ANALYSES OF THE INDONESIAN TUNA LONGLINE FISHERIES DATA IN THE INDIAN OCEAN, (1978-94)

- Joint research project between Indonesia (RIMF/CRIFI) and Japan (NRIFSF/OFCF) -

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INTRODUCTION

The joint research project between Indonesia (RIMF/CRIFI) and Japan (NRJFSF/OFCF) was conduced from February 21 to March 7, 2000 at the RIMF. The objective of this joint research project is to understand the basic features of the Indonesian tuna longline fisheries in the Indian Ocean by simple analyses including mapping using the GIS. This document summarizes the results of this joint research project. Appendix A shows the schedule of this joint research project.

DATA

Background

The Indonesian tuna longline logbook data from the PSB (Perikanan Samudera Besar) (1978-95 except 1986) are used for this study. The PSB is the semi governmental longline fishing company based in the Benoa port, Bali Province. Tuna fisheries information from 1978-83 were initially compiled under the USAID/FRDP (Fisheries Research Development Program) project from 1990-93. Under the supervision of Prof. Saila (University of Rhode Island, USA) with CRIFI, Jacobus Uktolseja and other staff (RIMF) compiled the raw data. After this project was over, Sofri Bhafa and other staff (RIMF) further compiled the 11994-95 data under the RIMF own project. In 1996, the RIMF project stopped and the data after 1996 has not been compiled yet. Budi Iskandar (RIMF) created the database of these tuna longline data using the MS/Access. The reason why the 1986 data are missing is due to the oil shock, which caused the limited operations by only 5 PSB longline boats from October – December 1986.

Data screenings

Errors of the database were initially checked. Tremendous number of the data (nearly 20% of the data) was found as errors. We cross-checked the errors with the original logbook (raw) data. After we screened and corrected the data, we decided to use the information from 30 PSB (Samudera) longline data operated in the Indian Ocean. Table 1 shows the sample sizes of the data sets in different levels.

Table 1 Sample size of the PSB dataset

Statistics	Sample size
Number of all the data set	n=38,956
Number of error (code: D) ? fishermen's rest (non-operation) or errors	n= 2,945
Number of effective data	n= 36,011
Number of actual operations by 30 PSB longliners	n=35,158
Number of actual operations by 30 PSB longliners in the Indian Ocean	n=27,41 8

Note: Locations of the fishing operation are exact positions until 1994, but those in the 1995 data are based on 1x1 degree.

Study area

The study area is the PSB longline fishing ground in the eastern Indian Ocean, which is depicted in Fig. 1

Table 2 Description of the longline boat, Samudera, in the PSB.

Class	Samudera	GT	LOA	materials of the longline (1978-95)
	No. 30	15 t	14 m	Mono filament (nylon)
	No. 31			
	No. 32	40 t	20 m	
Small (n=10)	No. 33			Multi filament
	No. 34			(Mixed with nylon and Carlen?)
	No. 35			
	No. 36	60 t	23 m	Mono filament (nylon)
	No. 37			
	No. 38			
	No. 39			
	No. 1			
	No. 2			
	No. 3			
	No. 4			Multi filament
	No. 5	100 t	26-27 m	(Mixed with nylon and Carlen?)
	No. 6			
	No. 7			
	No. 8			
	No. 9			
Medium (n=I8)	No. 10			
	No. 11			
	No. 12			
	No. 14			
	No. 15	114 t	28 m	
	No. 16			
	No. 17			
	No. 18			
	No. 19			
Large (n=3)	No. 23	135 t	36 m	
→oprated mainly in the	No. 21	254 t	40 m	
Banda Sea	No. 22		42 m	

DESCRIPTIVE ANALYSES

Specification of the longliners

Table 2 shows the specifications of the 31 longliners analyzed. Fig. 2 shows the diagram of the longline.

Fishing effort

Various aspects on the fishing efforts of the PSB longliners, Samudera, are analyzed. Table 3 shows the annual number of operations by boat class, boat and type of longline. Table 4 shows the number of operations, standard deviation, mini and max of basket, HPB (hook per Basket) and hooks by type of LL and boat class. Fig. 3 shows frequency of operations regarding (a) hook per basket, (b) number of hooks and (c) number of baskets by type of the longliners (regular or deep) during 1978-95.

