International Council for the Exploration of the Sea

C.M. 1974/J:11
Pelagic Fish (Southern) Committee

On the maturation cycle of the pilchard (Sardina pilchardus Walbaum) off the south-west coast of England

by

W. G. Parnell
Fisheries Laboratory, Lowestoft, Suffolk

INTRODUCTION

In the immediate post-war period up till 1958, English catches of pilchard (Sardina pilchardus Walbaum), which were mainly taken off the south-west coast of England, were subject to wide fluctuations (Figure 1). The peak catch of 6038 metric tons was taken in 1956, but after 1958 a steady decline started, culminating in a total catch in 1969 of only 673 metric tons. During the whole of this period the catch was taken mainly by drift-nets, but then as a result of the introduction of pelagic trawling to the fishery an improvement in catches started and has since been maintained. With the revival of interest by the industry, an expanded programme of research into the pilchard was set up at Lowestoft in 1972, samples of fish being sent to the laboratory from the south-west packed in ice in insulated containers.

THE MATURITY CYCLE

One of the biggest sources of difficulty lay in the correct estimation of the state of maturity of the fish. Some of this was due to the fact that the material was not always fresh, because samples could be up to three or four days old on examination owing to the distance of the laboratory from the port of landing. Another source of difficulty lay in interpreting the maturation stages, due to doubts as to whether the pilchard was a serial spawner or not (Macer, C.M. 1974/J:9).

The original maturation scale used for the classification of pilchard gonads was the Hjort scale as used for herring, but this proved to be inadequate, particularly for staging the females. A new scale was devised for the females which differed from the old in two respects (Table 1). Stage 4 (the developing stage) was subdivided, and an additional subdivision to Stage 7 (spent) was inserted. Stage 4 was divided into 4(1) and 4(2), the 4(1) being assigned to an ovary which was firm, yellowish, had visible eggs and had the appearance of coming up to spawn for the first time in that season. The 4(2) stage was assigned to an ovary which was slacker,

partly-spent condition 7(1), redevelops at 4(2) and spawns again at Stage 6. This cycle continues until either all the sexual products have been released, in which case the fish passes from Stage 6 to 7(2) and finally to 8, or until resorption of the eggs starts when the fish passes to Stage 7(R) and then to 8. All fish eventually pass from Stage 8 to 3 and the cycle starts again. Thus, in this maturation cycle, Stages 4(1), 5, 7(2) and 7(R) should occur only once, and Stages 4(2), 6 and 7(1) two or more times during the course of a season.

THE SEASONAL OCCURRENCE OF MATURITY STAGES

Stage 5 fish are not present in high proportion in the samples at any time during the year and never make up more than 8.5 per cent of the total in any month (Figure 4). The percentages for Stages 4(1) and 4(2) as presented in Figure 4 may be somewhat biased because (a) they are based on female staging only and (b) it was possible to use only some of the data, since the split of Stage 4 into 4(1) and 4(2) was made part way through the sampling programme. Nevertheless it is clear that, except in February, fish in Stage 4(2) are more abundant in the samples than those in Stage 4(1). Moreover the difference in relative abundance tends to increase with time (Table 2): this supports the view that the pilchard is, in fact, a serial spawner (Macer, C.M. 1974/J:9).

Table 2 Number of fish in Maturity Stages 4(1) and 4(2) (females only)

Maturity stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Sept	Total
4(1)	0	4	15	50	21	7	5	0	102
4(2)	7	0	24	169	54	41	30	2	327
Ratio 4(2)/4(1)	∝	0	1.6	3.4	2.6	5.9	6.0	∝	3.2

Very few Stage 6 fish are actually seen in the samples; in the peak month of September there were only about 6 per cent, and this was a factor which had previously been noted by Hickling (1945). Indeed, few fish in a spawning condition were noted in samples taken at roughly the same time and in the same area as that in which Demir and Southward (1974) found high abundance of pilchard eggs in June-July and October-November. However, the percentage of recently-spent fish (Stage 7(1)) did increase in the June-July period and it would thus seem that the spawning Stage 6 is either of very short duration in the Cornish pilchard, or does not appear in the fished component.

