FISHERIES RESEARCH BOARD OF CANADA
Translation Series No. 1614

Schools of Saira in the Pacific Ocean

By A. S. Sokolovskii

Original title: K voprosu o stadakh sairy v Tikhom Okeane

From: Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii (TINRO) (Proceedings of the Pacific Scientific Research Institute of Fisheries & Oceanography), Vladivostock, Vol. 68, p. 203-208, 1969

Translated by the Translation Bureau(GD)
Foreign Languages Division
Department of the Secretary of State of Canada

Fisheries Research Board of Canada
Marine Ecology Laboratory
Dartmouth, N. S.

1971

12 pages typescript

FRB 1614

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU

FOREIGN LANGUAGES DIVISION

CANADA

SECRÉTARIAT D'ÉTAT
BUREAU DES TRADUCTIONS

DIVISION DES LANGUES ÉTRANGÈRES

TRANSLATED FROM – TRADUCTION DE	INTO – EN
RUSSIAN	ENGLISH

AUTHOR – AUTEUR

Sokolovskiy, A.S.

TITLE IN ENGLISH – TITRE ANGLAIS

On the Schools of Saira in the Pacific Ocean

Title in foreign language (transliterate foreign characters)

K voprosu o stadakh sairy v Tikhom Okeane

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 PHONÉTIQUES.

Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii (TINRO)

REFERENCE IN ENGLISH – RÉFÉRENCE EN ANGLAIS

Proceedings of the Pacific Scientific Research Institute of Fisheries and Oceanography

PUBLISHER – ÉDITEUR	DATE OF PUBLICATION / DATE DE PUBLICATION			PAGE NUMBERS IN ORIGINAL / NUMÉROS DES PAGES DANS L'ORIGINAL
	YEAR / ANNÉE	VOLUME	ISSUE NO. / NUMÉRO	203-208
PLACE OF PUBLICATION / LIEU DE PUBLICATION				NUMBER OF TYPED PAGES / NOMBRE DE PAGES DACTYLOGRAPHIÉES
USSR	1969	68	–	12

REQUESTING DEPARTMENT / MINISTÈRE-CLIENT: Fisheries & Forestry

BRANCH OR DIVISION / DIRECTION OU DIVISION: Fisheries Research Board, Marine Ecology Laboratory, Bedford Institute, Dartmouth N.S.

PERSON REQUESTING / DEMANDÉ PAR: Dr. B. S. Muir.

YOUR NUMBER / VOTRE DOSSIER N°:

DATE OF REQUEST / DATE DE LA DEMANDE: Sept. 28, 1970

TRANSLATION BUREAU NO. / NOTRE DOSSIER N°: 0257

TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES): GD

DATE COMPLETED / ACHEVÉ LE: JAN - 7 1971

UNEDITED DRAFT TRANSLATION
Only for information
TRADUCTION NON REVISÉE
Information seulement

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU
FOREIGN LANGUAGES DIVISION

CANADA

SECRÉTARIAT D'ÉTAT
BUREAU DES TRADUCTIONS
DIVISION DES LANGUES ÉTRANGÈRES

FRB 1674

CLIENT'S NO. / Nº DU CLIENT	DEPARTMENT / MINISTÈRE	DIVISION/BRANCH / DIVISION/DIRECTION	CITY / VILLE
	Fisheries & Forestry	F:R.B. Marine Ecology Lab.	Dartmouth, N.S.
BUREAU NO. / Nº DU BUREAU	**LANGUAGE / LANGUE**	**TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES)**	**DATE**
0257	Russian	G.D.	JAN - 7 1971

UNEDITED DRAFT TRANSLATION
Only for information
TRADUCTION NON REVISÉE
Information seulement

Proceedings of the Pacific Scientific Research Institute of Fisheries and Oceanography (TINRO), 1969, Vol. 68, pp 203-208.

On the Schools of Saira in the Pacific Ocean

By A.S. Sokolovskiy.

