INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 1383 Document No. 87

ANNUAL MEETING - JUNE 1964

# Relationship of Length Distribution of Redfish to Depth of Catch

by R. C. Hennemuth and B. E. Brown
Bureau of Commercial Fisheries, Biological Laboratory, Woods Hole, Massachusetts

Difficulties in interpretation of observed changes in length composition of redfish may arise because of an association of length with depth. Thus the average length in landings may depend on the distribution of catches relative to depth.

Length-frequency samples from landings of redfish by U.S. otter trawlers in 1962 and 1963 were analyzed to provide some measure of the importance of the depth variable. The samples were aggregated by sex, year, division, and 50-fathom depth zones*. There were not sufficient samples to analyze on a seasonal basis, however, there was not any differential distribution of samples among seasons and depth to confound the analysis. Depth zones will be referred to by their numerical designation: 1 = 30-60 f., 2= 61-100 f., 3= 101-150 f., 4 = 151-200 f. Depths greater than 200 fathoms were not fished.

The 25th, 50th, and 75th centile lengths were computed, and the differences, d, of each of these values between adjacent depths were used as the basic variables for comparative purposes. These data are presented in Table 1.

Inspection of Table 1 shows that within each year and division the length distributions for males were smaller than those for females. The greatest spread occurred at the 75th centile. The differences between depth zones were also less for males than for females.

There is some indication from these data that the samples taken in 1963 contained larger fish than those for 1962, and the differences between the depth zones were often greater in 1963.

The depth-differences are somewhat larger for the southern divisions, particularly 5Y and 4X, but there are several exceptions to this pattern.

For purposes of exposition, the trends noted above were ignored. The overall average between-depth differences were computed for each of the three centiles, and judged significant using a one-tailed t-test at the 5% probability level (Table 2), i.e., with the alternative hypothesis that the differences were greater than zero.

---

* The first two depth zones actually range from 0-60 and 61-100 fathoms respectively. Furthermore, all of the landings from the first depth zone, from which samples were taken, were caught in the 31-60 fathom depth range.

The mean differences between depth zones 1 and 2, $d_{2-1}$, for the 50th and 75th centiles were 3.8 and 4.8 cm., and were both significant. The mean differences between depth zones 2 and 3, $d_{3-2}$, which were all about 3 cm., were significant for all three measures. The mean differences between depth zones 3 and 4 were not significant.

The cumulative average differences (in cm.) between depth zones are as follows:

| Centile | Depth zone | | |
|---|---|---|---|
| | 2-1 | 3-1 | 4-1 |
| 25th | 2.2 | 5.1 | 5.9 |
| 50th | 3.8 | 6.9 | 7.5 |
| 75th | 4.8 | 7.5 | 7.8 |

The increases both with regard to centile and depth indicate not only an increasing average size with depth, but an increasing skewness to the right in the length-frequencies. However, the selectivity of the nets used, about 50-60 mm. mesh size, has some dampening effect on the differences for the lower centile lengths.

At any rate, there is a definite trend towards proportionately more of the larger fish in the catch with increasing depth, at least up to 150 fathoms. The implications of these conclusions regarding the study of dynamics of redfish populations are serious enough to warrant some further study of this problem with more comprehensive data.

Table 2. -- Average differences between depths, d, and tests of significance.

| | 25th centile | | | Median | | | 75th centile | | |
|---|---|---|---|---|---|---|---|---|---|
| | $d_{2-1}$ | $d_{3-2}$ | $d_{4-3}$ | $d_{2-1}$ | $d_{3-2}$ | $d_{4-3}$ | $d_{2-1}$ | $d_{3-2}$ | $d_{4-3}$ |
| $\Sigma d$ | 9 | 47 | 6 | 15 | 49 | 5 | 19 | 43 | 2 |
| n | 4 | 16 | 8 | 4 | 16 | 8 | 4 | 16 | 8 |
| $\bar{d}$ | 2.2 | 2 9 | 0.8 | 3 8 | 3.1 | 0.6 | 4.8 | 2.7 | 0.25 |
| $S_{\bar{d}}$ | 1.31 | 0.41 | 0.66 | 1.37 | 0.56 | 0.46 | 1.37 | 0.61 | 0.38 |
| t | 1 68 | 7.07* | 1.21 | 2.77* | 5.54* | 1.30 | 3.50* | 4.43* | 0.66 |

