

## Original papers

# Taxonomic structure of cestodofauna of two species of diving ducks *Aythya fuligula* and *A. marila* (Anseriformes: Aythyini) in north-western Poland

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**ABSTRACT.** Diving ducks Aythyini Delacour et Mayr, 1945 are an interesting object of the parasitological studies because due to living in two environments (aquatic and terrestrial) and migrating over long distances, they can come into contact with many potential hosts for parasites. In the recent years, a decrease in the population of diving ducks has been observed, especially of the tufted duck and the scaup. Both of them remain the most common species found in the region of West Pomerania, so the presented research is limited to the parasitological studies of these two species of ducks. The aim of this study was to determine the taxonomic structure of the cestodofauna of two species of diving ducks, the tufted duck and the scaup, wintering in north-west Poland. The research material consisted of 14,734 tapeworms collected from digestive tracts of 256 birds, 174 tufted ducks *Aythya fuligula* (Linnaeus, 1758) and 82 scaups *A. marila* (Linnaeus, 1761). All identified tapeworms obtained from digestive tracts of the hosts belonged to the Hymenolepididae family (order Cyclophyllidea). A total of 25 species of 9 genera were identified in the cestodofauna of the tufted duck, while in the cestodofauna of the scaup: 12 species of 7 genera. During 10 years of studies out of all of the 26 recorded species, 6 have been found in Poland for the first time. Moreover, 13 new, unlisted parasite-host relationships have been identified: 7 in the digestive tract of the tufted duck and 6 in the scaup.

**Keywords:** *Aythya fuligula*, *Aythya marila*, Cestoda, Poland, wild ducks

## Introduction

Diving ducks Aythyini Delacour et Mayr, 1945 belong to one of the eight tribes of the subfamily of ducks Anatinae Leach, 1820 in the order of the Anseriformes [1–3]. This tribe comprises 15 species belonging to the genera *Netta* Kaup, 1829 and *Aythya* Boie, 1822 [1]. Nine species of the Aythyini tribe live in Europe, including as many as 7 found in Poland: the red-crested pochard *Netta rufina* (Pallas, 1773), the ring-necked duck *Aythya collaris* (Donovan, 1809), the common pochard *A. ferina* (Linnaeus, 1758), the tufted duck *A. fuligula* (Linnaeus, 1758), the scaup *A. marila* (Linnaeus, 1761), the ferruginous duck *A. nyroca* (Guldenstadt, 1770) and the lesser scaup *A. affinis* (Eyton, 1838) [3]. Diving ducks breed mainly in the northern and

central part of Eurasia, but also in North-West Africa, and spend winters in the open waters of North-Western Europe, the Middle East, the Sub-Saharan Africa, Central and East Asia, and North America [1]. They feed on small invertebrates, mainly crustaceans and clams, with a small number of plants, which they collect at a depth of 2–7 meters [1–7]. Diving ducks are an interesting object of parasitological studies because due to living in two environments (aquatic and terrestrial) and migrating over long distances, they can come into contact with many potential hosts for parasites.

Some diving ducks breed in freshwater habitats in Poland, others are found only during the spring or autumn migration [2]. Observations in the years 2002–2008 confirmed the particular importance of north-western Poland as the wintering area for many

species of birds, including diving ducks. It is rich in freshwater basins and the winters are mild. 4,960 common pochards and 33,300 tufted ducks were found in that area, as well as up to 30% of the scaup population wintering in Europe [8]. In the recent years, a decrease in the population of diving ducks has been observed, especially of the tufted duck and the scaup. Still, both species remain the most common species found in the region of West Pomerania. For this reason, the presented research is limited to the parasitological studies of these two species of ducks.

The aim of this work was to determine the taxonomic structure of tapeworms in the tufted duck and the scaup wintering in north-western Poland, to prepare environmental characteristics of each tapeworm group in particular host species and compare the species composition of the cestodofauna of diving ducks in the research area with other areas of Poland. The obtained result was presented earlier in a doctoral dissertation titled "Ecological conditions of the formation of the cestodofauna of diving ducks Aythyini in West Pomerania" [9].

