Dam Owner's Guide To Animal Impacts On Earthen Dams

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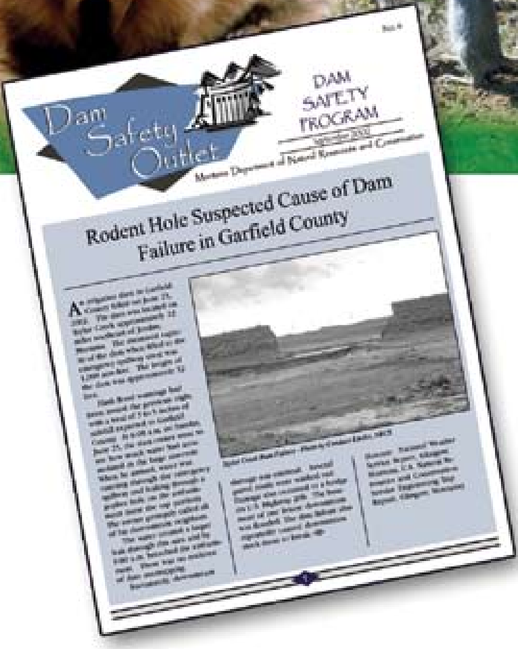
FEMA



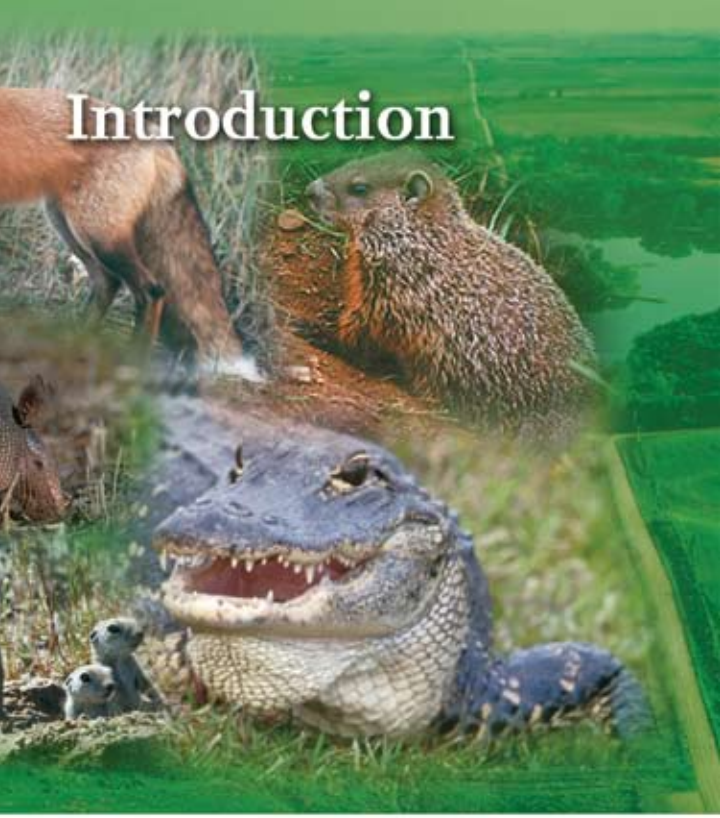
Dam Safety Outlet

DAM SAFETY PROGRAM

Montana Department of Natural Resources and Conservation

Rodent Hole Suspected Cause of Dam Failure in Garfield County

Introduction



Twenty-five states across the U.S. can write headlines of unsafe dam operations caused by nuisance wildlife intrusions, and many dam owners find the struggle to adequately manage nuisance wildlife at their dams a never-ending story. The tasks of proper and timely wildlife damage observation, species identification and management, and dam repair often prove to be daunting responsibilities that sometimes go unchecked, despite the good intentions of dam owners. The damages caused by nuisance wildlife often appear minor and small burrows, shallow dens, and limited erosion may not trigger a dam owner's concern. However, the news in many states is that "minor" damages such as these are often at the core of unsafe dam operations or outright dam failure.

The dam owner is the first line of defense against unsafe dam operations. As such, the Federal Emergency Management Agency (FEMA) published this brochure to help the dam owner manage nuisance wildlife and wildlife damages at earthen dams. To reduce the risk of dam failure due to wildlife intrusions, this brochure provides information on nuisance wildlife damages, wildlife observation during routine inspections, wildlife identification, and basic damage repair. Most simply, this brochure provides dam owners with a process for observing and managing wildlife intrusion damages. Regardless of which species or damages are encountered at the dam, coordination with the State Dam Safety Official and State Wildlife Manager is recommended to ensure that appropriate and lawful dam repair and wildlife management occurs.

