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SOME PROBLEMS OF THE BIOLOGY OF THE AUTUMN CHUM OF SAKHALIN

\*/108/

S. P. Volovik and A. Ye. Landyshevskaya

The chum is the second most abundant salmon of Sakhalin. Two forms of the chum are distinguished in this region: the summer and autumn chum defined by L. S. Berg (1953) as seasonal races.

The summer chum has been preserved at the present time in small quantity (catch of the order of several centners)\* in Terpenie Gulf.

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\* Translator's note. One Soviet centner = 100 kg.

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The autumn chum, which is more numerous, is of almost universal distribution. It is absent only from the rivers of the western coast in the stretch between the town of Uglegorsk and the town of Aleksandrovsk. It is mainly the anadromous Amur chum which is caught in the area of Rybnovsk. It occupies no more than 5.6% of the total area of spawning grounds in the rivers of Sakhalin. Approximately 70% of its spawning grounds are in the upper reaches of the Tym' River basin, which is an area of natural reproduction.

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In connection with the paucity of natural spawning grounds, artificial reproduction has come to be of fundamental importance in the reproduction of the chum on South Sakhalin. Thanks to the efforts of hatcheries it has here been possible to increase the abundance of the natural stocks, which is maintained at a constant level by the activity of a number of large hatcheries.

Published information concerning the Sakhalin chum is fragmentary (Taranets, 1937; Dvinin, 1952; 1957; Kamyshnaya, 1961; Landyshevskaya, 1964). The present article contains a biological description of the chum bred by hatcheries and spawning in the Tym' River. The article has been based on material collected in 1960--1964 by scientific officers of the salmonid laboratory of SakHTINRO (Sakhalin Division, Pacific Scientific Research Institute for Fisheries and Oceanography), G. I. Erolenko, M. D. Leont'ev, L. I. Pritchina, A. P. Shershnev, V. K. Kovalenko and the authors; use has also been made of the earlier data of P. A. Dvinin and I. S. Pavlov contained in manuscript reports for 1952--1958.

The quantity of the chum reaching Sakhalin is subject to annual variations.

Catches along the sea coast fluctuate considerably in relation to the abundance of the migrating populations and to weather conditions at the time of fishing. It is usually only the first runs of the chum (approximately to October 1 -- 5) which are caught along the southeastern coast. Since 1959 a large part of the catch has consisted of salmon caught around the salmon counting fence of the Sokolovsk Fish Hatchery. The total catch of the chum in this area has varied between 737 and 18,111 centners over the last 19 years (1946--1964).

Catches on the northeastern coast (Tym' River) have ranged from 1.1 thousand centners (1949) to 10.4 thousand centners (1951). At the present time /109/ they have been stabilized at a level of 4.0--5.0 thousand centners.

On the southwestern coast the chum is caught in and around the estuarine reaches of the rivers at the fish counting fences of the fish hatcheries. The

X success of artificial propagation of the chum is to some extent attested by the catch of 6.7 thousand centners in 1964.

The proportion of fish caught differs according to the spawning area. Almost all the salmon which arrive are caught on the southwestern coast in front of the river mouths. Approximately 20--40 % of the migrating schools of chum are caught annually near the mouth of the Naiba River in the inshore areas of the sea; it is only the fish of the first runs which are more heavily caught. A low rate of exploitation is apparent along the northeastern coast of Sakhalin. The time at which the chum approaches the **and the river mouths** inshore area is approximately the same in different regions but there is a noticeable tendency for delay in the more southerly parts of the range. The spawning run lasts from the middle or end of August to the beginning or end of November.

The chum initially approaches the rivers of the southwestern coast with sexual products in stage IV and IV--V of maturity and subsequently in stage V. Its spawning livery is already exhibited throughout the entire spawning run.

On the southeastern coast (Naiba River), where the chum spawning grounds are 70--80 km from the mouth, fish without signs of spawning livery (stages III and III--IV of maturity) are found in trap net catches until the middle of the third 10-day period of September.

The chum enters the Tym' River, in which the spawning grounds are more than 250 km from the mouth, throughout the entire spawning run as the smolt.

