

# ON THE COMPARATIVE FISHING EXPERIMENTS WITH A FOUR-SEAM AND A TWO-SEAM TRAWLS ON THE EAST COAST

A. V. V. SATYANARAYANA, G. NARAYANAPPA & D. A. NARASIMHA RAJU

*Central Institute of Fisheries Technology, Sub-station, Kakinada-2*

Fishing experiments were undertaken to study the relative utility of a newly designed four seam type net on a conventional two seam net at the centre along the East Coast in both inshore and deeper zones (upto 100 m.) and the results indicated that the new four seam net has given higher catch rate of 6 to 8% more with higher catch rate of fish supposed to belong to off bottom region. Further this gear found more selective in obtaining *Lactarius*, which is one of the good variety of fish from trawlers, in both quantity as well as in quality. In terms of horizontal spread this new net gave less on comparison with the conventional two seam net, thereby showed corresponding increase in vertical spread; but warp tension remained more or less same in both the gear. Both gear have worked equally well in majority of depth ranges experimented with optimum spread. Finally the results indicated that the new net can work well from the present trawlers along the coast.

## INTRODUCTION

Right from the early attempts (Hornell 1915; Raj, 1931; 1933) to the recent in the concentrated efforts (Anon 1951; 1961; 1963; Chidambaram 1953, 1954; Sivalingam and Medcof 1957; John *et. al.* 1959; Shariff 1961; Naumov 1961; Poliokov 1962; Sebastian *et. al.* 1962; Rao and Devara 1962; Sreekrishna and Narayanappa 1970) to establish commercial trawling at a few selected centres on the East Coast of India, the factor, which apparently remained constant is the use of a two seam type otter trawling net. Probably, the universal adoption of that gear up to the fifties of this century might have influenced

the early Indian workers. However, during the last two decades, popularisation of small boat trawling in the inshore waters has brought about a greater use of the four seam type trawl net, particularly on the West Coast of India. But on the East Coast, two seam type net continued its popularity even in small boat trawling.

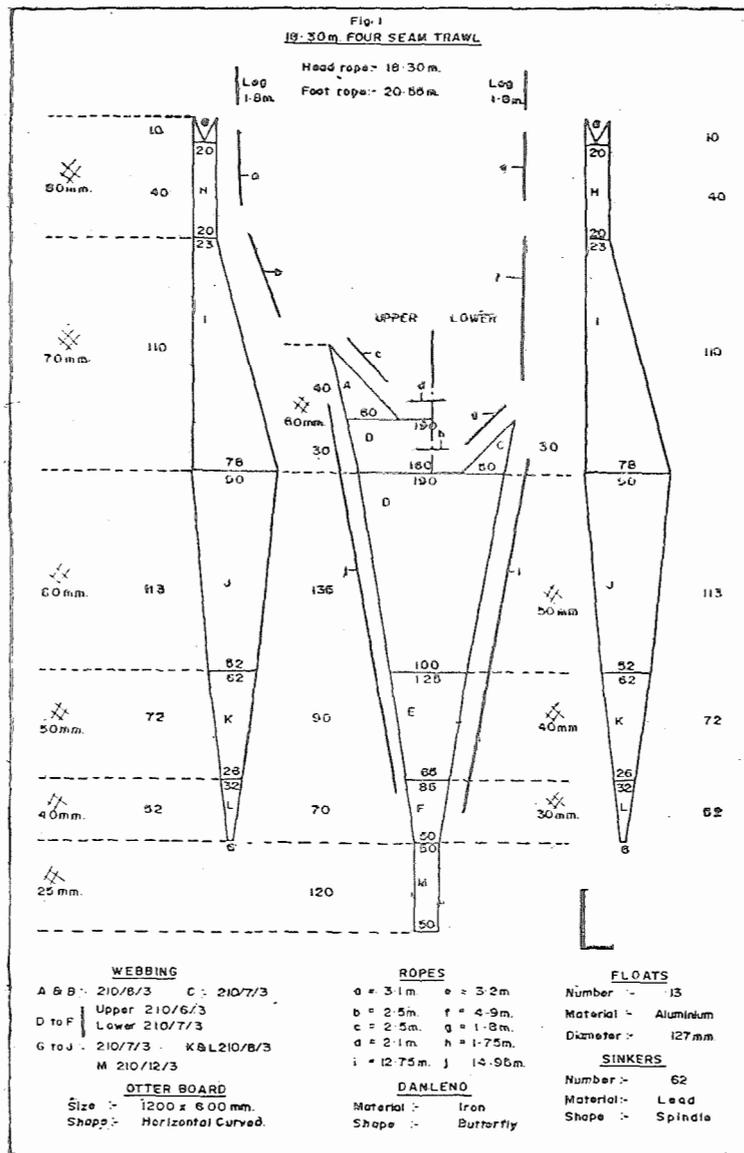
Hamuro (1964; 1967) after an elaborate study, of the two seam bottom trawl, showed certain defects like, more fluid resistance of gear for its mouth opening, large difference of water flow speed inside and outside the net, dragging of the floor by considerable portion of the wing and swollen shape in the fore body with rapid

