Original Article

Biological Features Of Some Species Of Filariata Parasites Of Birds Of Uzbekistan

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Abstract

This article presents original data on experimental studies of the life cycles of representatives of oviparous and viviparous filariates- *Aprocta cylindrica* Linstow, 1833, *Diplotriaena isabellina* Koroliowa, 1926, and *Ornithofilaria fallisensis* Anderson, 1954 at various stages of ontogenesis, the composition of their intermediate and final hosts of the bird fauna of Uzbekistan. At the same time, the ecological relationships in the system "definitive host - intermediate host - filaria", as well as the ways of their circulation in various biocenoses of Uzbekistan, were clarified.

As intermediate hosts of these filariates, parasitizing birds of Uzbekistan, we have registered representatives of arthropods, belonging mainly to the orders of Erect (Orthoptera) and Diptera (Diptera). It is quite obvious that the development of any preventive measures can only be based on a detailed knowledge of the biological characteristics of both the parasite and the host that ensure their contact in the external environment.

Keywords: Fauna, helminth, intermediate hosts, definitive hosts, circulation, biocenosis, ecosystem, filariates, microfilariates, birds.

1 INTRODUCTION

The overwhelming majority of species of this suborder are parasites in birds of various ecological groups. Undoubtedly, they cause serious damage to organs and systems of domestic and wild game birds - inhabitants of land and water qualifications.

The bird fauna of Uzbekistan is very diverse. According to E. Shernazarov et al. [1], 441 bird species are registered in the country, some of them nest on the territory of the republic or are found only on flights. At present, the number of bird species on the territory of the republic has increased to 462. The diversity of the species composition of birds is determined by the presence on its territory of a large number, sharply differing in their ecological characteristics of their habitats. As you know, these are landscape zones - deserts, semi-deserts, foothills, mountains and river valleys. Each of these zones has a characteristic avifauna, which, to a certain extent, is infested by helminths. Among them, as studies have shown, the class of roundworms, Nematoda, is widely represented, including filariates of various systematic groups. In this regard, the study of the life cycles of filariae of the families Aproctidae and Diplotriaenidae is of considerable interest, which are widely represented in wild game birds of Uzbekistan.

Purpose Of The Research.

The purpose of this study is to study the biological characteristics of the dominant species of bird parasites - nematodes of the suborder Filariata - *Aprocta cylindrica* (Linstow, 1883), *Diplotriaena isabellina* (Koroliowa, 1926), and *Ornithofilaria fallisensis* (Anderson, 1954) in Uzbekistan.

2 RESEARCH METHODS

In order to identify the circle of intermediate hosts of the dominant species of bird filarias participating in the functioning of the parasite-host system, during 2009-2014. collection of materials was carried out in various biocenoses of Uzbekistan. At the same time, in places of concentration of birds (domestic and wild), about 14 thousand specimens were collected and studied. Orthoptera and Diptera insects (Table. 1).

Table - 1. Insects - intermediate hosts of filariae of birds of Uzbekistan

Insects	Opened, specimen	Infested with parasite larvae		
		Number	%	Type of filaria
Orthoptera order - Orthoptera Locust family - Acrididae:				
Calliptamus turanicus	1050	26	2.5	Aprocta sp.
Dociostaurus kraussi	1610	65	4.0	Aprocta sp.
Bryodema tuberculatum	2600	81	3.1	Diplotriaena isabellina
Aiolopus oxianus	1701	21	1.2	
Diptera order - Diptera Midges family - Simulidae:				
Simulium vulgare	3156	38	1.2	Ornithofilaria sp.
S. multistriatum	1143	11	1.0	
Ceratopogonidae family - Ceratopogonidae:				
Culicoides desertorium	702	9	1.3	Ornithofilaria sp.
Family of Mosquitoes - Culicidae:				
Culex modertus	751	7	0.9	Paronchocerca sp.
Aedes caspius	1025	17	1.6	

To collect insects, we used the usual entomological methods [2,3]. Dissection of insects and determination of larvae was carried out according to the method of G. S. Nelsona. [4,5,6].

The detected nematode larvae were fixed in 1.5-2.0% formalin. Most of the larvae found were examined alive. The larvae were placed on a glass slide in a drop of saline and brought to a stationary state by light heating over an alcohol lamp, then covered with a cover glass and examined under a microscope. Invasive larvae (larvae of the 3rd stage) from naturally infected insects - Orthoptera and Diptera, served as material for reproducing the life cycles of the dominant species of filariatus birds.

