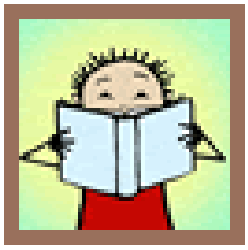
BIOLOGY, LEGAL STATUS, CONTROL MATERIALS, AND DIRECTIONS FOR USE

Moles

Scapanus spp. **and** ***Neurothichus gibbsii,*** **"Shrew-mole"**

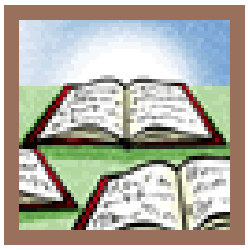
Family: Talpidae



Introduction: The mole is common throughout the US. In California, the broad footed mole (*S. latimanus*) is the main pest species. They inhabit the Sierra Nevada and Coast Range mountains, and coastal zone.

The mole is a small insect eating subterranean animal which develops complex tunnel networks. Shallow tunnels close to the surface, which the mole utilizes for food gathering, are responsible for major damage, particularly to turf, dislodged plants, and other cultivated settings. In general mole control is most efficient when an understanding of the animal's behavior is achieved. Indicative of the issue is the fact that mole trap development can be traced historically 150 years (Marsh 1996).

Identification: Moles can be distinguished from rodents such as meadow vole, shrews, and pocket gophers. Moles are 5 to 6 inches long with cylindrical bodies and a slender hairless pointed snout and short, bare, sparsely haired tails. Their limbs are short and spade like. They have poorly developed eyes, and their ears are not visible. Fur is short, dense, and velvety.



Legal Status: Moles are classified as nongame mammals by the California Fish and Game Code. Nongame mammals which are found to be injuring growing crops or other property may be taken at any time or in any manner by the owner or tenant of the premises. They may also be taken by officers or employees of the Department of Food and Agriculture or by federal or county officers or employees when acting in their official capacities pursuant to the provisions of the Food and Agricultural Code pertaining to pests.

Damage: Mole hills and tunnels disfigure lawns, gardens, parks and may interfere with hay harvesting machinery or other farm machinery. Townsend moles may eat tubers and roots of garden plants and disrupt small garden areas.

Mole damage is caused by their 'hunting' for food worms, insects, grubs in the soil. Shallow tunnels disturb and dislodge plants and their root systems.

It is important to properly identify the kind of animal causing the damage as control methods do differ for each species. Moles are often mistaken as members of the rodent family and pocket gopher damage is often misidentified as mole damage (Courtney & Barnes 2002).)

The easiest way to distinguish which animal is responsible is by looking at the burrow mounds. Moles create volcano shaped hills, made from clods of soil. The mole hills are pushed up from deep tunnels and may be 2 to 24 inches tall. In contrast, pocket gopher mounds are crescent shaped made from sifted and cloddy soil.

Range: Seven species of mole occur in North America. Four are found in the West. *Scapanus townsendi* (Townsend) and *S. orarius* (coast mole) are limited to northwestern coastal California. *Neurotrichus gibbsii* is found in northwestern California and along the coast to Monterey and in the Shasta-Trinity area. The shrew mole is also found along the West Coast from Santa Cruz to southern British Columbia (Yates and Peterson 1982). In California the broad footed mole (*S. latimanus*) is the main pest species.

Coast Mole

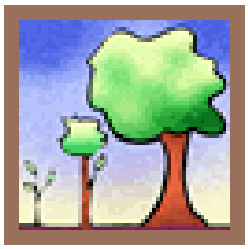
Shrew-Mole

Townsend's Mole

Habitat: *S. latimanus*: soft soils in valleys and mountain meadows; *S. townsendi*: moist meadows, fields, lawns and coniferous forests; *S. orarius*: meadows and deciduous forests; *N. gibbsii*: moist areas in shady ravines and along streams where ground is free of turf, from sea level to 8,000 feet.

In general moles live an isolated existence in underground burrows. Their tunnel systems are complex deep and shallow because the mole forages for food such as worms, insects grubs etc by tunneling. Food requirements of each mole mean 3 to 5 moles per acre is considered a high population. Thus when a mole problem is encountered it is often only one mole ranging throughout the area in search of food.

