

Some Scale Patterns of the Scad, *Decapterus maruadsi* (TEMMINCK et SCHLEGEL), and their Variations with Body Parts

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Introduction

The scad, *Decapterus maruadsi* (TEMMINCK et SCHLEGEL), is often caught by the purse-sein or trap-net together with mackerel and jack mackerel in the Japan Sea. Although the biological knowledges of this species are a little known, there are at present no informations on the age and growth of the fish.

Attempts were made to observe the scale patterns of the scad in detail for estimating the process of the early growth. In the present paper, the variations in some scale patterns of this species with body parts were examined for the purpose of determining the most suitable part for scale sampling.

Materials and Methods

Three specimens, caught by a trap-net off Kunda, Miyazu City, Kyoto Prefecture, on 16 October 1968, were 216mm (♂), 224mm (♂) and 218mm (♀) in fork length (Table 1). Ten or 20 scales were respectively taken from 12 body parts from A to L divided on the left body side except the scutes (Fig. 1). After the scales were immersed in 5% KOH solution and sufficiently cleaned in water for removing the mucus, they were mounted between two microscope slides and observed with a projector under the magnification of 20 and 50 times. The central zone of "regenerated scales" was usually a blank, devoid of ridges and any other structures that were normally present, hence the normal scales were selected from each body part except the regenerated scales. Scale-sizes, mark-sizes and numbers of ridges were measured on the five scales sampled from each body part in the specimens.

The main technical terms of the scale patterns defined by KOBAYASHI (1950), BROWN (1957) and LAGLER *et al.* (1962) were used in the present paper.

Table 1. Sample specimens

Specimens	Fork length (mm)	Body weight (g)	Sex	Number of marks on the scale
I	216	140	♂	1
II	224	145	♂	1
III	218	145	♀	1

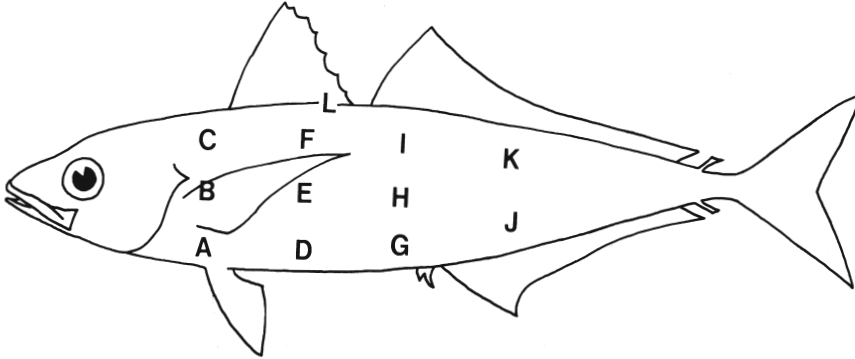


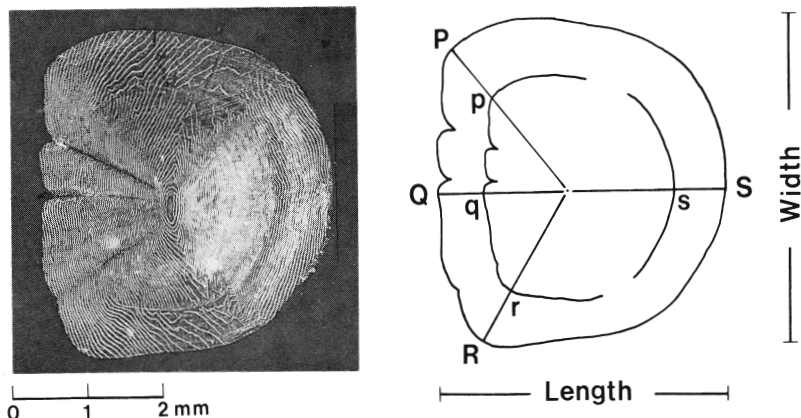
Fig. 1. Body parts from which scales were taken

Results

Outlines of the scale patterns : To describe the scale patterns, the scales were sampled from the parts near the center of the body side and behind the base of the pectoral fin, because they were larger than the other scales.

The standard scale is pentagonal, thin, flexible and transparent. It is classified as cycloid scales with four fields. The ridges do not run parallel to the edge of the scale, but generally from one lateral side to the other, changing from a circular shape around the central zone to almost linear at the anterior and posterior margins. The ridges in the anterior field are widely spaced, whereas those in the posterior field are closely. The groove is radially formed from the central zone to the anterior margin, cutting off the ridges. The number of grooves ranges from three to five. The mark is found by a discontinuity or break in the ridges. Especially, the clear mark appears in the anterior and lateral fields (Figs. 2 and 4).

Scale-sizes : The measured axes of the scales of some fishes have been defined by many investigators including HORII (1952), KOBAYASHI (1955), YAMADA (1961) and PAUL (1968). The main measured axes of the scales of the scad were almost the same as those in the above reports. The measurements herein taken are as follows (Fig. 2) : (1) The anterior radius (Q)



P : Upper antero-lateral radius p, r, q, s : mark-size
 R : Lower antero-lateral radius
 Q : Anterior radius
 S : Posterior radius

Fig. 2. General features of a scale sampled from the body part E (left).
 Measurements of scale-size and mark-size on a scale (right).

is measured from the focus to the center of the anterior margins. (2) The posterior radius (S) is from the focus to the tip of the posterior field. (3) The upper and lower antero-lateral radii (P ; Q) are represented by the distance between the focus and the antero-lateral angles. (4) The length (L) corresponds closely with the anterior radius extending to the tip of the posterior field. (5) The width (W) is the widest calibre across the upper and lower lateral margins.

