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# The Age Composition of Spawning Population, the Rate of Sexual Maturity and Growth of Herring of the 1969 Year Class in the Norwegian Sea



by

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## Abstract

Significant change in the age structure of the spawning stock of the Atlantic-Scandinavian herring, due to specimens, that recruited to the 1969 year class, is registered. The growth rate, sexual maturity of the 1969 year class specimens are analysed; features, confirming that the 1969 year class was poor, but exceeds the 1 962, 1965–1968 and 1970 year classes by the abundance are revealed.

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Spawning population of the Atlantic-Scandinavian herring up to 1971 consisted of specimens of the numerous 1959–1961 year classes. Very poor 1965–1968 and 1970 year classes(Yudanov, 1966; Anon, 1967, 1969, 1969a, 1970) didn't significantly influence on the age structure of the spawning population. The 1969 year class is also poor (Seliverstov, Penin, 1972; Anon, 1969a), but exceeds some times the earlier poor classes by the abundance. The first time spawners of the 1969 year class appeared on the spawning grounds in 1972 (19.8%). In 1973 herring of this year class made up 77.7%, in 1974–96.8% in the spawning stock (Table 1).

The living conditions of herring at the different stages of life cycle define the southern and northern types of scale, certain ratio of the coastal, oceanic and spawning rings (formula of scale) and the types of growth(Shutova-Korzh, 1960; Lea, 1929; Ottestad, 1934; Kunnström, 1936, Seliverstova, 1968, 1970, 1972).

Herring with the northern type of scale of the numerous 1959–1961 year classes were mainly met with on the spawning grounds in 1969–1971. Number of herring with the southern type of scale didn't exceed 12.2% during these years. Number of specimens with the southern type of scale increased up to 44.9% with the begining of sexual maturation of the 1969 year class ( Table 2).

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The ratio of herring with different number of coastal rings has significantly changed on the spawning grounds. Up to 1972 the specimens with the three and four coastal rings on scale prevailed in the spawning population (herring, grown up in the coastal waters of the Northern Norway and in the Barents Sea), while in 1972-1973 specimens with the 2 coastal rings on scale predominated (from the southern and central coastal waters of Norway). In 1974 the spawning population was recruited with herring with the 3 coastal rings (Table 3).

Nearly equal ratio of specimens with the southern and northern types of scale at the age of 3 and 4 years is characteristic of the 1969 year class. A sharp increase in the number of specimens of the 1969 year class with the northern type of scale takes place at the age of 5 years. Prevalence of herring with the northern type of scale for numerous year classes is already observed at the age of 4 years (Table 4).

The significant portion of specimens with the southern type of scale in the 1969 year class led to the fact, that in 1972 and 1973 spawning of the first time spawners and repeated-spawned herring took place further south (62°N) than in 1969 (64°N). Herring spawned on the Langgrunn and Buagrunnen Banks in 1972; in 1973 the main spawning, according to data obtained by R/V "F.Nansen", was registered on the Svinøy Bank. Small concentrations of herring were registered on the Frøya Bank, that is situated northward. In 1974 the spawning occurred on the banks of the Lofoten Shallows, when herring with the northern type of scale and 3 coastal rings entered the spawning stock.

An important moment in the life cycle of the Atlantic-Scandinavian herring is the recruitment with the first time spawners to the spawning stock. Average age of the first time spawners with the southern type of scale of separate year classes didn't nearly change (4.4 years); and that of herring with the northern type of scale varies from 5.1 up to 7.4 years (Østvedt, 1958). In the 1969 year class average age of the first time spawners with the southern type of scale was the same as that of specimens of the poor year classes, originated in the fifties-sixties (Seliverstova, 1973), making up 3.8 years. For specimens with the northern type of scale of the 1969 year class the average age further reduced when comparing with

the earlier year classes (Table 5).

