

# PRINCIPLES OF VERTEBRATE PEST MANAGEMENT

## Introduction

The term 'Vertebrate Pest' refers to skeletal animals that have reached a population that causes problems of an economic, social or environmental nature.

Vertebrate pests while not as numerous or pervasive as disease or invertebrate problems, can occasionally be a real concern.

A pest can be defined as an organism that causes, or is perceived to cause, or is likely to cause economic or aesthetic damage to humans or their property. When attempting to manage a vertebrate pest there are many things you need to consider first.

Before beginning any direct control action, such as the use of traps or poison baits, think if there are alternative ways the animals can be managed.

First, is control really necessary? There are several variables that should affect your decision.

1. For example,... What kind of animal is it? Positive **identification** of the pest is essential for effective management. This must often be done by studying the signs left by the animal as most vertebrates are nocturnal or difficult to observe.
2. How much **damage** might occur without any control? AND....
3. What are the **benefits of control** vs. the **cost of damage**?

In other words, what are the economic or aesthetic thresholds?

4. Is there any **aesthetic** or **recreational** value of the species involved, or are they legally protected? This may limit the action you would otherwise take.
5. Finally, What will be the **effect** of a control program on non-target animals and the environment?

Once you've considered these things, if you still believe a control program is called for, there are usually several options, depending on the pest to be managed. Ideally, what we want to do is eliminate or repel the pest animal or change its bad habits in a way that will not endanger humans, other non-target animals or the environment.

## Population dynamics and pest management

Some pests can be managed indirectly, without resorting to chemicals or traps, by manipulating the habitat. To do this most effectively, one should have a working knowledge of population dynamics—or how populations change in relation to the environment.

In its simplest form -- each living area has a limited **CARRYING CAPACITY** for a given species. Each living area or habitat, will hold only a limited number of any given species. Excess population either dies or migrates.

The carrying capacity is determined in part by three limiting factors -- **FOOD, WATER** , and **SHELTER**. If we can control these factors, especially food and shelter, we can manipulate the population density, even if we do nothing else.

## Economic Threshold and Types of Pests

Pest populations over time follow the pattern with fluctuations about a general equilibrium position (GEP). In terms of economic pests, two further points on the curves may be described in terms of economic damage: the economic injury level (EIL) represents that population size which causes economic damage. That is, where the loss of revenue due to pest damage equals/exceeds the cost of controlling the pest. The economic threshold level (ET) is that population size at which controls should be applied, to prevent increasing pest numbers from reaching the EIL (Stern, 1965). Pests may be further

categorized as severe (GEP above EIL), perennial (GEP below EIL but regularly reaches EIL each season), occasional (GEP below EIL, but reaches EIL irregularly, say 2 in 5 years), or uneconomic (where GEP and population peaks are always below the EIL) (Figure 5).

## **Life Cycle Strategies of Pests**

Pests vary considerably in their reproductive abilities or fecundity (the ability to produce multiple offspring), the number of generations per year and competitive ability.

From an ecological viewpoint, pests range across a continuum from so-called "*r*"- to "*K*"-type pests.

***r*-pests** have high fecundity and short generation times - they are the opportunistic pests which may rapidly build up to high population levels in agricultural systems. They are especially adapted to short-term, potentially unstable cropping systems (for example rats). Populations reach damaging levels often before competition between natural enemies or between individuals of the pest population itself causes a crash in pest numbers. They have a "boom and bust" type of population development.

***K*-pests**, on the other hand, are adapted to more stable, natural ecosystems, and devote much of their energy to warding off competition from natural enemies. Such pests have low fecundity and long generation intervals. They tend to attain fairly stable populations, limited by the resources in the environment. Many agricultural pests are intermediate between these two extremes

To summarise then, the degree of intervention by farmers, in terms of pest control, depends on the crop type and value, the type of pest (non-product or product), the farmer's economic situation and perceptions of pest problems (risk-taker or risk averse).

To improve pest control practices we need to appreciate the complex interrelationships between pest populations, the host plant/animal and the environment with which these interact

## **Common vertebrate pests & how to manage them**

### **Rats and Mice**

Worldwide, rats and mice are the most notorious of all the vertebrate pests that plague humankind. Of these, the **Norway Rat**, (*Rattus norvegicus*) and the **House Mouse**, (*Mus musculus*) are the most common.

There are three major reasons why rats and mice are considered pests:

- a. They consume and damage human foods in the field and in stores. In addition they spoil it in stores by urine and droppings reducing the sales value.
- b. Through their gnawing and burrowing habit they destroy many articles (packaging, clothes and furniture) and structures (floors, buildings, bridges, etc.). By gnawing through electrical cables they can cause fires.
- c. They are responsible for transmitting diseases dangerous to man.

Adult **Norway Rats** are robust, weighing 10-17 ounces and are 13-18 inches total length. The tail is usually shorter than the head and body. Colors range from gray to brown to almost black.

The **Roof Rat**, (*Rattus rattus*), is the same length but lighter in build and not as widespread as the Norway rat. The tail is LONGER than combined head and body length and the belly is often white.

The common **House Mouse** is another Asian Murine rodent, second only to the rats as a destructive pest. House mice can be distinguished from young rats by their proportionally smaller heads and feet.

Outlying areas are likely to have native **Deer Mice** (*Peromyscus maniculatus*) rather than the imported House Mice. Deer mice have white underparts of the body and tail.

Rats and mice are mostly nocturnal in their habits so an infestation often goes undetected until the rodents become very numerous. By knowing what signs to look for, a rodent problem can usually be caught before it gets out of hand.

Rats and mice tend to move over regular routes and usually produce defined runways. These show up particularly well in dusty areas, especially if flour or other tracking powder is sprinkled around likely spots.

Outdoors, rats will leave trails through vegetation and dig or gnaw holes around buildings and foundations.

Another tell-tail is that rats leave grease smudges when traveling close to a wall, around a beam or through a hole.

Finally, fresh rat and mouse droppings which are moist and soft, are a very reliable sign of infestation.

## **CONTROL**

There are four important steps to effective rat and mouse control.

1. **Elimination of shelter or harborage**
2. **Rodent-proofing structures**
3. **Elimination of food and water**
4. **Killing rodents**

### **ELIMINATION OF HARBORAGE**

Elimination of harborage is often overlooked in a rodent control program. Rats in particular like to inhabit woodpiles and stacks of stored material..

Materials that are stored in stacks or piles should be on pallets at least **8 inches** off the ground -- 18 inches is even better. If possible, they should also be 18 inches from adjacent walls and stacked no more than six feet wide, leaving at least a 12 inch aisle between stacks.

Dense **vegetation** and **rubbish piles** around structures should be reduced as much possible and ornamental shrubs should be pruned away from the ground.

Also, avoid planting ground cover such as ivy, that can offer harborage to rats.

Finally, spaces under buildings should be **blocked off** and old burrows filled in.

### **RODENT-PROOFING STRUCTURES**

Complete rodent-proofing is usually not possible, especially in barns and older buildings, but if approached properly will go a long way towards reducing an infestation.

To keep rats out of buildings, any opening they can get their teeth into (that is over **1/2 inch** in diameter) must be closed up. Mice can often squeeze through openings as small as **3/8 inch**.

Be sure to **seal up openings** around pipes and floor drains and keep the drains tightly covered.

**Edges subject to gnawing** such as door bottoms, should be covered with heavy sheet metal or wire mesh.

Place metal **rat guards** on pipes, wires and other places rats climb.

