



BAY OF BENGAL PROGRAMME
DEVELOPMENT OF SMALL-SCALE FISHERIES



FISHING TRIALS WITH
HIGH-OPENING BOTTOM TRAWLS
IN PALK BAY, TAMILNADU

BOBP/WP/10

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IN PALK BAY, TAMIL NADU

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PREFACE

This document is the first report of fishing trials held with high-opening bottom trawls in Palk Bay, off Mandapam in Tamil Nadu, India, during March-July 1980. The trials were conducted jointly by the Bay of Bengal Programme and the Government of Tamil Nadu. The main objective of the trials was to ascertain the technical and economic feasibility of using high-opening bottom trawls to tap demersal and pelagic stocks of food fish in the Palk Bay areas, and to train local counterparts in the design, construction and use of these trawls.

The Bay of Bengal Programme provided a consultant masterfisherman, Mr. John Crockett, to conduct the trials, under the supervision of Mr. G. Pajot, fishing technologist. On behalf of the Tamil Nadu Government, Mr. S. Pandurangan and Mr. P. V. Ramamurthy served as counterparts.

The document may be found useful by fishing gear technologists, by fishermen and by officials concerned with small-scale fisheries planning and development.

The document is a working paper, and has not been officially cleared either by the Government or the FAO.

The Bay of Bengal Programme (Development of Small-Scale Fisheries in the Bay of Bengal) is a regional FAO programme that covers five countries bordering the Bay of Bengal – Bangladesh, India, Malaysia, Sri Lanka and Thailand. The Programme's main goals are to demonstrate and develop appropriate technologies to improve the conditions of small-scale fishermen and the supplies of fish from the small-scale sector in the Bay of Bengal region.

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1 INTRODUCTION

The state of Tamil Nadu has a coastline of about 1,000 km and a continental shelf area of 41,000 km² with extensive shallow water trawling grounds accessible to small fishing craft. Estimates of the fish resources vary considerably, but it is believed that the potential yield may be about 320,000 tonnes per year. Present production is estimated at 220,000 tonnes per year.

The state's prawn resources, usually found in depths of less than 30 to 40 m, are intensively fished and may be nearing maximum exploitation. The small demersal species, mainly silver bellies, occur as a by-catch of the prawn trawlers and are also heavily exploited in some areas, while the stocks of larger demersal species and small and large semi-pelagic and pelagic species within the same depth range are generally under-exploited.

About 60% of the catch is taken by traditional craft, and about 40% by some 2,000 motorized boats, 9 to 10.5 m in length. The traditional craft use fishing gears of various types and sizes: gillnets, beach and boat seines, handlines, longlines, etc. and land the bulk of the most highly prized species of food fish. Almost all motorized boats concentrate on catching prawns and only occasionally during the prawn off-season do they deliberately exploit food fish stocks.

The development effort during the last two decades has concentrated on the introduction of motorized boats in the prawn fishery, and this fleet has become the basis of a lucrative export trade. This development has tended, however to operate to the detriment of other fisheries.

Today, the main problem for the small-scale trawl fishery is that the maximum sustainable yield of prawn has been reached; at best only small production increases can be expected without risking over-exploitation. Even if total production increases, the catch per boat is likely to decline at a time when operating costs are rising. It is therefore desirable to re-deploy some of the inshore trawlers. The existence of under-exploited food fish makes such redeployment possible, if suitable fishing gear and methods can be evolved and these are shown to be more profitable than fishing for prawns.

2 OBJECTIVES

With this strategy in view, an experimental fishing project was initiated by the Bay of Bengal Programme with the following objectives:

- (i) To ascertain whether the under-exploited demersal and pelagic stocks could be fished by small motorized trawlers, and to identify the most suitable fishing gear and methods.
- (ii) To obtain an indication of likely costs and earnings of small motorized trawlers in the food fishery.
- (iii) In the course of carrying out practical trials at sea in pursuance of the above objectives, to identify possible improvements to the fishing boats as regards fishing performance and gear handling.
- (iv) During the trials, to train counterparts in the design, construction and use of the new fishing gear, equipment and methods.
- (v) In due course, to disseminate to trawler operators any potentially useful results obtained during the experiments, through practical demonstration and by other means.

This working paper discusses the initial work related to the above objectives. This concentrated on investigating the potential of high-opening bottom trawls, which have come more and more into use in various parts of the world during the last few decades in situations where significant quantities of fish are to be found within a few metres of the bottom. Experience elsewhere also indicated that two-boat trawling is sometimes more effective than single-boat, and arrangements were accordingly made to try both methods.

3 PLANNING AND CONDUCT OF EXPERIMENTS

Planning of the experiments began in July 1979. The Tamil Nadu Directorate of Fisheries undertook to provide two standard motorized inshore trawlers, shore facilities, two "counterpart" officials, and crew. The BOBP undertook to pay for the necessary modification of the two boats, supplement the proceeds of fish sale for payment of all running expenses, provide necessary equipment (echo sounder, radio telephones, trawl gear and accessories) and consultancy services as required for the full duration of the trials (initially one year).

Boats and gear: The fishing boats made available by the Directorate of Fisheries (Appendix 2) were constructed by the boatyard of the Tamil Nadu Fisheries Corporation to the design commonly used by commercial trawlermen, of which the principal characteristics are:

—Type	Trawler
— Year of construction	1978-1980
— Material	Wood
—LOA(m)	9.80
— Beam (m)	2.90
— Draft (m)	1.10
— Horse power (hp) max. installed	65.0
— Cruising speed (knots) about	7

Small echo sounders for depth measurement and fish finding were fitted to the vessel.

Designs of single and two-boat medium and high-opening bottom trawls were selected on the basis of experience in commercial fisheries in other similar tropical areas. Full particulars of the designs of the trawls, their construction, the material used etc. are given in Appendices 3, 4 and 5. The designs are all of the two-panel type – simple to construct, easy to use and adjust, and particularly suited to smooth level grounds as in Palk Bay. They can also, with suitable rigging and adjustment, be adapted for use on relatively rough and uneven bottoms.

Experimental work: Practical work on the project began early February 1980. The boats were completed and the fishing gear constructed in time for fishing trials to begin on 10 March; this series of trials, which form the principal subject of this report, continued until July 30, 1980.

During the trials, the boats were based at Mandapam. Trawling operations were restricted to that area of Palk Bay currently fished by motorized boats engaged in the prawn fishery, as shown in Appendix 1. Trawling operations were carried out only during daylight in order to minimise interference with the traditional fisheries using passive methods of capture such as lines and gillnets.

The trials were conducted along commercial lines to the extent that all the fish landed was sold to local buyers at the currently ruling market prices. This was to allow a tentative first estimate to be made of the possible earnings of commercial vessels using the same gear and methods.

