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Dung beetles of the genera *Onthophagus* Latreille and *Aphodius* Illiger (Coleoptera: Scarabaeidae) found in canine faeces in mown parks and in equine faeces in and around the city of Brno

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FISCHER O. A. 2006: Dung beetles of the genera *Onthophagus* Latreille and *Aphodius* Illiger (Coleoptera: Scarabaeidae) found in canine faeces in mown parks and in equine faeces in and around the city of Brno. *Acta Musei Moraviae, Scientiae Biologicae* (Brno) **91:** 83–91. – Canine faeces on mown public grass often contain the causative agents of zoonoses, especially parasitoses. Dung beetles of the genera *Onthophagus* Latreille, 1802 and *Aphodius* Illiger, 1798 are able to develop in canine faeces and partly decompose them, but they may also contaminate grazing pastures for animals, such as horses, with the causative agents of canine zoonoses originating from canine excrement. The numbers of canine faecal deposits were counted on 18 mown areas of public grass in the city of Brno (Moravia, Czech Republic) between April and June 2003. The species composition of dung beetle fauna associated with canine and equine faeces was studied in twelve Brno localities in the years 2001–2003. The mean number of canine faeces was 10.9±10.2 per 100 m^2 in city parks in April–June 2003. Only two (1%) of 196 canine faeces were colonized by dung beetles. A total of 211 dung beetles were collected, 92 of them in canine faeces and 119 in equine faeces. *Onthophagus fracticornis* (Preyssler), *O. coenobita* (Herbst), *O. ovatus* (Linnaeus), *Aphodius distinctus* (O. F. Müller), *A. sticticus* (Panzer), *A. prodromus* (Brahm) and *A. fimetarius* (Linnaeus) were found in both canine and equine faeces. *O. vacca* (Linnaeus) was found only in canine faeces. The eudominant species found in canine and horse faeces were *O. fracticornis* and *O. ovatus* and *A. prodromus, A. fimetarius, A. sticticus*, respectively. The similarity of species composition in dung beetle communities in canine and equine faeces was high (84.4%).

Key words. Municipal faecal waste, canine zoonoses, pastures, coprophagous insects

Introduction

Canine faeces may lead to serious public health and animal health problems in towns and villages, because they may contain various causative agents of zoonoses, such as salmonellosis, cryptosporidiosis and giardiasis (FUKATA *et al.* 2002, HACKETT & LAPIN 2003, TRAUB *et al.* 2003), echinococcosis (LENSKÁ & SVOBODOVÁ 2003) and larval toxocariasis (BALICKA-RAMISZ *et al.* 2005). Dung beetles of the genera *Aphodius* Illiger, 1798 and *Onthophagus* Latreille, 1802 utilize the faeces of many animal species as food resources. They penetrate the faeces, partially enabling their decomposition (BALTHASAR 1956, TESAŘ 1957, ZAHRADNÍK 1974, HOLTER *et al.* 2002, GONZÁLES-MEGÍAS & SÁNCHEZ-PIÑERO 2003). Many species of dung beetles are included in the life cycles of parasitic nematodes, such as nematodes of the family Spiruridae, as intermediate hosts (SPREHN 1957, KUDO *et al.* 2003). Some dung beetles may contaminate pastures with the eggs of parasitic helminths (BÍLÝ *et al.* 1978, KABILOV 1978, LONC 1980) and cryptosporidial oocysts (MATHISON & DITRICH 1999) originating from faeces. If the pastures are contaminated by dung beetles, infection of grazing animals, such as horses, is possible. Although dung beetles have often been studied in the faeces of herbivorous

animals, there is a lack of information about their occurrence in the faeces of carnivorous animals, especially dogs. Canine faeces were counted and the species composition of dung beetles of the genera *Onthophagus* and *Aphodius*, which are able to utilize canine faeces, and their occurrence in equine faeces were studied in and around the city of Brno.

Material and Methods

Study areas. Dung beetles of the genera *Onthophagus* and *Aphodius* were observed in 14 localities (Appendix I) in the city of Brno (Moravia, Czech Republic). The industrial city of Brno has more than 400.000 inhabitants and a concomitantly large canine population. The whole city area, around 430 km^2, includes, typically enough, various places with quite different environmental conditions: densely populated city quarters with numerous blocks of flats, streets and squares, public parks, spruce and deciduous forests, forest parks, open parks, fields and gardens, as well as pastures for horses (FISCHER 2005). The horse pastures are situated in Brno-Ořešín (locality 2), Brno-Soběšice (locality 3) and Brno-Bystrc (locality 5) (Appendix I). In addition, there are stables in the University of Veterinary and Pharmaceutical Sciences in Brno-Královo Pole (locality 7), the Eliot and Moravan horse riding clubs in Brno-Bystrc (locality 5) and Brno-Žabovřesky (locality 9), respectively (Appendix I).

