January 1994

WATERFOWL

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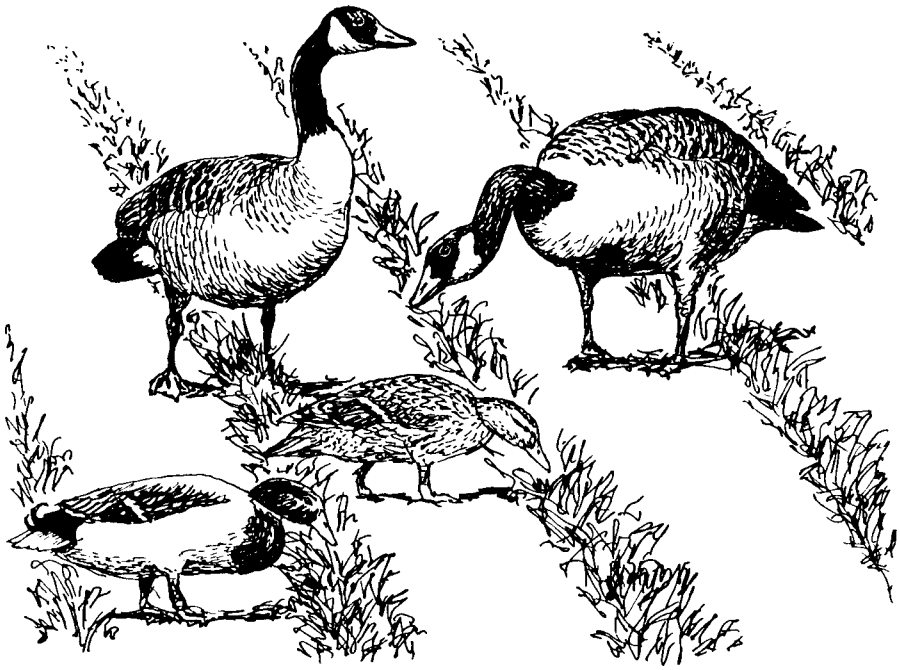


Fig. 1. Geese, ducks, and other waterfowl may damage crops by feeding in fields.

Damage Prevention and Control Methods

Habitat Modification

Vertically straighten pond banks.

Allow ponds to freeze in winter.

Eliminate vegetation (nesting/escape cover) in and around ponds.

Reduce or eliminate fertilizer use around ponds.

Exclusion

Install fence around ponds, gardens, and yards.

Install overhead grids or netting on ponds, reservoirs, and fish raceways.

Cultural Methods

Change the timing of planting and harvesting of vulnerable crops.

Produce winter grains instead of spring grains.

Use grain dryers to allow earlier harvest of high-moisture grain.

Plant crops uniformly in spring.

Delay fall plowing as long as possible.

Use less-preferred plant species in parks, cemeteries, and lawns.

Plant trees and shrubs to block flight path.

Provide lure crops.

Field baiting.

Frightening

Flags.

Mylar tape.

Balloons.

Scarecrows.

Water spray devices.

Automatic exploders.

Pyrotechnics.

Recorded distress calls.

Dogs.

Live Capture

Walk-in funnel trap.

Rocket/cannon nets.

Spring-powered nets.

Net launchers.

Alpha-chloralose.

Repellents

None are currently registered.

Toxicants

None are currently registered.

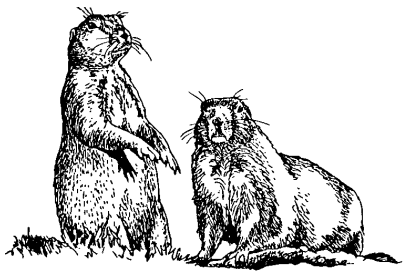
Shooting

Hunting is the preferred method of reducing localized populations, where safe and legal. Hunting has a strong repellent effect.

Killing under special permit is advised only in extreme situations.

Other Methods

Destruction of nests and eggs helps to slow down local population growth.



PREVENTION AND CONTROL OF WILDLIFE DAMAGE — 1994

Cooperative Extension Division
Institute of Agriculture and Natural Resources
University of Nebraska - Lincoln

United States Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control

Great Plains Agricultural Council
Wildlife Committee

E-129

Identification

The term *waterfowl* is properly applied only to ducks, geese, and swans (Fig. 1). Space does not permit full species descriptions here. A bird identification guide should be consulted for exact species descriptions.

Many of the control techniques are equally applicable to damage situations involving coots, rails, and cranes, which are not discussed in this publication.

Range

In North America, most waterfowl are migratory, flying long distances in the spring and fall between the summer breeding grounds and wintering areas. Some species or geographic populations of some species, however, never leave the breeding areas. The Florida and mottled ducks, southern populations of wood ducks and hooded mergansers, and some populations of Canada geese are nonmigratory.

Ducks and geese breed throughout North America. The primary goose production areas for Central, Mississippi, and Atlantic Flyway geese are Banks Island, Baffin Island, and the greater Hudson Bay area. Most of these birds winter in the southern Great Plains, Texas, Louisiana, and Mississippi coastal marshes, or the Chesapeake Bay and mid-Atlantic states' coastal marshes and barrier islands.

The primary breeding grounds for geese using the Pacific Flyway are the Yukon, Kuskokwin, and Copper River deltas and the north and west coasts of Alaska. These birds typically winter in Washington, Oregon, and California (especially Baja California, the Baja California Sur coastal marshes, and the central valley of California).

