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China's Annual report – Part II: The Squid Jigging Fishery

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National Report of China to the 2015 SPRFMO Science Committee Part II: the Squid Jigging Fishery

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1 *Description of Chinese Squid Jigging Fishery*

Jumbo flying squid (*Dosidicus gigas*) has been targeted by the Chinese distant-water squid jigging fleet since 2001. During June and September in 2001, the Chinese squid jigging industry made their first resources survey of jumbo flying squid in the high seas of Peru and Costa Rica, followed by commercial production (Chen et al., 2008).

The Chinese squid jigging vessels only operate in the international waters outside Peru and Chile economic zones. In general, small vessels with hand jiggers catch jumbo flying squid all year round, while the big vessels equipped auto-machined jiggers move to the South East Pacific from the south-western Atlantic to catch jumbo flying in a few months of the year.

The total of 22 fishing vessels arrived at the international waters of the South East Pacific in 2001.The number of vessels increased to 119 in 2004 and then declined continuously in the flowing three years. Over the period 2005-2014, the number of Chinese vessels increased rapidly and peaked in 2014 (Table 1).

The number of active fishing vessels is constantly changing month by month in a calendar year. During 2012-2014, the number of operating vessels was more than 150 for 5 or 6 months a year. In 2014, the number of active fishing vessels peaked in September, however, a total of 256 vessels were recorded to operate in the South East Pacific in that year. In the first half of 2015, the number of fishing vessels changed between 118 and 160 (Figure 1).

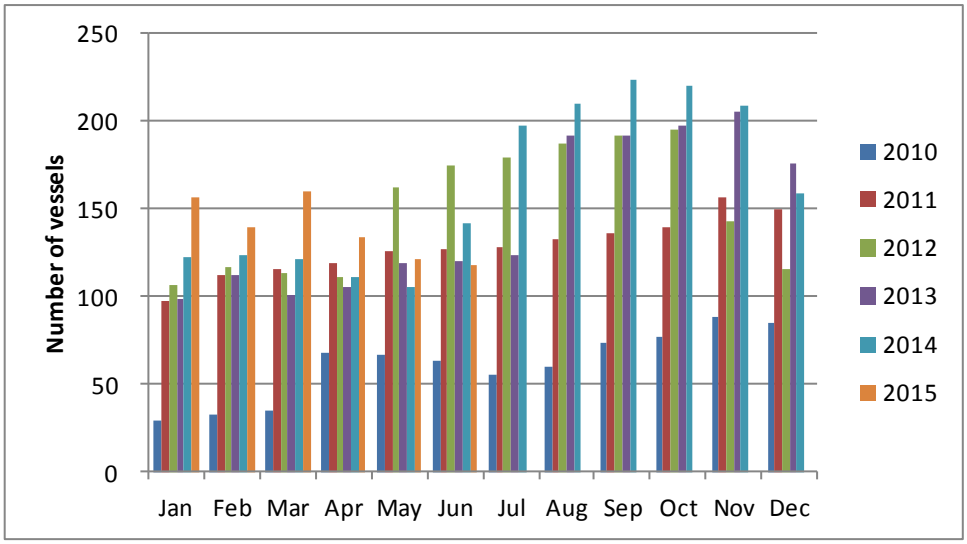


Figure 1 Monthly variation in number of vessels during 2010-2015

Annual catch of jumbo flying squid presented similar trend as the number of vessels during 2001-2014. Only 17,770 tons squid caught by 22 vessels in the first fishing year, and increased rapidly in the following three years, however it declined continuously in the next three years. Staring from 2008, the catch increased again and reached a record 325 thousand ton in 2014 (Table 1).

Table 1 Number of vessels in the South East Pacific during 2001-2015

Year	Number of vessels	Catch in tons
2001	22	17,770
2002	43	50,483
2003	74	81,000
2004	119	205,600
2005	93	86,000
2006	43	62,000
2007	37	46,400
2008	50	79,064
2009	54	70,000
2010	104	142,000
2011	172	250,000
2012	254	261,000
2013	205	264,000
2014	264	325,000
2015*	160	129,000

Note: The total catch was 129,000 ton through June 2015.

2 Catch, Effort and CPUE Summaries

Annual total catches of the Chinese squid jigging fishery in the South East Pacific were over 250 thousand tons during the period of 2011-2014, before that the highest catch was 205 thousand tons. In 2015, total catch was 129 thousand ton up until June.