## Materials and Methods

The research material consisted of 14,734 tapeworms isolated from digestive tracks of 256 birds, representing two species of the tribe of diving ducks Aythyini: *Aythya fuligula* (n=174) and *Aythya marila* (n=82). The ducks were obtained in the years 1999–2009 from fishermen in fisheries located in freshwater basins in north-western Poland.

All birds were subjected to a standard selection procedure and their digestive tracts were isolated. The extracted tapeworms were transferred to 75% ethyl alcohol serving as a preservative and stained with iron acetocarmine. Selected specimens were put in Hoyer's medium. Available keys and numerous original works were used to mark the parasites.

The environmental analysis of the cestodofauna of diving ducks requires the use of quantitative environmental indicators included: frequency, prevalence, intensity (mean and range), abundance (relative density) and dominance index (Janion's index). The obtained values of the dominance index were the basis for qualifying particular parasite species to one of 4 groups, differing in the degree of dominance of the host's cestodofauna [10]: super-dominant species ( $DI \geq 10.0$ ), dominant species

( $10.0 > DI \geq 1.0$ ), subdominant species ( $1.0 > DI \geq 0.1$ ), satellite species ( $DI < 0.1$ ).

## Results

A total of 23,351 helminths were isolated from digestive tracts of the tested birds, including as many as 16,180 found in the 174 examined tufted ducks and only 7,171 in the 82 examined scaups. In the helminth fauna of the tufted duck, as many as 12,917 specimens (79.8%) were representatives of cestodes, while among the scaup, the majority of specimens belonged to the class of Digenea: 4,318 (60.2%). In the helminth fauna of the tufted duck, there were significantly less Digenea (n=2,692), and nematodes (n=571), while in the helminth fauna of the scaup, there were fewer tapeworms (n=1,817) and nematodes (n=1,035). In addition, one thorny-headed worm was found in the helminth fauna of the scaup. 1,782 tapeworms were not identified (1,582 in the cestodofauna of the tufted duck and 200 of the scaup) as they were too young or destroyed.

All identified tapeworms belonged to the family Hymenolepididae Fuhrmann, 1907 (order Cyclophyllidea van Beneden in Braun, 1900). The systematic classification of the marked tapeworms was given after Pojmańska and Cielecka [11] with the changes proposed by Fauna Europaea [3]. In the cestodofauna of the tufted duck, 25 species in 9 genera have been identified (Table 2); in the cestodofauna of the scaup, 12 species in 7 genera have been identified. It should be emphasised that 11 species were common to both hosts, while 14 were found only in the tufted duck and one only in the scaup. In total, 4,700 specimens from the tufted duck and 460 from the scaup were identified only to species (they were immature or destroyed).

## Taxonomic structure

**Genus *Aploparaksis* Clerc, 1903.** Among the tested ducks, only one species in the *Aploparaksis* genus was found *A. kulachkovae* (Bondarenko, 1987). *A. kulachkovae* has been so far found on the territory of Russia in the small intestine and the ileum of the ducks of the *Anas* and *Aythya* genera [12]. In Poland it was first reported in the tufted duck [13]. In own studies, there were 5 specimens *A. kulachkovae* in the jejunum and the ileum of three tufted ducks [9]. The mean intensity and the abundance were very low (Table 1). Based on the dominance index ( $DI < 0.1$ ) it was found that