The primary North American breeding grounds for ducks are the prairie pothole region of Alberta, Saskatchewan, Manitoba, Montana, North and South Dakota, and Minnesota. Historically, this area probably produced more ducks than the rest of the continent combined. Other important breeding areas include coastal and interior Alaska, and the Mackenzie River Delta. Primary duck wintering grounds include the central valley of California, the southern Great Plains, Gulf Coast marshes, Caribbean Islands, and Central and South America.

Many of the historical North American waterfowl breeding, migrating, and wintering areas are changing because of agricultural and land-clearing practices, northern prairie pothole drainage, and development of the US Fish and Wildlife Service's National Wildlife Refuge system. Worldwide, waterfowl occur on every major land mass except Antarctica.

Habitat

Waterfowl, as their name implies, are most often found near water. They can, however, fly long distances to and from favorite feeding grounds, which may include agricultural or upland sites. Some species, such as the mallard and certain subspecies of Canada geese, are extremely adaptable. They are equally at home in rural and urban environments, on a pond in a city park, or on a marsh in Alaska.

Food Habits

The food of individual waterfowl species ranges from fish to insects to plants in various combinations, depending on availability. Waterfowl bills have evolved to allow the exploitation of a wide variety of food sources and associated habitats. Even though many species are adapted to feeding in the water, most will readily come on land to take advantage of available food. Since space does not permit a species-by-species description of food habits, a few general comments will suffice.

During the prefledging period, young waterfowl feed primarily on aquatic insects and other invertebrates. As adults, waterfowl have an omnivorous diet. Dabbling ducks, whistling ducks, and shovelers are primarily filter feeders and will consume almost anything edible. Torrent ducks, blue ducks, and scaups feed heavily on aquatic insect larvae, snails, and other invertebrates found on and under rocks in streams and ponds. Large eiders, scoters, and steamer ducks feed heavily on mollusks and shellfish. Steller's eider feeds more on soft-shelled invertebrates. Fish are the main food of mergansers. Swans are aquatic grazers and geese are terrestrial grazers.

General Biology, Reproduction, and Behavior

Waterfowl are normally monogamous and solitary nesters. The size of the nesting territory is determined by the aggressiveness of the particular pair of birds. Pair formation in geese and swans tends to be permanent until one of the pair dies; the remaining bird will often remate. Ducks seek a new mate each year.

Ducks and the Ross's goose generally lay one egg each day until the clutch is complete. Most other geese and probably all swans lay an egg every other day until the clutch is complete. Incubation is not started until the last or next-to-the-last egg is laid, thus all the eggs hatch at about the same time. There is a slight correlation between the length of incubation and the size of the adult bird. Incubation periods range from about 23 days for cackling Canada geese, 28 days for giant Canada geese and mallards, to 38 days for trumpeter swans. Young waterfowl are precocial and begin foraging shortly after hatching. The nest site is abandoned 1 to 2 days after hatching.

Studies indicate many species have a first-year mortality rate of 60% to 70% and a 35% to 40% mortality rate in subsequent years. Life spans of 10 to 20 years for captive ducks and 20 to 30 for captive geese and swans are not uncommon.

Damage and Damage Identification

Goose problems in urban and suburban areas are primarily caused by giant Canada geese, which are probably the most adaptable of all waterfowl. If left undisturbed, these geese will readily establish nesting territories on ponds in residential yards, golf courses, condominium complexes, city parks, or on farms. Most people will readily welcome a pair of geese on a pond. They can soon turn from pet to pest, however. A pair of geese can, in 5 to 7 years, easily become 50 to 100 birds that are fouling ponds and surrounding yards and damaging landscaping, gardens, and golf courses. Defense of nests or young by geese and swans can result in injuries to people who come too close.

Migrant waterfowl damage agricultural crops in northern and central North American. In the spring, waterfowl graze and trample crops such as soybeans, sunflowers, and cereal grains. In autumn, swathed grains are vulnerable to damage by ducks, coots, geese, and cranes through feeding, trampling, and fouling. Young alfalfa is susceptible to damage by grazing waterfowl. Geese sometimes damage standing crops such as corn, soybeans, and wheat. In southern agricultural areas, overwintering waterfowl can cause problems in rice, lettuce, and winter wheat.

Mergansers, mallards, and black ducks cause problems at some aquaculture facilities by feeding on fish fry and fingerlings. Common eiders and black and surf scoters cause problems when they feed in commercial blue mussel and razor clam beds. For more information, see **Bird Damage at Aquaculture Facilities.**

Legal Status

In the United States, migratory birds, including most waterfowl, as well as their nests and eggs, are federally protected (50 CFR 10.12) by the Migratory Bird Treaty Act (MBTA) (16 USC. 703-711). A complete list of all migratory birds protected by the MBTA can be found in 50 CFR 10.13. Also, all states protect most waterfowl. Exotic and feral waterfowl species including mute swans, greylag geese, muscovy ducks, and Pekin ducks are not protected by the MBTA, but may be protected by state law or local ordinance.

Persons wishing to take any migratory bird outside of the legal hunting season must first secure a federal permit from the US Fish and Wildlife Service (USFWS), and in some cases a state permit. "Take" means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect (50 CFR 10.12). "A federal permit is not required to merely scare or herd depredating migratory birds other than endangered or threatened species or bald or golden eagles" (50 CFR 21.43a).

Three species and one subspecies of waterfowl that occur in the United States are listed as endangered in 50 CFR 17.11, October 1, 1992 edition (Table 1). In addition, five subspecies of rails, and one species and one subspecies of crane are listed.

