ANALYSIS OF OPERATION PATTERN OF JAPANESE LONGLINERS IN THE TROPICAL ATLANTIC AND THEIR BLUE MARLIN CATCH

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SUMMARY

The operation pattern in terms of gear configuration of Japanese longliners in the tropical Atlantic and their blue marlin (Makaira nigricans) *catch were analyzed for the years 1975 to 1998. The gear configuration of Japanese longliners changed drastically and the gears that were popular during 1975-79 and 1980-84 almost disappeared in the 1990s. The fishing ground of Japanese longliners in the tropical Atlantic also changed and the amount of fishing effort in the main distribution area of blue marlin decreased substantially.*

RESUMEN

Se analizaron los tipos de operación, en términos de configuración del arte de los palangreros japoneses en el Atlántico tropical, así como su captura de aguja azul (Makaira nigricans) *respecto a los años 1975 a 1998. La configuración del arte de los palangreros japoneses cambió de forma drástica y los artes mas usados en los periodos 1975-79 y 1980-84, desaparecieron prácticamente en la década de los años 90. También cambió el caladero de estos barcos en el Atlántico tropical y el esfuerzo de pesca en la principal área de distribución de la aguja azul disminuyó sustancialmente.*

RÉSUMÉ

Le mode d'opération en termes de configuration des engins des palangriers japonais dans l'Atlantique tropical et leur capture de makaire bleu (Makaira nigricans) *ont été analysés pour les années 1975-1998. La configuration des engins des palangriers japonais a changé drastiquement, et les engins qui étaient populaires en 1979 et entre 1980-84 avaient pratiquement disparu dans les années 1990. La zone de pêche des palangriers japonais dans l'Atlantique tropical a également changé, et le montant de l'effort de pêche dans la principale zone de répartition du makaire bleu a considérablement chuté.*

KEYWORDS

Tuna fisheries, High seas fisheries, Longlining, By catch, Fishing gear, Fishing effort

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INTRODUCTION

Suzuki and Kume (1982) reported that deep longline operation, which was introduced by the Japanese longliners in 1980's to the Atlantic Ocean, has some effects on bigeye tuna catches because the vertical distribution of bigeye tuna reaches down deeper than normal longline gear does. Uozumi and Nakano (1994) reviewed the relationship between the change in operation pattern of Japanese longliners in the Atlantic Ocean and billfish catches for the years of 1956-89. They concluded that billfish catches by Japanese longliners in the Atlantic Ocean were affected by the switch of target species by Japanese longliners from albacore to bigeye tuna in 1975 with the introduction of the deep longline operations. They also noted that the fishing effort in the southwest Atlantic was decreased drastically in the 1970s as the development of super-cold freezers on board enabled Japanese longliners to catch bigeye, bluefin and southern bluefin tunas, destined for Sashimi –use, in the areas off Nova Scotia, Morocco/Sahara, Angola and South Africa. This change in target species and fishing grounds caused a significant decrease of billfish catches by Japanese longliners in the Atlantic Ocean, and, since then, most billfish catches have been made in the marginal area of billfish distribution.

The purpose of this document is to update the information about Japanese longliner operations in the Atlantic Ocean up to 1998 in terms of operation pattern and their catches of blue marlin.

MATERIAL AND METHODS

Information about gear configuration of Japanese longliners operating in the Atlantic Ocean was available from 1975 to 1998, compiled by the National Research Institute of Far Seas Fisheries, Japan. In this study, aggregated data by month and 5x5 degree blocks, and gear configuration (expressed by the number of hooks per float, NHF) were used. NHF was classified into 6 categories (NHF = 3-4, 5-6, 7-9, 10-11,12-15, and >15) for the analysis. In the document,sets with NHF>9 are referred to as deep-longline operations.

RESULTS

Historical change of operation pattern

The historical change in the amount of effort by gear configuration (NHF) by the Japanese longline fishery in the Atlantic for 1975-1998 is shown in Fig. 1. During 1975-81, the conventional longline gear with 5-6 hooks between floats (HF) was predominant in the fishery, and decreased rapidly thereafter. In its place, the amount of deep longline effort (NHF > 9) increased after 1981. The fishing effort made with 10-11 HF was predominant in 1982-84, which was replaced by effort made with 12-15 HF in 1985-1990, and finally effort made with with NHF>15 became predominant after 1990. The fishing effort corresponding to 5-6 HF occupies only a small percentage of the total effort made in the most recent years. The amount of effort of operations with 7-9 HF increased from 800 thousand hooks in 1976 to 1,400 thousand hooks in 1981, and a further increase in fishing effort for this gear configuration was observed in the middle of 1980s. The fishing effort with 7-9 HF attained about 24,000 thousand hooks in 1998 and this value was the second-highest one among the six gear categories (Fig. 1).

The average annual distribution of effort (number of hooks) and CPUE (numbers caught per 1,000 hooks) of blue marlin by gear configuration for the periods 1975-79, 1980-84, 1985-89, 1990-94, and 1995-98 are shown in Figures 2-7 and 8-13, respectively.

The fishing effort with 3-9 NHF in the tropical decreased over the years (Figs. 2-7). This is particularly the case for the southwestern Atlantic, where blue marlin is abundant, and where very small amounts of effort have been exerted after 1984. In the high-latitude areas of the Atlantic (over 30 degrees north and south), the amounts of effort of the operations with 3-6 HF were predominant in 1970s, but they were gradually replaced by the operations with 7-9 HF for the period of 1980-94, and were subsequently almost completely substituted by 7-9 HF operations in the period of 1995-98.

As for the deep longline, the main fishing ground of Japanese deep longliners has been in the tropical area of the eastern Atlantic (Figs. 5-7). The amount of effort exerted in the tropical area of the western Atlantic, where blue marlin is abundant, was minor compared with the eastern side for 1975-79. Furthermore, the fishing effort in the western tropical waters has continued to decrease after 1979 and only a few Japanese longline operations were observed in the most recent years.

High values of CPUE of blue marlin were observed in the water off Florida, the Caribbean Sea as well as in the tropical waters off the east coast of the South America, irrespective of the periods and the gear configurations (Figs. 8-13).

The percentages of catches (in number) for the major species by gear configuration are shown in Figure 14. Higher percentages of bluefin tuna catch were observed in operations with 3-4 HF throughout the period analyzed, except for most recent two years compared with the other gear categories. For 5-6 HF operations, relatively high catch ratios of southern bluefin tuna were observed in 1975-93 and high catch ratios of bluefin tuna were observed in the 1990s. For operations with 7-9 HF, bigeye tuna had been the main catch item in later half of 1970s and 1980s, and the percentage of bluefin and southern bluefin tuna caught increased in 1990's. For the deep longline operations (NHF>9), bigeye tuna catch occupied more than 70% of the total for almost all years.

Trend of blue marlin catch by gear configuration

The catch in numbers and the trend in the nominal CPUE of blue marlin by gear configuration are shown in Figures 15 and 16. During the second half of the 1970s, most blue marlin were caught by operations made with 5-6 HF. After 1980, blue marlin was predominantly caught by deep longline, thus operations with 10-11 HF for 1980-84, operations with 12-15 HF for 1985-89, and operations with HF>15 for 1990-98. The catch by each gear category, which was the most dominant in a period, occupied the largest number of blue marlin catch for the period. About 80% of the blue marlin caught in the later half of the 1980s and more than 95% in of the blue marlin caught in the 1990s were caught by deep longline operations.

Figure 16 shows the nominal CPUE of Atlantic blue marlin by gear category. This figure shows that the CPUE for each category has fluctuated independently of each other, especially between shallow (3-9 HF) and deep (>9) longline gear. The most interesting phenomenon observed in Figure 16 is that the most dominant gear in eachparticular period had the highest nominal CPUE compared with the other gears in that same period. In the 1990s, the nominal CPUE by HF>15 is the highest, followed by the CPUE made by 12-15 HF and by 10-11 HF, even though the deeper longline gear is supposed to be less effective for catching blue marlin which is distributed in the shallower part of the water column.

Operation pattern in the tropical area

Atlantic blue marlin are known to be distributed in the tropical area of the Atlantic, especially in Brazilian waters (ICCAT, 1998). In the tropical area of the Atlantic, the operation pattern of Japanese longliners has also changed in terms of gear configuration and fishing grounds for the years between 1975 and 1998 (Figs. 17 and 18).

In the tropical area of the Atlantic Ocean, the operations with 3-6 HF were the most common gear configuration in the later half of 1970s, and the annual amount of effort exerted in this period was 8-15 million hooks (Fig. 17). In the earlier half of the 1980s, operations made with 7-11 HF becamepredominant and the annual amount of effort for this gear configuration was 20-40 million hooks. In the later half of the 1980s, the operations made with 10-15 HF became predominant. And, in the 1990s, the operations with HF>11 made up more than 80% of the total annual effort. The amount of annual fishing effort in the 1990s was 40-50 million hooks, except for 1998 when the fishing effort decreased to 30 million hooks. After 1994, the amount of effort of operations made with 3-4, 5-6, and 7-9 HF decreased down to less than 1.5% of the total.