Recording of Data: For the experimental operations with the high-opening trawls, the following information was recorded for each haul – date, position, type of trawl, fishing depth, fishing time, total catch, species composition, etc.

Data were subsequently processed and analysed by staff of the Directorate of Fisheries and the BOBP.

In order to obtain a comparison with the earnings of similar vessels engaged primarily in fishing for prawns, records were kept of the catches and earnings of a number of such vessels operating in the same area during the same period.

Results and comments: Tables 1 and 2 summarize the fishing operations with high-opening trawls. The two boats attained a total of 96 fishing days during which 109 hauls were made with the single-boat high opening trawl and 246 hauls with the two-boat high-opening trawl. A total of 168,539 kg was caught and a gross income of Rs. 106,091 .32 was obtained.

In Tables 1, 2 and 3, the definition of “fishing hours” is the time for which the trawl was actually fishing, that is, the time for which it was towed along the seabed. This allows direct comparison of the intrinsic fishing performance of the various designs of trawl. However, from the standpoint of the vessel owner and operator, the total time of a trawling operation is of more immediate interest, and this includes, in addition to the towing time, the time taken to shoot and haul the trawl, empty out the catch and get the trawl ready to shoot again, including any repairs that may be necessary. The time taken to carry out each of these operations may be intrinsically different for different types of trawl and for different situations, e.g. rough or smooth bottom, fine or bad weather, shallow or deep water. However, for the purposes of the present trials it is believed that the handling times of the single-boat and two-boat high-opening trawls, and of the orthodox prawn trawl, should in practice be very similar, and that valid comparisons can therefore be made on the basis of fishing hours.

The catch per hour of fishing varied with the type of trawl, its rigging, the tactics used, the location, the time and the season. The species composition of the catches varied with the same factors.

The two-boat high-opening trawl catches more fish and a higher proportion of the valuable pelagic and semi-pelagic species than does the single-boat high-opening trawl. This is because two boats can tow a larger net (but not always one twice as big as a single-boat trawl, for technical reasons); two boats towing a trawl between them herd the fish towards the trawl (this effect may be enhanced if each boat tows the trawl by two warps instead of one) whereas a single boat towing the trawl directly behind may scare some fish away from the path of the trawl especially in shallow water. However, during the monsoon season in Kerala,

there was an increase in the price of silver bellies; this gave the single boat high-opening trawl an advantage during this period.

The orthodox prawn trawl averaged 103 kg per hour of fishing, mainly silver bellies and miscellaneous low-value species; the high-opening trawls captured 158 to 282 kg/hr and with a higher proportion of semi-pelagic and pelagic species (Table 3).

Both the two-boat and single-boat high-opening trawls took more food fish and of more valuable varieties than did the orthodox prawn trawl (Table 4).

Tentative costs and earnings estimates suggest that boats using high-opening trawls may achieve net monthly incomes in the range Rs. 5,000 to 7,000 per boat, which is higher than can normally be achieved by the prawn trawlers during the period over which the trials took place. Costs will be about the same as for prawn fishing.

The vessels provided were of a design widely used in the commercial fleet. In the course of the trials it became apparent that this design leaves something to be desired as regards seaworthiness in a rough sea (lateral stability and freeboard) and fish-carrying capacity. Improvements might also be made in layout. These matters may have to be investigated at some future time. But it was necessary to take immediate steps to facilitate the handling of the fishing gear with minimum loss of time and to bring aboard big catches safely and expeditiously. This was accomplished by designing, constructing and installing a gantry on board one of the two vessels, as shown in Appendices 7 and 8. This proved to be an effective and valuable tool for fast and easy handling of the gear and for bringing big catches on board.

The echo sounders used for ascertaining bottom depths and for fish finding during the trials were of the type that records the signals on a roll of special paper. For commercial use, a simpler, cheaper and easy-to-use flashing echo sounder may be adequate in areas such as Palk Bay.

The two national fisheries officers attached to the project for the duration of the trials participated fully in the construction and use of the fishing gear and equipment. Commercial fishermen and boat owners have evinced keen interest in the high-opening trawls—and in the possibility of using them.

4 PROVISIONAL FINDINGS AND CONCLUSIONS

Although the results outlined above seem very promising, any conclusions drawn at present **can only be tentative, because** the trials have not yet lasted even one annual cycle. It is seldom if ever possible to conduct fishing experiments on a big enough scale and over **a long enough** time for the results to be statistically significant: a decision to implement the results commercially must be based to a certain extent on judgement. However, the following provisional conclusions seem justified:

- (i) The experimental fishing trials seem to have confirmed that in Palk Bay there are demersal and pelagic stocks which are not available or not fully available to capture by the orthodox prawn trawl but which would be accessible to the existing trawlers if suitable high-opening trawls and appropriate methods were used.
- (ii) With the adoption of one-boat and two-boat high opening bottom trawling, redeployment of the prawn trawling fleet into the food fish fishery is therefore possible.
- (iii) High-opening bottom trawling is technically feasible and apparently also commercially viable. It is a better tool than the orthodox prawn trawl for increase of food fish production without additional capital and running cost.
- (iv) For harvesting the under-exploited resources of demersal, semi-pelagic and pelagic fish, selection of the most appropriate fishing gear and methods will very much depend on the predominant species sought, fishing area, type of boat, horse power, etc. and also very

much upon season. Therefore no simple guidance can be given. For semi-pelagic and pelagic species, living close to and off the bottom, two-boat trawling will be most productive in terms of weight of catch. Because of seasonal variations in prices, it may pay owners and operators to change from two-boat to single-boat trawling at certain times of the year.

It remains to be added that the redeployment of substantial numbers of prawn trawlers for taking food fish with high-opening trawls should probably be subject to control and regulation. The estimates of potential additional yield are tentative and it would be only too easy to deploy sufficient effort to reduce the stocks below optimum yield size or to reduce the catch per boat below the economic level. Regulation of cod-end mesh sizes, fishing areas and seasons may be desirable, and consideration may have to be given to avoiding possible interference with the traditional fisheries.

5 RECOMMENDATIONS

- (i) The experiment should be continued in order to extend the seasonal and geographical coverage. In particular, it should be carried out in the Gulf of Mannar and Palk Bay, using Tuticorin and Mandapam as bases.
- (ii) The trawl designs should be adapted to work on the rougher patches in these areas as well as on the smooth ground.
- (iii) Further work should be done on simple methods of improving the fishing operations and gear handling.
- (iv) Consideration should be given by government to promoting the use of high-opening bottom-trawls by the commercial fleet. Demonstration and extension programmes should be organized in major fishing centres of the relevant districts. In order to prepare this programme and later undertake dissemination work, an extension officer should be assigned to the project.
- (v) In conjunction with (iv) above, immediate consideration should be given by government to establishing a system of control and regulation of the fishery to avoid over-fishing in either the biological or the economic sense, and also to avoid interference with the operations of traditional fishermen. Regulations may be needed on such matters as number of boats, cod-end mesh sizes, restricted areas and restricted seasons.
- (vi) Consideration should be given to developing the design for an improved motorized trawler. This trawler should be able to perform better than the existing trawlers on various counts: seaworthiness in rough weather (lateral stability and freeboard) ; fish carrying capacity, handling of fishing gear; equipment-handling; deck layout.

