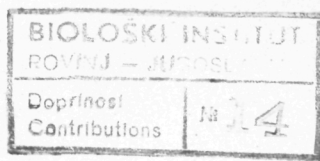


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**ÉTUDES DES ÉCAILLES DU SPRAT DU
NORD DE L'ADRIATIQUE (SPRATTUS
SPRATTUS L.)**

**STUDIES ON THE SCALES OF THE
NORTH ADRIATIC SPRAT (SPRATTUS
SPRATTUS L.)**

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ABSTRACT

It was established during the study of the scales of the North Adriatic sprat (*Sprattus sprattus* L.) that in most cases the rings are poorly developed or may be absent entirely. The origin of the rings is discussed. It was noticed that the most common are diffuse rings, and these were normally considered as annual rings. But narrow and sharp rings are also present on the scales. In addition, the abnormalities of the scales are studied.

RÉSUMÉ

Au cours de l'étude des écailles du sprat du nord de l'Adriatique (*Sprattus sprattus* L.), il a été établi que dans la plupart des cas les anneaux qu'elles portent sont faiblement développés ou peuvent être entièrement absents. L'origine des anneaux est examinée. Il a été relevé que les plus courants sont les anneaux diffus et ils étaient normalement considérés comme anneaux annuels. Mais il existe aussi sur les écailles des anneaux étroits et des anneaux nets. En outre, l'auteur étudie les anomalies des écailles.

One of the main difficulties which research workers face during studies on any fish species is the determination of age. This may be done by studying the scales, the otoliths, the fin rays of the bones, but in work on most fish species only the scales and otoliths are used. Because of frequent unevenness of the marked rings of the scales and the otoliths, the age readings may not be the same (Robertson, 1938; Mužinić, 1961) and therefore it is advisable to combine the two methods, at least in the study of the clupeoids. Because of this, during our studies of the north Adriatic

sprat (*Sprattus sprattus* L.), the age of a single fish was determined using both the scales and otoliths, whenever this was possible. However, in this report, only results of the analyses of the scales are given.

The main difficulty for age determinations of the Adriatic sprat, according to the scales, is the lack of scales. The Adriatic sprat is a very frail fish, and usually during catching using nets nearly all the scales fall off and specimens without a scale remaining are frequently caught.

In our studies only fresh material was

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used. The representative samples were obtained from commercial catches made during light fishing in the years 1960-1962. Scales were taken from the area under the dorsal fin, but, when there were no scales there, scales from other parts of the body were used. For the wet conservation of the scales, the methods proposed by FAO Fisheries Division (1957) and Chugunova (1959) were used. The cleaning of the scales was done according to Mužinić's method (1959); however, the scales were wiped with white blotting paper. The scales, three from each fish, were mounted on clean glass slides as suggested by FAO Fisheries Division. The dimensions of the slides were 76 × 26 millimeters (3 in × 1 in), and on each slide scales from ten specimens were mounted.

The scales were examined by means of a binocular dissecting microscope in semi-reflected daily light, and by means of a Huygens microfiche reader.

The rings and their origin

It is a characteristic of the north Adriatic sprat that the scales are read with even greater difficulty than those of the sardine. The rings are normally confused and are frequently absent entirely. In such cases the age of the fish can be determined by the otoliths, or — approximately — by the length of the fish according to Petersen's method.

From outward appearances, the ring may be dark or light. This is dependent upon the direction of the striae in relation one to the other.

In comparison with scale striation of the sardine, the striae of the sprat are coarse, strong, and on the apex and shoulders of the scale they run almost parallel with its edges. For this reason in many cases the ring is interrupted at the apex. In origin the dark ring is formed by the striae moving closer together, or by each stria becoming thicker

(Figure 1 a, b). The case is the reverse for the forming of light rings, when the striae are further apart. After this they continue in the same direction as before with the same distance between them (Figure 1 c). Another way in which a light ring may be formed is when the single striae become narrower or when either straight or bent striae are suddenly interrupted (Figure 1 d, e). It is rare that the same ring (light or dark) is of the same origin along its entire length. Frequently the light ring begins at the sides as a typical sharp ring, marked by the interruption of the striae. Approaching the apex, the light ring is formed by the gradual moving further apart of the striae and this process is frequently linked with their narrowing. Very often the rings are doubled, consisting of one light and one dark ring (Figure 1 g). This is the result of simultaneous approaching and drawing apart of the striae as they bend. Sometimes the newly formed part of the scale (the new growth zone) is much brighter than the old one and this is the result of the poorer striation in the newer part (Figure 1 f). In such a case, some of the striae are suddenly cut off, others are joined together, and some are continued