During the 1980s, Japanese deep longline operations were mainly conducted in the southeast Atlantic (ICCAT Area 7, Fig. 18). The amount of effort by Japanese deep longliners in the southeast Atlantic increased from 1980 to 1994, and decreased rapidly since 1995, down to 21 millions hooks in 1998. The amount of effort in the southwest Atlantic (Area 6) started to increase since 1988, reached to 12.6 million hooks in 1990, and then began to decrease and fell down to 1.7 million hooks in 1998. In the northeast Atlantic (area 4B), the amount of effort showed an increasing trend since 1992 and reached to 17 millions hooks in 1998.

DISCUSSION

Uozumi and Nakano (1994) analyzed Japanese longline gear configuration and distribution data in the Atlantic for 1975-89. They classified operations with 7-15 HF as deep longline operations targeting bigeye tuna in the tropical area. At the end of the 1980s, a new pattern of operations with HF>15 was initiated. The amount of effort made by this new gear configuration increased drastically and it became the most popular gear for the Japanese longliners targeting bigeye tuna in the tropical area of the Atlantic within only a few years. Operations made with 7-9 HF had previously been one of the main strategies of bigeye targeting operations, but the role of this gear was completely changed in the 1990s as it became the main gear for catching bluefin/southern bluefin tunas in the high latitudinal areas.

During the period between 1975 and 1998, Japanese longliners operating in the tropical Atlantic changed their gear configuration to make deeper-water settings. The speed of this change was so fast that one category of gear configuration almost disappeared and a new category appeared in just 5 years, a very short time interval.

At the same time, the fishing grounds also changed. In the 1980s, Japanese longliners operated in the tropical Atlantic, especially concentrated in the southeastern Atlantic; they gradually shifted to the northeastern Atlantic in the 1990s.

Atlantic blue marlin are distributed in the shallower water column of the tropical waters, mainly in the western Atlantic. In the early fishery period (1950s), the distribution of fishing effort made by Japanese longliners coincided with the distribution of blue marlin geographically and vertically, because most of the Japanese longliners were concentrated in the tropical western Atlantic and used shallow longline gear. But the fishing ground then changed from one coinciding with the main blue marlins habitat, to a marginal one, not only horizontally but also vertically. Furthermore, these changes occurred not gradually, but drastically during a short time period. Now the major shallow gear, which is more efficient for catching blue marlin, is concentrated in temperate waters a marginal area in terms of blue marlin distribution. In contrast, the major deep longline gear, which is less effective for catching blue marlin, is concentrated in the eastern tropical waters, a secondary area for blue marlin.

It is probable that these vertical and horizontal changes in gear distribution may cause nominal CPUE to decrease more substantially than the change in the abundance of blue marlin itself. Therefore, it must be necessary to take into account these operational and distributional characteristics carefully if one tries to obtain an abundance index of blue marlin based on the data of Japanese longliners. And we must keep in mind that the data obtained by the Japanese longline fishery has covered only the marginal part of the habitat of blue marlin, both geographically and vertically, and that therefore we do not know what is going on in the main habitat of blue marlin.

During the period between 1975 and 1998, Japanese longliners operating in the tropical Atlantic have changed their gear configuration to make deeper-water sets. The speed of this change was so fast that one category of gear configuration almost disappeared, and new category started, during a very short time interval (5 years). At the same time, the fishing ground also changed. In the 1980s, Japanese longliners operated in the tropical Atlantic, especially concentrated in the southeastern Atlantic, and they gradually shifted to the northeastern Atlantic in the 1990s.

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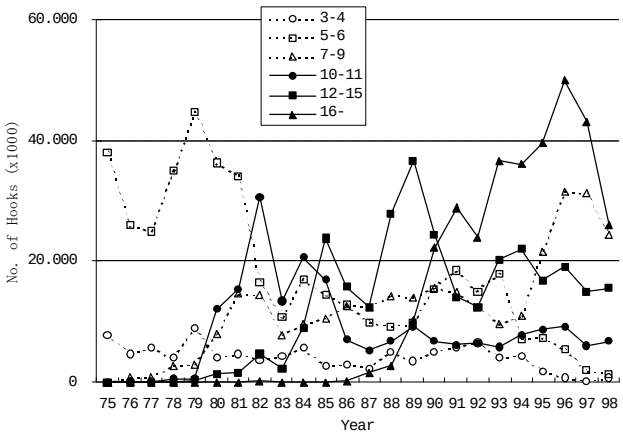

Figure 1. The amount of fishing effort (No. of hooks) of Japanese longliners by gear configuration in the Atlantic. The gear configuration is classified into 6 categories by the number of hooks between floats.

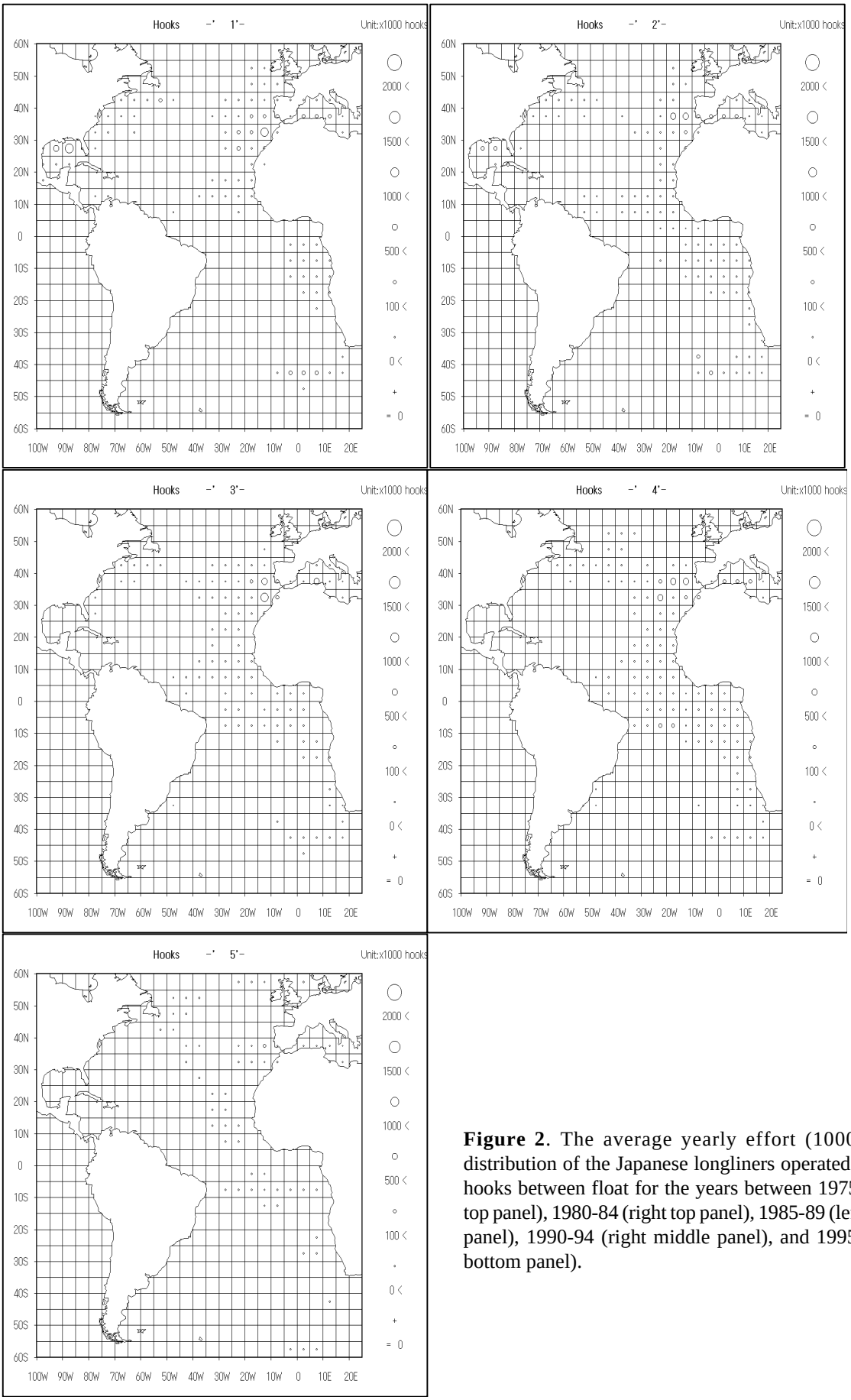

Figure 2. The average yearly effort (1000 hooks) distribution of the Japanese longliners operated with 3-4 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

