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Assessment of the herring stocks in the Western Baltic

by

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Contrary to all other herring fisheries in the Baltic the herring catches in the Western Baltic have been found to decline fairly steadily since 1964. Whereas the total landings of the ICES area 22 (Belt Sea including Western Baltic) amounted to 41.000 t at that time, they dropped to 14.000 t in 1974 (ANN., 1975; ANN., 1976).

Material and Method

This paper covers the period 1965 to 1974. During the years 1965 to 1967 an intensive market sampling system had been established (WEBER, 1970). In 1968 and 1969 there were sporadic market samplings. In the years following, up to 1974, quarterly samples of each market assortment were taken. In total a number of 20.100 age and race determinations are taken into account.

The market samplings were from the herring landings only in the Federal Republic of Germany, the cutters concerned were catching in the Western Baltic (Kiel and Mecklenburg Bay). The remaining fishery in the ICES area 22 was then exploited by Denmark and the German Democratic Republic.

Though the method of exploitation by these 3 countries may not be nearly the same it is assumed that the fish caught in the area belong to the same stock, investigations on the age and racial composition for which were based only from market samples collected in the Federal Republik of Germany (Table 1).

Because of insufficient data for the years 1968 to 1969, two approaches have been made:

(a) The numbers of each year class caught in the years 1968 and 1969 were supplemented (Table 1). They were estimated by means of the total number per market assortment landed and by the number of each year class caught in the years earlier and later.

(b) The time of consideration was divided into two periods - 1965 to 1967 and 1970 to 1974 - for which average year classes were calculated (Table 2).

For the application of the Cohort Analysis the total mortality rates Z are based on earlier investigations (WEBER, 1970). Due to a lack of reliable effort data, the estimated value for the instantaneous natural mortality M is 0.2.

Results

Year class strength

The separation of the landings into the races (Table 1) shows already a decrease of the year class strengths in both groups. The Cohort Analysis with the supplemented catches for 1968 and 1969 (approach (a)) proves this trend especially for the autumn spawners (Fig.1). For the spring spawners the year class strengths have also been found to be declining since 1969. The average year classes of the different observation periods (approach (b)) confirm a drop only for the autumn spawners, while the spring spawners are showing a stable situation (Table 2).

Though the exploitation of the herring stocks in the Baltic as a whole is rather different, the downward trend of the autumn spawners appears to be generally the same (STRZYZEWSKA, 1976). The year class strength of the various Baltic spring spawners fluctuate widely (ANN.,1976).

The decrease over a period of several years can be found only in the Western Baltic. The neighbouring Rügen stock, on the contrary increased its strength during the same time (ANN., 1975).

Variation of F with age

The Cohort Analysis of approach (b) is producing sets of F values which are varying with age. Fig.2 shows in general for both races and periods similar trends. After recruitment in autumn of their first year (age group 0), with a low fishing mortality, the F values of age group 1 in three cases were relatively high. High F values were also shown by the graph for the older age groups. Should these variations of F are real the first peak could be explained by a higher natural mortality. For these calculations M is taken to be constant. If this is not so a variation in M will appear as a variation of F. In a stock where all year classes are distributed in the same area it is not likely that young herring have a higher fishing mortality than older ones, where as natural mortality of young fish should be relatively high because of predation.

Concerning the increased losses of old herring an explanation is indicated by recent taggings. Spring spawners of the Schlei fjord (WEBER, 1975) as well as of Rügen island (BIESTER et al, 1976; KRÜGER et al, 1976) are migrating during summer to the Kattegat and Skagerak. As the recaptures from this area were exclusively old herring (26 cm) a conclusion can be drawn, that the older age groups suffer an additional mortality during the summer months when herring fishery in the Western Baltic is more or less of a complete stop. Though the results of the above mentioned tagging experiments leave no doubts about these migrations, such a migratory phenomenon has not been reported from earlier studies on meristic characters.

The average F values for the age groups 1 to 5 show only small differences between the two periods of observation. While F seems to drop from 1.18 to 1.12 for the spring spawners, for the autumn spawners F increases from 0.85 to 0.93. Compared to other herring stocks of the Baltic (RECHLIN, 1975; STRZYZEWSKA, 1975) these values are high.

They would, however, only correspond to the values given by THUROW (1974), calculated for the Northern Baltic group of herring and to the Bornholm autumn spawners (RECHLIN, 1971). The difference in the mortality between the two races is due to more intensive exploitation of the spring spawners on the spawning grounds.

