International Council for
the Exploration of the Sea

Gear & Behaviour Committee
CM 1975/B:23

Results of a Comparative Fishing Experiment for Flat Fish using an Electrified Beam Trawl

by

Peter A M Stewart

Marine Laboratory
Aberdeen, Scotland.

INTRODUCTION

The fishing experiment described in this paper was part of a comprehensive study of marine electrical fishing being carried out at the Marine Laboratory, Aberdeen. Experiments are in progress to study the behaviour of marine fish under electric stimulation in both aquarium and natural conditions. The reactions of flatfish (Pleuronectidae) to a moving electrical stimulus have been investigated (Stewart 1975) and the data obtained was used to select the electrical stimulus for this experiment.

Flat fish gears usually incorporate chain ticklers to dig the fish out of the bottom. It was found that an electric stimulus delivered by a system of light-weight electrodes was very effective in forcing fish up off the bottom, and that the most efficient stimulation pattern was 1s long bursts of DC pulses at 20 Hz, with 1s delay periods between bursts. 20 Hz appears to be slightly higher than the frequency threshold for tetanus for pleuronectid flat fish. At higher frequencies the muscles of the fish are more strongly tetanised and a greater percentage remain on the bottom after the field is removed. At lower frequencies, below tetanus, the stimulus tends to be too weak to stimulate a large percentage into movement. It was also found that the 20 Hz interrupted stimulus tended to preferentially stimulate larger flat fish.

To investigate the practical application of an electric stimulus in the capture of flat fish a comparative fishing experiment was designed using a beam trawl. The beam trawl has certain advantages for electrical fishing in that it provides a rigid framework to support and protect the electrical equipment. Comparative data was obtained by dividing the gear in two and electrifying only one side during each haul.

Apparatus and Experimental Techniques

In figure 1 the 9m beam trawl used in the experiment is shown. The net was divided in two from the beam aft to twin cod-ends. Identical electrode arrays of stainless steel warp were slung on each side of the gear and the fore-ends of the electrodes were attached by ropes to the beam. The electrodes were 1m apart. The groundrope was weighted with light chain, and the centre of the groundrope was 5m aft of the beam. The pulse generator was mounted on the centre of the beam, thus minimising the lengths of the electrical connections to the electrodes. Power was supplied to the system from the towing vessel via an armoured cable. The electrical system is described in detail elsewhere (Stewart 1975).

The electrical stimulus was 1s bursts of 2ms duration, exponential shaped, DC pulses at 20Hz, with 1s delays between bursts. The peak voltage between the electrodes was 50-60V.

Experimental trawling was carried out in the Moray Firth and on Turbot Bank, from FRV "Clupea". The side of the gear to be electrified was chosen at random. Tows lasted for approximately one hour and after each haul the catch was measured. The towing speed was usually 1.0-1.5 m/s. A haul was considered to provide a valid comparison if the gear was undamaged and appeared to have been fishing evenly, and if the electrical system functioned as designed for the whole tow.

RESULTS

The catches consisted mainly of plaice, Pleuronectes platessa, lemon sole Microstomus kitt and the common dab Limanda limanda. Some skate Raja naevus and juvenile dover sole Solea solea were also caught. The catch in each valid haul is shown in Table 1, with the non-electrified value underlined. The combined length distributions for the catches of the three main species and for the total catch are shown in Figures 2 and 3.

DISCUSSION

Analysis of the data showed the catch differences for certain size groups to be statistically significant. The catch ratios for these groups are shown in Table 2. The non-significant results obtained for small plaice and lemon sole and large common dabs may be due to the small amounts of data collected for these groups. The analysis also showed that there were no significant differences between the catches taken by each side of the gear.

In this experiment the catch obtained with a light electric tickler system was compared with the catch obtained using the tickling effect of a weighted footrope. Clearly the electric tickler system is considerably more efficient than a weighted footrope. The next stage of the experiment will be to compare the catch when using an electric tickler with the catch when using a chain tickler. It is possible that the two systems will be found to be equally effective, in which case the advantage of an electric tickler system will be in secondary factors, such as reduced damage to juvenile flat fish and reduction in gear weight and vessel towing power required for the same catch.

REFERENCES

Stewart P A M 1975 Experiments in Burghead Bay on the reactions of flat fish to electrical stimulation. Marine Laboratory Internal Report 1975 No 6. (Unpublished typescript).

Stewart P A M 1975 Comparative fishing for Nephrops norvegicus using a beam trawl fitted with electric ticklers. Mar Res 1975 No 1.

