Prevalence and Intensity of Helminth Parasites in Wild and Domestic Canids from Fecal Samples at Rice Creek Field Station

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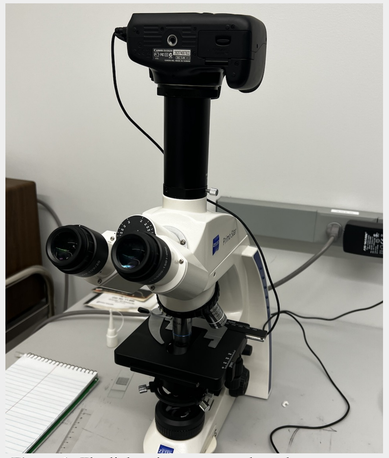

Figure 1: The light microscope used to take measure, count, and take photos of the samples.

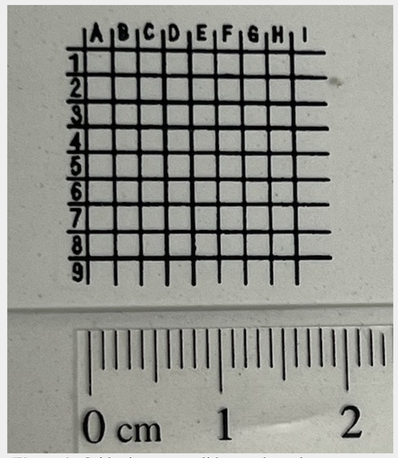

Figure 2: Grid microscope slides used to take accurate counts of eggs and larva in samples.

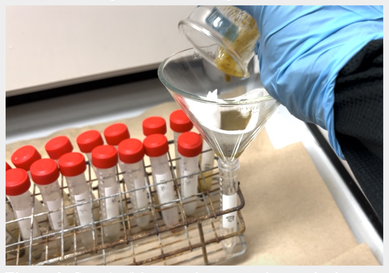

Figure 3: Step 1 of the sample preparation method.

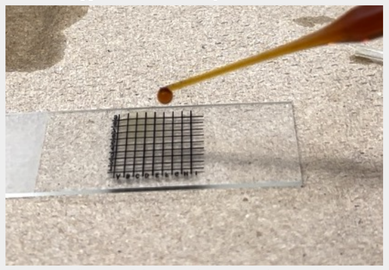

Figure 4: Step 9 of the sample preparation method.

Sample Preparation (Garcia, 2007):

1. 4 g of stool mixed with 10 ml of 5% formalin in a paper cup, mixed thoroughly, strained through gauze into a 15 ml centrifuge tube (Figure 3).
2. 0.85% NaCl was added to fill the tube, the tube was centrifuged for 10 min at 500 X g to obtain 0.5-1 ml of sediment.
3. Supernatant decanted, 0.85% NaCl was added to fill the tube to about 2-3 ml below the rim.
4. Tube was centrifuged again for 10 min at 500 X g.
5. Supernatant decanted, sediment resuspended in 7 ml 5% formalin and 4-5 mL ethyl acetate.
6. Tube was shaken for 30 sec, centrifuged a final time for 10 min at 500 X g.
7. After final centrifugation, four layers could be seen in the tube. Supernatant decanted to leave only drops of fluid on top of the sediment.
8. This fluid was mixed with the sediment using a pipette, a drop was removed with a pipette, placed on a grid slide with a 22 x 22 mm coverslip (Figure 4).
9. Lugol's iodine was added to stain the eggs.

Figure 5: Measuring animal tracks found near the sample to determine the species of origin according to Murie, 1982.

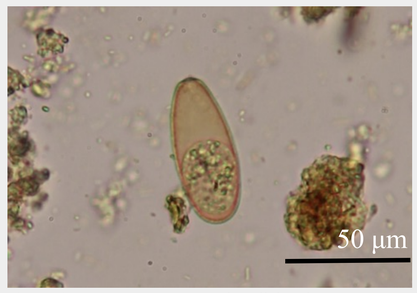

Figure 6: *Monocystis* oocysts under a light microscope at 40x objective magnification.

