees west longitude of the equatorial waters in the first four months. Most fishing activities occurred in the high seas off Ecuador and Peru in May and June, after that some squid jiggers came back to the equatorial waters again. The Ministry of Agriculture and Rural Affairs adopted a closure measure in 2020 and all the Chinese vessels Chinese squid jigging vessels were prohibited fishing in the area of East Pacific (5°N-5°S, 110°W-95°W) from 1 September to 30 November since 2020, thus the fishing activities were disappeared in this closure area during September-November 2020.

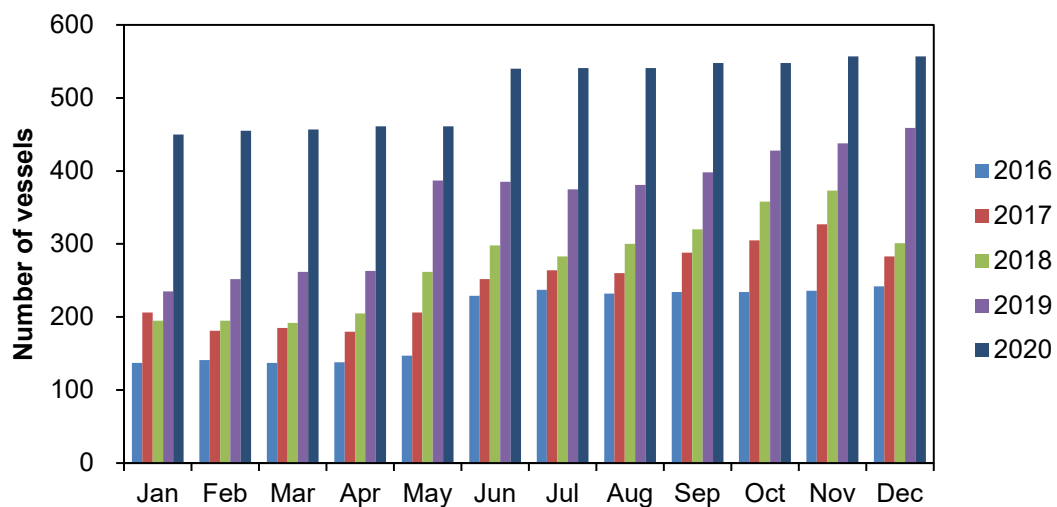


Figure 1 The number of monthly maximum active fishing vessels during 2016-2020

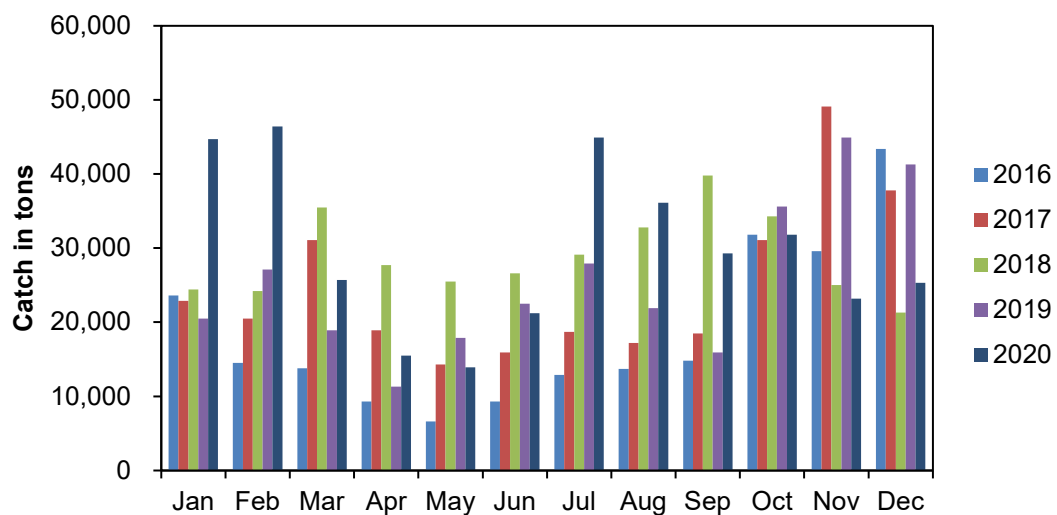


Figure 2 Estimated monthly catch during 2016-2020

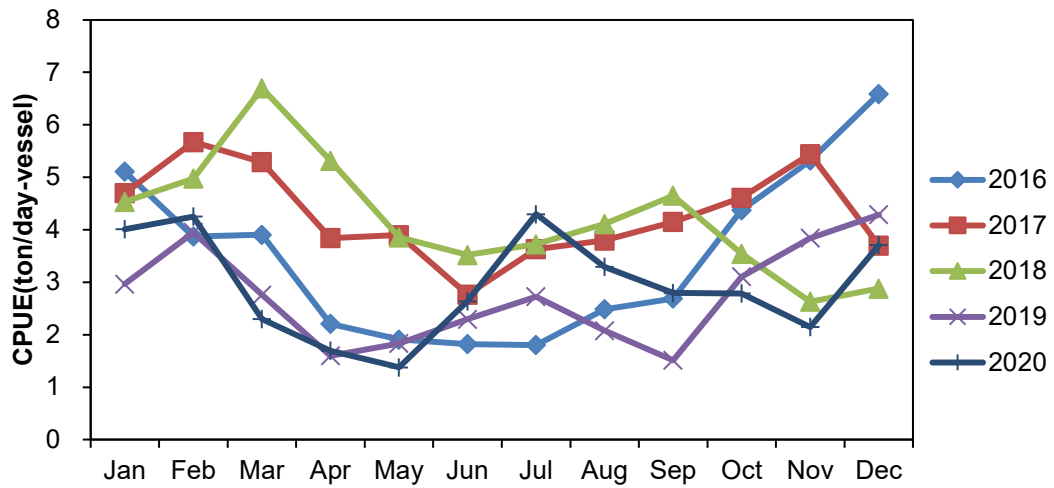


Figure 3 Estimated monthly CPUE during 2016-2020

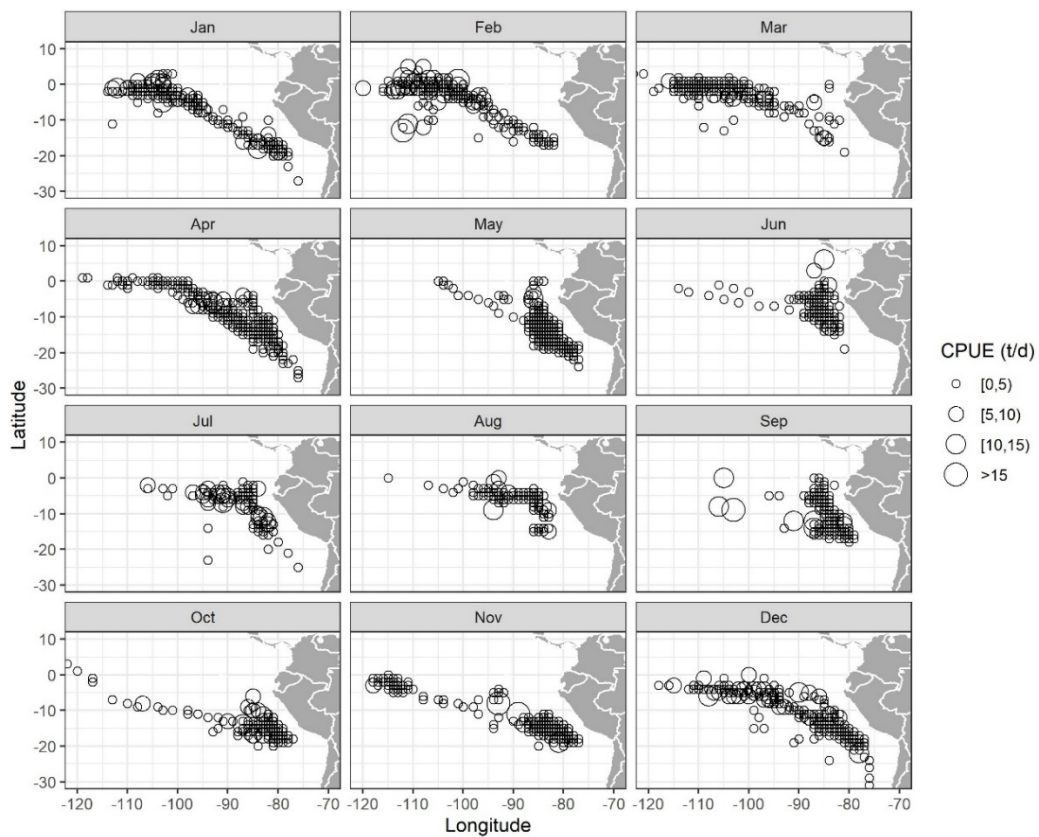


Figure 4 Monthly catch rate distribution of the Chinese squid jigging fishery in 2020

