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Overview of the skipper's note of Japanese surface longliners based in Kessennuma in the period between 2004 and 2009

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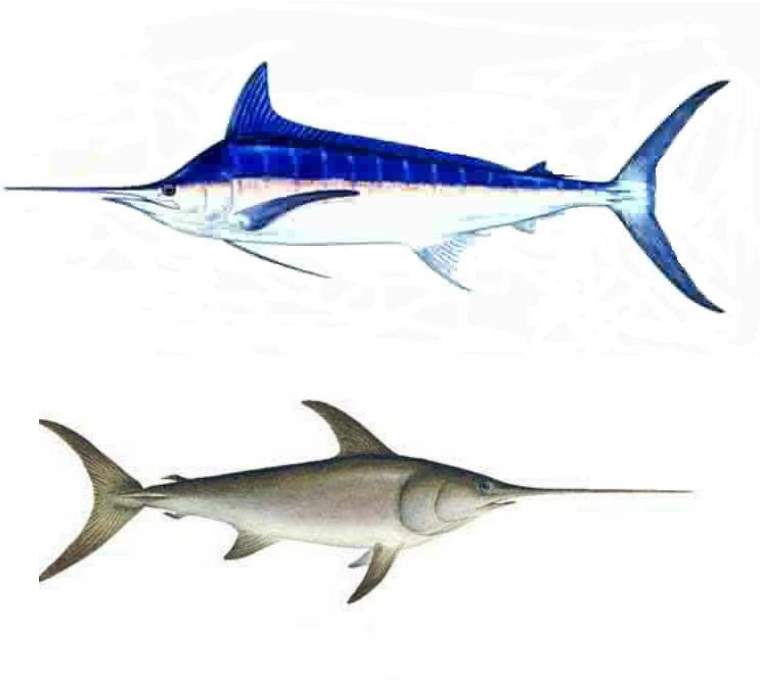

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Overview of the data of skipper's note of Japanese surface longliners based in Kesennuma in the period between 2004 and 2009

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Abstract

Japan National Research Institute of Far Seas Fisheries has been collecting the data recorded in the skipper's note of Japanese surface longliners since July 2004. The data includes detail of longline operations and biological information, and it has almost same amount of information as the data collected by observers. This document overviewed the data and provided preliminary analyses of schools and sex ratio at size. The data showed that the number of swordfish catch had been decreasing since 2004, mainly due to the decrease of catch of small sized fish. The result of the preliminaly analysis of detailed operation data suggest the working hypothesis that the school size of swordfish was larger in late autumn to early spring (main fishing season) than late spring to summer (spawning season). The result also suggested that decrease of swordfish CPUE caused not by the decrease of the number of fish in a school but by the number of school encountered during one set. Furthermore, the analysis of the sex ratio at size expressed by female percentage to the total showed monotonic increase in all quarters and areas. The results were different from the Atlantic and Mediterranean Sea, thus further study should be needed.

Introduction

The National Research Institute of Far Seas Fisheries has been collecting the data of skipper's note of Japanese surface longliners based on Kesennuma fishing port since July 2004. The information include ship name, date, the number of hooks per basket, the number of baskets, the time and locations of set and retrivement of radio buoy which is deployed in every 80-100 floats, and size category of each swordfish caught. Part of catch of swordfish was measured its length and sexed. Identification of sex of swordfish was conducted by clues of each boat with naked eye observation of gonad. For this purpose, NRIFSF had distributed a simple manual of sex identification to every boat. The purpose of this document is to provide an overview of these data as well as results of preliminary analyses to address the working hypothesis for the future cooperative studies among members of ISC billfish working group.

Material and Method

The data of skipper's note of Japanese surface longliners is available between July 2004 and May 2009. The data include the name of ship, date of operation, hooks per basket, the number of baskets, length of mainline (meter), distance of longline (mile), interval of radio buoys (mile), target species, time at gear setting and retrieving, latitude and longitude of each radio buoy at gear setting and retrieving to the nearest minutes, and biological information of catches in each buoy. Biological information has length, sex, and size category which is divided length into 5 categories (over 184cm, 164-184cm, 148-164cm, 118-148cm, under 118cm).

The analyses of these data were made as follows;

- ✓ The number of monitored ships by quarter and by year
- ✓ The number of observed sets by quarter and by year, and the percentage of them which was operated in the west of date line
- ✓ Average and standard deviation of length of catches and the number of catch in each size category
- ✓ Total number of catch by quarter and by year, and the percentage of catch in each size category
- ✓ Sex ratio of catch by quarter by year
- ✓ Length frequency of catch by sex
- ✓ Average catch per set by size category and by year

  All data and the data only operated in the west or east of date line were analyzed by year. Moreover, the data only in the west of date line were analyzed by quarterly bases.
- ✓ Average number of schools and its average school size by quarter and by year

  It was assumed that swordfish caught between radio buoys belonged to the same single school, because the interval of buoys was 3-4 miles. It was also assumed that the number of swordfish caught between radio buoys represented the school size, i.e., total number of fish constituting the school. The average number of schools and its average school size were calculated by quarter and by year.
- ✓ Sex ratio at size by quarter and by area

  Sex ratio at size data were analyzed by using GLM analysis, and the results were shown by female percentage at length. It is known that there is a difference among ships in sex-determination, thus the outlier was detected by fitting the following GLM to the data.

