

# MANAGEMENT OF THE RACCOON ROUNDWORM IN TEXAS

JACOB L. OGDEE AND SCOTT E. HENKE



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# MANAGEMENT OF THE RACCOON ROUNDWORM IN TEXAS

JACOB L. OGDÉE AND SCOTT E. HENKE

Caesar Kleberg Wildlife Research Institute  
Texas A&M University-Kingsville

**Abstract:** The raccoon roundworm (*Baylisascaris procyonis*) is a large parasitic nematode found in the small intestine of raccoons. The raccoon is the definitive host since this species reproduces in the raccoon. Larvae of raccoon roundworms can infect a variety of mammal and bird hosts, including humans. Infections occurring in humans may result in liver damage, blindness, seizures, coma, and death. Raccoon roundworms are spread by infected raccoons through their feces. Infected raccoons can shed millions of eggs per day, which may lead to widespread contamination. The objective of this bulletin is to provide details about the potential threat posed by raccoon roundworms, and highlight best practices concerning raccoon and raccoon roundworm management.

## INTRODUCTION

Raccoons (*Procyon lotor*) are one of North America's most charismatic mammals, and are adaptable to a variety of living conditions. Their adaptability has enabled them to thrive in both natural and human-dominated environments. Though many people believe raccoons to be cute and cuddly creatures, raccoons are still wild animals with the potential to spread disease.

The raccoon roundworm (*Baylisascaris procyonis*) is a large nematode that resides in the small intestine of raccoons, and is a disease-causing agent that can infect humans, a variety of wildlife, and domestic animals. Since the raccoon roundworm is able to infect humans, the parasite is considered zoonotic (passed from animal to human). When humans and other animals are infected with raccoon roundworms, the outcome is generally severe. The purpose of this management bulletin is to give a brief background of raccoons, to inform Texans of the hazards presented by raccoon roundworms, and to outline some best practices for management of raccoons and the raccoon roundworm.

## DISTRIBUTION AND STATUS IN TEXAS

Raccoons have a transcontinental distribution, but were originally found only in their native ranges of North and Central America (Goldman and Jackson 1950). Historically, raccoons occurred from southern Canada to Panama, and almost continuously across

the United States, except the Rocky Mountain region (Nelson and Goldman 1930, Gehrt 2003). Raccoons have spread outside their native range primarily because of human introductions, and have established populations in Europe and Asia. In Texas, raccoons are common throughout the state; however, raccoon abundance appears greater in the eastern half of the State.

Raccoon populations are doing well throughout their range, and are increasing in number (Cuarón et al. 2008). Gehrt (2003) attributes the raccoons' success to their intelligence, adaptability, and to favorable changes by humans of their environment, such as agriculture and urbanization. Raccoons can adapt to and thrive in human-dominated landscapes because of the abundance of usable human-related resources, such as garbage, pet food in self-feeders or open bowls, bird feed, and other food sources (Graser et al. 2012).

As one of North America's most charismatic mammals, raccoons may seem like a perfect pet choice. After all, they are smart, and can be found frequenting many human-dominated areas. However, keeping a raccoon as a pet is against Texas law. Raccoons are classified as fur-bearing animals by Texas Parks and Wildlife Code 71.001. Possession of live fur-bearing animals is restricted to licensed fur-bearing animal propagators, persons authorized under Texas Parks and Wildlife Code Chapter 43, and representatives of recognized organizations for approved instruction or demonstration purposes. Also, raccoons are considered a high risk for transmission of rabies, and can only be transported by authorized individuals as a part of their official duties

(Texas Department of State Health Services 2013). Violation of this law is a class C misdemeanor.

## **RACCOON ECOLOGY**

### **Habitat**

Raccoons can use a variety of natural habitat types, but generally their habitats are associated with wooded areas with water such as near rivers, streams, ponds, and other wetlands (Photo 1; Kaufmann 1982, Pedlar et al. 1997). Wooded habitats near agricultural lands present a unique opportunity that benefit raccoons. Wooded areas bordering agricultural lands provide denning sites and protective cover for raccoons, while the agricultural areas provide increased foraging opportunities (Pedlar et al. 1997). The suburban and urban environments of humans also have created artificial habitat that raccoons can easily exploit. In these human-dominated areas raccoons utilize residential buildings, sewers, and wooded parks (Gehrt 2003, Prange et al. 2003). It is important to note that raccoon densities in urban/suburban landscapes are often much higher than in natural landscapes, and increases the chance for human-raccoon conflicts. For example, Prange et al. (2003) found raccoon densities in urban, suburban, and rural areas in autumn of 1997 to be 70, 60, and 5 raccoons per 0.4 mi<sup>2</sup> (1 km<sup>2</sup>).