The upper and lower antero-lateral radii were rejected, despite the larger measurements, because the positions of the antero-lateral angles were unstable.

Statistical values of the other measurements are listed below.

(1) Length (Appendix Table 1) : The maximums of the lengths are shown in the part H (sp.† I), the part B (sp. II) and the part E (sp. III), whereas the minimums were shown in the part C (sp. I ; sp. III) and the part L (sp. II), as seen in Fig. 3-1. The maximums of the coefficients of variation in the lengths within each part occurred on the part C (sp. I ; sp. III), and the part A (sp. II), whereas the minimums occurred on the part K (sp. I), the part E (sp. II) and the part H (sp. III).

(2) Width (Appendix Table 2) : The maximums of the widths are shown in the part H (sp. I ; sp. II) and the part A (sp. III), whereas the minimums are shown in the part L (sp. I ; sp. II ; sp. III), as seen in Fig. 3-2.

† specimen

The maximums of the coefficients of variation in the widths within each part occurred on the part C (sp. I), the part L (sp. II) and the part A (sp. III), whereas the minimums occurred on the part E (sp. I), the part D (sp. II) and the part C (sp. III).

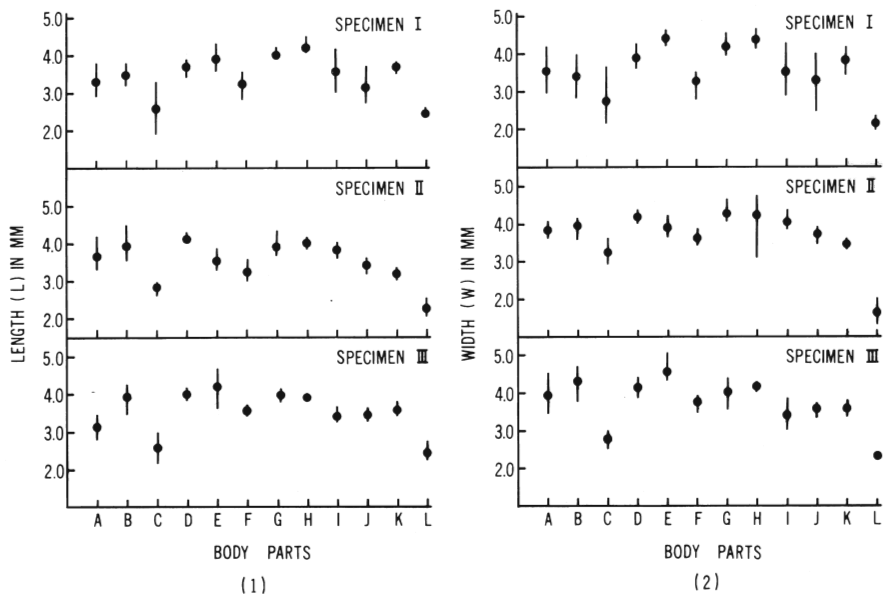


Fig. 3. Ranges and means of scale-sizes (L and W) on different body parts in each specimen. Solid circles show means.

(3) Anterior radius (Appendix Table 3) : The maximums of the anterior radii are shown in the part G (sp. I), the part D (sp. II ; sp. III), whereas the minimums are shown in the part C (sp. I ; sp. III) and the part L (sp. II). The maximums of the coefficients of variation in the anterior radii within each part occurred on the part C (sp. I), the parts F and G (sp. II), and the part D (sp. III), whereas the minimums occurred on the part K (sp. I ; sp. II ; sp. III).

(4) Posterior radius (Appendix Table 4) : The maximums of the posterior radii are shown in the part H (sp. I), the part B (sp. II) and the part E (sp. III), whereas the minimums are shown in the part C (sp. I ; sp. III) and the part L (sp. II). The maximums of the coefficients of variation in the posterior radii within each part occurred on the part C (sp. I ; sp. III) and the part L (sp. II), whereas the minimums occurred on the part H (sp. I ; sp. II) and the part F (sp. III).

In short, the scales from each body part differed greatly in shape and size. They were larger and uniform in the central and ventral body side (the parts E, G and H in Fig. 1), and smaller near the head and the tail, and near the dorsal edge of the body side (the parts C, K and L).

Mark-sizes : The mark-size was measured from the focus to the outside

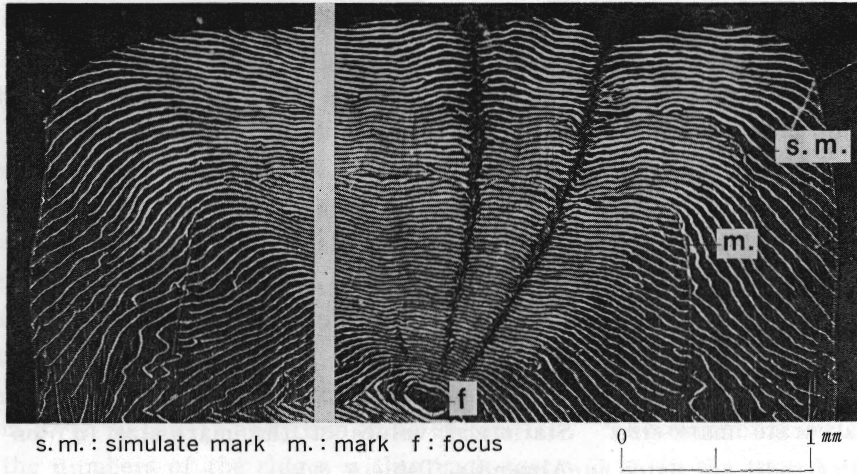


Fig. 4. Mark and "simulate mark" on a scale sampled from the body part H of the specimen I.

of the ridge first surrounding the discontinuity or break in the ridges. On the other hand, it was found that another mark was incompletely formed near one mark in some portion on a few scales (Fig.4). The incomplete mark was herein named "simulate mark" and rejected for the purpose of measuring the accurate mark-size.

