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The Spatial Distribution of Habitat Preferences for Striped Marlin

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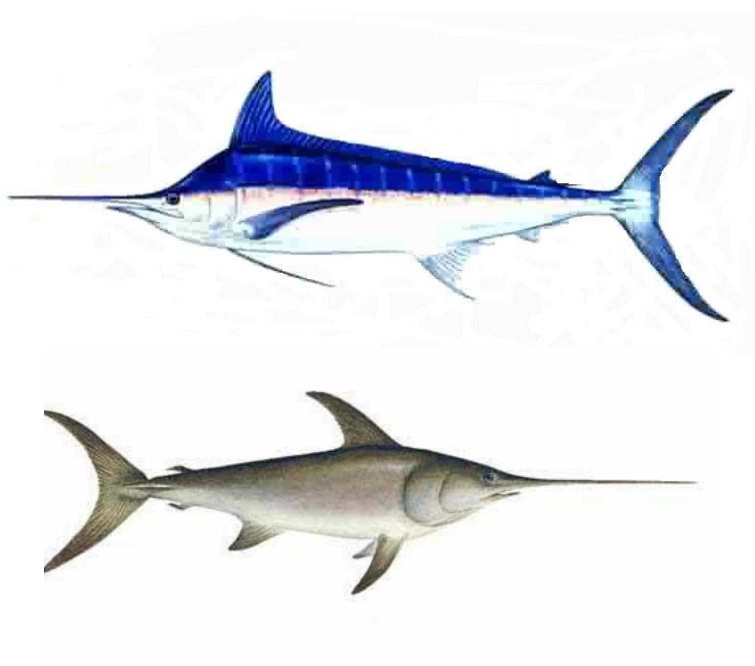

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Summary

The trial of investigation for habitat preferences is applied for striped marlin by using Japanese longline fishery statistics. Kanaiwa et al. (2008) shows ambient temperature is one of good indicator for habitat preference and there is some trend in spatial and seasonal distribution of nominal CPUE but not clear trend in hooks per baskets (HPB), sea surface temperature and deepest hook's temperature (DHT). In only the area close from US coast, there is some trend by HPB and DHT. From these results, we can say there may be some preferences for striped marlin but much further study should be necessary to obtain reasonable areal and seasonal distribution pattern by depth.

Introduction

Habitat preferences are important factor to understand the biology of marine organisms which is targeted by the fishery. Many environmental factors such as temperature, salinity, chlorophyll, and depth would affect on it. The water temperature in each depth and the vertical profile of the water temperature are reported to be one of most important factors, but there are limited numbers of studies to examine the relationship between the water temperature and geographical condition (or distribution) which defines the habitat preferences of fish stocks. Fishery depend data has some advantages to clarify it because it is covering wide area and seasons, though it also has disadvantages of precision and accuracy, at the same time. Purpose of our trial is to investigate the availability to estimate the habitat preferences from fishery dependent data. The longline fishery data for striped marlin is analyzed for this purpose.

Material and Methods

Data set

Catch and effort data used in this analysis was provided from the Japanese longline fishery statistics compiled at the National Research Institute of Far Seas Fisheries for 1975-2006. This data has the information of catch number by species and number of hooks and aggregated by month, 5x5 degree blocks area and gear configuration, i.e. the number of branch lines between floats (hooks par baskets: HPB).

Environmental covariates of ambient temperature was obtained from the Global Ocean Data Assimilation System (GODAS, *http://cfs.ncep.noaa.gov/cfs/godas/*) and processed according to Bigelow and Maunder (2007). This is the same as in Kanaiwa *et al.* (2008 a), also. These temperature data is used for the estimation of observed habitat preference, also.

Because the data of GODAS is only available since 1980, the longline statistics in the period between 1975 and 1979 is omitted from the analysis.

Results and Discussions

The area stratification is used in this study, which is same as the one followed by Yokawa & Clarke (2005) is shown in Fig. 1. Area 5 occupied the most of the catch in early 1980s even if the fishery effort is low, and it was replaced by area 1 during 1990s probably due to the high fishery effort (Fig. 2). This makes high nominal CPUE (catch divided by 1000 hooks: nCPUE) around area 5 during 1980s and 1990s but flat nCPUE after 2000 (Fig 2). In area 1, in the summer, nCPUE is higher than in winter and in area 2, 4 and 5, in winter it is higher than summer (Fig. 3). This would reflect the seasonal migration of striped marlin. In area 3, there is no clear trend. So there are some spatial and seasonal characteristics on striped marlin's nCPUE.

