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The Determination of the Age and Growth of *Nemipterus virgatus* (HOUTTUYN)

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Nemipterus virgatus is distributed widely in the inshore waters in the middle region of the main island of Japan and southwards. The age and growth of this species were studied as a part of the population study of the coastal fishes. Four hundred and seventeen specimens were collected from landings mostly caught by the set net and a few by line and hook off Fukuoka during the period from June 1959 to October 1960 and from these fishes their scales were removed.

I. Age

All fish are measured from the snout to fork of the caudal fin and the body and gonad weighed. The scales of this species, ctenoid type, are soaked in five percent solution of potassium hydroxide overnight and then cleaned by washing well. The scales are mounted in dry condition between two glass microscope slides for observation. The scale picture is of the inflection type in both lateral

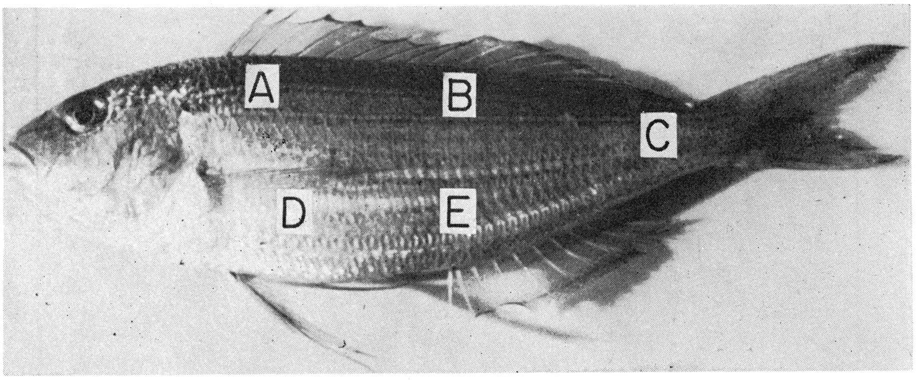

Fig. 1 Photograph showing portion on the body from which scales have been taken

sectors and of concrecence type in the anterior sector. The marks on the scale are definable as the distortion of ridges in both lateral sectors and concurrently with them widely spaced ridges in anterior sector. Scale-size and mark-size on the longitudinal axis of the scale, that is, axis from the origin of growth to antero-lateral lobe in scale, are measured with a projector under magnification 20 times natural size. The relationship between scale-size (R) and mark-size (r_n) - *similarity* - is exammined for each scale groups scraped off from five different portions of the body respectively (Fig. 1 and Fig. 2). Although *similarity* of mark-size is well recognized in the scales of every body portion, the rate of the mark formation is 100 percent only among scales scraped off from the portion D, behind the pectoral fin. Moreover, it is found that in this portion there are greater number of scales of typical form and large size than in samples from other portions of the body. A scale, therefore, scraped off from the portion D is used for age determination.

The relationship between fork-length (L) and scale-size (R) is found to be curved and can be expressed by the equation (Fig. 3),

$$L=2.28\hat{R}^2-3.83\hat{R}+74.9 \cdots\cdots\cdots 1)$$

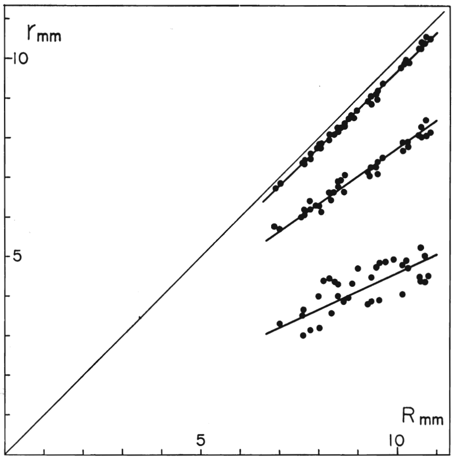

Fig. 2 Relationship between scale-size and mark-size on scale taken from various body portion of a individual

To take away the variation of the mark-size resulting from the difference of scale-size in the same fork-length samples the measurementes of scale-size and mark-size are standardized by multipling with the factor, $\hat{R}/R$, since this regression is attended with considerable variation in plotting of scale-size against fork-length and *similarity* is recognizable between scale-size and mark-size as mentioned above.