Table 1. Members of the families Anatidae (ducks, geese, and swans), Rallidae (coots and rails), and Gruidae (cranes) occurring in the United States listed as endangered in the Code of Federal Regulations, Title 50, Sec. 17.11, 10-1-92 edition.

ANATIDAE:

Laysan duck (*Anas laysanensis*)
Hawaiian duck (*Anas wyvilliana*)
Aleutian Canada goose (*Branta canadensis leucopareia*)
Hawaiian goose (*Nesochen sandvicensis*)

RALLIDAE:

Hawaiian coot (*Fulica Americana alai*)
California clapper rail (*Rallus longirostris obsoletus*)
Light-footed clapper rail (*Rallus longirostris levipes*)
Yuma clapper rail (*Rallus longirostris yumanensis*)
Hawaiian moorhen (*Galinula chloropus sanduicensisie*)

GRUIDAE:

Mississippi sandhill crane (*Grus canadensis pulla*)
Whooping crane (*Grus americana*)

Contact personnel from your local USDA-APHIS-ADC office for information on obtaining a federal permit to take migratory birds.

"Landowners, sharecroppers, tenants, or their employees or agents actually engaged in the production of rice in Louisiana may, without a permit, shoot purple gallinules (*Ionornis martinica*) when found committing or about to commit serious depredations to growing rice crops on the premises owned or occupied by such persons . . . between May 1 and August 15 in any year." (50 CFR 21.45).

Damage Prevention and Control Methods

Waterfowl can be difficult to disperse once they become established on a pond or feeding site. Promptness and persistence are the keys to success when attempting to repel nuisance or depredating waterfowl. Frightening devices and repellents should be in place before the damage starts to prevent the birds from becoming acclimated to the site.

Habitat Modification

Discourage geese and other waterfowl from using a pond by making it and the surrounding area unattractive to them. Reduce nesting, loafing, and escape cover by mowing to the edge of the pond, and by using herbicides to eliminate emergent aquatic vegetation. Contact your local Cooperative Extension office for specific recommendations for vegetation management in ponds. Reduce or eliminate fertilizer applications to the surrounding grass area to make the grass less nutritionally attractive to grazing waterfowl. Feeding of waterfowl around the pond site should be prohibited. In cold climates, shut off pond aerators in the winter and allow the pond to freeze.

Giant Canada geese generally will not establish nesting territories in areas where they cannot easily walk in and out of the local pond. Construct new ponds so there is an 18- to 24-inch (45- to 60-cm) vertical bank at the water's edge. Discourage Canada geese from using existing ponds by vertically straightening the banks or by erecting a 30- to 36-inch (75- to 90-cm) high poultry-wire fence around the pond at the water's edge. Use large boulder rip-rap, which geese cannot easily climb over, in locations such as levees or banks around airport runways. **Caution:** Large boulder rip-rap may provide nesting or loafing habitat for some species of gulls.

Exclusion

Construct overhead grids of 0.015- to 0.030-inch (0.4- to 0.8-mm) stainless steel spring wire, or 0.071-inch (1.8-mm) and heavier ultraviolet-protected monofilament line to stop waterfowl from using reservoirs, lakes, ponds, and fish-rearing facilities. Several hundred feet (m) of monofilament line or stainless steel wire can be supported between two standard, 5-foot (1.5-m), steel fence posts, because these materials are extremely light. The 0.072-inch (0.18-cm) polyester line weighs about 12.1 pounds per mile (3.4 kg/km); 0.016-inch (0.041-cm) stainless steel wire weighs about 4 pounds per mile (1.14 kg/km).

Construct grids on 20-foot (6-m) centers to stop geese; grids with 10-foot (3-m) centers will stop most ducks. Grid wire spacing may need to be reduced to 5 feet (1.5 m) or less to stop all waterfowl. In most instances, grid lines should be installed high enough to allow people and equipment to move beneath them. Tie the grid wires together wherever two lines cross to prevent rubbing. Excessive rubbing will result in line breakage. Independently attach lines to each post and not in a constant run. This will prevent having to rebuild the entire grid when one line breaks.

Where aesthetics or other factors preclude overhead grids, grids can be installed at the water surface, or no more than 1 inch (2.5 cm) below. In these installations, grid wire spacing should be no more than 5 feet (1.5 m).

Use 1- to 1.5-inch (2.5- to 3.75-cm) mesh polypropylene UV-protected netting when total exclusion is needed, as in contaminated oil containment basins. Support the netting with at least 0.19-inch (0.46-cm), 7 x 19-strand galvanized coated cable on 20-foot centers. The support cables must be well-anchored to carry the weight of the netting and to allow the cable to be stretched tight to reduce sag as much as possible. High winds are the greatest hazard to this type of netting installation. Attach the netting to the support cables to prevent wind-caused abrasion. Abrasion can be more damaging than UV radiation.

Three-foot (1-m) poultry-wire fences around gardens or yards will help keep geese out of such places, as adult geese with young will not cross a fence and leave their young behind. Good results have also been reported using 20-pound test (9-kg), or heavier, monofilament line to make a 2- to 3-strand fence in situations where aesthetics preclude the use of woven-wire fencing. String the first line 6 inches (15 cm) off the ground, with each additional line spaced 6 inches (15 cm) above the preceding line. Suspend thin strips of aluminum foil at 3- to 6-foot (1- to 2-m) intervals along the lines to increase visibility of the barrier. Best results are obtained when the monofilament line fence is in place before geese start grazing.

