

# A comparison of the Vignerón-Dahl Trawling Gear with the Steam Otter Trawl, in the Hake Fishery.

By

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**I**n the early part of 1922, considerable interest was shewn by the British trawling industry in a new type of trawl which was then in course of adoption by the French trawling fleets, especially at La Rochelle. This net was said to be much superior in efficiency to the steam otter trawl (hereafter referred to as the S. O. T.) then in use in the English fleets, especially in the capture of hake, for which it was originally designed. It was said to be based on the "bull-net" or "filet-boeuf", a type of large net already in use, but of necessity towed between two steamers. By the new method, however, a net somewhat similar to the "bull-net" could be towed by a single trawler. The "V-D" or "French gear" is now too widely used and too well-known to need re-description here. A recent account of it, illustrated by excellent models prepared by the inventors, has been written by LE GALL (1).

In August, 1922, two trawlers at Plymouth were equipped with the new gear; by March, 1923, the Cardiff fleet was so equipped, and Swansea soon followed suit. During the period from February, 1923, to March, 1924, the English hake ports were actively fitting out their ships with the new gear, and, though there were set-backs, and though Fleetwood was somewhat conservative in its attitude, by the latter date the V. D. trawl was firmly established in the English hake fishery, and has been in almost universal use, though subjected\* to an infinity of variations and modifications, ever since.

During the period from February, 1923, to March, 1924, therefore, the old and the new types of gear were competing against each other.

The Fisheries Department of the Ministry of Agriculture and Fisheries collected data as to the landings of ships using the two types of gear, and this enables us to compare their respective performances during this period. Unluckily, the original records have been destroyed; nothing is now available except the extracted and combined results, which are set out in Tables I and II below.

These data do not distinguish the fish into species. They have been so combined and calculated as to shew, by months, the weight of fish (of all species) landed per 100 hours' fishing in the statistical regions West of Scotland, West of Ireland and South of Ireland, by ships fitted out with the V. D. and the S. O. T. respectively.

For the months of February, March and April, 1923, the data were not distinguished into regions. They are set out below, in Table I.

Table I.

Month	Number of Voyages		Landing of all species per 100 hours		Efficiency of V.D. compared with S. O. T.
	V. D.	S. O. T.	V. D.	S. O. T.	
1923 February .	4	22	191	186	V. D. Greater by 3%
March . . . .	3	22	360	239	V. D. Greater by 50%
April . . . .	7	29	323	157	V. D. Greater by 106%

The remaining data, in which the regions are distinguished, are set out in Table II.

In Column 1 of Table II is given the month and the year, in Column 2 the mean landing of hake per 100 hours' fishing in the regions and month concerned, and in Column 3 the percentage of hake in the total weight of demersal fish landed from the region concerned in that particular month. The data in Column 2 are taken from the writer's Natural History of the Hake, Parts I and II, Appendix Table V. (2). Those in Column 3 are calculated from data supplied by the Statistical Branch of the Fisheries Department.

In Columns 6 and 7 are given the mean landing, in cwts. per 100 hours' fishing, of all demersal fish caught by ships using the V. D. gear (Column 6) and S. O. T. (Column 7) respectively.

In Columns 4 and 5 are shewn the number of voyages on which the data in Columns 6 and 7 are based, and finally, in Column 8, the efficiency of the V. D. gear, as compared with the S. O. T. is shewn, based on the data in Columns 6 and 7.

Table II. A comparison of the efficiency of the V. D. gear (as compared with the S. O. T.) with the landings of hake and the percentage of hake in the total landing.

