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ON THE BIOLOGY OF THE NEMATODE PHILOMETRA OBTURANS (PRENANT, 1886) IN THE FISHPOND SYSTEM OF MÁCHA LAKE, CZECHOSLOVAKIA

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Abstract. A description is given of the occurrence of the nematode *Philometra obturans* (Prenant, 1886) in pike (*Esox lucius* L.) from the Mácha Lake fishpond system in Czechoslovakia (N. Bohemia) based on the results of an investigation conducted in the years 1975—1977. By contrast to other philometrid nematodes, this pathogenic, specific parasite of pike does not exhibit clear-cut seasonal changes in its maturation, and gravid females are recovered throughout the year. The natural reservoir hosts of larvae of *Ph. obturans* are recorded for the first time. In the locality under consideration these are mainly perch (*Perca fluviatilis* L.), less frequently rudd (*Scardinius erythrophthalmus* (L.)); these forage fishes are evidently the principle source of *Ph. obturans* infection for pike. Differences in an affinity of *Ph. obturans* for the various size groups of pike are influenced mainly by the growth changes in the composition of food of these hosts. The development and circulation of *Ph. obturans* in the environment, and the problem of reservoir hosts of this nematode are discussed.

The nematode *Philometra obturans* (Prenant, 1886) is a widely distributed pathogenic parasite of pike (*Esox lucius* L.). Due to its unusual location (blood system) of gravid and subgravid females in the host and the minute size of body of the male and mature female, this parasite has only been recorded occasionally during standard dissections of the fish; consequently, in spite of its frequent incidence in European pike, little knowledge has been available of this nematode until recently. A redescription of the gravid female of *Ph. obturans* and descriptions of the male and mature and subgravid females of this species were given only by Moravec (1971, 1978a) and Molnár (1976). The latter author found in experiments several copepod species to be intermediate hosts of *Ph. obturans*, and Moravec (1978b) described the larval morphogenesis of the nematode in these intermediate hosts up to the infective stage. So far there are no data available on the biology and ecology of this helminth in the natural environment.

MATERIALS AND METHODS

The occurrence of *Philometra obturans* was traced in pike (*Esox lucius* L.), length 10—73 cm, age 0^+—6^+, from the fishpond system of Mácha Lake in Czechoslovakia (N. Bohemia, basin of the Elbe River). A description of the fishpond system, composed of two large fishponds near Doksy (Mácha Lake and the fishpond Břehyně) interconnected by the Břehyně Brook, has been given in an earlier paper (Moravec 1978c). Most fishes were caught with an electric fishing machine from the section of the Břehyně Brook connecting the two fishponds and a few specimens only were obtained during the fishing of Mácha Lake. A total of 225 pike specimens was examined from this locality. In 1976, pike samples were taken each month for examination; this material was completed with examinations of fishes obtained during several months of the years 1966, 1975, and 1977 (Table 1). Every organ of the fish was carefully examined in postmortem. First the complete gill apparatus together with the aorta and the heart were separated from the fish body and placed in saline on a petri dish. There, the aorta was cut open to release the bodies of gravid females of *Ph. obturans* which were most fre-

quently extended into it. Then, the bones were removed from the individual branchial arches and the gill arteries were examined by tearing them carefully to pieces with the aid of preparation needles; the remaining organs were examined with standard helminthological methods by means of a dissecting microscope. The nematodes recovered were fixed with a mixture of saline and 40 % formalin (9 : 1) and then stored in 4 % formalin.

In order to obtain information on the range of the reservoir hosts of *Ph. obturans*, in addition to pike various other fish species were examined from the study area, i.e., 48 perch (*Perca fluviatilis* L.), 2 pikeperch (*Stizostedion lucioperca* (L.)), 46 bream (*Abramis brama* (L.)), 34 roach (*Rutilus rutilus* (L.)), 42 rudd (*Scardinius erythrophthalmus* (L.)), 1 chub (*Leuciscus cephalus* (L.)), 8 gudgeon (*Gobio gobio* (L.)), 37 tench (*Tinca tinca* (L.)), 8 carp (*Cyprinus carpio* L.), and 37 eel (*Anguilla anguilla* (L.)).

Table 1. Survey of *E. lucius* examined from the Mácha Lake fishpond system and their infection with *Ph. obturans*.

Year and month	No. of pike examined	No. of pike infected	Incidence (%)	Intensity of infection	Body length of pike in cm (mean, range)
1966					
January	8	—	—	—	22 (20—24)
February	5	—	—	—	34 (27—43)
1975					
November	4	3		1—2	36 (22—45)
1976					
January	11	1	9.0	1	24 (18—32)
February	17	3	18.7	1—2	25 (16—37)
March	10	1	10.0	1	25 (21—31)
April	13	4	38.2	1—2	26 (21—37)
May	11	4	36.4	1	31 (19—54)
June	10	2	20.0	1—2	27 (24—31)
July	13	4	30.7	1	27 (22—33)
August	13	1	7.6	2	24 (20—30)
September	13	3	23.0	1	27 (10—39)
October	12	4	33.3	1	27 (16—34)
November	14	4	28.5	1—4	42 (17—73)
December	9	3	33.3	1	28 (15—43)
1977					
March	13	2	15.3	1—2	23 (12—36)
April	30	3	10.0	1—2	21 (14—26)
May	19	2	10.5	1—2	22 (13—27)
Total	225	44	19.5	1—4	26 (10—73)

OBSERVATIONS

A. THE OCCURRENCE OF *PH. OBTURANS* IN THE DEFINITIVE HOST

In the locality under consideration, pike (*Esox lucius* L.) was the only definitive host of *Ph. obturans*. This confirmed the strict host specificity of this nematode recorded in all earlier studies. Out of a total of 225 pike examined, 44 (19.5 %), aged 1—5 years, were found to harbour *Ph. obturans*. These nematodes were present in all samples except for those of pike examined in 1966 (Table 1); but the parasite might have been overlooked because, at that time, only insufficient attention was paid to the incidence of *Ph. obturans*. The findings consisted almost entirely of gravid and subgravid females of *Ph. obturans* from the blood system of pike; a male and a mature female located in the eye were recovered only once each. Generally, the infected fishes con-

tained 1, rarely 2 nematodes; in one case only 4 gravid females of the parasite were recovered from a single host.

