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Studies on the parasites of salmonoid fishes in Japan. I

by Tamao Fukiu

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(Collection of theses in commemoration of the tenth
anniversary of the opening of the University.)

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Studies on the parasites of salmonoid fishes in Japan (1)

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I. Introduction

The author made investigations of parasites in Salmonidae since 1955 at the request of the Fisheries Agency and wishes here to make a tentative summary. In 1955 and 1956 the investigations were based on the specimens, collected by officials of the Fisheries Agency on its research vessels. In 1957 and 1958, the investigations were based on the frozen specimens, which were sent to the Fisheries Agency from the United States, and on the specimens, which the author collected in Hokkaido and Aomori-Ken.

The present investigations were made possible by the assistance of officials of the Ministry of Agriculture and Forestry, who collected parasites on board the research vessels in the Northern Pacific under a great deal of difficulty, of research institutes, experimental stations, hatcheries, and work shops of the Fisheries Agency and its district offices, of experimental stations, hatcheries, and fish farms, which are maintained by prefectural governments, and of private hatcheries. The author hereby wishes to express his deep gratitude to these officers. Further, he wishes to express his appreciation for research grants by such institutions as the Fisheries Agency, and the Northern Pacific Resources Research Conference.

II. Species of Salmonidae in the North Pacific and in Japan

It is believed that the following 14 species of 4 genera constitute the fishes of the salmonidae found in the North Pacific and in Japan.

(1) *Oncorhynchus* SUCKLEY, 1860

1. *Oncorhynchus nerka* (WALBAUM, 1792). Syn. *Salmo nerka* WALBAUM. U.S. name red, sockeye, blueback, smolt (two year old fish). *O. adonis* JORDAN et MCGREGOR 1925. *O. Kawamurae* JORDAN et MCGREGOR, 1925 - the species in land-locked.

2. *Oncorhynchus gorbuscha* (WALBAUM, 1792). Syn. *Salmo gorbuscha* WALBAUM. U.S. name pink, humpback salmon, fry (young or two year old fish).

3. *Oncorhynchus tschawytscha* (WALBAUM, 1792). Syn. *Salmo tscha-*

wytscha WALBAUM. U.S. name king, chinook, quinnat spring salmon.

4. *Oncorhynchus keta* (WALBUAM, 1792). Syn. *Salmo Keta* vel kayko WALBAUM, *Oncorhynchus haberi* HILGENDORF, 1876, *O. yessoensis* HILGENDORF, 1876. U.S. name chum, keta, dog salmon.

5. *Oncorhynchus rhodurus* JORDAN et MCGREGOR, 1925. Syn. *Macrosotomus* JORDAN et MCGREGOR, 1925. *Salmo perryi* JORDAN et SNYDER, 1902.

6. *Oncorhynchus masou* (BREVOORT, 1856). Syn. *Salmo masou* Brevoort, *S. perryi* JORDAN et SNYDER, 1902. *S. Formosanus* JORDAN et OSHIMA, 1919, *Onchorhynchus rhodurus* JORDAN et MCGREGOR, 1925, *O. ishikawae* JORDAN et MCGREGOR, 1925, *Salmo milktschisch* TANAKA, 1933.

7. *Oncorhynchus kisutch* (WALBAUM, 1792). Syn. *Salmo kisutch* WALBAUM. U.S. name coho, silver salmon.

(2) *Salmo* LINNAEUS, 1758

8. *Salmo gairdneri* RICHARDSON

9. *Salmo irideus* GIBBONS. Introduced from the U.S.A. in 1887.

(3) *Hucho* Gunther, 1866.

10. *Hucho perryi* (BREVOORT, 1856). Syn. *Salmo perryi* BREVOORT, *S. Blackistoni* HILGENDORF, 1876.

(4) *Salvelinus* RICHARDSON, 1836.

11. *Salvelinus leucomaenis* (PALLAS, 1811). Syn. *Salmo leucomaenis* PALLAS, *Salvelinus kundscha* JORDAN et EVERMANN, 1898, *Salvelinus latus* OTA, 1916, *Salvelinus imbrius* JORDAN et MCGREGOR, *Salvelinus malma imbrius* MORI, 1936, *Salvelinus leucomaenis imbrius* OKADA et MATSUBARA, 1938.

12. *Salvelinus fontinalis* (NITCHILL). English name brook trout, speckled trout. Introduced from the U.S.A. during 1901-1903.

13. *Salvelinus pluvius* (HILGENDORF, 1876). Syn. *Salmo pluvius* HILGENDORF, *Salvelinus malma* TARANETZ, 1936, *S. Malma* TANAKA, 1936, *Salvelinus malma pluvius* MORI, 1936, *Salvelinus leucomaenis pluvius* OKADA et MATSUBARA, 1938.

14. *Salvelinus malma* (WALBAUM, 1792). Syn. *Salmo malma* WALBAUM, *S. curilus* PALLAS, 1811, *S. laevigatus* PALLAS, 1811, *S. Numifer* CUVIER et VALENCIENNES, 1848, *S. fariopiis* STEINDACHNER, 1870, *S. alpinus malma* BERG, 1909, *S. pluvius* JORDAN et SNYDER, 1902, *S. miyabei* OSHIMA, 1938.

Generally these are fishes of Salmonidae, which are considered to be separate species. They inhabit the North Pacific, the seas, and fresh water areas around Japan (due to Heishi Aoyanagi). Of these, the author investigated five species -- red, pink, king, chum, and coho. Investigations centred chiefly around red, pink, and chum as hosts of parasites.

III. Studies of parasites in fishes of Salmonidae in Japan

In order to carry out the present investigations, the author studied the results of work in Japan. He feels certain that there are some which have not been brought to his attention. An outline of past researches is given below in chronological order:

In 1889 Takeshi Iijima experimentally proved, using his body, that *Dibothriocphalus lats* L. which lived upon human beings, came from *Oncorhynchus masou*. His thesis, "Source of *Bothriocephalus latus* in Japan", was reported in Tokyo Teikoku Daigakku Rika Daigaku Kiyo (Tokyo Imperial University Bulletin of Science).

In 1904 Tsunenobu Fujita published an article on scabies in fresh water fishes in *Dobutsu-Gaku Zasshi*, Vol. 16 (Zoological Magazine). In 1905 Tokujiro Koshita published an article "On a species of Nematoda parasitic on salmonoid fishes" in No. 12, Vol. 5 of *Hokkaido Suisan Zasshi* (Hokkamido Fisheries Bulletin); it appears as though this was a specie of *Oxyuris*. Further the same author published in 1910 an article "Survey of nematodes parasitic in fish in fish farms" in the third annual report of Hokkaido Fisheries Experimental Station.

In 1916 Shigeyoshi Ishii published an article on a new nematode, *Ancyracanthus salmonicola* n. sp., which is parasitic on an air bladder of *Oncorhynchus masou*, in *Dobutsu-Gaku Zasshi*, Vol 28.

In 1915, Shigeyoshi Ishii published an article on his investigation of "white spot disease" in fresh water fish farms in No. 5, Vol. 12 of Suisan Koshusho Shiken Hokoku (Report of Experiments of Fisheries Research Station).

In 1916, Tsunenobu Fujita published an article, which was titled "Vermes parasitic on fry of salmon", in Dobutsu-Gaku Zasshi Vol. 28. In it he dealt with parasites which were parasitic on fry of *Onchorhynchus keta* which were found in large groups in small streams of Sapporo. Parasites were a specie of *Crepidostomum*, a specie of *Cucullanus*, and a specie of *Acanthocephalus*. He described among other matters their appearance for a three year period covering 1913 - 1915, and noted their marked increase at the time when fry devoured *Gammarus*.

In 1918 Tsunenobu Fujita obtained a new specie of Trematoda, *Azygia perryi* n. sp. in *Hucho perryi* of Hokkaido and made a report in Dobutsu-Gaku Zasshi Vol. 30.

In 1920 Tsunenobu Fujita obtained *Crepidostomum uchimii* in dace of Hokkaido and reported his findings in Dobutsu-Gaku Zasshi Vol. 32.

During 1920-1922 Tsunenobu Fujita again made reports on a few parasites in his thesis, "Parasites in Fish", which was published in Dobutsu-Gaku Zasshi Volume 32, 33, and 34. Of these species parasitic on fishes of Salmonidae are as follows:

Echinorhynchus gadi Müll (= *E. acus* Rud.) and *Acanthocephalus echingoensis* no. sp. found in the intestine and appendix pylorica

of *Onchorhynchus keta* in Sanmen River in Niigata-Ken: A.
oncorhyachi n. sp. in fry of *Oncorhynchus keta* in a Sapporo;
Crepidostomum salmonis n. sp. and *Cystidicola oncorhunchi* n. sp.
found in the intestines of fry of *Oncorhynchus keta* in Sapporo
(later changed to *Rhabdochona*)

Cystidicola fujiii n. sp. found in the intestine of *O. adonis*
JORDAN et MCGREGOR and *Oncorhynchus rhodurus* JORDAN et MCGREGOR
found in Lake Shieki in Hokkaido:

Spiroptern salvelini n. sp. (later transferred to *Cystidicola*) in
the intestine of *Oncorhynchus rhodurus* JORDAN et MCGREGOR in the
Shieki Lake:

Phyllobothrium salmonis n. sp. (larvae) found in large quantities
in the intestines of *Oncorhynchus keta* and of *Oncorhynchus masou*
ascending Tone River, Shintsu River, Sanmen River, Ishikari River,
and Nijibetsu River:

Plerocercoid sp. found in the gall-bladder of *Oncorhynchus keta* and
other fishes.

In 1922 Sueo Eguchi published a report on *Dibothriocephalus latus*
in Shintsu River in Aichi Igaku Senmon Gakko Zasshi (Aichi Medical School
periodical) Volume 29.

In 1923 Tsunenobu Fujita published a thesis entitled "Studies on
Myxosporidia of Japan" in Hokkaido Teikoku Daigaku Nogaku-Bu Kiyo (Bulletin
of the Faculty of Agriculture of Hokkaido Imperial University) and reported
on several species of *Myxosporidia*. Of these the one which are parasitic

on Salmonidae are as follows:

Myxidium oncorhynchi n. sp. found in *Oncorhynchus masou*;
Chloromyxum salvelini n. sp. found in *Salvelinus leucomaenis*
Chloromyxum chitosense n. sp. found in *Oncorhynchus keta*
Chloromyxum giganteum n. sp. found in *Onchorhynchus gorbuscha*
 and *Chloromyxum quadriforme* n. sp. found in *Oncorhynchus keta*,
Oncorhynchus gorbuscha, and *Oncorhynchus masou*.

In 1927 Tsunenobu Fujita reported on nematodes which are parasitic on fishes of Lake Biwa in a thesis entitled "On new nematodes from fishes of Lake Biwa" in *Nihon Dobutsu-Gaku Shuho* Volume 1 (*Japanese Zoological Review*). He mentioned a new specie, *Rhabdochona salvelini* n. sp found in *Salvelinus pluvius*.

During the period, 1926-1928, Tsuneobu Fujita reported on many parasites in three articles entitled "Vermes parasitic on fishes in Lake Biwa" in Volumes 38, 39, and 40 of *Dobutsu-Gaku Zasshi*. He mentioned, as parasites on Salmonidae, three types of nematodes obtained from *Salvelinus pluvius*: they are *Rhabdochona salvelini* (from the abdominal cavity), *Cystidicola salvelini* (Fujita) (*Spiroptera salvelini* Fujitu, 1922) (from the intestines), and *Cystidicola iwana* n. sp. (from the abdominal cavity).

In 1931 Van Cleave of the U.S.A. contributed an article, entitled "Acanthocephala from Japan 2. Two New species of the genus *Acanthocephalus*", to Volume 13 of *Dobutsu-Gaku Rui-Ho*, and reported on *Acanthocephalus aculeatus* n. sp., which he had obtained in land-locked *Oncorhynchus nerka* from Lake Aoki, and on *Acanthocephalus acerbus* n. sp. which he had found in

Salmo irideus Gibbons from Kisaki Hatchery.

In 1933 Sueo Nguchi reported on *Allocreadium oncorhynchi* n. sp. which he found in *Oncorhynchus thodurus* from Nagara River, in an article entitled "Studies on parasites in *Oncorhynchus* Suckley and *Salmo gairdneri* Richardson. Part 1, A new trematoda in *Oncorhynchus rhodurus*" in Volume 1 of *Osaka Koto Igaku Somon Gakko Zasshi* (Osaka Medical College Periodical).

