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# Catch and Effort in the Irish Lobster/Crawfish Fisheries 1951-1969

by
F. A. Gibson[x)]



## Introduction

In recent years, increasing attention has been paid to the interpretation of the effects of fishing effort upon the stock abundance of commercially valuable decapod crustacea. Simpson (1970) has emphasised the value of and urgent need for, precise information concerning the effects of fishing effort on lobster and crawfish stocks.

By their very nature, lobsters and crawfish do not lend themselves particularly well to conformity with established methods of catch and effort analyses as applied to fish stocks. Therefore, whilst this almost traditional approach is adopted for lobster and crawfish studies, it may well be that considerable adjustments in the methodology are required if finer estimations are to be achieved concerning the effects of fishing effort upon these animals.

A most important gap in our knowledge is that of the mechanism of recruitment. Without reliable estimates of annual recruitment it is difficult to interpret its effects on abundance of good or poor year classes. Fully reliable methods of ageing lobsters have not been perfected.

## Recruitment and Repopulation

It is not possible at this stage to provide satisfactory explanations of the means by which discrete stocks of lobsters are replenished. Gibson (1967) pointed to an annual influx of sub-legal (under 83 mm carapace length) lobsters to a fishery every October/November, during the period of investigation from 1958 to 1963. Presumably, the strength of these recruiting lobsters could be used as a means of determining the success of year classes, if exact information could be collected annually from sufficient boats, and a comparison made of their numerical strength over at least one decade. This would be valuable information, but it would not answer the more important questions dealing with the origin of recruits and the means by which they have joined particular individual stocks, during the period from larval life to adolescence.

Observations made in the Irish fisheries show that individual stocks of lobsters can be so reduced in strength as to become uneconomic to continued trapping. But traps are not highly efficient means of attracting lobsters and crawfish. Furthermore, they may not compete successfully with the natural food available and thus an uneconomic yield from a particular area which follows sustained heavy fishing, does not mean that all the adult lobsters or crawfish have been caught, nor is it known what proportion of the stock remains. On the other hand, these areas become repopulated in a relatively short time perhaps a year, rarely more than two years, by legal sized lobsters. The questions following this widespread and recurring phenomenon are many and include:-

(i) Is the total numerical strength of individual lobster stocks much greater than the annual catch would suggest?

x) Dr. F. A. Gibson,
Dept. of Agriculture and Fisheries,
Fisheries Division,
3, Cathal Brugha Street,
Dublin, Ireland.

(ii) How do territory conscious lobsters recognise that ground is unoccupied and what prompts them to make the migrations needed to accomplish repopulation? How do such migrations agree with general tagging operations the results from which show such marked lack of migration?

(iii) Does H. gammarus occupy a far more varied type of substrate than those rocky reefs which fishermen by tradition accept to be their habitat? (The work of Simpson 1961 and Dybern 1967, shows that H. gammarus may occupy a greater variety of substrate than might be expected).

(iv) To what extent do unexploited stocks comprise the reservoir of larval production, which larvae, transported by water movement, replenish fished stocks? Will the exploitation of hitherto unfished stocks, upset the stock recruitment mechanism?

(v) What methods ought to be enforced for protecting all stocks against over-exploitation?

R. H. Dow (pers. comm.) states that it is his belief that most of the measures at present in force for the protection of lobster stocks, including closed seasons, return of ovigerous females to the sea or size limits are insufficient to ensure stock stability. In the case of crawfish stocks, off western European coastlines, limited measures only, are in force to rationalise exploitation. There is insufficient information about the biology and behaviour of this species to date, to justify implementing the traditional protective measures.

Catch and Effort

One of the objects of this paper is to present such data as are available from Irish records of catch and effort. Relevant material on changes in the size distribution is given in the next section.

