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THE INTERMEDIATE HOSTS OF ASCAROPS STRONGYLINA (RUD.) AND PHYSOCEPHALUS SEXALATUS (MOLIN) IN BOHEMIA

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Abstract. The utilization of coprophagous beetles by the stomach nematodes *Ascarops strongylina* (Rud.) and *Physocephalus sexalatus* (Molin) as principal intermediate hosts has been studied in the reservation Květov, in which the wild hog populations have to be provided with additional food throughout the year. Larvae of *Ascarops strongylina* were found in *Geotrupes stercorarius* (84.6%), in *G. stercorosus, aberr. monticola* (Heer.) (44.0%), in *G. vernalis* L. (37.0%) and in *Aphodius sticticus* Panz. (1.28%); larvae of *Physocephalus sexalatus* were present in *G. stercorarius* L. (26.4%) and in *G. stercorarius, aberr. monticola* (Heer.) (9.09%). The second- and third-stage larvae overwinter in the beetles. In the summer months, these intermediate hosts are infected mostly with second-stage larvae.

The stomach nematodes *Ascarops strongylina* (Rudolphi, 1819) and *Physocephalus sexalatus* (Molin, 1860) are frequent parasites of the wild hog in Czechoslovakia (Jurášek 1959; Páv, Kotrlý and Zajíček 1961, 1963). During our investigations of the epizootology of both nematode species, various localities frequently visited by wild hog (the vicinity of feeding troughs and sites of wild hog concentration in the reservation Květov) were inspected every third week (from May till October 1970) in order to obtain information on the incidence of coprophagous beetles. The reservation Květov (forest block Milevsko, district Písek) covers an area of 780 ha; it lies at 410—450 m above sea level on a bed of biotite granite; the vegetation consists of 70% of coniferous and 30% of deciduous trees. This indicates that the carrying capacity of this reservation is very low.

MATERIAL AND METHODS

After collection, the beetles were identified and then examined in postmortem. The contents of their body cavity was emptied by pressure and inspected. We examined a total of 117 *Geotrupes stercorarius* L., 25 *G. stercorosus* Scriba, *aberr. monticola* (Heer.), 16 *G. vernalis* L., 234 *Aphodius sticticus* Panz, 56 *A. fimetarius* L., 27 *A. ater Degger* and 97 beetles of the genera *Quedius L.* and *Creophilus L.*

RESULTS

First-, second- and third-stage larvae of *Ascarops strongylina* (Rud.) were found in the beetle species *Geotrupes stercorarius* L., *G. stercorosus, aberr. monticola* (Heer.), *G. vernalis* L. and *Aphodius sticticus* Panz. The measurements are given in Table 1.

Table 1. Larvae measurements of *Ascarops strongylina* and *Physocephalus sexalatus* (in mm.)

Developmental stages		*Ascarops strongylina*			*Physocephalus sexalatus*		
		Shmytova, 1961	T. del Valle, Baruš, 1969	Own findings	Ryzhikov, 1952	Baruš, Moravec, Prokopič, 1970	Own findings
I.	Body length			0.116—0.132			0.118—0.132
	Body width			0.008			0.018—0.024
II.	Body length	0.672—2.07		0.696—1.98	1.2		0.045—1.2
	Body width	0.042—0.06		0.048—0.066	0.06		0.035—0.06
	Oral cavity length	0.029—0.051		0.024—0.048			
	Oesophagus length	0.21—0.79		0.208—0.756			
	Nerve ring from the cranial end	0.096—0.146		0.09—0.138			0.088
	Excretory porus from the cranial end	0.11—0.172		0.114—0.168			0.1
III.	Body length	2.10—2.78	2.10—2.47	2.1—2.6	1.4—1.6	0.69—0.84	0.90—1.4
	Body width	0.068—0.096	0.077—0.091	0.06—0.096	0.068—0.072	0.045—0.066	0.06—0.07
	Pharynx length	0.059—0.078	0.049—0.055	0.048—0.06	0.086	0.057—0.061	0.06—0.08
	Muscular part of oesophagus length	—	0.15—0.21	0.148—0.23	0.073	0.048—0.066	0.06—0.07
	Glandular part of oesophagus length	—	0.71—0.78	0.708—0.8	0.498—0.535	0.24—0.46	0.48—0.52
	Nerve ring from the cranial end	0.132—0.179	0.14—0.17	0.138—0.168	0.13	0.096—0.11	0.1—0.12
	Excretory porus from the cranial end	0.169—0.209	0.17—0.21	0.168—0.21		0.11—0.13	0.128—0.13
	Anus from the caudal end	0.072—0.09	0.068—0.082	0.07—0.088	0.054	0.054—0.066	0.058—0.07