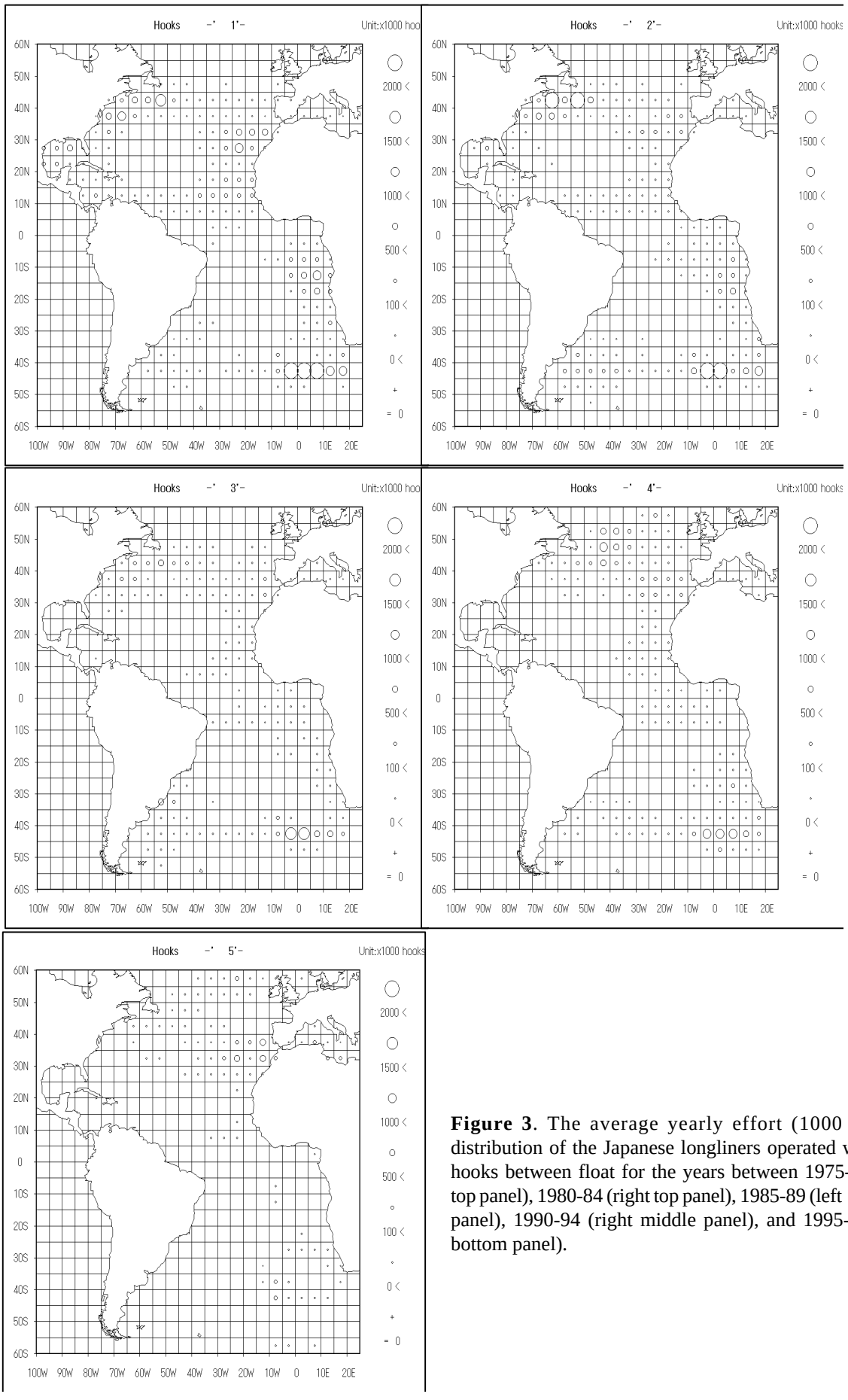

Figure 3. The average yearly effort (1000 hooks) distribution of the Japanese longliners operated with 5-6 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

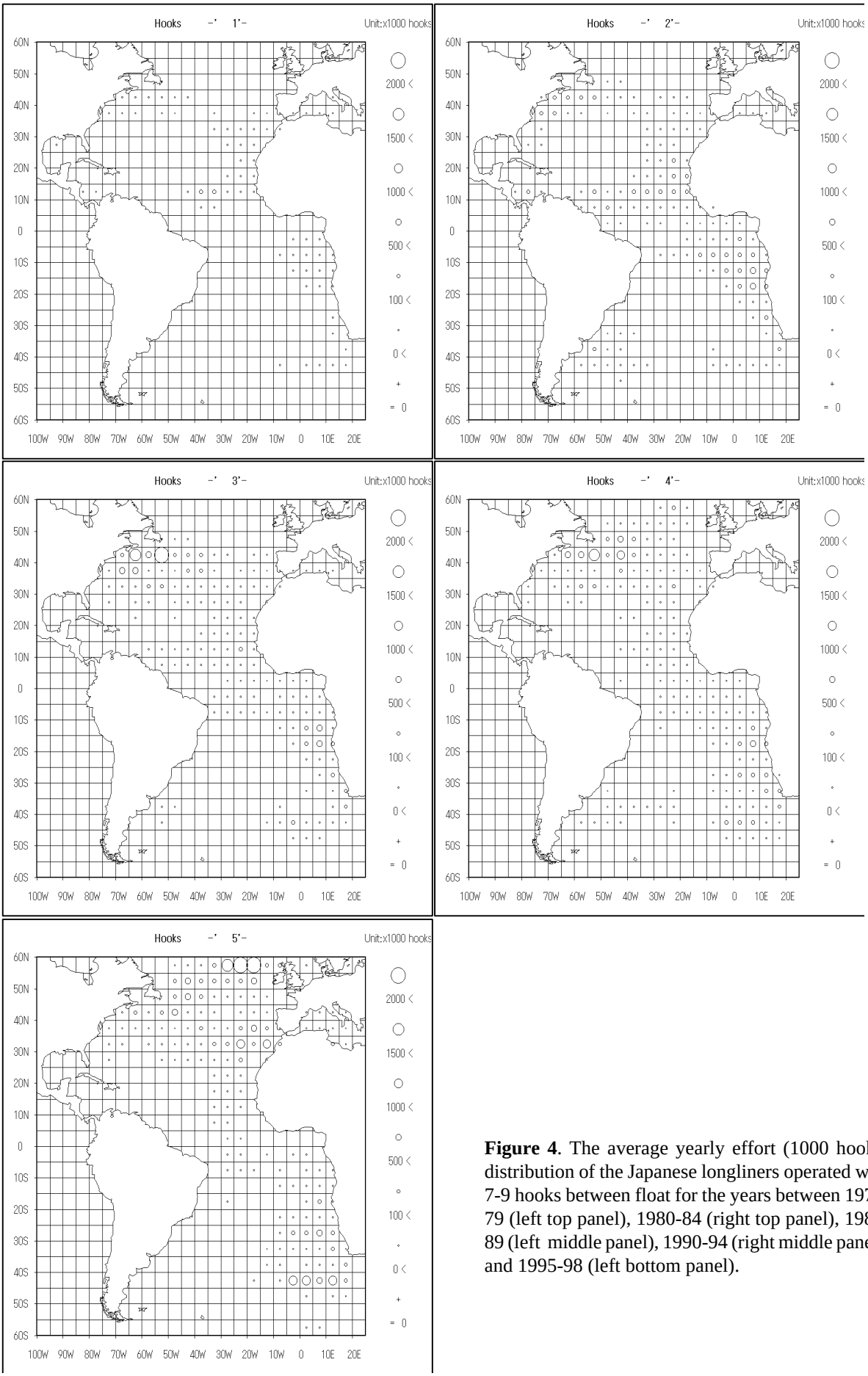

Figure 4. The average yearly effort (1000 hooks) distribution of the Japanese longliners operated with 7-9 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

