ISC/05/MAR&SWO-WGs/ 18

Operation patterns of Japanese offshore and distant-water longliners in the north Pacific, with emphasis on the billfishes [1]

Kotaro Yokawa
National Research Institute of Far Seas Fisheries, Japan
5-7-1 Orido, Simizu-ku, Shizuoka 424-8633, JAPAN

---

[1]Working document prepared for the joint session of the Marlin and Swordfish Working Groups of the Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean, Shimizu, Shizuoka, Japan, August 29 – September 2 2005. Document not to be cited without permission of the authors.

Operation patterns of Japanese offshore and distant-water longliners in the north Pacific, with emphasis on the billfishes

Kotaro Yokawa
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu-Ku, Shizuoka, 424-8633, Japan

Introduction

This document outlines the operation pattern of the Japanese offshore and distant-water longliners in the north Pacific for the period between 1975 and 2004. Major purpose of the analysis presented in this document is to evaluate input factors to the model of CPUE standardization for billfishes from the view point of data coverage and relevance of factors.

In the Atlantic Ocean, horizontal and vertical changes in effort of Japanese longliners in the time series caused unrealistic results when the CPUE of marlins was standardized (ICCAT, 2005). The major concern in this Atlantic analysis was a shift in the set depth of gear from shallower layers in early periods to deeper layers in recent years, as well as sudden drop of horizontal area coverage of effort observed in the first half of the 1970s.

If similar situations as in the Atlantic were also observed in the north Pacific, analysis of marlin CPUE should be conducted carefully so that it can correct for similar problems. Yokawa (2004) reports that traditional GLM analysis of CPUE of striped marlin caught by Japanese longliners in the northwest and north central Pacific produced an unrealistic result of higher CPUE of deep longline operation than shallower.

Materials and Methods

The data used in this study are the aggregated logbook data of Japanese offshore and distant-water longliners operating in the north Pacific (0-40N, 140E-85W), compiled in the National Research Institute of Far Seas Fisheries, Japan. Because the information on gear configuration expressed by the number of hooks per float (NHF) are available since 1975, data for the period of 1975 – 2004 are the main focus of this study. The logbook data are aggregated by month, 5x5 blocks, and NHF for 1975 – 2004, and aggregated by month and 5x5 blocks for 1952 - 1974. NHF is further categorized into 6 categories, 3-4 (gear 1), 5-6 (gear 2), 7-9 (gear 3), 10-11(gear 4), 12-15(gear 5), and >15 (gear 6). To check for regional differences in operation patterns, the north Pacific is divided into 11 areas (Fig. 1). Area stratification shown in Fig. 1 is a modification of the one used in the last CPUE standardization of striped marlin caught by Japanese offshore and distant-water longliners (Yokawa, 2004). In this study, the area around the Hawaiian island is excluded from analysis because operations of Japanese longliners in this area largely restricted by the set of the US 200 mile EEZ.

Results

Overall trends of fishery

Figure 2 shows the amount of effort (number of hooks) of Japanese longliners by gear category in the north Pacific for 1975 – 2004. As in the Atlantic, shallower sets (gears 1-3) form the majority of operations in the north Pacific in the period before the 1980s, subsequently the ratio of deeper sets (gears 5-6) gradually increases. The two most major gear categories (gears 2 & 4) in 1975-1983 have almost disappeared in recent years. Effort in the shallowest gear category (gear 1), which is minor in 1975-1982, more than doubled in the mid 1980s, and has leveled off since then.

Figure 3 shows the catch in number of striped marlin, swordfish and blue marlin by gear category. Most of swordfish were caught by gear 2 (NHF 5-6) in 1975-1982, which was gradually replaced by gear 1 (NHF 3-4) in the mid 1980s, until the late 1980s when gear 2 was almost completely out phased. Blue marlin are mainly caught by gears 2-4 in 1975-1983, but these gear types were gradually replaced by the deeper sets. Most blue marlin are caught by the deepest gear type (gear 6) since the 1990s. Striped marlin seemed to be caught by all gear categories until the late 1990s, but are caught mainly by gears 1, 5, and 6 in recent years.

Figure 4 shows the number of striped marlin, swordfish and blue marlin caught by area for 1952 - 2004. Most swordfish are caught in areas 2 and 3 which is the main fishing ground of Japanese offshore surface longliners targeting swordfish. Blue marlin are caught in the tropical areas of the north Pacific (areas 5, 9, and 11), but also in the subtropical areas in the northwest Pacific (areas 2 and 3). Striped marlin are mainly caught in subtropical areas (areas 2, 3, 7, 8, 10, and 11). In the northeast Pacific, a large number of striped marlins were caught in areas 10 and 11 in the periods between the mid 1960's and the late 1980s. Most of them were caught by operations targeting striped marlin.

Regional trends of fishery

Catch composition of major tunas and billfishes for 1952–2004, amount of effort by gear category for 1975-2004, and catch composition of major tunas and billfishes by the gear category for 1975-2004 are reviewed in each area to see the historical change of major target species and major gear configurations for catching them.

Figures 5 and 6 show the summary of history of the fishery in area 1. The major target species in area 1 are albacore, bigeye tuna and yellowfin tuna. They are caught by gears 2-5 prior to the 1990s when gear 6 becomes the major gear. Few swordfish fishery operation with shallow sets are seen in this area. This area is known as the one of main fishing grounds of the bluefin tuna fishery in the spring.

Figures 7 and 8 show a summary of the history of the fishery in area 2. Major targeted species in Area 2 are albacore, bigeye tuna and swordfish. Swordfish is caught by gear 2 until the mid 1980s when the fishery gradually shifts into gear 1. These two gear categories also catch bigeye tuna and

albacore. Operations with deeper sets are also observed. They are conducted with gears 4 and 5 up to the end of the 1980s when they are gradually substituted by gear 6. Gear 6 become the principal gear type since the end of the 1990s.

Figures 9 and 10 show a summary of the history of the fishery in area 3. The operation pattern of Japanese longliners in area 3 is similar to those in area 2. The main species caught in area 3 are albacore, bigeye tuna and swordfish. Swordfish is caught by gear 2 until the mid 1980s when the fishery gradually shifts to gear 1. These shallow sets also catch some yellowfin tunas and striped marlins. Deeper sets also observed as in area 2. Gears 3, 4 and 5 are the main gear configurations in the period before the late 1980s when they are gradually substituted by gear 6. These deep sets catch mainly albacore and bigeye tuna, and also some yellowfin tunas and striped marlins.

Figures 11 and 12 show a summary of history of the fishery in area 4. The main gear configurations during the 1970s are gear 2, 4 and 5. Gear 2 almost disappears in the 1980s, and operations with gear 6 started at the same time. The ratio of operations with gear 6 increased gradually in the 1980s, and became dominant in the 1990s and there after. Bigeye tuna and yellowfin tuna are two major target species in this area, and they are caught by all gear categories. In addition, the catch of albacore increased rapidly in the 1990s. Some blue marlin catches are also observed throughout the period analyzed, but striped marlin catch is almost nothing.

Figures 13 and 14 show a summary of the history of the fishery in area 5. Operation patterns of Japanese longliners in area 5 are similar to those in area 4, but the catch of subtropical species such as albacore and striped marlin is nil. Major target species in area 5 is yellowfin and bigeye tuna. Some catch of blue marlin is also observed. In the 1970s, gears 2-5 are observed. The amount of effort of gear 2 comprises about two thirds of the total, but it rapidly disappears in the 1980s. The amount of effort employing gears 4 and 5 increased in the 1980s, but these are superseded by gear 6 in the 1990s. All gear categories catch bigeye and yellowfin tunas in the periods analyzed. Some blue marlins are also caught by all gear types.

Figures 15 and 16 show the summary of history of the fishery in area 6.Gears 2, 3, 4, and 5 are recorded during the 1970s and amount of effort of gear 2 is about half of the total. Since the beginning of the 1980s, the amount of effort of gear 3 starts to increase and other three gear categories becomes minor in the 1990s. Bigeye tuna and albacore are the main target species, and swordfish is also caught mainly in shallow sets (gears 2 and 3).

Figures 17 and 18 show a summary of the history of the fishery in area 7. Gears 2, 3, 4, and 5 are recorded during the 1970s but gear 2 almost disappears in the 1980s. Larger amount of effort of gear 6 are recorded in 1999, 2000, 2002 and 2003. Catch of bigeye tuna occupied largest part of the total, except for some years when albacore catch are the largest. Catch of striped marlin is also observed in 1969-1973. Japanese longliners have used a variety of gear configurations historically, but bigeye tuna are believed to be the main target in most cases.

Figures 19 and 20 show a summary of the history of the fishery in area 8. Gears 2, 3, 4, and 5 are used by Japanese longliners in the 1970s, but gears 2 and 3 have almost disappeared by the 1980s. Gear 6 begins to replace Gears 4 and 5 in the mid 1990s and it becomes dominant in the end of the 1990s. Bigeye tuna is the most important species in this area for the Japanese longliners throughout the period analyzed. Some yellowfin tuna, striped marlin and blue marlin are also observed.

Figures 21 and 22 show a summary of the history of the fishery in area 9. Gears 2, 3, 4, and 5 are used by Japanese longliners up to the mid 1980s when the amount of total effort significantly declined. The amount of effort starts to increase in the mid 1990s due to operations with gear 6. Bigeye tuna and yellowfin tuna are the main target species in this area, and some catch of blue marlin and swordfish is also observed.

Figures 23 and 24 show a summary of the history of the fishery in area 10. Shallow sets (gear 1 and 2) are the main strategy for Japanese longliners in the 1970s and the 1980s. Japanese longliners mainly caught striped marlin and bigeye tuna in these periods. Japanese longliners started to target only bigeye tuna with gear 3 since the end of the 1990s. Most striped marlins are caught by gears 1 and 2.

Figures 25 and 26 show a summary of the history of the fishery in area 11. Gears 2, 3, 4, and 5 are used by Japanese longliners up to the mid 1980s when the amount of total effort significantly declined. The amount of effort began to increase in the mid 1990s due to operations with gears 3 and 6. The most important fish in this area is bigeye tuna, and some yellowfin tuna, striped marlin as well as blue marlin also appeared in the catch. The historical pattern of operation of Japanese longliners is similar to those in area 9.

Discussion

Japanese longliners operating in the north Pacific seemed to target albacore, bigeye tuna and swordfish in the northern areas (areas 2 and 6); albacore, bigeye tuna, swordfish and striped marlin in the middle latitude areas (area 3, 7, 10); and target bigeye tuna and yellowfin tuna in the tropical areas (areas 1, 4, 5, 8, 9, and 10). In most of areas, target species appeared not to change over time while gear configurations used in each area changed from shallow to deep. Major gear categories in the 1970s became quite minor or almost disappeared in the 1990s. This drastic change of gear configuration would have a significant impact on the estimation of effect of gear configuration in the traditional GLM analysis (Yokawa, 2003).