The Sakhalin chum matures, in the main, in the fourth year of life. The quantity of fish at an age of 2+ and 4+ is usually less, but their percentage ratio varies from year to year (Table 1). The quantity of fish 2+ years old in the spawning populations is sharply increased (up to 86 %) in the southern regions in some years. Chum 5+ years old, like fish at an age of 1+, are rarely encountered. It should be noted that the yearling chum is encountered in isolation almost every year in the last runs. A similar phenomenon has also

been noted for the chum of Hokkaido (Sano, 1959), where yearlings may comprise more than 10 % of the total number of fish. The spawning populations also include fish at an age of 1+ in the rivers of the American mainland (Shepard, 1961). M. L. Krykhtin (1962) has reported on the frequency of occurrence of sexually mature yearling chum in the Amur. Such early maturation of the chum is probably more characteristic for the southern parts of its range.

The age composition of the chum alters in the course of the spawning run. It is mainly older fish (4+) which run in the initial period and younger fish (2+) at the end of the run. However, the dominant age group is usually clearly traceable in all the runs of the chum (Table 2).

The percentage ratio of the age groups also varies quite widely by rivers within the same region.

The chum of Northeastern Sakhalin is slightly different in age composition: here the quantity of fish of the older age groups is usually higher. In addition, the Tym' River is annually entered by chum at an age of 5+ and 6+, which are practically absent on Southern Sakhalin.

The sex ratio of chum from trap net catches in the inshore zone of the sea was determined from biological analysis samples and during mass measurements. In rivers where fish counting fences of fish hatcheries have been installed the quantity of fish of each sex was recorded as they entered the traps.

It is not possible to distinguish a pattern to the sex ratio during the period of the spawning run of the chum. For example, males were considerably more abundant than females in the Kalininka River throughout the entire spawning run during the last two years (1963--1964). In 1955 the run included a large quantity of males only in September and thereafter females predominated (Table 3). Nor is any strict pattern to be observed in changes in the sex ratio for other rivers of Southern Sakhalin. /111/

Таблица 1

/110/

2  
Возрастной состав кеты, заходящей на нерест в реки южного Сахалина, %

3 Годы	4 Юго-западное побережье (р. Калининка)					5 Юго-восточное побережье (р. Найба)					6 Чьи данные
	1+	2+	3+	4+	5+	1+	2+	3+	4+	5+	
1951		16,0	82,5	1,5							7 П. А. Двинин, И. С. Павлов
1952		11,5	73,5	15,0			16,0	82,5	1,5		8 И. С. Павлов
1953		7,0	84,0	9,0			66,0	30,0	4,0		
1954		8,0	87,0	5,0			7,0	81,0	10,0	2,0	
1955	2,7	7,5	83,6	6,2		2,7	8,2	83,6	5,5		
1956		1,3	96,0	2,7			2,0	93,0	4,5	0,5	
1957		86,0	12,5	1,5			60,0	33,0	7,0		9 П. А. Двинин, И. С. Павлов
1958		12,2	82,1	5,7			3,5	93,8	2,7		10 И. С. Павлов
1959		5,0	89,0	6,0			13,2	84,0	2,8		
1960		24,2	66,2	9,2	0,4		28,6	66,4	5,0		11 А. Е. Ландышевская,
1961		2,5	88,5	8,3	0,6		3,5	93,8	2,7		12 Л. А. Фроленко
1962		8,0	57,0	35,0		0,3	19,0	45,5	31,8	3,4	13 С. П. Воловик
1963	0,3	18,2	50,0	29,1	2,4	0,3	16,9	67,1	14,8	0,9	14 С. П. Воловик
1964		9,0	86,4	4,6			65,2	34,0	0,8		15 М. Д. Леонтьев
											16 А. Е. Ландышевская
											17 А. Е. Ландышевская
											18 М. Д. Леонтьев, Л. И. Пritchina
											19 А. П. Шершнеv.

Key to Table 1: 1. Table 1 2. Age composition of the chum entering rivers of South Sakhalin to spawn, % 3. Years 4. Southwestern coast (Kalininka River) 5. Southeastern coast (Naiba River) 6. Data of 7. P. A. Dvinin, I. S. Pavlov 8. I. S. Pavlov 9. P. A. Dvinin, I. S. Pavlov 10. I. S. Pavlov 11. A. E. Landyshevskaya 12. L. A. Frolenko 13. S. P. Volovik 14. S. P. Volovik 15. M. D. Leont'ev 16. A. E. Landyshevskaya 17. A. E. Landyshevskaya 18. M. D. Leont'ev, L. I. Pritchina 19. A. P. Shershnev