Other openings can be covered with **19 gauge** or heavier hardware cloth no larger than **1/4 inch**.

In severe cases, burrowing under foundations by rats can be eliminated by building an **off-set curtain wall** of concrete or sheet metal.

### **ELIMINATION OF FOOD AND WATER**

Elimination of food and water is the third step for effective rat and mouse control. Strict control of food materials is essential in any rodent control program.

- Be sure all human and animal foods are stored in **rodent-proof** buildings, rooms or containers.
- Dispose of garbage and other waste in tightly covered metal cans
- It's very important not to feed outside pets more than they can eat at one sitting.
- Be sure to clean up pet droppings -- rats can do very well on a straight diet of feces.
- Clean up windfall fruits, nuts and ornamental seed pods.
- Finally, don't scatter food for birds and squirrels. Even if you have a rodent-proof feeding station, birds will often throw seed onto the ground.

## **KILLING EXISTING RODENTS**

Along with general clean-up and controlling food sources, direct reduction of the infestation is obtained by careful use of **rodenticides** and **traps**.

### **Rodenticides**

There are several effective rodenticides on the market. These are available as **concentrates**, **mixed baits**, **weather-proof blocks** and **pre-measured packets**.

They are all effective and safe to use as long as the label directions are followed. **Always read the label before using any pesticide** (a pesticide is any insecticide, herbicide, fungicide OR rodenticide).

The most widely available rodent poisons are the anti-coagulants, usually containing warfarin, brodifacoum, diphacinone or bromadiolone as the active ingredient. There are many brands available.

**Anti-coagulant rodenticides** work by reducing the clotting properties of the blood until the animal painlessly bleeds to death internally, usually after several feedings. Most other types of rodent poisons are either not readily available or contain chemicals highly toxic to humans and animals.

Baits containing **Warfarin** were the most popular of the rodenticides for many years and are still usually effective if used correctly. These materials are relatively non-toxic to humans, pets and stock. An animal poisoned by anti-coagulants may bleed at the nose and mouth, have a bloody stool, have labored breathing, or all three symptoms. Vitamin K1, administered for an extended length of time is the antidote.

The problem with Warfarin based rodenticides and other **1<sup>st</sup> generation anticoagulants** such as **diphacinone**, is that the rodents must feed almost exclusively on the bait for several days in order for them to kill and a few populations of rats have developed resistance.

The more modern **2<sup>nd</sup> generation anti-coagulants** such as **brodifacoum**, **bromadiolone** and **difethialone** are often effective with a single dose. This may make them a bit more hazardous to use if the label is not followed exactly but they are probably more effective than milder poisons where other food sources can not be eliminated. In addition, no U.S. rodent populations have developed resistance to these materials. With some of these chemicals, there is a hazard of secondary poisoning of wildlife and pets if they feed on a number of dead rodents.

There are only a few **non-anti-coagulant rodenticides** available to the public. These contain the ingredients **cholecalciferol**, **bromethalin** or **zinc phosphide**.

**Cholecalciferol** (Vitamin D<sub>3</sub>) is a calcium-mobilizing chemical that upsets the rodent's blood-calcium level and the animal dies of hypercalcemia. Most other mammals are not as sensitive to changes in blood-calcium levels so the poison has relatively low to moderate toxicity to most non-target animals. This material is not known to cause secondary poisoning.

**Bromethalin** is another recent addition to the rodenticide shelf. This material is a potent nerve poison that paralyzes and kills rodents within 2-4 days.

**Zinc phosphide** is the oldest of the available non-anti-coagulant rodenticides. This chemical, available under several brand names, is a quick-acting stomach poison that will sometimes kill a rodent within 17 minutes after feeding.

Zinc phosphide is quite toxic to all warm blooded animals and must be used with caution. It must not be handled with bare hands as it can be absorbed directly through the skin and care must be taken not to breathe the dust or vapors. Also, it decomposes quickly, especially in damp situations and has a short shelf life (if you can't smell it, it's too old). Fortunately, zinc phosphide is repellent to most animals due to its strong odor and taste which rodents seem to like. There may be a

possible problem with secondary poisoning using this chemical since some sources claim that it can remain active in an animal's gut for a couple days after death.

One of the main disadvantages of acute, or quick-kill rodenticides in general is that the target animal will often sample just a small dose of the bait to begin with. Sub-lethal doses of these quick-acting poisons make the animal very sick. After recovering, these animals become **bait-shy** and very difficult to poison.

To overcome this problem, it's best to first **pre-bait** the area with grain until all the rodents are feeding well, then replace the non-toxic baits with a quick-kill rodenticide in a similar grain base. Since the rodents are used to feeding at these stations, they will gorge on the poison and die. This technique results in good control very quickly and is often more economical when dealing with large numbers of rodents..

With any rodenticide, once control is achieved, it's a good idea to continue with a **preventative baiting** program using an anti-coagulant. This is especially important on farms and other areas where there is a good chance of reinfestation.

Permanent, tamper-proof bait stations placed around buildings will take care of any incoming rodents before they can become a problem.

Remember, if there is a lot of other food available or too few bait stations, or not enough bait set out for a long enough time, you will not get good control.

To be most effective, bait stations must be placed where the rodents can easily get to them. At the same time, they must be protected from dampness, pets, stock, and children. This can easily be done by placing pans of bait in runways and covering with a board or a box with a hole in each end,

For prolonged baiting and outdoor situations, a tamper-proof bait-box can easily be made that will safely present a continuous supply of fresh bait to the pests.

Traps can also be used effectively to help control rat and mouse infestations. They are especially useful when poisons are not wanted or to catch bait-shy rodents left after a baiting program.

When **traps** are used for **rats**, it is most effective to set one or two at least every **15 to 20 feet**, the same spacing you'd use for bait, wherever there are signs of activity. For **mice**, place traps every **5 to 10 feet**.

A "**tracking patch**" of flour or dust placed along walls is an excellent way to check areas for these pests.

The traps should be placed along baseboards facing the wall and near possible entry holes or other cover. When possible, it's a good idea to wire traps to some secure anchor to prevent dying rodents from dragging them off.

You may have to try several baits to find what works best in your situation. Whichever attractant you choose, be sure it is fixed securely to the trap so it can not be licked off. Nut-meats, gumdrops or bacon usually work well. Even a wad of cotton can be effective as the rodents like to use it for nesting material. To help ensure a good catch, it's a good idea to place the baited traps UN-SET until the rodents begin taking the bait. Being very cautious by nature, rats will sometimes avoid a trap or strange bait for up to 14 days. For rats, it is usually a good idea to leave the baited traps unset until rodents are feeding on them. Mice, on the other hand, are generally unwary and easily caught right away.

The **glue-board trap** is another kind of trap available for setting in runways and is quite effective. The large size can be used for either rats or mice but rats can sometimes escape with these so fasten them down when possible. In addition, remember that glue-boards do not work well in very cold, wet or dusty areas and captured rodents are often alive and struggling when found.

Remember to check sets daily to remove dead rodents and re-set any sprung traps. Wear gloves when emptying the traps to avoid being bitten by fleas and lice. Drop the dead rodents directly into sealable plastic bags for disposal.

One of the big advantages of trapping is that the pests don't die in an inaccessible place. With baiting, rodents will sometimes die between the walls and begin to smell in a couple days. If you can locate the odor source, a small hole can be drilled in the wall, 6 inches above the floor and a pint of deodorant or disinfectant sprayed in. This should be repeated between the 2 adjacent studs. Commercial deodorants are the most effective and may be available through hospital supply houses or drugstores. If the odor cannot be precisely located, apply the deodorant in the general area.