Fishing effort, catch rate during 2010-2014 are showed in Table 2. Effort was increased rapidly with the increasing fishing vessels and maintained high level in the past 4 years. However, effort decreased from 65,530 fishing days in 2012 to 58,831 fishing days in 2013, and showed a slightly increase in 2014.

CPUE was fluctuant between 4.0 and 6.4 ton/day-vessel from 2010 to 2014. Catch rate declined in the first 3 years but showed an increase trend from 2013 and reached 5.5 ton/day-vessel in 2014. The monthly catches over the period 2010-2015 are presented in Figure 2.

Monthly catches in the last 5 months during 2012-2014 increased obviously. The maximum was over 60 thousand tons, appeared in November 2014, and followed by 49.7 thousand tons in November 2013 and 41.6 thousand tons in August 2012. In 2015, monthly catch data were available up until June and monthly catch declined from 300 thousand ton in January to 118 thousand ton in June.

Table 2 Catch, fishing days and catch per day of jack mackerel by the Chinese fishing fleets over the period of 2010-2015

Year	Catch in tons	Fishing days	CPUE(ton/day-vessel)
2010	142,000	22,242	6.4
2011	250,000	46,493	5.4
2012	261,000	65,530	4.0
2013	264,000	57,771	4.6
2014	325,000	58,831	5.5
2015	129,000	-	-

