WILDLIFE DAMAGE
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MANAGING WILDLIFE DAMAGE: MOLES

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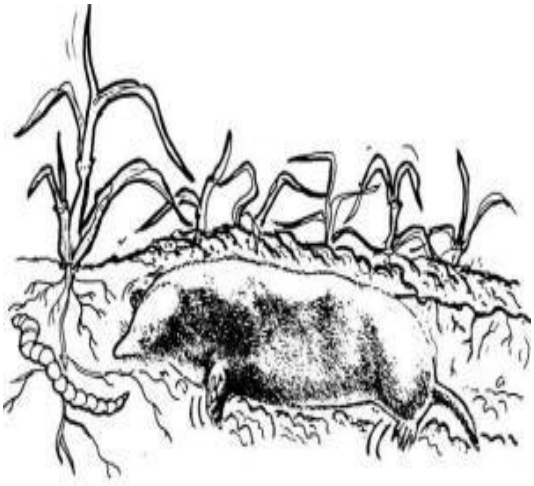
INTRODUCTION

Three mole species occur in Georgia: the eastern mole (*Scalopus aquaticus*), hairy-tailed mole (*Parascalops breweri*), and star-nosed mole (*Condylura cristata*). While the eastern mole is well distributed throughout the entire state (Figure 1), the hairy-tailed mole is considered critically imperiled and is restricted to extreme northeast Georgia (Figure 2). The star-nosed mole, a rare species in Georgia, is also found in the northeastern corner of the state but its range extends along the coast as well (Figure 3). Because the hairy-tailed and star-nosed moles are relatively uncommon, this paper will focus on damage issues and management alternatives concerning the common eastern mole.



TAXONOMY

The eastern mole was first described by Carl Linnaeus. The genus *Scalopus* is derived from the Greek word "Skalops" meaning "blind rat". The species name, *aquaticus*, was selected by Linnaeus because the first specimen was found dead in a well and its front feet were semi-webbed. These details led Linnaeus to presume, incorrectly, that the mole was aquatic.

Order Insectivora – Shrews and Moles
Family Talpidae
Eastern Mole – *Scalopus aquaticus*
Hairy-tailed Mole – *Parascalops breweri*
Star-nosed Mole – *Condylura cristata*

STATUS

In Georgia, moles are protected and may not be taken, but there are exceptions when the animal is committing damage to a person's property. Check with your local Conservation Officer or the

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Wildlife Resources Division for specific guidance. The hairy-tailed mole is reported (http://georgiawildlife.dnr.state.ga.us/content/displaycontent.asp?txtDocument=89&txtPage=9) only from Rabun and White Counties and is considered critically imperiled in Georgia because of its extreme rarity. The star-nosed mole is reported only from Charlton and Effingham Counties. It is considered imperiled because there are fewer than 10 known locations.

NATURAL HISTORY

Identification. The eastern mole is a burrowing mammal about the size of an eastern chipmunk (*Tamius striatus*) when adult. They have grayish brown to silver velvety fur, with a pointed, hairless snout and nearly hairless tail. Average body size for a male is 4-6 inches with a 1-inch tail; weight is about 4 ounces. Females are only slightly smaller. The eyes and ear openings are quite small and almost completely concealed by fur. Moles have a keen sense of smell and touch, and although nearly blind, they are capable of distinguishing light from dark. The broad forefeet appear oversized for the animal. They have well developed claws for digging but the hind feet are small and slender.

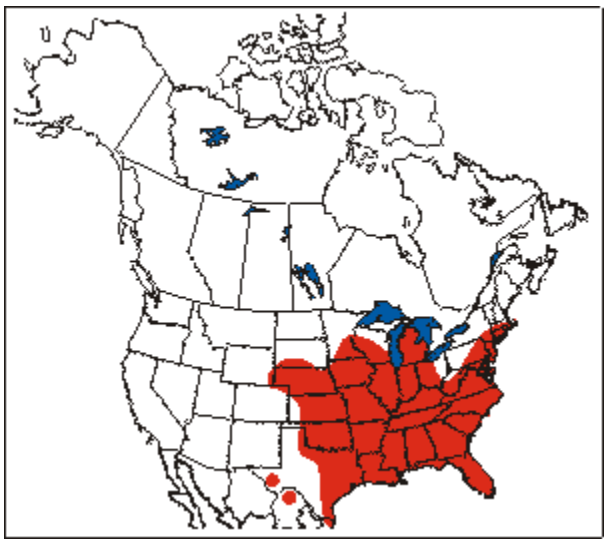

Figure 1. Distribution of the eastern mole in North America.