Table 1
MONTHLY RECORD OF OPERATION OF TWO-BOAT
HIGH-OPENING BOTTOM TRAWL

Date	No. of hauls	Area (ref. map)	Fishing hours Hrs. min	Daily catch (kg)	% of silver bellies	Catch per hour (kg)	Sale value of fish (Rs.)	Average price of landing (Rs./kg)
MARCH 1980								
20-3-80	3	10K	2.15	1,589	21.4	706	606.55	0.38
21-3-80	5	10K	6.30	979	56.7	151	647.98	0.66
24-3-80	5	9K	5.30	934	42.8	181	613.12	0.62
25-3-80	5	9K	6.45	3,048	26.1	452	2,122.24	0.70
26-3-80	4	8J-9K	6.00	2,123	33.0	354	1,343.02	0.63
27-3-80	5	9J	7.20	1,859	53.8	254	1,167.96	0.63
28-3-80	5	9K	7.30	2,423	57.8	323	1,568.51	0.65
29-3-80	4	9J-9K	5.10	1,441	12.5	279	984.50	0.68
31-3-80	4	9J-9K	6.00	1,607	45.4	268	1,097.06	0.68
Total	40		53.00	16,003	38.0	302	10,150.94	0.63
APRIL 1980								
01-4-80	4	9J-9K	6.20	1,545	38.8	244	936.10	0.61
02-4-80	5	7J,8J,9K	6.15	2,876	36.5	460	1,815.39	0.63
03-4-80	4	8M,9J	6.00	2,022	43.0	337	1,341.92	0.66
05-4-80	4	9J	8.00	1,721	66.5	215	1,145.63	0.67
11-4-80	5	9J, 10K	7.45	1,847	51.4	238	1,039.54	0.56
12-4-80	2	9M	3.00	723	83.0	244	352.04	0.48
14-4-80	5	9J-9K	7.30	1,596	50.1	213	906.84	0.57
15-4-80	3	9J-11K	5.30	703	82.5	128	358.21	0.51
16-4-80	4	9J	7.45	1,725	66.7	223	986.69	0.57
17-4-80	4	9J	7.45	1,887	58.3	243	1,794.65	0.95
18-4-80	5	9J,10K	7.15	960	67.1	132	596.69	0.62
19-4-80	5	9J	6.00	1,239	39.5	207	916.00	0.74
22-4-80	4	9J	8.00	3,236	68.3	405	1,505.12	0.47
24-4-80	4	9J,9L	7.30	2,775	82.6	370	1,279.73	0.46
25-4-80	4	9K,9L	8.00	1,849	63.7	231	956.00	0.52
26-4-80	6	9L,9K	11.30	2,091	46.6	182	1,223.91	0.59
28-4-80	3	9L,9M	5.30	958	65.1	174	483.85	0.51
29-4-80	4	9K,9L	8.00	1,273	4.4	159	753.23	0.59
30-4-80	2	9K	3.00	64	50.0	21	32.64	0.51
Total	77		130.30	31,090	56.9	237	18,886.39	0.60

Table 1 (continued)

Date	No. of hauls	Area (ref. map)	Fishing hours Hrs. min	Daily catch (kg)	% of silver bellies	Catch per hour (kg)	Sale value of fish (Rs.)	Average price of landing (Rs./kg)
MAY 1980								
02-5-80	4	9K,10K	8.00	2,858	85.06	357	1,392.85	0.49
03-5-80	4	9K,9L,10K	8.00	3,027	68.62	378	1,626.85	0.54
05-5-80	4	8J,9J,9K	8.15	843	69.28	102	475.05	0.56
06-5-80	3		6.00	1,084	60.06	181	713.20	0.66
07-5-80	4	9J	7.30	2,729	81.57	364	1,381.40	0.51
08-5-80	3	8K,9J,9K	8.30	2,204	58.58	259	1,303.75	0.59
09-5-80	3	9J,9K	7.45	3,334	86.00	428	1,661.40	0.50
10-5-80	3		6.15	2,233	73.67	357	1,207.90	0.54
12-5-80	3	9J	7.30	3,407	80.22	454	1,694.15	0.50
13-5-80	3	9J,9K	6.30	2,813	84.89	433	1,393.65	0.50
14-5-80	4	9J,9K,10K	7.30	2,815	62.84	375	1,616.50	0.57
15-5-80	3	9K,10K	6.00	1,294	—	216	1,425.10	1.10
17-5-80	1	9J	0.30	11	—	22	27.25	2.48
19-5-80	3	9J	6.30	2,113	75.58	325	1,091.55	0.52
20-5-80	3	8J,9J,9K	8.15	922	53.80	112	628.00	0.68
21-5-80	4	8J,9J,9K	8.00	2,868	96.13	359	1,334.00	0.47
22-5-80	3	9J	8.15	2,182	78.69	264	1,132.10	0.52
23-5-80	4	9J,9K	8.30	1,520	78.36	179	800.60	0.53
24-5-80	4	9J,9K,9L	8.00	2,494	86.05	312	1,211.50	0.49
26-5-80	4	9J,9K	6.45	2,065	89.25	306	1,025.15	0.50
27-5-80	3	8J,9K	5.15	3,632	19.08	692	2,503.55	0.69
28-5-80	3	8J,9K	6.00	1,722	71.84	287	923.70	0.54
29-5-80	3	9J,9K	6.45	1,505	84.98	238	781.70	0.49
30-5-80	3	9J,9K	5.30	180	55.56	33	101.80	0.57
31-5-80	4	8K,9J,9K,9L	5.30	250	65.20	45	143.45	0.57
Total	83		171.30	50,185	72.24	293	27,596.15	0.55
JUNE 1980								
02-6-80	3	9J,9K	7.00	1,279	91.16	183	738.45	0.58
16-6-80	2	9L,9M	3.30	1,790	14.64	511	1,843.20	1.00
17-6-80	2	9K,9L	2.30	92	92.39	37	80.50	0.88
18-6-80	3	9L,10K	5.45	860	76.51	150	617.90	0.72
23-6-80	3	9L,9M,10M	6.00	2,874	93.98	479	2,063.45	0.72
24-6-80	3	9L,9M	6.00	2,814	94.95	469	2,007.80	0.71
25-6-80	4	9K,10K	8.30	3,027	97.72	356	2,156.90	0.71
26-6-80	2	9J, 9K	4.00	2,627	30.99	657	1,929.55	0.73
27-6-80	3	9J,9K	7.30	2,191	80.65	292	1,624.10	0.74
28-6-80	3	9L,9M	6.00	3,688	97.80	615	2,597.55	0.70
29-6-80	2	9M	4.30	1,566	97.06	348	1,102.35	0.70
30-6-80	3	9L,9K	8.30	1,054	82.83	124	924.45	0.88
Total	33		69.45	23,862	79.97	342	17,686.10	0.74
JULY 1980								
01-7-80	3	9K,9L	5.30	1,342	62.2	244	1,547.25	1.15
02-7-80	2	10K	4.00	133	98.5	33	99.45	0.75
03-7-80	3	9K,10K	6.45	743	93.5	110	585.65	0.79
04-7-80	3	9L,10L	5.30	793	94.6	144	621.60	0.78
05-7-80	2	9L,9M	5.15	3,446	98.8	656	2,589.60	0.75
Total	13		27.00	6,457	90.1	239	5,443.55	0.84
Total for the reported period	246		452.00	127,597	70.0	282	79,763.13	0.63

