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Observer report on Jumbo flying squid jigging fishery  
in the SPRFMO Area

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## The Observer report on Jumbo Flying Squid Jigging Fishery in the SPRFMO Convention Area

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### Introduction

The aim of this survey is to collect basic information on the sustainable use of fisheries resources in the South Pacific and on the impacts of fishing on the marine ecosystem. A scientific observer was on board a jigging vessel which targets jumbo flying squids in the SPRFMO Convention Area to conduct the survey. The survey was conducted from 18<sup>th</sup> October to 31<sup>st</sup> December 2015, total 75 days, in the open seas of southeast Pacific (Area 87) and was mainly conducted in the area 15-19°S, 77-82°W. The survey items include biological observations of the target; observations of bycatch species, marine mammals, and sea birds; monitoring of waste disposal; and observations of the marine environment.

### Fishing Gear Details

Use of a sea anchor, parachute, buoy, and sinkers allows the vessel to float along the current which assists handlines' vertical movements and vessel's natural movements to other fishing grounds. Korean jigger vessels which operate in the SPRFMO Convention Area used halogen and metal for the source of their light attraction; under-water lights are not used. Handline consists of a main line and a branch line. The main line is for the actual fishing while the branch line is for preventing misguided squids fall out when passing the front roller. There is also a jig machine to pull up squids which have taken the bait and a single and a double guide which lead the squid to the deck (Figure 1).

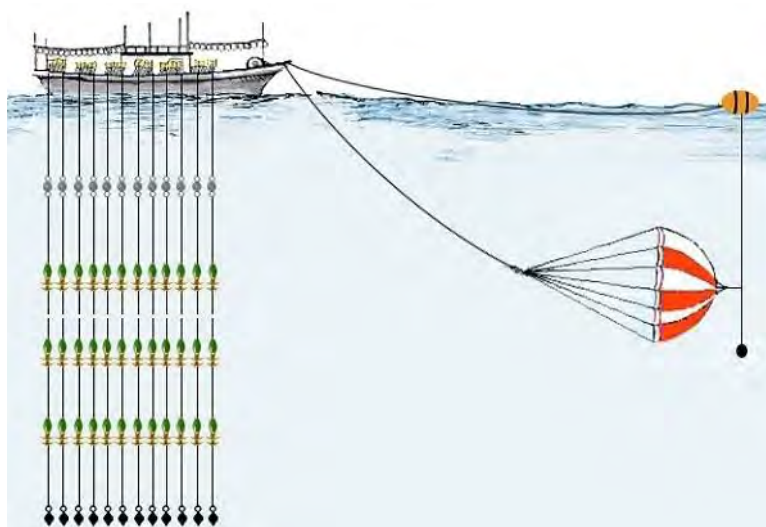


Figure 1. Illustration of jigging gear.

### Observed Species

The target species and four bycatch species were observed during the survey. The proportion of bycatch was low: 2 cephalopods other than the target and 1 common dolphinfish, escolar, and blue shark each. The total bycatch was 62.8 kg which is 0.003% of the total catch (Table 1 and Figure 2).

**Table 1. Lists of observed species in SPRFMO convention area by Korean jigging vessel in 2015**

Species Code	Scientific name	English name
GIS	<i>Dosidicus gigas</i>	Jumbo Flying Squid
YUR	<i>Thysanoteuthis rhombus</i>	Diamondback Squid
DOL	<i>Coryhaena hippurus</i>	Common Dolphinfish
LEC	<i>Lepidocybium flavobrunneum</i>	Escolar
BSH	<i>Prionace glauca</i>	Blue shark

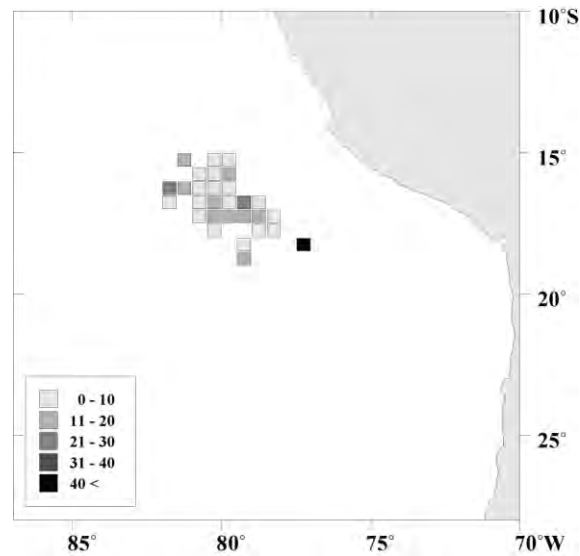


**Figure 2. Photos of bycatch species by a Korean jigging vessel in SPRFMO Convention area in 2015.**

### Catch and Effort of Target Species

During the survey, the vessel had a frequent transfer of location to search for schools, and it even had a movement of 120 NM distance to search for schools using an echo-sounder. The largest

monthly catch was in November, and the mean CPUE was 12.4 tons/day (Figure 3).