Table 2. Incidence of spirurid larvae in intermediate hosts

Intermediate host	Month	Number of examined	*Ascarops strongylina*					*Physocephalus sexalatus*				
			Positives	Intensity of larval stages			Incidence in %	Positives	Intensity of larval stages			Incidence in %
				1°	2°	3°			1°	2°	3°	
Geotrupes stercorarius L.	V.	16	11	—	4—21	3—87	68.75	—	—	—	—	—
	VI.	22	17	—	2—68	6—80	77.27	4	—	12—21	—	18.18
	VII.	18	18	—	10—211	6—124	100.0	11	—	4—10	2—12	61.11
	VIII.	19	18	11—15	1—145	1—134	94.73	3	1—5	2—5	—	15.78
	IX.	27	21	—	3—110	4—64	77.77	6	—	3—6	6—14	22.22
	X.	15	14	—	8—121	4—72	93.33	7	—	2—4	2—8	46.66
Total		117	99	11—15	1—211	1—134	84.61	31	1—5	2—21	2—14	26.49
G. vernalis L.	VII.	5	1	—	42	15	20.0	—	—	—	—	—
	VIII.	7	3	—	6—32	2—14	42.85	—	—	—	—	—
	IX.	4	2	—	4—48	3—12	50.0	—	—	—	—	—
Total		16	6	—	4—48	2—15	37.5	—	—	—	—	—
G. stercorosus Scriba, aberr. montico'a (Heer.)	VII.	7	2	—	2—16	1—23	28.57	—	—	—	—	—
	VIII.	11	6	3—5	6—34	2—18	54.54	1	—	2	—	18.18
	IX.	5	3	1—4	2—26	1—12	60.0	—	—	—	—	—
	X.	2	—	—	—	—	—	—	—	—	—	—
Total		25	11	1—5	2—34	1—23	44.0	1	—	2	—	9.09
Aphodius sticticus Panz.	V.	25	—	—	—	—	—	—	—	—	—	—
	VI.	88	1	—	—	1	1.13	—	—	—	—	—
	VII.	43	—	—	—	—	—	—	—	—	—	—
	VIII.	56	2	—	1—3	—	3.57	—	—	—	—	
	IX.	22	—	—	—	—	—	—	—	—	—	—
Total		234	3	—	—	—	1.28	—	—	—	—	—
Intermediate hosts—total		492	119	1—15	1—211	1—134	24.18	32	1—5	2—21	2—14	6.56

Findings of first-stage larvae were very infrequent in these intermediate hosts. These larvae are characterized by a rounded cephalic end armed with two distinct hooks and 14—16 parallel rows of small hooks. The larvae move freely in the body cavity. The most frequent larval stage in these intermediate hosts was the second-stage larva. A typical sign of these larvae is their pointed cephalic end, the conical tail and the smooth cuticle. The larvae surrounded by a thin-walled cyst, are located in the gut. They emerge upon slightest pressure and then move freely. Third-stage larvae were found in the gut wall. They are coiled in thick-walled cysts which attain a diameter of 0.84—1.2 mm. The cephalic end with sharp dorsoventral elevations is encircled by external and internal papillae. The papillae of both circles are paired. On the outer circle the location of the papillae is subdorsal and subventral, on the inner circle subdorsal, subventral and lateral. The pointed tail was sometimes slightly enlarged at its tip. The cuticle was feebly transversely striated. The genital anlage measuring 0.016—0.024 × × 0.009—0.012 mm was at 1.4 to 1.68 mm from the anterior end of the body. The larvae were immobile; they emerged with difficulty from the cyst and, when liberated by pressure, they remained immobile (Fig. 1).