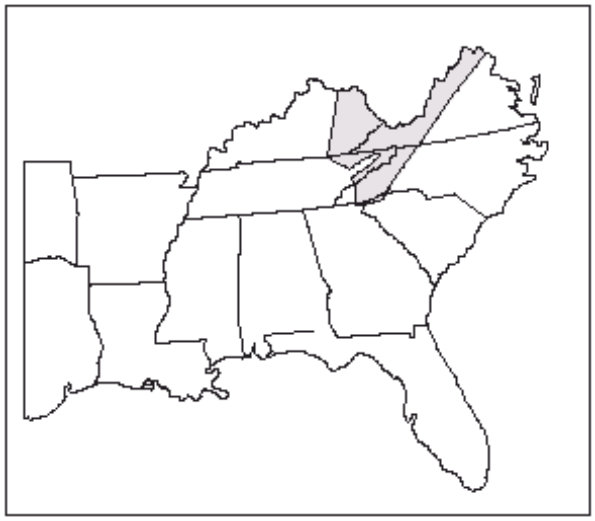

Figure 2. Distribution map of the hairy-tailed mole.

Habitat. Moles are solitary animals that spend nearly all of their lives tunneling underground. Generally, they only venture to the surface for water, nesting material, or dispersal. They prefer habitats with sandy loam soils. Loose soil that is cool and moist but well-drained provides for easier digging and an abundance of prey (see 'Feeding Habits' section below). Moles will avoid habitats with soils that are too dry or compacted, as well as those that contain large amounts of clay or rock. Soils that are too saturated and cannot maintain the structural integrity of tunnel systems likewise will not be used. Most often, moles are found in meadows, pastures, lawns, open woodlands, orchards, fallow fields, gardens, golf courses, cemeteries, playgrounds, and parks.

Two types of tunnels are created and used by moles: surface tunnels and deep tunnels. Surface tunnels are those that create the characteristic raised ridges just under the surface of the ground. These tunnels are used for foraging and feeding, and may only be used a handful of times. Surface tunnels will tend to follow man-made borders such as fence- and hedgerows, sidewalks, and driveways, and can be dug at a rate of up to one foot per minute.

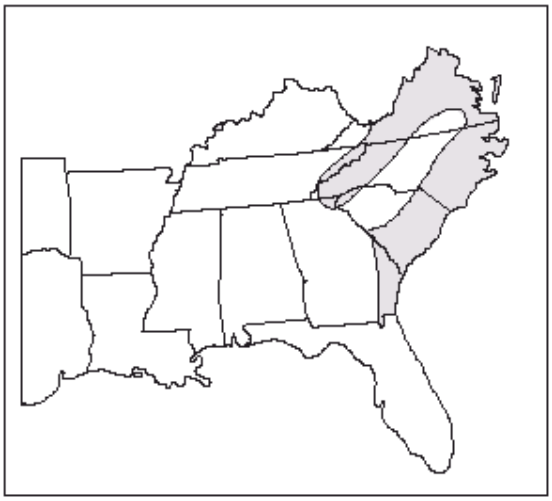

Figure 3. Distribution map of the star-nosed mole.

Deep tunnels (6-24 inches below the surface) are used regularly. They connect nesting and rest chambers with the remaining tunnel system, including the surface tunnels. Deep tunnels are constructed below the frost line for warmth in winter and coolness in the summer months, and they are capable of being excavated at a rate of 12 to 15 feet per hour. Nesting and rest chambers are enlargements of the deeper tunnels. These chambers are generally located under natural protection such as boulders, trees, stumps, fences, or sidewalks and they often contain coarse grasses and leaves. Soil displaced through tunneling is deposited onto the surface through short vertical tunnels, creating volcano-shaped mounds. These should not be confused with gopher mounds (*Geomys* spp.) that are much larger, horseshoe-shaped, and contain a characteristic plug where soil has been pushed up.

