FOLIA PARASITOLOGICA 36: 143–151, 1989.

THREE SPECIES OF PHILOMETRID NEMATODES FROM FISHES IN JAPAN

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Abstract. The paper comprises the description of a new species, *Philometra plotosi* sp. n., and the redescriptions of *Philometra inimici* Yamaguti, 1941 and *Philometroides masu* (Fujita, 1940) based on newly collected materials from marine and freshwater fishes from Japan. *Ph. plotosi* sp. n. (females only) from the subcutaneous tissue of the marine fish *Plotosus lineatus* from Sun Piazza Aquarium in Sapporo (sampling locality unknown) is characterized mainly by the shape and size of the body, presence of 8 cephalic papillae and a large anterior oesophageal bulb, and by the absence of caudal papillae. *Ph. inimici* (females), found in the testis of the marine scorpaeniform fish *Platycephalus indicus* from Mikawa Bay, represents a new host record. Study of the femals of *Philometroides masu* from the abdominal cavity of *Hucho perryi* (new host record) from three rivers in Hokkaido has showed that this species differs from all other members of the Philometrinae in possessing multinucleate oesophageal glands.

Taxonomically the family Philometridae, comprising tissue-dwelling parasites of freshwater and marine fishes, represents one of the most difficult groups of parasitic nematodes, this being mainly due to the morphological and biological peculiarities of its members (Chabaud 1975, Moravec 1986). Moreover, many species have been inadequately described which complicates considerably the species identification. Therefore, redescriptions of such forms based on newly collected topotypic materials are quite necessary. In Japan, a number of philometrids have been described by Ishii (1916, 1931a, b, c), Fujita (1939, 1940) and Yamaguti (1935, 1941, 1961); however, the descriptions of some of them are insufficient and these species have not been recorded since.

During several recent years, the junior author of the present paper (K. Nagasawa) collected samples of helminths from freshwater and marine fishes from different places in Japan. These materials have also included specimens of the three species of philometrids, one new and two previously described, whose account is given in this paper.

MATERIALS AND METHODS

The nematodes, having been dissected out of the host's body, were washed in physiological saline and fixed in hot 4 % formaldehyde in saline; then the specimens were stored in 70 % ethanol. *En face* views were prepared according to Anderson's (1958) method. Drawings were made with the aid of a Zeiss microscope drawing attachment. The specimens have been deposited in the helminthological collection of the Meguro Parasitological Museum, Tokyo, and partly also in the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice.

In the following review of the species encountered the measurements are given in millimetres.

REVIEW OF SPECIES

1. *Philometra plotosi* sp. n. Fig. 1

Host: marine fish, *Plotosus lineatus* (Thunberg) (fam. Plotosidae, Siluriformes).
Localization: under skin.
Locality: Sun Piazza Aquarium, Sapporo, Hokkaido, Japan (sampling locality unknown) (15 April 1986).
Deposition of type specimens: holotype (♀) + paratypes (♀♀) in Meguro Parasitological Museum, Tokyo (M.P.M. Coll. No. 19523); one paratype (♀) in Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice (Coll No. N-359).
Etymology: The specific name of this nematode is derived from the generic name of its type host.

Description of female (6 specimens, measurements of holotype in parentheses): Body of gravid and subgravid females whitish, comparatively short for *Philometra*, tapering somewhat to round cephalic and caudal ends. Cuticle of gravid female (holotype) almost smooth, with distinct, fairly wide and longitudinally wrinkled lateral fields; cuticle of younger females (paratypes) strongly transversely wrinkled, its epicuticle