  $\log[p/(1-p)] = \text{intercept} + \text{ship} + \text{ship}*\text{size class}$

  where p is female percentage, the size bin is 10cm between 120cm and 200cm, and length below 100cm, between 100cm and 120cm, or over 200cm were put into one size class. The results showed that the data of 21 ships were considered as outlier.

The data excluding outlier were fitted to the following GLM to obtain sex ratio at size. In this model, the area was stratified into 5 areas (Figure 1). Area was defined where swordfish caught which was expressed by average latitude and longitude of the adjacent buoys at gear setting and retrieving. The number of data in the 3rd quarter in the areas 3 and 4 were extremely small, thus these data were also excluding from the analysis.

log[p/(1-p)] = intercept + quarter + area + size class + quarter*area

Results and Discussion

Total 35 surface longliners submitted data during the period analyzed. The number of sets that latitude and longitude at both gear setting and retrieving were available, was 23,061 between 2004 and 2009. Total number of catch was 174,497 in the whole period, and the 89% or 71% of the data have only length or both length and sex information, respectively.

The number of monitored ships, the number of sets, and the percentage of sets in the west of date line by quarter and by year were shown in Figure 2 and 3. The number of the data in the 3rd quarter in 2004 and in the 4th quarter in 2009 was relatively small, because it was the beginning of the data collection, or it was under the data compilation. The number of monitored ships was between 25 and 30 before the middle of 2008, but it was decreasing to below 25 ships thereafter due to the decrease of total number of ship. The number of sets was largest in every 1st quarter, which was between 1,400 and 1,600. The 4th quarter was also large and these two seasons are their main fishing season. On the other hand, about 800 sets in the 3rd quarter was the smallest number of sets as all ships put into dock in this quarter. The sets were held mainly in the west of date line and its percentage was more than 80% of the total sets in all quarters except the 2nd one. The percentage of sets conducted in the west of date line was gradually increasing to over 90% in the most recent year.

Figure 4 shows average and standard deviation of length of catches and the number of catch in each size category, and Figure 5 shows the number of catch and its composition by size category in quarterly bases. The number of catch in 118-147cm was about 60,000 and the largest among all categories. In each size category, average length was similar to the median of the size range, and the largest standard deviation was observed in the largest size category.

In Figure 5, it is clear that the substantial catch was taken in the 1st and the 4th quarters. The largest quarterly catch number was about 20,000 in the 1st quarter in 2005, but it was gradually decreased to 13,000 in the 4th quarter in 2008. In the 2nd or the 3rd quarters, about 5,000 were caught in every year. The catches were consisted mainly by two size categories, 118-147cm and 147-164cm. The percentage of catch in 118-147cm was decreased in 2009 compared to one in 2004. Meanwhile the percentage in over 164cm was gradually increased since 2006.

Sex ratio of catch by quarter and by year is shown in Figure 6, and the ratio of female was

almost constant in between 0.6 and 0.7. Length frequency of catch by sex is also shown in Figure 7. The observed maximum length was male with 310cm, and the minimum was female with 59cm. The length of female was mainly between 140cm and 180cm, and its mean was 155cm. On the other hand, the length of male was slightly smaller than female, and it was mainly between 120cm and 150cm. The mean of male length was 145cm.

Average catch number per set by size category and by year was calculated in Figure 8. In all data (Figure 8-a), the average catch in size categories below 164cm was decreased since 2004. Especially the catch in between 118cm and 148cm was largely degreased. The remaining categories showed a slightly increasing trend. The contrast between decreasing trend of smaller size categories and slightly increasing trend of larger size categories would indicate that the failures of recruitments were occurred in the northwestern Pacific in the analyzed period. Similar trends in all categories were obtained in the analysis of the sets only in the west of date line (Figure 8-b). In the east of date line (Figure 8-c), they were more fluctuated, and the values over 148cm were larger than those in the west. The quarterly analysis in the west of date line showed similar trends in the 1st and the 4th quarters to those with all data (Figure 8-d, g). In the 2nd and the 3rd quarters (Figure 8-e, f), all size categories showed similar values and fluctuation, and the values were relatively smaller than other quarters.

In Figure 9, average number of schools encountered between two continuous radio buoys and its school size (the number of fish caught between two continuous radio buoys) were shown, and both showed decreasing trends in all quarters through 2004 and 2009. Average number of schools in the 1st and the 4th quarters were larger, while the 2nd quarter was the smallest. The magnitude of reduction observed in the period between 2004 and 2009 was roughly 2 or 3 schools. On the contrary, average school size was similar around 1.5 fish in all quarters except the 4th one which was above 1.5. Taking into account the fact that the distance between branch lines is rather small (less than 30m, this means the high density of hooks), this result indicated that the number of fish in a swordfish school is rather small or many swordfish swims independently. The magnitude of reduction was only between 0.15 and 0.35. It was thought that there is a possibility that the school size was larger in main fishing season than spawning season (between the end of the 2nd quarter and the beginning of the 3rd quarter), and its size was slightly getting smaller. It might be also indicated that the number of schools was considerably decreased, especially in the 1st and the 4th quarters, though the size was not largely changed. This result would indicate that decrease of swordfish CPUE observed in the analyzed period caused not by the decrease of the number of fish in a school but by the number of school encountered during one set. This analysis would be better to be conducted by size category as different size of swordfish would not form a school.