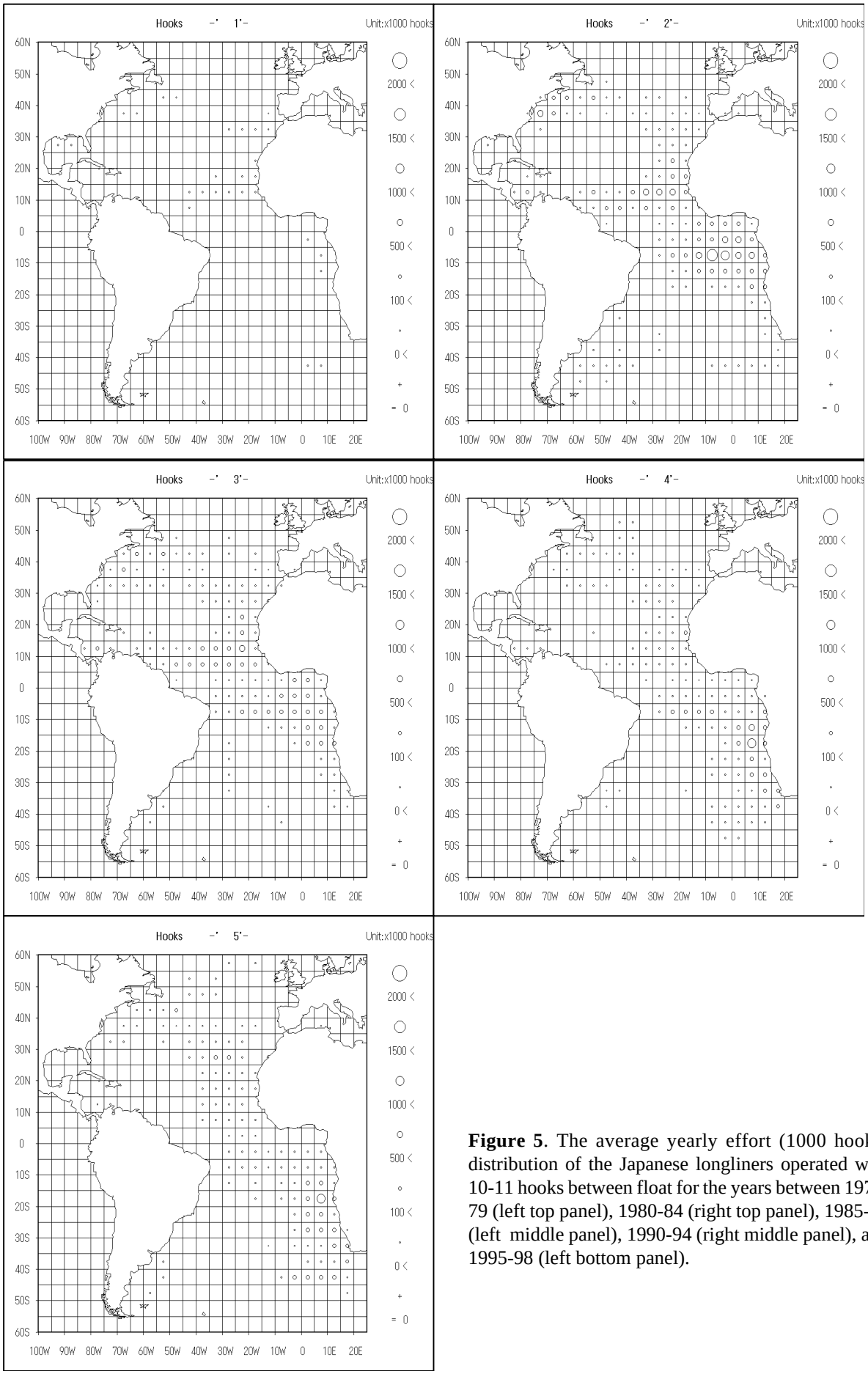

Figure 5. The average yearly effort (1000 hooks) distribution of the Japanese longliners operated with 10-11 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

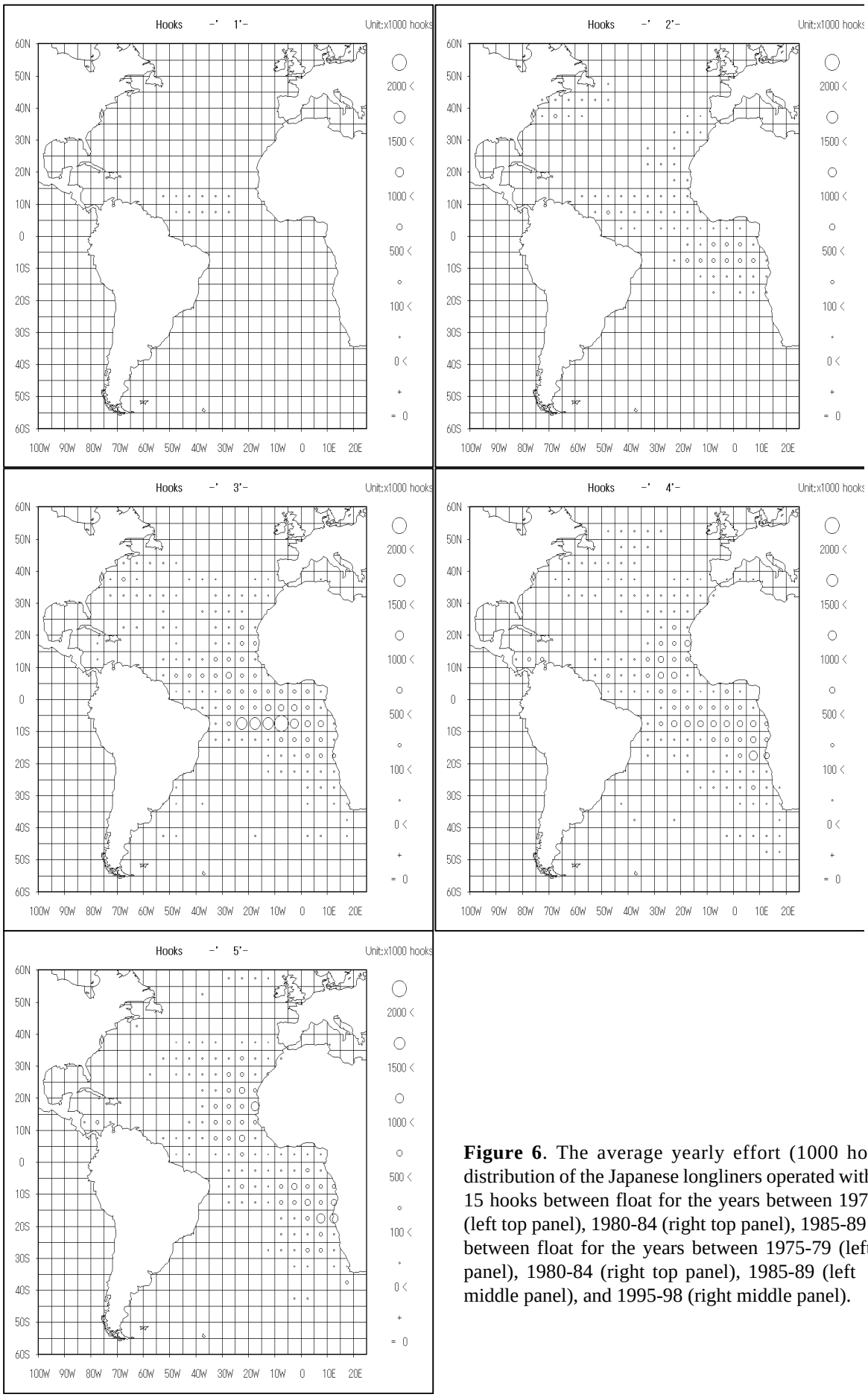

Figure 6. The average yearly effort (1000 hooks) distribution of the Japanese longliners operated with 12-15 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left (left middle panel), and 1995-98 (right middle panel).

