ISSN - 0704- 3716

CANADIAN TRANSLATION OF FISHERIES AND AQUATIC SCIENCES

No. 4600

The ralationship between the number of gill rakers and the nature of the diet of char of genus Salvelinus

by Yu.S. Reshetnikov

Original Title: O svyazi mezhdu kolichestvom zhabernykh tychinok i kharakterom pitaniya u gol'tsov roda Salvelinus

From: Zool. Zh. XL: 1574-1577, 1961

Translated by the Translation Bureau (NKM)
Multilingual Services Division
Department of the Secretary of State of Canada

Department of Fisheries and Oceans
Newfoundland Environment Center
St. John's, Nfld.

1979

7 pages typescript

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU

MULTILINGUAL SERVICES DIVISION

CANADA

SECRÉTARIAT D'ÉTAT
BUREAU DES TRADUCTIONS

DIVISION DES SERVICES MULTILINGUES

CTFAS 4600

TRANSLATED FROM – TRADUCTION DE	INTO – EN
Russian	English

AUTHOR – AUTEUR

Yu. S. Reshetnikov

TITLE IN ENGLISH – TITRE ANGLAIS

The relationship between the number of gill rakers and the nature of the diet of char of genus Salvelinus

TITLE IN FOREIGN LANGUAGE (TRANSLITERATE FOREIGN CHARACTERS)
TITRE EN LANGUE ÉTRANGÈRE (TRANSCRIRE EN CARACTÈRES ROMAINS)

O svyazi mezhdu kolichestvom zhabernykh tychinok i kharakterom pitaniya u gol'tsov roda Salvelinus

REFERENCE IN FOREIGN LANGUAGE (NAME OF BOOK OR PUBLICATION) IN FULL. TRANSLITERATE FOREIGN CHARACTERS.
RÉFÉRENCE EN LANGUE ÉTRANGÈRE (NOM DU LIVRE OU PUBLICATION), AU COMPLET, TRANSCRIRE EN CARACTÈRES ROMAINS.

Zoologicheskii zhurnal

REFERENCE IN ENGLISH – RÉFÉRENCE EN ANGLAIS

Journal of zoology

PUBLISHER – ÉDITEUR	DATE OF PUBLICATION / DATE DE PUBLICATION			PAGE NUMBERS IN ORIGINAL / NUMÉROS DES PAGES DANS L'ORIGINAL
---	YEAR / ANNÉE	VOLUME	ISSUE NO. / NUMÉRO	7
PLACE OF PUBLICATION / LIEU DE PUBLICATION				NUMBER OF TYPED PAGES / NOMBRE DE PAGES DACTYLOGRAPHIÉES
(USSR)	1961	XL	10	1574-77

REQUESTING DEPARTMENT / MINISTÈRE-CLIENT: D. Dempson

TRANSLATION BUREAU NO. / NOTRE DOSSIER N°: 2050708

BRANCH OR DIVISION / DIRECTION OU DIVISION: DFO

TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES): NKM

PERSON REQUESTING / DEMANDÉ PAR: Sc. Info. & Pub. Br.

YOUR NUMBER / VOTRE DOSSIER N°:

DATE OF REQUEST / DATE DE LA DEMANDE: 26.11.79

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISÉE
Information seulement

DEC 11 1979

SOS-200-10-6 (REV. 2/68)
7530-21-029-5333

Secretary of State / Secrétariat d'État

MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU BUREAU DES TRADUCTIONS

Client's No.–N° du client	Department – Ministère	Division/Branch – Division/Direction	City – Ville
	DFO	Sc. Info. & Pub. Br.	St. John's
Bureau No.–N° du bureau	**Language – Langue**	**Translator (Initials) – Traducteur (Initiales)**	
2050708	Russian	NKM	DEC 11 1979

Source: Zool. zhurnal, 1961: XL, 10, 1574-1577

The relationship between the number of gill rakers and the nature of the diet of char of genus Salvelinus

Yu. S. Reshetnikov,
Department of Ichthyology, Moscow State University

The nature of the diet of fish has an effect primarily /1574 on the structure of the digestive system. The number of pyloric caeca and gill rakers should be seen as one of the adaptations to food type.