Next, the formation rates of the simulate marks on the four measured axes were examined (Table 2). The simulate marks on the antero-lateral

Table 2. Formation rates of simulate marks on scales sampled from different body parts in each specimen (%).

Measured axes	Specimens	Body parts											
		A	B	C	D	E	F	G	H	I	J	K	L
P	I	0	0	0	0	0	0	0	20	60	0	60	0
	II	0	0	0	0	0	20	0	0	80	0	0	0
	III	0	60	0	0	0	0	60	40	0	0	0	0
Q	I	0	0	0	0	0	0	0	0	0	0	40	0
	II	0	0	0	0	0	0	0	0	40	0	0	0
	III	0	0	0	0	0	0	40	20	0	0	0	0
R	I	0	0	0	0	0	0	40	40	20	0	60	0
	II	0	0	0	0	0	20	0	0	60	0	20	0
	III	20	80	0	0	0	0	40	20	0	0	0	0
S	I	0	0	0	0	0	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	20	0	0	0	0	0

radii (P ; R) appeared in the parts A, B, F, G, H, I and K, where their formation rates were relatively higher. On the anterior and posterior radii (Q ; S), they appeared in the parts G, H, I and K, where their formation rates were lower. Therefore, the anterior and posterior radii were selected and the formation rates of the marks on these radii were examined. As shown in Table 3, the formation rates of the marks on the anterior radii were 100 percent in all parts of each specimen, whereas the formation rates of the marks on the posterior radii were considerably lower. It was evident that the lower formation rates of the marks on the posterior radii were caused by a blank or diminution of the ridges in the posterior fields on the scales. Consequently, the anterior radii were the most suitable axes for measuring the accurate mark-size. Statistical values of the mark-size (q) on the anterior radii are listed in Appendix Table 5.

The maximums of the mark-sizes are shown in the part G (sp. I) and the part D (sp. II ; sp. III), whereas the minimums are shown in the part C (sp. I) and the part L (sp. II ; sp. III). The minimums of the coefficients of variation in the mark-sizes within each part occurred on the part H (sp. I), the part K (sp. II) and the part A (sp. III).

Table 3. Formation rates of marks on scales sampled from different body parts in each specimen (%).

Measured axes	Specimens	Body parts											
		A	B	C	D	E	F	G	H	I	J	K	L
Q	I	100	100	100	100	100	100	100	100	100	100	100	100
	II	100	100	100	100	100	100	100	100	100	100	100	100
	III	100	100	100	100	100	100	100	100	100	100	100	100
S	I	60	100	100	0	100	100	60	100	100	100	80	60
	II	0	100	100	0	100	100	100	100	100	100	100	80
	III	20	100	60	60	100	100	100	100	100	100	100	80

Statistical values of the ratios of the mark-sizes to the anterior radii are listed in Appendix Table 6. The ratios among the parts of each specimen did not differ greatly. The coefficients of variation in the ratios within each part were smaller. Consequently, it seemed that the marks were formed in the relatively equal positions on the scales from the different body parts.

Numbers of ridges : The ridges were formed clearly in the anterior field on the scales from all parts. Hence, the statistical values of the numbers of the ridges crossing the anterior radii and the mark-sizes on the scales are listed in Appendix Tables 7 and 8.

The numbers of the ridges crossing the anterior radii varied from 46 to 86 (sp. I), from 42 to 86 (sp. II) and from 47 to 88 (sp. III). The means of the numbers of the ridges ranged from 52 to 77 (sp. I), from 47 to 79 (sp. II) and from 54 to 86 (sp. III). The maximum difference of the numbers of the ridges within each part was 31 in the part A (sp. I), 21 in the part F (sp. II) and 22 in the part B (sp. III), whereas the minimum difference was 5 in the parts F and H (sp. I), 6 in the part C (sp. II) and 4 in the parts G, H and L (sp. III). The numbers of the ridges crossing the mark-size varied from 29 to 57 (sp. I), from 21 to 54 (sp. II) and from 29 to 53 (sp. III).

The means of the numbers of the ridges ranged from 33 to 52 (sp. I), from 27 to 50 (sp. II) and from 32 to 50 (sp. III). The maximum difference of the numbers of the ridges within each part was 28 in the part A (sp. I), 12 in the part A (sp. II) and 14 in the part I (sp. III), whereas the minimum difference was 4 in the parts G, H and K (sp. I), 1 in the part C (sp. II) and 3 in the part L (sp. III).

In short, there were considerable variations in the numbers of the ridges crossing the anterior radii and the mark-sizes on the scales from each part.