State of exploitation

To derive the state of exploitation, yield per recruit curves are drawn following a program of B. JONES (Fig.3). For both the herring races the maximum yield per recruit is lower in the early 70th compared with the mid 60th. The reason for this fact is the higher mortality in their first year of life (0-group).
Considering the present situation, fishing has exceeded by far the maximum yield (Fig.3). For this reason a reduction of fishing effort of both races would be advisable. The other herring stocks of the Baltic are still in better condition (ANN, 1974; SJÖBLOM & PARMANNE, 1976). Only the situation in the Gulf of Riga seems similar to that of the Western Baltic.

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References

ANN. (1974): Report of the working group on assessment of pelagic stocks in the Baltic. ICES, C.M.1974/H:3, 1-37.

ANN. (1975): Report of the working group on assessment of pelagic stocks in the Baltic. ICES, C.M.1975/P:18, 1-19.

ANN. (1976): Report of the working group on assessment of pelagic stocks in the Baltic. ICES, C.M.1976/P:3, 1-7.

BIESTER, E., JÖNSSON, N. and KRÜGER, G. (1976): The results of marking experiments in 1975 on the Rügen spring herring ICES, C.M.1976/P:15, 1-8.

KRÜGER, G., BIESTER, E. and JÖNSSON, N. (1976): Preliminary results of the herring marking action in the Greifswalder Bodden in 1976. ICES, C.M.1976/P:16, 1-7.

RECHLIN, O. (1971): Ergebnisse zur Gesamtsterblichkeit beim Herbsthering der Bornholmsee aus den Jahren 1966 - 1969. Fisch.Forsch. 9, 1, 33-34.

RECHLIN, O. (1975): On the total mortality rate of spring spawning herring of the Northwestern Baltic. ICES, C.M.1975/P:8, 1-3.

SJÖBLOM, V. and PARMANNE, R. (1976): Assessment of the state of exploitation of Baltic herring in Finnish fisheries in 1970 - 1975. ICES, C.M.1976/P:11, 1-17.

STRZYZEWSKA, K. (1975): Growth and mortality coefficients in Baltic herring local populations. ICES, C.M.1975/P:15, 1-10.

- (1976): Changes in occurrence of juvenile spring and autumn herrings in Southern Baltic catches from 1961 to 1975. ICES, C.M.1976/P:19, 1-6.

THUROW, F. (1974): Assessment of the state of exploitation of the stocks of herring, sprat and cod in the Baltic from published data. Mskr. presented at the Meeting of the Working group on herring and sprat in the Baltic, Riga 1974.

WEBER, W. (1970): Untersuchungen an den Beständen des Herings (Clupea harengus L.) der westlichen Ostsee. Diss., Mskr.Kiel, 1-85.

- (1975): A tagging experiment on spring-spawning herring of the Kiel Bay. Ber.dt.wiss.Komm.Meeresforsch.24, 184-188.

Tab. 1 a: Catch composition of spring spawners in area 22 ($N \cdot 10^3$)
(the figures for 1968/69 are supplemented)

year \ age	0	1	2	3	4	5	6	total
1965	62 543	218 851	104 885	21 289	6 210	2 924	321	417 023
1966	161 828	283 670	40 688	35 332	16 055	4 925	592	543 090
1967	154 743	947 774	127 196	30 212	17 780	9 204	384	1 287 294
1968	370 000	225 000	150 000	30 000	7 500	4 500	500	787 500
1969	400 000	300 000	90 000	50 000	8 000	1 900	300	850 200
1970	591 987	708 743	109 268	30 212	16 011	1 338	58	1 457 617
1971	286 669	470 613	152 119	23 863	7 076	4 139	1 042	945 521
1972	172 652	505 780	70 493	21 018	4 026	2 034	949	776 952
1973	192 114	338 829	106 847	33 934	4 558	1 631	658	678 571
1974	45 727	143 998	50 346	38 502	4 311	934	62	283 880

Tab. 1 b: Catch composition of autumn spawners in area 22 (N · 10^3)
(the figures for 1968/69 are supplemented)

year \ age	0	1	2	3	4	5	6	total
1965	202 830	175 345	11 312	14 435	7 712	6 431	1 168	419 233
1966	183 018	522 275	18 730	3 780	7 101	4 586	1 378	740 868
1967	161 973	291 770	202 049	8 441	1 788	8 736	1 614	676 371
1968	60 000	110 000	80 000	50 000	2 000	500	2 000	304 500
1969	15 000	45 000	43 000	25 000	12 000	500	100	140 600
1970	42 023	23 587	16 033	14 183	7 399	1 708	-	104 933
1971	9 242	6 046	5 751	1 185	201	18	9	22 452
1972	27 020	43 513	26 134	4 427	3 249	3 233	538	108 114
1973	35 952	26 794	11 869	509	171	2	-	75 297
1974	20 999	12 275	9 252	901	723	-	-	44 150