The distribution pattern of nominal CPUE by decades revealed that high CPUE of striped marlin (>2.0) is only observed in EPO area (area 5) in the period analyzed, and the operations conducted in the position where high CPUE obtained in the 1980s and in the 1990s are almost disappeared in the 2000s (Fig. 4). In the western and central north Pacific (areas 1-4), there seems no particular longitudinal trend of CPUE but only latitudinal trend existing. This should indicate rather uniformly distribution pattern of striped marlin in the western and central north Pacific,

Kanaiwa et al. (2008) shows that ambient temperature is one of the alternatives to figure out habitat preferences, using data by Japanese training vessels which has detailed operational information such number of branch line hooked by fish. However usual fishery dependent data, such as log-book of Japanese commercial longliners, has no data about the number of hooked branch line for each caught fish.

Results of the analysis of relationship between the HPB and nCPUE of striped marlin by area indicated that no clear relationship is observed between two except for area 5 where the negative correlations was observed (Fig. 5). This result in areas 1-4 apparently contradicts with the results obtained by Kanaiwa et al. (2008) which indicates higher CPUE of striped marlin in shallower layers. This may be due to the fact that majority of positive catch is occupied by one fish caught per operation and this one fish is hooked by shallowest branch line irrespective of HPB value of the operation. The set depth of shallowest hooks would not so largely different by HPB because it is mainly controlled by the length of float line which has less variability than HPB.

So in this paper, we use sea surface temperature (SST) and deepest hook temperature (DHT) as the control factor of nCPUE of striped marlin. To calculate deepest hook's temperature, we calculated deepest hook depth by using catenary curve followed by Yoshihara (1951 & 1954) and hooks per basket data. The nCPUE does not change by SST in any area (Fig. 6) but deepest hook's temperature affect in area 5. Especially, around 22 - 24 □, the nCPUE become higher than other conditions, but such temperature could be seen in all areas analyzed.

From these results, we can say there may be some preferences for striped marlin but much further study should be necessary to obtain reasonable areal and seasonal distribution pattern by depth. The one of the reason there is not so many catch except in area 5 so there is few variation of location where stripe marlin is caught.

References

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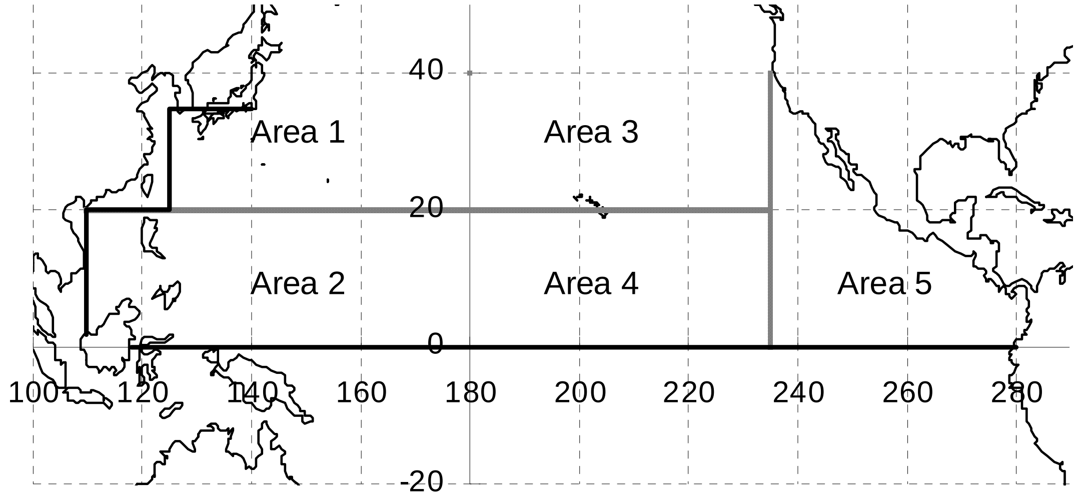