Sterile poultry was used for experimental infection with invasive filarial larvae. Experimental and control animals were kept under conditions excluding natural infestation by filarial larvae.

3 RESULTS

Aprocta cylindrica Linstow, 1883. Nematodes of this species parasitize in the eye and nasal cavities of birds. This species was found in many regions of Uzbekistan in the field pipit, the common oriole, the Spanish, mountain, desert wheatear, the common redstart, the southern nightingale, and varkushka (order Passeriformes).

The life cycles of representatives of the genus *Aprocta* and the family *Aproctidae* in general have not been deciphered. The main work on deciphering the biological cycle of A. cylindrica is the attempt by Quentin et al. [7] experimental infestation of Locusta migratoria with eggs of the parasite from weavers - Ploceidae (*Quelea quelea, Ploceus capitalis, P. cucullatus and Euplectes orix*) in Africa. The authors found that the developing larvae were in the locust hemocele. They observed the development of the larva in the body of the intermediate host, where 2 molts proceeded for 6 - 11 days at a temperature of 280C. After 15 days, the length of the larva reached 408 µm.

In the process of collecting biological material in the areas of Tashkent, Syrdarya and Jizzakh regions of Uzbekistan, we found larvae of filariates in various stages of development from representatives of locusts (*Acrididae*). Among them were invasive third stage larvae. Larvae were observed in the following locust species: *Calliptomus turanicus* (EI - 2.2%), *Dociostaurus kraussi* (EI - 4.0%), *Locusta migratoria* (EI - 3.9%) with an invasion rate of 5 - 11 ind. The larvae were in the hemocele and fatty body, surrounded by a thin, transparent membrane (cyst).

The body of invasive larvae is cylindrical, 0.462 - 0.508 mm long, 0.040 - 0.046 mm wide. It narrows significantly towards the front and rear ends. The cuticle is transversely striated. The body of the larva, in particular the intestines, is abundantly filled with granular bodies. Invasive larvae from each locust species were fed to experimental chicks of the house sparrow *Passer domesticus* (Linnaeus, 1758). Three chicks were used for the experiment, each of them was infected with 34–37 invasive larvae (Table 2). Experimental infection of chicks was carried out in June - July 2012. The chicks were opened 25, 35, 45 days after infection in order to establish the development of larvae to mature forms in the organism of the definitive host.

As shown by the results of our research, 25 - 35 days after infection in the nasal cavity of experimental chicks No. 1, 2, developing juvenile forms of male and female nematodes were found, in which the genitals were clearly visible. On the 45th day, chick No. 3 also found mature nematodes in the nasal cavity: 5 males and 11 females.

Table - 2.Experimental infection of birds with invasive larvae *Aprocta cylindrica* Linstow, 1883, isolated from the locust of Uzbekistan

Chicks	Calliptomus turanicus	Dociostaurus kraussi	Locusta migratoria	Time of research (days) after infection
	Number of larvae			
Passer domesticus				
№1	34	-	-	25
№2	-	36	-	35
№3	-	-	37	45

The morphological parameters of males and females were in full agreement with the characters of mature worms *Aprocta cylindrica*, found by us in a number of passerine species and in the literature [8]. At the same time, a significant number of laid eggs with thick shells were also found in the nasal cavity. Egg sizes ranged from 0.042-0.056x0.040 mm, 0.046-0.058x0.028-0.036 mm. Morphometric data of *A. cylindrica* are presented in table. 3, figure 1.

Table - 3. Dimensions A. cylindrica Linstow, 1883 from experimental infected birds (n - 15 males and 15 females)

Signs	House sparrow, mm		
	lim	M±m	Cv
Males:			
Body Length	14.1-16.6	15.472±0.225	5.64
Body width	0.44-0.52	0.48±0.007	5.86
Esophageal length	0.65-0.96	0.80±0.025	12.31
Distance to the nerve end	0.14-0.18	0.160±0.003	7.87
Tail length	0.12-0.20	0.16±0.006	14.48
Spicule length I	0.28-0.32	0.30±0.004	4.88
Spicule length II	0.24-0.26	0.25±0.002	2.83
Females:			
Body Length	26.0-36.0	31.29±0.866	10.71
Body width	0.44-0.90	0.62±0.042	26.04
Esophageal length	0.98-1.02	0.99±0.003	1.13
Distance to the nerve end	0.12-0.26	0.19±0.012	23.53
Distance to the vulva (from the head end)	0.44-0.76	0.59±0.029	19.50
Egg sizes: length width	0.040-0.046 x 0.028-0.036	0.04±0.001 x 0.04±0.001	4.07x8.71

Thus, in the process of development of larvae in the organism of the vertebrate host, a further increase in the length and width of the body occurs, and the growth rates at this stage are different in males and females. There is an intensive development of the reproductive system in both sexes. On the 45th day after infection, almost all organs and systems of the filariae of the species under consideration were fully formed, and, probably, they begin to mate. This may be evidenced by laid eggs found in the lumen and tissues of the nasal cavity of infected birds.