Table 3 Annual number of operations by boat class, boat and type of longline

Note: L= Large, M= Medium, 5= Small C= Conventional LL(hooks <=6), D= Deep LL(7 <—hooks)

Note Two hooks at the edges of one unit line are not actually used if no.of hook per basket is 10 or more after 1994.

Class	Boat	Type	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
L	Sam21	C				31	36									1				
		D						15							2	3				
	Sam22	C				9	87													
		D						30	5						20	1				
	Sam23	C				33														
		D						15												
M	Sam01	C	142	10																
		D										1					1	1		1
	Sam02	C	93	53	153	143	61					3								
		D						66	94	120		38	95	160	66	25				
	Sam03	C	125	69	174	109	68	33							3					
		D						40	72	97		108	80	131	63	18				
	Sam04	C	142	93	108	62	79					7						1		
		D						55	90	122		47	82	98	106	17	19	133	143	110
	Sam05	C	145	89	168	25	93					4								
		D					1	78	94	78		71	57	145	52	36	1			8
	Sam06	C	13	52	191	134	86		100	34		59				9	4			
		D						50		19		21	95	149	34	44	144	56	93	114
	Sam07	C	118	83	161	84	84					10				9				
		D						69	103	108		58	79	158	49	34				20
	Sam08	C	150	73	117	60	40	17	131	170		50				2	2		1	
		D						32	12			68	121	128	110	6	141	152	111	118
	Sam09	C	118	44	122	57	66					15					7			
		D						48	152	110		86	65	103	84	13	192	140	124	111
	Sam10	C	163	85	119	90	29			1		10	12							1
		D						61	75	71		59	104	160	65	35				
	Sam11	C	102	70	149	86	60													
		D						36	65	103		39	96	124	58	55	143	155	124	72
	Sam12	C	106	86	105	46	77									5				
		D						17	120	92		110	83	139	73	30				1
	Sam13	C																		
		D																		
	Sam14	C	77	86	169	66	88									1				
		D						45	110	139		88	86	124	125	31	78	164	111	134
	Sam15	C	97	71	174	94	78	55				8								1
		D						28	126	90		73	108	129	74	41	166	172	98	143
	Sam16	C	94	46	122	65	105										1		1	
		D						50	112	159		90	63	145	47	52	121	158	98	145
	Sam17	C	187	88	141	57	92					3				4			2	
		D						86	77	101		32	102	99	113	42	177	167	114	120
	Sam18	C	96	96	182	50	79					5				8				
		D						70	105	155		99	79	154	78	46	1			1
	Sam19	C	96	94	158	93	83					11		4		7				
		D	1					78	73	99		75	54	160	26	47				
S	Sam30	C														2				
		D														118	184	138	112	142
	Sam31	C															2	1		
		D														55	208	134	109	128
	Sam32	C																4	1	10
		D																	30	76
	Sam33	C																		4
		D																	24	59
	Sam34	C																	1	
		D																	56	105
	Sam35	C																		
		D																	48	125
	Sam36	C																		
		D																	20	135
	Sam37	C																		
		D																	29	131
	Sam38	C																		
		D																	1	125
	Sam39	C																		29
		D																		77

Table 4 Number of operations (N), standard deviation, mini and max of basket, HPB (hook per Basket) and ho oks by type of LL (regular or deep) and boat class (small, medium and large).

