# Bay of Bengal Programme

**Development of Small-Scale Fisheries** 

PROMOTION OF BOTTOM SET LONGLINING IN SRI LANKA

BOBP/WP/40



SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY



FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

BAY OF BENGAL PROGRAMME Development of Small-Scale Fisheries BOBP/WP/40 GCP/RAS/040/SWE

PROMOTION OF BOTTOM SET LONGLINING IN SRI LANKA

BOBP/WP/40

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Development of Small-Scale Fisheries in the Bay of Bengal. Madras, India, August 1985 Mailing Address: Post Bag No. 1054, Madras 600018, India Street Address: 91, St. Mary's Road, Abhiramapuram, Madras 600018, India Cables: FOODAGRI;Telex: MS-311 FISH; Phones: 71294,71296,71587, 77760 This document is the third report of bottom set longlining trials conducted by BOBP in cooperation with the Ministry of Fisheries, Sri Lanka. The two earlier reports covered trials off the south west coast of Sri Lanka between October 1979 and March 1980 (BOBP/WP/6) and on the east and west coasts of Sri Lanka during August 1980—July 1981 (BOBP/WP/16). This report summarizes the results of the trials conducted between 1981 and 1 983 and also discusses biological information obtained from the trials during the period 1979—82.

The report concludes that bottom longlining might be a viable alternative fishery for both the 28-footers and the 18' GRP boats during the lean season for driftnet fisheries. This conclusion is based on trials conducted in Negombo, 1981 /82 and Puduwakattuwa, Dehiwala, Panadura and Ratmalana, 1 982/83.

This report, and the trials on which it is based, are activities of the small-scale fisheries project of the Bay of Bengal Programme (BOBP). It began in 1979 and covers five countries bordering the Bay of Bengal – Bangladesh, India, Malaysia, Sri Lanka and Thailand. Funded by SIDA (Swedish International Development Authority) and executed by the FAO (Food and Agriculture Organization of the United Nations), the project seeks to develop, demonstrate and promote appropriate technologies and methodologies to improve the conditions of small-scale fisherfolk and the supply of fish from the small-scale sector in the member countries.

This document is a working paper and has not been officially cleared by the Government concerned or the FAO.

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#### BOTTOM SET LONGLINING IN NEGOMBO, 1981/82

by K. T. Weerasooriya, Scientific Officer (Fishing Technologist) National Aquatic Resources Agency

#### 1.1 INTRODUCTION

The 31 tonners around Sri Lanka engage mainly in driftnetting and surface longlining. The boats on the west coast usually face a lean period for driftnetting during January—May. The results of bottomset longlining (BSLL) trials carried out by Ministry of Fisheries/BOBP in 1980/81 (BOBP/WP/16) indicated possibilities for carrying out bottomset longlining successfully in the west coast during January—May. It was also thought that this method could be a substitute for driftnetting and drift longlining during the lean season.

During the trials carried out in 1980/81, the following constraints and shortcomings, which would restrict commercial viability of BSLL operations with 28' boats (31 ton), were observed:

- Use of too few hooks per day. (A total of about 1000 hooks per day would ensure viability.)
- Difficulties in obtaining proper fishing gear materials.
- Inadequate supply of good quality bait at low cost.

It was felt that some effort was needed to encourage the 31 tonners, which usually engage in driftnetting, to diversify their effort towards BSLL fishing during the lean driftnetting season in order to improve their earning capacity.

During the Negombo trials in 1981, a few private boats showed interest and took to commercial BSLL fishing. In some cases this method proved viable. Subsequent discussions with private boat owners revealed that more fishermen would take to BSLL fishing during the lean driftnetting season if assistance were given. The project, therefore, decided to concentrate its efforts on the extension of BSLL fishing in the Negombo area during the lean driftnetting season 1981/82.

The objectives of these operations were to:

- introduce BSLL to the 28' class fishing boats and smaller boats (18' GRP type) usually engaged in driftnetting/surface longlining,
- encourage newcomers to BSLL by supplying proper fishing gear materials at subsidised rates and by making available technical know-how for rigging the fishing gear and fishing operations, and
- monitor the fishery and evaluate the results in order to improve further the efficiency of such
  operations.

#### 1.2 CRAFT AND FISHING GEAR

The craft used in these operations were mostly the 28' (31 ton) class of boats. In December 1981, five boats commenced BSLL operations but by March 1982, this number had increased to 19. Four 18' G RP boats (powered by outboard motors) also joined this fishery in March 1982.

In addition, the FAO/BOBP beachcraft SAL-iI (26'-long prototype made of marine plywood with GAP sheathing and powered by a 12 hp inboard air-cooled engine) also engaged in BSLL operations during the period.

Suitable fishing gear for BSLL was difficult to obtain locally. Adequate amount of fishing gear was imported and sold to interested parties below the cost price, so that these prices were lower than the prices prevailing in the local market. In certain cases, in order to encourage fishermen to take up the fishery, fishing gear was given on loan.

Fishing gear specifications and designs were as follows:

- The main lines used were polyester (PES) ropes of 4.2 and 4.8 mm diameter. Some fishermen used 5 mm and 6 mm tarred Kurlon ropes which are usually used for drift longlines;
- Snoods (branch lines) were mostly of nylon monofilament 0.9—1.1 mm diameter. Lengths ranged from 0.5 to 0.8 m. The distance between two consecutive snoods ranged from 1.9 to 2.2 m;
- Introduction of brass barrel swivels to connect snood to the mainline, which prevents kinking of the snoods, permits easy handling of the gear and reduces the breakage of snoods by fish. A few fishermen adopted this system;
- Mustad Kirby and round bent hook Nos. 5, 6 and 7 were used. A majority of fishermen had a liking for Nos. 6 and 7, which permitted the use of smaller-sized bait.

#### 1.3 RESULTS OF FISHING OPERATIONS

Commercial fishing operations started December 1981 and continued up to the end of March 1982, when they came to an abrupt halt due to festivities and fishermen starting to prepare driftnets for an expected early south-west monsoon.

The operational base was Negombo. The majority of fishing operations was carried out close to Colombo which the fishermen believe to be a richer fishing ground than Negombo. The area of fishing was 10–15 miles off Colombo (260°–280°bff Colombo harbour) at depths of 25–70 metres.

All boats departed from base around 4 p.m. and returned to base around 6 am. the next morning. Each boat made of 2 or 3 settings of line (sometimes 4) during this period.

Baiting of the lines was always carried out on the way to the fishing grounds. Squid, cuttlefish, sardines and herring, either fresh or frozen, were used as bait. Herring and sardines were purchased locally in Negombo, while squid and cuttlefish were purchased from Colombo on many occasions.

The longlines were usually coiled in wooden or GI (galvanised iron) tubs or cane baskets with the hooks clipped on to the rim of the tub or basket. When baiting, each hook is unclipped from the rim, cut pieces of bait (20—30 g) are attached to the hook and left hanging outside the tub just below the rim. A total of 270,000 hooks were used, the average number of hooks per operation per boat being 721.

At the start of BSLL season in December 1981, only 6 boats of the 28' class were engaged in this fishery. The number increased gradually to 8 in January 1982, 16 in February and 21 in March. Of these, 3,4,8 and 13 boats were engaged full time in BSLL fishery during the months of December 1981, January, February and March 1982, respectively. Other boats took up BSLL fishing only when landings of the regular BSLL boats were good. Four boats made a few attempts but gave up because of continuously poor landings or loss of fishing gear at sea.

During earlier trials, most of the operations were carried out in the early mornings. The best results were usually obtained around sunrise and the chances of fish getting hooked decreased gradually towards noon. In such operations, failure in the first setting would upset the whole operation for the day. It was observed that when operations were carried out in the night, chances of fish getting hooked were almost even throughout the night. Unlike early morning operations, this increased the chances of good fishing even if the first attempt failed.

Generally, the first setting was made around 6.30—7.00 p.m. and hauled around 8.00—8.30 p.m. The second setting was made immediately after and hauled in around 11.00 p.m—midnight. Depending on the quantity of bait left and the richness of the fishing ground further sets may be made. The shooting was done either from the starboard side while drifting, or from the stern while running ahead at 2–3 knots.

Identification of fishing grounds was usually carried out by finding depths with a lead line and aligning with known landmarks (or lights).

A group of research assistants (3—4) from NARA (National Aquatic Resources Agency) monitored the fishery under the supervision of a Research Officer (also from NARA). The functions of this group were to:

- help newcomers to the fishery in preparation of the fishing gear,
- \_ give instructions on operational aspects, and
- collect data on catch and economics (fishing time, fishing gear details, catch, incomes and expenditure).

The catch records (i.e., species, no. of fish and approximate weight) were collected by research assistants when the boats returned to the base after fishing. Other information, such as number of settings made, number of hooks used, fishing ground, etc., were collected from the skippers of the boats.

The fish landed were sold through the local auction at Negombo. The prices obtained were dependent on the time of arrival of boat at base, abundance of fish in the market and quality of fish. In comparison to the other areas, the Negombo market always fetched a higher price.

#### 1.3.1 Catch and catch rates

Table 1 shows the variation of catch and catch rates on a weekly basis for the whole period. On the basis of monthly averages, the catch rate was more or less uniform at 11 kg/i 00 hooks during December, January and February; it was considerably lower, at 8 kg/iOO hooks in March. Although there was a slight decline in the number of pieces per 100 hooks in January and February as compared to December, this was compensated by an increase in the average weight of individual fish. However, the increasing weight of individual fish could not compensate for the reduction in the number of pieces in the month of March. The decline in catch rates in March could be attributed to choppy seas and strong currents which occurred from time to time.

