



Falkland Island Fisheries Department

***Loligo gahi* Stock Assessment Survey, First Season 2006**

| | |
|------------------------|--------------------------------|
| Vessel | Argos Vigo (ZDLU1) |
| Flag | Falkland Islands |
| Dates | 9/02/2006-23/02/2006 |
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SUMMARY

A research survey was conducted in the *Loligo* box of the Falkland Islands shelf on board the F/V Argos Vigo between the 9th and 23rd of February 2006. 70 hauls were carried out in selected localities with a total catch of 375.8 tons. The estimated biomass at the time of the survey was 10213 tons of only one cohort squid. The survey was carried out just before the first fishing season therefore biomass projection was not required.

INTRODUCTION

In May 2004 we introduced a stock assessment survey on a vessel of the *Loligo* commercial fleet, the F/V Argos Vigo, as a new source of information on the current status of the stock. We also developed a mathematical model useful to project the estimated biomass into the future, specifically into the coming fishing season, taking into account natural mortality, individual growth, and the observed length frequency distributions and sex proportion (Anon. 2004). In February 2005 we carried out a second survey on board the F/V Capricorn, and that survey also yielded useful information on the current status of the stock (Anon. 2005a). In April-May 2005 we made a third survey on board of F/V Robin Lee using the same methodology as in the previous surveys (Anon. 2005b). Then we assessed the biomass of the first cohort at the end of the first season of 2005 and projected the biomass to the second cohort to the start of the second season, July 15th.

In 2006 we have carried out the fourth scientific survey between 9th and 23rd February on board F/V Argos Vigo. As we made the scientific survey just before the beginning of the first fishing season, biomass projection at the beginning of this season was not required. Therefore we report only the survey results. The mathematical and statistical methodology has been described previously (Anon. 2004, 2005) so we omit it here.

METHODOLOGY

All fishing activities were performed on the F/V Argos Vigo, a Stanley registered stern trawler with total length of 77.5m, a beam of 13m and draught of 4.8 m. The gross registered tonnage is 2074 Mt with a net registered tonnage 672 Mt. A total of 70 hauls were conducted on locations selected by the scientists yielding a total catch of 375.8 tons.

Between five and six trawls were conducted each day when the weather allowed. The trawl was a standard Spanish made bottom trawl with small mesh liner in the codend. The door opening varied from 91 to 142 m with a mean of 116 m, and the horizontal trawl opening ranged from 25 to 43 m with a mean of 35 m depending on the course and trawl speed. Trawl duration varied but was normally between two to three hours. Every fifteen minutes during each tow the bridge officers noted the position, trawl speed, door opening and quantity and quality of the marks observed on the echosounder.

The net was hauled on board and lifted into place to allow the catch to flow into one of two fish bins at stern of the trawl deck. The fish bins fed a conveyor system in the factory. A random sample of 150 squid was taken from every trawl and as soon as they were separated by sex and maturity they were measured for length frequency analyses. Additionally, all by-catch species were collected from each trawl by crew members working at the conveyor belt. After the contents of the trawl had been processed, the bycatch was weighed and some species like *Illex argentinus*, rockcod, icefish and skates were examined in greater detail.

The survey covered the whole shelf area of the *Loligo* box (depths ranging between 50 and 200 m). The survey consisted of 14 transects, with several trawls on each transect depending on the width of the shelf in the area (**Fig. 1**).

