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ON AGE AND RACE OF SOME SALMONID FISHES

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1 Sockeye Salmon, *Oncorhynchus nerka* (Walbaum)

Two races are distinguishable among the sockeye salmons caught around Kamtchatka; the east coast race and the west coast race (Yokoyama and Hanai, 1931, 32'). The east coast race ascends Kamtchtka River to spawn and appears near land soon after the beginning of the fishing season, whereas the west coast race which migrates into the tributaries of the Ozernaya River, appears after May, somewhat later than the east coast race. The characteristics of the scale pictures of the two races are markedly different.

There are three scale types, such as A-, B- and C-. In A-type scale, the bands of wide ridges (growth zone) and those of narrow ridges (winter zone) are arranged alternately outwards just from the nucleus of scale. While, both B- and C-type scales are provided with stream zone in the central portion, which is finely ridged and formed during the stream life as parr. Outside this zone, the growth zones and winter zones are present alternately. It is assumed from the scale pictures that the specimen with A-type scale will migrate into the sea early at fry stage, whereas those of B-type scale with wide stream zone will begin seaward migration as parr of 2-age, and those of C-type with narrow stream zone will leave the stream as parr of 1-age. The specimen with the A-type scale, which are predominant among the catches along the east coast of Kamtchatka, especially near Kamtchatka

River, is called the east coast race. The specimen with the C-type scale becomes dominant in catches toward the end of the fishing season., appearing later in fishing grounds off the east coast, from whence they migrate into the Okhotsk Sea. Thus, they are known as the west coast race. The specimen with the B-type scale are evident in all fishing grounds during the entire season, although in relatively small numbers.

These scale types are also related to several transitional types, such as B_1-, B_2- AB-, etc., although these are never clearly defined. An effort has been made to numerically define these scale types. The semi-diameter of the first rings (r_1 mm), the total length of scale (T mm) along the longitudinal axis in the covered portion of scale, and similarly the semi-diameter of the stream zone are all measured, and also the number of ridges within them is counted. On observing the relation between the semi-diameter and the number of ridges (see fig. 1), we found three isolated groups and their average values of semi-diameter and the average number of ridges as indicated below.

Scale type	Semi-diameter	Number of ridges
A - type scale	129.7±13.0	28.1±1.9
B - type scale	72.1± 9.5	21.5±1.6
C - type scale	53.2± 7.1	17.7±2.1

Reliabilities of differences between these average values are computed below

Scale type	Semi-diameter		Number of ridges	
	B - type scale	C - type scale	B-type scale	C-type scale
A - type scale	4.9	7.3	3.7	5.2
B - type scale	—	2.3	—	2.0

Thus, we see that A-type scale is markedly different in both values from the other two types, but B- and C-type scales differ only slightly, although the differences are never negligible. The frequency distribution of semi-diameter (fig. 2) and that of the number of ridges (fig. 3) show also respectively three isolated groups, and the transitional scale types are rather scarce as a whole, so that they can be considered as abnormal scale types.

B-type scales with wide stream zone and large number of ridges are also scarce, compared with those of the other two

types. Thus, it is assumed that the specimens with the B-type scale exist in a rather abnormal habitation, on the one hand spending a year more in the stream than those with the A-type scale and, on the other, leaving the stream life a year later than those with the C-type scale.

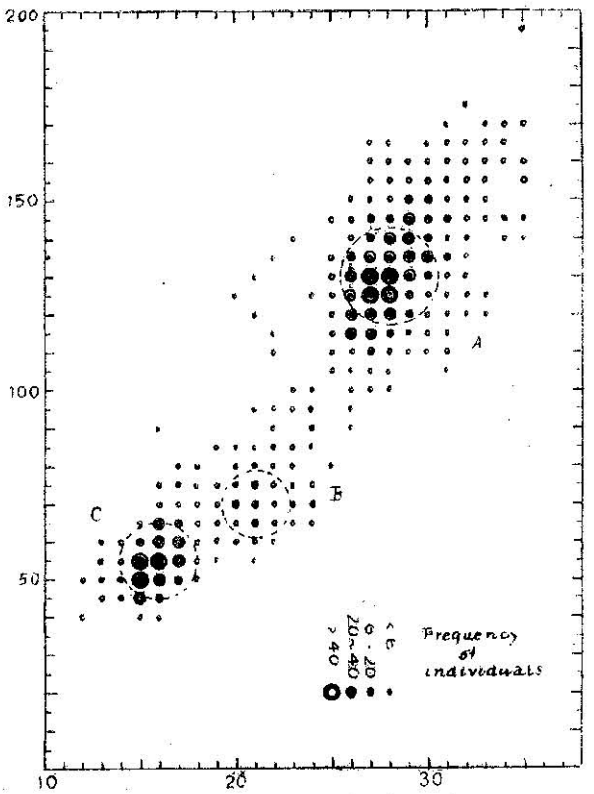

Fig. 1. Relation of semi-diameter of 1st. ring (A-type scale) and those of the stream zones (B- and C-type scales) with the number of ridges within them.