Fig. 1. Area stratification

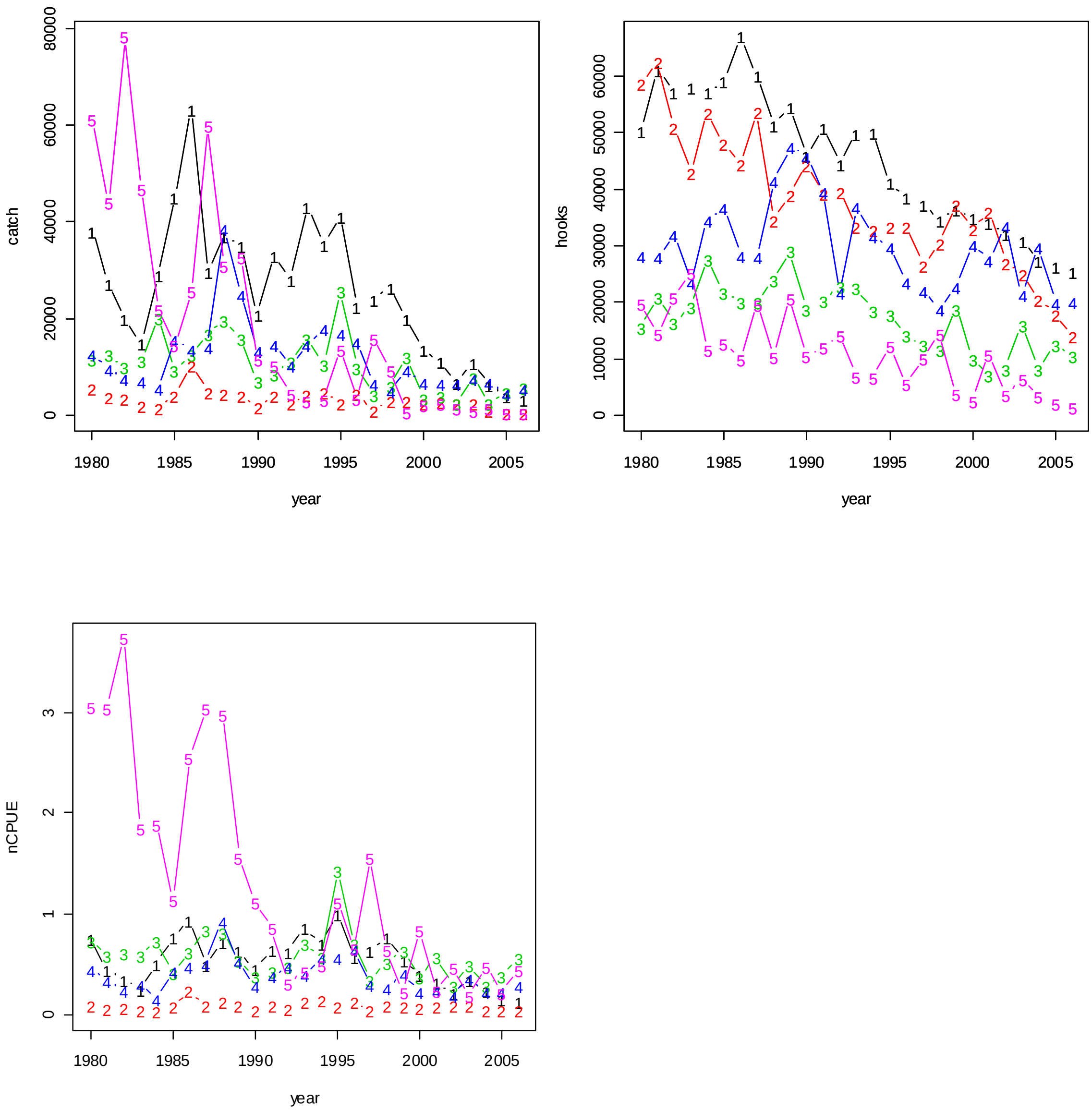


Fig. 2. Catch number, effort (1000 hooks number) and nominal CPUE

