

Fig. 1. The designation of the subareas used in the CPUE standardization by Database-I in the period between 1952 – 75.

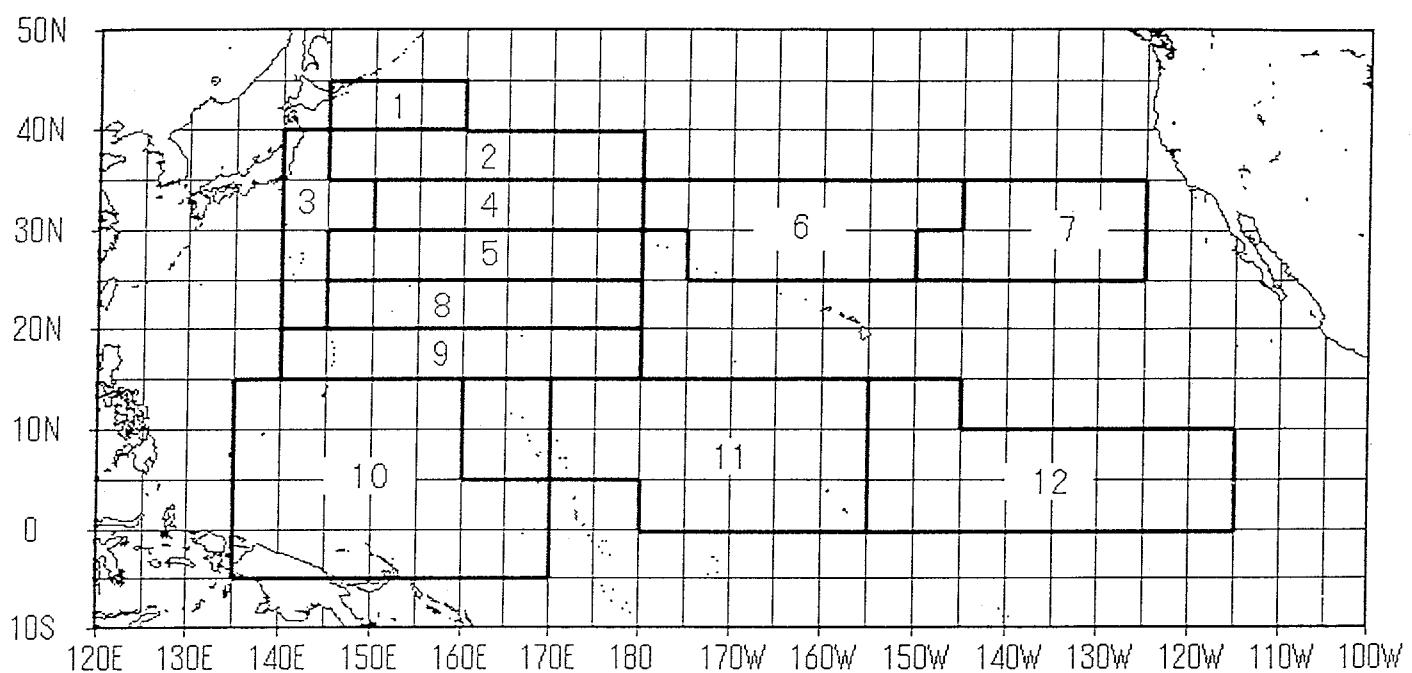


Fig. 2. The designation of the subarea used in the CPUE standardization by Database-II in the period between 1975 – 97.

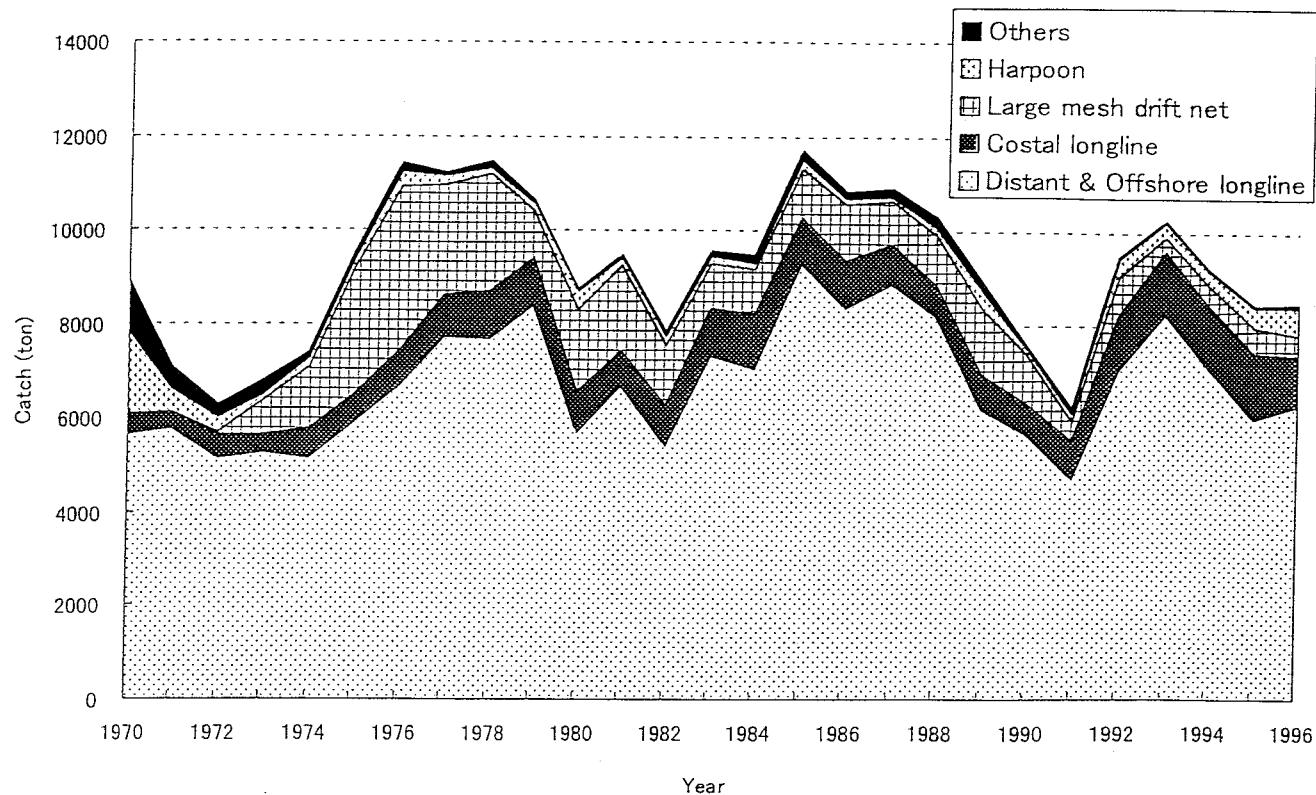


Fig. 3. Japanese swordfish catch (ton) by fishery.

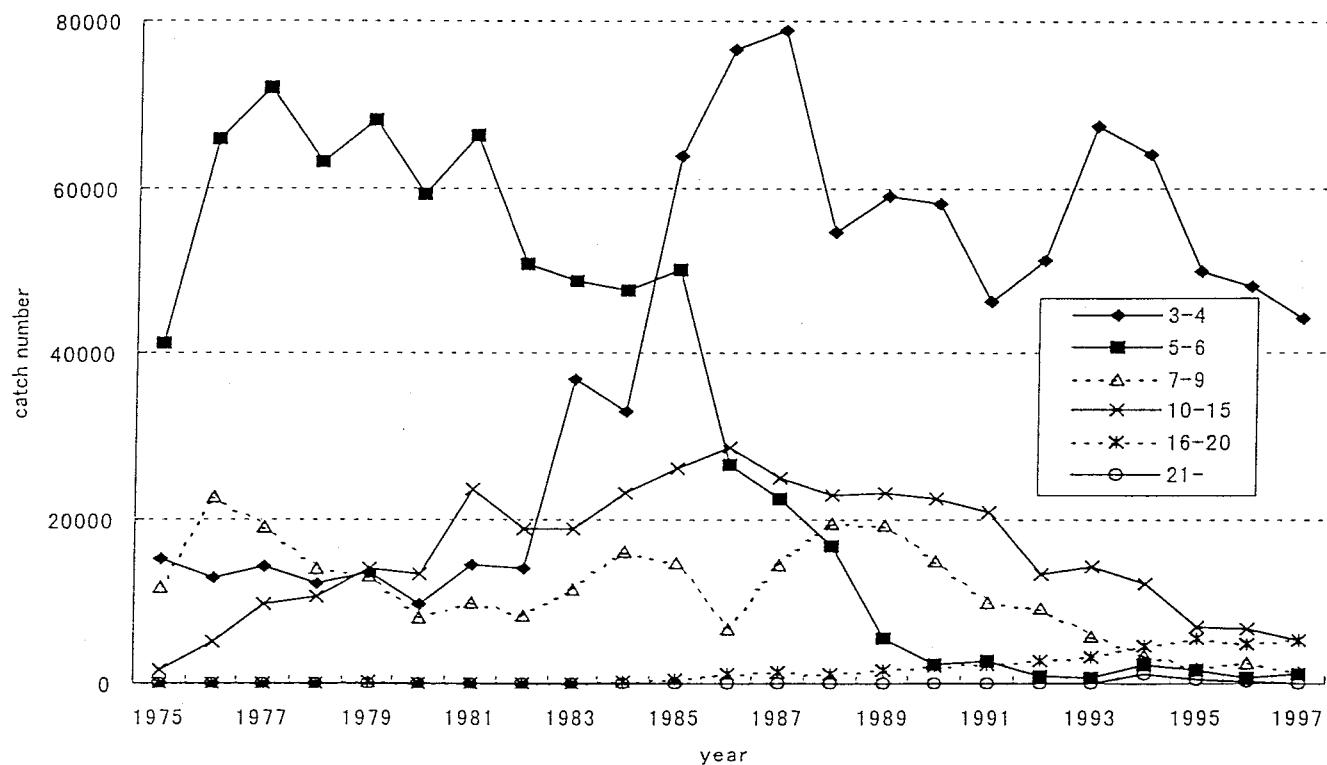


Fig. 4. Number of swordfish catch by Japanese distant water and offshore longline fishery by gear configuration (number of hooks between floats) in the northwest and the north-central Pacific.