Areas 2 and 3 are the main fishing grounds of Japanese surface longliners targeting on swordfish. One of main differences in this fishery from others is that this fishery sets gear during the night time. In recent years, Japanese surface longliners exclusively use gear 1, which began to started to be major gear category in the mid 1980s. Gear 2 is dominant in the period before the mid 1980s. Because the swordfish targeting fishery in the northwest Pacific started before the 1950s, at least part of operations with gear 2 in areas 2 and 3 are the night sets. Most of operations with gear 2 in other areas are believed

to be day sets targeting striped marlin, albacore, bigeye tuna as well as yellowfin tuna. These differences in set times should be taken into account in the analysis of CPUE.

Gears 4 and 5 are popular gear categories during the 1980s in most of areas. In the 1980s, Japanese longliners use these two categories of gear to catch bigeye tuna and albacore in the subtropical areas (areas 6, 7, and 8), but also Japanese longliners use these gear to catch bigeye tuna and yellowfin tuna in the tropical areas (areas 5, 9, and 11). It would be interesting to examine if there are any differences in the CPUE of marlins caught by these gears in the subtropical and the tropical areas.

In the Atlantic, It is suggested that the significant decline of the horizontal coverage of data of Japanese longliners observed in the first half of the 1970s, which occurred due to a decrease in the amount of effort, caused a large bias in estimation of the trends of CPUE of marlins standardized by GLM (ICCAT, 2005). In the north Pacific, significantly decreased amounts of effort are observed in areas 1, 3, 6, 8, 9, 10, and 11. The impacts of these declines in the amount of effort on the results of CPUE standardization of billfish should be investigated.

The results of this study strongly indicate that standardized CPUE estimated by the traditional GLM methods (Yokawa, 2003) should not be used alone in a stock assessment but be used in the comparison with indices estimated by other methods. And also, a standardization of CPUE of billfishes caught by Japanese longliners in the north Pacific should not be conducted in an integrated stock assessment model as such way would hamper to evaluate possible biases descried above.

References

ICCAT (2005); Report of the data-preparatory meeting for the 2006 billfish assessment. ICCAT SCRS/2005/010, 73p.

Yokawa (2003); Preliminary results of study on the effect of gear configuration in CPUE standardization by GLM methods. ICCAT SCRS/2003/035, 20p.

Yokawa (2004); Standardizations of CPUE of striped marlin caught by Japanese offshore and distant-water longliners in the northwest and north central Pacific. ISC/04/MARLIN-WG/2,13p.

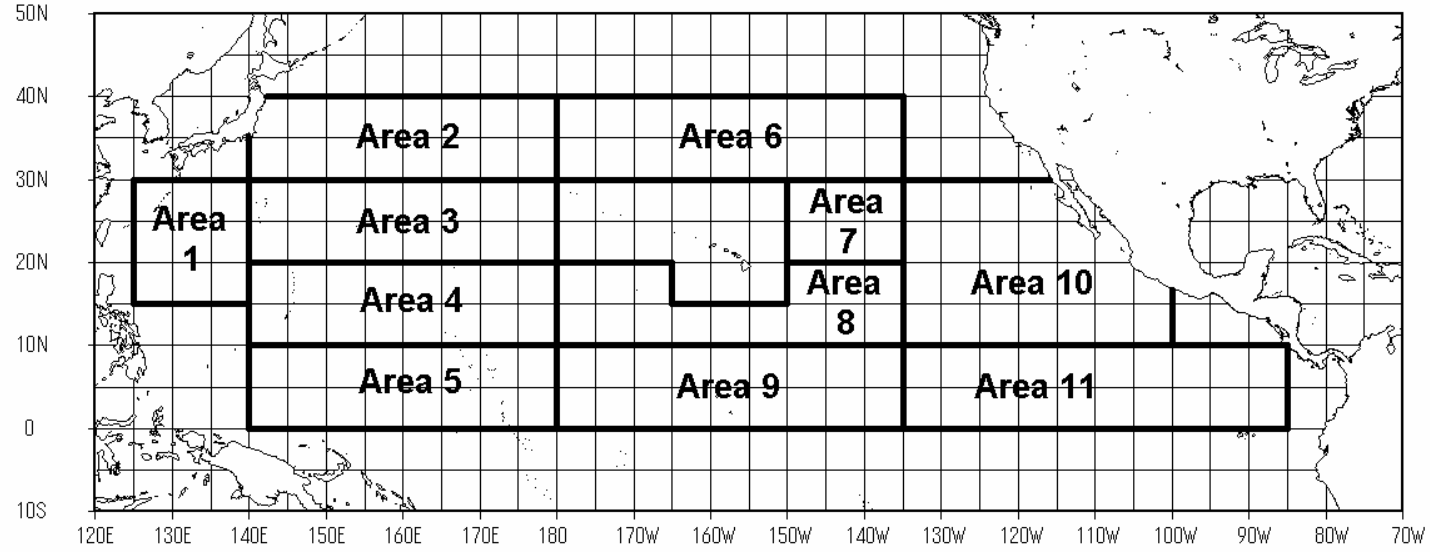

Fig. 1. Area stratification used in this study.

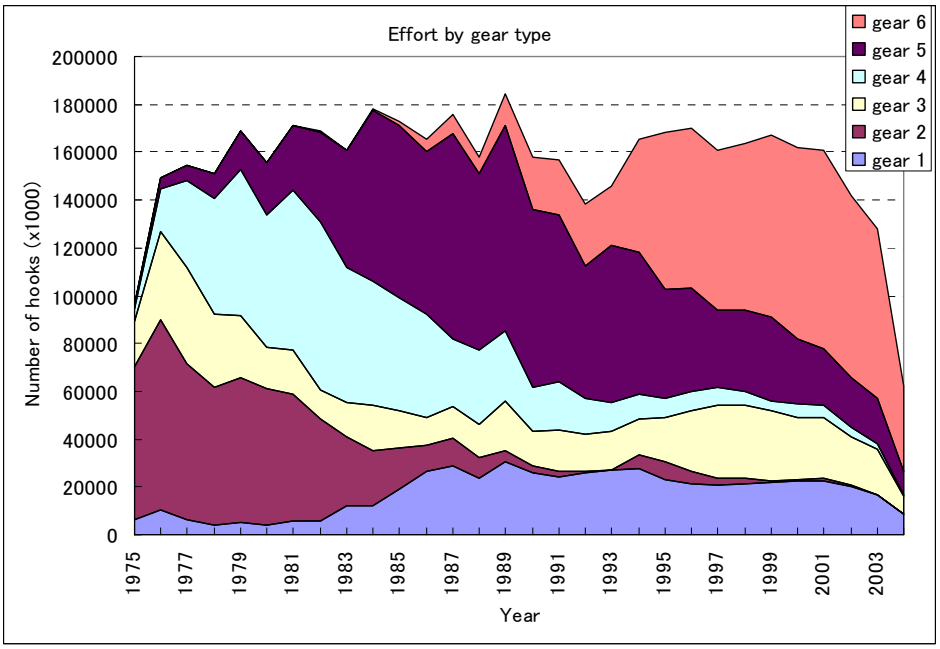

Fig. 2. Amount of effort of Japanese offshore and distant-water longliners in the north Pacific by gear category for 1975 - 2004. Data outside of the designated areas shown in Fig. 1 is eliminated.

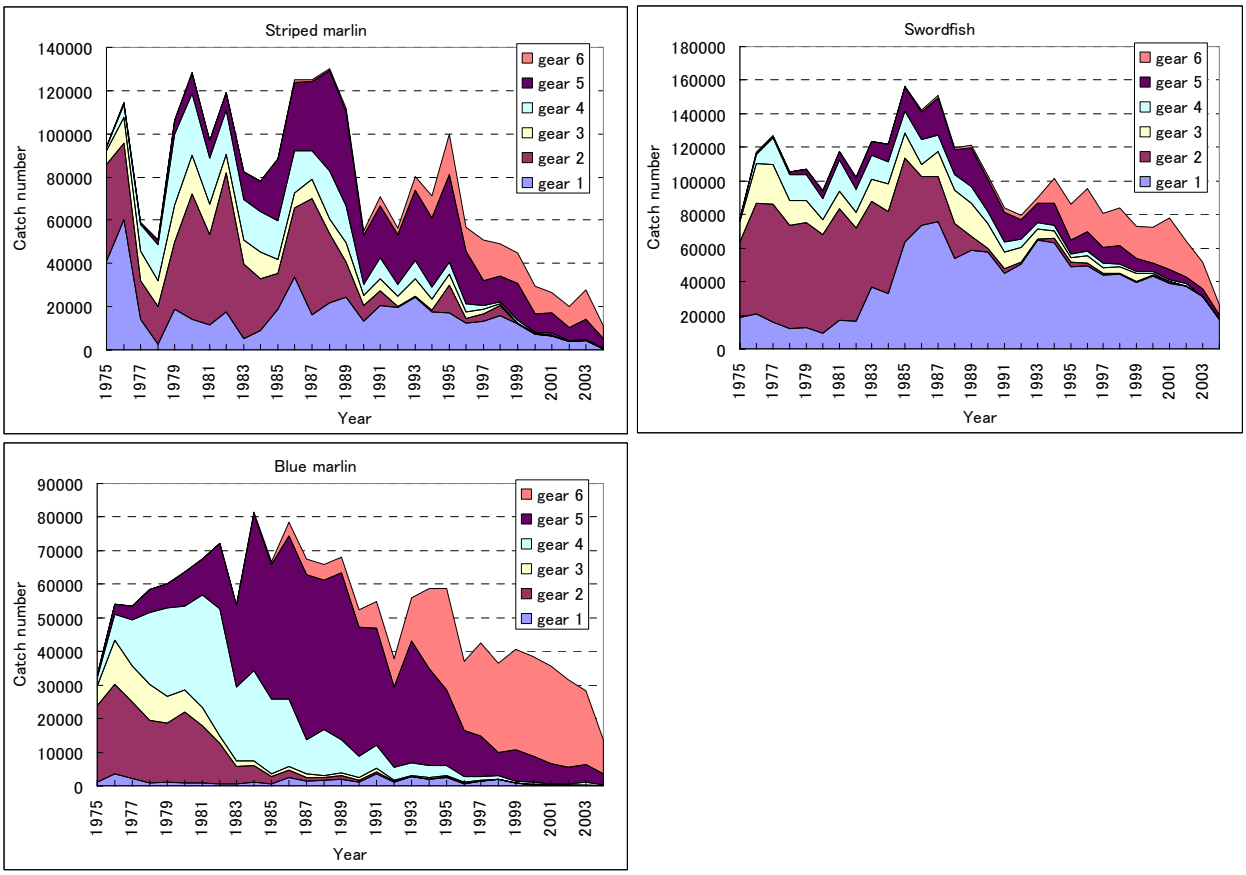

Fig. 3. Catch in number of striped marlin (left top), swordfish (right top) and blue marlin (left bottom) caught by Japanese offshore and distant-water longliners in the north Pacific by gear category for 1975 - 2004. Data outside of the designated areas shown in Fig. 1 is eliminated.