Cololabis saira Brevoort is one of the most prolific /203# fish inhabiting the subtropical and temperate waters of the northern part of the Pacific Ocean between 20 and 55° N.L. from the Asian to the American continent. The area of distribution of saira is divided into the reproductive (spawning) and foraging parts (Parin, 1967, 1968). The reproductive part of the range of the saira is located in the waters of the Kuroshio and its continuations, and also in the waters of the North Pacific and Californian Currents. In the period of foraging the saira moves to the north where it concentrates in the areas of contact between warm and cold waters and penetrates into the comparatively cold subarctic waters.

At the present time, fishing for saira is carried on mainly in the north-western part of the Pacific Ocean. The scale of the

---

#Numbers in the right margin indicate the corresponding pages in the original.

fishing is such that its further development in this area must be regulated according to the condition of reserves. In connection with this, with regard to the estimation of quantities, it is necessary to have a clear representation of the structure of the saira population. In this way, the study of the composition of the population of the species C. saira has, in addition to a purely scientific, a definite practical interest as well.

The suggestion that there are several schools of saira in the vast water area of its distribution has been put forward by Yu. V. Novikov (1967), N.V. Parin (1967), V.P. Shuntov (1967) and other authors, but because of the insufficiency of data, this question has not been investigated up to this time. In foreign literature, not considering the works of Sugama (Sugama, 1959) who is inclined, on the basis of the differences in the structure of otholiths, to consider the Sea of Japan and Pacific Ocean saira as separate varieties, the information on the presence of different schools of saira is lacking. The materials gathered by the author on the voyages of the scientific-research vessels of TINRO in the northern and eastern parts of the Pacific Ocean in 1965-67 served as the basis for the present report.

Examination of the question of the presence within the bounds of the species C. saira of differing populations involved material on the composition of parasitofauna in addition to comparison of morphometric facts and a comparison of the biological characteristics of saira from different areas of its distribution was also carried out.

/204

Results of measurements of basic morphological characters of saury from different regions

Table 1

Таблица 1

Результаты измерений основных морфологических признаков сайры из различных районов

Character	Наименование признака	Asian saury Азиатская сайра (n=75)			Aleutian saury Алеутская сайра (n=75)			American saury Американская сайра (n=84)		
		M±m	3σ	C	M±m	3σ	C	M±m	3σ	C
	Plastic Пластические									
Pre-ventral	Антевентральное расстояние	53,41±0,09	±2,34	1,46	53,14±0,10	±2,61	1,62	52,57±0,13	±3,54	2,24
Pre-dorsal distance	Антедорсальное расстояние	69,75±0,10	±2,73	1,30	69,51±0,09	±2,31	1,10	69,15±0,11	±2,91	1,40
Pre-anal distance	Антеанальное расстояние	67,54±0,11	±2,91	1,42	67,30±0,07	±1,95	0,90	66,56±0,14	±3,84	1,90
Length of head	Длина головы	21,79±0,09	±2,34	3,54	21,46±0,06	±1,74	2,70	21,15±0,07	±1,96	3,17
Distance P-V	Расстояние P—V	32,79±0,09	±2,25	2,13	32,20±0,10	±2,64	2,73	30,92±0,13	±3,66	3,96
Distance V-A	Расстояние V—A	13,84±0,07	±1,92	4,62	14,56±0,09	±2,34	5,35	14,50±0,10	±2,61	6,00
Length of base D	Длина основания Д	9,04±0,05	±1,32	4,89	9,56±0,08	±2,16	7,53	8,89±0,08	±2,22	8,44
Length of base A	Длина основания А	9,84±0,09	±2,46	8,41	10,58±0,06	±1,65	5,20	9,78±0,07	±1,89	6,59
Length of body H	Высота тела H	12,59±0,08	±2,10	5,83	13,61±0,07	±1,86	4,55	11,97±0,08	±2,19	6,19
	Meristic Меристические									
Ray in D	Лучей в Д	10,98±0,04	±1,60	3,65	11,23±0,05	±1,32	3,91	10,89±0,05	±1,32	4,07
Ray in A	Лучей в А	13,24±0,05	±1,41	3,55	13,40±0,06	±1,74	4,32	13,12±0,06	±1,65	4,26
Additional d	Дополнительных d	5,06±0,03	±0,96	6,38	5,16±0,05	±1,32	8,52	5,19±0,05	±1,41	9,02
Additional a	Дополнительных a	6,14±0,05	±1,44	7,80	6,40±0,06	±1,68	8,75	6,23±0,05	±1,32	7,31
No. branchiate stamen	Число жаберных тычинок	37,28±0,07	±1,92	1,74	37,82±0,14	±3,66	3,22	37,42±0,15	±4,08	3,62
No. vertebrae	Число позвонков	64,16±0,05	±1,38	1,46	64,34±0,07	±1,86	0,90	63,88±0,09	±2,37	1,23