Table I

Catch obtained in each statistically valid haul (Non-electrified catch value underlined)

Haul No.	Side Electrified	Lemon Sole		Plaice		Common Dab		Skate		Dover Sole	
74/32	STBD	18	14	20	11	130	79	-	-	-	-
74/33	"	13	7	8	8	66	64	-	-	1	0
74/34	"	31	26	3	1	28	33	3	0	1	0
74/40	PORT	12	12	15	7	26	28	7	5	1	0
74/43	"	2	3	20	12	9	30	3	0	-	-
74/44	"	15	8	8	4	11	12	2	2	-	-
74/48	"	1	1	16	8	72	48	1	2	-	-
74/51	STBD	-	-	9	10	47	19	0	1	-	-
74/52	"	1	0	15	4	22	4	-	-	-	-
74/53	"	2	0	11	4	42	30	1	0	-	-
74/54	PORT	0	-	4	2	45	22	1	0	-	-
74/57	"	1	0	12	13	120	44	0	1	-	-
74/59	"	32	24	7	4	24	13	-	-	1	0
74/61	STBD	3	4	46	43	2	3	-	-	-	-
74/62	PORT	5	2	19	8	11	0	2	2	-	-
74/65	"	11	3	94	58	235	110	0	3	8	2
74/66	STBD	2	2	37	29	127	64	-	-	3	3
74/67	"	1	3	92	75	57	166	-	-	0	3
TOTALS		150	110	436	301	1074	749	20	16	15	8

Table 2

Ratio of electrified to non-electrified catch for various size groupings.

SPECIES	< 20cm in Length	≥ 20cm in Length	ALL SIZES
Lemon Sole	-	1.31	1.28
Plaice	-	1.62	1.58
Common Dab	1.53	-	1.49
TOTAL CATCH	1.40	1.54	1.54