Table 2
MONTHLY RECORD OF OPERATION OF ONE-BOAT
HIGH-OPENING BOTTOM TRAWL

Date	No. of hauls	Area (ref. map)	Fishing hours Hrs. min	Daily catch (kg)	% of silver bellies	Catch per hour (kg)	Sale value of fish (Rs.)	Average price of landing (Rs./kg)
MARCH 1980								
10-3-80	3	9J	6.00	450	63.5	75	307.60	0.68
11-3-80	3	9J,9K	6.00	681	78.9	114	402.70	0.59
12-3-80	2	9K	4.00	404	82.0	101	202.20	0.50
13-3-80	3	9L	6.00	767	87.2	128	379.70	0.49
17-3-80	2	7J	4.00	973	2.5	243	530.69	0.55
18-3-80	2	8K,9L	3.30	312	88.0	89	184.80	0.59
19-3-80	2	9L	4.00	296	87.8	74	163.60	0.55
Total	17		33.30	3,883	61.0	116	2,171.29	0.56
APRIL 1980								
23-4-80	9	9K	13.30	1,703	92.84	126	798.27	0.47
JUNE 1980								
03-6-80	3	9K	7.00	1,564	95.97	223	879.50	0.56
04-6-80	6	9K,9L, D5, D6	15.00	2,831	94.77	189	1,645.35	0.58
05-6-80	6	9K,9L	16.00	2,830	94.42	177	1,620.80	0.57
06-6-80	6		16.00	4,058	93.72	254	2,288.90	0.56
10-6-80	3	9K,9L	6.30	767	93.86	118	508.60	0.66
11-6-80	3	9K,10K	6.30	227	74.00	35	156.45	0.69
12-6-80	6	9K,9L	15.00	3,612	86.21	241	2,575.10	0.71
13-6-80	6	9K,9L,10K	15.00	1,659	89.26	111	1,113.45	0.67
14-6-80	6	9K,9L,10K	15.00	3,146	92.23	210	2,077.50	0.66
15-6-80	3	9K,9L,10L	7.00	596	91.60	85	414.13	0.69
19-6-80	6	9K,10K	15.45	1,199	93.66	76	853.25	0.71
20-6-80	5	9K	15.45	3,065	96.35	195	2,213.35	0.72
21-6-80	4	9K,10K	12.00	1,261	92.47	105	920.35	0.73
Total	63		162.30	26,815	92.95	165	17,266.73	0.64
JULY 1980								
07-7-80	4	10K	10.30	1,239	99.68	118	867.70	0.70
08-7-80	6	10L	14.00	2,723	97.94	195	1,955.45	0.72
09-7-80	4	10K	12.00	1,738	98.85	145	1,234.35	0.71
10-7-80	3	9L,9M	7.00	1,706	99.71	244	1,198.90	0.70
11-7-80	3	9L	6.30	1,135	98.07	175	835.50	0.74
Total	20		50.00	8,541	98.75	171	6,091.90	0.71
Total for the reported period	109		259.30	40,942	91.00	158	26,328.19	0.64

Table 3

CATCH PER HOUR OF DIFFERENT TYPES OF TRAWLS AND METHODS

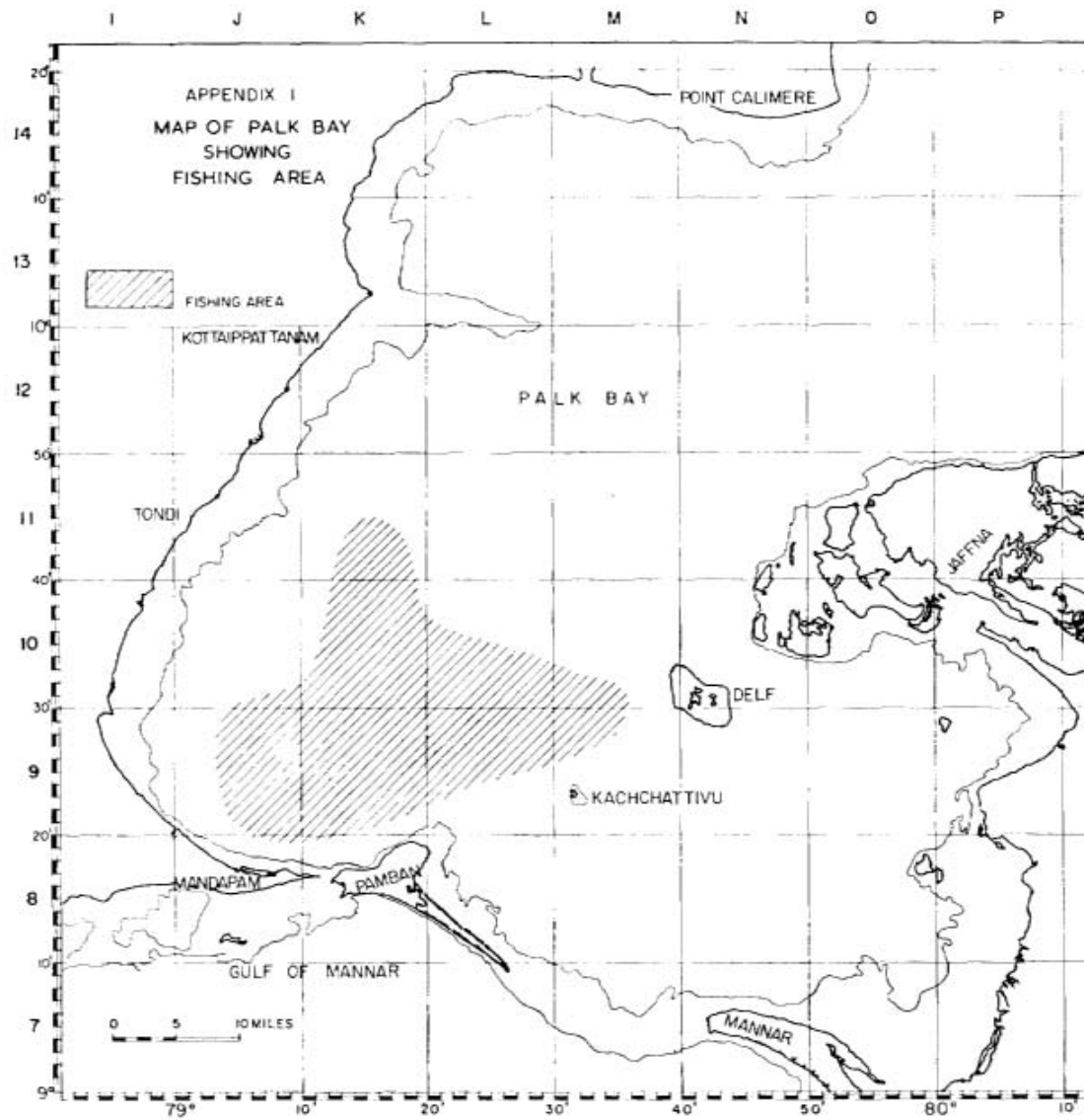
	One-boat high-opening bottom trawl	Two-boat high-opening bottom trawl	One-boat traditional trawl
Day fishing	26	70	90
Fishing hours (hrs)	259.5	452	835
Total catch (kg)	40,942.0	127,597	86,224
Catch perhour (kg)	158	282	103

