# SHALLOW WATER AREA MANAGEMENT FOR WILDLIFE

United States Department of Agriculture – Natural Resources Conservation Service

**Fact Sheet** **June 2008**

## INTRODUCTION

Shallow water areas can provide habitat for waterfowl resting and feeding, and can also support reptiles, amphibians, and insects that serve as important food sources for waterfowl, wading birds, and other wildlife. Shallow water areas are designed and managed to provide water depths, flooding durations, and food availability suitable for the desired wildlife. Seasonal water levels and vegetation in shallow water areas are usually actively managed to benefit wildlife, primarily waterfowl and wading birds.

Shallow water areas contain shallow surface water, typically from 1 to 18 inches deep, from at least late fall through early spring. They are usually drained or allowed to dry out naturally during late spring and summer. Small areas of permanent water may remain to provide reptile and amphibian habitat when water levels are low.

Proper management can increase and maintain desirable plants and other foods for waterfowl, wading birds, and other species of wildlife. Establishment of vegetation in the pool area is not required, but provides the benefits of wildlife food and cover. Naturally occurring annual and perennial "moist-soil" plants are the most beneficial for wildlife. Annual grain crops or crop residue can also be used to provide wildlife food.

Seeds and rootstocks of plants are important waterfowl foods. Their germination, growth, and availability for food are dependent on the water regime of a site. Plants also serve as a food source for many smaller members of the animal community. When plants and plant debris are flooded and begin to deteriorate, they provide nutrients for many small aquatic invertebrates. These small animals, such as snails, insects (especially caddis flies, beetles, true flies, and midges/ bloodworms), crustaceans (fairy shrimp, clam shrimp, water fleas, scuds), and earthworms, provide a major food source for waterfowl and wading birds. They are especially important during protein-demanding periods such as egg-laying or molting.

*Photo by Charlie Rewa, NRCS, Beltsville*

After seed producing plants have matured, and during the fall waterfowl migration, shallow water areas are usually allowed to flood to a depth of 1 to 18 inches. The actual depth and timing of flooding should be based on the needs of the desired species (see Table 4 in this fact sheet for more information). Flooded plants provide excellent resting and feeding areas for "puddle ducks" that "tip" to feed, such as mallard, widgeon, pintail, and teal. The optimum feeding depth for most of these ducks is 3 to 8 inches of water. In the spring during a slow drawdown, shallow water areas (mud flats to 3 inches deep) are especially beneficial for shorebirds, such as plovers and sandpipers, on their northward migration. Canada geese will also feed in these shallow depths.

## MANAGEMENT OF WATER AND PLANTS

Water levels and plants can be managed in various combinations to provide resting and feeding habitat for waterfowl, wading birds, frogs, turtles, and other wildlife. Management plans are developed based upon the needs of the targeted wildlife species, taking into consideration location, water supply, available resources, and regulatory and cost-share program requirements (if applicable).

### Water Considerations

Water levels can be managed by human actions, such as by adding or removing boards in a water control structure, or they can be allowed to vary naturally in response to seasonal changes in rainfall, groundwater levels, and evaporation rates. Many shallow water sites are completely dry in the summer, due to managed drawdowns or seasonal availability of water.

Providing permanently or semi-permanently wet "frog holes" on at least 20% of the site will especially benefit resident wildlife, such as ducks, geese, herons, frogs, toads, salamanders, and turtles, that need a long-term water supply. Most amphibians, for example, need semi-permanent water (at least until July) for egg-laying and tadpole development, while some need water year-round. Depending on the species, adult amphibians may spend most of their lives in shallow water or in adjacent upland forests and wet meadows. Semi-permanent waters (e.g., Delmarva Bays) are especially important for many amphibians because they lack predatory fishes that will feed on amphibian larvae.

Most aquatic wildlife need to spend some time resting, preening, or basking out of the water. Large tree branches or logs can be placed in the shallow water area to provide this type of habitat.

### Providing Wildlife Foods

There are four basic ways to provide quality wildlife foods on a shallow water site: (1) periodic manipulation of water and soil to encourage the growth of natural moist-soil plants; (2) minimal management to support mostly perennial (and some annual) moist-soil plants; (3) planting and flooding an annual grain crop ("food plot") for wildlife; and (4) flooding of crop residue. The following sections of this fact sheet provide more information about these management options.

***Natural plants vs. planted crops – which are best?*** Some advantages of using natural moist-soil plants vs. planting annual crops or using crop residue are:

- Moist-soil plants have greater nutrient value for waterfowl than row crops, and don't deteriorate as quickly as row crops when flooded (see Table 1);
- Greater plant diversity supports a more diverse food supply and attracts a greater diversity of wildlife;
- Management costs are usually lower (natural seed is "free" and doesn't need to be planted);
- Moist-soil management is well-suited for marginal row crop sites;
- Production of natural moist-soil plants is less dependent on weather.