The distribution of *Ph. obturans* in the pike population was not uniform (Fig. 2). Infection with this parasite was found in pike specimens measuring more than 20 cm

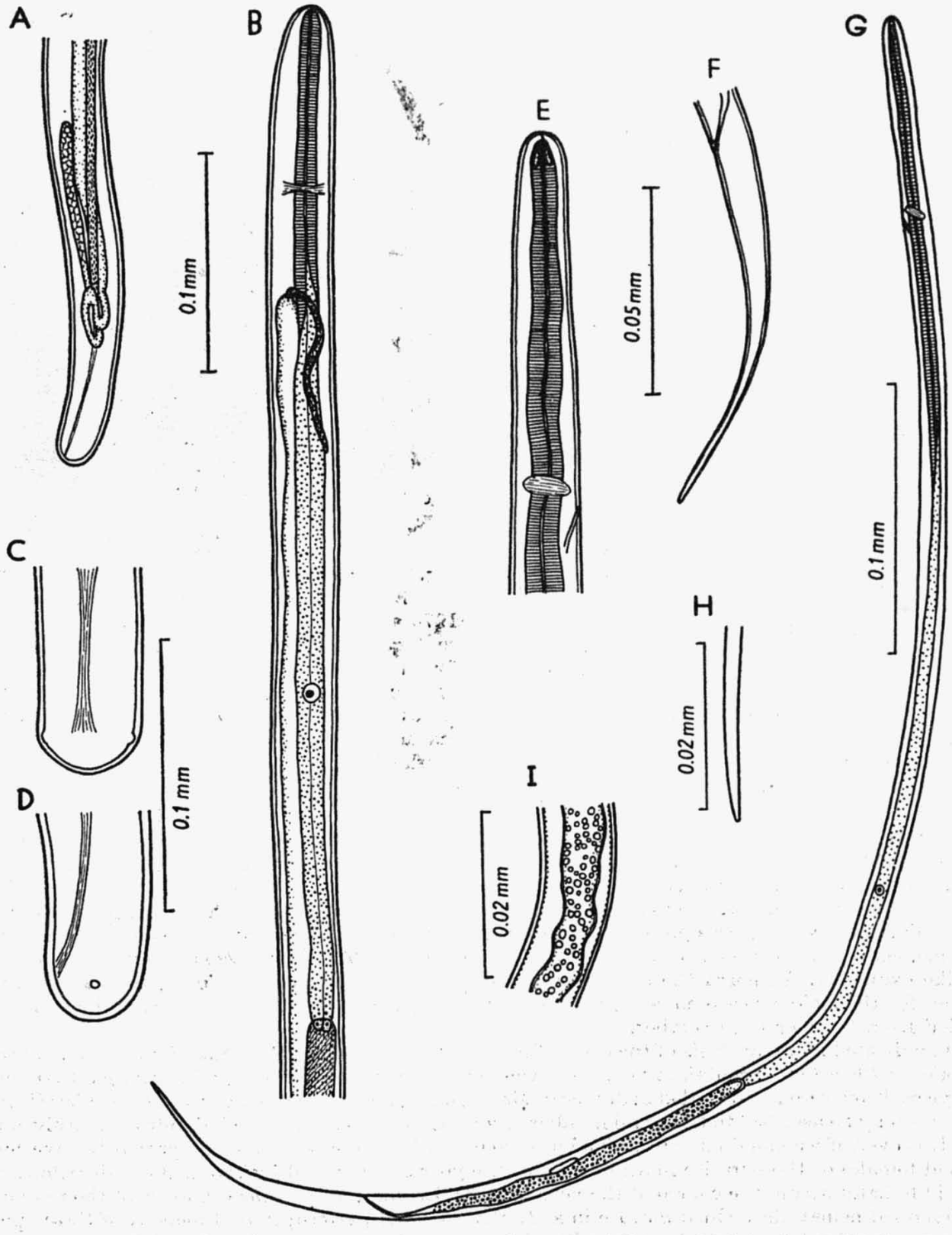

Fig. 1. *Philometra obturans* (Prenant, 1886). A—D — smallest female (body length 6.8 mm) obtained from the gill artery of *Esox lucius* (A — posterior end of body, B — anterior end of body, C, D — posterior extremity, dorsal and lateral views); E—I — infective larva from the eye of *Perca fluviatilis* (E — head end, F — tail, G — total view, H — tail tip, I — part of body in the gut area).

in length (i.e., in pike older than one year), never in younger specimens. Values for the incidence and mean intensity of infection with *Ph. obturans* increased gradually in proportion to the size of pike, they were highest in pike measuring 40—50 cm in length (age 3—4 years); both the values again decreased considerably in bigger pike (above 50 cm of length) (Fig. 2). No differences in the state of maturity of nematodes recovered from the individual size groups of pike were observed; gravid females of *Ph. obturans* were present already in pike measuring 22—24 cm in length; this confirmed that the complete development of the parasite did not last longer than one year.