-5-

Таблица 2

/111/

2 Изменение соотношения возрастных групп чумы  
в течение нерестового хода в 1964 г., %

3 Река, дата	4. Возраст		
	2+	3-	4-
5 Калининка, 15.IX	2,0	97,0	1,0
17.IX	14,7	83,3	2,0
3.X	13,2	83,6	3,0
6 За сезон	9,0	86,4	4,6
7 Наиба, 11.IX	52,5	45,0	2,5
17.IX	45,9	54,1	—
28.IX	83,0	15,0	2,0
13.X	91,9	8,1	—
8 За сезон	65,2	34,0	0,8

Key to Table 2: 1. Table 2 2. Alteration in the percentage ratio of chum age groups during the spawning run in 1964 3. River, date 4. Age 5. Kalininka 6. Over the season 7. Naiba 8. Over the season.

The sex ratio by age groups varies in the course of the run. There are far more males of 2+ among the chum of southern regions of Sakhalin than females of the same age. Conversely, females predominate among the chum of the younger age groups along the northeastern coast. /112/

Considerable predominance of fish of one sex is observed over several years among the fish approaching the counting fences of the fish hatcheries. This may possibly be to some extent dependent on the selective nature of fishing in the open sea. Since the chum of Northern Sakhalin as well as that of Southern Sakhalin is subjected to catching in the sea, it may be assumed that this circumstance is not the main factor affecting the sex ratio in the different populations. The sexual composition of the salmon in schools caught in the in-shore area of the sea near the mouth of the Naiba River and in the first runs to the fish counting fence of the Sokolovsk Fish Hatchery is practically the same.

The size and weight of the chum vary considerably from region to region (Table 4).

Таблица 3

2 Соотношение полов кеты в течение нерестового хода в р. Калининке, %

3 Месяц, декада	4 Пол	1955		1963		1964	
		%		%		%	
5 Август III	6 Самцы			52,3			
	7 Самки			47,7			
8 Сентябрь I	9 Самцы			55,4		62,7	
	10 Самки			44,6		37,3	
II	11 Самцы	58,6		59,5		68,6	
	12 Самки	41,4		40,5		31,4	
III	13 Самцы	52,3		55,4		57,4	
	14 Самки	47,7		44,6		42,6	
15 Октябрь I	16 Самцы	41,2		64,0		59,0	
	17 Самки	58,8		36,0		41,0	
II	18 Самцы	830,3		61,1		61,8	
	19 Самки	69,7		38,9		38,2	
III	20 Самцы	29,5		68,1		83,6	
	21 Самки	70,5		31,9		16,4	
22 За весь период	23 Самцы	36,5		61,0		60,0	
	24 Самки	63,5		39,0		39,4	
25 Всего	100,0		100,0		100,0		
		(19 453 шт.)		(55 884 шт.)		(172 828 шт.)	
		26		27		28	

Key to Table 3: 1. Table 3 2. Sex ratio of the chum during the spawning run in the Kalininka River, % 3. Month, 10-day period 4. Sex 5. August 6. Males 7. Females 8. September 9. Males 10. Females 11. Males 12. Females 13. Males 14. Females 15. October 16. Males 17. Females 18. Males 19. Females 20. Males 21. Females 22. Over the whole period 23. Males 24. Females 25. Total 26. (19 453 fish) 27. (55 884 fish) 28. (172 828 fish).

Тум' chum males are on average 2.9--6.4 cm longer than females and 0.5--1.09 kg heavier. The length range of males is from 57 to 88 cm and of females 57--79 cm; the corresponding weight ranges are 1.80--7.50 kg and 1.95--5.75 kg. Males therefore have a considerably wider range of variation in size and weight.