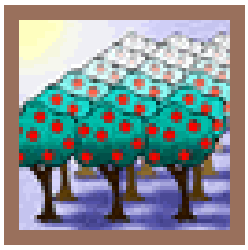
Moles make their home burrow in high dry spots but 'hunt' in cool, moist soil where their food preferences are more plentiful. The home burrows are often found under large trees, buildings or sidewalks. Other animals such as voles and mice commonly use mole burrows as runways



Biology: Moles are active the year round, and except for the Townsend mole, chiefly diurnal. The shrew mole spends considerable time on the surface of the ground but the other three moles rarely venture out of their tunnels. Tunnels are of two types: temporary surface tunnels where the sod is raised in ridges as the mole searches out worms and other food, and deeper tunnels from which the mole must excavate dirt, forming molehills. The deeper tunnels are resorted to when surface soil becomes dry, and, by some moles, as nest sites. Moles are solitary for the most part, though common pathways are occasionally used by Townsend moles to get to different areas. Moles are adept at running backwards and at turning around in their burrows.

All moles eat worms and insect larvae chiefly, and many eat some vegetable matter as well. Their sight is very poor. They are sensitive to odors and ground vibrations which aid in locating food. Moles will leave surface tunnels and go deeper when ground vibrations are felt, although this is only temporarily. Relatively little is known about their breeding habits due to their secretive existence. The shrew mole has more than one litter a year of 1 to 4 young; the shrew mole breeds throughout the year except possibly in December and January. The shrew mole nests in rotting stumps or logs. The *Scapanus* species have one litter a year of 2 to 6 young. The young are born in March or April after a probable gestation of about 4 weeks. The young are born relatively large and in Oregon they reach adult size in two months.

There is little information on natural enemies or longevity in the literature. The hairy tail mole of the eastern United States has longevity of 4 to 5 years and their young attain sexual maturity at 10 months.



Damage Prevention and Control Methods: Moles remove insects and grubs from lawns and gardens which might be of some benefit. On the other hand moles can cause significant problems in landscape or garden areas i.e. turf and plant disruption. No one method of control has proven entirely successful, a combination of techniques may be necessary.

Exclusion: This is practical for smaller areas, seed beds, raised flower or vegetable gardens.

Use ¼ inch wire mesh or hardware cloth to line the bottom of flower beds etc. This will exclude moles and pocket gophers.

Alternatively, in larger areas use underground wire mesh barriers. Dig a trench 24 inches deep six inches wide and place wire mesh or hardware cloth perpendicular in trench bending bottom 6 inches at 90 angle and allowing barrier to protrude from surface (Marsh 1996). While this may provide a temporary effect, it should be noted cost and the fact moles can dig deeper than 24 inches should be taken into consideration. Barriers ultimately only slow mole movement.

Habitat Modification: Restriction of available food by using available pesticides to reduce mole food resources is not recommended (Marsh 1996). This theory requires invertebrate control to restrict the mole population. The data are sketchy at best as to success.

Packing soil with a roller is one method that may work temporarily. This may even have the effect of killing moles if done in the early morning or late evening.

Frightening: Caveat emptor – buyer beware. There is a 50 year history of vibration, magnetic, and electronic devices being promoted as effective in frightening or repelling moles (Marsh 1996). While it is true moles are sensitive to vibrations, it is equally true that they have learned to live alongside busy railroads where, each time a train passes, and the ground vibrates for several hundred feet around the tracks. Consequently while such devices may have some temporary effect they are not considered effective for permanent control.

Fumigants: A variety of fumigants have been explored and registered for use on moles, including gas cartridges. Most have proven ineffective or too expensive due to the moles ability to rapidly plug tunnels, avoid toxic gasses, and the depth and complexity of mole burrow systems, which prevents gasses from penetrating.

Gas cartridges may the best alternative and will work on recent mole arrivals where burrow systems are shallow. Marsh 1996 reports that golf course owners report successful use of aluminum phosphide to repel moles from surface tunnels.

Repellents

In general repellents do not work for mole control. Several plants and chemical substances have been registered or sold as repellents but there is no evidence of their effectiveness (Marsh 1996).