In comparison with the average catch rates obtained during the 1980/81 trials, a tremendous improvement was seen during the 1981/82 trials in December, January and February. However, the average catch rates obtained in March 1981 were higher than those in March 1982. The best catches in 1981 were obtained during April while in 1982 no operation was carried out during that month.

#### 1.3.2 Catch composition

Table 1.2 shows catch composition of the monthly landings. A gradual decrease in the percentage of emperors (*Lethrinus nebulosus*, *L. miniatus* and *L. caeruleus*) is seen over the period, while the percentage of snapper (*Lutjanus* spp.) increased gradually over the period. No significant changes in other major varieties were evident.

#### 1.3.3 Wide gap hooks experiment

During the 1980/81 BSLL trials, experiments were carried out for a short period of time to compare the efficiency of wide gap hooks with that of conventional type of hooks (round bent) (BOBP/WP/1 6).

As the number of hooks operated was insufficient for drawing any conclusion, the trials were repeated in Negombo for a longer period during the 1981/82 trials, utilizing Kirby hooks instead of round bent hooks. Most BSLL fishermen now use Kirby hooks as they feel it is more efficient than the round bent type. The results are presented in Table 1.3.

The results gave average hook rates (no. of pieces/100 hooks) for wide gap and Kirby as 5.6 and 5.2 respectively and the average catch rate (weight/i 00 hooks) as 14.0 kg and 10.1 kg respectively. These figures indicate an 8% and 39% increase respectively, for hook rate and catch rate in favour of the wide gap hooks. It was also observed that the average weight of individual fish caught with the wide gap hooks was higher by about 32% than the fish caught with the Kirby hooks, indicating thereby that the wide gap hooks caught comparatively larger sized fish.

However, in the 1980/81 trials, increases of 49% and 72% respectively, were recorded in hook rate and catch rate for wide gap hook catches as compared with those of round bent hooks. Considering the higher price of wide gap hooks, which is nearly double that of Kirby or round bent hooks, other operational difficulties experienced in using wide gap hooks and inconsistency of results of the two sets of trials held at two different places, the former on the east coast and the latter on the south-west coast, conclusions have to await further study.

#### 1.3.4 Economics of operation

The fishing grounds were about 25 miles from the base. It takes about 3 hours to sail one way and requires about 8 to 10 gallons of fuel for the trip. These fishing grounds are only 10—15 miles from Colombo. If the operations are carried out from Colombo the fuel required would be only 5—6 gallons for the trip. Although attempts were made to encourage Negombo fishermen to operate from Colombo as the base, this could not be executed due to various economic reasons.

The cost of bait could be reduced by about one-third in February and March as compared to the earlier two months. This was achieved by utilizing a mixture of expensive and cheap bait varieties, combined with the use of only the optimum quantity of bait and reduction of wastage. Fishermen prefer to use squid or cuttlefish, which are difficult to obtain in Negombo in the required quantities and are also very expensive. Cuttlefish is usually brought from Colombo. The purchase prices of bait were as follows:

Squid & cuttlefish (whole)	Rs. 14-	—17 per kg
Cuttlefish lobes (remainder after processing for export)	Rs. 9	—li per kg
Herring	Rs. 10-	—12 per kg
Sardine	Rs. 6-	<ul> <li>9 per kg</li> </ul>

In order to reduce bait cost, some fishermen used cheaper bait, such as sardines mixed with cuttlefish. Availability and prices of bait may thus affect the operations sometimes.

#### (i) 28'boats (31 ton)

Details of catch rates, expenditure, income and net revenue are presented in Table 1.4 for both the 31 tonners and the 18' GRP boats.

Δc

Fixed and variable costs were estimated as follows:

			7.5.
Fixed costs _	Capital repayment +interest payment per fishing day	 	150.00
	Depreciation of fishing gear per fishing day	 	20.00
	Boat repair cost per fishing day	 	30.00
Variable costs _	Salary and food allowance for 4 crew members	 	240.00
	Fuel and bait costs	 	330.00

These boats are basically driftnetters, and bottom set longlining is carried out only to earn an extra income during the lean driftnetting season. As such, the fixed costs include only the depreciation of fishing gear and cost of boat repairs. Breakeven is achieved if the gross revenue (proceeds from fish sales) equals the sum of fixed costs and the variable costs (bait and fuel costs and crew salary). On these assumptions, boats obtaining a net revenue (proceeds from fish sales—fuel cost, bait cost) of more than Rs. 290.00 (salary and food allowance and the fixed cost) per operation could be taken as being capable of carrying out commercially viable operations. Of the 11 boats which engaged in BSLL steadily, 4 boats performed very well, making a net revenue in the range of Rs. 590—800; 3 boats made a net revenue in the range of Rs. 300—500; while the remaining 4 boats failed to attain the breakeven point of As. 290.

The variability in catch/boat may have been due to differences in:

- skill of crew,
- \_ lack of knowledge of the fishing grounds,
- \_ differences in fuel costs owing to differences in distance of the fishing grounds from the base
- variation in the number of hooks operated per fishing day, and
- \_ number of fishing days/boat.

#### (ii) 18' GRP Boats

Fixed and variable costs were estimated as follows:

Fixed costs	<ul> <li>Capital repayment+ interest payment per fishing data</li> </ul>	ау	70.00
	Boat & engine repair cost per fishing day		30.00
	Depreciation of fishing gear/fishing day		20.00
Variable costs	s = Salary and food allowance for 3 crew members $\dots$		180.00
	Fuel and bait cost		240.00

Rs.

For these boats the breakeven was calculated, on assumptions similar to those for 28' boats, as Rs. 230. Three out of four 18' GRP boats engaging in BSLL achieved results better than breakeven, earning incomes ranging from Rs. 389 to Rs. 583. One boat narrowly missed the breakeven point. In view of the lack of experience of the crews and the short periods of BSLL operations, these results are encouraging. It would appear from these results, that BSLL with 18' GRP boats is a commercially viable proposition.

#### 1.3.5 Fishing grounds

The fishermen have only a limited knowledge of the grounds in this area. Most of the newcomers fail to obtain good catches as there is no proper guidance in respect of fishing grounds. Professional jealousies tend to prevent experienced fishermen from guiding newcomers to good fishing grounds. Details of uneven rocky patches (the areas where demersal varieties are likely to dwell) are not available. It may be a good idea to carry out a topographical survey with a view to expanding the knowledge on bottom characteristics in this area. Such a survey could be undertaken by NARA or the Ministry of Fisheries with local or foreign financial assistance.

#### Bait

One major constraint which could limit the BSLL operations is the poor availability and high cost of good quality bait.

Negombo fishermen have to travel to Colombo to buy bait. Although there are private parties who store bait, the prices they charge are exorbitant. There is a definite need for an organization to undertake the supply of good quality bait at reasonable prices. This could easily be done by a fishermen's cooperative society or a fisheries extension society.

#### 1.3.6 Comparison with earlier results

A summary of all fishing trials and commercial operations since October 1979 till May 1983 is presented in Table 1.5. It is seen from the table that except in the case of the last trial in the Trincomalee area during May-August 1982, BSLL operations may not be rewarding. It is, however, seen that the results have been improving progressively over the period, with the best performance coming in the last trials. The improved performance of the trial boats with the passage of time has paved the way for commercial operations off Negombo and recently off Dehiwala and Panadura. These results have established beyond doubt the economic viability of the BSLL operations.

The inference which could be drawn is that, BSLL as a fishing method may be suitable only as a secondary method, i.e., to obtain a supplementary income during the lean driftnetting season. The reasons are,

- (a) operational limitations due to weather conditions,
- (b) limitation of gear carrying capacity and operating capacity of present fleet of craft. Even the maximum BSLL yield is not as good as good driftnet catches, and
- (c) difficulty of operation compared to driftnetting or surface longlining.

The following constraints could hamper the promotion of this method, even as a secondary method:

- 1. supply of good quality bait at reasonable prices,
- 2. marketing of demersal species in those areas where the prices offered are low,
- 3. lack of knowledge of bottom conditions,
- 4. non-availability of proper fishing gear/exploitation by private dealers of fishing gear,
- 5. lack of technical know-how.

2. Marketing

3. Lack of knowledge of bottom conditions

These constraints can be remedied through:

- 1. Supply of bait (a) Organize through cooperative societies or other establishments.
  - (b) Encourage small-scale fishermen from the same community to fish for bait species.
  - (c) Arrange for one ring-netter to operate in the area exclusively for bait supply.
  - (a) Organize marketing through state organizations or cooperative societies.
  - (b) Explore possibilities of export.
  - (a) Conduct bottom configuration surveys along with fishing trials with the aim of preparing a fishing grounds chart for at least the most prominent areas of demersal fishing.
    - (b) Design of any demersal fishing trials should include collection of data on the correct position and bottom configuration of fishing stations (both navigational and fishing).

For both these tasks well equipped vessels are required.

- 4. Non-availability of proper Promote a subsidy scheme for BSLL gear. fishing gear
- 5. Lack of technical know-how Train Extension Officers and FTC personnel in technical work related to BSLL and use them to educate the fishermen.