Reproduction. The eastern mole breeds once a year, usually in late winter or early spring. After a 42-day gestation period, three to five young are born, usually between March and early April. Young are weaned at one month and leave the nest shortly thereafter, reaching sexual maturity at one year.

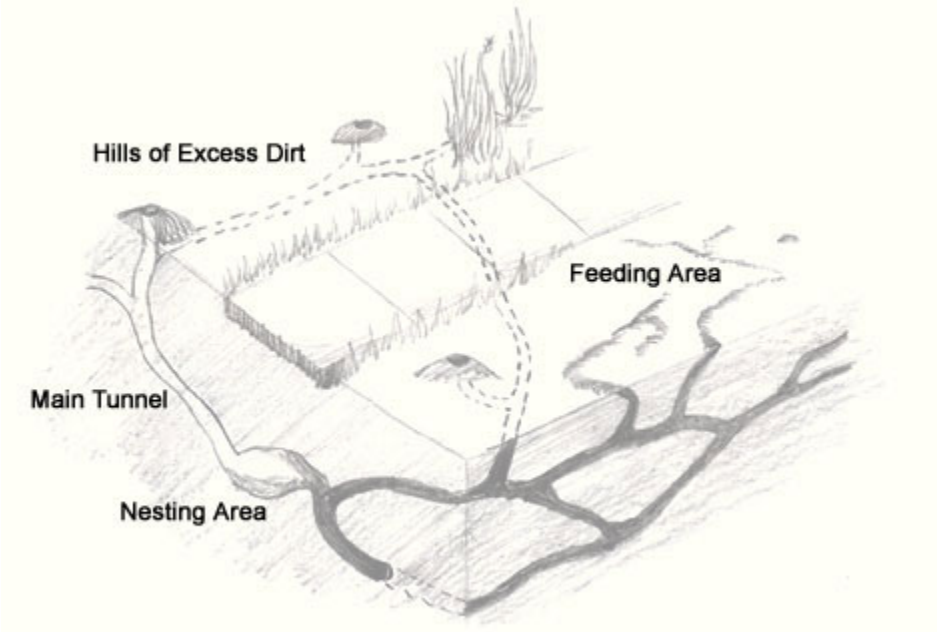

Figure 4. Schematic of eastern mole tunnel system where the dashed lines indicate a deeper tunnel.

Feeding Habits. Moles are carnivores. They feed on a variety of insects and other invertebrates, including earthworms, grubs, beetles, centipedes and millipedes, spiders, snails, slugs, and both adult and larval insects. Small amounts of vegetable matter, such as young plant shoots, seeds, and grasses may also be consumed inadvertently. Moles have a voracious appetite, and are capable of consuming 70 to 100% of their body weight daily to compensate for the tremendous amount of energy expended excavating tunnels. Some studies report that 80 to 90% of their diet consists of beneficial earthworms, so spraying insecticides for grub control may have little impact on the mole.

DAMAGE ISSUES

The most common forms of mole damage are ridges created from surface tunnel systems, and the mole mounds associated with them. These ridges and mounds disfigure lawns, parks, golf courses, and cemeteries, and may destroy flower beds and gardens. Additionally, tunneling can dislodge plants and bulbs, and expose root systems, resulting in poor nutrient uptake and desiccation. Moles may damage plants by occasionally feeding on underground plant parts, but this type of damage is more often associated with the southeastern pocket gopher (*Geomys pinetis*). In addition to potential negative impacts on landscaping, tunnels created by moles can make activities such as mowing or disking difficult, and may damage equipment or expose irrigation tubes.

ECONOMICS

Although mole activity creates some negative impacts, moles are also a beneficial part of the biological community. Their constant tunneling and burrowing aerates the soil and redistributes minerals in the soil. Moles also help control insect populations, and they are known to prey on Japanese beetle larvae and cutworms, both of which cause much lawn and garden damage. Additionally, the tunnel systems created by moles are used by other small mammals including voles, mice, and shrews. More often than not, the damage blamed on moles was actually caused by these other species. Moles are also taken by predators such as cats, coyotes, hawks, owls, and snakes, adding to their importance within the ecosystem.