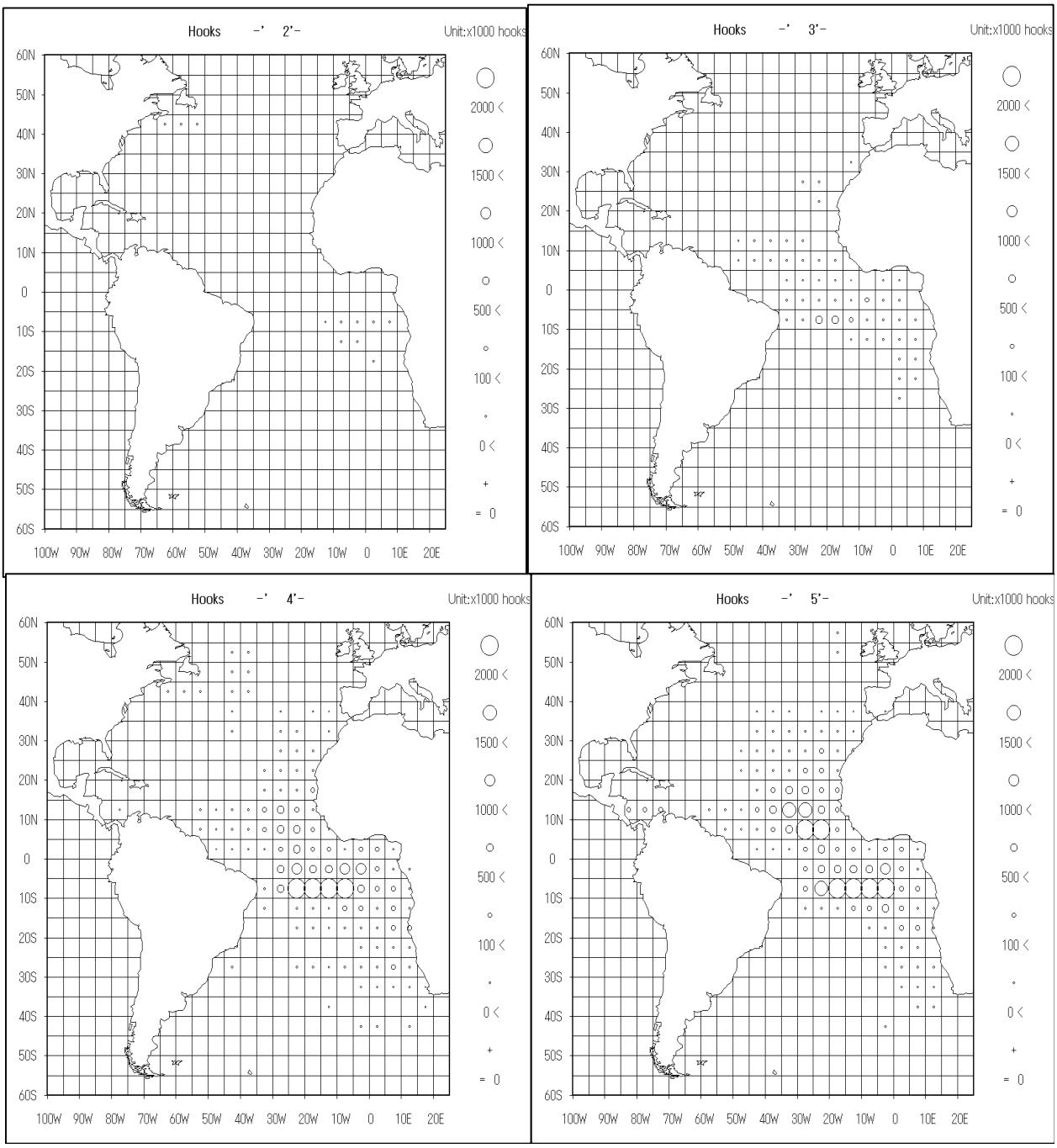

Figure 7. The average yearly effort (1000 hooks) distribution of the Japanese longliners operated with 16- hooks between float for the years between 1980-84 (left top panel), 1985-89 (right top panel), 1990-94 (left middle panel), and 1995-98 (right middle panel).

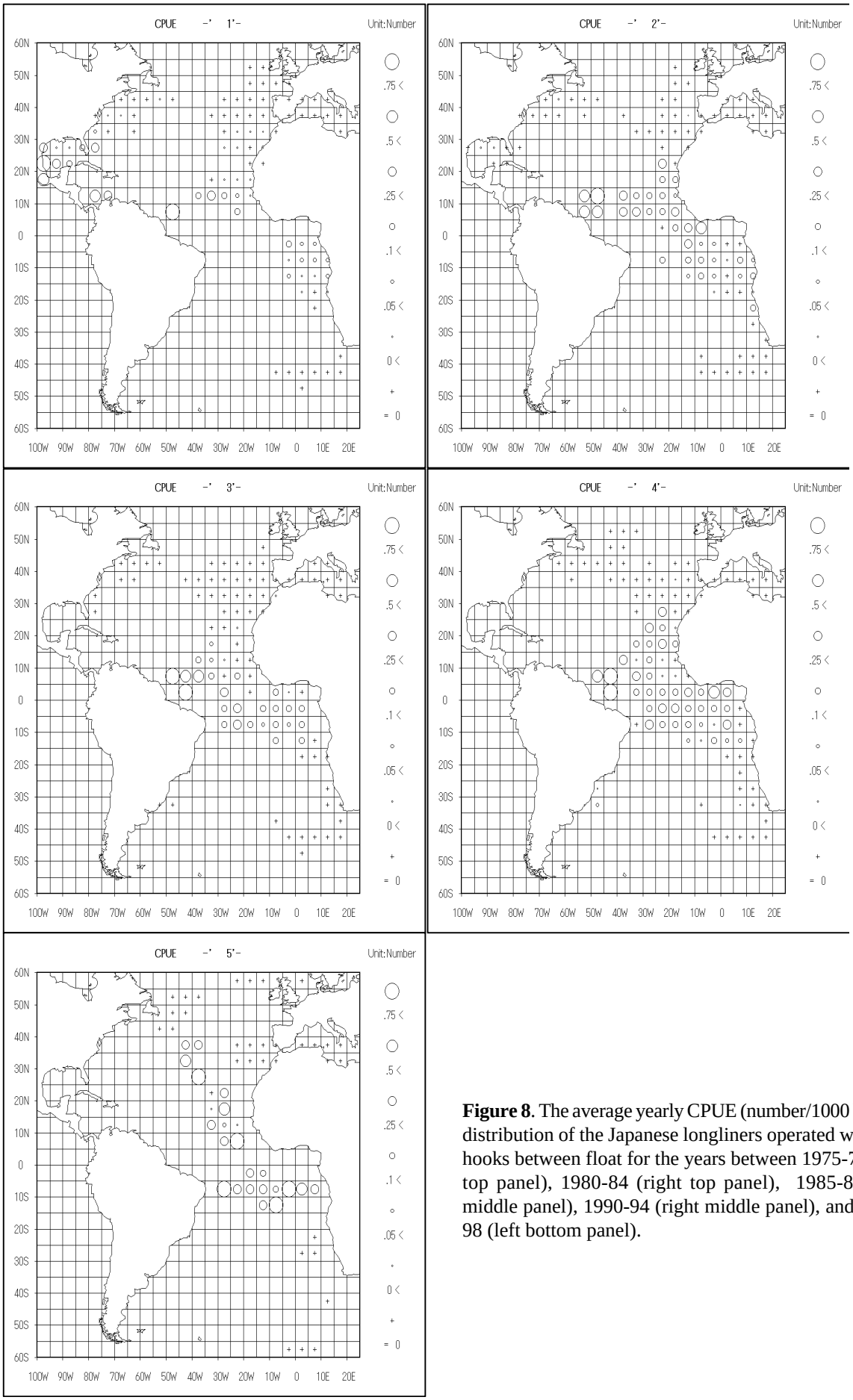

Figure 8. The average yearly CPUE (number/1000 hooks) distribution of the Japanese longliners operated with 3-4 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

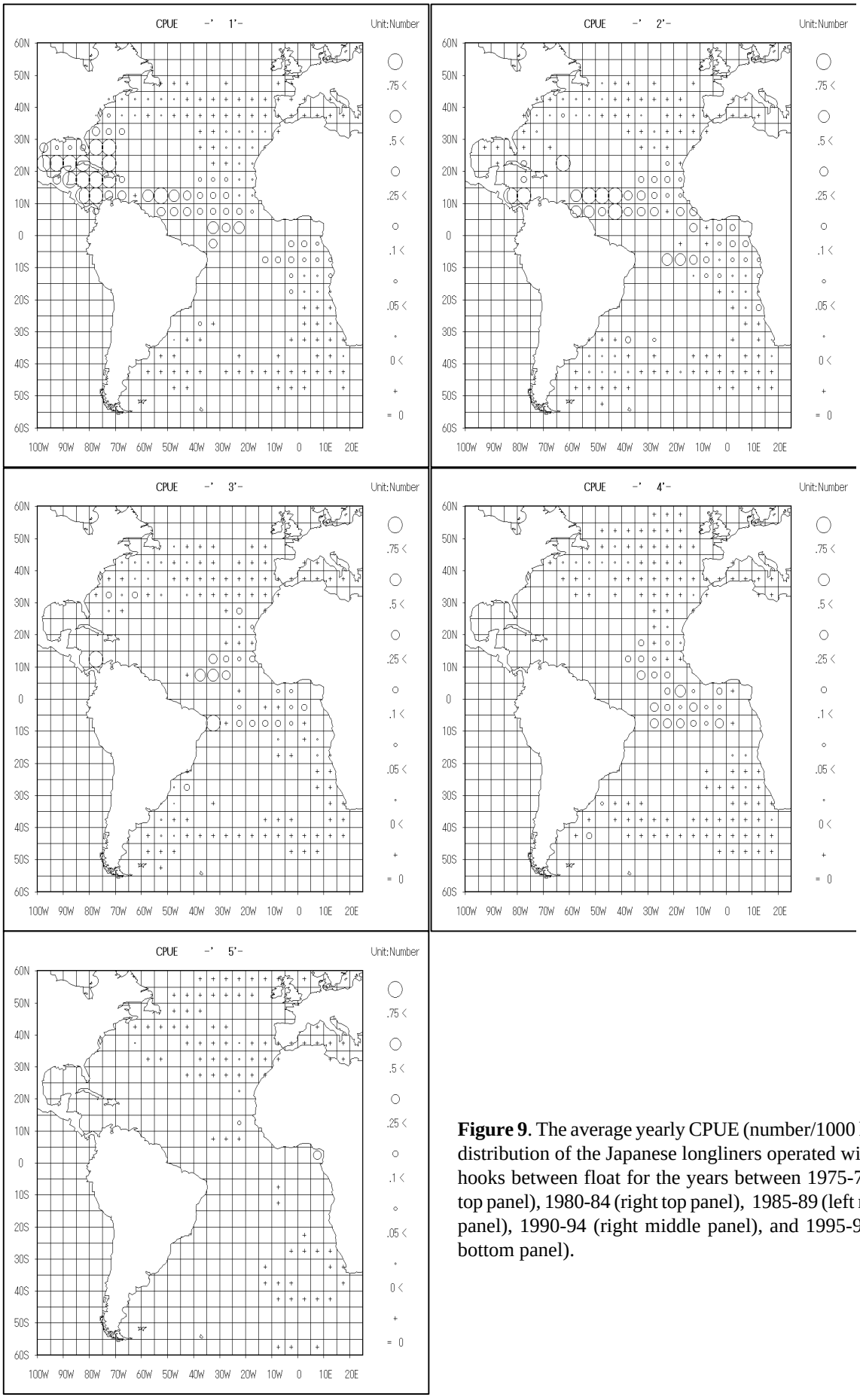

Figure 9. The average yearly CPUE (number/1000 hooks) distribution of the Japanese longliners operated with 5-6 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