During 1934-1935, Satyu Yamaguchi in articles, which he contributed to Volumes 5 and 6 of *Dobutsu-Gaku Rui-Ho*, entitled "Studies of the helminth fauna of Japan", dealt with a wide range of parasites. In parts 2, 4, 6, and 9 of the articles he reported on many parasites; of these the ones concerned with fishes of Salmonidae are as follows:

of trematodes, *Brachyphallus crenatus* (RUD., 1802) ODHNER, 1905 was found in *Oncorhynchus masou* of unknown origin, and *Lecithaster salmonis* n. sp. in *Oncorhynchus keta* of unknown origin; of tapeworms, larvae of *Pilichnibothrium* were obtained from *Oncorhynchus keta* and from *Oncorhynchus masou* from Mutsu Bay: of nematodes, he discussed the propriety of calling so-called *Ascaris capsularia*, which are commonly found in many species of fish (in 33 species in Yamaguchi's table) *Anisakis salaris* (Adult corresponds to *A. simplex* Rud., 1804), and found larvae of the specie in *Oncorhynchus keta*. He found *Rhabdochona amago* n. sp. in the small intestine of *Oncorhynchus rhodurus* (Tajima products), reported on *Cystidicola salvelini* (Fujita, 1920) Fujita. 1928 from Lake Biwa and reported the fact he had found *Cystidicola salmonicola* in the same host.

In 1935, Jun Suzuki contributed an article entitled "On the relation between temperature and propagation of pathogenic vermin of "white spot" disease" to volume 3 of Nihon Suisan-Gaku Kaishi (Journal of the Japan Fisheries Science Society).

In 1935, H.A. Baylis contributed an article entitled "Four new species of nematodes" to Ann. Mag. Nat. Hist., Ser. 10, Vol. 16; in this article he reported on a new nematode *Metabronema truttae*, which he had obtained from *Salmo trutta* and made comparisons with *Cystidicola salvelini*, which Tsunenobu Fujita had obtained from *Salvelinus leucomaenis*, *Salvelinus pluvius*, and *Oncorhynchus nerka* and reported in 1922 and 1928, and which Satyu Yamaguchi also has found in *Salvelinus pluvius* and reported in 1935; he noted several differences and reported that it was indeterminate. He defined *Metabronema* = *Cystidicola*.

In 1935 Isokichi Harada reported on several species of *Acanthocephala* in an article entitled "Zur Acanthocephalenfauna von Japan", which he contributed to Volume 14 of Taihoku Teikoku Daigaku Ri-No-Gaku-Bu Kiyo (Bulletin of the Faculty of Science and Agriculture of Taihoku Imperial University); in this article he investigated 14 specimens, which he collected from *O. adonis* Joran et McGregor, and reported marked variations in the number of hooks around the mouth and in the size of eggs, and suggested that *Acanthocephalus oncorhynchi* Fujita, 1921., *A. acureatus* VanCleave, 1931., and *A. acerbus* VanCleave, 1931, which had been reported in fishes of the Salmonidae in the past, should be treated as synonymous with *A. echigoensis* Fujita, 1920.

In 1935 Suguru Okada reported on the ecology and pathology of *Cystidicola salmonicola* (Ishii) in an article entitled "On nematodes parasitic in the air-bladder of salmon family", which he contributed to Volume 3 of *Shokubutsu oyobi Dobutsu* (Plant and Animals).

In 1935 Muneshige Watanabe reported on *Ichthyophthirius multifiliis* in an article entitled "White spot disease in fry of salmon and trout and sea-water" in Volume 7 of *Sake Masu Rui-Ho* (Salmon, Trout Report); he noted the fact that the parasite survived for a long period of time if the fish is placed in sea-water since the surface of the fish is impervious to sea-water while the parasite died within approximately one minute when it was placed in sea-water.

In 1935 Hisao Kobayashi published a book, "Fresh water fishes of Japan and their parasites", through Yokendo and summarized the knowledge concerning fresh water fish and their parasites. In this book he made mention of *Rhabdochona fujiii* (FUJITA) (Intestine) and *Acanthocephalus aculeatus* VANCELEAVE as parasites in *Oncorhynchus adonis* Jordan et McGregor, *Chloromyxum giganteum* FUJITA (the gall-bladder) as that in *Oncorhynchus gorboscha*, and *Rhabdochona oncorhynchii* FUJITA (the intestine in fry), *Lecithaster salmonis* YAMAGUTI (the large intestine), *Echinorhynchus gadi* MULL (the intestine), *Acanthocephalus oncorhynchi* FUJITA (the intestine), *A. echigoensis* FUJITA (appendix pylorica), *Chloromyxum chitosensens* FUJITA (the gall-bladder), and *C. quadriforme* FUJITA (the gall-bladder; parasitic on *Oncorhynchus gorboscha* and *Oncorhynchus mosou* also) as those in *Oncorhynchus keta*.

He further noted as parasites in *Oncorhynchus masou* *Dephyllobothrium latum* (LENNAEUS) (as muscle Plerocercoid), *Crepidostomum uchimii* FUJITA (the intestine), *Brachyphallus crenatus* (Rut.) (the Stomach), *Cystidicola salmonicola* (ISHII) (the intestine), *Myxidium oncorhynchi* FUJITA (the gall-bladder), as those in *Oncorhynchus rhodurus* *Allocreadium oncorhynchi* EGUCHI (the intestine), *Rhabdochona amago* YAMAGUTI (the small intestine), as those in *Salvelinus pluvius* *Cystidicola salvelini* (FUJITA) (the abdominal cavity) and *C. Iwana* FUJITA (the abdominal cavity), as that in *Salvelinus leucomaenis* *Chloromyxum salvelini* FUJITA (the gall-bladder), and as that in *Hucho perryi* *Azygia perryii* FUJITA (the fill, the surface and the back of gill cover, oral cavity, and pectoral fins; in the present case, the parasite crawled out of the stomach after death).

In 1936 in an article, "Parasites in salmon and trout families of Japan", in Volume 8 of *Sake-Masu Rui-Ho*, Hisao Kobayashi reported generally on the species mentioned above in a summary. The points of difference are that he stated *Acanthocephalus aculeatus* VANCELEAVE in *Oncorhynchus adonis* Jordan et McGregor as synonymous with *A. echigoensis* FUJITA, and that in the section on *Oncorhynchus keta* he stated *Acanthocephalus oncorhynchi* FUJITA to be also synonymous with *A. echigoensis* FUJITA, this agreeing with the opinion of Harada, and added larvae of *Pelichnibothrium* (the intestine) and *Crepidostomum salmonis* FUJITA (the intestine). In the section on *Oncorhynchus masou* he treated *Crepidostomum uchimii* FUJITA in yamame (land-locked specie of *Oncorhynchus masou*). Further, he added *Ichthyophthirius multifiliis*, which caused "white spot" disease in fry of salmon and trout.

In 1936 Tamao Fukui and Tetsuo Morishita in an article "On several species of Acanthocephala of Japan" on p. 761 of Volume 48, Dobutsugaku Zasshi reported on Acanthocephalus echigoensis FUJITA, 1920, which Yoshifus Kurozawa had obtained from the intestine of Salmo mocrostoma of the Sano River in Yamanushi-Ken.

L.C. Lyod and J.E. Cuberlet contributed an article "Syncoelium filiferum (SARS) from the Pacific salmon" on pp. 44-48, Volume 55 of Trans. Amer. Micr. Soc.

In 1937 Tsunenobu Fujita published his "Fish Pathology", a well-written and, in Japan, a unique volume, from Koseikaku. Parasites, which are mentioned as parasitic on fishes of Salmonidae are as follows:

(A) On skin

Costia flagellate, fry of Oncorhynchus masou (few in Europe and U.S.A.)

Ichthyophthirius multifiliis FOUQUET, flagellate, of Oncorhynchus masou and

Oncorhynchus keta

Cyclochaeta domerquei WALLENGREN, flagellate, fry of Oncorhynchus masou

Pontobdella moorei OKA, sea leech, Oncorhynchus keta

Caligus rapax (M. EDWARDS), Copepoda, Oncorhynchus masou (Europe and U.S.A.)

Lepeophtheirus salmonis (KROYER), Copepoda, Oncorhynchus masou (Europe and

U.S.A.)

L. stromii (BAIRD), Copepoda, Oncorhynchus masou (Europe and U.S.A.)

Argulus salmini, Branchiopoda, Oncorhynchus keta (Europe)

(B) Parasitic in muscles

Henneguya salmonicola WARD, Myxosporidia, *Oncorhynchus keta*, *Oncorhynchus kisutch* (Alaska)

Lymphosporidium truttae "monospore" parasite (?), *Salvelinus fontinalis* (U.S.A.)

Diphyllobothrium latum (LINNE), larvae, Cestoidea, *Oncorhynchus masou*

(C) Parasitic on bone and cartilage

Lentospora cerebralis (HOFER), Myxosporidia, *Salmoirideus* GIBBONS (Europe), *Oncorhynchus masou* (Atlantic), *Salvelinus fontinalis*

(D) Parasitic in the abdominal cavity.

Schistocephalus gasterostei (FABRICIUS), Cestoidea, *Oncorhynchus keta* (Europe)

S. solidus (MULLER), Cestoidea, *Oncorhynchus keta* (Europe).

Tetrarhynchus quadrirostris (GOEZE), Cestoidea, *Oncorhynchus tshawytscha* (Kamchatka), *Oncorhynchus keta* (Atlantin)

Contraecum ochotense FUJITA, nematode, *Oncorhynchus nerka* (the Sea of Okhotsk)

C. Senimasu FUJITA, nematode, *Oncorhynchus nerka*, *Oncorhynchus masou* (the Sea of Okhotsk)

Rhabdochona salvelini FUJITA, nematode, *Salvelinus pluvius*

Metabronema iwana (FUJITA), nematode, *Salvelinus pluvius*

Philonema oncorhynchi KUTTUNEN-EKBAUM, nematode, *Oncorhynchus nerka* (Canada)

P. ocotense FUJITA, *Oncorhynchus nerka* (the Sea of Okhotsk)

(E) Parasitic on the gills

Discocotyle salmonis SCHAFFER. Trematoda. *Oncorhynchus Salmo irideus*

GIBBONS, and *Oncorhynchus kisutch* (U.S.A.)

Caligus rapax. Copepoda. *Oncorhynchus masou* (Europe)

Lepeophtheirus stromii BAIRD. Copepoda. *Oncorhynchus masou* (Europe)

Lernaeopoda carpionis KROYER. Copepoda. *Oncorhynchus masou* (Europe)

L. salmonea KROYER. Copepoda. *Salvelinus pluvius* (Europe ?)

L. edwardsii OLSSON. Copepoda. *Salvelinus pluvius* (Europe ?)
(edwardsii?)

(F) Parasitic in the stomach and intestine

Octomilus intestinalis truttae (MOROFF), flagellate, *Salmo irideus*

GIBBONS (Europe)

O. salmonis MOORE, flagellate, ? (U.S.A.)

Trienophorus tricuspis, nematode, *Oncorhynchus keta*, *oncorhynchus*

masou (Europe), "white masu" (Canada)

Allocreadium oncorhynchi EGUCHI, Trematoda, *Oncorhynchus rhodurus*

Azygia perryi FUJITA, Trematoda, *Hucho perryi*

Crepidostomum salmonis FUJITA, Trematoda, *Oncorhynchus keta*, fry

C. uchimii FUJITA, Trematoda, *Oncorhynchus masou*, fry

C. farionis (MULLER), Trematoda, *Oncorhynchus masou*, *Oncorhynchus*

keta, "white masu" (Atlantic)

Lecitaster salmonis YAMAGUTI, Trematoda, *oncorhynchus keta*

L. gibbosus (RUDOLPHI), Trematoda, *oncorhynchus keta* (Atlantic)

L. bothryophorus OLSON, Trematoda, *Oncorhynchus keta* (Atlantic)

Bracyphallus crenatus (RUDOLPHI), Trematoda, *oncorhynchus masou*

(found in Europe also).