As by definition Stage 7(2) occurs only once in the spawning cycle and Stage 7(1) several times, the proportion of fish in Stage 7(1) should be greater than that in Stage 7(2) except at the end of the spawning season.

The relative number of fish in each stage by month (Table 3) reveals that Stage 7(1) tends to outnumber Stage 7(2) in the February to July period, though there is a hint of a drop in April and May. Stage 7(2) is more dominant between September and January: this implies that the majority of fish have by then completed the spawning cycle.

Table 3 Number of fish in Maturity Stages 7(1) and 7(2)

Maturity stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Sept	Nov	Dec	Total
7(1)	83	77	54	43	29	44	40	39	4	0	413
7(2)	122	52	41	45	31	11	15	65	5	2	389
Ratio 7(1)/7(2)	0.7	1.5	1.3	1.0	0.9	4.0	2.7	0.6	0.8	0	1.1

DISCUSSION

The maturation pattern of the pilchards as shown in Figure 4 reveals that the percentage of immature juvenile fish in Stages 1 and 2 is very small indeed throughout the year. The proportion of adult fish in the early stages of maturity (Stages 8, 3 and 3-4) increases between September and March but is at a very low level in the summer months when maturing and mature fish (Stages 4, 4(1), 4(2), 5 and 7(1)) are dominant. There are three peaks in the occurrence of both Stage 7(2) and Stage 5 fish, though unfortunately no data are available for the months of August and October. It is suggested that the May group of spents could be the same fish as were Stage 5 in February, the September spents the same as the Stage 5 fish in July, and the January spents the Stage 5 fish of November-December. Although there are no October data, it would appear that there is roughly a three-month gap between the first pre-spawning Stage 5 and the final spent Stage 7(2).

The implication is thus that there are three groups of spawning fish coming through the Cornish pilchard fishery in the course of a year, though it is impossible to define the relative importance of each.

Pilchard eggs are found in every month of the year in the inshore areas which are mainly covered by the English commercial fishery, with peak numbers occurring in two periods, June-July and October-November (Demir and Southward 1974).

However, Cushing (1957) and Wallace and Pleasants (1972) found the biggest concentrations of eggs offshore well outside the main area of the commercial fishery. Indeed, surveys made in May 1967 by ERNEST HOLT and a French research vessel indicated that at that time several groups of pilchards were spawning over a very wide area covering the Bay of Biscay, the Celtic Sea, the English Channel and the southern North Sea.

As the relationship between the stock fished inshore and that present offshore is quite unknown, it is impossible at the present time to relate the maturation cycle of the sampled fish to the peaks of egg production over the area as a whole. It is of interest, however, to note that the maturation cycle for the sampled pilchards does appear to relate to the peak inshore egg abundances in June-July and possibly October-November. The fact that the February component does not fit may imply that either it is very small and is of little significance or that it moves out of the fishery to spawn offshore.

SUMMARY

A new scale for the classification of pilchard maturation stages has been described. This maturation cycle suggests that a fish passes from the mature stage through spawning to a partly-spent condition, and back to mature again, until either all the sexual products have been released or until resorption of the sexual products takes place. There is roughly a three-month gap between the first pre-spawning condition and the final totally-spent stage. Three groups of spawning fish have been identified in the commercial fishery, though it has not been possible to determine the relative importance of each.

REFERENCES

CUSHING, D. H., 1957. The number of pilchards in the Channel. Fishery Invest., Lond., Ser. II, 21(5).

DEMIR, N. and SOUTHWARD, A. J., 1974. The distribution and abundance of eggs and larvae of teleost fishes off Plymouth in 1969 and 1970. J. mar. biol. Ass. U.K., 54. (In press.)

HICKLING, C. F., 1945. The seasonal cycle in the Cornish pilchard, Sardina pilchardus Walbaum. J. mar. biol. Ass. U.K., 26, 115-138.