Table 1. The ecological characteristic of the cestodofauna of *Aythya fuligula*

Cestode species	N/Prevalence (%)	Intensity range/mean	Abundance	Index of dominance
<i>Aploparaksis kulachkovae</i> n=5	3/1.72	1-3/1.67	0.03	0.0005
<i>Aploparaksis</i> sp. n=30	8/4.60	1-11/3.75	0.17	0.0079
<i>Cloacotaenia megalops</i> n=49	34/19.54	1-5/1.44	0.28	0.0550
<i>Dicranotaenia sacciperium</i> n=3	1/0.57	1&2/3.00	0.02	0.0001
<i>D. stenosacculata</i> n=5	2/1.15	2&3/2.50	0.03	0.0003
<i>Dicranotaenia</i> sp. n=18	1/0.57	18/18.00	0.10	0.0006
<i>Diorchis microcirrosa</i> n=129	21/12.07	1-29/6.14	0.74	0.0895
<i>D. ovofurcata</i> n=2677	76/43.68	1-89/35.22	15.39	6.7199
<i>D. stefanskii</i> n=1	1/0.57	1/1.00	0.01	0.0000
<i>D. tuvensis</i> n=66	13/7.47	1-20/5.08	0.38	0.0283
<i>Diorchis</i> sp. n=913	69/39.66	1-71/13.23	5.25	2.0808
<i>Echinocotyle rosseteri</i> n=59	4/2.30	2-34/14.75	0.34	0.0078
<i>Microsomacanthus arcuata</i> n=213	18/10.34	1-76/11.83	1.22	0.1266
<i>M. baeri</i> n=8	3/1.72	1-5/2.67	0.05	0.0008
<i>M. compressa</i> n=95	3/1.72	3-65/31.67	0.55	0.0094
<i>M. paracompressa</i> n=2	1/0.57	2/2.00	0.01	0.0001
<i>M. parvula</i> n=157	13/7.47	1-40/12.08	0.90	0.0674
<i>M. recurvata</i> n=2	1/0.57	2/2.00	0.01	0.0001
<i>M. spiralibursata</i> n=7	4/2.30	1&2/1.75	0.04	0.0009
<i>M. tuvensis</i> n=59	8/4.60	1-18/7.38	0.34	0.0156
<i>Microsomacanthus</i> sp. n=134	7/4.02	1-54/19.14	0.77	0.0310
<i>Retinometra macracanthos</i> n=3	1/0.57	3/3.00	0.02	0.0001
<i>R. pittalugai</i> n=10	5/2.87	1-3/2.00	0.06	0.0017
<i>Retinometra</i> sp. n=12	2/1.15	1&11/6.00	0.07	0.0008
<i>Sobolevicanthus aculeostyleticus</i> n=56	6/3.45	1-21/9.33	0.32	0.0111
<i>S. gracilissimus</i> n=2916	98/56.32	1-00/29.76	16.76	9.4388
<i>S. krabbeellus</i> n=24	5/2.87	2-9/4.80	0.14	0.0040
<i>S. octacanthus</i> n=2	1/0.57	2/2.00	0.01	0.0001
<i>S. wisniewskii</i> n=1	1/0.57	1/1.00	0.01	0.0000
<i>Sobolevicanthus</i> sp. n=3108	79/45.40	1-33/39.34	17.86	8.1098
<i>Fimbriaria sarcinalis</i> n=86	19/10.92	1-20/4.53	0.49	0.0540
<i>Fimbriaria</i> sp. n=484	66/37.93	1-56/7.33	2.78	1.0551
<i>Fimbriarioides</i> sp. n=1	1/0.57	1/1.00	0.01	0.0000

Explanations: n - number of cestodes; N - number of infected birds

*A. kulachkovae* was a satellite species in the tufted duck cestodofauna (Table 1).

**Genus *Cloacotaenia* Wolffhugel, 1938.** The *Cloacotaenia* genus was represented only by *C. megalops* (Nitzsch in Creplin, 1829). This species is cosmopolitan, common in the cloaca of the Anseriformes [11–21]. In own studies, this parasite was a satellite species in the cestodofauna of both host species (DI<0.1). It was found in the cloaca of 19.5% of the tufted duck and in almost 11.0% of the scaup (Tables 1, 2). The mean intensity was 1.4 in both of the host species and the abundance was 0.28 and 0.16 in the tufted duck and the scaup, respectively (Tables 1, 2) [9].