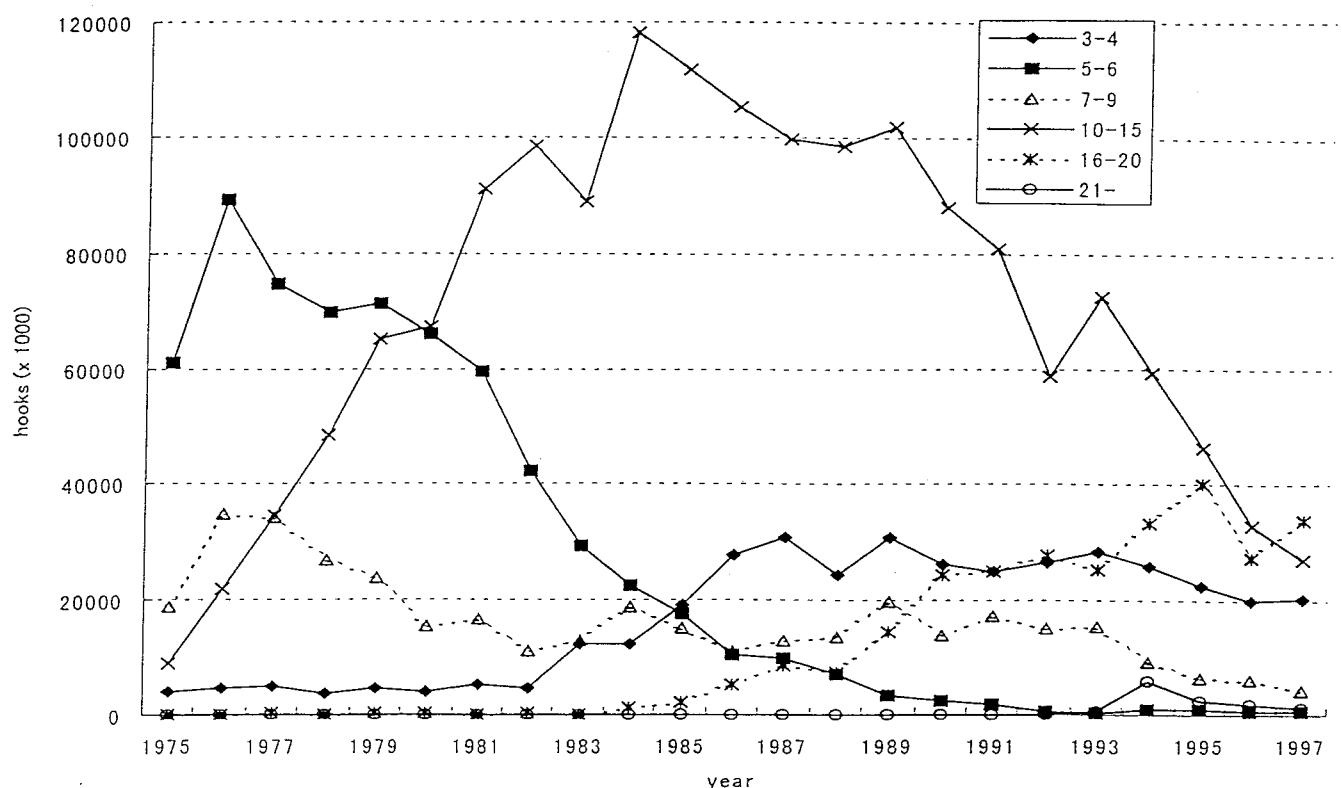


Fig. 5. Yearly change of effort (number of hook) of Japanese distance water and offshore longline fishery by gear configuration (number of hooks between floats) in the northwest and the north-central Pacific.

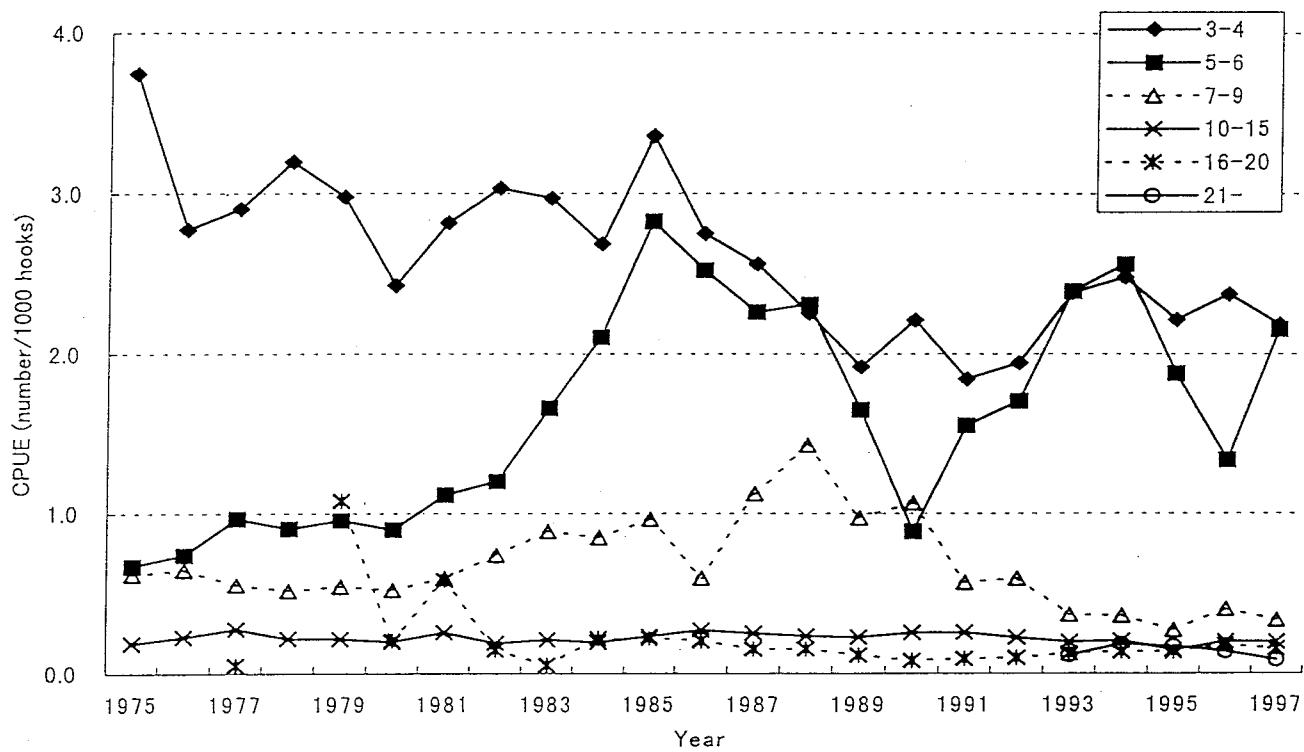


Fig. 6. Nominal swordfish CPUEs (number of catch per 1000 hooks) of Japanese distant water and offshore longline fishery by gear configuration (number of hooks between floats) in the northwest and the north-central Pacific.

3-4 Night set
5-6 Probably day sets

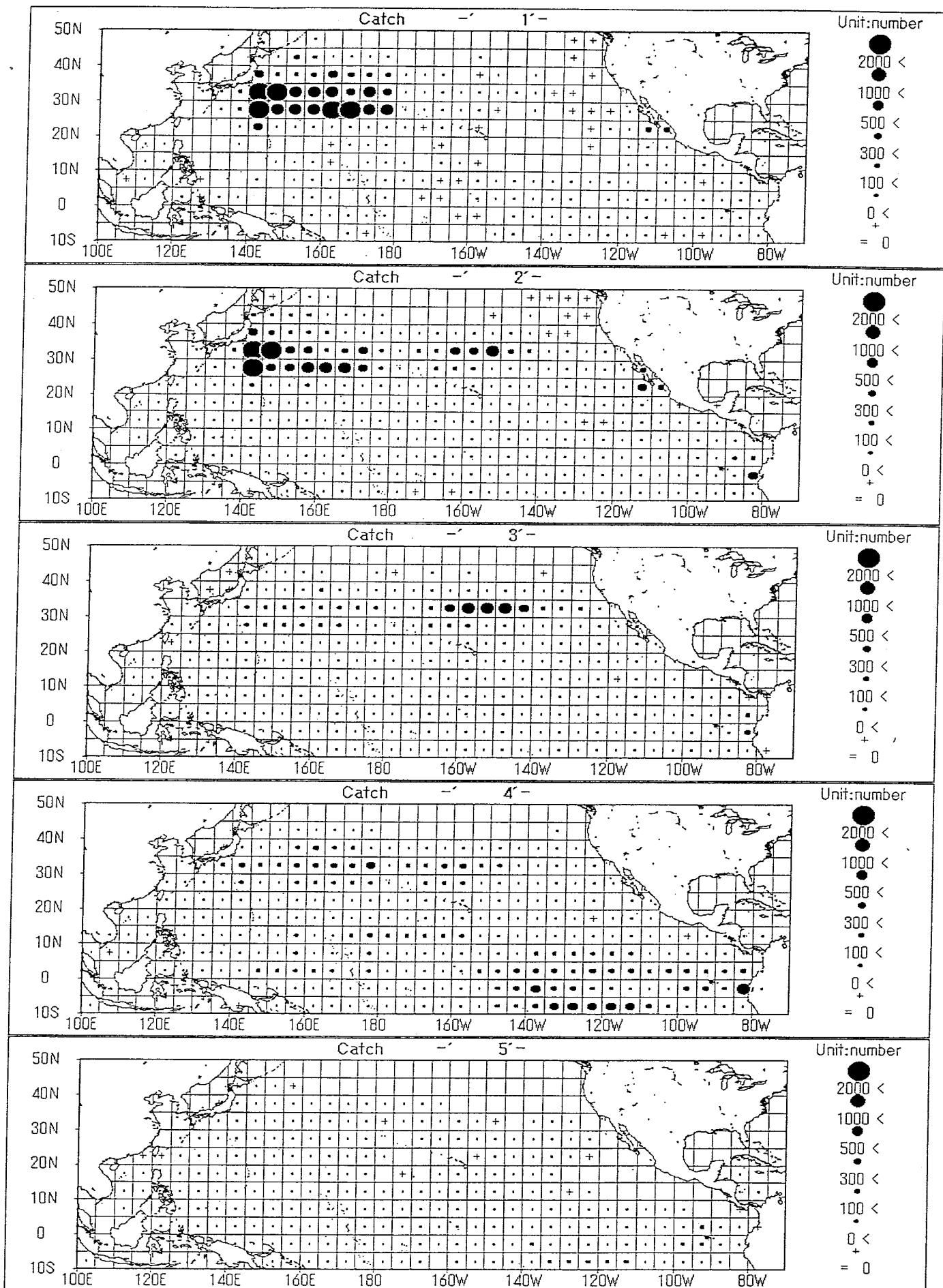


Fig. 7. Average yearly catch number distribution by gear configuration (number of hooks between floats) of swordfish caught by Japanese distant water and offshore longliners in the period between 1975 and 1997. The number of hooks between floats are 3 – 4 in the 1st top panel, 5 – 6 in 2nd, 7 – 9 in 3rd, 10 – 15 in 4th, and 16< in the last panel.