Derogenes varians (MULLER), Trematoda, *oncorhynchus keta* (Atlantic)

(found in "namikajika" in Japan)

Diplocotyle olrikii KRABBE, cestodea, *Salvelinus pluvius*, "white masu" (U.S.A.)

Cyathocephalus truncatus (PALLAS), cestodea, *Salvelinus pluvius*, "white masu" (Europe, U.S.A., and Canada)

Eubothrium crassum (BLOCH), Cestoidea, *Oncorhynchus masou*, *Salvelinus pluvius* (Europe and U.S.A.)

E. oncorhynchi WARKLE, Cestoidea, *Oncorhynchus masou*, *Oncorhynchus keta*, *Oncorhynchus kisutch* (west coast of U.S.A.)

E. salvelini (SCHRANK), Cestoidea, *Salvelinus pluvius*, *Oncorhynchus nerka* (Europe and U.S.A.)

Phyllobothrium salmonis FUJITA, larvae, Cestoidea, *Oncorhynchus keta*

Proteocephalus longicollis (RUDOLPHI), Cestoidea, *Oncorhynchus masou*, "white masu" (Europe)

P. torulosa, Cestoidea, *Oncorhynchus keta*, *Oncorhynchus masou*, *Salvelinus pluvius*, or "white masu" (U.S.A.)

P. salvelini, Cestoidea, as in above

P. arcticus, Cestoidea, as in above

P. coregoni, Cestoidea, as in above

P. laruei, Cestoidea, as in above

Triaenoporus tricuspidatus (BLOCH) Cestoidea *Oncorhynchus masou* (Europe)

Triaenoporus tricuspidatus (BLOCH), Cestoidae, larvae, Cestoidea, *Oncorhynchus masou*, "white masu" (liver) (Europe)

- Contracaecum adunca (RUDOLPHI), nematode, Oncorhynchus masou (Europe)
- C. clavata (RUDOLPHI), nematode, Oncorhynchus masou (Europe)
- C. four species, many of which are found in the abdominal cavity and
occasionally in the intestine, nematode, Salmonidae
- Cystidicola salvelini (FUJITA), nematode, Salvelinus leucomaenis,
Oncorhynchus adonis JORDAN et MCGREGOR
- Rhabdochona oncorhynchi (FUJITA), nematode, fry of Oncorhynchus keta
- R. fujiiii (FUJITA), nematode, Salvelinus leucomaenis, Oncorhynchus
adonis JORDAN et MCGREGOR
- Camallanus lacustris ZOEGER, nematode, Salmonidae (Europe)
- Spinitectus tenuissima (RUDOLPHI), nematode, Oncorhynchus masou
(Europe)
- Acanthocephalus oncorhynchi FUJITA, Acanthocephala, fry of Oncor-
hynchus keta
- A. echigoensis FUJITA, Acanthocephala, appendix pylorica, Oncorhyn-
chus keta
- A. aculeatus VANCLEAVE, Acanthocephala, Oncorhynchus nerka
- A. acerbus VANCLEAVE, Acanthocephala, Salmo irideus GIBBONS
- A. anguillae (MULLER), Acanthocephala, Oncorhynchus masou (Europe)
- Bolbosoma caenoforme (HEITZE), Acanthocephala, Oncorhynchus nerka
(Kamchatka)
- B. heteracanthae (HEITZE) Acanthocephala (also in the appendix
pylorica) Oncorhynchus keta (Europe)
- Echinorhynchus salmonis MULLER, Acanthocephala, Oncorhynchus keta,
"white masu" (Europe)

E. truttae SCHRANK, Acanthocephala, "masu" species (Europe)
Neoechinorhynchus rutili (MULLER), Acanthocephala, *Oncorhynchus*
masou, *salmo fario*, *S. truttae* (Central Europe)

(G) Parasitic in the air-bladder

Cytidicola salmonicola (ISHII), nematode, *Oncorhynchus masou*,
Oncorhynchus keta, *Salvelinius pluvius*

C. farionis FISCHER, nematode, *Oncorhynchus masou* (Europe and U.S.A.)

C. impar SCHNEIDER, nematode, *Oncorhynchus masou*, "white masu"
 (Europe)

(H) Parasitic in liver

Taenia longicollis (RUDOLPHI), Cestodea, *Oncorhynchus masou* (Europe)

(I) Parasitic in the gall-bladder

Myxidium oncorhynchi FUJITA, Myxosporidia, *Oncorhynchus masou*

M. oviforme PARISI, Myxosporidia, *Oncorhynchus masou* (Europe)

Salmo irideus GIBBONS (U.S.A.)

Chloromyxum chitosense FUJITA, Myxosporidia, *Oncorhynchus keta*

C. quadriforme FUJITA, Myxosporidia, *Oncorhynchus masou*, *Oncorhyn-*
chus gorbuscha

C. salvelini FUJITA, Myxosporidia, *Salvelinus pluvius*, *Oncorhynchus*
adonis JORDAN et MCGREGOR

C. truttae LEGER, Myxosporidia, *Oncorhynchus masou* (France)

(J) Parasitic in ovary

Thelohania ovicola (AUERBACK), "microspore worm", "white masu"

(Sweden)

In 1937 Tamac Fukui and Tetsuo Morishita contributed an article, entitled "Further note on several species of *Acanthocophalus* of Japan" in No. 12, Vol. 21 of the Journal of Experimental Medicine, and reported on several species; *Rhadinorhynchoides miyagawai* n.g., n. sp. (collected by Shiro Komamura), which had been obtained from *Salvelinus pluvius* from Taguchi River in Niigata-Ken, was included.

Tetsuo Morishita reported on two species of *Acanthocephala* found in Tsingtao in No. 12, Vol. 21 of *Jikken Igaku Zasshi*; of these, one species was *Neoechinorhynchus tsintaensis* n. sp. which had been found in *Oncorhynchus masou*.

In 1939 Sanaka Yamaguchi mentioned *Lepeophtheirus uenoi* n. sp., which he had obtained in *Oncorhynchus gorbuscha* from Kokumokin Lake in Kitami in Hokkaido, on page 461 of Vol. 2 "Dr. Sadao Yoshida Celebration Commemorative Publication, Europe". Further, he described *Salmincola falculata* (WILSON, 1908) WILSON, 1915, which had been found in the oral cavity of *Oncorhynchus nerka* from Penke Lake in Kushiro in Hokkaido.

Tsunenobu Fujita contributed an article "On the Nematode parasite of the Pacific salmon" on pp. 239-266, Vol. 42 of *Hokkaido Teikoku Daigaku Nogaku-Bu Kiyō* and published the following nematodes: *Anisakis salaris* (GMERIN) (from *Oncorhynchus gorbuscha*, *Oncorhynchus keta*,

Oncorhynchus nerka, and *Oncorhynchus masou* from Kamchatka, Saghalien, and Hokkaido; *Contracaecum hypomesi* FUJITA (*Oncorhynchus gorbuscha* in Anaiwa, Yoman, and Kaihyoto, *Oncorhynchus nerka* in Kabacha, and *Oncorhynchus keta* in Rusakoff (?); *C. crassicaudatum* n. sp. (from *Oncorhynchus kisutch* of the Suribacki-Bay of Okhotsk); *C. tridentatum* n. sp. (from *Oncorhynchus keta* and *Oncorhynchus masou* of Monbetsu); *C. unidentatum* n. sp. (from *Oncorhynchus keta* of Kaihyo-To); *C. robustum* n. sp. (from *Oncorhynchus gorbuscha* of Kaihyo-To); *Metabronema oncorhynchi* n. sp. (from *Oncorhynchus* of Rausu); *M. kosugii* n. sp. (from *Salvelinus leucomaenis* from Rausu); *M. amemasu* n. sp. (from *Salvelinus leucomaenis* from Rausu); *M. salvelini* n. sp. (from *Salvelinus leucomaenis* and *Oncorhynchus keta* of Tarandomari in Saghalien); *M. laticauda* n. sp. (from *Salvelinus malma* of Rausu); *Philonema kondai* n. sp. (from *Oncorhynchus* of Bibinskaya); *Ph. salvelini* n. sp. (from *Salvelinus leucomaenis* of Rausu); and *Ph. tenuicauda* n. sp. (? no record).

In 1940 Tsunenobu Fujita reported on the following nematodes in an article entitled "Further notes on nematodes of salmonoid fishes in Japan" in Vol. 8 of *Dobutsu-Gaku Shu-Ho* (Zoological Bulletin): *Contracaecum okadai* n. sp. (from the stomach of *Salvelinus malma* in Chitose River in Hokkaido); *Contracaecum salvelini* n. sp. (as above); *contracaecum longispiculum* n. sp. (from the coeloma of *Oncorhynchus keta* in Tarandomari River in Saghalien); *Contracaecum oshoroensis* n. sp. (from the coeloma of *Oncorhynchus keta* of Shinoji in Hokkaido); *Goezia oncorhynchi* n. sp. (from the coeloma of *Oncorhynchus keta* in Masuke in Hokkaido); *Cystidicola chitose* n. sp. (from the air-bladder of fry of *Oncorhynchus keta* in Chitose River in Hokkaido); *Rhabdochona oncorhynchi* n. sp. (from the intestine of

fry of *Oncorhynchus keta* in Sapporo); *Philonoma masu* n. sp. (from the coeloma of *Oncorhynchus masou* in Obihiro River in Hokkaido); and *Philonoma elongata* n. sp. (from the coeloma of *O. Kawamurae* JORDAN et MCGREGOR).

In the preceding paragraphs the author merely mentioned parasites, of fishes of Salmonidae which had been described in references on hand, chronologically. There is no doubt that there are articles other than the above mentioned. The author has no time to search for those and mentioned merely those that he is aware of. He wished by some means to add to the list as he finds new references.

IV. An Outline of Recent Researches in U.S.A., Canada, and the Soviet Union

Since 1955 U.S.A. and Canada have been conducting research on parasites in salmonoid fishes in connection with problems in fisheries in the North Pacific; the Soviet Union has also been conducting research in connection with fisheries in Kamchatka. The following is a summary of the outline of these studies:

According to the 1955 Annual Report of the North Pacific Fisheries International Commission, which was published in Vancouver, Canada in 1956, the research workers in Canada have been conducting work in close cooperation with those of the U.S.A.: Canadian workers devoted their efforts mainly to the study of *Oncorhynchus nerka* and *Oncorhynchus gorbusha*, and the U.S. workers to the study of *Oncorhynchus keta* and some *Oncorhynchus nerka* in an attempt to distinguish the fishes of Asiatic lineage and American lineage on the basis of parasites. Materials used were approximately 1000 fish consisting of ones migrating towards the sea, fry in inland seas, and

those which had been caught commercially or experimentally. The areas covered were Columbia River to Alaska in the north and the Sea of Okhotsk in the west.

Oncorhynchus gorbuscha is limited to those of the American waters. No parasite was found in fry (B.C. and Alaska); however, in young fish and adult fish, three species of Trematoda and a specie of Copepoda were found.

Parasites were detected in a considerable number of specimens of *Oncorhynchus nerka*; 3 species of parasites were collected from two-year fish, i.e., *Diplostomulum* sp. of Trematoda, *Diphyllobothrium* sp. of Cestodea, and *Philonema* sp. of Nematoda. Further, a larger number of parasites were found in adult fish. The main species are shown in the following table.

Headings to Table 1 on page 594

first sub-columnar heading -- Area

Entries - Fraser River, B.C.

Bristol Bay, Alaska

King Cove, Alaska Peninsula

Attu, the Aleutian Islands, Alaska

48°43' - 48°50' N.

170°23' - 173° E.

57°33'N., - 159°4'E.

The Sea of Okhotsk

second sub-columnar heading - Date of capture

Entries - July 26

July 15

July 7-Aug. 4

July 28-Aug. 9

May 18

July 14

July 30-Aug. 10

Second column - Trematoda

Third column - Cestoidea

Fourth column - Nematoda

Fifth column - Acanthocephala

Numerals outside parentheses show the percentage of detection of parasites.

Numerals inside parentheses show the average number of parasites among fishes which harbored the parasites.