A.N. Svetovidov established first for herring (1932) and later for many other fish of various families and orders (1934, 1953) that fish which feed on larger food have a larger number of pyloric caeca than those which feed on smaller organisms. The number of gill rakers is inversely related to the food type. Thus, most predatory fish have a large number of pyloric caeca and a small number of gill rakers.

An exception to this rule are Pacific salmon of genus Oncorhynchus, for which an inverse relationship between the number of gill rakers and the number of pyloric caeca does not exist. Nor is this relationship observed in char of genus Salvelinus (Esipov, 1935; Berg, 1948; Vladykov, 1933, 1954; Andrews and Lear, 1956; Miller and Kennedy, 1948; Lobovikova, 1959; Greze, 1953; Podlesnyi and Lobovikova, 1953).

In non-predatory char, the number of gill rakers is not inversely related to the size of the food mass, while predator char have both more pyloric caeca and more gill rakers.

The purpose of this work was to study the relationship between the number of gill rakers and the nature of the diet of

various biological forms of malma (S. malma), taking into account the change with age in both the nature of the diet itself and the number of gill rakers and pyloric caeca.

The material was collected in the summer and autumn of 1959 in the basin of the Paratunka River (Kamchatka) where there are fresh-water lake and river forms along with typical diadromous char, and in Lake Dalnii where the resident lake char of the "paliya"* type never leaves the lake.

All three forms of char differ in the nature of their diets. The lake and river char are bentophages (Savvantova and Reshetnikov, 1961).

The diadromous char in fresh water feeds on aerial insects, benthos and fish; in the sea, the basis of the diet of char, according to L. A. Andrievskaya (1957) is Parathemisto japonica and fish. The young of both diadromous char and lake and river char feed on aerial insects and the aquatic larvae of insects in streams.

Resident lake char is a typical predator with a narrow diet spectrum. The basis of its food is threespine and ninespine stickleback (90-97%) and very rarely amphipods, mollusks and the larvae of caddis flies and chironomids. Only fish are found in the diet of fish over 30 cm long.

All three forms of char differ markedly in the number of pyloric caeca in relation to differences in the diets (Table 1).

In comparison with diadromous char, lake and river char have a larger number of pyloric caeca and a longer intestine. This is apparently associated with the fact that mollusks which are poorly assimilated assume the leading role in the diet of lake and river char (Bokova, 1940).

Similar phenomena are noted by I.P. Belogurov (1939) for /1575 sturgeon. Sturgeon /Acipenser - Tr./ compared to "sevryuga" /Acipenser stellatus - Tr./ and "beluga" /Huso huso - Tr./ has a relatively heavier intestine and /heavier/ pyloric caeca. This is apparently associated with the fact that sturgeon in contrast with "sevryuga" and "beluga" feed on mollusks as well as on fish.

---

*According to W.E. Ricker (Russian-English Dictionary for Students of Fisheries and Aquatic Biology), "paliya" is rendered as 1. char (in general - genus Salvelinus; 2. lake char(S. lepechini - related to S. alpinus)

Table 1

Number of pyloric caeca and gill rakers, and the relative length of the intestine in different forms of char

Char form	Number of gill rakers		Number of pyloric caeca		Relative length of intestine, in %	Number of fish studied
	range	mean	range	mean		
Lake and river	20—25	21,8	25—42	32,8	114,8	245
Diadromous	20—25	22,1	21—35	28,9	109,8	105
Resident lake	24—29	26,7	34—63	48,4	113,2	72

Table 2

Number of pyloric caeca and gill rakers in lake and river char of various body lengths