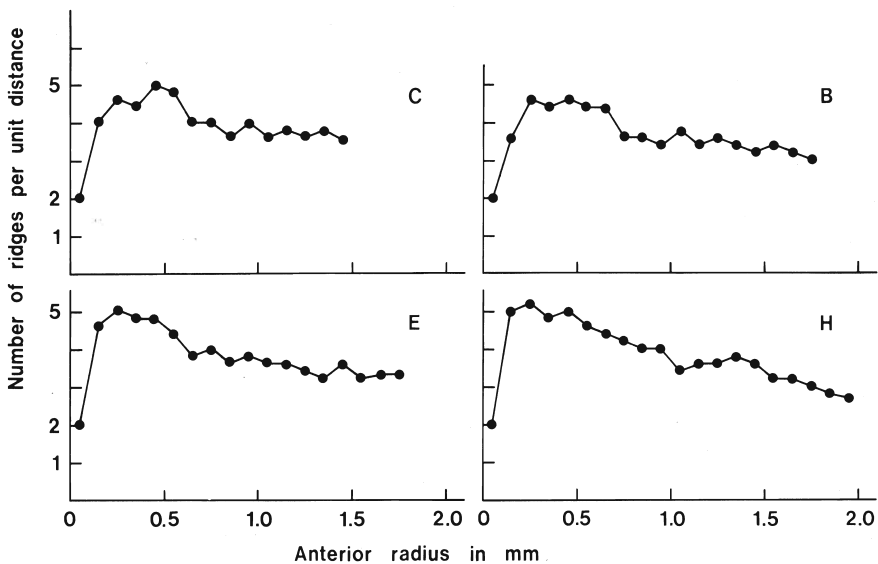


Fig 5. Variations in mean numbers of ridges per unit distance according to the anterior radius in the parts B,C,E and H of the specimen II.

The variations in the mean numbers of the ridges per unit distance according to the anterior radii in the parts B,C,E and H of the specimen II are shown in Fig. 5. It was obvious that the mean numbers of the ridges per unit distance decreased as the anterior radius grew larger, after they ranged from the minimum value near the focus to the maximum value, as

seen in other specimens.

Strictly speaking, their variations were slightly different in the body part, though a pattern or tendency of their variations was almost constant in any body part.

Discussion

The relations between the means of the lengths and the means of the widths of the scales from each part in the specimens I and II are shown in Fig. 6. The means of the widths were somewhat larger than the means of the lengths except for the parts B, I and L, as seen in the specimen III. Although the variations of the antero-lateral radii with the body parts were not examined, it is presumable from the above observations that a constant tendency is revealed in the variations of the scale-sizes on the scales.

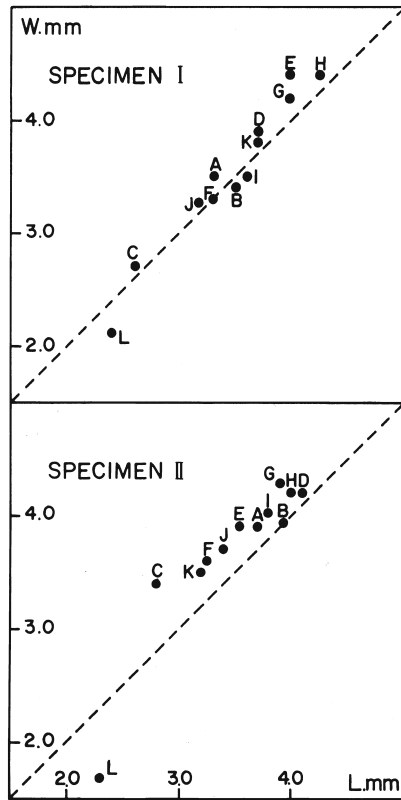


Fig. 6. Relationship between the means of the length (L) and the means of the width (W) of scales from each part in the specimens I and II.

For an accurate estimation of the age and growth of the older scad, it is necessary to investigate the time of the formation of the mark on the scales, the relationship between the body length and the mark-size, and

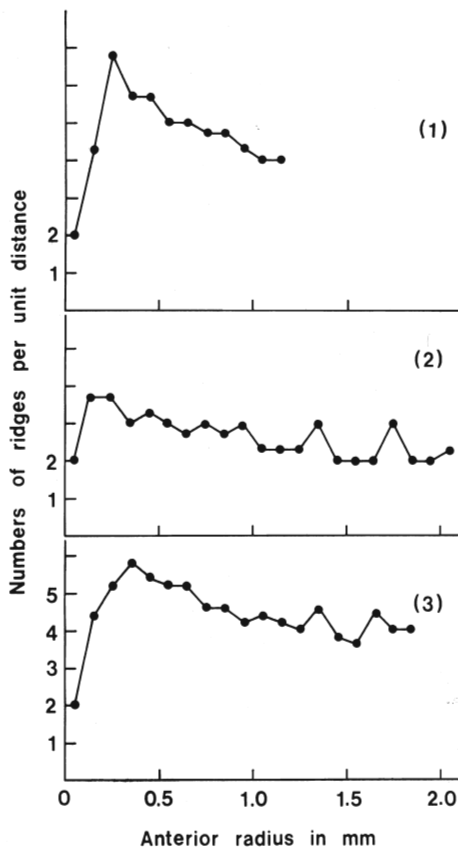


Fig. 7. Variations in mean numbers of ridges per unit distance according to the anterior radii on the scales from the same parts E in the specimens of the other species of scad and jack mackerel. (1) a specimen, *Decapterus muroadsi* (TEMMINCK et SCHLEGEL), caught on 25 June, 1969, off Sakai City, 296 mm in fork length; (2) *Decapterus russelli* (RÜPPEL), collected on 21 June, 1969, at Sakai City, 308 mm in fork length; (3) *Trachurus japonicus* (TEMMINCK et SCHLEGEL), caught on 1 April, 1968, off Niigata City, 237 mm in fork length.

the significance of the simulate marks.