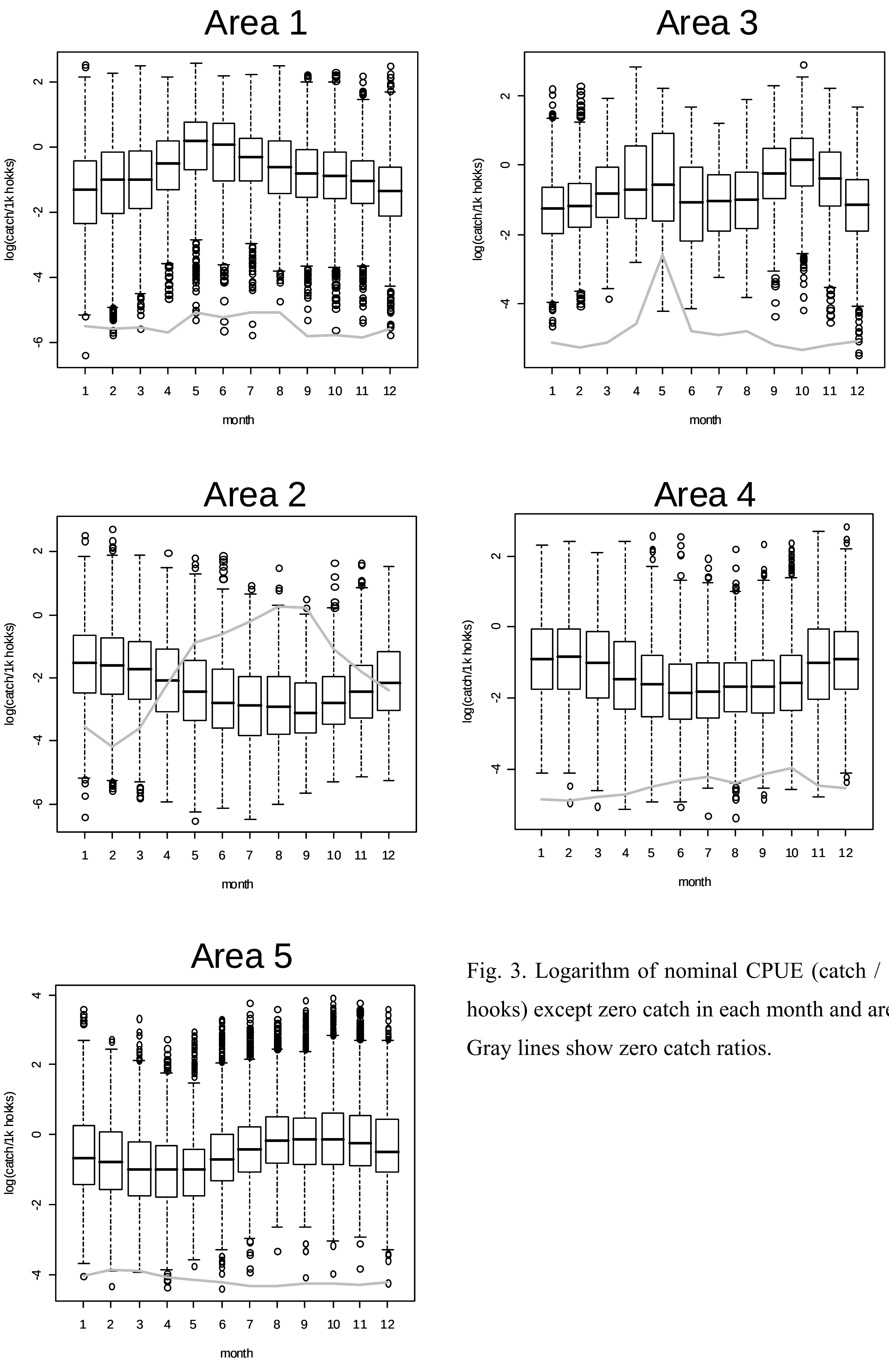
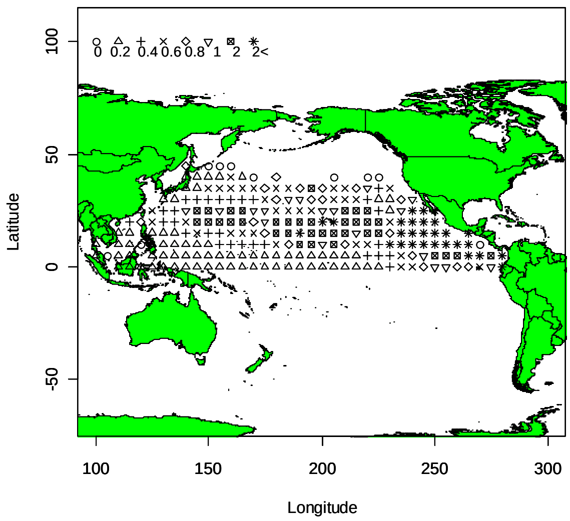
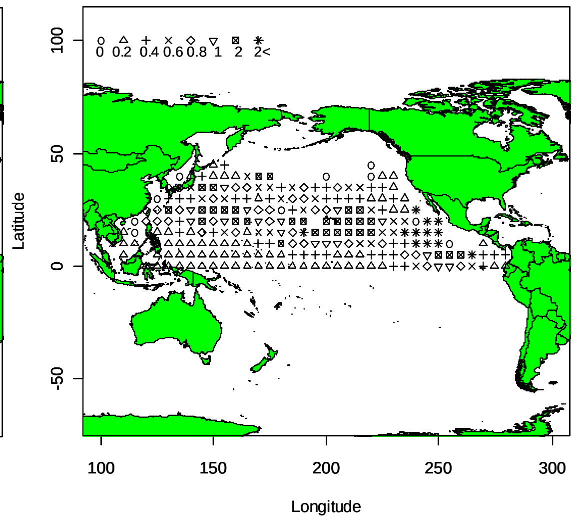