### **Diet**

Raccoons are opportunistic exploiters of a wide range of food items. This opportunistic dietary strategy allows them to survive in a variety of environments. Raccoon diets are highly variable, and change with



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**Photo 1. Raccoons can be found in a variety of habitats due to their opportunistic and omnivorous diet.**

availability of food sources across habitat types (Gehrt 2003) and during different seasons. Plants make up a large part of raccoon diets throughout all seasons with variability between seasons (Kaufmann 1982). In habitats associated with water, raccoons take advantage of prey animals such as crayfish, frogs and toads, and clams. In environments dominated by agriculture, raccoons may rely on crops, such as corn, as an important part of their diet during autumn, winter, and spring seasons. Other raccoon prey includes a variety of insects, birds and their eggs (e.g., bobwhite eggs), reptile eggs, and rodents. Raccoons adapted to urban and suburban landscapes will forage in trash, eat pet food, and use other human refuse. In short, raccoons adapt their opportunistic diet to their associated environment, and the unique opportunities presented by that environment.

### **Behavior**

Raccoons are intelligent animals with a highly developed sense of touch. They are considered to have one of the best senses of touch among carnivorous species (Kaufmann 1982), which enable them to forage for and identify a variety of food items in the dark (Sanderson 1987, Gehrt 2003). Feeling and probing in water with its front paws is a common behavior for raccoons. Raccoons are primarily nocturnal and they are solitary animals except for family groups consisting of mother and young.

Two important raccoon behaviors to consider in combination are their defecation habits and their ability to thrive alongside humans. Raccoons may defecate in random locations, but they often defecate repeatedly in one area called a latrine (Stains 1956). Some latrines may be communal, containing the feces of several raccoons (Page et al. 1998). Raccoon latrines can occur in a variety of locations in both natural and human environments (Photo 2). Documented latrine locations include bases of trees, in raised crotches of trees, large logs, stumps, rocks, tree limbs, other horizontal structures, barn lofts, garages, woodpiles, decks, roofs, attics, chimneys, and children's play areas (Page et al. 1999, Kazacos 2001, Gavin et al. 2005). However, Ogdee (2015) found that raccoons in southern Texas did not commonly display communal defecation habits. Of the 781 defecation sites sampled, 95% represented isolated defecation sites while 5% represented communal latrine sites (Ogdee 2015). Of the latrine sites, the majority were located in areas associated with humans.





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**Photo 2. Raccoons often defecate at communal sites known as latrines. This latrine is located in an attic.**

Raccoons are synanthropic, or able to live alongside and benefit from humans and human-created environments (Graser et al. 2012). Therefore, raccoons reach higher population densities in urban and suburban areas, thus raising the likelihood of human encounters with raccoons and contact with raccoon latrines also (Riley et al. 1998, Gehrt 2003). Increased human-raccoon encounters have important implications for accidental human infections. Therefore, as human and raccoon populations continue to grow and expand, the potential probability of humans coming in contact with latrines and areas contaminated with raccoon roundworm eggs also increases.

## RACCOON ROUNDWORM

The raccoon roundworm was first documented in New York in 1933 (McClure 1933). Adult raccoon roundworms are tan-colored with females ranging between 7.9–8.6 inches (20–22 cm) long and males 3.5–4.3 inches (9–11 cm) long (Photo 3). Raccoon roundworm eggs are microscopic, brown in color, and ellipsoidal in shape (Photo 4; Kazacos 2001).

