Urban Otter Health: Part 1

July 28, 2020
by Dawn Tanner, PhD
VLAWMO Program Development Coordinator

Otters at rural and urban sites included in this project:

Preliminary insights from pilot data

- **Remote-camera data shows a behavioral shift toward increased nocturnality at urban compared to rural sites (2018-2019)**

- **Scat survey indicates higher presence and diversity of parasites at urban compared to rural sites (2020)**

VLAWMO makes it a priority to better understand our wetlands in a variety of ways. One way we do that is by conducting research on indicator species. Indicator species tell us something special about the environment in which they live. Some species are indicators of habitat health and water quality (e.g., River otters). These species are of particular interest as we work to learn more about wildlife diversity in the Vadnais Lake Area Watershed. In our River otter project, we are asking about the behavior and health of urban otters compared to rural otters. We know that otters are present in our watershed. We wonder: Are they as healthy as otters living in more pristine habitats? In our urbanized watershed, which wetland areas are most important for urban otters? Can we use our information about otters to better inform wetland preservation and restoration efforts?

Remote-camera summary:

The remote-camera portion of this project is presented in detail in the full report-camera monitoring report (available on the VLAWMO website and as a StoryMap). Key elements are summarized here.

River otters were frequently photographed in Vadnais-Sucker Regional Park and along Lambert Creek. As follow-up of initial remote-camera data, VLAWMO requested reports from the public about River otter activity locations. Staff visited sites reported by residents and documented otter-activity sites observed during remote-camera exploration and setup. Many latrines, a den site, tracks, trails, and feeding areas were observed and documented. A map was generated with these results.