Tab. 2: Catch and stock size ($N \cdot 10^3$) of average herring year classes at two periods in Area 22 (Cohort Analysis)

Spring Spawners

Age group	1965 - 67 Catch	F	Stock	1970 - 74 Catch	F	Stock
0	126 371	0.14	1 052 789	257 830	0.29	1 117 664
1	483 432	1.25	747 605	433 593	1.21	681 772
2	90 923	0.86	174 660	97 815	1.05	165 856
3	28 944	0.75	60 729	29 506	1.17	47 285
4	13 348	0.99	23 531	7 196	1.08	12 015
5	5 684	2.07	7 188	2 015	1.11	3 326
6	432	1.00	742	554	1.10	900
average F (AG 1-5)		1.18			1.12	

Autumn Spawners

0	182 607	0.28	834 932	27 047	0.35	100 931
1	329 797	1.21	518 355	22 443	0.56	58 162
2	77 364	1.14	125 981	13 808	0.82	27 312
3	8 885	0.35	33 142	4 241	0.64	9 867
4	5 534	0.39	19 095	2 349	0.95	4 233
5	6 584	1.15	10 626	992	1.70	1 340
6	1 387	0.80	2 743	109	0.90	200
average F (AG 1-5)		0.85			0.93	

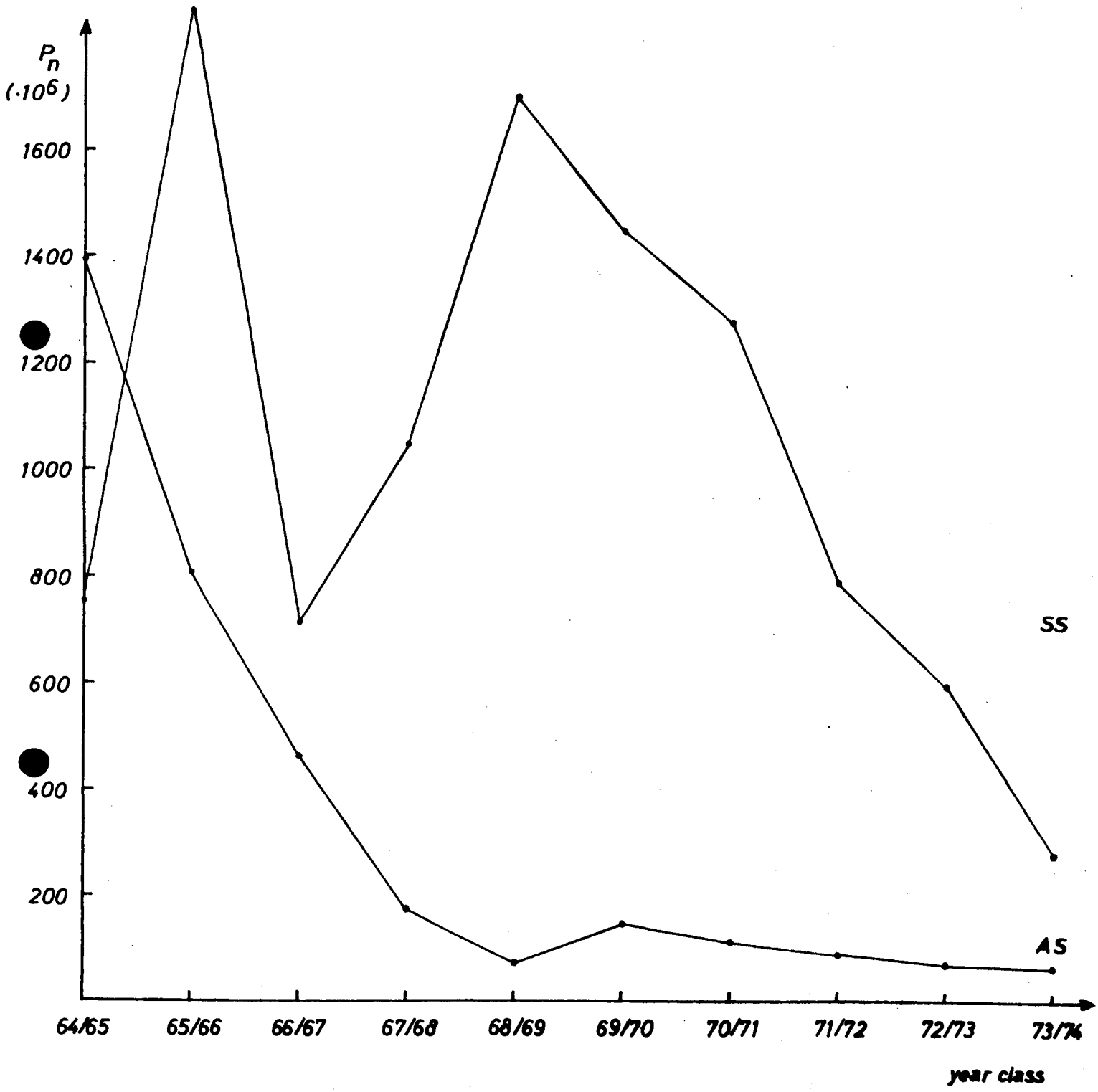

Fig. 1: Year class strength of spring (SS) and autumn spawning (AS) herring in ICES area 22

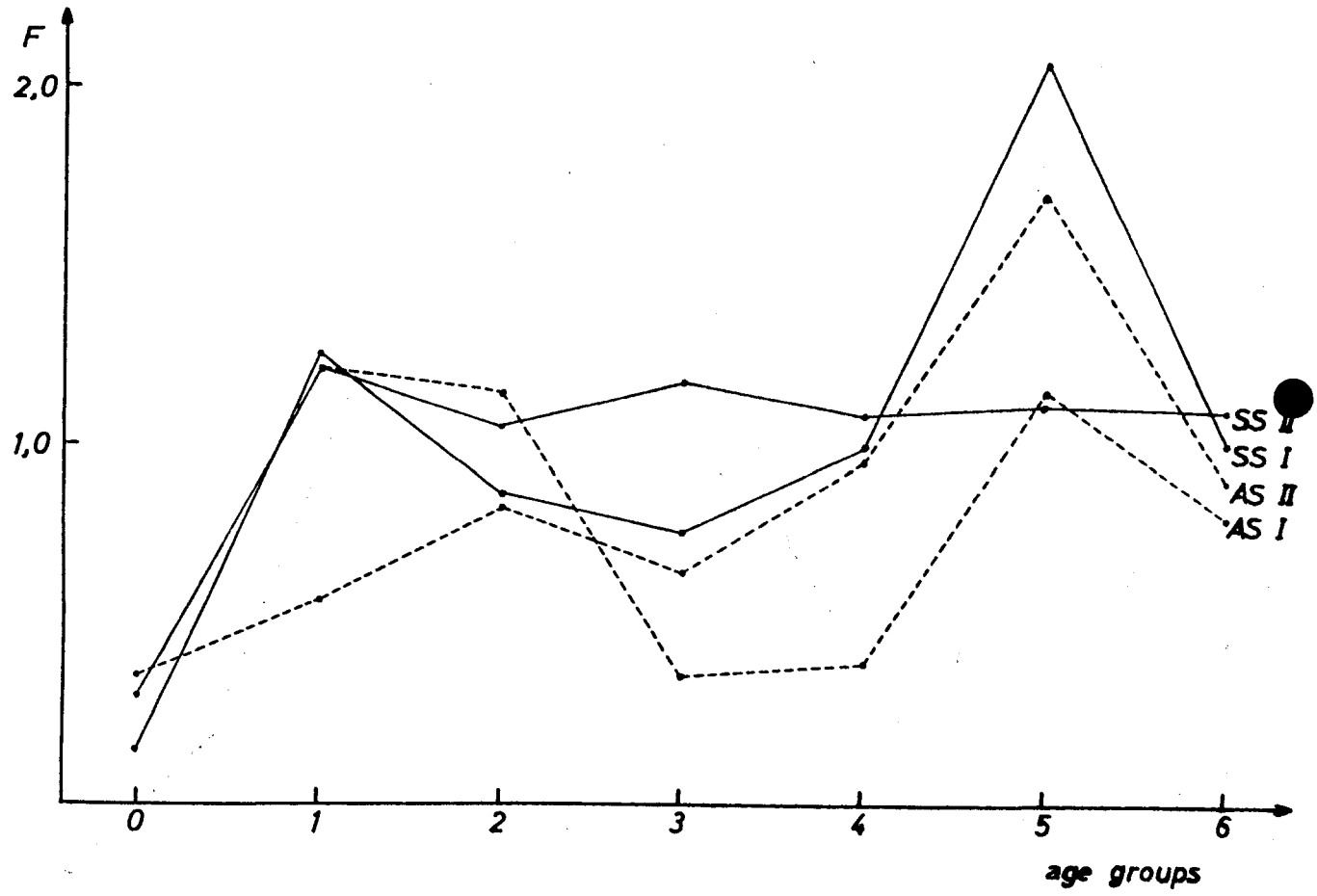

Fig. 2: Variation of the fishing mortality F with age for spring (SS) and autumn spawners (AS) in two different time periods: I = 1965 - 67 and II = 1970 - 74 (from Cohort Analysis)