narrowing of the after belly in towing. The same author suggested the design of a four seam net to overcome these defects. Apart from the studies made by Perumal and Sriram (1962) off Cochin, and Deshpande et al. (1968) off Veraval, on the comparison between two and four seam nets, there is no systematic study conducted in this country, particularly on the East Coast. Therefore, the design of a four seam net suitable for fishing conditions at Kakinada centre was worked out. Comparative fishing experiments with the new

net and the conventional two seam gear of the coast was attempted. Further, the suitability of the new design has been studied with special reference to the off bottom fishes like *Lactarius* sp. and Clupeids. The results together with the observations made are incorporated in this communication.

*Experimental gear:*

The new gear experimented, consisted of a four seam net as per the design diagram shown in Text. Fig. 1.



The design details of the conventional two seam net is similar in essential details to the 18. 25 m. trawl described by Satyanarayana *et. al.* (1962).

Otter boards used in the experiments were of the horizontal curved type, described by Mukundan *et. al.* (1967), but with increased dimensions namely 120 cm. x 60 cm. and weighing 50 kgs. each. The type and method of rigging between the net and the otter board is of single sweep wire system having 20 m sweep on each side.

*Method of experiments:*

Fishing experiments were conducted off Kakinada from Fish Tech No. 7 - Length 12. 2 m. (40'-0) fitted with a 60 b. h. p. engine, mechanical driven winch and a single gallow and the fishing grounds were distributed within depth ranges from 10 m. to 100. The period of fishing operations extended for six months from January to June 1968. Since the comparative fishing operations were undertaken from a single boat, balanced latin aquare method was adopted to avoid possible variation between hauls, times of hauls, days of operation, depth of hauls and other related fishing conditions. Although nearly one hundred fifty comparative hauls were made, data pertain-

ing to ninentysix comparable hauls in all respects, have only been taken into consideration for an objective comparison. Thro-ugh out the experiments the speed of tow ranged on an average between 2.00 to 2.30 knots and the duration of each drag was one hour. For each haul, the total catch as well as the species composition were recorded, besides the usual environmental data. The horizontal opening between the otter boards was measured adopting the method of Okonski ( 1968 ), while the warp tension was recorded with the tension meter described by Satyanarayara and Nair (1965).

*Results:*

The results of the comparable hauls with respect to catch, effort and catch rate by the new four seam and the conventional two seam nets are presented in Table I. Since the catch rate as well as composition in the inshore and off-shore regions where found entirely different, the results are shown separately. Depth range up to 50 m. is taken as inshore and depths beyond 51m. as off-shore.

The calculated horizontal spread between otter boards and the warp tension, while in tow, in each of the experimental nets at different depth ranges are shown in Table II.