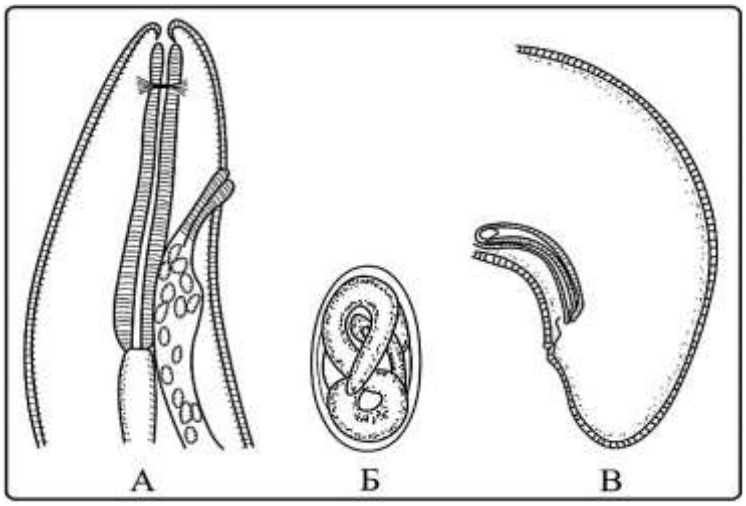

Рис. 1. *Aprocta cylindrica* Linstow, 1883: A - anterior end of the female; B-the egg; C-the tail end of the female.

Summarizing the presented materials on the biology of *A. cylindrica*, the following can be noted. The eggs of the parasite, released by the final host into the external environment, contain the larva of the first stage. In the external environment, the development of the larva in the egg does not occur. The egg is swallowed by the intermediate host. The role of the latter is played by locusts. In their body, the larva molts twice, after which it reaches an invasive state. Infection of a definitive host occurs as a result of eating an intermediate containing invasive larvae.

In the body of the final host, the larvae, migrating, reach the nasal cavity and the orbit of the bird's eyes, developing, reaching a mature state.
The results of the conducted studies allow us to note a number of locust species (*C. turanicus, D. kraussi and L. migratoria*) as intermediate hosts of *A. cylindrica* under the conditions of Uzbekistan. Their invasiveness is quite high. The ecological relations of birds with locusts in the natural conditions of Uzbekistan contribute to the formation of the parasitic system "filaria - locust - birds".

Taking into account the literature data and our own research, it is possible to point out the range of definitive hosts considered by filariae of the genus *Aprocta* in the biocenoses of Uzbekistan. Certain bird species of the order Passerine, Goat-like, Crane-like and Cuckoo-like birds turned out to be the final hosts of the genus Aprocta.

4 DISCUSSION

***Diplotriaena isabellina* Koroliowa, 1926.** The genus Diplotriaena Skrjabin, 1915 includes 62 species of the world fauna, parasitizing in the air sacs, lungs and body cavities of birds of various orders, mainly in passerines. Twelve species of this genus have been recorded in birds of Uzbekistan.

Diplotriaena isabellina is one of the most common diplotriena species and is a parasite of many passerine birds. This species has also been noted in chickens - the gray partridge (Perdix perdix (Linnaeus, 1758) and the bearded partridge (Perdix dauuricae (Pallas, 1811)). The main work on deciphering the life cycle was carried out by Anderson [9]. He found that the main intermediate hosts of the parasite are Orthoptera (genus Melanoplus and Camnula from the family Acrididae) In their body, a larva emerging from a swallowed egg develops to the invasive stage, undergoing a two-fold molt.