Morphometric material was gathered in the region of Shikotan Island (Kurile Islands), to the south of the Aleutian Islands (44°S.L., 170°E.L.) in the region Santa Barbara Cape (California). Sexual dimorphism is not pronounced in saira, though Jasunari (jasunari, 1930) points out a difference in the length of the base of the dorsal and anal fins in males and females, and therefore, to avoid possible errors, the samples were composed of equal numbers of males and females. The results of the morphometric analysis are presented in Table 1. /205

To elicit the taxonomic differences, the method of differentials, or discrepancies in numbers, was used and this formula was applied

$$Diff = \frac{M_1 - M_2}{\pm\sqrt{m_1^2 + m_2^2}} > 3$$

(Pravdin, 1966).

Let us examine the actual differences in saira from different regions of its distribution according to the established meristic characters of the species. A.V. Morozov (according to Pravdin, 1966) suggested a method of comparing separate samples by means of the calculation of the sums of differences and the determination of their mean (M diff.). Tables 2 and 3 were compiled using this method.

The mean difference in all three cases is less than 3, which supports, regardless of the vastness of its distribution, the existence in the northern part of the Pacific Ocean of only one species, Cololabis saira Brevoort. The saira of the American seacoast were first described by Gilbert in 1915 as an independent species Cololabis brevirostris Peters, and only one year later

Table 2

Differences in meristic characters among saira from different regions of its range (M diff)

Character	Aleutian and American	Aleutian and Asian	Asian and American
Ray in D	4.85	4.16	3.16
Ray in A	3.29	2.00	1.71
Addition (d) D	0.42	1.66	2.16
Addition (a) A	2.12	3.71	1.28
No. branchiate stamen	1.90	3.46	0.87
No. vertebrae	4.18	2.00	2.80
Sum of differences	16.76	16.99	11.98
Mean difference M diff	2.79	2.81	1.99

Hubbs (Hubbs, 1916), on the basis of a comparison of 4 specimens of saira from the American and Asian regions, established their complete similarity and the synonymity of the names Cololabis Brevirostris Peters and Cololabis saira Brevoort.

For the determination of intraspecific differences changes in unstable morphological characteristics were researched. Such changes are peculiar most of all to the plastic characteristics (see table 3).

In this instance the mean difference is greater than 3 in all samples, which is grounds for speaking of the existence of differences between the samples examined.

Attracting attention is the significant difference among samples according to the characteristic of greatest body length (see table 3). The longest in body length is the saira of the central part of the ocean (Aleutian). This fact explains well the peculiarities of its biology. The number of Aleutian saira is comparatively / 206 small, and its population during its entire life period is in a rather dispersed condition, and for that reason there is no strong

Table 3

Differences in plastic characters (M diff) among saira from different regions of its range

Character	Aleutian and American	Aleutian and Asian	Asian and American
Pre-ventral distance	3.93	1.84	5.44
Pre-dorsal distance	2.57	1.84	3.33
Pre-anal distance	2.69	2.07	1.00
Length of head C	3.44	3.50	7.63
Distance P-V	8.00	4.53	11.69
Distance V-A	0.46	6.54	5.50
Length of base D	6.09	5.77	1.66
Lengthof base A	9.00	7.40	0.54
Length of body H	16.40	10.20	5.63
Sum of differences	53.58	43.69	42.42
Mean difference M diff	5.95	4.85	4.71

competition for food and food requirements are more easily satisfied. Saira of the Asian and American regions form dense concentrations during the foraging period and as a consequence their food requirements are not as well satisfied (Novikov, 1967).

