

RESEARCH NOTE

Reproductive Characteristics of Mature Female Chum Salmon (*Oncorhynchus keta*) in the Pinacheva River, Kamchatka

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Abstract. — Reproductive characteristics were examined for mature female chum salmon (*Oncorhynchus keta*) collected in the Pinacheva River, Kamchatka, in August 1994. Age 0.4 fish (71.7%) were the most abundant age group, followed by age 0.3 (20.8%) and age 0.5 (7.5%) fish. Average fork lengths and body weights were: 61.1 cm and 2.8 kg for age 0.3 fish, 61.4 cm and 2.8 kg for age 0.4 fish, and 65.5 cm and 3.5 kg for age 0.5 fish, respectively. Absolute fecundity (AFC) and relative fecundity (RFC) showed a significant positive relationship with fork length (FL): $AFC = 8.16 \times FL - 3,006$ and $RFC = 0.081 \times FL - 17.33$. Egg diameter ranged from 7.10-8.75 (mean 7.88) mm. The relationship between fork length and egg diameter was not statistically significant.

Introduction

The Ketkino Salmon Hatchery was constructed on the Pinacheva River, a tributary of the Avacha River, Kamchatka, as a joint venture between Russia and Japan in 1993. Chum salmon (*Oncorhynchus keta*) are the main species produced at this hatchery. Natural spawners collected in the Pinacheva River were used to produce the first hatchery generation, because there was no return from hatchery-produced salmon. To monitor changes in reproductive characteristics of chum salmon produced by hatchery operations, it is very important to clarify original characteristics of chum salmon produced under natural conditions. This report describes the preliminary results of the Japan-Russia cooperative study on reproductive characteristics (age composition, body size, and fecundity) of chum salmon from the natural population from the Pinacheva River. The results are compared with those characteristics of chum salmon from other stocks in Russia and North America.

Materials and Methods

A total of 53 female chum salmon were obtained from the Pinacheva River on August 11, 1994 (Fig. 1). The peak runs occurred here in July and August. For each female, fork length and body weight were measured, the total weight of eggs was measured, and then its subsample was taken and put into a plastic bag. After weighing the subsample, the plastic bag was filled with water, and the eggs were hardened for about one hour. Absolute fecundity was determined by counting the number of eggs in a subsample and extrapolating to the whole gonad. To estimate egg diameter, the length of 20 eggs placed on a plastic measuring ruler was measured in millimeters. Scales were also taken from each fish for subsequent age determination.

Results

Age 0.4 fish (n = 38, 71.7%) were the most abundant age group, followed by age 0.3 (n = 11, 20.8%) and age 0.5 (n = 4, 7.5%) fish. Average fork lengths (FL) and body weights were: 61.1 cm and 2.8 kg for age 0.3 fish, 61.5 cm and 2.8 kg for age 0.4 fish, and

Contribution A No. 352 from the Hokkaido Salmon Hatchery.

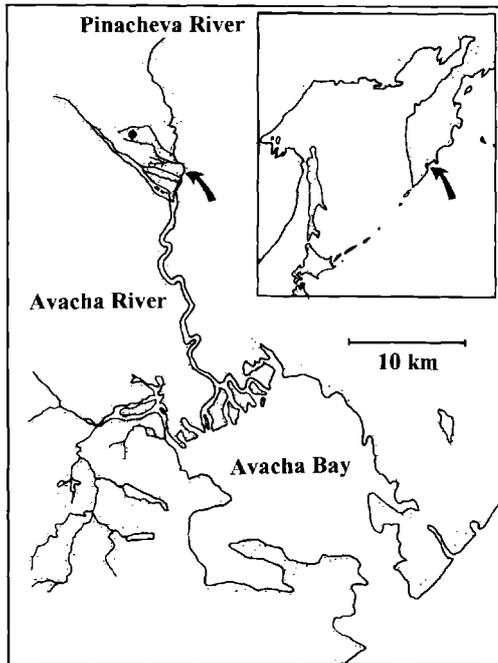


Fig. 1. Location of chum salmon sampled in August 1994. Arrows indicate the sampling location. Closed circle indicates the location of the Ketkino Salmon Hatchery.

65.5 cm and 3.5 kg for age 0.5 fish, respectively (Table 1).

Absolute fecundity (AFC) ranged from 1,007-2,860 (mean 2,016) eggs per female (Appendix Table 1). Excluding one fish (No. 44) which had a relatively small number of eggs due to partial spawning, there was a significant positive relationship between FL and AFC: $AFC = 8.16 \times FL - 3,006$ ($r = 0.55, P < 0.01$)(Fig. 2A). Relative fecundity (RFC) ranged from 14.9-45.8 (mean 32.6) eggs/cm and also had a significant positive relationship with FL: $RFC = 0.081 \times FL - 17.33$ ($r = 0.37, P < 0.01$)(Fig. 2B).

Egg diameter (ED) ranged from 7.10-8.75 (mean 7.88) mm. There was no significant relationship between FL and ED (Fig. 2C). However, AFC and ED showed a significant negative relationship: $ED = -0.0003 \times AFC + 8.57$ ($r = -0.46, P < 0.01$)(Fig. 2D).