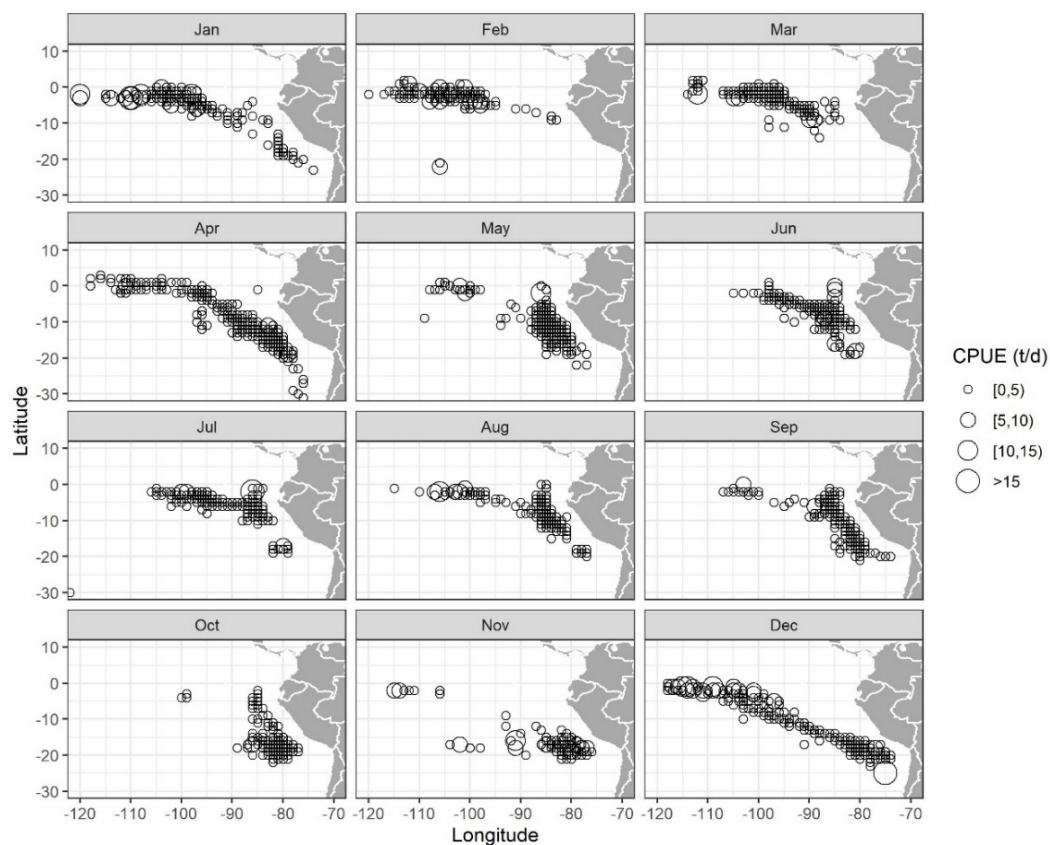


Figure 4 Monthly catch rate distribution of the Chinese squid jigging fishery in 2019