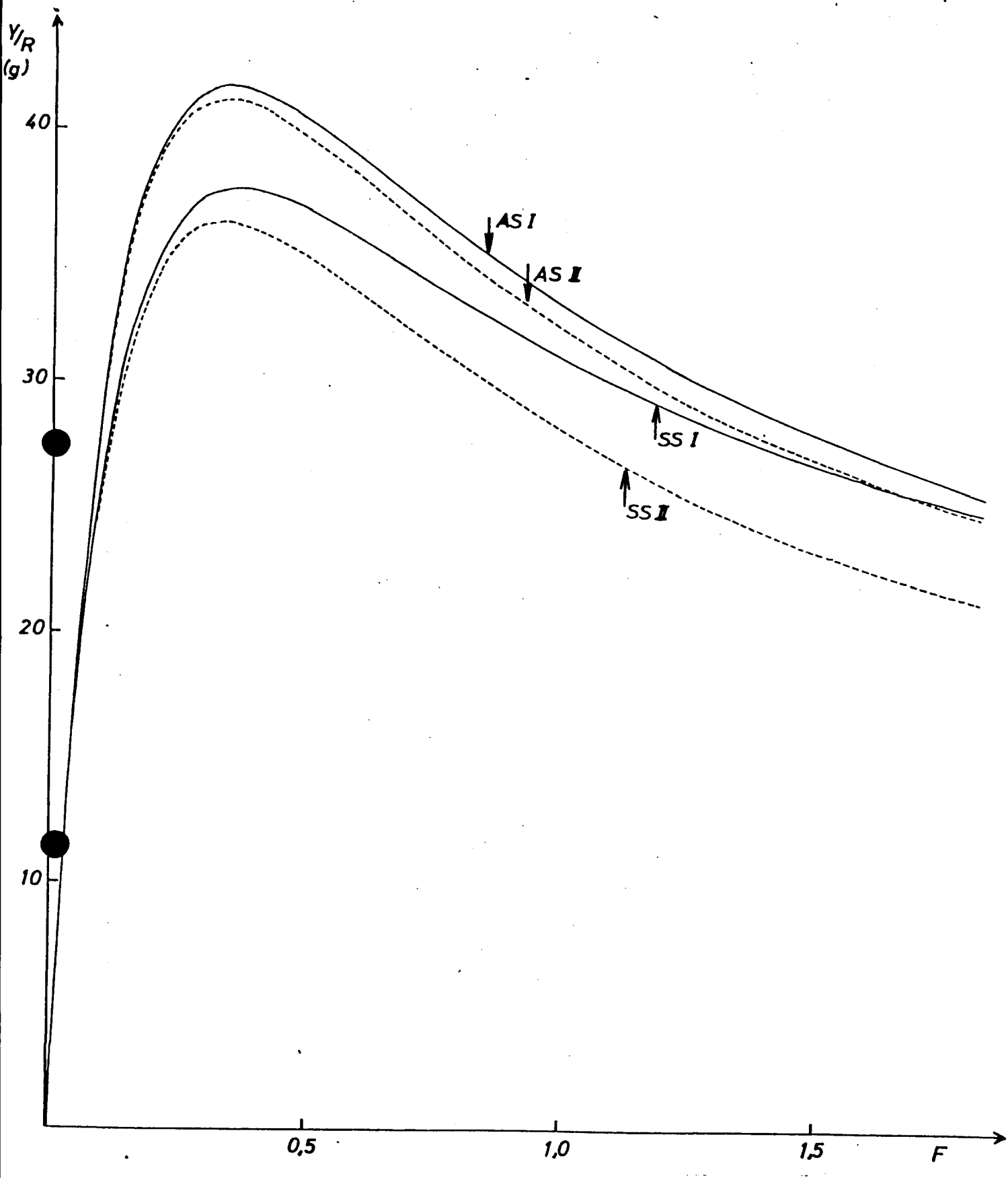

Fig. 3: Yield per recruit curves for spring (SS) and autumn spawning herring (AS) in two different time periods: I = 1965 - 67 and II = 1970 - 74