Rate of maturity of year classes,different by the abundance is not the same (Seliverstova,1973). Herring of the numerous year classes have more delayed rate of sexual maturity than those of poor year classes. Specimens of the 1950,1951 year classes (numerous) attained maturity at the age of 7 years,those of the 1959, 1960 year classes-at the age of 6 years. Herring of the poor and moderate year classes (by the abundance) became mature at the age of 5 years (Seliyerstova,1973). Herring of the 1969 year class practically attained maturity at the age of 5 years by the spring of 1974 (Table 6). In October-December 1973 only mature herring with gonads at the III-IV,IV stages of maturity were met with in the wintering areas in the north-eastern Norwegian Sea,where immature specimens were usualy met with too. In November 1974 a few specimens of herring were caught in the eastern wintering area,the first spawning of which would have occurred in the spring of 1975. Only single specimens of herring were found in the catches taken by research vessels,even in the spring of 1973 in the Barents Sea.

Six types of growth are noted for the Atlantic-Scandinavian herring:A,B,C,B-C, D,C-D (Shutova-Korzh,1960;Lea,1929;Ottestad, 1934;Seliverstova 1968,1970,1972).

Herring of the 1969 year class have type of growth A. This type as well as type of growth B,are characteristic of the year classes of poor and moderate abundance and they are indirectly indicative of the areas of young fish distribution. Specimens with the type of growth D and C-D (Table 7),young fish of which are brought to the north-eastern Norwegian Sea and Barents Sea in great quantities make up a significant portion in the numerous year classes.

Herring of the 1969 year class have the same formula of scale as those of the 1950,1959,1963,1964 year classes (Seliverstova,1968,1970,1972). The difference is that a significant amount of herring with one coastal ring on the scale,that attained maturity at the age of 3 (SI+I, NI+I) and 4 years (SI+2,NI+2) were found on the spawning grounds,that is also indicative of the southern distribution of young fish of the 1969 year class.

The first time spawners of the 1969 year class(at the age of

3 years)originated in 1972 in the southern Norwegian Shallows. In 1973 they spawned in the same area again,that is proved by the comparison between rates of grоth of these specimens. It could not be herring,that spent winter in 1971 in the area 3c,as in October 1971 they had the stage of maturity II and lower rate of growth. In 1974 herring,that spent winter in the north-eastern Norwegian Sea,spawned in the Lofoten Shallows (Table 8).

Unusually high rate of growth during all periods of life is characteristic of herring of the 1969 year class,comparing with the 1950 and 1959 year classes. However herring with the southern type of scale have less variations in their length in different year classes,than those with the northern type of scale (Table 9).

Conclusions:

1. At present reproduction of the stock of the Atlantic-Scandinavian herring takes place only at the cost of specimens of the 1969 year class.
2. Prevalence of herring with the southern type of scale at the age of 3-4 years,type of growth A,significant portion of specimens with one-two coastal rings on the scale,high rate of growth,early sexual maturity-these are features,peculiar to poor year classes. They confirm the assessment of the 1969 year class as a poor one.
3. An increase in the number of herring with the formula of scale N3+I,that matured at the age of five years,that is usually typical for strong year classes,is indicative of increased abundance of the 1969 year class,relative to very poor 1962,1965-1968 and 1970 year classes.

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Table 1

Age composition of the spawning-population of the Atlantic-Scandinavian herring on the spawning grounds in the Norwegian Sea.

| Age | Year | | | | | |
|---|---|---|---|---|---|---|
| | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
| 3 | 0,1 | 0,2 | - | 19,8 | 5,3 | - |
| 4 | 0,5 | 4,3 | 0,5 | 19,8 | 77,7 | 0,5 |
| 5 | 5,0 | 3,6 | 2,4 | 22,2 | 10,9 | 96,8 |
| 6 | 4,0 | 15,9 | 2,9 | 11,6 | 1,5 | 1,6 |
| 7 | 3,2 | 3,8 | 4,3 | 5,8 | 1,9 | 0,8 |
| 8 | 16,6 | 4,2 | 9,0 | 4,6 | 0,4 | - |
| 9 | 32,6 | 13,9 | 14,6 | 2,3 | 0,4 | - |
| 10 | 33,9 | 29,8 | 26,5 | 7,0 | - | - |
| 11 | 1,0 | 21,7 | 25,6 | 4,6 | - | 0,3 |
| 12 | 0,3 | 0,2 | 14,2 | 2,3 | 0,4 | - |
| 13 | 0,5 | 0,2 | - | - | 1,1 | - |
| 14 | 0,7 | 0,5 | - | - | 0,4 | - |
| 15 | 0,1 | 0,8 | - | - | - | - |
| 16 | 0,4 | 0,3 | - | - | - | - |
| 17 | 0,6 | 0,2 | - | - | - | - |
| 18 | 0,2 | - | - | - | - | - |
| 19 | 0,3 | 0,2 | - | - | - | - |
| 20 | - | 0,2 | - | - | - | - |
| Number | 929 | 560 | 211 | 86 | 265 | 370 |

