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NEMATODES OF THE EURASIAN WIGEON (*ANAS PENELOPE*) AND THE COMMON TEAL (*A. CRECCA*) IN NORTHWESTERN RUSSIA

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Nematode fauna of two duck species, the Eurasian wigeon, *Anas penelope* Linnaeus, 1758, and the common teal *A. crecca* Linnaeus, 1758, breeding at Lake Ladoga (Republic of Karelia, Russia) was studied. The examined birds hosted 9 nematode species: 6 were revealed in the wigeon, and 7, in the teal. Life cycles of these species are either direct or involve intermediate hosts. The teal's species composition of nematodes differed depending on whether the bird was taken in autumn or spring. The species *Poroccaecum crassum* Deslongchamps, 1824 was identified in the ducks of Karelia for the first time. Nematodes were carried over from the birds' wintering grounds and were not found in the birds surveyed in Karelia in autumn. Most likely the species cannot continue their development in Karelia because their intermediate hosts are absent in the local fauna.
Key words: Anatidae, Eurasian wigeon, common teal, nematodes, Lake Ladoga.

НЕМАТОДЫ СВИЯЗИ (*ANAS PENELOPE*) И ЧИРКА-СВИСТУНКА (*A. CRECCA*) СЕВЕРО-ЗАПАДА РОССИИ

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Исследована фауна нематод двух массовых видов уток — свиязи *Anas penelope* Linnaeus, 1758 и чирка-свистунка *A. crecca* Linnaeus, 1758, гнездящихся в акватории Ладожского озера (Республика Карелия, Российская Федерация). У исследованных уток было обнаружено 9 видов нематод: у свиязи — 6, у чирка — 7. Среди обнаруженных нематод найдены виды, жизненные циклы которых реализуются с участием промежуточных хозяев, а также те, что имеют прямой путь развития. Впервые у уток в Карелии отмечен вид *Poroccaecum crassum* Deslongchamps, 1824. Этот вид зареги-

стрирован у птиц только весной. Он занесен утками с мест зимовки и, по-видимому, не способен развиваться из-за отсутствия в местной фауне промежуточных хозяев. Установлены различия видового состава нематод чирка-свистунка, добытых в осенний и весенний периоды.

Ключевые слова: утиные, свиязь, чирок-свистунок, нематоды, Ладожское озеро.

Lake Ladoga is the largest water body in Europe, being located on the East-Atlantic flyway. Numerous lakes and wetlands in the Ladoga drainage basin favor seasonal stopover and breeding of many waterfowl species. Among them the anatids is the most abundant and diverse group. Together with many duck species breeding in Karelia, this group includes the wigeon and the teal (Zimin et al., 1993).

Great numbers of wigeons overwinter in the Netherlands, forming the European core of the population, which includes Denmark, Germany, Belgium, Great Britain and Ireland (Wetlands..., 2006). The main stopover areas for migrating wigeons on the East—Atlantic flyway include the Lake Ladoga coast and eastern Gulf of Finland, where, according to Buzun (2005), up to a half million of these ducks are recorded annually. The wigeon forages mainly on plants. Seeds are of secondary significance, but their contribution may increase in some seasons. Animal food may be swallowed only accidentally with plants (Zimin, Ivanter, 2002).

The teal in Europe occurs mostly to the latitude 45 °N. Wintering grounds are located in the southern part of the range, down to the Mediterranean and Central Africa (Scott, Rose, 1996). Teals have a mixed diet, with animal foods prevailing in spring and summer, and plant food in autumn and winter (Zimin, Ivanter, 2002). Animal food includes mollusks, worms, insects, and crustaceans; plant food includes seeds of aquatic plants, herbs, sedges, and cereals (including bread grains and rice).

Parasites are markers of bird migration pathways and feeding habits, and therefore need to be researched. Helminthes of Anatidae living on Lake Ladoga have been partially studied (Yakovleva et al., 2013; Lebedeva et al., 2015). Yet, information on the nematode fauna of wigeon and teal in Karelia had so far been missing. This study is meant to fill in this gap.

MATERIALS AND METHODS

The material for the study included birds taken from Lake Ladoga coast (61° 12′ N, 32°54′ E) during spring and autumn hunting seasons in 2011—2015. Nematode infection was studied in 11 wigeons and 22 teals (see table).

The parasitological study was conducted according to Dubinina (1971). Gastrointestinal tracts were extracted as a whole and then divided into nine anatomical sections (the esophagus, proventriculus, gizzard, jejunum, ileum, rectum, cecum, and cloaca with bursa of Fabricius). Helminths were acquired from each section. The isolated parasites were fixed and stored in 70 % ethanol. Prior to microscopic examination, nematodes were cleared in 80 % lactic acid and mounted in glycerin (Dubinina, 1971). The nematodes were identified based on keys and numerous original descriptions (Baruš et al., 1978; Sonin, Baruš, 1996; Anderson, 2000; Borgsteede et al., 2006; Stapf et al., 2013).