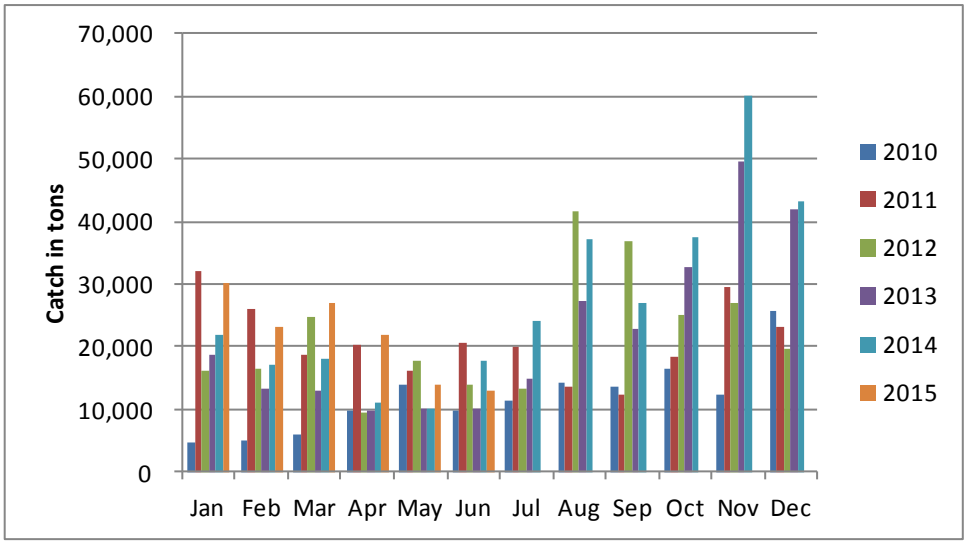


Figure 2 Monthly catches of the Chinese squid jigging vessels during 2010-2015

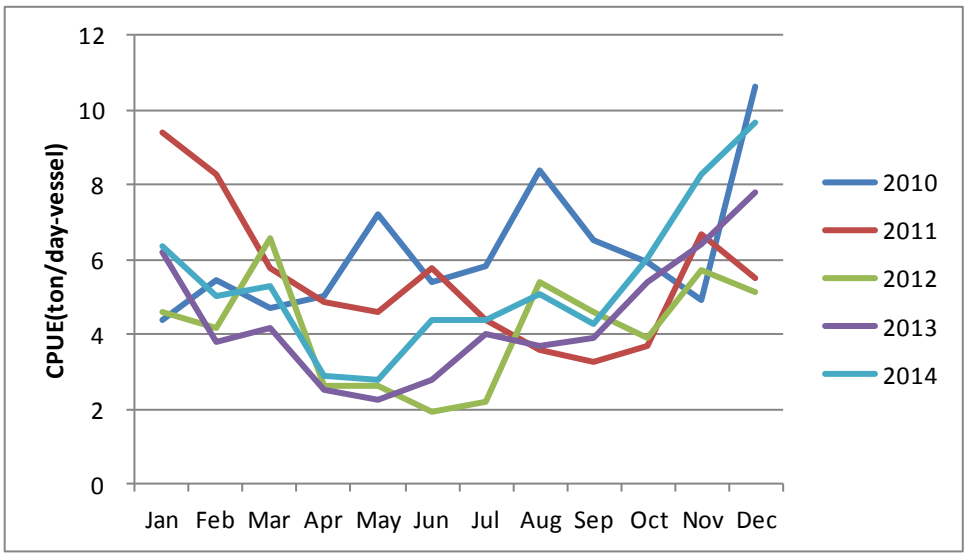


Figure 3 Monthly CPUE of the Chinese squid jigging vessels during 2010-2014

Monthly nominal CPUEs showed the similar trends from 2012 to 2014 that they decreased from January to June but increased in the second half of year. In 2011, this decreased trend continued to September except for a small increase in June. The monthly CPUEs in 2010 fluctuated strongly, but for the entire, they were on the rise.

3 Fisheries Data Collection and Research Activities

China Distant Water Fisheries Association (CDWFA) and Shanghai Ocean University (SHOU) jointly take charge of the fisheries data collection. Data collection of the Chinese squid jigging fishery began in 2001, the same year as the Chinese scientists started research work for jumbo flying squid and its fishery in the South East Pacific.

Data collection was relatively simple early on in the Chinese squid jigging fishery. Fishery data collection system has been established and more detail fishery data such as operating time, location and catch derived from logbooks have been collected since 2003. Moreover, the fishing companies were request to supply the weekly fishing report in which include number of fishing vessels, the status of fishing vessels (operating, being repaired, returning or shifting), catch, catch per vessel and accumulated catch.

As another important part of the system, biological and environmental data were also collected by the Chinese scientists. The environmental data (such as temperature, and salinity of water columns) and some important biological information e.g. mantle length (ML), weight, sex, stage of maturity were collected on board directivity by the scientists. Furthermore, the scientists cooperated with fishmen and entrust them to collect samples of jumbo flying squid on the sea. These squid samples were transported to SHOU finally.

One of the purposes of the Fishery data collection system for the jumbo flying squid in the South East Pacific is to do scientific researches, which mainly related to fisheries biology, stock structure, assessment and relationship with marine environment. Some results have been published in international journals in recent years. For example, Chen et al (2011) studied age, maturation and population structure of the jumbo flying squid stock off the Chilean economic zone base on samples collected during 2007-2008. Age determined by counting daily rings on the statolith. At least two spawning groups were identified, the main spawning peak tended to occur between August and November (austral spring group), and the secondary peak

appeared during March to June (austral autumn group). In the high seas of Chilean waters, the squid were sampled in from 2008 to 2010 for aging and estimating time of hatch (Liu et al., 2013). Estimated ages ranged from 144 to 633 days. Occurrence of mature females and hatching in each month indicated that this species spawned year-round but peaked between January and March. Area adjacent to 11°S off the Peruvian may be a potential spawning ground.

Trace elements in statoliths of the jumbo flying squid were studied. Sr: Ca, and Mg:Ca were good indicators for distinguishing squid from autumn and winter spawning seasons. Sr:Ca and Ba:Ca distribution patterns in statoliths confirmed that paralarvae and juvenile squid inhabit surface waters, while subadult squid migrate into deeper waters (Liu et al., 2011). The spatial difference in trace elements of statolith can be used to separate geographic populations. Jumbo flying squid in the high seas off Costa Rica could be separated from those off Peru and Chile mostly due to the differences in Ni, Sr, and Co, while samples off Peru and Chile could be distinguished mainly because of differences in Mn and Co (Liu et al., 2013). And, furthermore, morphology (Liu et al., 2015) and gene technology (Liu et al, 2014) were also used to identify different geographic populations of the jumbo flying squid in the South Pacific.

4 Biological Sampling and Length Composition of Catches

A total of 732 jumbo flying squid was sampled on the Chinese vessel in the Eastern Central Pacific (110°W- 20 °W and 2°N-5°S) from April and June 2014. Collected data include length, weight, sex, maturity stage, stomach fullness, and so on. Among the 732 jumbo flying squid samples, 487 samples were measured mantle length or body weight only, and 100 samples were measured for mantle length and body weight and determined sex and mature stage by checking the gonad on the sea. There were 145 samples were measured and examined in the laboratory of SHOU to get more detailed biological characteristics such as age, gonad weigh, tentacle length, dimension of beak and statolith etc. Body weight of jumbo flying squid samples ranged from 275 g to 3330 g with mean of 596 g (sample size was 596).