Month	Mean Landing of Hake per 100 Hours	Percent of Hake in Total Catch	Number of Voyages		Landing of all Species per 100 Hours		Efficiency of V.D. compared with S.O.T., based on 6 and 7	
			V.D.	S.O.T.	V.D.	S.O.T.		
1	2	3	4	5	6	7	8	
<b>West of Scotland</b>								
1923 Sept. ...	68	43.7	5	194	382	227	V.D. Greater by	68%
Oct. ...	70	42.6	18	203	270	183	— —	48%
Nov. ...	69	39.0	29	170	227	201	— —	13%
Dec. ...	47	27.3	27	161	196	201	— Less by	3%
1924 Jan. ....	9	6.0	7	147	203	218	— —	7%
Feb. ....	9	4.4	12	177	296	268	— Greater by	10%
Mar. ....	(15)							
Average ...	45							21.5
<b>West of Ireland</b>								
1923 May ...	163	73.8	44	13	261	176	V.D. Greater by	48%
June ...	153	63.6	6	3	210	165	— —	27%
July ...								
Aug. ...	159	78.6	45	16	231	168	— —	37%
Sept. ...	125	64.3	55	13	191	147	— —	30%
Oct. ...	129	57.0	87	8	227	172	— —	32%
Nov. ...	104	47.0	49	7	219	155	— —	41%
Dec. ....	147	52.8	20	4	321	203	— —	58%
1924 Jan. ....	138	51.4	38	5	287	134	— —	114%
Feb. ....	205	58.7	26	1	392	221	— —	77%
Mar. ....	(153)							
Average ...	147							51.6
<b>South of Ireland</b>								
1923 May <sup>1)</sup> ...	89	59.6	101	88	216	153	V.D. Greater by	41%
June <sup>2)</sup> ..	110	61.8	112	121	232	159	— —	46%
July <sup>2)</sup> ...	121	69.5	50	50	240	143	— —	68%
Aug. <sup>2)</sup> ..	85	67.7	17	10	196	112	— —	75%
Sept. <sup>2)</sup> ..	59	68.7	16	9	184	137	— —	34%
Oct. <sup>2)</sup> ...	57	55.4	22	11	221	177	— —	25%
Nov. <sup>2)</sup> ...	54	37.9	43	79	223	166	— —	34%
Dec. <sup>2)</sup> ...	68	48.2	43	16	229	167	— —	37%
1924 Jan. <sup>1)</sup> ...	70	47.6	146	83	210	144	— —	46%
Feb. <sup>1)</sup> ...	82	56.9	146	69	232	203	— —	14%
Mar. ....	(49)							
Average ...	79.5							42.0

<sup>1)</sup> Based on the data referring to the whole region.

<sup>2)</sup> Based on the data referring to the individual rectangles, excluding Rectangles XX<sub>1</sub> and XX<sub>2</sub>, the Smalls herring trawling grounds.

Before proceeding to discuss the material before us, several remarks must be made. Firstly, the number of voyages (Columns 4 and 5) on which the data in Columns 6, 7 and 8 are calculated, shews great variation and often great disparity. Thus, for the region West of Scotland, the mean landing for ships fitted with the S. O. T. is based on a large number of voyages, that for ships fitted with the V. D. on comparatively few; the reverse is true of the region West of Ireland. Secondly, I have had to recalculate the data for the months from July to December, 1923, in the region South of Ireland, since the original data include the results of the Smalls herring-trawling fishery, which is a very intensive and peculiar fishery better eliminated from the present discussion, though, in this fishery, the S. O. T. appeared definitely to outfish the V. D. Thirdly, it is well known that the largest and most powerful trawlers were the first to be fitted out with the V. D. gear, and, in our comparison, some allowance may be made for this.

Fourthly, the first V. D. trawls used were of French manufacture, and some appear to have had a decidedly smaller mesh than the S. O. T. in use in the English fleets. (See also Postscript, second paragraph).

Lastly, we must clearly bear in mind that the data in Columns 6, 7 and 8 are based on landings of all demersal fish, whereas, in the discussion, we shall focus our attention upon the hake fishery.

#### Discussion.

The efficiency of the V. D. gear has been vaguely but enthusiastically assessed at twice or thrice that of the S. O. T. The superiority of the new gear is, of course, claimed by the inventors, and is said to be due, chiefly, to two factors. Firstly the gear has a much greater effective width than the S. O. T.; this is achieved by the long bridles (up to 100 fathoms in length) which connect the net to the trawl boards, and which, by stirring up the mud on the sea floor, drive the fish inwards towards the advancing net, and have, therefore, the effect of a net of enormous width. Secondly, the gear has a much greater sweep in height; this is attained by buoying up the headline with floats, the net being so designed as to enhance this effect.