As may be the case elsewhere, there are mixed lobster/crawfish fisheries, separate lobster fisheries, but no wholly crawfish fishery in Irish coastal waters. Annual censa of the type and number of fishing boats, together with the length of the fishing season have allowed the data in Table 1 to be shown in terms of catch per boat per season, and catch per boat per month, in the case of separate lobster and lobster/crawfish fisheries from 1951 to 1969. (Table 1. p. 3).

It can be seen that except for 1951, 1954, 1960, 1961 and 1965, the catch per boat per month was higher for craft fishing for lobsters only. This can be attributed to the extreme variability of the crawfish catch, caused not by the abundance of crawfish, but by the fact that there are so few boats engaged on crawfish fishing only. It seems likely that the crawfish fishery remains relatively underexploited, which is also the conclusion of Molloy (1970). The fluctuations in catch per boat per month for lobster fishing only, may, therefore, have more serious implications. In Table 1 the mean of the lobster only, and lobster/crawfish catches, compared with the total landings of both species are shown in the last two columns. Plotted against each other, these two sets of figures show a correlation at the 5% level ($r = 0.47$) which is not sufficient to confirm linearity. The reasons for this can only become known when sufficient catch per unit effort data have been collected. Catch per 100 trap lifts for certain areas have been collected for lobster fishing in 1958, 1959, 1960, 1964, 1965, 1968 and 1969. These are shown in Table 2 (see p. 3). Since they apply to selected parts of the coast only, they may not reflect the national position. These figures, even though they arise from selected observations, could be significant if the drop in catch per effort which they indicate from 1964 to 1969, is a reasonable index of abundance.

Table 1. Catch per boat per season and per month from 1951 to 1969.

| Year | No. of boats | Catch/boat/season | | | Catch/boat/month | | | Total catch lobsters and crawfish |
|---|---|---|---|---|---|---|---|---|
| | | A Lobsters only | B Lobster and crawfish | Mean of A + B | C Lobsters only | D Lobsters and crawfish | Mean of C + D | |
| 1951 | 634 | 405 | 461 | 433 | 108 | 124 | 116 | 333 522 |
| 1952 | 651 | 836 | 476 | 656 | 199 | 160 | 180 | 436 614 |
| 1953 | 739 | 628 | 466 | 547 | 160 | 111 | 136 | 435 386 |
| 1954 | 672 | 544 | 630 | 587 | 142 | 156 | 149 | 418 515 |
| 1955 | 383 | 1 380 | 2 428 | 1 904 | 350 | 344 | 347 | 570 990 |
| 1956 | 560 | 1 217 | 1 194 | 1 206 | 246 | 229 | 238 | 677 911 |
| 1957 | 544 | 1 152 | 1 108 | 1 130 | 282 | 227 | 260 | 643 283 |
| 1958 | 532 | 1 092 | 966 | 1 024 | 269 | 199 | 234 | 723 840 |
| 1959 | 558 | 2 179 | 1 000 | 1 589 | 369 | 175 | 272 | 894 707 |
| 1960 | 563 | 855 | 1 102 | 979 | 213 | 278 | 246 | 674 303 |
| 1961 | 526 | 680 | 856 | 768 | 180 | 226 | 203 | 453 373 |
| 1962 | 565 | 695 | 617 | 654 | 193 | 172 | 188 | 383 775 |
| 1963 | 531 | 683 | 622 | 653 | 196 | 178 | 187 | 354 548 |
| 1964 | 522 | 984 | 812 | 898 | 252 | 208 | 230 | 493 260 |
| 1965 | 565 | 864 | 1 130 | 997 | 211 | 276 | 244 | 526 250 |
| 1966 | 556 | 1 223 | 974 | 1 079 | 285 | 227 | 256 | 652 361 |
| 1967 | 640 | 1 125 | 648 | 887 | 263 | 151 | 207 | 624 670 |
| 1968 | 626 | 1 096 | 750 | 923 | 233 | 160 | 197 | 633 414 |
| 1969 | 671 | 1 053 | 784 | 919 | 182 | 135 | 159 | 660 769 |

Table 2. Catch per 100 trap lifts from 1958 to 1969 for certain years only.

| Year | Catch/100 trap lifts |
|---|---|
| 1958 | 34 |
| 1959 | 33 |
| 1960 | 28 |
| 1964 | 34 |
| 1965 | 27 |
| 1968 | 22 |
| 1969 | 14 |

The number of boats divided into the mean catch per boat per season is shown in Table 3, and if these are plotted against each other, no pattern of any kind emerges.