DEEP					
DC=Deep C=Large					
Variable	N	Mean	Std. Dev.	Minimum	Maximum
BASKET	91	184.5385	94.7397966	30.0000000	295.0000000
HPB	91	8.296703	1.0381020	7.0000000	10.0000000
HOOKS	91	1510.02	829.7800509	280.0000000	2655.00
DC=Deep C=Med					
Variable	N	Mean	Std. Dev.	Minimum	Maximum
BASKET	15362	175.4505	63.4203296	57.0000000	300.0000000
HPB	15362	9.839669	1.1363093	7.0000000	15.0000000
HOOKS	15362	1726.71	668.2570336	540.0000000	3471.00
DC=Deep C=Small					
Variable	N	Mean	Std. Dev.	Minimum	Maximum
BASKET	2370	115.8553	17.2838562	35.0000000	176.0000000
HPB	2370	9.349367	0.5828287	7.0000000	11.0000000
HOOKS	2370	1082.99	171.6832240	320.0000000	1600.00
REGULAR					
DC=regular C=Large					
Variable	N	Mean	Std. Dev.	Minimum	Maximum
BASKET	197	226.1066	34.9118980	120.0000000	300.0000000
HPB	197	5.994924	0.0712470	5.0000000	6.0000000
HOOKS	197	1355.12	207.3110932	720.0000000	1800.00
DC=regular C=Med					
Variable	N	Mean	Std. Dev.	Minimum	Maximum
BASKET	9265	259.8414	23.4319332	60.0000000	350.0000000
HPB	9265	5.993092	0.0983225	4.0000000	6.0000000
HOOKS	9265	1557.68	143.8175238	300.0000000	2100.00
DC=regular C=Small					
Variable	N	Mean	Std. Dev.	Minimum	Maximum
BASKET	89	200.809	84.8230613	60.0000000	300.0000000
HPB	89	5.898876	0.3386116	4.0000000	6.0000000
HOOKS	89	1194.56	521.7041994	300.0000000	1800.00

Catch

Fig. 4 shows species composition in umber, i.e., (a) regular LL, (b) deep LL, (c) by quarter for regular LL and (d) by quarter for the deep LL.

CPUE

Fig. 5 shows annual trends (1978-94) of (a) overall nominal CPUE by species and (b) species composition in number. Fig. 6 shows annual trends (1978-94) of the CPUE by type of the LL for (a) YFT and (b) BET. Fig. 7 shows annual trends (1978-94) of number of hooks per baskets.

Summary

Fishing effort

- Majority fishing operations of the PSB longliners were conducted by the medium size boat (100-114 t class), while those by the small and the large boats operated in much less numbers. Small size longliners (15-60 t) started to operate fishing in 1990's in the Indian Ocean, while the large size (135-254 t) has been operating sporadically throughout 1981-91 in the Indian Ocean, which, however, mainly operated in the Pacific Ocean side.

- Majority of the conventional longline in the PSB shifted drastically to the deep longliners in 1983. But, it took 8 years (1983-91) to fully develop the deep longline fisheries. Therefore, the period of 1983-91 is considered as the developmental (transitional) stage to move to the deep longline fishing. As a conclusion, the PSB longline fisheries have following three stages, (a) regular longline stage (1978-87), (b) transitional stage to shift to the deep longline (1983-91) and (c) deep longline stage (1992-95). It is interesting to learn if other longliners of the non-PSB boats are the similar trends.
- The conventional longliners used 6 hooks per basket, while the deep longliners use from 9-11. In the transitional stage, the mean number of hooks per basket was 10.0, while the one in the developed stage was 9.2.
- Majority of the PSB longliners used 1,000-2,000 hooks in each operation.
- Majority of the PSB regular longliners used 200-300 baskets in each operation, while those of the deep longliners had in two ranges, i.e., 100.175 and 225-300.

CATCH AND CPUE

- Species compositions are considerably different between regular and deep longlines. For the regular longliners, they caught more YFT and SHK, while the deep ones, more BET.
- For the regular longliners, more YFT were caught in the 1st and 4th quarters, while for the deep longliners, no seasonality in YFF catch was observed.
- For BET, there were more catches in the 1st and 4th quarter in the deep longliners, while, for the regular one, less catch was observed in the 2nd quarter.
- For ALB and SHK, more catch was observed in the 2nd and quartet for both regular and deep longliners.
- Nominal overall CPUE shows gentle decreasing trend from 1978-95.
- BET catches have been gradually increasing from 1978-91 and sharply increased in 1992-95, then more than 80% of the catch turned to be BET.
- During 1978-91, YFF CPUE shows the gentle increasing trend, while BET CPUE shows the gentle decreasing trend.
- CPUE of YFT and BET in recent years (1992-95) shows the decreasing trends, although the BET CPUE significantly jumped in 1992 due to the full development of the deep longliner fisheries.