Lastly, preliminary analysis of sex ratio at size by quarter and by area is shown in Figure 10. In

all quarters and areas, the ratio expressed by female percentage to the total showed monotonic increase. Ratio of female was larger in the 1st and the 4th quarters than 2nd and 3rd quarters in all bins. The ratio of female was slightly larger in areas 1 and 3 (Figure 10-a, c) in all length bins than in the areas 2 and 4 (Figure 10-b, d).

The analysis of sex ratio at size in this study consulted the same study in the Atlantic and Mediterranean Sea. According to the previous studies, three general patterns were suggested, and known as “spawning”, “feeding” and “transition” (Mejuto *et al*., 1998), which were also roughly recognized in the Indian Ocean (Mejuto *et al*., 1995). Especially in the spawning region, the sex ratio at size showed highly characteristic pattern, but the results of this study did not obtain such pattern, and there was no significant difference in all areas.

For the future study, further analysis of the sex ratio at size and analysis about the schools will be promoted. It is also considered that it would be necessary to include similar data from other nations into this study for the swordfish in the north Pacific.

References

MEJUTO, J., J.M. de la Serna, B. García. 1995. An overview of the sex-ratio at size of the swordfish (*Xiphias gladius* L.) around the world: Similarity between different strata. ICCAT Col. Vol. Sci. Pap. Vol. XVIX(3):197-205.

MEJUTO, J., J.M. de la Serna, B. García. 1998. “ Some considerations on the spatial and temporal variability in the sex-ratio at size of the swordfish (*Xiphias gladius* L.)”. ICCAT. Col. Vol. Sci. Pap. Vol. XLVIII(1):204-215. (SCRS 97/32).

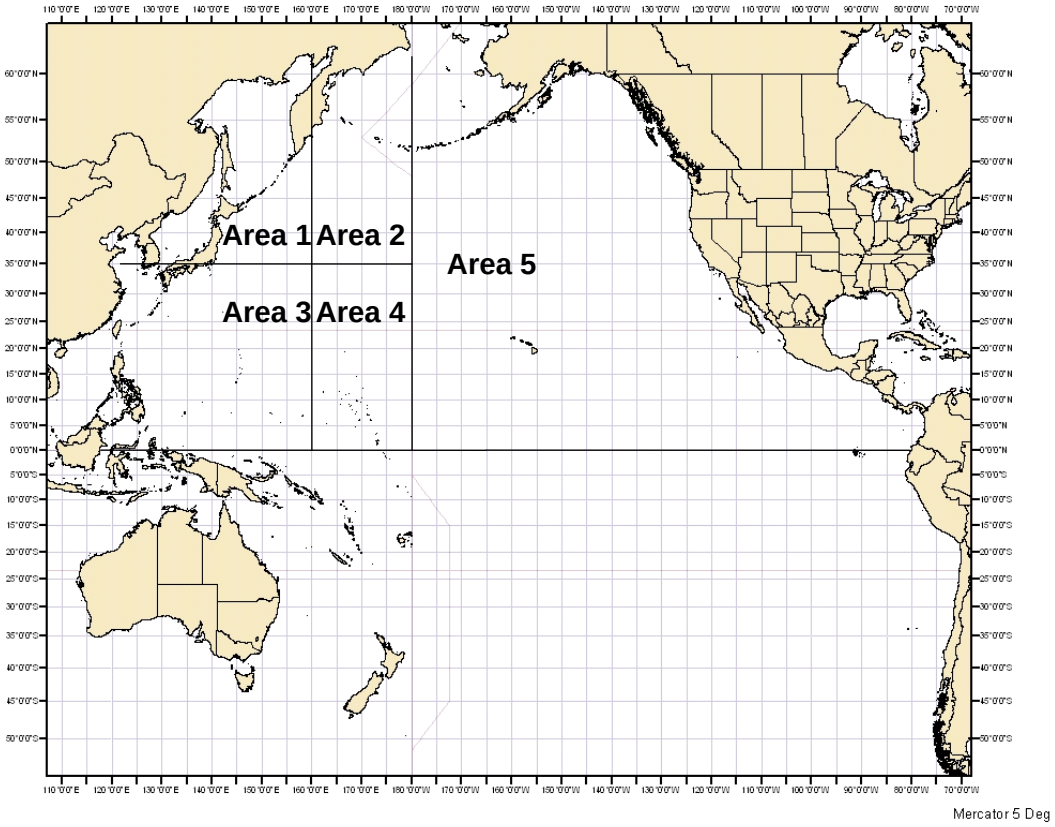

Figure 1. Area stratification for the GLM analysis.