Table 2

Ratio of herring with different types of scale in the spawning population in the Norwegian Sea,%.

| Year | Type of scale | | Number |
|---|---|---|---|
| | Southern | Northern | |
| I969 | I2,2 | 87,8 | 929 |
| I970 | I0,7 | 89,3 | 560 |
| I97I | 5,2 | 94,8 | 2II |
| I972 | 48,9 | 5I,I | 86 |
| I973 | 44,9 | 55,I | 265 |
| I974 | 5,I | 94,9 | 370 |

Table 3

Ratio of herring with different number of coastal rings on scale in the spawning population in the Norwegian Sea,%.

| Year | Type of scale | | | | Number |
|---|---|---|---|---|---|
| | Southern | | Northern | | |
| | S | N2 | N3 | N4 | |
| I969 | I2,2 | 23,0 | 40,0 | 24,8 | 929 |
| I970 | I0,7 | 22,5 | 4I,3 | 25,5 | 560 |
| I97I | 5,2 | I9,0 | 36,0 | 39,8 | 2II |
| I972 | 48,9 | 33,7 | I5,I | 2,3 | 86 |
| I973 | 44,9 | 32,I | 2I,5 | I,5 | 265 |
| I974 | 5,I | II,4 | 74,6 | 8,9 | 370 |

Table 4

**Ratio of herring with the southern and northern types of scale in the year classes of different abundance on the spawning grounds,%.**

| Year class | Age | Type of scale | | Number |
|---|---|---|---|---|
| | | Southern | Northern | |
| **Poor** | | | | |
| I968 | 4 | 64,7 | 35,3 | I7 |
| | 5 | 38,0 | 62,0 | 29 |
| I969 | 3 | 47,I | 52,9 | I7 |
| | 4 | 47,I | 52,9 | 206 |
| | 5 | 5,3 | 94,7 | 358 |
| I970 | 3 | 7I,4 | 28,6 | I4 |
| | 4 | | I00,0 | 2 |
| **Numerous** | | | | |
| I950 | 4 | I8,2 | 8I,8 | II |
| | 5 | 55,5 | 44,5 | 9 |
| I959 | 3 | 50,0 | 50,0 | 2 |
| | 4 | 8,0 | 92,0 | 477 |
| | 5 | 6,2 | 93,8 | 497 |
| I960 | 3 | 30,8 | 69,2 | I3 |
| | 4 | 32,5 | 67,5 | 43 |
| | 5 | II,5 | 88,5 | II3 |

Table 5

Average age of the first spawned herring of different year classes

| Year class | Type of scale | | | |
|---|---|---|---|---|
| | Southern | Number | Northern | Number |
| **Numerous** | | | | |
| I950 | 4,I | I78 | 5,7 | 2I75 |
| I959 | 4,2 | I94 | 5,2 | I856 |
| I960 | 3,9 | II0 | 5,I | 887 |
| **Poor** | | | | |
| I953 | 3,9 | 64 | 5,I | I94 |
| I955 | 3,7 | 3I | 4,8 | 32 |
| I962 | 3,8 | 25 | 4,7 | 54 |
| I969 | 3,8 | I24 | 4,5 | 456 |

Table 6

Rate of herring maturity with the northern type of scale of the 1969 year class,%.

| | Age | | | | Number |
|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | |
| Ratio of the first time spawners | 2,9 | 26,0 | 68,4 | 2,7 | 680 |
| Rate of recruitment | 2,9 | 28,9 | 97,3 | I00,0 | |

Table 7

Ratio of herring with different types of growth in year classes,%.