From the relation between the body-length (l cm) and the length of scale (T mm), the following equations are established (see fig. 4)

A-type race $l_n=0.107\ r_n+17.7$
B-type race $l_n=0.3\ r_n-44.0$
C-type race $l_n=0.266\ r_n-15.3$

where, r_n is the semi-diameter of the nth. ring. Measured values of r_n and calculated body-length (l cm) are tabulated in table 1.

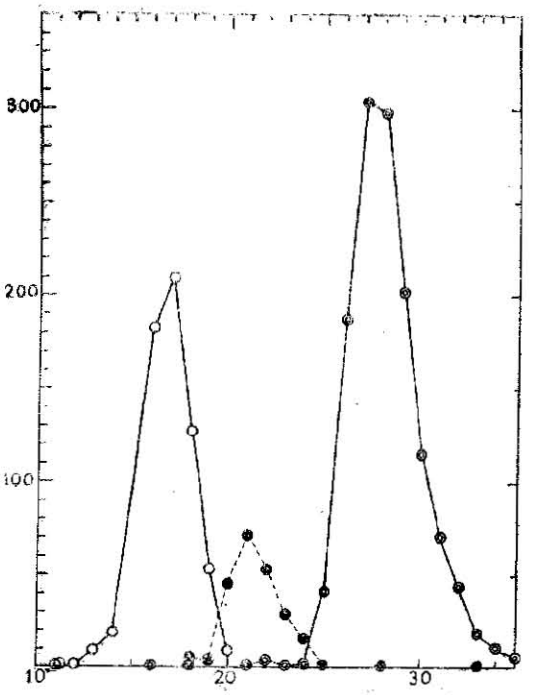

Fig. 2. Frequency distribution of the number of ridges within the 1st. year mark of A-type scale and within the stream zones of B- and C-type scales.

Lee's phenomenon is also observed in this case, as the body-length of the young age group becomes smaller, when it is calculated with the ring of the older age group. The reason why

Table. 1. *r and calculated l of each age group for different race*

age	A - type scale		B - type scale		C - type scale	
	r	*l*	*r*	*l*	*r*	*l*
0	120.0±13.9	12.8±1.8	—	—	50.0± 0.0	—
1	204.4±17.1	21.9±1.8	70.5± 1.5	—	149.6±14.3	24.5±2.4
II	271.7±23.3	29.1+2.5	184.5±14.3	11.4±1.3	225.4±21.5	44.7±4.3
III	305.0±11.7	32.8±1.3	244.2±21.4	29.3±2.4	279.9±26.9	59.2±5.7
IV	—	—	285.1±21.4	41.5±2.6	296.0± 0.0	63.7±0.0
V	—	—	312.3±18.6	49.7±2.2	—	—

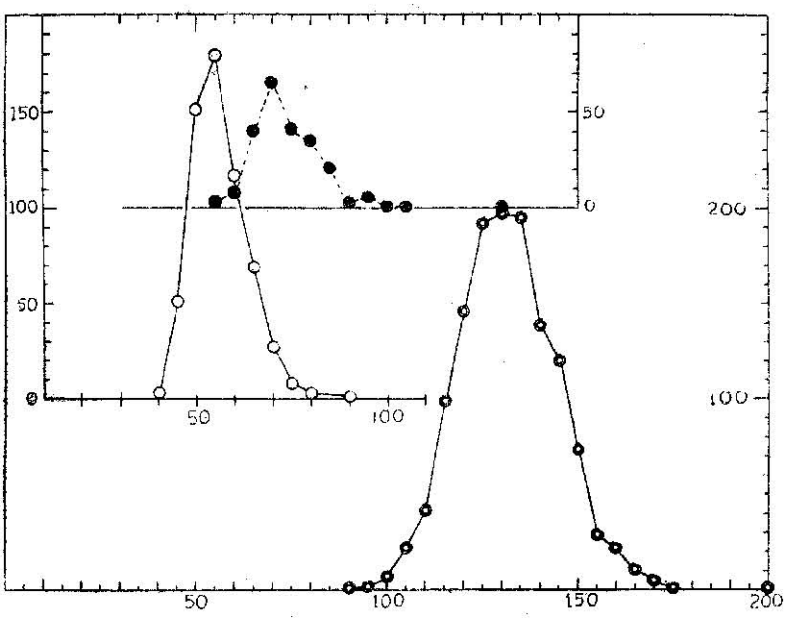

Fig. 3. Frequency distribution of the semi-diameter of the 1st. ring of A-type scale (◎) and those of the stream zone of B- (●) and C-type scales (○). (Sockeye salmon).