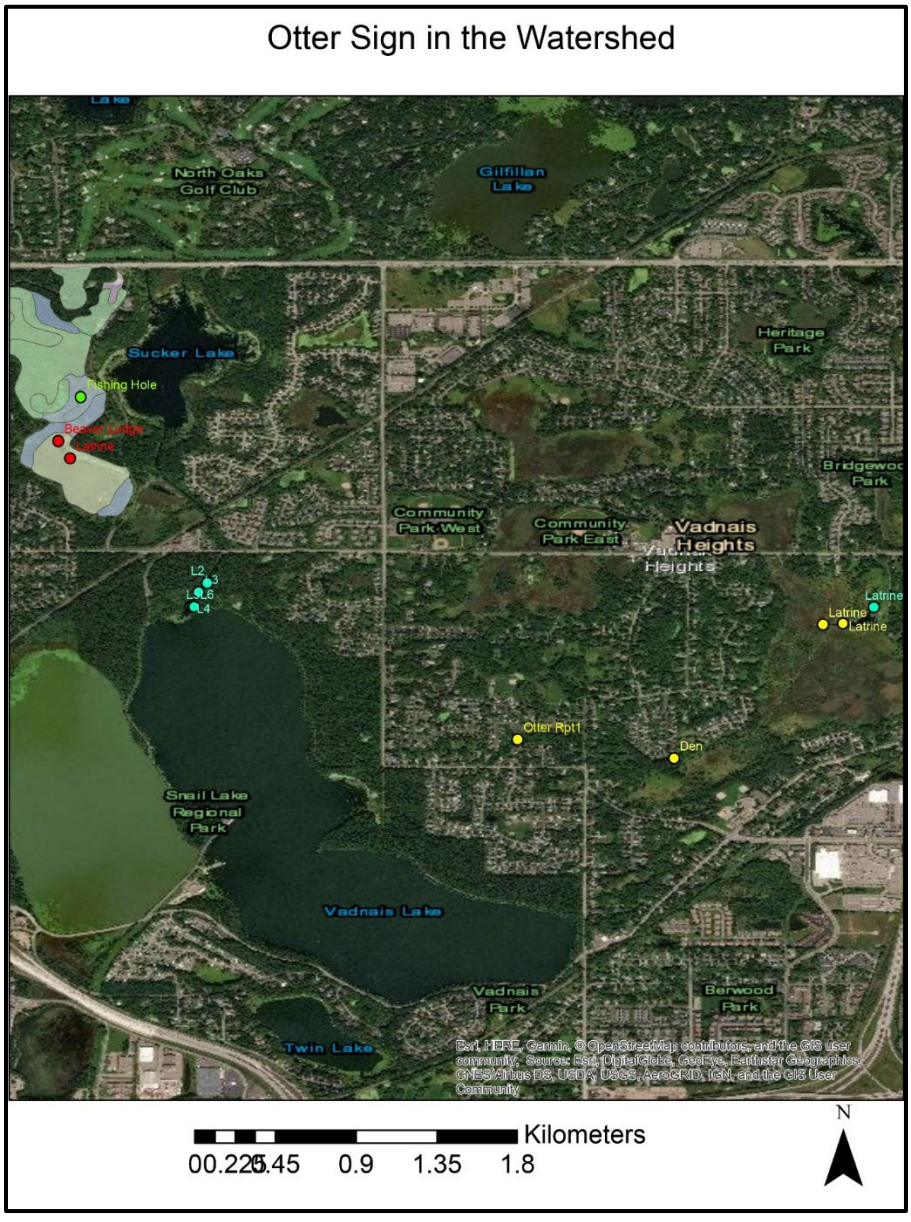

Figure 1: Otter sign observed during fall, 2018, through spring, 2019.

Rationale

River otters are of particular interest to VLAWMO because they are apex predators that bioaccumulate environmental toxins (e.g., PBDEs, PCBs, lead, mercury) and are indicators of water quality and habitat health (Dornbos et al. 2013; Nelson & Schulte 2015; Holland et al. 2018). A healthy population of otters bodes well for water quality, which is of additional importance because East Vadnais Lake is the drinking-water reservoir for many residents of St. Paul and surrounding communities. Otters need healthy wetlands and sympatric species closely associated with water (e.g., beavers). Urban otters may face more challenges surviving (e.g., high quality habitat areas separated by road networks) and have increased exposure to disease and pollutants than rural otters. Research has shown that Sea otters are 3 times more likely to be infected by *Toxoplasma gondii*, a parasite carried by domestic cats, near freshwater flow areas (Shapiro et al. 2019). Otters and other mustelids are more likely to be infected by this parasite in urban areas (Barros et al. 2018). The risk of Toxoplasmosis to a developing human fetus is the reason pregnant women are advised to avoid cleaning the litter box, wash vegetables thoroughly, and avoid eating undercooked meat. As a watershed with important freshwater resources and an urbanized landscape, these kinds of disease issues are important to understand more clearly. These are issues VLAWMO is working to pursue as we increase focus on improving water quality and better understanding, conserving, and restoring wetlands in the watershed.

Remote cameras provide information about wildlife activity patterns. A recent paper published in Science focused on this question. The authors conducted a global study of published research that used remote cameras and radio telemetry. They found that many wildlife species are shifting activity patterns to be more nocturnal in urban areas. They hypothesized that animals do this to avoid negative encounters with humans by separating themselves in time rather than space (Gaynor et al. 2018). The authors recognized that there may be negative consequences of this shift including: reduced foraging/feeding time, increased stress hormone production, and overall decreased activity. The study concluded that “such responses can result in marked shifts away from natural patterns of activity, with consequences for fitness, population persistence, community interactions, and evolution.”

Within our watershed organization, there is not an opportunity to conduct a full-scale research project on River otter activity patterns. However, we were able to conduct this pilot project by monitoring a latrine site in a rural location (outside of Long Prairie, Minnesota, along the Long Prairie River) and compare that to data collected in the watershed (Figures 3, 4, and 5). The results of that comparison support the conclusions of the global paper referenced above. We saw higher activity throughout 24 hours in the rural setting. We saw greatly reduced activity during daylight hours in the urban setting.

As a result of remote-camera surveys, VLAWMO is working with partners to conduct a small radio telemetry study on River otters. A wetland survey and delineation is scheduled for summer 2020, focused in the East Vadnais and Sucker Lake subwatershed. The otter telemetry study and wetland delineation will further illuminate wetland needs and help identify priority wetland areas.

Figures 3, 4, and 5: Otter activity at rural (~17 months of data collected) versus urban (~6.5 months of data collected) latrine sites.