Counting of canine faeces on grass in the city of Brno. Canine faecal deposits (for the purposes of this paper defined as the product of one act of defecation by one dog) were counted during meander walking at 18 randomly chosen pieces of mown grass in six localities (localities 5, 6, 7, 8, 11, 12) in Brno from April to June 2003. An area of 100 m^2 of each site was examined. The number of canine faecal deposits per area and their colonization by the dung beetles were recorded (Tab. 1).

Locality	Number of lawns examined	Number of canine feces per one lawn	Number of canine feces examined	Number of canine feces colonized by the dung beetles (%)	Months
5	2	12.0 ± 2.8	24	0 (0)	IV
6	2	0.5 ± 0.7	1	0 (0)	IV
7	5	15.4 ± 14.9	78	1 (1.3)	IV-V
8	4	3.5 ± 2.7	14	0 (0)	V-VI
11	3	16.0 ± 7.8	48	0 (0)	IV
12	2	15.5 ± 7.8	31	1 (3.2)	IV
Total	18	10.9 ± 10.2	196	2 (1.0)	IV-VI

Tab. 1. Occurrence of canine faecal deposits on grassy areas in six Brno localities and their colonization by dung beetles.
Tab. 1. Výskyt psího trusu na trávnících na šesti brněnských lokalitách a jeho osídlení chrobáky.

Collection of dung beetles. Imagos of the dung beetles were found in animal faeces in periods from March to November during the years 2001–2003. No collections of dung beetle imagos of were carried out in the winter months (December–February). The imagos collected were killed with ethyl acetate vapour, washed with warm water with a tenside (1% solution of "Jar", a local washing-up liquid) to remove particles of soil and faeces, then air dried, prepared, determined (TESAŘ 1957, MEDVEDEV 1965, DELLACASA & DELLACASA 2003) and counted. The dung beetles were named according to the nomenclature used by TESAŘ (1957), KRÁL (1993) and CHOBOT (1997).

Statistical methods. The index of dominance (D) (Tabs 2, 3) was expressed as a percentage of dung beetle species in a community (HANEL & ZELENÝ 2000). The species were divided according to LAŠTŮVKA & KREJČOVÁ (2000) into the following four classes of dominance:

- eudominant species, which constitute more than 10% of a specimen
- dominant species, which constitute 5.1–10% of a specimen
- subdominant species, which constitute 2.1–5.0% of a specimen
- recedent species, which constitute 1.0–2.0% of a specimen

Any similarities in the species composition of communities of dung beetles found in canine and equine faeces were assessed through Sørensen´s index of similarity of species composition of communities, as modified by Spellerberger (C_n) after HANEL & ZELENÝ (2000).

Results

Numbers of canine faecal deposits on mown grass in the city of Brno. The total mean number of canine faecal deposits per 100 m^2 was 10.9±10.2. The highest mean number of canine faecal deposits (16.0±7.8) was recorded in locality 11 on April 2003. Only two (1%) of 196 canine faecal deposits were colonized by dung beetles (Tab. 1).

Occurrence of the dung beetles in canine faeces. A total of 92 imagos of dung beetles belonging to following eight species were found in canine faeces: *O. fracticornis* Preyssler*, O. coenobita* Herbst*, O. vacca* Linnaeus, *O. ovatus* Linnaeus*, A. prodromus* Brahm, *A. fimetarius* Linnaeus*, A. sticticus* Panzer and *A. distinctus* Müller. The most abundant (eudominant) species were *O. fracticornis* and *O. ovatus* (Tab. 2, Fig. 1).

Occurrence of the dung beetles in horse faeces. A total of 119 imagos of dung beetles belonging to following seven species were found in equine faeces: *O. fracticornis, O. coenobita, O. ovatus, A. prodromus, A. fimetarius, A. sticticus* and *A. distinctus*. Eudominant species were *A. prodromus*, *A. fimetarius* and *A. sticticus* (Tab. 3, Fig. 1).