A special study of the parasitofauna of the Asian and American regions indicates that 8 species of parasites are peculiar to the saira of both regions, 12 species are encountered only in the Asian saira and 2 only in the American.

Penella sp. was used as the species-indicator for American saira.

According to the findings of Eberchard (Eberchard, 1954) 15-20% of the saira population is affected by this parasite, but according to our observations, up to 30% are affected.

The prolific ectoparasite of the Asian and American saira is Caligus macerovi (Gussev); 30-60% of the first are affected by it and 90% of the second, but this parasite is not found in the Aleutian saira.

Comparison of a series of biological characteristics and requirements of external conditions also revealed a series of substantial differences among the saira of various regions.

Yu. V. Novikov (1961), according to his own observations and referring to Odate (Odate, 1956) considers that the Asian saira becomes sexually mature at a length of no less than 25 cm. Our observations indicate that in American saira the basic mass of fish reach sexual maturity at a length of 22-24 cm., and separate /207 individuals at a length of 18-20 cm. (table 4). One might compare the fertility of the saira of the American region (our facts) and the Asian region (facts of Yu. V. Novikov, 1967). To do this it is necessary to focus attention on the differences in the dimensions of Asian and American saira.

As can be seen from the facts in tables 5 and 6, the minimal fertility in American saira is significantly lower than in the Asian -6.5 thousand eggs as against 9.1 thousand. Consequently, in an equal number of spawning individuals, the total fertility of the saira of the American region is 1.5 -2 times lower than in the Asian.

The spawning areas of saira correspond to independent hydrologic complexes; Asian saira spawn in the waters of the Kuroshio and its continuations, Aleutian in the waters of the North Pacific Ocean Current, and American in the system of the Californian Current.

The date of spawning coincides for all groups of saira,

Table 4

Relation of sexually immature and sexually mature saira of different lengths along the sea coast of North America in the region of Santa Barbara Cape in March 1967.

Maturity / Состояние зрелости	Length / Длина (AC) в см 16	17	18	19	20	21	22	23	24	25	Колич. рыб
Immature — Незрелые	15	15	36	36	41	44	15	3	—	—	205
Mature — Зрелые	—	—	1	7	22	56	97	47	38	27	295
% mature — % зрелых	—	—	2	17	35	56	87	94	100	100	
300											

No. of fish

Table 5

Absolute and relative fertility of saira in the region of Santa Barbara Cape (California)

Body Length — Длина тела (AC), см	Колич. экз., шт. #	Колич. икринок на 1 г веса рыбы, шт. ##	Абсолютная плодовитость, тыс. икринок
19,1—20,0	2	242	6,530
20,1—21,0	7	265	9,045
21,1—22,0	5	253	9,360
22,1—23,0	5	241	10,600
23,1—24,0	1	244	12,200

Absolute fertility Thous. eggs

Table 6

Absolute and relative fertility of Asian saira (According to Yu. V. Novikov, 1967)

Body Length — Длина тела (AC), см	Колич. экз., шт. #	Колич. икринок на 1 г веса рыбы, шт. ##	Абсолютная плодовитость, тыс. икринок
25,1—26,0	1	111	9,1
26,1—27,0	—	—	—
27,1—28,0	5	154	13,7
28,1—29,0	8	155	15,0
29,1—30,0	20	153	16,8
30,1—31,0	14	154	18,0
31,1—32,0	12	158	19,4
32,1—33,0	3	137	20,9
33,1—34,0	1	159	22,3

Absolute fertility Thous. eggs

Number of samples

Number of eggs per gram weight of fish

but the temperatures at which spawning takes place are different. In the Asian saira it takes place at a temperature of 14-25° (Odate, 1956), Aleutian saira spawn at a temperature of 13-22°, and American, according to our observations, at 12-16°, although fingerlings were found at San Lucas Cape (Californian Peninsula) at a temperature of 23°.