Small Animals Can Cause Big Problems

Earthen embankment dams are used by private landowners and State and Federal agencies to store farm water supplies, city water supplies, recreational waters, flood waters, and wastewater lagoons. Earthen dams rely on a thick placement of compacted soils to withstand the water pressure of the pool contained behind the embankment. Often constructed outside of developed areas, the earthen dam environment is usually near a water source and can contain a variety of vegetation; given these characteristics, earthen dam environments can be naturally conducive to use by wildlife. Through their

Wildlife interacts with the dam environment as if it were natural habitat. However, pocket gopher burrows and beaver dams can lead to disaster in the earthen dam environment.

natural desire to create dens, search for food, or escape predators, wildlife burrow, graze, root, and traverse the embankment as if it were natural field or forest. These activities cause a host of damages to an earthen dam and can even lead to dam failure.

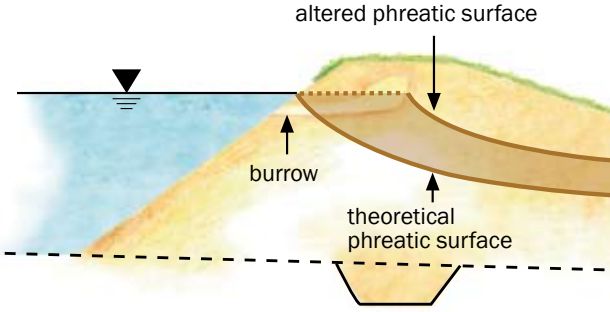
The first step in fortifying a dam against unsafe operations caused by wildlife damage is to understand what could go wrong if wildlife

Wildlife species that routinely damage earthen dams include: Muskrat, Beaver, Mountain Beaver, Woodchuck, Pocket Gopher, North American Badger, Nutria, Prairie Dog, Ground Squirrel, Armadillo, Livestock (cow, sheep, horse, pig and wild pig), Crayfish, Coyote, Moles and Voles, River Otter, Gopher Tortoise, Red Fox and Gray Fox, Canada Goose, American Alligator, and Ants.

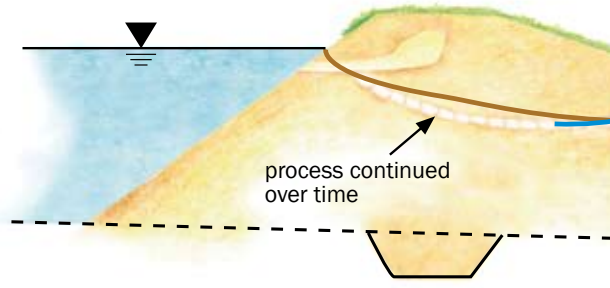
damage is left unchecked. While a dam owner may observe a few small burrows on the upstream and downstream slopes, it is important to understand that potential problems, like those burrows, often run deep below the surface. In general, there are three main serious effects that wildlife activities can have on earthen dams: hydraulic alteration, structural integrity losses, and surface erosion.

Hydraulic Alteration

This is the most significant and often least obvious impact of wildlife intrusions. Burrows on the upstream and downstream slopes can dramatically alter how a dam controls the water pooled behind the dam. Dramatic changes to the designed hydraulic function of a dam include:



Burrows can alter dam hydraulics by shortening seepage paths.

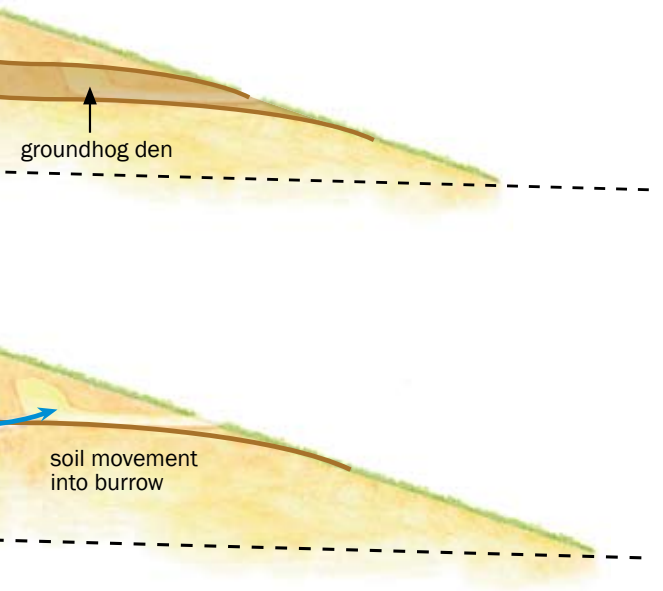


Burrows can lead to piping within an embankment.