Hard-to-locate odors can sometimes be pinpointed by releasing a few blowflies in the room. These will soon congregate on the wall at the source of the problem which can then be treated. If left untreated, the odor will usually disappear on its own in about a month.

**Electronic sonic repellents** are often sold in catalogs for rodent control. These units, made by several companies, are said to emit sonic waves which disrupt the rodent's activities and eventually drive them away. **When tested under laboratory conditions, none of the devices have been proven effective for ANY pest.**

## Bats



Bats are the only true flying mammals. These "non-rodents" are sometimes persistent invaders of attics and wall voids. Although they don't usually cause any structural damage, and are, in fact, very beneficial insect eaters, many homeowners dislike the noises they sometimes make. In addition, large colonies leave quantities of smelly guano and may carry parasites. Furthermore, infected bats can sometimes transmit rabies. For this reason, one should never handle a live bat with bare hands and especially avoid handling any bat acting abnormally, such as fluttering on the ground. If bitten or scratched, capture the animal with the brain intact for examination by health authorities. Be very sure your pets are vaccinated and don't allow them to lick your exposed skin if they might have access to bats.

There are many species of bats in the Pacific Northwest but the one causing most of the problems in buildings is the **Little Brown Bat** (*Myotis lucifugus*). These little animals are highly colonial during winter hibernation, as well as during the summer. The Summer and winter roosts are usually separate. Young are born in June or July, one per female.

The surest way to eliminate or prevent a bat problem is to **build them out**. Depending on the species, bats can enter cracks as narrow as **3/8 of an inch**.

Before bat-proofing a building, one must first evict any bats present. This is best accomplished by hanging **1/4 inch mesh bird netting** loosely over the entrances, securing it on the top and sides with tape and leaving the bottom free-hanging a foot or so below the opening. Bats will be able to leave but not return. This should only be done early in the Summer or in the Fall to prevent young, flightless bats from dying inside. Depending on the building, two or more nets may be needed and it's a good idea to erect a bat house nearby to give the animals a place to go. This may prevent them from looking for other ways into the structure. Older structures may be very difficult to bat-proof.

After eviction, which may take three or four days, large openings in a building can be closed with sheet metal, wood or 1/4 inch or smaller screen. Small holes, cracks and gaps in shakes and tiles can be caulked or filled with foam insulation.

Any lingering odors can be masked with deodorants or disinfectants.

## Moles



Our number one animal pest in yards is probably the mole. This animal is **not a rodent** as is commonly thought, but an **insectivore**, and the Pacific Northwest has four separate species; the **Shrew-mole** (*Neurotrichus gibbsi*), the **Coast Mole** (*Scapanus orarius*), the **Broadhanded Mole** (*Scapanus latimanus*) and one of the largest moles in the world, the **Townsend Mole** (*Scapanus townsendi*).

Problems are caused by three larger species, the Coast, Broadhanded and Townsend Moles. These animals are very similar in appearance and can be serious pests in lawns, gardens and fields.

Seldom seen, these animals are best known by their large, volcano-like mole-hills that they push up periodically along their tunnel systems.

Moles feed almost exclusively on **earthworms**, **soil insects** and **grubs** found while tunneling. Occasionally, they may sample bulbs, root crops and sprouting seeds but there is much disagreement on this point. Most plant damage blamed on the mole is actually caused by **meadow voles** (*Microtus sp.*) which often use the mole's tunnel systems.

Moles are active all year round. Mating usually takes place during February and March and an average of 3 young are born from late March to early May in underground nest chambers.

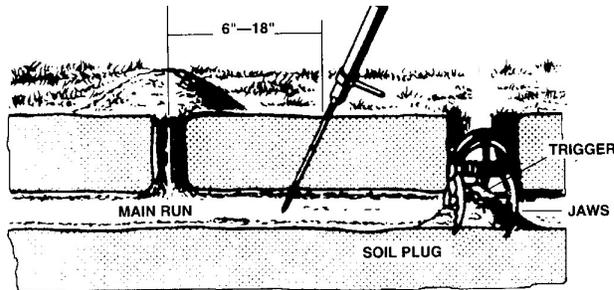
### Controls

Where moles are a definite problem, the only sure way to control them is by **trapping**. In Washington State though, [lethal mole traps are not legal to use](#) for catching moles as of November 2000 when the citizens of Washington passed I-713. "Common rat and mouse traps" may be used but are ineffective for trapping moles.

Where legal, the scissors-type mole trap such as the "Tunnel trap" or "Out-of-Sight" trap is one of the better designs and is very effective if used properly. Other mole traps may also work well if used according to label directions.

One of the most important rules in mole trapping is to **use a tunnel that is active**. You can easily locate these by stomping down the mole hills in the afternoon. By the next morning, the hills that are being used will be pushed back up. During some times of the year you may see no activity at all.

**Locate a deep run about 6 to 18 inches away from the mound** using a steel rod or long screwdriver as a probe. When the tunnel is struck, the probe will suddenly drop a couple inches. (fig. 1)



**Figure 1**

At this point, cut out a section from the tunnel **exactly the width** of the trap. Locate the tunnel holes and build a small, firm **plug of soil** for the trigger to rest on.

Place the set trap with the safety catch on in the hole, making sure that **the trigger rests on the plug** and that the tunnel passes between **both** sets of jaws. In addition, be sure there are no rocks to jam the trap and the trigger set wire has room to function. Remove the safety catch and the set is done. When children or pets are present, put a tub or bucket over the trap to protect them and the trap. Some trappers sift loose soil onto the trap to exclude light and cover the jaws. If there are no results within several days, move the trap to another fresh location as moles change their travel habits regularly.

If you have trouble with moles getting through your trap without getting caught, try placing a piece of shingle or the metal end from a tin can between the trigger of the trap and the soil plug. Also make sure the trigger works smoothly so that the trap is easily sprung.

**BE PERSISTENT** and you will be successful.

### **Other Controls**

The application of **soil insecticides** that kill worms and grubs will, apparently, sometimes cause moles to move. However, this method can be quite expensive, may take several weeks to show results and is hazardous to the environment. There are **NO** pesticides registered for killing beneficial earthworms, which comprise a mole's main diet..

**Mole baits** are inconsistent as a control measure. Most species of moles will generally not eat these products. The majority of mole baits use zinc phosphide as the active ingredient. "RCO Mole Patrol", using chlorophacinone as the A.I., has shown apparent effectiveness on **Eastern moles** (*Scalopus aquaticus*) but has not, so far, been effective in deterring Townsend's moles.

As of 2008, there are also three "gel-based" baits registered in Washington that are, as yet, unproven on our western species. "Kaput Mole Gel Bait", "Adios Mole Killer in a Gel", and "Moletox Baited-gel" are made with warfarin as the active ingredient. They are packaged in syringes so the material can be injected into mole tunnels.

Some of the newest mole baits registered in Washington are the bromethalin-based artificial worms and grubs. "Talpid Mole Bait", a "moleicide" that actually looks, feels and tastes (so they say) like earthworms, was the first to come on the market. Bell Laboratories says they have tested their product extensively and they claim it is the only mole bait that has been submitted to EPA with efficacy studies (other companies dispute that statement). Bromethalin mole baits are also sold as "Motomco Mole Killer" and "Tomcat Mole Killer" worms and grubs.

Castor oil based **repellents** (Mole-Med, Scoot Mole, etc.) have been scientifically tested **on Eastern moles** and appear effective on that particular species. Effectiveness has not been proven on our Western species.