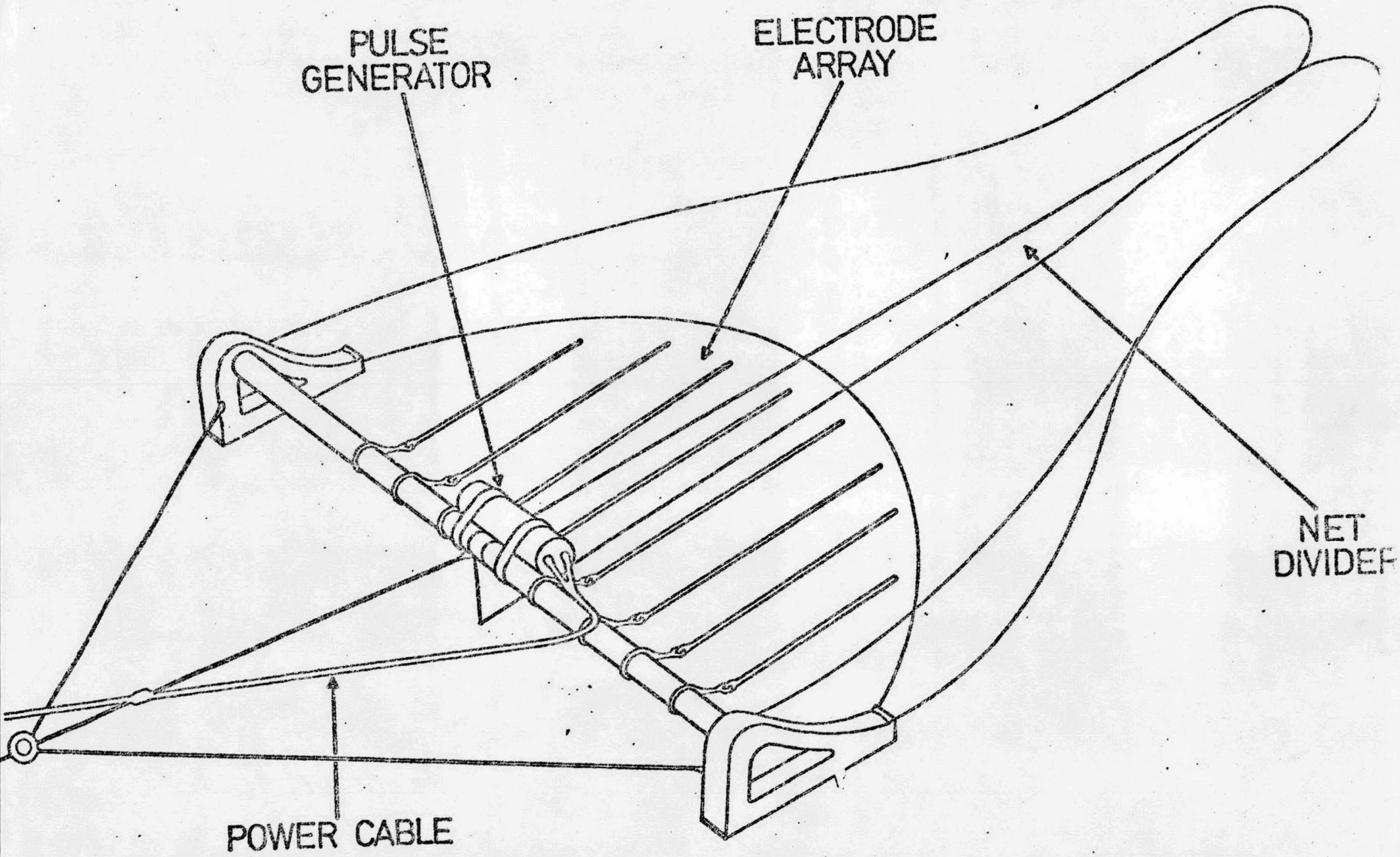

Figure 1. Divided beam trawl showing electrode array, pulse generator and transmission cable.

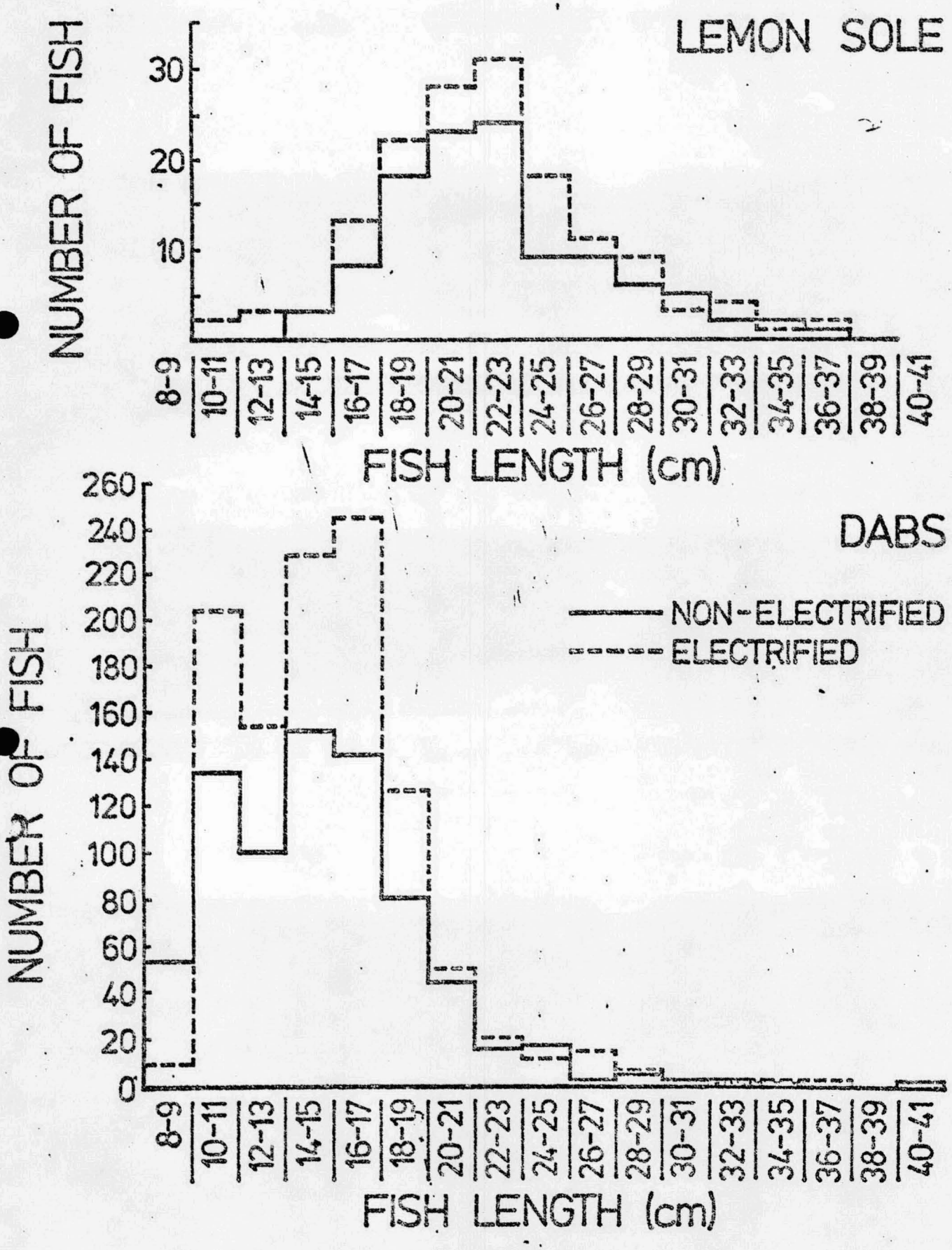

Figure 2. Length distributions of catches of lemon soles and dabs.