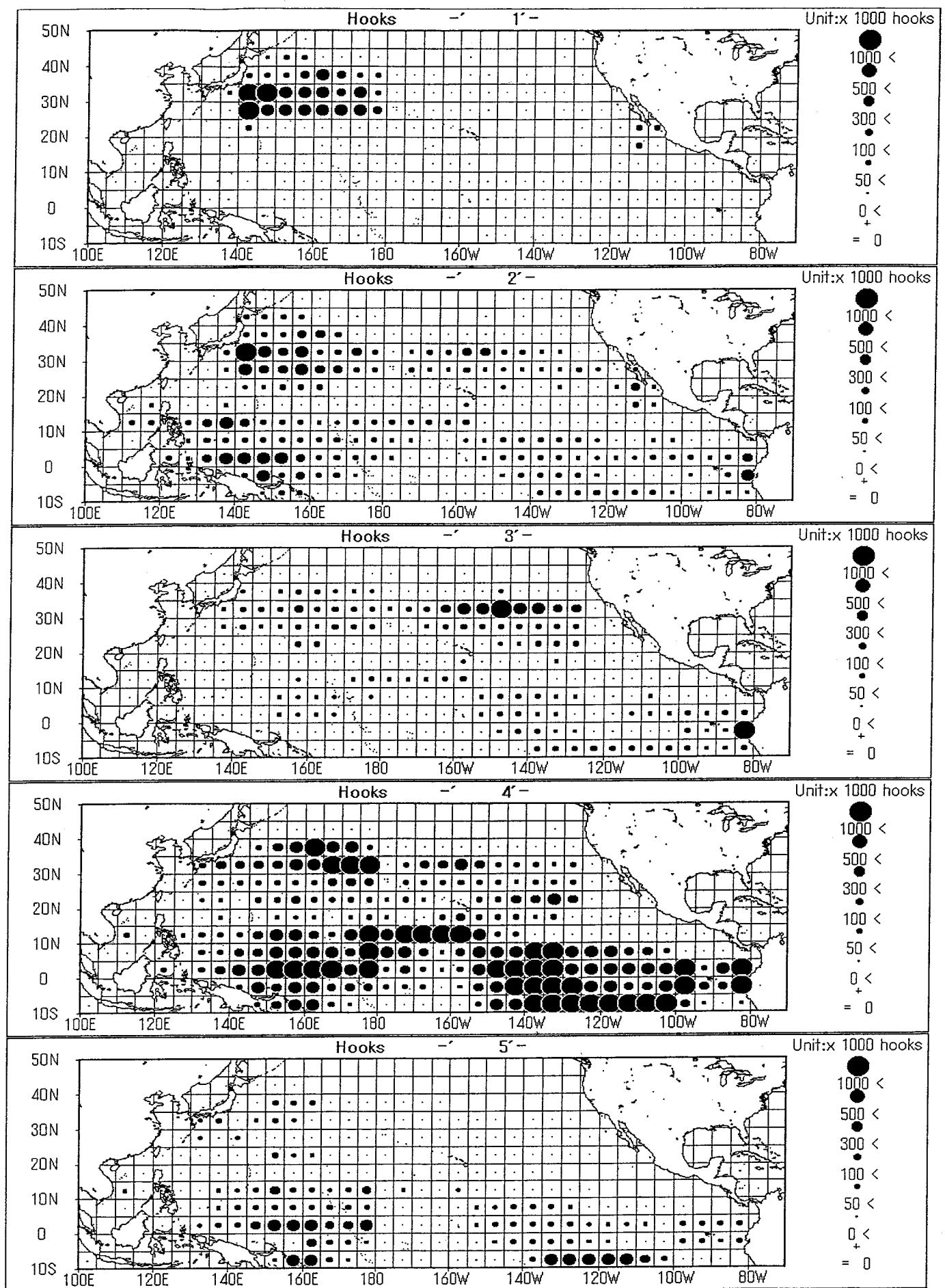


Fig. 8. Average yearly effort (hooks) distribution by gear configuration (number of hooks between floats) of swordfish caught by Japanese distant water and offshore longliners in the period between 1975 and 1997. The number of hooks between floats are 3 - 4 in the 1st top panel, 5 - 6 in 2nd, 7 - 9 in 3rd, 10 - 15 in 4th, and 16< in the last panel.

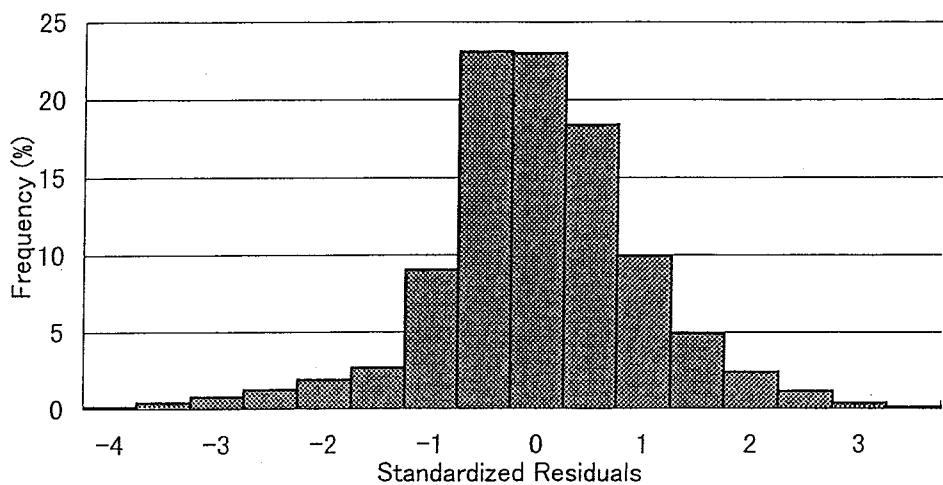


Fig. 9. Overall histograms of standardized residuals from the final model.
Database I in the northwest and north-central Pacific in the period
between 1952 and 1975.

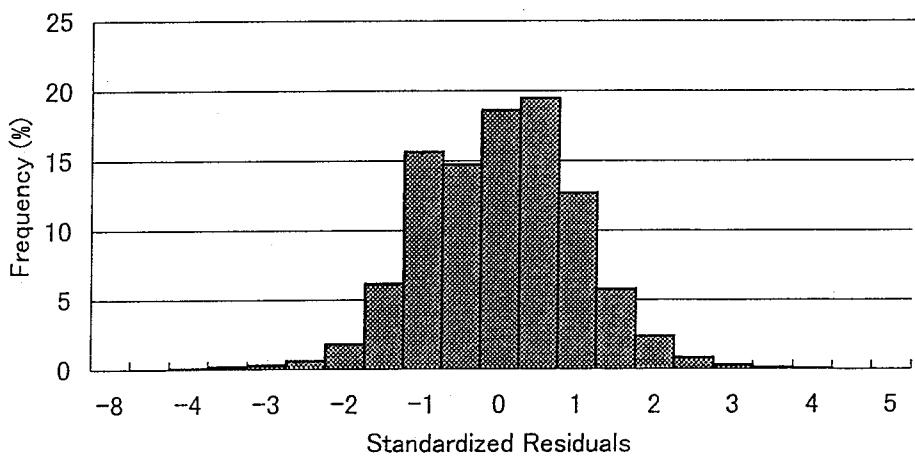


Fig. 10. Overall histograms of standardized residuals from the final model.
Database II in the northwest and north-central Pacific in the period
between 1975 and 1997.