Dates of development of *D. isabellina* in the organism of an intermediate host (*Melanoplus bilituratus, M. fusciatus, Camnula pellucida*): the larva molts for the first time on the 9th - 11th day after swallowing the egg, the second time - on the 14th - 16th day; experimental birds (*Hylocichla fuscescens, H. ustulata* from the thrush family - Turdidae) were dissected 55 and 301 days after feeding them the larvae. Only immature specimens of nematodes were found in them.
According to this scheme, the biological cycle is likely to be carried out in other species of the genus, which are localized in organs that communicate with the external environment (air sacs, orbital cavities, nasal cavities, etc.). This point of view can be confirmed by data obtained by a number of authors [10, 11], who also established diplotriene (*D. agelaeus, D. tricuspis, D. tridens, D. bargusinica*) representatives of locusts (*Camnula pellucid, Melanoplus bilituratus, M. fusciatus, M. sanguinipes, Locusta migratoria, Schistocerca gregaria*).

It should be noted that the locust *Bryodema tuberculatum* was established as an intermediate host of *D. isabellina* in the foothill zone of the Tashkent region by Kabilov [12]. Its infection with larvae of this species of filaria was 3.9%. During the study of locusts on the territory of Jizzakh, Syrdarya, Tashkent regions, we also identified larvae of nematodes of the genus *Diplotriena. Filaria* larvae at various stages of development were recorded in the summer of 2009–2014. in the following locust species: *Bryodema tuberculatum* (3.1%), *Aiolopus oxianus* (1.2%), *Melanoplus frigidis* (4.2%). With a sufficiently high extent of invasion, the intensity in some locust species was from 3 to 7 specimens. The larvae were found in the fat body, surrounded by a thin membrane (cyst).

The body of the invasive larva is cylindrical. Their sizes are significantly variable. Length 0.528 - 0.641 mm, with a maximum width of 0.042 - 0.048 mm. It narrows sharply towards the front and rear ends. From the anterior end of the body to the nerve ring 0.057 - 0.060 mm, to the excretory foramen 0.076 - 0.080 mm. The esophagus consists of two sections. The muscular part of the esophagus is short - 0.074 - 0.076 mm, glandular - 0.460 - 0.464 mm, length. The apex of the tail is 0.038 - 0.040 mm distant from the anus. Cuticle with fine cross-striation. The body of the larva is filled with granular bodies (Fig. 2).

Thus, the range of intermediate hosts, taking into account our data, has significantly expanded and includes 6 species of locusts. To clarify the possibility of further development of the discovered larvae of filariae in the organism of a definitive host, we tried to infect chicks of chickens and passerine birds with them. The experiments were carried out on three quails (*Coturnix coturnix* (Linnaeus, 1758), three chukots (*Alectoris chucar* (Gray, 1830) and three mynae (*Acridotheres tristis* (Linnaeus, 1758)) in June - August 2010 - 2012. At the same time, invasive larvae from of each locust species: *B. tuberculatum, A. oxianus, M. frigidis* were fed to individual specimens of experimental chicks.

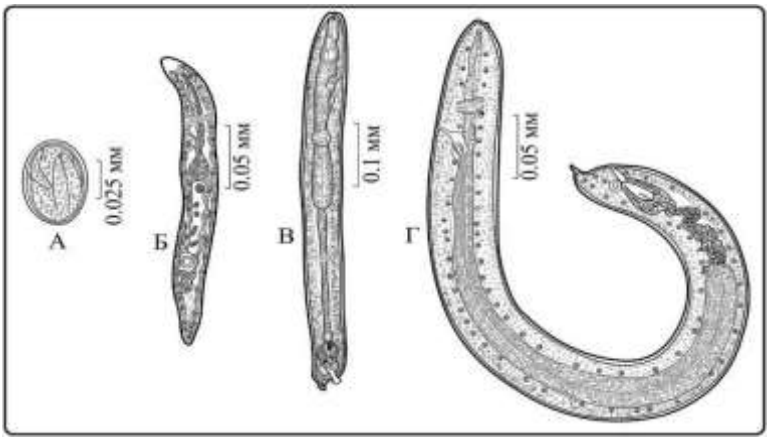

Рис. 2. ***Diplotriaena isabellina*** **Koroliowa, 1926:** A - an egg with a larva; B - larva of stage I; C - stage II larva; D - larva of the III stage in the intermediate host.

A total of 9 chicks were used, each of them was assigned 35 - 45 invasive larvae (Table 4.).