## Weekly analysis of catch data

Period	Total no. of	Total no. of hooks	Tot cat	tal ch	Fish size kg/pcs.	Cate 100	ch per hooks	Value of catch per 100 hooks	Value of catch	Value of catch per kg	Cost of fuel	Cost of fuel per 100 hooks	Cost of bait	Cost of bait per 100 hooks	Net revenue	Net revenue/ boat per operations
	operations		Pcs.	kg		Pcs.	kg	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
01—08 December 1981 09—15 16—23 24—31	12 15 15 03	6,320 7,925 7,995 1,850	449 252 404 iii	806 471 1074 311	1.8 1.9 2.7 2.8	7.1 3.2 5.1 6.0	12.4 5.9 13.4 16.8	188 83 183 205	11,872,. 6,592 14,653 3,794	14.7 13.4 13.6 12.2	1,357 2,063 1,795 271	21 26 22 15	1,716 1,938 2,623 720	27 24 33 39	8,799 2,591 10,235 2,803	733 173 682 934
Monthlytotal/average	45	24,090	1216	2662		5.0	11.1		36,911	13.9	5,486	23	6,997	29	24,468	543
01—07 January 1982 08—15 16—22 23—31	13 19 17 23	7,000 12,500 10,480 14,575	305 675 475 595	836 1523 1145 1541	2.7 2.3 2.4 2.6	4.4 5.4 4.5 4.1	11.9 12.2 10.9 10.6	161 156 138 138	11,293 19,474 14,437 20,182	13.5 12.8 12.6 13.1	1,727 2,401 2,173 3,046	25 19 21 21	2,481 3,547 3,015 4,431	35 28 29 30	7,085 13,526 9,249 12,705	545 712 544 552
Monthlytotal/average	72	44,555	2050	5044		4.6	11.3		65,389	13.0	9,347	21	13,477	30	42,565	591
01—07 February 1982 08—14 15—21 22—28	15 18 32 40	12,790 15,325 24,915 27,270	337 277 1499 1307	827 686 4067 3300	2.5 2.5 2.7 2.5	2.6 1.8 6.0 4.8	6.5 4.5 16.3 12.1	79 56 163 134	10,157 8,629 40,635 36,582	12.3 12.6 10.0 11.1	2,037 2,525 6,445 7,984	16 16 26 29	2,495 2,904 4,220 5,727	20 19 17 21	5,625 3,200 29,970 22,871	375 178 936 572
Monthlytotal/average	105	80,300	3420	8880		4.3	11.1		96,003	10.8	18,991	24	15,346	10	61,666	587
01—08 March 1982 09—16 17—23 24—31	57 52 44 41	40,150 40,232 32,645 32,680	1586 1008 815 850	3988 2662 2497 2329	2.5 2.6 3.1 2.7	4.0 2.5 2.5 2.6	9.9 6.6 7.6 7.1	108 77 82 79	43,447 31,016 26,646 25,753	10.9 11.7 10.7 11.1	12,255 10,802 7,786 7,023	31 27 24 21	8,467 7,298 6,104 6,747	21 18 19 21	22,725 12,916 12,756 11,983	399 248 290 292
Monthly total/average	194	145,707	4259	11476		2.9	7.9		126,862	11 .1	37,866	26	28,616	20	60,380	311

(Net Revenue = Value of catch—Cost of fuel—Cost of bait)

Species	Decemb	er '81	January	'82	February	'82	March	n '82
Lethrinus nebulosus L. miniatus L. cacreleus	53.0 4.2 16.4	73.6	46.2 6.6 27.7	70.5	45.2 6.9 15.6	67.7	40.0 8.4 18.0	66.4
Gymnocranius robinsoni	0.3		0.4		0.8		0.7	
Plectorhynchuspictus	2.1	2.4	1.2	1.6	1.5	2.3	1.3	2.0
Lutjanusbohar	4.1		3.2		4.0		5.3	
L.rivu/atus	1.2		3.3		1.5		4.3	
L. argeritimaculatus	0.1	5.6	0.1	9.5	0.7	14.2	1.5	17.1
L.malabaricus	0.1		1.6		1.1		1.2	
L. coccinues	_		1.0		2.1		0.6	
Other <i>Lutjanus</i> spp.	0.2		0.3		4.8		4.2	
Cepha/opholes sonnerati	0.5		2.0		1.2'		2.1	
Epinephelusundulosus	3.7		4.7		2.5		4.0	
E.areo/atus	1.8		0.6		1.2		1.3	90
E. chlorostigma	0.4	6.5	_	8.0	_	5.0	0.3	
E. inalasarious	0.4		1.1		?		0.3	
Other Epinephelus spp.	0.2		1.6		?		0.8	
Caranx sp.	2.0		1.3		1.0		1.0	
Catfish	3.1		2.2		1.7		0.8	
Shark	3.1		3.4		4.5		0.8	
Others	3.3		3.3		3.3		3.1	
		100.2		101.5	5	97.7		100.0

## Percentage catch composition of different species

## Table 1.3

## Summary of catch data—wide gap hooks experiment

## (January-March 1982)

Month	No. of wide gap	(	Cat Catch 10		ch rate/ ) hooks	No. of No. 7		Catch	Catch ra atch 100 hoc	
Month	NOOKS	Pcs.	kg.	Pcs.	kg.	NOOKS	Pcs.	kg.	Pcs.	kg.
January 1982	3125	136	354.5	4.3	11.3	3125	147	293.5	4.7	9.4
February	5000	265	631.5	5.3	12.6	5000	292	585.0	5.8	11.7
March	3500	249	639.0	7.1	18.3	3500	168	290.0	4.8	8.2
	11625	650	1625.0	5.6	14.0	11625	607	1168.5	5.2	10.1

## Performance of fishing boats undertaking bottom set longlining in Negombo (Cost and earnings analysis for the period December 1981—March 1982)

(Listed in descending order of net income/day)

Craft	No. of BSLL operations	Total no. of hooks	Average no of hooks per	). Ca	atch	Catch 100	rate! hooks	Value of catch	Bait cost (Rs.)	Fuel cost (Rs.)	Net revenue	Net revenue per day
	(days)		fishing day	Pcs.	kg	Pcs.	kg	(As.)	, , , , , , , , , , , , , , , , , , ,	<b>、</b> ,	(As.)	(As.)
(3½ tonners)												
Sindupriya SAL—il (BOBP) Samudra Sampath	36 59 19	29,280 49,775 13,728	813 844 722	865 2108 746	3401 5768 1981	3.0 4.2 5.0	11.6 11.6 14.4	41,092 65,392 20,715	4,449 13,324 2,699	7,764 5,006 3,628	28,830 47,062 14,388	802 798 757
Madu Rani NM 90 St.Anthony	53 16 58	42,255 9,500 40,210	797 594 693	1461 380 1i54	4502 1178 3428	3.4 4.0 2.0	10.6 12.4 8.5	50,392 13,37i 41,112	9,021 2,410 9,053	9,949 3,174 9,363	31,422 7,787 22,696	593 487 391
Janitha Jesthamani Vasantha Caney	05 04 19	3,450 3,950 14,505	690 988 763	92 77 489	249 254 1181	2.6 1.9 3.3	7.2 6.4 8.0	3,559 2,807 12,571	585 558 2,740	1,056 894 3,930	1,917 1,355 5,901	383 339 311
Priyantha Jalaweera Indika	03 10 22	3,000 7,980 17,545	1000 798 798	52 211 376	144 557 1143	1.7 2.6 2.0	4.8 7.0 6.5	2,040 6,644 13,730	475 1,427 2,830	650 2,397 5,112	915 2,820 5,788	305 282 263
Kalvari   Cyril	36 ii	24,540 8,250	610 681 795	621 160	1655 564	2.8 2.5 1.8	9.1 6.7 6.4	5,869 18,936 5,171	5,074 1,910	2,005 5,590 1,021	2,604 8,272 2,240	200 230 204
AP 18 309	22 17 04	9,420 1,150 1,625	428 656 406	255 270 49	651 79	2.7 2.4 3.0	8.1 5.8 4.8	9,060 7,759 1,210	2,225 2,195 435	3,991 3,640 569	2,844 1,924 206	129 113 52
Samanmalee Jeevani Ganga	02 01	350	350 350	44 06	93	4.0 1.7	8.5 2.0	665 128	300 150	344 163	—185	—185
<i>18' GRP Boats</i> Sinduthri NMDF 13 Jalaweera	09 09 04	5,000 5,100 2,925	556 567 731	204 270 63	763 523 175	4.1 3.3 2.1	15.2 10.2 5.9	7,695 5,639 2,185	1,060 1,177 520	1,386 957 550	5,249 3,505 1,115	583 389 279
NMDF 104	15	8,540	569	220	640	2.6	7.5	6,758	1,645	1,738	3,375	225