Further, examinations were made of the data from Fraser River, Rivers Inlet, and Skeena River in B.C. and of the data from Japanese high sea fishery in Petersburg and in longitude 167°50' in Alaska and the following conclusions were made; that *Hemiurus levinseni* and *Echinorhynchus* sp. are observed commonly in specimens from the western portion; that they are observed rarely or not at all in specimens from the eastern portion; that *Lecithaster gibbosus* is found in a large number of cases east of Attu Island but in few cases west of Attu Island; and that it might be possible so far as *Oncorhynchus nerka* is concerned to distinguish Asiatic lineage and American lineage on the basis of these parasites although further study was necessary. Further, although it is not evident in the table above, *Brachyphallus* sp. was found in all *Oncorhynchus nerka* in the high sea north of 48° N,

it was not found at all in *Oncorhynchus nerka* and *Oncorhynchus gorboscha* found in the high sea south or 48°N , or in waters south of Queen Charlotte Sound, which is located in B.C. coastal water. Thus, it was evident that there was a difference in the distribution of parasites in north and south. Again, different parasites were found in *Oncorhynchus nerka* and *Oncorhynchus gorboscha* in adult fishes in the Fraser River in B.C. and it was reported that because of this, surveys on one specie did not enable one to estimate the conditions in other species. The U.S. report is extremely simple. It reported that the distribution of parasites in *Oncorhynchus keta* was extremely different between those of American and Asiatic lineages; that *Echinorhynchus gadi* especially was found only on the Asiatic side and *Tubulovesicula* sp. on the American side. This finding was similar to Canadian investigators working in the same area in the study of *Oncorhynchus nerka*. The investigations were carried on by the staff of the Fisheries Research Board of Canada for Canada and by the staff of U.S. Fish and Wildlife Service for U.S.A.

"Progress Report on Research by Canada in 1955" of International North Pacific Fisheries Commission for the year 1955 gives generally similar accounts as above: we may add that the report states that a total of 11 species, consisting of 9 species of Trematoda, one specie of Nematoda, and one specie of Copepoda, were found in *Oncorhynchus gorboscha* which had been caught in the sea; that *Lecithaster gibbosus* was observed in 50% in Alert Bay and Cuarled Islands; and that the rate of infection was low for other species. A total of 13 species were found in adult fish of *Oncorhynchus gorboscha* of Fraser River -- 7 species of Trematoda, 2 species of Cestoidea,

2 species of Nematoda, and 1 specie of Acanthocephala: of these as many as 5 species were found in over 90%, and as many as 2 species in over 75%. It was reported that *Lecithaster gibbosus* was found in largest number in adult fish and also in young fish in the sea. Since young fish of *Oncorhynchus nerka* remain in fresh water for a considerable length of time, unlike in the case of *Oncorhynchus gorboscha*, 14 species of parasites were found; of these 4 species were widely distributed; of these two species had somewhat high rates of infection. Of the 14 species, many species become parasitic in the digestive tract from outside; thus, they fall off as soon as the fish entres the sea. The 2 species with high rates of infection are parasitic in tissues; thus, it appears as though they are not affected by entry into the sea. It is not known whether these two species can be found in *Oncorhynchus nerka* on the Asiatic side. It is reported that *Lecithaster gibbosus* is found in a large number in young fish living in the sea. It is reported that the study on parasites were conducted by Mr. LEO MARGOLIS with Mr. J.R. ADAMUS and Miss D. WAHKROUCHEFF also taking part depending on the season.

Biological Investigation Document of the North Pacific Fisheries International Commission, which was published in 1956 by the First Research Section of the Survey and Investigation Division of the Fisheries Agency, is concerned in part with the conversation with Mr. Jackson: in Chaper 4 of the document entitled, "an outline of results of investigation in U.S. and Canada, deals with the investigations of parasites. It is reported that investigations in Canada were conducted with Dr. Margolis as leader, that 30-35 species were found among 150 adult specimens of *Oncorhynchus nerka*, 400 smolt of *oncorhynchus nerka*, which had been caught in fresh water, that

these parasites could not be utilized to distinguish the Asiatic strain from the American strain since many of them showed wide distribution, that few, for instance Echinorhynchus, were found in a large number in the sea of Okhotsk, but merely once in the eastern Pacific, and that Lecithaster, on the other hand, was found in an extremely large number in the eastern Pacific but rarely in the west. Dr. Uzman, in his research, noted that Acanthocephala (means Echinorhynchus) appeared in Oncorhynchus nerka of Asiatic strain at a high rate but in small number in U.S. side, that Anisakis of Nematoda showed a high ratio in the western Pacific, and that the same specie showed similar high rate in the east. He further noted that Echinorhynchus showed some promise in determining the strain of Oncorhynchus keta, that Tubulovesicula was discovered only in Bristol Bay in Alaska but not in seas around Japan, that Phyllebothrium of Cestoidea became parasitic in Oncorhynchus nerka and Oncorhynchus keta in a similar manner, that the rate of infection of Anisakis of Nematoda was also high. Further, the same report contains an item entitled, a study on parasites in salmonoid fish in the Pacific, a report by the Canadian Fisheries Biological Research Station in Nanaimo, B.C. in Canada; the article deals with parasites in Oncorhynchus nerka and Oncorhynchus gorbuscha, which were caught by U.S.A. Canada, and Japan. With respect to Oncorhynchus gorbuscha, 30 fry of Alert Bay, B.C., 50 fry from southeastern Alaska, 44 and 50 young fish from Alert Bay and Gnarlad Island in B.C., and 24 adult fish from the Fraser River in B.C. were investigated; no parasites were found in the fry. Main species of parasites in young and mature fish from the sea and the rates of infection are shown in Table 2; there are 5 species not discovered in others: it is

reported that of these 1 species has not been recorded. Of these recorded in the table, *Brachyphallus crenatus* is found only in those fish found in the extreme north. It is reported that a similar phenomenon is observed in *Oncorhynchus nerka*. 17 species of parasites are known to infect smolts of *Oncorhynchus nerka*: of these 10 species, exclusive of 7 species only occasionally observed, are shown in Table 4.

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Table 2

1st columnar heading - Area

Entries - Alert Bay, B.C.

Young fry

Gnarlad Island

Young fish

2nd columnar heading - Date of capture

Entires - June 28, 1955

June 29, 1955

3rd columnar heading - Trematoda

4th columnar heading - Nematoda

sub-heading - *Contracecum*

larvae (from the coeloma)

5th columnar heading - Copepoda

Note - numbers indicate % of infection: numerals inside the parentheses show average number of parasites in those which were infected. (same in the tables which follow)

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Table 3

Entries in the 1st column - Fraser River., B.C.

Mature fish

Caught on August 2 and 3, 1955

2nd columnar heading - Trematoda

3rd columnar heading - Cestoidea

4th columnar heading - Nematoda, Contracaecum, Anisakis
(Digestive organ) (Larvae)

5th columnar heading - Copepoda

6th columnar heading - Acanthocephala

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Table 4

1st columnar heading - Area

Entries - Cultus Lake, Fraser River; Cultus Lake, Fraser River;
Chilco Lake, Fraser River; Port John, Central B.C.;
Lekelse Lake, Skeena River; Babine Lake, Skeena River;
Redfish Lake, Columbia River; Okanagan River, Columbia
River; Wenatches Lake, Columbia River; Puget Sound,
Baker River; Bristol Bay, Aleknagik Lkae; Brooks River,
Alaska.

2nd columnar heading - Date of capture

Entries - April 25, 1955; May 30, 1955; April 20, 1955; May 20,
1955; May 20, 1955; June 10, 1955; May 19, 1955, May 17,
1954; May 10, 1955; April 15-22, 1955; June 20, 1955;
May 31, 1955.

3rd columnar heading - Acanthecephala

4th columnar heading - Nematoda

Oncorhynchi

Nematoda

Larvae

5th columnar heading - Trematoda

Diplostomulum sp.

Larvae

6th columnar heading - Cestoidea

Eubothrium

Dephyllobothrium sp.

Larvae

Proteocephalus

Trienophorus crassus

Larvae

7th columnar heading - Copepoda

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Table 5

1st columnar heading - Date collected

Entires - June 28, 1955; July 14, 1955

3rd columnar heading - Contracaecum

Larvae (the coeloma)

4th columnar heading - 1 Nematoda

Larvae

5th columnar heading - Diphyllbothrium

Larvae

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Table 6

1st columnar heading - Area

Entries - Fraser River, B.C.; Bristol Bay, Alaska; Attu, Aleutian Islands, Alaska; King Cove, Alaska Peninsula; 48°43' - 48°50'N; 170°23' -173°E; 51°33' 159°04'E; the Sea of Okhotsk.

2nd columnar heading - Date of capture

Entries - July 26, 1955; July 15, 1955; July 28-September 8, 1955; July 7-August 4, 1955; May 18, 1955; July 14, 1955; June 20-August 10, 1955.

3rd columnar heading - Trematoda

4th columnar heading - Cestoidea

5th columnar heading - Nematoda

6th columnar heading - Acanthocephala

7th columnar heading - Copepoda

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Table 7

1st columnar heading - Area

- Entries - 1. The sea of Okhotsk (Japanese high sea fishery)
2. Western sea (Japanese high sea fishery) (eastern part of Tenshu Island, southern extremity of Kamchatka Peninsula)

3. Central sea (Japanese high sea fishery) (south-eastern off shore, Kamchatka Peninsula)
4. Eastern sea (Japanese high sea fishery) (east south-east far off shore, Kamchatka Peninsula)
5. Date-change-line sea
6. Unalaska sea (southern side of eastern part of the Aleutian Islands)
7. King Cove (north east of 6), Alaska
8. Seldovia (?), Alaska (Southern shore of Alaska)
9. Alaska Bay
10. Petersburg, Alaska
11. Skeena River, B.C.
12. Rivers Inlet, B.C.
13. Fraser River, B.C.
14. Samish (?) River, Washington.

2nd columnar heading - Date collected

Entries - June 30, 1955; July 10, 1955, July 20, 1955; July 30, 1955; July 27, 1955; July 30, 1955; August 10, 1955; June 1, 1955; July 13, 1955; July 13, 1955; May 18, 1955; May 18, 1955; June 1, 1955; September 3, 1955; September 3, 1955; September 4, 1955; September 4, 1955; September 19, 1955; July 30, 1955; July 31, 1955; August 1, 1955; August 2, 1955; June 27-August 4, 1955; July 25, 1955; July 13, 1955; July 14, 1955; July 16, 1955; July 12, 1955; July 17, 1955; July 5-August 23, 1955; not investigated; no entry; November 1, 1955; December 8, 1955.

3rd columnar heading - Position

4th columnar heading - Number of fish

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Table 8

1st columnar heading - Area

2nd columnar heading - Trematoda

3rd columnar heading - Cestoidea

4th columnar heading - Nematoda

5th columnar heading - Acanthocephala

6th columnar heading - Copepoda

Of those mentioned above, the parasites, which are found in mature fish, are *Philonema oncorhynchi*, *Diphyllbothrium* sp. and *Diplostomulum* sp.; places infected are the coeloma, the stomach, cyst membrane on the outer wall of the appendix pylorica, or inside the eye, which are less affected by fresh water.

It is reported that examination of the tables will enable one to distinguish a large river system which has tributaries. The summary for young fish caught at sea in Alert Bay in B.C. is shown in Table 5.

Table 6 shows parasites in mature fish which were caught at sea.

It is reported that the parasites mentioned in preceding sections are main species, that additional 16 species have been found, and that of these one seems to be a new specie. The examination of the above table

shows that Lecithaster, Trematoda, are clearly found in a large number in the east and that Echinorhynchus are found in the west. It will be noted that this Acanthocephala is not found in the sea which is noted in the third line from the bottom of the table and which belongs to the western region. It is reported that the date of capture was May 18 in this area while that of all other areas is June to July; that it is possible that the parasites of the previous year fall off by May, and that during June and July new parasites infect the fish.

In the same year, Mr. J.R. Uzmann of Pacific Salmon and Trout Investigations Division of the U.S. Fish and Wildlife Service in Seattle, Washington made the following report under the title, a study of parasites in chum salmon. The number of parasites, which had been collected from *Oncorhynchus keta* from areas mentioned in Table 7, were as many as 27 species; of these, for various reasons, 3 species were chosen and their distributions and densities of infections were noted. The three species were larvae of *Anisakis*, Larve of *Bolbosomay*, and *Echinorhynchus gadi*. It was reported that these parasites are found in large number in areas 1 to 4 of Table 7 and that the boundary was approximately between 170°E and 180°E . The main areas and parasites are shown in Table 7 and 8; it was further illustrated by means of four maps.