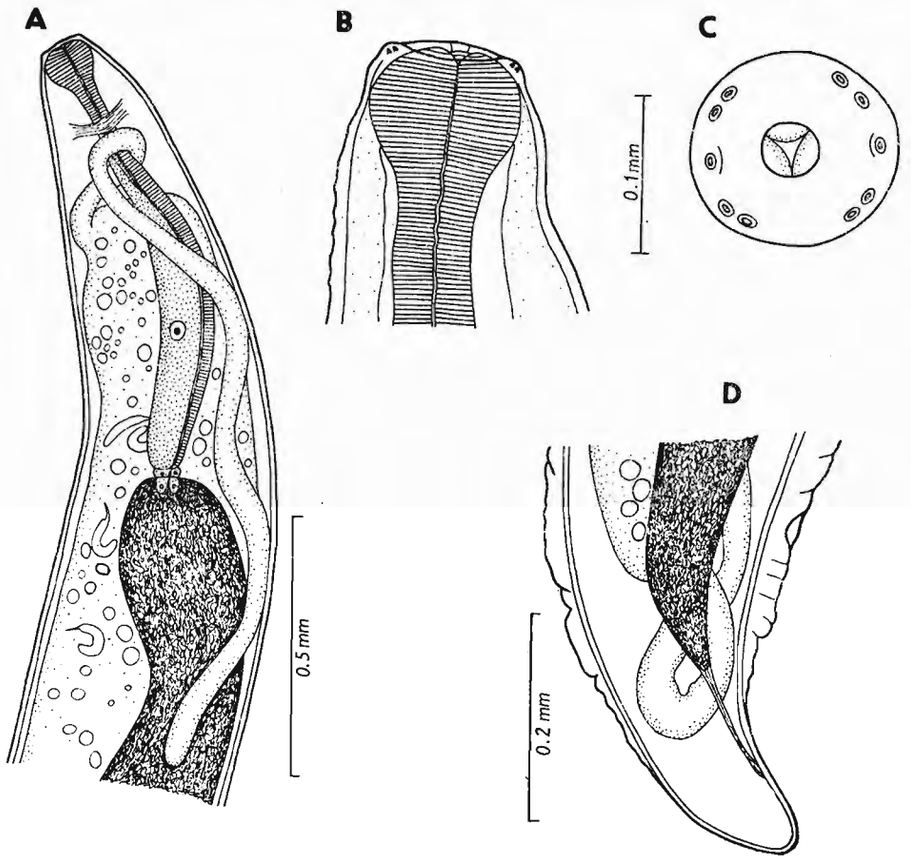

Fig. 1. *Philometra plotosi* sp. n. – gravid female. A – anterior part of body; B, C – head end, lateral and apical views; D – posterior end of body.

forming numerous processes. Length of body 7.41–15.78 (15.78), maximum width 0.612–0.816 (0.612). Head end rounded, with distinct cephalic papillae in lateral view. Oral opening circular; three oesophageal lobes protruding out of mouth as flat surfaces. Cephalic papillae relatively flat, 8 in number, forming submedian pairs; two lateral amphids present. Oesophagus swollen near mouth to form large muscular bulb 0.096–0.156 (0.099) long and 0.105–0.174 (0.105) wide. Overall length of oesophagus including anterior bulb 0.789–0.979 (0.979), representing 6–13 (6) % of whole body length; maximum width of its cylindrical part 0.095–0.122 (0.109). Dorsal oesophageal gland prominent, relatively wide, extending anteriorly up to nerve ring level; posterior end of oesophagus with small ventriculus and oesophageal valves projecting into intestine; latter 0.063–0.066 (0.063) long. Oesophageal gland provided with large cell nucleus located in about its mid-length, 0.544–0.707 (0.707) from anterior extremity. Nerve ring 0.225–0.300 (0.233) from anterior end of body, excretory pore not located. Intestine light-coloured, straight, displaced laterally by uterus; its posterior end atrophied, forming ligament attached ventrally to body wall. Posterior end of body narrowed, rounded, in holotype (0.075) wide at level of intestinal ligament, without any processes or papillae. Vagina and vulva absent. Ovaries situated near anterior and posterior ends of body; anterior ovary reaching anteriorly to nerve ring level, posterior ovary to level of intestinal ligament. Uterus occupying major part of body, being filled only with eggs and developing embrya in paratypes, while that of holotype containing also individual larvae. Body of larvae conspicuously plump, with very thin tail; length of larvae (0.141–0.165), their maximum width (0.018).