Half-inch (11-mm) mylar tape can also be used to construct 2- to 3-strand vertical goose-resistant fencing around lawns, gardens, and crop areas. Place the first strand 1 foot (0.3 m) above the ground, with each succeeding strand 1.5 feet (0.5 m) above the previous strand.

Commercial clam growers have been able to protect their clam beds from common eiders by covering them with heavy 0.5-inch (1.27-cm) mesh nylon netting. Mussel ropes can be protected from scoters and eiders by suspending them in cages made of 0.25-inch (0.64-cm) mesh plastic coated wire fencing. **Caution:** Birds may become entangled in the netting or wire and drown. This could expose the owner to prosecution under the Migratory Bird Treaty Act.

Cultural Methods

Agricultural Crops. Agricultural damage caused by waterfowl can be reduced by timing crop planting or harvest periods so they do not coincide with periods of migration. For example, teal may damage early-planted rice in some southern states. Rice that is planted in April, however, after the birds have migrated north, is relatively safe from damage by waterfowl.

Spring grains are vulnerable to waterfowl damage in some northern regions because of the agricultural practices required for their production. Many spring grains are swathed at harvest time, allowed to dry in the field, and then combined. The short growing season, possible early frost, uneven soil types, and topography sometimes prevent the even ripening needed for straight combining. In areas of severe waterfowl damage, farmers should consider the use of on-farm or commercial grain dryers so that high-moisture grain can be combined early. Early harvest and forced drying of high-moisture grain, however, is expensive, and can result in shrinkage and reduction of grain quality.

Where conditions permit, the production of winter grains instead of spring grains may help eliminate waterfowl damage. Winter grains can normally be straight combined in July and August, long before migrating waterfowl arrive in the area. Admittedly, a winter grain's rosette of leaves is vulnerable to grazing and puddling damage by waterfowl in both the fall and spring. Research, however, has shown that light grazing of the winter rosette can actually increase stooling and grain yield.

Conduct spring planting in as short a time as possible. This may reduce the length of time that area crops are vulnerable in the fall and allow harvesting in the shortest time possible. Delay fall plowing as long as possible in areas where waterfowl damage standing or swathed grains. Waterfowl can be encouraged to feed in the stubble, away from unharvested crops, by using harvested fields as field-baiting sites (see Alternate Food Sources below).

Recent research indicates that geese prefer certain grass species over others for food. Bluegrass (*Poa* spp.) is one of the most preferred, and tall fescue (*Festuca arundinaceae*) is one of the least preferred. Plant tall fescue instead of bluegrass to reduce goose grazing in golf courses, parks, or cemeteries. Plant trees to interfere with the birds' flight paths and plant shrubs to reduce the birds' on-ground visibility.

Alternate Food Sources. Waterfowl damage to crops can be reduced by providing alternate food sources in the form of lure crops or direct feeding. For maximum benefit, an established and well-organized program should be in place.

Lure crops are typically grains that are used to attract and hold waterfowl, thereby protecting other crop areas. Two general strategies are used in establishing lure crop areas: (1) seeding selected areas known to have a high incidence of waterfowl damage with the specific intent of allowing the birds to utilize the lure crop; (2) allowing the birds to select a lure crop field and then paying the landowner for the resulting loss.

Plant lure crops using local crop(s) most subject to waterfowl damage. Plant at the normal rate when using good quality seed. Increase the normal planting rate by a factor of 1.5 to 2 when using commodity grain or out-of-date seed to offset reduced germination rates. Do not allow any hunting or harassment of waterfowl in the lure crop area until all crops are harvested and the damage season is over.

Field baiting involves scattering grain in previously harvested fields or at natural waterfowl feeding and/or loafing areas to attract and hold waterfowl away from unharvested fields. Studies in North Dakota indicate that the most effective diversion of waterfowl occurs when the bait is made available within 2 to 3 days of the birds' first feeding in an area. There are no set rules about the amount or type of bait to use. Make enough bait available to ensure that none of the birds go away hungry. If the birds cannot get enough to eat at the baiting site, they will go elsewhere. The bait grain should be something the birds are familiar with and prefer. The same material that is grown in the field should work well. Do not allow any harassment of waterfowl in the area of the baited field until all crops are harvested and the damage season is over.

Surplus grain to conduct these feeding programs can be obtained from the Commodity Credit Corporation (CCC). People interested in obtaining CCC grain for use in waterfowl damage abatement programs should contact personnel from their local US Fish and Wildlife Service regional office. CCC surplus grain may only be used for the direct feeding of depredating waterfowl or for seeding waterfowl feeding areas. It may not be used to replace grain lost to depredating waterfowl.

Regardless of the method used (lure crop or field baiting), it may be necessary to initially scare or herd the waterfowl away from the surrounding fields. Once the birds have habituated to the feeding site, and damage has stopped, repelling efforts can be reduced.

Federal law requires that all artificial feeding be stopped and all grain be removed at least 10 days before hunting waterfowl within the zone of influence of the baited area (50 CFR 20.21i).

Frightening

Waterfowl may be repelled by almost any large foreign object or mechanical noise-making device placed in a field. The length of time frightening devices are effective depends on the nature, number, and variety of devices used. Move frightening devices every 2 to 3 days and use them in varying combinations to improve efficacy and prevent habituation. Repellents should be in place before the start of the damage season to prevent waterfowl from establishing a use pattern.

Visual repellents such as flags, balloons, and scarecrows are normally used at one per 3 to 5 acres (1.2 to 2 ha) before waterfowl become accustomed to loafing or feeding in the area. After the birds become accustomed to using an area, one or more per acre (0.4 ha) may be necessary. Visual repellents should be reinforced with audio repellents such as automatic exploders, pyrotechnics, or distress calls for optimum results.