Table 3. Ratio of catch per season to number of boats in the fishery.

| Year | No. of boats | Mean catch per season | Ratio |
|---|---|---|---|
| 1951 | 634 | 433 | 0.684 |
| 1952 | 651 | 656 | 1.008 |
| 1953 | 739 | 547 | 0.740 |
| 1954 | 672 | 587 | 0.874 |
| 1955 | 383 | 1 904 | 4.971 |
| 1956 | 560 | 1 206 | 2.153 |
| 1957 | 544 | 1 130 | 2.077 |
| 1958 | 532 | 1 024 | 1.924 |
| 1959 | 558 | 1 589 | 2.847 |
| 1960 | 563 | 979 | 1.739 |
| 1961 | 626 | 768 | 1.227 |
| 1962 | 565 | 654 | 1.158 |
| 1963 | 531 | 653 | 1.230 |
| 1964 | 522 | 898 | 1.720 |
| 1965 | 565 | 997 | 1.765 |
| 1966 | 556 | 1 099 | 1.977 |
| 1967 | 640 | 887 | 1.386 |
| 1968 | 626 | 923 | 1.474 |
| 1969 | 671 | 919 | 1.370 |

It would appear, therefore, that the high catch per boat per season from 1955 to 1959, including years of good and bad fishing weather, is related to stock abundance over this period. From 1964 to date, the mean catch per boat per season has been 954, and the variation from that mean from + 145 to - 69. This persistent fishing yield is the result of more standardised fishing techniques and it suggests that little progress has been made towards exploiting hitherto unfished stocks. Furthermore, the new carapace size limit (83 mm) was introduced during this period. All these data, have been collated in Figure 1 in which the mean catch of lobsters/crawfish and lobsters only per boat per month from 1951 - 1969 have been plotted. The graph suggests that the period from 1955 to 1959 was one of high stock abundance followed by a sharp fall in yield during the early 1960's. The continued descent of the yield since 1966 is alarming, especially as the 1969 season was one of the longest (5.8 months) over the whole period.

All the information so far suggests that with a few exceptions, the areas of coast fished remain unchanged from one year to the next. The majority of fishermen seem to be content to trap only those areas of coastal water where from past experience, lobsters are known to be present. In a small number of areas, fishermen explore new fishing grounds continually and are able to rotate their fishing grounds annually. It may be significant that in these areas, the catch per boat per season is well above the national average.

The fishing effort data are coarse, due to lack of precise catch data. It is only during the last three years that it has been possible to make an annual trap census, and to collect as supplementary information, details of catch per 100 trap hauls from a relatively small, though growing, number of boats. The deposition of catch plotted against catch per effort given in Figure 2, is therefore, based only

on the crude data associated with annual number of boats times length of season in months, and the total catch. Thus the points shcwn in Figure 2 are scattered. However, one or two worthwhile observations may be postulated from the data. For example, a number of the points show a tendency to lie along the classical shape of a catch per effort distribution. But, many lie well outside that curve and even if their position has been grossly exaggerated by the crudity of the basic data, nevertheless the high yield per effort of 1955 must be compared with the low yield per effort of 1969. In both these years, the total catch was about the same for lobsters, yet the catch per effort in 1955 was vastly greater than in 1969. The data in Figure 2 seen to strengthen the view that ammassing length data from the catch will not, by itself, provide a good picture of mortality occurring in the fished areas. Furthermore, Figure 2 suggests that in traditional areas of fishing in Irish waters, the yield per effort has been dropping rapidly in recent years. How much of this has been due to overfishing or to the absence of strong recruit year classes is unknown, but the problems pose the most important questions for the management of lobster, and possibly, crawfish stocks as well.