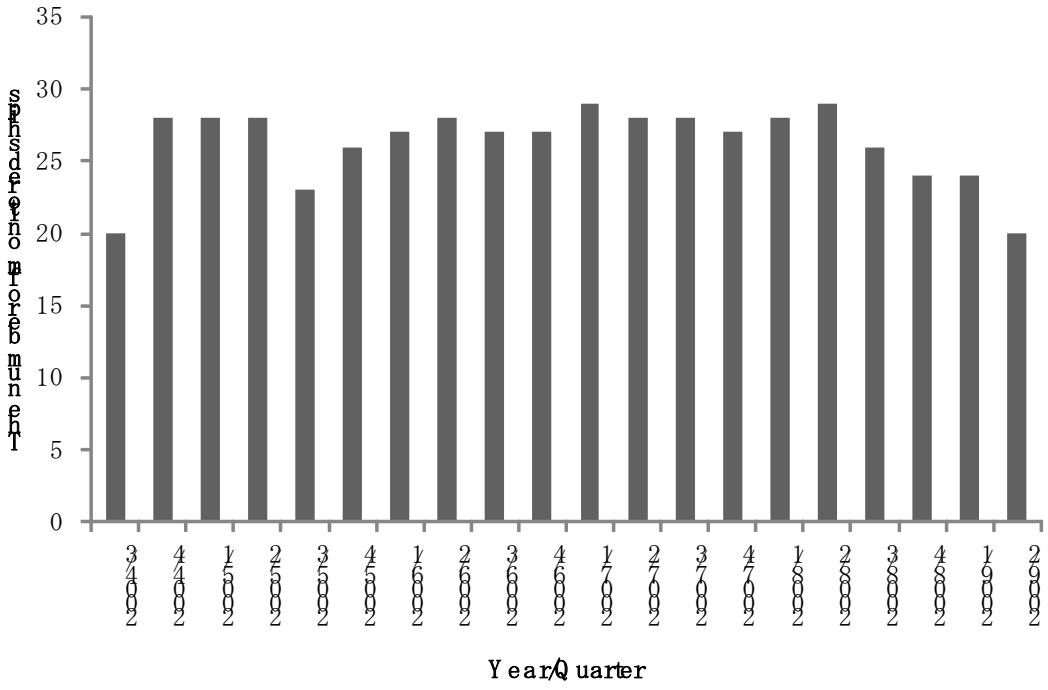

Figure 2. The number of monitored ships by quarter and by year.

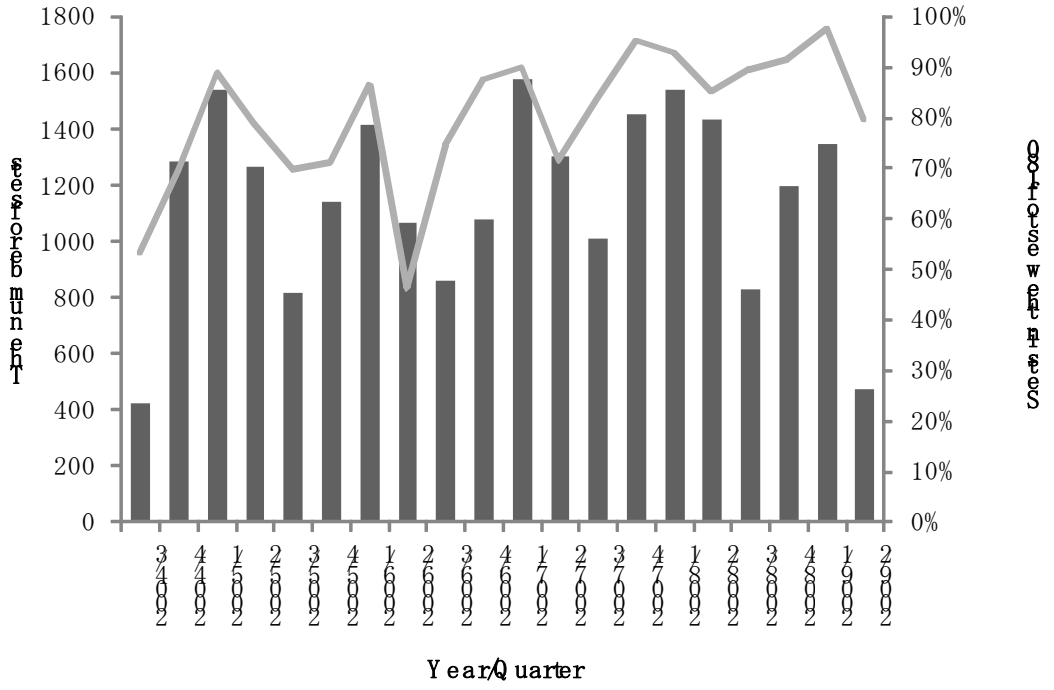

Figure 3. The number of observed sets by quarter and by year (bar), and the percentage of those which was operated in the west of date line (line).