TABLE I: CATCH DETAILS OF COMPARATIVE FISHING OPERATIONS BETWEEN THE NEW FOUR SEAM AND CONVENTIONAL TWO SEAM NETS

L. O. A: 12.2 m (40') Gross tonnage 17 tons.

Net Item	Conventional two seam trawl			New four seam trawl		
	Inshore	Off-shore	Both combined	Inshore	Off-shore	Both combined
Number of comparable hauls	79	11	90	79	11	90
Trawling time in Hrs.	79.0	11.0	90.0	79.0	11.0	90.0
Total catch in Kgs.	5115.5	3788.0	8903.5	5410.5	4089.0	9499.5
Catch per haul/ Tr.						
Hr. in Kgs.	64.75	344.36	98.93	68.49	371.73	105.55

TABLE II: SHOWING THE AVERAGE HORIZONTAL SPREAD AND WARP TENSION OF EACH OF THE NETS AT DIFFERENT DEPTH RANGES OPERATED AND AT CORRESPONDING AVERAGE TOWING SPEEDS

Depth range in m/Scope ratio	Average tow speed in knots.		Horizontal spread between Otter boards in m.		Warp tension in Kgs	
	T. S.	F. S.	T. S.	F. S.	T. S.	F. S.
10-20/1:5	2.18	2.13	21.97	22.98	367	353
21-30/1:5	2.15	2.10	24.44	25.99	369	368
31-40/1:5	2.14	2.11	25.10	24.54	399	426
41-50/1:5	2.12	2.07	24.95	22.98	380	398
51-60/1:4	2.02	2.05	29.02	27.52	362	360
61-70/1:4	no data	2.06	no data	24.69	no data	414
71-80/1:3.5	2.15	2.02	26.99	24.20	420	422
81-90/1:3.5	2.00	2.06	23.50	22.77	414	422
91-100/1:3.5	no data	2.30	no data	24.04	no data	477

T. S. : Two seam net

F. S. : Four seam net.

*Discussion:*

1. Catch rates: It is evident from Table I, that the total catch of fish including prawn per one hour haul, landed by the new four seam net was 68.49 and 371.73 kgs. respectively from the inshore and off shore waters as against 64.75 and 344.36 kgs. by the conventional two seam net. Eventhough the increase is not spectacular, it is significant to note that this may be the first four seam net which gave satisfactory performance in this area. The catch rates recorded well exceed the catch rate of 51.0 kg/Tr. Hour (Shariff 1961) obtained in the corresponding D-zone on this coast, with in the depths of 20 to 100 m.

Statistical analysis by applying tests of variance and t-test were attempted on the data collected, vide 'Appendix I' attached and the results of both the tests did not show any significant statistical difference between the nets as well as between the hauls. In spite of that, the catch rate in absolute terms showed a distinct increase of 3.74 and 27.47 kg.

off-shore regions by their inshore and new net.

The frequency of catch per haul from each of the nets in both the regions of fishing are shown in Table III.

TABLE III: FREQUENCY WEIGHT RANGE

"Weight range in" " Kgs.	Frequency in " " Two seam net - Four seam net	
i. Inshore operations.		
0 — 20	5	5
21 — 40	18	31
41 — 60	23	11
61 — 80	15	10
81 — 100	9	9
101 — 120	4	3
121 — 140	1	5
141 — 160	—	1
161 — 200	2	1
201 — 300	1	1
301 — 400	1	2
Total	79	79

"Weight range in" Kgs.	"Frequency in Two seam net - Four seam net"
------------------------	---

ii. Off-shore operations.

0 — 100	2	1
101 — 200	2	1
201 — 300	1	nil
301 — 400	2	4
401 — 500	1	2
501 — 600	nil	3
601 — 700	2	nil
701 — 800	1	nil
Total	11	11

The trend of frequency of landings in different weight ranges showed difference between the two gear.

2. Catch Composition:

Dutt (1968), while discussing the catch composition pointed out that the catches along the East Coast contain relatively more fish when compared to the West Coast. Hence, the catch obtained from each net was analysed to study its composition in detail from both the regions separately. The percentage of each of the individual fishes contributing the catch is shown in Table IV together with their absolute quantities.