Table - 4. Experimental infection of birds with invasive larvae *Diplotriaena isabellina* Koroliowa, 1926, isolated from the locust of Uzbekistan

Chicks	Number of larvae			Time of research (days) after infection
	Bryodema tuberculatum	Aiolopus oxianus	Melanoplus frigidis	
I. Coturnix coturnix (quail):				
№1	35	-	-	35
№2	-	33	-	45
№3	-	-	45	55
II. Alectoris chucar (partridge):				
№1	43	-	-	40
№2	-	34	-	55
№3	-	-	39	75
III. Acridotheres tristis (mynah):				
№1	34	-	-	45
№2	-	41	-	55
№3	-	-	44	65

Table - 5. Dimensions of Diplotriaena isabellina from experimentally infected birds (n-15 males and females, mm)

Признак	From partridge							From mynah					
	males				females			males			females		
	n	lim	M±m	Cv	lim	M±m	Cv	lim	M±m	Cv	lim	M±m	Cv
Body Length	15	28-32	30.1±0.34	4.34	34-52	42,1±1.51	13.9	33-58	43.7±2.07	18.4	36-62	49.9±2.39	18.5
Maximum width	15	0.64-0.80	0.71±0.01	7.20	0.68-0.90	0.79±0.02	9.42	0.68-0.82	0.75±0.01	5.80	0.90-0.94	0.92±0.003	1.54
Total length of the esophagus	15	2.04-3.88	2.98±0.15	19.7	2.56-4.55	3.53±0.18	19.8	2.86-4.60	3.65±0.17	18.1	3.50-4.90	4.27±0.13	11.8
The length of the muscular part of the esophagus	15	0.38-0.46	0.42±0.01	7.20	0.38-0.47	0.42±0.01	6.88	0.40-0.47	0.44±0.01	5.22	0.39-0.48	0.43±0.01	6.74
Length of the glandular part of the esophagus	15	2.66 - 3.30	3.01±0.06	8.34	2.78 - 3.80	3.20±0.09	10.8	2.77 - 4.00	3.27±0.16	13.7	2.86 - 4.50	3.61±0.16	17.6
Distance to the nerve ring	15	0.222 - 0.276	0.25±0.004	7.15	0.266 - 0.280	0.27±0.001	1.74	0.278 - 0.286	0.28±0.0006	0.89	0.280 - 0.290	0.28±0.001	1.61
Distance to the vulva	15	-	-	-	0.47 - 0.56	0.52±0.007	5.59	-	-	-	0.46 - 0.58	0.51±0.009	6.46
Length of tridents	15	0.115 - 0.118	0,116±0.0002	0.87	0.120 - 0.130	0.13±0.0008	2.55	0.128 - 0.510	0.33±0.05	40.9	0.131- 0.140	0.14±0.0007	2.05
Spicule length: left right	15	0.644 - 0.658 0.452 - 0.462	0.61±0.04 0.46±0.001	24.7 0.73	- -	-	-	0.656 - 0.720 0.450 - 0.460	0.69±0.005 0.45±0.0008	3.07 0.69	- -	-	-
Egg sizes	15	-	-	-	0.050 - 0.052 x 0.032 - 0.034	0.05±0.0001 x 0.03±0.0002	1.08 x1.90	-	-	-	0.052 -0.054 x 0.032 -0.034	0.053±0.0002 x 0.033±0.0002	1.18 x 1.90

Investigation of experimentally infected birds (quails, partridges and mynahs) with invasive larvae of the nematode *D. isabellina* obtained the following results. The birds were opened at intervals of 35 - 65 days after infection.

Among the total mass of nematodes, there were single specimens of both males and females, the sizes of which corresponded to mature parasites. The length of males reached 19 - 23 mm, females - 28 - 35 mm. As shown by the autopsies of experimental birds - mynahs No. 3 and partridges No. 3, most of the detected parasites were mature.

In the air sac of the mynahs, 8 males and 13 females were found, and in the partridges - 7 ♂ and 11 ♀. Morphological features of mature forms of *D. isabellina* isolated from experimental birds are presented in Table 5.

Thus, during the development of the larvae in the organism of the final host, an increase in body length occurs, the formation of genital organs in both males and females.

Materials of morphometric indicators of *D. isabellina* practically correspond to the data of previous researchers [13]. Slight differences in the size of individual organs are likely to depend on the physiological state of the host birds and the geographic zone.

In general, the scheme of the biological development cycle of the nematode under consideration corresponds to the known data with the only difference that we note new locust species as intermediate hosts of *D. isabellina*. The timing of the development of the parasite in the organism of definitive hosts (quail, partridge, and myna) was much faster than in Anderson's experiments [9].

Summarizing the data of our own research and literature, it can be noted that the nematode *D. isabellina* parasitizes in the air sacs of many passerine species and other ecological groups of birds. The females lay eggs containing the larva. Eggs, through the respiratory tube, enter the digestive tract of the bird and are thrown into the external environment with feces. The role of intermediate hosts is played by locust genera (*Melanoplus, Camnula, Bryodema, Aiolopus*), possibly other representatives. In their body, the larva, which emerged from the swallowed egg, develops to the invasive stage, while undergoing a double molt.