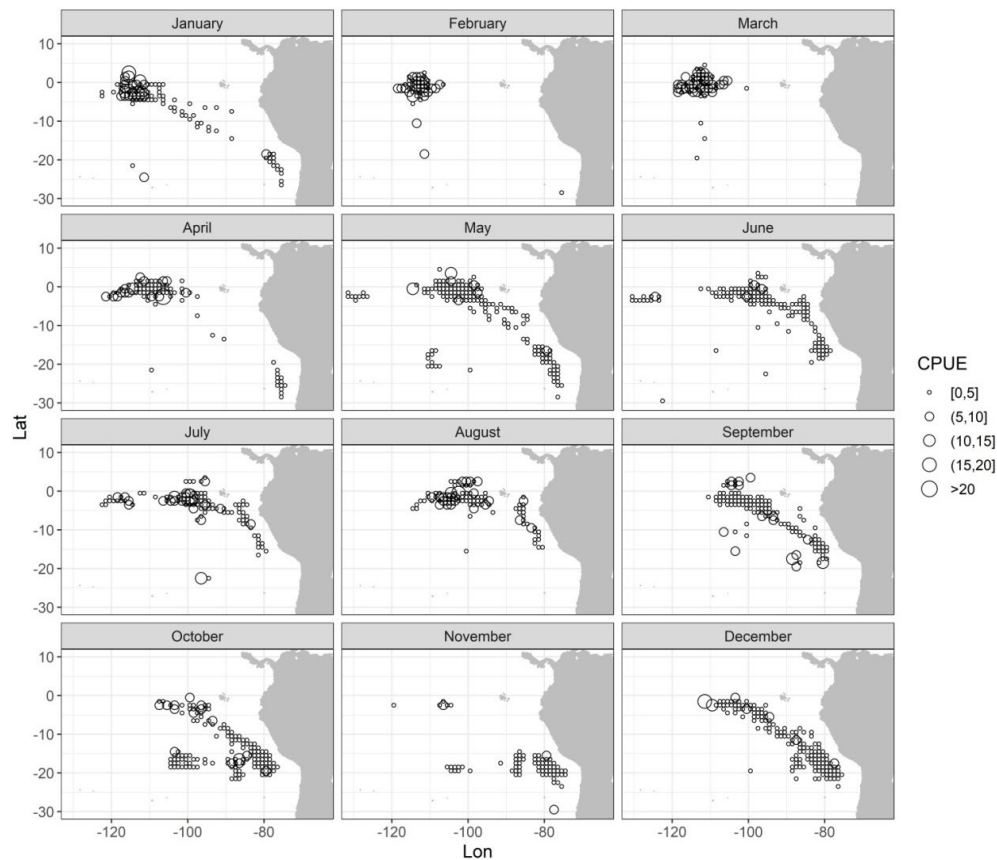


Figure 5 Monthly catch rate distribution of the Chinese squid jigging fishery in 2018

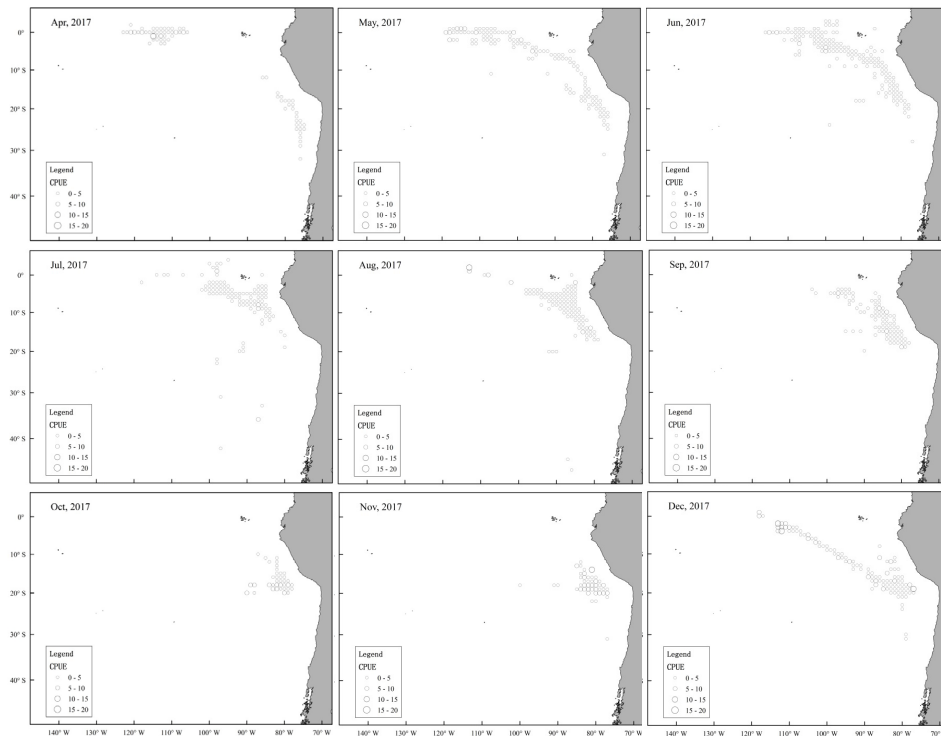


Figure 6 Monthly catch rate distribution of the Chinese squid jigging fishery in 2017