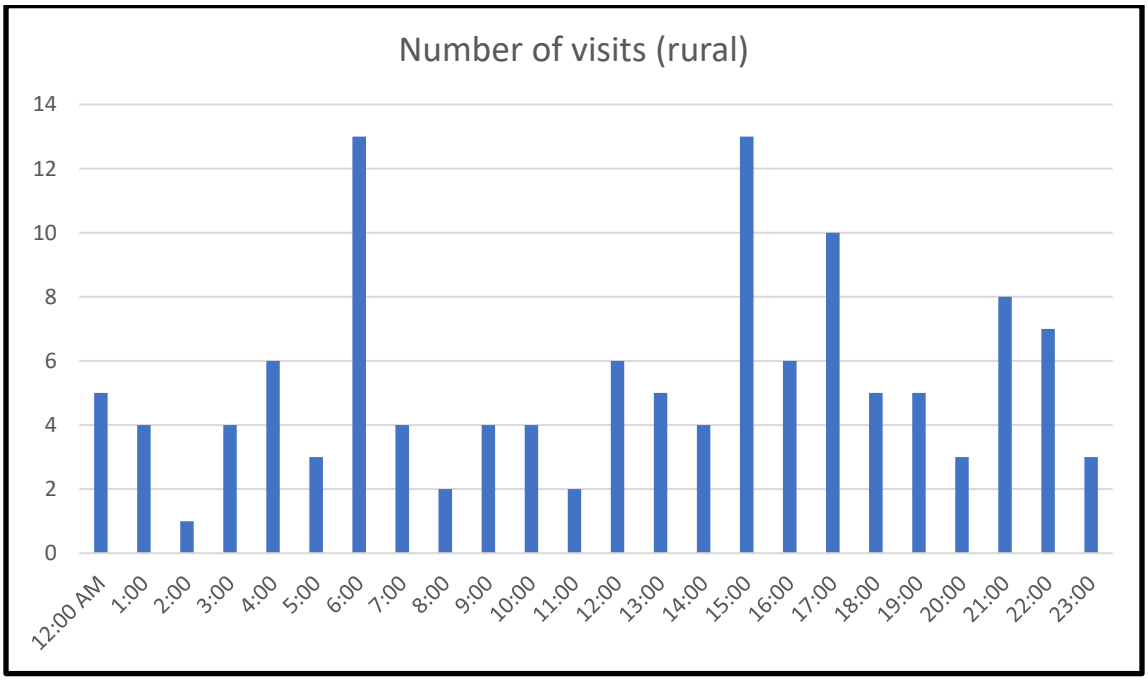

Figure 3: Otter activity at latrine sites (rural)