The variations in the mean numbers of the ridges per unit distance according to the anterior radii on the scales from the same part E in the specimens of the other species of the scad, *Decapterus muroadsi* (TEMMINCK et SCHLEGEL), *D. russelli* (RÜPPEL), and the jack mackerel, *Trachurus japonicus* (TEMMINCK et SCHLEGEL), are shown in Fig. 7. The variations in these species are more or less different, though a pattern or tendency of them show some similarities.

It is uncertain whether they show only individual variations or a specific pattern of variations. Consequently, it is conceivable from the above observa-

tions that the changes of the early growth of these fishes are reflected on the variations of the density of the ridge, as reported by Mio (1995).

The scale-sizes, mark-sizes and numbers of ridges on the scales from the parts behind the base of the pectoral fin or near the central body side are larger and more uniform. It is concluded that the most suitable body parts for scale sampling are these parts.

Summary

- (1) Some scale patterns of three specimens of the scad, *Decapterus maruadsi* (TEMMINCK et SCHLEGEL), are described and their variations with the different body parts are examined.
- (2) The scales sampled from 12 body parts divided on the left body side except the scutes differed greatly in shape and size. In general, they are larger and more uniform in the central and ventral body side, but smaller near the head and the tail, and near the dorsal edge of the body side.
- (3) The marks on the scales from each part are indicated by the discontinuity or break in the ridges. It seemed that these marks on the scales from the same individual are formed in relatively equal positions on the anterior radii.
- (4) There are considerable variations in the numbers of the ridges crossing the anterior radii and the mark-sizes on the scales from each body part.
- (5) The most suitable body parts for routine scale sampling are the parts behind the base of the pectoral fin or near the central body side.

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マルアジ鱗相の採鱗部位による変異

鈴木 智 之

要 約

ムロアジ属のマルアジ *Decapterus maruadsi* (TEMMINCK et SCHLEGEL) は日本海でもまき網や定置網で、しばしば、マアジ・マサバとともに漁獲されるが、この魚種の生物学的知見は少なく、年令と成長に関する情報も得られてない。著者はマルアジの初期の成長過程を推定する目的で、鱗相を詳細に観察することを試みた。この報告では、採鱗に最も適した部位を定めるために、部位による鱗相の変異を検討した。

供試魚としては、1968年10月16日に京都府宮津市栗田沖の定置網で漁獲された尾又長216mm (♂)、224mm (♂)、218mm (♀) の3尾を用いた。体側表面を12部位にわけ各部位から楕鱗をのぞいて10~20枚ずつの鱗を採取した。採取した鱗を5%のKOHに浸漬して表面の粘液を除去した後、十分に水洗し2枚のスライドガラスにはさみ、投影機によつて20~50倍に拡大して観察した。鱗の中心付近の隆起線が欠けて再生鱗とみなされるものは除外し、各部位5枚ずつ正常な鱗をえらんで、形状、標示径、隆起線数を調べた。

正常鱗はほぼ五角形状の薄板で、鱗面の構造には円鱗としての一般的特徴が多く認められた。これらの鱗は体側面の中央から腹側の部位で大きく、背側・頭側・尾側に向つて小さくなる傾向が認められた。鱗面に形成された標示はとくに鱗の前域から側域にかけて隆起線の不連続または断ち切りとして認められた。この標示は同一個体内ではどの部位においても、相対的にはほぼ等しい位置にあつた。前域における隆起線数は部位内・部位間での変動が大きかつた。前方径を切る単位間隔内隆起線数は鱗の成長にともなつて変動するが、同一個体内の体側中央部ではほぼ一定の変動傾向を示した。採鱗部位としては胸びれ基部の後または体側中央部が最適であつた。

Appendix Table 1. Statistical values of length (L) of scale sampled from different body parts in each specimen.
S. D., standard deviations ; C. V., coefficients of variation.

Specimens	Body parts	Length (mm)			
		Ranges	Means	S. D.	C. V.
I	A	2.93-3.80	3.33	0.325	0.098
	B	3.23-3.80	3.53	0.207	0.059
	C	1.93-3.33	2.64	0.615	0.233
	D	3.40-3.88	3.66	0.178	0.049
	E	3.63-4.27	3.98	0.259	0.065
	F	2.78-3.55	3.26	0.289	0.089
	G	3.90-4.18	3.99	0.129	0.032
	H	4.15-4.45	4.25	0.125	0.030
	I	3.03-4.15	3.59	0.515	0.143
	J	2.73-3.73	3.17	0.367	0.116
	K	3.53-3.80	3.70	0.104	0.028
	L	2.36-2.55	2.44	0.071	0.029
II	A	3.30-4.20	3.73	0.375	0.101
	B	3.58-4.50	3.94	0.360	0.091
	C	2.60-2.95	2.84	0.139	0.049
	D	4.00-4.25	4.13	0.102	0.025
	E	3.30-3.88	3.55	0.264	0.074
	F	3.00-3.60	3.25	0.233	0.071
	G	3.68-4.33	3.94	0.265	0.067
	H	3.88-4.15	4.02	0.124	0.031
	I	3.61-4.03	3.81	0.159	0.042
	J	3.18-3.63	3.40	0.202	0.059
	K	3.03-3.30	3.22	0.110	0.034
	L	2.06-2.54	2.28	0.186	0.082
III	A	2.83-3.45	3.16	0.236	0.075
	B	3.45-4.25	3.92	0.325	0.083
	C	2.18-3.00	2.61	0.375	0.144
	D	3.85-4.18	4.00	0.118	0.029
	E	3.65-4.70	4.22	0.399	0.094
	F	3.43-3.73	3.58	0.145	0.040
	G	3.81-4.17	3.96	0.133	0.034
	H	3.85-4.00	3.91	0.069	0.018
	I	3.25-3.65	3.43	0.160	0.047
	J	3.25-3.63	3.47	0.157	0.045
	K	3.41-3.80	3.57	0.153	0.043
	L	2.28-2.74	2.48	0.169	0.068

