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# On the recruitment to the Downs herring



by

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The state of the Downs herring stock has deteroriated over time, the total catch in the southern North Sea dropped from 224.000 tons in 1948 to 12.000 tons in 1966. The decline has been of such order that recruitment to this stock could be affected by the recent low abundance of the parent stock. Recruitment to the Downs stock has been estimated by Cushing and Burd by analysing the stock data of the East Anglian herring, sampled by the driftnet fishery in the southern North Sea.

Cushing (1966) corrected the recruitment data in the postwar years for the increase in efficiency, dealing thus with possible over-estimates of recruitment.

Burd (1966), in order to minimize availability effects on recruitment estimates, used estimates of Z in his calculations based on catchcurves for each yearclass, as Garrod did for the Barends Sea Cod.

Both series of data show a decline of recruitment, which could be related to the decline of the parent stock. This decline in recruitment however is not apparent when the increase in efficiency or availability effects are not taken in account (table 1).

Table 1. Recruitment to the East Anglian herring (x $10^3$).

| Yearclass | R.3 (uncorrected) | R.3 (eff.corr.) | R.3 (avail.corr). |
|---|---|---|---|
| 1943 | 10.0 | 10.0 | 18.2 |
| 1944 | 13.0 | 9.1 | 27.1 |
| 1945 | 20.4 | 18.0 | 40.9 |
| 1946 | 17.4 | 13.0 | 44.3 |
| 1947 | 10.0 | 8.0 | 22.6 |
| 1948 | 8.0 | 5.5 | 25.5 |
| 1949 | 12.6 | 9.8 | 26.8 |
| 1950 | 11.0 | 10.8 | 31.5 |
| 1951 | 13.0 | 9.4 | 21.8 |
| 1952 | 8.0 | 4.0 | 10.9 |
| 1953 | 20.0 | 11.0 | 32.1 |
| 1954 | 13.8 | 7.0 | 24.3 |
| 1955 | 8.0 | 2.5 | 9.5 |
| 1956 | 17.0 | 6.0 | 18.0 |
| 1957 | 10.0 | 3.0 | 8.0 |
| 1958 | 27.0 | 11.0 | 36.6 |

Another source by which the recruitment to the Downs stock could be estimated was the Dutch trawlfishery in the southern North Sea and the English Channel. In these fisheries a marked shortening of the season coincided with the decline of the total catch of the Downs herring (table 2). In the period 1955 - 1957 the season lasted for 7 to 6 weeks, whereas in 1963 - 1965 duration of the season decreased to 4 to 2 weeks.

- Table 2 -

Table 2. The Dutch trawlfishery in the southern North Sea.

| Year | weeks | weeknumber | data | Catch a | Catch b | totalcatch |
|---|---|---|---|---|---|---|
| 1955 | 6 | 47/52 | 13/11-31/12 | 4.347 kg | 5.546 kg | 168.000 tons |
| 1956 | 7 | 47/53 | 11/11-29/12 | 3.969 " | 3.291 " | 134.000 " |
| 1957 | 7 | 46/52 | 10/11-28/12 | 3.084 " | 3.093 " | 125.000 " |
| 1958 | 3 | 47/49 | 16/11- 6/12 | 1.706 " | 3.410 " | 93.000 " |
| 1959 | 4 | 48/51 | 22/11-21/12 | 3.909 " | 5.864 " | 77.000 " |
| 1960 | 4 | 47/50 | 21/11-18/12 | 2.523 " | 3.783 " | 78.000 " |
| 1961 | 4 | 47/50 | 20/11-16/12 | 4.521 " | 6.782 " | 101.000 " |
| 1962 | 6 | 47/52 | 18/11-29/12 | 1.645 " | 2.468 " | 60.000 " |
| 1963 | 3 | 47/49 | 18/11- 7/12 | 2.203 " | 4.403 " | 51.000 " |
| 1964 | 4 | 46/49 | 9/11- 5/12 | 1.760 " | 3.668 " | 55.000 " |
| 1965 | 2 | 48/49 | 22/11-44/12 | 850 " | 2.550 " | 26.000 " |
| 1966 | - | --- | ------ | --- | --- | 12.000 " |

Catch a: catch per day of a standard trawler of 500 bhp in a standard number (6) of weeks (weeknumber 47 - 52), weeks with no catch included.
Catch b: catch per day of a standard trawler during the real duration of the season.
Total catch: total catch of the Downs stock by all fisheries in the southern North Sea and the English Channel.