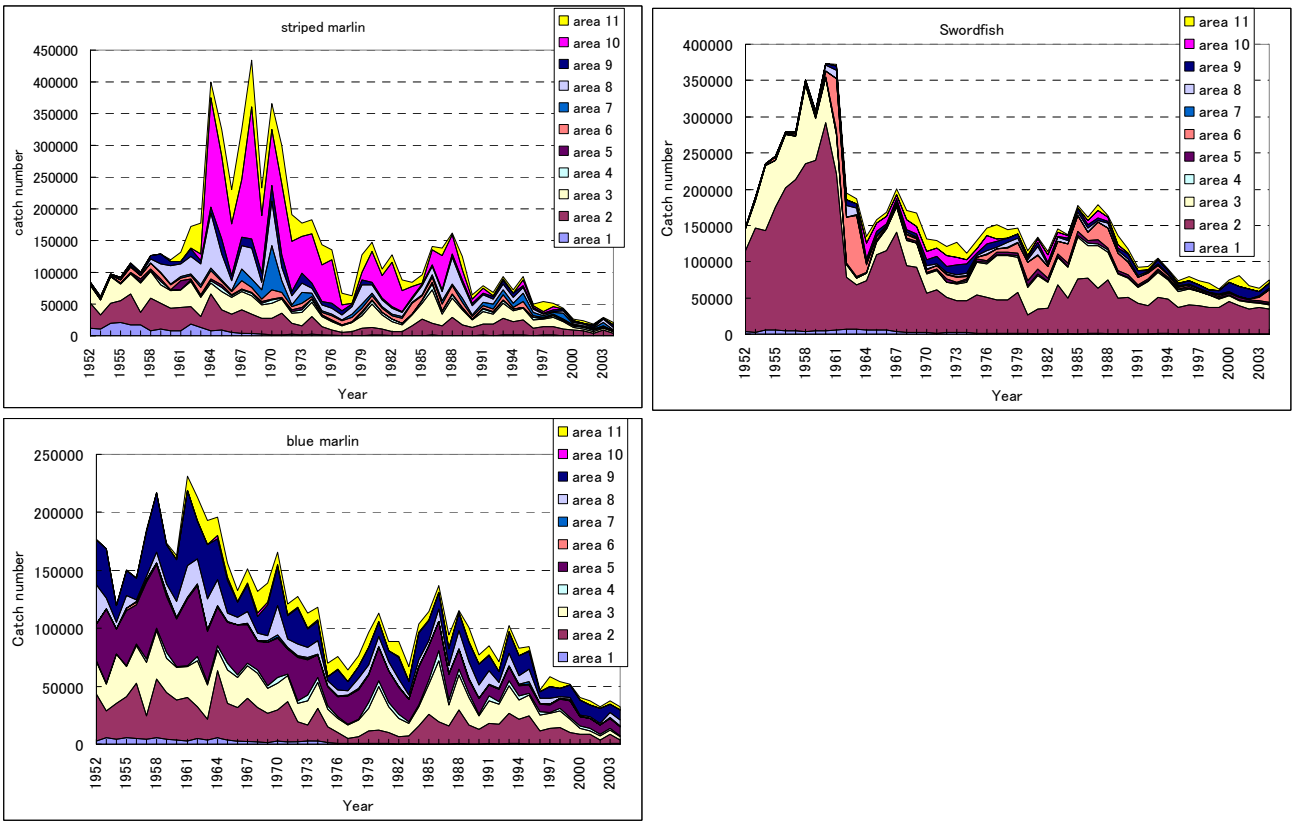

Fig. 4. Catch number of striped marlin (left top), swordfish (right top) and blue marlin (left bottom) caught by Japanese offshore and distant-water longliners in the north Pacific by area for 1952 - 2004. Data outside of the designated areas shown in Fig. 1 is eliminated.

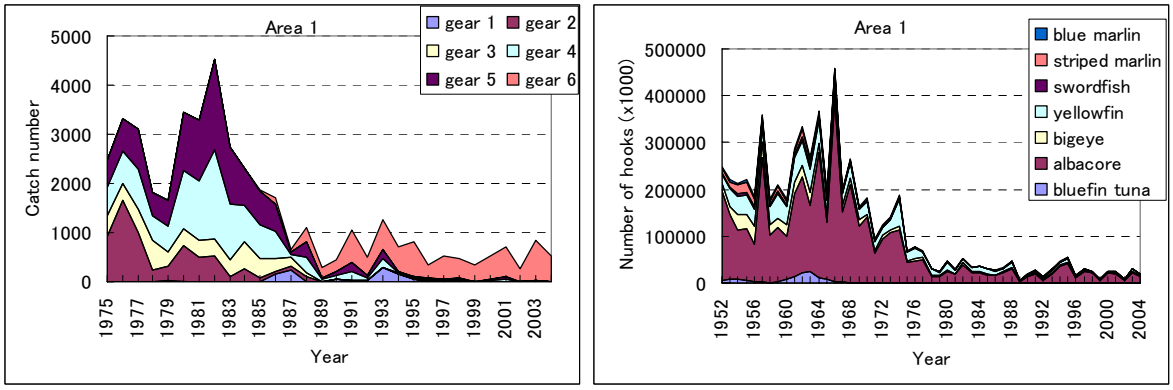

Fig. 5. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 1 (left panel) for 1952 – 2004, and amount of effort by gear category in area 1 for 1975 – 2004 (right panel).

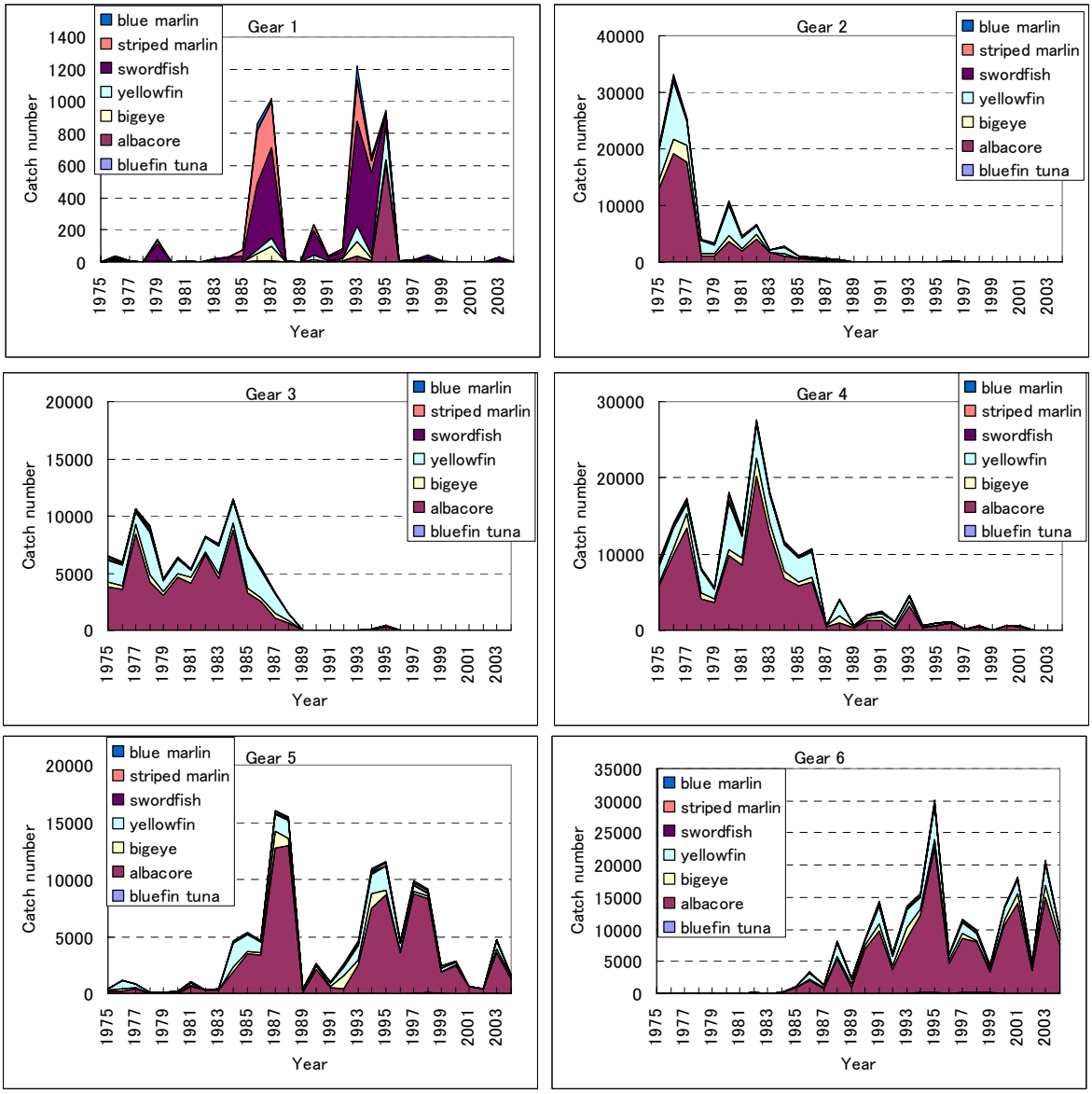

Fig. 6. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 1 for 1975 – 2004.

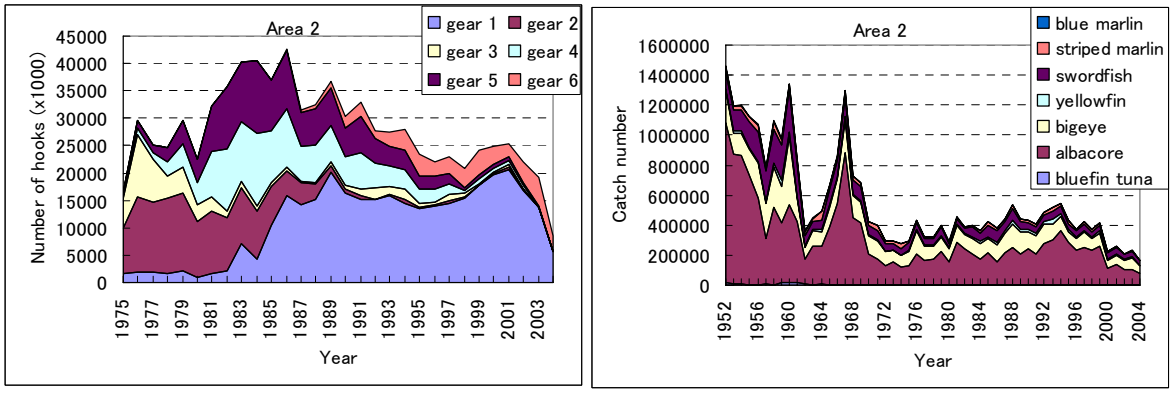

Fig. 7. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 2 (left panel) for 1952 – 2004, and amount of effort by gear category in area 2 for 1975 – 2004 (right panel).