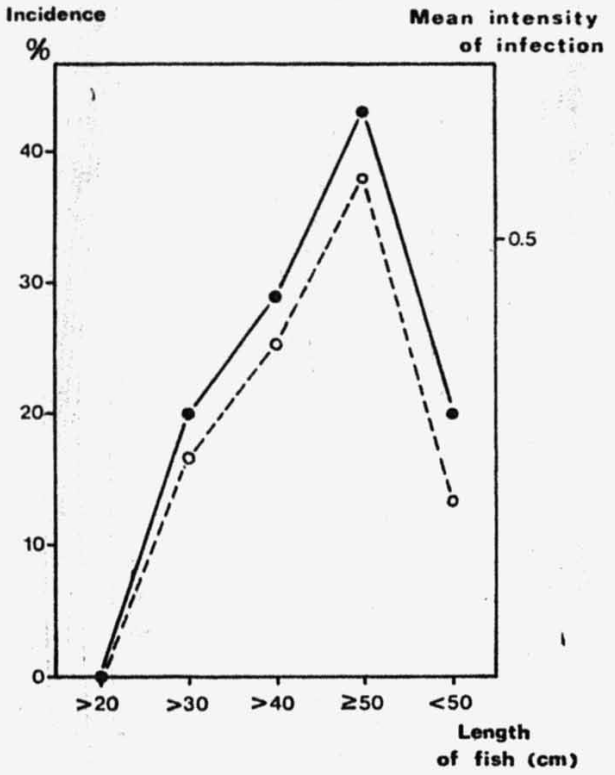

Fig. 2. Dependence of the incidence (————) and mean intensity (- - - - -) of *Ph. obturans* infection on the body length of pike.

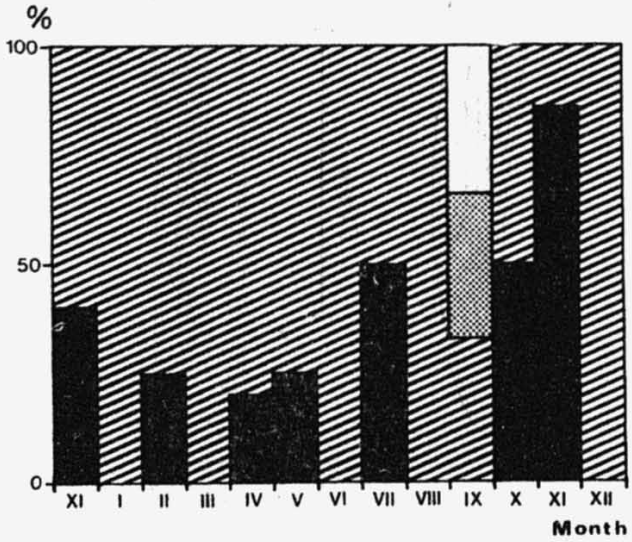

Fig. 3. Monthly changes in the state of maturity of *Philometra obturans* in pike samples from 1975 and 1976. The data are expressed as percentages of the total number of nematodes found per month: gravid females from blood system (blackened), subgravid and young females from blood system (obliquely hatched), mature females from eye (stippled), and males (unshaded).

Although pike from this locality were examined in regular monthly intervals throughout the year 1976, the number of fishes examined was too small and the rate of infestation with *Ph. obturans* too low to allow for a statistical evaluation and, hence, for a reliable estimate of the seasonal dynamics of this parasite in *E. lucius*. As a result of a different affinity of *Ph. obturans* for the individual size groups of the host, the data were also partly influenced by the size of pike in the samples. According to our data, *Ph. obturans* was present in pike throughout the year, whereby in the years 1976 and 1977 the incidence ranged from 7.6 to 38.2 % and in November 1975, it was even found in 3 out of the 4 pike examined. Although the character of these data is merely orientational, they suggest that values for the incidence are highest in the spring and at the beginning of summer, and again in the period from October to December.

As indicated by an analysis of the state of maturity of nematodes in the individual months, gravid females of *Ph. obturans* containing motile larvae in their uteri were found in pike during all seasons of the year. They were not recorded in January, March, June, August, September and December (Fig. 3), but this may be ascribed to the small number of worms recovered from the individual monthly samples. However, if we could have examined a more extensive material, we would probably have found gravid females of the parasite in all months of the year as suggested by the mode of distribution of gravid females within the course of the year (Fig. 3). In this *Ph. obturans* differs from the remaining philometrid nematodes, which mature in a strictly seasonal pattern; gravid females of these species were recovered solely during 1—2 months of the year. Also subgravid females of *Ph. obturans* with eggs in their uteri were present in pike throughout the year (Fig. 3), whereas young females without eggs were occasionally recovered from gill arteries in May and August only. A male and a mature female located in the eye were found in two pike examined in September 1976.

Gravid, subgravid and young females (without eggs) of *Ph. obturans* were always found in the blood system of pike. The most frequent location of gravid and subgravid females was the ventral aorta. Their body, bent mid-ways, formed a narrow loop. The bent part of the body was extended frequently into the bulbus arteriosus (Plate I, Fig. 1) while the free ends of the nematode reached two different gill arteries generally belonging to two anterior gill arches, mostly at the same side of the host body.