**Smoke bombs** - see under Pocket Gopher.

Mole-plants, chewing gum, mothballs, etc. have not been proven effective.

## Pocket Gophers



**Pocket gophers** (*Thomomys sp.*) are burrowing rodents that can cause a great deal of damage to vegetation, buried cables, dikes and irrigation pipe. Unlike moles, pocket gophers feed almost exclusively on plant material below and occasionally above ground.

There are **six species** of pocket gopher in the Pacific Northwest. Most are 5 to 6 1/2 inches in length with a 2 to 3 inch tail. Fur is usually brown or grayish in color and the typical rodent's "buck teeth" are easily visible. The name "pocket gopher" comes from the external, fur-lined cheek pouches on each side of the mouth that are used for transporting food to storage areas.

Females may have from one to three broods per year, depending on the availability of high-quality forage, with an average litter size of 5 -6 (sometimes up to 13!) The young stay in the nest for several weeks but eventually wander off to form their own territories.

### Moles or Gophers?

While moles usually prefer moist lowland areas West of the Cascades and gophers are mostly found East of the range, they do occur together in some localities. Since most controls are very different for the two species, accurate identification is a must.

The **appearance of the mound** will tell us which pest we must deal with. Mole mounds are usually conical with a "cloddy" look to the soil while gopher mounds, consisting of finer soil, are usually flatter and somewhat fan-shaped with an obvious plug in one end.

### Controls

Pocket gophers may be controlled any time of the year but it is most successful when new mounds are appearing, usually in the Spring and Fall. **Trapping** (*note that ALL body-gripping and impaling traps are illegal to use in Washington as of Dec. 7, 2000, as Initiative 713 is interpreted by Washington State Dept. of Fish and Wildlife and the Sr. Ass't Attorney General*) and **toxic baits** are both available to the public and are both effective. Before using lethal controls on pocket gophers in western Washington, read the information from [Washington Dept. of Fish and Wildlife](#)

Special **pocket gopher traps** of several styles are widely available and easy to use in States where they are legal. These may be set in the lateral tunnel leading to the mound but are more effective when set in the main run which can be located by probing a foot or so away from the mound. Two traps should be placed back to back in the deep run and should be staked down to prevent loss. Relocate the traps if a catch is not made within 2 or 3 days.

**Toxic gopher baits**, if used, should be placed in the main tunnels according to label directions. The tunnels may be located with the probe and the bait placed down the probe-hole or the tunnel may be excavated with a trowel and the bait placed directly in the run. Dose each burrow system in two or three different places for best results. Check the area periodically for 2 weeks after treatment and dispose of any carcasses found.

**Smoke bombs**, though available, are seldom effective unless the soil is saturated with water or consists of dense clay.

### Voles



There are several species of **voles** (*Microtus sp.*) or "meadow mice" in the Pacific Northwest. All of them are plant feeders and many are proficient burrowers. Voles can cause damage in orchards by feeding on the roots and girdling trunks. These **small, short-eared, short-tailed rodents** will also tunnel through vegetable and flower gardens, feeding on juicy roots, tubers and bulbs -- damage that is often blamed on our poor, insect-eating moles! Voles will even use the moles' tunnels when making these raids.

Voles are active day and night in all seasons. They are seldom seen as they spend most of their time underground or in dense grass. They can have up to 5 litters per year with up to 11 per litter and are the main food source for many predators.

### SIGNS

How can you tell if you have a vole problem? Obvious signs include **gnawed roots** and **root crops** (note the small **grooves** left by the 2 large front teeth). In badly infested orchards, you can locate the dead trees during the dormant period by reaching out and giving them a wiggle. If they move very much, the entire root system is probably gone. In the growing season, damaged trees are leggy and thinly leafed with a reddish tinge to the foliage. If you pull the tree up, the underground part often looks as if it was run through a pencil sharpener. **Girdling of tree trunks** extending to just above soil line (rabbits usually damage trunks and twigs higher up and leave larger tooth marks at 45 degree angles while Mountain Beavers clip the branches, leaving 2 inch stubs) and extensive, well-used tunnels through the soil and/or in the grass or thatch are other signs of infestation. Finally, voles often leave open, **1 inch** holes in areas of heavy activity.

## MANAGEMENT

**Vegetation management** is a key issue in keeping vole populations low. In orchards, keep the tree rows free of vegetation at least 36 inches on both sides of the trunk. This can be done by weeding or by using a registered herbicide. If you are using a string weeder (Weedeater, Weed Whacker, etc.) be sure not to hit trunks. Despite assurances that they are safe, they can injure the thin bark of young trees. In orchards where voles are known to be a problem, mow the grass in late Fall to reduce harborage. This is particularly important in years with snow cover, because snow protects voles from predators.

Be very careful if you use mulches around trees and shrubs! Voles are often encouraged by a nice, loose mulch. Mow the grass in between rows and keep it short. Avoid thatch that the voles can hide under. Finally, be sure to pick up any fallen fruits so the voles can not feed on them.

**Hardware cloth cylinders** (1/4 inch mesh) can be placed around shrubs and young trees to exclude voles if the lower edge is buried 6 inches deep.

In gardens, try to keep surrounding areas free of tall grass and thatch and don't leave root vegetables in the ground over winter.

## CONTROL

*Biological:* Almost all small meat-eaters love to feed on voles. By encouraging hawks, owls, coyotes, foxes, weasels and shrews you can help keep vole populations from exploding.

*Mechanical:* For very small populations, trapping may be sufficient. Ordinary **mouse-traps** can be baited with peanut butter or apple and set **IN** the runs. Dig into the underground tunnels to place the traps and then cover with a board for the most effective set. Check traps daily and re-set as needed. This is a very time-consuming method but useful where poisoned baits are not wanted. Tree guards that are effective in controlling rabbit damage, will **NOT** discourage voles since they feed largely underground. In fact, voles have been known to nest under loose-fitting guards!

*Chemical:* There is one rodenticide, "Adios Mouse Killer in a Block" (warfarin is the active ingredient) registered for homeowner use against voles in Washington State (2008).

Most "Mole & Gopher" baits registered for home use will kill voles when applied according to label directions but they are not specifically registered for use on these rodents.



Several rodenticides are registered for professional use on voles. Some are more water-resistant and acceptable to the mice than others. **ALWAYS READ THE LABEL BEFORE USING ANY PESTICIDE!!!** Some of the chemicals registered include zinc phosphide (very toxic - decomposes quickly in damp situations), chlorophacinone and diphacinone (anticoagulants-require multiple feeding. Some secondary poisoning hazard to wildlife). Keep the bait as dry a possible to encourage feeding. Bait pellets **MUST** get into the burrows to be most effective.

How do you know where to place the baits? Damaged areas, tunnels and runways are always likely areas. However, since vole populations fluctuate wildly, it's a good idea to first place apple or carrot pieces in your various target areas and cover with a shingle or 12"x12" piece of cardboard (be sure the cover doesn't blow away). If there is no feeding on these materials within 24-48 hours, there are probably no voles in the immediate few square yards. If more than 20% of the apples are nibbled, there is possibility of plant damage. You can save time and effort by working only where the mice show feeding activity. Fall is the most important time to monitor vole populations to prevent winter damage.

About a week after you place the bait, put out some more apple or carrot pieces. If there is no feeding within a couple days, your baiting program was successful.