Table 4

MONTHLY CATCH COMPOSITION BY SPECIES OF DIFFERENT TYPES OF TRAWLS AND METHODS

Month	One-boat high-opening bottom trawl					Two-boat high-opening bottom trawl					One-boat traditional trawl				
	March	April	May	June	July	March	April	May	June	July	March	April	May	June	July
Species—Group_of_species_(%)															
Silver Belly	61	—	—	93	99	38	57	72	80	90	—	92	98	98	98
Sardines	29	—	—	1	—	40	25	11.5	0.5	—	—	—	—	—	—
Catfish	0.5	—	—	1.5	0.3	14	11	12.5	16	1	—	2.4	—	—	—
Perches	0.5	—	—	0.5	0.5	1	1.5	1	1	7.5	—	—	—	—	—
Carangs	—	—	—	—	0.3	—	1	0.5	—	0.5	—	—	—	—	—
Pomfret	2	—	—	—	—	1	1	4	—	—	—	—	—	—	—
Ray	1.5	—	—	2	0.2	—	1.5	1.5	1.5	0.5	—	0.9	0.5	0.3	0.6
Seer	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Prawn	0.5	—	—	—	—	—	—	4	—	—	—	—	—	—	—
Mixed varieties	5	—	—	2	—	6	2	1	1	0.5	—	4.7	1.5	1.6	1.7

[01]