The presence of *Ph. obturans* in the bulbus arteriosus caused a focal primary damage to the endothelium, this being responsible for the formation of extensive parietal thrombi, which at this time were mostly at a stage of organisation (Plate II, Fig. 1). Apart from this initial phase characterized by a proliferation of the vasa vasorum and a proliferation of fibroblasts, we observed the phase at which the parietal thrombi cicatrized. In the ventral aorta in which the parasite had more space than in the bulbus arteriosus, there was a mere hypertrophy of the endothelium.

Occasionally, gravid females were found in a coiled position inside large nodules located in the wall of the aorta, the bulbus arteriosus or the heart. At the time of release of the laravae, gravid females penetrated actively with their anterior body end the wall of the gill artery (in approximately the middle of the gill arch) and extruded part of their body into the water. There it burst under the influence of osmotic pressure and the larvae were released into the external environment.

The only sites of location of younger subgravid females and females without eggs were the gill arteries. The smallest female recovered from a gill artery (Fig. 1 A—D) measured 6.8 mm in length with a width of 0.068 mm; its oesophagus measured 1.03 mm, the nerve ring was at a distance of 0.180 mm; the rounded posterior end of the larval body possessed two minute lateral papilla-like processes, the tubular uterus was still without eggs, the vulva was already absent. A freely moving male and a mature female were found in the vitreous body of the eye of the host. Larvae of *Ph. obturans* were not found in pike.

B. INTERMEDIATE AND RESERVOIR HOSTS OF *PH. OBTURANS*

Molnár (1976) and Moravec (1978b) determined in experiments various cyclopoid copepods as the intermediate hosts of *Ph. obturans: Cyclops strenuus* Fischer, *Eucyclops serrulatus* (Fischer), *Acanthocyclops vernalis* (Fischer), *A. viridis* (Jurine), *Macrocyclops albidus* (Jurine) and *M. fuscus* (Jurine). With the exception of *A. viridis* and *M. fuscus*, all these copepod species were present in plankton samples taken from the fishpond Břehyně and the Břehyně Brook in February and March 1977. The abundance of these copepods (in addition to several other species) in the plankton of the locality and the fact that they constituted one of its major components suggested that they were utilized by *Ph. obturans* as its intermediate hosts.

In the locality under consideration we found that perch (*Perca fluviatilis*) and rudd (*Scardinius erythrophthalmus*) acted as reservoir hosts of infective larvae of *Ph. obturans* which moved freely in the vitreous body of these hosts. Irrespective of the season of the year, infective larvae were found in 5 out of the 48 specimens of *P. fluviatilis* examined (body length 13—19 cm); the incidence was 10.4 %, the intensity of infection 1—7 (average 3) larvae. Out of a total of 42 specimens of *S. erythrophthalmus* examined we recovered 3 larvae from one specimen only (body length 24 cm), the incidence being 2.4 %.

Description of the larvae: Larval body very slender (Fig. 1E-I), its cuticle thin and almost smooth. Body length 0.678—0.747 mm, maximum width 0.009—0.010 mm. Cephalic end rounded, bearing indistinct mouth papillae. Two small, inconspicuous drop-shaped penetration glands present in area of anterior end of oesophagus. Entire oesophagus 0.390 to 0.483 mm long, representing 57—65 % of total length of larval body; length of oesophageal gland 0.240—0.270 mm. Nerve ring

situated 0.050 mm from anterior end of body, excretory pore just posterior to nerve ring. Oesophageal gland of feebly granular structure. Giant cell nucleus just prior to mid-length of oesophageal gland. Intestine straight, containing numerous spherical orange-brown granules. Small, oval-shaped genital primordium situated on ventral side of body, approximately level with mid-length of intestine. Rectum a narrow hyaline tube. Tail conical, slender, 0.090—0.105 mm long, ending in a sharp tip.

DISCUSSION

What information there is concerning the development of nematodes of the genus *Philometra* and related genera under natural conditions of the temperate zone is conform in that the life cycle of these nematodes is annual and that there are distinct seasonal differences in the incidence and state of maturity of these parasites in their fish hosts. According to the literature the appearance of gravid females of these parasites in fishes is strictly seasonal in that they are present mostly for a period of 1—2 months of the year, largely during the late spring and at the beginning of summer. This fact has been confirmed, e.g., in the species *Philometra abdominalis* (Molnár 1967, Moravec 1977a), *Ph. ovata* (Molnár 1966), *Ph. rischta* (Molnár 1966), *Ph. kotlani* (Molnár 1969), *Ph. cylindracea* (Molnár and Fernando 1975), *Philometra* sp. (Bier et al. 1974), *Philometroides sanguinea* (Wierzbicki 1960), *Ph. lusiana* (Vismanis 1964, Vasilkov 1968), *Ph. huronensis* (Uhazy 1977a, b) and some others. Hence, *Ph. obturans* is the first species for which the incidence of gravid females has been recorded throughout the year. One reason for this difference from other philometrid nematodes is apparently the fact that the definitive host (pike) acquires infection with *Ph. obturans* mainly by feeding on forage fishes, the reservoir hosts of larvae of this parasite; the larvae are present in these fishes throughout the year. Pike is a predator and feeds mainly on forage fishes and therefore, a direct transmission of the infection by copepods may be possible in small pike specimens only (up to a length of about 3 cm) which feed on plankton. However, feeding on plankton is limited to a short period as a result of the considerable rate of growth of this fish. On the other hand, we feel justified to assume that the main, if not sole, source of infection of the definitive host with other hitherto studied philometrid nematodes are copepods, because these nematodes parasitize mainly cyprinids and other nonpredatory fishes. The availability of infective philometrid larvae in copepods appears to depend on seasonal changes brought forth by population dynamics of the copepods, and by an arrest or a retardation of the development of larval philometrids in these intermediate hosts under conditions of decreased water temperatures during the winter season. These seasonal changes in the availability of infective larvae of the parasite, and apparently several additional factors, are responsible for a seasonal rhythm in maturation of these species.