Prior to 1940, the annual yield from the Irish lobsters fishery remained at or above 1.25 million lbs per annum from 1895 to 1939. However, during this period, the fishery was entirely one for lobsters alone, and therefore only lobster fishing gear was in use. A greater number of traps were fished and therefore a larger area of sea-bed was searched. Thus it would appear that the only means by which a yield of this kind could be revived would be by extending considerably the area fished at present.

Size Distribution of the Catch

Since 1957, lobsters have been examined for length distribution (except in 1961). The percentage frequency occurrence of male and female lobsters in the catch, for all coastal waters, in one cn carapace length groups have been used for the calculation of total nortality (Gibson 1967).

The data here have been plotted, for nales only, as percentage frequency $\log_e$ distribution, in Figure 3. The 10 mm carapace length frequency group have not been converted to age groups. After Beverton and Holt, total nortality was estimated from the formula:-

$$Z = \frac{K\,(L^{\infty} - \bar{l})}{\bar{l} - l_c}$$

where, $\bar{l}$ is the mean length and $l_c$ is the length at which lobsters appear to be fully exposed to capture ($L^{\infty} = 174.3$ and $K = 0.121$, Gibson, 1967).

Estimates of nortality amongst nale lobsters from 1957 to 1969 are as follows:-

| Year | Total nortality estimate (%) |
|---|---|
| 1957 | 73.3 |
| 1958 | 67.4 |
| 1959 | 61.0 |
| 1960 | 73.5 |
| 1962 | 68.7 |
| 1963 | 55.8 |
| 1964 | 61.1 |
| 1965 | 62.8 |
| 1966 | 61.0 |
| 1967 | 73.6 |
| 1968 | 55.5 |
| 1969 | 65.8 |

The independent and unmeasured variables exerting influence upon calculations of total mortality in the larger decapods are many. They include fishing limitations imposed on catch by the relative conservatism of fishermen some of whom tend to fish repeatedly in the same area; the absence of marked migrations by lobsters; the limitations imposed on fishing by the weather; and the unknown role played by recruitment.

## Conclusions

The purpose of this paper is to stimulate interest in the study of methods for the management of decapod fisheries. Information of great value is available from many research centres and a pooling of this data would lead to a better understanding of the problems resulting in means of cropping these valuable crustaceans to their fullest.

## References

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FIGURE 1. MEAN CATCH, BY NUMBERS, OF LOBSTERS AND LOBSTERS/CRAWFISH PER BOAT PER MONTH FROM 1951 TO 1969. (THE FIGURES IN THE GRAPH REPRESENT THE TOTAL CATCH OF LOBSTERS AND CRAWFISH IN THOUSANDS. THE UNDERLINED FIGURES ARE THE LENGTH OF THE LOBSTER FISHING SEASON IN MONTHS).

