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FISHING POWER AND FISHING EFFORT OF VESSELS LANDING AT ABERDEEN

by

J. A. POPE

Marine Laboratory
Aberdeen

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1. INTRODUCTION

One of the main factors controlling the state of an exploited fish population is the effort expended by fishermen. A simple measure of the effort of a single vessel or of a group of vessels is provided, for example, by the number of hours fishing in the case of trawlers or the number of hauls in the case of seiners. However, the duration of a fishing operation by itself is not always a reliable measure of effort. The fishing efficiency of a vessel will clearly depend to a large extent on the size and the nature of the rig of its gear as well as on the specification of the vessel and on the ability of the skipper and crew among other things. Thus, when constructing indices of abundance of a fish population it is desirable to calibrate the efforts expended by all vessels so that they may be made comparable and combined to give a proper measure of the true overall effort. This may be done by defining the effort expended by a single vessel during one trip as the product of the duration of fishing (or number of fishing operations) and the fishing power of the vessel, the latter being a weighting coefficient introduced to make the efforts comparable.

The fishing power of a vessel is defined as the ratio of its catch per unit fishing time (or per unit fishing operation) to that of a standard vessel of specified characteristics and gear fishing on the same density of fish. (See Beverton & Parrish. In press.) The fishing effort of a vessel is then seen to be the product of its fishing power and the time for which that power has been in operation.

Strictly speaking the fishing power of a vessel should be defined with reference to one particular species of fish. However, in most cases it is usual for the vessels of a particular fleet to adopt a standard gear suitable to the grounds and species normally worked. In such cases the relative fishing powers within that fleet for different species are likely to be equal. This assertion has to a certain extent been verified in the present investigation.

As defined, the fishing power of a vessel will be on an arbitrary scale depending only on the vessel chosen as standard. However, fishing power is likely to be associated with the size of the vessel and the size of gear it employs and the use of some measureable vessel characteristic in place of an arbitrary number would seem preferable in practice. This possibility has been investigated by Beverton & Holt (In press) who concluded that, to a good approximation, fishing power was proportional to gross tonnage for both steam and motor trawlers in England, the constant of proportionality being different in the two cases. Since then a more detailed investigation of the English trawler fleet has been carried out by Gulland (This meeting and in press). He also finds a relationship between gross tonnage and power factor for English trawlers, fishing power being approximately proportional to gross tonnage for steam and motor trawlers above 150 gross tons, but smaller trawlers being, ton for ton, 1.3 times more powerful than the larger trawlers.

The use of horse power instead of gross tonnage as a measure of the fishing power of English trawlers has also been investigated by Gulland (In press) He concluded that fishing power was influenced by both gross tonnage and horse power and hence that gross tonnage is a suitable measure provided engine power remains constant. It is worth noting that horse power is regarded by Belgian workers as a more suitable measure of the fishing power of their trawlers (Gilis, 1954).

The work of both Beverton & Holt and Gulland refers only to English trawlers although Gulland has investigated some English seiners to a limited extent. The purpose of the present paper is to give a brief account of some results of an investigation which is at present being carried out at the Marine Laboratory, Aberdeen into the fishing efficiencies of Scottish trawlers and seiners. Results here are confined to vessels landing at the port of Aberdeen. In particular only steam trawlers working the grounds off the east coast of Scotland and seiners operating in the same area are dealt with.

2. ABERDEEN STEAM TRAWLERS

The statistics of commercial landings for the year 1953 were selected for analysis, this being the latest complete year for which details of landings and grounds fished were available when the investigation was begun. In addition, 1953 was the only year when a fairly large number of grounds were differentiated and entered on the seine-net statistical returns. In most respects, and in particular as regards fishing activity at the port, 1953 was quite typical of late post-war years.

During the year some 100 trawlers worked the near water grounds off the east coast of Scotland more or less consistently throughout the year. These grounds are located in statistical squares

	11B	11C	
	12B	12C	12D
	13B	13C	13D
	14C	14D	
and	15C		

The 100 trawlers studied in this analysis do not differ markedly in size. The actual composition of this fleet by gross tonnage is shown in Table 1. These vessels engaged in 1953 mainly in trips averaging two to three days' duration, the most important species, by weight, taken from these grounds being haddock and whiting.

Power factors were worked out initially for a group of 28 trawlers of tonnage range 173-221 tons, chosen because they gave a large number of statistical square comparisons. These power factors were based on comparisons of the total demersal catches per 10 hours' fishing per trip, comparisons being obtained on each occasion when two or more vessels of the group were fishing at the same time in the same statistical square, following the method used by Gulland (In press).

For this group of trawlers it was found that the differences between their estimated power factors were relatively small. Taking into account the variation of the individual values from which these estimates were obtained, the differences between trawlers were not significant nor was there any evidence to suggest that they were associated with gross tonnage.