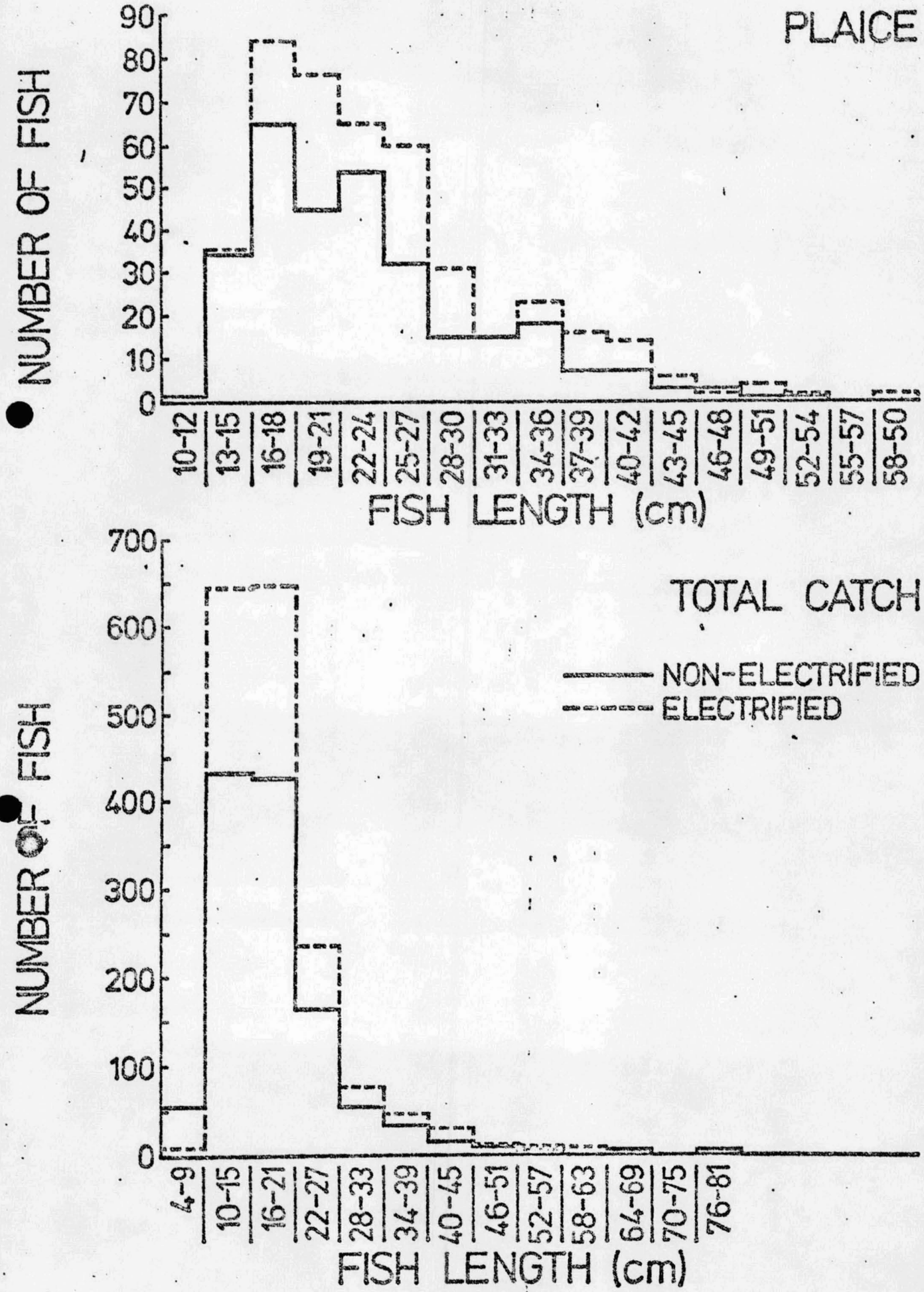

Figure 3. Length distributions of catch of plaice and of total catch of all species.