Length frequency based on all these samples was presented in Figure 4. In 2104, the first mode of mantle length was 30-35 cm and the second was 25-30cm. Data from 2013 survey showed that the vessel caught the similar size of squid, but the principal mantle length was at 25-30 cm and the second was 30-35 cm (sample size was 2018). Furthermore, smaller squid with mantle length at 5-20 cm were also caught.

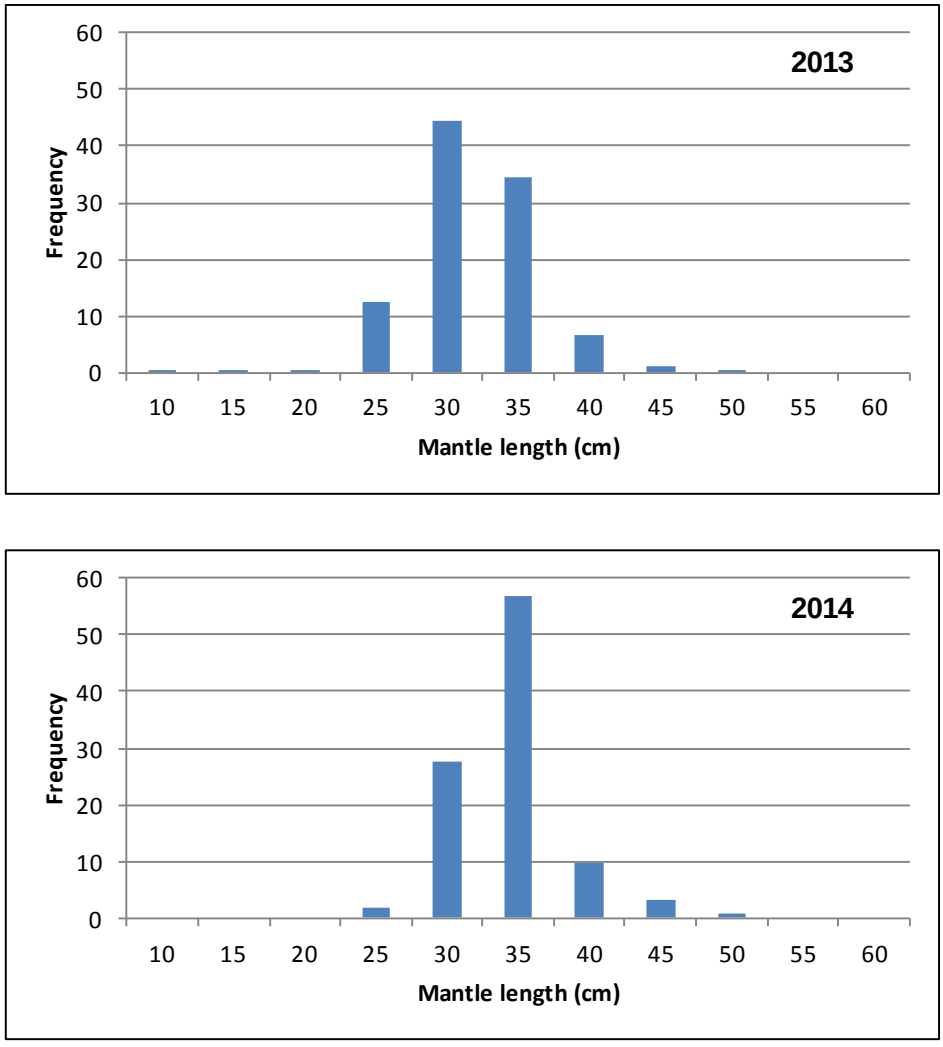


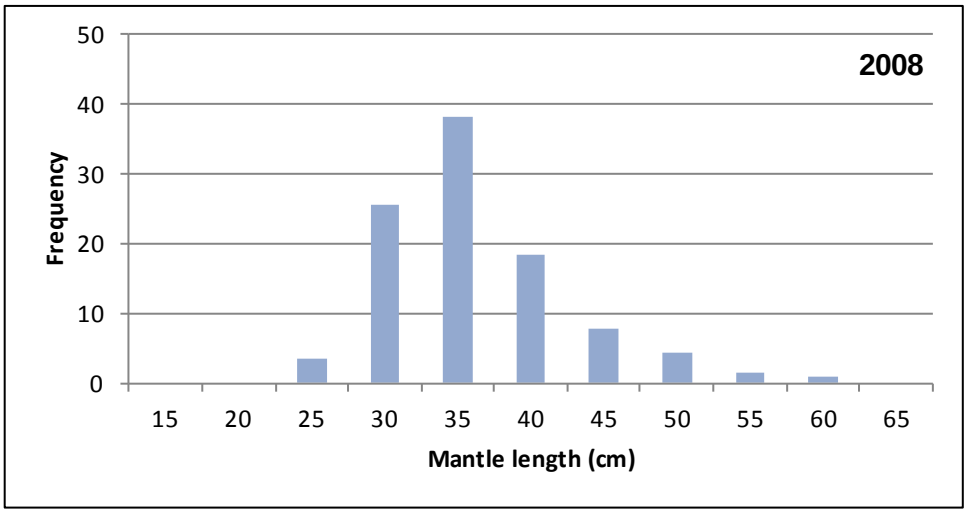
Figure 4 Mantle length frequency of jumbo flying squid in the Eastern Central Pacific in 2013 and 2014

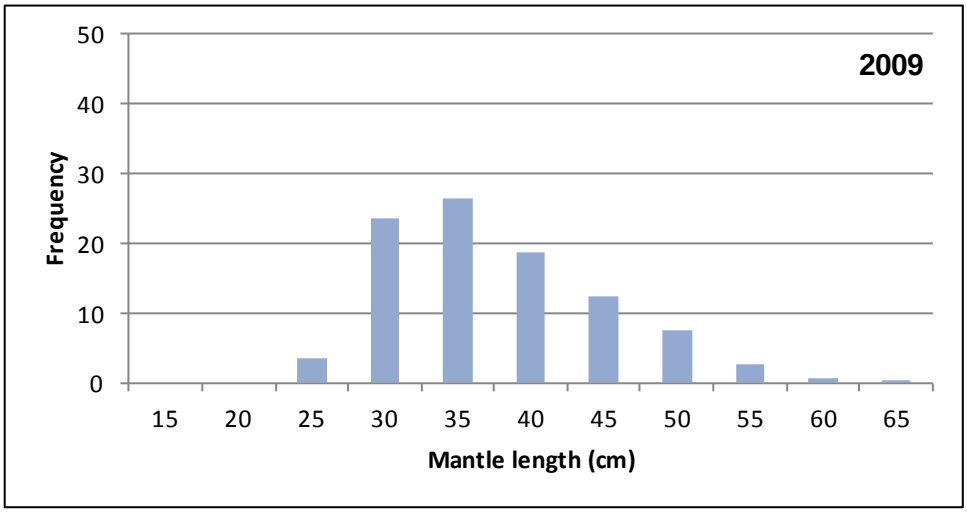
Figure 5 and 6 present the series of mantle length distributions based on the biological data collected in the international waters of Peru and Chile during 2006-2013. The squid caught in the north area (Peru) seems smaller than it caught in south area (Chile). However, additional measurement for the large