Using this group of 28 trawlers as standard vessels all of unit power factor the power factors of the other 72 trawlers were estimated. Again there was no evidence of any real difference between trawlers nor any association between power factor and gross tonnage.

The 100 trawlers working in this area therefore exhibited no significant difference in power during 1953.

The same conclusions may be reached if performance instead of fishing power is considered. The performance of a vessel during a specified period is the catch per 100 hours' fishing during that period. (This definition is due to Hickling, 1946). The performance differentiates neither grounds nor trips within the period as does the fishing power and therefore does not

take account of the fact that some vessels may consistently fish better grounds than others during the period. However, as the total area fished in the present case is relatively small and the density of fish fairly uniform over the whole area it is reasonable to assume in this instance that power factor and performance are proportional.

Using a 10 ton grouping the performances of the 100 trawlers were evaluated by months with reference to haddock, whiting and total demersal catch separately. The results are given in Tables 3, 4 and 5, where it may be seen that the performances showed no evidence of any relationship with gross tonnage.

In view of the similarity of the catch compositions of these vessels and the fact that haddock and whiting constitute a large proportion of the catches, this result implies that there is no significant difference between the performances, and hence the powers, of these trawlers with respect to the other demersal species caught in this area. This was substantiated for plaice by an analysis of the catches of a random sample, stratified by months and vessel tonnages, of approximately 3% of the total landings.

These results indicate that although gross tonnage may be a useful and reliable measure of the fishing power of a trawler in many cases, tonnage by itself is certainly no measure of the fishing power of the Aberdeen vessels which work the local grounds nor is there any reason to suppose that horse power or length, for example, would be more significant measures.

These conclusions may be accounted for by the following facts.

(i) The tonnage range of the vessels studied here is not great, being only 80 tons.

(ii) The vessels are all old, although age by itself may not, in general, have any bearing on fishing power. For example, Gulland (In press) has shown that for the English trawler fleet newer vessels do not have greater power factors than older vessels of the same tonnage.

(iii) The larger of the trawlers do not, in general, use a bigger trawl than the smaller, the trawl in common use being a short winged trawl of headline-length about 62 ft.

(iv) All vessels tow at about the same speed for about the same duration.

It is also worth comparing the present results with those shown in Fig. 1 of Beverton & Parrish (I.C.E.S. paper, 1954, No. 25 and in press). In their case the linear relationship between power factor and gross tonnage is not maintained from 190 tons to 250 tons, a range corresponding closely with that of the trawlers dealt with here.

3. SEINE-NET VESSELS

The work on seine-net vessels has so far been confined to those which fished the grounds off the east coast of Scotland and landed at Aberdeen during 1953.

These vessels fall into two groups, (a) those under 40 ft. in length which use the flat-fish seine working in the bays along the coast, and which will be ignored here, and (b) those of 40 ft. and over which use the round-fish seine and work the deeper waters frequented by the trawlers. The length frequency distribution of the latter group is given in Table 2. All seiners dealt with here adopt the method of "fly-dragging" as distinct from anchor seining.

It was found that the catch compositions of all vessels of 40 ft. and over were similar to each other and that results true for the total demersal catch also hold for haddock and whiting, the major species landed by these vessels. Accordingly, details of the results for total catch only will be given here.

The monthly performances* of all vessels, using a 10 ft. grouping, working the same grounds as the local trawlers, are shown in Table 6 where it may be seen that there is no significant association between performance and vessel size. Performance should again be a good and reliable measure of fishing power.

Unlike the trawlers which landed all their catches at Aberdeen few of the seiners dealt with here landed regularly at the port during 1953. As the Aberdeen landings only were available for analysis the results may well be unrepresentative. In fact there is reason to believe that quite a large number of seiners land only their best catches in Aberdeen and, if this is so, it may tend to smooth over differences which may exist between vessels of different sizes. However, this should not obscure any differences entirely and it is significant that Gulland concluded that power is independent of size of vessel for English anchor seiners.

On the other hand some boats have more powerful engines than others and it may be that horse power is a relevant factor. Unfortunately, data for horse power are not immediately available but it is important to note that any advantage of additional power is likely to be effective only in the last stages of hauling-in the net. The possibility that greater performances are associated with the vessels of greater engine power is being investigated. Meanwhile it seems that the chief advantages of greater size and power are likely to be in the ability to fish farther from port and in rougher weather.

4. TRAWLER-SEINER COMPARISONS

Provisional estimates of the equivalent trawler tonnage of the seiners were obtained by comparing their performances with those of the trawlers. By defining performance in the case of trawlers in terms of catch per days absence a reasonably accurate comparison should be obtained in this instance. The performances of the trawlers were therefore calculated by dividing their combined catches over a month by the total days absent for that month and comparing this with the corresponding figure for seiners. This gave an estimate of 150 tons as the equivalent trawler tonnage of seiners over 40' in length based on the catches of all demersal species, which may be compared with Gulland's estimate of 160 tons for English seiners arrived at by rather different methods. The equivalent tonnages based on the catches of haddock and whiting were found to be 150 tons and 350 tons respectively. The rather high figure for whiting would at least partly be accounted for if the trawlers tended to reject the smaller sizes of that species during 1953 but it is improbable that this provides a complete explanation.

