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TAENIASIS IN NORTHERN WHITE-BREASTED HEDGEHOGS *ERINACEUS ROUMANICUS* (BARRETT-HAMILTON, 1900) BASED ON PRELIMINARY POST-MORTEM EXAMINATIONS OF HEDGEHOGS FROM AN URBANIZED ENVIRONMENT

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ABSTRACT: *Taeniasis* in free-living insectivores, including hedgehogs, is rarely described in the Polish literature. All species of hedgehogs occurring in Poland are under strict protection, and thus analyses of tapeworm fauna have been conducted only sporadically, using material from post-mortem examinations of hedgehogs which in most cases died in road accidents. Regular testing is not currently conducted in Poland. The most recent analyses of tapeworm fauna in hedgehogs were conducted over half a century ago, and were both local and incidental in Poland. The aim of this study was an attempt at a preliminary analysis of the composition of intestinal tapeworm fauna in the Northern white-breasted hedgehog, detected in necropsies and faecal examinations in hedgehogs from an urban agglomeration. The prevalence of Cestoda infection was found to be 47%. The main element of the Cestoda fauna was *Rodentolepis erinacei*, but the tapeworm *Dipylidium caninum*, which is not characteristic of insectivorous mammals, was detected as well.

KEY WORDS: Northern white-breasted hedgehog *Erinaceus roumanicus*, taeniasis, *Rodentolepis erinacei*, *Dipylidium caninum*, zoonosis, Poland

Introduction

The Northern white-breasted hedgehog *Erinaceus roumanicus* (Barrett-Hamilton, 1900) belongs to the order of insectivorous mammals (Insectivora). It has a relatively stable population distributed in eastern and southern Europe and part of Asia. It is a protected species on the IUCN Red List with LC (Least Concern) status. It is living environment includes wooded areas, forests, parks and urban green areas. It is often encountered in urbanized areas, even large cities, where it finds suitable conditions for reproduce and life in urban green areas including parks, large flower beds, gardens, or allotment gardens. The biological activity of hedgehogs begins after hibernation in March and ends in October. Their nocturnal way of life is often interrupted during the spring and summer by the early sunrise, which leads to a loss of activity at its feeding site. For this reason they are often found by people in large urban agglomerations, on lawns, pavements or paths. A lack of understanding of the biology of this species leads to close contact between hedgehogs and human beings; this occurs when someone attempts to handle a hedgehog while it is sleeping or motionless during the day. Equally common are road accidents involving hedgehogs, which lie motionlessly after being hit by a vehicle, usually at the site of the accident. People who handle such an animal in an attempt to help it, or take a sleeping hedgehog home, may be bitten when the hedgehog attempts to defend itself, and thereby come into contact with its saliva. Very often the hedgehog dies during observation for rabies, which begins after someone is bitten and comes into contact with the animal's saliva. Dead animals are sent to government veterinary laboratories for rabies testing. In addition to rabies, a serious threat is posed by other zoonotic organisms, such as other microorganisms and parasites, including internal parasites such as tapeworms (Cestoda). Dead hedgehogs sent for rabies testing were the source of the material used for parasitological analysis.

The aim of the study was to determine the tapeworm fauna occurring in hedgehogs inhabiting urbanized areas based on the example of the city of Lublin (S Poland), taking into account the potential threat to public health. This study does not include a discussion of the other parasites observed, as it focuses exclusively on tapeworms.

Material and methods

The material for the study was collected from 17 Northern white-breasted hedgehogs sent for rabies testing in the years 2007-2013. None of the hedgehogs examined was found to be infected with the rabies virus. Species identification of the hedgehogs was carried out based on an identification key for mammals of Poland (Pucek 1984). All of the hedgehogs were determined to belong to the species *Erinaceus roumanicus.* All of the hedgehogs examined came from the urban environment of Lublin.

During the necropsy all of the intestines and the stomach were collected for further analysis. Because the subject of the examination was only tapeworm fauna, the parasitological examination was limited to the digestive tract, from the stomach to the rectum.

Following isolation of the digestive tract it was subjected to further testing, in which faeces were collected for flotation and sedimentation tests and a search for adult parasites was conducted.

Faecal flotation was performed using the Fecalyzer & Fecasol kit (Vetoquinol Biowet). The search for adult parasites was carried out

by examining the digesta from the intestines, after rinsing it with a stream of water, macroscopically and under a stereoscopic microscope. The faecal flotation test was performed according to the method described in the producer's instructions and was followed by a sedimentation test. The adult forms of parasites collected were placed in saline solution for 24 hours in order to kill them. After washing with saline solution the parasites were fixed in 75% ethanol and then stained with alum carmine solution for 15-20 minutes. The parasites were identified based on the keys contained in Keys to the Cestode Parasite of Vertebrates (Khalil et al. 1994).

Results

Adult forms of the tapeworm *Hymenolepis erinacei* (Gmelin, 1790) were found in seven hedgehogs, and one hedgehog was infected with the tapeworm *Dipylidium caninum* (Linnaeus, 1758). In the faeces collected from the intestines of the hedgehogs, the flotation and sedimentation tests detected *H. erinacei* eggs in all seven hedgehogs with adult forms of this tapeworm and single cysticercoids in four hedgehogs with adult *H. erinacei*. In the single case of infection with *D. caninum* the presence of eggs of this parasite was noted in the digesta (Tab.1).