Comments: – The family Philometridae includes a large number of species that are parasites of both freshwater and marine fishes. The present state of the taxonomy of this nematode group is unsatisfactory and, because males are unknown for many species, the system of philometrids is principally based on the female morphology. In addition to morphological features, the data on the site of localization of gravid females in the host's body, characteristic of each species, are also important for the identification of philometrid nematodes.

The morphology of the female nematodes from the subcutaneous tissue of *Plotosus lineatus* corresponds to the genus *Philometra* Costa, 1845 (syn. *Twaitia* Rasheed, 1963 – see Moravec and Ergens 1970), showing a close relationship of this species with some congeneric species the females of which are localized under the skin or in the fins of their fish hosts. Of many *Philometra* members, only females of the following 8 species occur under the skin or in the fins of fishes: *Philometra bagri* (Khalil, 1965) comb. n., *Ph. baueri* Vismanis et Nikulina, 1972, *Ph. beninensis* Obiekezie, 1986, *Ph. oreoleucisci* Moravec et Ergens, 1970, *Ph. pinnicola* Yamaguti, 1935, *Ph. rischta* Skrjabin, 1923, *Ph. sebastodis* Yamaguti, 1941 and *Ph. sydneyi* Rasheed, 1963. Out of them, *Ph. bagri*, *Ph. baueri*, *Ph. oreoleucisci* and *Ph. rischta* differ from *Ph. plotosi* sp. n. in possessing two large caudal processes and four conspicuous cephalic lobes that are absent from the new species; moreover, all these four species are parasitic in freshwater fishes, whereas *Ph. plotosi* sp. n. is a parasite of the marine fish. *Ph. sydneyi*, described from "a large white fish" from Australia, differs from the new species by the markedly longer body and oesophagus (body length 30–150 mm versus 7.7–15.8 mm in *Ph. plotosi*; length of oesophagus about 5 mm versus 0.8–1.0 mm). *Ph. pinnicola* and *Ph. sebastodis*, both described from the fins of host fishes in Japan, have been reported, in contrast to *Ph. plotosi* sp. n., to have no cephalic papillae; in addition, the body of the first species is dark red in living specimens and the anterior end of its oesophagus is only slightly swollen (body whitish and anterior end of oesophagus markedly inflated in *Ph. plotosi*), whereas the oesophagus of *Ph.*

sebastodis is much shorter than that of *Ph. plotosi* sp. n. (0.24—0.27 mm versus 0.8—1.0 mm). We had not at our disposal the description of *Ph. beninensis*, a species described from the fins and the operculum of the giant African threadfin, *Polydactylus quadrifiliis* (Polynemidae, Perciformes) in Africa, but this species can be distinguished from the new one on the basis of its host type (Perciformes versus Siluriformes) and geographical distribution (Africa versus Japan).

The general morphology of *Ph. plotosi* sp. n. resembles also that of members of the genus *Clavinema* Yamaguti, 1935, including the species *C. parasiluri* Yamaguti, 1935 (type species), *C. fujimotoi* (Furuyama, 1932) and *C. mariae* (Layman, 1930) (syn. *Philometra americana* Kuitunen—Ekbaum, 1933 and *Ph. zebrini* Yamaguti, 1961). This genus was considered a junior synonym of *Philometra* by Rasheed (1963), but later it was re-erected by Margolis and Moravec (1987) (see also Machida 1970). All the above mentioned species of *Clavinema* differ from *Ph. plotosi* sp. n. in the structure of the oesophagus (anterior oesophageal bulb very large and distinctly separated from the cylindrical part of oesophagus and oesophageal gland poorly developed) and in having no cephalic papillae.

A remarkable feature of *Ph. plotosi* sp. n. seems to be the shape of larvae from the female uterus; their body is conspicuously plump, with a very thin tail. In other *Philometra* species the larvae are more slender, with body gradually tapering to the posterior end. Moreover, the larvae of most *Philometra* species are substantially larger, only Yamaguti (1941) reported the measurements of larvae of *Ph. sebastodis* (body length 0.17—0.19 mm, width 0.003 mm) to be similar to those found in *Ph. plotosi* sp. n.