Appendix Table 2. Statistical values of width (W) of scales sampled from different body parts in each specimen.
S.D., standard deviations ; C. V., coefficients of variation.

Specimens	Body parts	Width (mm)			
		Ranges	Means	S. D.	C. V.
I	A	2.98-4.18	3.54	0.511	0.144
	B	2.83-3.93	3.43	0.395	0.115
	C	2.15-3.68	2.74	0.652	0.238
	D	3.63-4.28	3.90	0.241	0.062
	E	4.21-4.58	4.40	0.024	0.005
	F	2.75-3.50	3.26	0.214	0.066
	G	3.95-4.55	4.19	0.229	0.055
	H	4.10-4.63	4.37	0.223	0.051
	I	2.85-4.25	3.51	0.614	0.175
	J	2.45-3.98	3.27	0.550	0.168
	K	3.43-4.12	3.80	0.258	0.068
	L	1.96-2.38	2.13	0.170	0.080
	II	A	3.68-4.10	3.86	0.169
B		3.60-4.15	3.94	0.259	0.066
C		2.95-3.68	3.39	0.299	0.088
D		4.08-4.40	4.20	0.139	0.033
E		3.65-4.23	3.93	0.238	0.061
F		3.40-3.85	3.62	0.188	0.052
G		4.05-4.68	4.28	0.242	0.057
H		3.13-4.75	4.21	0.629	0.149
I		3.88-4.35	4.05	0.192	0.047
J		3.45-3.90	3.70	0.188	0.051
K		3.30-3.63	3.47	0.145	0.042
L		1.34-2.00	1.68	0.256	0.153
III		A	3.48-5.13	3.99	0.657
	B	3.75-4.73	4.31	0.357	0.083
	C	2.50-3.00	2.80	0.020	0.007
	D	3.88-4.35	4.12	0.185	0.045
	E	4.35-5.08	4.57	0.295	0.065
	F	3.48-3.90	3.78	0.187	0.049
	G	3.58-4.38	4.02	0.290	0.072
	H	4.00-4.29	4.20	0.116	0.028
	I	3.00-3.85	3.41	0.337	0.099
	J	3.35-3.70	3.59	0.139	0.039
	K	3.38-3.80	3.55	0.169	0.048
	L	2.25-2.33	2.30	0.030	0.013

Appendix Table 3. Statistical values of anterior radius (Q) on scales sampled from different body parts in each specimen.
S.D., standard deviations ; C. V., coefficients of variation.

Specimens	Body parts	Q (mm)			
		Ranges	Means	S. D.	C. V.
I	A	1.73-2.16	1.97	0.162	0.082
	B	1.42-1.79	1.66	0.151	0.091
	C	0.91-1.73	1.33	0.357	0.269
	D	1.80-2.21	1.93	0.170	0.088
	E	1.66-2.01	1.87	0.131	0.070
	F	1.46-1.71	1.56	0.097	0.062
	G	1.95-2.25	2.07	0.112	0.054
	H	1.90-2.10	2.00	0.080	0.040
	I	1.59-1.97	1.78	0.176	0.099
	J	1.75-1.88	1.63	0.169	0.103
	K	1.43-1.89	1.81	0.048	0.026
	L	1.10-1.41	1.26	0.110	0.087
II	A	1.88-2.15	1.97	0.106	0.054
	B	1.69-1.95	1.82	0.117	0.064
	C	1.40-1.54	1.47	0.060	0.041
	D	2.28-2.60	2.47	0.143	0.058
	E	1.72-1.96	1.85	0.101	0.055
	F	1.55-1.94	1.75	0.160	0.092
	G	1.88-2.35	2.07	0.190	0.092
	H	1.97-2.20	2.09	0.098	0.047
	I	2.00-2.18	2.10	0.079	0.038
	J	1.60-2.04	1.85	0.159	0.086
	K	1.70-1.84	1.77	0.052	0.029
	L	1.06-1.35	1.21	0.107	0.088
III	A	1.68-1.85	1.78	0.063	0.035
	B	1.59-2.33	1.94	0.280	0.144
	C	1.20-1.60	1.35	0.176	0.130
	D	1.60-2.40	2.09	0.311	0.149
	E	1.89-2.22	2.07	0.122	0.059
	F	1.69-1.96	1.82	0.132	0.072
	G	2.15-2.30	2.20	0.063	0.029
	H	1.92-2.10	2.01	0.065	0.033
	I	1.64-1.86	1.77	0.090	0.051
	J	1.73-1.87	1.80	0.062	0.034
	K	1.83-1.96	1.92	0.054	0.028
	L	1.26-1.49	1.33	0.096	0.073

Appendix Table 4. Statistical values of posterior radius (S) on scales sampled from different body parts in each specimen. S.D., standard deviations; C. V., coefficients of variation.