Summary of fishing trials data

No. of	Total no.	o. Catch		Catch rate! Catch 100 hooks		Average size!	Value of	Bait cost	Fuel cost	Net	Net revenue!	Catch! operation/	Price of	Average
operations	of hooks	Pcs.	kg	Pcs.	kg	fish kg	catch Rs.	Rs.	As.	revenue As	boat/day Rs.	boat kg	fish/kg As.	no. of hooks! operation/boat
92	99,475	2032	4535	2.0	4.6	2.2	N.A.	N.A.	N.A.	N.A.	N.A.	49.3	N.A.	1081
258	177,800	3897	9700	2.2	5.4	2.5	71,814.00	30,839.00	41,400.00	2,570.00	10.00	37.6	7.71	689
15	10,090	345	545	3.2	5.0	1.6	2,554.00	1,192.50	2,980.00	—1,618.00	—107.87	36.3	4.68	673
116	58,267	1511	4309	2.6	7.4	2.8	37,966.00	19,929.00	1,687.00	1,687.00	14.50	37.1	8.81	502
48	71,031	2419	6425	3.4	9.1	2.7	58,374.00	29,618.00	25,450.00	3,306.00	69.00	133.8	9.08	1480
27	23,375	977	2050	4.3	9.0	2.1	20,373.00	3,872.00	3,059.75	13,441.25	497.80	75.9	9.93	866
407	297,723	9588	28137	3.2	9.4	2.9	322,223.00	63,019.00	70,236.00	188,968.00	407.00	69.1	11.45	732
37	21,565	657	2099	3.0	9.7	3.2	22,277.00	4,402.00	4,631.00	13,244.00	358.00	56.7	10.61	583
71	91,025	1751	5429	1.9	6.0	3.1	78,374.00	14,945.00	17,292.00	46,137.00	650.00	76.5	14.44	1282
64	55,850	1270	3906	2.3	7.0	3.1	55,557,00	10,810.00	9,707.00	35,040.00	547.50	61.0	14.22	873
28	33,325	285	772	0.85	2.3	2.7	11,670.00	3,808.00		7,862.00	280.78	27.6	15.11	1190

	Period	Base	Area covered	No. of boats
A.	Indicative trials:			
	1. Oct. '79—March '80	Galle Beruwela	Galle to Panadura	01 (38' GRP)
	2. Aug. '80—July '81	Kalkudah	Batticaloa banks	01/02 (28'— <b>3½</b> ton)
	3. Nov. '80—Dec. '80	Silavathurai	Gulf of Mannar (pearl banks)	01 (28'— <b>3</b> 1 ton)
	4. Dec. '80—May '81	Negombo	Negombo Colombo	01/02 (28'—: <b>3½</b> ton)
	5. March '81 —May '81	Colombo (mono trials)	Colombo to Negombo	01 (38' GRP)
	6. May '82—August '82	Puduwakattuwa	Trincomalee	01 (28'—: <b>3½</b> ton)
В.	Commercial operations:			
	1. Dec. '81—March '82	Negombo	Negombo to Colombo	<b>20</b> (28'— <b>3</b> 1 ton) 04(18' GRP)
	2 Dec '82—March '83	Dehiwala	Dehiwala to	01 (18'GRP)
		Dernwala	Colombo	
	3. Feb. '83—May '83	Panadura	Panadura	01 ( <b>31 ton)</b>
	4. Feb. '83—March '83	Ratmalana	Ratmalana	01 (21'Oru)

N.A. == Not available

## BOTTOM SET LONGLINING IN PUDUWAKATTUWA, DEHIWALA, PANADURA AND RATMALANA, 1982/83

by K. T. Weerasooriya, *Scientific Officer (Fishing Technologist), NARA* and S. S. C. Pieris, *Assistant Scientific Officer (Fishing Technologist), NARA* 

## 2.1 INTRODUCTION

Results of the bottom longlining (BSLL) trials carried out by the Ministry of Fisheries/FAO Bay of Bengal Programme in 1980/81 (results published in BOB P/WP/16—*Further fishing trials with bottom set longlines in Sri Lanka*) indicated the possibilities of carrying out economically viable BSLL operations in the West coast during the intermonsoon period (October—May) by **31** tonners. Viable commercial operations were carried out by a few fishermen from Negombo, who followed the work done by the project, during the same season. In the intermonsoon period 1981/82, these private boats and a few others were encouraged by an extension programme conducted by National Aquatic Resources Agency's (NARA) Fishing Technology Division with the assistance of BOB P. During this period, 24 boats were engaged in BSLL fishery. Some boats were fully engaged, while others took up to fishery only from time to time.

These results were promising and BOB P. along with NARA, decided to continue the promotional work in other areas too. Further work was done in Puduwakattuwa, Dehiwala, Ratmalana and Panadura areas during the 1982/83 intermonsoon. BSLL operations were carried out by 3'2 tonners, 18' GRP boats and the traditional outrigger cances (oru). The project personnel encouraged at least one craft to engage consistently in BSLL fishing so that others would follow suit if the operations of this craft worked out well. In the case of Panadura, this tactic was successful. But in the case of Dehiwala it did not work although the selected craft did well.

#### 2.2 CRAFT AND FISHING GEAR

In the cases of Puduwakattuwa and Panadura, the craft used were **3**<sup>1</sup>/<sub>4</sub> tonners (28'). At Dehiwala, a 18' GAP powered by OBM (outboard motor) was used while at Ratmalana a 21' traditional outrigger canoe (oru) was used.

## 2.3 FISHING OPERATIONS

#### 2.3.1 Puduwakattuwa

Fishing trials started in May 1982 and continued till the end of August 1982. During May/June very encouraging results were obtained. But in July the catch rates dropped precipitously, the reason being the operation of CFC trawlers in the same grounds. After three days of poor catches the fishing operations had to be temporarily suspended. Operations resumed in August. Except for good catches on a couple of occasions, the operations yielded poor results in general. The trawling by CFC trawlers continued again in mid-August and BSLL operations had tobe stopped. Further attempts to encourage the fishermen to continue fishing were not successful and finding other fishermen willing to undertake the BSLL operation was not fruitful. Therefore, the operations in this area had to be stopped. The monthly summary of operations is listed in Table 2.1.

During the period May—August 1982, 27 BSLL operations were carried out using a total of 23,373 hooks, the average per operation being 865 hooks.

The operational base was Puduwakattuwa (Sagarapura). The fishing ground was 11—16 km off the base at depths of 30—70 m. The boats mostly left base early evening (around 4—5 p.m.) and returned either late in the evening or early next morning; on a few occasions when morning fishing was done, the boat left base in the morning and returned around noon.

The number of sets per day was limited to one or two. Flying fish was used as bait in May and June while squid and sardine were used in July and August.

In these trials, the fuel cost for the operations was borne by the project to encourage the fishermen. The fishermen provided the bait, crew, etc., and took the proceeds from fish sales. One member of the project staff was stationed at the base to provide necessary instructions in rigging and repair of fishing gear, fishing operations, etc., and to monitor the fishery.

#### 2.3.2 Dehiwala

A 18' GAP boat fitted with a 15 hp outboard motor was used by the fishermen. In these operations, the project supplied the fishing gear on loan initially and also provided technical knowhow on rigging of fishing gear and fishing operations. The operations started in November 1982 and continued till end of March 1983. A total of 71 operations were carried out utilizing 91,025 hooks, the average per fishing day being 1,282 hooks.

Some times the base was shifted to Colombo from Dehiwala. Fishing operations were carried out in the Colombo-Dehiwala stretch at depths of 45-75 m.

At first, fishing operations were carried out in the mornings so that fishermen would leave base early in the morning and return in the afternoon. This was subsequently changed to night fishing – the fishermen left base in the early evening, carried out fishing through the night and returned early next morning.

An average of 3–4 sets were made per fishing trip and there were instances of even 5 sets. Sardines purchased either at Dehiwala or Colombo were mainly used as bait while squid and cuttlefish too were used when they were available at low prices.

The monthly summary of operations is given in Table 2.2.

#### 2.3.3 Panadura

A 31 tonner (28') boat was used from this base. The project supplied the fishing gear at subsidized prices and provided technical know-how on rigging of fishing gear and operations. Although this boat had been carrying out BSLL fishing operations from **time to time since** December 1982, the project helped regularize the operation from February to May 1983. In May, the fishing was stopped as the boat had to be moved to Colombo on account of the on-coming monsoon. Table 2.3 provides the monthwise operational summary.

A total of 64 operations were carried out, utilizing 55,850 hooks. Fishing was carried out at depths of 45-75 m.

At the beginning in February, fishing was done both in the morning and at night. As the night sets were found to yield better catches, almost all operations since March were carried out at night. On a majority of fishing days only two sets were made, but when the catches were poor, further sets were tried. This, however, depended on the quantity of bait available on hand.

Mainly, squid and cuttlefish purchased in Colombo were used as bait while sardines were used on days when squid was not available.

#### 2.3.4 Ratmalana

A 21' outrigger cance (oru) with sail, which usually engaged in hand line fishing, showed interest in operating BSLL. The project provided part of the fishing gear on loan; instructions on rigging the lines and fishing operation were provided to the fishermen. The aim was to encourage this craft to take up to BSLL on a regular basis during the intermonsoon so that other orus too would follow suit if the operation was successful. Table 2.4 gives the results of operations.

A total of 28 operations were carried out utilizing 33,325 hooks. Unlike mechanized crafts, this craft could fish only in depths of 35—50 m, speed being the limiting factor. Fishermen left base early in the morning for fishing and returned in the afternoon. Two or three sets were carried out per fishing trip. Due to intermittent rough weather in April and poor catches during the last few days of March, the operations had to be suspended.

## 2.4 CATCH AND CATCH RATES

The Puduwakattuwa operations in June yielded the best catch rates among all the trials conducted by this project. Even in the overall performance, the catch rates, both in terms of number of pieces and their total weight, were the best of all total operations held till then. The decline in the months of July and August was likely due to outside influences which disturbed the habitat.

Catch rates obtained at Panadura and Dehiwala generally fluctuated between 5 and 7 kg except at Panadura in March 1983 when a higher catch rate (8 kg) was obtained. This was similar to the high catch rates obtained in the Colombo and Negombo trials in 1980/81. However, it can be seen that the catch rates at both Dehiwala and Panadura are much lower than the catch rates obtained by BSLL boats operated in Colombo and Negombo during the previous season. This probably suggests a variation in population density of demersal species between north of Colombo area and south of Colombo, as the level of expertise of fishermen of both areas is almost equal.