The success of the V. D. trawl speaks for itself; this note is written because the writer, who is examining the statistics of the hake fishery, must take this innovation into account, and he must endeavour to distinguish the effect of its introduction from that of natural fluctuations in the hake stock.

A glance at Tables I and II will shew that the V. D. trawl enjoys no

constant superiority in performance over the S. O. T. Its efficiency, in fact, has varied between 114 % greater and 7 % less than that of the S. O. T. It is true that there may be little relation between the data for landing in unit time (Columns 6 and 7, Table II) and the percentage superiority of the V. D. gear over the S. O. T. (Column 8, Table II). For instance, in January, 1924, the landing per 100 hours' fishing was decidedly lower than in the months immediately before and after, yet the percentage superiority of the V. D. was much higher. But other factors, and especially climatic factors must be considered. Bad weather throughout any month would adversely affect ships using each type of gear, without necessarily affecting one more than the other.

The three months in Table I shew a rapidly increasing superiority in the performance of the V. D. gear, and this might perhaps be ascribed to an increase in technical efficiency. But a study of the later months reveals a different picture.

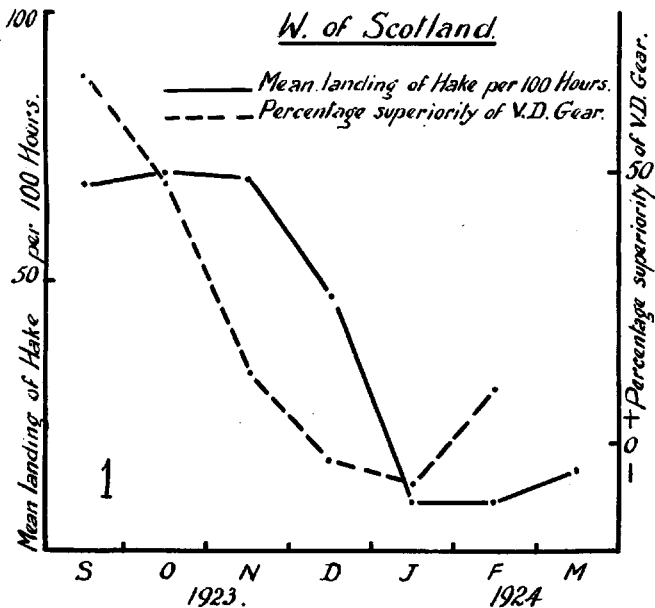


Fig. 1. Region West of Scotland. Comparison between the efficiency of the V. D. gear and the mean monthly landings of hake, per 100 hours' fishing.

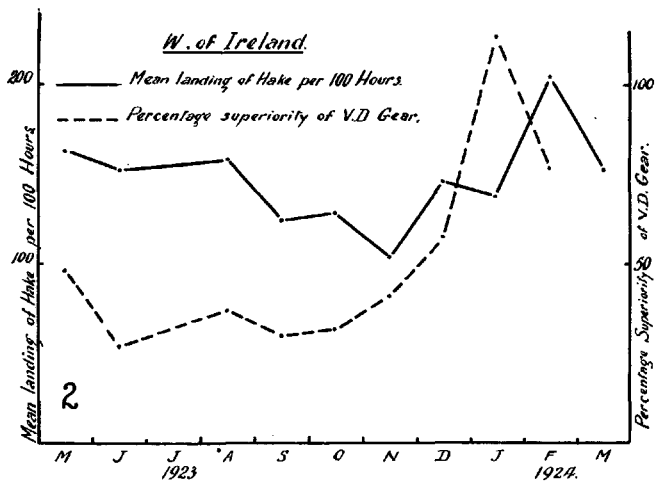


Fig. 2. Region West of Ireland. Comparison between the efficiency of the V. D. gear and the mean monthly landings of hake, per 100 hours' fishing.