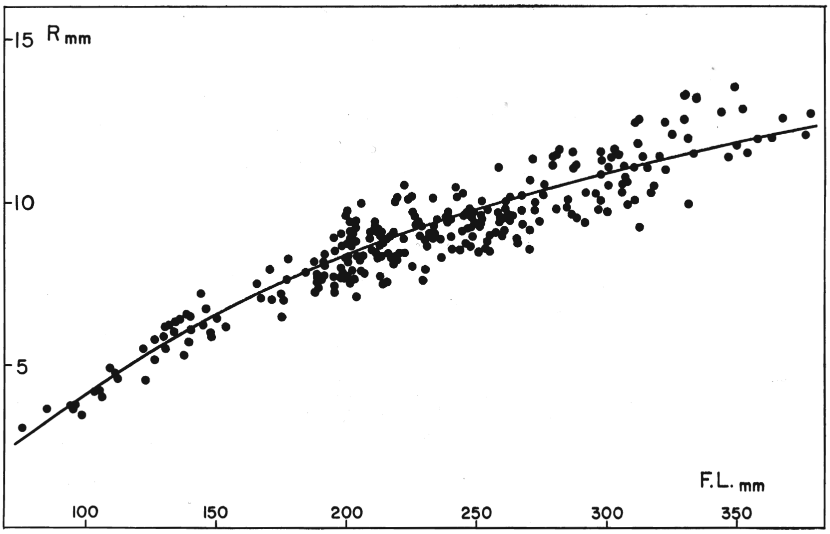

Fig. 3 Relationship between fork-length and scale-size

Sampling of specimens are accompanied inevitably by following three objections for age determination: a) the young fish is sampled in a larger numer than the old one, b) the frequency distribution of fork-length in the same age classes fluctuates irregularly in each season, c) the number of samples vary with season. On the other hand, the relationship between scale-size and mark-size for each month data is found to be intemittent with several short linear regressions and by the intermittent parts along the ordinates each individuals for each month data are divided into each successive age class (Fig. 4). Combining the phenomena and these three objections, therefore, the mode of mark-size frequency distribution result in obscurity. However, the standard mark-size representing this species is more accurately obtained from the relationship between fork-length (L) and mark-size (r_n) which are derived from each age class and month data (Fig. 5). Hence, the back calculated fork-length (l) at the time of formation of different marks are estimated from the equation 1) and the standard mark-size. In the relationship between scale-size and fork-length, and the relationship between mark-size and fork-length no significant difference in different sexes are recognized, but in the frequency distribution of fork-length the older specimens are dominant in the male than in the female.

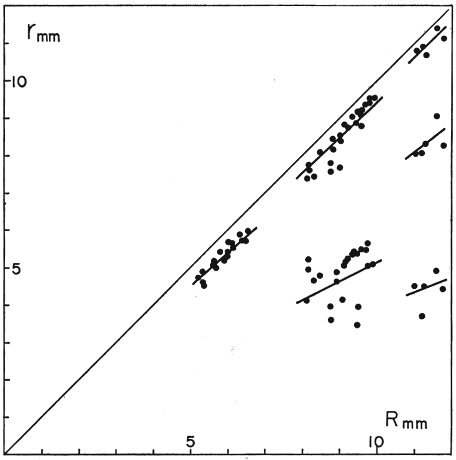

Fig. 4 Relationship beween scale-size and mark-size in May.