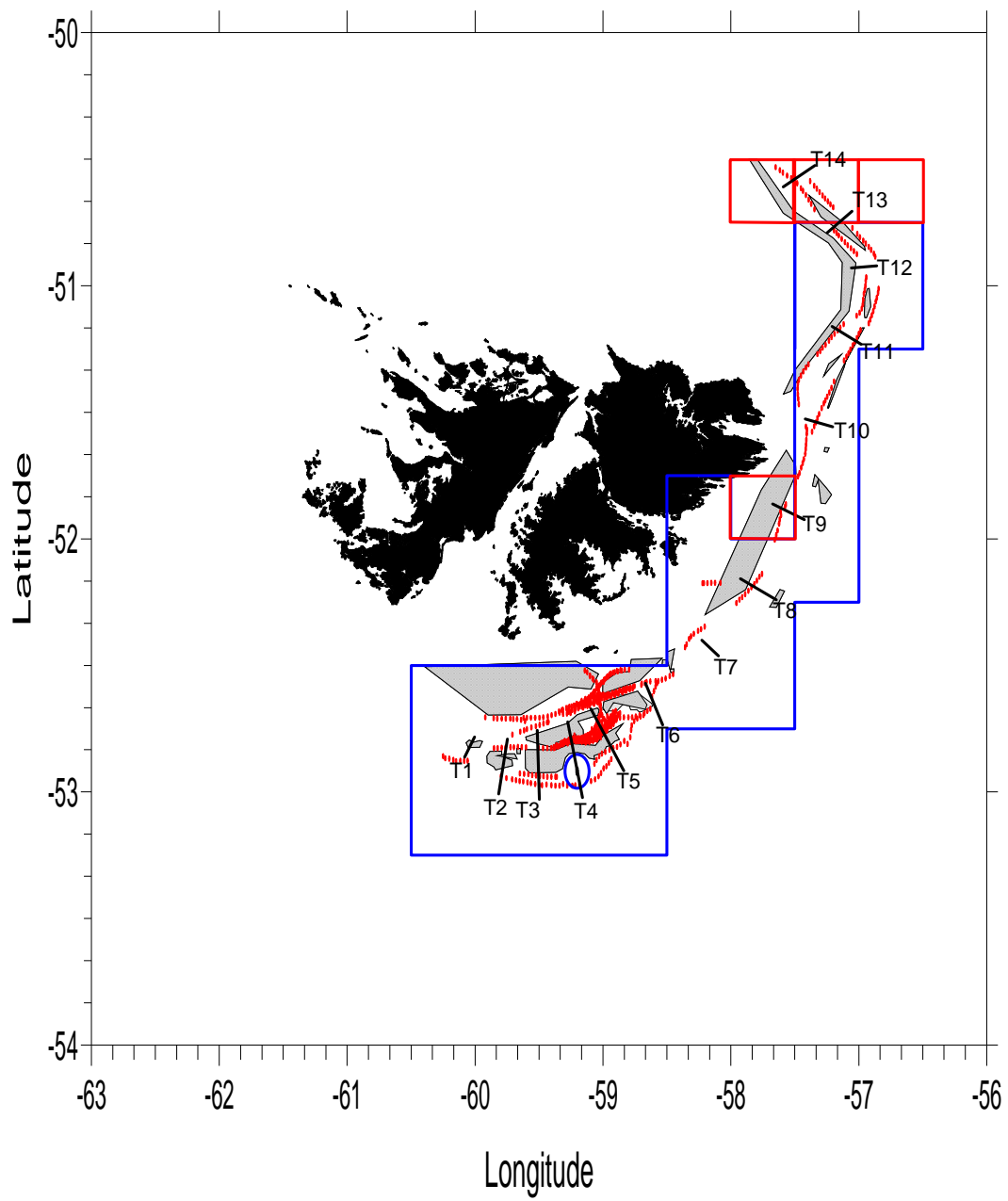


Fig. 1. Adaptive sampling design of 70 trawls (red dotted lines) throughout 14 transects (black lines) of the *Loligo* survey in February 2006.

RESULTS AND DISCUSSION

Loligo was concentrated in the south area of the *Loligo* box, and it was nearly absent in the middle and north areas (Fig. 2).