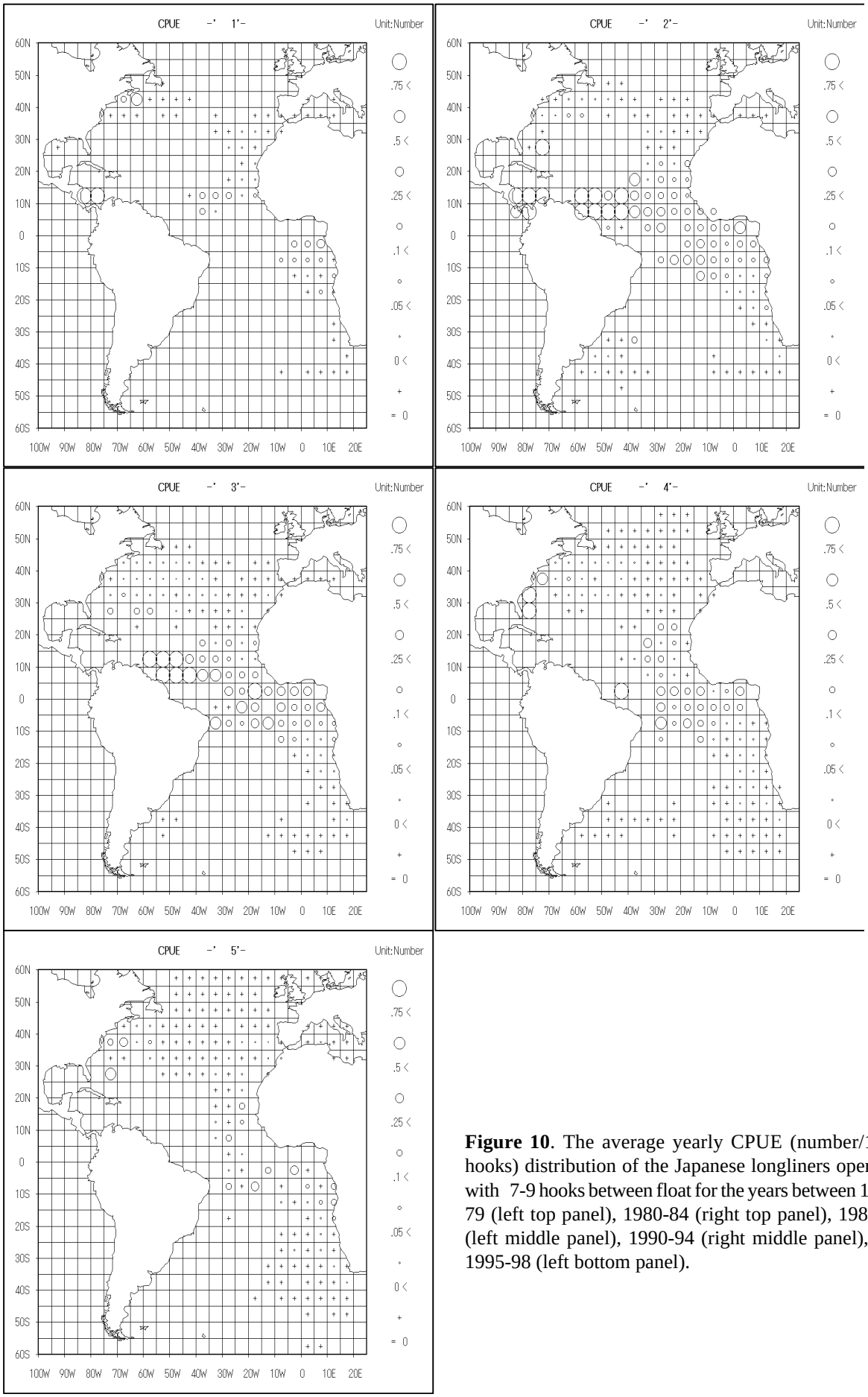

Figure 10. The average yearly CPUE (number/1000 hooks) distribution of the Japanese longliners operated with 7-9 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

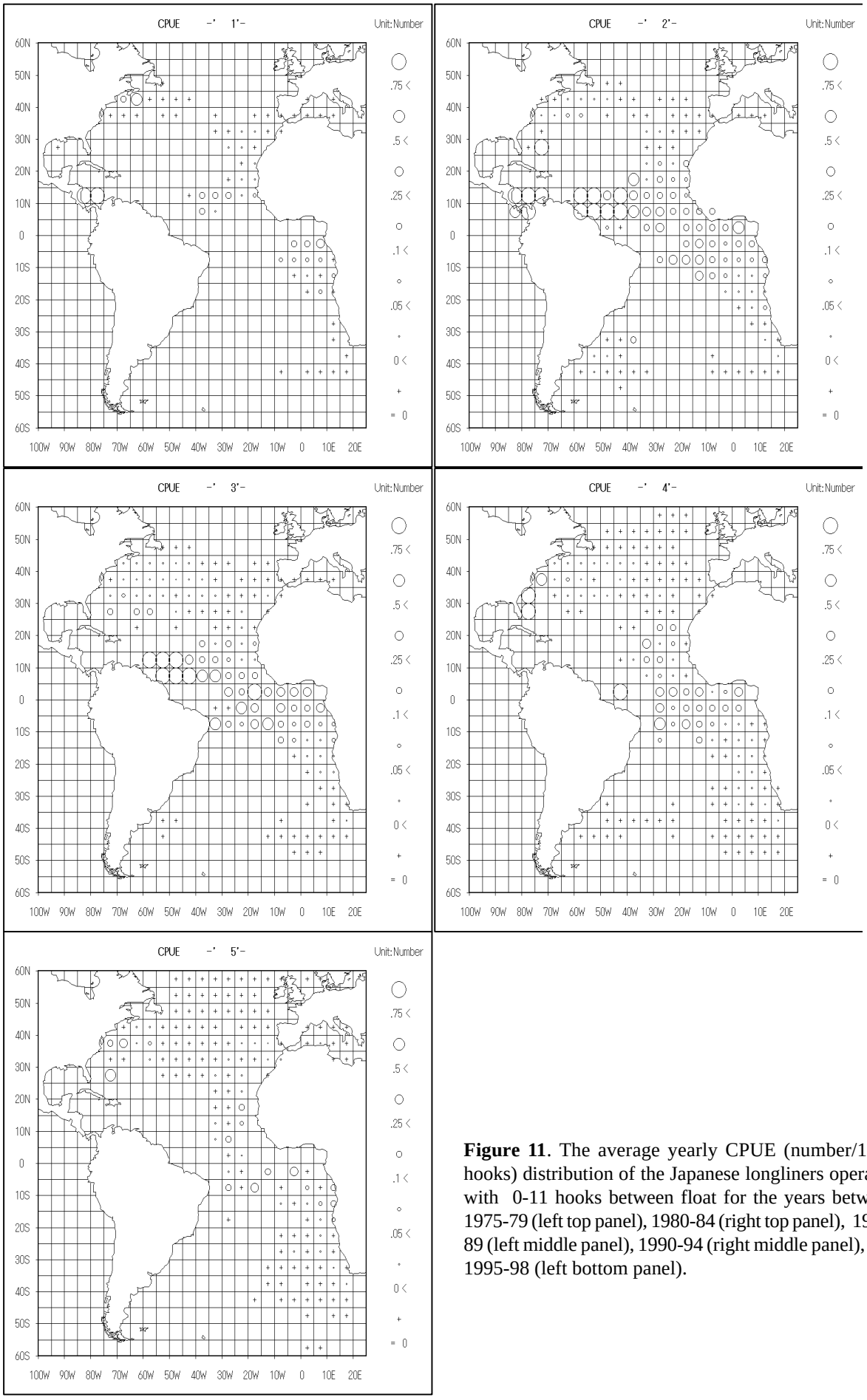

Figure 11. The average yearly CPUE (number/1000 hooks) distribution of the Japanese longliners operated with 0-11 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