The perusal of the above table indicate striking difference in their catch

TABLE IV: CATCH COMPOSITION OF THE TWO SEAM AND FOUR SEAM NETS IN INSHORE AND OFF-SHORE REGIONS

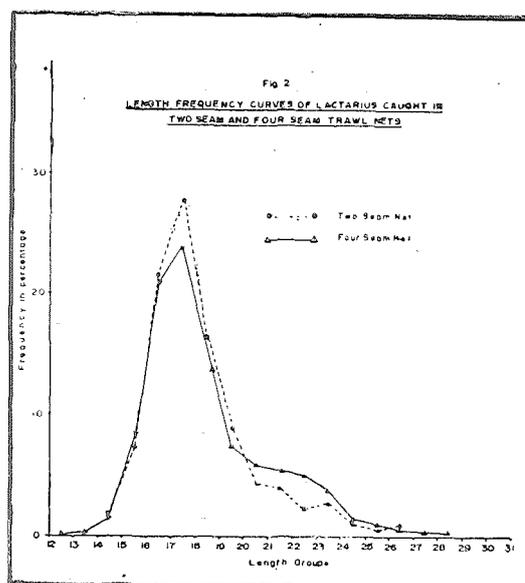
Fish	Catch in inshore region				Catch in off-shore region			
	Two seam net (Kgs)	(%)	Four seam net Kgs.	(%)	Two seam net (Kgs)	(%)	Four seam net (Kgs.)	(%)
Sciaenids	746.0	14.58	1464.0	27.06	251.0	6.23	349.0	8.53
Lactarius	382.5	7.48	475.0	8.78	—	—	—	—
Clupeids & Carangids	536.0	10.48	508.0	9.39	—	—	—	—
Pomfrets	12.0	0.23	27.0	0.50	—	—	55.5	1.35
Ribbon fish	73.5	1.44	75.5	1.40	36.0	0.96	11.0	0.27
Saurida	429.0	8.89	215.0	3.97	—	—	—	—
Silver Belly	665.0	13.00	595.0	11.01	—	—	—	—
Soles	346.5	6.77	175.5	3.24	149.0	3.93	115.5	2.83
Cat fish	159.0	3.11	231.0	4.27	48.0	1.28	58.0	1.42
Prawns	116.5	2.28	160.5	2.97	1.0	0.02	2.0	0.05
Skates & Rays	690.5	13.50	344.5	6.37	—	—	—	—
Upeneoides & Synagris	856.0	16.73	749.0	13.84	2384.0	62.91	2839.0	69.43
Psenes	—	—	99.0	1.83	596.0	15.73	522.0	12.77
Decapterus	—	—	—	—	294.0	7.76	106.0	2.59
Miscellaneous	103.0	2.01	291.0	5.37	29.0	0.78	31.0	0.76
Total:	5115.5	100.00	5410.5	100.00	3788.0	100.00	4089.0	100.00

composition of two seam and four seam nets. The well known bottom forms like Soles, Skates & Rays and *Saurida* are comparatively less in the four seam net whereas the better quality fishes of the area (i.e) *Lactarius*, Pomfrets, Sciaenids and Cat fish are represented more in the four seam net. The quality and quantity of fish from each of the regions of operations are also different as already dealt in the authors previous communication (1968). Carangids and Silver bellies present in inshore areas are found more in two seam net with 25% in total as against 20% in the four seam net. Representation of Pomfrets in the off-shore catch of four seam net is another feature of the net. It is to be noted here that the availability of Prawns in the area during the season is very poor and hence cannot be considered to indicate its trend. Considering the above, it is in general, observed that the catch from the new four seam net consisted of the better quality fishes supposed to be off bottom forms, with less of purely bottom forms.

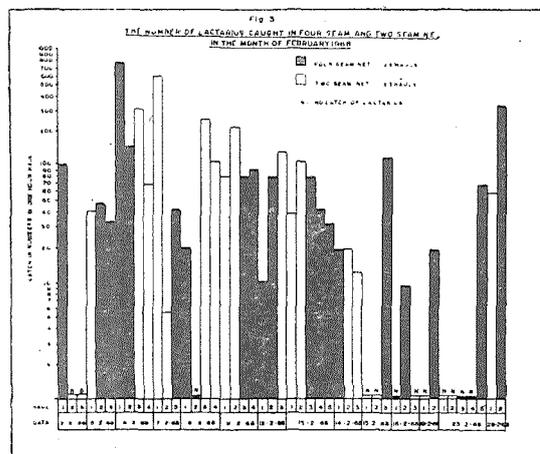
*Net selectivity in catching Lactarius:*

Among quality fishes *Lactarius*, formed about 10% of the trawl catch in the area. Hence morphometric data with respect to the total length of fishes caught in both the nets were collected in the month of February, when they were obtained in comparatively better quantities and analysed to study their selectivity in each of the gear. The length frequency distribution curves of all samples of fish measured during the month for each of the experimented nets, are represented in the Text. Fig. 2.