Nematodes in the Eurasian wigeon and the common teal from Northern Europe

Host species	*Anas penelope* (Eurasian wigeon) Autumn (n = 11)			*Anas crecca* (common teal) Autumn (n = 12)			*Anas crecca* (common teal) Spring (n = 10)		
Nematode species	Prevalence,* %	Mean abundance*	Intensity (min—max)	Prevalence,* %	Mean abundance*	Intensity (min—max)	Prevalence,* %	Mean abundance*	Intensity (min—max)
Capillaria anatis (Schrank, 1790)	18	0.25	1—2	17	1.8	1—21	—	—	—
Pseudocapillaria mergi (Madsen, 1945)	—	—	—	—	—	—	10	0.1	(1)
Eucoleus contortus (Creplin, 1839)	—	—	—	33	1.42	3—11	30	0.5	1—3
Amidostomum acutum (Lundahl, 1848)	27	0.5	1—3	42	1.3	1—8	40	1.8	2—7
Epomidiostomum uncinatum (Lundahl, 1848)	18	0.83	4—6	—	—	—	—	—	—
Echinuria uncinata (Rudolphi, 1819)	8	1.6	(19)	—	—	—	—	—	—
Streptocara crassicauda (Creplin, 1829)	9	0.73	(8)	33	1.42	1—2	10	0.1	(1)
Tetrameres fissispina (Diesing, 1861)	18	0.25	1—2	17	0.6	1—6	10	0.1	(1)
Porrocaecum crassum (Deslongchamps, 1824)	—	—	—	—	—	—	10	0.1	(1)
Total		6			5			6	

Note. * — the confidential intervals were not indicated due to small number of samples.

Microscopic examination and measurements of the parasites were performed using an Olympus CX-41 microscope and Laevenhuk ToupView 3.5 software of the collective usage platform (Institute of Biology, Karelian Research Centre of the Russian Academy of Sciences). The infection was quantified using the following indices: prevalence (E) or percentage of the infected population (%) and mean abundance.

Similarities and distinctions in the nematode species richness between the examined duck species were analyzed using multivariate statistical methods with PAST v. 2.17 software (Hammer et al., 2001). The limitations on the use of qualitative data were solved using the values 1 (parasites present) and 0 (no parasites) because binary values correspond to the absolute scale and the Euclidean distance measure applies (Korosov, Gorbach, 2007).

RESULTS

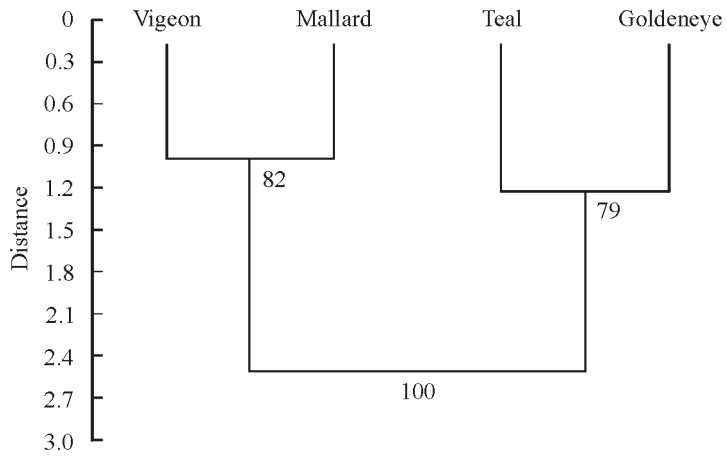
The examined birds hosted 9 nematode species: 6 were found in the wigeon, and 7, in the teal (see table). All the retrieved nematodes are typical and frequent parasites of Anatidae, and were located in their usual sites in the host organism. Four of the species, i. e. *Tetrameres fissispina*, *Streptocara crassicauda*, *Amidostomum acutum*, and *Capillaria anatis*, were found in both wigeon and teal. The species *T. fissispina* and *S. crassicauda* possess a complex life cycle involving aquatic invertebrates, Daphnia and Amphipoda (Sonin, Baruš, 1996; Anderson, 2000). Nematodes *A. acutum* and *C. anatis* possess a direct life cycle.

Two nematode species, *Epomidiostomum uncinatum* and *Echinuria uncinata*, were found only in the wigeon. The former parasite has a direct life cycle, and the latter infests birds as they feed on infected amphipods. Teals contained three species missing from wigeons, namely *Eucoleus contortus*, *Pseudocapillaria mergi*, and *Porrocaecum crassum*. The first two have a direct life cycle, and the earthworm is the intermediate host for *P. crassum*. It should be also mentioned that the only *P. mergi* and *P. crassum* in teals were found in the birds taken in spring.