The catch rates obtained at Ratmalana are very low. This could be attributed to the fact that these operations were carried out in comparatively shallow depths (35-50 m compared to 45-75 m at Panadura and Dehiwala). During the 1980/81 season, the best catch rates in Negombo and Colombo were obtained at depths of 50-70 m.

#### 2.5 CATCH COMPOSITION

Table 2.5 shows the percentage composition of the BSLL catches at the four centres of operations.

At all the centres, the emperor fish, *Lethrinus* spp. was the most important group, and, *L. nebulosus* was the most common species. The groupers and rock fishes, *Epinephelus* spp. and related species, represent the next most important group; however, they appear to be less important, than the snappers (*Lutjanus* spp.), at Panadura; more data is, however, required before any definite conclusions as to whether this is indicative of the species composition in the respective areas can be reached. The third important group is the snappers of which the most common species at all the centres is *Lut/anus rivulatus: L. bohar* appears to be equally important at Dehiwala and Panadura.

#### 2.6 ECONOMICS OF OPERATION

Table 2.6 shows the details of the performance of the boats at different centres.

Unlike in the Negombo operations in 1980/81 and 1981 /82, where boats travelled about 25 miles to the fishing grounds, BSLL fishermen from Puduwakattuwa and Panadura fished close to their base keeping the fuel costs low. Fishermen from Dehiwala tended to fish in the Colombo area which is away from their base. So a significant increase could be seen in their fuel bills; yet they earned a higher net revenue.

Efforts to use the maximum number of hooks possible could be seen both at Dehiwala (1282 hooks/trip) and Ratmalana (1190 hooks/trip). This ensured a worthwhile catch, even when the catch rates were low. This could be clearly seen at Dehiwala in March 1983. At a low catch rate of 5.5 kg/100 hooks the fisherman has obtained 77.0 kg/fishing trip when he utilized 1463 hooks per trip. The increase in the number of hooks/trip also allowed fishermen to use up all the bait productively which otherwise could go bad and may have had to be discarded.

Except for June and August at Puduwakattuwa, prices obtained were better compared to the prices of earlier seasons for the fish landed at all the four stations. But these prices hardly compare with prices received for pelagic species except perhaps in a few cases.

Attempts to keep the bait cost low could be seen at Dehiwala and Ratmalana where low priced bait such as sardines were used and at Puduwakattuwa where flying fish which was abundant during May and June was used. However, at Panadura, fishermen used more of the higherpriced cuttlefish and squid. It was noted that the increase in bait cost was accompanied by very little concomitant change in catch rates. Example: there was little difference between Panadura and Dehiwala, the latter centre using a combination of sardine and squid as bait.

Following the basis used to evaluate the commercial viability in the case of the Negombo operations in 1981 /82 (i.e., **3**] tonners) showing a net revenue of Rs. 290 per fishing trip and a 18' GAP boat showing a net revenue of Rs. 230, it may be seen that the net revenue was distinctly higher than the breakeven point at Puduwakattuwa, Dehiwala and Panadura. Even month-wise records indicate that the results were positive in all the months, except for the months of July and August 1982 at Puduwakattuwa. As mentioned earlier, this was due to causes beyond the operational control of the boats.

In respect of the traditional non-motorized oru, the net revenue was Rs. 230 and Rs. 161 for February and March 1983, respectively, which should comfortably cover the wages and food bill of the fishermen. The fishermen have put in their best effort to use as many hooks as possible per fishing trip. But due to operational limitations in reaching the best fishing grounds in deeper waters, they were unable to get higher returns.

Generally, the operations conducted at all these places have indicated that the **3**<sup>1</sup>/<sub>4</sub> tonners and 18' GAP boats can be employed in BSLL operations economically from December through June.

## Monthly summary of BSLL operations off Puduwakattuwa, 1982

			May <b>1982</b>	June 1982	July 1982	August 1982	Total
	Number of boats		 01	01	01	01	01
	Number of fishing trips		 05	13	03	06	27
	Number of sets	 	 07	14	03	09	33
	Total no. of hooks	 	 4000	9525	2250	7600	23375
	Number of hooks per trip (set)	 	 800(571)	733(680)	750(750)	1266(844)	865(708)
	Total catch, Pcs.	 	 191	552	31	203	977
	kg	 	 356.5	1293.0	64.5	336	2050
	Catch rate/i00 hooks, Pcs.		 4.8	5.8	1.4	2.7	4,3
13	kg		 8.9	13.6	2.9	4.4	9.0
-	Catch/fishing trip, kg	 	 71.3	99.5	21.5	56.0	75.9
	Value of catch, Rs.		 4194.00	11944.00	1300.00	2935.00	20373.00
	Fuel cost, Rs.		 651.50	1410.75	399.00	598.50	3059.75
	Bait cost, Rs.		 534.00	1664.00	448.00	1 226.00	3872.00
	Net revenue, Rs.		 3008.50	8869.25	453.00	1110.50	13441 .25
	Net revenue/fishing trip, Rs.		 601.70	682.25	1 51 .00	185.00	497.80
	Price of fish/kg, Rs.		 11.76	9.24	20.15	8.73	994
	Bait		 Flying fish	Flying fish	Squid, Herrings	Squid, Herrings	Sardines
	Quantity of bait, kg	 	 69.0	193.0	56.0	86.5	404.5
	Price of bait/kg, Rs.	 	 7.74	8.62	8.00	14.17	9.57

## Monthly summary of BSLL operations off Dehiwala, 1982/83

			November 1982	December 1982	January 1983	February 1983	March 1983	Total
Number of boats			 01	01	01	01	01	_
Number of fishing trips		•.	 02	16	20	14	19	71
Number of sets			 03	45	84	58	71	261
Total no. of hooks			 1500	16325	22975	22225	28000	91025
Number of hooks per tri	ip (set)		 750(500)	1020(363)	1149(274)	1587(383)	1474(394)	1282(349)
Total catch, Pcs.	•.		 36	354	533	377	451	1751
kg .			 111.5	1173	1456	1226	1463	5429.5
Catch rate/i 00 hooks, I	Pcs.	•.	 2,4	2.2	2.4	1.7	1.7	1.9
	kg		 7.4	7.2	6.4	5.6	5.3	6.0
Catch/fishing trip, kg			55.7	73.4	72.8	87.6	77.0	76.5
Value of catch, Rs.			 1126.00	14473.00	28727.00	14715.00	19333.00	78373.00
Fuel cost, Rs.	•.		 325.00	3513.00	4737.00	3500.00	5215.00	17290.00
Bait cost, Rs.			 245.00	2725.00	5150.00	3190.00	3635.00	14945.00
Net revenue, Rs.			 556.00	8223.00	18840.00	8025.00	10843.00	46138.00
Net revenue/fishing trip,	Rs.		 278.00	514.50	942.00	573.20	551.70	649.83
Price of fish/kg, Rs			 10.10	12.34	19.73	12.00	13.21	14.43
Variety of bait			 Squid, Sardine	Sardine, Squid	Sardine, Squid	Sardine, Squid	Sardine, Squid	
Quantity of bait, kg			 32.0	275.0	452.0	320.0	404.0	1483.0
Price of bait/kg, Rs			 7.65	9.90	11.39	9.97	9.00	10.07

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Table 2.3								
Monthly summary of BS	<b>SLL</b> operations	off	Panadura,	1983				

	—		February 1 983	March 1983	April 1983	May <b>1983</b>	Total
Number of boats			01	01	01	01	01
Number of fishing trips		 	17	25	16	06	64
Numberof sets		 	45	49	31	12	137
Total no. of hooks		 	16650	21150	13250	4800	55850
Number of hooks per trip (set)		 	979(370)	846(432)	828(427)	800(400)	872(408)
Total catch, Pcs.			340	583	262	85	1270
kg			1004	1702	952	248	3906
Catch rate/i 00 hooks Pcs.		 	2.1	2.8	2.0	1.8	2.3
kg		 	6.1	8.1	7.2	5.2	7.0
Catch/fishing trip, kg		 	59.1	68.1	59.5	41.4	61.0
Value of catch, Rs.		 	13076.00	23487.00	14194.00	4800.00	55557.00
Fuel cost, Rs.		 	1790.00	2640.00	2000.00	992.00	7422.00
Bait cost, As.		 	2595.00	4840.00	4285.00	1375.00	13095.00
Net revenue, As.		 	8691.00	1 6007.00	7909.00	2433.00	35030.00
Net revenue/trip, Rs.		 	511 .00	640.00	494.00	405.50	547.34
Price of fish/kg, Rs.		 	13.02	13.80	14.90	19.35	14.22
Variety of bait			Squid, Sardine	Squid	Squid, Sardine	Squid	
Quantity of bait, kg		 	218	300	237	86	
Price of bait/kg, Rs.		 	11.90	16.13	18.08	15.99	

## Monthly summary of BSLL operations off Ratmalana (Oru), 1983

	February 1983	March 1983	Total
Number of boots	04	04	04
Number of boats	01	01	01
Number of fishing trips	25	13	38
Total numberof hooks	18350	14975	33325
Number of hooks per trip (set)	734	1152	1190
Total catch, Pcs.	182	103	285
kg	560	212	772
Catch rate/i 00 hooks, Pcs.	1.0	0.7	0.85
kg	3.1	1.4	2.3
Catch/fishing trip, kg	22.2	16.3	27.6
Value of catch, Rs.	7640.00	4030.00	11670.00
Bait cost, Rs.	1878.00	1930.00	3808.00
Net revenue, As.	5762.00	2100.00	7862.00
Net revenue/trip, Rs.	230.48	161 .54	206.89
Price of fish/kg Rs.	13.64	19.00	15.00
Variety of bait	Sardine	Sardine	
Quantity of bait, kg	208.0	250.0	
Price of bait/kg Rs.	9.02	7.72	