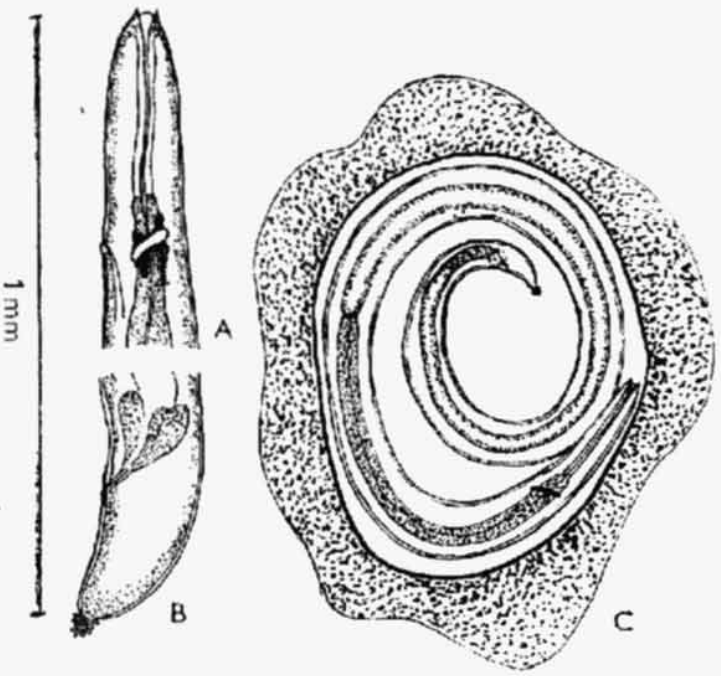

Fig. 1. *Ascarops strongylina* (Rud.). A — cephalic end of infective larva; B — tail end of infective larva; C — infective larva.

The three larval stages of *Physocephalus sexalatus* (Molin) were found only in beetles of the species *Geotrupes stercorarius L.* and *G. stercorosus, aberr. monticola* (Heer.). Their measurements are given in Table 1. We found only two first-stage larvae. Their cranial end armed with 15 rows of spines and one large spine placed in dorsal position, are typical signs of these larvae. Their movements were vivid. Second-stage larvae were of yellowish colour, their body was stout and cylindrical. They were immobile, coiled in thin-walled cysts. The enlarged tail end was armed with a spine. Around the anal opening there were small elevations of the cuticle. Third-stage larvae were coiled inside cysts with thicker walls. Their shape was spherical, their diameter 0.96—1.2 mm. Although these larvae resembled the larvae of *A. strongylina*, they could be distinguished from them by the typical enlargement of the tip of the tail bearing irregularly arranged minute spines. The larvae were of a feebly yellowish colour, the cuticle showed fine transverse striation. The gut contrasted from the larvae in its darker colour.

The incidence and intensity of infection with the larvae of both nematode species was studied in the coprophagous beetles from May till the end of September. The results are given in Table 2. While first-stage larvae of *A. strongylina* were found only occasionally, numerous second- and third-stage larvae were present continuously throughout our investigation. From July till the end of September, the incidence of second-stage larvae was higher than that of infective larvae. This indicates that the intermediate hosts had been infected in the late spring. On the other hand, the incidence of infective larvae was higher than that of second stage larvae in May and June, because these larvae had overwintered in their intermediate hosts. The number of larvae was consistent with

the postmortem findings in animals shot in the autumn. The most frequently infected beetle species were *Geotrupes stercorarius* (34.6 %), *G. stercorosus aberr. monticola* (44 %) and *G. vernalis* (37.0 %). In *Aphodius sticticus*, an ocassional larva only (1.28 %) was found.