## Ground Squirrels

Ground squirrels (*Spermophilus sp.*) of several species occur mostly east of the Cascade range. These rodents range in size from the tiny **Idaho ground squirrel** (8 1/2 in.) up to the **California ground squirrel**, our only coastal ground squirrel in Oregon and California (18 in. ). Ground squirrels feed mostly on vegetation and can be very damaging to gardens. They are also vigorous burrowers, leaving many open holes throughout their home ranges and have been implicated in the transmission of plague and other diseases.

Ground squirrels are generally dormant during the hottest part of Summer as well as during the Winter. Breeding takes place soon after emergence in the spring and a single litter of 2 to 10 young are born 4 to 5 weeks later. some species can reach population densities of over 100 per acre.

### Controls

Ground squirrels can be excluded from buildings with standard **rodent-proofing** techniques. Metal rodent guards will usually keep them out of fruit and nut trees.

**Fencing** is usually **not** effective in barring these rodents from an area and scare-devices also do not work.

**Trapping** the rodents can be effective in small infestations. **Cage-type** traps may be used but check with your local Extension office or Wildlife department before releasing these rodents back into the environment. Relocation may not be legal. If the animal must be destroyed, the entire trap can be dropped into a large garbage can full of water. **Lethal traps** such as the "Better Squirrel and Rat Trap" (a choker-type trap) or the Conibear 110 body-catch trap may be used (**note that ALL body-gripping and impaling traps, other than "common rat and mouse traps", are illegal to use in Washington as of Dec. 7, 2000, as Initiative 713 is interpreted by Washington State Dept. of Fish and Wildlife and the Sr. Ass't Attorney General.**) For small ground squirrels, you may be able to use regular **rat traps**. One trap for every 10 - 15 squirrels present should be used to quickly control the population. Be sure to keep the traps inaccessible to non-target wildlife and pets. Ground squirrels are generally unprotected but check with your local laws before using lethal methods.

**Gas bombs** are available for the home gardener and can be quite effective if used when the rodents are active. They work best when the soil is moist and dense, which helps keep the gas in the burrows.

**Rodenticides** are usually not registered for the home gardener to use on ground squirrels. Check with your Extension office to see if any are legal to use in your State.

## Mountain Beaver



Another occasional pest in the western parts of Oregon and Washington is the world's most primitive living rodent, the **Mountain Beaver** (*Aplodontia rufa*). This animal does not usually live high in the mountains and is not a beaver of any kind, being more closely related to squirrels. It is found only in the Coastal areas and foothills of Western North America.

The Mountain Beaver belongs to its very own taxonomic family (Aplodontiidae) and is known by several common names including "boomer", "whistler", "chehalis" and "sewellel". This rodent weighs two to four pounds and is about a foot in length, resembling a tailless muskrat with large, digging claws. It usually lives in or near wooded lands having large masses of tangled vegetation such as

sword fern, blackberry and salal, its primary foods.

These solitary animals dig shallow tunnels 4 - 8 inches in diameter throughout their half-acre territories and feed on any available vegetation which they sometimes stack near their burrows.

The Mountain Beaver becomes a pest when it begins feeding in reforestation units, Christmas tree farms and home yards and gardens. It generally destroys much more vegetation than it eats. In home gardens, the Mountain Beaver is primarily a pest of **rhododendrons**. It usually damages the plants by clipping off stems and branches, leaving **2 inch stubs**. They will also occasionally gnaw the bark from the bases of larger trees.

### Controlling Mountain Beaver

In an area where there is only limited damage such as a single rhodie or tree being stripped, enclosing the plant in a **wire fence** will often discourage the



pest. A two-strand **electric fence** with the bottom wire about 4 inches above the ground should also work. One can also fence the entire yard with a rabbit-proof fence (chain-link, chicken wire, etc.) to protect the landscape. Be sure the bottom of the fence is tight against the ground or even buried a foot or two.

**Repellents** have not proven consistently effective but some researchers have had fair results with 36% putrescent egg solid based products. Other researchers have found the Thiram based repellents of some value for protecting Douglas fir seedlings.

Mountain Beavers can also be easily **cage-trapped** and re-located, although some studies have shown that most re-located wildlife does not long survive. Drowning the animals in a garbage can full of cold water may be the most humane treatment. Check with your local State Wildlife Department for their recommendations.

A rabbit-size cage trap can be set directly in the main entrance of the mountain beaver's tunnel system and covered with a tarp or burlap bag. The cover directs the animal into the trap and protects it until it can be dealt with. You can also bait the trap with a piece of apple or sweet potato. Mountain beavers are very prone to hypothermia so do your trapping when the weather is mild.

With any trap, it is most important to make the set at an active burrow. Mountain Beavers make a lot of holes but use only a few regularly.

**Wildlife control professionals** can also be hired to deal with these problems. The local State Wildlife Department usually has a list of licensed nuisance animal trappers.

## Beavers

True beavers, *Castor canadensis* are the largest of our North American rodents. They can grow to over three feet in length and can weigh over 60 lbs. This well-known, semi-aquatic rodent is common in lakes, creeks and rivers throughout the Pacific Northwest.

Beavers are accomplished engineers and are famous for their well-built dams and beaver lodges. Dams and lodges are not ALWAYS present where beavers are living but the damage inflicted on trees and shrubs by the beaver's huge incisor teeth is a positive sign that these animals are around.

Breeding usually takes place between January and March, with an average of four "kits" being born after a gestation of about three months. The young stay with the adults for about 1-2 years before migrating away to form their own colonies of between 2 and 12 individuals.

## Damage & Management

Beaver dams are beneficial to wildlife but they can flood a considerable area and can not always be tolerated. Where dams are causing problems, the water level can sometimes be altered by flow devices to keep flooding within reasonable limits. Installation of flow-control devices (or removal of dams, which is generally a waste of time) requires a Hydraulic Project Permit from your local office of the Washington State Dept. of Fish and Wildlife. The WDFW can also provide information on designs and installation of such devices.

If beavers are damaging trees and/or ornamental shrubs, there are several ways plants can be protected.

Large trees and shrubs can be loosely wrapped with layers of chicken wire, hardware cloth or galvanized wire fencing, at least three feet high. Be sure you monitor the trees as they grow and/or leave room for the plant to expand. More slender trees can be protected by splitting 3 foot lengths of plastic pipe and fitting them around the trunks. Be aware that dark colored plastic may cause overheating and damage to young trees.

Large plantings can be protected with a variety of fencing. Four foot field fencing, installed so that the bottom is tight against the ground, works well as does a 2-strand electric fence with the strands stretched off the ground at 8 and 12 inches.

Repellents can also be helpful in reducing beaver damage, especially if the animals are new to the area. Even so, repellents are seldom 100% effective. Commercial repellents containing egg solids have shown some success but must be reapplied often.

Repellent paint for applying to tree trunks can be made by mixing 2/3 cups masonry sand (30 mil or 70 mil) per quart of latex paint. Mix it well while applying.

If beavers must be removed, it is best to contact the WDFW to locate a professional wildlife control operator. In some cases, you may be allowed to shoot the offending animals but removal is seldom a permanent solution as good habitats are usually repopulated by migrating beavers within a couple years.

## Deer and Elk

Several species of deer and elk occur widely in the Pacific Northwest. In most places they are highly valued as game animals and "watchable wildlife". In a garden or orchard, however, they can cause extensive and continuing damage to crops and ornamentals.

Two sub-species of **mule deer**, are the most common cloven-hoofed pests in the Pacific Northwest. On the West side of the Cascades we have the **blacktail deer** (*Odocoileus hemionus columbianus*) and on the East side lives the **mule deer** (*O. hemionus hemionus*). The **whitetail deer** (*O. virginianus*) also lives in many parts of the Pacific Northwest. The whitetail is easily identified by its bushy tail which is used as a "flag" to signal alarm. Mulies have smaller tails with black markings.