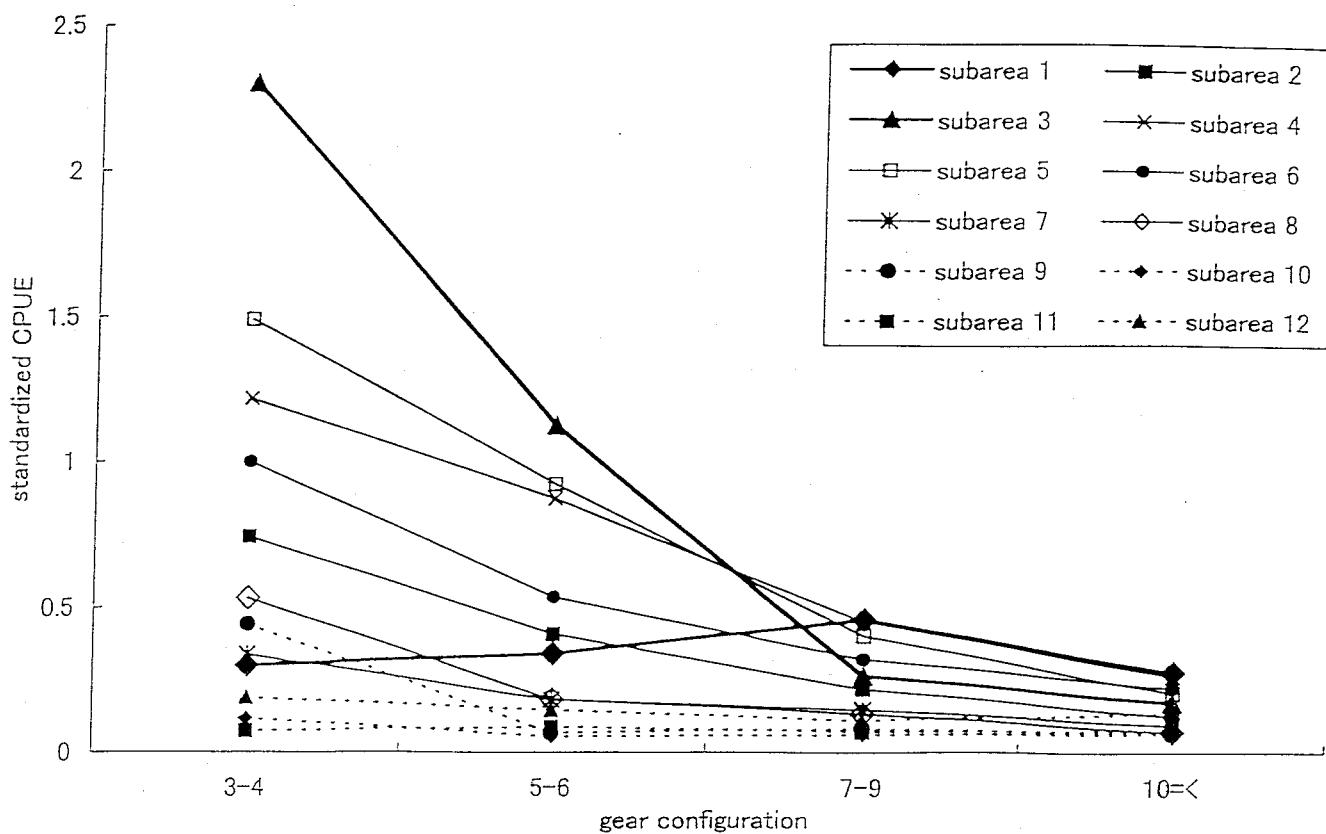


Fig. 11. The values of the standardized CPUE by subarea and by gear configuration. All the data used in the CPUE standardization with the Database-II in the period between 1975 and 1997 were applied. All the solid lines are those for subareas in Higashioki and north of Hawaii area (north of 20° N) and broken lines for subareas south of 20° N.

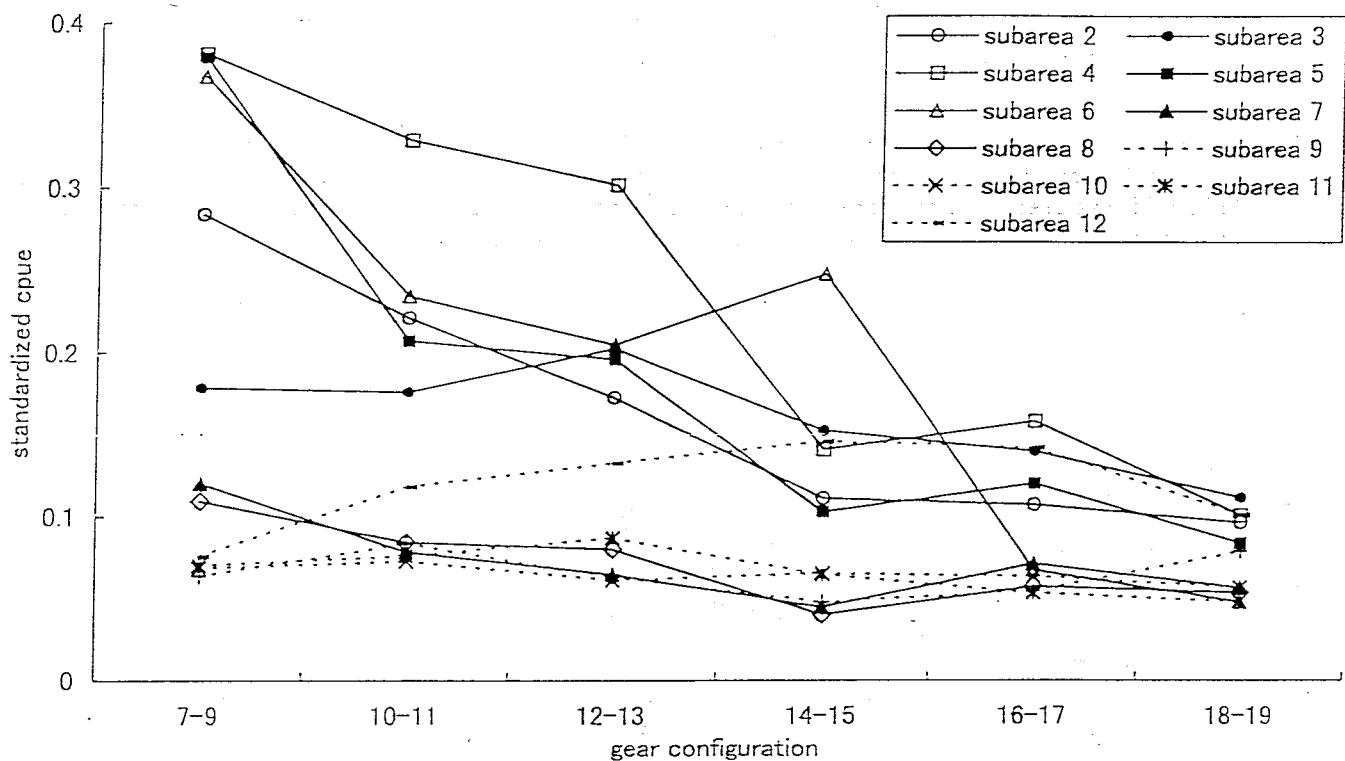


Fig. 12. The values of the standardized CPUE by subarea and by gear configuration. Data for the subareas 2 – 12 and the period between 1985 and 1997 of the Database-II were used. All the solid lines are those for subareas in Higashioki and north of Hawaii area (north of 20° N) and broken lines for subareas south of 20° N.

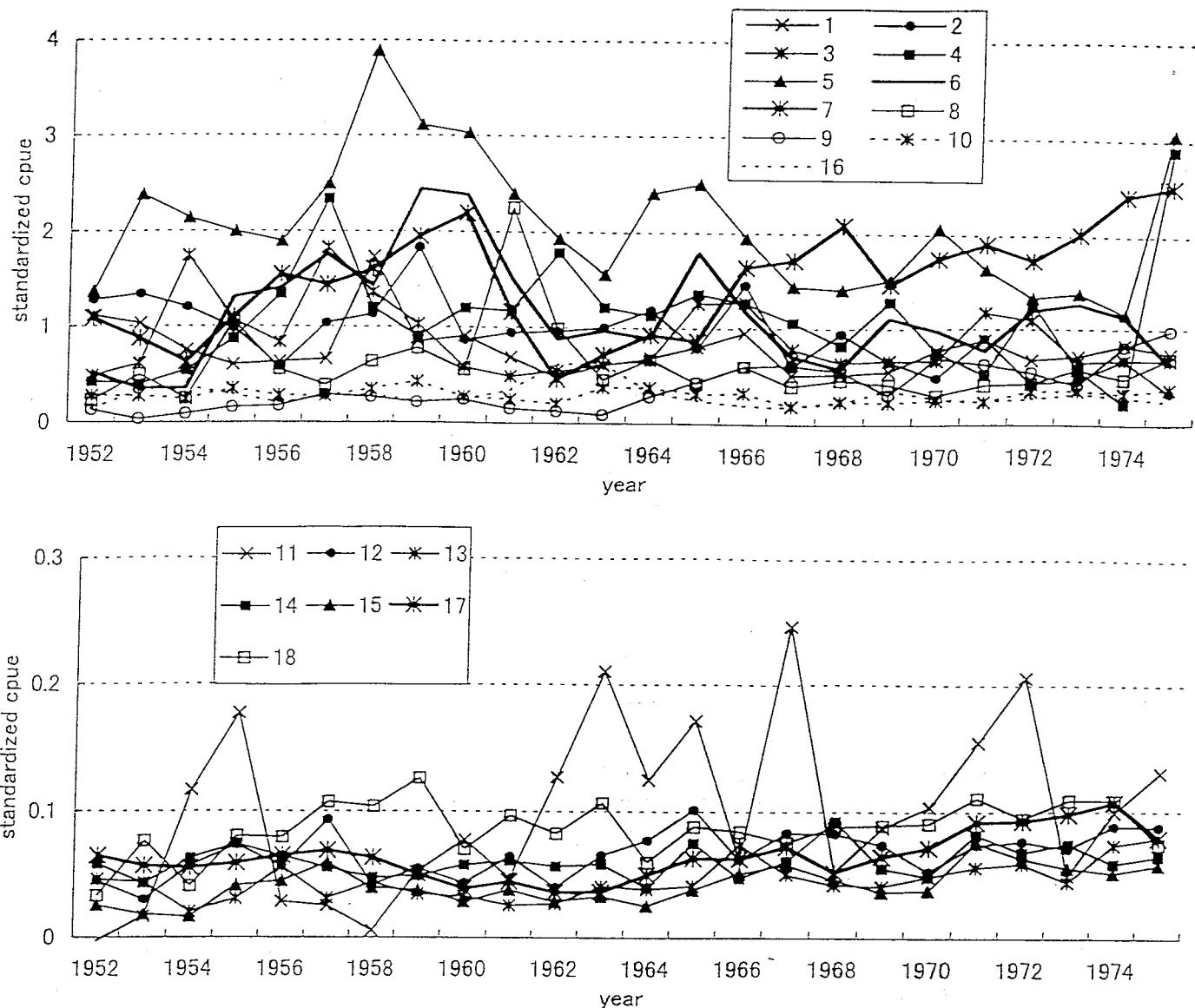


Fig. 13. The standardized CPUE by the designated area of the swordfish caught by the Japanese distant water and offshore longliners in the northwest and the north central Pacific. Database-II for the period between 1952 – 75 was used. The top panel is the CPUEs for the subareas in the Higashioki and north of Hawaii area (north of 20° N, 1 – 10, 16) and the bottom for the subareas south of 20° N (11 – 15, 17,18).