The findings of *Physocephalus sexalatus* larvae were less numerous than those of the foregoing species. Of the three larval stages, the most numerous findings were those ofinfective larvae. The incidence of larvae was highest in the summer, from June onwards. In all instances, an infection with *Ph. sexalatus* was accompanied by an infection with *A. strongylina*, but the incidence of the former was lower. Our findings in the beetles were consistent with the incidence of infection in the hog established in postmortem

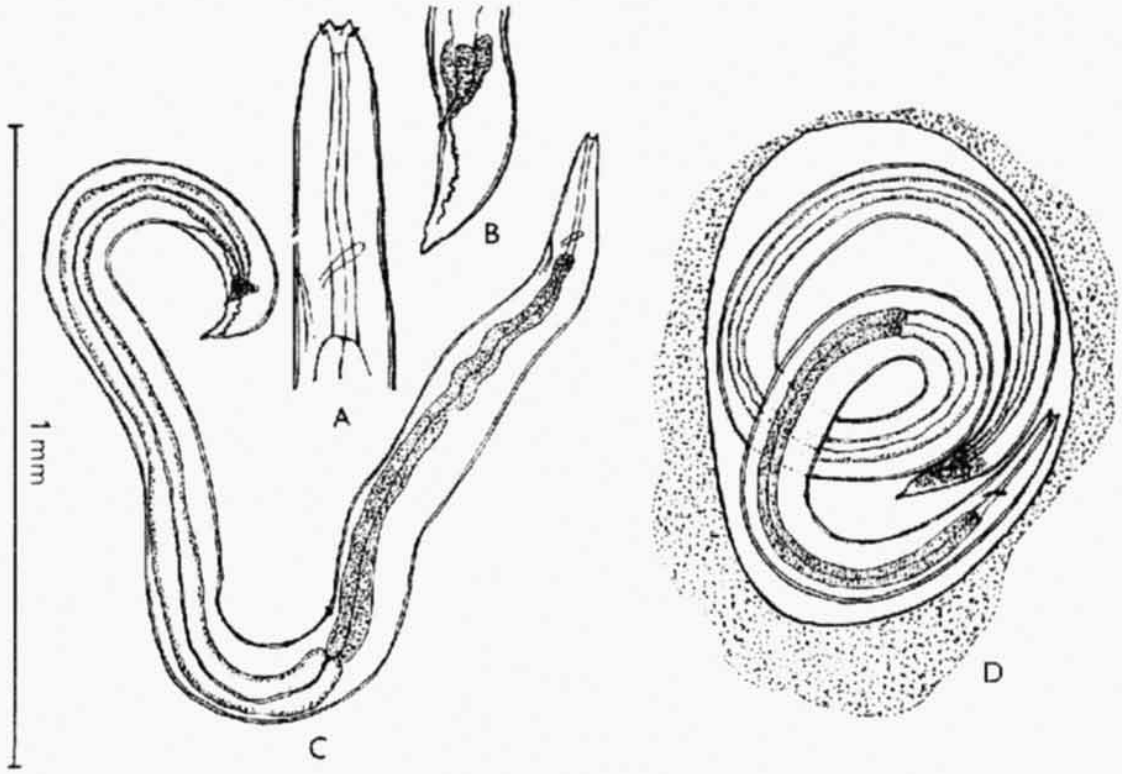

Fig. 2. *Physocephalus sexalatus* (Molin). A — cephalic end of infective larva; B — tail end of infective larva; C — infective larva inside the cyst; D — infective larva inside the cyst.

examination. The most frequently infected intermediate hosts were *Geotrupes stercorarius* (26.49%) and *G. stercorosus aberr. monticola* (9.09%).