Two sub-species of elk also occur in the Pacific Northwest. The **Roosevelt elk** (*Cervus elaphus roosevelti*) inhabits the west side of the Cascade range and the **Rocky Mountain elk** (*C. e. nelsoni*) is found in some areas to the East.

### Damage

Deer and elk feed on a wide variety of plants, both woody and herbaceous. Most damage is caused by browsing on woody ornamentals and crops. Browsing damage is easily identified by the **ragged tips** where the twigs have been broken. Rodents and rabbits leave a clean cut when they browse.

### Management

The only consistently effective management tool for reducing deer and elk damage is some sort of **fencing system**. These range from simple, baited electric fences to expensive 7 foot high-tension New Zealand-type fences or woven-wire fences. The simple fences are quite effective in areas where deer are just beginning to cause damage. In areas where deer and elk have been feeding for some time, the more impenetrable fences are necessary. It is also important that the fences are visible so the animals don't accidentally stampede through them.

If deer or elk are browsing on a few plants, cylinders of welded wire mesh can be placed around each one. New seedlings can be protected with plastic mesh tubes or netting.

In some cases registered **repellents** can reduce damage sufficiently but must be re-applied periodically - especially after a heavy rain. If the animals are habituated to feeding in the area, repellents are less effective.

There are many home remedies mentioned in the literature ranging from hanging bars of deodorant soap to scattering lion dung about the garden. Sometimes these methods work but many times they do not.

Replacing heavily damaged plants with more **resistant varieties** is another option. There are many kinds of ornamental plants that deer and elk don't like. Even some of these will be browsed if the animals are really hungry

In areas where **hunting** is allowed, opening your land to responsible sportspeople can help reduce browsing damage.

For more information specific to your location, contact your State Fish and Wildlife Department.

## Tree Squirrels

The Pacific northwest is home to several species of native and introduced squirrels. On the West side of the Cascades the native **Douglas squirrel** (*Tamiasciurus douglasi*) with its dark red coat and orange belly is still quite common although the large, introduced **Eastern gray squirrel** (*Sciurus carolinensis*) with its rusty-gray pelage and white belly has taken over in

many areas. On the East side of the Cascade range the common species is the **Red squirrel** (*Tamiasciurus hudsonicus*) with its dark red back and white belly. The introduced **Eastern Fox squirrel** (*Sciurus niger*) with its reddish coat and belly is the largest of the North American squirrels and is not common in most areas. The shy, native **Western gray squirrel** (*Sciurus griseus*) with its gray coat and dusky feet is not common, either, being found mainly in areas where the Gary oak thrives west of Idaho and Nevada. Finally, a common but seldom seen native is the nocturnal **Northern flying squirrel** (*Glaucomys sabrinus*). This little glider thrives wherever there are coniferous forests.

### **Damage**

Squirrels can become troublesome when they attack **fruit, nut and vegetable crops**. They are also incessant raiders of bird feeders and bird nests and can damage ornamental trees by **clipping twigs** and **stripping bark**. In areas where nesting places are scarce they will gnaw into attics and wall voids, causing serious damage.

### **Management**

Methods used for controlling squirrels vary according to location and species to be managed. Native squirrels are usually protected by law so a combination of non-lethal methods can be used, including **exclusion, repellents** and **cage-trapping**. In many places, non-native squirrels are not protected (check with your local wildlife department) so trapped animals may be humanely destroyed. Euthanasia is often recommended when dealing with Eastern grays since re-location would spread these destructive rodents into new areas or place them in an area already at carrying capacity where they would probably suffer a lingering death.

In areas where squirrels are a potential problem, **feeding should be discouraged** to help keep the carrying capacity low. Lots of food means lots of squirrels! Clean up fallen fruits, nuts, ornamental berries, seeds, etc. as much as possible. If birds are fed, be sure the seed is presented in **squirrel-proof** feeders.

**Attic vents** in buildings should be covered by heavy wire mesh and other openings should be sealed.

Plants that are being damaged can be protected somewhat with registered **repellents** or **wire cages**. Where **bulbs** are being dug up, chicken wire can be laid down, staked securely and lightly covered with mulch.

**Fruit and nut trees** can often be protected by placing 24 inch wide rodent-guards on the trunk 6 feet off the ground. This will NOT work if there are tall trees, fences or buildings nearby or if the tree branches are near the ground.

## **Raccoons**

Raccoons (*Procyon lotor*) are native carnivores that live throughout most of the United States. These animals, which can grow up to 50 lbs., readily adapt to suburban environments. With few predators and human-supplied food, populations often grow out of control.

### **Damage**

Raccoons are generally nocturnal in habit and omnivorous in diet. They will often stage midnight raids on gardens and orchards. They can easily climb fruit trees, tip over garbage cans and will even roll up newly laid turf to get at the worms and grubs living underneath. In addition, 'coons will try to invade crawlspaces and can destroy the insulation under houses, leaving quantities of odorous feces. In some areas they are important vectors of rabies and the raccoon roundworm.

### **Management**

Exclusion is usually the most effective way of managing raccoon damage. Orchards and gardens can be protected by erecting a two-strand electric fence with the first wire about 6 inches from the ground and the second wire 6 inches higher. Chain link and chickenwire fences will also work if a single strand of electric fence is stretched along the top.

Large fruit trees can be protected by installing sheet metal "rodent guards" as suggested for squirrels.

In some situations, a radio left playing in the garden will repel the pests until harvest but this is usually a temporary measure.

A noisy dog patrolling the yard is usually an effective deterrent for many vertebrate pests.

For animals nesting under houses, find out where they are getting in and **securely** block the entrance when they leave at night to forage. Be sure any young have left, also. A tracking patch at the entrance can indicate when the animals have emerged.

If you choose to try a cage-trap, check with your local State wildlife department for instructions.

## Opossums

Possums are the only marsupials native to the western hemisphere. The Virginia opossum (*Didelphis marsupialis virginianus*) is an introduced species in the PNW, being established here in the '30's. They are often described as "giant gray rats" since they have a naked, rat-like tail. They may reach lengths of up to 40 inches and weight up to 14 lbs.

### Damage

Possums are omnivorous feeders and are usually quite beneficial as they eat a wide variety of insects and other invertebrates. They will, however, also raid gardens, fruit trees, bird feeders, garbage cans and bird nests. As with raccoons, they will also nest under houses, causing considerable damage and odor problems.

### Management

Controls for this animal are the same as for raccoon. If you choose to use a cage trap, check with your local State wildlife department. Since this animal is not native to the PNW, your State may not allow releasing back to the wild.

## Rabbits

In the Pacific Northwest, there are eight species of rabbits and hares. A few of them can sometimes become pests in the home garden.

**Whitetail and Blacktail "Jackrabbits"** (*Lepus townsendii* and *L. californicus*) are actually hares and are generally found East of the Cascades in the Pacific Northwest. Our only other hare is the **Snowshoe hare** (*L. americanus*) that lives throughout most of the PNW except the very driest areas.

The true rabbits include the **Mountain Cottontail** (*Sylvilagus nuttalli*) and **Pygmy Rabbit** (*S. idahoensis*) East of the Cascades. The **Brush Rabbit** (*S. bachmani*) is found in W. Oregon. The **Eastern Cottontail** (*S. floridanus*) and **Domestic Rabbit** (*Oryctolagus cuniculus*) have been introduced into parts of the PNW.