Literature and websites often refer to home remedies as repelling moles e.g. lye, kerosene, castor oil and derivatives, and plants *Euphorbia lathyris*. The evidence is inconclusive at best. More likely is that the moles feeding and activity patterns provide the rationale for claiming success. Moles are singular animals that 'swim' in large tunnels often several hundred feet. Thus, those who claim to have removed a mole may be the inadvertent victim of timing when placing the repellent at which time the mole has gone to a new area of its tunnel. When it returns it appears to be a new mole. Other repellent methods, such as placing ground glass, razor blades, barbed wire, rose bush thorn canes have no scientific basis and may in fact be harmful to the person placing them. Moles are able to successfully tunnel around such measures.

Toxic Bait: The moles main diet is earthworms and insects. Poisoning with traditional grain based baits has been relatively ineffective.

However, several forms of toxic control are commercially available that have been reported effective in some situations. These are either in the form of a 'gel' (warfarin based Kaput® Mole Gel bait) or an artificial worm Talpioid™, intended to mimic the moles food source (Poche 2002 and Courtney and Barnes 2002).

The gel is a relatively new product. The initial scientific testing has been positive as a control method for ease, of use, safety and efficacy. Application of the gel is by injection directly into a tunnel. Care should be taken to not cover the gel bait when resealing the tunnel. Alternatively utilizing a plastic pipe bait station similar to that for ground squirrels is recommended as this makes for ease of gel application on a continuous basis. Only apply the gel in tunnels, not above ground, as the bait may prove harmful to children or wildlife.

An alternative is pellet form bait. A number of commercially available products are sold this way and use castor oil as the active ingredient. Recent scientific studies suggest some efficacy in treatment with clay pellets on lawn areas where Eastern moles were present (Courtney and Barnes 2002).

A new product on the market is Talprid®. It is a bromethalin based gum/gel formed in the shape of a worm. These baits are placed underground in mole's burrow. Follow label instructions carefully.

Trapping: Trapping is the most universally recommended method of mole control.

A number of different mole traps are available at hardware stores, nurseries, or direct from the factory. Keep in mind that the best mole traps differ from those for pocket gophers; very few traps are effective for both animals. Understanding mole behavior helps improve trapping. Most mole traps utilize the theory that a mole will push his way into a soil block in its tunnel. For this reason, 'set' traps generally straddle the runway, encircle it or are suspended above it, and are usually sprung by the pressure of the mole's body or the movement of soil against a triggering plate.

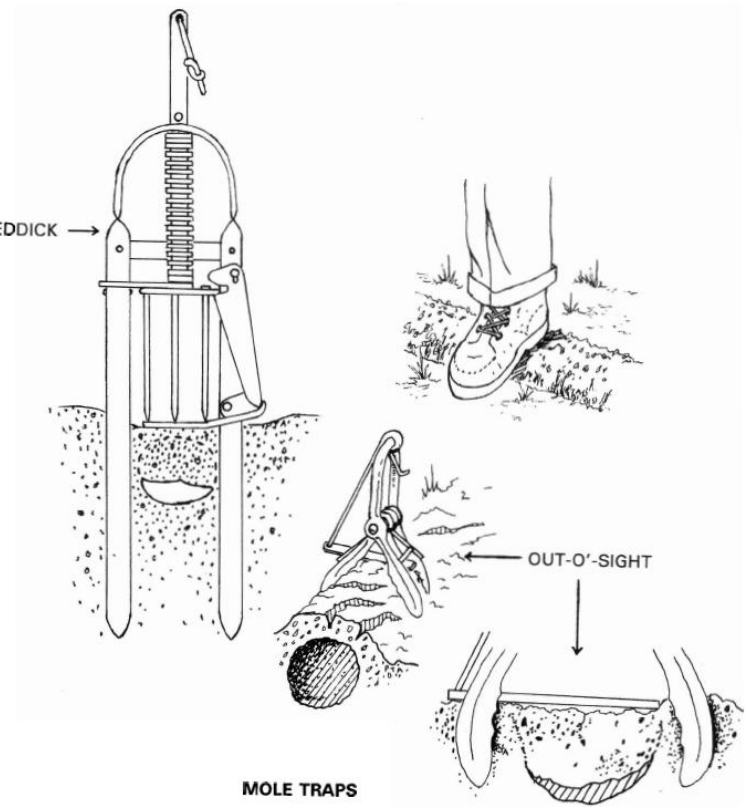
Before setting any traps, it is necessary to determine which runways are in current use. To determine activity, stamp down short sections of runways and mole hills and observe daily; restamp any raised sections or mounds. Moles dig a system of deep tunnels as well as a network of surface runs. Some of the surface tunnels are only temporary runs dug in search of food and may not be reused, while the deep

runways are more or less in permanent usage. The deeper runways may be located by probing downward with a pointed stick, slender metal rod or a standard gopher probe see illustration; between, or next to, a fresh mole hill. Success in locating the deeper runs is determined when a sudden give is felt as the probe breaks into the burrow. The selection of a main or frequently used runway in which to set a trap is of prime importance in obtaining results.