The perusal of the Text. Fig. 2. reveals that the trend of fish caught in the nets within small size groups looks similar whereas it is distinctly different as far as the capture of high size groups are concerned. The four seam net is found to obtain higher percentage of the fish, sp-



ecially in bigger size groups, on comparison with the two seam net, though the mesh sizes in the cod end and throat of both the gear are same. From the commercial fishery point of view, these bigger sized fishes has got more market and economic value. The total number of fish as caught per haul in each of the days, when morphometric data was collected is plotted as histograms on log. paper as shown in Text. Fig. 3.



The figure indicates the pattern of catches in the hauls made with each of the nets during the fourteen day period in the month and the respective catch trend. The number of hauls in which the catch of *Lactarius* is less than 100 in number, consist of 8 and 16 times in two seam and four seam nets respectively.

Further, hauls with no catch of *Lactarius* in two seam and four seam nets are found to be 8 and 4. Thus the new four seam net is found to be superior and selective in catching *Lactarius* fish.

*Operational characters of the nets:*

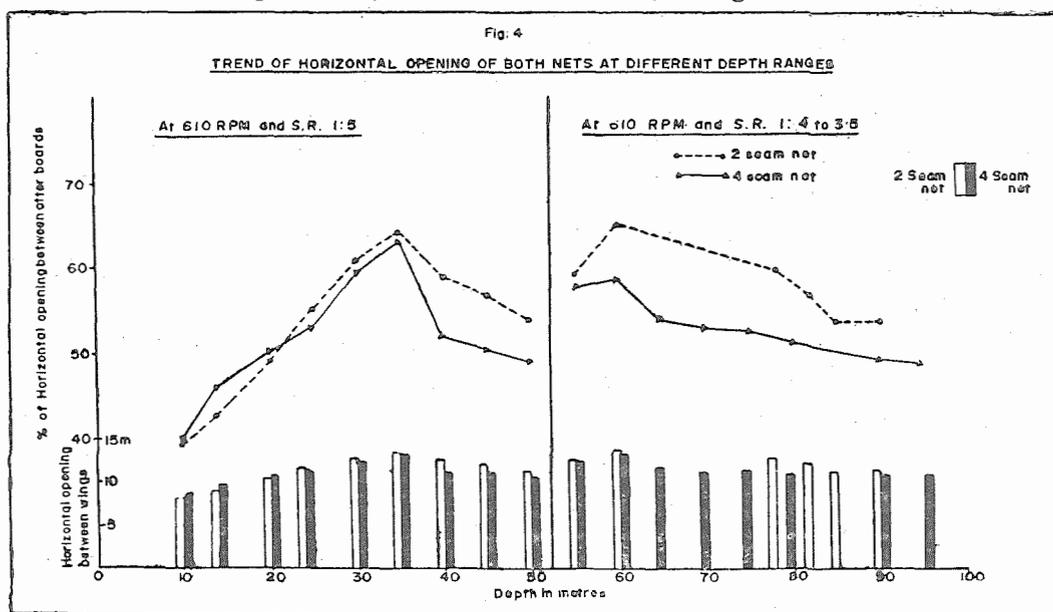
Both the nets have been operated at depth ranges between 10 m. to 100 with suitable scope ratios and under relative towing speeds of 2.00 to 2.30 knots but at constant Engine R. P. M. of 600 to 610. Even though the engine output for all the operations were kept constant at 600 to 610 R. P. M. the variation in the towing speed as could be noticed in the Table II, may be mainly due to the combined effect of the magnitude and direction of sea currents (both bottom and surface) prevailing on the operational grounds. Actually, the towing speed measured, is only a relative one, taken with respect to the boat and sea surface; corresponding to this alone, the horizontal spread of gear was compared. It is evident from the same table that the horizontal opening of the conventional two seam net is invariably higher than the new four seam net in all depth ranges except the first two. This indirectly indicates that the four seam net has obtained more vertical spread, which accounted for the comparatively better

catch of off-bottom varieties.