Rates of infection and population of the main species in each area are shown in Table 8. No investigations were made in area 11.

In October 1956 Mr. Leo Margolis of Canada published a fairly detailed report from the Biological Station in Nanaimo on parasites of

sockeye and pink salmon which had been caught in 1955. It appears that this is a more detailed version of the report by the same author which has already been mentioned. According to this report, he examined a total of 1,509 fishes. Of these 966 (476 fry going to the sea, 92 young and 398 mature fishes caught at sea) were *Oncorhynchus nerka*; 543 (100 fry and 94 young fishes and 349 mature fishes caught in the sea) were *Oncorhynchus gorbuscha*. Over 50 species of parasites were found; of these 42 (16 fresh water species, 24 salt water species, and 2 unknown species) were found in the former, and 27 species (1 specie probably a fresh water type, 25 salt water species and 1 unknown specie) were found in the latter. There were 24 species common to the two (22 salt water species, 1 fresh water specie, and 1 unknown specie). The report noted that the reason for the large number of fresh water species in *Oncorhynchus nerka* was that the fish spent a relatively long period in fresh water, 1-3 years; and that *Oncorhynchus gorbuscha* went down to the sea shortly after hatching and that this was the reason for the non-existence of parasites in fry. The report contains a fair amount of detail; a simple summary of species of parasites, place infected, hosts, the distribution whether there is more in the east or the west is as follows. (The table was compiled by the author for his convenience and is not in the original report).

Headings for summary on pages 605, 606, 607, and 608.

1st column - Number	2nd column - Name
3rd column - Infected part	4th column - Host
5th column - Area	6th column - Distribution
7th column - Remarks	

Entries

1. Trematoda Gyrodactyloides strelkowi; the gills; Oncorhynchus nerka and Oncorhynchus gorbuscha; Sea; wide; not entry.
2. Tetraonchus alaskenis; the gills; fry of Oncorhynchus nerka; fresh water; only once; no entry
3. Bucephaloides sp.; intestine; oncorhynchus gorbuscha; sea; east
4. Bacciger sp.; no entry; Oncorhynchus nerka and Oncorhynchus gorbuscha; sea; small; resembles B harengulae well.
5. Podocotyle shawi; no entry; Oncorhynchus nerka; sea; 50%; no entry.
6. Diplostomulum sp. larvae; eyes; Oncorhynchus nerka; fresh water; many; no entry.
7. Tetracotyle sp. larvae; pericardial cavity and mesentery; fry of Oncorhynchus nerka; fresh water; scattered; no entry.
8. Hemiurus levinseni; the stomach; Oncorhynchus nerka and Oncorhynchus gorbuscha; sea; numerous in the west; distributed fairly widely, and found in large number in the west in Oncorhynchus nerka.
9. Parahemiurus sp.; the stomach; Oncorhynchus nerka and Oncorhynchus gorbuscha; sea; few; found in the coast, once in Oncorhynchus nerka, appears as though it is P. achnoviae.
10. Brachyphallus crenatus; the stomach; Oncorhynchus nerka and Oncorhynchus gorbuscha; sea; almost 100%; no entry.
11. Tubulovesicula lindbergi; the stomach; Oncorhynchus nerka and Oncorhynchus gorbuscha; sea; numerous in the east.
12. Lecithaster gibbosus; intestine; Oncorhynchus nerka and Oncorhynchus gorbuscha; sea; numerous in the east; numerous in those found along the coastal line.

13. *Genolinea oncorhynchi*; stomach; *Oncorhynchus gorbuscha*; sea; found only in two, rare; no entry.
14. *Derogenes varicus*; stomach; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; wide, in the east in *Oncorhynchus gorbuscha*; no entry.
15. *Aponurus* sp.; stomach; *Oncorhynchus nerka*; sea; wide; not in *Oncorhynchus gorbuscha*.
16. *Syncaelium katuwo*; gills; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; no entry; no entry; once only in *Oncorhynchus nerka*.

Gestoidea

17. *Diphyllobothrium*; stomach and appendix phylorica; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; fresh water; wide; in a cyst, adult parasite infects bears on Kodiak Island, *D. ursi*.
18. *Triaenophorus crassus*, larvae; no entry; fry of *Oncorhynchus nerka*; no entry; ordinary; no entry.
19. *Eubothrium salvelini*; appendix pylorica; fry of *Oncorhynchus nerka*; fresh water; few; no entry.
20. *Eubothrium oncorhynchi*; appendix pylorica and intestine; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; rare in the west, twice in *Oncorhynchus nerka*, *Oncorhynchus gorbuscha* east.
21. *Eubothrium* sp.; appendix pylorica and intestine; fry of *Oncorhynchus nerka*; fresh water; no entry; *E. salvelini*?
22. *Diplocotyle* sp.; intestine; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; common in *Oncorhynchus gorbuscha*, Attu; *D. olriki*?
23. *Phyllobothrium caudatum* later period larvae; intestine; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; ordinary; no entry.

24. *Nybelinia sumenicola* later period larvae; stomach; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; few; in cyst.
25. *Proteocephallus* sp. larvae or later period larvae; intestine and appendix pylorica; fry of *Oncorhynchus nerka*; fresh water; ordinary; mature insect is *P. salmonicida*, not found in mature *Oncorhynchus nerka*.

Acanthocephala

26. *Bolbosoma* sp. later period larvae; intestine; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; numerous in the west; no entry.
27. *Corynosoma strumosum* later period larvae; intestinal organs; *Oncorhynchus gorbuscha*; sea; 2 only; no entry.
28. *Corynosoma* spp. later period larvae; intestinal organs; no entry; sea; few; in cyst.
29. *Nipporhynchus* sp.; intestine and stomach; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; few; no entry.
30. *Echinorhynchus gadi*; intestine; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; numerous in west; no entry.
31. *Neodechinorhynchus rutili*; intestine; fry of *Oncorhynchus nerka*; fresh water; numerous; no entry.

Nematoda

32. *Anisakis* sp (spp) larvae; several places; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; numerous; in cyst in such places as muscles, mesentery, surface of intestinal organs, and coeloma.
33. *Terranova* (=Porrocaecum) sp. larvae; deep muscle; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; few; larvae of *T.* (=P.) *deciplane*

34. *Contracaecum* spp.; no entry; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; numerous, in *Oncorhynchus gorbuscha* in east; no entry
35. *Ascarophis skrjabini*; stomach, intestine; *Oncorhynchus gorbuscha*; sea; few; no entry
36. *Dacnitis truttae*; intestine; *Oncorhynchus nerka*; fresh water; few; no entry
37. *Rhabdochona* sp. (?); intestine; fry of *Oncorhynchus nerka*; fresh water; rare; no entry
38. *Capillaria* sp.; intestine; fry of *Oncorhynchus nerka*; fresh water; rare; no entry
39. *Philonema oncorhynchi*; coeloma; *Oncorhynchus nerka*; fresh water; numerous; no entry
40. Larvae of Nematoda, small ones; mesenteric, air-bladder wall; fry of *Oncorhynchus nerka*; fresh water; numerous; larvae of *Philonema*?

Copepoda

41. *Salmoncola ferculata*; gills, body surface; fry of *Oncorhynchus nerka*; fresh water; few; no entry
42. *Ergasilus* (two species); gills; fry of *Oncorhynchus nerka*; fresh water; numerous; no entry
43. *Lepeophthirus salmonis*; body surface; *Oncorhynchus nerka* and *Oncorhynchus gorbuscha*; sea; numerous; more in *Oncorhynchus gorbuscha* than in *Oncorhynchus nerka*

Protozoa

44. *Henneguya salmincola*; muscle; *Oncorhynchus nerka*; ?; few; cyst.

In the above table, spp. indicates the inclusion of several species; = indicates parasites in which differences can be recognized between east and west in the North Pacific.

In Vol. 93 of Pacific Fisheries and Oceanographic Research Report in the 10th Collection of references on the Soviet north sea fisheries, published by the North Sea Resources Research Conference in July, 1957, there is a report, entitled Parasites in fish in Kamchatka River by A.Yh. Akhmerov; in this article, at the beginning there is a brief reference to work in the past. They include; (1) Zschokke and Heitz investigated the 5 species of salmonoid fishes, which had been going up-stream and which had been collected by Schmidt(?)--*Salvelines malma*, *Oncorhynchus nerka*, *Oncorhynchus keta*, *Oncorhynchus tshawytscha*, and *Oncorhynchus kisutch*-- and recorded one specie of Protozoa, 6 species of Cestoidea, 2 species of Acanthocephala, and 4 species of Nematoda, a total of 13 species; (2) Heitz wrote on a new specie, *Bolbosoma coenoforme* of Acanthocephala, and (3) Grizusr(?) stated Sporozoa found in *Oncorhynchus kisutch* of Kamchatka to be *Henneguya zschokkei*. Affmeroff examined 327 fishes which were made up of 15 species, 10 genera, and 6 families. Of these salmonoid fishes were 29 *Oncorhynchus nerka*, 20 *Oncorhynchus kisutch*, 20 *Oncorhynchus gorbuscha*, 7 *Salmo mykiss*, 21 *Salvelinus malma*, which were going up-stream, and 12 *Kliliskigaletz* (?) (fresh water variety). In addition, he examined, among the fish collected at Tinro Kamachatka sub-station, 15 yearling *Oncorhynchus nerka*, 15 one-year old *Salvelinus malma* from Kaluimaiski (?) Reservoir (Bolyshya River ?). He arranged parasites taxonomically, and made explanation of each specie; next, he explained characteristics and comparative material with respect

to each specie of fish. The author made summaries of those concerning salmonoid fish below:

Myxosporidia

1. *Henneguya salminicola* WARD, 1919. Host: *Oncorhynchus keta*, *Oncorhynchus nerka*, *Oncorhynchus kisutch*, *Salmo thymallus*. Found as a vesicle under the skin at the tip of scale in the tail, in the muscle on the dorsal side, and on gill cartilage. The original author discussed the similarities and differences between *H. zchokkei* and this specie, defined as two subspecies, *H. salminicola* subsp. *salminicola* (fresh water sea) and *H.s.* subsp. *zschokkei*, and stated the latter to be a fresh water variety.

Trematoda

2. *Bucephalopsis basargini* LAYMAN, 1930. Host: *Oncorhynchus gorbuscha*, *Salvelinas malma*. Intestine (Sea).
3. *Crepidostomum farionis* O. F. MULLER (Syn. *C. baicalense* LAYMAN).
Host: *Salmo mykiss*, *Salvelinas leucomaenis*, *Salvelinas malma*, *Salmo thymallus* (fresh water).
4. *Kemiurus levinseni* ODHNER. Host: *Salvelinas malma*, *Savelinas leucomaenis*, and *Oncorhynchus nerka*. Intestine (sea and mouth of river).
5. *Brachyphallus amurensis* BABASKIN. Host: *Oncorhynchus keta*, *Oncorhynchus gorbuscha*, *Salvelinas malma*, and *Salvelinas leucomaenis*.
Intestine (sea).
6. *Sterrhurus* sp. Host: *Oncorhynchus nerka*. Intestine (sea).
7. *Lecithaster gibbosus* RUD. Host: *Salvelinas malma*, *Oncorhynchus nerka*, *Oncorhynchus keta*, and *Oncorhynchus gorbuscha*. Intestine (sea).

8. *Derogenes varicus* O.F. MULLER, 1784. Host: *Salvelinas leucomaenis*.
Intestine. (sea).
9. *Azygia robusta* ODHNER. Host: *Oncorhynchus tschawytscha* (WALBAUM, 1792).
Intestine. (sea and fresh water).