# Table 2.5Percentage species composition of BSLL catches

	Puduwakattuwa								Dehiwala							
	Мау	ʻ '82	June	e'82	July	'82	Aug.	'82	Dec.	'82	Jan.	. '83	Feb.	'83	Mar.	'83
Lethrinusnebulosus	42.2	37.9	41.6	34.0	25.8	36.2	40.9	41.7	29.0	26.4	19.3	18.1	25.9	24.1	34.1	29.7
L. miniatus	_	_	1.1	0.5	_	_	_	_	28.7	482	35.2	51.0	26.2	36.5	18.1	21.4
Other Lethrinus species	5.7	2.0	0.5	0.3	_	_	_	_	0.6	0.1	1.5	0.4	0.8	0.2	0.4	0.7
Lut/anusrivulatus	16.7	35.1	13.6	27.0	25.8	40.1	5.9	13.7	2.2	4.0	2.3	3.9	4.5	7.1	4.9	6.1
L. bohar	_	_	_	_	_	_	_	_	1.9	2.4	0.7	1.3	7.3	7.3	10.0	13.5
L. sehae	2.1	2.1	3.6	2.7	_	_	11.8	8.6	_							
L.coccineus	_	_	_	_	_	_	10.3	12.5	5—	_	_	_	_	_	_	_
Other Lutjanus species	2.6	0.6	4.2	2.0	_	_	6.4	2.5	7.5	2.0	1.9	1.2	1.0	1.1	_	_
Epinephelusundulosus	5.7	8.2	1.9	1.6	16.1	16.5	6.4	4.5	3.6	3.7	0.7	0.1	_	_	_	_
Cephalapholussonnerati	1.6	0.4	0.5	0.2	_	_	_	_	13.4	2.2	15.1	4.2	12.4	2.4	6.4	1.1
Other large <i>Epinephelus</i> species Small <i>Epinephelus</i>	1.0	1.2	10.0	12.0	3.2	1.6	10.4	10.9	1.7	3.1	6.5	5.3	12.4	15.3	17.0	0.3
species	9.4	1.2	12.1	8.2	29.0	5.5	1.1	0.3	5.6	1.2	1.3	0.6	1.5	0.1	1.8	_
Caranxspp.	3.1	3.9	2.7	4.9	_	—	_	_	_	—	0.7	1.7	1.0	1.6	2.2	3.4
Shark & Skate	5.2	3.5	1.8	1.9	_	_	_	_	0.6	4.2	3.6	1.5	7.4	1.4	_	_
Catfish	_	_	_	_	_	_	_	_	_	_	0.2	0.1	_	_	_	_
Others	4.7	3.9	6.4	4.7	_	_	6.9	5.3	5.2	2.5	11.0	9.8	2.6	2.9	4.5	0.9

Note: Italicised numbers refer to percentage composition by weight (kg) while non-italicised numbers refer to percentage composition by

				Ratmalana							
Apr.	'83	May	y '83	Feb.	'83	Mar.	'83				
33.6	23.3	29.4	27.3	46.4	46.9	29.1	33.0				
5.3	6.7	2.5	1.6	5.7	5.2	24.3	21.7				
4.3	7.0		_	_		_	_				
8.6	7.4	17.6	33.3	4.6	6.7	7.8	7.5				
18.6	27.7	3.5	4.0	_	_	_	_				
	—	—		3.4	4.0	1.0	0.9				
	_	1.2	2.0	_	_	_	_				
_	_	_	_	13.8	1.3	15.5	1.9				
13.6	15.5	7.5	6.8	9.1	20.1	2.9	6.1				
_	_	_	_	1.7	0.6	3.9	0.5				
1.8	1.4	1.0	2.0	5.7	5.2	6.8	14.1				
_		_	_	1.1	1.3	1.0	2.8				
4.6	3.9	28.2	21.7	0.7	1.7	<u>—</u> .	_				
11.4	1.1	9.6	1.3	7.4	3,0	7.8	3.3				

16-A

## Performance of fishing boats undertaking BSLL fishing in Puduwakattuwa, Dehiwala, Panadura and Ratmalana (cost and earnings anatysis for the

period	1982—	83)
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	Puduwakattuwa tonner31	a Dehiwala 18' GRP	Panadura tonner31	Ratmalana 21' oru
	May August 1982	November 1982— March 1983	February 1983— May 1983	February 1983— March 1983
No. of BSLL operations	27	71	64	28
Total no. of hooks	23375	91025	55850	33325
Hooks per day	865	1282	873	1190
Catch—Pcs.	975	1751	1270	285
—kg	2050	5429.5	3906	772
Catch rate per 100 hooks—Pcs.	4.3	1.9	2.3	0.85
_ kg	9.0	6.0	7.0	2.3
Value of catch, Rs.	20373.00	78374.00	55557.00	11670.00
Bait cost, Rs.	3872.00	14945.00	10810.00	3808.00
Fuel cost, Rs.	3059.75	17292.00	9707.00	_
Net revenue, Rs.	13441 .25	46137.00	35040.00	7862.00
Net revenue per day, Rs.	497.80	649.80	547.50	280.78
Price of fish/kg, Rs.	9.93	14.43	14.22	15.12
Catch per day, kg	75.9	76.5	61.0	27.6

#### SOME BIOLOGICAL OBSERVATIONS FROM BOTTOM SET LONGLINING TRIALS AROUND SRI LANKA, 1979-82

by Malkanthi Fonseka Scientific Officer (Marine Biologist), NARA

#### 3.1 INTRODUCTION

The primary interest of the local fishermen in Sri Lanka at present is in the pelagic fishery. This is because of the relatively greater demand for pelagic species and the rapid expansion in the fishery for such varieties, through the use of driftnets and motorized boats. With the increasing popularity of the 31 tonners for pelagic fishery among the fishermen, the demersal fishery has become relatively less important in some parts of Sri Lanka.

The expansion of pelagic fisheries has a?so resulted in an uneven distribution of fishing effort. In certain areas there are too many boats and the catch per boat is poor when compared to the effort. Thus it has become essential that some of this effort be directed towards the underexploited demersal fishery resources. To begin with, during the lean seasons of the pelagic fishery, it appears advisable to divert the effort to demersal fisheries. This would benefit both the fishermen and the economy of the country as a whole as there would be better production during the lean seasons.

Demersal fishing methods that are in use at present are: trawling by small boats, mostly in the northern area; bottom set longlining in the south and east coasts as seasonal fishery; handlining scattered all around the island; bottom set gilinets in a few places in the north and west; trap fishing by bamboo pots to a very limited extent in shallow waters in the north coast.

Of these, handlining is already being practised extensively all around the island. For bottom trawling, there is only limited scope because of the rocky and rough bottom conditions and because it is expensive for small-scale fishermen to take to trawling. The economic viability of trap fishing has not yet been adequately demonstrated for it to be expanded.

Bottom set giffrietting is also an expensive method due to frequent loss of nets in coral reefs, etc. The hauling equipment that has to be used in deeper waters is also complex and expensive for the average local fisherman.

Bottom set longlining involves low-cost fishing gear which could be used by the average fisherman in Sri Lanka using the 31 ton or even smaller boats.

In order to explore the constraints hampering the expansion of demersal fishery and to promote its development, the Bay of Bengal Programme initiated a demersal fishing project in Sri Lanka. The results of the trials conducted by the Programme have been published earlier (BOBP/WP/6; BOBP/WP/16). This report deals with, in greater detail, the catch composition, the seasonal variation and the catch rates at all the five locations of trial fishing: Beruwela, Galle, Kalkudah, Negombo, and Trincomalee.

A summary of the broad features of the bottom set longline operations conducted from 1979 to 1982 is given in Table 3.1; the salient features of operations have been summarized by Weerasooriya (the first paper in this report).

The dominant species of demersal fish that were caught during bottom set longline trials are listed in the table below:

Scientific Name	Common English Name	Sinhala Name	Tamil Name
Family: Lethrinidae (Emperor fis Lethrinus nebulosus Lethrinus miniatus Lethrinus caeruleus	sh) Starry pig face bream Long face emperor	Meevatiya Atissa Hota ula, Uru hota Kabarwaya	Vellameen Thinan
Family: Lutjanidae (Snappers) Lut/anus argentimaculatus Lutjarius bohor Lut/anus gibbus	Mangrove red snapper Two spot red snapper Humback red snapper Malabar red snapper	Thambalaya Rath golla	Adallu
Lutjanus malanancus Lut/anus sanguir7eus	Blood snapper Emperor red snapper	Rath gal malu	Konde sevalai
Lutjanus sebae Lutjanus rivulatus Pristipomoides typus Apr/on virescens	Blue lined snapper Sharp tooth snapper Green job fish	Hadava, Rumasse Kalamiya, Lomassa Dhiulava	Kuruvilla Lomia Dhiula
Family: Serranidae (Groupers) Epinephelus merra Epinephelus morrhua	Wire netting reef cod Banded cheek reef cod	Pulli kossa	Pulli kaleva Kullu kaleva
Epinephe/us areolatus Epinephe/us uridu/osus Cephalopholis sonnerati	Brown lined reef cod Red coral cod	Lavaya Ran thambuwa	Panchi kaleva Segepu kaleva
Fami'y: Carangidae Caranx ignoblis	Yellowfin trevally		

## 3.2 CATCH COMPOSITION

The demersal fish discussed here can be broadly grouped as emperor fishes, snappers, groupers and reef cods, jacks and trevallys. All other m<sup>1nor</sup> varieties are grouped under the category "other species."

