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# Age and Growth of Sardinella aurita off NW-Africa

by

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The determination of the age and growth is also considerable importance in the case of fish from tropical deep-sea fishing grounds, although the problems involved are still unsolved in several respects. It can, however, definitely be stated that rings can be observed on the scales of tropical fish. When we assume that, as in the fish from temperate and sub-arctic latitides, the rings are expressions of differences in growth intensity, this is only one possible explanation since appropriate literature contains various opinions regarding the causes leading to the formation of the rings on the scales.

The number of investigations on the age and growth of Sardinella aurita is not inconsiderable, but there is nevertheless no uniform opinion.

Since our material obtained in the waters off Cap Blanc to the Gambia estuary contained fish with lengths of between 12 and 40 cm, and thus contained a corresponding number of year classes, it provided an ideal opportunity for conducting studies regarding the above problem.

## Material and methods

The material was collected during voyages of the fisheries research vessels "Ernst Haeckel" and "Eisbär" during 1970/71 in the waters stretching from Cap Blanc to the Gambia estuary off North-West Africa and was supplemented by material collected by the fishing vessels belonging to the fleet operated by VEB Fischkombinat Rostock. A total of 1,707 fish were investigated, 8 - 12 scales from each fish being read. The scales

were taken from the middle part of the body in front of the dorsal fin. The lengths of scales were measured from the middle to the edge of the scale along the axis of the body in the forward direction.

The lengths of the fish were denoted by $L_t$.

In order to determine the relation between fish length and scale length, 323 fish were measured because regressive calculation of the growth rate requires proportionality between the length of the scale and the length of the fish (figure 1). In the case of Sardinella aurita, this relation increases allometrically during the course of life so that the two quantities are directly proportional in this part of the body. Scales taken from the edge of the belly side and from the back are not suitable because they vary in size and shape.

Results

The results of age determination investigations contained in the literature regarding Sardinella aurita and the growth rate of this fish differ considerably. The differences, which even occur within a single investigation area, are due to different interpretations of the annual rings, intermediate rings and additional rings.

Large numbers of intermediate and additional rings can be observed particularly during the first two years. From the third year of life on, they are only found sporadically on a few scales.

According to our investigations, one annual ring and one intermediate ring, i.e. two rings, are created during a single annual growth increment. The annual ring is usually formed during the period of June to July. A Connection with the main spawning period is conceivable since the food intake occurs throughout the year, including the spawning period. Correspondingly, the intermediate ring could be formed during the period of October - November, i.e. during the second main spawning period.

A small percentage of the fish appear to form the annual rings at other times. A newly formed ring could be observed on the scales of some fish caught during November and February, one possible explanation for this being a prolonged spawning period for portion spawning.

The first intermediate ring is formed at a length of 11 - 14 cm (year class 0) and the second occurring at a length of about 20 cm (year class 1). Intermediate rings are only found occasionally on older fish.

The variation in length of the year classes varies considerably, the main proportion, however, being within the range of 3...5 cm.

The year classes include the following fish lengths for large numbers of fish:

| Year class | Length |
|---|---|
| 1 | 16 - 19 cm |
| 2 | 23 - 26 cm |
| 3 | 25 - 28 cm |
| 4 | 29 - 34 cm |
| 5 | 32 - 36 cm |
| 6 | 34 - 37 cm |
| 7 | 35 - 38 cm |

The year class forming the majority of the catch is greatly dependent on the time of the catch and the fishing ground.

All year classes with the exception of year classes 0 and 1 were caught in the sea area south of Cap Blanc in February/March, particularly year classes 3 - 5. The year class 2 formed the majority during the period from May - June and the year classes 0 and 1 appeared from August on. The older fish had already disappeared at this time.

The growth of S. aurita reaches its maximum during the first year and then decreases considerably in the second year and thereafter (table 1).