Rabbits and hares are very prolific, having up to 6 (or more) litters per year with several in each litter.

### Damage

Hares and rabbits will eat a wide variety of herbaceous and woody plants. A diet of bark and stems is often preferred during the colder months when much damage to gardens and orchards may occur, especially during peak population years. In the Spring and Summer, they develop an appetite for flowers (especially tulips) and vegetables.

Rabbit-damaged trees and shrubs are easily identified by the characteristic **toothmarks** left when the animals feed. Twigs are usually clipped cleanly at a **45 degree angle** and bark on lower stems and branches is gnawed away, leaving **parallel grooves** in the wood.

### Management

Since rabbits and hares are usually classified as game animals, one should contact the local Fish and Wildlife department for regulations about trapping or shooting.

One of the most effective methods of reducing damage is to **fence** the animals out. A fence of chicken wire two feet high is usually sufficient to protect the garden from rabbits. Mesh size should be no more than one inch and the bottom of the fence must be tight against the ground or buried a few inches. If feral domestic rabbits or hares are the problem, the fence should be 30 – 36 inches high with the bottom 6 inches of fencing bent outward buried 6 inches. Individual plants may be protected with cylinders of 1/4 inch mesh hardware cloth about 18 to 20 inches long. Commercial tree wraps can also be effective.

**Habitat manipulation** can also help reduce rabbit/hare damage. Removing briar patches, brush piles and other hiding places will reduce the overall number of animals in the area.

There are several **repellents** registered for rabbit and hare management. Most of these are somewhat effective if the feeding pressure is not too great. Many are labeled only for use on ornamentals.

## Birds

Birds can cause problems in farm and home garden situations by their **roosting**, **nesting** and **feeding** habits, depending on the species. The most common culprits are **crows**, **starlings**, **woodpeckers**, **pigeons**, **house ("English") sparrows**, **robins**, and **geese**. Other species may be occasional pests.

Bird management can present special problems since most species are protected by law but there are many tools available for reducing damage.

### Roosting and Nesting Damage

Where birds roost or nest, droppings must fall. Bird droppings can damage machinery, stored feed and present possible disease hazards.

Roosting can be prevented by making the area uncomfortable for birds through the use of **barriers**. Solid, angled barriers or wire obstructions ("porcupine" wires and stretched wire) can prevent birds from using ledges as roosts. The wire obstructions also work well on building peaks.

"**Bird glues**" can also be used to reduce roosting. Bird don't like getting these sticky materials on their feathers so they will usually avoid contact. Glues must be re-applied occasionally and don't work well in dusty or wet conditions.

House sparrows, starlings and swallows often try to nest in or on buildings. **Bird netting**, **screens** and **wire barriers** can be used to prevent these invasions. Try to close up any unnecessary openings.

Woodpeckers can present special problems when they use a structure as a "drumming station" during courtship. Cedar siding is especially attractive and prone to damage. An infestation of carpenter ants or solitary bees can also lure woodpeckers to peck holes in the wood siding. "**Scare devices**" are sometimes useful in driving these birds away. Hanging **bird netting** from the eaves so it dangles a few inches from the side of the structure can also work. If carpenter ants are present in the structure, they should be eliminated.

Sapsuckers, a type of woodpecker, can be pests of ornamental and fruit trees. These birds feed largely on sap that they harvest by drilling shallow holes, usually arranged in neat rows, in the bark of the trees. These "sap wells" usually do not cause permanent damage but are unsightly and, if extensive enough, could kill smaller trees.



### Crop Damage

Birds can cause extensive damage to all kinds of crops. Those most prone to damage include **strawberries**, **cherries**, **blueberries**, **apples**, **grapes** and **hazelnuts**.

Low growing plants can be covered with **bird netting** to prevent damage. Be sure the netting reaches the ground or is gathered around the trunk of the plant or the birds will fly up underneath to attack.

Various "**scare devices**" (scare-crows, hanging flashers, flags, balloons, etc.) can reduce damage if they are moved about so the birds do not become accustomed to them.

**Sonic devices** that broadcast **alarm calls** are useful for the particular species making the call. Ultrasonic and sub-sonic devices have not been proven effective on any pest species.

The **repellent**, Methyl anthranilate, has recently been registered for home use on a variety of crops. This material is derived from grape skins and has proven useful in reducing bird damage in test plots. Effectiveness in field situations is variable.

**Trapping** can only be used against **non-protected** birds (house sparrows, domestic pigeons and starlings) but it can still be of use for reducing local populations of those species. Cage traps of various kinds must be used to avoid harming protected species.

**Animal Damage Control in Washington.** Washington State University Cooperative Extension. EB 1147. 88pp.(Out of Print)

**Pest Management Study Manual for Pest Control Operators.** Washington State University Cooperative Extension. MISC 0096, 139pp.

**Prevention and Control of Wildlife Damage.** University of Nebraska Cooperative Extension, Great Plains Agricultural Council Wildlife Committee, USDA/APHIS/Animal Damage Control. Vol. 1 and 2

**Vertebrate Pest Control.** University of California Cooperative Extension. Leaflet 2976. 15pp.

## DEFINATION

Vertebrate pests refer to skeletal animals whose population has reached a stage that cause economic, social or environmental problems. Vertebrate pests could include house rats, wild rodents, birds, rabbits and even foxes, predatory wild dogs, pigs, bats, small and large animals.

## DISTRIBUTION

Vetebrate pests are well distributed depending on the availability of space and sustenance. Among the factors determining their distribution are:

- a. Availability of food: availability of food is a major determinant to vertebrate distribution. While many birds and rodents prefer grains, its availability on the field (before harvest) and in store determines pest presence. The more the food is available, the higher the population of the pests.
- b. Season: There are variations in the abundance of food for verterbrate pests. During the growth season, major pests can be herbivores such as cane rats, rodents etc. That feed on the fresh stems while at harvest and storage the grain feeders are dominant. The harvest season is the period that supports abundance of vertebrate pests.
- c. Habitat: For birds, the place to roost is very important for its distribution. Birds can only fly hundreds of kilometers from roost to place of feeding. The rodents also require secluded places such as tunnels, holes, crevices in wood and offices to live and reproduce for continuity.
- d. Taste preferences: this may be a factor in birds and rodent distribution. The pests have various preferences but can easily adapt to changes in food source and types.
- e. Abundance: a major factor in the vertebrate pest abundance is availability of food. At the peak of harvest (when the rain has stopped) a lot of grains (of grasses and planted crops) are available on the ground: this is the period of high population of vertebrate pests such as rats, mice and birds. Abundance can be as a result of their getting wise of traps; thus avoiding death and then increase in population. It can also be as a result of lack of control measures, hence build up a population.
- f. Destruction of forest covers by bush fire and clearing characterizing the dry season between October and March adversely affects their distribution and abundance.
- g. Threats: Rats, rodents prefer where their lives is not constantly threatened and they can move easily to their food source.