Table 1.--Estimated centile lengths of redfish and differences between depth zones.

| Sex | Year | Div. | 25th centile Depth Zone 1 | 2 | 3 | 4 | differences (d) 2-1 | 3-2 | 4-3 | median 1 | 2 | 3 | 4 | differences (d) 2-1 | 3-2 | 4-3 | 75th centile Depth Zone 1 | 2 | 3 | 4 | differences (d) 2-1 | 3-2 | 4-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male | 1962 | 3N | --- | --- | 23 | 23 | --- | --- | 0 | --- | --- | 25 | 24 | --- | --- | -1 | --- | --- | 26 | 26 | --- | --- | 0 |
| | | 3O | --- | --- | 23 | 23 | --- | --- | 0 | --- | --- | 24 | 24 | --- | --- | 0 | --- | --- | 26 | 26 | --- | --- | 0 |
| | | 4V | --- | 22 | 23 | --- | --- | 1 | --- | --- | 24 | 26 | --- | --- | 2 | --- | --- | 26 | 27 | --- | --- | 1 | --- |
| | | 4W | --- | 21 | 22 | --- | --- | 1 | --- | --- | 22 | 24 | --- | --- | 2 | --- | --- | 24 | 25 | --- | --- | 1 | --- |
| | | 4X | --- | 21 | 23 | --- | --- | 2 | --- | --- | 23 | 27 | --- | --- | 4 | 0 | --- | 25 | 30 | --- | --- | 5 | --- |
| | | 5Y | 17 | 21 | 23 | --- | 4 | 2 | --- | 19 | 24 | 24 | --- | 5 | 0 | --- | 21 | 27 | 26 | --- | 6 | -1 | --- |
| | Sum | | 17 | 85 | 137 | 46 | 4 | 6 | 0 | 19 | 93 | 150 | 48 | 5 | 8 | -1 | 21 | 101 | 160 | 52 | 6 | 8 | 0 |
| | N | | 1 | 4 | 6 | 2 | 1 | 4 | 2 | 1 | 4 | 6 | 2 | 1 | 4 | 2 | 1 | 4 | 6 | 2 | 1 | 4 | 2 |
| | mean | | 17.0 | 21.2 | 22.8 | 23.0 | 4.0 | 1.5 | 0 | 19.0 | 23.2 | 25.0 | 24.0 | 5.0 | 2.0 | -0.5 | 21.0 | 25.2 | 26.7 | 26.0 | 6.0 | 1.5 | 0 |
| Female | 1962 | 3N | --- | --- | 24 | 26 | --- | --- | 2 | --- | --- | 27 | 28 | --- | --- | 1 | --- | --- | 30 | 31 | --- | --- | 1 |
| | | 3O | --- | --- | 24 | 24 | --- | --- | 0 | --- | --- | 25 | 26 | --- | --- | 1 | --- | --- | 27 | 29 | --- | --- | 2 |
| | | 4V | --- | 23 | 26 | --- | --- | 3 | --- | --- | 26 | 29 | --- | --- | 3 | --- | --- | 29 | 31 | --- | --- | 2 | --- |
| | | 4W | --- | 22 | 24 | --- | --- | 2 | --- | --- | 25 | 26 | --- | --- | 1 | --- | --- | 27 | 29 | --- | --- | 2 | --- |
| | | 4X | --- | 23 | 26 | --- | --- | 3 | --- | --- | 25 | 32 | --- | --- | 7 | --- | --- | 28 | 35 | --- | --- | 7 | --- |
| | | 5Y | 18 | 23 | 28 | --- | 5 | 2 | --- | 20 | 27 | 28 | --- | 7 | 1 | --- | 24 | 32 | 31 | --- | 8 | -1 | --- |