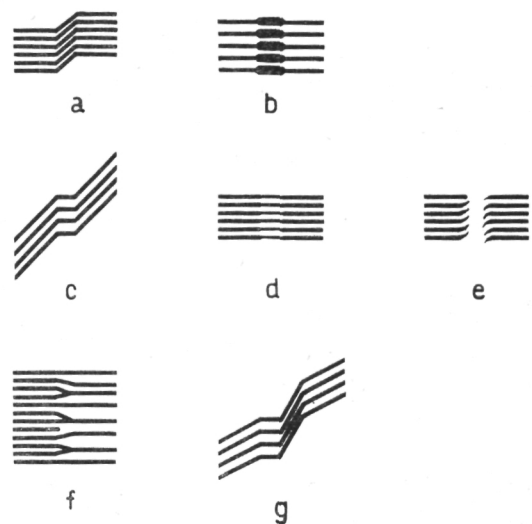


FIGURE 1. A drawing of the origin of a ring.

after bending a little. However in this case a true ring is not formed, but the difference between the old and the new growth zones is well-marked. This formation takes place always when a new annual ring should be formed. Therefore we see there a formation which corresponds to an annual ring.

According to their widths and clearness, the rings can be diffuse, narrow and sharp. The most common are diffuse rings, formed by the approaching or by the contraction of the striae, or by the combination showed in Figure 1 g.

The diffuse rings may be formed also by means of the drawing apart of the striae, but this way of striation is more typical for narrow rings. Besides this, the sudden widening or contraction of the striae results also in the formation of a narrow ring. Sharp rings, which are formed by the sudden interruption of the striation, are rarer than diffuse rings and they are observed in only one third of the number of scales examined. In addition to this they are normally limited only to the sides of the scale and are continued as light, narrow or, on the apex, even diffuse rings. Double sharp rings are only exceptionally formed in the scales of the north Adriatic sprat.

The interpretation of the rings

It is established that most wide diffuse rings, and the formations shown in Figures 1 f and 1 g, are formed in winter, and therefore they are interpreted as true annual rings. Also at this time a light narrow ring may be formed, but in such cases this is sometimes not completed at one side of the scale. Usually the wide diffuse ring is then absent and a narrow ring should be considered as the annual ring (Figure 2). The annual rings are present in all the scales of one single fish, but in some specimens one year or older the annual rings were not found in any scale at

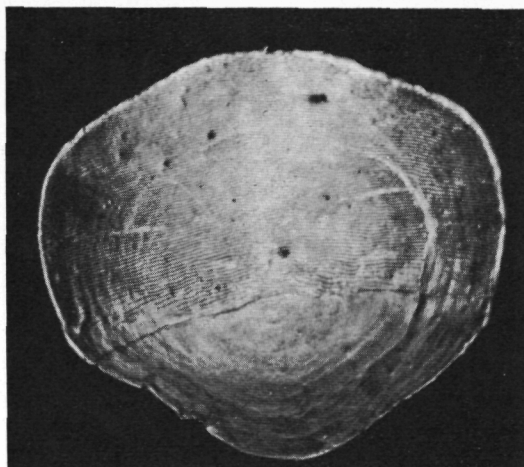


FIGURE 2. *The scale of a one-year-old sprat with a well-marked annual ring.*

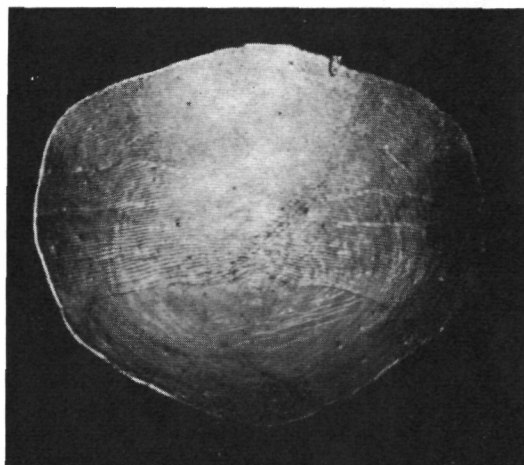


FIGURE 3. *The scale of a one-year-old sprat without an annual ring.*

all (Figure 3). The reason for this is not known.

However, usually on the scales, incomplete accessory rings are also present, mostly of the narrow or sharp type. Normally there is only one accessory ring marked in each growth zone, up to the age of three or four years. The first accessory ring is often formed in the first year of life, before the formation of the first annual ring, and it is formed probably dur-