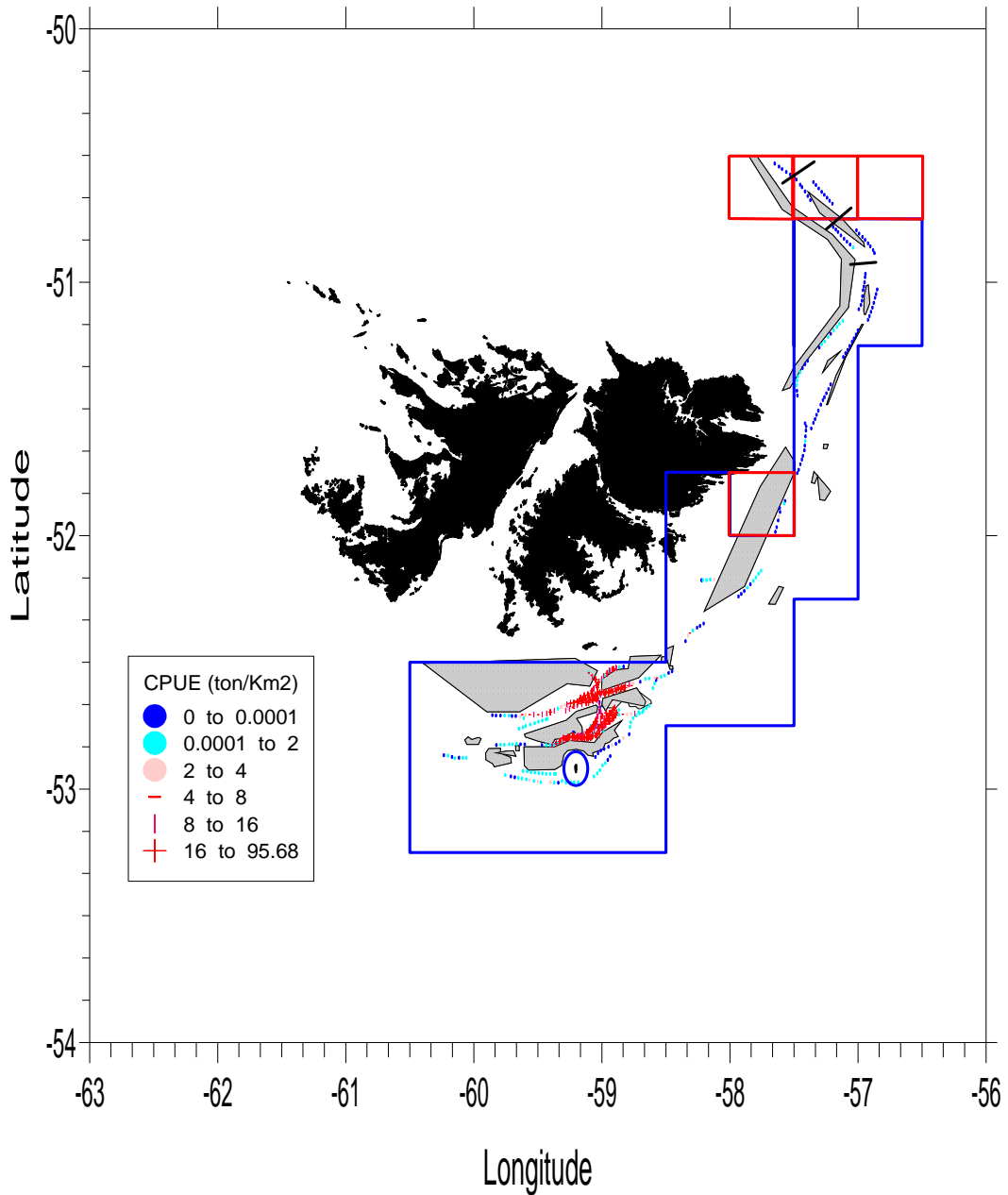


Fig.2. CPUE (ton/km²) of *L. gahi* observed during the February 2006 Loligo Survey.

Most of the trawls made in the middle and the north area had zero or very small *Loligo* catches. In the southern area, *Loligo* was highly concentrated to the north-east of Beauchene Island, and its abundance increased to the north (Fig. 3). This suggests *Loligo* was still migrating from the north (shallow) areas, close to Sea Lion Island, to the *Loligo* box.