- Shortened seepage paths;
- Increased seepage volumes;
- Increased probability of slope failure; and
- Internal erosion of embankment materials (piping), which is a progressive condition that can rapidly lead to failure of the dam.

In addition, beaver mounds may block principal and emergency spillways and riser outlets, resulting in:

- Increased normal pool levels and reduced spillway discharge capacity;
- Sudden high discharges from the dam if the beaver dam fails;
- Clogged water control structures as debris from an upstream beaver dam floats downstream; and
- Erosion of the downstream toe as a result of elevated tailwater caused by beaver activity.



Structural Integrity Losses

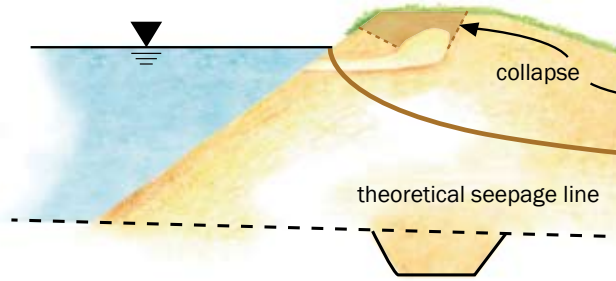
Many species excavate dens and burrows within embankment dams, causing large voids that weaken the structural integrity of the dam. Typical voids can range from the size of a bowling ball to a beach ball and much larger, and can cause many adverse effects:

- Localized burrow collapse can occur due to heavy rain and snow melt, or heavy equipment or vehicle use on the crest.
- Collapsed burrows can progressively lead to sinkholes or depressions on the embankment surface.
- Collapsed crest soils can result in a loss of freeboard, thus endangering the dam during storm events.
- Massive slope instability can result from collapsed burrows and soil losses.

Surface Erosion

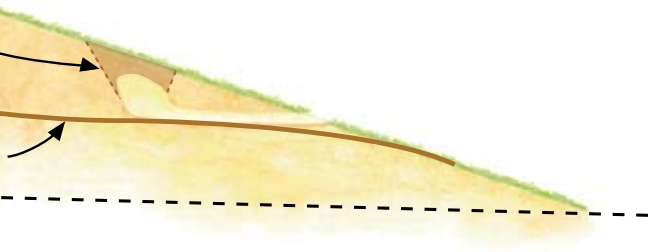
Wildlife that graze or traverse areas of open vegetation associated with dam embankments can cause a widespread loss of vegetative cover. This increased feeding and traffic pressure on the dam's vegetative groundcover can lead to:

- Erosion paths;
- Decreased soil retention on the dam's crest and slope;



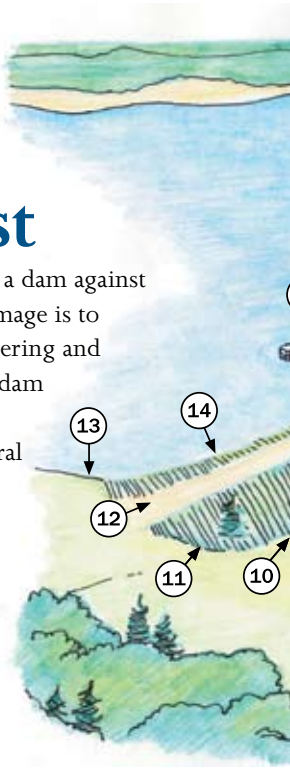
- Increased rates of soil erosion because of the lack of stabilizing vegetation from grazing and trafficking;
- Irregular surface erosion and the formation of rills and gullies; and
- Reduction in freeboard and loss of cross section, and in turn, an increase in the dam's vulnerability to damage from high water during large storm events.

Livestock can remove stabilizing vegetation through grazing and hoof traffic.