### Distribution

The raccoon roundworm is native to the U.S. and is most common in midwestern, northeastern, and west coast states (Kazacos and Boyce 1989). In Texas, Kerr et al. (1997) found high prevalence of the rac-

coon roundworm in raccoons near Agua Dulce, Corpus Christi, and Kingsville, Texas, and was the first to document the raccoon roundworm in raccoons in Texas. Long et al. (2006) also found raccoon roundworms in Conception, Texas. A statewide survey for the parasite produced positive results for Denton, Tarrant, Dallas, Brazos, Travis, Bexar, Victoria, Nueces, and Kleberg counties (Kresta et al. 2010). The raccoon roundworm is now considered common in Texas and can be found in central, eastern, and coastal Texas (Kazacos 2001, Kresta et al. 2010).

### Life Cycle and Transmission

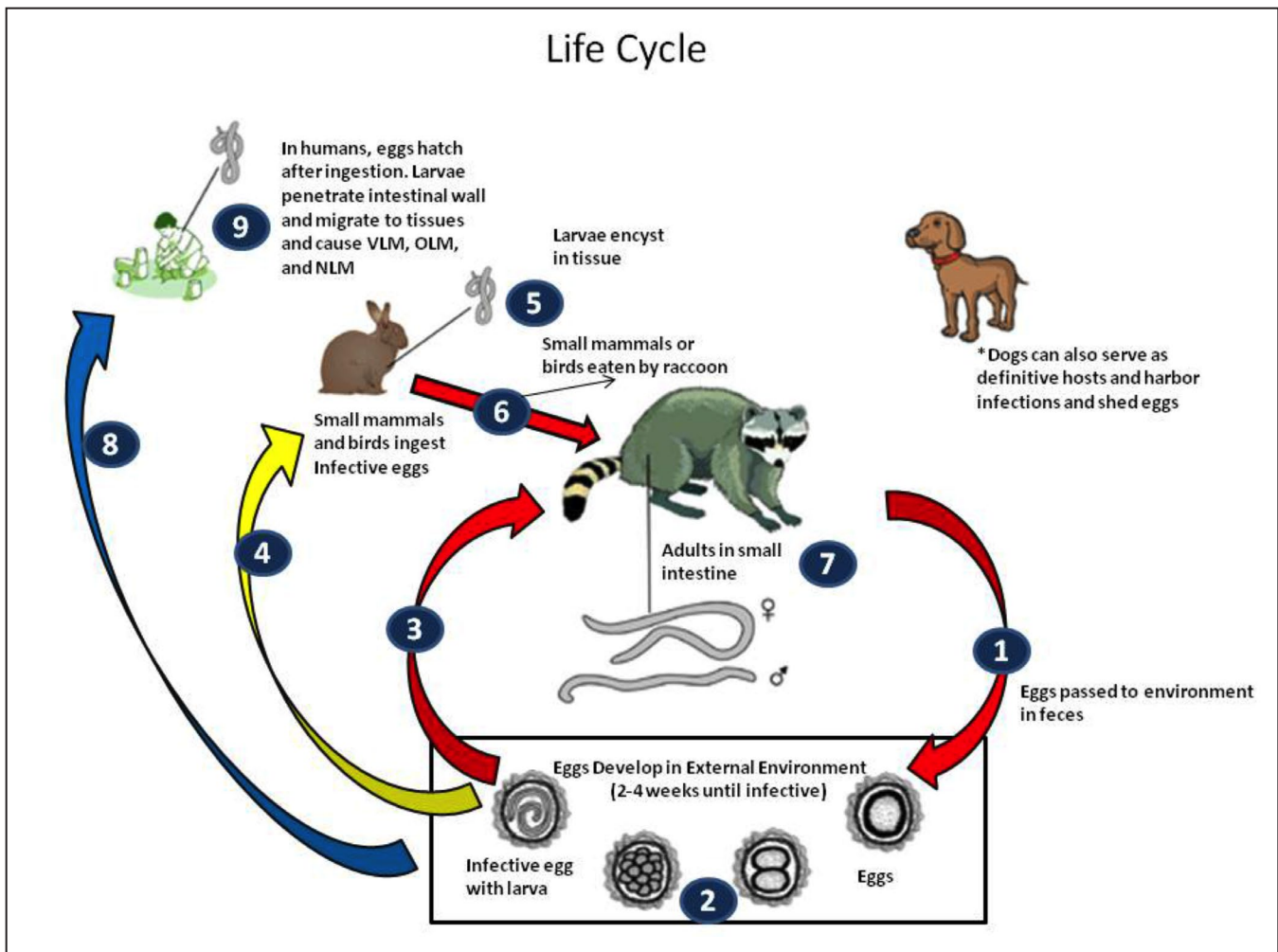
Raccoons are the definitive host of the raccoon roundworm, which means that the parasite can complete its life cycle and breed within a raccoon host. Infected raccoons can shed millions of raccoon roundworm eggs per day in their feces, and have the potential to heavily contaminate an area. Once raccoon roundworm eggs are deposited in the environment, they must develop until they reach the infective stage. Infected feces average 20,000 to 26,000 eggs per gram of feces (Figure 1, Kazacos 2001). Under optimal environmental conditions, which are approximately 75°F (24°C) and 100% humidity, eggs can reach infectivity in as little as 2 weeks (Sakla et al. 1989).