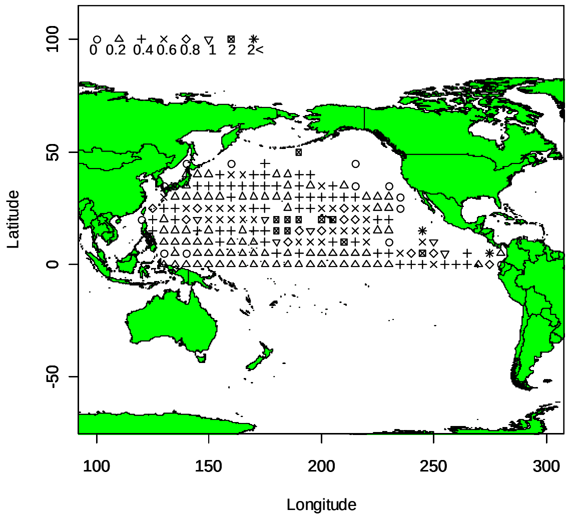
Fig. 3. Logarithm of nominal CPUE (catch / 1k hooks) except zero catch in each month and area. Gray lines show zero catch ratios.



1980-1989

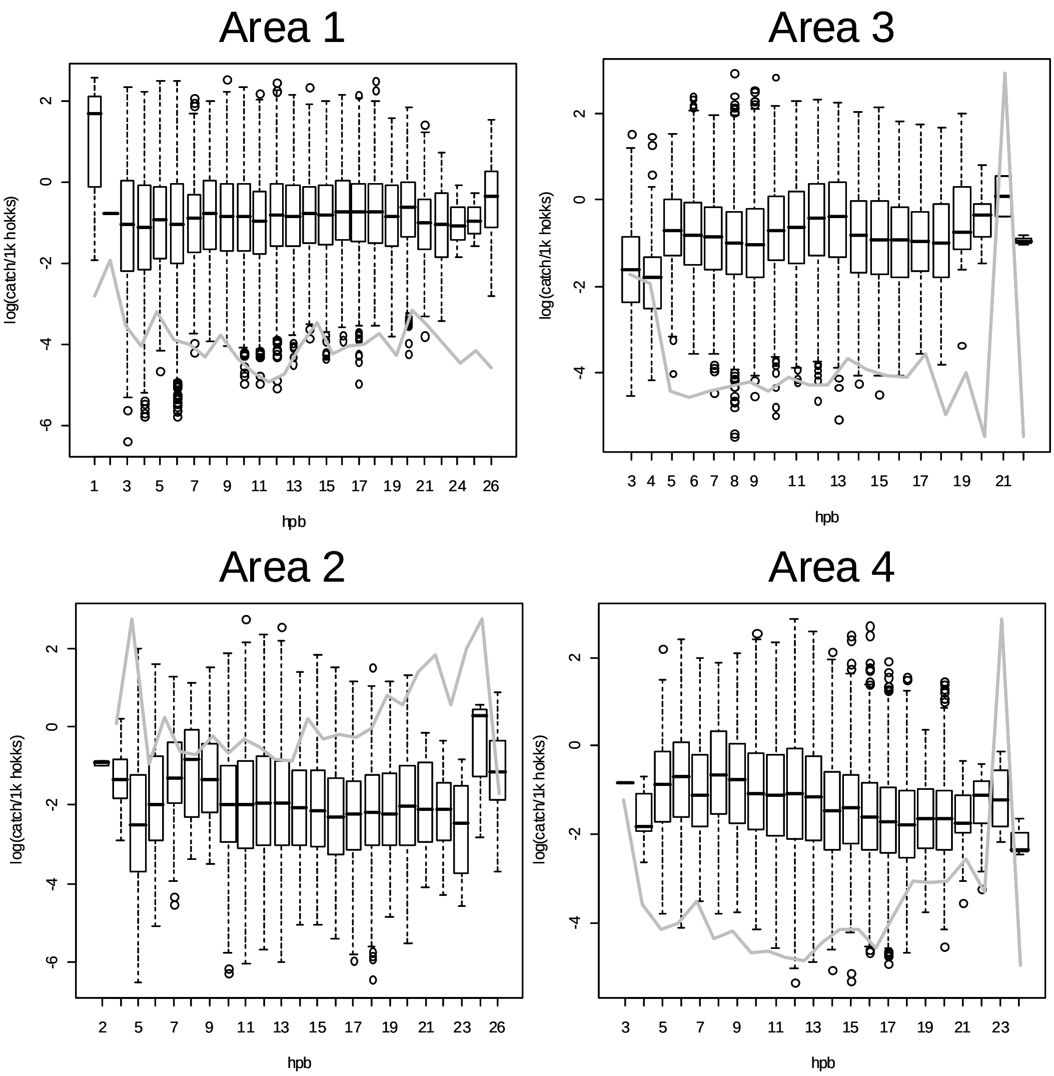


1990-1999



2000-

Fig. 4. Spatial distribution of nominal CPUE in each decade.



