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REINTRODUCTION OF THE EUROPEAN BEAVER (*CASTOR FIBER* L.) INTO SERBIA AND RETURN OF ITS PARASITE: THE CASE OF *STICHORCHIS SUBTRIQUETRUS*

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Abstract — After becoming extinct in the second half of the 20th century, the European beaver (*Castor fiber* L., 1758) was successfully reintroduced from Bavaria into Serbia during 2004-2005. In the necropsy of an adult female beaver (found dead in December of 2007), we discovered some parasites identified as *Stichorchis subtriquetrus* in the colon and peritoneal area. This is the first occurrence of the given specific parasite of beavers in Serbia. Decoding of a subcutaneous implanted microchip has confirmed that our specimen was one of the released beavers. We therefore conclude that the parasite in question was reintroduced into Serbia with the beavers originating from Bavaria.

Key words: European beaver, reintroduction, *Stichorchis subtriquetrus*, parasite, Bavaria, Serbia

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INTRODUCTION

The European beaver (*Castor fiber* L., 1758) is a semi-aquatic species that used to be widely distributed in the past. It formerly inhabited almost the whole Eurasian region, excluding the southeastern and central desert parts of Asia and the mountain massif of the Himalayas. Excessive hunting has led to the almost complete disappearance of this species from its natural area of distribution, so that at the beginning of the 20th century there were only eight surviving relict populations in the whole range. It was estimated that these relict beaver populations included only about 1200 individuals (Halley and Rosell, 2002). These relict populations served as the source of individuals for numerous reintroductions realized throughout the continent in the last 80 years, when this species was returned to the territories of most European countries (McDonald et al., 1995; Halley and Rosell, 2002).

An identical destiny affected the European beaver in Serbia. As in the other parts of its range, excessive hunting led to the disappearance of this species. According to written documents, the last beavers were recorded in the second half of the 19th century; however, according to a non-documented source, the last beaver was shot on the Danube in the vicinity of Belgrade at the very beginning of the last century. At that point, the given species became extinct not only in Serbia, but also along the whole course of the Danube and all its tributaries. At the same time, these were the last beaver extinctions in Europe (Ćirović et al., 2003, 2007).

Almost a century later, in 1999, an accidentally shot beaver was reported from Northern Serbia (Vojvodina, Bačka region). This was an immigrant, an individual that had been reintroduced from Bavaria into Hungary (vicinity of Baja). The record in question initiated a national beaver reintroduction program in Serbia (Ćirović et al., 2001, 2003).

In the period of 2004-2005, there were four reintroductions into the Obedska Bara and Zasavica Special Reserves, Serbia, that included 75 beavers

from Bavaria. In order to facilitate further monitoring, all the introduced animals were marked with subcutaneously implanted microchips (Ćirović et al., 2007).

Disappearance of beavers entailed the disappearance of specific beaver parasites such as *Stichorchis* from the same area (Sprent, 1992; Stork and Lyal, 1993). Later, after the beavers were reintroduced, it was possible that the parasites were reintroduced as well. For this reason, simultaneously with monitoring the increase in population numbers of beavers in Serbia, their parasite fauna was also studied. In this paper, we discuss the beaver's return and record the first occurrence in Serbia of *Stichorchis subtriquetrus*, which is a specific parasite of European beavers.

MATERIAL AND METHODS

Within monitoring activities started after the reintroduction of beavers into Serbia, one of the main goals was to establish the causes of mortality of this species. In the period 2004-2008, post-mortem analysis was performed on eight beaver carcasses. Only beavers dying in accidents (traffic accidents, drowning, etc.) were excluded from the post-mortem analysis procedure.

All collected carcasses were immediately transported to the Scientific Veterinary Institute of Serbia in Belgrade and subjected to post-mortem examination. For parasitological examination, we used the method of total dissection of all individual organs. The intestine and other organs were slit open and visible parasites removed. The contents and wash water were passed through a gauze sieve under a jet of tap water, and the remaining material was examined in small quantities at a time in a large enamel tray.

The necropsy revealed 56 *Paramphistomum*-like parasites in the stomach. For further determination, the parasites were fixed in 10% formaldehyde, embedded in paraffin, cut into 5-6–μm mediosagittal sections, and stained with aceto alum carmine and HEA.