Raccoon roundworms have both direct and indirect life cycles, which generally depend on the age of the raccoon (Kazacos 2001). Infant raccoons are directly infected within the first few months of life by ingesting infective eggs from the environment, such as their mother's contaminated teats or fur, contaminated den,



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**Photo 3. Raccoon roundworms are large, ranging from 3.5–8.6 inches (9–22 cm), and adult females are larger than adult males.**



**Figure 1. The raccoon roundworm life cycle:** (1) Raccoons shed eggs via their feces into the environment, (2) Eggs develop to infectivity and can either be (3) directly transmitted back to raccoons or (4) transmitted to a secondary host such as small mammals or birds; (5) Larvae migrate and encyst in secondary small mammal or bird hosts causing fatal or detrimental visceral larva migrans (VLM), ocular larva migrans (OLM), and neural larva migrans (NLM); (6) Secondary small mammal or bird hosts succumb to or are debilitated by larva migrans, making an easy meal for raccoons to complete the indirect infectious cycle; (7) Larvae develop into adults and begin breeding to produce eggs that will be shed in raccoon feces (1); (8) Humans unsuspectingly come into contact with infective raccoon roundworm eggs and unknowingly ingest eggs; (9) Eggs hatch in humans and migrate inside the body causing VLM, OLM, and NLM. (Figure adapted from cdc.gov).

or from nearby raccoon latrine sites. Older raccoons may become infected indirectly by killing or scavenging rodents and birds infected with the roundworm larvae. Larvae that encysted in and killed secondary hosts, such as birds and rodents, are easy meals for raccoons.

In the direct infection cycle, raccoon roundworm larvae grow into adults and begin breeding 50–76 days post infection. Larvae ingested during the indirect cycle grow into adults and breed 32–38 days post infection (Kazacos 2001). Raccoon roundworm eggs are then shed in the environment via raccoon feces and can persist for years. Ogdee (2015) conducted a study

in southern Texas and found that even in the extreme southern Texas climate >92% of eggs remained viable after two years irrespective of soil type, moisture, and canopy cover.

It is important to note that the raccoon roundworm has completed its life cycle in other hosts such as man's best friend, the domestic dog (Kazacos 2001). In cases where raccoon roundworms have successfully established in dogs, the parasite's eggs will be shed in the dog's feces (Kazacos 2001), thus increasing the potential of exposure to humans.



wwwnc.cdc.gov

**Photo 4. An infective raccoon roundworm egg with fully formed larva (left). Undeveloped noninfective egg (right).**

### Secondary Host Infection

The raccoon roundworm is considered highly indiscriminate and has infected over 100 species, including birds, rodents, and humans (Gavin et al. 2005). Like raccoons, secondary hosts must ingest infective raccoon roundworm eggs to become infected. However, unlike in raccoon infections the parasite does not fully satisfy its life cycle and cannot reproduce in secondary hosts.

In secondary hosts, larvae penetrate the intestinal wall and undergo migration inside the body. Larvae can migrate to various organs and tissues resulting in visceral larva migrans (VLM), ocular larva migrans (OLM), and neural larva migrans (NLM). After larva encyst in a particular organ, clinical manifestations of a diseased state may vary in severity, and are dependent upon the type of host, where larva migrans encysted, and how many infective eggs or larva were ingested (Tiner 1953, 1954).