| | Sum | | 18 | 91 | 149 | 50 | 5 | 10 | 2 | 20 | 103 | 167 | 54 | 7 | 12 | 2 | 24 | 116 | 185 | 60 | 8 | 10 | 3 |
| | N | | 1 | 4 | 6 | 2 | 1 | 4 | 2 | 1 | 4 | 6 | 2 | 1 | 4 | 2 | 1 | 4 | 6 | 2 | 1 | 4 | 2 |
| | mean | | 18.0 | 22.8 | 24.8 | 25.0 | 5.0 | 2.5 | 1.0 | 20.0 | 25.8 | 27.8 | 27.0 | 7.0 | 3.0 | 1.0 | 24.0 | 29.0 | 30.8 | 30.0 | 8.0 | 2.5 | 1.5 |
| Male | 1963 | 3N | --- | --- | 24 | 24 | --- | --- | 0 | --- | --- | 25 | 26 | --- | --- | 1 | --- | --- | 27 | 27 | --- | --- | 0 |
| | | 4V | --- | 23 | 24 | 27 | --- | 1 | 3 | --- | 25 | 27 | 28 | --- | 2 | 1 | --- | 27 | 30 | 30 | --- | 3 | 0 |
| | | 4W | --- | 20 | 24 | --- | --- | 4 | --- | --- | 22 | 26 | --- | --- | 4 | --- | --- | 26 | 28 | --- | --- | 4 | --- |
| | | 4X | --- | 20 | 25 | --- | --- | 5 | --- | --- | 22 | 27 | --- | --- | 5 | --- | --- | 24 | 29 | --- | --- | 5 | --- |
| | | 5Y | 22 | 22 | 24 | --- | 0 | 2 | --- | 23 | 25 | 28 | --- | 2 | 1 | --- | 25 | 28 | 28 | --- | 3 | 0 | --- |
| | Sum | | 22 | 85 | 121 | 51 | 0 | 12 | 3 | 23 | 96 | 131 | 54 | 2 | 12 | 2 | 25 | 103 | 142 | 57 | 3 | 12 | 0 |
| | N | | 1 | 4 | 5 | 2 | 1 | 4 | 2 | 1 | 4 | 5 | 2 | 1 | 4 | 2 | 1 | 4 | 5 | 2 | 1 | 4 | 2 |
| | mean | | 22.0 | 21.2 | 24.2 | 25.5 | 0 | 3.0 | 1.5 | 23.0 | 23.5 | 26.2 | 27.0 | 2.0 | 3.0 | 1.0 | 25.0 | 25.8 | 28.4 | 28.5 | 3.0 | 3.0 | 0 |
| Female | 1963 | 3N | --- | --- | 26 | 24 | --- | --- | -2 | --- | --- | 28 | 27 | --- | --- | -1 | --- | --- | 32 | 30 | --- | --- | -2 |
| | | 4V | --- | 25 | 28 | 31 | --- | 3 | 3 | --- | 29 | 30 | 33 | --- | 1 | 3 | --- | 32 | 34 | 35 | --- | 2 | 1 |
| | | 4W | --- | 22 | 27 | --- | --- | 5 | --- | --- | 24 | 30 | --- | --- | 6 | --- | --- | 27 | 33 | --- | --- | 6 | --- |
| | | 4X | --- | 21 | 28 | --- | --- | 7 | --- | --- | 24 | 31 | --- | --- | 7 | --- | --- | 28 | 33 | --- | --- | 5 | --- |
| | | 5Y | 23 | 23 | 27 | --- | 0 | 4 | --- | 26 | 27 | 30 | --- | 1 | 3 | --- | 29 | 31 | 33 | --- | 2 | 2 | --- |
| | Sum | | 23 | 91 | 136 | 55 | 0 | 19 | 1 | 26 | 104 | 149 | 60 | 1 | 17 | 2 | 29 | 118 | 165 | 65 | 2 | 15 | -1 |
| | N | | 1 | 4 | 5 | 2 | 1 | 4 | 2 | 1 | 4 | 5 | 2 | 1 | 4 | 2 | 1 | 4 | 5 | 2 | 1 | 4 | 2 |
| | mean | | 23.0 | 22.8 | 27.2 | 27.5 | 0 | 4.8 | 0.5 | 26.0 | 26.0 | 29.8 | 30.0 | 1.0 | 4.2 | 1.0 | 29.0 | 29.5 | 33.0 | 32.5 | 2.0 | 3.8 | -0.5 |