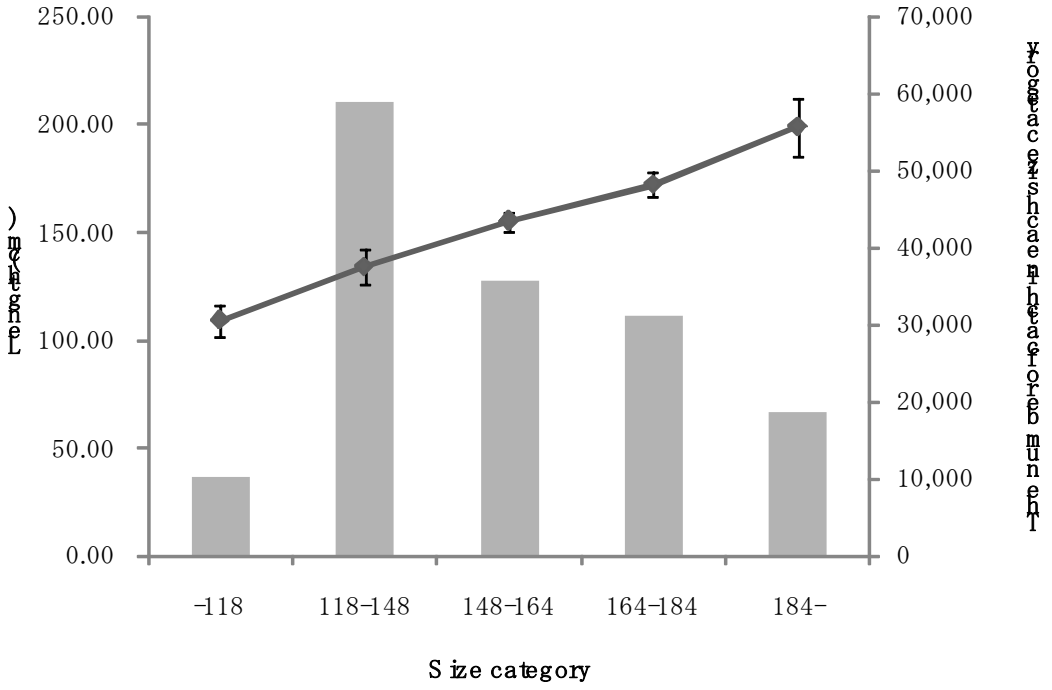

Figure 4. Average and standard deviation of length of catches (line) and the number of catch in each size category (bar).

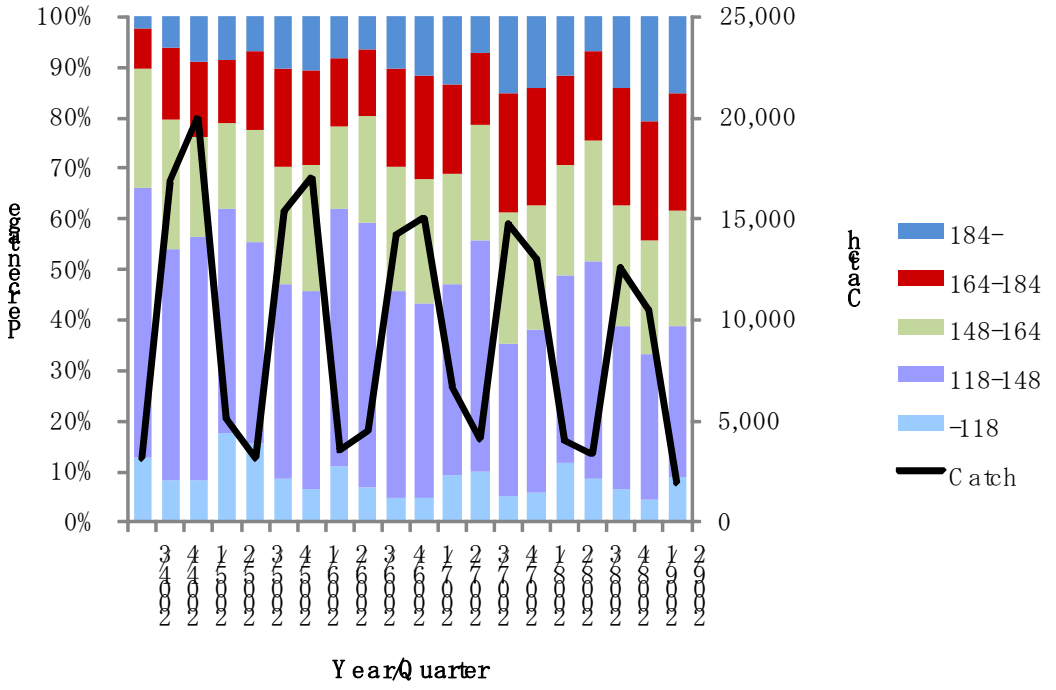

Figure 5. Total number of catch by quarter and by year (line) and the percentage of catch in five size category (bar): over 184cm, 164-184cm, 148-164cm, 118-148cm, under 118cm.

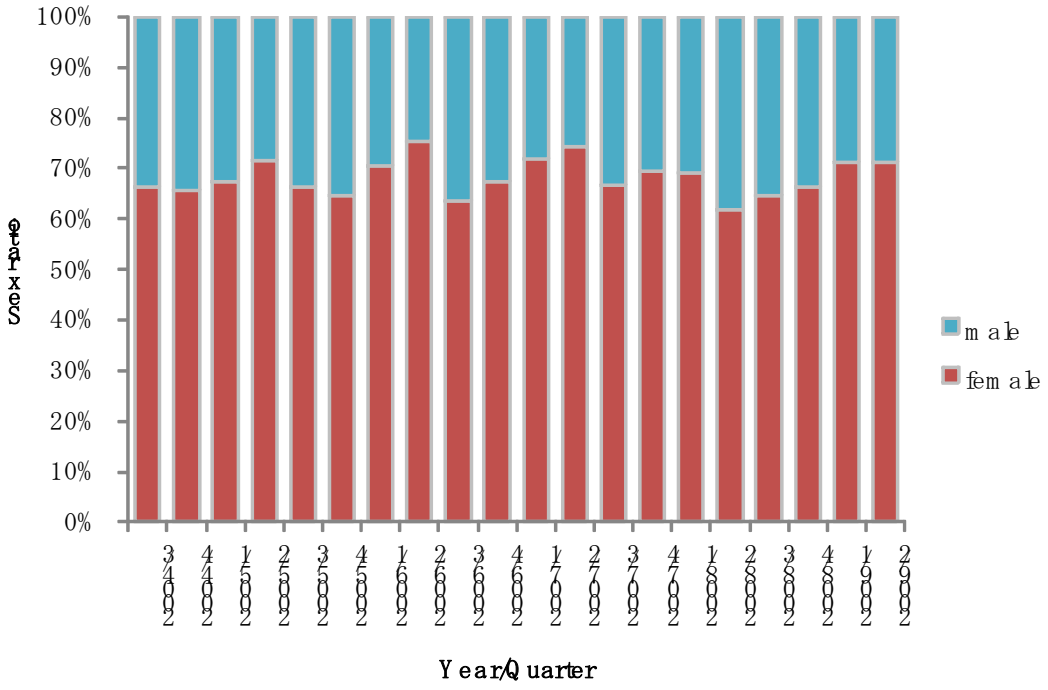

Figure 6. Sex ratio of catch by quarter and by year.