Infections resulting in NLM have proven fatal in dogs, rabbits, porcupines, and a variety of rodents and birds. For example, 85 bobwhites suffered 100% mortality from infections after being housed in a contaminated pen (Reed et al. 1981). The raccoon roundworm also is credited with the extirpation of the Allegheny woodrat in New York State, Connecticut, and its continued decline in the northeastern United States (Kazacos 2001; Smyser et al. 2013). However, some species experience no harmful effects or are completely resistant to the parasite. For example, no NLM cases were documented in livestock or hoofed zoo animals, and only limited migrations were detected in sheep, goats, and swine (Kazacos 2001).

## DANGERS TO HUMANS

Humans may be accidentally infected with the raccoon roundworm by ingesting infective eggs from contaminated surfaces, objects, water, or parts of the body that have been contaminated such as hands. Human infections of the raccoon roundworm are known as baylisascariasis. Infants have the highest risk of ingesting eggs as they have a tendency to place objects in their mouths. Older children playing in egg-contaminated outdoor areas also are at a higher risk (Photo 5; Kelly et al. 2011).

After a human has ingested infective eggs the larvae penetrate the intestinal wall and migrate. The larvae can migrate to the viscera, eyes, and brain. The most severe disease results from larva migrating to the central nervous system (CNS) resulting in NLM. Humans suffering from NLM may experience fever, weakness, irritability, loss of coordination and motor skills, tremors, seizures, stupor, paralysis, coma, and death (Kazacos 2001). At least 14 human NLM cases have occurred in the U.S. resulting in 4 deaths (Gavin et al. 2005, Peters et al. 2012). All NLM cases involved children or individuals with developmental delays. The most recent U.S. human NLM case occurred in a Boston, Massachusetts suburb, and involved a 14-month-old boy (Peters et al. 2012). In this NLM case, the boy had a history of placing objects in his mouth and played in



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**Photo 5. Be vigilant of toddlers playing outdoors and discourage attempts by them to place potentially egg-contaminated objects, such as soil and wood chips, in their mouths. Be aware of what types of wildlife visit your yard, such as raccoons.**



a yard where raccoons visited. Another case of NLM infection was documented in a 73-year-old woman with moderate to severe Alzheimer-like dementia; this infection was considered light and was believed unlikely to cause clinical manifestations in the patient (Hung et al. 2012). Human raccoon roundworm infection is thought to be more common in endemic areas. However, low-level infections in humans are unlikely to produce clinical manifestations and may go undiagnosed (Kazacos 2001, Hung et al. 2012).

Prognosis for humans suffering from raccoon roundworm NLM is poor. Treatments for NLM are generally ineffective at preventing negative outcomes. Human survivors of NLM usually experience neurological deficiency, and only one documented case of human NLM reported full recovery (Pai et al. 2007).

Larvae also can invade the lungs, liver, and heart, and other organs. Visceral larva migrans may cause rash, inflammation of the lungs, swelling of the liver, and labored rapid breathing. Ocular larva migrans occurs when the larvae migrate to the eyes, which may cause vision impairment and blindness. At least one confirmed human case of *B. procyonis* OLM exists, but there also many suspected cases (Kazacos et al. 1985; Goldberg et al. 1993).

Treatments usually consist of anthelmintic drugs and corticosteroids such as Thiabendazole, Ivermectin, Prednisone, Albendazole, and others (Gavin et al. 2005). However, many anthelmintics have proven ineffective and unable to penetrate the blood-brain barrier to kill the larvae in human NLM cases; hence, the poor prognosis. Human cases have resulted in blindness, epilepsy, and death. Early recognition of possible or positive contamination and ingestion of eggs is critical if larvae are to be killed prior to entering the CNS. No vaccinations exist for the prevention of infection.

## MANAGEMENT RECOMMENDATIONS

Given the severity of human infection with raccoon roundworms, and the lack of effective treatments for NLM, prevention of infection is critical. Three important elements to consider for prevention and control of raccoon roundworm infection in humans are (1) reducing environmental contamination, (2) preventing contact with contaminated areas and objects, and (3) educating the public about the risks associated with

raccoon roundworms (Kazacos 2001). These three elements should be considered to achieve the best results.