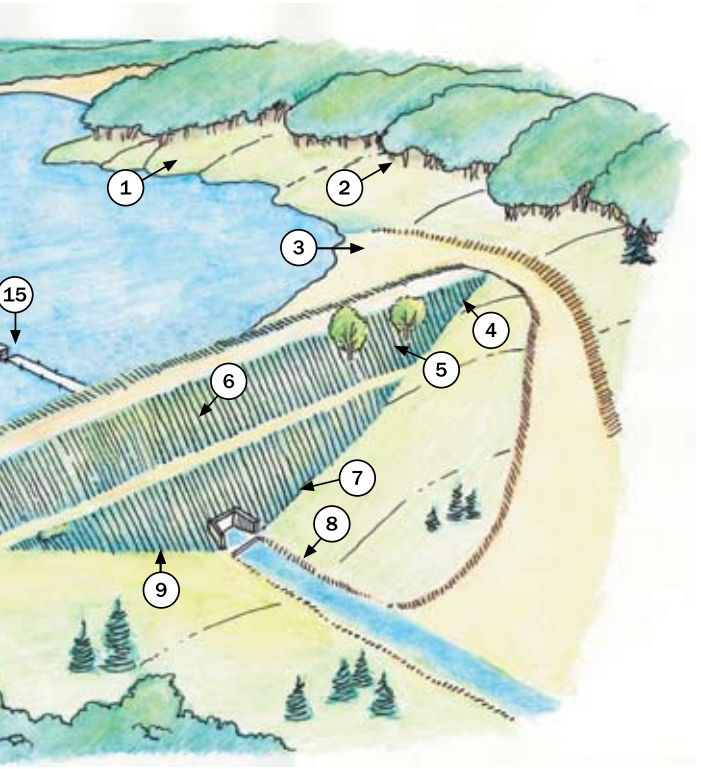
Burrows can collapse, leading to formation of sink-holes and loss of structural integrity.

Routine Inspection With A Twist



The second step toward fortifying a dam against the effects of nuisance wildlife damage is to inspect the dam from both engineering and biological perspectives. While the dam inspection is focused primarily on seepage, deformation, and structural deficiencies, dam owners should supplement their regular dam inspection (as required by dam safety) with wildlife behavior, hunting, and burrow location preferences so that routine inspections can be representative of the full range of potential performance problems.

1. **Upland Areas.** Many species live in the upland areas, away from the water. Even the downstream slope, abutments, and groin areas of the dam can be considered upland in terms of habitat.
2. **Forest Fringe.** The zone between two environments (the edge) is the best place to observe those species living at and around the dam. The more habitat types at the dam, the greater number of species likely to inhabit the dam. Mountain beaver or armadillo prefer forested/wooded areas.
3. **Emergency Spillway.** Beaver often dam the spillway, causing the pond water levels to rise.
4. **Left Abutment Contact.**
5. **Inappropriate Vegetation on Embankment.** Many dams contain vegetation other than mowed grass. Improper vegetation provides cover and food supply, which encourage animals to inhabit the dam.
6. **Downstream Slope.** This area is often the location where groundhogs, coyote, and fox excavate burrows. Canada geese will feed on the downstream slope, which could cause loss of protective vegetative cover and associated erosion. Species that prefer upland areas could be found in this area.



7. **Left Groin.**
8. **Discharge Conduit and Outlet Channel.** Beaver can dam the outlet structure. Aquatic species may inhabit this area depending on water flow and availability of vegetation.
9. **Toe of Embankment and Right Groin.**
10. **Erosion Pathways on the Embankment.** Livestock traverse the embankment creating erosion pathways.
11. **Right Abutment Contact.**
12. **Crest.** Livestock traverse the crest, which creates ruts. The ceilings of beaver and muskrat burrows in the upstream slope are often just below the dam crest.
13. **Aquatic Fringe.** The zone where the bank meets the pond usually contains aquatic vegetation preferred by many animals such as nutria.
14. **Upstream Slope.** Beaver, muskrat, and nutria prefer the upstream slope for burrow excavation. Alligators, otters, and turtles usually live in the shallow waters near the upstream slope.
15. **Principal Spillway (with riser and trash rack).** Beavers can block principal spillways by constructing dams.

Given the dynamic nature of wildlife and its desire to avoid human interaction, a dam owner will seldom witness wildlife causing damage to dams, and as such, accurate wildlife identification may be difficult. Misidentification of a wildlife species may result in inadequate mitigation, which could allow damage to continue, and perhaps lead to dam failure. As a general management approach, dam owners should become familiar with wildlife at their dam and the damage the wildlife can cause so that they can identify and mitigate wildlife damages before dam operations are compromised.