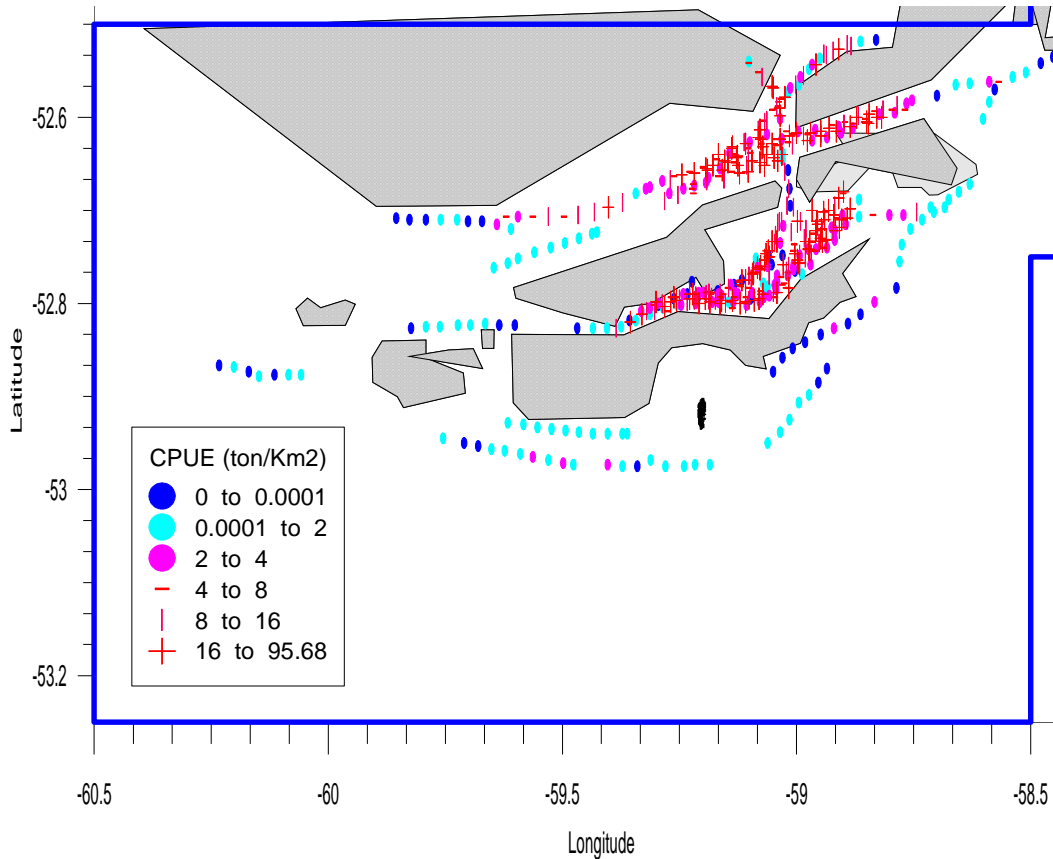


Fig. 3. CPUE (ton/km²) of *L. gahi* observed during the February 2006 *Loligo* Survey in south area of *Loligo* box (blue line).

Rockcod (*marujito*, *Patagonotothen ramsayi*) was abundant and located in deeper waters than *Loligo*. It was also observed in the middle and northern areas of the *Loligo* box (Fig.4). There was an inverse relationship between the proportions of *Loligo* and rockcod in total catches (Fig. 5). This situation contrasts with the last survey carried out in the April-May 2005 when *Loligo* and rockcod were more mixed. Therefore, during this survey, possible species interference in the acoustic mark identification was smaller.