Although reservoir parasitism has been reported earlier for several species of dracunculoid nematodes such as *Dracunculus ophidensis* (Brackett 1938) and *Avioserpens mosgovoyi* (Supryaga 1968), it has been recorded only recently for a member of the family Philometridae. Molnár (1976) demonstrated in experiments that pike may acquire infection with *Ph. obturans* by feeding on carp fry which swallowed infected copepods; however, the author failed to recover nematode larvae from these forage fishes. Our findings of infective larvae of *Ph. obturans* in several naturally infected fishes (perch, rudd) confirmed the participation of reservoir hosts in the circulation of this helminth which so far is the only species of philometrid nematodes for which reservoir parasitism has been proved. Although we did not confirm in feeding experiments that larvae from the vitreous body of *Perca fluviatilis* and *Scardinius erythrophthalmus* were conspecific with *Ph. obturans*, there are no doubts that these larvae belong to this species.

These larvae were both morphologically and metrically (Table 2) conform to infective larvae of *Ph. obturans* from copepods (Moravec 1978b) except for the absence of exuviae from the second moult. They could hardly have been mistaken for the infective larvae of other dracunculoid nematodes. In addition to *Ph. obturans*, the only other philometrid species found in the locality was *Philometra ovata*, a parasite of

Table 2. Comparison of measurements of the invasive larvae of *Ph. obturans* from copepods and perch. (In mm).

Measurements	from copepods	from perch
Length of body	0.708—0.789	0.678—0.747
Width of body	0.009—0.012	0.009—0.010
Length of oesophagus	0.399—0.516	0.390—0.483
Length of oesophageal gland	0.210—0.228	0.240—0.270
Distance of nerve ring	0.055—0.066	0.050
Length of tail	0.102—0.111	0.090—0.105

bream and several other cyprinids; also *Ph. abdominalis* may have been present. However, infective larvae of *Ph. ovata* and *Ph. abdominalis* have a rounded tail tip provided with 2—3 delicate mucrones (Moravec 1977b, new unpublished data) while the tail tip of *Ph. obturans* is almost conical without any mucrones; infective larvae of *Ph. obturans* from cyclops measure 0.71—0.79 mm, those of *Ph. ovata* 0.40 to 0.59 mm, of *Ph. abdominalis* 0.46—0.57 mm. There may also have been nematodes of the genus *Avioserpens* parasitic in waterbirds and *Dracunculus oesophageus* parasitic in the grass-snake in the locality. Among other differences, infective larvae of both the genera differ from those of *Ph. obturans* in having 3—4 small, well-developed conical mucrones at their tail tip (Supryaga 1965, Desportes 1938). Also the location of the larvae recovered from the bodies of the reservoir hosts indicated that they belonged to *Ph. obturans*. It appears that the mode of penetration to the vitreous body of the eye by infective larvae of *Ph. obturans* is similar in both the reservoir and definitive hosts, but the larvae complete their development in the latter host only, while in the former they persist without developmental changes. The juvenile forms of other philometrid nematodes are located in the definitive host mainly in the abdominal cavity and below the serosal cover of the airbladder.

The incidence of larval *Ph. obturans* in the eyes of perch seems to be fairly common. From Czechoslovakia they have been recorded as Nematoda gen. sp. from perch of the Latorica River (the Danube basin) (Žitňan 1967, Moravec 1971) and from the Bystřice Brook near Hradec Králové (the Elbe basin) (Moravec 1971). Molnár (1970) recorded them under the name *Agamospirura* sp. from Lake Velence in Hungary; in addition to perch, he found them also in *Stizostedion lucioperca*. In most of these localities, also adult forms of *Ph. obturans* were found in pike.

The most important reservoir host of *Ph. obturans* is perch (*P. fluviatilis*) and in this locality larvae of the parasite were found most frequently in this host, although they can occur in other fishes as well. Undoubtedly, it is due to the fact that even larger perch specimens consume large quantities of plankton. This accounts for a heavier concentration of larval *Ph. obturans* in this species in comparison with other fishes which may also be utilized by the parasite as its reservoir hosts. Therefore, from the point of epizootology, perch constitutes the most important source of infection of pike with *Ph. obturans*, as it also follows from a comparison of the affinity of *Ph. obturans*

for the individual size groups of pike from the fishpond system of Mácha Lake (Fig. 2). As reported in another paper (Moravec 1978c), the diet of smaller pike (up to a length of 40 cm) in this locality was composed mainly of small perch (74 %), while that of bigger pike (above 40 cm) consisted mainly of cyprinids and small pike and, to a small degree (about 20 % or less), of perch. These food relationships (the share of perch in the diet of pike) were distinctly reflected in the degree of infestation of pike in the individual size groups notable particularly in, e.g., a marked decrease in the incidence and intensity of infection with *Ph. obturans* in the biggest pike (Fig. 2). The fact that the pike population in a locality is always considerably less numerous than those of other fish species, and that these predatory fishes are feeding for a short period only (during their initial development) on plankton, leaves little doubt about the immense importance of reservoir hosts in the maintenance of the population of this parasite in the locality. Reservoir parasitism can be supposed as well in other species of philometrid nematodes parasitic in predatory fishes (e.g. *Philometra bagri*, *Ph. fujimotoi*, *Ph. hyderabadensis* and others).