FISHING GROUNDS

- The PSB longline fishing ground in the Indian Ocean widely spans from the offshore waters to the high seas off the entire southern part of Indonesia.
- The regular longline fishing grounds wider than the one of the deep longliners. The fishing grounds of the deep longliners are concentrated in the waters off Jawa Island.
- YFF by the regular longliners were caught in the wider area than the catch by the deep longliners. On the other hands, BET by the deep longliners were caught much wider waters than the one by the regular longliners.
- Higher YFT CPUE areas by the regular longliners were scattered in the entire fishing grounds, while the ones by the deep longliners are located in the eastern part of the fishing grounds.
- Similarly, higher BET CPUE areas by the regular longliners were scattered in the entire fishing round, while the ones by the deep longliners are located in the offshore to distant waters off Jawa Island and also in the waters off southern part of Sumatra.

RECOMMENDATIONS

- This type of the Indonesian longline information is highly valuable to understand the trends of the tuna fishing and resources in the eastern part of the Indian Ocean. Thus, it is recommended that further detail analyses need to be continued using updated data after 1996 by incorporating the environmental data using the GIS.
- Although difficulty to collect more information from other longline fishing companies is understood, it is strongly recommended to put more effort to collect such data and to analyze them as in this paper, so that the whole picture of the Indonesian longline fisheries in the Indian Ocean can be learned.
- Nearly 20% of the original database used in this study was found out as errors. Quality controls of the data collections, entry and processing need to be improved and strengthened.
- Size and weight data are also important to understand details on the tuna longline fisheries and tuna resources. Thus, it is strongly recommended to initial to collect such biological data in the major tuna longline landing sites in Jakarta and Benoa ports.
- It is strongly recommended for Indonesia to joint the IOTC (Indian Ocean Tuna Commons) to share the knowledge of tuna fisheries and its resources in the Indian Ocean. This is because Indonesia is the 3~ or

4th largest tuna fishing country in the Indian Ocean. To implement this, IOTC, developed countries or some international funding Agencies need to provide finical support to Indonesia because the major reason why Indonesia can not become a member country is the finical difficulty to pay the membership fee.

- If the extra research funding is available, it is recommended to initiate the tagging experiments in the Indian Ocean to understand the basic knowledge of ecology and biology of YFF, BET and SKJ.

ACKNOWLEDGEMENTS

We wish to express our sincere appreciation to Drs Subhat Nurhakim (Director, RIMF) and Moth. F. Sukadi (Director, CRlFI) of Indonesia and also to Mr Simba Fukuda (Assistant Director, Training Affair Division, OFCF) of Japan, for their generous supports to conduct this joint research activity. Further appreciation is indebted to the PSB, Bali, which provided the variable information.

REFERENCE

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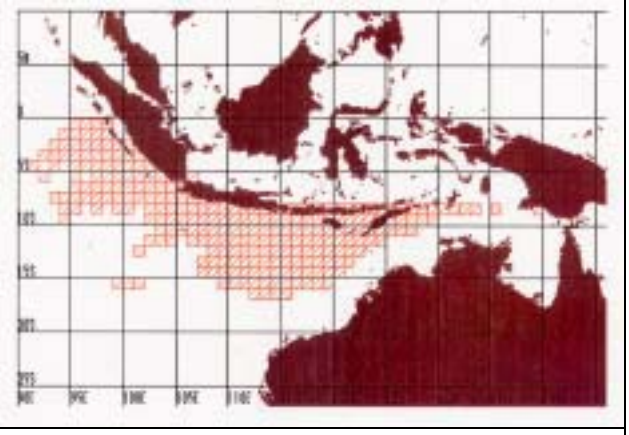


Fig. 1 Fishing (study) area of the 31 PSB longliners operated in the Indian Ocean (1978-95 except 1986)

(Note: 1x1 degree area where there was at lease one fishing operation)