Specimens	Body parts	S (mm)			
		Ranges	Means	S. D.	C. V.
I	A	1.20-1.82	1.50	0.252	0.169
	B	1.72-1.90	1.81	0.068	0.037
	C	1.01-1.60	1.31	0.273	0.208
	D	1.68-2.06	1.86	0.143	0.077
	E	1.89-2.30	2.08	0.178	0.086
	F	1.30-1.86	1.70	0.226	0.133
	G	1.87-2.09	2.02	0.093	0.046
	H	2.21-2.34	2.27	0.051	0.023
	I	1.45-2.28	1.86	0.376	0.203
	J	1.80-2.10	1.94	0.111	0.057
	K	1.30-1.90	1.57	0.221	0.141
	L	1.13-1.26	1.18	0.048	0.041
	II	A	1.43-2.06	1.75	0.236
B		1.82-2.65	2.07	0.332	0.160
C		1.14-1.58	1.40	0.165	0.118
D		1.75-1.93	1.84	0.079	0.043
E		1.53-1.96	1.69	0.178	0.105
F		1.44-1.77	1.55	0.131	0.084
G		1.78-2.10	1.92	0.272	0.141
H		1.88-2.06	1.96	0.068	0.035
I		1.71-2.03	1.80	0.135	0.075
J		1.49-1.77	1.67	0.113	0.068
K		1.47-1.65	1.55	0.070	0.045
L		0.93-1.39	1.08	0.179	0.166
III		A	1.14-1.62	1.43	0.196
	B	1.88-2.35	2.11	0.228	0.108
	C	1.01-1.56	1.28	0.215	0.168
	D	1.69-2.24	1.91	0.214	0.112
	E	1.75-2.47	2.16	0.292	0.135
	F	1.79-1.81	1.80	0.007	0.004
	G	1.70-2.00	1.87	0.132	0.070
	H	1.86-1.99	1.94	0.175	0.090
	I	1.60-1.83	1.68	0.103	0.061
	J	1.48-1.78	1.68	0.123	0.074
	K	1.58-1.92	1.74	0.122	0.070
	L	1.02-1.27	1.13	0.093	0.082

Appendix Table 5. Statistical values of mark-size (q) on scales sampled from different body parts in each specimen.
S. D., standard deviations C. V., coefficients of variation.

Specimens	Body parts	q (mm)			
		Ranges	Means	S. D.	C. V.
I	A	1.05-1.30	1.20	0.113	0.094
	B	0.89-1.17	1.03	0.126	0.123
	C	0.64-1.01	0.83	0.175	0.211
	D	1.13-1.34	1.20	0.090	0.075
	E	1.03-1.18	1.14	0.064	0.056
	F	0.89-1.08	0.99	0.079	0.080
	G	1.16-1.40	1.24	0.096	0.078
	H	1.16-1.26	1.23	0.044	0.036
	I	0.94-1.21	1.09	0.111	0.102
	J	0.93-1.06	1.01	0.054	0.053
	K	1.03-1.16	1.10	0.051	0.046
	L	0.67-0.86	0.76	0.069	0.091
II	A	1.18-1.35	1.23	0.068	0.055
	B	1.04-1.22	1.10	0.071	0.065
	C	0.92-1.04	0.99	0.050	0.051
	D	1.38-1.60	1.50	0.093	0.062
	E	1.04-1.19	1.12	0.073	0.065
	F	0.91-1.20	1.03	0.109	0.106
	G	1.01-1.48	1.23	0.181	0.147
	H	1.23-1.36	1.29	0.059	0.046
	I	1.16-1.30	1.25	0.055	0.044
	J	1.08-1.32	1.23	0.090	0.073
	K	1.10-1.13	1.11	0.013	0.012
	L	0.68-0.81	0.69	0.123	0.179
III	A	0.92-1.04	0.99	0.054	0.003
	B	0.90-1.32	1.14	0.172	0.151
	C	0.67-0.89	0.76	0.101	0.132
	D	0.89-1.35	1.21	0.193	0.160
	E	1.00-1.21	1.14	0.083	0.072
	F	0.94-1.11	1.03	0.079	0.020
	G	1.13-1.31	1.19	0.073	0.062
	H	1.12-1.19	1.16	0.027	0.023
	I	0.94-1.05	1.00	0.046	0.046
	J	0.96-1.05	1.00	0.043	0.043
	K	1.04-1.10	1.08	0.025	0.023
	L	0.66-0.81	0.71	0.056	0.079

Appendix Table 6. Statistical values of ratios of mark-size (q) to anterior radius (Q) on scales sampled from different body parts in each specimen. S. D., standard deviation; C. V., coefficients of variation.