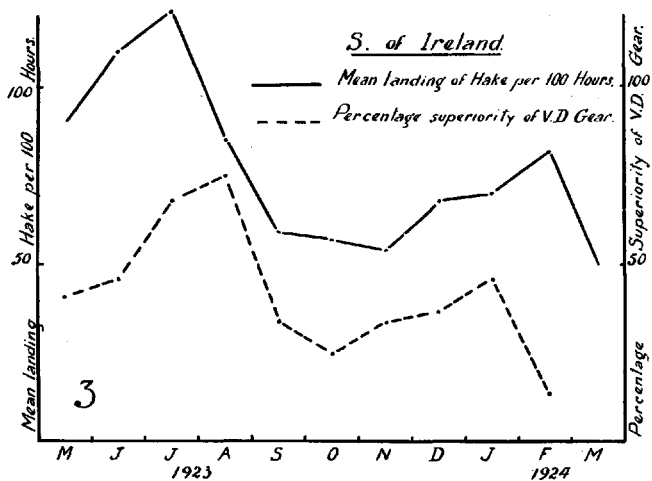


Fig. 3. Region South of Ireland. Comparison between the efficiency of the V. D. gear and the mean monthly landings of hake, per 100 hours' fishing.

In Figures 1, 2 and 3, the data in Table II are plotted graphically for the regions West of Scotland, West of Ireland, and South of Ireland respectively. The broken line represents, in all cases, the variation from month to month in the efficiency of the V. D. gear as compared with the S. O. T. (data in Column 8, Table II).

The variation in the relative efficiency of the V. D. gear is not haphazard, but forms strikingly regular curves in each region.

In the region West of Scotland, the relative efficiency of the V. D. falls from 68 % greater in September, 1923, to 7 % less in January, 1924, recovering to 10 % greater in February.

In the region West of Ireland, the relative efficiency of the V. D. fluctuates about 40 % greater from May, 1923, to October, 1923, when it increases to 114 % in January, 1924, falling to 77 % in February.

In the region South of Ireland, the relative efficiency of the V. D. increases from 44 % greater in May, 1923, to 75 % greater in August, 1923. Then there is a decline to 25 % greater in October, 1923, and then a recovery to 46 % greater in January, 1924, and finally, a fall to 14% greater in February, 1924.

It is quite clear that no technical factor is here involved. A biological factor at once suggests itself. The monthly variation in the superiority of the V. D. gear is similar to the mean monthly variation in the catch of hake. The continuous lines in Figures 1, 2 and 3 join the points representing the mean monthly landing of hake, per 100 hours' fishing, in the appropriate regions and months (data in Column 2, Table II). The curves so obtained are closely similar to the curves representing the monthly variation in the relative efficiency of the V. D. gear. Though the shape of the two curves is so similar, their modes do not coincide, and, in Figure 1 and the latter part of the curves in Figures 2 and 3, there is a "lag" of about one month on the part of the mean landing, per 100 hours, of hake. It is as if the V. D. gear had anticipated the mean landing, in unit time, of hake in the whole area. The explanation may lie in this, that the larger ships, which were the first to carry the new gear, were working in deeper water, where the concentrations and dispersions of the hake are felt earlier than in the region as a whole. In the region South of Ireland, however, the peak in the curve for "percentage superiority of the V. D. gear", in August, is one month ahead of that in the curve for "mean landing of hake."

Finally, if the average monthly landing of hake, over the period of comparison, is compared with the average monthly superiority of the V. D. gear, in each region ("Averages", Table II) there is excellent agreement. Thus, the region West of Scotland has an average landing of hake

of 45 cwts. per 100 hours' fishing, and an average V. D. superiority of 21.5 %; the corresponding figures for the West of Ireland are 138 cwts. per 100 hours' fishing, and 52 %, and for the South of Ireland, 79.5 cwts. per 100 hours' fishing, and 41.6 %.

We are justified in thus comparing the mean landing of hake, with data as to relative performance based on the landings of all species, at least in the regions West of Ireland and South of Ireland, because, as may be seen in Column 3, Table II, hake is there the dominant species, usually comprising more than half the total landings from the region. In the region West of Scotland (and, less markedly, in the other regions) the percentage of hake in the landings corresponds with the landing of hake in unit time, and with the relative performance of the V. D.