Similarity of species composition in the dung beetle communities. The species composition of communities of dung beetles in canine and equine faeces were very similar (C_n = 84.4%). *O. fracticornis*, *A. prodromus* and *O. fracticornis*, *O. ovatus,*

Species	Number of the dung beetles	D (%)	Class of dominance	Localities	Months
Onthophagus fracticornis (Preyssler, 1790)	45	48.9	eudominant	1,2,4,5,8,9,12	V-X
Onthophagus coenobita (Herbst, 1783)	4	4.4	subdominant	7,12,14	V-IX
Onthophagus vacca (Linnaeus, 1767)	3	3.3	subdominant	5,9	V-X
Onthophagus ovatus (Linnaeus, 1767)	28	30.4	eudominant	4,5,7,14	IV-VII
Aphodius prodromus (Brahm, 1790)	5	5.4	dominant	2,5,10	X-XI
Aphodius fimetarius (Linnaeus, 1758)	1	1.1	recedent	12	IV
Aphodius sticticus (Panzer, 1798)	5	5.4	dominant	5,10	X
Aphodius distinctus (O.F. Müller, 1776)	1	1.1	recedent	5	XI
Total	92				VI-XI

Tab. 2. Dung beetles found in canine faeces. (D = index of dominance.)
Tab. 2. Chrobáci nalezení v psím trusu. (D = index dominance.)

Species	Number of the dung beetles	D (%)	Class of dominance	Localities	Months
Onthophagus fracticornis (Preyssler, 1790)	8	6.7	dominant	2,5	V-X
Onthophagus coenobita (Herbst, 1783)	2	1.7	recedent	5	IV-V
Onthophagus ovatus (Linnaeus, 1767)	4	3.4	subdominant	5	IV-X
Aphodius prodromus (Brahm, 1790)	29	24.4	eudominant	2,3,5	III-XI
Aphodius fimetarius (Linnaeus, 1758)	35	29.4	eudominant	1,2,5,13	VII-XI
Aphodius sticticus (Panzer, 1798)	39	32.8	eudominant	1,2,3,5,9	V-IX
Aphodius distinctus (O.F. Müller, 1776)	2	1.7	recedent	9	IX
Total	119				III-XI

Tab. 3. Dung beetles found in equine faeces. (D = index of dominance.)
Tab. 3. Chrobáci nalezení v koňském trusu. (D = index dominance.)

A. prodromus, *A. sticticus* were found in both canine and equine faeces in locality 2 (Brno-Ořešín) and locality 5 (Brno-Bystrc), respectively.

Periods of dung beetle activity. Most of the dung beetles were active from April or May to November (Tabs. 2 and 3). *A. prodromus* had the longest period of activity, from March to November (Tab. 3).

Discussion

Some dung beetles utilize decaying plant remnants, others consume the fungi, carcasses or waste found in bird nests (KRIŠTOFÍK *et al.* 2003, ŠUSTEK & KRIŠTOFÍK 2003), but most of them prefer the faeces of herbivorous and omnivorous animal species