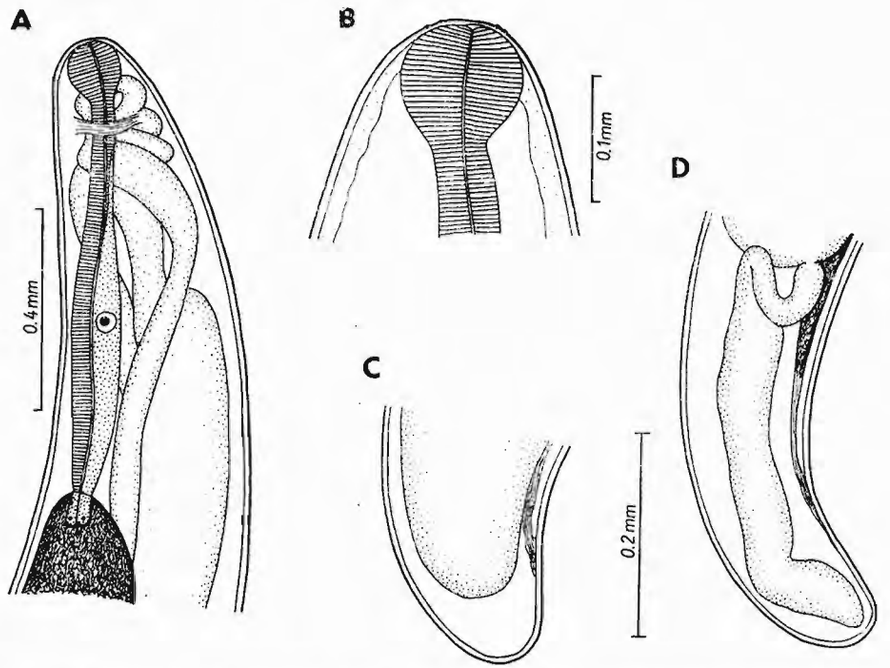

Fig. 2. *Philometra inimici* Yamaguti, 1941 — gravid female from *Platycephalus indicus*. A — anterior part of body; B — head end; C, D — posterior end of body.

2. ***Philometra inimici*** Yamaguti, 1941 Fig. 2

(Syn.: *Philometra cryptocentri* Yamaguti, 1961)

Host: marine fish, *Platycephalus indicus* (Linnaeus) (fam. Platycephalidae, Scorpaeniformes).
Localization: testis.
Locality: Mikawa Bay, Aichi Prefecture, Japan (30 July 1980).
Specimens: Meguro Parasitological Museum, Tokyo (M. P. M. Coll. No. 19524).

Description of female (3 specimens, measurements of one young female without larvae in uterus given in parentheses): Body of gravid and subgravid females whitish, conspicuously slender and long, with smooth cuticle. Length of body of gravid females 60.97—76.36 (28.97), its maximum width 0.666—0.734 (0.326). Head end rounded, cephalic papillae almost indistinct in lateral view. Oesophagus swollen near mouth to form distinct muscular bulb 0.111—0.117 (0.090) long and 0.117—0.120 (0.090) wide. Overall length of oesophagus including anterior bulb 0.748—0.979 (0.734), representing 1.2—1.3 (2.5) % of whole body length; maximum width of cylindrical part of oesophagus 0.082 (0.051). Dorsal oesophageal gland well developed, extending from nerve ring level to posterior end of oesophagus; oesophageal gland provided with large cell nucleus located in about its mid-length, 0.490—0.653 (0.476) from anterior end of body. Ventriculus indistinct; oesophageal valves projecting into intestine 0.068 (0.041) long. Nerve ring 0.204—0.231 (0.177) from anterior extremity, excretory pore not located. Intestine dark, straight, displaced laterally by uterus; its posterior end atrophied, forming ligament attached ventrally to body wall near posterior extremity. Posterior end of body rounded, without any papillae or processes. Vagina and vulva absent. Ovaries situated near anterior and posterior ends of body; anterior ovary reaching anteriorly to nerve ring level (coils of germiduct up to level of anterior bulb of oesophagus), posterior ovary almost to posterior end of body. Uterus occupying major part of body, being filled with slender larvae 0.306—0.345 long and 0.009—0.015 wide.