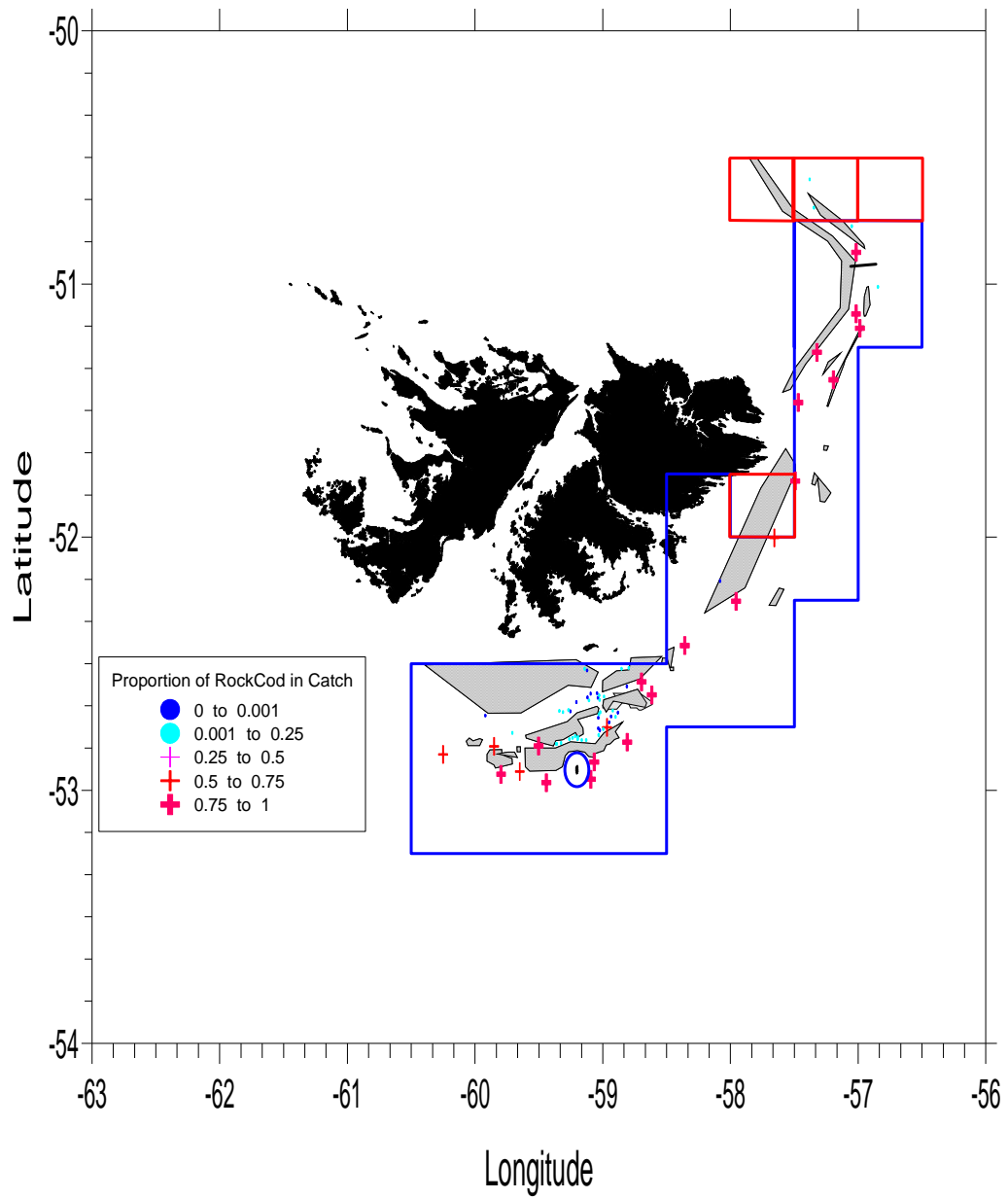


Fig. 4. Proportion of Rockcod in total catch at the initial positions of each trawl.

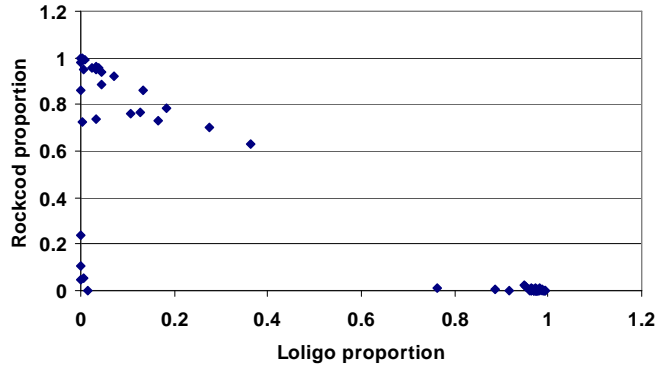


Fig. 5. Relation between proportion of *Loligo* and rockcod in total catch by each trawl.

The *Loligo* size frequency had a mode of 9 cm mantle length for both sexes (**Fig. 6**). This mode was 1 cm smaller than the one found in February 2005 survey.

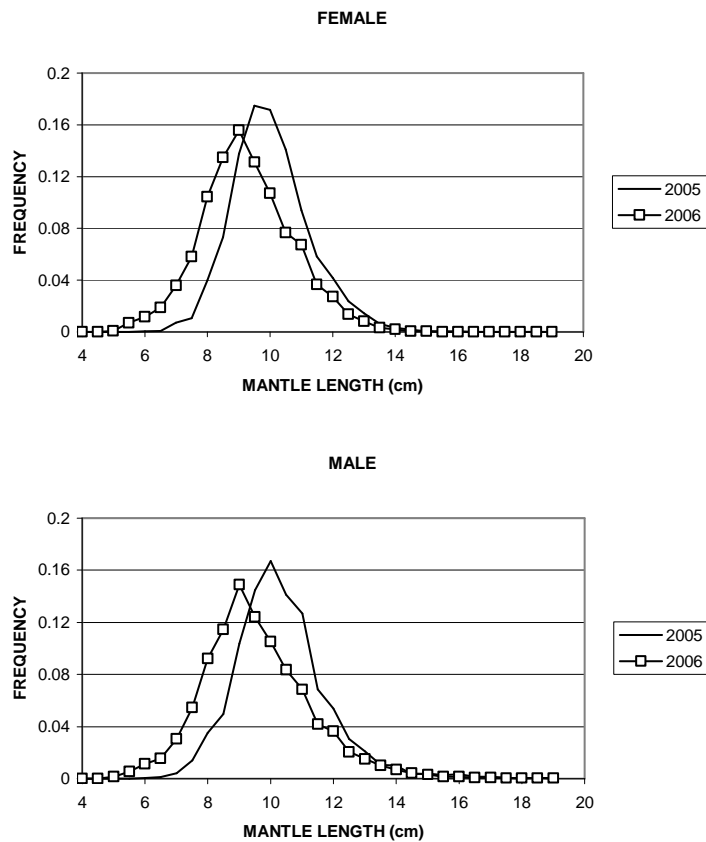


Fig. 6. Mantle length frequency by sex found in February 2006 and February 2005 in *Loligo* surveys.