MACER, C. T., 1974. Some observations of the fecundity of the pilchard (Sardina pilchardus Walbaum) off the south-west coast of England. ICES C.M. 1974/J:9.

WALLACE, P. D. and PLEASANTS, C. A., 1972. The distribution of eggs and larvae of some pelagic fish species in the English Channel and adjacent waters in 1967 and 1968. ICES C.M. 1972/J:8.

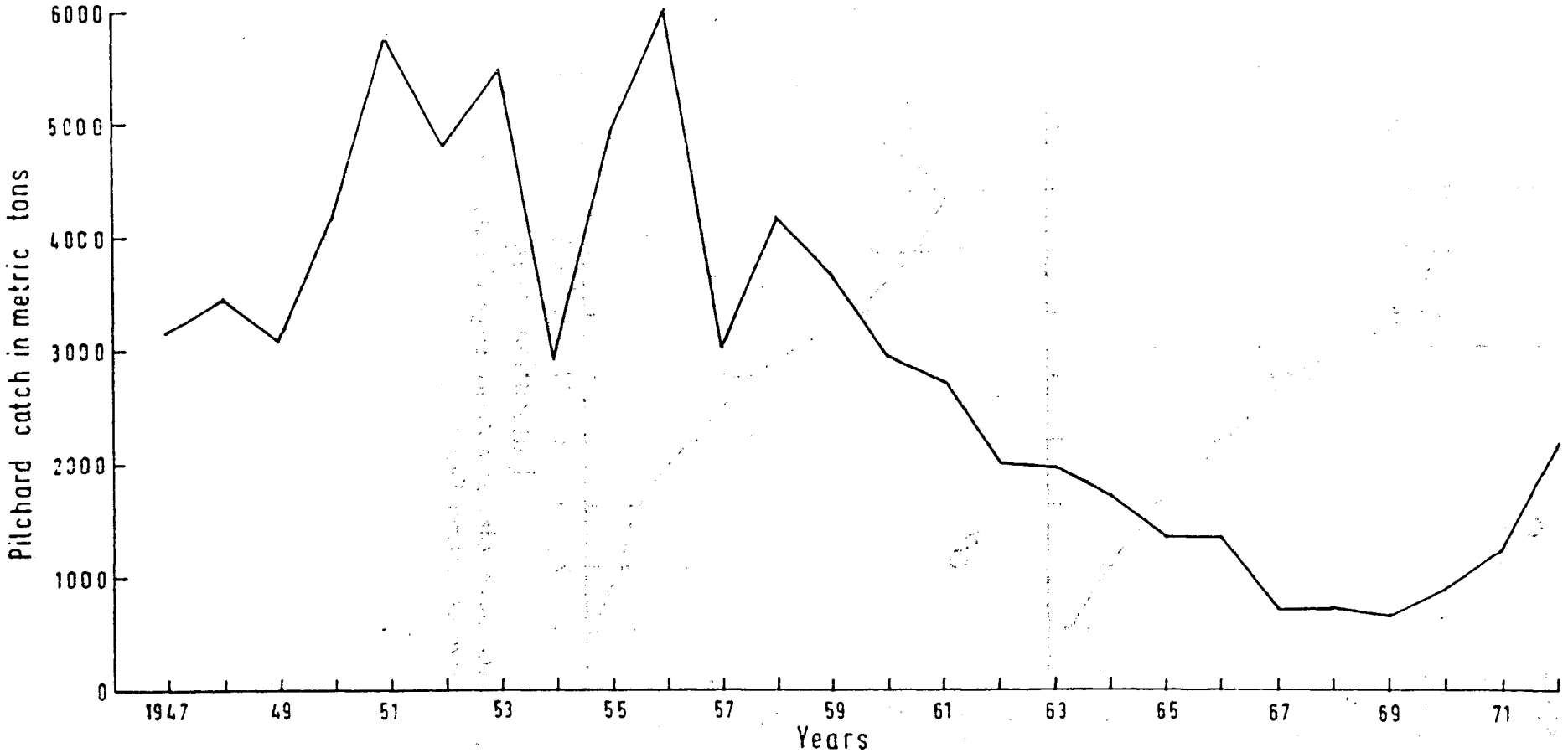

Fig.1. English pilchard catch

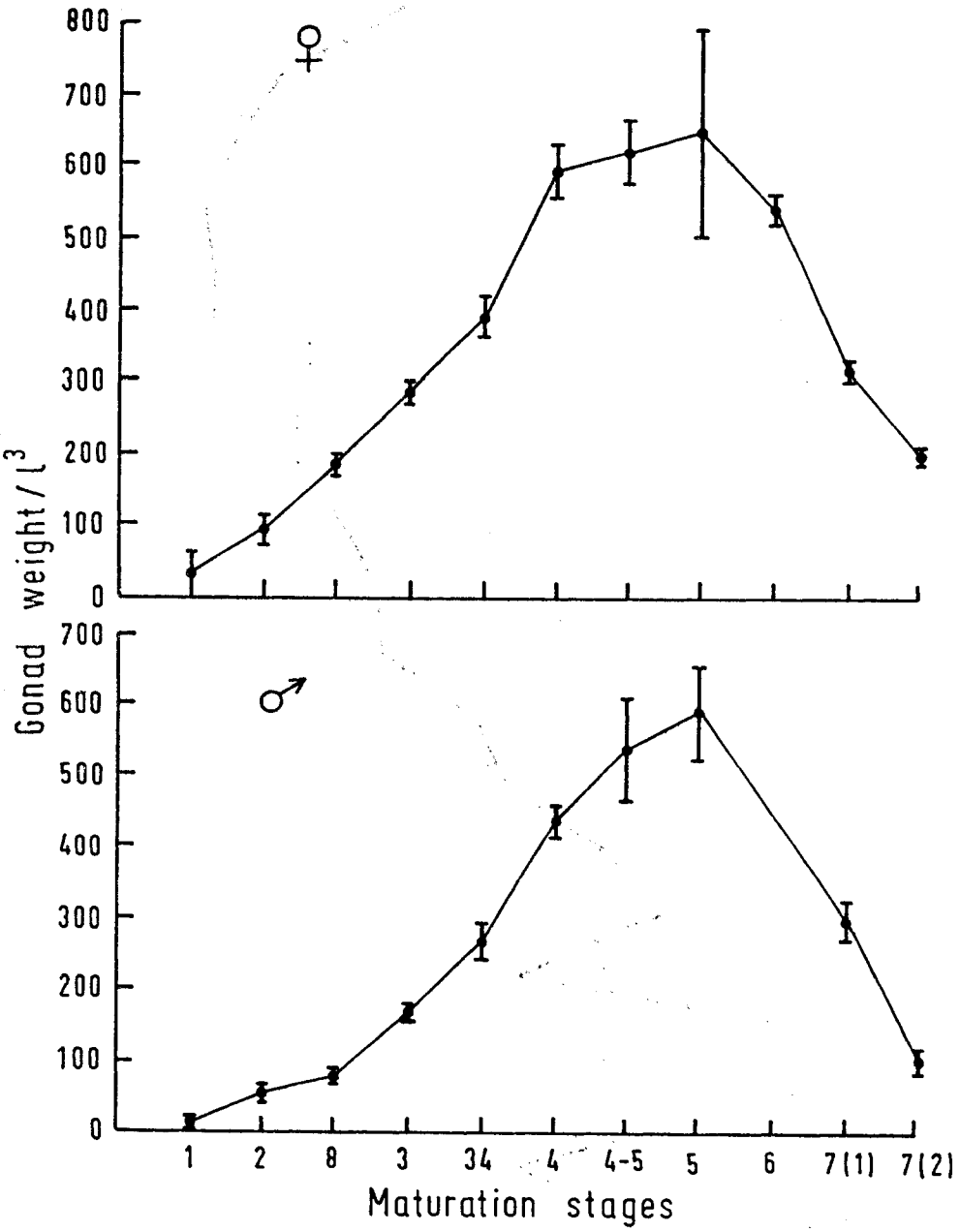

Fig.2. Mean gonad index by maturity stage (2 x standard error of mean shown by vertical lines.)