On the Asian seaboard, saira eggs and fingerlings are / 208 passively transported north by the Kuroshio Current to temperate waters with a high biological productivity (the region of intermixture of subtropical and subarctic waters), but on the American seaboard immature fish are located in less favorable conditions. Here, in the course of development, immature saira are carried south by the California Current to a comparatively plankton-poor region with a water temperature of 22-24°, and it is not exceptional that a small number of immature fish will be carried by the current to the tropical zone with a high water temperature, where it is possible that they will die. N.V. Parin (1967) proposes an analogous view about young saira coming into the system of the Alyaskin Current which carries them to the cold waters of the Alyaskin Gulf where the immature fish die. Consequently, one might suggest that the spawning of the American saira at a lower water temperature is a favorable factor. The more northerly is located the place of spawning, the more favorable the conditions will be for the immature fish, that is, the passive transport will proceed to temperate waters. The spawning of saira in pre-Aleutian waters has so far been poorly studied.

Summarizing the material on the morphometric characteristics, parasitofauna, and a series of biological characteristics of saira in the northern part of the Pacific Ocean, one can draw the conclusion that the species Cololabis saira is homogeneous, but that there exist within the bounds of its total range schools distinguishable one from another - the Asian, Aleutian and American. There is no clear boundary between the schools inhabiting these regions. There are rather wide zones of mixture of these schools, where are encountered, for the most part, sexually immature and young individuals which may differ somewhat from the basic definitive school. Apparently, for the Asian and Aleutian schools it is the region between 165-170° E.L., for American and Aleutian between 150 and 155° W.L. In these zones are encountered separate individuals of saira affected by Caligus macarovi (Gussev); near the Asian and American continents the percentage of individuals affected increases sharply, and the saira of pre-Aleutian waters are free of this species of parasite. Observations indicate that fishing is based on separate schools; consequently excessive fishing will negatively affect the reserves.

Bibliography

1. Novikov, Yu. V., 1961. Biologiya sairy (Biology of Saira), in the collection "Saira", Primorskoe kraevoe izdatel'stvo (Primorskiy Kray Publishing House), Vladivostok.
2. Novikov, Yu. V., 1967, Osnovnye cherty biologii i sostoyanie zapasov Tikhookeanskoi sairy (Basic features of the biology and condition of reserves of the Pacific Ocean saira), Publishing House of TINRO (Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii) (Pacific Scientific Research Institute of

Fisheries and Oceanography), Vol. 56.

3. Parin, N.V., 1967, Obshchaya kharakteristika ikhtiofauny epipelagiali (General characteristics of icthyofauna epipelagiali), in book "Tikhii Okean" (Pacific Ocean), Book 2, Vol. 7, Publishing House "Nauka" (Science), Moscow.

4. Parin, N.V., 1968, Ikhtiofauna okeanicheskoi epipelagiali (Icthyofauna of Oceanic epipelagiali), Publishing House "Nauka" (Science), Moscow.

5. Shuntov, V.P., 1967, Saira Yaponskogo morya (Saira of the Sea of Japan), Publishing House TINRO, Vol. 56.

6. Pravdin, I.F., 1966, Rukovodstvo po izucheniyu ryb (Manual for the study of fish), Pishchepromizdat (Gosudarstvennoe nauchno-tekhnicheskoe izdatel'stvo Pishchevoi promyshlennosti) (State Scientific and Technical Publishing House of the Food Industry), Moscow.

7. Eberchard, R.L., 1954. Observation on the saury (Cololabis saira) seen near California coast during 1950-1952. Calif. Fish and Game, v. 40 N1.

8. Jasunari[#] I. 1930. A biometric study of sexual dimorphism, a Teleost, Cololabis saira (Br.)

9. Hubbs C. 1916. Notes on the marine fishes of California. Univ. Calif Publ. Zool., vol. 16, N 13.

10. Odate [##] S., 1956. On the distribution of larvae and the young of the saury Cololabis saira and the condition of maturity of the gonad of the spawning fish in the Izu Island

and the north eastern sea area of Japan. Bull. Tohoku Reg. Fish. Res. Lab. N 7.

11. Sugama###K., 1959. Analysis of population of the saury (Cololabis saira Br.) on the basis of character of the otolith. Bull. Hokk. Reg. Fish. Res. Lab. N 16.

#Translator's Note: Appeared as "Iasunari" in the original text.

Appeared as "Adate" in the original text.

Appeared as "Suqama" in the original text.