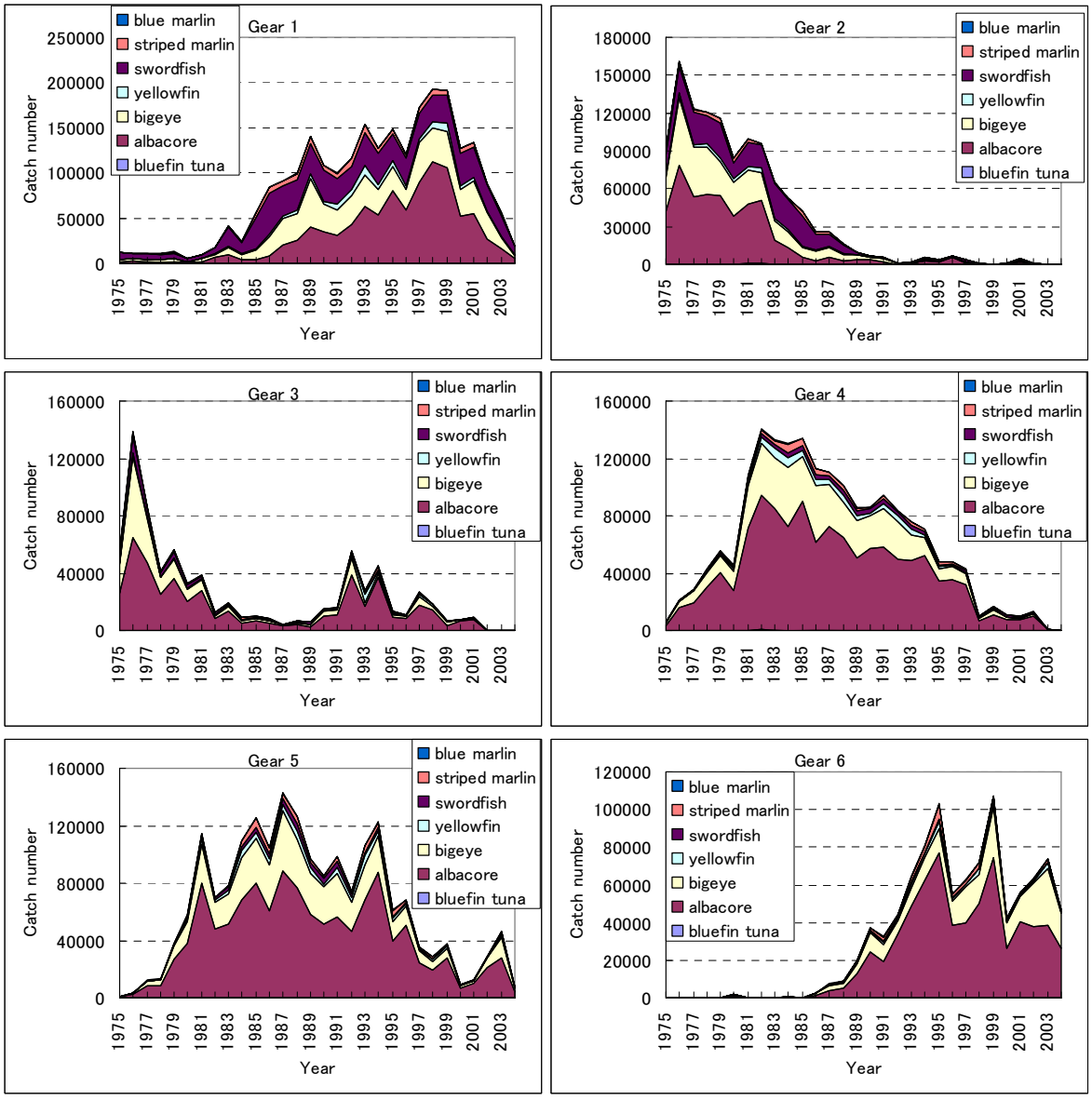

Fig. 8. Catch number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 2 for 1975 – 2004.

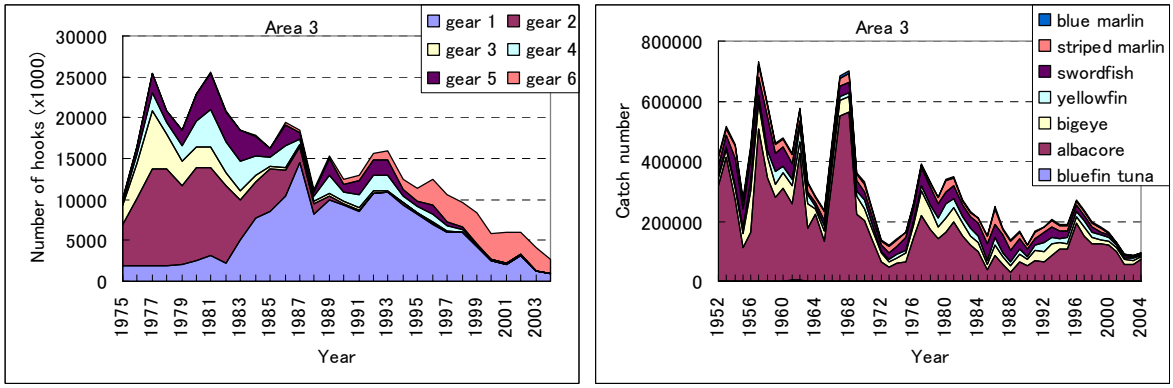

Fig. 9. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 3 (left panel) for 1952 – 2004, and amount of effort by gear category in area 3 for 1975 – 2004 (right panel).

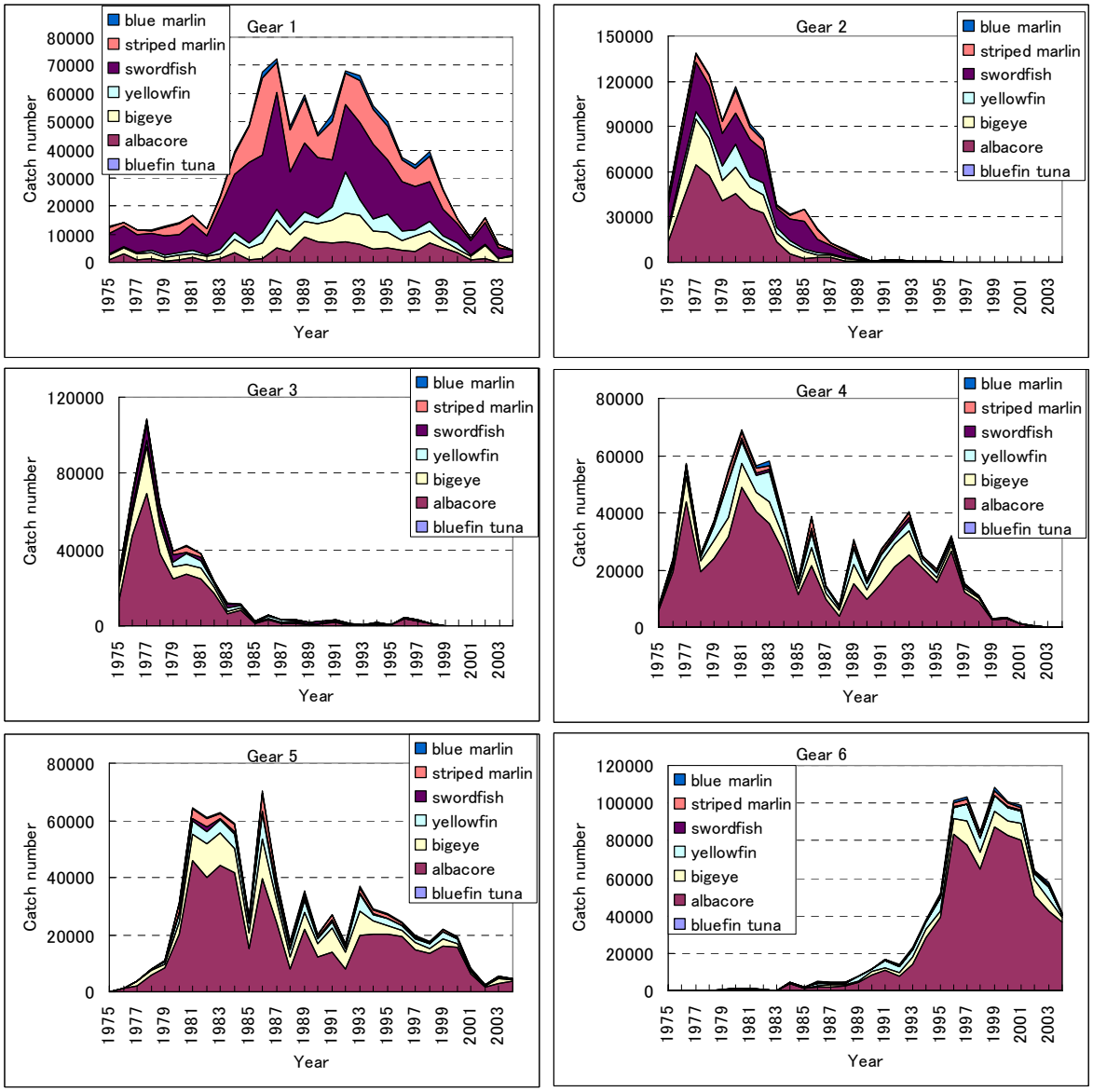

Fig. 10. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 3 for 1975 – 2004.

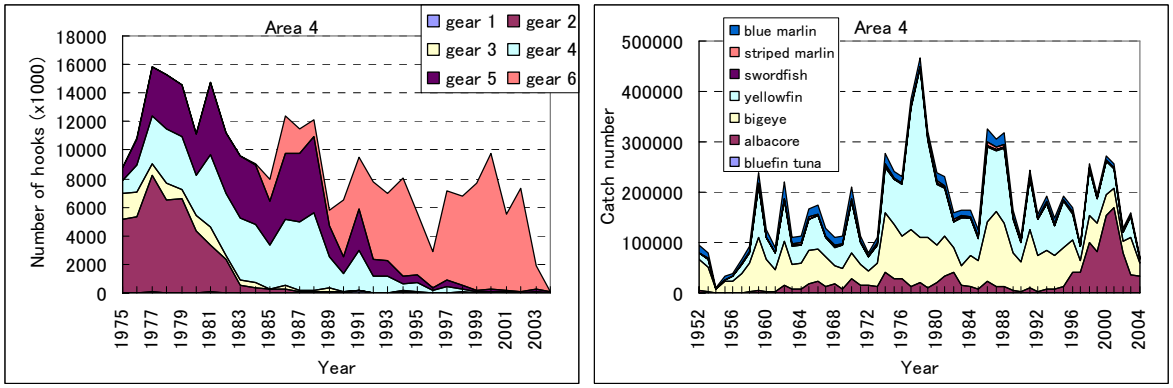

Fig. 11. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 4 (left panel) for 1952 – 2004, and amount of effort by gear category in area 4 for 1975 – 2004 (right panel).