**Figure 3. Distribution of CPUE (ton/day) by a Korean jigging vessel in 2015.**

During the total 75 days of its survey, the vessel conducted a total of 222 sets with the minimum, maximum, and average daily sets being 1, 10, and 3 sets. The total operation time is from jigging of the first set to hauling of the last set and was 1,136 hours 54 minutes. The average time for a set was 5 hours 07 minutes. Fishing depth was from 50 to 175m, and the range of temperature at catch was 18 - 19.9° C (Table 2).

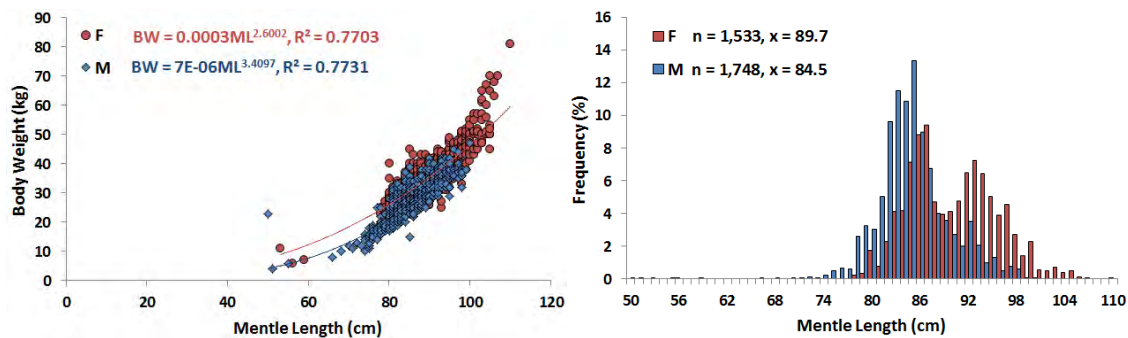
**Table 2. Information on the operation and fishing environment**

<b>Factors</b>	<b>Total</b>	<b>Range</b>	<b>Mean</b>
Number of operation (set)	222	1 - 10	3
Operated hours (hr)	1136.9	0.1 - 23.8	5.1
Fished depth (m)	-	50 - 175	106
Fished temperature (° C)	-	18.0 - 19.9	18.6

### **Biological Measurement**

A total of 3,281 individuals of jumbo flying squids were measured for biological observation, and mantle length frequency ranged from 50 to 110 cm. The proportion of female individuals was greater than that of males, and more females were in the length class greater than 90cm than males. Although

the proportion of males in the group of large sizes was small, the difference between the mantle length-weight relationship of males and females was not large (Figure 4).



**Figure 4.** Length frequency (left) and length-weight relation (right) of jumbo flying squid by a Korean jigging vessel in 2015.

The maturity of jumbo flying squid was classified into 5 stages, and the identification was conducted based on the following figure (Figure 5). Stage 4 (Gravid) was the dominant stage of maturity observed for both male and female jumbo flying squids during the trip. In case of the females, stages 2 to 4 were observed at the end of October, which was the starting point of observation, and in December, many individuals were observed to be in the spent stage as many of them either had an empty ovary or the color of its roe being turbid milky. Most of the males were observed to be in the stage 4, and in December, the color of the roe in the testis turned to turbid milky, regardless of the testis size, and lost resilience (Figure 6).

Maturity stages	SEX	
	Female	Male
1 Immature	-	-
2 Resting	-	-
3 Developed		

4  
Gravid



5  
Spent



Figure 5. Photos of maturity stages standards of jumbo flying squid.