The composition of the catches in the different areas is given in Table 3.2.

Emperor fishes were the most important constituent of the catch in all the places except Kalkudah where jacks, trevallys and snappers contributed a greater percentage than the emperor fishes. The snappers were second in importance in Negombo and Trincomalee, whereas in Beruwela. the groupers occupied the second position. At Kalkudah, all the major groups were found more or less equally distributed; except groupers whose contribution was slightly lower. At the other three places, the emperors, snappers and groupers together constituted more than 80% of the catches both by weight and by number of pieces. (b) Except off Kalkudah, in all other areas, jacks and trevallys contributed less than 10% by weight to the total catch. (c) Relative to other areas, there was a high percentage of jacks and trevallys in Kalkudah. This was especially evident during the months May to August (Fig. 3.2) due to the fact that during this period the operations were oriented specifically at fishing in muddy patches where jacks and trevallys are concentrated.

#### Seasonal variations

Sri Lankan fishery displays large seasonal fluctuations due to the effect of the winds of the south-west and the north-east monsoons. The north-east monsoon sets in by October and continues till December; it sometimes extends to January. The south-west monsoon operates from May to August. Minor shifts in the onset of these monsoons, however, may occur from

time to time. The periods between January and April and again between September and October could be considered as inter-monsoonal seasons. Generally, during the inter-monsoonal seasons the sea is fairly calm. But during these periods too, rough weather can be experienced occasionally due to inter-monsoonal winds.

During the north-east monsoon, due to the rough weather conditions prevaiing in the east coast which cause several operational hazards, it is expected that demersal production would be low. Trials were conducted during this period in the east coast mainly to determine the feasibility of fishing in such conditions.

To determine any changes in the catch composition related to seasonal variations, the trials should have been conducted continuously, at least over a period of one year. Hence it is not advisable to generalize the trend based on the data available in other areas, with the exception of Kalkudah.

Off Kalkudah, during the north-east monsoon, emperors and snappers were found to be equally abundant and these two varieties together contributed an average of about 60% to the total weight of the catches (Fig. 3.2). The density of these two varieties by count was 54% (Fag. 3.3). During the south-west monsoon, these two varieties amounted to only half the quantity that they contributed during the north-east monsoon. The high contribution by snappers and emperors during the north-east monsoon continued even during the inter-monsoonal period that followed. Before the commencement of the north-east monsoon (September—October), snappers formed the highest proportion of the total catch while the contribution by the emperors decreased. However, during the south-west monsoon the snappers and the emperors contributed very little to the total catch.

Off Negombo, during the entire period of the trials, emperors contributed 50–60% of the weight of the total catch. Snappers were 26% by weight during the inter-monsoonal period January to April and 30% in May, by which time the south-west monsoon had just about set in. Groupers and reef cods followed a pattern somewhat similar to that exhibited in Kalkudah.

Off Trincomalee, the trials covered only the south-west monsoon period and the catch composition pattern was different from that observed in Kalkudah. Here the emperors constituted 36% by weight closely followed by snappers with 32%; the contributions from groupers and reef cods was 19% and that from jacks and trevallys, less than 10%.

In the west coast, Negombo and Beruwela areas showed some variations in the composition of the catches during the only common season (January—April). Emperors were the most important group in both areas. But the percentage of groupers and reef cods was greater in Beruwela than in Negombo and the reverse was the case in respect of snappers. The proportions of jacks and trevallys were almost similar in both areas.

## 3.2.1 Catch composition according to fishing depths

Fig. 3.4 illustrates the percentage composition of the catch by weight at different depths. Off Kalkudah the emperors and the snappers were more abundant in deeper waters (51 - 80 m); within this depth range, the emperors recorded the highest percentage at 71 - 80 m and the snappers at 61 - 70 m. The groupers and rock cods declined steadily from shallow to deeper waters, white jacks and trevallys were most abundant at 41 - 50 m, the shaJiow and deeper waters recording lower percentages.

Off Negombo, the operations were at comparatively shallower depths. Within the depth range 11 - 60 m, both the emperors and snappers showed peak abundance at 31 - 40 m. The groupers and rock cods showed an erratic trend, while the jacks and trevallys appeared to be more abundant in deeper waters of 41 - 60 m.

Off Trincomalee the records are limited to only two depth ranges—31--40 m and 41—50 m, hence the distribution pattern is not discussed.

However, it should be mentioned here that according to the topography of the sea bottom in the areas covered during the trials, before the edge of the continental shelf is reached, a basin

like stretch is present between the gradual slope from the shore and the shelf edge. Most of the fishing during the trials was done in this basin area where most of the demersat fish are usually aggregated. Thus, as seen in Fig. 3.1, the distance from the shore is not a correct indication of the depths of fishing. A greater depth could be in the inshore area as well as in an offshore area.

## 3.3 CATCH RATES

Table 3.3 summarizes the catch rate and hook rate recorded during the trials at all the five places. The highest catch rate of 11..1 kg/1 00 hooks was obtained off Trincomalee. Negombo had the second highest average catch rate of 7.4 kg/1 00 hooks. Trials off Beruweta and Galle in the south-west coast gave catch rates of 5.9 kg/1 00 hooks and 4.0 kg/1 00 hooks respectively, but these two values were obtained from trials lasting for very short periods. On the east coast, off Kalkudah, a catch rate of 5.5 kg/1 00 hooks was obtained which is but half that off Trincomalee. It should, however, be noted that these areas were not all covered during the same period of time or for the same duration.

The hook rate followed more or less the same pattern with the maximum being 4/100 hooks off Trincomalee and the next best of 2.6 off Negombo. At the other three places, the rate was almost similar and in the range 2.0—2.2. At Beruwela, Negombo and Trincomalee, the average weight of each piece was 2.8 to 3.0 kg, whereas the fishes at Galle and Kalkudah registered 1.9 and 2.5 kg per piece, respectively.

3.3.1 Seasonal variations in catch rates

Off Kalkudah there were two peaks in the catch rates, one in February with 7.2 kg/1 00 hooks and the next in June with 7.4 kg/100 hooks. Poor catch rates were obtained in November and during the entire north-east monsoon period (Fig. 3.5).

Off Trincomalee, trials during the south-west monsoon period showed very high catch rates of 14 to 15 kg for the months of May and June. However there was a steep drop in July and August, probably due to trawling in the same area by large boats.

On the south-west coast, the catch rates were similar to the trend seen off Kalkudah during the period of the north-east monsoon and the inter-monsoonal period before it. But these periods of trial do not correspond to the same year, but to successive years.

Off Negombo, the highest catch rate of 14.5 kg was observed in April; March also showed a relatively high catch rate of 10.8 kg. January and February recorded the lowest catch rates of 3–5 kg. However, Kalkudah and the south-west coast showed a similar trend in the catch rates during the months October to January but corresponding to two different years. Negombo and Kalkudah showed a similar increasing trend in the catch rates during January and February. But the actua' catch rates off Negombo during the above two months were lowerthan those for Kalkudah. But in March and April the catch rates off Negombo far exceeded those for Kalkudah. The hook rate too, exhibited a pattern similar to that by weight in afl the areas covered(Fig. 3.6).

Off Kalkudah, among the emperor fishes, *Lethrinus miniatus* was the dominant species, whereas off Negombo it was *L. nebulosus*. Of the snappers, *Lutjanus rivulatus* was common in both areas and of the other Lutjanid species, *L. malabaricus* and *Aprion virescens* were dominant off Kalkudah, whereas in Negombo the dominant species was *L. argentimaculatus*.

The relatively high catch rates obtained during March and April, off Negombo may be attributed mainly to the larger number of *L. nebulosus* contributing to the catch. *L. nebulosus* alone was about 40% of the total catch by weight and by number.

The high catch rates in the months of May and June off Trincomalee might also be attributed to a greater contribution by emperors, though groupers too made a relatively larger contribution in this area than in other two areas discussed above.

The variations observed in the catch rates could also have been due to variations in the depth ranges of the fishing grounds within any one area or between the areas covered.

#### 3.3.2 Catch rates relative to the depths

Off Negombo, the highest catch rate of 14.2 kg was obtained at a depth of 50 m, but this depth range was covered only in April and May. In the depth ranges between 10 and 50 m, the catch rate varied between 4.4 and 10.5 kg (Fig. 3.7). The catch rates of individual varieties showed a trend similar to the total catch rates up to the 40—50 m depth range. But beyond this depth range, only the emperor fishes showed the same trend as the total catch rate. It can clearly be seen that emperor fishes contribute largely to the increased total catch rate in the 50—60 m depth range.

Off Kalkudah, the catch rate showed a gradual increase from 3.9kg in the 10—20 m depth range to 7.0 kg in the 60—70 m depth range. However, beyond 70 m a sharp decline to 4.7 kg was observed. All the varieties with the exception of jacks and trevallys, displayed a trend similar to that of the total catch rate. The catch rate of jacks and trevallys increased upto 50 m depth and beyond that a sharp decline was seen (Fig. 3.8). The catch rate for snappers also reached a peak of 3.5 kg in the 60—70 m depth range.