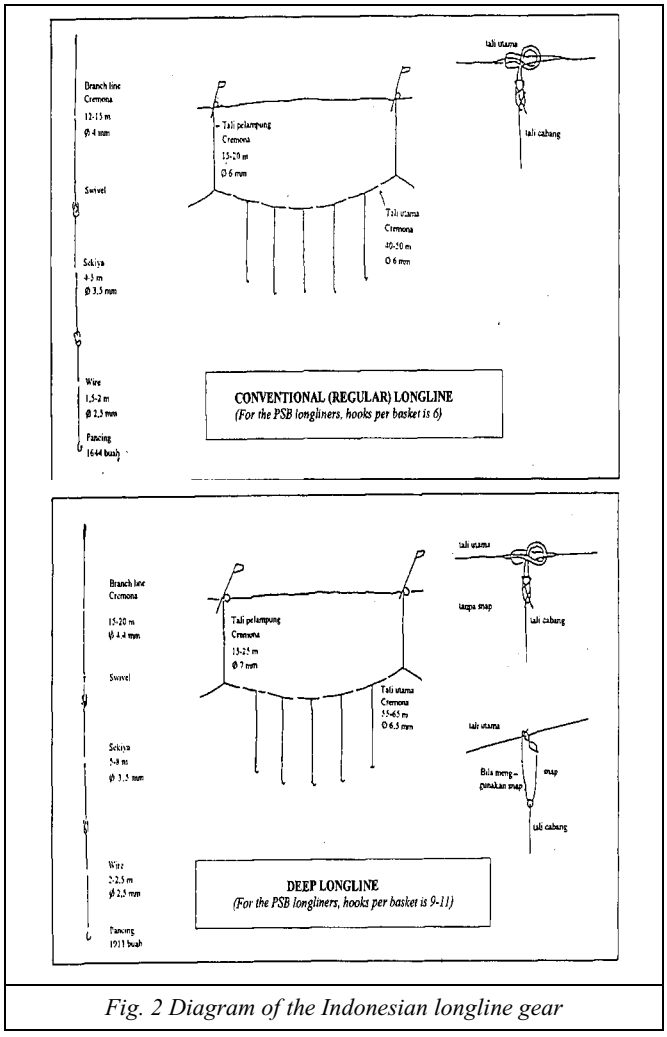
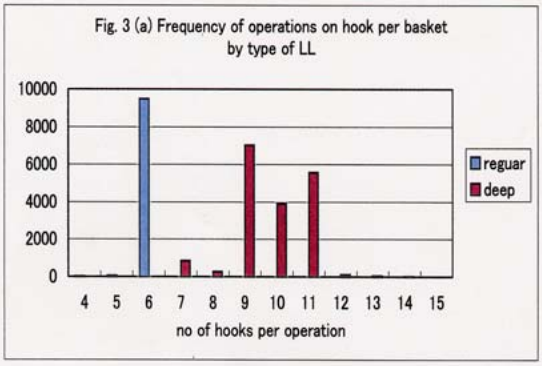
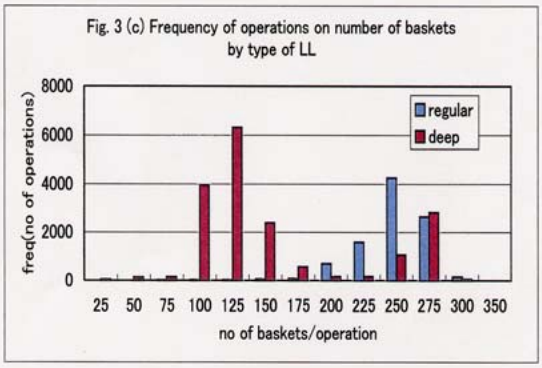