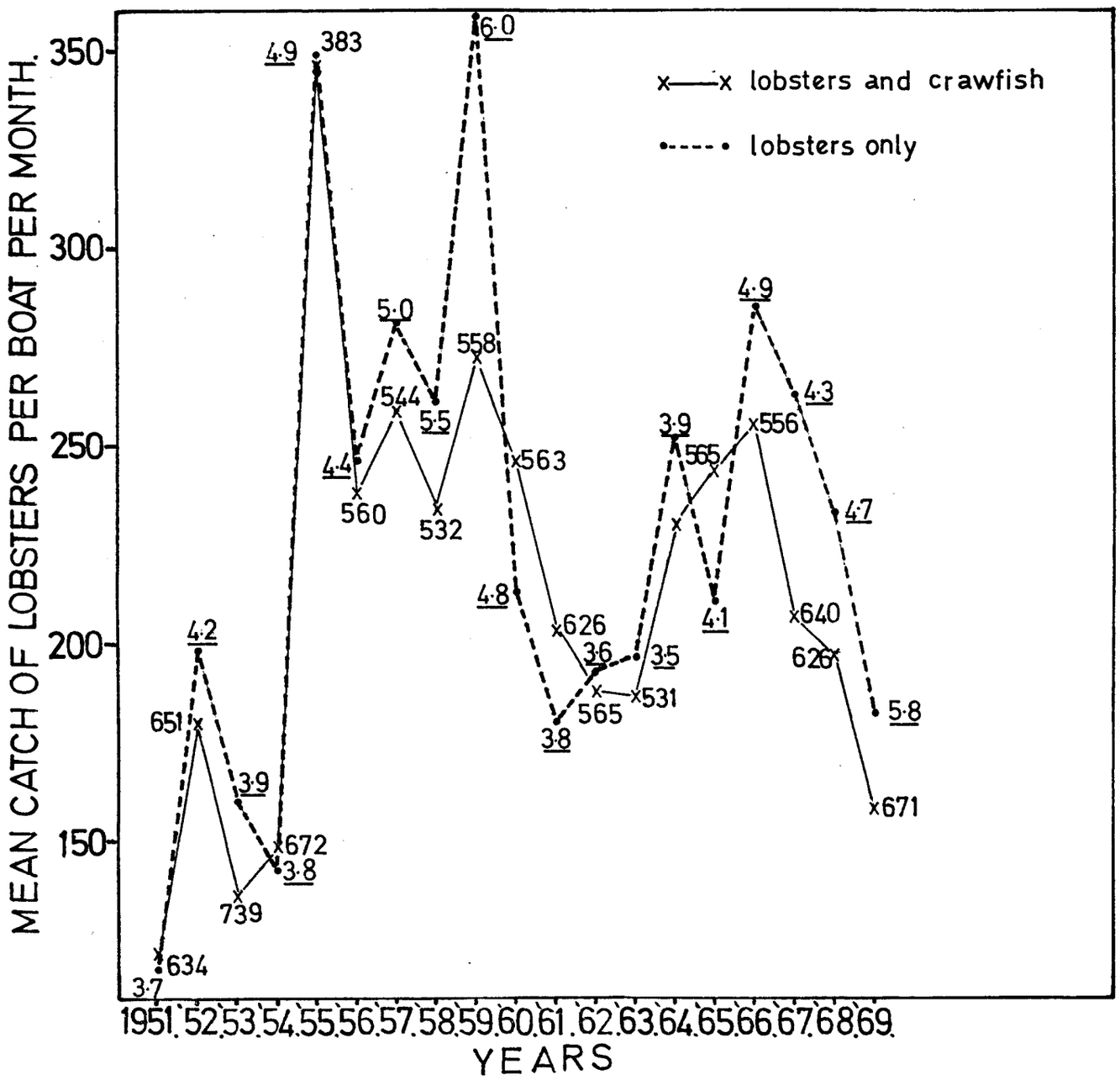


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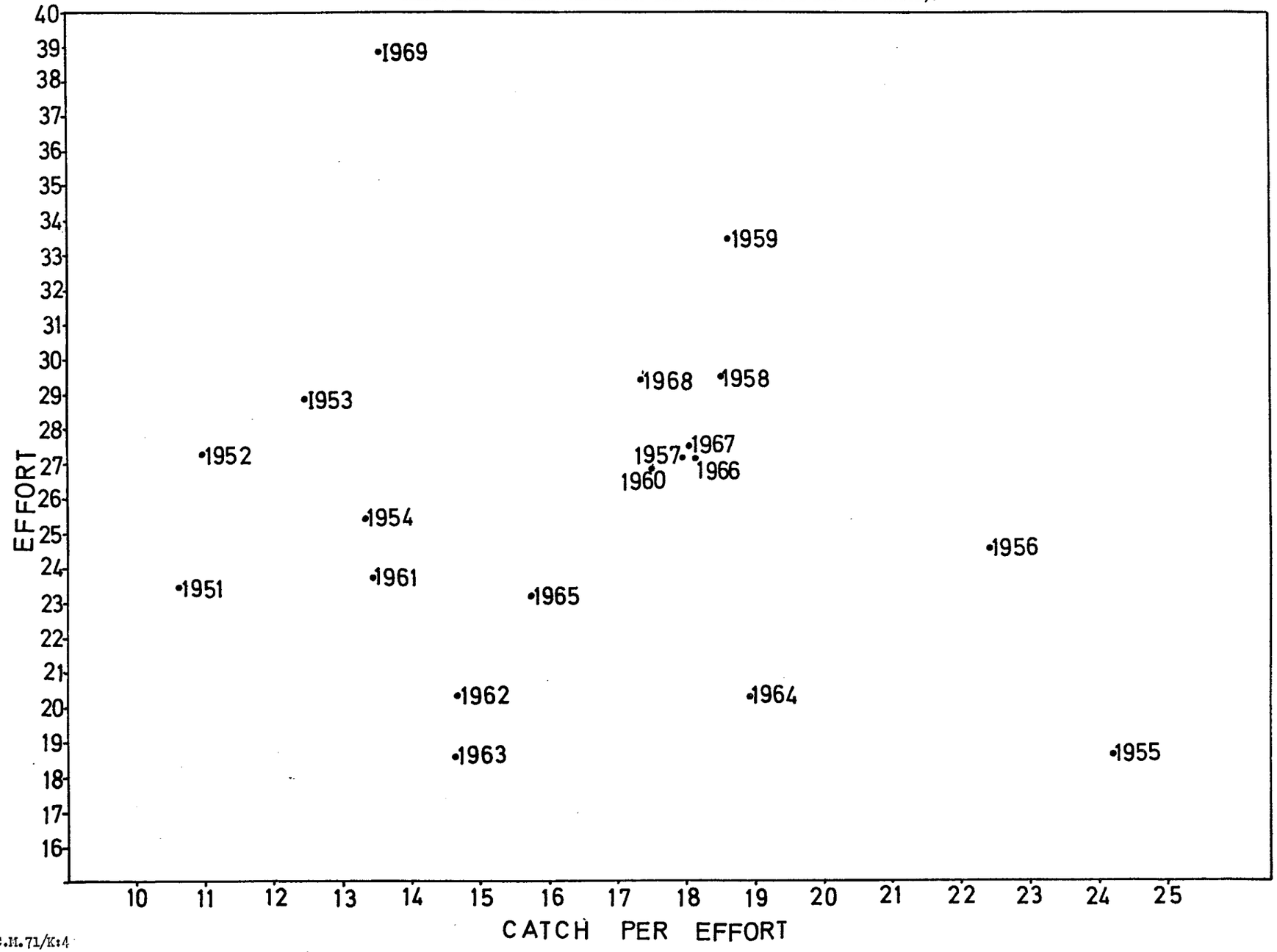
FIGURE 2. THE CATCH PER EFFORT PLOTTED AGAINST TOTAL EFFORT IN THE LOBSTER FISHERIES FROM 1951 TO 1969. (EFFORT BEING THE NUMBER OF BOATS X BY THE LENGTH OF SEASON AND THE CATCH PER EFFORT BEING THE CATCH PER BOAT PER MONTH).