Further, it cannot be argued that the performance of the V. D. trawl is associated with the fluctuations in the hake fishery because ships equipped with the V. D. gear were fishing largely for hake, while ships equipped with the S. O. T. were fishing largely for other species. In many cases the performance of the two types of gear in the same statistical rectangle (see EDSEB, 6), in the same month, are separately given in the Ministry's statistics, though not inserted in Table II. These data, referring to much smaller units of area, shew the same relation between the relative performance of the two types of gear, and the landings of hake, as the much larger statistical regions given in Table II. I know of few statistical rectangles in which two separate fisheries may be prosecuted at the same time.

We are driven, then, to the surprising and perplexing conclusion that the performance of the V. D. trawl, as compared with the S. O. T., in the period dealt with, was dominated by the natural seasonal fluctuations in the hake fishery, and that the greater the landing of hake in unit time, i. e. the denser the concentration of the hake, the greater the superiority of the V. D. gear over the S. O. T. At low concentrations of hake we find little to choose between the two; indeed, on some cases the S. O. T. appears to have more than held its own, especially when it is remembered that the most powerful trawlers were the first to be equipped with the new gear, and that the first V. D. nets appear to have had a smaller mesh than the S. O. T. then in use. In the rest of the discussion, we shall extend this conclusion, based on the seasonal fluctuation in the fishery, so as to apply to fluctuations in the fishery from year to year.

If the superior performance of the V. D. gear were due to a greater effective width, we should expect to find a fairly constant superiority in efficiency, just as, using GARSTANG's well-known analogy of a shovel



scooping marbles off a table, doubling the width of the shovel will roughly double the number of marbles taken at each scoop of the shovel (3). The fact that there does appear to be a residual superiority, if it is not due to a smaller mesh, may be due to this greater width.

A possible explanation of the seasonally-fluctuating performance of the V. D. gear may be found in the undoubtedly bathypelagic habits of the hake, as shewn, for example, by its diurnal vertical migrations, and by the nature of its food (2). We may imagine that the hake, even by day, does not lie actually on the bottom, but near it, that is, the hake shoal is distributed in height as well as in area. Therefore, the greater effective height of the V. D. gear, owing to its long buoyant headline, will enable it to catch hake floating at a greater distance from the sea bed than can be reached by the headline of the S. O. T. The denser the shoal of hake, the greater the number of hake taken by the V. D. but missed by the S. O. T. Such an explanation fits the facts as they apply to the hake fishery. Yet it seems that in the trawled herring fishery, a fishery for a species which is more pelagic in its habits than the hake, the S. O. T. had a greater efficiency than the V. D.

Let us endeavour to assess the effect of introducing the V. D. gear into the hake fishery, by considering two identical stocks of hake, one of which is fished by the V. D. and the other by the S. O. T. At the end of a year, say, the stock fished by the V. D. will have yielded a greater weight of fish, but will be left with the prospect of a lower catch in unit time, than that fished by the S. O. T. Now let an abundant year-class enter the fishery, in both cases. In the case of the stock fished by the V. D. gear, the new year-class, during the period when it is still relatively concentrated, will be very much more heavily cropped than that in the stock fished by the S. O. T. At the end of this year, therefore, the V. D. will have taken enormous quantities of small hake, giving a much greater total yield of hake, than the S. O. T., especially if the V. D. cod-end is of smaller mesh. But, as the new year-class becomes thinned out in subsequent years by fishing operations, natural mortality, and by the natural scattering and spreading out into deeper water as the fish grow larger, the toll levied by the two types of gear becomes much more even. Meanwhile, however, the initial very heavy cropping of the year-class by the V. D. gear will have resulted in a reduction of its strength to an extent which will more than offset any residual superiority of fishing power still possessed by the V. D. trawl over the S. O. T. At the end of a certain small number of years, therefore, we should expect to find the stock fished by the V. D. yielding definitely less larger hake, though more smaller hake (derived from subsequent spawnings) in unit time, than that fished by the S. O. T. This

effect is not the same as that of, say, doubling the fishing power of the S. O. T. as, for instance, by doubling the number of ships using it. In the latter case there would be a doubling of the landings of all sizes of hake and an evenly distributed strain; with the V. D. the strain appears to be exceedingly heavy when the hake are dense, as they are when a successful brood enters the fishery, and it is then, in my view, that the differential destruction of the year-class takes place.