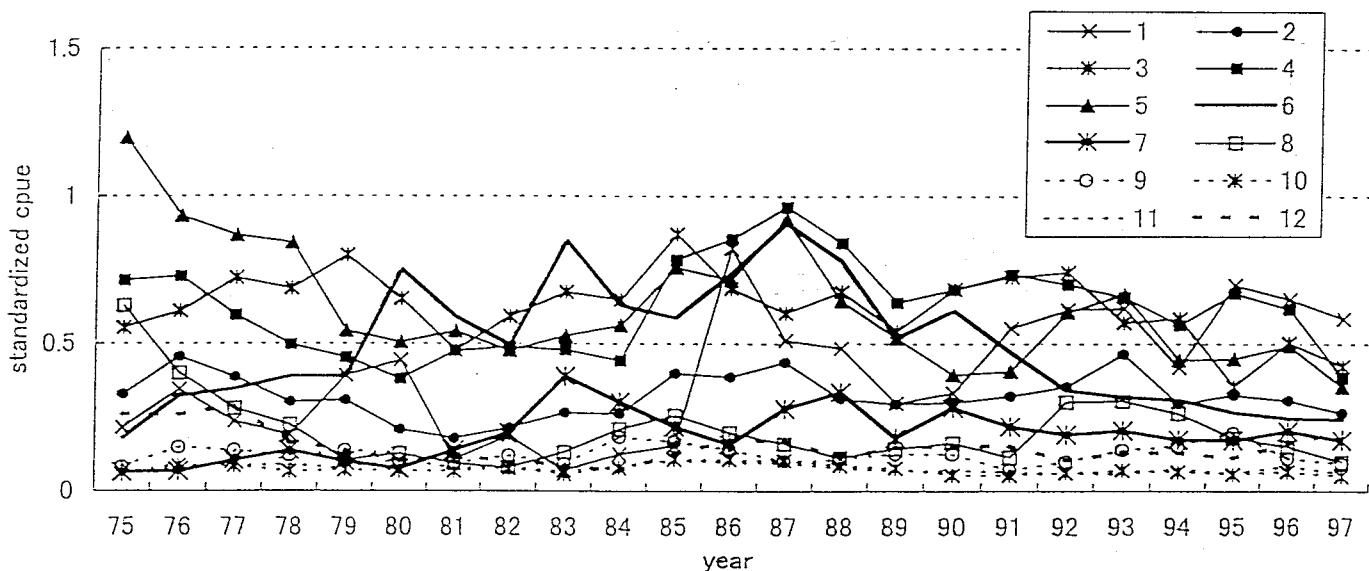


Fig. 14. The standardized CPUE by the designated area of the swordfish caught by the Japanese distant water and offshore longliners in the northwest and the north central Pacific. Database-II for the period between 1975 – 97 was used. All the solid lines are for the subareas in the Higashioki and north of Hawaii area (north of 20° N, 1 – 8) and the broken lines for the subareas south of 20° N (9 – 12).

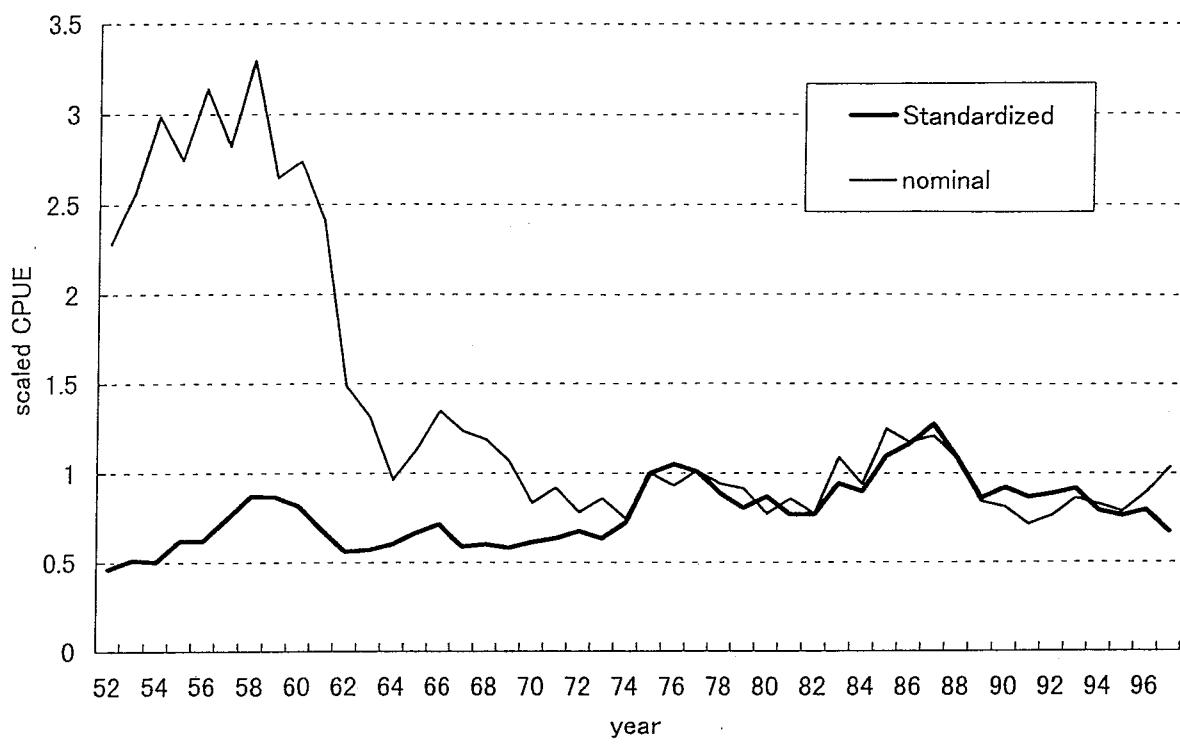


Fig. 15. The trend of the standardized and nominal CPUE of the swordfish caught by the Japanese distant water and offshore longliners in the northwest and the north-central Pacific.
All the values scaled to that in 1975 which set at 1.0.

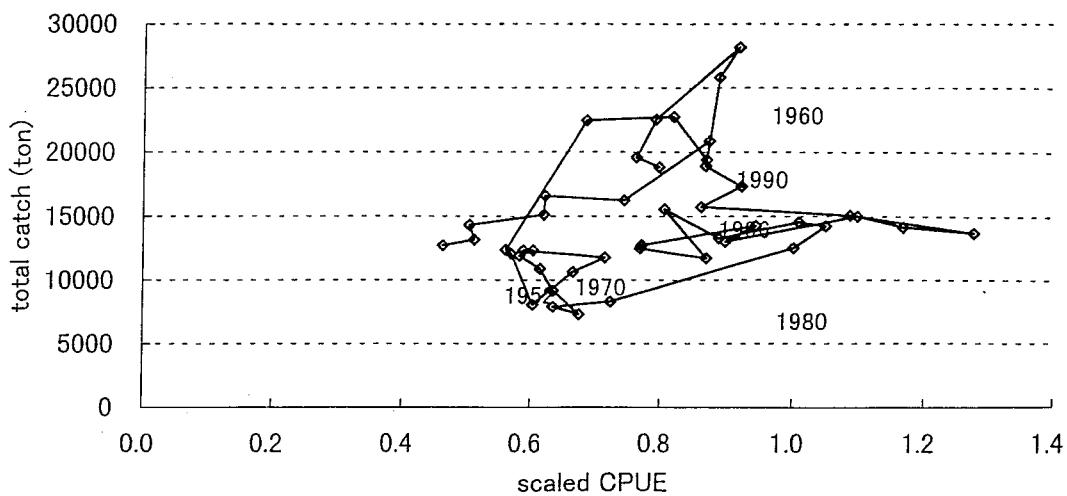


Fig. 16. The relationship between the standardized CPUE and the total catch in the northwest and the north central Pacific for the period between 1952 and 1996.

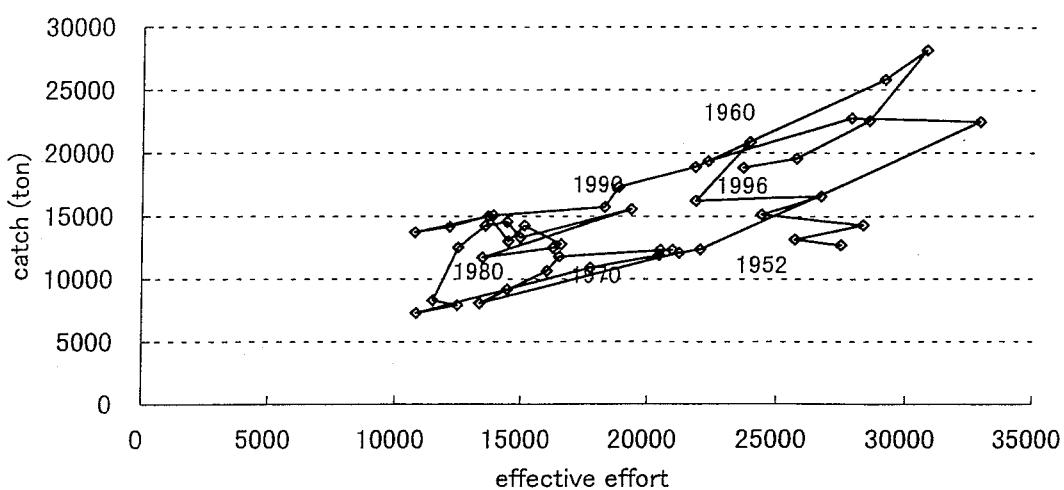


Fig. 17. The relationship between the estimated total catch of the swordfish in the northwest and the north central Pacific, and effective effort calculated from the standardized CPUE of the Japanese distant water and offshore longliners for the period between 1952 and 1996.