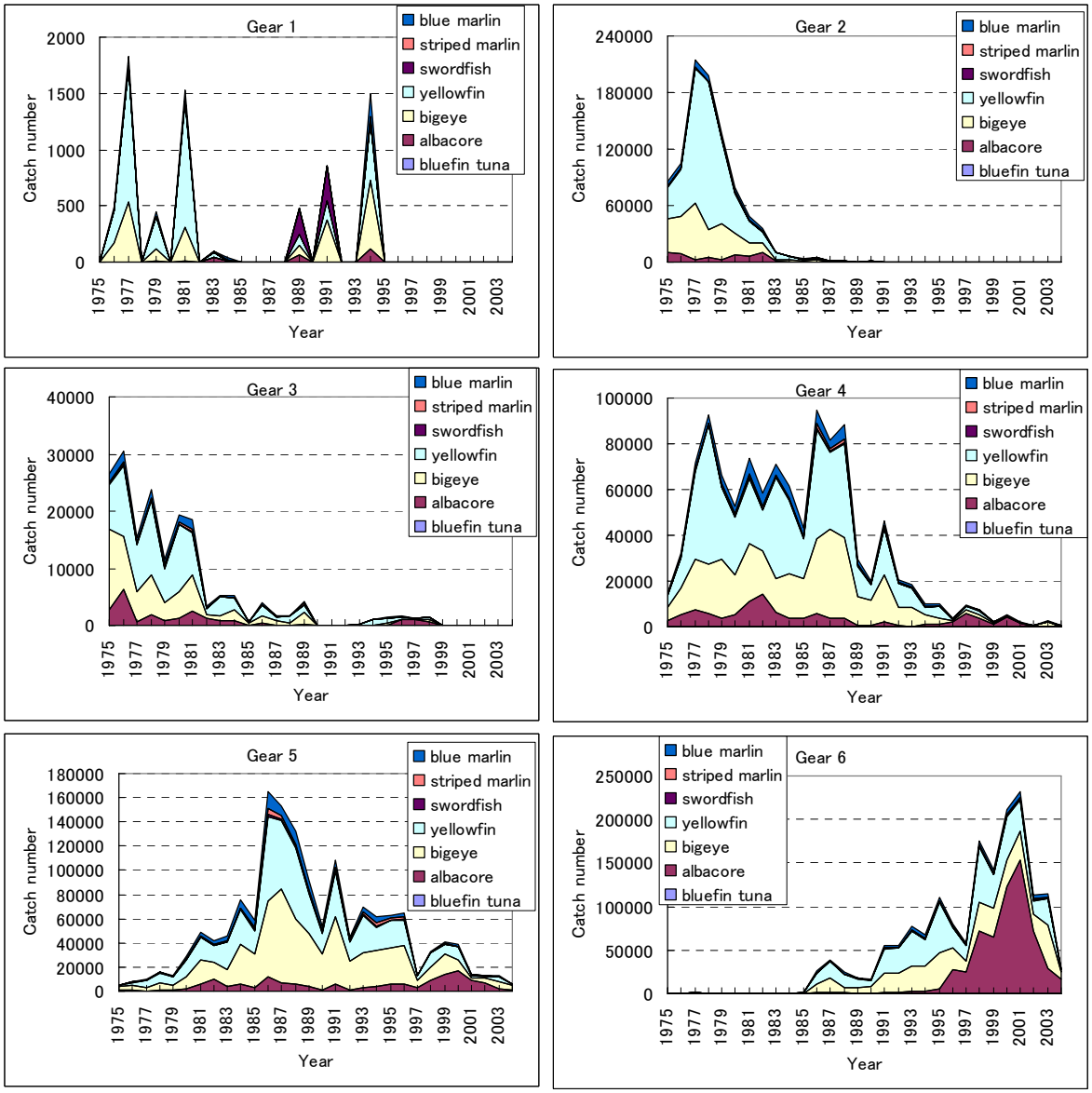

Fig. 12. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 4 for 1975 – 2004.

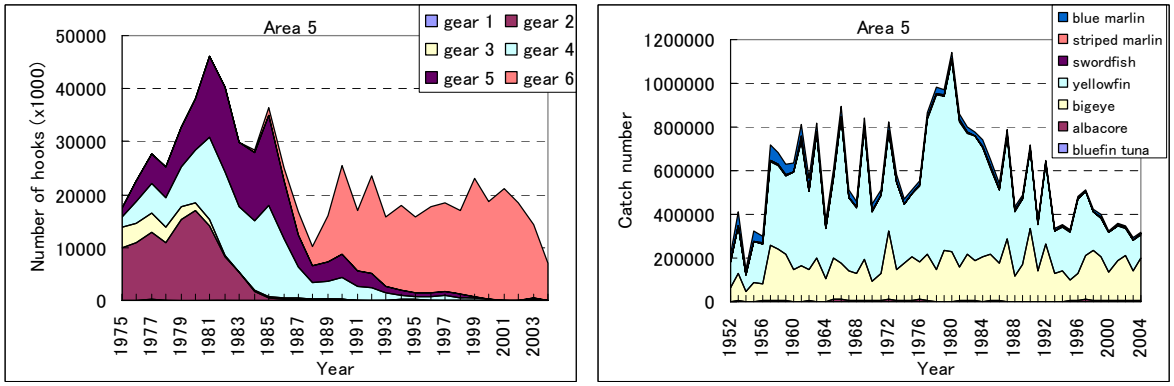

Fig. 13. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 5 (left panel) for 1952 – 2004, and amount of effort by gear category in area 5 for 1975 – 2004 (right panel).

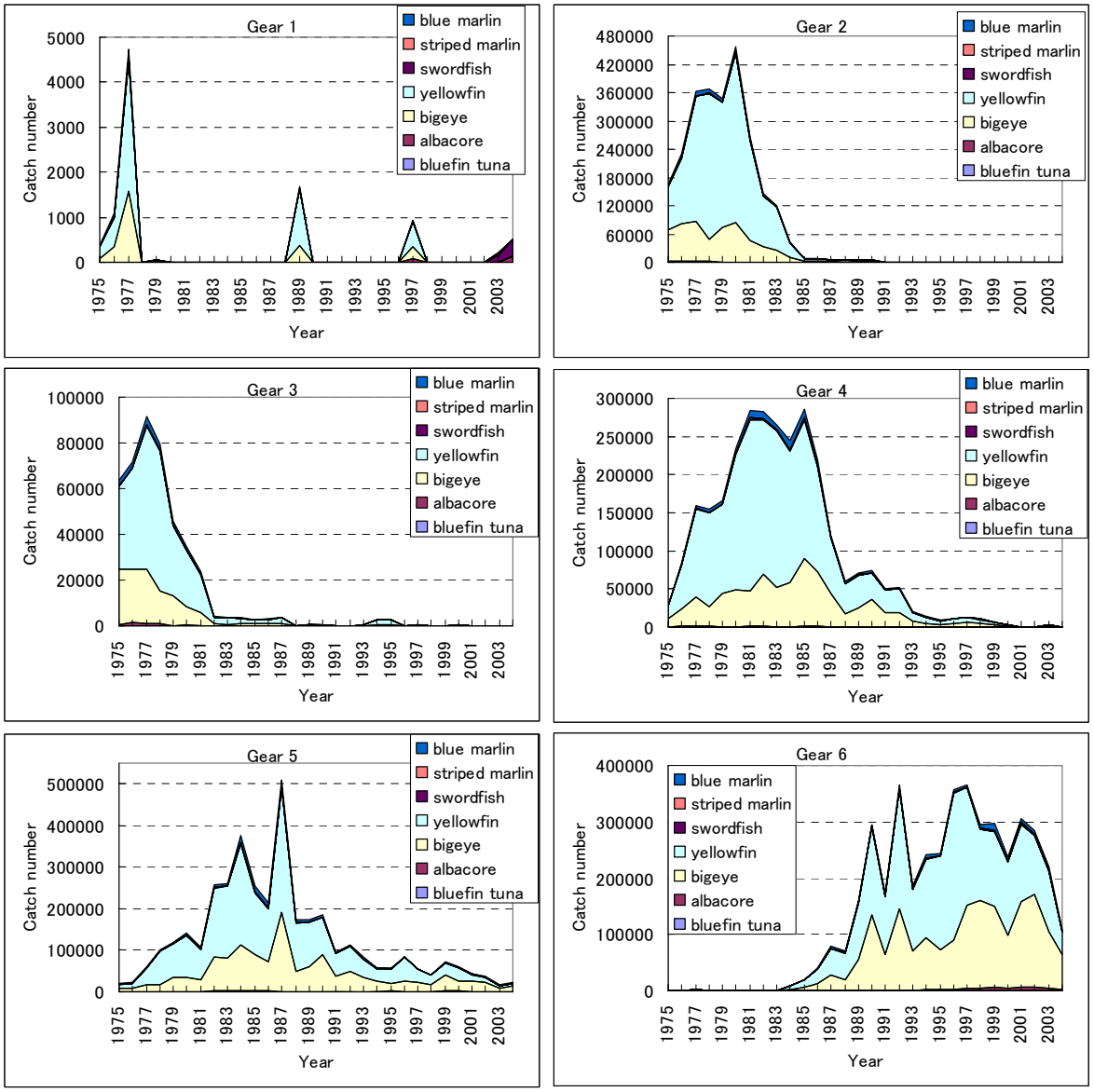

Fig. 14. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 5 for 1975 – 2004.