Length of fish in mm		Number of gill rakers		Number of pyloric caeca		Number of fish studied
from-to	mean	range	mean	range	mean	
25—29	29,0	—	8	—	23	1
31—34	32,7	10—14	12,6	20—27	24,0	11
35—39	36,9	13—17	14,5	20—28	24,5	10
40—44	44,0	16—20	17,0	20—30	26,0	7
45—49	46,7	17—20	17,3	23—32	26,4	9
50—59	253,0	19—21	20,3	26—30	27,1	8
60—79	73,5	19—22	20,7	20—33	27,2	9
80—99	90,0	19—24	21,4	23—33	28,0	22
100—149	128,7	20—23	21,8	22—35	29,0	24
150—199	178,4	20—24	21,7	22—39	30,6	68
200—249	226,7	20—25	21,8	25—42	32,3	94
250—299	275,2	20—24	21,9	25—41	32,9	91
300—370	321,6	21—24	21,8	25—42	33,5	60

Predator lake char have the largest number of pyloric caeca and also the largest number of gill rakers.

Age variability is noted in the number of pyloric caeca and gill rakers. For Atlantic salmon and some American char, V.D. Vladykov (1954) notes that the number of pyloric caeca increases as the size of the fish increases. We examined age variability in the number of pyloric caeca and gill rakers, on the basis of lake and river char (Table 2 and Fig. 1)

The fastest increase in the number of gill rakers with respect to the growth of fish occurs in the early stages of development (to a length of 70-80 mm), after which the number of gill rakers inceases more slowly. The final number of gill rakers (21,8) is formed in fish 120-130 mm long; subsequently, only insignificant deviations from the mean number appear. The number of phyloric caeca increases continuously as the size of the fish increases.

We cannot follow through such an age variability in resident lake char since we have almost no data on the biology of the young of this char, which apparently live in the pelagic zone of the lake and are virtually not caught at the shores. We only had large char at our disposal; however, even these incomplete data permit one to conclude that the same pattern would occur in resident lake char as in lake and river char:

Size of fish in mm	260 —280	— 300	—320	—340	—360
Number of gill rakers	26,5	26,9	26,4	26,7	26,6
Number of pyloric caeca	43,5	47,8	51,4	52,0	54,5

In analysing the change in the shape of the gill rakers /1576 in relation to an increase in the size of the fish (Fig. 2), one may assume that the young resident lake char feed on plankton. In order to feed on small plankton organisms, the young of lake char must have a good filtering apparatus consisting of a large number of long thin gill rakers. For this reason, more gill rakers are laid down in resident lake char than in other char. Large char gradually change over to feeding on fish. They now need short thick gill rakers which would help to retain the prey; a large number of gill rakers is not necessary. The marginal gill rakers are reduced and converted to barely noticeable tubercles, and the remainder take on the same appearance as in predators -

short and thick, many of them are hamately bent and with spines. In fact, in large lake char, only 16-18 gill rakers are normally developed. In diadromous and lake and river char all gill rakers are equally well developed and they are longer and thinner (Fig. 2).

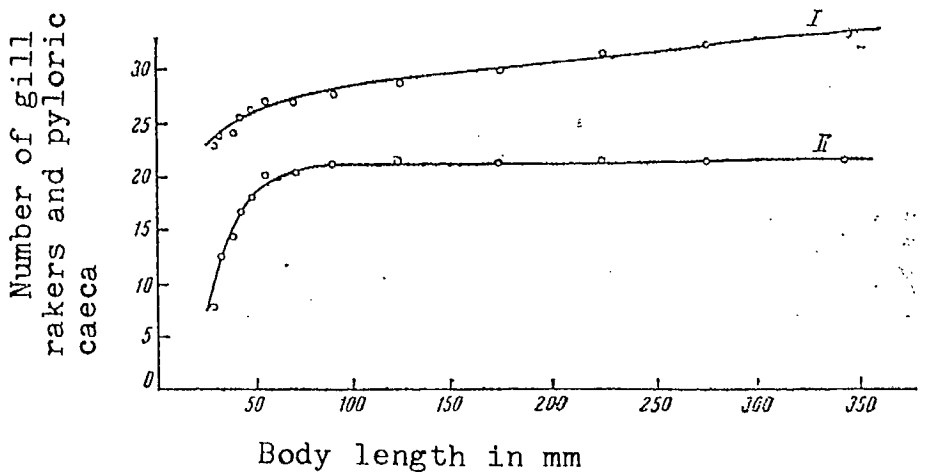

Fig. 1. Change in (I) the number of pyloric caeca and (II) the number of gill rakers with an increase in the body size of fish