Fig. 2 Diagram of the Indonesian longline gear





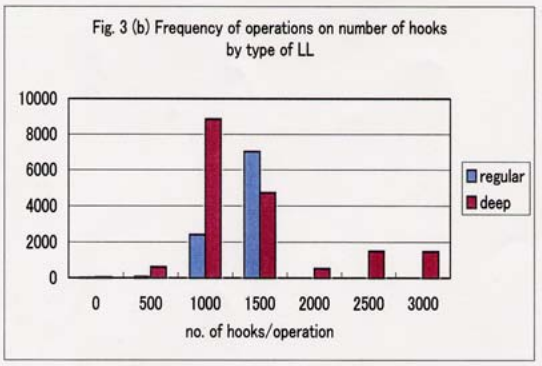
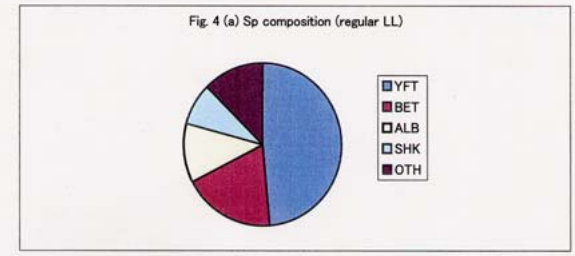
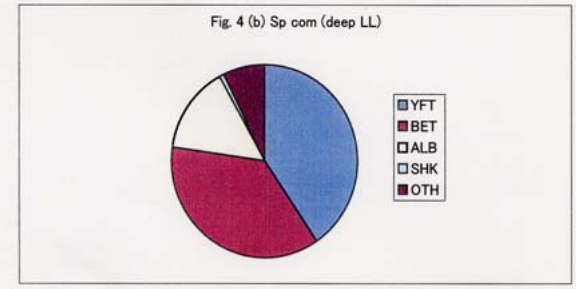
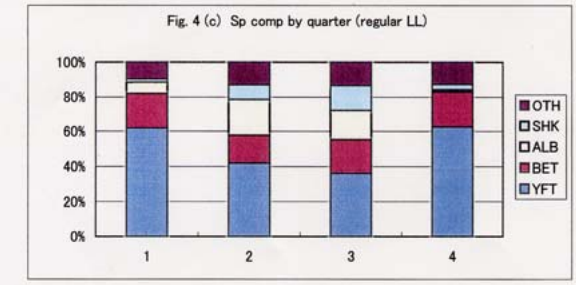


Fig.3 Frequency of operations regarding (a) hook per basket, (b) number of hooks and (c) number of baskets by type of the longliners (regular or deep) during 1978-95.







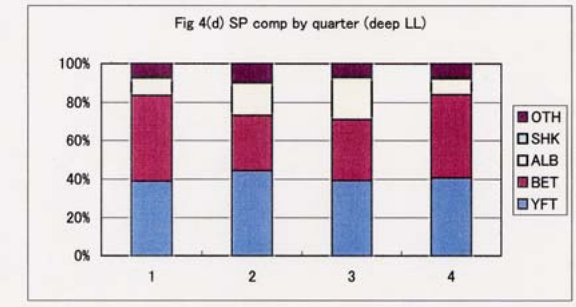


Fig. 4 Species compositions (based on number of fish)

