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Veterinary Parasitology

The prevalence, abundance and distribution of cyathostomins (small stongyles) in horses from Western Romania

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ABSTRACT

Forty seven working horses from Romania were post-mortem examined for small strongyles (Cyathostominae) infections. All horses were found infected. The overall cyathostomins intensity ranged from 390 to 13,010 and horses were infected by 8–24 species. The intensity was higher in ventral colon (1531) and dorsal colon (824), the lowest in the caecum (524). Twenty four species were identified. *Cyathostomum catinatum*, *Cylicocyclus insigne*, and *C. Nassatus* had 100% of prevalence. Over 50% of horses were infected by *Coronocyclus coronatus*, *Cylicostephanus calicatus*, *C. goldi*, and *C. longibursatus*. Other prevalent species (34%–45%) were *Cyathostomum tetracanthum*, *Cylicostephanus minutus* and *Gyalocephalus capitatus*. *Coronocyclus labiatus*, *Parapoteriostomum mettami*, *Poteriostomum imparidentatum* and *P. ratzii* had the lowest prevalence. Most species showed high organ preference with a niche breadth value between 1 and 1.96 while only 7 species (*Coronocyclus labiatus*, *Cyathostomum tetracanthum*, *C. brevicapsulatus*, *Cylicocyclus elongatus*, *C. insigne*, *C. leptostomum* and *C. radiatus*) showed a more generalist selection. The niche breadth of 10 species was significantly ($p < 0.05$) influenced by itself intensity (*Coronocyclus labratus*, *Cyathostomum pateratum*, *C. tetracanthum*, *Cylicocyclus elongatus*, *C. radiatus*, *C. ultrajectinus*, *C. leptostomum*, *Cylicodontophorus euproctus*, *Poteriostomum imparidentatum*, *P. ratzii*). The niche breadth of *Cylicocyclus nassatus* was positively ($p < 0.05$) influenced by the summed intensity of the other species while that of *Cylicocyclus elongatus* was negatively ($p < 0.05$) influenced by the intensity of the other species. The cluster analysis of the Cyathostominae community composition showed a major cluster composed by the three dominant species, followed by a cluster composed by *Coronocyclus coronatus*, while all the other species presented a tree like structure.

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1. Introduction

Small strongyles (Nematoda, Stongylidae), known with the common name of cyathostomins (Cyathostominae), have emerged since the end of the last century as the most significant nematode pathogens of horses (Herd, 1990). Most horses harbour thousands of these worms without developing clinical disease, but in some case, cyathostomin infection leads to a severe inflammatory enteropathy affecting the large intestine. The cyathostomins have a direct life cycle, during which the larval stages undergo a period of inhibited development in the intestinal wall. Inhibited larvae play a crucial role in cyathostomin-associated disease, as large numbers of larvae can accumulate and subsequently reactivate to cause a syndrome known as larval cyathostominosis characterized by weight loss, diarrhoea and/or subcutaneous oedema and various types of equine colic (Mathews et al., 2004). Furthermore, anthelmintic resistance is widely spread in this group of parasites (Nielsesn et al., 2014).

There are approximately 50 cyathostomin species recognized in the world (Lichtenfels et al., 2008), however only a few species are dominant (Reinemeyer et al., 1984; Lyons et al., 1999; Lichtenfels et al., 2008) and the prevalence of the less common species is greatly underestimated (Chapman et al., 2003; Traversa et al., 2010). Several studies have been carried out on the distribution and the prevalence of cyathostomins worldwide (Bucknell et al., 1996; Gawor, 1995; Linc et al., 1999; Lyons et al., 2000; Collobert-Laugier

et al., 2002; Peregrine et al., 2006; Traversa et al., 2010). Despite this, data of distribution and prevalence of cyathotomins in Romania are scanty, and the only data available are from the studies carried out by Morariu (2003) and Morariu et al. (2003) based on the identification of L_3 larvae from faecal cultures. This study reports the prevalence, mean intensity and distribution of cyathostomins from the large intestine of horses from Western Romania.

2. Materials and methods

A nonprobabilistic sampling procedure of convenience was used to sample 47 working horses from Western Romania. Western Romania. Horses were regularly slaughtered for meet human consumption in a local abattoir holding Euro RO 181 authorization and authorized to export to EU countries. Horses were never treated against parasites and were examined from May 2004 to March 2007. Horses were 1–23 year-old (median 10.5 years), 18 were female and 29 male horses. The necropsy procedures were carried out as described by Ogbourne (1975) and Duncan et al. (2002). Briefly, the large intestine was removed, ventral and dorsal colon and the caecum were isolated and separated with a double ligature. Each segment was opened, the contents removed and the mucosa thoroughly washed to remove free parasites. A sample of approximately 10% was taken and fixed in 10% formalin. The samples were examined under a magnifying lens, specimens retrieved, clarified in Amman's lactophenol and identified under a compound microscope at ×100 and ×400 n by morphological criteria according to the Lichtenfels et al. (2008).