All applicable state and local laws must be observed when using frightening devices. Pay particular attention to laws governing the making of loud noises, discharging of firearms, use of pyrotechnics, and use of free-running dogs. Also consider the possible reaction of neighbors.

Flags for repelling waterfowl can be made with 4-foot (1.2-m) laths and 6 x 30-inch (15 x 76-cm) strips of 3-mil safety orange plastic or red and silver mylar ribbon (Fig. 2). Tests conducted at Audubon National Wildlife Refuge indicate that black flags are not effective. Place flags so they are visible by waterfowl from all points in a field. Waterfowl will land in an area where flags are not visible. Once the birds land in a field with flags and begin feeding, the flags' effectiveness may be lost.

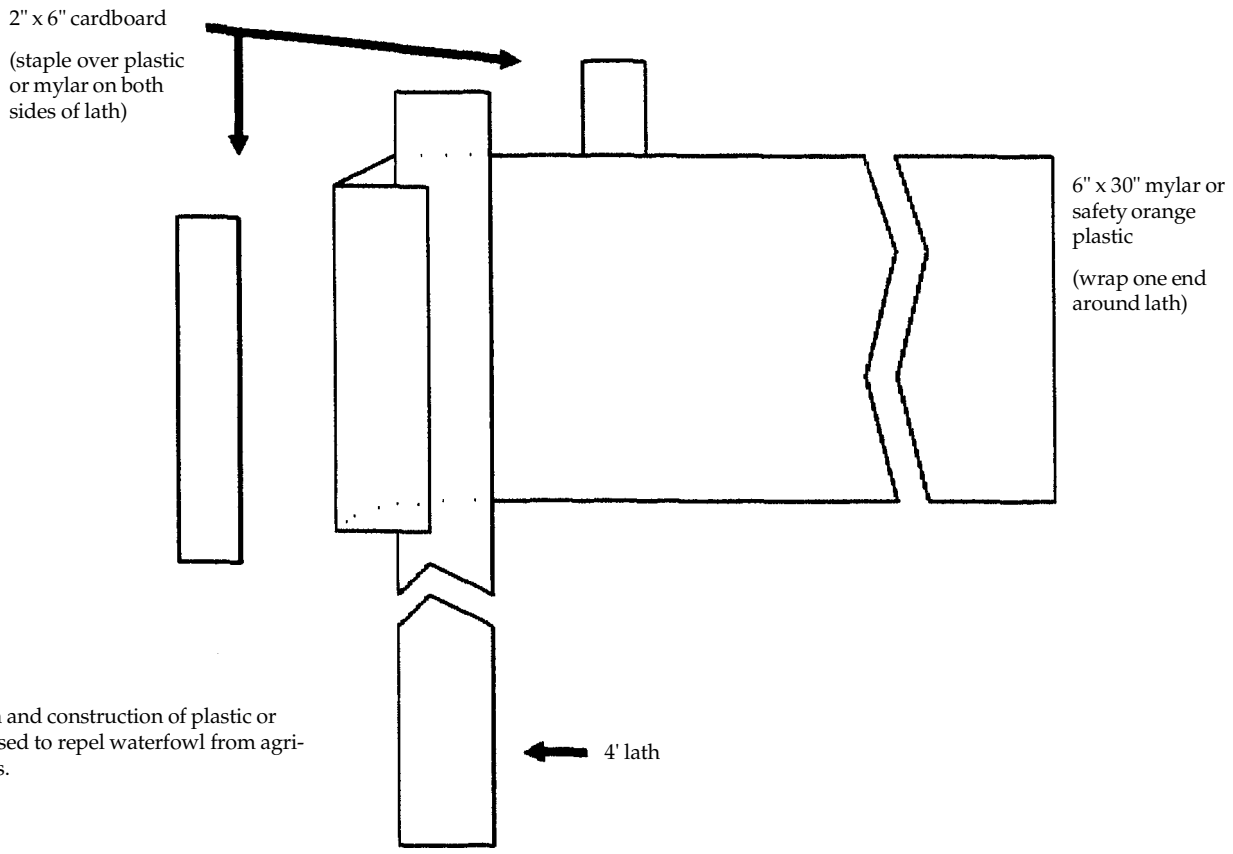


Fig. 2 Design and construction of plastic or mylar flags used to repel waterfowl from agricultural fields.

Balloons filled with helium, staked in open fields or over water, have proven to be effective waterfowl repellents. Tether the balloons with enough 75-pound (34-kg) test monofilament line to allow them to rise at least 10 feet (3 m) into the air. The use of balloons larger than 2 feet (0.6 m) in diameter is not recommended due to their increased wind resistance. Balloons with large contrasting eye spots seem more effective than balloons without eye spots.

Scarecrows can be made out of almost any material available. Three concepts should be incorporated into any scarecrow design: movement, bright colors, and large eyes. For maximum effect, the arms and legs should readily move in the wind. Construction materials should be of bright colors such as red, blaze orange, or safety yellow. Research indicates that scarecrows with large eyes are more effective than scarecrows with small eyes.

Mylar tape, 1/2 inch (11 mm) wide, has been used successfully to protect lawns, crops, and other areas from bird damage. When properly installed, mylar tape combines three control strategies in one — overhead grids, sound repellents, and visual repellents. Wind blowing over the tape will produce a roaring sound as the tape twists and flashes, reflecting the sunlight. Install the tape 1 to 3 feet (0.3 to 1 m) above the area to be protected on 6- to 30-foot (2- to 10-m) centers. For a 100-foot (30-m) span, the tape should be twisted no more than 4 or 5 times before tying it off. Over-twisting will reduce the flashing and roaring effect. Mylar tape has a tendency to break at the knot. This can be overcome by covering the last foot (0.3 m) of the mylar with nylon strapping tape before tying it off.