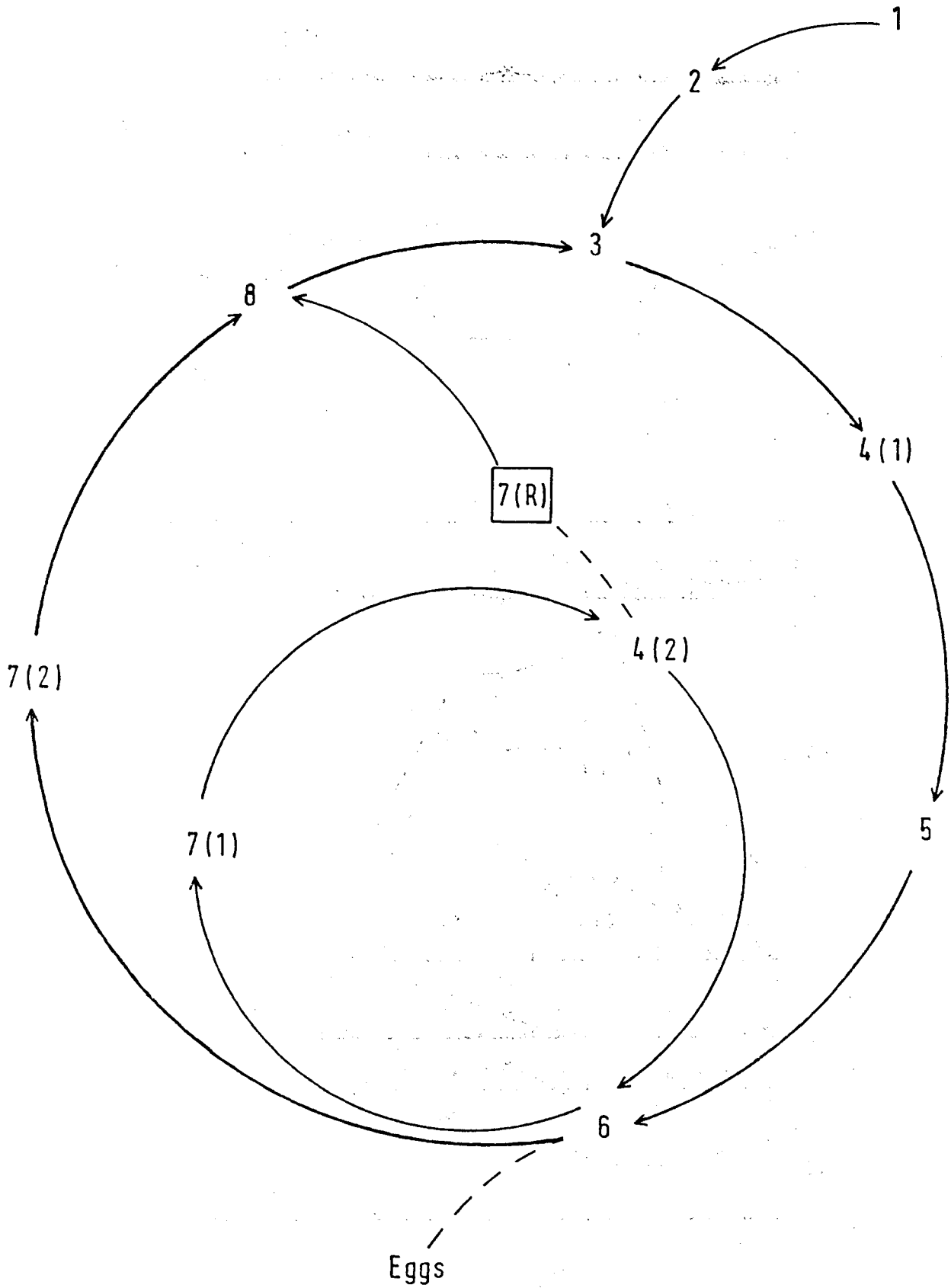

Fig. 3. A hypothetical pilchard maturation cycle