(Balthasar 1956, Tesař 1957). Canine faeces are not the primary food of the dung beetles, but they are also utilized. Most species of the genus *Aphodius* employ endocoprid nesting (thus being termed "endocoprids"), in which adults lay eggs and the resulting larvae complete development inside faeces (Holter *et al.* 2002, Gonzáles-Megías & Sánchez-Piñero 2003). Most species of the genus *Onthophagus* are paracoprid species ("tunnellers"), which construct nests directly under faecal deposits by digging a burrow in which they store the faeces in the form of brood masses. Their eggs are laid inside the brood masses (Zahradník 1974, Holter *et al.* 2002, Gonzáles-Megías & Sánchez-Piñero 2003). Canine faeces are more suitable for paracoprid nesting than for endocoprid development. Great differences of faecal preference in different species of dung beetles were recognized in this study. *A. fimetarius*, which is considered polyphagous (Lonc 1980), was found massively in equine faeces (29.4%), in great similarity to a report by Tesař (1957), but surprisingly only one imago (1.1%) of *A. fimetarius* was found in canine faeces (Tab. 2). This species also utilizes human stool and can ingest the eggs of the tapeworm *Taenia saginata* Goeze and then excrete them in faeces as long as 12 hours afterwards (Lonc 1980). It may carry and disseminate the eggs of *T. saginata* (Bílý *et al.* 1978) and serve as intermediate host in the life cycle of the parasitic nematode *Gongylonema pulchrum* Molin (Sprehn 1957). However, the rare occurrence of this species in canine faeces indicates its low importance for the spread of agents of canine zoonoses. *O. fracticornis*, the most numerous beetle, which was found in canine faeces, is abundant (Tesař 1957, Chobot 1997), as is *O. coenobita* (Tesař 1957) and *O. ovatus* (Skuhravý & Novák 1957, Skuhravý *et al.* 1959). *O. ovatus* has been found in a bird's nest (Krištofík *et al.* 2003). Species *O. vacca* was once considered to be rare (Týr 1997), but its occurrence in Brno corresponds with previous findings of *O. vacca* in the Brno-Kohoutovice locality (referred as locality No. 11 in Appendix I) reported by Juřena (1996). *A. distinctus, A. sticticus* and *A. prodromus* are abundant species that occur in spring and very frequently fly (Tesař 1957, Chobot 1997). Although Laštůvka & Krejčová (2000) proposed five classes of dominance, no dung beetles belonging to the fifth class (subrecedent species, which constitute less than 1% of a specimen) were found in this study. Although Jaccard´s or Sørensen´s index of similarity of species composition of communities is often used (Laštůvka & Krejčová 2000), they tend to exaggerate the importance of rare species (Hanel & Zelený 2000) and therefore a modified version of Sørensen´s index of similarity of species composition of communities of dung beetles (Hanel & Zelený 2000) was used in this study. The similarity of species composition of communities of canine faecal dung beetles and equine faeces was high (84.4%). The dung beetles associated with canine faeces must be included among insects of sanitary importance; they are abundant, able to fly and contaminate with causative agents of canine zoonoses plants that are eaten by herbivorous animals. For example, one study demonstrated that *O. ovatus* was one of the most abundant beetle species in fields of red clover (*Trifolium pratense*) (Skuhravý *et al.* 1959). Although dung beetles are useful, in that they contribute to the decomposition of faeces and decrease the numbers of free-living parasitic nematode larvae surviving in faeces (Waghorn *et al.* 2002, Chirico *et al.* 2003), their possible role in contamination of pastures should not be neglected.