3 Fisheries Data Collection and Research Activities

Two types of fishery data were collected for the squid jigging fishery, the catch data, and biological data. The logbook was designed and made by China Distant Water Fisheries Association (CDWFA). Some key information such as the fishing vessel (name, engine power, total light power, etc.) and fishing activities (start and end locations and time, catch and by-catch species of marine mammals, birds and turtles) are all list in the logbook. Moreover, the fishing companies were requested to report the estimated catch and number of fishing vessels with their status (operating, being repaired, returning or shifting) every week. Since 2015, data collection work has been in the charge of the National Data Center for Distant-water Fisheries of China (NDCDF). The e-logbook system developed by NDCDF has been tested and applied to the squid jiggers gradually in the last two years to improving quality and efficiency of data collection.

More than 100 thousand recorders of daily fishing activity form 546 active Chinese squid jiggers that operated in the high seas of Southeast Pacific in 2020 were collected,

checked and then submitted finally this year, and the rate of logbook submission reached to 98 percent.

Biological data and samples were also collected in 2020 by the scientific observer and studying fleet. Observers are requested to record catch data and collect length, sex, maturity, and by-catch information, and monitor transshipment on the sea. The caught jumbo flying squid were sampled randomly for length measurement each time, in which some individuals were weighed and determined sex and maturity. A total of 21,682 squid were measured by the observer on the sea from October 2020 to April 2021, among which 10,196 squid were measured in 2020. Besides that, the other 1,062 samples were frozen and transported to the laboratory of Shanghai Ocean University for biological examination and genetic research. Five squid jiggers served as the studying vessels to collect length data and biological samples in 2020, they measured mantle length from 8,437 specimen onboard and sent 1,846 squid to the lab. Some samples still have been stored in the factory cold storage and are waiting for sent to the lab for analysis because of the COVID-2019 pandemic.

Research activities of the squid research team of SHOU focused on genetic diversity and feeding ecology of the jumbo flying squid. Genetic studying was continued and the preliminary result indicated that low genetic differentiation and low genetic diversity among phenotypes because of heterozygote deficiency and inbreeding. There is neither significant differentiation nor geographical isolation of the three phenotypes based on the results of population differentiation, genetic structure and the population genetic distance.

Yu et al. (2021) assessed the relationship between habitat pattern of jumbo squid and El Niño–Southern Oscillation by habitat suitability index (HSI) modelling approach and found that both SST anomaly and SSHa were significantly positively related to the ENSO index during 1950-2015. Moreover, a significantly negative association was found between the HSI values and the ENSO index. Due to the El Niño events, SST off Peru became higher and sea level rose, resulting in suitable habitats dramatically

decreased. In contrast, during the ENSO-neutral and La Niña years, the extent of suitable SST and SSHA increased due to the colder water and lower sea level, and suitable habitat expanded. The latitudinal gravity center of HSI was significantly positively associated with the ENSO index. Relative to the ENSO-neutral and La Niña years, a southward movement of the monthly preferred SST isotherm for jumbo flying during the El Niño years could explain the occurrence of more suitable habitats in southern waters off Peru.

Gong et al. (2021) examined the abundance and characteristics of Microplastics (MPs) in the gill, intestine, and stomach of jumbo flying squid to evaluate MP contamination status of this commercially important species. The average abundance ranged from 4.0 to 7.4 items/individual and 0.2 to 0.7 items/g wet weight for the three tissues. The MPs were sized 80.75 to 4632.27 μm , with larger MPs generally found in the stomach. The majority of MPs were fibrous in shape, blue or black-gray in color, and cellophane in composition. These results revealed the MP distribution in jumbo flying squid and could be driven by its movement pattern and habitat use. Furthermore, this study provides evidence that adherence to gills is probably an alternative means by which pelagic squid accumulate MPs.