Water spray devices, using high pressure, rotating, clapper-type sprinkler heads have been used to repel other bird species from reservoirs and fish raceways. Gulls have been repelled from drinking water reservoirs by covering 50% of the total water surface with the sprinklers and cycling them on and off (5 minutes on and 35 to 45 minutes off) during the daylight hours. Similar methodology may be effective against waterfowl.

Automatic exploders, also known as propane cannons, make a loud noise without discharging a projectile. One exploder may protect up to 25 acres (10 ha) under ideal conditions. The rate of firing is manually adjustable; exploders should be set to fire about every 5 to 10 minutes. Reduce waterfowl habituation and increase the effectiveness of exploders by mounting them on turntables so the cannon rotates a few degrees with each firing. Turn exploders off after dusk and on at dawn to reduce neighbor complaints, bird habituation, and save on fuel. Clock timers or photocells are available for this purpose. Waterfowl may use fields on bright moonlit nights. When they do, it may be desirable to run exploders all night.

Pyrotechnics such as shellcrackers, whistle bombs, screamer/banger rockets, and noise bombs can be used to repel depredating waterfowl. These devices should be fired to explode in the air just over the birds to produce the greatest scaring effect and reduce the fire hazard. Allowing pyrotechnics to explode on the ground could ignite

dry grass or weeds. Refer to **Bird Dispersal Techniques** for additional information.

Recorded distress calls have been used to repel several species of nuisance birds. Canada goose distress call tapes are not commercially available as of this writing. Individuals have made their own Canada goose distress call recordings and have successfully repelled nuisance geese.

Dogs trained to chase waterfowl have been used to protect golf courses and grain fields. Depending on the location and situation, dogs can be free running, on slip-wires, tethered, or under the control of a handler.

Live Capture

Local concentrations of problem waterfowl can be reduced by live trapping. The final disposition of trapped birds should be agreed upon in advance by all relevant state and federal agencies. The trapping method to use will depend on the type of birds and the location of the problem. Secure a federal permit before carrying out live capture activity (50 CFR 21.41a).

Walk-in funnel traps (Fig. 3) are the most effective traps for capturing Canada geese in late June or early July, when the adult birds are molting and have lost the ability to fly, and the goslings have not yet fledged. The traps also work well for feral ducks and geese in parks and similar locations.

Set up the trap next to a lake or pond being frequented by the birds. When possible, place the trap in the area where the geese normally walk in and out of the water. In situations where there is no lake or pond, place the trap in a large open area.

Construct a walk-in funnel trap using the following, or similar materials:

1. 100 to 200 feet (30 to 60 m) of 3-foot (1-m) poultry wire (for the trap wings).
2. 60 to 80 feet (18 to 24 m) of 5-foot (1.5-m) woven-wire fencing (for the holding pen).
3. 21, 5-foot (1.5-m) steel fence posts to support the fencing.
4. Netting to cover the top of the holding pen if the geese are to be held several hours or overnight.

Once the trap is constructed, herd the geese into it using boats, and/or people walking on land. The exact number of boats and people needed depends on the size of the area and the number of geese. Gasoline-powered boats are not recommended because they are too noisy. Canoes, rowboats, or boats with electric trolling motors work best. Surround the geese on three sides, leaving the only avenue of escape towards and into the trap. Once in position, slowly and quietly drive the geese into the trap opening (Fig. 4) and into the holding pen. From there, load the birds into suitable transport equipment (such as turkey crates and covered pickup trucks) for final disposition. When handling birds, wear eye protection and long-sleeved shirts to avoid getting hit, scratched, or pecked.