squid were carried out in the 2009 survey outside Peru economic area, the maximum mantle length was 114.9 cm with body weight 61.9 kg (Table 3).

Table 3 Mantle length and body weight for the large squid measured in 2009

Number	Data	Mantle length (cm)	Body weight (kg)
1	9-Sep-09	98.26	-
2	10-Sep-09	101.56	-
3	12-Sep-09	90.56	-
4	12-Sep-09	70.5	11.87
5	13-Sep-09	97.33	-
6	13-Sep-09	95.33	-
7	14-Sep-09	113.85	-
8	15-Sep-09	66.47	-
9	16-Sep-09	100.9	-
10	16-Sep-09	100.8	-
11	16-Sep-09	73.4	-
12	18-Sep-09	76.8	-
13	20-Sep-09	103.3	-
14	23-Sep-09	98.85	36.5
15	24-Sep-09	103.25	47.1
16	25-Sep-09	108.9	53.2
17	1-Oct-09	97.4	40.5
18	1-Oct-09	94.9	30.5
19	4-Oct-09	100.08	33
20	4-Oct-09	99.28	33.1
21	4-Oct-09	97.8	42.3
22	4-Oct-09	85.4	21
23	6-Oct-09	102.48	44.8
24	6-Oct-09	91.48	25.8
25	10-Oct-09	114.9	61.9
26	10-Oct-09	93.51	32.3
27	10-Oct-09	81.6	16.1
28	14-Oct-09	111.8	54.5