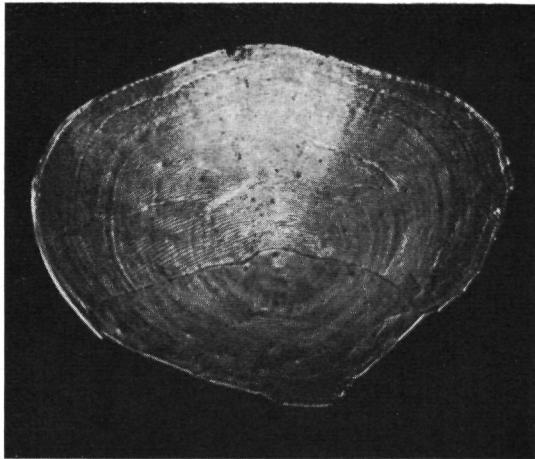


FIGURE 4. *The scale of a three-year-old sprat with accessory ring.*

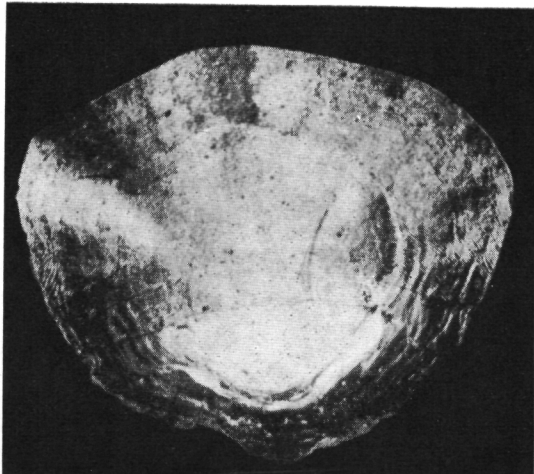


FIGURE 5. *The scale of a five-year-old sprat.*

ing migration across the north Adriatic (Zavodnik and Zavodnik, 1966). The frequent absence of accessory rings in the scales of old fishes is caused in all probability by the relative reduction in the size of the growth zones; therefore the accessory "condition" rings draw near to the annual rings and the result is a good marked ring of a sharp or double type. Rarely in one growth zone are two or even three accessory rings formed. Often

however, two neighbouring rings are formed, of which one begins at one side of the scale, as a narrow ring, goes later through the shoulders and apex and disappears below the shoulder on the other side as a wide diffuse ring. The other ring begins and disappears in the opposite

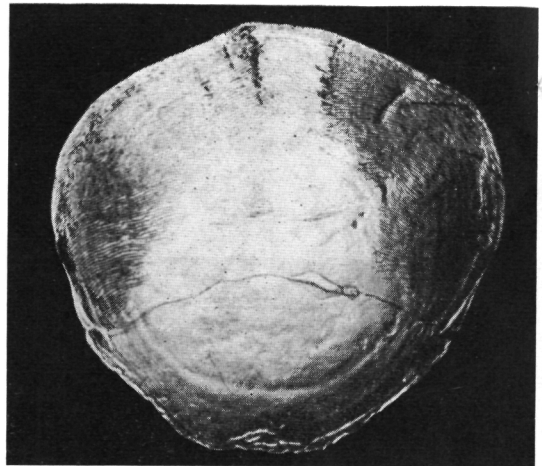


FIGURE 6. *The scale of a three-year-old sprat with smooth unstriated central area. The striae have changed direction near the apex.*

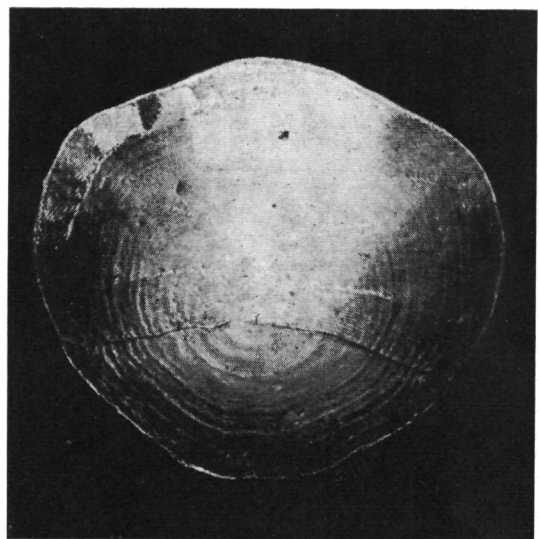


FIGURE 7. *The scale of a three-year-old sprat. The striae have changed direction within the last growing zone on the left shoulder.*

direction. It is obvious that one of these is an annual and the other an accessory ring, but because they are incomplete they were interpreted as one annual ring.

The abnormalities of the scales

The most common abnormalities are the absence of the striation and the changes in the direction of the striae (Figures 6, 7). In the latter case the age of the fish can usually be successfully determined, as changes take place normally within one single growth zone. Contrary to this, the scales without striae on one area of the scale could not be used for age determinations. The absence of the striation (and therefore the rings) is caused by local damage to the scale or by its entire regeneration.

Abnormal changes in the scale shape are rare in the north Adriatic sprat. Not one asymmetrical scale was observed amongst the scales obtained below the dorsal fin, although in sardines such abnormalities occur. Also, wearing-off of the scale margins in freshly caught sprat is very rare.

It is interesting to indicate a doubling of the scales. This phenomenon is extraordinarily rare and its cause is unknown. Among some thousands of scales studied by us, only one doubled scale was detected.

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