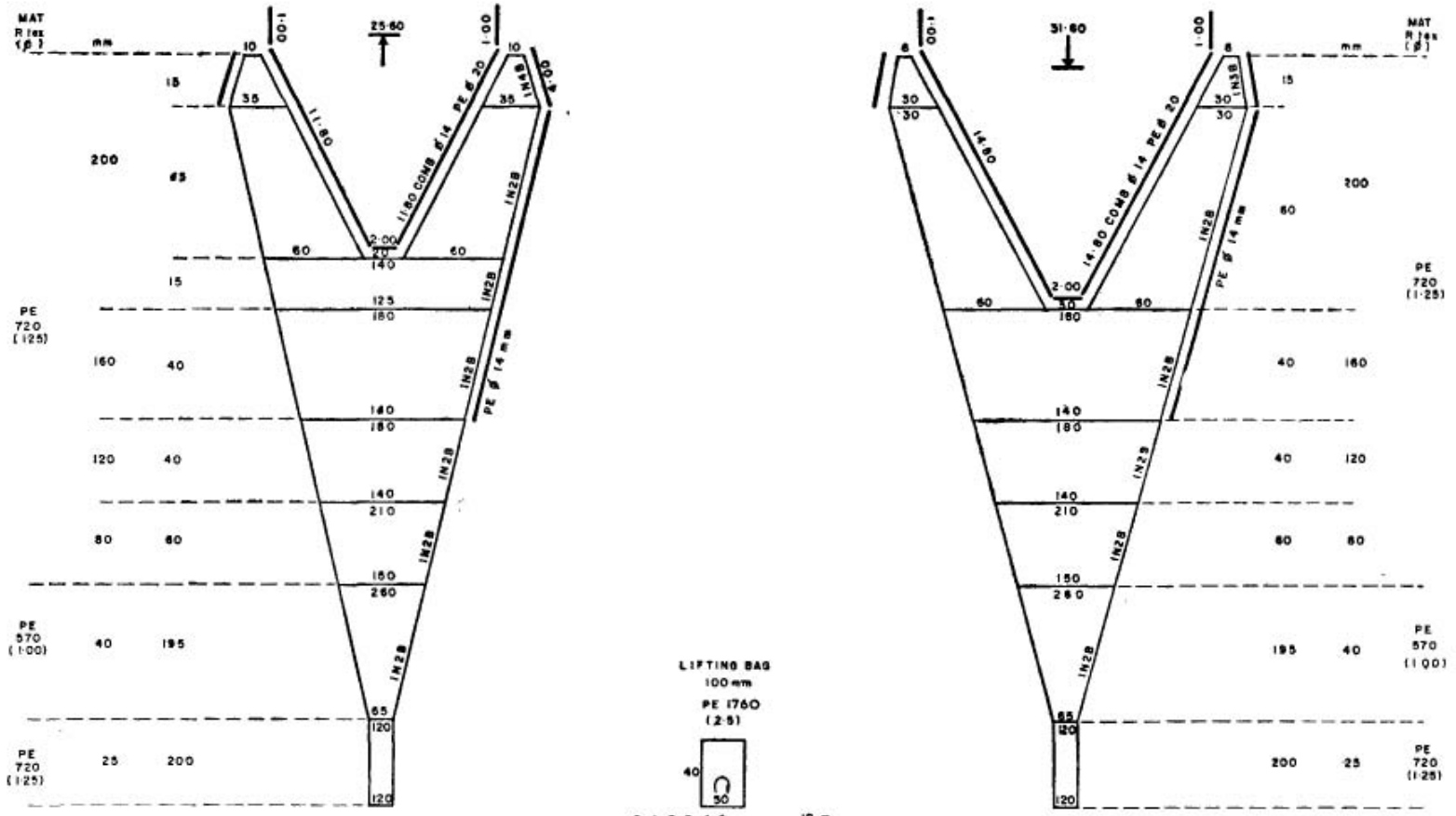
Appendix 2

TRAWLER USED FOR THE HIGH-OPENING BOTTOM TRAWL EXPERIMENTS

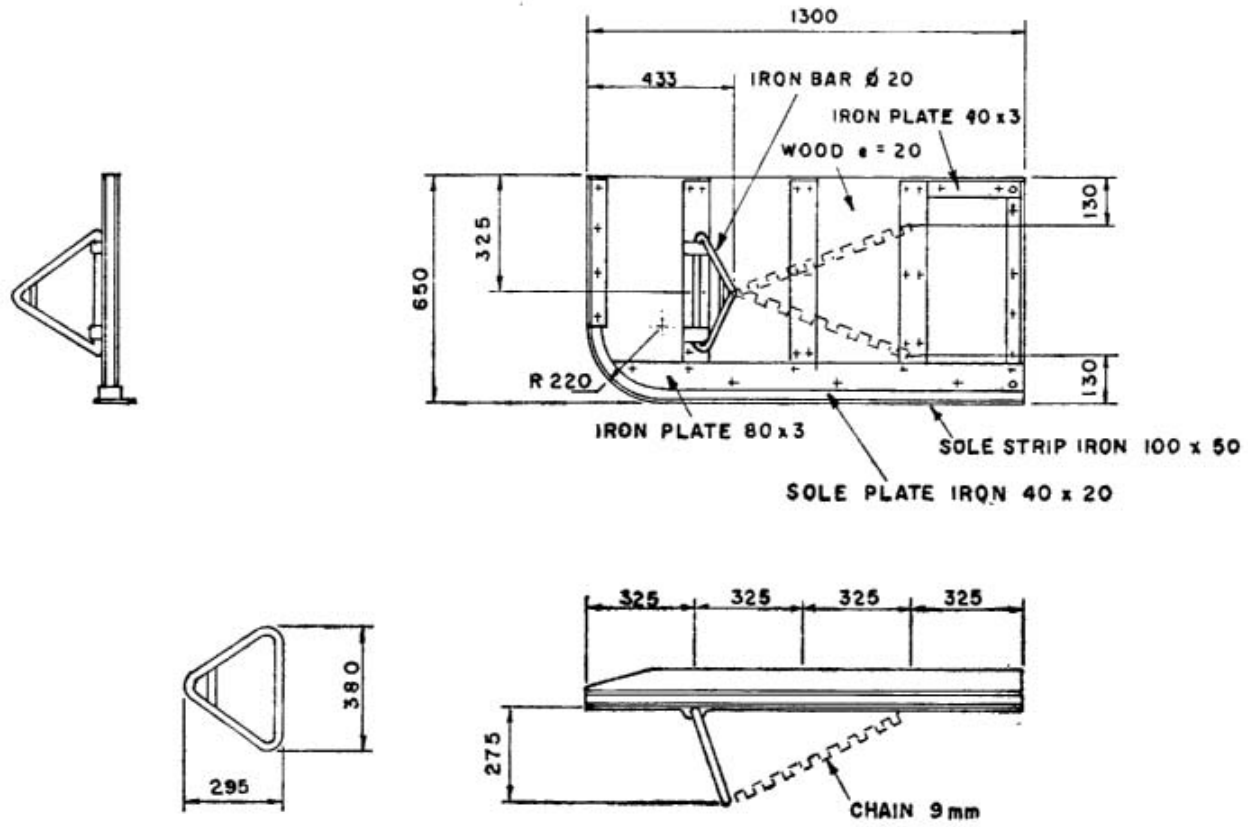


One of the two trawlers of the Tamil Nadu Fisheries Development Corporation which were used for the high-opening bottom trawl experiments in Palk Bay, off Mandapam.

APPENDIX 3. ONE BOAT HIGH OPENING BOTTOM TRAWL
 360 MESHES OF 160mm(STRETCHED)



[13]