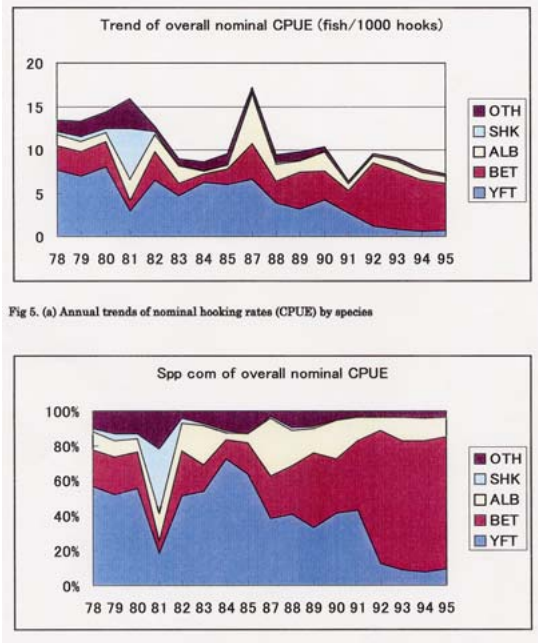
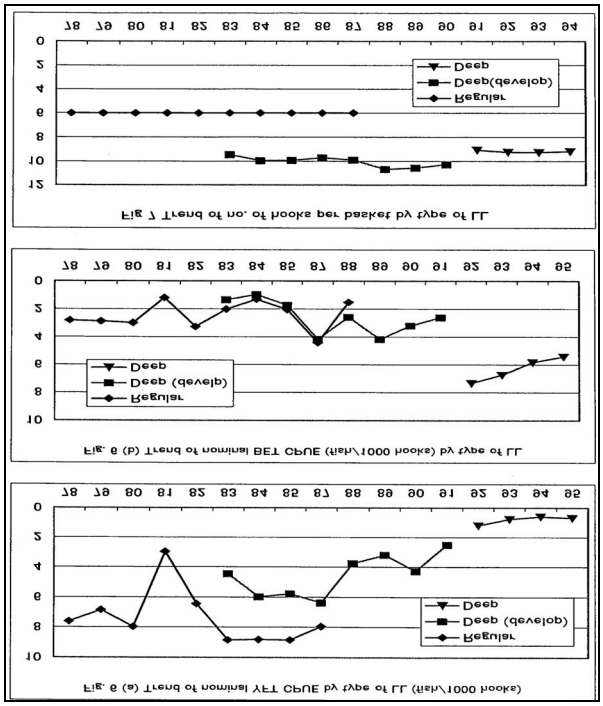


Fig 5. (a) Annual trends of nominal hooking rates (CPUE) by species

Fig. 5 (b) Species composition of nominal hooking rates (CPUE) based on fish/1000 hooks data)



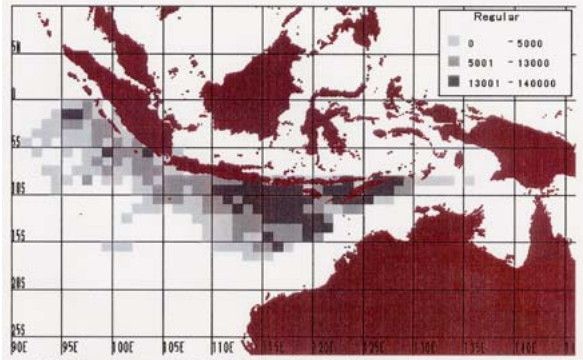
(note: information with annual operations < 50 are excluded)

MAPING OF THE INFORMATION USING THE MARINE GIS (MARINE EXPLORER)

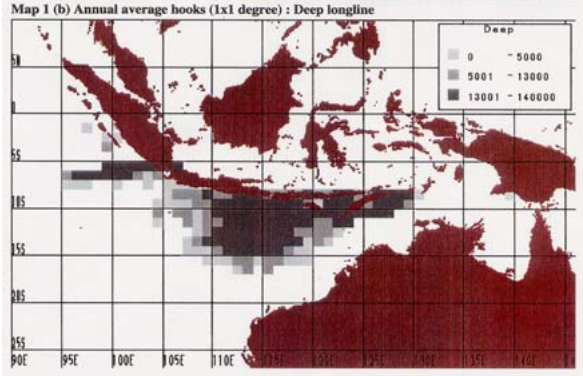
Fishing efforts

Catch

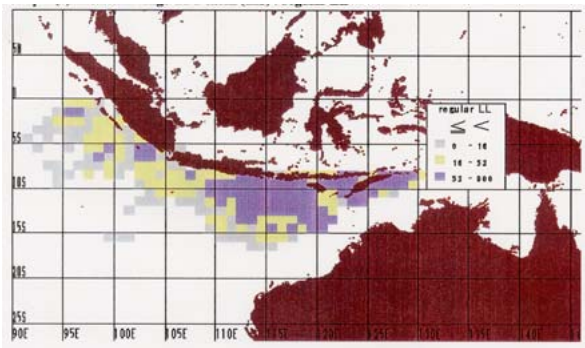
Map 1 (a) Annual average hooks (1x1 degree): Regular longline