Discussion

Hedgehogs are rarely the subject of parasitological research. The important role of hedgehogs as vectors of infectious diseases in humans has been discussed in numerous publications (e.g Bunnell T. 2001, Foldvaria G. et.al.2011). The role of hedgehogs as reservoirs of parasitic diseases is not fully understood. A relatively constant composition of intestinal parasite fauna has been established; it is not subject to significant fluctuations. Preliminary research has shown that the composition of this fauna can change and may cause changes in the helminth fauna of a given biotope (Prokopic 1975, Bunnell 2001, Cirak et al. 2010, Gaglio et al. 2010, Mizgajska-Wiktor et al. 2010). The identification of *D. caninum*, a new tapeworm species that had not previously been described for hedgehogs, clearly indicates that a different species may be involved in the developmental cycle of this pathogen as a paratenic host. It is interesting that the development of the tapeworm *D. caninum* requires the participation of an intermediate host such as fleas or lice. Thus far *Ctenocephalides* spp. fleas parasitizing carnivorous animals and adult forms of lice have been identified as intermediate hosts for *D. caninum* larvae. The detection of this tapeworm in hedgehogs suggests that fleas parasitizing a hedgehog may be an intermediate host for *D. caninum*. It has been indisputably confirmed that fleas typical of carnivores whose definitive host is *D. caninum* can parasitize hedgehogs. This is worth noting because the area in question is urbanized (a medium-sized city of half a million inhabitants) with a large concentration of both domesticated and free-living carnivores (synanthropic foxes and other carnivorous mammals inhabiting urbanized areas) as well as insectivores such as hedgehogs. The role of hedgehogs as vectors of infectious diseases posing a threat to human beings has frequently been described in the literature (e.g. Bunnell T. 2001, Foldvaria G. et.al.2011), but the threat they pose with regard to parasites is little known. When human beings come into close contact with hedgehogs they are thus at risk of chance infection by parasites from these animals, as has been described in the case of parasites of pets such as dogs or cats (Narasimham et al. 2013). Taeniasis induced by *D. caninum* in humans usually affects children and the infections are often subclinical. Because carnivorous pets are defined as the main

source of the threat, research has not focused on hedgehogs as a potential source of infection. The literature describes *D. caninum* infections in humans that are mainly asymptomatic, but frequent complications, particularly in the case of mass infection, include loss of body weight, anemia, digestion disorders, and other symptoms of low specificity (Molina et al. 2003, Ramana et al. 2011). The main source of infections for humans is the swallowing of a flea which is an intermediate host for *D. caninum*, which occurs when a flea-infested animal lives in close proximity to a human being. Hedgehogs as carriers of various species of fleas which are intermediate hosts for *D. caninum* meet the criteria for its transmission. (Foldvaria et al. 2011, Ramana et al. .2011, Narasimham et al 2013).

Attention should also be given to infection with tapeworms of the genus *Hymenolepis* in humans. Although no case of *Hymenolepis erinacei* infection has yet been noted in humans, infections with other tapeworms of this genus, such as *Hymenolepis diminuta* (Rudolphi 1819) or *Hymenolepis nana* (Siebold 1852), are among the most frequent taeniases registered in humans (Ratliff & Donalson 1965, Levi et al. 1987). Thus it cannot be ruled out that there may also be cases of occurrence of the parasite *H. erinacei* in humans as a paratenic host.

Table 1. Infection intensity of tapeworms in the hedgehogs analysed and detection of the presence of eggs and cysticercoids.

Hedgehog no.	***Hymenolepis erinacei*/ Infection intensity**			***Dipylidium caninum*/ Infection intensity**	
	adult forms	eggs	cysticercoid	adult forms	eggs
1	0	+	0	0	0
2	11	+	+	0	0
3	4	+	0	0	0
4	13	+	+	0	0
5	19	+	+	0	0
6	12	+	+	0	0
7	2	+	0	0	0
8	0	0	0	4	+

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Streszczenie

Tasiemczyce jeży wschodnioeuropejskich Erinaceus roumanicus (Barrett-Hamilton, 1900) na podstawie wstępnych badań sekcyjnych jeży pochodzących ze środowiska zurbanizowanego.

Tasiemczyce wolnożyjących zwierząt owadożernych, w tym jeży, są rzadko opisywane w polskiej literaturze. Wszystkie gatunki jeży występujące w Polsce podlegają ścisłej ochronie i stąd badania fauny tasiemców, jeżeli w ogóle były przeprowadzane, to tylko sporadycznie z wykorzytaniem materiału sekcyjnego pochodzącego ze zwłok tych zwierząt, padłych najczęściej w wyniku incydentów komunikacyjnych. Regularne badania w Polsce w chwili obecnej nie sa przeprowadzane. Ostatnio przeprowadzone w Polsce badania w kierunku analizy fauny tasiemców jeży były ponad pół wieku temu i miały charakter zarówno lokalny jak i incydentalny. Celem pracy była próba wstępnej analizy składu fauny jelitowej tasiemców jeża wschodnioeuropejskiego wykazane w badaniach sekcyjnych oraz koproskopowych u jeży z terenu aglomeracji miejskiej. Stwierdzono ekstensywność inwazji Cestoda na poziomie 47%, jak również, że głównym elementem fauny Cestoda jest tasiemiec *Rodentolepis erinacei*, stwierdzono wystąpienie także obcego dla ssaków owadożernych tasiemca *Dipylidium caninum*.