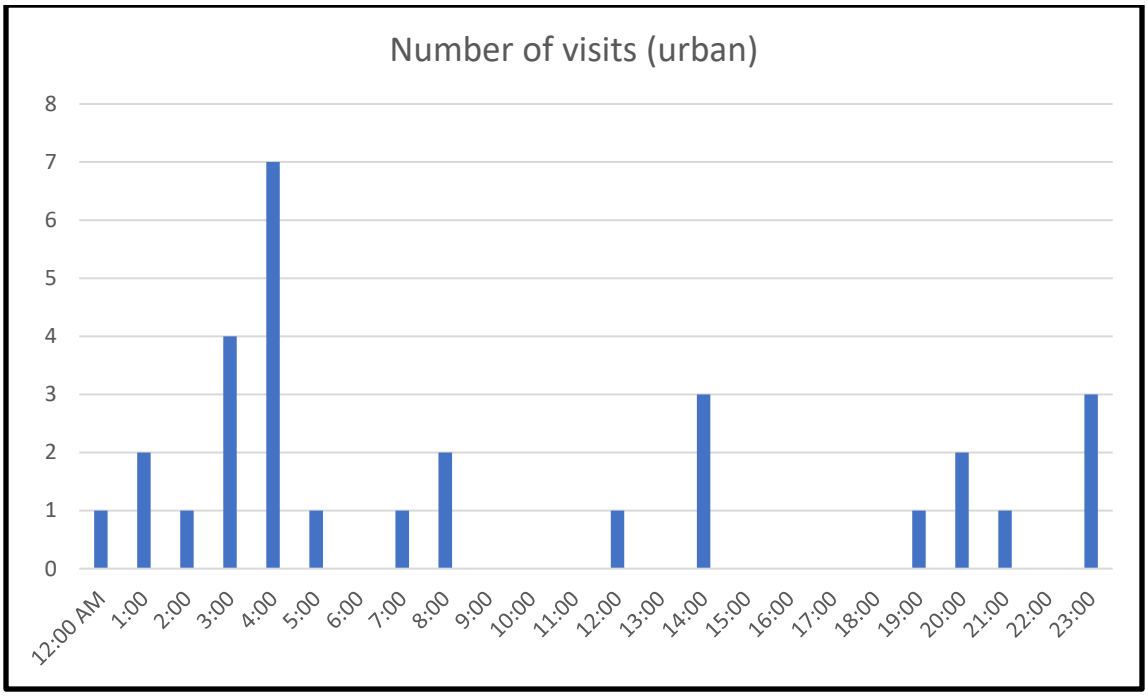

Figure 4: Otter activity at latrine sites (urban)

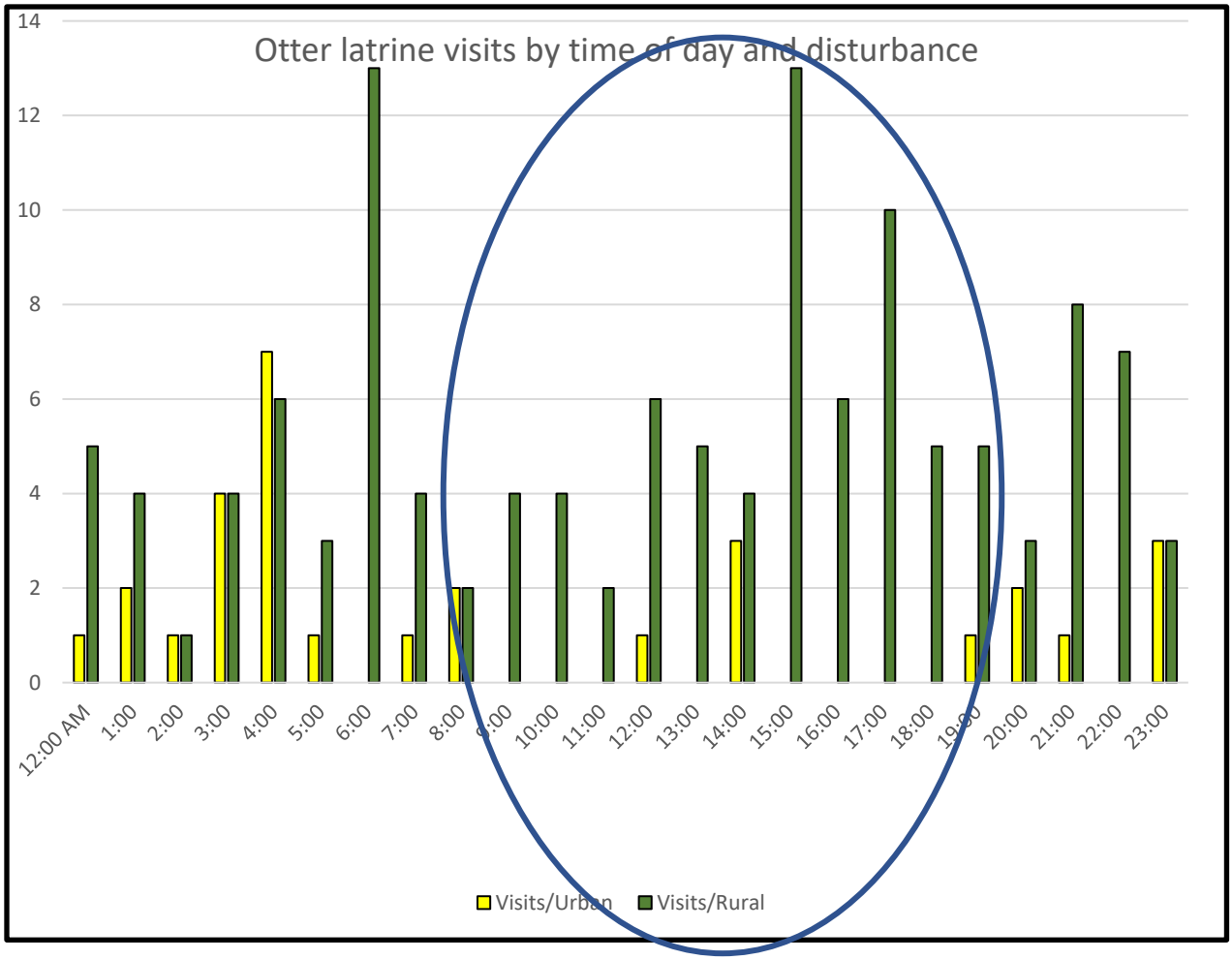

Figure 5: This graph shows urban and rural visits at latrine sites by River otters side by side. Otters are active throughout day and night hours at the rural site. Visits to the latrine during daylight hours are greatly reduced at the urban site.