Figure 7: *Isospora belli* oocyst under a light microscope at 40x objective magnification.

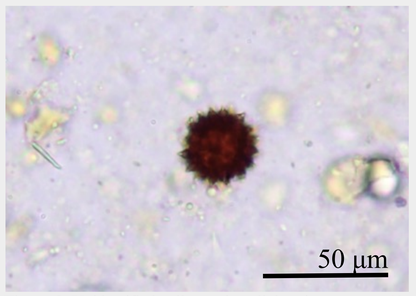

Figure 8: Unidentified pollen under a light microscope at 40x.

Introduction

- Many helminth parasites (worms) can infect Canidae. Most commonly roundworms (Nematoda) such as hookworms, whipworms, and ascarids have been observed because they have a direct life cycle and fecal-oral transmission (Gompper, M. E., et al., 2003; Lucio-Forster, A., & Bowman, D. D., 2011).
- There is a lack of peer-reviewed articles examining these parasites and the possibility of spillover from wild to domestic canids in Oswego, New York. Rice Creek Field Station is inhabited by a variety of wildlife and has four trails where people are welcome to walk their dogs (*Canis familiaris*).
- The goal of this study was to compare the prevalence and intensity of helminth infections in wild canids (*Canis latrans* and *Vulpes vulpes*) and domestic canids (*C. familiaris*).

Materials and Methods

- Stool samples from wild canids (*C. latrans, V. vulpes*) and domestic dogs (*C. familiaris*) collected on trails of Rice Creek Field Station. The origin of the sample was determined by referencing field guides (Murie, 1982) (Figure 5).
- Eggs were photographed at a total magnification of 400 X or 1000 X. Eggs were identified to the lowest taxonomic rank using a combination of human and veterinary parasitology reference manuals (Bowman, 2014: Colville, 2006; Despommier et al. 2019; Foreyt, 2001; Garcia, 2007; Hendrix, 2006; Michel, 2015).
- A light microscope with a digital camera (Figure 1) and a grid microscope slide (Figure 2) were used to count each parasite and determine the approximate intensity of eggs from each fecal smear from each sample.

Results

- 15 samples from domestic canines, 12 from wild canines (Table 1).
- Two parasitic protist species. Oocysts of *Isospora belli* (Apicomplexa) (Figure 6) were observed in one wild canine sample (Table 1). *Isospora* spp. infect the small intestine of dogs and cats. Oocysts of the earthworm parasite, *Monocystis lumbrici* (Figure 7) were observed in two wild samples (Table 1).
- Several unidentified pollen grains (Figure 8), and pine pollen (*Pinus* sp.) (Figure 9).
- Hookworm eggs are ovular with a thin shell, contain a conspicuous morula (Figure10). Larvae of the hookworm spp. were found in the samples (Figure 11).
- *Toxocara canis* eggs are spherical, containing a deep pigmented embryo surrounded by a rough, pitted shell (Figure 12).
- Whipworm eggs (*Trichuris vulpes*) are elongated, lemon-shaped, with polar plugs on opposite ends (Figure 13).
- *Alaria* sp. eggs were observed in one wild sample (Figure 14). Eggs are large (>100 µm), ovoid, unembryonated, with a small operculum (Bowman, 2014).