Tab. 1 Growth of S. aurita

| Age | $L_t$ cm | yearly growth in cm |
|---|---|---|
| 1 | 15.8 | 15.8 |
| 2 | 21.7 | 5.9 |
| 3 | 26.6 | 4.9 |
| 4 | 30.4 | 3.8 |
| 5 | 33.2 | 2.8 |
| 6 | 35.0 | 1.8 |
| 7 | 36.3 | 1.3 |
| 8 | 37.5 | 1.2 |
| 9 | 38.6 | 1.1 |
| 10 | 39.6 | 1.0 |

The growth rate differs ~~greatly~~ between and female. The females had a rather higher growth rate in all year classes (figure 2a and 2b).

The "LEE phenomenon" accorred in fish from the sixth year on during the regressive calculation of the growth, but did not account for more than 1 cm reduction of the value for the first year.

In comparison with S.aurita from other areas and the data supplied by other authors, table 2 was drawn up on the basis of data taken from the literature and compared with the growth of the different year classes. The oldest animals and the highest growth rate have been found in North-West African waters (table 2).

Literatur

BEN-TUVIA, A., 1956. The biology of Sardinella aurita with a systematic account to the family Clupeidae of the Mediterranean coast of Israel. Fish.Bull., Haifa, (7), 20-24, (8), 14-15, 20-25

BOUNHIOL, J.P., 1921. Sur la biologie de l'Allache (Sardinella aurita Val.) des côtes d'Algérie. C.R.Ass.franc. Avanc.Sci., Paris, (44), 279-281

BUI DINH CHUNG, 1973. Untersuchungen zur Biometrie, Biologie und Bestandsdynamik von Sardinella aurita Val. in den Gewässern vor Nordwest-Afrika. Universität Rostock, Dissertation (unpubl.)

DIEUZEIDE, R., J. ROLAND, 1957. Étude biometrique de Sardine pilchardus Walb. et de Sardinella aurita C.V. capturées dans la Baie de Castiglione. Bull.Sta.Aquic. Pêche Castiglione, (8), 111-225

EL-MAGHRABY, A.M., G.A. BOTROS, I.A.M. SOLIMAN, 1970. Age and Growth Studies on Sardinella madrensis Lowe and Sardinella aurita Cuv. & Val. from the Mediterranean Sea at Alexandria (U.A.R.). Bull.Inst.Ocean.Fish., Kairo. Vol. 1, 49-82.

HEALD, E.J., R.C. GRIFFITHS, 1967. The age determination, from scale readings, of the Sardine, Sardinella anchovia, of the Gulf of Cariaro, Eastern Venezuela. Ser.Rec. y Expl.Pesqu., Vol.1, No.10, 375-446

NAVARRO, 1932. Nuevos estudios sobre la alacha (Sardinella aurita C.V.) de Baleares y de Canarias. Ibid., 2(60), 1-35

NEFEDOV, G.N., 1962. O vosrastnom sostave i tempo rosta Sardinella aurita v raionach Dakara i Takoradi. (über die Alterszusammensetzung von S.aurita in Gebieten Dakar und Takoradi). Trudy.AtscherNIRO, Vyp. 20, 40-45

PHAM THUOC, J. SZYPULA, 1971. Age and Growth Rate of Gilt Sardine (Sardinella aurita Cuv. et Val.) from the North-West African. Int.Coun.Expl.Sea, C.M./J5, 6p

POSTEL, E., 1960. Report sur la Sardinella (Sardinella aurita) Atlantique Africain. Proc.World Sci.Meet.Biol. Sardines Rel. Spec., Spec.Syn. 1

PROBATOV, A.N., 1960a. Vtoraja nautschno-promyslovaja ekspedizija v vodsch srednei Atlantiki (k sapadnoi Afrike) s 31 janvarja po 18 ijulja 1958 g. natraulerach "Kasan" i "Alaseja". (Zweite fischerei-wissenschaftliche Expedition in Gewässern des Zentralatlantiks (West-Afrika) vom 31.1. bis 18.7.1958 auf den Trawlern "Kasan" und "Alaseja") Trudy BaltNIRO, Vyp.5, 3-59