| Year class | Type of growth | | | | | | | Relative abundance of year class[x] |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | B–C | D | C–D | No | |
| I947 | 29,6 | 6,5 | 42,7 | I,6 | 9,8 | 9,8 | 6I | above average |
| I95I | 38,5 | 53,8 | 7,7 | – | – | – | I3 | average |
| I959 | 36,4 | 29,4 | 25,2 | 0,6 | 6,0 | 2,4 | 975 | strong |
| I960 | 39,I | 7,7 | 46,7 | 6,5 | – | – | I69 | very strong |
| I965 | 62,6 | 29,2 | 4,I | 4,I | – | – | 24 | poor |
| I966 | I00,0 | | | | | | 24 | " |
| I967 | 47,4 | 36,8 | 5,3 | I0,5 | – | – | I9 | " |
| I968 | 23,9 | 69,6 | – | 4,3 | 2,2 | – | 46 | " |
| I969 | 8I,0 | I,I | I5,3 | – | 2,4 | 0,2 | 582 | " |
| I970 | 93,8 | 6,2 | – | – | – | – | I6 | " |

[x] after Yudanov,1964,1966.

Table 8

Rate of growth of herring of the 1969 year class in the Norwegian Sea, cm.

| Area | Year | Month | Type of growth, formula of sc. | $L_1$ | $L_2$ | $L_3$ | $L_4$ | $L_5$ | $L_6$ | Number |
|---|---|---|---|---|---|---|---|---|---|---|
| II | I972 | II | ASI+I | I2,8 | 23,2 | 26,9 | | | | 8 |
| | I973 | II | | I2,4 | 22,I | 27,I | 29,6 | | | I8 |
| 3c | I97I | X | ASI+2 | II,3 | I9,2 | 23,4 | | | | I3 |
| II | I973 | II | | I2,0 | I9,8 | 24,5 | 28,4 | | | 64 |
| 3 c | I973 | X-XII | | I0,8 | I8,5 | 23,3 | 27,0 | 29,4 | | II6 |
| I0 | I974 | II | | II,4 | I9,I | 23,6 | 27,I | 29,2 | | I7 |
| 3 c | I974 | XI | | II,8 | I9,3 | 23,8 | 27,3 | 29,5 | 3I,3 | I7 |
| II | I972 | II | ANI+I | I3,I | 22,6 | 27,4 | | | | 9 |
| | I973 | II | | I2,4 | 2I,4 | 26,6 | 29,2 | | | II |
| 3 c | I97I | X | ANI+2 | II,4 | I9,2 | 23,2 | | | | I0 |
| II | I973 | II | | II,7 | I9,4 | 24,6 | 28,8 | | | 23 |
| 3 c | I973 | X-XII | | II,I | I8,9 | 23,6 | 27,4 | 29,7 | | 62 |
| I0 | I974 | II | | II,3 | I9,I | 23,8 | 27,I | 29,I | | I4 |
| 3c | I974 | XI | | II,2 | I9,8 | 23,4 | 26,8 | 29,I | 30,8 | 7 |
| 3 c | I97I | X | AN2+I | I0,8 | I8,2 | 22,8 | | | | 30 |
| II | I973 | II | | II,4 | I9,0 | 24,6 | 28,7 | | | 22 |
| 3 c | I973 | X-XII | | I0,6 | I8,3 | 23,4 | 27,3 | 29,4 | | 43 |
| I0 | I974 | II | | II,0 | I8,7 | 23,6 | 27,2 | 29,4 | | I6 |
| 3 c | I974 | XI | | I0,6 | I8,3 | 23,4 | 26,6 | 29,I | 30,8 | 5 |
| II | I973 | II | AN3+0 | II,4 | I8,8 | 23,7 | 28,3 | | | 23 |
| 3 c | I973 | X-XII | | I0,6 | I7,9 | 23,0 | 27,2 | 29,6 | | 74 |
| I0 | I974 | II | | I0,4 | I8,I | 23,I | 27,I | 29,5 | | 5I |
| 3 c | I974 | XI | | I0,I | I7,6 | 22,4 | 26,4 | 28,8 | 30,8 | 39 |
| 3 c | I973 | X-XII | AN3+I | 9,9 | I7,I | 22,0 | 26,2 | 29,0 | | 489 |
| I0 | I974 | II | | I0,0 | I7,3 | 22,2 | 26,2 | 28,9 | | I38 |
| 3 c | I974 | XI | | 9,4 | I6,6 | 2I,6 | 25,8 | 28,8 | 30,8 | 79 |
| II | I973 | II | CN3+0 | II,0 | I8,4 | 22,8 | 28,4 | | | I6 |
| 3 c | I973 | X-XII | | I0,6 | I8,I | 22,I | 27,4 | 29,4 | | 34 |
| I0 | I974 | II | | I0,8 | I8,4 | 22,2 | 27,I | 29,I | | I0 |
| 3 c | I974 | XI | | I0,4 | I7,6 | 2I,4 | 26,6 | 29,0 | 30,8 | I5 |
| 3 c | I973 | X-XII | CN3+I | 9,8 | I7,I | 20,9 | 26,I | 28,8 | | I59 |
| I0 | I974 | II | | I0,0 | I7,I | 20,9 | 26,0 | 28,6 | | 57 |
| 3 c | I974 | XI | | 9,3 | I6,7 | 20,3 | 25,5 | 28,4 | 30,4 | 36 |