4 Biological Sampling and Length Composition of Catches

In 2020, biological sampling for jumbo flying squid was carried out by the scientific observers and studying vessels. Two observers worked onboard from October 2020 to April 2021. A total of 21,682 individuals of jumbo flying squid were measured for length onboard by the observers, and some of the specimens were also determined sex maturity stage and stomach fullness. Moreover, the observer also sampled 1,062 squids, which were delivered to the lab of SHOU. JINHAI 868 and other four squid jiggers were appointed as studying vessels to collect length data, report daily fishing activities and take random samples weekly. A total of 8,437 length data were reported and 1,846 frozen squid were sent to the lab for biological measurement. The hard structures of these samples including statolith, beak, gladius, and lenses of eyes were also extracted, and muscular tissue was applied to the genetic study. Some samples still have been stored in the factory cold storage and are waiting for sent to the lab for

analysis because of the COVID-2019 pandemic.

The length frequency (samples size N=20,380) based on jumbo flying squid sampled or measured in 2020 by observers and studying vessels in Figure 8. Mantle length ranged from 10.9 cm to 97.6 cm, and four models can be distinguished obviously. The dominant size class was 24-27 cm, followed by 80-65 cm, 59-64cm and 42-48cm. In general, the small phenotype squid derived from catch in the northern fishing area around the equatorial waters, and the large phenotype were caught in the high seas off Peru. Compared with the historic length composition, the range of length distribution was wider and the difference of frequency of each size group was smaller in 2020 and indicated that samples are more representative. This benefits from the studying vessels. Fishmen of the studying vessels measured 30 length a day by following the guidance, thus the sampling covered all the whole fishing grounds and seasons.

Gonad maturity stage measurements were divided into two groups according to 8 degrees latitude south in 2019. In 2020, gonad maturity stage measurements were also divided into two groups, small-medium size group and large size group, however the standard was designed by the phenotypes with different mantle length that described by Csirke et al. (2018). For the small-medium size group, frequency of the sex-specific sexual maturity was very similar with 2018 and 2019, immature male and female squid were dominant, which take account for about 75 percent of the total of females or males. Similarly, male squid became sexually mature earlier than females and females were larger than males when they are mature. We can also find or deduce that jumbo flying squid stop growing when the gonad maturing. For the large group that caught in the southern fishing ground during October to December, more than 95 percent squid were mature, which indicated that the fourth quarter is the spawning season for the large phenotype. As previous years, the mean size at the maturity stage of the large phenotype squid regardless of sex increased with the gonad developing, and the matured females were larger than the matured males.