Discussion

Changes in reproductive characteristics due to natural and artificial factors are important characteristics to monitor in salmon populations (Kaeriyama and Urawa, 1992; Quinn and Bloomberg, 1992). Recent changes in age composition and body size of chum salmon have been reported for Asian chum salmon and North American salmonids (Ricker, 1981; Kaeriyama, 1989; Ishida et al., 1993). Although the present results are based on a small number of female chum salmon, the high proportion of age 0.4 fish from the Pinacheva River is consistent with those in other stocks of the Kamchatka and Bolshaya Rivers (Ishida et al., 1993).

Mean fecundities of chum salmon are known to range from 1,800-4,297 eggs per female in Asia and from 2,107-3,962 eggs per female in North America (Salo, 1991). Also, in Asia, northern chum salmon stocks generally have a higher RFC than do southern stocks (Kulikova, 1972). The fecundities estimated in the present study are lower than those previously reported. These differences are partly due to the uncertainty in data collection in previous studies including partial spawning before eggs were removed. As pointed out by Salo (1991), individual measurements may be comparable, but it is not certain whether the samples are representative for the reported geographical regions and rivers of origin (Salo, 1991). For ED, however, the present results are consistent with those of previous studies (Salo, 1991).

In conclusion, the following methods should be incorporated into future research under the Japan-

Table 1. Average fork length, absolute fecundity, relative fecundity, and egg diameter of mature female chum salmon of three age groups from the Pinacheva River in Kamchatka on August 11, 1994.

Age	Sample size	Fork length (FL, cm)	Body weight (kg)	Absolute fecundity (No. eggs)	Relative fecundity (No. eggs/FL)	Egg diameter (mm)
0.3	11	61.1	2.8	2,161	35.3	7.73
0.4	38	61.4	2.8	1,939	31.4	7.88
0.5	4	65.5	3.5	2,449*	38.0*	8.22
Total	53	61.6	2.9	2,016*	32.6*	7.88

*Excluding one fish (No. 44) (see Appendix Table 1).

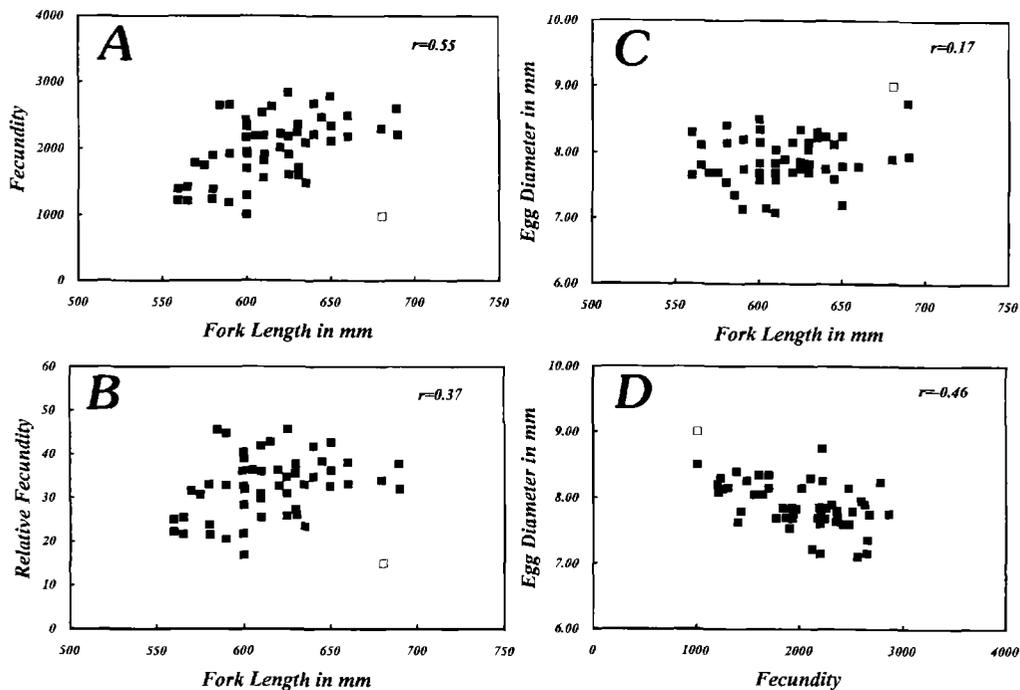


Fig. 2. Relationships of fork length to absolute fecundity (A), relative fecundity (B), egg diameter (C), and relationship of absolute fecundity to egg diameter (D). Open square indicates data point excluded for analysis.

Russia Science and Technology Cooperative Plan for Fisheries: 1) collection of representative samples that accounts for spawning season and body size of fish sampled, 2) accurate estimation of fecundity that accounts for partial spawning before measurements, and 3) accurate estimation of egg diameter using the volumetric method.