**Genus *Dicranotaenia* Railliet, 1892.** In own studies, two species of the *Dicranotaenia* genus

were found: *D. saccipaerium* (Mayhew, 1925) and *D. stenosacculata* Macko, 1988. *D. sacciperium* is a cosmopolitan species, while *D. stenocassulata* has been so far found only in Slovakia and Poland [3,13,22–25]. The results of this research shown minor prevalence and mean intensity of both species (Tables 1, 2). Only 0.6% of tufted ducks and 1.2% of scaups were infected by *D. sacciperium* and 1.1% tufted ducks and 2.4% scaups were infected with *D. stenosacculata*. In own studies both of them were found as satellite species (DI<0.1, Tables 1, 2).

**Genus *Diorchis* Clerc, 1903.** The *Diorchis* genus was represented by 4 species: *D. microcirrosa* Mayhew, 1929; *D. ovofurcata* Czaplinski, 1972; *D. stefanskii* Czaplinski, 1956 and *D. tuvensis* Spasskii, 1963. *D. ovofurcata* is a typical species for

Table 2. The ecological characteristic of the cestodofauna of *Aythya marila*

Cestode species	N/Prevalence (%)	Intensity range/mean	Abundance	Index of dominance
<i>Cloacotaenia megalops</i> n=13	9/10.98	1-3/1.44	0.16	0.0174
<i>Dicranotaenia sacciperium</i> n=5	1/1.22	5/5.00	0.06	0.0007
<i>D. stenoscaculata</i> n=4	2/2.44	2&2/2.00	0.05	0.0012
<i>Dicranotaenia</i> sp. n=10	2/2.44	2&8/5.00	0.12	0.0030
<i>D. ovofurcata</i> n=313	19/23.17	1-81/16.47	3.82	0.8844
<i>D. stefanskii</i> n=1	1/1.22	1/1.00	0.01	0.0001
<i>Diorchis</i> sp. n=98	15/18.29	1-21/6.53	1.20	0.2186
<i>Gastrotaenia dogieli</i> n=2	1/1.22	2/2.00	0.02	0.0003
<i>Microsomacanthus arcuata</i> n=53	10/12.20	1-25/5.30	0.65	0.0788
<i>M. baeri</i> n=1	1/1.22	1/1.00	0.01	0.0001
<i>M. tuvensis</i> n=68	3/3.66	1-36/22.67	0.83	0.0303
<i>Microsomacanthus</i> sp. n=2	2/2.44	1&1/1.00	0.02	0.0006
<i>Sobolevicanthus aculeostyleticus</i> n=2	1/1.22	2/2.00	0.02	0.0003
<i>S. gracilissimus</i> n=686	34/41.46	1-85/20.18	8.37	3.4688
<i>Sobolevicanthus</i> sp. n=278	14/17.07	1-1/19.86	3.39	0.5788
<i>Fimbriaria sarcinalis</i> n=9	1/1.22	9/9.00	0.11	0.0013
<i>Fimbriaria</i> sp. n=72	15/18.29	1-17/4.80	0.88	0.1606

Explanations: n - number of cestodes; N - number of infected birds

diving ducks [3,14,26]. In own studies, that species accounted for 20% of all identified tapeworms. The species was found mostly in the ileum, however, it was also detected in the duodenum, the jejunum, the caecum and the rectum. In addition, *D. ovofurcata* was found in 43.7% of the examined tufted duck and in 23.2% of the scaup, with the mean intensity of 35.2 in the tufted duck (Table 1) and 16.8 in the scaup (Table 2). *D. ovofurcata* was a dominant species ( $10.0 > DI \geq 1.0$ ) in the tufted duck cestodofauna (Table 1) and a subdominant species (Table 2) in the scaup cestodofauna.