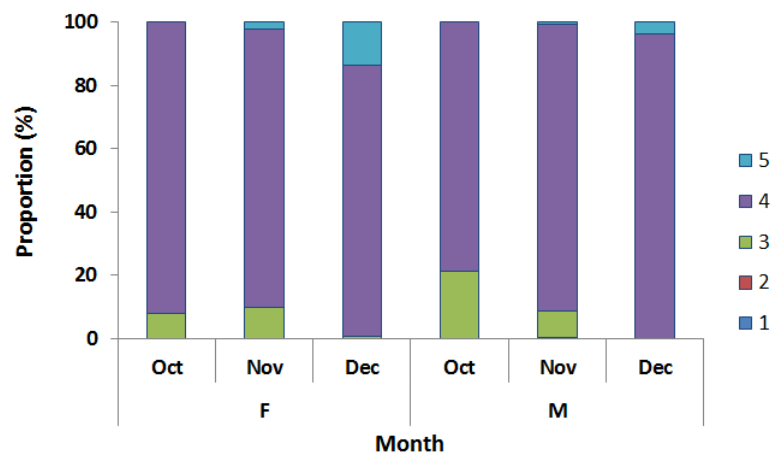


Figure 6. Monthly maturity proportions of jumbo flying squid with sex.

### Stomach Content

Stomach contents of the sampled jumbo flying squids consisted of jumbo flying squids; cannibalism, which is to feed on its cohorts, was observed (Figure 7).



**Figure 7. Stomach contents of jumbo flying squid in SPRFMO Convention area.**

### Sea Bird and Marine Mammal Observations

Only a small number of sea birds were observed during the survey in the SPRFMO Convention Area. The sea birds were not continuously observed during fishing operations, but rather circled around the vessel several times and disappeared. 4 species of sea birds were observed: Wedgetailed shearwater, Storm Petrel, Brown Booby, and Masked Booby (Table 3). No entanglement of sea bird was observed during fishing operations.

A total of 35 Pilot whales were observed during twice of the observations. They were observed when the surface was in a calm condition; observation was difficult during bad weather conditions. Pilot whales showed grouping behaviors. It was observed that they approached near the vessel in operation, swam slowly, and repeated their dives.

**Table 3. Observed sea birds and marine mammals**

Species Code	Scientific name	English name	Number of time observed	Abundance
DSQ	<i>Sula dactylatra</i>	Masked booby	3	10 >
-	<i>Sula leucogaster</i>	Brown Booby	1	10 >
OCO	<i>Oceanites oceanicus</i>	Wilson's storm petrel	4	10 >
PFZ	<i>Puffinus pacificus</i>	Wedge-tailed shearwater	3	10 >
GLO	<i>Globicephala</i> spp	Pilot whales nei	2	35

### Waste Disposal

After the processing, approximately 25% of a whole jumbo flying squid of discards occurs. They are mainly offal and were kept until discharged when the vessel moves or seeks for the target. Waste including plastic, carton boxes were incinerated and kept on board, and only the food waste was discharged.

## Marine Environment

Observations on the marine environment were made; the weather of 26 days was fair while that of 49 days was cloudy. Beaufort's wind scale was applied to record the sea condition by each set, and 85% over the total 222 sets were observed to be in 'Gentle and Moderate breeze' (Table 4).

**Table 4. Beaufort scale observed during the jigging operations in the SPRFMO Convention Area**

Force	WMO Classification	Appearance of Wind Effects on the Water	Wind (Knots)	Frequency	Rate (%)
2	Light breeze	Small wavelets, crests glassy, no breaking	4-6	8	3.6
3	Gentle breeze	Large wavelets, crests begin to break, scattered whitecaps	7-10	82	36.6
4	Moderate breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	11-16	106	47.9
5	Fresh breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	17-21	24	10.8
6	Strong breeze	Larger waves 8-13 ft, whitecaps common, more spray	22-27	2	1.1

## Summary

Indirect information on the biology of the target species as well as components of the ecosystem which may be impacted by fishing was collected through the jigging fisheries survey in the SPRFMO Convention Area. Five species including the target were observed. The largest monthly catch was in November, and the mean CPUE was 12.4 tons/day. A total of 3,281 jumbo flying squids were measured for biological observations. Mantle length frequency ranged from 50 to 110 cm. The proportion of females was greater, and more of them were in the length class greater than 90cm than males. However, the difference between the mantle length-weight relationship of males and females was not significant. The dominant stage of maturity observed for both male and female jumbo flying squids was gravid. Stomach contents of sampled jumbo flying squids contained only its cohorts. The vessel conducted a total of 222 sets, and the average operation time for a set was 5 hours 07 minutes. Fishing depth was from 50 to 175m, and the range of temperature at catch was 18°C-19.9°C. The weather of 26 days was fair while 49 days was cloudy. 85% over the total sets were recorded as 'Gentle and Moderate breeze'. Korea is planning to strengthen its efforts to conduct research on the composition of the ecosystem including the target and bycatch species, sea birds, and marine mammals by maintaining its interest in jigging surveys and dispatching observers on jigging vessels.