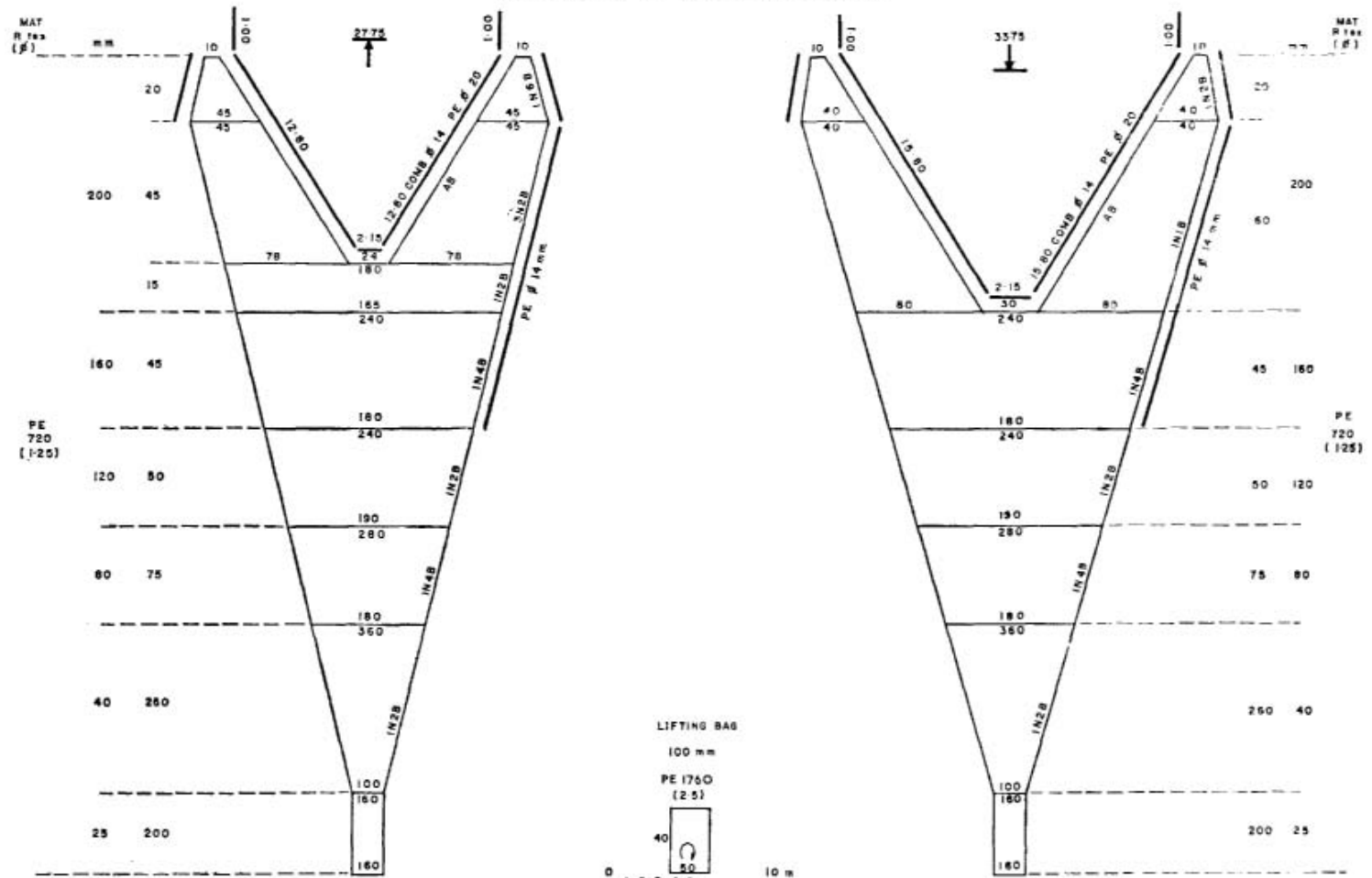


WEIGHT 50 kg

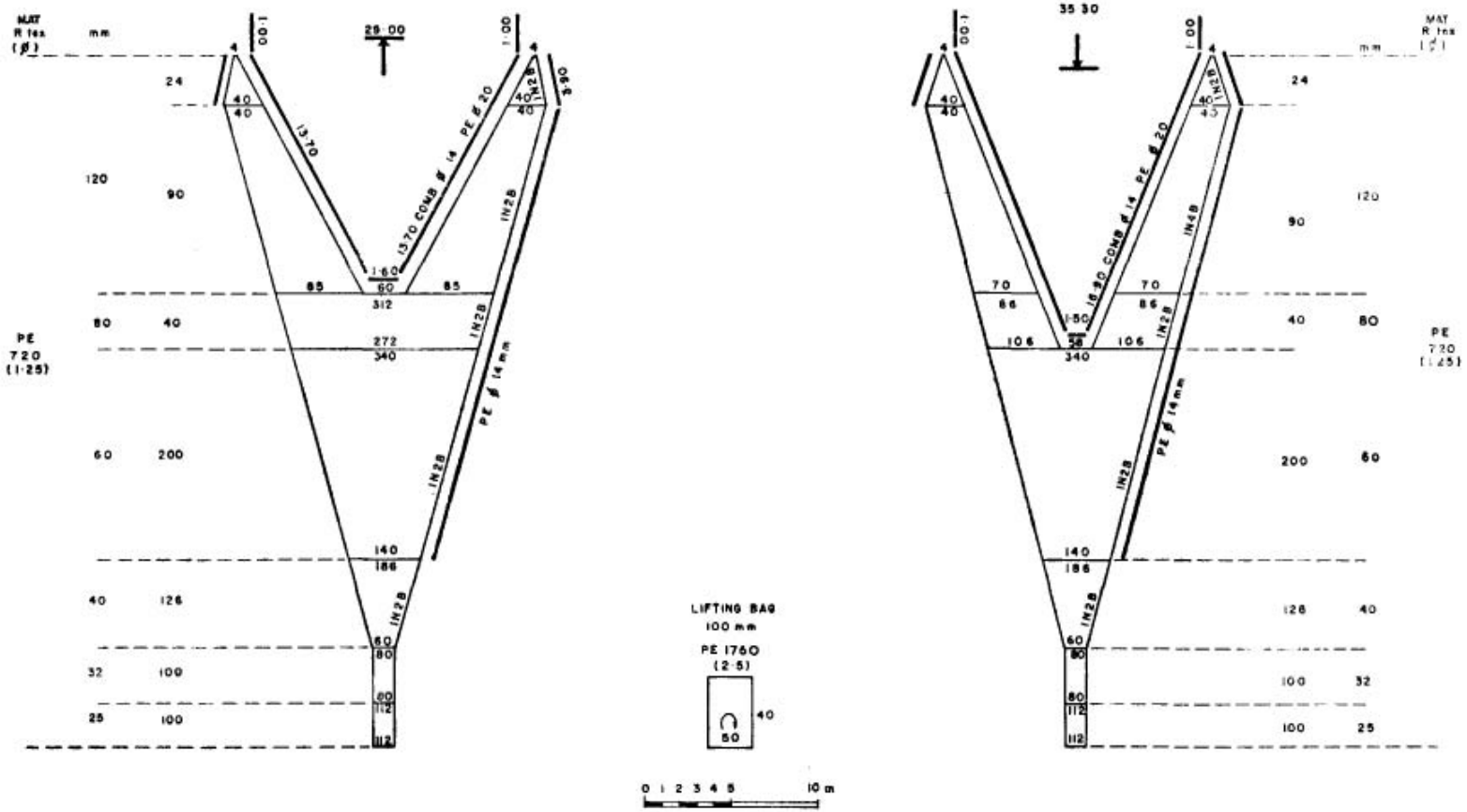
PROJECTION FIRST ANGLE

APPENDIX 4
OTTER BOARD FOR
ONE BOAT HIGH OPENING
TRAWL

APPENDIX.5 TWO BOAT HIGH OPENING BOTTOM TRAWL
 480 MESHES OF 160 mm (STRETCHED)