What is of particular interest is that in own studies [9], *D. microcirrosa* was found in the tufted duck, a rare species previously found in the ileum of the blue-winged tail (*Anas discors*) in North America [27]. In own studies, the prevalence of *D. microcirrosa* was 12.1% and the mean intensity was 6.2 (Table 1). This species forms a new parasite-host relationship with the tufted duck and it was a satellite species ( $DI < 0.1$ ). Perhaps, *D. microcirrosa* has been brought to Europe during migrations of wintering flocks and the parasite has been transferred to a new host [9].

Another species, *D. tuvensis*, is regarded in literature as typical not only to dabbling ducks but also to the tufted duck [28–30]. In own studies, it

was found as a satellite species, located in the jejunum and the ileum of 7.5% of the tested tufted duck and the mean intensity was 5.1 (Table 1).

The last species of the *Diorchis* genus, *D. stefanskii*, parasite in birds of the genera: *Anser*, *Tadorna*, *Anas*, *Netta*, *Aythya*, *Oxyura* [14,31,32]. In the presented work, only single specimens in both the tufted duck and the scaup were found (Table 1). The values of occurrence parameters were small (prevalence 1.0%, mean intensity 1.0).

#### Genus *Echinocotyle* Blanchard, 1891.

*Echinocotyle rosseteri* Blanchard, 1891 is a cosmopolitan bird parasite of the genera: *Tadorna*, *Anas*, *Histrionicus* and rarely found in birds in order Passeriformes [11,14,32–34]. In this study, the parasite was found only in 4 out of 174 the examined tufted ducks (2.3%), with the mean intensity of 14.7 and range from 2 to 34 (Table 1). This parasite was a satellite species in the cestodofauna of the tufted duck. In addition, it should be noted that in our studies in 2012 it was the first recorded occurrence of this parasite in the tufted duck [9].

**Genus *Gastrotaenia* Wolffhugel, 1938.** Another interesting parasite, found only in the cestodofauna of the scaup, is *G. dogieli* (Ginetsinskaya, 1944). It is the only tapeworm which embeds itself under the stratum corneum of the gizzard. It is a typical

species found in the Anseriformes [29,34,35], its first recorded occurrence in the scaup was in 2011 [9,13]. In own studies, only two specimens were found in one adult female (Table 2). *G. dogieli* was a satellite species in the cestodofauna of the scaup ( $DI < 0.1$ ).

**Genus *Microsomacanthus* Lopez-Neyra, 1942.**

As many as 8 species of the *Microsomacanthus* genus were found, including two (*M. baeri* Czaplinski et Vaucher, 1977 and *M. tuvensis* Spasskaya et Spasskii, 1961) found in Poland for the first time during the examination of the cestodofauna of wild ducks conducted in West Pomerania [36–38]. All recorded species occur worldwide, mainly in the Anseriformes [17–19,22,33,34,39]. Large numbers of *M. arcuata* (Kowalewski, 1904), *M. parvula* (Kowalewski, 1904), *M. tuvensis* and *M. compressa* (Linton, 1892) were found in own studies. *M. paracompressa* (Czaplinski, 1956), *M. recurvata* Spasskaya et Spasskii, 1961, *M. spiralibursata* (Czaplinski, 1956) and *M. baeri* were represented by less than 10 specimens. All 8 species were found in the cestodofauna of the tufted duck, while only three (*M. arcuata*, *M. baeri* and *M. tuvensis*) were found in the scaup.

*M. arcuata* had the greatest prevalence, both in the tufted duck and the scaup (10.3% and 12.2% in the tufted duck and the scaup, respectively (Tables 1, 2). In terms of the mean intensity, the highest value was recorded for *M. compressa* (31.7 of tapeworm) in the tufted duck, and for *M. tuvensis* in the scaup (22.7). All of collected species in this genus were satellite species, except of *M. arcuata*, which was a subdominant species ( $1.0 > DI \geq 0.1$ ) in the cestodofauna of the tufted duck (Table 1).