PROSVIROV, E.S., O.G.RJABIKOV, 1961a. Nekotorye voprosy biologii i promysla sardinella vida Sardinella aurita raionov Takoradi i Dakara. (Einige Probleme der Biologie und des Fanges der Sardinella-Art Sardinella aurita aus Gebieten von Takoradi und Dakar) Trudy BaltNIRO, Vyp.7, 3-16

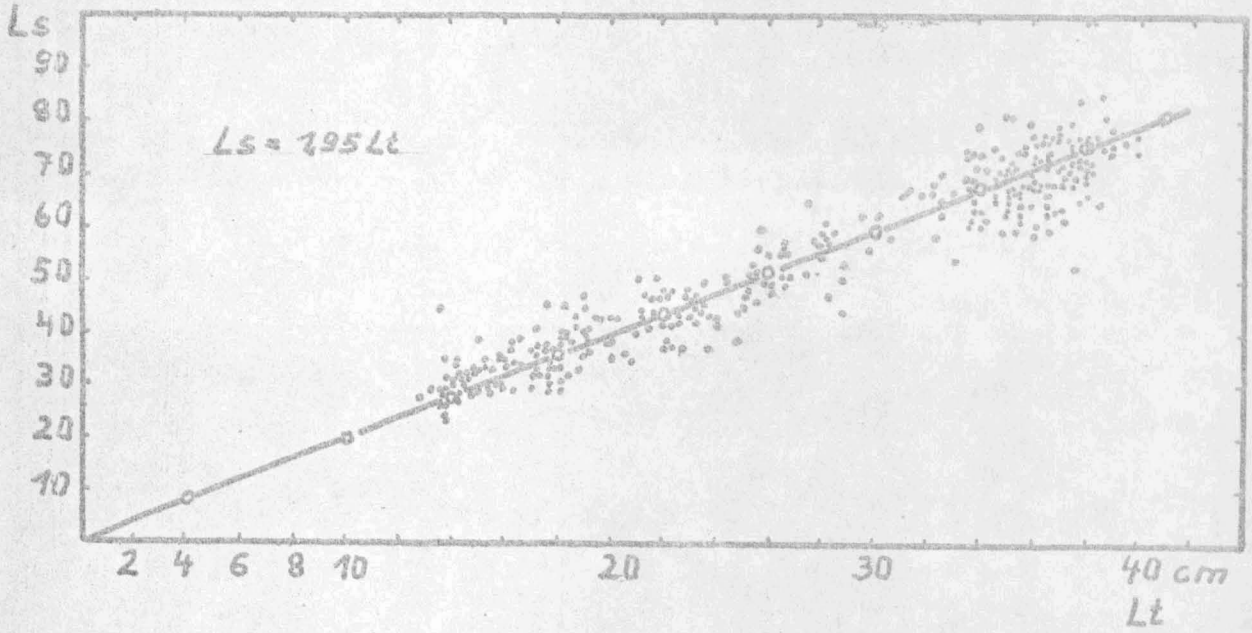
RICHARDSON, I.D., G. VAZZOLEV, A. de FARIA, M.N. de MOREAS, 1960. Report on Sardine investigation in Brazil. Proc.World Sci.Meet.Biol. Sardines Rel. Spec., Exp.Paper 13. 1051-1079

ROSSIGNOL, M., 1955. Premieres observations sur la biologique des Sardinelles dans la region de Pointe-Noire. Rapp.Proc. Verb. Reun., Vol.27, 17-20