Comments: — The nematodes of the present material correspond, more or less, to the description of the species *Philometra inimici* Yamaguti, 1941, differing from it only in a somewhat shorter body and a little different shape of ovaries. However, the shape of ovary is not considered as a character of valid taxonomic importance in *Philometra* (see Rasheed 1963); moreover, the original description of *Ph. inimici* is based on a single specimen so that the character cannot be generalized for that species. Since also the hosts of both *Ph. inimici* and nematodes of the present material are related and originating from the same geographical region (both nematode forms were recovered from the marine scorpaeniform fishes of Japan), we consider the nematodes from *P. indicus* to be conspecific with *Ph. inimici*.

Ph. inimici was originally described by Yamaguti (1941) from one gravid female found in the abdominal cavity of *Inimicus japonicus* from Japan (Hamazima). Later the same author (Yamaguti 1961) described another species, *Philometra cryptocentri*, from the body cavity of *Cryptocentrus filifer* from the Inland Sea from Japan; this was synonymized with *Ph. inimici* by Rasheed (1963).

The males of *Ph. inimici* are unknown so far. The characteristic features of the gravid females by which this species can be distinguished from other related congeneric species parasitizing marine fishes are the well developed anterior oesophageal bulb, minute cephalic papillae, absence of caudal papillae or processes, shape and length of the body, length of the oesophagus, dark intestine, situation of ovaries, extent of the uterus, and size and shape of larvae.