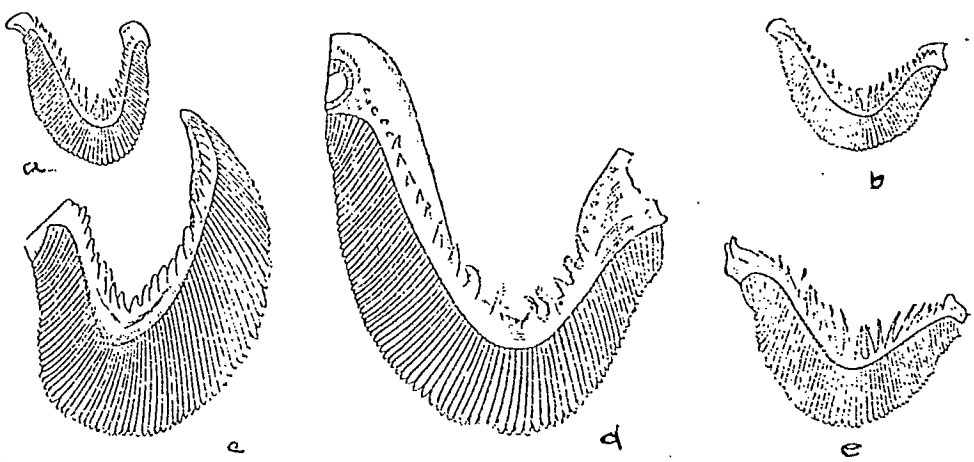

Fig. 2. a, b, c, d - first gill arches of resident lake char, length of fish being respectively 270, 280, 525 and 588 mm; e - gill arches of lake and river char, length of fish 332 mm

Usually, all gill rakers are counted, including those that are reduced, and their numbers are related to the nature of the diet of mature fish. Therefore, in salmon, no inverse relationship is obtained between the number of gill rakers and the number of pyloric caeca. The final number of gill rakers is formed in small fish and is to a large degree apparently determined by the nature of the diet of the young, and the number of pyloric caeca increases continuously in proportion to the growth of the fish and is related to the nature of the diet of mature fish.

If we take into account the fact that the young of most Pacific salmon reside in fresh water 1-3 years, then it may be assumed that the number of gill rakers is related to the nature of the diet of the young in fresh water, whereas the final number of pyloric caeca is determined by the nature of the diet of the mature fish in the sea.

References

1. Andrievskaya L.D. 1957. "Summer migrations of Pacific salmon and their diet in the sea period of life." Izv. Tikhookeansk. n.-i. in-ta morsk. rybn. kh-va i okeanogr., vol. XLIV.

2. Belogurov I.P. 1939. "On the question of the differences in the digestive tract of sturgeon with respect to diet." Dokl. AN SSSR, vol. XXII, No. 1.

3. Berg L.S. 1948. Fresh-water fish of the USSR and adjacent countries, vol. 1. Izd-vo AN SSSR.

4. Bokova E.N. 1940. "The consumption and assimilation of the food of volba (roach)." Tr. Vses. n.-i. in-ta morsk. rybn. kh-va i okeanogr., vol. XI, part II.

5. Greze I.I. 1953. "The diet of the fish of Lake Taimyr." Tr. Irkutsk. gos. un-ta, ser. biol., vol. VII, issue 1-2.

6. Yesipov V.K. 1935. "Materials on the biology and fishing of Novaya Zemlya char." Tr. Arkt. in-ta, vol. 17.

7. Lobovikova A.A. 1959. "Lake char ("paliya") Salvelinus drjagini from Lake Makovskii." Tr. Vses. gidrobiol. o-va, vol. IX.

8. Podlesnyi A.V. and Lobovikova A.A. 1953. "Paliya (Salvelinus) of Lake Taimyr." Tr. Irkutsk. gos. in-ta, ser. biol., vol. VII, No. 1-2.