Cestoidea

10. *Eubothrium crassum* BLOH. Host: *Oncorhynchus keta*, *Oncorhynchus tschawytscha*, and *Oncorhynchus kisutch*. Intestine (sea).
11. *Eubothrium salvelini* SCHRANK. Host: *Salvelinas leuchomaenis*, *Salvelinas malma*, *Salmo mykiss*, and *Salmo thymallus*. (sea)
12. *Nybelinia* sp. Larvae. Host: Coeloma of *Oncorhynchus tschawytscha*. (sea). Adults are found in sharks and skates.
13. *Callibothrium filicolle* ZSCHOKKE. Larvae (There are three names of the larvae -- *Scolex polymorphus*, *Pelichnibothrium caudatum*, and *Phyllobothrium caudatum*. The first refers to larvae in early period: the third refers to the larvae in later period). Host: *Oncorhynchus keta*, *Oncorhynchus gorbusha*, *Oncorhynchus tschawytscha*, *Oncorhynchus kisutch*, *Oncorhynchus nerka*, *Salvelinas malma*. S.p. in gall-bladder and intestine; Pc. in intestine (fresh water sea?)
14. *Proteocephalus exiguus* LA RUE. Host: *Oncorhynchus nerka*, *Salvelinus malma*, and *Oncorhynchus tschawytscha*. Intestine (fresh water).
15. Pleroceroid. Host: *Oncorhynchus nerka*. Intestine. *Salvelinus leuchmaenis*. Coeloma. The larva is the larva of *Diphyllobothrium*; however, it does not infect humans. Adults unknown. According to Chujoie (?), this may be the larva of *D. strictum* or *D. minus* which infect sea-gulls in Lake Baikal.

Acanthocephala

16. *Echinorhynchus gadi* ZOEGA. Host: *Oncorhynchus kisutch*, *Oncorhynchus keta*, *Oncorhynchus tshawytscha*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, and *Salvelinus malma*. Intestine (sea).
17. *Echinorhynchus salmonis* MULL. Host: *Salmo mykiss*, *Salvelinus leucomaenis*, *Salmo thymallus*. Intestine (fresh water).
18. *Corynosoma strumosum* RUD. Larvae?. (? after larvae in original manuscript). Host: *Salvelinus leucomaenis*. Coeloma (sea). Adults are found in marine mammals such as seal.
19. *Bolbosoma coenoforme* HEITZ. Larvae. Host: *Oncorhynchus keta*, *Salvelinus malma*, *Oncorhynchus nerka*, and *Oncorhynchus gorbuscha*. Intestine (sea). Adults in seals and others. Mr. Buihoffskaya (?) terms this *Echinorhynchus Coenoforme* HEITZ.
20. *Neoechinorhynchus crassus* VANCLEAVE. Host: *Salmo mykiss*. Intestine (fresh water).
21. *Neoechinorhynchus cristatus* LYNCH. Host: *Salvelinus leucomaenis*. Intestine ? (? in original manuscript). (fresh water). Only once.

Nematoda

22. *Anisakis simplex* RUDOLPH, 1819 (= *A. salaris* YAMAGUTI). Larvae. Host: *Oncorhynchus nerka*, *Salvelinus malma*, *Salvelinus leucomaenis*, *Oncorhynchus keta*, *Oncorhynchus gorbuscha*, *Oncorhynchus tshawytscha*, *Oncorhynchus kisutch*, and *Salmo mykiss*. Muscle, intestine, coeloma, stomach, and mesentery. (sea).
23. *Contraecum aduncum* RUD., 1802. Host: *Salvelinus leucomaenis*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Salmo mykiss*, *Salmo thymallus*, *Oncorhynchus keta* (immature parasites), *Salvelinus malma*(same).

Intestine, stomach, coeloma, esophagus (sea). There is a mention of a report in 1940 of Tsunenobu Fujita.

24. *Dacnitis truttae* DUJARDIN. Host: *Salvelinus leucomaenis*, *Salmo mykiss*, *Oncorhynchus nerka* (chance). Intestine. (fresh water).
25. *Cystidicola farionis* FISHER. Host: *Salvelinus leucomaenis*, *Salmo mykiss*. Air bladder, intestine, and esophagus. (fresh water).
26. *Ascarophis malmae* ACHMEROW. Host: *Salvelinus melma* fries (none in Kaluimaeski Reservoir on Bolshoi River or in Kamchatka). Intestine. (fresh water).
27. *Philonema oncorhynchi* KUTTUNEN-EKBAUM (=Ph. gubernaculum SIMON et SIMON. 1936. Ph. elongata FUJITA, 1940) Host: *Oncorhynchus nerka*, *Oncorhynchus keta*, and *Salvelinus leucomaenis*, Protuberance in pylorus (sea).

Copepoda

28. *Lepeophtheirus salmonis* KROYER. Host: *Oncorhynchus tshawytscha*, *Oncorhynchus gorbuscha*. Body surface. (sea).
29. *Salmonicola thymalli* KESSLER. Host: *Salmo thymallus*. Gills. (fresh water).
30. *Salminicola edwardi* OKSEN. Host: *Asabarch* (?), subspecies of *Oncorhynchus nerka* (not found in *Oncorhynchus nerka*). Gills (fresh water).
31. *Salminicola bicauliculata* WILSON. Host: *Salmo mykiss* and *Salvelinus malma*. Gills. (fresh water).

The above summary concerns those in rivers in Kamchatka only: however, in view of the difficulty in obtaining material from the Soviet Union, it seems valuable.

Differences, in a tabular form, in eastern and western portions of the North Pacific, based on data of 1955 and 1956, are as follows. The information is based on 1955 Annual Report of the North Pacific Fisheries International Commission, which was published in Vancouver, Canada in 1957:

Those prevalent in east.	Those prevalent in west.
In <i>Oncorhynchus nerka</i>	
<i>Lecithaster gibbosus</i>	<i>Hemiurus levinseni</i>
<i>Tubulovesicula lindbergi</i>	<i>Echinorhynchus gadi</i>
In <i>Oncorhynchus gorbuscha</i>	
<i>Contracecum</i>	<i>Bolbosoma</i>
<i>Bucephaloides</i>	<i>Echinorhynchus gadi</i>
<i>Tubulovesicula lindbergi</i>	
<i>Lecithaster gibbosus</i>	
<i>Eubothrium</i>	
<i>Derogenes various</i>	

Further, an example of one, which seems extremely localized, is *Podocotyle shawi*, of Trematoda which are found only in *Oncorhynchus nerka* in the Columbia River; *Diplocotyle* of Cestoda, which were found only in *Oncorhynchus nerka* and *Oncorhynchus gorbuscha* in Attu Island. It is stated that the facts may be of some value in identifying the birth place of fishes caught in the high sea.

In short, these reports of U.S.A., Canada, and the Soviet Union are not pure parasitological reports but concern themselves with fisheries problems in the North Pacific; their main purpose, as has been stated, is to

distinguish fishes, which had been born in rivers of Asia and those of U.S.A. and Canada, by means of parasites, if this is possible. However, the problem arises with respect to identification. This criticism can also be directed to work of the author. In the first part of this report, only the generic names of parasites are shown: the author feels that this procedure was adopted to simplify the work. However, it is extremely rough, though this cannot be helped in the case of larvae or in the case of parasites not yet completely identified.

V. Known Parasites in salmonoid fishes

A tabular presentation of known parasites of salmonoid fishes in accordance with the Japanese references, which have already been cited, and in accordance with recent reports of U.S.A., Canada, and the Soviet Union, are as follows. It is needless to mention that there are species of salmonoid fishes other than those listed here: there are also many parasites known other than those listed. Here, the author listed only those related to Japan and the North Pacific for the time being:

Protozoa

Sporozoa

1. *Chloromyxum chitosense* FUJITA, 1923. *Oncorhynchus keta*. Gall-bladder
2. *Ch. giganteum* FUJITA, 1923. *Oncorhynchus gorbuscha*. Gall-bladder.
3. *Ch. quadriforme* FUJITA, 1923. *Oncorhynchus keta*, *Oncorhynchus gorbuscha*, and *Oncorhynchus masou*. Gall-bladder.
4. *Ch. salvelini* FUJITA, 1923. *Salvelinus leucomaenis*, *Salvelinus*

- pluvius, and *Oncorhynchus adonis* JORDAN et MCGREGOR. Gall-bladder.
5. *Henneguya salmonicola* WARD, 1919. *Oncorhynchus keta*, *Oncorhynchus kisutch*, *Salmo thymallus*, *Oncorhynchus nerka*
 At the tip of scales in tail portion, under skin, in dorsal muscles, and in branchial arch cartilage as vesicle.
H. salmonicola salinicola (fresh water) (sea).
H. salmonicola zschokkei (only in fresh water). *Oncorhynchus kisutch* (Kamchatka).
6. *Lymphosporidium truttae*. *Salvelinus fontinalis* (U.S.A.). Muscle.
7. *Myxidium oncorhynchi* FUJITA, 1923. *Oncorhynchus masou*. Gall-bladder.
8. *M. oviforme* PARISI. *Salmo irideus* GIBBONS (U.S.A.). Gall-bladder.

Ciliata

9. *Ichthyophthirius multifiliis* FOUQUET. *Oncorhynchus keta*, *Oncorhynchus masou*, fry. Skin.
10. *Cyclochaeta domerqueis* WALENGREN, 1895. *Oncorhynchus masou* fry.
 Skin.

Platyhelminthes

Trematoda

11. *Allocreadium oncorhynchi* EGUCHI, 1933. *Oncorhynchus rhodurus* JORDAN et MCGREGOR. Intestine.
12. *A. shawi* (MCINTOSH, 1939). *Oncorhynchus kisutch*.
13. *Aponurus* sp. *Oncorhynchus keta*. Stomach. Fraser River, Sarmishu River(?) (sea).
14. *Azygia perryi* FUJITA, 1918. *Hucho perryi*. Stomach.

15. *A. robusta* ODHNER, 1911. *Oncorhynchus tshawytscha*. Intestine (sea and fresh water).
16. *Bacciger* sp. (*B. harengulae* YAMAGUTI, 1938?) (? in original). *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. (sea).
17. *Brachyphallus amuriensis* BABASKIN, 1928. *Oncorhynchus keta*, *Oncorhynchus gorbuscha*, *Salvelinus malma*, *Salvelinus leucomaenis*. Intestine. (sea).
18. *B. crenatus* (RUDOLPHI, 1802). *Oncorhynchus masou*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Oncorhynchus keta*. Prevalent in east. (sea).
19. *Bucephaloides* ps. *Oncorhynchus gorbuscha*. Intestine. East. (sea).
20. *Bucephalopsis basargini* LAYMAN, 1930. *Oncorhynchus gorbuscha*, *Salvelinus malma*. Intestine. (sea).
21. *Crepidostomum farionis* O.F. MULLER, 1784. (= *C. baicalensis* LAYMAN, 1933). *Salvelinus leucomaenis*, *Salvelinus malma*, *Salmo mykiss*, *S. thymallus*. (fresh water).
22. *C. salmonis* FUJITA, 1921. *Oncorhynchus keta* fry. Intestine (fresh water).
23. *C. uchimi* FUJITA, 1921. *Salmo mocrstoma*, *Oncorhynchus masou*. Intestine. (fresh water).
24. *Derogenes varicus* (MULLER, 1784) LOOSS, 1901. *Oncorhynchus gorbuscha*, *Oncorhynchus masou*, *Oncorhynchus nerka*, *Salvelinus leucomaenis*. Intestine, stomach. (sea).
25. *Diplostomulum* sp. Larvae. *Oncorhynchus nerka*. Inside eye-ball. (fresh water).
26. *Genolinea oncorhynchi*. *Oncorhynchus gorbuscha*. Stomach. Rare (found only in two). (sea).

27. *Gyrodactyloides strelkowi*. *Oncorhynchus gorbuscha*, *Oncorhynchus nerka*. (sea).
28. *Hemiurus levinseni* ODHNER, 1905. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Oncorhynchus keta*, *Salvelinus malma*, *Salvelinus leucomaenis*. Stomach, intestine. Prevalent in the west. (sea).
29. *Lecithaster gibbosus* (RUDOLPHI, 1802) LUHE?, 1901. *Oncorhynchus keta*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Salvelinus malma*. Intestine. Prevalent in the east. (sea).
30. *L. salmonis* YAMAGUTI, 1934. *Oncorhynchus keta*. Intestine.
31. *Parahemiurus* sp. (*P. anchoviae* VAZ et PEREIRA, 1930?) (? in original). *Oncorhynchus gorbuscha*, *Oncorhynchus nerka*, *Oncorhynchus keta*. Stomach. (sea).
32. *Podocotyle shawi*. *Oncorhynchus nerka*. Columbia River only. (sea).
33. *Sterrurus* sp. *Oncorhynchus nerka*. Intestine. (sea).
34. *Syncoelium katuwo* YAMAGUTI, 1938. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Stomach. Only once in *Oncorhynchus nerka*. (sea).
35. *Tetracotyle* sp. Larvae. Fry, *Oncorhynchus nerka*. Pericardial cavity, mesentery. (fresh water).
36. *Tetracnchus alaskensis*. *Oncorhynchus nerka* fry. Gills. Rare, only once. (fresh water).
37. *Tuburovesicula lindbergi* (LAYMAN, 1930). *Oncorhynchus keta*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. East. (sea).