All 56 collected parasites were also morphometrically analyzed, and body length and width were measured in all specimens. Basic statistics (X, min, max, sd, CV) were established for the cited morphometric parameters. In addition, length and width of the acetabulum were measured in five dissected specimens. For these parameters, only the mean value is presented.

RESULTS

Out of eight beavers subjected to post-mortem analysis, adult parasites were recorded in the stomach of only one adult female, which was found dead on December 7th, 2006 in a suburb of Šabac (West Serbia, N 44° 54.202', E 019° 38.664'). There were 56 adult parasites in the sample. The female beaver was identified through decoding of the subcutaneously implanted microchip (ID No. 342635) of the type used to mark all the beavers reintroduced into Serbia. This female beaver found in the vicinity of Šabac was one of the 20 beavers released in the Obedska Bara Reserve in December of 2004.

After microscopic analysis of 56 adult helminths, the parasites were identified as belonging to the species *Stichorchis subtriquetrus* Rudolphi, 1814 (syn. *Paramphistomum castori*) (Fig. 1). This record represents the first information on the presence of the given species within the territory of Serbia and indicates that the beaver-specific parasite in question was returned together with its host.

All the collected parasites were measured. The average body length of adult individuals varied from 0.69 to 1.25 cm (on average 0.97 cm), while the width ranged from 0.51 to 0.75 cm (on average 0.69 cm) (Table 1).

Structure of the dorsal part of acetabulum (AC) is characteristic of this species (Fig. 2). Muscles of the dorsal circular layer have two parts – dorsal external part 1 (De 1) and dorsal external part 2 (De 2), and these are diagnostic characteristics of the family Paramphistomidae (Fig. 2). The De 1 part was strongly developed, and together with the ventral external circular layer protruded at the dorsal and ventral joints of the acetabulum (forming a strong sphincter). Average dimensions of the acetabulum

Fig. 1. *Stichorchis subtriquetrus* – ventral view.

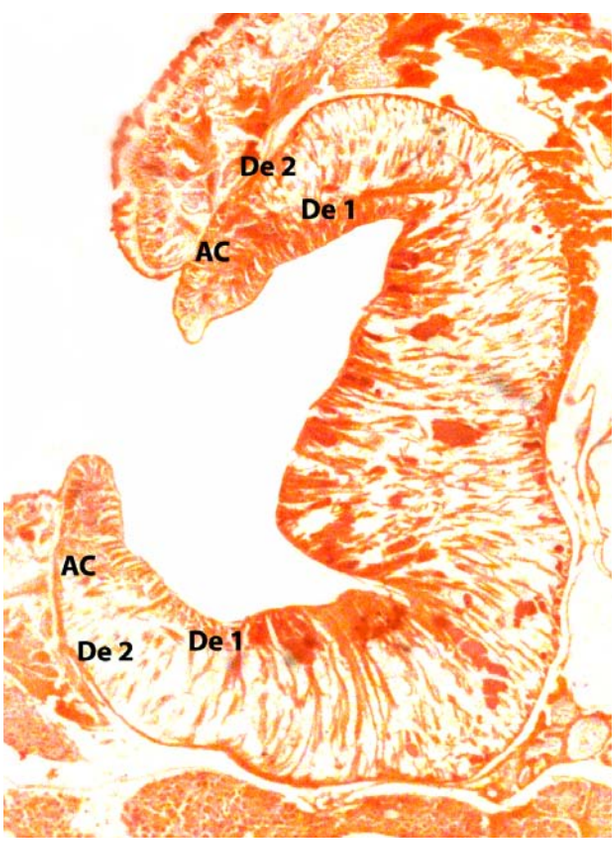

Fig. 2. Mediosagittal section of acetabulum.

Table 1. Morphometric parameters of *Stichorchis subtrique*trus.

	N	x	Min	Max	sd	CV
Length (cm)	56	0.97	0.69	1.25	0.1573	16.2178
Width (cm)	56	0.69	0.51	0.79	0.0503	7.2910

were 0.78 mm (width) and 1.37 mm (length). The shape, position, and dimension ratios of the radial layer, external longitudinal layer, and muscle of the acetabulum were within the normal range for *S. subtriquetrus*.

The life cycle of *S. subtriquetrus* is generally similar to that of all other trematodes. The development cycle includes intermediate hosts – either aquatic snails (*Planorbis vortex*, *Bythinia tentaculata*, and *Lymnea ovata*) or the terrestrial snail *Suvccinea putris* (Skrjabin, 1949). The parasite is transferred to the beaver via infected vegetation, as beavers are specialized herbivores with a high ratio of aquatic macrophytes in their diet, leading to the risk of infection with *S. subtriquetrus* (Romashov, 1976a, 1976b; McMaster and McMaster, 2001).