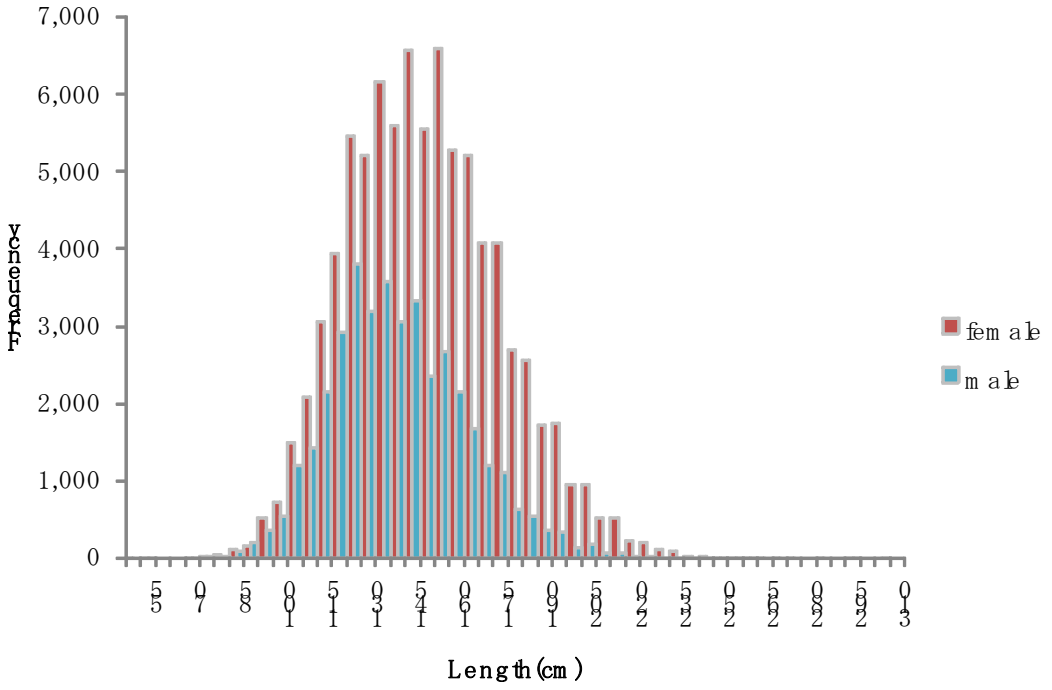

Figure 7. Length frequency of catch by sex.