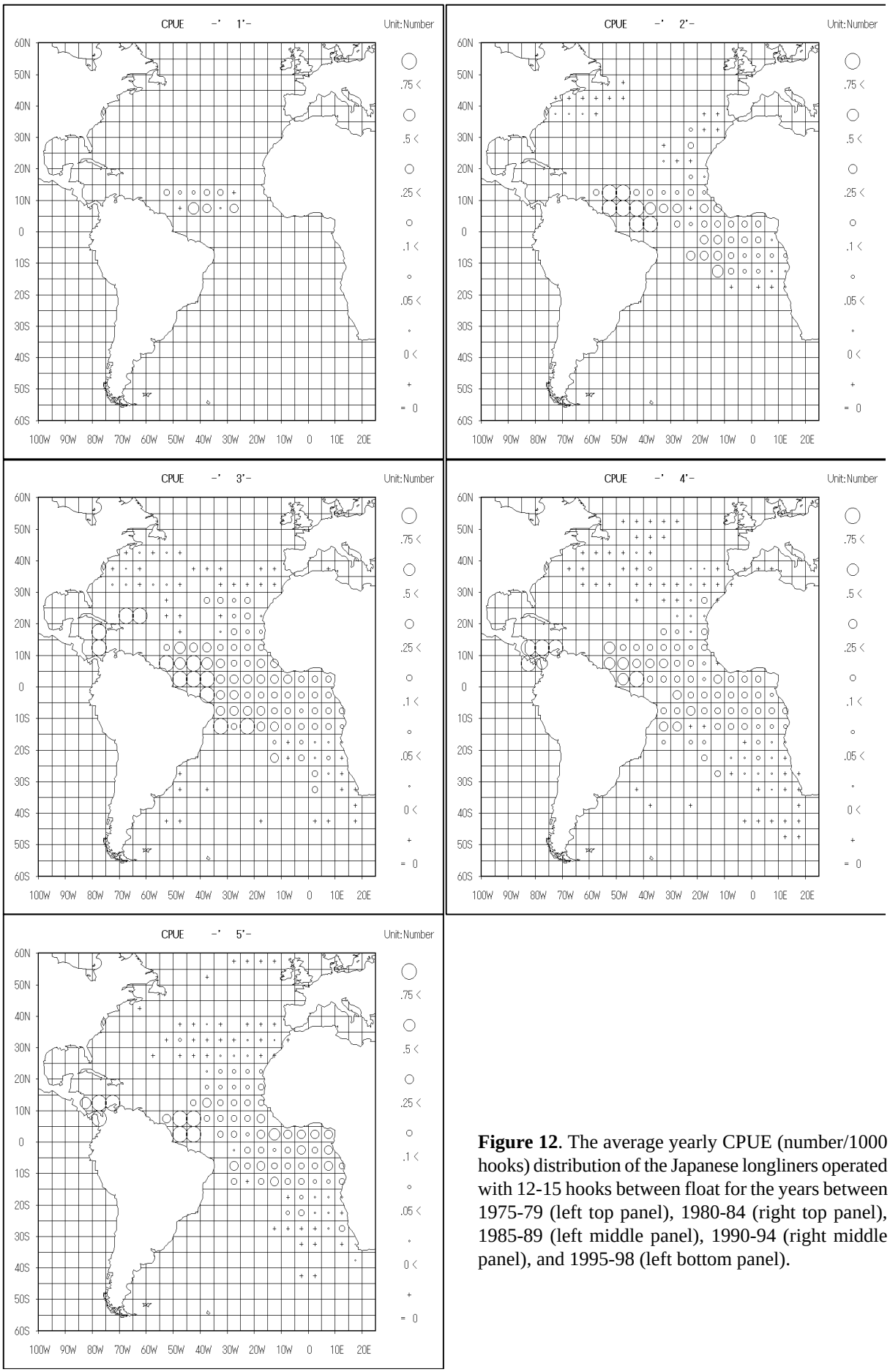

Figure 12. The average yearly CPUE (number/1000 hooks) distribution of the Japanese longliners operated with 12-15 hooks between float for the years between 1975-79 (left top panel), 1980-84 (right top panel), 1985-89 (left middle panel), 1990-94 (right middle panel), and 1995-98 (left bottom panel).

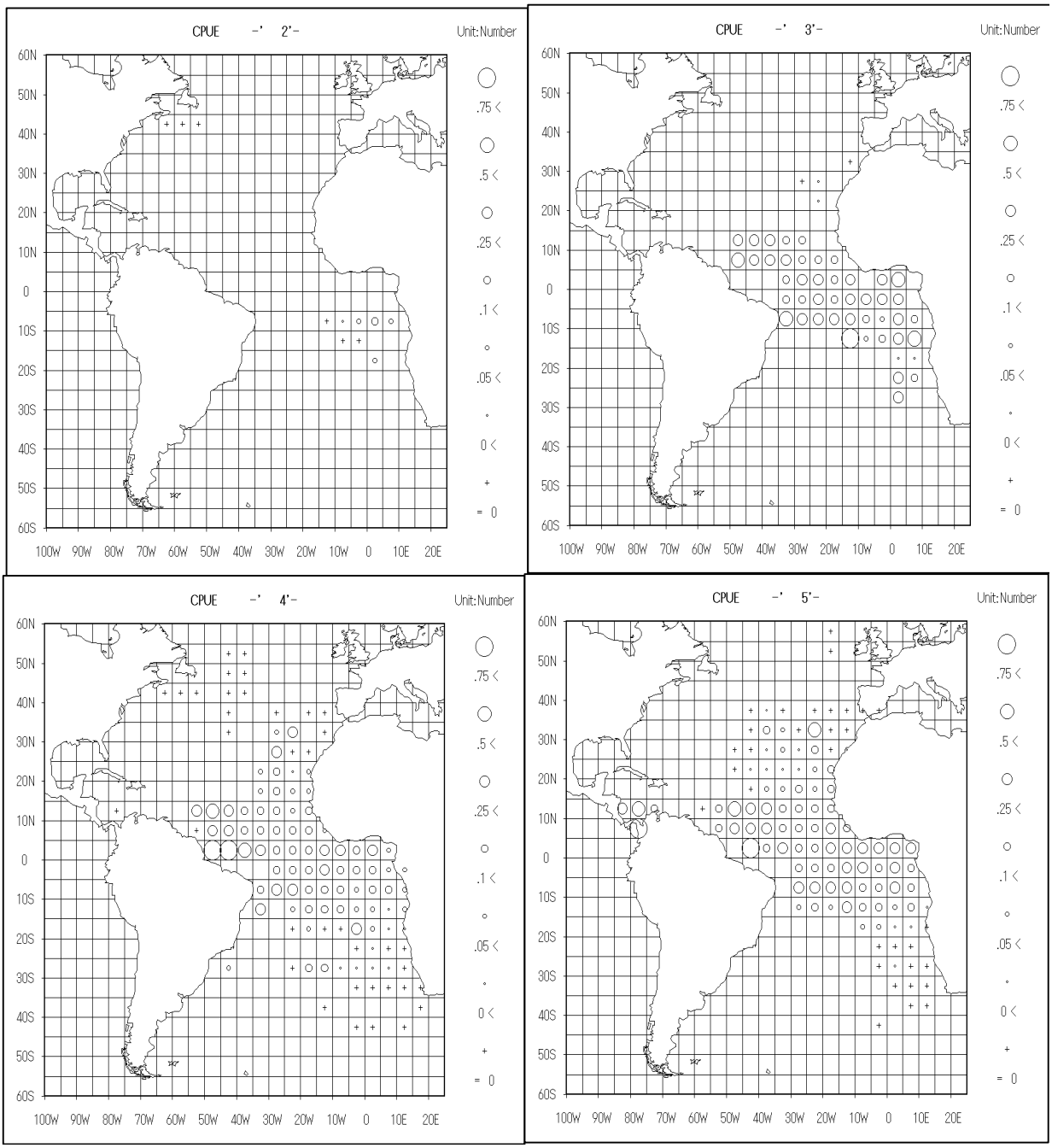

Figure 13. The average yearly CPUE (number/1000 hooks) distribution of the Japanese longliners operated with 16- hooks between float for the years between 1980-84 (left top panel), 1985-89 (right top panel), 1990-94 (left middle panel), and 1995-98 (right middle panel).