DISCUSSION

Of the nine nematode species five have a direct life cycle. They apparently infest the ducks as they forage in wet waterside strips and water-logged meadows. The teal's preference for such habitats in wintering grounds agrees with the infection with *P. crassum*, which intermediate hosts are earthworms. Note however that the infection (prevalence and intensity) with soil-transmitted helminths is minor in both wigeon and teal (see table). The rates of infection with *T. fissispina*, *A. acutum*, and *S. crassicauda* were higher in both duck species. The life cycle of these parasites involves aquatic invertebrates (Daphnia and Amphipoda). *Amidostomum acutum* was a clear dominant among them (see table).

The species composition of nematodes detected in teal and wigeon is nearly identical to that in the mallard and goldeneye, other previously surveyed anatid species common in Karelia (Lebedeva et al., 2014, 2015). In terms of nematode fauna differences these ducks form two clusters: wigeon and mallard with a re-



Dendrogram of the nematode species richness differences in the mallard, goldeneye, wigeon and teal (Ward′s method). Number of bootstrap replicates 3000.

latively richer composition of nematodes, as compared to the teal and goldeneye (see figure). Bootstrap analysis showed insignificant differences of the parasite fauna within the duck species pairs, with less than 95 percent replicates, whereas differences between the two clusters were statistically significant. This pairing is predetermined by ecological preferences and feeding habits. The mallard and the wigeon contained mainly nematodes with a direct life cycle, indicating a predominantly vegetative diet, whereas the nematode fauna of the goldeneye and the teal was dominated by species involving aquatic crustaceans in their life cycle.

The nematode fauna of wigeons and teals breeding in southern Karelia (at Lake Ladoga) is very similar to the nematode fauna of birds wintering in Europe. Anatids that spend winter on the North Sea coast have virtually the same nematode composition within their diverse helminth fauna as that reported for wigeons and teals from Karelia.

The similarity of the nematode fauna in wigeon and teal in wintering and breeding areas is corroborated by the ringing data. According to Rezvyi et al. (1995), foreign-ringed recoveries in the Leningrad Province and southern Karelia included mostly birds from the Netherlands, Great Britain, Denmark, and France, where the key wintering areas of Russian wigeons were located.

Ringing of teals born in southeastern Ladoga demonstrated wide dispersal of ducks in the first year of life, with recoveries reported from the Netherlands, Krasnodar Region, and Nigeria (Rezvyi et al., 1995).

Parasitological data fully agree with ornithologists′ observations. Studies of teal and wigeon parasites are, unfortunately, few. When these ducks were examined for parasites in Africa, the wigeon was found to contain the nematodes *Epomidiostomum uncinatum* and *Echinuria uncinata* (Algeria), and the teal, *Amidostomum anseris* and *Epomidiostomum querquedulae* (Egypt) (Alexander, McLaughlin, 1997).

The nematode fauna of Karelia demonstrates high similarity with nematodes of ducks from Europe — Czech Republic, Slovakia (Sitko, Okulewicz, 2010), and Poland (Kavetska, 2006; Kavetska et al., 2012). *Amidostomum acutum* was

also the dominant species. The nematode fauna was formed of *Echinuria uncinata*, *Epomidiostomum uncinatum*, *Eucoleus contortus*, *Poroccaecum crassum*, and *Tetrameres fissispina*. Yet, birds arriving on Lake Ladoga shores carry *P. crassum* in spring, but this parasite cannot develop further in the area (Baruš et al., 1978).

As opposed to the Anatidae surveyed in Europe, the nematode *Hystrichis tricolor* Dujardin, 1845 was missing from ducks that breed in Karelia. According to literature (Baruš et al., 1978; Sitko, Okulewicz, 2010), it has been reported from Italy, Czech Republic, Slovakia, Bulgaria, Ukraine, and Azerbaijan. This species has a complex life cycle. Its intermediate hosts are freshwater oligochaetes, *Allolobophora dubiosa pontica* Pop, 1938, *Criodrilus lacuum* Hoffmeister 1845, *Eiseniella tetraedra* Savigny, 1826, and *Eophila leoni* Michaelsen, 1949 (Baruš et al., 1978; Anderson, 2000), which do not occur in the local benthic fauna (Gerd, 1950; Kurashov, 2000). One can expect however to find *H. tricolor* in the ducks immediately after spring migration.

The newly obtained information on nematodes in wigeons and teals in the Lake Ladoga area supplement the previously available data on the helminth fauna of anatids, and help better understanding the biological and ecological characteristics of the hosts.

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