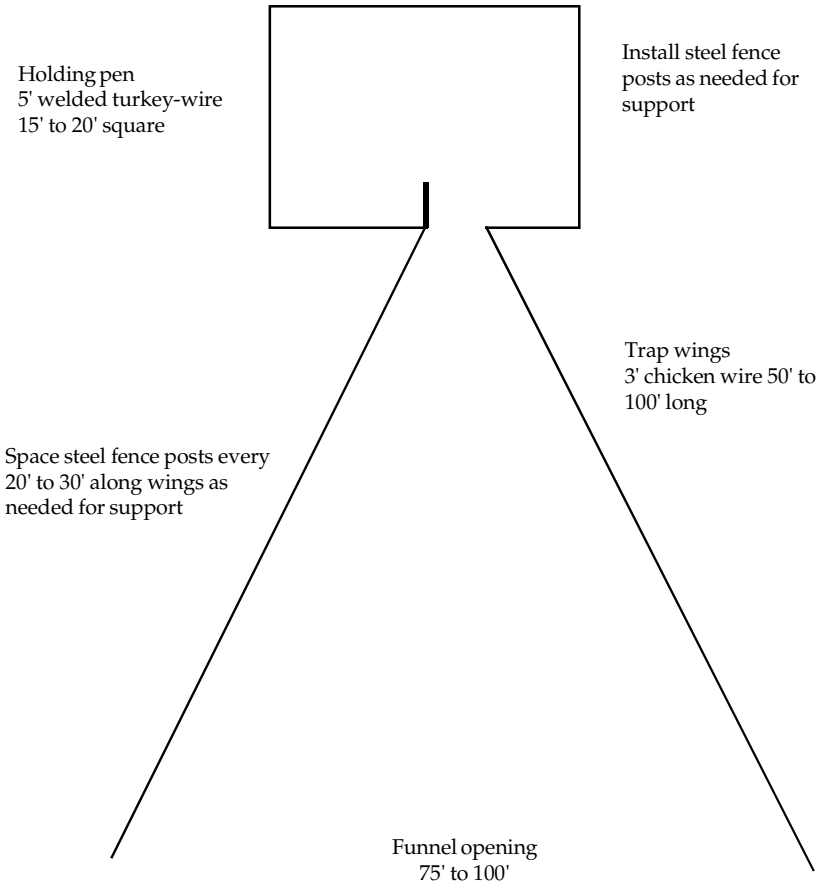


Fig. 3. Layout for walk-in funnel trap to capture flightless geese. Canada geese can be herded into a walk-in funnel trap during the flightless period for capture and relocation.

Fig. 4. Herding geese into a walk-in funnel trap.

Rocket or cannon nets, typically 25 x 50 feet (8 x 24 m) can be used to capture waterfowl. Nets with 1- to 1.5-inch (2.5- to 3.8-cm) mesh work well for ducks; 2- to 2.5-inch (5- to 6.3-cm) mesh is best for large geese. Place the net at a baiting site located close to water and bait the site with corn or other suitable bait until the bait is well accepted. Once the target birds are trained to feed at the bait site, capturing them is merely a matter of re-baiting the area, allowing the birds to concentrate on the bait, then firing the rockets or cannons that carry the net over the birds. Remove the trapped birds from the net as quickly as possible. Place the birds in suitable transport equipment (chicken crates, turkey crates) and take them to the predetermined location.

Spring-powered nets, about half the size of a standard rocket or cannon net (16 x 25 feet or 4.9 x 7.6 m), are available. They can be triggered manually or electronically. One manufacturer claims a closure time of less than 0.75 seconds using No. 3 mesh netting, and 1.5 seconds using No. 6 mesh netting. Spring-powered netting's quiet operation and the absence of explosive and flying projectiles may, in some situations, be an advantage even with the net's small area.

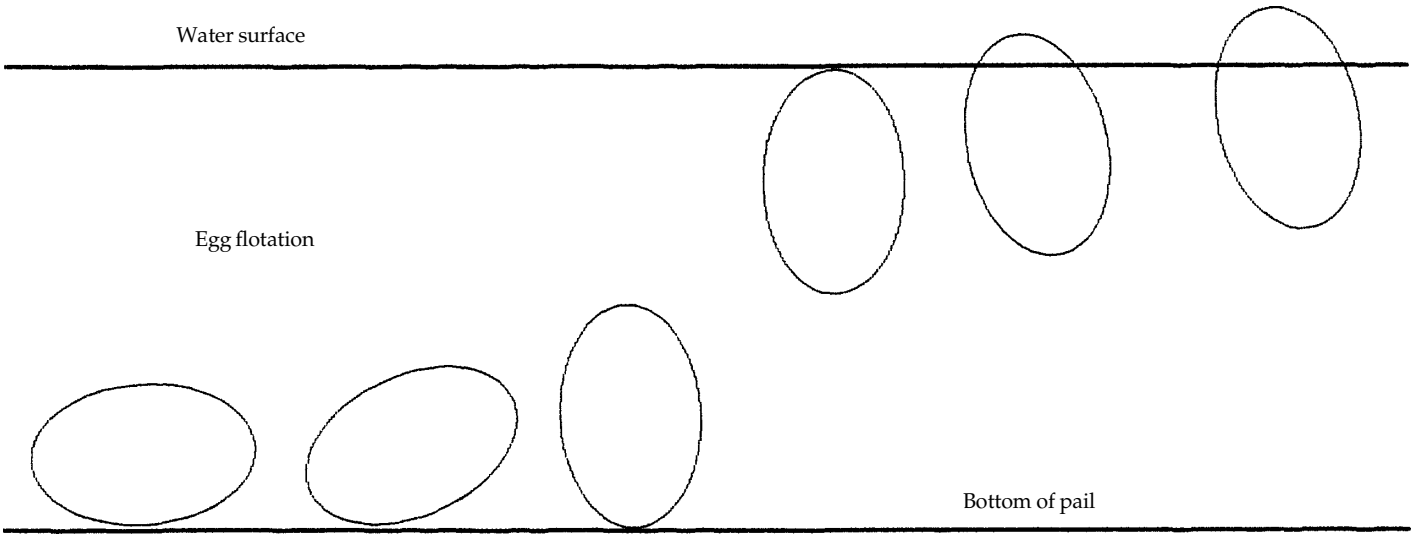
Net launchers use a single large rifle blank cartridge to propel the net. They are fired from the shoulder much like a shotgun or rifle. Net launchers are available in two styles: wide angle for launching a 20 x 20-foot (6 x 6-m) net, designed for air-to-ground helicopter capture, and narrow angle for launching a 12 x 12-foot (3.6 x 3.6-m) net, designed for ground-to-ground capture. The smaller net launchers are well suited for capturing individual or small groups of problem birds.

Alpha-chloralose is an immobilizing agent that depresses the cortical centers of the brain. Waterfowl fed about 30 mg of alpha-chloralose per kg of body weight become comatose in 20 to 90 minutes. Full recovery occurs 4 to 24 hours later. Alpha-chloralose is best suited for capturing individual or small groups of problem waterfowl in situations or at times when other methods are not safe or practical.