Wildlife Identification And Damage Repair

Complex repairs and preventive action design requires the services of a professional engineer and should not be attempted by the dam owner

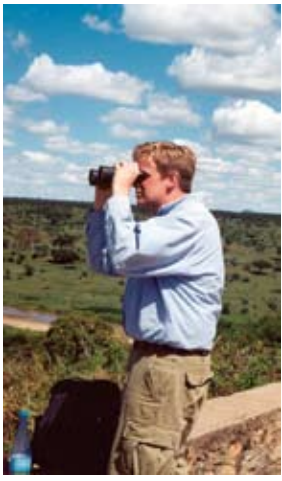
Once dam owners identify wildlife damages and narrow down which species may be responsible, they should coordinate with their state dam safety representative (www.damsafety.org) and their state wildlife agency (http://offices.fws.gov/statelinks.html). At this point, precise wildlife identification and assessment and repair of the damage must occur to protect dam operations and prevent further damage.

Dam owners should seek positive wildlife identification either through their state wildlife agency contact or though a professional trapper (www.nationaltrappers.com). A dam owner who uses *A Dam Owner's Guide to Animal Intrusions* (FEMA 2004) is likely to positively identify the responsible species depending on the field clues available. However, professional input will provide the most accurate species identification results, and will be required should it be necessary to remove the species from the dam environment.

Appropriate repairs to the dam would be made once a dam owner identifies the damage and the species responsible. In some cases, basic repairs can be conducted by the dam owner following coordination with the dam safety representative. However, complex repairs and preventive action design (such as installing rip-rap on the upstream slope) requires the input of a professional engineer and should not be attempted by the dam owner.

Monitoring

The next step to maintaining safe dam operation is to monitor the effectiveness of the repair or preventive action. In many cases, regular dam inspections and swift damage mitigation will adequately preserve safe dam operations. However, it is possible for a dam to become overrun by a nuisance species, or for several species to cumulatively compromise safe dam operation. In these

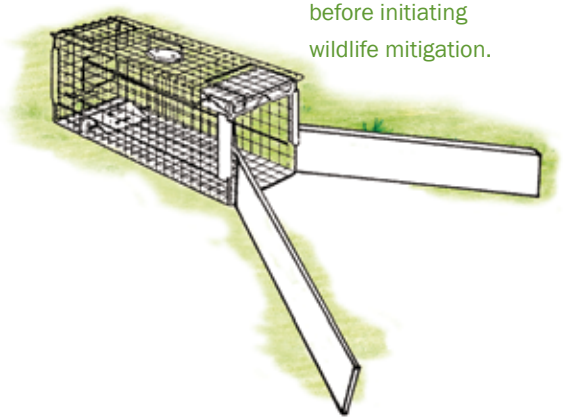


Frequent owner inspection after animal damage repair can ascertain the extent of wildlife activity and guide future management actions.

cases, repair actions are only partial solutions. Monitoring can help the dam owner determine whether wildlife mitigation is necessary.

In general, it is recommended that the dam owner inspect the dam once every three months after first finding and repairing animal damage. At this frequency, the dam owner will be able to confirm that the animal has not returned to the dam once the damage has been repaired. As a guideline, if the dam owner finds new animal damage, such as burrows, in the dam on two consecutive inspections following repair and preventive actions, then implementing a wildlife control strategy is probably necessary to maintain safe dam operation. Coordination with the state wildlife agency is required prior to removing wildlife from the dam environment.

Protect water resources and special status wildlife by coordinating with appropriate State and Federal agencies before initiating wildlife mitigation.



Wildlife Mitigation Measures

Wildlife mitigation measures typically include habitat modification, trapping, fumigants, toxicants, frightening, repellants, or shooting, used singularly or in combination. Wildlife mitigation in the dam environment can be beneficial and at times necessary to protect human populations from the disastrous effects of dam failure. However, applied indiscriminately, mitigation methods can adversely affect the dam environment, protected wildlife species, and even human populations. For this reason, nuisance wildlife management practices should be implemented only with coordination and input from appropriate State and Federal agencies and the county agent responsible for toxicant and fumigant registration and application. Coordination with these agencies will allow the dam owner to determine the most appropriate wildlife mitigation method, and implement the method in compliance with applicable State and Federal wildlife and water resource protection laws, such as the Endangered Species Act, the Clean Water Act, and the Federal Insecticide, Fungicide and Rodenticide Act.

Conclusion

Routine dam inspection and management that is conducted with wildlife behavior, hunting, and burrow location preferences in mind allow for comprehensive dam management. A dam owner who is knowledgeable of the full range of potential performance problems—those stemming from wildlife behavior as well as engineering function—is the best line of defense to prevent unsafe dam operations or outright failures. FEMA hopes this brochure helps dam owners nationwide identify and mitigate wildlife damages before adverse effects occur.

For information on obtaining a print, CD, or online version of this publication or the technical manual go to www.fema.gov/fima/damsafe.