In California, the Out-O-Sight and the Victor (spear or harpoon type) are the two traps most often seen used, however, other kinds and types of mole traps are employed. Moles have occasionally been caught with Macabee gopher traps that were set in mole runways, but this is not a recommended trap for moles. Trap manufacturers often provide detailed instructions for the use of their particular mole traps. For best results, these directions should be followed explicitly. Mole traps can be relatively expensive so most people buy only one. As moles are active throughout the year, they may be trapped at any time. However, the opportune time is when fresh signs of mole activity are evident. Moles are much more difficult to trap then are pocket gophers.

Scissor-jaw traps should be set in a main underground tunnel, usually 8 to 12 inches deep. Using a garden trowel or small shovel, remove a section of soil slightly larger than the trap width about 6 inches. Build a plug of soil in the center of the opened runway for the trigger pan to rest on. Use moist soil from the opened tunnel or from a nearby fresh mound to build the plug. Wedge the set trap, with safety catch in place, firmly into the opened burrow with the trigger placed snugly against the top of the soil plug. Scatter loose soil onto the set trap to about the level of the top of the tunnel. This will exclude light from the opened burrow and likely make the mole less suspicious of the plugged tunnel. Finally release safety catch.

Harpoon traps work in deeper tunnels and also on the surface over an active runway ridge that has been pressed down under the trigger pan. To install a harpoon trap, depress a small portion of the ridge about halfway down to the bottom of the tunnel and set the trap so that the trigger rests lightly on the depressed area. The trap will be set off when the mole attempts to pass through the depressed section of the tunnel.



MOLE TRAPS

Other Methods: There are numerous 'home remedies' as already discussed. These are not recommended.

Flooding burrow system to drown or force moles out or above ground where it can be dispatched is not recommended. Moles have deep burrow systems and flooding is likely to be ineffective and wasteful of a valuable resource (Marsh 1996).

REFERENCES AND ADDITIONAL READING

Borrecco, John E., H.C. Black, 1990. Animal Damage Problems and Control Activities on National Forest System Lands. Proc.!4th Vertebrate Pest Conf. (L.R. Davis and R.E. Marsh, Eds.) Published at Univ. of Calif., Davis. Pp. 192-198.

Courtney, Amy, T.G. Barnes, 2002. The Efficacy of Molexit for Reducing Damage from Eastern Moles (Scalopus aquaticus) Proc. 20th Vertebrate Pest Conf. (R.M. Timm and R.H. Schmidt, Eds.) Published at Univ. of Calif., Davis. Pp.299-302.

Poche, Richard M., 2002. Field Tests of a Warafin Gel Bait for Moles. Proc. 20th Vertebrate Pest Conf. (R.M. Timm and R.H. Schmidt, Eds.) Published at Univ. of Calif., Davis. Pp. 295-298.

Jackson, Jeffery J., 1990. Controlling Vertebrate Animal damage in Southern Pines. Proc. 14th Vertebrate Pest Conf. (L.R. Davis and R.E. Marsh, Eds.) Published at Univ. of Calif., Davis. Pp. 199-202.

Koehler, Ann E., R.E. Marsh, T.P. Salmon, 1990. Frightening Methods And Devices/Stimuli to Prevent Mammal Damage- A Review. Proc.14th Vertebrate Pest Conf. (L.R. Davis and R.E. Marsh, Eds.) Published at Univ. of Calif., Davis Pp. 168-173.

Marsh, Rex E., 1996. Mole Control-A Historical Perspective. Proc. 17th Vertebrate Pest Conf. (R.M. Timm & A.C. Crabb, Eds.) Published at Univ. of Calif., Davis. Pp. 34-39.