## FACTORS PREDISPOSING CROPS TO ATTACK

On the field:

1. Weed: this is an important predisposing factor to vertebrate pest attacks. Weeds form effective cover for rats and rodents particularly on rice and wheat farms enabling them to cut and feed on the stems.  
Oil palm seedlings are also attacked by cane rats if the farms are weedy and the seedlings are not covered by wire collar. Hence farm sanitation is an important measure in crop husbandry.
2. Bird Scaring: crops such as rice when exposed to physical attack by birds during grain filling can result to total yield loss.
3. Over ripening and delayed harvesting: Non-harvesting of crops at maturity and allowing matured crops to remain on the field can lead to severe yield loss. If it is fruits such as tomatoes, oranges, pawpaw, pineapple and mango. Birds usually invade the field, feeding on their juice. Such damaged fruits usually lose their market value and rot. Tuber crops such as yam and cassava are usually attacked by burrowing rodents. The rotting of such tubers usually start from the point of feeding, hence early harvesting is encouraged.
4. Lack of proper storage: A major factor predisposing crops to attack by vertebrate pests is mode of storage. Rats and rodents attack stored grains of cereals crops and legumes (cowpea) when not properly protected. Losses due to vertebrate pest have not been quantified. The rats and rodents feed on the endosperm of the maize and can destroy the entire storage if not protected rendering it unmarketable.
5. Lack of chemical treatment of planted seeds usually lead to rats and birds picking up the germinating seeds or removing the grains when the seedlings have emerged.  
Planted seedlings of cocoa is also fed on by squirrels (*Scirus* spp) particularly tree squirrels. Hence, non protection of with chemicals and lack of physical barrier with wire gauze predispose seedlings to vertebrate pests.
6. Lack of physical infrastructures like wooden boxes and protective wire gauze can encourage damage by birds and rodents.
7. Physical structures of the crop may be a factor in preventing vertebrate pest damage.  
During grain filling of wheat and barley, the structure of the panicles with apointed lignin prevents patching of birds and thus prevents predisposition to birds.

## **RODENTS AND RATS**

These are the most common animals that constitute pest problems in the house, offices, stores and farms. There are three species of these rats: the house mouse (*Mus musculus*), the Norway rats (*Rattus norvegicus*) and root rat (*Rattus rattus*). House mouse is a small animal with large ears, poor vision, relying on sense of smell to locate food. Commonly found living in man made structures in the house. Its long sensitive whiskers on its nose above the eyes are tactile sensors.

### **a. Detection of rats and rodents**

It is fundamental to understand the presence and activities of rats and rodents, their movements, types of habitat they occupy and the damage they cause before one can assess the damage they cause.

Specific signs are associated with rat infestation and these can be used to detect their presence and ecology.

- a. Urine – smell of urine along the run ways
- b. Smudges or rub marks – oily dirty marks
- c. Gnawing marks – saw-dust like wood chips are produced around doors, boards e.t.c.
- d. Droppings – littering the run-ways. Can even tell time of infestation.
- e. Pest excitement – pawing and excitement of dogs and cats in an area indicate presence of rats.
- f. Run-ways – their movement between shelter, source of food and water create a definite pathway.

g. Tracks – tail drags if the place is sandy and leaves footprints.

b. The damage by rats/rodents

Usually extensive on crops both in storage and on the field.

- a. Farm infrastructures, stores, crop produce causing spoilage, rotting and loss of economic and cosmetic values.
- b. Infect humans directly with diseases such as hanta virus, rabbit fever, *Leptospirosis* and *Salmorellosis*.
- c. Serve as reservoir for diseases transmitted by ectoparasites such as tick.
- d. Feeding on young stems of rice, wheat and other cereals during seedling and young stage.
- e. Cut down and feed on rice, sugar cane and oil palm seedlings.
- f. Feed on fresh ears of maize.
- g. Peak feeding periods are at dusk and just before dawn.

### 1. Management of rodents in the house and field

➤ Sanitation

Correction of sanitation deficiencies is basic to rodent control.

- i. Elimination of food source.
- ii. Proper storage of food from access by the animals.
- iii. Elimination of garbage and rubbish.

➤ Exclusion

Exclusion of initial invasion is primary

- i. Blocking of rodent access, concrete blockage
- ii. Sealing holes with durable materials, screen ventilation e.t.c.
- iii. Regular elimination of harborage
- iv. Keeping surroundings weed free

➤ Elimination

- i. with traps: trapping with cage, trigger traps e.t.c.
- ii. Glue board- this also can monitor new inclusions

➤ Noise and Electrical devices

Rats and mice are easily frightened by strange noise, particularly repeated sound

➤ Baits

- Several anticoagulants are used as baits
- Advantages and disadvantages
- Precaution for handling anticoagulants

➤ Rodenticides:

- They are either chronic poison for quick knockdown
- Effects on other warm blooded animals. Resistance to rodenticides

➤ Fumigants:

- Application into burrows, whole buildings
- Advantages and Disadvantages

### Rodents on Field Crops

Rodents feed on various crops at different stages of their growth on the field.

- Burrowing rats and rodents cause extensive damage to tuber crops.

Cultural practices for management.

- Land preparation with hoes, ploughs and other heavy machinery to destroy their habitats.
- Weed control within plots, bunds and dykes in case of lowland rice and wheat.
- Synchronisation of planting and harvesting of cereal crops ( rice, maize, wheat, millet e.t.c.) on large scale farming scheme involving many farmers.
- Off season field clearing will cause crash in population.
- Maintenance of constant irrigation on wheat and rice farms will keep rodents away.
- Early harvesting when crop is matured reduce period of exposure.

Destruction by chemicals

- Poisoning: acute and chronic

### **BIRDS AS VERTEBRATE PESTS**

Usually found in large population in towns and cities apart from the bush. Birds constitute serious pest problems to human beings at home, in the office and on crops in the field.

#### **Damages caused by birds in towns and cities**

- Contaminate food and sources of water supply
- Birds carry parasites and when they inhabit a house, pass such parasites to the household
- Contaminate water supply to house by resting on water storage tanks
- Their droppings cummunate and encourage growth of fungi
- One of such fungi is *Histoplasma capulatum* which causes flu if the spores are inhaled.
- Birds constitute a serious nuisance by the excessive noise made by collection of birds in their roosting point.
- Records in developed countries showed that over 800 deaths were recorded out of 50 million such as flu infection.
- A virus cryptococuss neoformans from pigeon droppings when they roost on water towers can cause lung and skin infection.
- Car paints are also damaged by bird droppings.

#### **Ecology and damage by birds on the field.**

The domestic pigeon (*Columba hvia*) is one of the common birds causing economic damage. It originates from rock doves. Others are Quelea birds(*Quelea quelea*), golden sparrow(*Passev luteus*) and village weaver birds (*Ploceus cucullatus*). Birds generally are gregarious with roosting sites protected from adverse weather.

- Birds fly long distances from the roost sites to their food source over established flight routes. It is therefore extremely important to study their activities before embarking on any control measures.
- It is also important to identify the birds status- are they resident migrant.
- A lot of birds cause destruction of field crops.
- They dig our planted seed and seedling and feed on them.
- They also feed on all other farm produce e.g guava, banana and plantain, cashew when they are ripened up.
- The quelea birds and the golden sparrow feed on wheat and rice grains during the milking stages. A farm of upto 5hectares can be destroyed by the quelea birds in 3days if unchecked.
- The village weaver birds can also cause severe damage to rice, millet and wheat leaves apart from feeding on the grains.
- They tear the leaves for making their nests.

#### **Control/management of birds on the field.**

- The ability of Quelea birds to migrate for over a thousand kilometer.
- Birds scaring makes its difficult.

1. Physical driving of birds from the fields by hired labour.

11. Scaring by throwing stones and projectiles.

111.By firing guns , siren or making loud noise.

- Covering the crops with iron or cloth nets.
- Fumigation by spraying low flying helicopters on large irrigation schemes.
- If the roosts is discovered one can place large drums containing petrol under the plants and ignite to wipe out the birds at night.