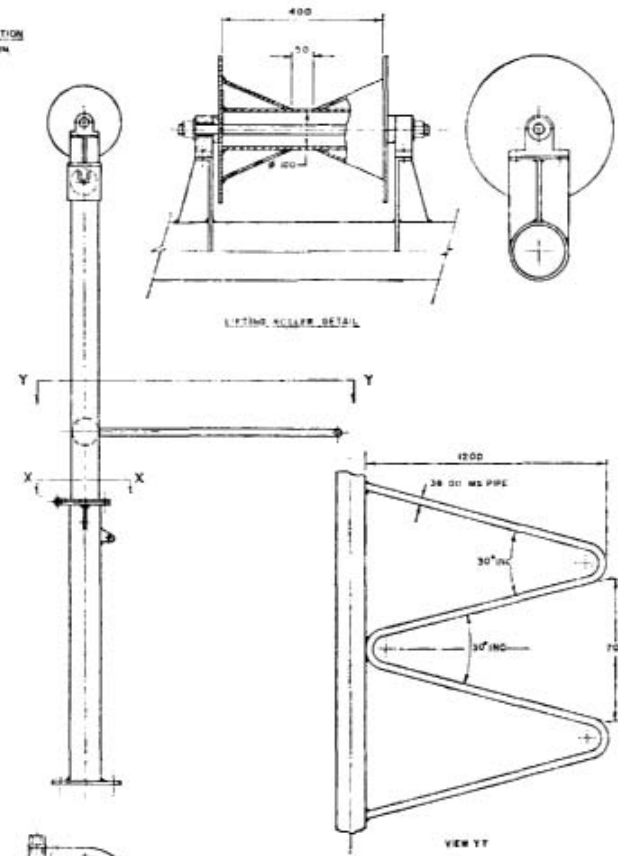
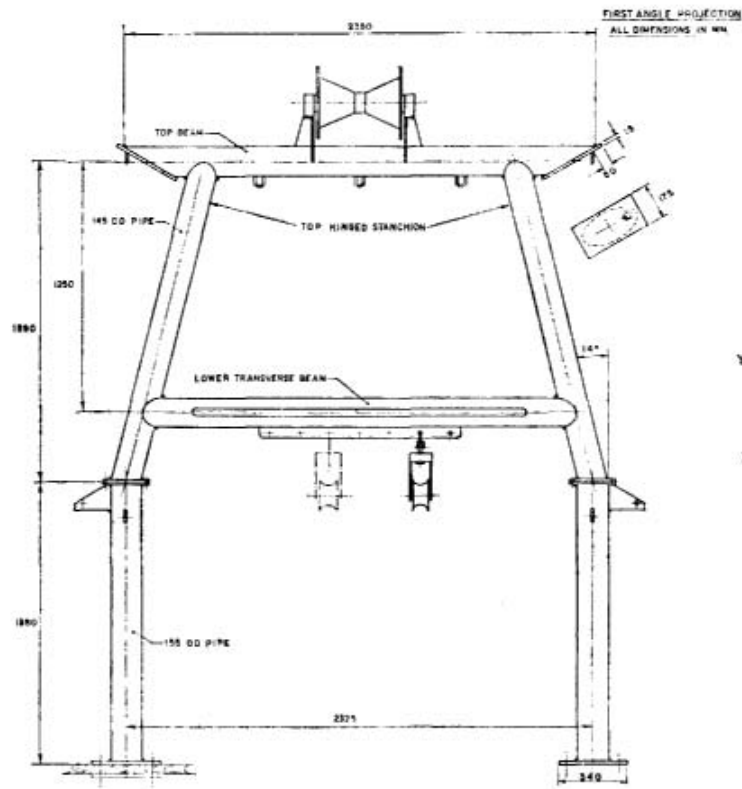


APPENDIX. 6 TWO BOAT HIGH OPENING BOTTOM TRAWL
680 MESHES OF 60 mm (STRETCHED)

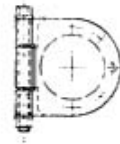


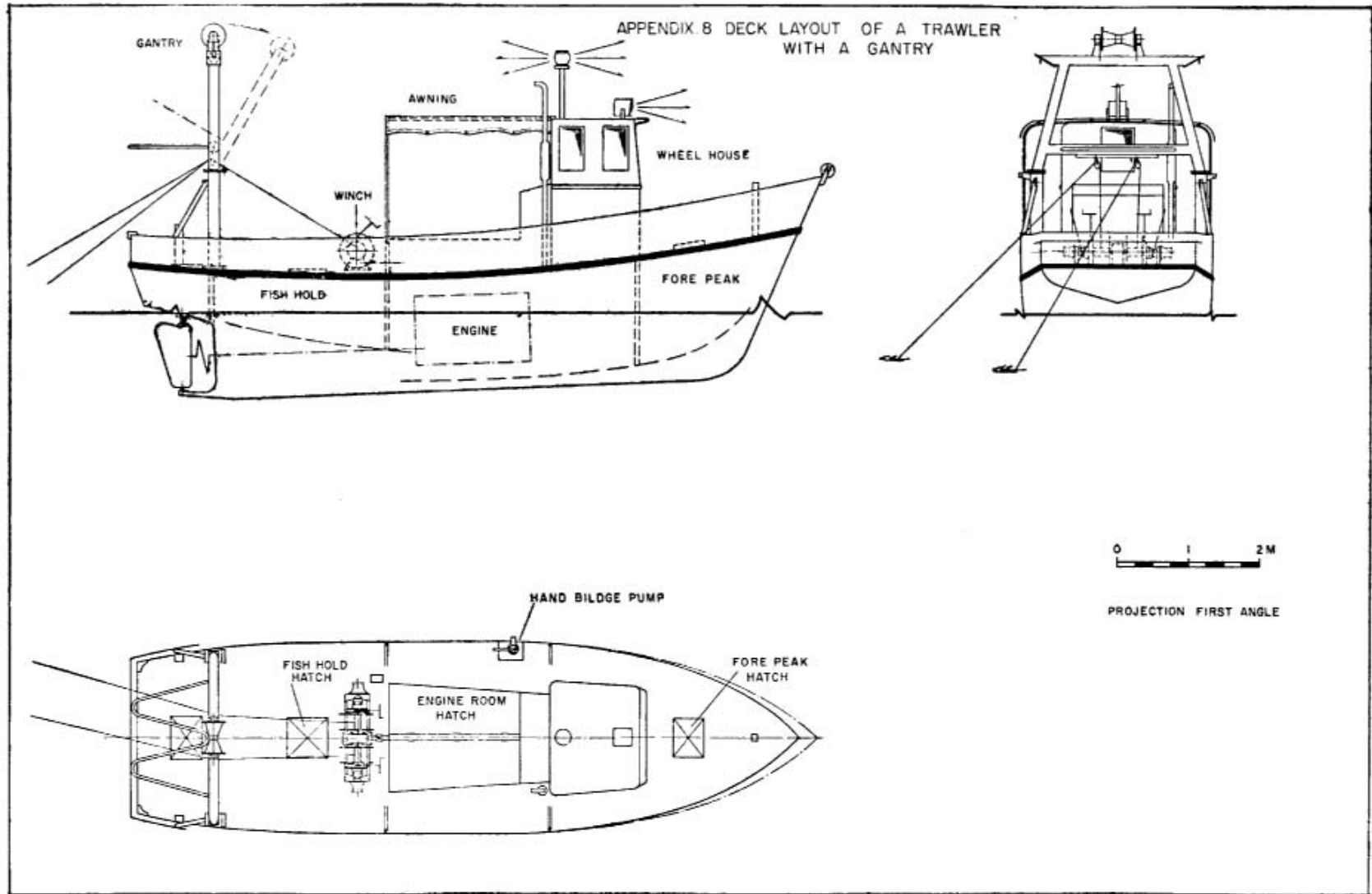
[16]

APPENDIX 7
DESIGN OF GANTRY



ALTERNATIVE DESIGN
OF HINGED FLANGE
FOR COLLAPSABLE
GANTRY





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