CONTROL

Exclusion. Aluminum sheeting or flashing can be used as a physical barrier to mole tunneling. Because of the amount of time and effort required for installation, aluminum sheeting is only practical in small scale situations, such as surrounding a garden or flower bed. The flashing should be buried no less than 12 inches below ground, and preferably with a 90° bend to prevent burrowing under the flashing (Figure 5).

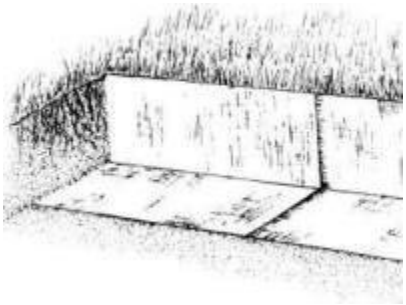

Figure 5. Mole exclusion fence showing the placement of an aluminum sheeting barrier.

Habitat Modification. Moles will generally avoid habitats with soil that is too dry or compacted. Therefore, reducing soil moisture and packing soil using a roller, are viable options for discouraging mole activity. Also, the use of insecticides to reduce prey abundance may result in dispersal from the area. White grubs, a favorite prey item of moles, can be controlled by introducing milky-spore disease. Spore dust can be applied at a rate of about two pounds per acre. It may, however, take several years for the disease to establish and begin to affect the white grub population. Careful consideration should be used when dealing with insecticides, however, as their use will not only affect mole populations, but also other insects and invertebrates, as well as songbirds and shrews.

Repellents. No chemical mole repellents are registered. There are several electronic, magnetic, and vibration devices that allegedly deter moles, but none have proven effective. People have used castor oil as a repellent but this too has not proven to be effective.

Toxicants. Mole toxicants come in many bait forms including granules, sprays, gels, and even those that are molded to mimic an earthworm. These baits contain one of the following registered active ingredients: strychnine alkaloid, zinc phosphide (for example, Moletox II and Mole-Nots), warfarin (for example, Kaput® mole gel), and chlorophacinone (for example, Mole Patrol Bait; not registered in all states). The newest registered mole bait, Talpirid® (Bell Labs, Madison, WI), is a bromethalin-based product that looks like a gummy worm.

Fumigants. Aluminum phosphide and gas cartridges are federally registered for use against moles. These are most successful when placed in the deep tunnels versus surface tunnels.

Home Remedies/Folklore. Various home remedies, such as gassing tunnels with automobile exhaust, lining tunnels with broken glass, pins, razorblades, chewing gum, castor beans, and even human hair have all been suggested for mole control, but none have proven effective. Additionally, the use of harsh household chemicals such as bleaches, petroleum products, sheep dip, and lye generally do not work, and **may be illegal**. It is thought that planting borders of marigolds may deter moles, but this has not been scientifically validated. The mole plant - caper spurge (*Euphorbia latharis*) may act as a living deterrent, but this too is unproven.

Trapping. Kill traps are considered the most practical and successful means of controlling mole populations. They are generally most effective during the spring and fall, when mole activity is at its peak. There are several mole traps available for use today. The three most common designs are: Out O' Sight® (scissor-jawed trap), Victor® (harpoon) mole trap, and the Nash® (choker loop) trap (designs a, b, and c respectively in Figure 6).

Each of these traps is set above a known mole surface tunnel, and relies on the uplifting of dirt as a mole passes through the tunnel to trigger the pan and spring the trap. The first step in trapping is to locate an active surface tunnel. This can be done by depressing a section of the tunnel, marking it, and noting how long it takes for repair. If the damaged portion is repaired within 12 to 24 hours, it is an active tunnel, and should therefore be considered for trapping. Also, sections of surface tunnels that are straight for an extended distance, connect two mounds or tunnels systems, follow fencerows or other man-made structures, or follow the woody perimeter of a field or yard, are likely spots for trapping success. Next, a portion of the burrow should be dug out and exposed, then replaced by packing down the soil where the trigger pan will rest. Traps should be dry-fired several times before the final setting