According to the growth model fitted by Arkhipkin and Roa-Ureta (2005), *Loligo* individuals found in February 2006 survey require 10 more days of growth to reach the same mean weight observed in February 2005 survey (**Fig. 7**). It seems that the length differences were not related to the date of the surveys per se but more likely related with the environmental conditions, which were exceptionally good for *Loligo* in 2005 and seem to come back to regular values in 2006.

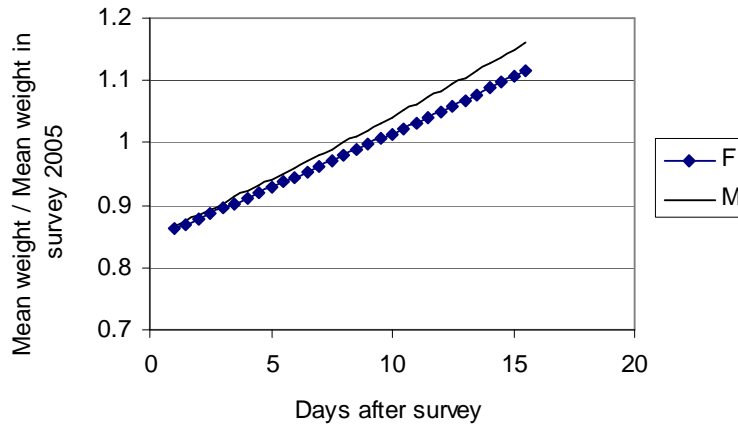


Fig. 7. Projected growth that *Loligo*, found in February 2006 survey, should have in 15 days after the survey. The mean weight is shown as a ratio to mean weight observed in the February 2005 survey (F= female and M= male).

Biomass available to the survey in February 2006 was estimated in 10213 tons (CV=97%) which corresponds to 433 millions of individuals with a 53% of females. This biomass constituted only 28% of the biomass estimated in February 2005 survey (**Table 1**). All main parameters were lower than in February 2005 survey (**Fig. 8**).

Table 1. Main results of February surveys.

| | February 2005 | February 2006 |
|--|---------------|---------------|
| Biomass (Ton) | 36023 | 10213 |
| Number (million) | 1228 | 433 |
| Mean Density (g/cm²) | 8.14 | 2.94 |
| Area occupied by the stock | 4427 | 3473 |
| Mean Body Mass (g) | 29.32 | 23.57 |
| Fishing Grounds Area (km²) | 7027 | 7027 |

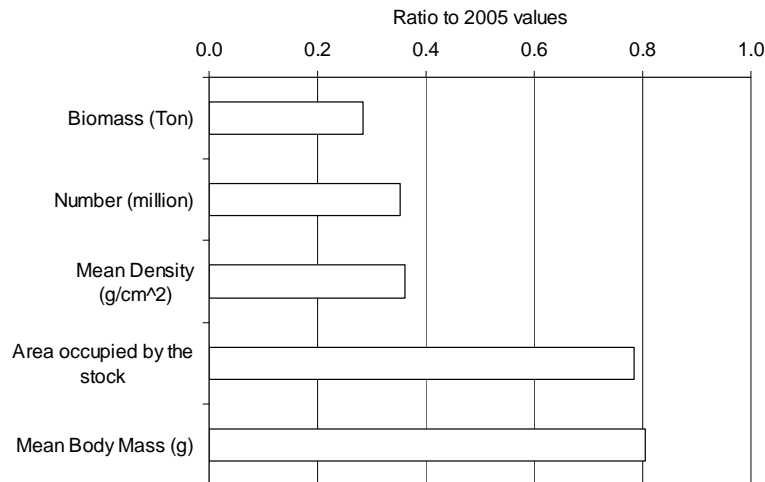


Fig. 8. Main February 2006 survey results as proportions to the February 2005 survey.

The general descriptive statistics showed that the February 2006 survey had greater number of observations than February 2005, but a smaller minimum distance between observations (**Table 2**). The maximum distance between observations was similar between surveys because this is constrained by size of the *Loligo* box.