Lee's phenomenon occurs will be considered later. Observing the body-length of each age grup, it is evident that the A-type race develops slowly, the C-type quickly, and the B-type rather normally.

Among the catches taken in the northern Kurile Islands, the A-type specimens were predominant at the beginning of the fishing season, diminishing gradually as the season wore on, whereas the C-type specimens were very scarce at first, but gradually increased, until they comprised most of the catch at the close of the season. On the other hand, the B-type specimens remained nearly constant throughout the season.

2. King Salmon, *Oncorhynchus tschawytscha* (Walbaum)

From the measurements of 573 specimens of King salmon caught at the north fishing grounds of Katchatka River during

June and July in 1942, age was determined by the same method utilized for sockeye salmon. Scale of king salmon is of typical salmonid type, and the bands of wide ridges (growth zone) and

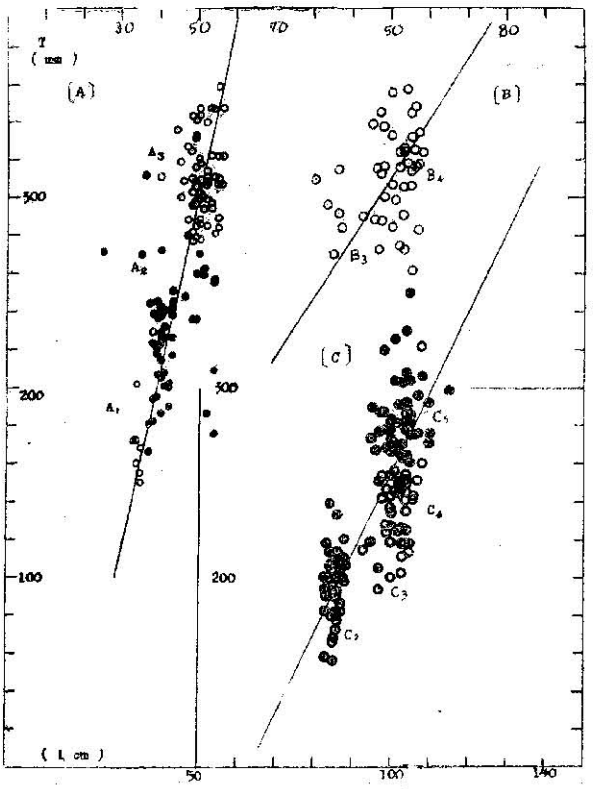

Fig. 4. Relation between the body-length (l cm) and the length of covered portion of scale (T mm) (Sockeye salmon).

those of narrow ridges (winter zone) are arranged alternately, forming distinct year marks. The number of ridges increases in accordance with the increase in scale size (T mm) and also in body-length (L cm) (see fig. 5)

From the frequency distribution of body-length ranging from 35 cm to 100 cm, it is evident that there occurs two dominant peaks at 58 cm and also at the range from 79 cm to 81 cm, and, in addition to these, two small peaks are present respectively, the one in the smaller range near 35 cm, and the other in the larger

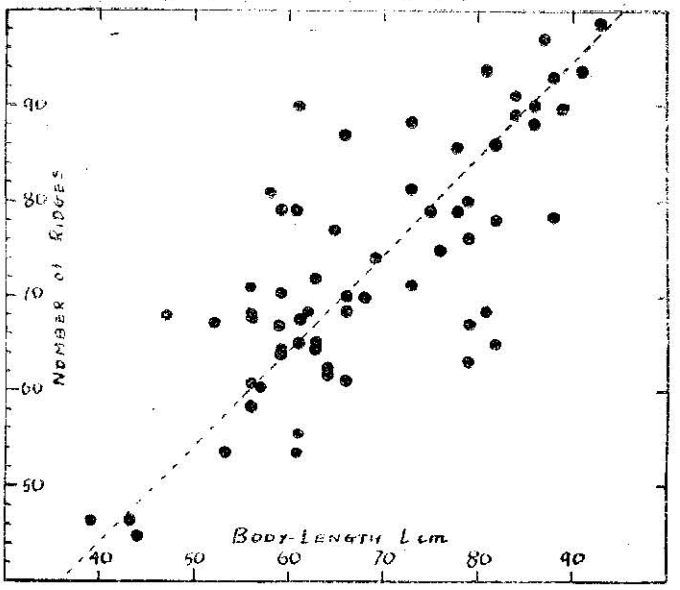

Fig. 5. Relation between the number of ridges and body-length (l cm). (Sockeye salmon)