The effect of introducing the V. D. trawl into the hake fishery, from the argument given above, would be to give enormous catches of small hake whenever a rich year-class enters the fishery, but a corresponding depression, later, in the catches of older and larger hake. This corresponds with the actual results of the hake fishery in recent years. The character of the fishery has changed to one based largely on small hake.

At an Inter-Departmental Conference on Fishery Investigations, an enquiry was held into the effect of the V. D. gear, with special reference to the haddock fishery. It was concluded that the V. D. gear was the more efficient apparatus for haddock, and that the use of this gear reduces the chances of a haddock being able to escape to live to a good marketable size; the gear was described as "a method of fishing capable of eliminating enormous numbers of fish before they have reached maturity, or even marketable size."

From the biological point of view, there need not be great alarm at the change in the character of the fishery, to one based largely on small hake, since there will always, probably, be enough survivors to reach maturity and maintain the species; but, from the economic point of view, a fishery based on small fish is at the mercy of natural fluctuations in the strength of the year-classes, to a much greater extent than a fishery in which there is a larger proportion of bigger and older fish, to act as a reserve in the intervals between the appearances of successful year-classes. Moreover, in the new conditions, a rich year-class will be so heavily fished as to glut the market with small hake. This actually happened in 1925 and 1926, when a prominent English trawler owner complained (4) of "the terrible gluts, which are one of the principal causes of the shocking conditions in which the fishing industry finds itself to-day." Since then, however, the market for small hake has improved, though still very sensitive when landings of small hake are heavy, and the abundance of small hake, in 1930, was welcomed.

When the V. D. gear was still a novelty, in September, 1923, the writer saw it in use for the first time, and in a short account of it (5) he records the fisherman's opinion that the new gear is more merciful to the small hake than the old. But there is good reason to believe that, in 1923 and

1924, small hake were comparatively scarce, owing to a failure of year-classes. With the entry of the rich year-classes, probably of 1920 and 1921, into the fishery, vast catches of small hake became a prominent feature of the fishery, and, in October, 1926, the writer saw a haul, by no means exceptional, which included 5 score of big and medium sized hake, but no less than 80 baskets of small hake.

### Summary.

The efficiency of the Vigneron-Dahl trawling gear is compared with that of the steam otter trawl, with especial reference to the hake fishery. On the data available, it appears that the V. D. is generally more efficient than the S. O. T., but in very varying degree. Its superiority varies to a considerable extent with the varying concentration of the hake, and is greatest where the concentration of hake is densest.

It is concluded that the effect of introducing such a gear into the fishery will result in enormous catches of small hake whenever a rich year-class enters that fishery, but in a corresponding depression later in the catches of larger hake. Its tendency, in short, will be to change the fishery into a violently fluctuating one based chiefly on small fish. This appears to have actually happened in the hake fishery.

### Literature.

- (1) LE GALL, J. *La Pêche Maritime* etc. 14e Année No. 666. 1931.
- (2) HICKLING, C. F. *Fisheries Investigations*, Series II. Vol. X. No. 2. 1927.
- (3) GARSTANG, W. Buckland Foundation Lecture. "Fishing News", June 7, 1930.
- (4) LAWFORD, E. D. W. "The Times", Sept. 5, 1926.
- (5) HICKLING, C. F. "Fish Trades Gazette", Nov. 17, 1923.
- (6) EDSER, T. *Rapports et Procès-Verbaux*. Vol. XXXVI.

**Postscript.** Through the kindness of trawler owners at Fleetwood, I have had access to the results of some trawlers at the time of conversion from the S.O.T. to the V.D. gear. These tend to confirm my conclusion that the superiority of the V.D. gear varies "with the varying concentration of the hake, and is greatest where the concentration of hake is densest". Thus, in the months from May to July, when the spawning concentrations of the hake occur (2), the V.D. caught three times the quantity of big and medium hake (which include almost all the spawners) caught by the S.O.T., but slightly less small hake than the S.O.T., per day's absence: whereas in autumn, when the small hake are taken in quantities in the shallower waters (2) the V.D. caught little more big and medium, but three times the quantity of small hake, caught per day's absence by the S.O.T.

On the first voyages with the new gear an additional expert fishing skipper was carried as instructor; I understand that the subsequent voyages generally shewed less striking results.