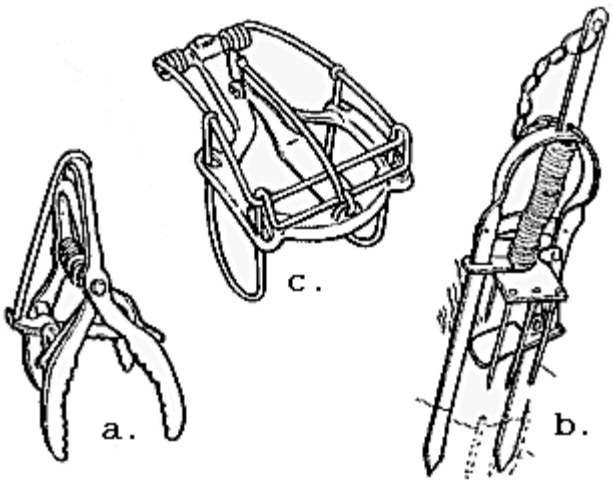

Figure 6. Three common mole trap designs. a – Scissor style trap; b – Plunger or harpoon style trap; c – Choker style trap.

to ensure the impaling spikes, scissor jaws, or choker loops will not clog or delay when sprung. If a mole is not captured after a few days from initial trap setting, it likely means that the tunnel is inactive or the trap was improperly set or it was detected by the mole, and should be reset in a new location. It is important to note that even if trapping is successful and moles are removed, ideal habitat will quickly be repopulated by moles from the surrounding area.

Although it is time consuming and requires much patience, moles can be live-captured, if so desired. Because moles are most active in the early morning and evening hours, and especially following a rain shower, these are the best times to observe mole activity. It is possible to observe a mole in the act of burrowing through a tunnel and to dig it out of the tunnel by striking a spade or shovel behind it and throwing it onto the open ground. Moles have been successfully flooded out of their tunnel system using a garden hose, but this technique is not always reliable. Finally, a version of pit-fall trapping can be used to live-capture moles. The active tunnel should be detected and a section dug out. A coffee can or quart-sized glass jar can then be buried in the dugout area, directly in the path of the tunnel. Soil should be caved in on both sides of the tunnel just in front of the jar, and a board (or some comparable object) set above the tunnel to shut out all light (Figure 7). The mole will unknowingly fall into the jar or coffee can as it makes its way through the tunnel.

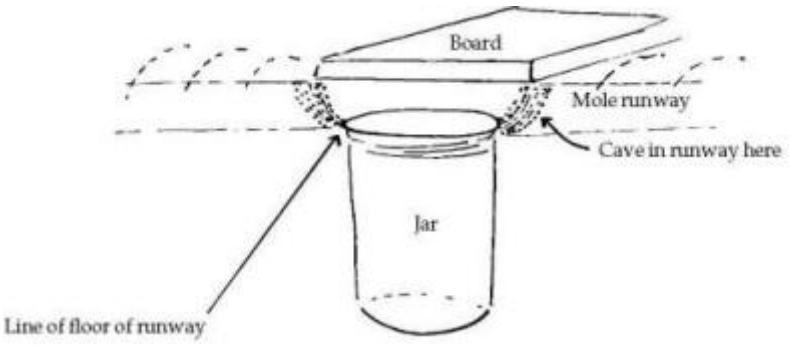

Figure 7. Live pitfall trap for moles.

DISCUSSION

When dealing with mole damage and control alternatives, it is important to weigh the negatives of mole activity with the positives. Moles play an integral part in habitat and ecosystem development and balance. Certainly, in urban situations where landscaping and aesthetics are important factors, trapping and removal, followed by habitat modification and/or exclusion efforts, are likely the way to go. However, if the appearance of ridges and mounds is not a primary concern, accepting the presence of these unique animals and the important role they play in nature should be considered.

ILLUSTRATION ACKNOWLEDGEMENTS

Title: http://icwdm.org/images/mole/Moles_img_3.jpg
Figure 1: http://icwdm.org/images/mole/Moles_img_2.jpg
Figure 4: http://www.cooperseeds.com/images/MoleWorld.jpg
Figure 5: http://icwdm.org/images/mole/Moles_img_7.jpg
Figure 6: http://www.extension.umn.edu/distribution/naturalresources/images/1139fig03.gif
Figure 7: http://icwdm.org/images/mole/Moles_img_16.jpg

ADDITIONAL INFORMATION AND SOURCES

http://www.ext.vt.edu/pubs/wildlife/420-201/420-201.html
http://icwdm.org/handbook/mammals/Moles.asp
http://www.ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=92
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