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カムチャツカのピナチェバ川におけるサケ成熟雌の再生産特性

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1994年8月にカムチャツカのピナチェバ川で採集したサケ成熟雌の再生産特性を調査した。0.4歳魚(71.1%)がもっとも多く、0.3歳魚(20.8%)と0.5歳魚(7.5%)がこれに続いた。平均尾叉長と体重は、0.3歳魚で61.1 cm, 2.8 kg, 0.4歳魚で61.4 cm, 2.8 kg, 0.5歳魚で65.5 cm, 3.5 kgであった。孕卵数(AFC)は1,007-2,860(平均2,016)粒、尾叉長当たりの孕卵数は14.9-45.8(平均32.6)粒/cmであった。AFCとRFCは尾叉長(FL)と有意な正の相関関係(AFC=8.16×FL-3,006, RFC=0.081×FL-17.33)を示した。卵径は7.10-8.75(平均7.88) mmであった。尾叉長と卵径の間には有意な関係は認められなかった。

ISHIDA ET AL. — REPRODUCTIVE CHARACTERISTICS OF KAMCHATKAN CHUM SALMON

Appendix Table 1. Biological characteristics of 53 mature female chum salmon from the Pinacheva River in Kamchatka on August 11, 1994.

No.	Fork length (FL, cm)	Body weight (kg)	Age	Gonad weight (g)	Absolute fecundity (No. eggs)	Relative fecundity (No. eggs/FL)	Egg diameter (mm)
1	580	2.5	0.3	415	1,905	32.8	7.55
2	610	2.9	0.4	464	1,871	30.7	7.70
3	620	3.1	0.4	545	2,022	32.6	8.15
4	650	3.1	0.4	432	2,123	32.7	7.20
5	645	3.6	0.4	615	2,475	38.4	7.60
6	610	2.6	0.4	392	1,568	25.7	8.05
7	680	3.8	0.4	555	2,307	33.9	7.90
8	605	2.4	0.3	362	2,197	36.3	7.15
9	600	2.4	0.4	282	1,007	16.8	8.50
10	630	3.2	0.4	410	1,640	26.0	8.05
11	565	2.2	0.4	336	1,223	21.6	8.10
12	610	2.9	0.3	442	2,558	41.9	7.10
13	650	3.3	0.4	545	2,356	36.2	7.80
14	585	2.2	0.4	454	2,651	45.3	7.35
15	590	2.6	0.3	500	2,645	44.8	7.15
16	660	3.7	0.3	645	2,511	38.0	7.80
17	600	2.4	0.4	424	1,930	32.2	7.70
18	600	2.5	0.4	498	2,422	40.4	7.60
19	560	2.1	0.4	314	1,400	25.0	7.65
20	630	3.3	0.4	555	2,255	35.8	7.85
21	610	2.7	0.4	480	2,196	36.0	7.60
22	580	2.5	0.4	336	1,252	21.6	8.15
23	600	2.4	0.4	505	2,170	36.2	7.70
24	635	3.1	0.3	402	1,486	23.4	8.25
25	600	2.4	0.4	420	1,950	32.5	7.85
26	575	2.2	0.4	410	1,769	30.8	7.70
27	690	4.3	0.4	610	2,603	37.7	7.95
28	590	2.3	0.4	440	1,933	32.8	7.75
29	630	3.2	0.4	466	1,699	27.0	8.15
30	650	3.3	0.5	745	2,779	42.8	8.25
31	565	2.2	0.4	312	1,429	25.3	7.80
32	600	2.6	0.5	505	2,350	39.2	7.65
33	615	3.1	0.3	595	2,625	42.7	7.90
34	645	3.1	0.4	700	2,473	38.3	8.15
35	570	2.4	0.4	378	1,778	31.2	7.70
36	590	2.2	0.4	310	1,200	20.3	8.20
37	690	4.2	0.5	675	2,218	32.1	8.75
38	560	2.1	0.3	322	1,241	22.2	8.30
39	610	2.8	0.4	438	1,827	30.0	7.85
40	625	2.8	0.4	438	1,614	25.8	8.35
41	600	2.4	0.4	336	1,297	21.6	8.15
42	635	2.9	0.4	535	2,104	33.1	8.30
43	640	3.3	0.4	600	2,224	34.7	8.25
44	680	4.0	0.5	340	1,011	14.9	9.00
45	625	3.3	0.4	650	2,860	45.8	7.75
46	600	2.6	0.3	436	1,694	28.2	8.35
47	630	3.2	0.4	510	2,366	37.6	7.70
48	660	3.2	0.4	510	2,202	33.4	7.80
49	640	3.3	0.3	575	2,673	41.8	7.75
50	620	2.9	0.3	480	2,240	36.1	7.70
51	580	2.5	0.4	386	1,383	23.8	8.40
52	625	2.9	0.4	505	2,188	35.0	7.85
53	625	3.0	0.4	462	1,927	30.8	7.85
Mean	616.4	2.9		474.2*	2,015.7*	32.6*	7.88*
S.D	32.7	6.5		108.6*	474.9*	7.1*	0.40*

*Excluding fish No. 44.