In terms of warp tension, there is not much appreciable variation between the two nets, indicating that the new net can profitably be used from the trawlers using the conventional two seam net without using more power of the boat. The total resistance offered by both the gear showed a variation of nearly 200 kgs. between the operational extreme depth ranges with a minimum of 297 kgs. in inshore depth and a maximum of 480 kgs. in deep waters. Thus both the gear which were made of nylon twine, required only 7.25 H. P. for their towing even at 100 m. depth with 3.5 times warp out (i. e) only about 12% of the power was utilised, indicating that the existing trawlers can use a cotton net with an appropriate twine size without any adverse effects on its engine power.

*Horizontal spread between otter boards and wing ends:*

Strictly comparable data on horizontal opening in each of the gear at each of the depth ranges was taken and their percentage to the total length of the head rope between the otter boards was calculated. The trend of the above is shown in Text. Fig. IV.



In the figure, the curve showing the trend is drawn separately for inshore depths where the scope ratio is 1:5 and offshore depths where the scope ratio is 1:3.5. In the same figure, the actual horizontal opening between wing ends of the two different gear at each of the depths, was shown in histograms for their easy comparison.

The curves clearly indicate that both the gears have worked satisfactorily with optimum horizontal opening between 50 to 60% within the depth ranges of 20 to 90 m. in which depths, the existing trawlers as well as the coming medium to big trawlers can work effectively along this coast. The horizontal spread between wings of the new four seam net, within the effective depth zones of operation is found to be less on comparison with the conventional two seam net, as could be evidenced from the histograms, which clearly indicate the proportional increase in its vertical spreads, enabling it to catch more off bottom forms. The scope ratios tried with the gear at different depths were found to be effective and optimum with satisfactory, horizontal as well as vertical spread, which could be advantageously utilised by the trawlers operating in the areas along the coast for the efficient working of their gear.

#### ACKNOWLEDGEMENT:

The authors are thankful to Dr. V. K. Pillai, Director for helpful criticism and kind permission to publish this paper. They are very grateful to Shri G. K. Kuriyan, Senior Fishery Scientist (Craft & Gear) for his constant guidance in the course of the experiments and for his valuable suggestions.

#### REFERENCES

Anon 1951 Report on the working of Deep Sea Fishing Scheme, Govt. of West Bengal, PP 1—13.

- „ 1961 *Ind. Fish. Bull.* VIII (4), October Govt. of India, PP 5—28.
- „ 1963 *Ind. Fish. Bull.* X (2), April, Govt. of India, PP 1—22.
- Chidambaram, K. 1953 *Proc. of I. P. F. C.* (4th meeting 1952), Sec. II PP 225—33
- „ 1954 *Proc. of I. P. F. C.* Abstract No. 22. 1—8.
- Deshpande, S. D. Sivan, T. M., Kartha, K. N. and Rama Rao, S. V. S. 1968 *I. P. F. C.* (13th Session) C. 68/SYM 31, PP 1—7.
- Dutt, S. 1968 *Sea Food trade Jour.* VIII (8); PP 17—21.
- Hamuro, C. 1964 “Moderan Fishing gear of the World-2” Fishing news boons Ltd., London, 191—199.
- „ 1967 *Report F. A. O./U. N. D. A.* (T. A.) 2277-II, PP 109—129.
- Hornell, J. 1915 *Mad. Fish. Bull.* No. 8: PP 23—43.
- John, V., Chacko P. I., Venkataraman, R. and Sherieff A. T. 1959 Report on Fishing experiments in the inshore waters of Madras State; *Mad. Govt. Publ.* PP 1—54.
- Mukundan, M., Satyanarayana, A. V. V. and Krishna Iyer, H. 1967 *Fish. Technol.* IV. (2). PP 53—61.
- Narayanappa, G., Narasimha Raju, D. A. and Satyanarayana, A. V. V. 1968 *I. P. F. C.* 13th session, Sec. II
- Naumov, V. M. 1961 *F. A. O./E. T. A. P.* Rept. No. 1393: PP 1—53.
- Okonski, S. L. 1968 *I. P. F. C.* 13th Session. C. 68 24: PP 1—10.
- Poliokov, M. P. 1962 *F. A. O./E. T. A. P.* Rept. No. 1573: PP 1—39.
- Perumal, M. C. and Sreeram, V. 1962 *Ind. J. of Fish.* 9 (1): PP 71—88.
- Rao, S. N. and Devara, V. S. 1962 *I. P. F. C.* 10th Session, C. 62/Tech.