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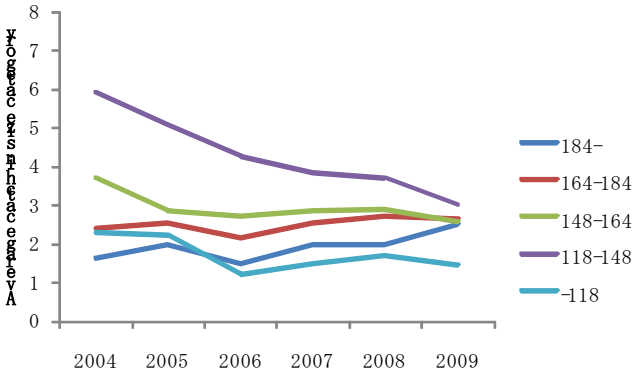
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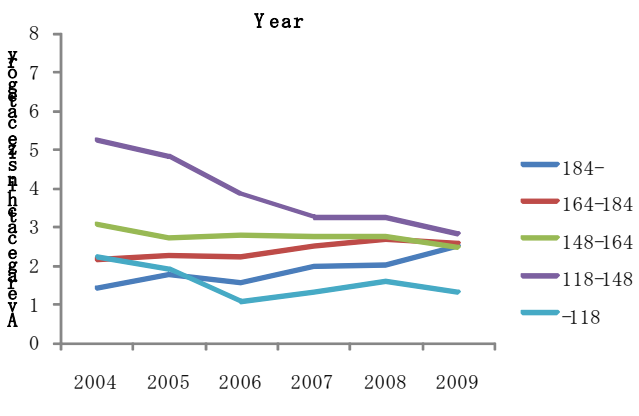
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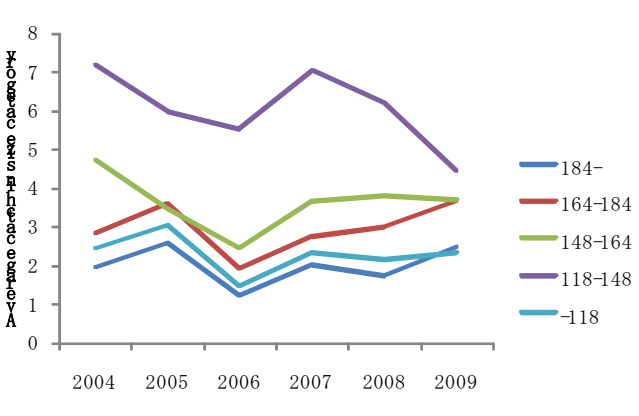
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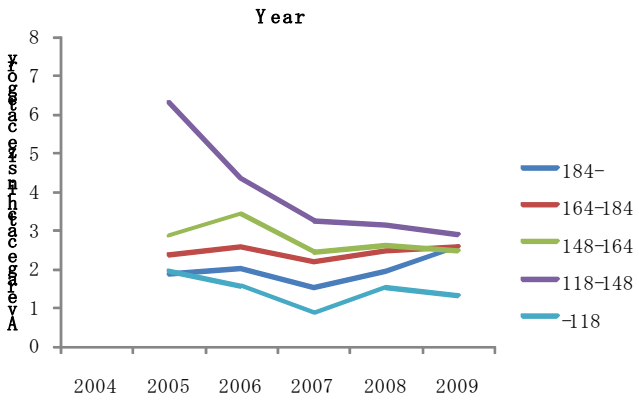
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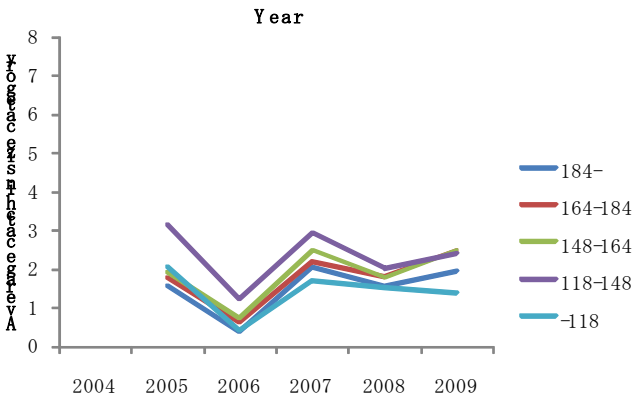
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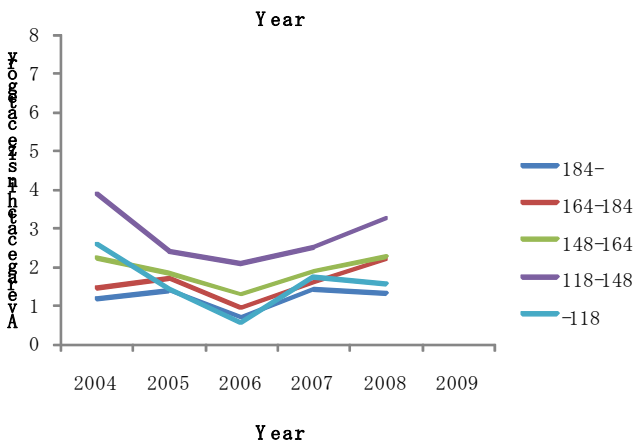
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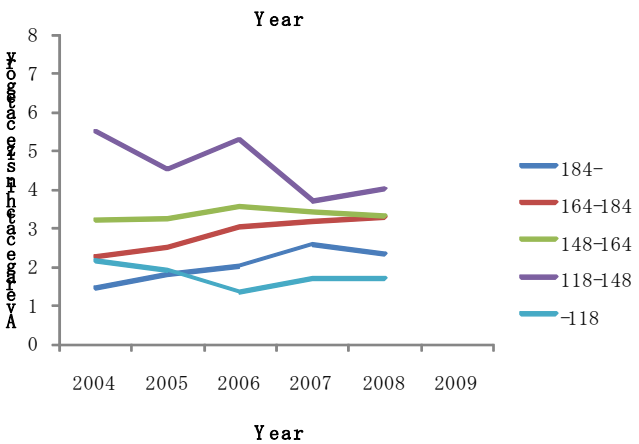
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Figure 8. Average catch number per set by size category and by year, analyzing (a) all data, data only operated in the west (b) or east (c) of date line, and the data only in the west by quarterly bases (d-g, corresponding to the 1st-4th quarter).