The present data on the occurrence of *Ph. obturans* in the fishpond system of Mácha Lake provided a rough outline of the mode of development of this parasite: First-stage larvae of *Ph. obturans* are released by the gravid females into the water all the year round. According to Moravec (1978b) these larvae are capable of surviving free in the water for a period of several days to almost one month (in dependence on the water temperature) before being ingested by various species of cyclopoid copepods, their intermediate hosts. Having completed two moults in the haemocoel of the copepod, the larvae become infective to fishes. At a water temperature of 20—22 °C, they attain the infective stage within roughly 10 days, while in lower temperatures their development is greatly retarded or even arrested (Moravec 1978b). Infection of pike can occur by feeding directly on an infected copepod (Moravec 1978b), but this is not a frequent mode of acquiring infection, because these predatory fishes start very early to feed on small fishes. The most important source of *Ph. obturans* infection for pike are the reservoir hosts of the larvae of this parasite, i.e., fishes feeding on plankton — mainly perch. Since these fishes consume large quantities of plankton, they function as a kind of "filter" in retaining and concentration infective larvae of *Ph. obturans*. In this they increase many times the probability of closing the cycle of the parasite. After pike swallowed and digested an infected copepod or a reservoir host, infective larvae of *Ph. obturans* penetrate from the digestive tract to the abdominal cavity of this definitive host; after some time they arrive eventually in the vitreous body of the eye to mature there. As suggested by data of Molnár (1976), these parasites may apparently become mature even in the abdominal cavity, under the serosal cover of the airbladder or in other organs. The males die after copulation and the females migrate to the gill arteries of the host. They grow there and embryos start to develop gradually in their uteri. The body of the rapidly growing subgravid females extends as far as to the aorta. When the uterus of the female has become filled with first-stage larvae, the nematode pushes its anterior body end through the wall of the gill artery into the water; it bursts under the influence of osmotic pressure and releases larvae into the external environment. The life cycle of the parasite is annual, but pike acquire infection throughout the year by feeding on reservoir hosts of this parasite. This accounts for the absence of seasonal changes in maturation of these nematodes in their definitive host.

There is no doubt that *Ph. obturans* is highly pathogenic to its host. It feeds on its blood (Plate I, Fig. 2), considerable blood losses are caused mainly by subgravid and gravid females which attain a length of up to 170 mm (Moravec 1978a). The location of the parasite in the bulbus arteriosus, the ventral aorta and the gill arteries is a serious

mechanical obstacle to the circulating blood and leads to thrombotic changes. Also the perforation of the blood arteries (Plate II, Fig. 2) caused by the females of *Ph. obturans* during the release of first-stage larvae participates in circulatory failures.

Thus, the presence of the nematode has a negative effect on the state of health of pike and reduces considerably its resistence to unfavourable conditions of the external environment. Surprisingly low values of the intensity of infection with *Ph. obturans* in pike (generally 1—2 nematodes per fish) along with considerably high values in the incidence indicate that the more heavily infested fishes either perish or, as a result of their changed behaviour, become an easy prey for large pike specimens or other predatory fishes.

К БИОЛОГИИ НЕМАТОДЫ *PHILOMETRA OBTURANS* (PRENANT, 1886) В ПРУДОВОЙ СИСТЕМЕ МАХОВА ОЗЕРА В ЧЕХОСЛОВАКИИ

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Резюме. В работе описана встречаемость нематоды *Philometra obturans* (Prenant, 1886) у щуки (*Esox lucius* L.) из прудовой системы Махова озера в Чехословакии (Северная Чехия) на основе результатов исследований в 1975—1977 гг. В отличие от других филометрид, у этого патогенного специфического паразита щуки авторам не удалось обнаружить сезонных изменений в созревании и его гравидные самки встречались круглогодично. В первый раз обнаружены естественные резервуарные хозяева личинок *Ph. obturans*. На вышеуказанном местонахождении это прежде всего *Perca fluviatilis* L. и иногда *Scardinius erythrophthalmus* (L.) которые являются, по-видимому, главным источником инвазий *Ph. obturans* для щуки. Различия в аффинитете *Ph. obturans* к отдельным отличающимся по размерам группам щук связаны главным образом с изменениями состава пищи этих хозяев в течение их роста. Обсуждается развитие и циркуляция *Ph. obturans* в среде и вопрос резервуарных хозяев этой нематоды.