2008
Frequency
0
10
20
30
40
50
15
20
25
30
35
40
45
50
55
60
65
Mantle length (cm)


2009
Frequency
0
10
20
30
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25
30
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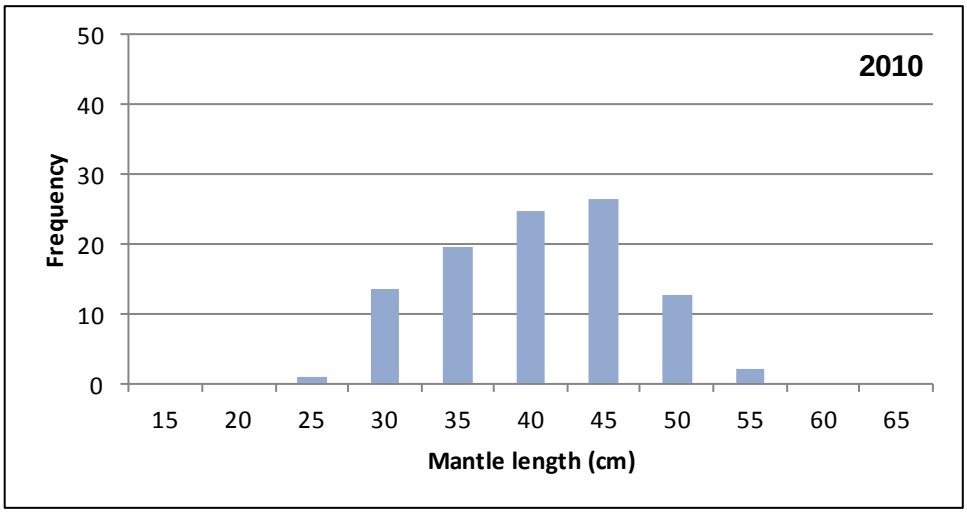
Mantle length (cm)


2010
Frequency
0
10
20
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40
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50
55
60
65
Mantle length (cm)