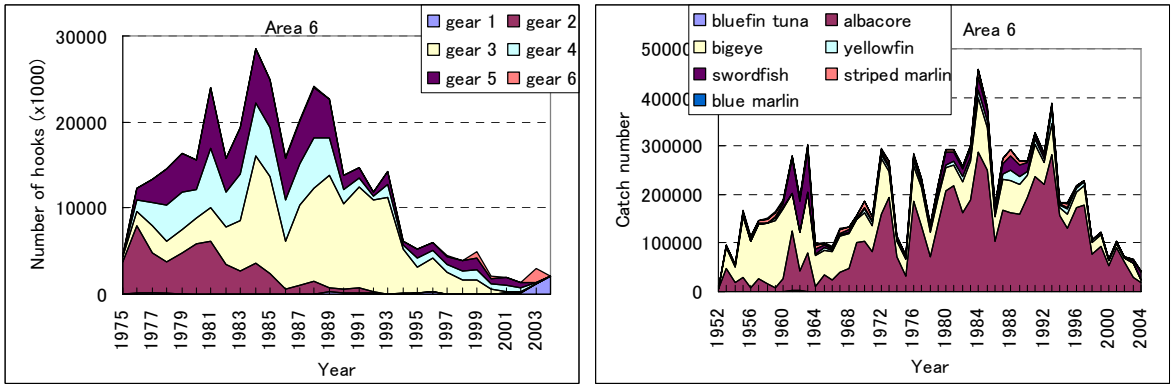

Fig. 15. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 6 (left panel) for 1952 – 2004, and amount of effort by gear category in area 6 for 1975 – 2004 (right panel).

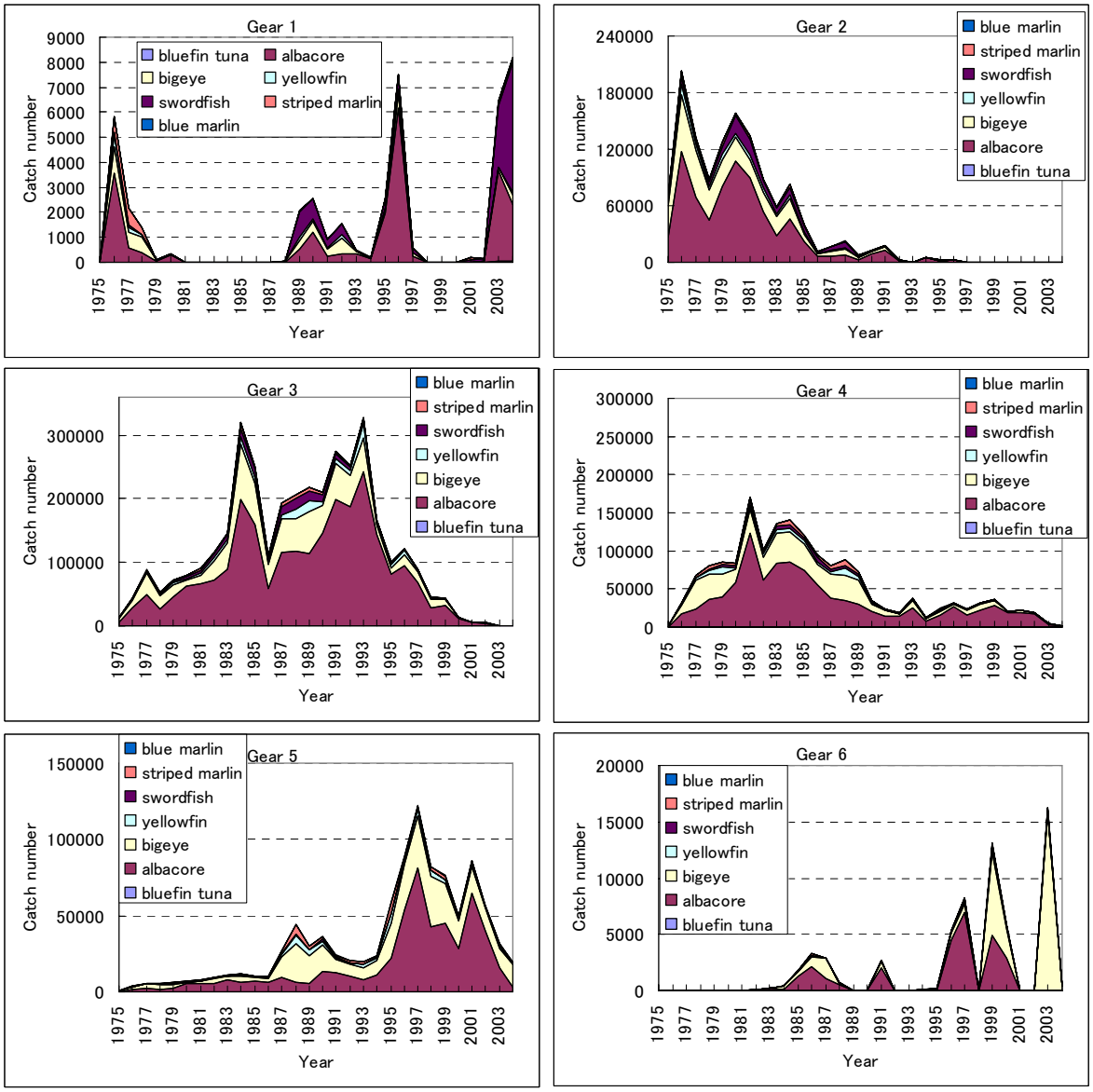

Fig. 16. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 6 for 1975 – 2004.

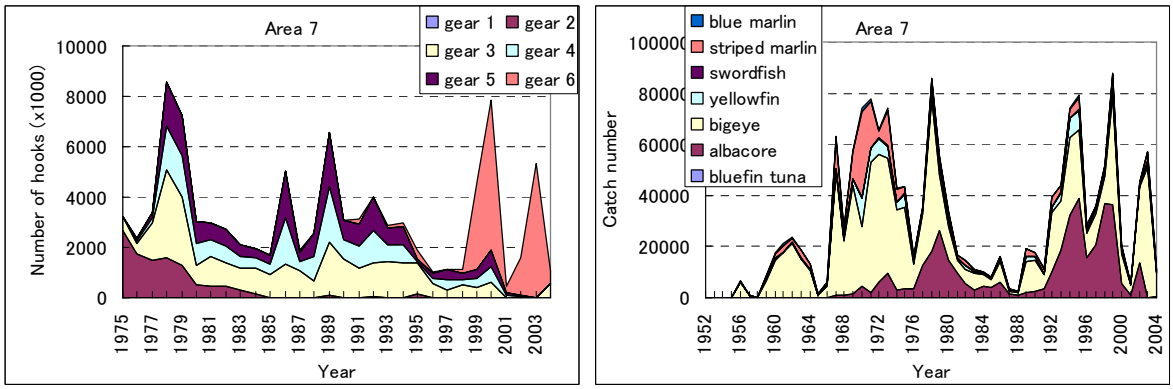

Fig. 17. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 7 (left panel) for 1952 – 2004, and amount of effort by gear category in area 7 for 1975 – 2004 (right panel).

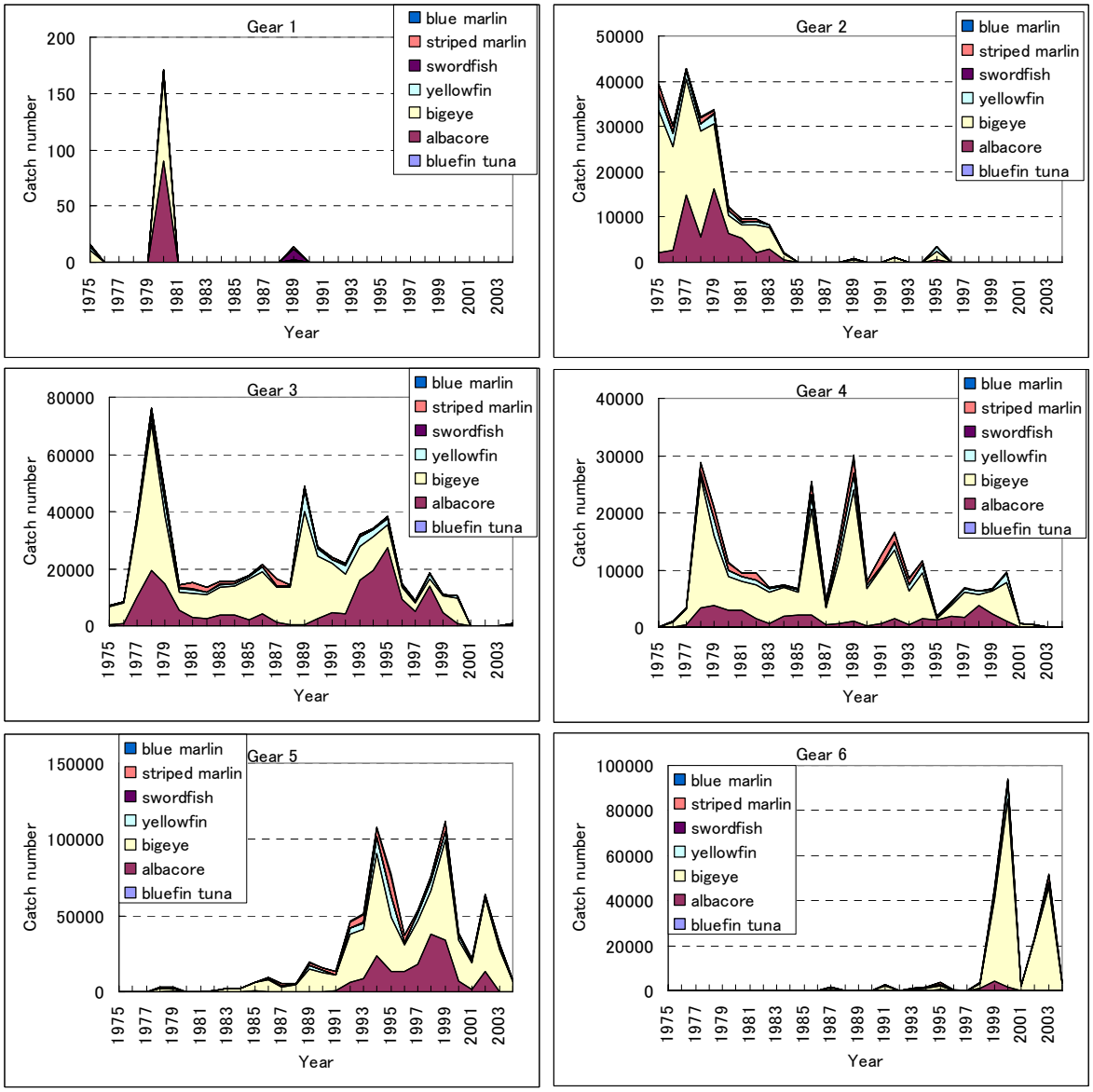

Fig. 18. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 7 for 1975 – 2004.