### Reducing Raccoon Contact and Environmental Contamination

#### 1. Avoid direct contact with raccoons and raccoon latrines

Remember raccoons are not pets and should never be treated as such.

#### 2. Never use raccoon feces as fertilizer

About 0.04 ounces (1 gram) of contaminated feces can contain about 25,000 raccoon roundworm eggs (Reed et al. 2012).

#### 3. Discard brush piles and other yard waste

Promptly discard brush piles, and do not store junk piles outside for long periods of time as raccoons may be attracted to and use these places as latrines (Photo 6).

#### 4. Treating with anthelmintics

Environmental contamination with raccoon roundworm eggs may be reduced by treating infected raccoon populations and potential secondary rodent hosts with deworming medications. Page et al. (2011) demonstrated that this technique has promise, but it must be conducted at the raccoon population level (i.e., treating small acreages, such



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**Photo 6. Brush and trash piles behind homes and barns entice raccoons to the property. Remove such debris as quickly as possible to reduce potential exposure to raccoon feces.**





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**Photo 7. Do not have pet doors or secure the doors when not in use to avoid unwanted raccoon guests.**

as land surrounding a suburban home, would have little if any effect), and raccoons could become re-infected after treatment.

#### **5. Do not use pet doors**

If possible, avoid using pet doors (Photo 7), or secure the pet doors during periods of non-use, to avoid unwanted raccoons as guests in your house. Also, always securely close garage doors.

#### **6. Lethal removal of infected raccoons**

Removing infected raccoon populations occurring near humans by lethal means is a viable option, but may be met with public opposition (Kazacos 2001, Page et al. 2011, Smyser et al. 2013). Also, lethal removal of raccoons could create a population ‘sink’, into which nearby raccoons could immigrate into the void. Check with authorities (i.e., city or county animal control) in your area prior to conducting trapping or lethal removal to determine the legal options available to you for removal of raccoons.

#### **7. Do not use self-feeders for outside pets**

Raccoons can quickly learn how to use self-feeding devices, which increases the chances of latrines being created in your area. Also, cover or empty containers that may hold water, and pick up fallen fruit from trees. Removing food and water sources can discourage raccoons from using the area.

#### **8. Remove latrines and use anthelmintics**

A combination of treatment and removal of contaminated raccoon latrines is likely to produce the best chance to reduce the potential for environmental contamination. It is important to consider that raccoon roundworm eggs are extremely hardy, and may persist in the environment for years and represent a source of reinfection. Thus, successfully treated raccoons may come into contact with contaminated areas and reinfect themselves. Removal of raccoon latrine sites combined with anthelmintic treatment of raccoons and rodents has shown success in reducing raccoon roundworm contamination and reinfection (Page et al. 2011, Smyser et al. 2013).

#### **9. Wildlife proof pier and beam homes**

Raccoons will live under homes, so bury fencing around the perimeter of pier and beam homes to exclude wildlife.

#### **10. Secure open or damaged areas of houses**

Raccoons will enter and live in attics of homes (Photo 8). It is important to quickly fix holes in eaves and damaged air-vent screens, and use chimney caps to keep raccoons out of houses.

#### **11. Trim trees away from roof**

Remove overhanging trees and bushes at least 4 feet from the roof line. Doing so will help reduce



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**Photo 8. Raccoons often gain access to attics. Damage should be repaired to limit raccoon access and potential roundworm contamination from raccoon feces. Ensure all raccoons have been trapped before repairing holes as to not trap raccoons inside your home.**

raccoon access to your roof and attic by climbing on the vegetation.

**12. Use caution with home-grown garden vegetables**

If you grow a home garden for vegetables and fruits, always thoroughly wash produce before eating. Raccoon scats decay into soil, and infected scats will have eggs percolate into soil. Tilling the soil for garden use may bring the eggs back to the surface (Ogdee 2015). Raccoon roundworm eggs are sticky and can adhere to growing vegetables.

**13. Keep a close watch on pet dogs**

Dogs have the potential to become infected and shed eggs via feces. Make sure to routinely deworm pet dogs with anthelmintics. If worms are noticed in feces resembling adult roundworms, then notify your veterinarian to positively identify the parasites. Decontaminate any potential areas contaminated by the dog's feces.