Tab.2: Growth of S.aurita in several areas
x: transformed of Lf to $L_t$, we used the equation $L_t = \frac{Lf - 1.10}{0.818}$ from own measurements

| Autor | Gebiet | $L_1$ | $L_2$ | $L_3$ | $L_4$ | $L_5$ | $L_6$ | $L_7$ | $L_8$ | $L_9$ | $L_{10}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mittelmeer: | | | | | | | | | | |
| Bounhiol (1921) | Algerien | | 20-21 | | 32-33 | | | | | | |
| Dieuzeide u. Roland (1957) | Israel | 13-16 | 17-20 | 21-26 | | | | | | | |
| Ben-Tuvia (1956) | Israel | 15,8 | 19,2 | 21,7 | 23,4 | 25,7 | | | | | |
| El-Maghraby (1970) u.a. | Alexandria | 13,2 | 18,2 | 10,8 | 22,7 | | | | | | |
| Navarro (1932) | Balearen | 18,2 | 21,8 | 23,8 | | | | | | | |
| | Westafrika: | | | | | | | | | | |
| Postel (1960) | Kanarische Ins. | 14 | 18-19 | 23-24 | 26-27 | 28-29 | | | | | |
| Nefedov (1962) | Cap Vert | 13-15 | 16-21 | 23-24 | | | | | | | |
| Pham-Thuoc u. Szypula (1970) | Cap Blanc-Cap Vert | 16,7 | 23,0 | 27,5 | 31,5 | 34,0 | 36,0 | 37,3 | | | |
| Bui Dinh Chung | Cap Blanc-Cap Vert | 15,8 | 21,7 | 26,6 | 30,4 | 33,2 | 35,0 | 36,3 | 37,5 | 38,6 | 39,6 |
| Probatov (1960a)x | Cap Blanc-Äquator | 11-15 | 19-23 | 21-27 | 26-32 | | | | | | |
| Prosvirov u. Rjabikov (1961)x | Cap Vert-Takoradi | 12,3 | 19,7 | 22,5 | | | | | | | |
| Studensky (1961)x | Takoradi | 12,4 | 22,5 | | | | | | | | |
| Neredov (1962)x | Takoradi | 13-15 | 18-21 | 21-22 | | | | | | | |
| Rossignol (1955) | Pointe Noire | 15 | 23 | 27-29 | | | | | | | |
| | Ostamerika: | | | | | | | | | | |
| Haeld u. Griffiths (1967) | Venezuela | 13,7 | 16,8 | 17,9 | 20,2 | | | | | | |
| Richardson (1960) | Santos (Brasilien) | 16,4 | 17,7 | 18,9 | 20,1 | 22,5 | 23,7 | 23,7 | | | |
| | Rio de Janeiro | 15,2 | 18,6 | 20,4 | 21,9 | 22,8 | 23,3 | 23,8 | | | |