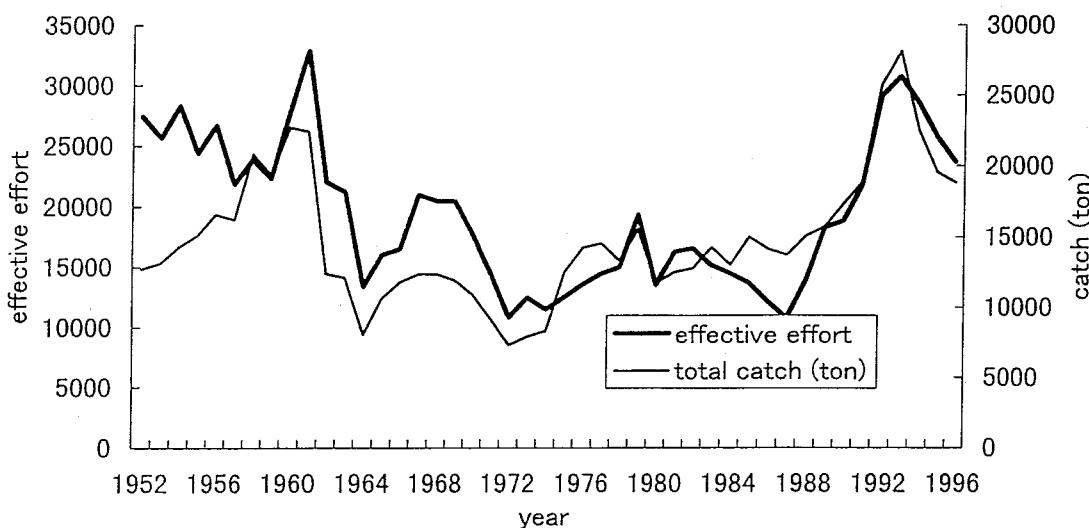


Fig. 18. The trend of effective effort of swordfish in the northwest and the north central Pacific and total catch of the swordfish. The effective effort was calculated by the standardized CPUE of the Japanese distant water and offshore longliners.

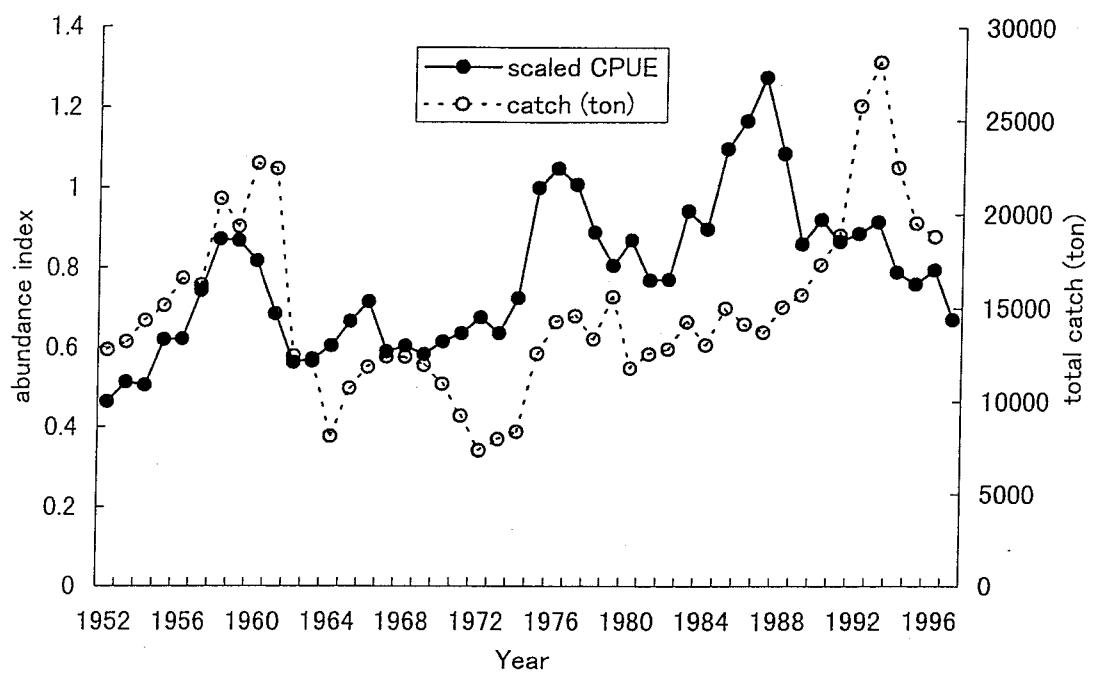


Fig. 19. The comparison between the standardized CPUE by the Japanese distant water and offshore longliners and estimated total catch (ton) of the swordfish in the northwest and north central Pacific (north of 0° N).

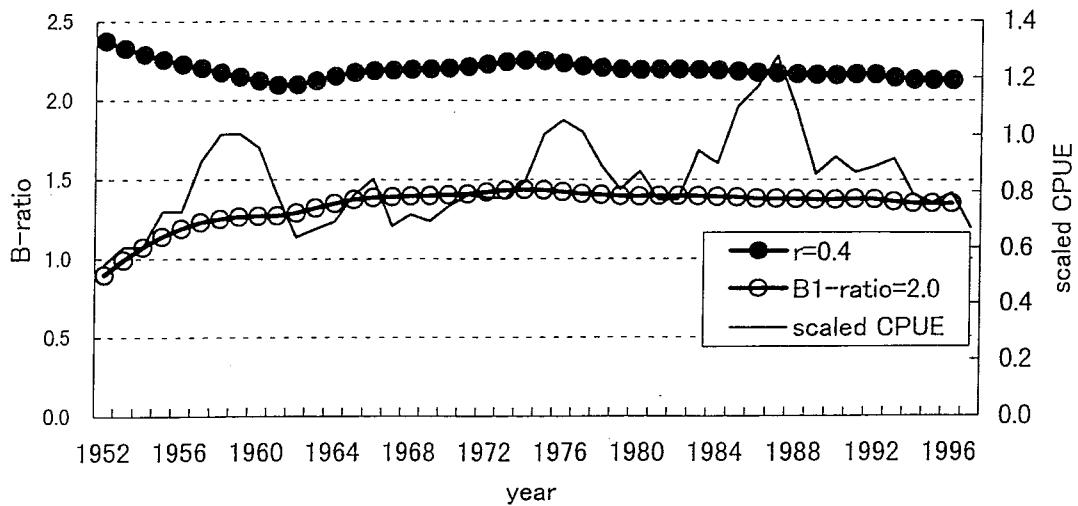


Fig. 20. The results of the ASPIC calculation by the data for the period between 1952 – 96 (thick line) with its r value fixed at 0.4 (closed circle) and B1-ratio at 2.0 (open circle). The thin line shows the standardized CPUE for the same period.

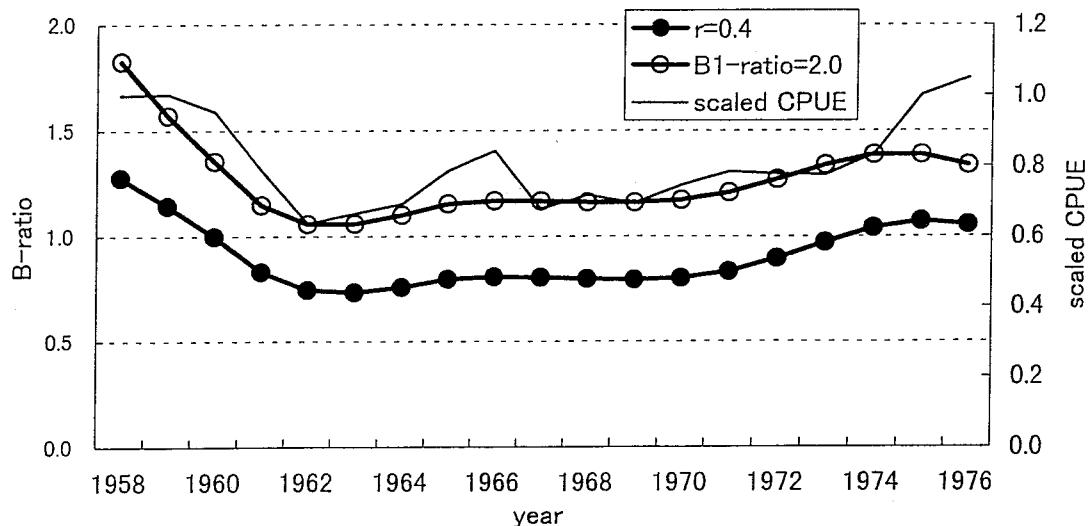


Fig. 21. The results of the ASPIC calculation by the data for the period between 1958 – 76 (thick line) with its r value fixed at 0.4 (closed circle) and B1-ratio at 2.0 (open circle). The thin line shows the standardized CPUE for the same period.

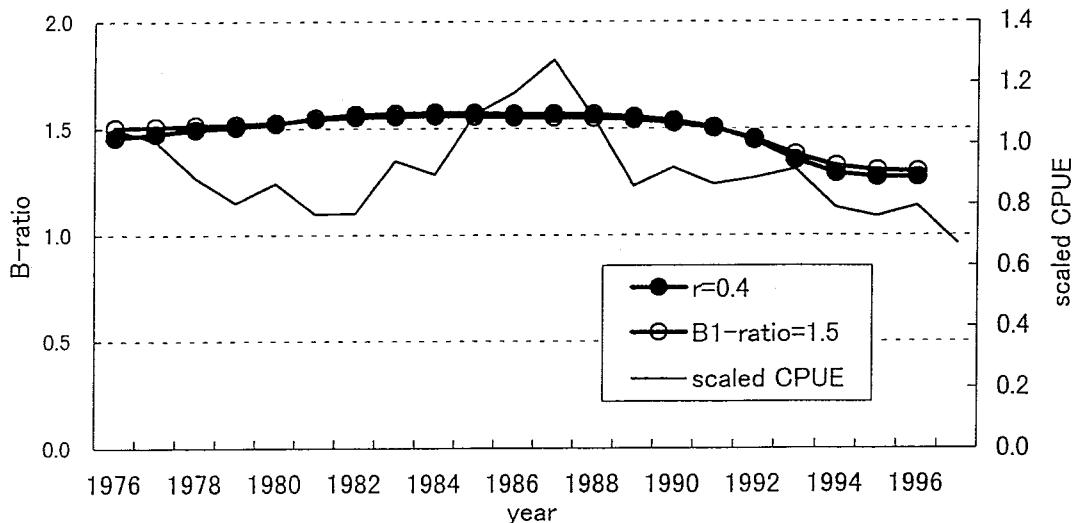


Fig. 22. The results of the ASPIC calculation by the data for the period between 1976 – 96 (thick line) with its r value fixed at 0.4 (closed circle) and B1-ratio at 1.5 (open circle). The thin line shows the standardized CPUE for the same period.