range near 90 cm. It is also noticed from counting the number of year rings that four ring groups, such as 2–, 3–, 4– and 5– are present. The 2-ring group has a peak between 38 cm and and 41 cm, 3– between 56 cm and 59 cm, 4– between 77 cm and 79 cm, and 5– between 89 cm and 91 cm (fig. 6).

Table 2. *Frequency distribution of body-length*

l (cm)	Ring composition				l (cm)	Ring composition			
	2	3	4	sum		3	4	5	sum
35	2			2	68	4	5		9
36		1		1	69	5	5		10
37					70	4	14	1	19
38	2			2	71	3	8		11
39	2			2	72		9		9
40	1	1		2	73	4	9		13
41	2	2		4	74	2	13	1	16
42		1		1	75	1	13		14
43		1		1	76		13	1	14

44	1	1		2	77	4	16		20
45					78	2	15	1	18
46		1		1	79	1	19		20
47	1	4		5	80	1	7		8
48			1	1	81		10	1	11
49		2		2	82		12	2	14
50	1	6	1	8	83	2	6	2	10
51		4		4	84		6	1	7
52		6	1	7	85		7	4	11
53	11	11		11	86		4	2	6
54		8	1	9	87		5	2	7
55		19	1	20	88		7	1	8
56		25	4	29	89		5	5	10
57	1	21	2	24	90		4	4	8
58		27	4	31	91		1	6	7
59		28	2	30	92		2	2	4
60	1	14	3	18	93		1	3	4
61		17	2	19	94			2	2
62		12	1	13	95				
63		13	3	16	96			1	1
64		11	2	13	97				
65		10	5	15	98		1		1
66		9	6	15	99		1		1
67		3	5	8	100			2	2

From the relation of body-length (l cm) with the length of scale (T mm) of the covered portion, the following equations are established.

	male	female
2-ring groupe	$l_2=27.3\ r_2-\ 1.64$	—
3-ring groupe	$l_3=51.1\ r_3-51.2$	$l_3=172.0\ r_3-3628.8$
4-ring groupe	$l_4=51.3\ r_4-76.5$	$l_4=\ 27.2\ r_4-\ 2.7$
5-ring groupe	$l_5=24.0\ r_5+\ 5.6$	$l_5=\ 12.2\ r_5+\ 46.0$

Treated data all together, the equations are

Male $l_n=32.2\ r_n-16.0$
Femal $l_n=27.2\ r_n-\ 2.7$

Table 3. *Results of measurements of scales and body-lengths*

Age	Sex	Average	Measurement of scale				
		l (cm)	T (mm)	r_1 (mm)	r_2 (mm)	r_3 (mm)	r_4 (mm)
II	m	43.16±7.75	1.681±0.245	0.416±0.082	1.227±0.201		
	f	41.00	1.747	0.396	1.116		
III	m	59.00±6.08	2.175±0.212	0.383±0.079	1.079±0.147	1.828±0.204	
	f	67.00±8.31	2.242±0.226	0.379±0.030	1.104±0.077	1.831±0.203	
IV	m	74.21±9.85	2.978±0.236	0.381±0.031	1.088±0.144	1.822±0.172	2.560±0.21
	f	75.30±6.86	3.025±0.254	0.400±0.026	1.100±0.127	1.893±0.155	2.655±0.21
V	m	91.00±6.48	3.485±0.410	0.374±0.038	0.993±0.188	1.692±0.138	2.525±0.24
	f	88.60±3.74	3.545±0.547	0.393±0.060	1.022±0.064	1.764±0.254	2.528±0.37