Fig.1 The scale-fishlength-relation of S. aurita



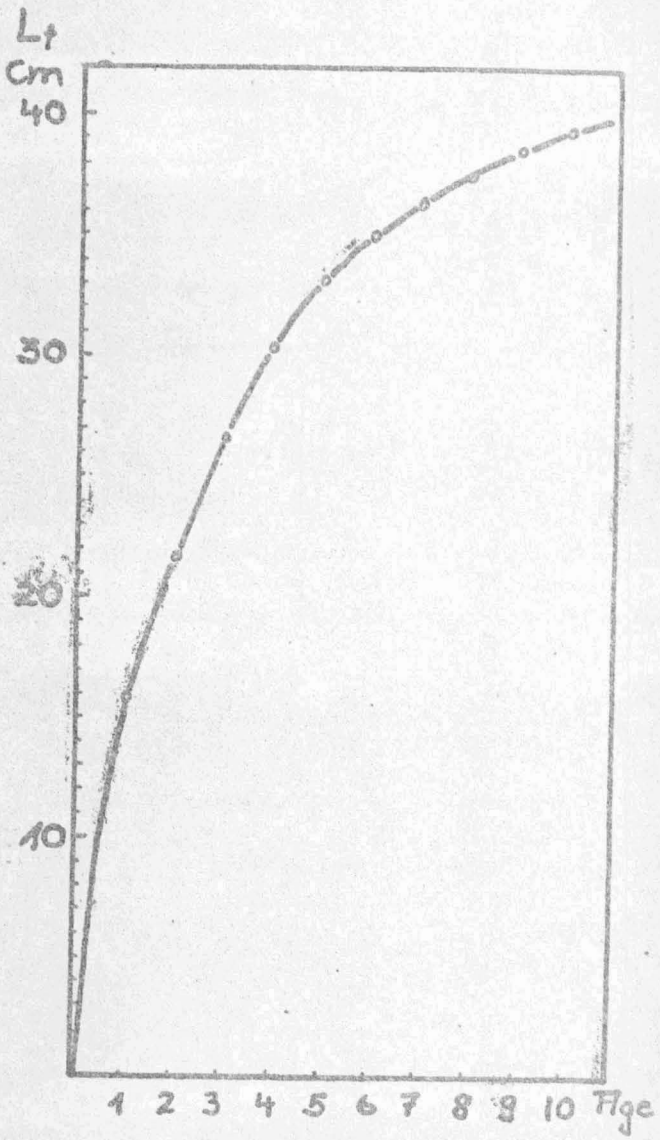



Fig. 2a Growth curve of S. aurita

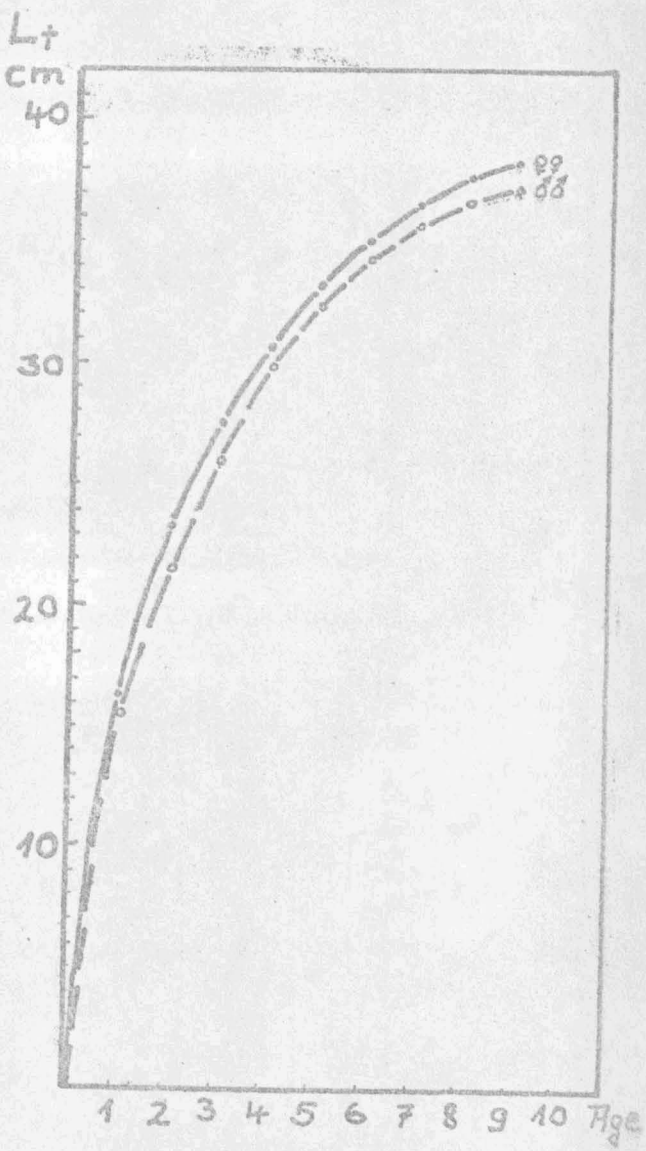



Fig. 2b Growth curve of S.aurita separated by sexes