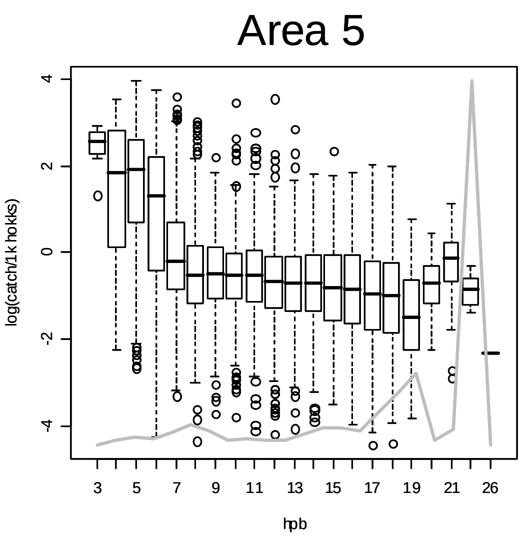
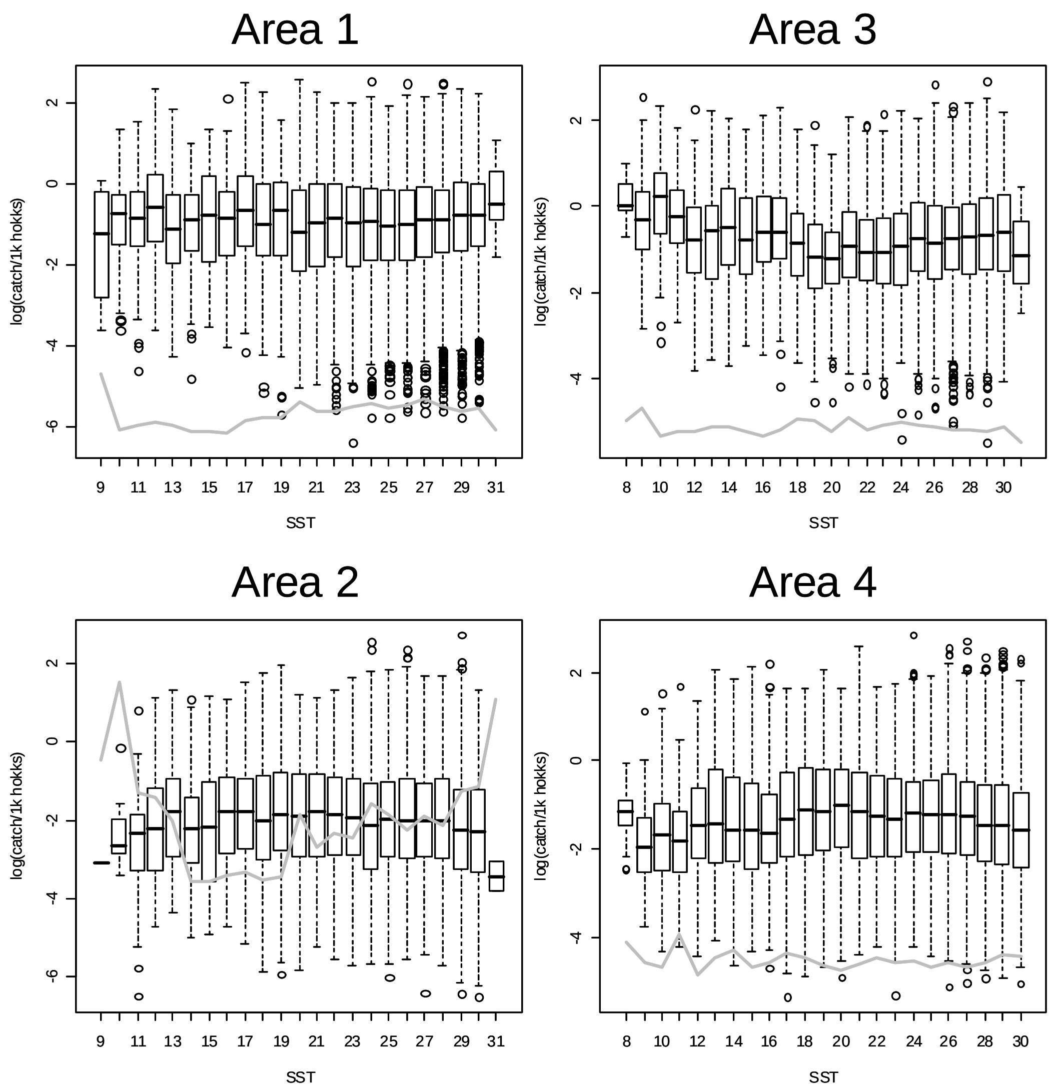


Fig. 5. Logarithm of nominal CPUE (catch / 1k hooks) except zero catch in each hooks per basket and area. Gray lines show zero catch ratios.