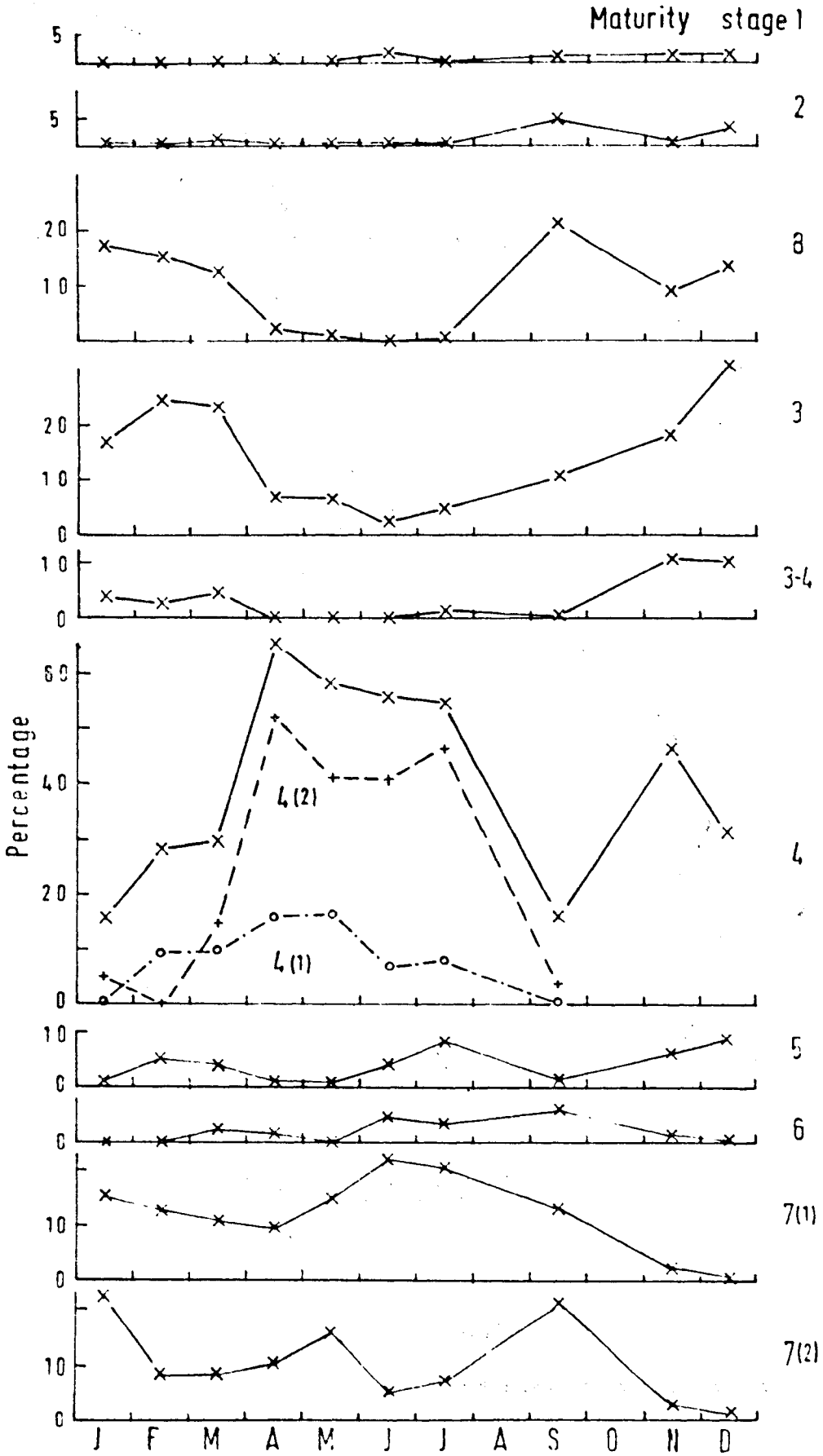

Fig. 4 Season variation in maturity stages