**Genus *Retinometra* Spasskii, 1955.** The *Retinometra* genus was represented in this study by two species: *R. macracanthos* (von Linstow, 1877) and *R. pittalugai* (Lopez-Neyra, 1932). *R. macracanthos* has been found in West Pomerania for the first time in the common merganser *Mergus merganser* [40,41], and *R. pittalugai* has been found in the study of the cestodofauna of diving ducks in West Pomerania [42]. In own studies, only three specimens of *R. macracanthos* were found in one tufted duck (0.4%) and 10 specimens of *R. pittalugai* in 5 tufted ducks (1.9%, Table 1). The mean intensity was small and amounted to 3.0 for *R. macracanthos* and 2.0 for *R. pittalugai* in one infected tufted duck. Both species were found only in the jejunum of the tufted duck and both of them were satellite species (Table 1).

**Genus *Sobolevicanthus* Spasskii et Spasskaya, 1954.** Five species of the *Sobolevicanthus* genus were found (*S. aculeostileticus* Birová et Macko, 1991, *S. gracilissimus* Czaplinski et Czaplinska, 1990, *S. krabbeellus* (Hughes, 1940) sensu Czaplinski, 1956, *S. octacanthus* (Krabbe, 1869) and *S. wisniewskii* Czaplinski, 1956), with *S. gracilissimus* as a clearly super-dominant species in the cestodofauna of the tufted duck and a dominant species in the cestodofauna of the scaup (Tables 1, 2). So far, *S. gracilissimus* has been found only in Poland [3,14,43]. Tufted ducks are its typical hosts and it embeds itself in the jejunum. In own studies, this species had high values of prevalence (56.3% of tufted ducks and 41.4% of scaups were infected) and the mean intensity (almost 30 in the tufted duck and 20.1 in the scaup, Tables 1, 2). It was the most numerous in the jejunum. Moreover, the results of this study and the analysis of literature indicate that *S. gracilissimus* forms a new parasite-host relationship with the scaup [9,44].

Another species, *S. aculeostyleticus*, previously found in Ukraine and Slovakia [32,45], has been found in Poland for the first time during the study of the cestodofauna of the mallard in West Pomerania [36]. In own studies, it was found in the duodenum and the jejunum of 3.5% of the examined tufted duck (Table 1) and 1.2% of the scaup (Table 2). The mean intensity of this parasite was 9.3 in the tufted duck and only 2.0 in the scaup. It should be noted that *S. aculeostyleticus*, previously found in the mallard, forms a new parasite-host relationship with the tufted duck and the scaup [9].

Next three species of these genera *S. krabbeellus*, *S. octacanthus* and *S. wisniewskii* are cosmopolitan and commonly occur in the Anseriformes [16,17,22,33,34,39]. In own studies, single specimens were found in the jejunum of the tufted duck (Tables 1, 2). Two of them *S. krabbeellus* and *S. wisniewskii* form new parasite-host relationships with the tufted duck. The prevalence of the parasites was 0.6% in the case of *S. octacanthus* and *S. wisniewskii*, and 2.9% in the case of *S. krabbeellus*. The mean intensity of was small and ranged between one and 4.8.

**Genus *Fimbriaria* Froelich, 1802.** The only detected species was *F. sarcinalis* Grytner-Zieczina et Cielecka, 1994, described as late as in 1994 [46]. In own studies, *F. sarcinalis* was found in the duodenum, the jejunum and the ileum of the hosts. The tapeworm was found in 20 ducks (7.8%), with the mean intensity of 4.7 (between 1 and 20). It was a satellite species in the cestodofauna of both host

species (Tables 1, 2).

**Genus *Fimbriarioides* Fuhrmann, 1932.** In own studies, only one specimen was found in the duodenum of the tufted duck. It was very destroyed, so we can't identify it to the species.