WALFORD plot for standard mark-size is found to be a linear regression with excellent results and indicated the following equation.

$$r_{n+1}=0.575r_n+5.71 \qquad 2)$$

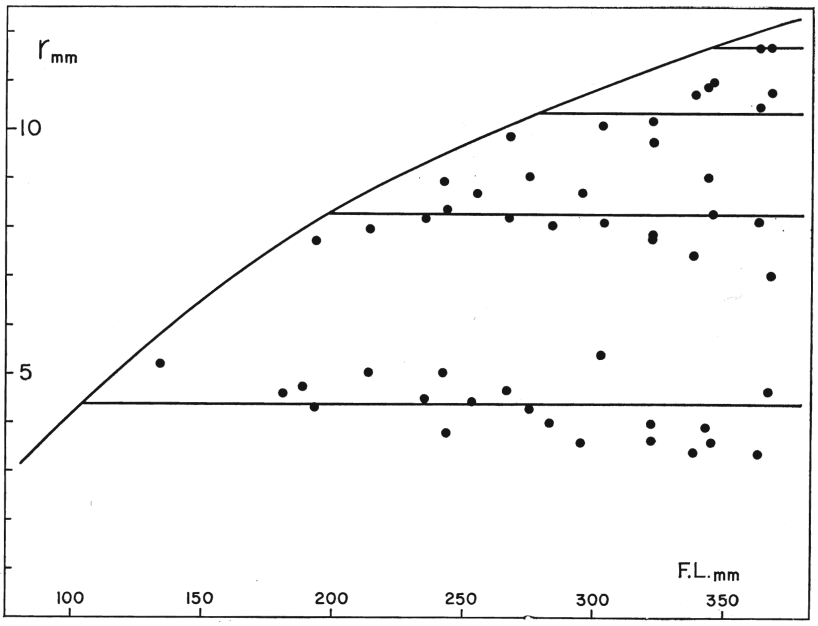

Fig. 5 Relationship between fork-length and mark-size represented by month and age class.

It is, therefore, estimated that these marks are formed at an equal time interval.

The evidence that the sesonal change of the marginal growth rate, $R-r_n/r_n-r_{n-1}$, attains the minimum value in May is accepted as sufficient proof of the fact that these marks are formed in May every year (Fig. 6).

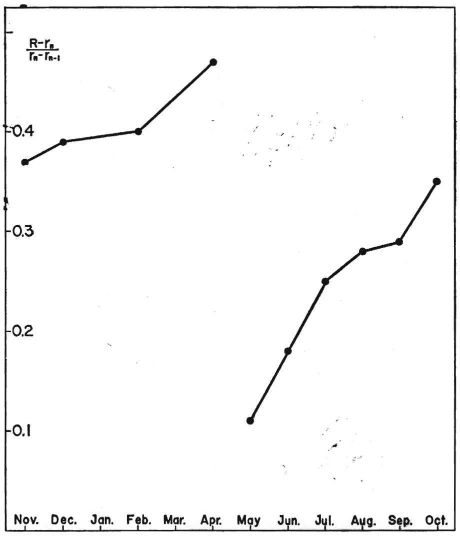

Fig. 6 Monthly change in marginal growth rate $(R-r_n/r_n-r_{n-1})$

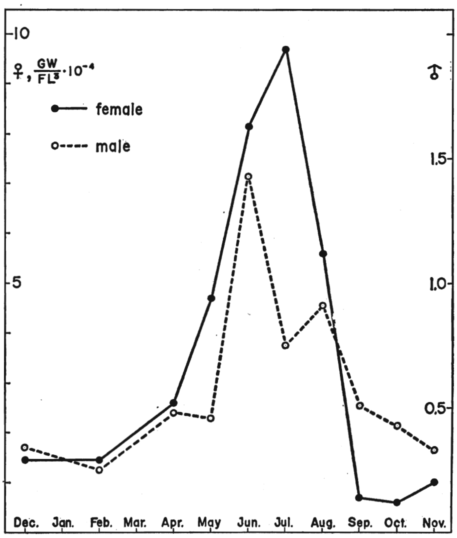

Fig. 7 Monthly change in maturity index (GW/L^3)