Specimens	Body parts	q/Q			
		Ranges	Means	S. D.	C. V.
I	A	0.541-0.751	0.610	0.085	0.140
	B	0.549-0.654	0.616	0.040	0.065
	C	0.562-0.714	0.633	0.056	0.089
	D	0.606-0.633	0.622	0.011	0.017
	E	0.582-0.638	0.611	0.020	0.033
	F	0.610-0.665	0.634	0.020	0.032
	G	0.579-0.622	0.599	0.017	0.029
	H	0.600-0.623	0.615	0.010	0.016
	I	0.591-0.626	0.611	0.014	0.022
	J	0.550-0.646	0.623	0.041	0.065
	K	0.575-0.626	0.610	0.020	0.033
	L	0.579-0.611	0.603	0.014	0.023
	II	A	0.611-0.639	0.625	0.011
B		0.533-0.639	0.605	0.044	0.073
C		0.634-0.714	0.674	0.029	0.043
D		0.596-0.615	0.605	0.008	0.013
E		0.591-0.624	0.604	0.013	0.021
F		0.469-0.652	0.595	0.074	0.124
G		0.521-0.628	0.592	0.044	0.073
H		0.618-0.624	0.620	0.003	0.004
I		0.580-0.644	0.605	0.025	0.041
J		0.649-0.675	0.663	0.012	0.018
K		0.614-0.647	0.628	0.014	0.024
L		0.462-0.616	0.565	0.061	0.018
III		A	0.523-0.575	0.558	0.020
	B	0.549-0.680	0.587	0.054	0.093
	C	0.556-0.578	0.564	0.010	0.019
	D	0.550-0.662	0.578	0.047	0.082
	E	0.529-0.578	0.553	0.019	0.034
	F	0.556-0.576	0.565	0.009	0.015
	G	0.523-0.570	0.541	0.018	0.033
	H	0.562-0.620	0.580	0.023	0.040
	I	0.538-0.591	0.566	0.023	0.041
	J	0.544-0.571	0.558	0.010	0.018
	K	0.551-0.573	0.563	0.009	0.016
	L	0.522-0.556	0.538	0.014	0.027

Appendix Table 7. Numbers of ridges crossing the anterior radius (Q) on scales from different body parts in each specimen. S. D., standard deviations; C. V., coefficients of variation.

Specimens	Body parts	Numbers of ridges			
		Ranges	Means	S. D.	C. V.
I	A	51-82	63	13.9	0.220
	B	55-63	61	3.2	0.053
	C	46-71	59	12.3	0.208
	D	69-77	72	3.3	0.046
	E	65-79	73	5.8	0.079
	F	62-67	64	1.9	0.030
	G	73-79	77	2.7	0.035
	H	73-78	76	1.9	0.025
	I	65-81	72	6.4	0.089
	J	59-86	67	11.0	0.165
	K	72-78	74	2.7	0.036
	L	46-58	52	4.3	0.082
II	A	51-67	56	6.6	0.117
	B	58-75	67	7.2	0.109
	C	56-62	58	2.4	0.041
	D	70-83	78	5.4	0.069
	E	61-77	69	6.7	0.096
	F	61-82	69	7.7	0.112
	G	70-86	79	6.2	0.078
	H	67-79	73	4.4	0.060
	I	72-82	78	3.7	0.047
	J	62-70	67	3.7	0.056
	K	67-77	73	4.3	0.059
	L	42-53	47	4.9	0.104
III	A	47-67	54	8.6	0.161
	B	66-88	76	9.0	0.118
	C	57-73	63	6.9	0.110
	D	62-83	74	7.6	0.103
	E	79-88	84	3.7	0.044
	F	73-85	79	5.9	0.074
	G	83-87	86	1.6	0.019
	H	78-82	80	1.6	0.021
	I	68-84	77	5.9	0.076
	J	75-84	79	3.3	0.041
	K	68-76	74	3.5	0.047
	L	56-60	57	1.5	0.026

Appendix Table 8. Numbers of ridges crossing the mark-size (q) on scales from different body parts in each specimen.
S. D., standard deviations ; C.V., coefficients of variation.

Specimens	Body parts	Numbers of ridges			
		Ranges	Means	S. D.	C. V.
I	A	29-57	40	12.5	0.313
	B	38-43	41	1.9	0.047
	C	32-47	38	6.1	0.159
	D	46-52	49	2.5	0.050
	E	44-52	49	3.0	0.061
	F	42-48	45	2.2	0.050
	G	49-53	51	1.5	0.029
	H	49-53	52	1.7	0.033
	I	42-54	48	4.5	0.094
	J	39-50	44	4.7	0.106
	K	48-52	49	1.6	0.032
	L	29-37	33	2.9	0.088
II	A	29-41	36	4.4	0.122
	B	39-48	43	3.4	0.079
	C	39-40	40	0.4	0.011
	D	43-53	50	4.2	0.085
	E	40-49	45	3.6	0.079
	F	41-48	44	2.8	0.063
	G	47-54	50	2.9	0.058
	H	46-53	49	2.7	0.055
	I	48-52	50	1.8	0.036
	J	44-50	47	2.3	0.048
	K	46-52	49	2.4	0.049
	L	21-32	27	4.5	0.056
III	A	29-41	33	5.0	0.152
	B	41-52	47	4.6	0.096
	C	33-41	36	3.8	0.104
	D	37-50	43	4.9	0.114
	E	46-52	50	2.4	0.047
	F	44-50	47	2.8	0.060
	G	49-53	50	1.7	0.033
	H	48-52	50	1.6	0.032
	I	35-49	44	5.8	0.131
	J	46-50	47	2.2	0.046
	K	41-47	45	2.2	0.050
	L	31-34	32	1.3	0.041