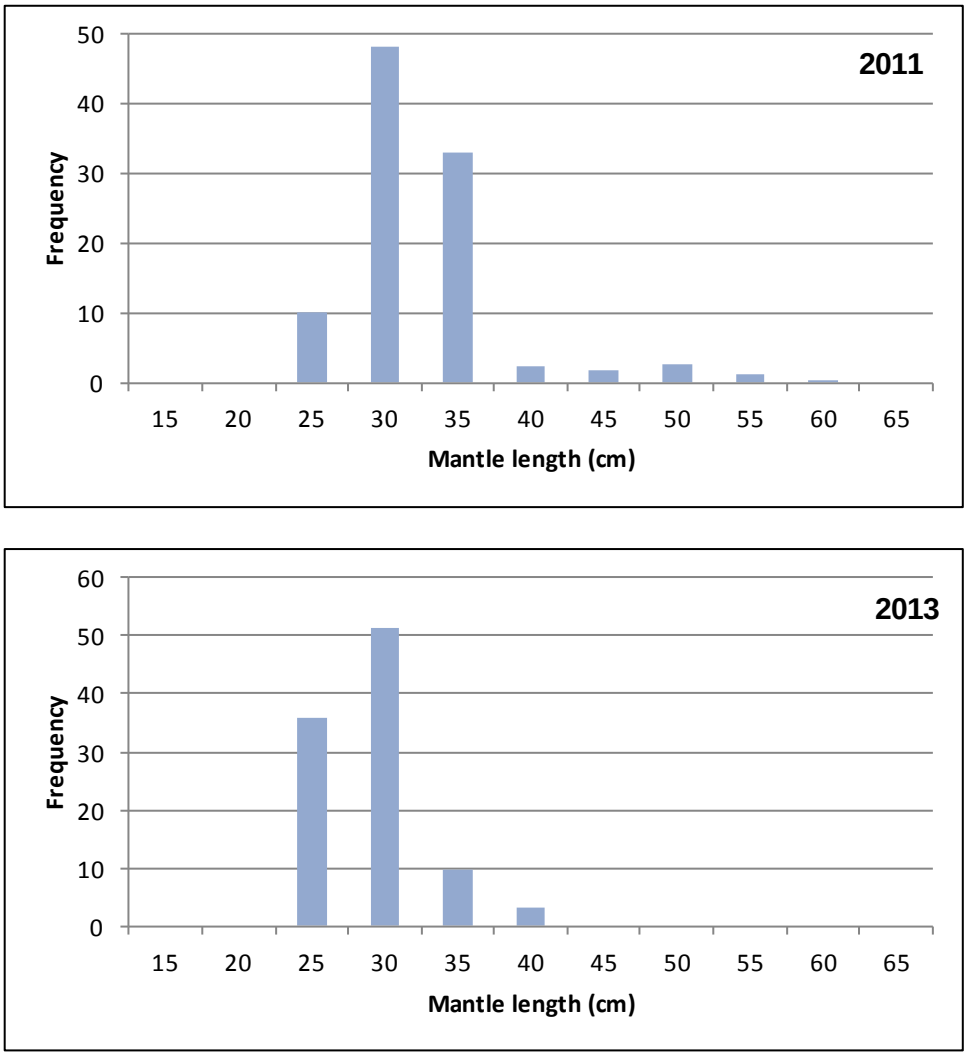
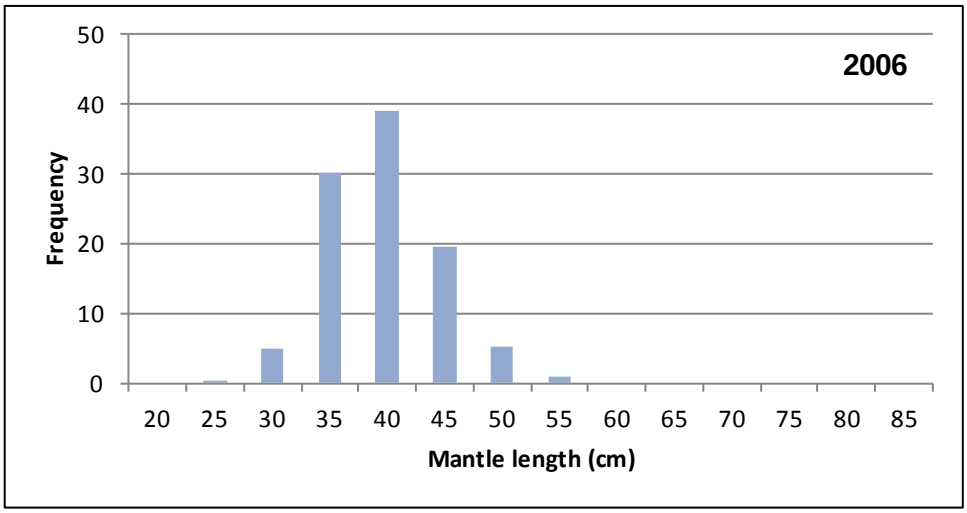
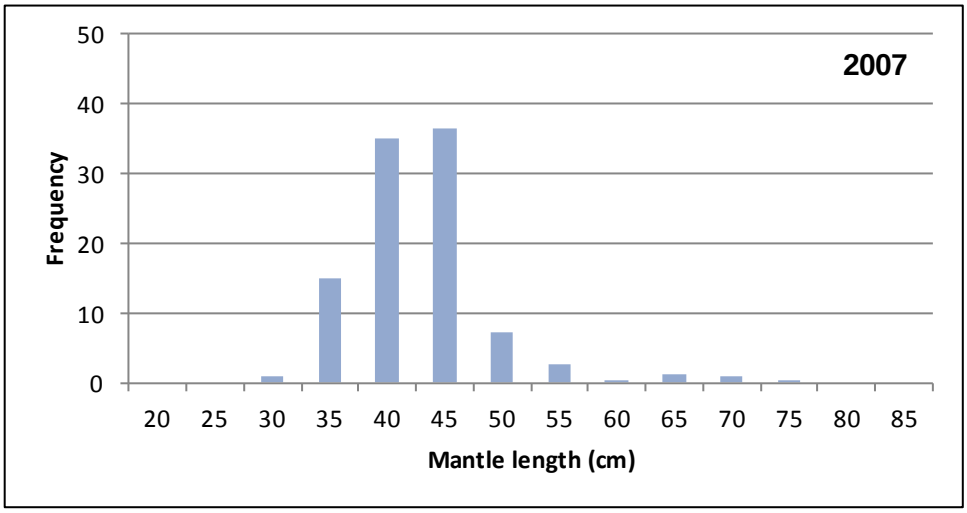
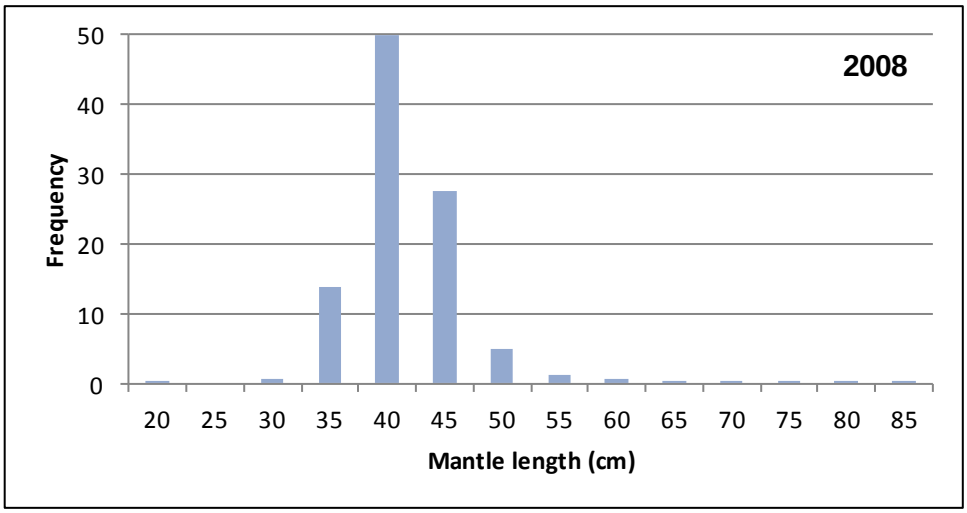