## Discussion

Previous studies of the cestodofauna of the tufted duck and the scaup were conducted in Poland only in some areas and often on single hosts [16,22,31,33,47–49]. Until 2007, 26 species of tapeworms were found in the tufted duck and only 8 in the scaup [14]. Despite the fact that the number of identified species in own studies is similar, the cestodofauna of the tufted duck and the scaup in West Pomerania is different in terms of composition, compared to the cestodofauna of diving ducks in Poland.

In the cestodofauna of the tufted duck, between 2 and 16 species of tapeworms have been found so far [16,22,33,47–49], whereas in the scaup: between 5 and 8 species [22,48]. It should be noted that only a few of them were common in the cestodofauna of diving ducks in West Pomerania and in other areas.

During our studies 6 species of tapeworms have been found in Poland for the first time: *A. kulachkovae*, *D. stenosacculata*, *D. microcirrosa*, *D. tuvensis*, *M. tuvensis*, *R. pittalugai* [22,37,44]. There were also 13 new forms of parasite-host relationships. As many as 7 species (*A. kulachkovae*, *D. microcirrosa*, *D. stefanskii*, *E. rosseteri*, *S. aculeostyleticus*, *S. krabbeellus*, *S. wisniewskii*) have been found the digestive tract of the tufted duck for the first time, and 6 species have been found in the scaup for the first time (*D. stenosacculata*, *D. stefanskii*, *G. dogieli*, *S. aculeostyleticus*, *S. gracilissimus* and *F. sarcinalis*).

Given the available data, it was determined that the species commonly found in the cestodofauna of the tufted duck in other areas but not found in own studies were *Diorchis coronula* (Dujardin, 1845), *D. acuminatus* (Clerc, 1902), *D. laevis* (Bloch, 1782) and *Fimbriaria fasciolaris* (Pallas, 1781). In addition, it seems that *Aploparaksis fuligulosa* Soloviev, 1911; *Diorchis danutae* Czaplinski, 1956; *Microsomacanthus abortiva* (von Linstow, 1904); *Retinometra venusta* (Rosseter, 1897); *Sobolevicanthus kenaiensis* (Schiller, 1952) and *S. gracilis* (Zeder, 1803) are species typical for the tufted duck in north-eastern Poland [11,22], *Drepanidotaenia lanceolata* (Bloch, 1782), *Microsomacanthus para-*

*microsoma* (Gasowska,1931) and *Hamatolepis teresoides* (Fuhrmann, 1906) are characteristic for the tufted duck in south-western Poland [16], while *Diorchis parvogenitalis* Mathevossian in Skrjabin et Mathevossian, 1945 and *Microsomacanthus recurvata* are common in the tufted duck in western Poland [49].

The cestodofauna of the scaup in West Pomerania did not include 7 species (*Diorchis coronula*, *D. acuminatus*, *Microsomacanthus compressa*, *M. paracompressa*, *M. spiralibursata*, *Sobolevicanthus gracilis* and *Fimbriaria fasciolaris*) found in north-eastern Poland [22].

Differences between earlier studies and this research in terms of the composition of species and the number of tapeworm species in the tufted duck and the scaup are probably due to the number of the tested birds. It is well-known that the number of the found parasite species depends directly on the size of the test sample [50,51]. However, it seems that various environmental factors typical to West Pomerania might be of a much bigger importance. They include mild winters, which prolong the feeding period of the ducks and their contact with potentially infective stages of parasites. What is also important is that flocks of thousands of different species of wild ducks spend the winter in West Pomerania, which is an important factor in the growth of the variety of species. According to a well-known theory, species living in very large groups are more prone to an accidental introduction of a new parasite [51–53].

Also, some aspects related to the general behaviour of the tested hosts are of significance. Birds wintering in western Poland come from different nesting areas, where they have contact with different food and environment. Due to migration, they are exposed to intermediate hosts of various parasites, also those non-specific to the Anseriformes. Differences in the qualitative composition of the cestodofauna of wild ducks might thus stem from the differences in the types of habitats visited by the tested birds and therefore, the differences in diet [9].

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