**14. Discard contaminated hay and straw**

Barn contents, such as hay and straw, that become contaminated should be burned, if possible. If burning is not possible, then the contaminated material should be deeply buried to reduce exposure. Potentially contaminated hay is not safe for livestock consumption.

**15. Use lock devices on garbage cans**

Raccoons often raid garbage cans in search of food. Install a locking device on lids of garbage cans so raccoons do not have access.

**Preventing Contact with Contaminated Areas and Objects**

**1. Be aware of your surroundings and identifying signs of raccoon activity**

Determine if raccoons frequent your property. This can be accomplished with infrared game cameras that are triggered as raccoons approach; however, these can be expensive. Learn to identify raccoon scat and tracks (Photos 9 and 10). Knowledge of the surrounding environment and its wildlife visitors, such as raccoons, is key in identifying "at risk" areas and objects. If infected raccoons



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**Photo 9. Learn to identify raccoon scat to avoid areas potentially contaminated with raccoon roundworm eggs. Raccoon scats often contain seeds.**

frequent a location there is the possibility that raccoons defecated and deposited raccoon roundworm eggs in and around that location. Infection risks are associated with contaminated raccoon latrine sites, which may be found in a variety of locations in the human environment. This includes yards, children's outdoor play areas, chimneys, fire places, attics, woodpiles, barns, garages, sheds, tree crevices, downed trees, and other areas. Any surface that has had raccoon feces on it at some point in time should be handled with caution. The absence of raccoon feces does not mean the risk of contamination is gone. Ogdee (2015) found that raccoon feces require, on average, 8 inches (20 cm) of precipitation to completely dissolve, and found that eggs on level terrain could be found up to 27 inches (68 cm) away from the point of origin with no trace of the scat present. Raccoon roundworm eggs may be present long after the feces have degraded (Kazacos 2001).

**2. Pay special attention to infants and toddlers**

Infants and toddlers should be kept away from raccoon latrines, or any area contaminated by infected raccoon feces. Parents should be attentive of children and discourage them from placing potentially contaminated objects in their mouths (Gavin et al. 2005). Also, hand washing should be encouraged after playing outside.



### 3. Do not encourage raccoon visits

Raccoons should be discouraged from visiting homes and yards by properly wildlife-proofing garbage, by not leaving pet food outside, and by refraining from intentionally feeding raccoons. Use wildlife-proof garbage receptacles, and refrain from throwing left over and spoiled food outside. It is impossible to know if a raccoon or its feces is infected with the raccoon roundworm without testing for its presence. Therefore, it is imperative that the public treat every raccoon as if it was infected and notify a local wildlife professional, veterinarian, or state health official to test for the raccoon roundworm.

### 4. Toys and sandboxes

Every effort should be made to collect and store child toys after play. Toys should be placed in an indoor protective structure. Wash toys left outside with a 10% bleach-water solution, and always wear disposable gloves. Bleach will not kill eggs, but will remove the adhesive coating of eggs to help wash eggs away. Sand boxes should be covered when not in use to discourage raccoons from defecating in them (Photo 11).



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**Photo 10. Raccoon tracks are commonly found in all regions of Texas. Their front feet almost resemble little human hand prints with 5 fingers. Their back feet also have 5 toes. The front feet measure around 2 inches (5 cm) in length and width, and the hind feet measure around 4 inches in length and 2 inches (5 cm) in width. Claws are present in most raccoon tracks. These tracks are usually found staggered with the rear print next to the front, and can be spaced anywhere from 6–20 inches (15–51 cm) apart depending on how fast the raccoon was traveling.**



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**Photo 11. Cover sandboxes when not in use and wash and store ‘outside’ toys in a secure shed or garage.**

## Educating People about the Raccoon Roundworm and its Associated Public Health Risks

### 1. Raise awareness

The purpose of this bulletin is to educate the public and wildlife handlers across Texas. Raising awareness regarding the raccoon roundworm as a public health risk is an important factor to avoid infection.