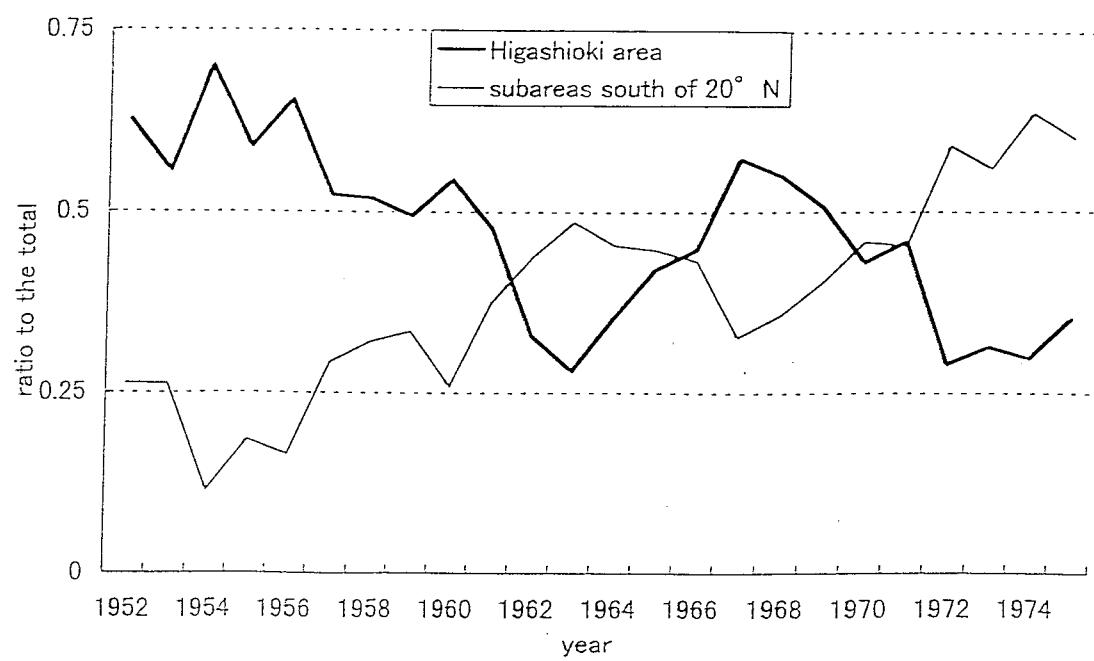


Fig. 23. Trend of the ratio of the amount of fishing effort of subareas in the Higashioki area (subarea 1 - 9) and subarea in the north of 20° N (subarea 12-15, 17,18) to the amount of all subareas in the period between 1952 - 75. Subarea staratification for the Database-I used.

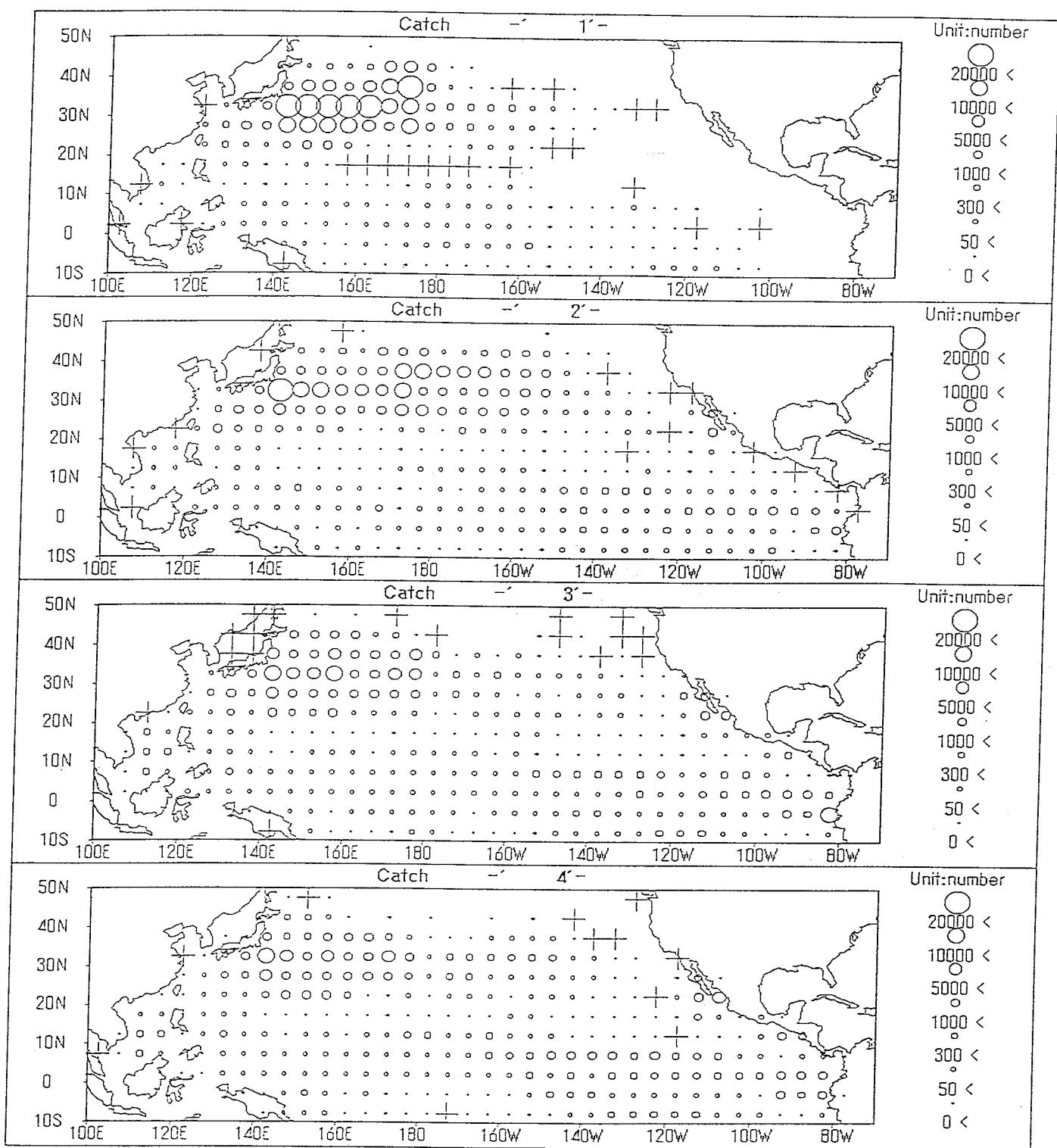


Fig. 24. The five year average catch distribution by 5x5 block of swordfish in the north Pacific caught by the Japanese distant water and offshore longliners in the period between 1955 and 1975. The first top panel is that of between 1955 and 1959, second one is between 1960 and 1964, third one is between 1965 and 1970 and fourth one is between 1970 and 1974.

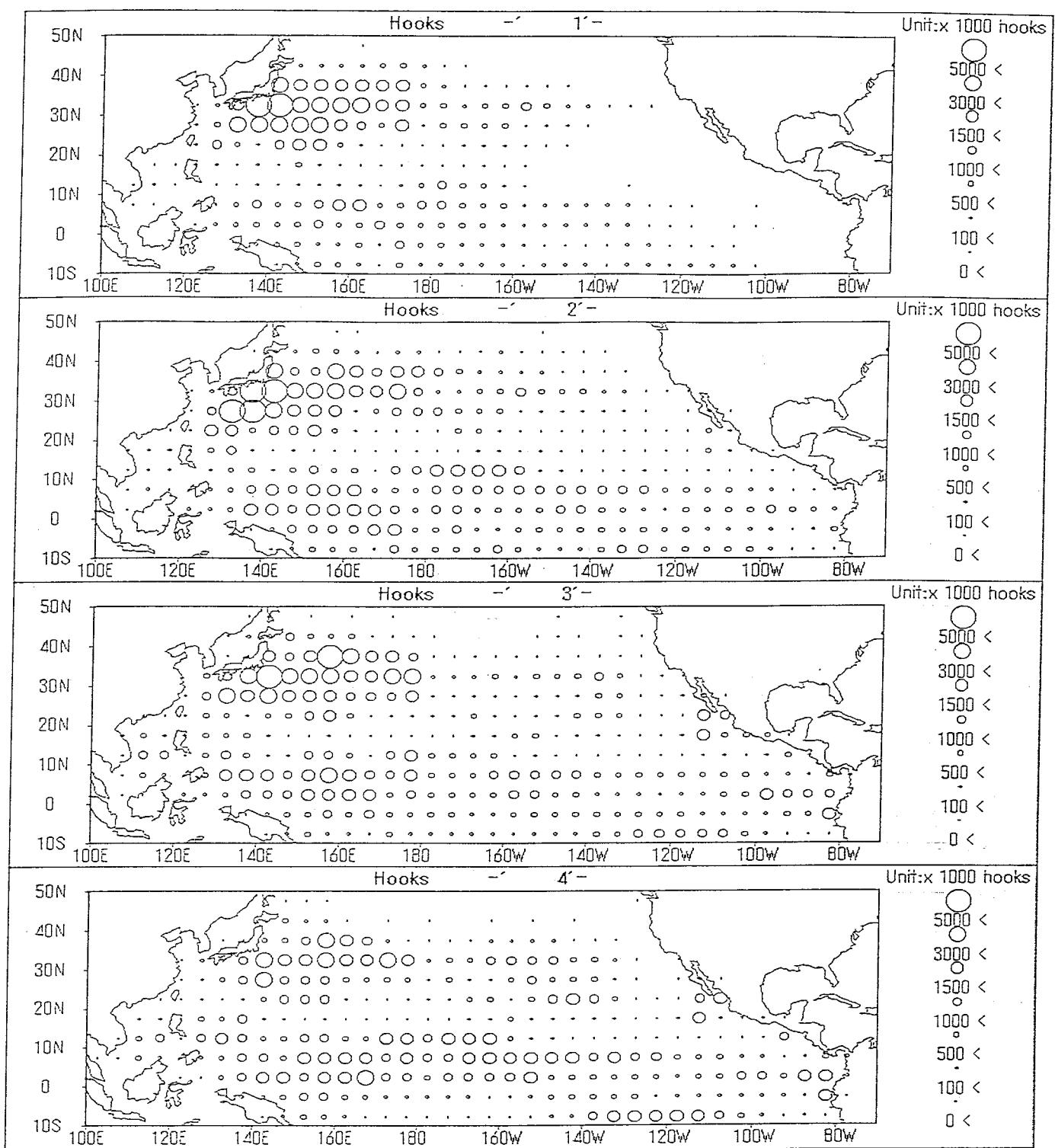


Fig. 25. The five year average effort (1000 hooks) distribution by 5x5 block of swordfish in the north Pacific caught by the Japanese distant water and offshore longliners in the period between 1955 and 1975. The first top panel is that of between 1955 and 1959, second one is between 1960 and 1964, third one is between 1965 and 1970 and fourth one is between 1970 and 1974.