9. Savvaitova K.A. and Reshetnikov Yu. S. 1961. "The diet of various biological forms of char (Salvelinus malma) in certain reservoirs of Kamchatka." Vopr. ikhtiol., No. 1 (18).

10. Svetovidov A.N. 1932. "On the relationship between the nature of the diet and the number of pyloric caeca in herring." Dokl. AN SSSR, No. 8.

- 1934. "On the relationship between the nature of the the diet and the number of pyloric caeca in fish." Dokl. AN SSSR, vol. III, No. 1.

- 1953. "On the relationship between the number of pyloric caeca and the nature of the diet of fish." Ocherki po obshch. vopr. ikhtiol. Izd-vo AN SSSR.

ЛИТЕРАТУРА

1 Андриевская Л. Д., 1957. Летние миграции тихоокеанских лососей и их питание в морской период жизни. Изв. Тихоокеанск. н.-и. ин-та морск. рыбн. х-ва и океаногр., т. XLIV.

2 Белогуров Н. П., 1939. К вопросу о различии пищеварительного тракта у осетровых рыб в связи с питанием, Докл. АН СССР, т. XXII, № 1.

3 Берг Л. С., 1948. Рыбы пресных вод СССР и сопредельных стран, т. I, Изд-во АН СССР.

4 Бокова Е. Н., 1940. Потребление и усвоение корма воблой, Тр. Всес. н.-и. ин-та морск. рыбн. х-ва и океаногр., т. XI, ч. II.

5 Грезе И. И., 1953. Питание рыб Таймырского озера, Тр. Иркутск. гос. ун-та, сер. биол., т. VII, вып. 1—2.

6 Есипов В. К., 1935. Материалы по биологии и промыслу новоземельского гольца, Тр. Аркт. ин-та, т. 17.

7 Лобовикова А. А., 1959. Озерный голец (палья) Salvelinus drjagini из оз. Маколского, Тр. Всес. гидробиол. о-ва, т. IX.

8 Подлесный А. В. и Лобовикова А. А., 1953. Палья (Salvelinus) Таймырского озера, Тр. Иркутск. гос. ун-та, сер. биол., т. VII, вып. 1—2.

9 Савваитова К. А. и Решетников Ю. С., 1961. Питание разных биологических форм гольца (Salvelinus malma) в некоторых водоемах Камчатки, Вопр. ихтиол., № 1 (18).

10 Световидов А. Н., 1932. О зависимости между характером пищи и числом пилорических придатков у сельдей, Докл. АН СССР, № 8.— 1934. О зависимости между характером пищи и количеством пилорических придатков у рыб, Докл. АН СССР, т. III, № 1.— 1953. О зависимости между количеством пилорических придатков и характером питания рыб, Очерки по общ. вопр. ихтиол., Изд-во АН СССР.

11 Andrews C. W. and Lear E., 1956. The Biology of Arctic Char (Salvelinus alpinus) in Northern Labrador, J. Fish. Res. Board Canada, vol. VIII, No. 6.

12 Miller R. B. and Kennedy W. A., 1948. Observations on the Lake Trout of Great Bear Lake. J. Fish. Res. Board Canada, vol. VII, No. 2.

13 Vladykov V. D., 1933. Fishes from Hudson Bay Region (Except the Coregonidae), Contrib. Canad Biol. and Fish. new, ser., vol. VIII, No. 2.— 1954. Taxonomic Characters of the Eastern North America Chars (Salvelinus and Cristivomer), J. Fish. Res. Board. Canada, vol. XI, No. 6.

ON THE CONNECTION BETWEEN THE AMOUNT OF GILL-RAKERS AND THE CHARACTER OF FEEDING IN CHARS OF THE GENUS SALVELINUS

Yu. RESHETNIKOV

Department of Ichthyology, State University of Moscow

Summary

Age variability of the number of gill-rakers and pyloric appendices shows the number of these latter to continuously increase with the growth of fish, and the final number of gill-rakers to be formed in young fishes when they attain the length of 120—130 *mm*. The number of gill-rakers is determined by the character of feeding of the young, while that of pyloric appendices is determined by the character of feeding of adult fishes.