Invasive larvae, 3rd stage larvae, as a rule, are localized in the adipose body or hemocele of locusts. Bird infection occurs when it eats intermediate hosts. In the body of a bird, the larvae migrate, enter the cavity of the air sac and develop into adult worms.

Thus, we have experimentally managed to determine the range of intermediate hosts of the nematode *D. isabellina* and infect some bird species of the orders of chickens and passerines in Uzbekistan. The development of the larva to the sexually mature stage in the body of birds - hosts continues for 65 - 75 days.

The circulation of invasions in the natural conditions of Uzbekistan occurs according to the scheme: "Filaria - intermediate host - definitive host" (Fig. 3).

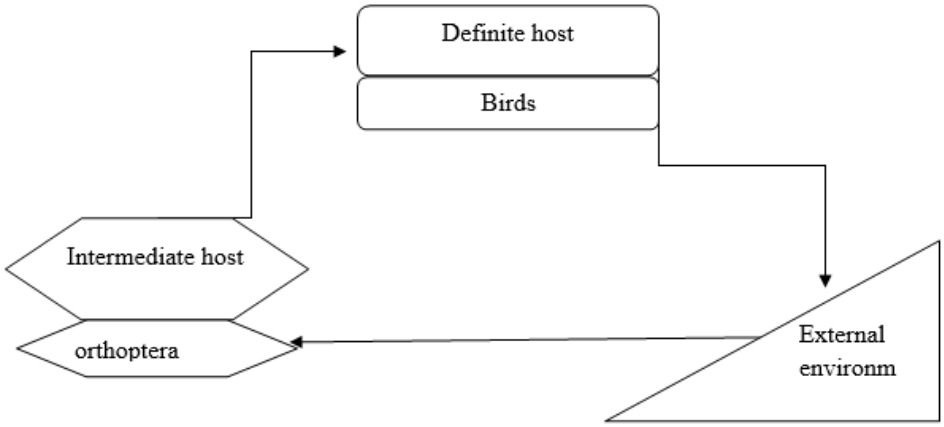

Fig. 3. Circulation diagram of Diplotriaena isabellina Koroliova, 1926 (original).

Ornithofilaria fallisensis Anderson, 1954. The biological development cycle of *Ornithofilaria fallisensis* was studied by Anderson [14]. He registered as intermediate hosts of this species in Canada - midges of the genus Simulium: *S. venustum, S. parnasum, S. ruglessi, S. euryadminiculum, S. croxtoni and S. latipes.*

Invasive larvae isolated from experimentally infected midges were introduced under the skin of experimental ducklings (*Anas plathyrinchos* Linnaeus, 1758 dom.). In the blood of experimental ducklings, microfilariae *O. fallisensis* were found on the 30th - 36th day after inoculation of the larvae. When the birds were dissected, sexually mature parasites were found.

In birds, 11 species of the genus Ornithofilaria are parasites [15]. Three of them are registered in different regions of Uzbekistan (*Ornithofilaria skrjabini, O. mavis, O. papillocerca*). They mainly parasitize in the hearts, joints of the legs and subcutaneous tissue of the hobby, merlin, pheasant and gray partridge.

During the study of blood-sucking dipterans of the North-East of Uzbekistan (2009 - 2013) in the natural conditions of the Syrdarya, Tashkent and Jizzakh regions, midges and biting midges infected with larvae (microfilariae) of filaria were caught in places where birds were concentrated. Midges of the genus Simulium: *S. vulgare* (1.2%), *S. multistriatum* (1.0%) and biting midges of the genus Culicoides: *C. desertorium* (1.3%) were infected with the larvae of the nematode *O. fallisensis*.

The larvae found in midges and biting midges were at various stages of development. The dimensions of the found microfilariae: length 0.190 - 0.121 mm with a width of 0.0056 mm; 2nd stage larvae measured 0.252 - 0.260 mm in length and 0.0046 mm in width. The dimensions of the third-stage invasive larvae extracted from midges and biting midges: length 0.380 - 0.456 mm, maximum width 0.0020 - 0.0022 mm. The sizes of the considered larvae practically correspond to the sizes of the larvae of the filariae *O. fallisensis* given in the work of Anderson [14].