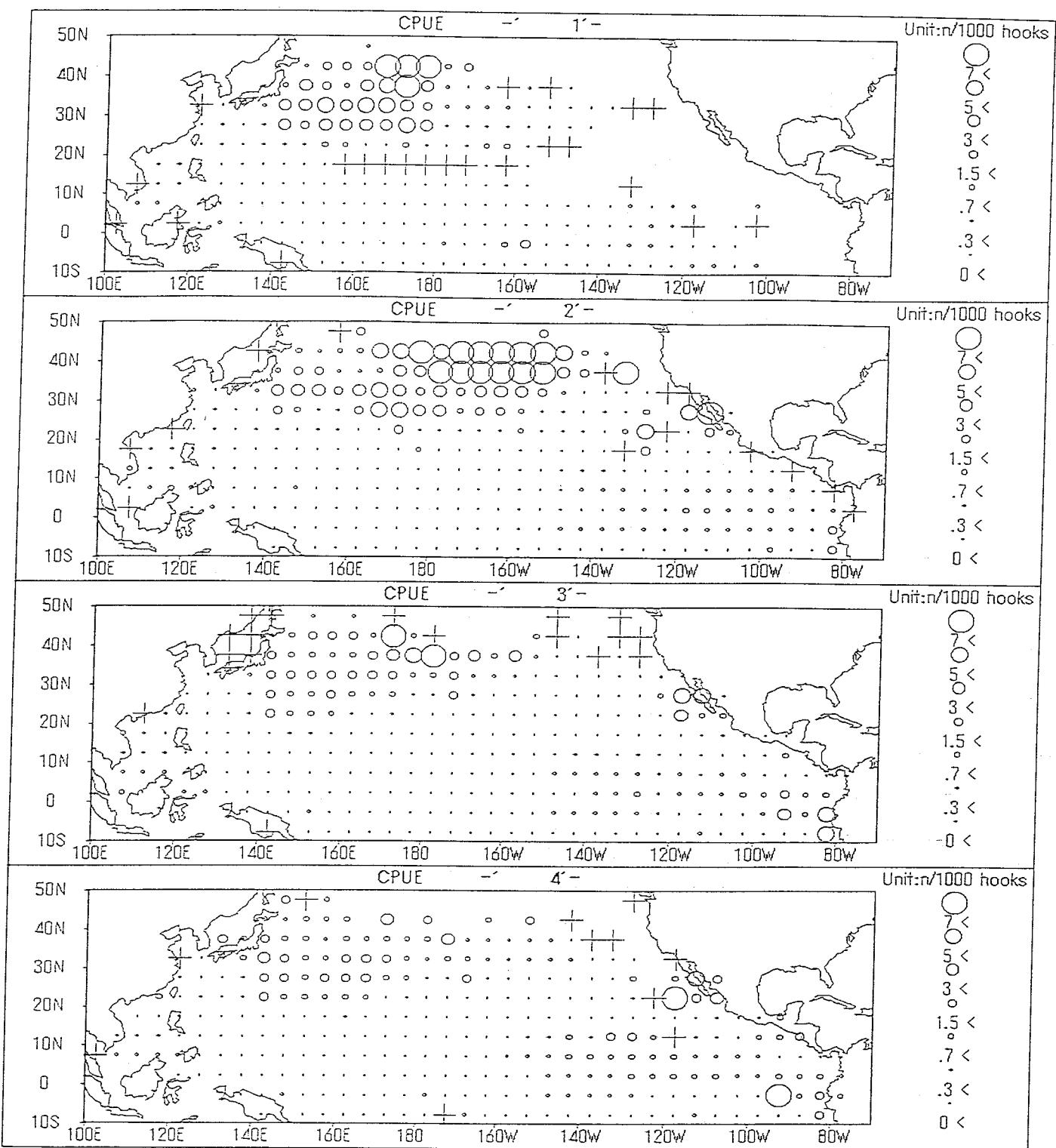


Fig. 26. The five year average CPUE (number/1000 hooks) distribution by 5x5 block of swordfish in the north Pacific caught by the Japanese distant water and offshore longliners in the period between 1955 and 1975. The first top panel is that of between 1955 and 1959, second one is between 1960 and 1964, third one is between 1965 and 1970 and fourth one is between 1970 and 1974.

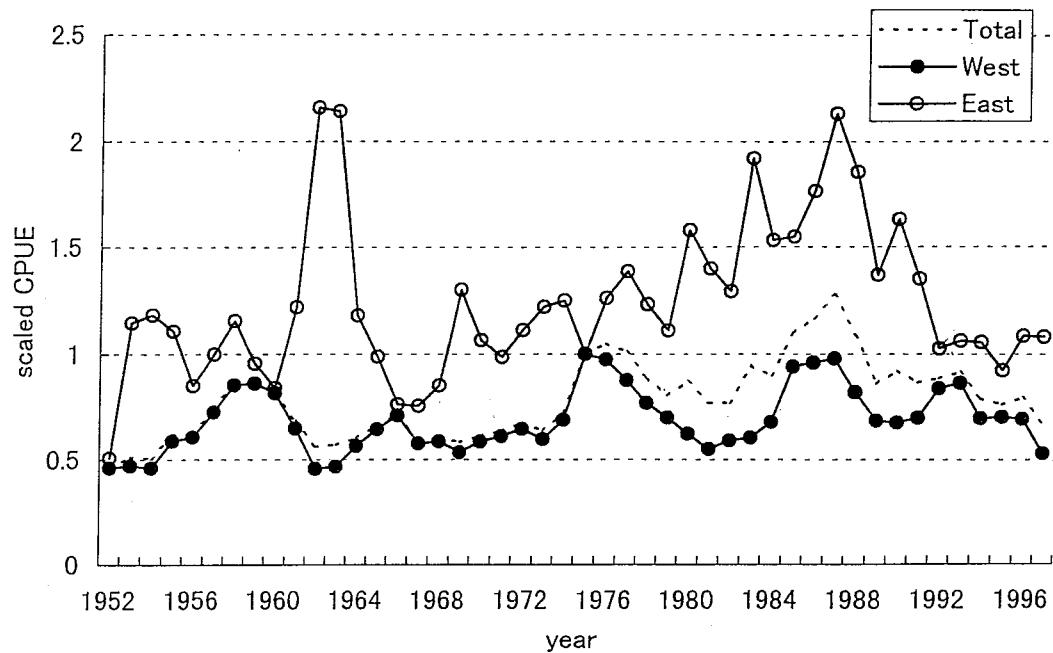


Fig. 27. The trend of the standardized CPUE for the west (closed circle) of 180° E and the east (open circle) in the north west and the north central Pacific in the period between 1952 – 97.

Table 1. Calculation of AIC for the models of swordfish CPUE standardization with database-II.
Four columns indicate combinations of two way interaction introduced into the model.

	1st	2nd	3rd	4th	No. of ob.	MSE	ln(MSE)	No. Par	AIC	Rank
quarter*area				87740	0.928	-0.075	92		-6356	5
quarter*gear			87740	0.950	-0.052	60		-4418	6	
yr*area			87740	0.965	-0.036	320		-2511	9	
area*gear			87740	0.950	-0.052	92		-4354	7	
quarter*area	quarter*gear		87740	0.923	-0.080	108		-6845	4	
quarter*area	yr*area		87740	0.950	-0.052	368		-3788	8	
quarter*area	area*gear		87740	0.886	-0.121	140		-10338	3	
quarter*area	area*gear	quarter*gear	87740	0.884	-0.124	156		-10555	2	
quarter*area	area*gear	quarter*gear	87740	0.859	-0.152	432		-12448	1	

Abbreviations: No. of ob., Number of observations; MSE, mean square error; No. par., number of parameter; AIC, Akaike's Information Criterion.

Table 2. Analysis of variance for Database-I in the northwest and north-central
 (north of 0° N and west of 125° W) for 1952 – 75.
 R square=0.60. CV=-64.00.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	485	21633.81711	44.60580847	62.51	0.0001
Error	20004	14275.00774	0.71360767		
Corrected Total	20489	35908.82485			

Table 3. Analysis of variance for Database-II in the northwest and north-central
 (north of 0° N and west of 125° W) for 1975 – 97.
 R-square=0.46. CV=-58.99.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	356	62289.40	174.97	200.16	0.0001
Error	85338	74597.34	0.87		
Corrected Total	85694	136886.74			

Table 4. The results of the ASPIC analysis under the various hypothesis.
 Bold numbers indicate the fixed ones.

period	input		results		
	B1-ratio	r	MSY	B1-ratio	r
1958–76	2.0		12,350	2.00	0.46
		0.4	12,370	1.36	0.40
1976–96	1.5		20,130	1.50	0.29
		0.4	20,730	0.71	0.40
1952–96	2.0		40,000	2.00	0.31
		0.4	40,000	1.10	0.40