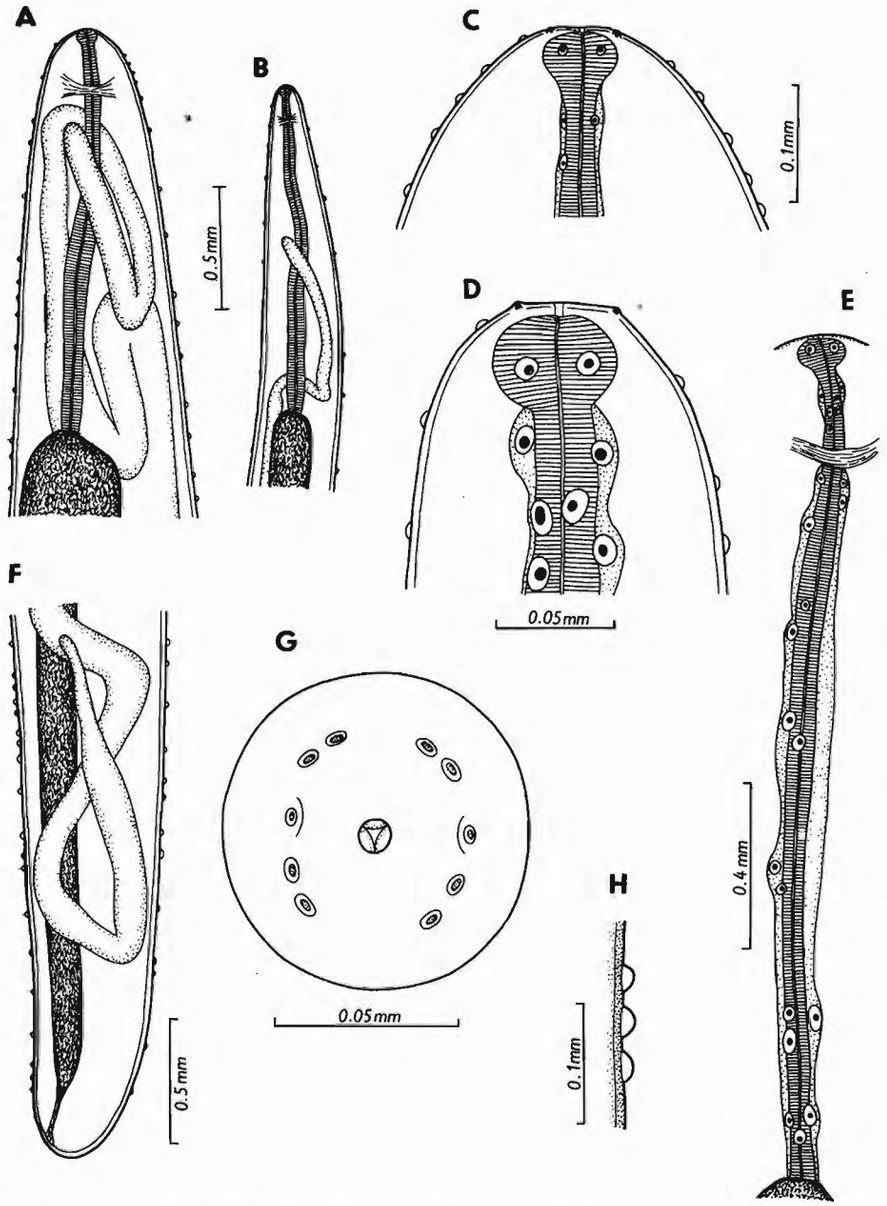

Fig. 3. *Philometriodes masu* (Fujita, 1940) — females from *Hucho perryi*. A — anterior part of body of gravid female; B — same of nongravid female; C — head end of gravid female; D — same of nongravid female; E — oesophagus; F — posterior end of gravid female; G — head end, apical view; H — cuticular excrescences.

3. ***Philometroides masu*** (Fujita, 1940) Rasheed, 1963 Fig. 3
(Syn.: *Philometra masu* Fujita, 1940)

Host: huchen, *Hucho perryi* (Brevoort) (fam. Salmonidae, Salmoniformes).
Localization: abdominal cavity.
Localities: Sarobetsu River (27 September 1980), Koetoi River (28 September 1980) and Sarufutsu River (1 August 1986), Hokkaido, Japan.
Specimens: Meguro Parasitological Museum, Tokyo (M. P. M. Coll. Nos. 19518, 19520, 19522); one specimen in Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice (Coll. No. N-285).

Description of female (13 specimens, measurements of two young females without larvae in uterus given in parentheses): Body of gravid and subgravid females whitish, cylindrical, with bluntly narrowing extremities. Cuticle with numerous small, transparent, irregularly distributed bosses, these being almost indistinct in some specimens; height of bosses 0.006—0.009 (0.003—0.009). Length of body of gravid females 85.000—110.00 (32.04—33.81), maximum width 1.21—1.32 (0.44—0.48). Head end rounded, cephalic papillae represented by four pairs of outer papillae, inner papillae not observed; amphids distinct. Oral opening circular, very small. Inner organs badly observable due to dim substance present in body cavity. Oesophagus inflated at anterior end to form distinct bulb 0.045—0.060 (0.045) long and 0.078—0.090 (0.057—0.060) wide. Overall length of oesophagus including anterior bulb 1.50—1.89 (1.46—1.51), representing 1.6—2.0 (4.5) % of whole body length; maximum width of cylindrical part of oesophagus 0.108—0.112 (0.060—0.063). Oesophageal gland multinucleate, initiating just below anterior oesophageal bulb and extending posteriorly up to oesophagus end; large cell nuclei irregularly scattered throughout its length. Ventriculus indistinct. Nerve ring 0.245 (0.163—0.177) from anterior extremity. Intestine straight, lightcoloured, its posterior end atrophied, forming ligament attached ventrally to body wall near posterior extremity. Posterior end of body rounded, without lateral caudal papillae or processes. Ovaries close to anterior and posterior ends of body; anterior ovary reaching almost to nerve ring level in gravid females (to mid-length of oesophagus in younger females), posterior ovary reflexed, at some distance from end of body. Uterus occupying major part of body, being packed with slender larvae 0.867—0.990 long and 0.015—0.016 wide; tail of larvae 0.114—0.135 long, representing 13—14 % of larval body.