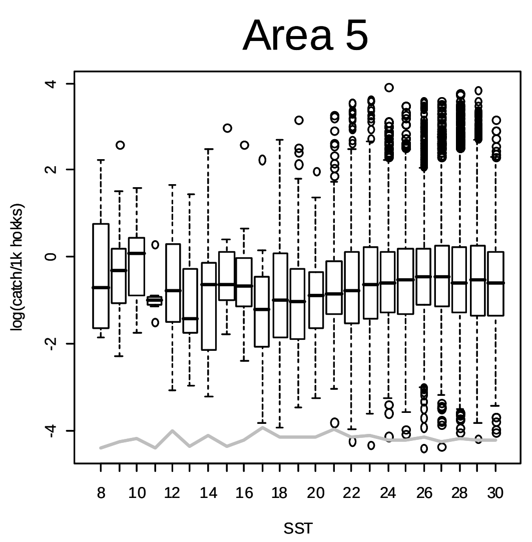
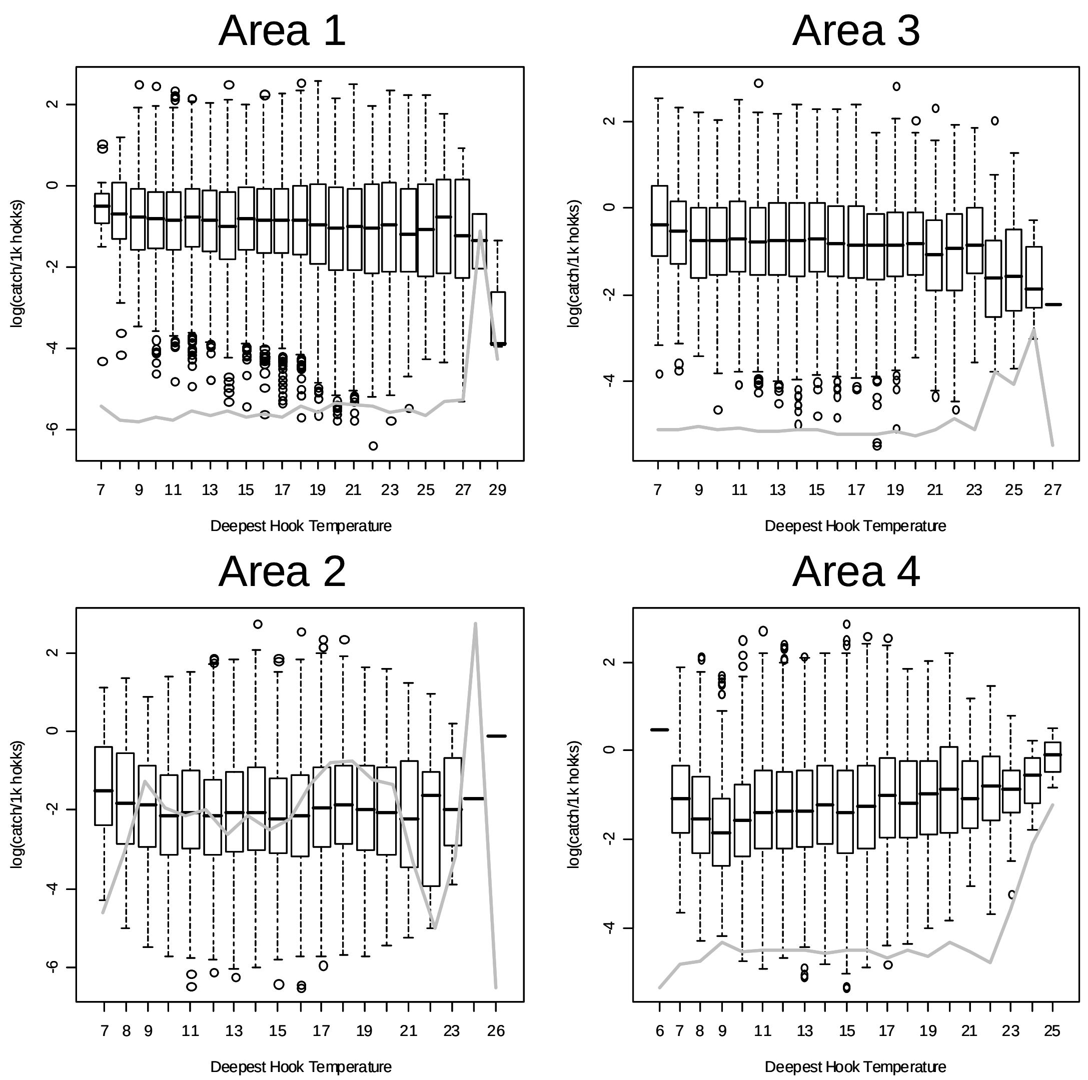


Fig. 6. Logarithm of nominal CPUE (catch / 1k hooks) except zero catch in each surface sea temperature and area. Gray lines show zero catch ratios.



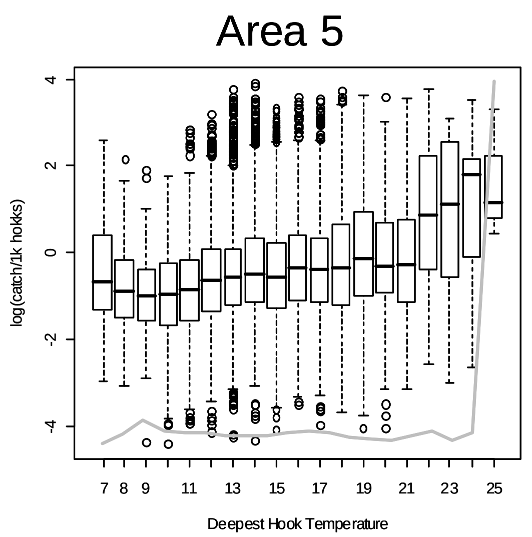


Fig. 7. Logarithm of nominal CPUE (catch / 1k hooks) except zero catch in each deepest hook's temperature and area. Gray lines show zero catch ratios.