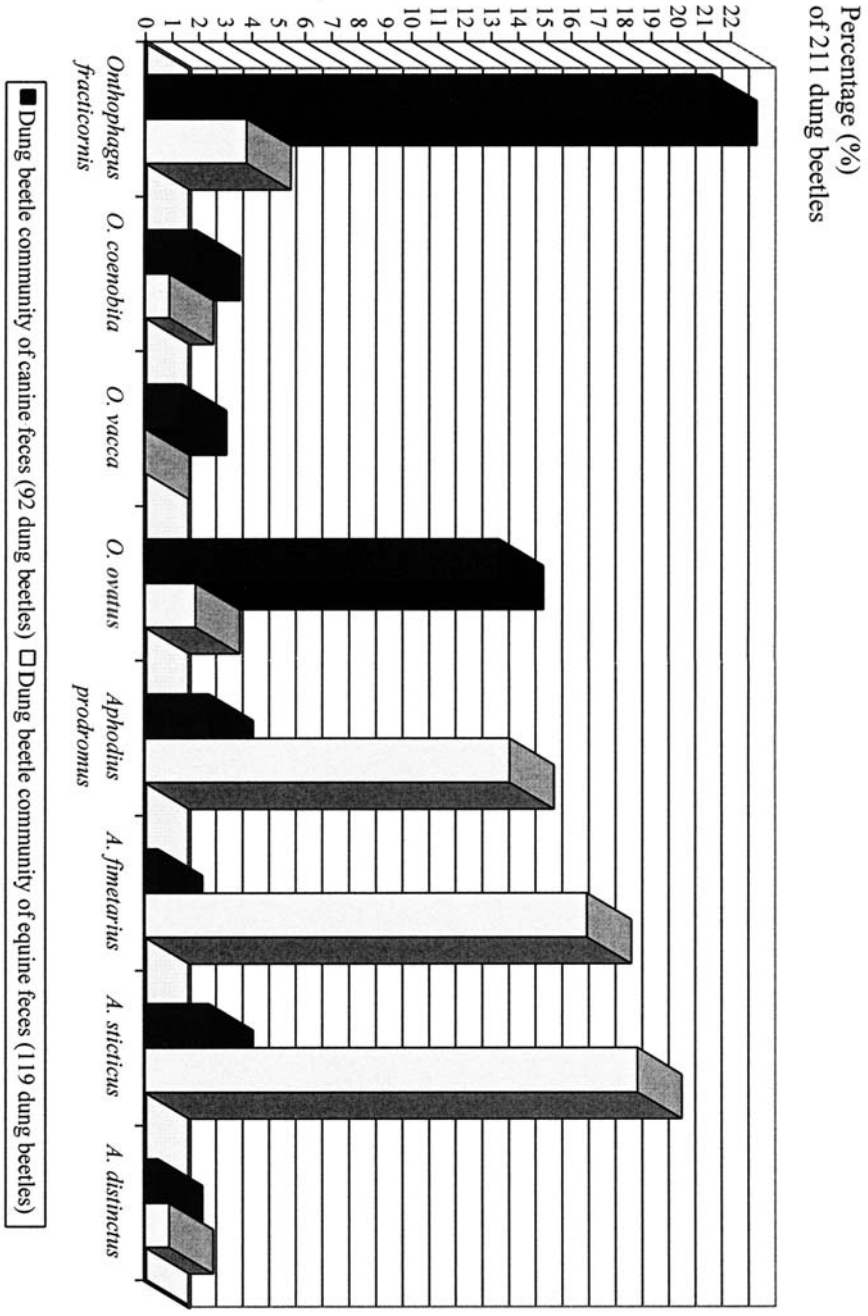

Fig. 1. Percentage of species composition of dung beetle communities of canine and equine feces.
Obr. 1. Procentické vyjádření druhového složení společenstev chrobáků psího a koňského trusu.

Souhrn

Psí trus na městských trávnících často obsahuje původce zoonóz, zejména parazitóz. Chrobáci rodů *Onthophagus* Latreille a *Aphodius* Illiger jsou schopni vyvíjet se v psím trusu a částečně jej rozkládat, ale mohou také kontaminovat pastviny, například pastviny koní, původci psích zoonóz pocházejícími z psího trusu. V dubnu až červnu 2003 byl počítán psí trus na 18 trávnících v městě Brně. V letech 2001–2003 bylo studováno druhové složení fauny chrobáků vyskytujících se v psím a koňském trusu na 12 brněnských lokalitách. Průměrný počet psího trusu na městských trávnících byl 10,9±10,2 na 1 ar (100 m^2), ale pouze dva (1%) ze 196 psích trusů byly osídleny chrobáky. Celkem bylo nalezeno 211 chrobáků, 92 z nich v psím trusu a 119 v koňském trusu. Jak v psím tak v koňském trusu byli nalezeni chrobáci *Onthophagus fracticornis* (Preyssler), *O. coenobita* (Herbst), *O. ovatus* (Linnaeus), *Aphodius distinctus* (O. F. Müller), *A. sticticus* (Panzer), *A. prodromus* (Brahm) a *A. fimetarius* (Linnaeus). Pouze v psím trusu byl nalezen *O. vacca* (Linnaeus). V psím trusu byli eudominantní *O. fracticornis* a *O. ovatus*. V koňském trusu byli eudominantní *A. prodromus, A. fimetarius* a *A. sticticus*. Podobnost druhového složení společenstev chrobáků v psím a koňském trusu byla vysoká (84,4%).

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APPENDIX

Number	Name	Coordinates	Elevation (m a. s. l.)	Faunistic code
1	Brno-Útěchov	49°17′ N 16°37′ E	461	6765
2	Brno-Ořešín	49°16′ N 16°36′ E	355	6765
3	Brno-Soběšice	49°15′ N 16°37′ E	373	6765
4	Brno-Medlánky	49°14′ N 16°34′ E	257	6765
5	Brno-Bystrc	49°13′ N 16°31′ E	215	6765
6	Brno-Komín	49°13′ N 16°33′ E	220	6765
7	Brno-Královo Pole	49°13′ N 16°35′ E	235	6765
8	Brno-Staré Brno	49°12′ N 16°11′ E	200	6765
9	Brno-Žabovřesky	49°12′ N 16°34′ E	270	6765
10	Brno-Černá Pole	49°12′ N 16°37′ E	240	6765
11	Brno-Kohoutovice	49°11′ N 16°32′ E	340	6865
12	Brno-Stránice	49°11′ N 16°34′ E	250	6865
13	Brno-Přízřenice	49°09′ N 16°37′ E	192	6865
14	Brno-Holásky	49°08′ N 16°39′ E	210	6865

Appendix I. Localities of study area.
Appendix I. Lokality sledované oblasti.