Scat Survey

Protocol

Otter latrine sites were identified as part of the remote-camera study that preceded scat collection and analysis. Through that study, otters were found to visit the focal latrines on average every 7-12 days (with longer gaps in the summer). We predicted that we would need to visit latrine sites daily for 1-2 weeks to obtain samples.

We partnered with University of Minnesota Veterinarian Erin Burton and her lab technician Susanne Prouty at the Veterinary Diagnostic Lab. The author (D. Tanner) collected fresh otter scat samples (usually within 24 hours of defecation) from urban (N = 4) and rural (N = 2) latrines. Urban latrines were

located at 2 primary sites, each with 2 separate latrines. The rural site included 1 primary site with 2 separate latrines. Within a site, latrines were located close to each other (within 200 m).

Latrines were checked daily, in the morning between 7:00-8:00 am, to guarantee that samples were as fresh as possible. Spring/early summer scat collection was used to avoid freezing or extreme heat that could damage parasites and eggs. Multiple latrines were checked daily to guarantee as much as possible that samples were from different individual otters. DNA analysis would be required to verify this for certain; that was not included in this project. Latrine checks began on June 3, 2020, and continued until 9 samples were found on the same day, on day 11 (June 13, 2020) at the urban site. At the rural site, checks were conducted during the same timeframe, extending to July 5, 2020. Checks were done on consecutive days over extended weekend periods. Sites were raked and vegetation trimmed back to make fresh samples easier to locate. Three fresh samples were collected at the rural site, and 1 desiccated sample that had been defecated days prior was collected and analyzed as a check to demonstrate the importance of fresh samples (no eggs or parasites were collected from this sample; it only contained mites that likely colonized the scat after defecation). Samples from urban and rural sites represent a snapshot of parasite presence in the population; they do not provide a broader assessment because of the limited number of samples and restricted timeframe.

Samples were collected, placed into plastic compote cups, and put in a cooler for transport. If samples could not be transported directly to the lab, they were maintained in the cooler with ice—protected from direct contact with ice or frozen packets, and placed in a refrigerator until they could be dropped off at the lab. A maximum of 3 days was needed depending upon lab availability. Samples were maintained in the refrigerator at the Veterinary Diagnostic Center until they could be picked up and analyzed by the lab. The lab conducted an Immunofluorescence Assay for Cryptosporidium and Giardia and a centrifugal fecal flotation (33% $ZnSO_4$) to identify parasite ova and eggs. Some parasite eggs in specific orders and suborders are indistinguishable using morphology alone. Additional analysis, such as a PCR/DNA test, would be required to further characterize to the genus or species level. On fecal flotation, parasite ova and eggs were identified as specifically as possible using established morphology and size parameters, with additional notes as relevant for regional prevalence. Frequency was identified semi-qualitatively (1-10 per coverslip = Low, 11-100 per field = Moderate, and >100 = High). In general, parasites tend to have more extreme impacts on host health at higher densities.

Scat at latrines:

Results

All samples were negative when tested for Cryptosporidium and Giardia.

Fecal float results for Urban Samples (LL = Lambert Lake, EV = East Vadnais Lake):

Location	Relevant Parasites detected (Y/N)	Prevalence (Low, Moderate, High)	Description
Urban #1, LL latrine #1	Y	Moderate	Pseudophyllidean-type (cestode)
Urban #2, LL latrine #1	Y	Moderate	Pseudophyllidean-type (cestode)
Urban #3 LL latrine #1	Y	Low	Pseudophyllidean-type (cestode)
Urban #4 LL latrine #1	N	-	-
Urban #5 EV latrine #2	Y	Low	Free-living nematode larvae (parasitic vs. environmental)
Urban #6 EV latrine #2	N	-	-
Urban #7 EV latrine #2	Y	Low	Strongyle-type ova (nematode)
	N	Low	Mite ova (likely from environment)
Urban #8 EV latrine #2	Y	Low	Free-living nematode larvae (parasitic vs. environmental)
Urban #9 LL latrine #2	Y	Low	Strongyle-type ova (nematode)

Conclusion: Relevant parasites and/or parasite eggs were found in 78% of samples (7/9). Quantity ranged from low to medium with most samples that had parasites present in the low range (72%, 5/7).