Cestoda

38. *Calliobothrium filicolle* ZSCHOKKE. Larvae. *Oncorhynchus keta*, *Oncorhynchus gorbuscha*, *Oncorhynchus tschawytscha*, *Oncorhynchus kisutch*, *Oncorhynchus nerka*, *Salvelinus malma*. Gall-bladder, intestine. (fresh

water, sea).

Names of larvae: in early stage - Scolex polymorphus, in intermediate stage - Pelichnibothrium caudatum, in late stage - Phyllobothrium caudatum.

39. *Diphyllobothrium latum* (LENNAEUS, 1758). Larvae. Plerocercoid. *Oncorhynchus masou*. Muscle.
40. *S. sp.* Larvae. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Stomach, outer wall of appendix pylorica in epiboly. Adult infects bears, *D. ursi*. (fresh water).
41. *D. sp.* Larvae. Plerocercoid. *Oncorhynchus nerka*. Intestine. *Salvelinus leucomaenis*. coeloma. Adult parasite unknown: however, it is suggested that *D. strictum* or *D. minus*, which infects sea gulls in Lake Baikal may be the adult form.
42. *Diplocotyle sp.* (*D. elrikii* KRABBE, 1874?) (? in original). *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Intestine. Only in Attu Island. (sea).
43. *Eubothrium crassum* BLOCH, 1779. *Oncorhynchus keta*, *Oncorhynchus tschawytscha*, *Oncorhynchus kisutch*. Intestine. (sea).
44. *E. oncorhynchi* WARDLE, 1932. *Oncorhynchus keta*, *Oncorhynchus nerka*. Intestine, appendix pylorica. Prevalent in eastern part of the North Pacific. (sea).
45. *E. salvelini* SCHRANK, 1790. Fry of *Oncorhynchus nerka*, *Salvelinus leucomaenis*, *Salvelinus malma*, *Salmo mykiss*, *S. thymallus*. Appendix pylorica, intestine. (fresh water, sea).
46. *Nybelinia surmenicola* OKADA, 1929. Late stage larvae. *Oncorhynchus*

- nerka, *Oncorhynchus gorbuscha*. Epiboly in stomach. Few. (sea).
47. N. sp. Larvae. *Oncorhynchus tschawytscha*. Coeloma. Adult infects sharks and skates. (sea).
48. *Pelichnibothrium* sp. Larvae. *Oncorhynchus keta*, *Oncorhynchus masou*.
49. *Phyllobothrium caudatum* ZSCHOKKE et HEITZ, 1914. Late stage larvae. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Intestine. (sea).
50. *Ph. salmonis* FUJITA, 1922. Larvae. *Oncorhynchus keta*. Intestine. (sea).
51. *Proteocephalus* sp. Larvae. *Oncorhynchus nerka*. Intestine, appendix pylorica. (fresh water).
52. *P. exiguus* LA RUE. *Oncorhynchus nerka*, *Oncorhynchus tschawytscha*, *Salvelinus malma*. Intestine. (fresh water).
53. *Tetrarhynchus quadrirostris* (GOEZE). *Oncorhynchus tschawytscha*. Coeloma. Kamachatka.
54. *Trienophorus crassus* FOREL, 1868. Larvae. Fry of *Oncorhynchus nerka*.

Nemathelminthes

Nematoda

55. *Anisakis salaris* (GMELIN, 1790) (= *Ascaris capsularia* RUDOLPHI, 1802). *Oncorhynchus keta*, and 33 other species. (sea).
- A. sp. Larvae. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Oncorhynchus keta*. Muscle, mesentery, surface of internal organs, coeloma, in epiboly.
- A. app. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Oncorhynchus keta*, *Oncorhynchus tschawytscha*, *Salvelinus malma*, *Salvelinus leucomaenis*, *Salmo mykiss*. Muscle, intestine, coeloma, stomach, mesentery.

- Adult is *Ascaris simplex* RUDOLPHI, 1804, *Anisakis simplex* RUDOLPHI, 1819
(=*A. salaris* YAMAGUITI).
56. *Ascarophis malmae* ACHMEROW. Fry of *Salvelinis malma*. Intestine.
(fresh water).
 57. *A. skrjabini*. *Oncorhynchus gorbuscha*. Intestine, stomach. Few.
(sea).
 58. *Capillaria* sp. Fries of *Oncorhynchus nerka*. Intestine. Rare.
(fresh water).
 59. *Contracecum adunca* RUDOLPHI, 1802. *Oncorhynchus keta*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Salvelinus leucomaenis*, *Salvelinus malma*, *Salmo mykiss*, *S. thymallus*. Esoptagus, stomach, intestine, coeloma. (sea).
 60. *C. benimasu* FUJITA. *Oncorhynchus nerka*, *Oncorhynchus masou*. Coeloma, Sea of Okhotsk. (sea).
 61. *C. longispicillum* FUJITA 1940. *Oncorhynchus keta*. Coeloma. (fresh water).
 62. *C. ochotense* FUJITA. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Coeloma, intestine. (sea).
 63. *C. okadai* FUJITA 1940. *Salvelinus malma*. Stomach. (fresh water).
 64. *C. oshoroensis* FUJITA 1940. *Oncorhynchus keta*. Coeloma.
 65. *C. salvelini* FUJITA 1940. *Oncorhynchus keta*. Coeloma. (fresh water).
 66. *C. spp.* *Oncorhynchus keta*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. (sea).
 67. *Cystidicola chitosense* FUJITA 1940. *Oncorhynchus keta* (fry). Air-bladder. (fresh water).
 68. *Cystidicola farionis* FISHER. *Salvelinus leucomaenis*, *Salmo mykiss*.

- Air bladder, intestine, stomach. (fresh water).
69. *C. iwana* FUJITA. *Salvelinus pluvius*. Coeloma. (fresh water).
70. *C. salmonicola* (ISHII) (= *Ancyracanthus salmonicola* ISHII). *Oncorhynchus masou*, *Oncorhynchus keta*, *Salvelinus pluvius*. Air bladder. (fresh water).
71. *C. salvelini* (FUJITA) (= *Spiroptera salvelini* FUJITA). *Salvelinus pluvius*, *Salvelinus leucomaenis*, *Oncorhynchus adonis* JORDAN et MCGREGOR. Intestine. (fresh water).
72. *Dacnitis truttae* DUDARDIN. *Oncorhynchus nerka*, *Salvelinus leucomaenis*, *Salmo mykiss*. Intestine. Few. (fresh water).
73. *Goezia oncorhynchi* FUJITA, 1940. *Oncorhynchus keta*. Coeloma.
74. *Metabronema iwana* (FUJITA). *Salvelinus pluvius*. Coeloma. (fresh water).
75. *M. truttae* BAYLIS, 1935 (= *M. salvelini*). *Salvelinus leucomaenis*, *Oncorhynchus nerka*, *Salvelinus malma*.
Philometra masu FUJITA, 1940. Coeloma of *Oncorhynchus masou*. (fresh water).
76. *Philonema elongata* FUJITA, 1940. *O. Kawamurae* JORDAN et MCGREGOR. Coeloma. (fresh water).
77. *Ph. masu* FUJITA, 1940. *Oncorhynchus masou*. Coeloma. (fresh water).
78. *Ph. ocotepse* FUJITA. *Oncorhynchus nerka*. Sea of Okhotsk.
79. *Ph. oncorhynchi* KUITNEN-EKBAUM (= *Ph. gubernaculum* SIMON et SIMON; 1936 = *Ph. elongata* FUJITA, 1940). *Oncorhynchus nerka*. Coeloma. Prevalent in Western shore of Canada. (fresh water). *Oncorhynchus keta*, *Salvelinus leucomaenis*. Protuberance in appendix pylorica. (fresh water) (sea).

80. *Rhabdochona amago* YAMAGUIT. *Oncorhynchus rhodurus* JORDAN et MCGREGOR.
Small intestine.
81. *Rh. fujii* (FUJITA, 1921) FUJITA, 1927 (=Cystidicola fujii) *Oncorhynchus adonis* JORDAN et MCGREGOR, *Salvelinus leucomaenis*. Intestine.
82. *Rh. oncorhynchi* (FUJITA, 1921) FUJITA, 1927 (=Cystidicola oncorhynchi).
Fry of *Oncorhynchus keta*. Intestine.
Rh. oncorhynchi FUJITA, 1938-1940. *Oncorhynchus keta*, fry. Intestine.
83. *Rh. salvelini* FUJITA. *Salvelinus pluvius*. Coeloma.
84. *Rh. sp. ?* (? in original). Fry of *Oncorhynchus nerka*. Intestine.
Rare. (fresh water).
Spiroptera ochracea. *Oncorhynchus masou* (Europe). Identical with *salvelini* Fujita *Cystidicola*). *Oncorhynchus rhodurus* JORDAN et MCGREGOR *Oncorhynchus masou*, *Oncorhynchus adonis* Jordan et MCGREGOR. Intestine (Shieki Lake) (fresh water).
85. *Terranova* (Porrocoecum) sp. Larvae. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Deep muscle. Few. (sea).
Larvae of *T. (=P.) decipiense*.

Acanthocephala

86. *Acanthocephalus acerbus* VANCELEAVE. *Salmo irideus* GIBBONS (land locked).
(fresh water).
87. *A. aculeatus* VANCELEAVE. *Salmo irideus* GIBBONS (land-locked), *Oncorhynchus nerka*. (fresh water).
88. *A. echigonensis* FUJITA. *Oncorhynchus keta*. Intestine, appendix pylorica.
89. *A. oncorhynchi* FUJITA, 1921. Fry of *Oncorhynchus keta*.

According to Mr. Isokichi Harada, the above four species are identical and should be termed *A. echigonensis*.

90. *Bolbosoma carnoforme* (HEITZE) (=Echinorhynchus caenoforme). *Oncorhynchus keta*, *Salvelinus malma*, *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Intestine. Adult is found in such animals as seal. (sea).
91. *B. sp.* later stage larvae. *Oncorhynchus nerka*, *Oncorhynchus keta*, *Oncorhynchus gorbuscha*. Prevalent in the west. (sea).
92. *Corynosoma strumosum*. HEITZ. Later stage larvae. *Oncorhynchus gorbuscha*, *Salvelinus leucomaenis*. Internal organs, coeloma. Adult is found in seals and other animals. (sea).
93. *C. spp.* Later stage larvae. Epiboly in internal organs.
94. *Echinorhynchus gadi* ZOEGER in MULLER, 1776 (=E. acus RUDOLPHI). Intestine, appendix pylorica. Prevalent in the west. (sea).
95. *E. Salmonis* MULLER. *Salvelinus leucomaenis*, *Salmo mykiss*, *S. thymallus*. Intestine. (fresh water).
96. *E. sp.* *Oncorhynchus nerka*, *Oncorhynchus keta*.
97. *Neoechinorhynchus crassus* LYNCH. *Salvelinus leucomaenis*. Intestine. Rare, only once. (fresh water).
N. cristatus LYNCH. *Salvelinus leucomaenis*. Intestine? Rare. Only once.
VANCLEAVE salmo mykiss. Intestine. (fresh water).
98. *N. rutili*. Fry of *Oncorhynchus nerka*. Intestine. Prevalent in the western shores of Canada. (fresh water).
N. tsintaensis MORISHITA, 1937. *Oncorhynchus masou*. Tsingao.
99. *Nipporhynchus sp.* *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*. Stomach, intestine. Few. (sea).
100. *Rhadinorhynchoides miyagawai* FUKUI et MORISHITA. *Salvelinus pluvius*. Intestine. (fresh water).

AnnelidaHirudinea

101. *Pontobdella moorei* OKA. *Oncorhynchus keta*.(sea) *Caligus rapax* (M. EDWARDS), *Oncorhynchus masou*. Europe and U.S.A.