Most of the beetles were obtained from the vicinity of two feeding troughs in a high forest with old tree stumps and wide open spaces among the trees, and from the area around a third feeding trough situated among young spruce with low branches. The first flight of the beetles was observed in May, because the winter of 1970 had been very long. From the end of June till July, the collection of beetles was difficult; in August, beetles were more readily available for collection, because a new population seemed to have hatched. At the end of the summer we collected the first *G. vernalis* L., but larval incidence in these beetles was less high than in *G. stercorarius*. Random collection of beetles in various other places of the reservation showed that the incidence of larvae in these intermediate hosts was the same everywhere in the reservation. No differences were observed in the rate of infection of male and female beetles. As regards distribution of both nematode species, a secondary role is played by some species of small coprophagous beetles (e.g. *Aphodius sticticus L.*), in which occasional larvae were found. Coprophagous beetles and their larvae are one of the components of food of the wild

hog and are ingested by them in large numbers. This fact was confirmed by inspection of the faeces of the juveniles, which contained undigestible chitinous remnants of the beetles' bodies.

DISCUSSION

Our measurements of larvae of the species *Ascarops strongylina* (Rud.) are consistent with those given by Shmytova (1961, 1962), T. del Valle and Baruš (1969), Fincher, Stewart and Davis (1969). The same applies to the larvae of *Physocephalus sexalatus* (Molin); their measurements and morphology are consistent with the data by Ryzhikov (1952), Ryzhikov and Nazarova (1959), T. del Valle and Baruš (1969) and Baruš, Moravec and Prokopič (1970). The latter authors described the finding of larvae of *Ph. sexalatus* in *Oeceptoma thoracica* L. and *Glomeris* sp. in Czechoslovakia. The larvae of *A. strongylina* and their intermediate hosts have not been described as yet in Czechoslovakia. Many references are available on the intermediate hosts of both nematode species in the literature and that mainly on beetles of the families Scarabeidae and Aphodidae (Roberman 1939 in Ryzhikov 1952, 1954, Ryzhikov and Nazarova 1959; Shmytova 1961, 1962 in the U.S.S.R.; Ono 1932 in Japan; Seurat 1913 in France; Hobmaier 1925 in Germany; Cram 1928, Alicata 1953, Fincher, Stewart and Davis 1969 in the U.S.A. and T. del Valle and Baruš 1969 in Cuba). The latter authors listed beetles of the family Tenebrionidae among the intermediate hosts of *Physocephalus sexalatus*.

According to Shmytova (1961), the speed of development of the larvae of *A. strongylina* in its intermediate host depends on the temperature of the external environment. At 25—29 °C, the development of the infective larva is completed in 25—27 days; at 8—3 °C, within 4 1/2 months. Alicata (1935) found infective larvae of *Ph. sexalatus* in the intermediate host on day 36 p.i. The phenomenon of reservoir parasitism has been observed in the larvae of both nematode species found in mammals, reptiles, amphibians, birds and fishes (Rhyzikov 1952, 1954; Ryzhikov and Nazarova 1959; Mozgovoy 1967). The larvae located in the various organs can be transmitted repeatedly from one animal to another before they infect their definitive host. All these well-known facts are important also for the wild hog populations in the reservation and participate in the maintenance of these nematode species and in their epizootology.

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ПРОМЕЖУТОЧНЫЕ ХОЗЯЕВА НЕМАТОД *ASCAROPS STRONGYLINA* (RUD.) И *PHYSOCEPHALUS SEXALATUS* (MOLIN) В ЧЕХИИ

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Резюме. Изучалось использование копрофагных жуков нематодами *Ascarops strongylina* (Rud.) и *Physocephalus sexalatus* (Molin) в качестве основных промежуточных хозяев. Наши наблюдения проводились в заповеднике Кветов, в котором популяции диких кабанов подкармливаются круглый год. Личинок нематоды *A. strongylina* находили в видах: *Geotrupes stercorarius* (84,6 %), *G. stercorosus, aberr. monticola* (Heer.) (44,0 %), в *G. vernalis* L. (37,0 %) и в *Aphodius sticticus* Panz. (1,28 %); личинки нематоды *P. sexalatus* находились в *G. stercorarius* L. (16,4 %) и в *G. stercorarius aberr. monticola* (Heer.) (9,09 %). Личинки первой и второй стадии зимуют в жуках. В летних месяцах эти промежуточные хозяева поражаются в большинстве случаев личинками второй стадии.

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