Fecal float results for Rural Samples:

Location	Relevant Parasites detected (Y/N)	Prevalence (Low, Moderate, High)	Description
Rural #1 latrine #1	N	Low	Mite ova (likely from environment)
Rural #2 latrine #2	N	-	-
Rural #3 latrine #2	N	Low	Mite ova (likely from environment)
Rural #4 Latrine #2	Y	Low	Strongyle-type ova (nematode)
	Y	Low	Coccidia oocysts (Cause coccidiosis and part of group (subclass) likely Cystoisospora sp. – not the species that causes Toxoplasmosis)

Conclusion: Rural #1 was the desiccated sample described above. It was collected to analyze and demonstrate whether or not fresh samples were needed. The lab recommended that other desiccated samples should not be analyzed. These samples were unlikely to yield parasites, because the parasites and eggs would not remain viable. This sample is shown in the table but not included in further results. Relevant parasites and/or parasite eggs were found in 33% of samples (1/3). Quantity was low and included Coccidia, likely Cystoisospora sp., which does not cause Toxoplasmosis. Cystoisospora sp. are species specific and can be seen in older animals with no clinical consequence, but can cause severe diarrheal disease in animals (of all species) under 4-6 months of age.

Identified parasites explanation

Pseudophyllidean-type (tapeworms)	*Pseudophyllidea* is an Order of tapeworms that have an aquatic lifecycle and an intermediate host. The parasite larvae establish in the muscle of an intermediate host. Intermediate hosts include many fish species. Parasites are consumed by the definitive host when they eat raw fish. Definitive hosts include fish-eating mammals in freshwater and marine environments. The larvae penetrate the intestine of the definitive host where they grow into adult tapeworms and reproduce. Eggs are deposited in scat. The broad fish tapeworm is an example of a species in this Order. Adult tapeworms can be quite long-lived in the definitive host, at the scale of years, although age is not known for River otters. Tapeworms tend to have a low level of impact on their host.
Free-living nematode larvae (environmental vs. parasitic)	*Nematoda* is a Phylum that comprise all parasitic and free-living environmental helminth parasites. Fecal flotation solutions can distort morphological features that aid in distinguishing free-living from parasitic larvae in scat. Additional testing, such as Baermann examination, is needed on fresh scat to determine if the larvae are parasitic or environmental contaminates that invaded the feces following defecation. Environmental larvae are prioritized over parasitic in this case based on size of larvae observed on fecal flotation.
Strongyle-type ova (nematode)	*Strongylida* is a suborder of nematode that commonly infect the gastrointestinal tract. The larval forms migrate through lungs and other organs to infect the gastrointestinal tract and undergo sexual reproduction. High levels of uncontrolled replication are harmful to the host.
Mite ova (likely from environment)	*Arachnida* is a Class of small arthropods. Mites are commonly found in the environment. Mites cause scabies/mange (commonly from *Sarcoptes scabiei*) in mammals and can be highly contagious. *Sarcoptes scabiei* can be found in feces of heavily infected animal secondary to grooming. However, the morphological appearance of the mites in the stool of the otter favored environmental contamination over and mites do not inhabit the digestive system. Mites in scat samples likely were included from the soil or colonized the sample after being defecated by an otter. These mites do not pose a health risk to the otter.
Coccidia oocysts (microscopic, spore-forming, protozoan)	*Coccidia* is a Subclass of parasites that includes the species that causes Toxoplasmosis. The coccidia observed in the feces of these otters was likely *Cystoisospora* sp. based on morphology. Coccidia can infect all mammals, some birds, some fish, some reptiles, and some amphibians. Most species of coccidia are host species-specific. However, *Toxoplasma gondii* can infect all mammals; it only undergoes sexual reproduction in cats. Toxoplasmosis has been documented to have serious health effects in Sea otters. It is an important primary cause of death in necropsied Sea otters. However, Toxoplasma oocysts have a distinct morphology on fecal flotation, and Toxoplasma oocyst were not observed in the fecal sample.