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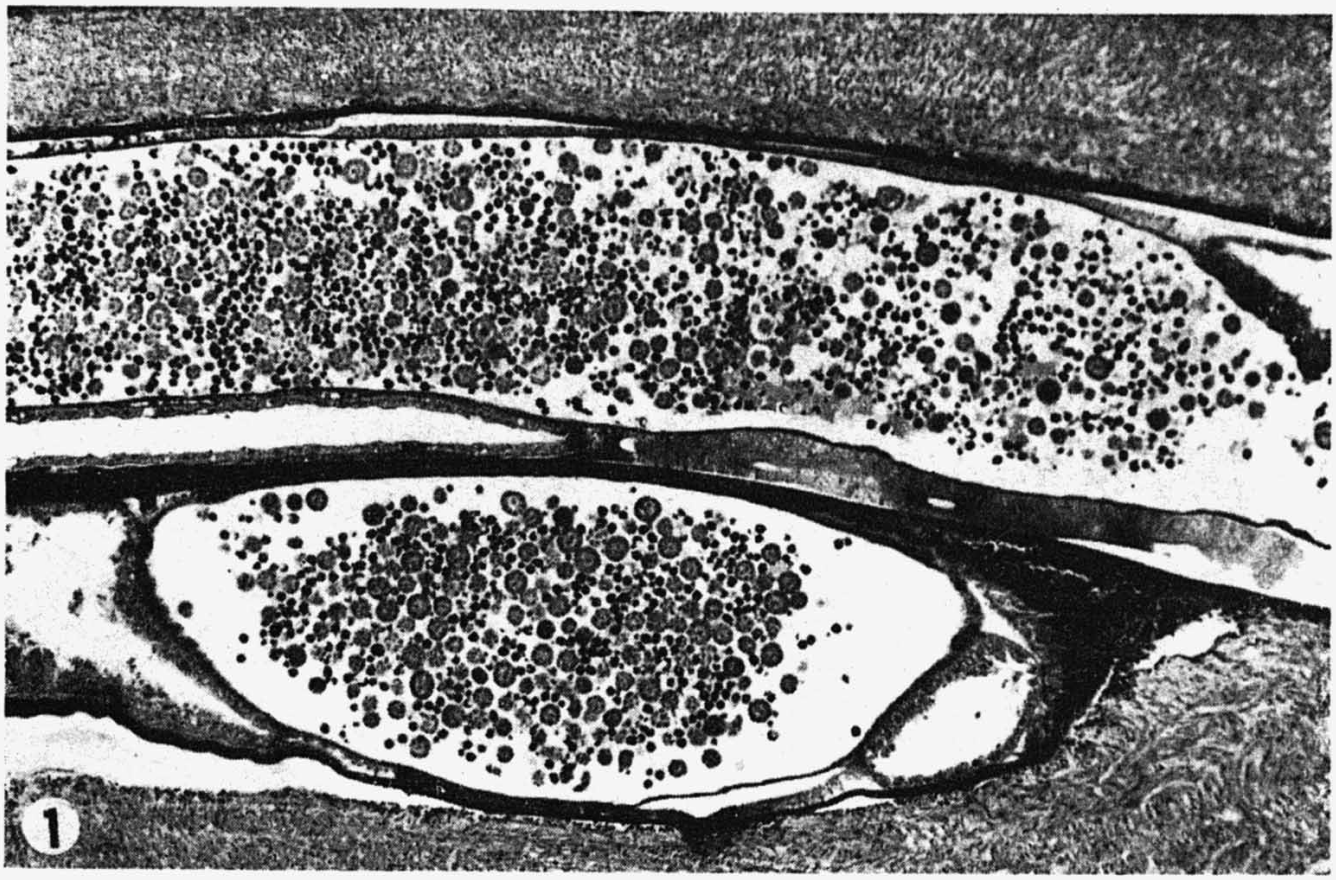