Таблица 4

## 2 Длина и вес осенней кеты Сахалина

3 Районы	1961		1962		1963		1964		
	4 самцы	5 самки	6 самцы	7 самки	8 самцы	9 самки	10 самцы	11 самки	
<b>12 Юго-западный Сахалин</b>									
13	Длина 14 мин.	57,0	57,4	55,0	56,0	57,0	59,5	57,0	57,0
	АС, см 15 макс.	80,3	79,0	75,0	74,4	81,0	80,0	89,5	79,5
	16 средняя	67,2	65,3	66,2	66,4	69,5	67,7	71,2	69,4
17	Вес об- 18 мин.	2,50	2,15	2,00	2,10	1,60	2,20	1,30	1,70
	щий, кг 19 макс.	5,10	4,97	5,20	5,20	5,40	5,10	7,95	5,65
	20 средний	3,51	3,18	3,69	3,52	3,51	3,29	3,68	3,41
<b>21 Юго-восточный Сахалин</b>									
22	Длина 23 мин.	50,5	50,5	49,0	49,0	52,0	56,0	50,0	49,0
	АС, см 24 макс.	81,0	74,0	75,0	75,0	86,0	75,0	78,5	75,0
	25 средняя	65,1	63,5	59,1	58,0	69,6	67,3	61,7	63,2
26	Вес об- 27 мин.	1,65	2,35	1,30	2,20	1,25	1,05	1,25	1,10
	щий, кг 28 макс.	4,87	4,85	5,80	5,00	5,85	4,75	5,05	4,65
	29 средний	3,18	3,29	2,84	2,81	3,70	3,48	2,54	2,80
<b>30 Северо-восточный Сахалин</b>									
31	Длина 32 мин.	57,0	58,0	61,5	60,0	60,0	62,0	60,0	57,0
	АС, см 33 макс.	88,0	76,0	86,0	78,0	86,0	79,0	79,0	73,0
	34 средняя	71,5	67,3	74,6	69,6	73,6	67,2	70,1	67,2
35	Вес об- 36 мин.	2,00	1,95	1,80	2,00	2,50	2,25	2,10	2,20
	щий, кг 37 макс.	7,30	5,20	7,25	5,75	7,50	5,25	6,65	5,05
	38 средний	4,23	3,48	4,40	3,65	4,69	3,60	4,16	3,60

Key to Table 4: 1. Table 4 2. Length and weight of the autumn chum of Sakhalin 3. Regions 4. Males 5. Females 6. Males 7. Females 8. Males 9. Females 10. Males 11. Females 12. Southwestern Sakhalin 13. Length AC, cm 14. min 15. max 16. mean 17. Total weight, kg 18. min 19. max 20. mean 21. Southeastern Sakhalin 22. Length AC, cm 23. min 24. max 25. mean 26. Total weight, kg 27. min 28. max 29. mean 30. Northeastern Sakhalin 31. Length AC, cm 32. min 33. max 34. mean 35. Total weight, kg 36. min 37. max 38. mean.

In southern regions of Sakhalin males are larger in some years and females in others, but the difference in the mean characteristics is not so great as in the chum from northern regions. Along the southwestern coast the variation in the mean sizes of males and females over the last five years has

been 0.2--1.8 cm and the variation in weight between 0.1 and 0.33 kg.

In the chum of the southeastern coast the difference between the mean lengths of males and females was 1.1--4.0 cm and the weight difference was 0.11--0.40 kg. /113/

As in other regions of the Far East, the size of males and females decreases toward the end of the spawning run. This is due to alteration in the age composition of the fish entering the river. The mean size and weight of the chum entering the Kalininka River were 68.8 cm and 3.6 kg at the beginning of the run in 1962 and respectively 64.5 cm and 3.31 kg and 62.3 cm and 3.24 kg in the middle and at the end of the run.

As has previously been noted, the yearling chum (1+) is found on Sakhalin almost every year. An examination was made of 16 fish in 1955, 9 of which were from catches in the Naiba River basin. The quantity of yearlings in the runs is in fact far higher. Along the southwestern coast of Sakhalin the yearling chum is caught every year with the pink salmon. Its size has ranged from 43.0 to 54.0 cm, on average 42.4 cm, and its weight from 720 to 1650 g, on average 1101 g.

Many authors (Birman, 1951; Birman and Levanidov, 1954 and others) note that as the quantity of salmon in a spawning population increases their size and weight decrease and the age rises. No such relationship is traced in the chum of Southern Sakhalin or in the West Kamchatkan chum (Semko, 1954); on the contrary, the material at our disposal on the Tym' chum indicates the existence of a positive correlation between the abundance and size of the fish.

The Sakhalin chum is characterized by a comparatively high growth rate. Its size ranges from 24 to 35 cm at the end of the first year of life and increments over the second year are between 9.5 and 20.0 cm. A slower growth rate, such as is also found in the chum of other regions of the Far East (Lovetskaya, 1948; Birman, 1951), is a feature of it in the following years.