II. Growth

Plotting the fork-length at age n on the x axis against fork-length at age $n+1$ on the y axis respectively, these points fall along a straight line and the line is expressed by the equation,

$$l_{n+1}=0.825l_n-115 \cdots\cdots\cdots\cdots\cdots\cdots \quad 3)$$

From the seasonal change of the maturity index, GW/FL^3, it is found that the species has a restricted spawning season during the months of June to August, its peak being in July (Fig. 7). The first mark just formed is attained in May of the 0-age. Thus putting $t=0$ at the spawning time, the growth in length (L) is given by the equation.

$$L_t=675\ (1-e^{-0.192t-0.008}) \cdots\cdots \quad 4)$$

where L_t is the fork-length at t years since spawned.

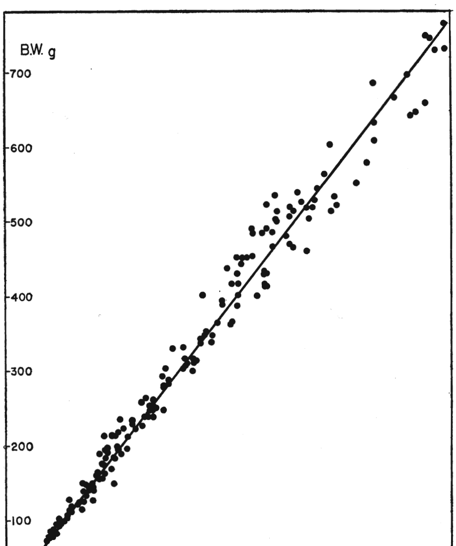

Fig. 8 Relationship between body weight and cube of fork-length.

The relationship between the body weight and the cubic of fork-length in this species conforms to the linear regresseion (Fig. 8).

$$W = 1.72 \cdot L^3 \cdot 10^{-2} \cdots\cdots\cdots\cdots\cdots\cdots 5)$$

The coefficient of fatness is constant without distinction of the age and sex of the fish. The growth in body weight is derived from the equations 4) and 5).

$$W_t = 4872\ (1 - e^{-0.192t-0.008})^3 \cdots\cdots\cdots\cdots\cdots\cdots 6)$$

where the time of the maximum growth rate is 5.50 years after spawning (FL; 436 mm, BW; 1425 g).

イトヨリダイ (*Nemipterus virgatus* (HOUTTUYN)) の年令および成長

三　尾　真　一

1959年7月から1960年10月にわたつて，福岡市場に水揚げされたイトヨリダイ417尾を採集し，その年令と成長について調べた．

年令形質としては，年令標示が明らかで採取・計測が容易な鱗を用いた．標示の相似性を検討し，併せて形成率，鱗の大きさの諸点から，年令査定にもつとも適している胸鰭付近の鱗を年令査定の形質として用いた．

フォーク長と鱗径との関係はゆるやかな曲線関係を示す．計測された各種示径は $\hat{R}/R$ でもつて標準化された．月別に求めた鱗径と標示径との関係から年級別に代表値を求め，フォーク長と各代表値との関係からこの種を代表する標準標示径を求めた．標準標示径を WALFORD の成長転換法によつて吟味すると，得られた各点は非常によく一直線上に乗る．縁辺成長率 $(R - r_n / r_n - r_{n-1})$ の月別変化から標示形成期は5月であることがわかつた．

産卵は7月を盛期として6～8月にわたつて行なわれる．産卵盛期の7月を $t=0$ として成長および増重をそれぞれ PÜTTER-BERTALANFFY, BUCH-ANDRESSEN-FISCHER の式で示した．また，体重とフォーク長の3乗値との関係は一直線で示され，肥満度は年令および性別に関係なく一定である．