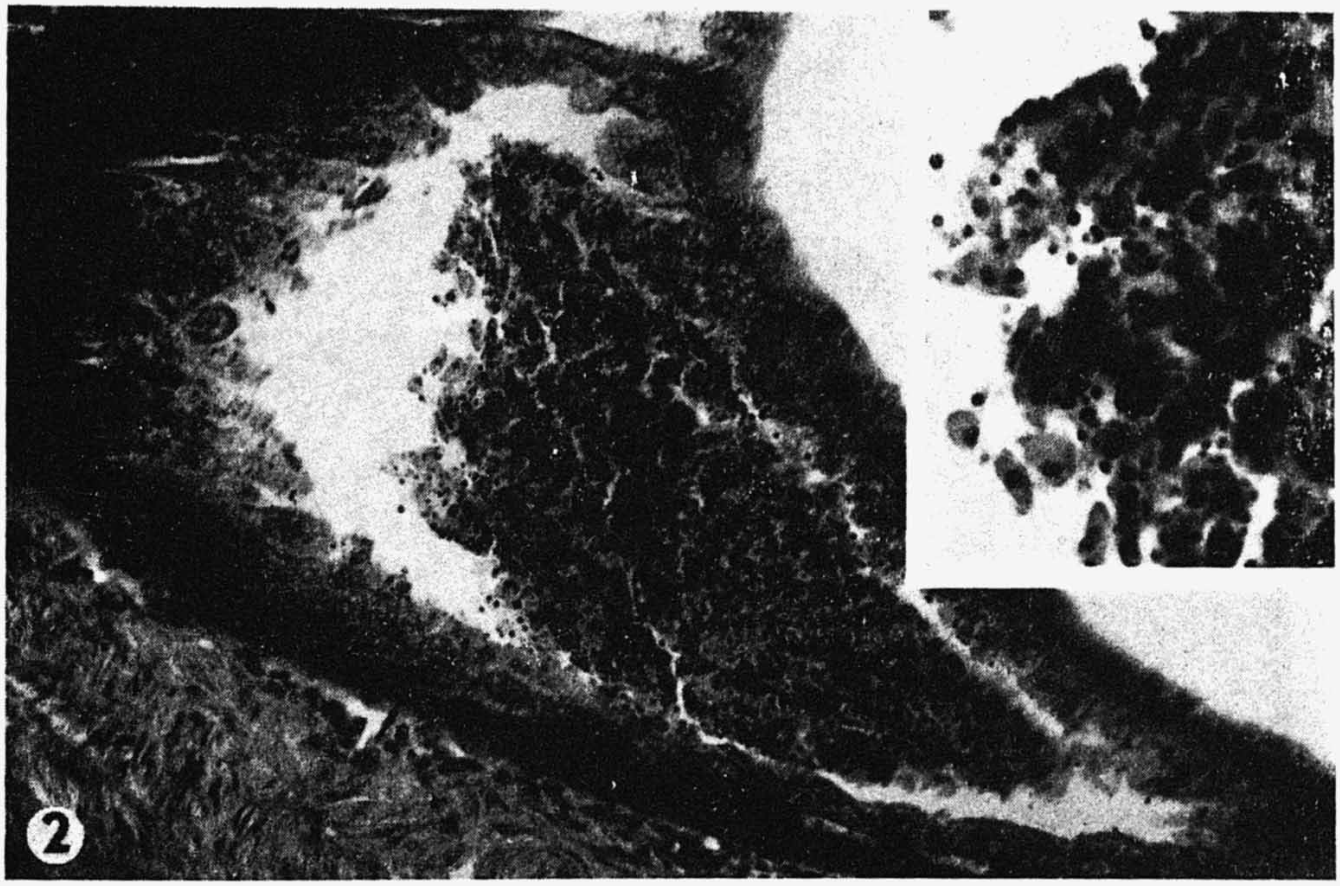

Fig. 1. *Philometra obturans* — a female located in bulbus arteriosus of the heart. Longitudinal section. Hematoxylin-eosin (× 90).
Fig. 2. *Philometra obturans*. Female's gut filled with erythrocytes of pike. Hematoxylin-eosin (× 350). Inset: erythrocytes in the gut (× 700).

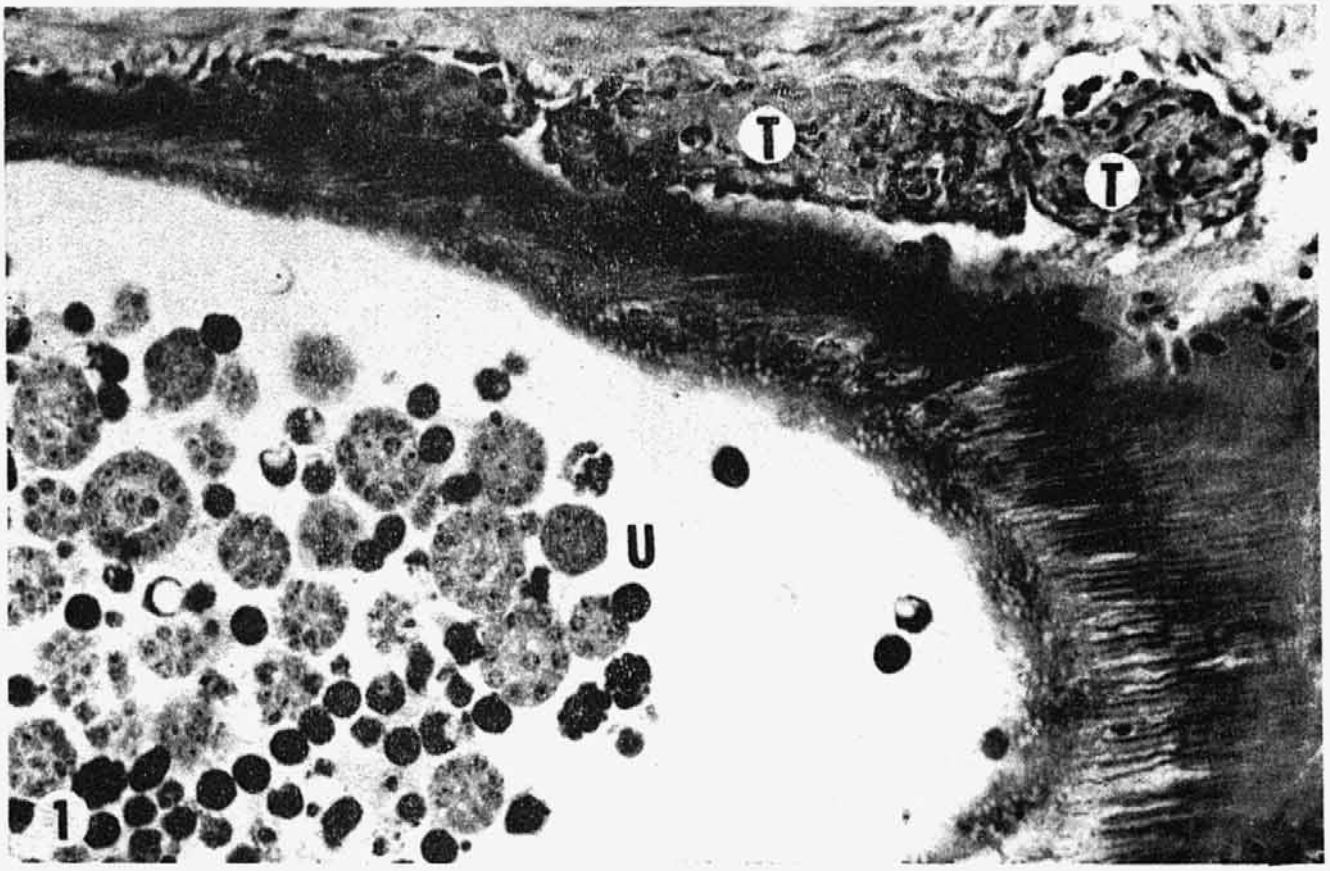

Fig. 1. Parietal thrombi (T) in the bulbus arteriosus of the heart. Female uterus with cleaved eggs (U). Hematoxylin-eosin (×350).

Fig. 2. Rupture of the gill artery caused by the female *Ph. obturans*. Remnants of the gill artery (A), haemorrhage (H) around the gill artery with a cross section through the female, gill vein (V). Hematoxylin-eosin (×135).