When the autumn chum of Sakhalin, the Amur River and Iturup Island are compared, it may be noted that the naturally-reproducing and artificially propagated Sakhalin chum have higher increments than the Amur chum, especially in the first years of life, but lower increments than the Iturup chum (Table 5).

Таблица 5

2 Годовые линейные приросты тела кеты Сахалина, р. Амура и о. Итуруп, см

3 Год жизни	4 Сахалин				9 р. Амур	10 о. Итуруп
	5 р. Тымь	6 р. Найба	7 р. Калининка	8 р. Форель		
11 1 год	29,8—30,7	26,1—28,5	29,3—32,5	31,2—31,6	25,8—27,8	28,6—30,6
12 2 год	11,0—18,0	9,2—19,5	11,3—14,3	12,8—13,9	16,4—17,2	13,8—20,0
13 3 год	11,0—19,7	6,0—11,9	7,6—13,1	10,4—20,2	10,0—11,2	9,8—22,0
14 4 год	6,4—11,5	9,5—11,8	7,7—10,6	9,6—9,9	8,4—11,5	9,9—15,5
15 5 год	6,8—8,9	10,5—10,7	6,6—8,4		4,9—6,0	9,7—12,0

16 Примечание: материалы по росту амурской кеты приведены по данным Е. А. Ловецкой (1948), И. Б. Бирмана (1951). Рост курильской кеты нами рассчитан по пробам, собранным В. Н. Иванковым.

Key to Table 5: 1. Table 5 2. Annual increases in the body length of the chum of Sakhalin, the Amur River and Iturup Island, cm 3. Year of life 4. Sakhalin 5. Tym' River 6. Naiba River 7. Kalininka River 8. Forel' River 9. Amur River 10. Iturup Island 11. First 12. Second 13. Third 14. Fourth 15. Fifth 16. Note: material on the growth of the Amur chum is cited in accordance with the data of E. A. Lovetskaya (1948) and I. B. Birman (1951). We calculated the growth of the Kuril' chum from samples taken by V. N. Ivankov.

The highest growth rate is characteristic of the chum of the northeastern coast and detectable in all age groups. The length of the chum from the southwestern coast is greater than that of the chum from the southeastern coast in the first year of life. The mean length over the first year of life varies within slight limits from region to region on Sakhalin: in the range 29.3--32.5 cm on the southwestern coast, 27.2--29.3 cm on the southeastern coast and 29.8--30.7 cm on the northeastern coast. /114/

The absolute fecundity of the Sakhalin chum is subject to considerable variations in relation to length, weight, age and the individual features of particular fish. The limits of the range are 1170--5245 eggs and mean fecundity varies from region to region between 2400 and 3670 eggs.

The chum of the southwestern coast of Sakhalin has the lowest fecundity; the difference is slight in other regions. The absolute fecundity of the chum from different areas does not differ significantly by age groups with the sole exception of the chum at an age of 3+. At this age the highest fecundity is observed in chum from the southeastern coast and the lowest in chum from the southwestern coast.

The mean relative fecundity (the number of eggs per 10 g of body weight) is on the whole extremely constant for the spawning stock of the chum from region to region and is between 7.2 and 9.8 eggs, although its range has very wide limits.

The Sakhalin chum has definite morphological features. It was established by analysis of material on some morphological characters that the relative length of its carcass and of its caudal peduncle are subject to slight variations in different periods of the spawning run, whereas the least body depth varies considerably (Table 6).

Meristic characters (the number of scales on the lateral line and the number of pyloric caeca) also had a considerable range of variation, but nevertheless differences with respect to them may be traced quite clearly in the chum of individual regions, especially in fish from the Kalininka and Naiba Rivers (Table 7).

Therefore, the foregoing material for morphological description of the chum of the southwestern and southeastern coasts justifies us in concluding that in each of these regions the chum belongs to an independent population. At the same time some differences are also to be noted between the chum of two closely adjacent rivers on the same stretch of the coast.

Study of the scale structure of the chum from different regions revealed

Таблица 7

2 Количество чешуй в боковой линии и пилорических придатков у кеты южного Сахалина (1962 г.)