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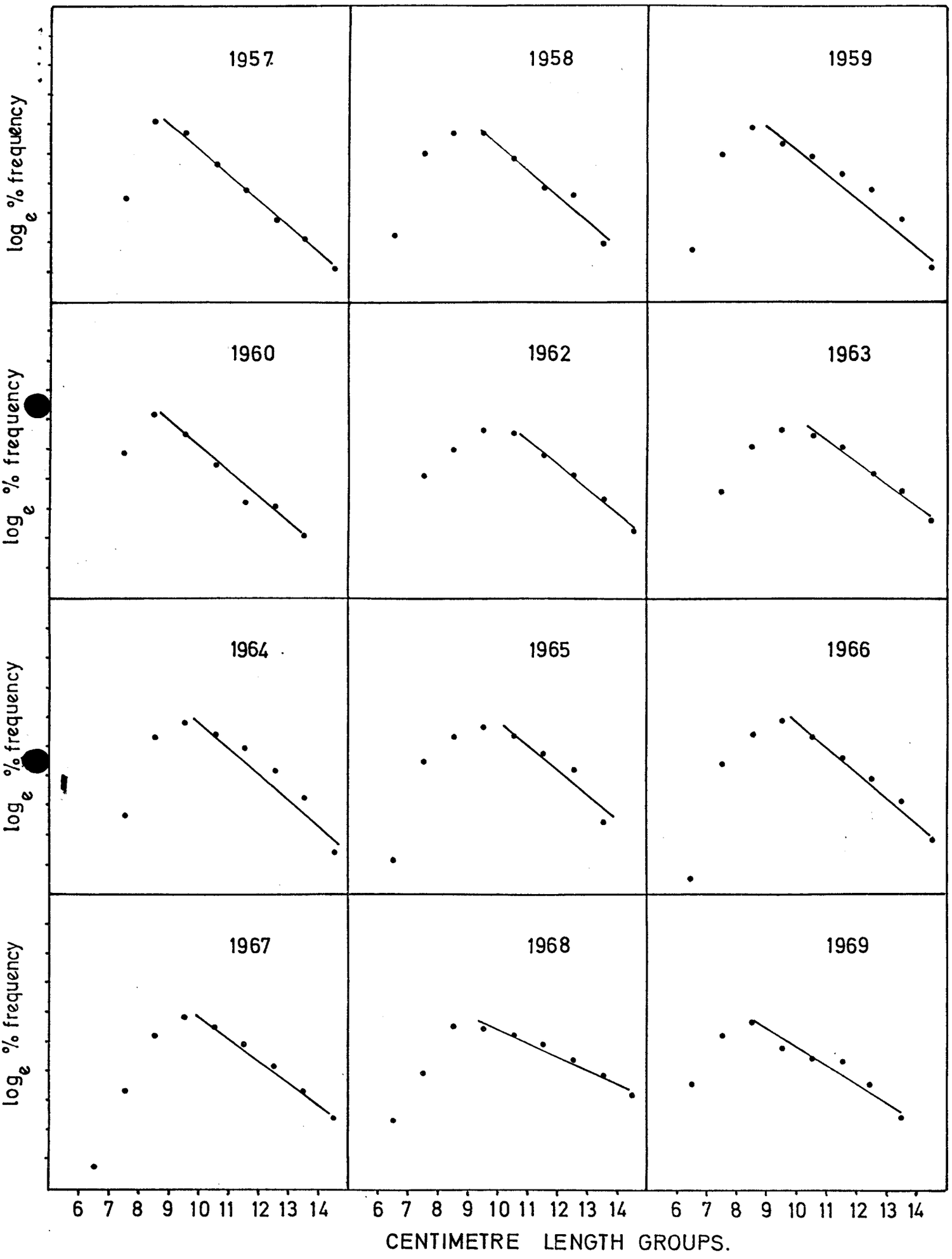


FIGURE 3. THE $\log_e$ % FREQUENCY LENGTH.FREQUENCY DISTRIBUTION OF LOBSTERS MEASURED FROM COMMERCIAL SAMPLES FROM 1957 TO 1969 (EXCLUDING 1961 WHEN NO DATA WERE COLLECTED).