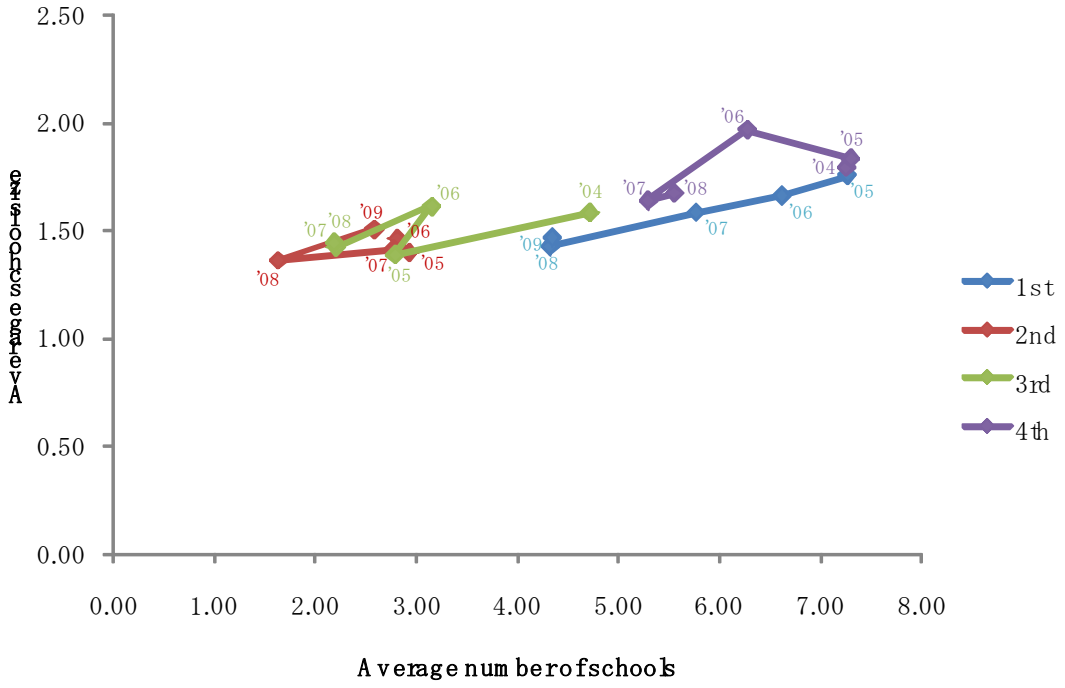

Figure 9. Average number of schools and its average school size by quarter and by year.

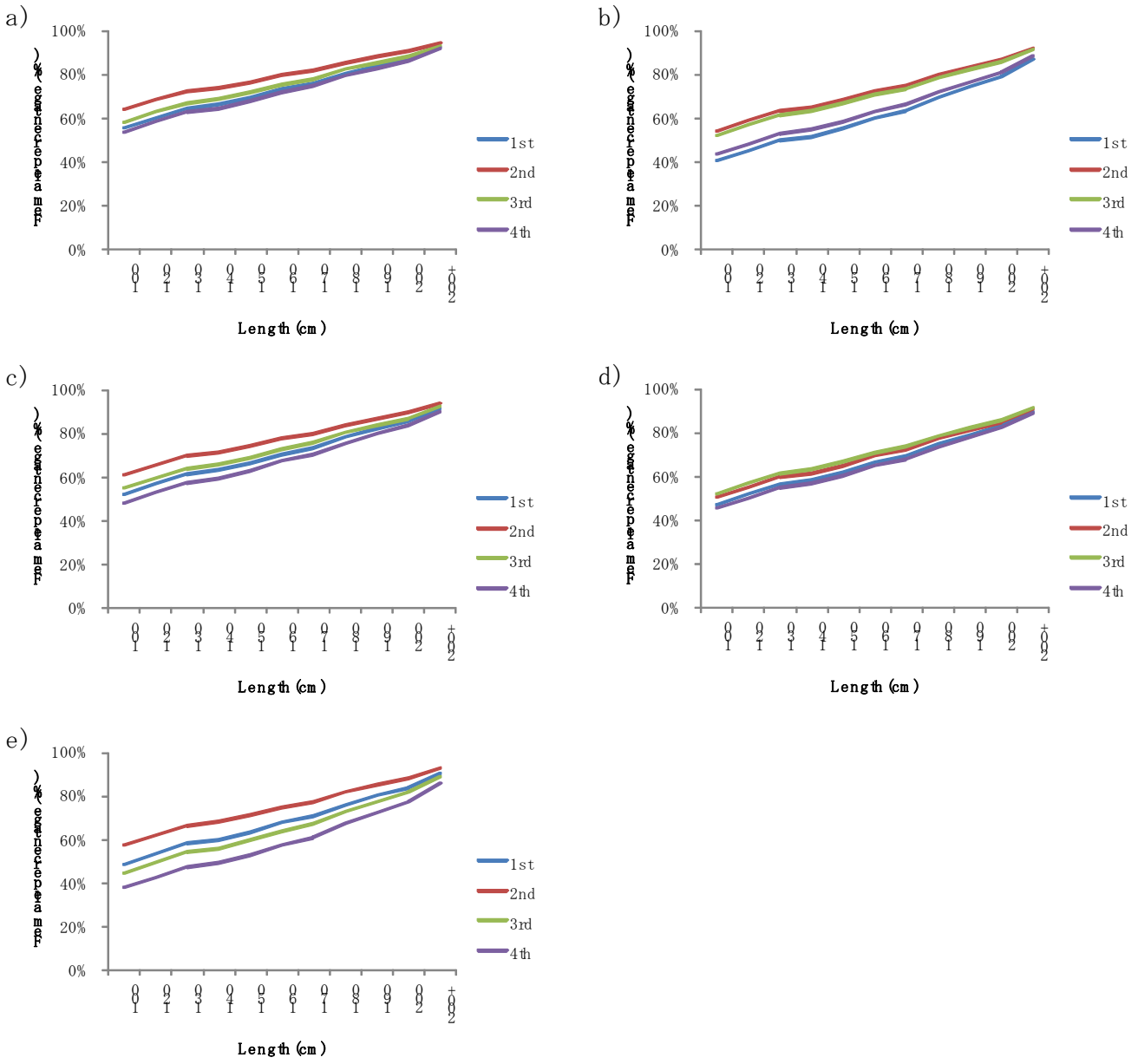

Figure 10. Sex ratio at size (female percentage) by quarter and by area, a) area 1, (b) area 2, (c) area 3, (d) area 4, and (e) area5 in Figure 1.