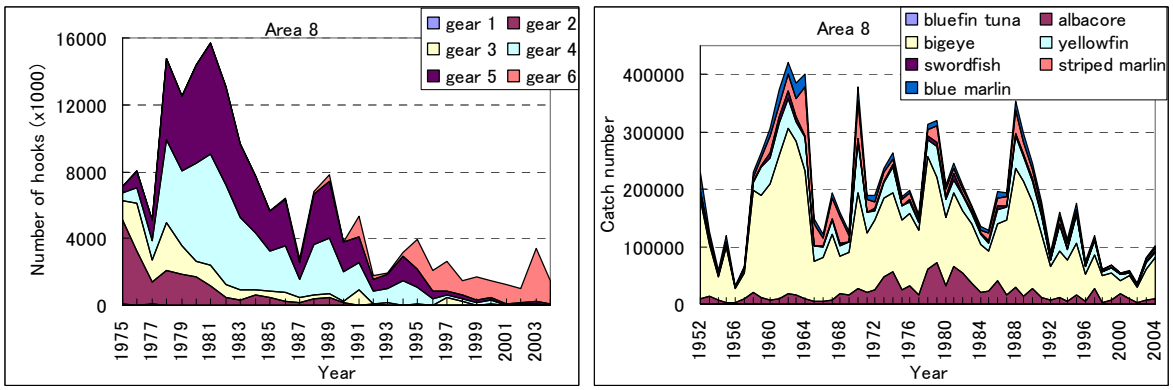

Fig. 19. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 8 (left panel) for 1952 – 2004, and amount of effort by gear category in area 8 for 1975 – 2004 (right panel).

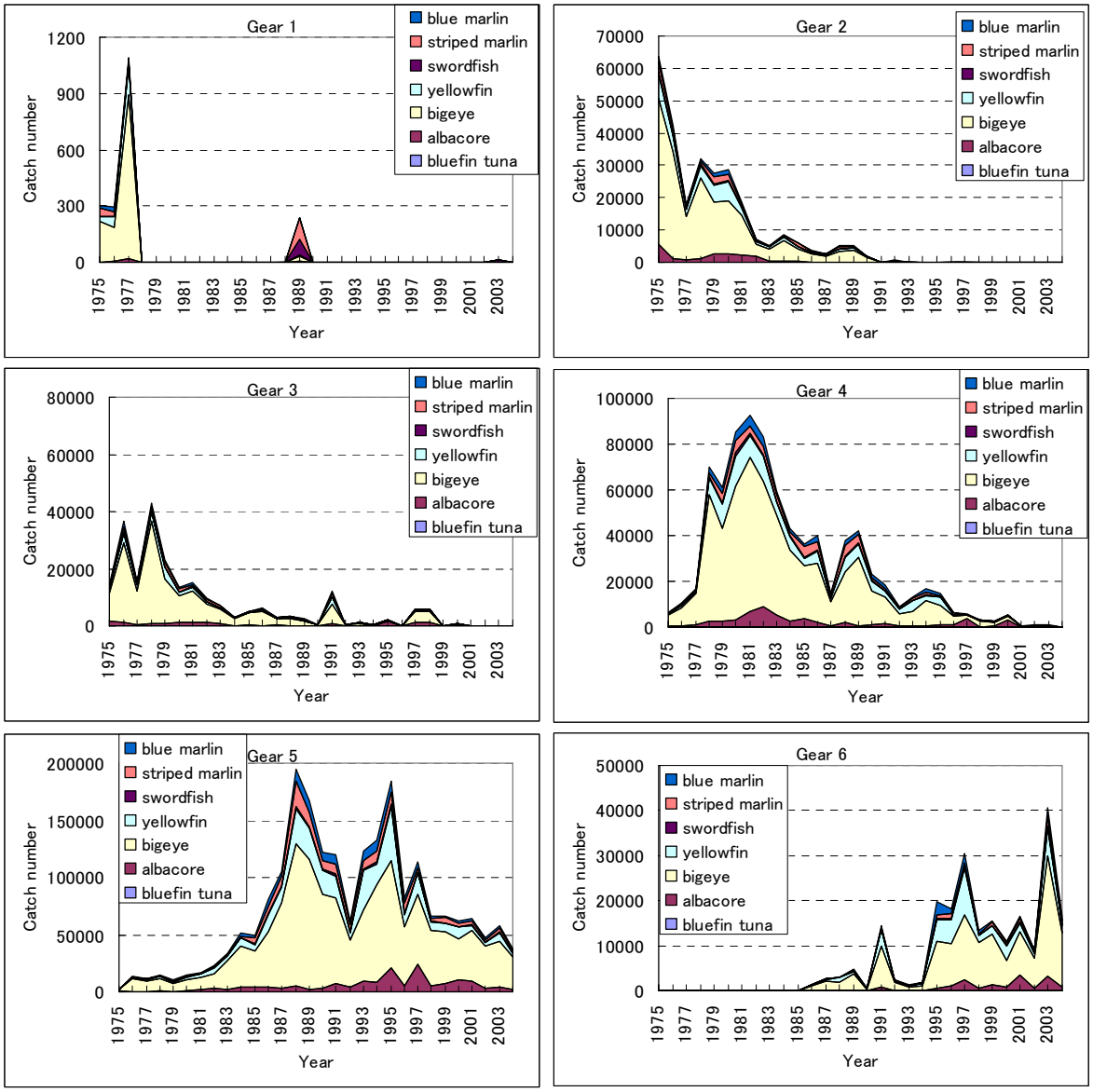

Fig. 20. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 8 for 1975 – 2004.

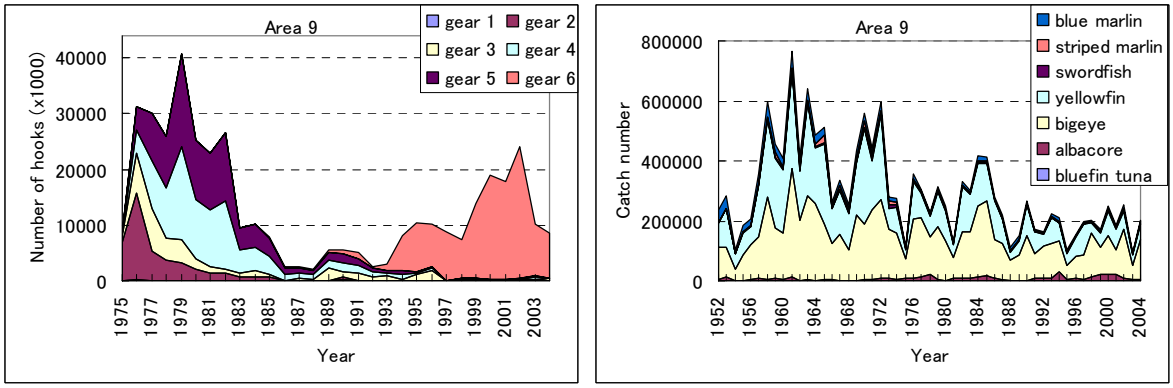

Fig. 21. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 9 (left panel) for 1952 – 2004, and amount of effort by gear category in area 9 for 1975 – 2004 (right panel).

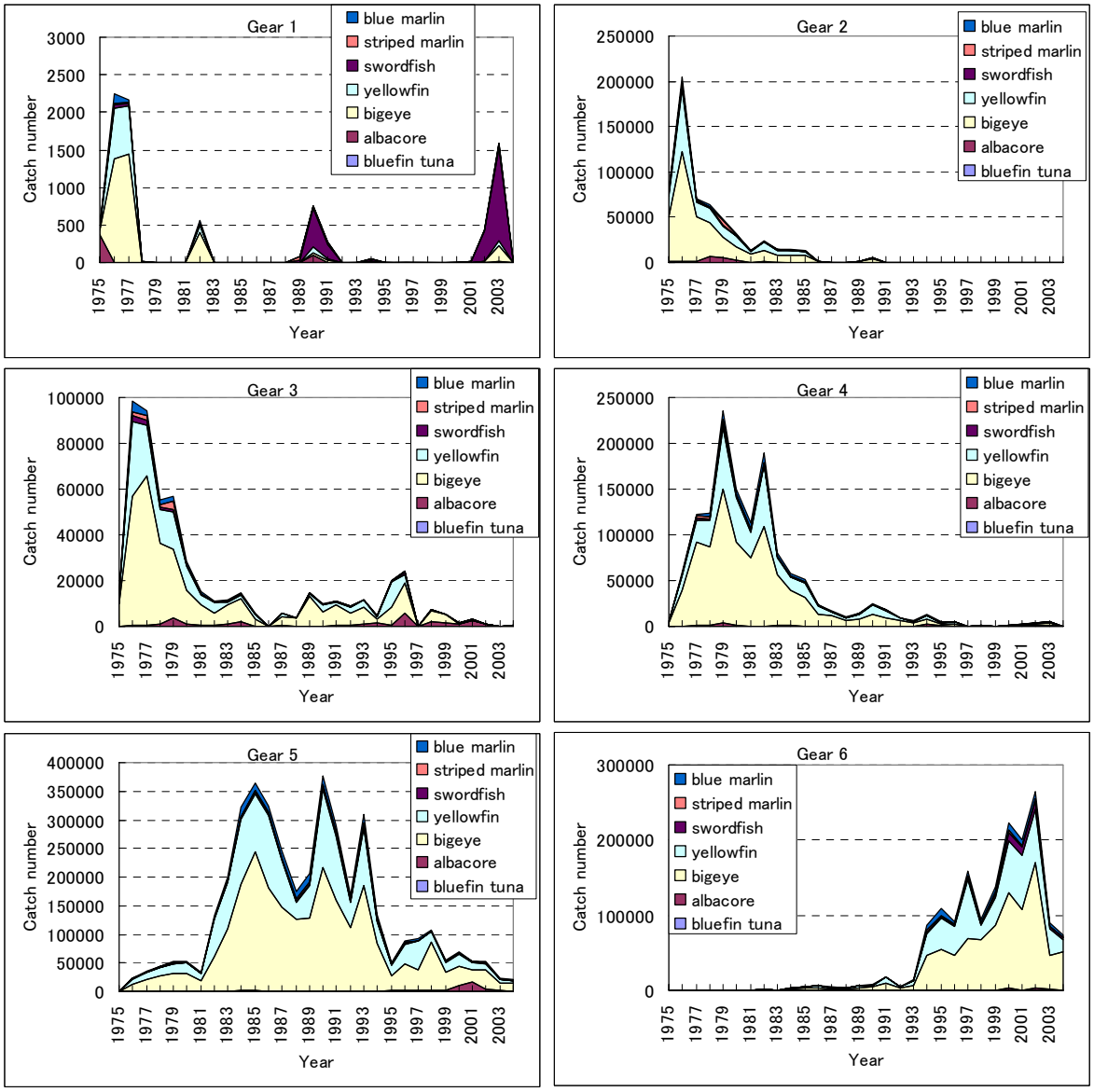

Fig. 22. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 9 for 1975 – 2004.