### 2. Do not keep raccoons as pets

Keeping raccoons as pets is highly discouraged and against Texas law. Raccoons are classified as fur-bearing animals in Texas Parks and Wildlife Code Section 71.001. Possession of live fur-bearing animals is restricted to licensed fur-bearing animal propagators, persons authorized under Texas Parks and Wildlife Code Chapter 43, and representatives of recognized organizations for approved instruction or demonstration purposes. If you know of someone who has a pet raccoon, or raccoon problems around their home, please make



them aware of this Bulletin. It is available online at <http://ckwri.tamuk.edu/publications/bulletins/>. Feeding raccoons is highly discouraged.

### Decontamination of Raccoon Latrines

Raccoon latrines contaminated with raccoon roundworm eggs pose a considerable public health risk. Cleaning latrine sites and contaminated areas should be done with caution, or by experienced professionals. Eggs have a sticky coating allowing them to



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**Photo 12. The propane torch is considered the most effective method to kill raccoon roundworm eggs. However, check local county and city ordinances prior to using this method to verify its legality in your area.**

adhere to any surface, including hands. It is important to note that common household cleaners, which include bleach, will not kill raccoon roundworm eggs. However, bleach will remove the sticky outer coating of eggs making them non-adhesive. Heat is the best way to kill the eggs. Boiling water, propane flame torches, steam cleaners, auto-claves, and other forms of extreme heat over 144°F (62°C) can be used to kill raccoon roundworm eggs (Kazacos 2001,

Shafir et al. 2011). Direct flame from propane torches (Photo 12) is considered to be most effective. However, check local laws and ordinances regarding use of fire in neighborhoods. Also, because of season and potential fire conditions, burn bans may be in effect even in rural areas. Swimming pools are more of a challenge and involve thoroughly cleaning the pool and filtering the water for at least a day. Pools should be drained, thoroughly cleaned, refilled, and filtered. Filters should be discarded after potential contamination occurs.

### Properly Protect Yourself before Decontaminating an Area by Wearing Protective Equipment (Photo 13)

1. disposable coveralls

2. rubber gloves
3. washable rubber boots
4. face mask



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### Cleaning Contaminated Areas Outdoors

1. Feces and contaminated material should be removed with a shovel or inverted plastic bag (Photo 14).
2. Feces and contaminated material should then be bagged and incinerated.
3. It is best to flame heat tolerant surfaces such as concrete and metal.
4. If the soil is contaminated, remove the top several inches, break up the soil, and then flame with a propane torch. Repeat several times.
5. Use boiling water or steam cleaners for surfaces that cannot be burned. If a vehicle is contaminated, it is highly unlikely that the vehicle will get hot enough to kill eggs, even if parked in direct sunlight with windows completely closed (Ogdee 2015).

**Photo 13. Wear protective equipment such as disposable masks and gloves when cleaning areas contaminated with raccoon roundworm eggs to help prevent infection.**



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**Photo 14. Place your gloved hand inside a plastic bag to pick up feces, then invert bag (i.e., turning it inside-out) so that the feces is now inside the plastic bag. Take off your gloves in the same manner, turning them inside out as you take them off. Place the gloves inside the plastic bag for incineration.**

### **Cleaning Contaminated Areas Indoors**

1. It is possible to inhale aerosolized eggs. Therefore, wear a respirator or medical face mask, available at most hardware stores and pharmacies, during decontamination activities.
2. For indoor areas, lightly mist the latrine or contaminated area to avoid stirring up dust. Use a shovel or inverted plastic bag to remove feces and contaminated materials.
3. Feces and contaminated materials should be bagged and incinerated.
4. If possible, treat unburnable surfaces with boiling water or steam. Otherwise, fill a bucket with hot soapy water and use a damp sponge to clean the contaminated surface. Rinse the sponge frequently in the hot soapy water.
5. After cleaning activities are accomplished, flush the water down the toilet, place the sponge in a plastic bag and incinerate, and treat the bucket with boiling water or flame if made of metal.

### **Properly Clean/Dispose Contaminated Equipment**

1. Flame metal tools, such as shovels.
2. Properly bag disposable protective wear such as gloves, coveralls, and mask and then incinerate. Remove gloves by turning them 'inside-out' to avoid contact with bare skin.
3. Treat washable rubber boots with boiling water or steam.

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Caesar Kleberg Wildlife Research Institute  
Texas A&M University-Kingsville  
700 University Boulevard, MSC 218  
Kingsville, Texas 78363-8202



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