3 Река	4 Ч и с л о						Кол. /3 экз.
	5 ч е ш у й			6 п и л о р и ч е с к и х п р и д а т к о в			
	мин. 7	макс. 8	среднее 9	мин. 10	макс. 11	среднее 12	
14 Форель	123	145	136,9±0,6	134	212	171,3	81
15 Калининка	126	152	139,0±0,6	158	218	180,5	50
16 Найба	118	148	133,0±0,8	126	206	166,0	50

Key to Table 7: 1. Table 7 2. Number of scales on lateral line and of pyloric caeca in the chum of South Sakhalin (1962) 3. River 4. Number 5. of scales 6. of pyloric caeca 7. min 8. max 9. mean 10. min 11. max 12. mean 13. Number of fish 14. Forel' 15. Kalininka 16. Naiba.

significant differences both in the size of the scales and in the general pattern of the sclerites. The chum of Northeastern Sakhalin has large scales and the chum of the southeastern coast has the smallest scales (Table 8).

Perceptible differences in the radius of what is known as the "fingerling ring" (mal'kovoe kol'tso) are a noteworthy feature. This ring is formed in the Sakhalin chum during existence in the river and in the period of foraging in the inshore zone of the sea. Young chum of the southwestern coast forage in the river and in the inshore areas of the sea from May until the end of August (data of L. A. Frolenko). Between 9 and 20 sclerites, on average 9.2--11.5, form on their /116/ scales during this period.

It would be more correct to term this zone of constricted sclerites the "first <sup>er</sup> supernumary ring" in contrast to the river ring formed only in the freshwater period of life. The sclerites are more widely spaced in the <sup>er</sup> supernumary ring than in the river ring, but closer together than in the zone of summer growth in the sea in the same year (Fig. 1). A river "fingerling ring" is also found on the scales of chum on the southwestern coast, but it is found in large quantity on the scales of salmon from the Naiba River (41%, Fig. 2). Between 3 and 8 sclerites

Таблица 6

2 Относительные величины тушки, длины хвостового стебля и наименьшей высоты тела кеты (в % длины по Смитту) из рек южного Сахалина

3 Название реки, дата взятия проб		4 Длина тушки		5 Длина хвостового стебля		6 Наименьшая высота тела	
		M ± m	Σ	M ± m	Σ	M ± m	Σ
7 Форель	24.IX.62 г.	74.50 ± 0.32	± 3.17	17.47 ± 0.30	± 0.29	7.10 ± 0.11	± 1.17
8 Калининка	26.IX.62 г.	74.05 ± 0.33	± 0.50	15.75 ± 0.12	± 0.85	7.05 ± 0.02	± 0.76
	8.X.62 г.	75.18 ± 0.23	± 2.33	15.55 ± 0.12	± 0.80	6.75 ± 0.04	± 0.23
9 Общая за сезон	26.X.62 г.	75.70 ± 0.63	± 3.78	15.71 ± 0.10	± 0.60	6.12 ± 0.05	± 0.27
	Общая за сезон	74.67 ± 0.16	± 2.35	15.65 ± 0.10	± 1.25	6.70 ± 0.08	± 0.99
	29.IX.62 г.	74.46 ± 0.29	± 2.52	15.85 ± 0.11	± 0.99	7.39 ± 0.08	± 0.27
10 Найба	3.IX.62 г.	74.12 ± 0.52	± 4.50	15.30 ± 0.15	± 1.31	6.80 ± 0.15	± 1.31
	// Общая за сезон	74.20 ± 0.25	± 3.11	15.24 ± 0.11	± 1.36	7.32 ± 0.12	± 1.41

Key to Table 6: 1. Table 6 2. Relative size of carcass, length of caudal peduncle and least body depth of the chum (as percentages of length as defined by Smitt) from rivers of South Sakhalin 3. Name of river and date of sample 4. Length of carcass 5. Length of caudal peduncle 6. Least body depth 7. Forel' 8. Kalininka 9. Total over the season 10. Naiba 11. Total over the season.

Таблица 8

2 Величина бокового радиуса чешуи и зоны малькового кольца у кеты в 1961 г., деления окулярмикронметра

3 Радиус	4 всей чешуи					5 малькового кольца				
	2+	3+	4+	5+	Сред- ний	2+	3+	4+	5+	Сред- ний
6 Возраст										
8 р. Калининка		52,9	54,1		53,5	9,3	8,0			9,2
9 р. Форель	51,0	57,7			56,3	11,5	11,5			11,5
10 р. Наiba	42,0	52,0	51,2	58,0	52,2	5,1	7,5	6,5	5,5	7,4
11 р. Тымь (Кировское)	56,1	59,3	63,5	62,5	61,0	5,2	5,0	4,7	3,5	5,0
12 р. Рейдовая (о. Итуруп)	53,0	56,5	60,0		57,4	7,2	7,2	8,1		7,6