Table 2.- Descriptive statistics and parameters of the spatial *Loligo* density process in February 2005 and February 2006 surveys.

| | February 2005 Female | February 2005 Male | February 2006 Both sexes |
|--|-------------------------|-----------------------|-----------------------------|
| Descriptive Statistics | | | |
| Number of Observations | 328 | 328 | 426 |
| Minimum Distance (km) | 0.29 | 0.29 | 0.11 |
| Maximum Distance(km) | 315.09 | 315.09 | 311.81 |
| Minimum Positive Density (ton/km ²) | 0.005 | 0.026 | 0.030 |
| Maximum Density (ton/km ²) | 28.36 | 45.66 | 95.67 |
| Mean Density (ton/km ²) | 4.27 | 3.87 | 2.94 |
| Spatial Correlation parameters of positive density | | | |
| Degree of smoothness | Inf | Inf | 1.027 |
| Variance of incomplete observation (ton ² /km ⁴) | 0.5247 | 0.7812 | 0.9009 |
| Variance of spatial density process (ton ² /km ⁴) | 1.205 | 1.654 | 1.731 |
| Distance of spatial correlation (km) | 6.003 | 6.282 | 13.52 |
| Spatial Correlation parameters of Presence/Absence | | | |
| Degree of smoothness | Inf | Inf | 1 |
| Variance of incomplete observation (ton ² /km ⁴) | 0 | 0 | 0 |
| Variance of spatial density process (ton ² /km ⁴) | 0.6847 | 0.6847 | 1.613 |
| Distance of spatial correlation (km) | 7.89 | 7.89 | 24.93 |

The differences in the spatial parameters fitted by year showed that *Loligo* was more concentrated in February 2006 than in February 2005 survey (**Table 2**). In February 2006 the spatial correlation was greater along the distance than in February 2005, both in terms of positive densities and presence/absence information (**Figs. 9 and 10**). In February 2006 the spatial correlation is still present at 50-100 kilometres of distance, while in February 2005 the correlations were absent at distances greater than 20 kilometres.

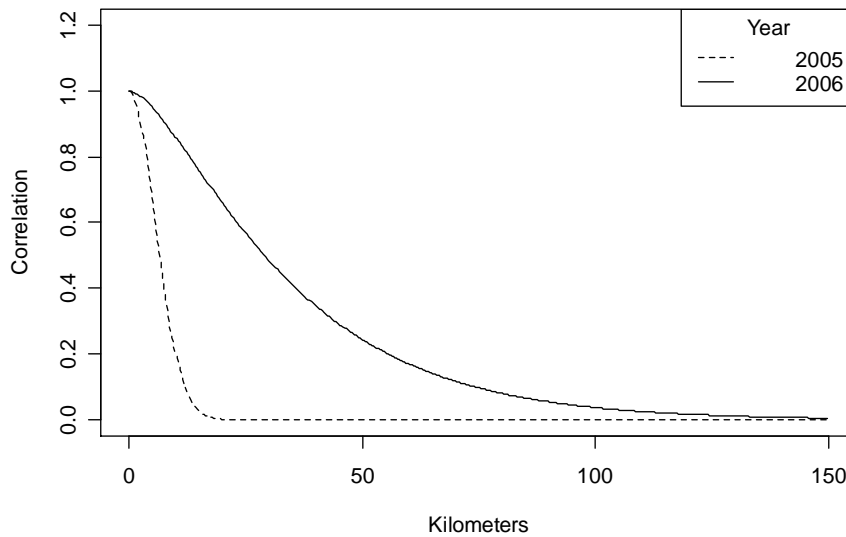


Fig. 9. Spatial correlation for presence/absence information for February 2005 and February 2006 surveys.

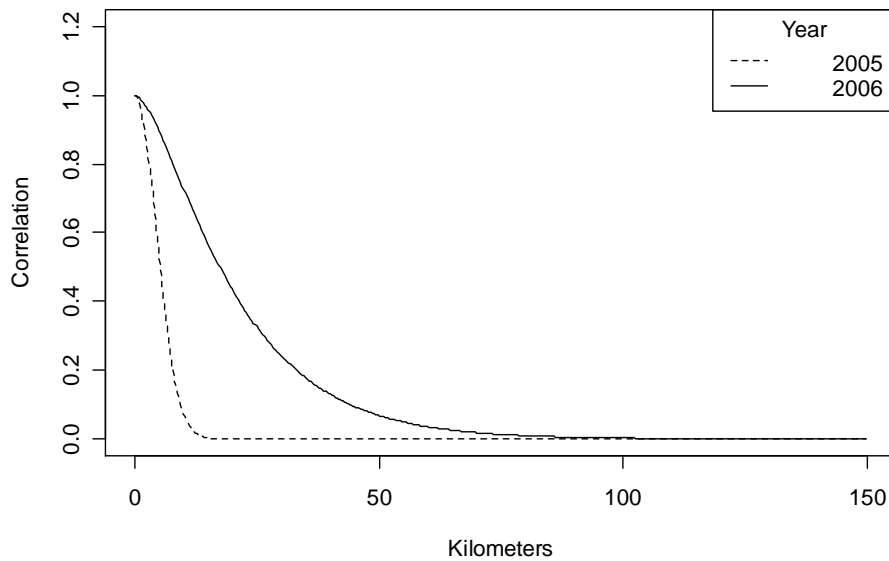


Fig. 10. Spatial correlation for positive density information for February 2005 and February 2006 surveys.