To confirm the participation of midges *S. vulgare, S. multistriatum*, and biting midges *C. desertorium* in the life cycle of *O. fallisensis*, we experimentally infected ducklings with invasive larvae isolated from the noted blood-sucking insects (Table 6).

Table - 6. Experimental infection of birds with *Ornithofilaria fallisensis* larvae, isolated from midges and biting midges in Uzbekistan

Chicks	Simulium vulgare	Simulium multistriatum	Culicoides desertorium	Time of research after infection (days)
	The number of larvae, approximately			
Anas plathyrinchos dom.				
№1	110	-	-	25
№2	-	120	-	28
№3	-	-	115	33
№4	Mixed larvae from three hosts			
	-	-	130	35

The experiments were carried out in June - July 2011. The ducklings were infected by inoculating the larvae under the skin in the neck in appropriate doses.

Experimental ducklings were examined 25, 28, 33 and 35 days after inoculation of nematode larvae. During the study on the 25th day, the filariae of males and females were found in the subcutaneous tissue, but they had not yet reached puberty. Studies on the 28th and 33rd day established that the nematodes were found mainly in the subcutaneous tissue of the head and neck of the bird. Found males and females are quite mature. Many microfilariae are noted in the uterus and vagina.

Table - 7. Dimensions of *Ornithofilaria fallisensis* from domestic duck (n - 15 males, females and microfilariae each, mm)

Sign	Males			Females		
	lim	M±m	Cv	lim	M±m	Cv
Body length	10 - 16	13.2±0.44	12.7	26 - 40	33±1.15	13.6
Body width	0.052 – 0.062	0.06±0.0008	5.49	0.073 – 0.090	0.082±0.001	7.09
Esophagus length	0.36 – 0.58	0.46±0.019	16.4	0.38 – 0.60	0.496±0.017	13.54
Distance to the nerve ring	0.092 – 0.140	0.16±0.005	16.5	0.076 – 0.140	0.11±0.006	22.9
Spicule length: Right Left	0.052 – 0.072 0.072 – 0.090	0.06±0.002 0.08±0.080	11.1 7.85	- -	- -	- -
Distance to the vulva	-	-	-	0.20 – 0.37	0.30±0.013	16.5
Sizes of eggs with microfilariae	-	-	-	0.019 – 0.025x 0.016 – 0.018	0.022±0.0005x 0.017±0.0002	8.95x3.95
Sizes of microfilariae	-	-	-	0.090 – 0.121	0.106±0.0027	10.05

Microfilariae are also found in blood smears of birds. Similar results were obtained when the birds were dissected on the 35th day after infection (Table 7, Fig. 4).

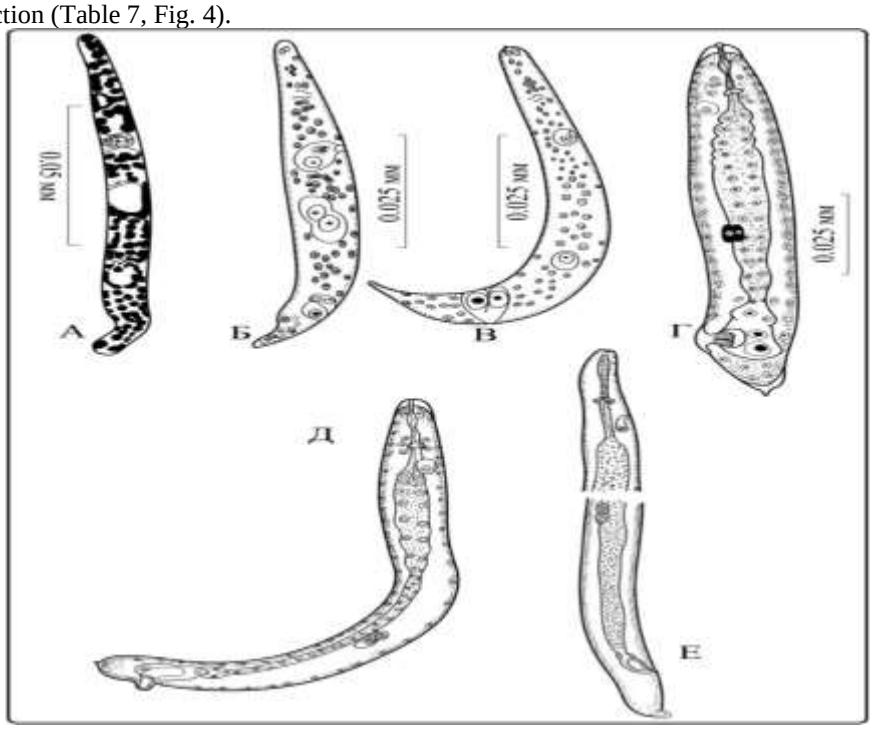

Fig. 4. *Ornithofilaria fallisensis* Anderson, 1954: A - microfilaria; B - D - stages of development in the intermediate host; E - invasive larva.