Off Trincomalee, the depth range at which the trials were conducted was within a narrow belt of 40 to 80 m. The majority of the trials were in the depth range of 40—60 m and hence it was not possible to differentiate the catch rates according to the depth.

As the hook rates (Fig. 3.5) also displayed a trend similar to the catch rates, in order to determine whether there was any correlation between the depth of the hshing ground and the average weight of the individual fish, the mean weights of the most dominant species were calculated (Table 3.4). In deeper waters there was a trend towards higher mean weights. Buta very clearcut correlation was not always seen. Thus it is not possible to come to any general conclusions as the fishing depths too did not correspond with the distance from the shore.

### 3.4 CONCLUSIONS

As the bottom set longline is a selective fishing gear depending on the hook sizes, type of bait used, etc., some demersal species are more vulnerable to this type of gear than others. The most dominant species in the catches of the BSLL trials were *Lethrinusnebulosus*, *Lethrinus miniatus*, *Aprion virescens*, *Lutjanus malabaricus*, *Epinephelus merra*, *Cephalopholus sonnerati* and *Caranx ignoblis*.

Although there are four principal groups, the emperor fishes are generally the most important group. Similarly the snappers were second in dominance followed by groupers and rock cods. There were differences in this trend between the east and west coasts, as well as between the two centres of the same coast. These differences may also have to be viewed in the context of the fact that the observations relate to different periods of time.

That the catch composition can vary seasonally due to the effect of the north-east and southwest monsoons is shown by the year round data off Kalkudah. During the north-east monsoon the emperors and snappers were predominant having almost equal importance. On the other hand, during the south-west monsoon the contribution of jacks and trevaltys exceeded that of both these varieties combined. During both the inter-monsoons, snappers predominated over the emperors.

Although the depth was no indication of the distance from the shore due to the topography of the areas covered during the trials, it was found that a correlation could be established between the depth and the percentage composition of the individual varieties. Off Kalkudah it was seen that within the depth range of 20 to 80 m, emperors and snappers showed a direct relationship of increasing percentage with increasing depth while groupers and reef cods exhibited an inverse relationship.

Comparing the two sets of data (Kalkudah and Negombo), it would appear that off Kalkudah the percentage of emperors and snappers was higher at greater depths as compared to Negombo. As for groupers and rock cods, the percentage by weight declined progressively with increase in depth at Kalkudah, while there was no definite pattern at Negombo. The jacks and trevallys

showed a parabolic pattern at Kalkudah, with the highest percentage at the 41 – 50 m depth range; there was an indication of increasing percentage at greater depths at Negombo.

Based on the higher catch rates obtained in the east coast, it would appear that greater effort towards demersal fishery, would be desirable during the months of January to September, when higher production of demersals is a distinct possibility. In the west coast, off Negombo, high catch rates were obtained during the inter-monsoonal period before the onset of the southwest monsoon. Greater BSLL efforts during this period, which is also the lean season for pelagics could be recommended to achieve a higher production of demersals in the months between February and May. However, in the south-west coast it is not possible to come to any definite conclusion, but it appears rather likely that here too, greater effort towards demersal resources during the same period as in Negombo would bring about better resu'ts.

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## Table 3.1

## Summary of the general features of bottom set longlining trials October 1979—August 1982

	Area	Period	Type &no. of crafts invotved	No.of fishing trips	Echo sounder! Line hauler	No. of sets	Total No. of hooks/ sets	Average No. of hooks/ set	Fishing hours	Fishing depth	Bait used
1.	Colombo (west coast)	17 March '81 to <b>7 May</b> ' <b>81</b>	1; 38 footer	48	Echo sounder and line hauler used	48	71031	1500	0400—1000 hrs.	40—70 m	Squid, Indian mackerel, flying fish—frozen
2.	Negombo	12 Dec. '80	2;28footer	116	Echo sounder used	220	58267	250	1800 hrs. to midnight	20—70m	Cuttlefish,squid, Indian herring, flying fish, sar- dines, prawns —fresh or frozen
3.	Panadura— GaMe (south-west)	27 Oct. '79 to 30 March '80	1; 38 footer	68	Echo sounder and line hauler used	92	99475	1100	0400—1000 hrs.	30—90 m	Squid, sardines, flying fish —frozen
4.	Kalkudah (east coast)	17 Aug. '80 to 29 July '81	3; 28 footer	258	Echo sounder used	505	177800	350	0500i 000 hrs.	20—90 m	Indian herring, squid, cuttle fish, sardines -—fresh, salted and frozen
5.	TrinconiaTee (east coast)	26 May '82 to 23 Aug. '82	1; 28 footer	27	Echo sounder used	35	19325	550	Both in the morning and at night	25—80 m	Squid, sardines, flying fish, —fresh, frozen

## Table 3.2

Variety	Variety		Negombo		Beruwela		Kalkudah		Trincomatee	
			Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
Emperors			50	54	39	41	21	20	36	42
Snappers			25	20	15	14	25	21	32	21
Groupers			10	12	30	27	11	15	19	22
Jack & trevallys			08	07	09	06	25	29	04	02
Other species			07	07	07	12	18	15	09	13

## Percentage catch composition in bottom set longlining trials

## Table 3.3

General catch rates in the areas covered during bottom set longlining trials

Aroo		Deried		Total	catch	<b>Aver</b> 10	Average catch/ 100 hooks		
Area		Penoa		kg	Number	· kg	Number		
Galle	 	Oct. '79—Jan. '80	15	555.0	822	4.(	) 2.1		
Beruwela		Jan. 80—Mar. '80	35	85.0	1210	5.9	2.0		
Negombo	 	Dec. '80—May '81	43	09.0	1511	7.4	2.6		
Kalkudah	 	Aug. '80—July '81	97	'01.6	3897	5.5	5 2.2		
Trincomalee	 	May '82—Aug. '82	21	50.0	776	11.1	4.0		

## Table 3.4

## Monthly mean weights of dominant demersal species of fish caught in BSLL trials at various depths in Kalkudah and Negombo

## (a) Lethrinus nebulosus

	20—30 m		30—40 m		40—50 m		50—60 m		60—70 m	
	Kalk. in kg	Neg. in kg	Kalk. in kg	Neg. in kg	Kalk. in <b>kg</b>	Neg. in <b>kg</b>	Kalk. in kg	Neg. in kg	Kalk. in kg	Neg. in kg
August		_	0.4	_	_	_	3.0	_	2.1	
September	3.0	_	2.4	_	_	_	3.3	_	2.5	
October		_	2.2	_	3.3	_	3.2	_	3.1	
November							2.8			
December		1.5	3.5	2.2	2.2	_	2.9			
January		2.0	_	2.8	_	_	2.6	_	2.0	
February		2.6	_	0.6	_	_	2.2			
March		_	_	2.7	_	2.0		1.6	2.3	
April		_	_	3.1	_	3.2	2.6	2.7	2.3	
May		_	_	1.3	3.2	_	2.4			
June		_	2.6	_	2.6					
July	2.4	—	2.9	—	2.7	—	2.9			
Average weight	2.5	2.0	2.5	2.4	2.9	2.4	2.8	2.1	2.4	

## (b) Lethrinus miniatus

	20—30 m		30—40 m		40—50 m		50—60 m		60-70 m	
	Kalk. in kg	Neg. in kg								
August										
September			3.3	_	—.	_	3.5	_		
October	3.3	_	6.0	_	_	_	3.5	_		
November			_	_	1.6	_				
December	_	4.0					4.3	_		
January	_	2.5	_	3.0	_	_	3.9	_	3.5	
February							3.4	_	2.4	
March			_	4.6	_	_	2.6	3.6	3.3	
April			_	5.0	_	3.8	4.0	_	3.3	
May	4.1	_	_	1.6	_	_	2.6	_		
June			5.1	_	_	_	3.8			
July	1.1	_	_	_	5.1	_				
Average weight	1.5	2.9	4.2	4.1	3.3	3.8	3.4	3.6	2.9	

## Table 3.4 (Continued)(c) Lutjanus rivulatus

	20—30 m		30—40 m		40—50 m		50—0	60 m
	<b>Kalk.</b> in kg	Neg. in kg	Kalk. in kg	Neg. <b>in kg</b>	Kalk. <b>in kg</b>	Neg. in kg	Kalk. in kg	Neg. in kg
August	 _	_	_	_	_	_	_	
September	 _	_	6.4	_	_	_	5.5	
October	 _	_	6.3	_	_	_	4.6	
November	 _	_	_	_	_	_	_	
December	 _	4.4	8.0	3.4	8.5	_	_	
January	 _	3.4	_	_	_	_	5.5	
February	 _	_	_	_	_	_	3.9	
March	 _	_	_	5.4	_	_	4.3	
April	 _	_	_	4.5	_	3.8	5.3	
Мау	 5.0	_	_	5.1	4.0	_	4.7	
June	 _	_	4.8	_	_	_	_	
July	 5.0	_	6.8		5.0	_	5.8	
Average weight	 5.0	3.9	6.2	4.9	6.5	3.8	5.0	



Fig. 3.1 Schematic topographic profile of sea bottom in the area



Fig. 3.2 Seasonal catch composition by weight



Fig. 3.3 Seasonal Catch composition by number



Fig. 3.4 Catch composition according to fishing depth

[31]



Fig. 3.5 Monthly catch rates by weight



Fig. 3.6 Monthly catch rates by number

6



Fig. 3.7 Catch rates according to depth in Negombo



Fig. 3.8 Catch rates according to depth in Ka/kudah



Appendix: GEOGRAPHIC LOCATION OF BOTTOM SET LONGLINING BASES

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