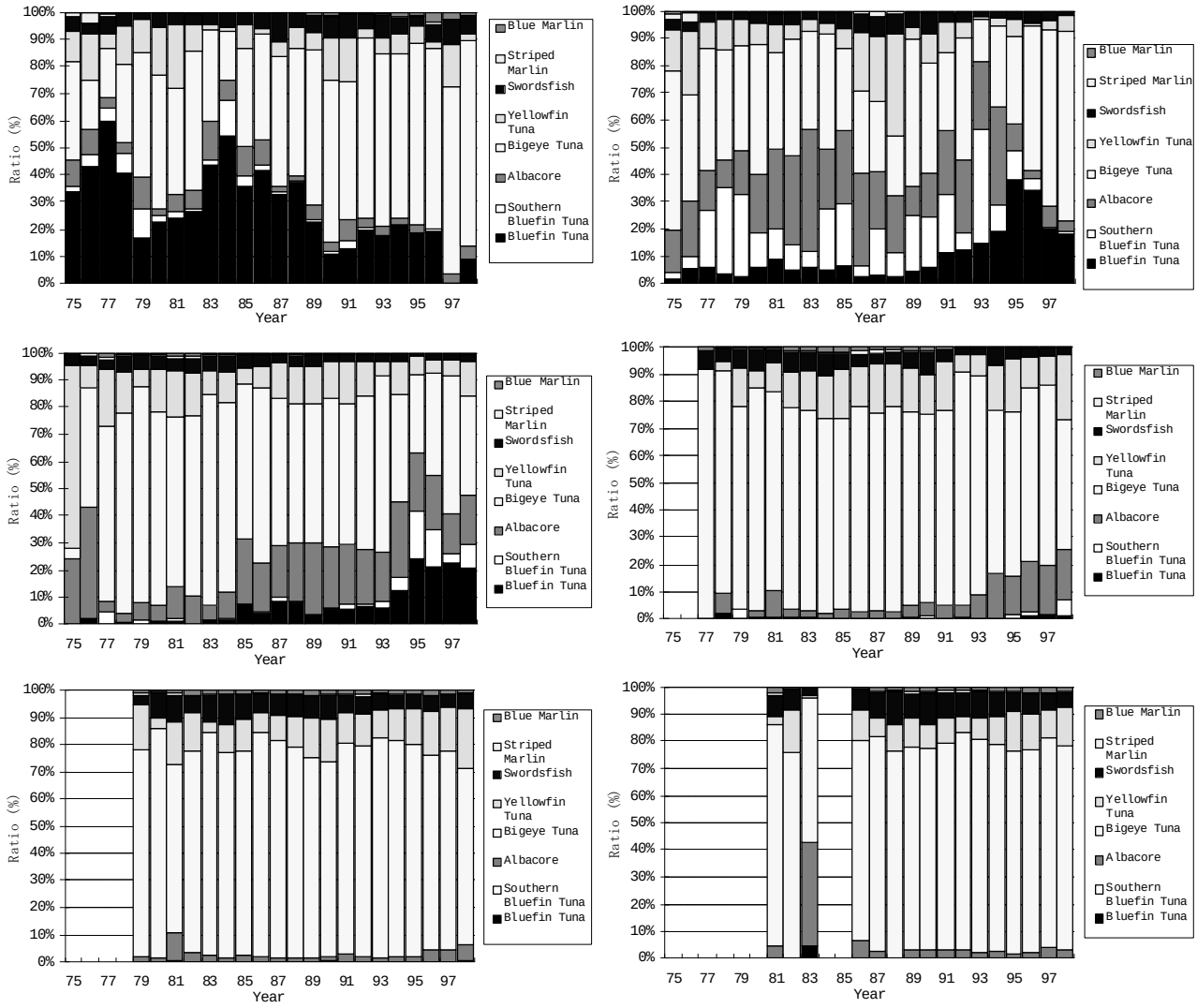

Figure 14.The ratio of catch number by species and by the gear configuration of Japanese longliners operated in the Atlantic. Left top panel shows the data for the operation with 3-4 hooks between floats, right top for the operations with 5-6 hooks between floats, left middle for the operations with 7-9 hooks between floats, right middle for the operations with 10-11 hooks between floats, left bottom for the operations with 12-15 hooks between floats, and right bottom for the operations with 15< hooks between floats.

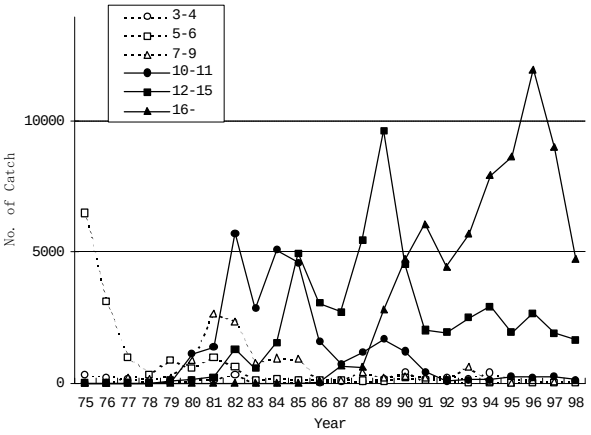

Figure 15. The number of blue marlin caught by Japanese longliners in the Atlantic by gear configuration. The gear configuration is classified into 6categories by the number of hooks between floats.

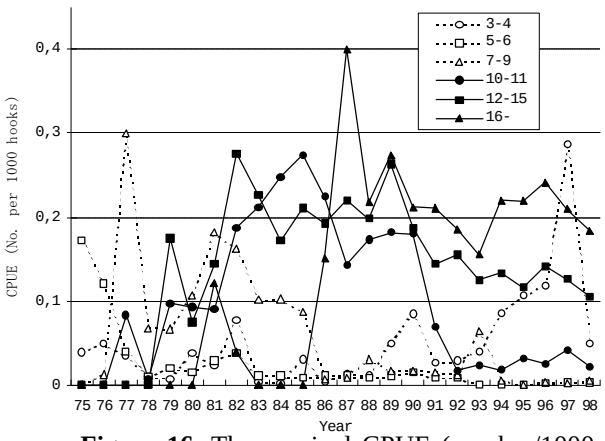

Figure 16. The nominal CPUE (number/1000 hooks) by gear configuration of blue Japanese longliners in the Atlantic. The gear configuration is classified into 6 categories by the number of hooks between floats.

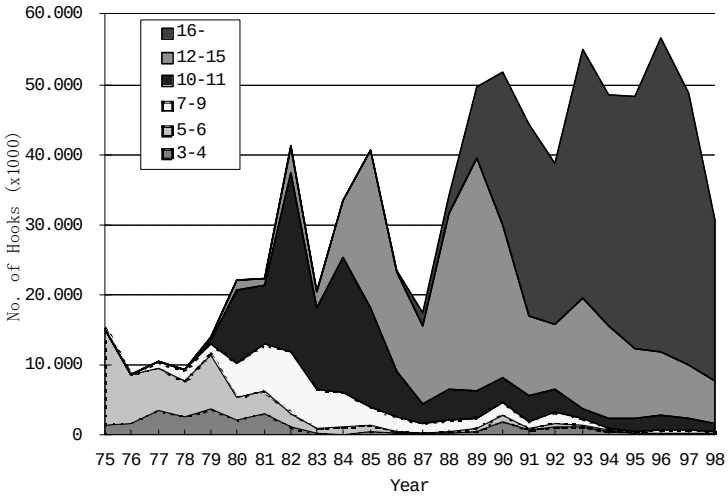

Figure 17. The amount of fishing effort (No. of hooks) of Japanese longliners by gear configuration in the tropical area of the Atlantic. Tropical area was defined by 15 degree N-15 degree south, and Caribbean Sea (west of 60 degree W).

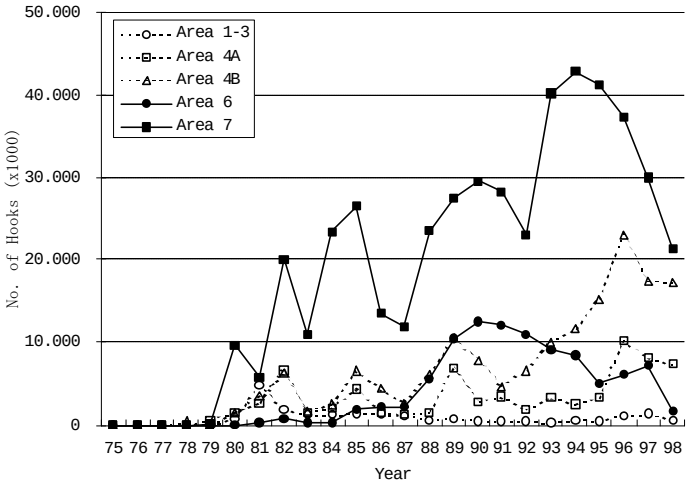

Figure 18. . The amount of fishing effort (No. of hooks) of Japanese deep longline operation (NHF is 9<) by ICCAT area in the tropical area of the Atlantic. Tropical area was defined by 15 degree N - 15 degree south, and Caribbean Sea (west of 60 degree W).