Comments: — In 1940, Fujita described *Philometra masu* from the females found in the abdominal cavity of masu salmon, *Oncorhynchus masou*, from the Obihiro River in Hokkaido, Japan. This species has not been reported since. While revising the genus *Philometra* s. l., Rasheed (1963) transferred *Ph. masu* to *Philometroides* Yamaguti, 1935 on the basis of the presence of cuticular bosses in gravid females.

Although Fujita's (1940) description of *Ph. masu* is inadequate and misleading in some respects, it is apparent that the nematodes of the present material belong to this species. Fujita only described the anterior oesophageal bulb and the following short part of oesophagus covered by glandular tissue (see Fig. 3) as a "pharynx constricted at middle" and the specimens at his disposal were somewhat smaller (16.5—63 mm long) than those of the present material. The hosts of nematodes of both Fujita's and our materials are salmonids and all the specimens were collected from the rivers in Hokkaido. It is probable that the "philometrid nematodes" reported by Shimazu (1981) from the body cavity of *Hucho perryi* and *Salvelinus leucomaenis* from the Kushiro R. and Bekanbeushi R. systems from Hokkaido (see Nagasawa et al. 1987) also belonged to *Ph. masu*.

Philometroides masu has so far been the only member of the subfamily Philometrinae known from salmonids. Ivashkin et al. (1971) characterized this subfamily, besides other features, by the presence of uninucleate oesophageal glands in contrast to multinucleate glands in the Philoneminae. The present study shows, however, that the oesophageal glands of *Ph. masu* are multinucleate instead of uninucleate, this being a unique feature within the Philometrinae. Unfortunately, little attention has so far been paid to the structure of oesophageal glands in philometrids, so it is not possible to make taxonomic conclusions at the present time. As to the genus *Philometroides*, some species (e.g. *Ph. atropi*, *Ph. pseudaspii*, *Ph. huronensis* — see Parukhin 1966, Moravec and Ergens 1970, Uhazy 1976) were described and illustrated to possess a uninucleate dorsal oesophageal gland, whereas the oesophageal glands of other species, including the type species *Ph. seriolae* (Ishii, 1931), have not been adequately described. In having multinucleate oesophageal gland, *Ph. masu* may be considered to have some affinities with *Philonema* species, also parasitic in salmonids. But by other features *Ph. masu* is a typical member of the Philometrinae. It would be desirable to discover and describe the males of this interesting species.

One of the characteristic features of *Ph. masu* is also the fact that the first-stage larvae from female uterus are unusually long in comparison with other philometrids.

Acknowledgements. We wish to thank the following persons for assisting us in collecting the nematodes: Naonori Okada, Sun Piazza Aquarium; Munenori Miyakawa, Aichi Prefectural Fisheries Experimental Station; Masashi Natsume, Hokkaido Fisheries Experimental Station; and Shigehiko Urawa, Hokkaido Salmon Hatchery.

ТРИ ВИДА НЕМАТОД СЕМ. PHILOMETRIDAE ОТ РЫБ ЯПОНИИ

Ф. Моравец и К. Нагасава

Резюме. В статье приводятся описание нового вида — *Philometra plotosi* sp. n. и переописание нематод *Philometra inimici* (Yamaguti, 1941) и *Philometroides masu* (Fujita, 1940) на основе новых материалов от морских и пресноводных рыб Японии. *Ph. plotosi* sp. n. (только самки) из подкожной ткани морской рыбы *Plotosus lineatus* из Sun Piazza Aquarium в Саппоро (первоначальное местонахождение неизвестно) характеризовали главным образом формой и размерами тела, наличием 8 головных сосочков и большего переднего расширения пищевода, и отсутствием хвостовых сосочков. *Ph. inimici* (самки), выделенный из семеника морской рыбы *Platycephalus indicus* из залива Микава (Mikawa Bay), представляет первую находку у этого вида хозяина. Изучение самок *Philometroides masu* из полости тела *Hucho perryi* (первая находка у этого хозяина) из трех рек острова Хоккаидо показало, что этот вид отличается от всех других представителей подсемейства Philometrinae наличием многоядерных пищеводных желез.

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Received 1 March 1988

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