The spatial correlation differences by year are obvious in the density plots that show a big and very concentrated area of approximately 50 kilometres of diameter in February 2006 and three main areas of 10 kilometres of diameter in February 2005 (Figs. 11 and 12).

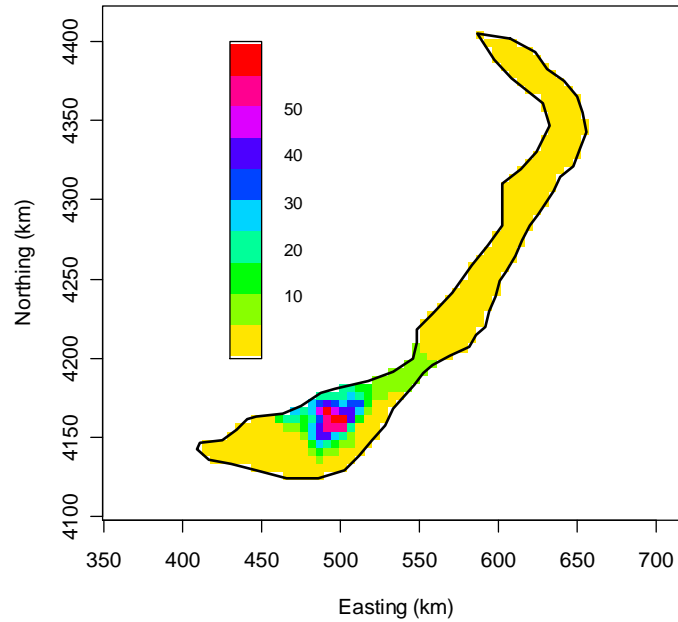


Fig. 11. Density (ton/km²) of *Loligo* in February 2006 survey.

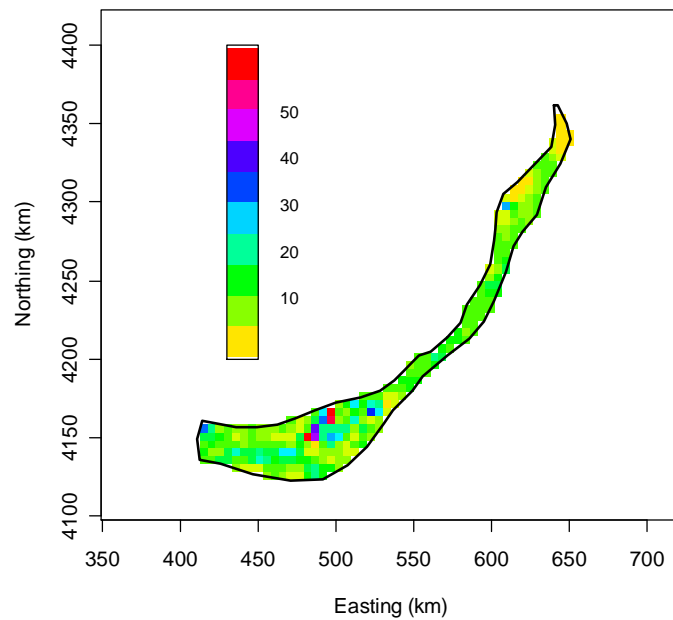


Fig. 12. Density (ton/km²) of *Loligo* in February 2005 survey.

CONCLUSIONS

1. - *Loligo* biomass estimating during the Argos Vigo survey between 9th and 23rd of February of 2006 was 10213 tons. This biomass corresponds to a 28% of the biomass estimated in the February 2005 survey.
2. - *Loligo* was highly concentrated in the south area of *Loligo* box in the north-east of Beauchene Island. This year *Loligo* was concentrated in only one large area, with presence of spatial correlations in distances as far as 100 kilometres while in the February 2005 it was concentrated in three main areas with no spatial correlations beyond 20 kilometres.
3. - Modal mantle length was 9 cm, which was 1 cm smaller than in February 2005 survey. *Loligo* should reach the mean weight observed in February 2005 survey in 10 days after the survey.
4. - It is likely that during the survey *Loligo* was still migrating from the Sea Lion Island area to the *Loligo* Box, therefore not all biomass of the first cohort was estimated.

REFERENCES

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