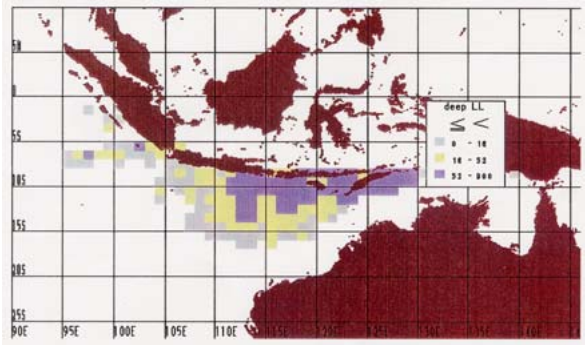
Map 1 (b) Annual average hooks (1x1 degree) : Deep longline



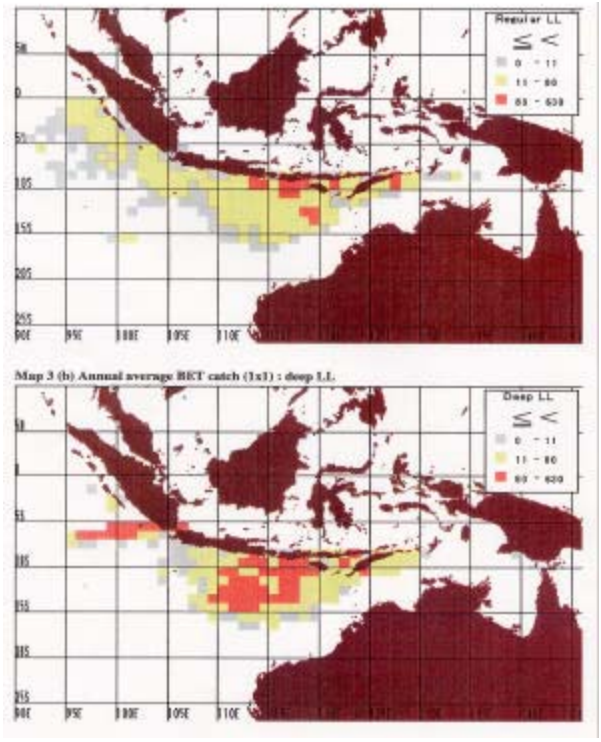
Map 2 (a) Annual average YFT catch (1x1): regular LL



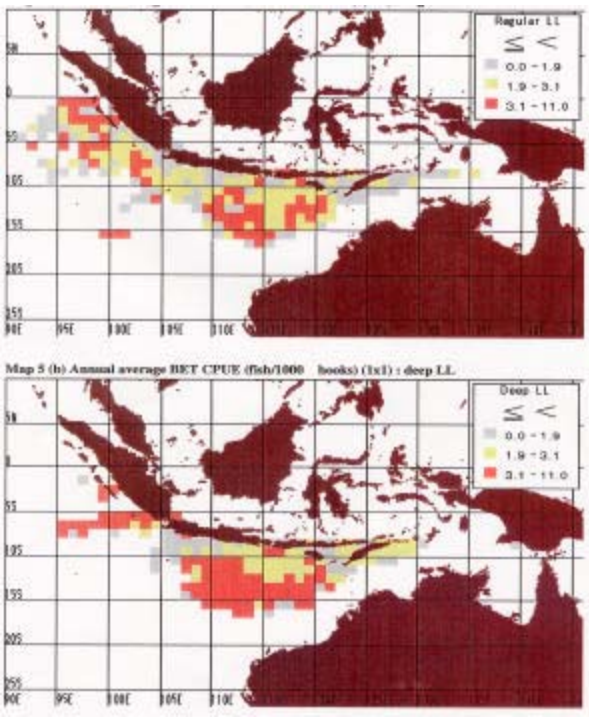
Map 2(b) Annual average YFT catch (1x1) : deep LL



Map 3 (a) Annual average BET catch (1x1): regular LL



Map 5 (a) Annual average BET CPUE (fish/1000 hooks) (1x1): regular LL



Map 4 (a) Annual average YFT CPUE (fish/1000 hooks) (1x1): regular LL