It should be remembered that these estimates only become real when allowance is made for the average number of days the two types of vessels can fish throughout the year there being, for instance, a considerable range among seiners between 40 and 80 feet in length.

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*For seiners performance has been defined as catch per days' absence.

REFERENCES

BEVERTON, R. J. H. and HOLT, S. J. 'On the dynamics of exploited fish populations.' Fish.Invest.,Lond.,Ser.2 (In press).

BEVERTON, R. J. H. and PARRISH, B. B. 'Commercial statistics in fish population studies.' I.C.E.S. Paper No. 25, 1954. Rapp.Cons. Explor.Mer. (In press).

GILIS, C. 1954. 'La pêche Belge aux poissons demersaux dans La Mer du Nord au cours des années 1946-1953'. Institut D'Etudes Maritimes Ostende.

GULLAND, J. A. 'On the measurement of demersal fishing effort.' (This meeting).

HICKLING, C. F. 1946. 'The recovery of a deep sea fishery.' Fish. Invest.,Lond.,Ser. 2, 18 (1).

TABLE 1

GROSS TONNAGES OF ABERDEEN TRAWLERS

Gross Tonnage	160-	170-	180-	190-	200-	210-	220-	230-	240-	Total
Number	2	2	4	20	28	25	11	3	5	100

TABLE 2

LENGTHS OF SEINERS LANDING AT ABERDEEN

Length	40.0-	50.0-	60.0-	70.0-	80.0-	Total
Number	16	45	35	5	2	103

TABLE 3

PERFORMANCES OF ABERDEEN TRAWLERS TOTAL DEMERSAL

(Catch/100 hr. fishing)

Tonnage	Jan.	Feb.	Mar.	Apl.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
160-69	208	206	248	228	223	126	223	196	231	191	228	333
170-79	176	162	286	171	204	180	207	202	178	173	238	191
180-89	230	163	224	142	193	181	241	234	271	202	223	287
190-99	208	178	242	187	169	218	224	136	229	186	206	210
200-9	225	139	161	202	218	276	242	242	251	225	233	258
210-19	158	180	230	195	191	243	258	227	252	202	184	240
220-29	210	161	220	186	204	213	227	217	222	184	193	216
230-39	164	131	330	239	163	188	225	179	221	231	151	393
240-49	249	153	276	156	282	218	294	228	376	337	289	240

TABLE 4

PERFORMANCES OF ABERDEEN TRAWLERS HADDOCK

(Catch/100 hr. fishing)

Tonnage	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
160-69	53	82	44	60	44	23	23	39	98	61	109	32
170-79	64	24	25	42	68	48	66	52	53	58	55	42
180-89	108	62	62	51	48	42	52	38	72	60	49	42
190-99	78	35	58	46	56	54	51	54	68	72	61	57
200-9	92	43	73	67	61	68	68	64	77	83	72	80
210-19	98	51	91	58	53	63	60	57	59	75	60	67
220-29	78	52	60	44	57	57	66	53	68	67	64	60
230-39	80	4	67	86	66	35	77	52	81	136	35	176
240-49	119	67	59	51	81	56	87	68	117	150	104	76

TABLE 5

PERFORMANCES OF ABERDEEN TRAWLERS WHITING

(Catch/100 hr. fishing)

Tonnage	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
160-69	43	30	24	17	25	45	61	38	11	18	22	128
170-79	29	19	20	30	23	31	34	54	37	23	78	75
180-89	55	28	28	22	30	49	56	46	53	32	43	54
190-99	54	26	34	34	46	57	57	53	45	36	48	69
200-9	50	29	59	40	44	64	52	65	42	37	52	79
210-19	53	39	43	43	33	55	54	42	34	25	38	52
220-29	58	31	27	35	27	49	45	41	40	23	48	53
230-39	30	54	40	56	23	48	43	28	32	23	42	56
240-49	55	36	43	44	30	44	36	8	23	37	48	85

TABLE 6

PERFORMANCES OF SEINE-NET VESSELS. TOTAL DEMERSAL

(Catch/days' absence)

Length	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
40.0-	20	7	23	14	17	18	25	20	19	14	21	31
50.0-	18	16	23	16	14	20	19	22	18	27	16	30
60.0-	19	19	22	18	16	24	23	21	20	16	16	9
70.0-	22	20	22	19	15	19	21	22	17	14	15	21
80.0-	21	22	16	-	-	-	-	-	-	-	-	-