ArthropodaCrustacea Copepoda

102. *Ergasilus* spp. Fry of *Oncorhynchus nerka*. Gills. Prevalent in the east. (sea).
103. *Lepecephtheirus salmonis* KROYER. *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Oncorhynchus tshawytscha*, *Oncorhynchus keta*. Body surface. (sea).
104. *L. Uenoi* YAMAGUTI. *Oncorhynchus gorbuscha*.(sea). *L. Stromii* (BAIRD). *Oncorhynchus masou*. Europe and U.S.A. *Lernaeopoda carpionis* KROYER. *Oncorhynchus masou*. Europe, *L. salmonea* KROYER. *Salvelinus pluvius*. Europe?, *L. Edwardsii* OLSSON. *Salvelinus pluvius*. Europe?.
105. *Salmincola bicauliculata*. *Salvelinus malma*, *Salmo mykiss*. Gills. (fresh water).
106. *S. edwardsi* OLSEN. "asabatchi" (a subspecies of *Oncorhynchus nerka*). not found in *Oncorhynchus nerka*. Gills. (fresh water).
107. *S. falculata* (WILSON, 1908) WILSON, 1915. *Oncorhynchus nerka*. Gills, body surface. Few. (fresh water).
108. (Branchiopoda) *Argulus salmini*. *Oncorhynchus keta*. Body surface. Europe. *S. thymalli* KESSLER. *Salmo thymallus*. Gills. (fresh water). *S. yamame* HOSHINA et SUENAGA, 1954. *Salmo mocróstoma*.

In compiling the above list, no effort was made to critically examine the literatures concerned. Thus, there is a possibility that dif-

ferent species are designated by the same name, or that the same specie is designated by different names. There can be errors in the spelling of scientific names. The list is for easy reference; the mistakes will be corrected as they are found. Further, it was the wish of the author to copy diagrams from the original sources as much as possible; however, because they were not available, the diagrams were copies from suitable sources and simplified. When proper illustrations were not available, diagrams of species resembling the specie under question were substituted (marked with ⊕); this was done in consideration of the convenience of readers who are not specialists in parasites. Some of the diagrams are not too satisfactory; however, they were merely copied in the lack of suitable material. They merely indicate general shapes of parasites concerned. Designations for parts of a body were not indicated. This was done because the author felt it to be unnecessary. If such be necessary, the author would refer such readers to respective reference works. The length of parasite is shown in μ mm or cm under the diagram. The author felt that the inclusion of the information will facilitate the estimation of the size of the parasite. In the case of Sporozoa, the major diameter of spore is shown. There is a considerable amount of variation in the length of the body; thus, a given parasite may measure considerably longer or shorter than the length indicated.

VI. Materials Investigated

The materials used in 1955 was collected from 101 fish of various species caught in the North Pacific and the Bering Sea by the survey ship, Dai-Ichi Tsukiyama-Maru (a steel vessel 186 tons, 330 h.p.) of the Fisheries Agency. The materials which were brought to the author, had been

placed in 123 tubes and bottles, packaged in two cases. The species consisted of *Oncorhynchus nerka*, *Oncorhynchus gorbuscha*, *Oncorhynchus tschawytscha*, *Oncorhynchus keta*, and *Oncorhynchus kisutch*; fish other than that of salmonoid was mackerel shark. The specimens were preserved in alcohol. However, due either to low alcoholic content or to vibration during transmission, much of the specimens was damaged badly. A number of specimens of tape-worm was dissolved into creamy condition and the identification was difficult. The 125 tubes and bottles were numbered. The listing number and content of these containers by host is as follows:

In the listing, the numeral indicates the tube or vessel number; N Nematoda; C Cestoda; Cr parasitic Copepoda of Crustacea; A Acanthocephala; ? unknown; and Ot other than parasite.

Oncorhynchus nerka

2_N 6_C 15_{Cr} 17_N 20_? 21_N 24_N 29_{Cr} 34_N 36_N 40_N 43_N 55_N 66_N 61_?
63_{N?} 65_N 69_N 76_N 83_N 87_N 103_N 107_N 116_N 117_N 124_? Total 26

Oncorhynchus keta

3_N 4_C 10_C 35_{Cr} 41_? 42_C 44_N 45_{Cr} 48_{Cr} 49_C 52_? 54_C 58_? 64_C 66_{Cr}
68_{Cr} 71_{Cr} 72_{Cr} 73_? 74_? 77_{Cr} 79_C 80_? 81_? 86_? 88_? 89_? 95_? 97_? 99_?
101_C 102_C 104_{Cr} 110_? 111_? 120_{Cr} 122_? 123_? 126_{Cr} Total 39

Oncorhynchus gorbuscha

5_{Cr} 7_{Cr} 8_{Cr} 9_{Cr} 23_? 26_{Cr} 27_? 28_{Cr} 30_{Cr} 31_{Cr} 37_{Cr} 38_{Cr} 39_{Cr} 47_C

^{57}Cr ^{67}Cr ^{75}Cr ^{78}Cr ^{84}Cr ^{85}Cr ^{90}Cr ^{92}Cr ^{93}Cr ^{94}Cr ^{98}Cr ^{100}Cr
 ^{105}Cr ^{106}Cr ^{109}Cr ^{112}Cr ^{119}Cr Total 31

Oncorhynchus kisutch

^{50}Cr ^{51}N ^{127}Cr Total 3

Oncorhynchus tshawytscha

^{16}A ^{18}A $^{19}\text{A?}$ Total 3

Host unknown

^1C ^{11}C $^{53?}$ $^{128?}$ Total 4

Not listed in the list sent but the numbered containers found

^{13}C $^{22?}$ $^{25?}$ ^{32}Cr ^{33}Ot ^{46}Cr ^{59}C $^{62?}$ ^{70}Ot $^{82?}$ ^{91}C ^{96}Ot ^{113}Cr
 ^{114}Cr ^{115}Ot ^{121}Cr ^{125}N Total 17

The examination of the above listing shows that N nematodes are prevalent in *Oncorhynchus nerka*, Tapeworms in *Oncorhynchus keta*; and that those found in *Oncorhynchus gorbuscha* are almost all Copepoda. This may indicate that on board a ship, where working conditions are not ideal, only the specimens, which attract attention, may be collected. The fact that there is no Trematoda may be that they are too small and missed.

As was mentioned above, these specimens were damaged badly with the exception of Copepoda. However, they were investigated carefully, and a report was made concerning the main three species, *Oncorhynchus nerka*, *Oncorhynchus keta*, and *Oncorhynchus gorbascha*, to the Fisheries Agency as follows:

Species of Parasites Found in Fishes of Various Species

	O. nerka	O. keta	O. gorbuscha
Nematoda <i>Contracaecum</i> sp.	+		
<i>Metabronema</i> sp.	+		
<i>Philonema ochotenuse</i> ? (? in original)	+		
<i>Raphidascaris</i> sp. Larvae	+	+	
<i>Rhabdochona</i> sp.	+		
Cestoidea <i>Schistocephalus solidus</i> ? (? in original)	+	+	+
Copepoda <i>Lepeophtheirus uenci</i>	+	+	+
YAMAGUTI			

(North Pacific Fisheries International Commission, Biological Investigation Material 5. 1955 North Pacific Salmon. Sea-Trout Report (Supplementary Material))

The route taken by the research vessel, Dai-Ichi Tsukiyama-Mar, is shown in Figure 9. (page 631).

Again in 1956 specimens were collected in the North Pacific and the Bering Sea by the research vessels of the Fisheries Agency, Takuyo-Mar (Steel vessel 171 tons, 330 H.P.), Etsuyama-Mar (steel vessel 153 tons, 330 H.P.), and Eiko-Mar (steel vessel 117 tons, 320 H.P.). The species collected were *Oncorhynchus nerka* (16), *Oncorhynchus gorbuscha* (5), *Oncorhynchus tshawytscha* (1), *Oncorhynchus keta* (31), and *Oncorhynchus kisutch* (5) in addition of "mizuu" (1), which does not belong to the salmonoid family, and unknown species (2) a total of 61 fishes. Ninety tubes and bottles in two packages were sent to the author. Of these 66 contained specimens; of the 66, 55 contained parasites. On this expedition, the

author had previous talks with the staff, who worked in the ships, with respect to the method of collection and advised them to use formalin as a preservative. Thus, the results were much better than those of 1955. Further, each bottle contained information on the latitude and the longitude of the place where the specimen had been obtained; thus, the author was able to know the distribution. The parasites and the host obtained from this expedition are shown in a tabular form below:

Type	Name of parasite	O. nerka	O. keta	O. gorbuscha
Nematoda	Anisakis salaris (GUMELIN) YAMAGUTI	1		
	Contracaecum adunca? (? in original)		1	
	Contracaecum benimasu		1	
	Philonema ochotense FUJITA	5		
	Philonema oncorhynchi KUTUNEN-EKUBAUM	2		
Cestoda	Diphyllobothrium sp. Larvae	1	4	
	Phyllobothrium salmonis Larvae	2	2	
	Proteocephalus sp. Larvae	3	1	
	Schistocephalus sp? (? in original)	1	19	
Acanthocephala	Bolbosoma sp Larvae	1		
Copepoda	Lepeophtheirus uenio YAMAGUTI		5	5

As shown above, the present results include some species, which were not observed in the previous collection. Cestoda are found in *Oncorhynchus nerka* and *Oncorhynchus keta*; Copepoda are found in equal number in *Oncorhynchus keta* and *Oncorhynchus gorbuscha*. Further, for the first time, Acanthocephala was obtained from *Oncorhynchus nerka*. As in the previous expedition, no Trematoda was observed.

The routes taken by Takuyo-Maru, Etsuyama-Maru, and Eiko-Maru are shown in Figure 10.

No collections by research vessels was made in 1957; however, the author made visits to hatcheries in Hokkaido during November 21 to 29 and was able to collect fresh material from *Oncorhynchus keta*. The author first made a visit to Hokkaido Sake-Masu Hatchery in Nakanoshima, outside of Sapporo, was informed of up-stream conditions of salmon, found that they were coming in a large number in the districts around Abshiri, Nemuro, and Kusiro, made visits, on the advice of staff members, to Hashino and Abashiri of Kitami sub-station, to Gosen and Juyonsen of Nakahyezu sub-station, and to Horouchi and Makubetsu of Tokachi sub-station, and collected parasites from male and female salmon. The purpose of the collection was to obtain better specimens of parasites than those obtained on board ships, and to obtain small parasites which had been missed. It was the author's good fortune to have been able to collect good specimens with the kind co-operation of people in charge.

In March of 1958, from the 26th to the 30th, the author visited experimental stations and hatcheries, both public and private, in Aomori-Ken. The purpose of the visits was to obtain parasites from fry of *Oncorhynchus keta*. In view of the schedule and time, the author first visited the Fisheries Branch of Aomori-Ken to obtain information on fry collected parasites from *Oncorhynchus gobuscha* at the prefectural experimental station at Ajigazawa on the western shore of Aomori-Ken, obtained next fry of *Oncorhynchus keta* at private hatcheries in Kominato and Nobeji, obtained somewhat larger fry of *Oncorhynchus keta* at private hatchery and prefectural fish farm in Aisaka in Towada-Shi, and returned to Tokyo. With the co-operation of ken officials and staff members of private hatcheries, the author

was able to collect material.

The article on parasites, which is to follow, is based on material collected by the above-mentioned research vessels and on material which, the author obtained in Hokkaido and Aomori-Ken.

Postscript

After the completion of the present article, the author collected parasites of *Oncorhynchus gorbuscha* and *Oncorhynchus masou* in Yabetsu and Shari in Hokkaido from August 31, 1958 to September 10. The author wishes to express his appreciation to staff members of the Fisheries Agency and of Hokkaido Government for thier assistance.

Further, the author obtained from Mr. Akio Ishida of Hokkaido Fisheries Experimental Station fry of *Oncorhynchus keta*, which had been obtained at the offing, facing Nemuro Strait in the eastern part of Hokkaido, and fry, which had been sent from the U.S.A. These are included in the material used. The author wishes to express his appreciation of Mr. Ishida.

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Figure 9. 1955. Route of Daiichi Tsukiyama-Maru.

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Figure 10. 1956 Routes: Takuyo-Maru () Etsuyama-Maru ()
and Eiko-Maru (). ○ Positions at noon:
⊙ Place of operation.