- Satyanarayana, A. V. V., Nair, R. S. and Kuriyan G. K. 1962 *I. P. F. C.* 10th Session. Sec. II.
- Satyanarayana, A. V. V., & Nair, R. S. 1965 *Res. and Ind.* **X** (8): PP 229--331.
- Sebastian, A. V., Sadanandan, K. A. and Satyanarayana, 1965 *Proc. of I. P. F. C.* 105h. Sesssion, Sec. II: PP 198--203.
- Shariff, A. T. 1961 *Souvenir Fisheries of Gujarat*: PP 46--54.
- Sivalingam, S. and Medcof, J. C. 1957 *Bull No. 6 Fish. Res. Stn. Dept. Fish. Ceylon*: 1--23.
- Sreekrishna, Y and Narayanappa, G. 1970 *Fish. Technol.* **7** (1): PP 33--37.
- Sunder Raj, B. 1931 *Mad. Fish. Bull.* **23** (3) PP 153--187.
- „ 1933 *Mad. Fish. Bull.* **24** (3) of 1930: 199--232.
- 

### Appendix I: ANALYSIS OF VARIANCE

(a) *Data from the inshore hauls of two seam and four seam nets.*

Source of variation	D. F.	S. S.	M. S.	Calculated F.	Theoretical F.
Between Nets	1	550.8	550.8	0.2094	7.011 at 1% & 3.947 at 5% levels
Between hauls	78	2,52,942.8	3,255.7	1.2379	1.541 at 1% & 1.347 at 5% levels
Error	78	2,05,138.7	2,630.0		
Total	157	4,59,632.8			No significance

(b) *Data from Deep water hauls of four seam and two seam nets.*

Source of variation	D. F.	S. S.	M. S.	Calculated F.	Theoretical F.
Between Nets	1	4,118	4,118	0.1582	1.044 at 1% & 4.965 at 5% levels.
Between hauls	10	5,23,409	52,340.9	2.0107	4.900 at 1% & 3.009 at 5% levels.
Error	10	2,60,300	26,030.0		

#### “t-Test”

No. of comparable hauls	(n)	“ $\bar{d} = \frac{\sum d}{n}$ ”	“ $\sqrt{\frac{\sum (d - \bar{d})^2}{n - 1}} = s$ ”	“ $t = \frac{\bar{d} \sqrt{n}}{s}$ ”	Theoretical value.
(a) Inshore hauls	79	3.73	81.27	0.4080	1.995
(b) Deep Water hauls	11	27.3	234.7	0.3630	2.262

“Not significant”



strength (kg)										
Quantity	10									3
Length (m)	3.1	2.5	2.5	2.1	3.2	4.9	1.8	1.8	12.75	14.85

Accessories	Floats	Sinkers	Danleno	Otter board
Number	13	62	2	2
Material	aluminium alloy	Lead	Iron	Wood and Iron
Shape	Spherical	spindle	Butter fly	Horizontal curved
Dia/bore dia. (cm)	12.74	1.90		2.7 (thickness)
Length (cm)	—	5.0		120
Breadth (cm)	—	—		60
Static Buoyancy (kg)	13.65	—		—
Weight in air (kg)	3.25	14.1		50.0
Weight submerged	—	12.7		

Head rope: 18.3 m (2.1 m bosom, 2.5 m each jib and 5.6 m on each wing)

Foot rope : 20.55 m (1.75 m bosom, 1.8 m each jib and 8.1 m on each wing)