Note:
3c - Eastern wintering area
I0 - Lofoten Shallows
II - Norwegian Shallows

Table 9

Rate of growth of the Atlantic-Scandinavian herring of some year classes in the Norwegian Sea, cm.

| Type of growth | Formula of scale | Year class | $L_1$ | $L_2$ | $L_3$ | $L_4$ | $L_5$ | $L_6$ | Number |
|---|---|---|---|---|---|---|---|---|---|
| A | SI+2 | I950 | I0,I | I8,5 | 24,2 | 27,4 | 28,7 | 29,4 | 42 |
| | | I969 | II,3 | I9,I | 22,6 | 27,4 | 29,4 | 3I,2 | 227 |
| | S2+I | I950 | 9,8 | I7,3 | 23,8 | 27,I | 28,6 | 29,5 | 57 |
| | | I959 | 8,8 | I6,0 | 22,2 | 26,4 | 28,3 | 29,5 | 766 |
| | | I969 | II,I | I9,0 | 24,4 | 28,4 | 29,6 | 32,I | 23 |
| | S2+2 | I959 | 8,4 | I5,3 | 2I,5 | 25,I | 28,2 | 29,4 | 278 |
| | | I969 | I0,I | I7,2 | 22,2 | 26,I | 28,9 | 29,6 | 29 |
| | N2+I | I950 | 9,6 | I7,0 | 23,4 | 27,I | 28,5 | 29,5 | 456 |
| | | I959 | 8,5 | I5,7 | 22,3 | 26,2 | 28,2 | 29,5 | I677 |
| | | I969 | I0,8 | I8,4 | 23,5 | 27,6 | 29,4 | 30,8 | II6 |
| | N2+2 | I950 | 9,4 | I6,6 | 22,6 | 26,7 | 28,5 | 29,5 | 9I |
| | | I959 | 8,2 | I4,9 | 20,9 | 25,0 | 27,9 | 29,2 | I080 |
| | | I969 | I0,2 | I7,4 | 22,4 | 26,3 | 29;0 | 30,8 | 83 |
| | N3+0 | I959 | 8,3 | I5,0 | 20,4 | 25,2 | 27,6 | 28,8 | 305 |
| | | I969 | I0,6 | I8,0 | 23,0 | 27,2 | 29,4 | 30,8 | I87 |
| | N3+I | I959 | 7,8 | I4,I | I9,0 | 24,2 | 27,4 | 28,9 | 557 |
| | | I969 | 9,9 | I7,I | 22,0 | 26,I | 29,0 | 30,8 | 706 |
| C | N3+0 | I959 | 7,9 | I4,2 | I8,4 | 24,4 | 27,I | 28,6 | 589 |
| | | I969 | I0,6 | I8,I | 22,I | 27,4 | 29,2 | 30,8 | 75 |
| | N3+I | I950 | 8,4 | I3,3 | I6,8 | 23,5 | 26,6 | 28,3 | I266 |
| | | I959 | 7,3 | I3,I | I6,8 | 23,2 | 26,8 | 28,6 | 4473 |
| | | I969 | 9,8 | I7,0 | 20,8 | 26,0 | 28,8 | 30,4 | 252 |
| D | N4+0 | I959 | 6,8 | I2,3 | I6,2 | I9,3 | 24,9 | 27,4 | 507 |
| | | I969 | I0,0 | I7,4 | 22,I | 24,6 | 28,4 | 30,7 | 26 |

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