According to this scheme, the biological cycle is carried out in viviparous groups of filarias. In a specific case, the nematodes *O. fallisensis* parasitize the subcutaneous tissue of ducks. The female secretes microfilariae, which enter the bloodstream.

Intermediate hosts are midges of the genus *Simulium* and biting midges *Culicoides*. These bloodsuckers attack birds to feed on its blood. Along with the blood of birds, intermediate hosts (midges and biting midges) swallow microfilariae. In the body of midges and biting midges, microfilariae grow, molt twice and turn into larvae of the invasive stage for the final host. With the repeated bite of a bird, midges containing invasive larvae infect them with a parasite. Further development of the parasite to puberty occurs already in the body of birds.

Thus, we have experimentally reproduced the biological cycle of filariae *O. fallisensis*, the main stages of development and their morphology coincide with the known data of Anderson, with the only difference that new intermediate hosts (species of the genera *Simulium* and *Culicoides*) have been established under the conditions of Uzbekistan. The development of this nematode in the organism of a definitive host (domestic ducks) occurs within 28 - 33 days, which is much shorter than according to Anderson [14].

5 CONCLUSION

The developmental cycles of bird filariae are quite sharply different and can be characterized as two types. These differences are likely to be in direct proportion to the localization of mature filariae in the organs and systems of birds. In some groups of species, females are viviparous, which lay larvae (microfilariae), their intermediate hosts are blood-sucking dipterans. Infection with invasive larvae of the final hosts occurs when bitten by bloodsuckers - vectors. According to this scheme, the biological cycle will be carried out in those types of filarias that are localized in organs that have no communication with the external environment, i.e. in closed body cavities.

In other groups of species, females are oviparous, their intermediate hosts are herbivorous and saprophytogous orthoptera, the infection of a bird occurs by eating invaded insects - intermediate hosts. According to this scheme, the life cycle will be carried out in those species of bird filarias that are localized in organs that communicate with the external environment (air sacs, orbital cavities, nasal cavities, etc.). Females of these species lay eggs in the lumen of organs, which in one way or another go out into the external environment, such as *Aprocta cylindrica* and *Diplotriaena isabellina.*

Consequently, the article presents original data on the biological characteristics of filarial species - *Aprocta cylindrica* Linstow, 1833, *Diplotriaena isabellina* Koroliowa, 1926, and *Ornithofilaria fallisensis* Anderson, 1954 - parasites of birds, their intermediate and final hosts in biocenoses of Uzbekistan. At the same time, we have identified locust species as *C. turanicus, D. kraussi* and *L. migratoria* as intermediate hosts of *Aprocta cylindrica*.

Taking into account the literature data and our own research, the circle of definitive hosts of *Aprocta cylindrica* in the biocenoses of Uzbekistan turned out to be certain species of birds of the order Passerine, Goat-like, Crane-like and Cuckoo-like.

Diplotriaena isabellina Koroliowa, 1926 - parasitizes in the air sacs, lungs and body cavities of birds of various orders, mainly in passerines and chickens. When studying locusts in the territory of Jizzakh, Syrdarya, and Tashkent regions of Uzbekistan, we found larvae of nematodes of the genus *Diplotriena* in the following locust species: *Bryodema tuberculatum* (3.1%), *Aiolopus oxianus* (1.2%), *Melanoplus frigidis* (4.2%).

In the conditions of Uzbekistan, three species of *Ornithofilaria* (*Ornithofilaria skrjabini, O. mavis, O. papillocerca*) parasitize in the hearts, joints of the legs and subcutaneous tissues of the hobby falcon, merlin, pheasant and gray partridges. During the study of blood-sucking dipterans of the North-East of Uzbekistan (2009 - 2013) in the natural conditions of the Syrdarya, Tashkent and Jizzakh regions, midges and biting midges infected with larvae (microfilariae) of filaria were caught in places where birds were concentrated. Midges of the genus *Simulium: S. vulgare* (1.2%), *S. multistriatum* (1.0%) and biting midges of the genus *Culicoides: C. desertorium* (1.3%) were infected with the larvae of the nematode *O. fallisensis*.

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