Discussion

- Some parasites, such as hookworms, are not easily identifiable based on morphology alone. Several hookworm species infect canines including *Ancylostoma caninum*, *A. tubaeforme*, *A. braziliense*, and *Uncinaria stenocephala* (Hendrix, 2006). Hookworm species cannot be differentiated based on egg measurements (Colville, 2006).
- *Alaria* spp. infect canids and felids. *Alaria* spp. have an indirect life cycle and must infect a snail, frog, and a snake intermediate host (Roberts et al., 2013). Trematodes and tapeworms have been reported from wild and domestic canids (Lucio-Forster, A., & Bowman, D. D., 2011) but are uncommon because they are acquired by ingesting an intermediate host.
- Based on the limited amount of data collected, it is possible that some spillover of whipworm may have occurred between the wild and domestic canines.
- The collections herein were made during one month, yielded 27 samples.
- Other studies demonstrated wild and domestic canines can be infected by the same helminth species, but are based on collections made over months to years with hundreds of samples collected (Gompper et al., 2003; Lucio-Forster et al., 2011; Whipps et al., 2019).
- The data herein may suggest a possible threat to domestic canines at Rice Creek Field Station if wild canine feces are ingested because 83.3% of wild canine samples contained at least one parasite.

Acknowledgements

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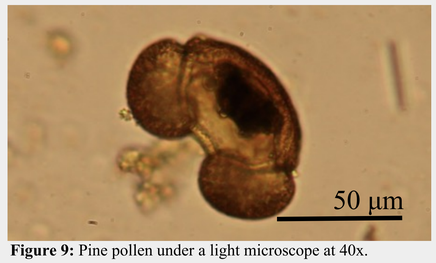

Figure 9: Pine pollen under a light microscope at 40x.

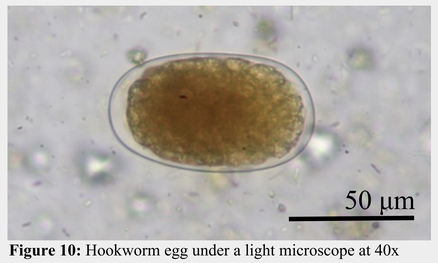

Figure 10: Hookworm egg under a light microscope at 40x objective magnification.

Figure 11: Hookworm larva under a light microscope at 40x objective magnification.

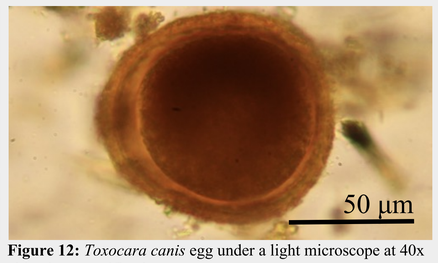

Figure 12: *Toxocara canis* egg under a light microscope at 40x objective magnification.

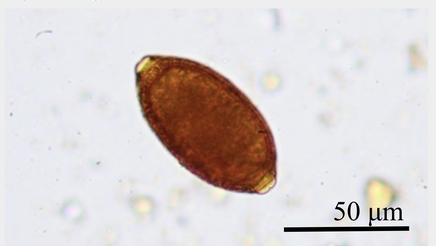

Figure 13: Whipworm under a light microscope at 40x objective magnification.

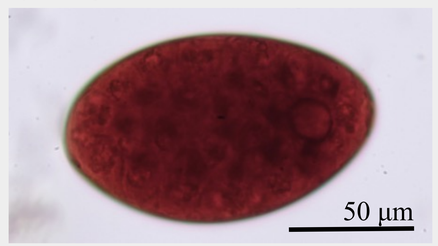

Figure 14: *Alaria* sp. egg under a light microscope at 40x objective magnification.

	Domestic (n = 15)		Wild (n = 12)	
	Prevalence	**Intensity Range**	**Prevalence**	**Intensity Range**
Nematoda				
Hookworm			7 (58.3%)	[1-8]
Trichuris vulpis	1 (6.7%)	[5]	2 (16.7%)	[1]
Toxocara canis	1 (6.7%)	[7]	1 (8.3%)	[1]
Platyhelminthes, Trematoda				
Alaria sp.			1 (8.3%)	[4]
Apicomplexa				
Isospora belli			1 (8.3%)	[4]
Monocystis			2 (16.7%)	[89-1942]

Table 1. The prevalence and intensity of parasites in wild and domestic canids form fecal samples collected at Rice Creek Field Station.

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