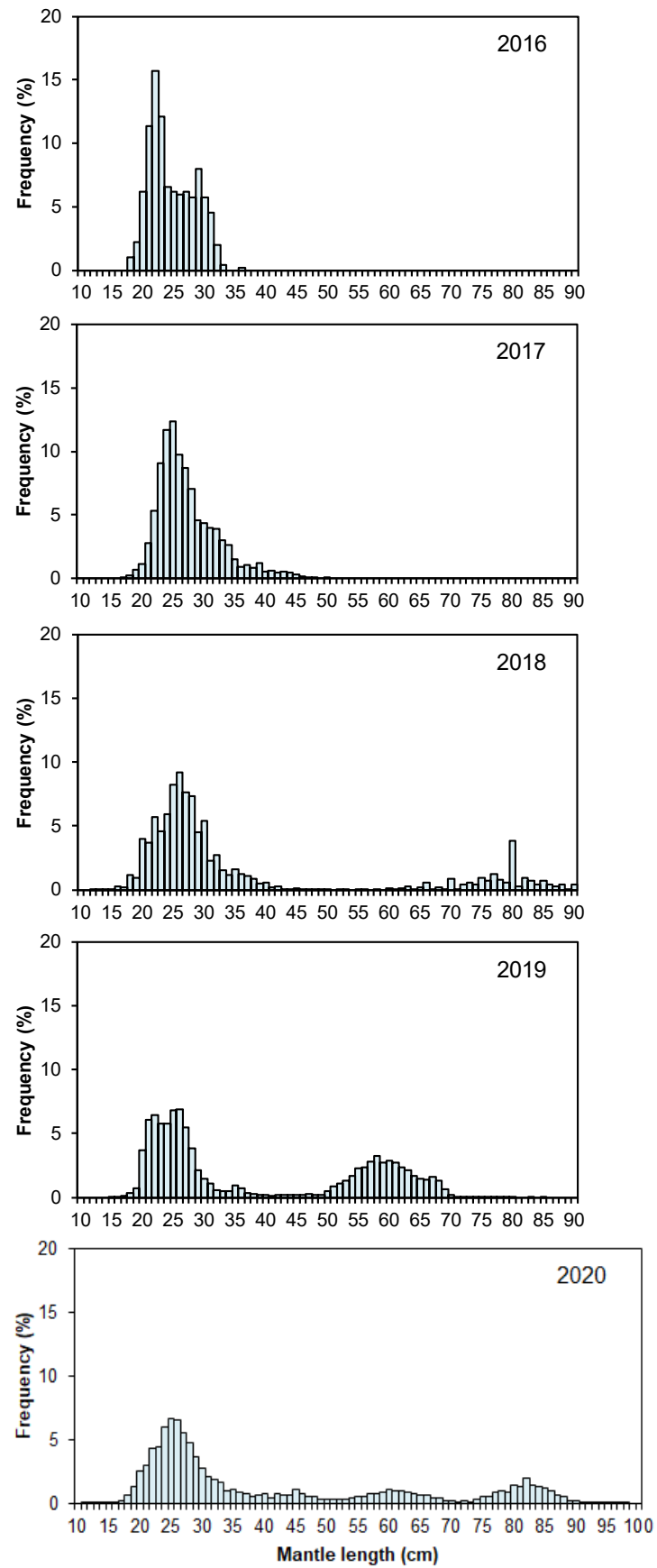


Figure 8 Size frequencies of the jumbo flying squid sampled in the high seas

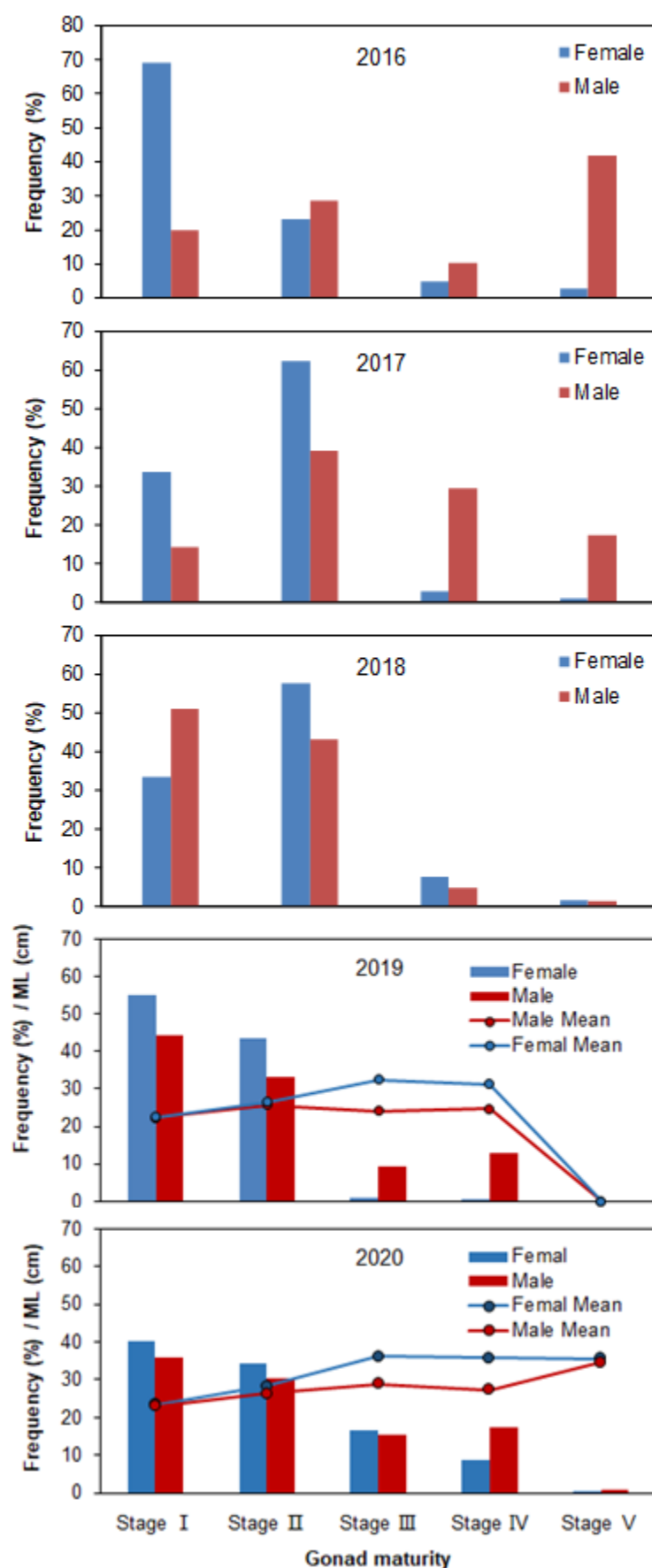


Figure 9 Sexual maturity stages of the small and medium jumbo flying squid

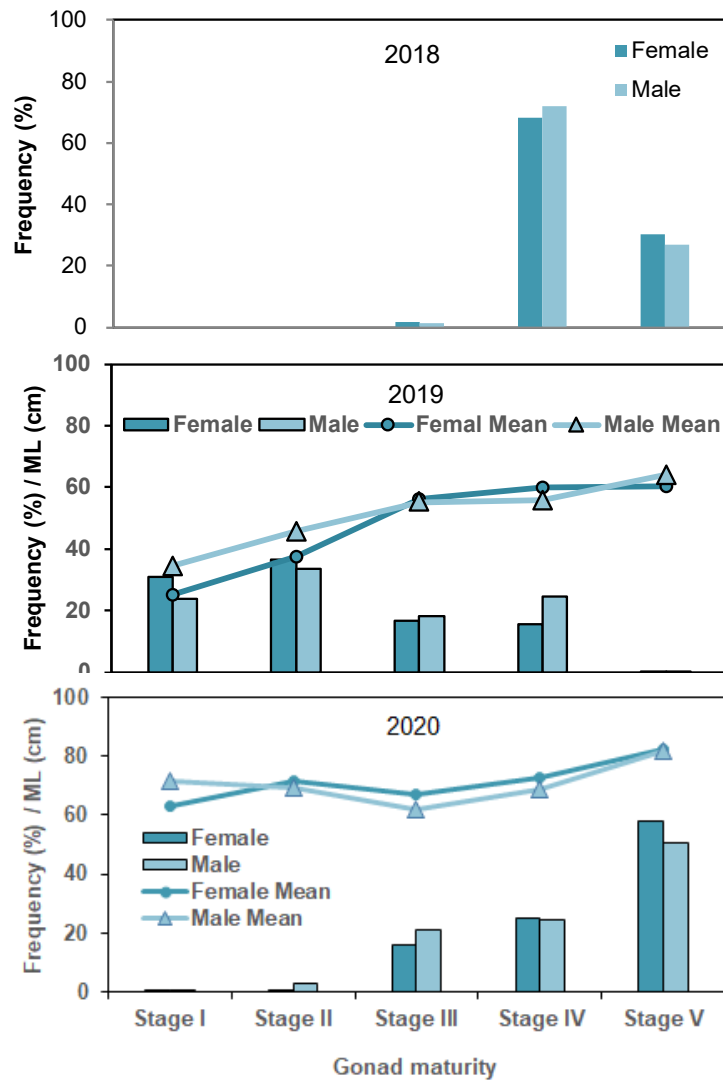


Figure 10 Sexual maturity stages of the big size jumbo flying squid

5 Observer Implementation Report

The observer program was designed to collect representative biological data for jumbo flying squid. Two observers and five studying vessels were designated to perform the observer program in 2020-2021. 300 fishing days were observed and 21,683 squids were measured by observers on the sea in the 2020-2021 observer mission. The observers also monitored transshipment on the sea, recorded bycatch and sea birds around vessels. The details of the observer mission are reported in the observer program implementation report of China to the SC9.

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