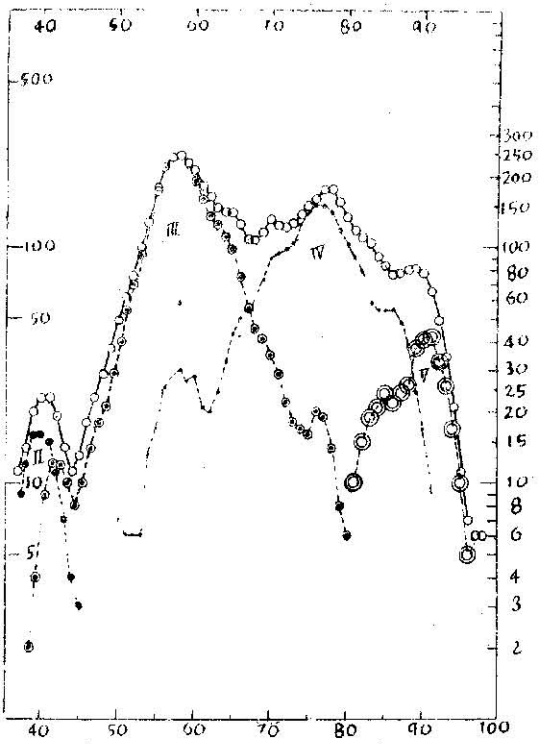

Fig. 6. Frequency distributions of body-length in total individuals and in each ring group.

The more adavanced the age becomes, the smaller the semi-diameter of the inner ring. Lee's phenomenon is also recognized

here. For the computation of body-length it is considered necessary to correct the above equations. However, the correction is rather useless, as Lee's phenomenon is not due to the error in measurement, but due to the ecological behaviour. The faster they grow, the earlier they join the migratory shoal. The older age group is predominantly a slow grower group. Then, the body-length, l_1-l_n cm, calculated from r_1-r_n of the same scale will indicate only the growth of this N-age group itself, but l_1 from r_1 of I-age group individual, l_2 from r_2 of 2-age, ... l_n from r_n of N-age will show the growth type of the shoal, to which they belong. Lee's phenomenon is a complex of two different growth phenomena.

The relation of body-weight (W kg) with body-length (l cm) is

$$W = 13.25 \times 10^{-3} \cdot l^{3.05}$$

then, the body-weight increases nearly proportionally with the cube of body-length. The minimum weight is also computable for each age group as is shown in Table 4.

Generally speaking, female specimens grow faster than male. On the contrary, male specimens apper earlier in the shoal, similar to behavorisms observed in the sockeye salmon, although the female specimen becomes more predominant among the older age group. Considered as a whole, the sex ratio is nearly 1 : 1

Table 4. *Body-length, body-weight, sex ratio and age composition of king salmon in Kamtchatka River*

Age	Sex	Body-length (cm)					W (Kg)	Sex ratio	Composition %
		l_1	l_2	l_3	l_4	l_5			
I	m	10.10							
	f	10.09							
II	m	10.68	31.42				0.48	6.8	
	f	9.30	26.20				0.33	1	2.0
III	m	10.38	29.25	49.60			1.18	3.7	
	f	11.30	33.00	54.70			1.68	1	40.0
IV	m	9.53	26.82	44.90	63.00		4.61	0.47	
	f	9.94	27.40	47.25	66.10		5.47	1	48.4
V	m	9.80	25.90	44.50	69.50	82.80	10.23	0.15	
	f	9.83	25.70	44.10	63.50	80.00	9.95	1	9.6

Table 5. *Body-weight (W Kg), gonad-weight (G Kg) and the factor (G/W)*

Age	Male				Female			
	l (cm)	*W* (Kg)	*G* (Kg)	*G/W*		*W* (Kg)	*G* (Kg)	*G/W*
II	43.2	2.86	0.056	0.020	41.0	1.50	0.780	0.520
III	59.0	3.69	0.127	0.037	67.0	5.82	0.480	0.082
IV	73.4	6.93	0.258	0.037	75.3	8.21	0.751	0.096
V	91.0	12.47	0.427	0.034	88.6	11.97	1.261	0.097

The factor, the gonad-weight devided by the body-weight, is similar and very small through all age groups, except the 2-age female group, so that the shoal here may not be a spawning shoal, but only a feeding one. When it is a spawning group, the older the age group the greater the factor. During June and July in 1942, the age composition of the catches remained constant, 3- and 4- age groups being generally prevalent, while 2- and 5-age groups were rather scarce. Considered also from the predominance of young age groups the shoal of king salmon in Kamtchatka River cannot therefore be a spawning group.

References

Sato, R. 1938, Bull. Jap. Soc. Sci. Fish., Vol. 7 No. 4; Yokoyama and Hanai, 1932, '32. Rep. Fish. Exper. Sta. Hokkaido.