2.1. Statistical analysis

For each parasite species prevalence and mean intensities were calculated according to Bush et al. (1997) providing 95% confidence intervals (C.I. 95%). For the prevalences, these were presented with the exact Agresti-Coull estimate (Agresti 2007).

For each infracommunity the Simpson's Index of diversity was computed as 1-D, where $D = \sum (n/N)$ with n = number of each chiatostomin species and N = sum of the total parasites in each horse. The Simpson's index thus represents the probability that two parasites randomly selected from an infracommunity will belong to different species.

Organ preference was evaluated through selection index (Krebs, 1999) which expresses the proportion of the parasite population which colonize each organs. Since in the case of Cyathostominae the available sites of colonization are 3, values greater than 0.33

Table 1
Intensity, mean species richness and mean species diversity of 24 cyathostomine species recovered in Horses from Romania.

	Intensity (CI 95%)	Mean species richness (CI 95%)	Mean species diversity (CI 95%)
Vental colon	1531.2 (1230–1831)	9.5 (8.6–10.4)	0.79 (0.77–0.80)
Dorsal colon	824 (670–977)	9.3 (8.3–10.2)	0.80 (0.79–0.82)
Caecum	523.6 (435–611)	8.8 (8.1–9.5)	0.71 (0.67–0.75)
Overall	2878.8 (2380–3377)	9.6 (8.6–10.5)	0.84 (0.83–0.85)

represents organs selected while lower values represents organ avoided.

Through Levin's index, niche breadth of each infrapopulation was calculated through the formula $1/\sum (p_i)^2$ (Simková et al., 2000), where p_i is the proportion of the infrapopulation exploiting each organ. For Cyathostominae, niche breadth range from 1, where all parasites infect a single organ, to 3 when parasites are equally distributed between organs.

To establish whether the niche breadth of each species was influenced by the organ crowding, generalized linear models (GLM) whit Gaussian family distribution were fitted for each species, considering niche breadth as response variable and as explanatory variables: the intensity of species under investigation and the sum of all other parasite intensities.

Finally, hierarchical cluster analysis using Euclidean distances and a complete linkage method was performed on individual horse abundances of each cyathostomin species in order to group parasite species on the basis of their patterns of distribution in the host (Fig. 2).

All of the statistical analyses were performed using the software R, version 3.2.1 (R Foundation for Statistical Computing, 2014) considering $p < 0.05$ as significance threshold.

3. Results

All horses were found infected with adult cyathostomins. Overall, 24 species belonging to the genera Coronocyclus, Cyathostomum, Cylicocyclus, Cylicostephanus, Cylicodontophorus, Gyalocephalus, Parapoteriostomum, Petrovinema and Poteriostomum, were found. The species intensity, mean richness and mean diversity in the caecun, ventral colon and dorsal colon are shown in Table 1. The overall intensity ranged from 390 to 13,010 and horses were infected by 8–24 species. The organ intensity was higher in ventral colon (1531) and dorsal colon (824), the lowest in the caecum (524). The mean species richness were similar in three organs with val-
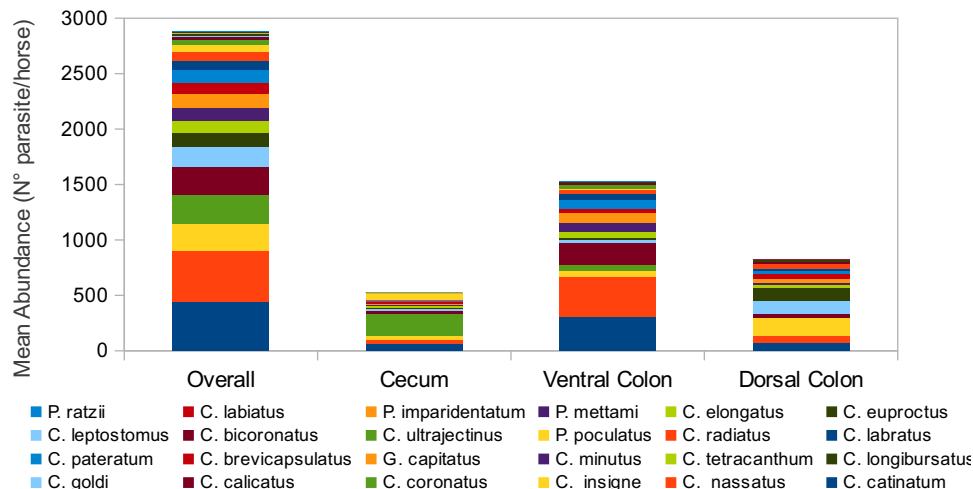

Fig. 1. Distribution of cyathostomin species in the large intestine of 47 horses from Romania.