The shortening of the fishing season is an exponent of the decrease of the total abundance of the Downs stock. When variations in the duration in the fishing season are not accounted for, these are apt to result in biases and variances in the estimated of abundance and hence recruitment estimates, as is discussed by Zijlstra and Boerema (1964). In order to account for the decrease of abundance, shown by a shortening of the season, they advocated to use in a time series a standard number of weeks in a fixed period of the year. This means that even in weeks with no catch in this period these weeks and the zero catch have to be included in the calculations. It was realised that in this case the abundance, estimated in a standard period, tends to be underestimated, as well as the abundance estimated with the real duration of the fishing season tends to be overestimated.

In table 2 the differences in the catch per effort, as estimated by the two methods discussed, are shown under a. and b.. The catch per effort in a standard period is in all except one case always lower as the catch per effort in the real fishing period. The reduction of the stock shown by the abundance measured in a standard period (a.) is more serious as when measured in the real season (b.).

This is more apparent when the period 1955 - 1967 is split in two parts, as is done below.

| Period | abundance (a) | reduction | abundance (b) | reduction |
|---|---|---|---|---|
| 1955/59 | 3.403 kg. | --- | 4.240 kg. | --- |
| 1960/65 | 2.250 kg. | 34% | 3.942 kg. | 7% |

With the abundance estimates, measured as the catch per day of a standard trawler of 500 B.H.P. in a fixed period of six weeks on the Sandettie and Channel spawning grounds, a stock analysis in numbers per yearclass has been made. On hand of these data the total instanteneous mortality (Z) for the different yearclasses has been estimated in the seasons 1955/56 until 1964/65. (Table 3).

Table 3. Total instanteneous mortality Downs herring 1955 - 1965.

| Season | >3/>4 | >2/>3 |
|---|---|---|
| 1955/56 | 0.96 | 0.92 |
| 1956/57 | 1.21 | 0.78 |
| 1957/58 | 1.53 | 1.33 |
| 1958/59 | 0.66 | 0.62 |
| 1959/60 | 1.59 | 1.57 |
| 1960/61 | 0.75 | 0.61 |
| 1961/62 | 1.74 | 1.54 |
| 1962/63 | 1.86 | 1.95 |
| 1963/64 | 1.48 | 1.07 |
| 1964/65 | 1.13 | 0.98 |

- With the stock -

With the stock analysis data and the mortality rates in the different seasons the recruitment strength of the yearclasses 1951-1962 of the Downs-herring is calculated as at three and four years of age, using respectively the estimates of the three, four, five and six years age groups only (table 4).

Table 4. Recruitment Downs herring (000's).

| Yearclass | R.3 | R.4 |
|---|---|---|
| 1951 | --- | 7.3 |
| 1952 | 6.9 | 3.6 |
| 1953 | 11.9 | 5.6 |
| 1954 | 15.3 | 4.3 |
| 1955 | 4.8 | 2.8 |
| 1956 | 29.4 | 6.3 |
| 1957 | 9.6 | 5.4 |
| 1958 | 27.8 | 5.3 |
| 1959 | 1.0 | 0.2 |
| 1960 | 12.6 | (4.6) |
| 1961 | (5.3) | (2.0) |
| 1962 | (1.7) | --- |

These recruitment data do show, especially after yearclass 1958, a decrease in recruitment; split in two periods this decrease will be the more apparent, as is shown below.

| Yearclass | R.3 | red. | yearclass | R.4 | red. |
|---|---|---|---|---|---|
| 1952/56 | 13.7 | | 1951/56 | 5.0 | |
| 1957/62 | 9.7 | 25% | 1957/61 | 3.5 | 30% |

The rate of reduction in both series, R.3 and R.4, is as has to be expected not very different. However the individual data of the different yearclasses do differ in some cases significantly, for example yearclass 1956 and year-class 1958. Both yearclasses are strong when estimated as at three years of age, but moderate when calculated as at four years of age.

Comparing the trawl-derived recruitment data with the driftnet derived recruitment data (Burd 1966) of the Downs herring the reduction in recruitment appears to be more serious in the trawldata.

| Yearclass | R.3 trawl | red. | R.3 driftnet | red. |
|---|---|---|---|---|
| 1952/56 | 13.7 | | 18.9 | |
| 1957/62 | 9.2 | 25% | 16.4 | 13% |

This discrepancy will partly be due to the difference in the recruitment figures of the 1956 yearclass. A comparison with the driftnet data corrected for efficiency (Cushing 1966) will be difficult as they do cover only a small common period, however large differences exist in the estimates of the re-cruitment figures for the yearclasses 1956 and 1958.

In general it can be suggested that the decrease of the total catch of the Downs herring stock in the southern North Sea and the English Channel has been followed as well by a reduction of the recruitment to this stock as by an increase of the total mortality.

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