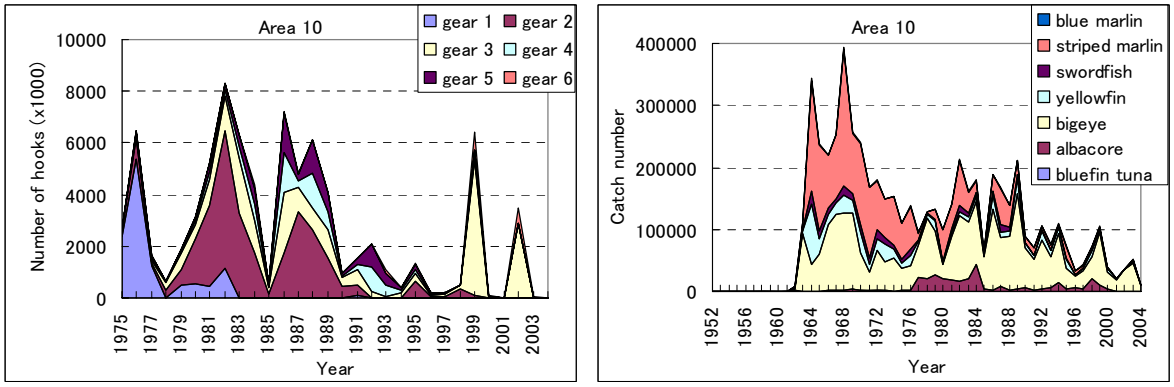

Fig. 23. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 10 (left panel) for 1952 – 2004, and amount of effort by gear category in area 10 for 1975 – 2004 (right panel).

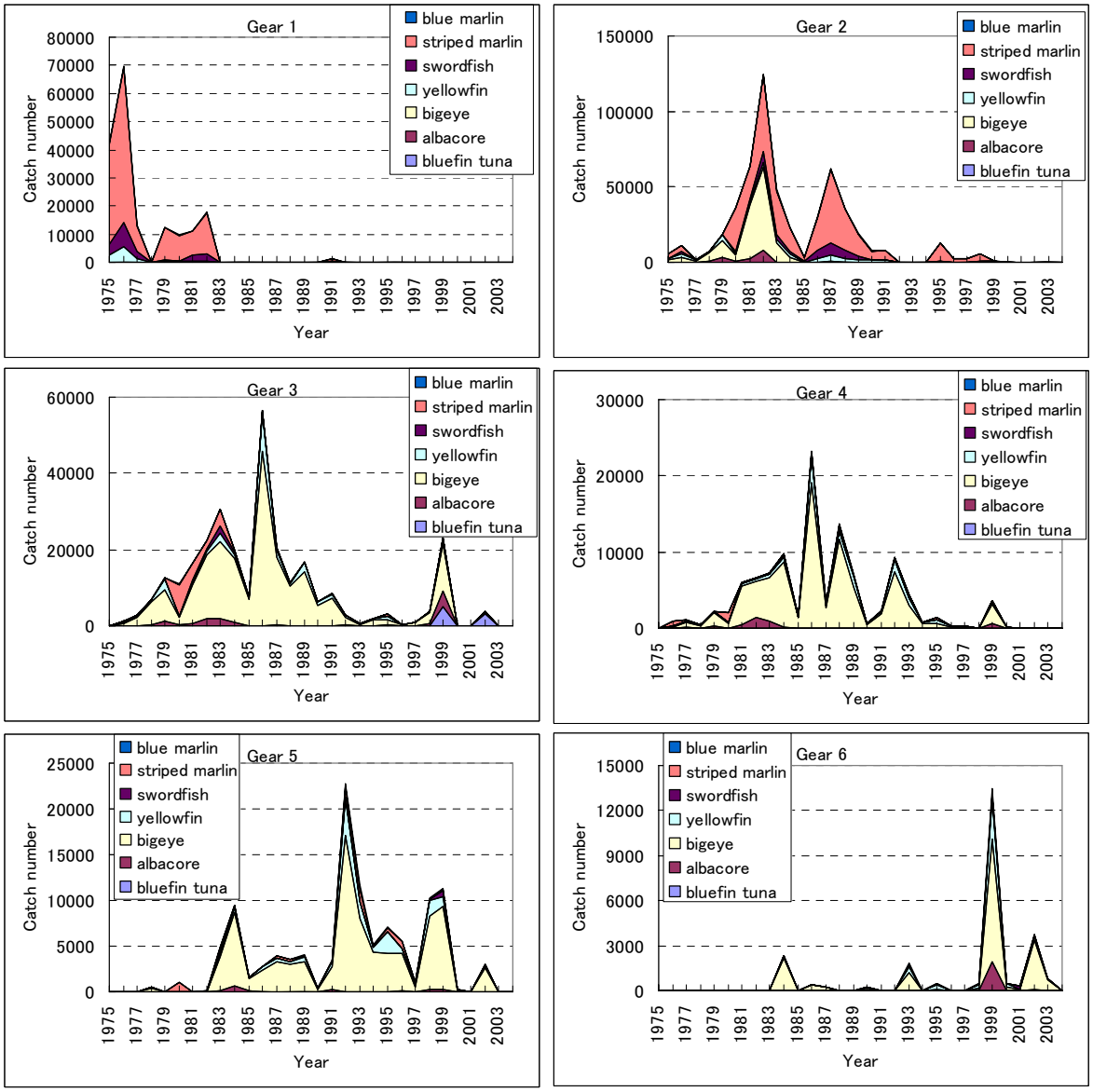

Fig. 24. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 10 for 1975 – 2004.

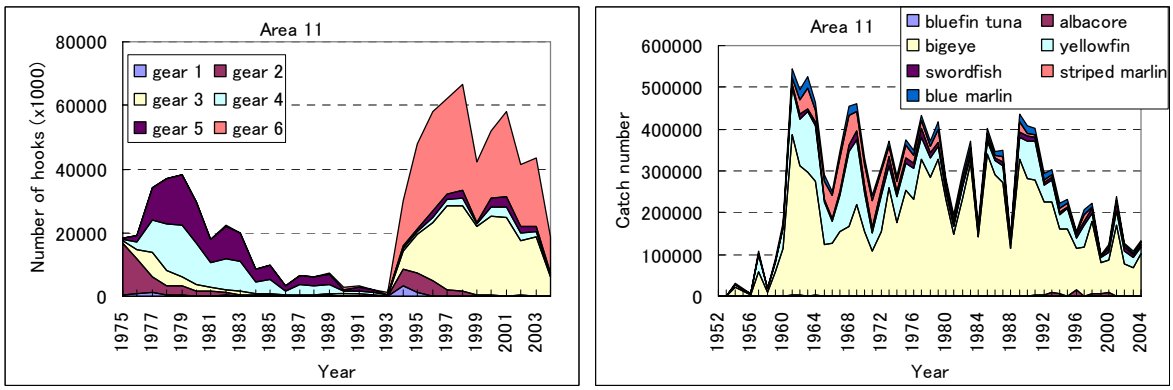

Fig. 25. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners in area 11 (left panel) for 1952 – 2004, and amount of effort by gear category in area 11 for 1975 – 2004 (right panel).

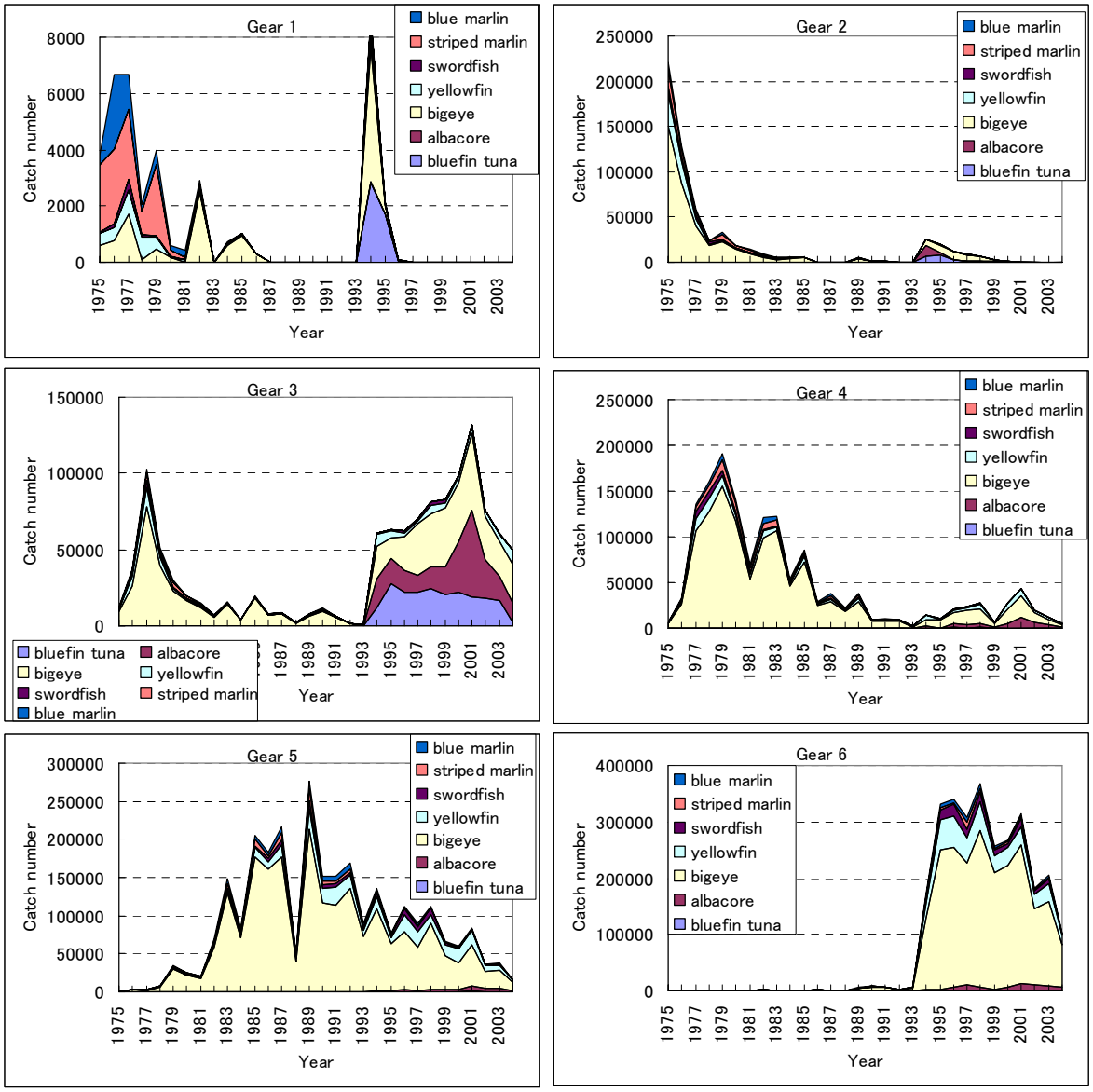

Fig. 26. Catch in number of major tunas and billfishes caught by Japanese offshore and distant-water longliners by gear category in area 11 for 1975 – 2004.