Figure 5. Mantle length frequency of jumbo flying squid in the high seas of Peru


2006
Frequency
0
10
20
30
40
50
20 25 30 35 40 45 50 55 60 65 70 75 80 85
Mantle length (cm)


2007
Frequency
0
10
20
30
40
50
20 25 30 35 40 45 50 55 60 65 70 75 80 85
Mantle length (cm)


2008
Frequency
0
10
20
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40
50
20 25 30 35 40 45 50 55 60 65 70 75 80 85
Mantle length (cm)

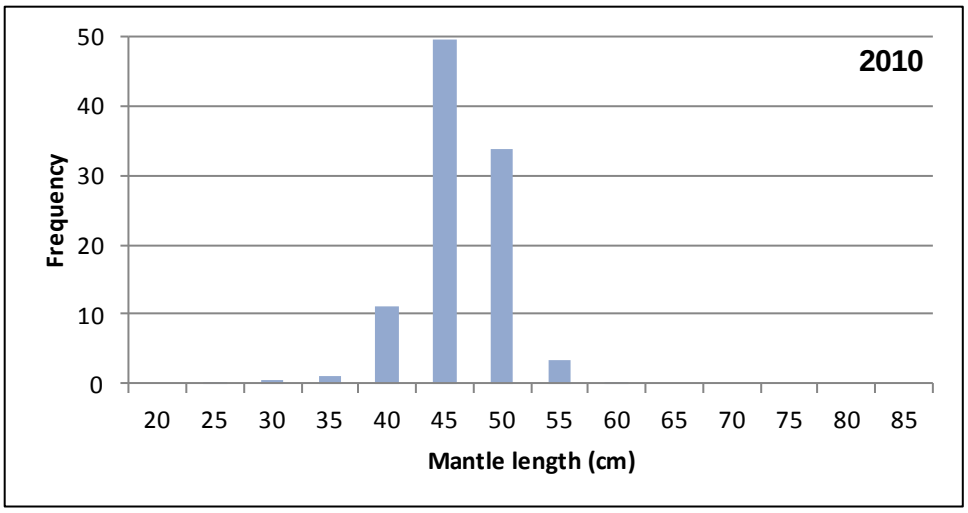

Figure 6. Mantle length frequency of jumbo flying squid in the high seas of Chile

5 Summary of Observer Programme

In 2001, China carried out the first survey for the jumbo flying squid in the South Pacific and sent the first scientist on board. Since 2007, CDWFA has cooperated with SHOU to send scientific observes on board to take charge of the survey. One of main responsibilities of the observers is to collect fishery and environmental data. The details of these surveys present in Table 4.

Table 4. Survey information of the Chinese squid jigging fishery

Survey time	Survey area	Observer number	Vessel type
Jun-Sep 2001	high seas of Peru and Costa Rica	1	squid jigging
Jan-Jun 2007	high seas of Chile	1	squid jigging
Feb-Mar 2008	high seas of Chile	2	squid jigging
July-Nov 2009	high seas of Peru and Costa Rica	2	squid jigging
Apr-Jun 2013	eastern equatorial Pacific	2	squid jigging
Apr-Jun 2014	eastern equatorial Pacific	2	squid jigging

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