Information compiled especially from: Garcia et al. 2018; Scholz et al. 2009; and E. Burton pers. comm.

Discussion

In this small sample of River otter scat, we documented the presence of a variety of parasites and their eggs at low to moderate levels. Previous studies have also documented these parasites in River otters (Hoberg et al. 1997; Kollars et al. 1997; Agnew et al. 2009). In the Agnew et al. study, River otters were trapped/harvested and necropsied (N = 67). Parasites were found in 67% of the otter digestive tracts and 60% of intestinal content samples. We did not harvest otters for this current project and instead analyzed scat samples. If we treat the results of this study as a baseline for comparison and use the intestinal content samples, parasite loads are higher in our urban samples (78%) versus rural samples (33%). However, this comes with a caveat of small sample size. A larger study would be needed to make statistically relevant conclusions and a robust comparison to this larger study with broader geographic distribution.

Further analysis will be conducted when the live-trapping phase of this project is conducted. Blood, tissue, hair, and scat samples will be collected from live otters and examined for disease agents, parasites, and heavy metals. This will also include a small sample size. It allows us to look and ask questions about the health of our urban otters as indicators of water quality. It does not allow us to make population-level conclusions.

Literature Cited

Agnew, M., A. M. Zajac, S. A. Smith, M. Fies. 2009. Parasites of the Northern river otter (*Lontra canadensis*) in Virginia, USA. Presented at International Association for Aquatic Animal Medicine (IAAAM). Download: https://www.vin.com/apputil/content/defaultadv1.aspx?id=3976372&pid=11285&print=1

Barros, M.; O. Cabezón, J. P. Dubey, S. Almeria, M. P. Ribas, L. E. Escobar, B. Ramos, G. Medina-Vogel. 2018. Toxoplasma gondii infection in wild mustelids and cats across an urban-rural gradient. *PLOS One*. 13(6): e0199085

Garcia, L. S., M. Arrowwood, E. Kokoskin, G. P. Paltridge, D. R. Pillai, G. W. Procop, N. Ryan, R. Y. Shimizu, G. Visvesvara. 2018. Laboratory diagnosis of parasites from the gastrointestinal tract. *Clinical Microbiology Review*: 31:e00025-17. https://doi.org/10.1128/CMR.00025-17.

Gaynor, K. M.; C. E. Hojnowski, N. H. Carter, J. S. Brashares. 2018. The influence of human disturbance on wildlife nocturnality. *Science*. 360: 1232-1235.

Grubbs, S. E., P. R. Krausman. 2009. Observations of coyote-cat interactions. *Journal of Wildlife Management*. 73: 683-685.

Hoberg, E. P., C. J. Henny, O. R. Hedstrom, and R. A. Grove. 1997. Intestinal helminths of river otters (*Lutra canadensis*) from the Pacific Northwest. *Journal of Parasitology.* 83: 105-110.

Holland, A.M.; E.M. Schauber; C.K. Nielsen; E.C. Hellgren. 2018. Stream community richness predicts apex predator occupancy dynamics in riparian systems. *Oikos*. 127:1422-1436.

Kollars, T. M., R. E. Lizotte, and W. E. Wilhelm. 1997. Gastrointestinal helminths in the river otter (*Lutra canadensis*) in Tennessee. *Journal of Parasitology*. 83: 158-160.

Nelson, C.; K. Drouillard; K. Cheng; J. Elliott; N. Ismail. 2015. Accumulation of PBDEs in an urban river otter population and an unusual finding of BDE-209. *Chemosphere*. 118: 322-328.

Scholz, T., H. H. Garcia, R. Kuchta, B. Wicht. 2009. Update on the human broad tapeworm (genus *DiphyllobothriumI*) including clinical relevance. *Clinical Microbiology Reviews*. 22: 146-160.

Sharpiro, K.; E. VanWormer, A. Packham, E. Dodd, P. A. Conrad, M. Miller. 2019. Type X strains of Toxoplasma gondii are virulent for southern sea otters (Enhydra lutris nereis) and present in felids from nearby watersheds. *Proceedings of the Royal Society*. 286: 20191334.