DISCUSSION

Stichorchis subtriquetrus is a highly specialized parasite recorded in both species of beavers – European beaver (*C. fiber*) and Canadian beaver (*C. canadensis*) (Romashov, 1976a, 1976b; Koubkova et al., 2002). The parasites usually occur in the coecum (Romashov and Safonov, 1965; Merkushava, 1978; McKown et al., 1995; Koubkova et al., 2002). In cases of mass infections, adult parasites were also recorded in the intestines (colon), causing progressive weight loss, anemia, intoxication, and even death (Romashov and Safonov, 1965; Drozdz et al., 2004).

Infestation with *S. subtriquetrus* is the most frequently recorded infection transmitted through an intermediate host into beaver populations. There are numerous papers regarding those infections. Most of these studies were performed in Europe. Romashov (1966), Romashov and Safonov (1965), and Kozhukhov (1978) examined the helminth fauna of beavers and found *S. subtriquetrus* in various parts of Russia. *Stichorchis subtriquetrus* was recorded in beavers in Belarus by Merkushava (1978) and Samusenko (1980), in Ukraine by Sharpilo and Panov (1976), and in Norway by Bakke (1978). Koubkova et al. (2002) studied these parasites of beavers in the Czech Republic, and Mažeika et al. (2003) in Lithuania. Joszt (1964) and Drozdz et al. (2004) found them in Poland, and Sager et al. (2005)

in Croatia. These parasites have been found worldwide and also occurred in Canadian beavers in the USA – in Texas (Fedynich et al., 1986) and Kansas (McKown, 1995).

Besides being widely distributed, *S. subtriquetrus* is also the most common parasite in both European and Canadian beavers. In most parasitological studies after beaver reintroductions, this parasite was recorded within a relatively short interval of time after the introduction or first appearance in an area (Mažeika et al., 2003; Sager et al., 2005). Most authors agree that the parasite arrived directly with the introduced individuals (Drozdz et al., 2004; Sager et al., 2005).

Explaining the origin of *S. subtriquetrus* in a beaver in Serbia, other authors maintain that the parasite was accidentally reintroduced in the adult stage together with its host from natural habitats in Bavaria. The arguments supporting this hypothesis stem from the fact that the dead female was one of 75 beavers reintroduced into Serbia from Bavaria (Ćirović et al., 2007). This also agrees with statements by other authors that the parasite was returned together with beavers elsewhere (Mažeika et al., 2003; Drozdz et al., 2004; Sager et al., 2005). The time interval from introduction of the infected female to its death was only two years. The complex development cycle includes various snail species as intermediate hosts (Skrjabin, 1949). It is therefore unlikely that the parasite arrived with another individual, completed the whole life cycle, and infected another beaver on the territory of Serbia.

The first record of *S. subtriquetrus* in beavers in Serbia has ecological-epidemiological importance, focusing attention on the need for continuous parasitological studies of this mammalian species. Parasitological monitoring is extremely important because individual beaver dispersions may reach 120 km (McDonald et al., 1995), making possible rapid spreading of this parasite specific for beavers, not only in our country, but also in the broader region around the Sava River.

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РЕИНТРОДУКЦИЈА ЕВРОПСКОГ ДАБРА (*CASTOR FIBER* L.) У СРБИЈУ И ПОВРАТАК ЊЕГОВОГ ПАРАЗИТА: СЛУЧАЈ *STICHORCHIS SUBTRIQUETRUS*

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Након нестанка у другој половини XX века, европски дабар (*Castor fiber* L. 1758) је током 2004-2005. године, успешно реинтродукован са подручја Баварске у Србију. Током обдукције једне адултне женке (пронађена мртва у децембру 2006) пронашли смо паразите у желуцу који су идентификовани као *Stichorchis subtriquetrus*. То је први налаз овог специфичног паразита дабра у Србији. Декодирањем субкутано имплантираног микрочипа, потврђено је да пронађена женка једна од 20 јединки које су децембра 2004. године насељене на подручју Специјалног резервата природе Обедска бара. Ова чињеница нам сугерише да је паразит нежељено реинтродукован у Србију заједно са дабровима који су пореклом из Баварске насељавани у Србију.