The US Food and Drug Administration (FDA) has approved alpha-chloralose as an immobilizing agent for the USDA-APHIS-ADC program to use in the capture of waterfowl, coots, and pigeons. This use is granted exclusively to ADC under a continuing Investigational New Animal Drug (INAD) application. Alpha-chloralose may only be obtained from the Pocatello Supply Depot for use as an avian wildlife immobilizing agent. Alpha-chloralose may only be used by ADC employees or biologists of other state or Federal wildlife management agencies that have been certified in its use, or persons under their direct supervision.

Repellents

There are no chemical repellents currently registered with the US Environmental Protection Agency (EPA) for controlling waterfowl. Several chemicals that have shown taste or olfactory repellent properties, including methyl anthranilate, are currently being studied by USDA-APHIS-ADC Denver Wildlife Research Center and other agencies.



Flotation stage:					
1	2	3	4	5	6
Approximate embryo age in days:					
0 - 3	4 - 8	9 - 13	14 - 18	19 - 23	24 - 27
Waiting period (days) prior to egg removal and nest destruction:					
20	15	10	5	0	0

Fig. 5. Age embryos by placing 3 or 4 eggs in a pail of water and determining the flotation.

Toxicants

There are no toxicants currently registered with EPA for controlling waterfowl.

Shooting

Hunting, where safe and legal, is the preferred method of reducing local populations of problem waterfowl. Hunting has a strong repellent effect as well. State wildlife management agencies can provide information on current waterfowl hunting regulations.

In situations involving real and direct threats to human health and safety, such as geese around an airport, it may be possible to obtain a permit from the US Fish and Wildlife Service to kill migratory game birds. "Such birds may only by killed by shooting with a shotgun not larger than No. 10 gauge fired from the shoulder, and only on or over the threatened area or areas" (50 CFR 21.42a). Such permits are generally issued only when the use of nonlethal control methods is not practical or possible. A solid rationale as to why nonlethal methods will not work and why the birds must be removed is generally required before a permit to kill migratory game birds is issued.

Other Methods

The growth of local waterfowl populations can be effectively slowed by destroying nests and eggs. This method is especially effective with nuisance Canada geese. Secure a federal permit before carrying out this activity (50 CFR 21.41a).

Render eggs nonproductive by vigorously shaking them as soon as possible after the full clutch is laid and incubation begins. The longer incubation continues, the more difficult it becomes to destroy the embryo by shaking. It is safe to assume that the clutch is complete and incubation has started if the eggs feel warm. In situations where the start of incubation is unknown, eggs can be aged using the flotation method (Fig. 5).

Eggs in flotation stage 6 may be on the verge of hatching. If pipping has started, the eggs should not be shaken, as shaking will probably only accelerate hatching. Also, the US Fish and Wildlife Service, Region 3 Law Enforcement, has taken the position that a pipped egg contains a live bird, not an embryo. Live birds may not be killed under authority of an egg destruction permit.

After shaking the eggs, return them to the nest, and allow the birds to incubate for at least 3 weeks. The eggs and nest should not be destroyed immediately after shaking. Doing so may cause the geese to renest. Usually geese will not attempt to renest if they have been incubating eggs for more than 3 weeks. Remove all nest materials and eggs from the area after the appropriate waiting period. The nest and eggs must be removed to discourage continuation of the nesting effort and defense of the nest territory.

Most nest/egg destruction permits do not authorize possession of waterfowl nests or eggs. Therefore, all eggs and nest materials collected under authority of such a permit must be disposed of immediately.

Economics of Damage and Control

Waterfowl cause significant losses to agricultural and aquacultural crops, damage golf courses, cemeteries, lawns, and gardens, and contaminate reservoirs. Their activities can cause real economic hardship, aggravate nuisance situations, or create human health hazards. A reliable figure for the total national economic loss caused by waterfowl does not exist. The following examples serve to illustrate the magnitude of the problem, however.

In 1960, waterfowl caused an estimated $12.6 million worth of damage to ripening small grains on the Canadian prairies. In 1980, waterfowl were credited with causing $454,000 worth of damage to small grains in North Dakota, South Dakota, and Minnesota combined.

The 1989 appraised crop losses due to goose damage totaled $105,000 in the four Wisconsin counties surrounding Horicon Marsh National Wildlife Refuge (NWR). It is estimated that in the autumn of 1989 over 1 million interior Canada geese passed through Horicon Marsh NWR. This area has one of the largest and most active goose damage abatement programs in the country, with an annual budget of more than $135,000.

Goose damage to golf courses is difficult to quantify. A survey in 1982 of 219 golf courses in the eastern United States, however, indicated that 26% had nuisance Canada goose problems. It is not uncommon for geese to cause $2,000 to $3,000 damage per year to a golf course. Two golf course superintendents in the greater Cleveland, Ohio, area estimated that Canada geese caused between $2,000 and $2,500 worth of property damage to each of their courses in 1989. Three other golf course superintendents, in the same geographic area, estimated that they spend $1,000 a year just cleaning up Canada goose droppings, exclusive of any direct property damage.

Acknowledgments

I wish to thank Richard A. Dolbeer and Paul P. Woronecki of the USDA-APHIS-ADC Denver Wildlife Research Center, and Douglas A. Andrews, Ohio USDA-APHIS-ADC, for their editorial assistance in the preparation of this manuscript.

Figure 2 adapted from Duncan (1980).

Figure 4 photo by T. W. Seamans.

Figure 5 adapted from Westerkov (1950).

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