Key to Table 8: 1. Table 8 2. Lateral radius of scale and of "fingerling ring" zone in the chum in 1961, scale divisions of eyepiece micrometer 3. Radius 4. Of entire scale 5. of "fingerling ring" 6. Age 7. Mean 8. Kalininka River 9. Forel' River 10. Naiba River 11. Tym' River (Kirovskoe) 12. Reidovaya River (Iturup Island).

may be counted in it. A "fingerling ring" was found on the scales of the Tym' chum in 20 % of the fish; a characteristic feature of it was the location of the second sclerite, which was removed from the central area bounded by the first sclerite by twice the distance between the third and second sclerites. A first <sup>er</sup> supernumary ring is found comparatively rarely on the scales of chum on the eastern coast (in 15--20 % of fish).

The number of sclerites in the first year of life (Table 9) may also serve as a distinguishing local character of the chum of different regions of Sakhalin when consideration is given at the same time to their location on the nuclear portion of the scale. /117/

It is evident from the foregoing data that the chum of Southwestern Sakhalin has the largest number of sclerites in the first year of life. The number of sclerites is considerably less in the chum from the Tym' River.

D. A. Biven (1961), who studied scale structure in the chum of the Naiba



Fig. 1. First supernumerary marine ring (AB) on the scale of a chum from the southwestern coast of Sakhalin.



Fig. 2. River ring (AB) on the scale of a chum from the Naiba River basin.

Таблица 9

Среднее количество склеритов на чешуе кеты в 1960—1962 гг.

3 Район	4 Количество склеритов						
	5 За первый год			2+	3+	4+	5+
	6 Среднее	7 от	8 до				
9 Сахалин							
10 Юго-западный	33.7	30.6	35.7	67.7	73.2		
11 Юго-восточный	29.4	27.5	31.0	53.7	60.4	70.8	66.5
12 Северо-восточный	27.6	23.0	29.6	53.3	61.8	68.3	
13 О. Итуруп (р. Рейдовая)*	28.2	26.0	28.5	52.8	65.3	70.1	66.5

Key to Table 9: 1. Table 9 2. Average number of sclerites on chum scales in 1960--1962 3. Region 4. Number of sclerites 5. Over the first year 6. Mean 7. From 8. To 9. Sakhalin 10. Southwestern 11. Southeastern 12. Northeastern 13. Iturup Island (Reidovaya River).

\* Data for 1961.

River basin, noted that  $29.05 \pm 0.56$  sclerites formed on it in the first year of life. Our data are similar to Biven's material.

It is highly interesting to compare the Sakhalin chum with the chum of the Amur and rivers of Hokkaido with respect to this character. N. I. Kulikova (1964) notes that 27.16--27.45 sclerites are formed in the first year of life in the Amur chum. Similar data are also given for this region by Hanamura (cited by Kulikova). The salmon of Hokkaido are characterized by 29.5 sclerites over a year of life.

Therefore, the chum from the Tym' River is similar to the Amur chum with respect to the number of sclerites formed during the first year of life, while the chum from the Naiba River is similar to the chum from the Okhotsk Coast of Hokkaido.

#### CONCLUSIONS

The autumn chum of Sakhalin, like that of the Amur, West Kamchatka and Hokkaido, consists of a number of populations associated with individual rivers. There are considerable differences in the size of the runs, the time of the run, size, weight, fecundity, growth rate, morphological and meristic characters and scale structure between chum coming to spawn in rivers in widely separated regions. These differences expressed to a lesser degree may also be traced when fish from closely adjacent rivers on the same coast are compared.

When establishing the existence of local populations of the chum it is essential to compare the whole range of biological characteristics. Because of the variability of morphological characters, the morphological method is capable of yielding positive results during the spawning run only on the basis of extensive long-term material completely covering the spawning runs. In addition, it is essential to make a comparative analysis of fish of one year-class. The rate of /118/ maturation of the gonads in the chum, which is conditioned by the distance of the spawning grounds from the sea and by the duration of the migrations of sexually

mature fish and young in fresh water, should be regarded as a hereditary character. There is a clear difference between the Sakhalin chum of all three spawning regions with respect to this character.

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