Some advantages of planting annual crops or using crop residue are:

- Production of waterfowl food can be greater in a "good" crop year;
- Timing and duration of drawdown is less critical for establishing row crops;
- Undesirable plants are easier to control, especially if noxious weeds or invasive plants are a problem on a site.

In some cases, altering the type of management every few years can make maintenance easier, and can increase the productivity and diversity of the site.

*Table 1. Deterioration of plant seeds after 90 days of inundation on a shallow water site (adapted from the Waterfowl Management Handbook, Fish and Wildlife Leaflet 13.1.1, 1988).*

| Plant Name | Percentage of Seeds Decomposed after 90 Days |
|---|---|
| Soybeans | 86 |
| Japanese millet | 57 |
| Corn | 50 |
| Buckwheat | 45 |
| Sorghum | 42 |
| Pennsylvania smartweed | 21 |
| Water oak (acorns) | 4 |
| Sesbania | 4 |
| Horned beakrush | 2 |
| Salt marsh bulrush | 1 |

***Seasonal management for natural moist-soil plants.*** Water level manipulations can promote germination of existing seed sources of high quality waterfowl food, such as wild millet, rice cutgrass, smartweeds, beggarticks, sedges, and rushes. Drawdown (de-watering) of the area is necessary for germination of moist-soil plants. Annual plants produce the most seed and provide an abundance of waterfowl food. To maintain the site in early successional species (mostly annuals), and to control unwanted species, it is best to de-water and lightly disk the site every 3 years.

The seedbank of a site plays an important role in plant community development, and can largely determine the potential effects of vegetation management. The composition of the seedbank, and the timing and rate of drawdown determine which plant species will grow in a particular shallow water site. Volunteer plant growth in past wet years, and plants growing in adjacent moist-soil areas are good indicators of seedbank composition. In general, early drawdowns during April result in germination of smartweeds and sedges, while midseason drawdowns during May produce millets and beggarticks. (See Table 3 for the response of common moist-soil plants to the timing of drawdown.) Drawdown timing can be used to control the growth of undesirable species. Seeding of desirable species, along with proper timing, may help to overcome problematic seed banks.

Slow drawdowns, over a period of 2 to 3 weeks, are usually more desirable for plant establishment and wildlife use, and will reduce the amount of nutrients leaving the site (see Table 2). To conduct slow drawdowns with flashboard risers, boards are removed one at a time, on intervals of three or four days. With a PVC standpipe and elbow, the standpipe is rotated downward a few inches at a time. Slow drawdowns provide optimum conditions for germination of moist-soil plants, resulting in greater seed production.

Shorebirds, such as plovers and sandpipers, feed on mud flats and in very shallow water (up to 3 inches) during the time of an early to midseason drawdown. Therefore, managed shallow water areas can be a very important source of food for shorebirds during their spring migration.

Following seed maturation, sites should be re-flooded to coincide with the arrival of fall migrant waterfowl, usually September through November. Flooding the site slowly over a period of 2 to 3 weeks allows new areas of food to become available with each change in water depth. (Refer to Table 4 for the water depths preferred by various waterfowl and wading birds.)

Moist-soil areas do not require fertilizer. To the extent possible, pesticide use should be avoided to prevent harm to wildlife. See page 6 for more information about controlling undesirable plants on shallow water sites.

*Table 2. Effects of fast vs. slow drawdowns on selected resource concerns (adapted from the Waterfowl Management Handbook, Fish and Wildlife Leaflet 13.4.6, 1991).*

| Resource Concern | Duration of Drawdown | |
|---|---|---|
| | Less than 4 days | More than 2 weeks |
| Time available for seed germination of moist-soil plants | Short | Long |
| Growth and seed production by moist-soil plants after April drawdown | Good | Excellent |
| Growth and seed production by moist-soil plants after May or June drawdown | Poor | Excellent |
| Cocklebur problems | High potential | Lower potential |
| Availability of snails, soil insects, and earthworms for waterfowl food | Low | High |
| Waterfowl use of the site during April drawdown | Good | Excellent |
| Waterfowl use of the site during May or June drawdown | Poor | Good |
| Nutrients leaving the site | High | Low |

***Minimal management for natural moist-soil plants.*** Under natural or "minimal" management, water levels rise and fall seasonally in response to varying natural conditions, such as rainfall, groundwater levels, evaporation rates, etc. The water level may be managed occasionally if needed to control noxious weeds or invasive species, or to make repairs.

Plants on minimally managed sites will tend to be perennials such as sedges, rushes, and grasses. Perennial plants usually produce fewer seeds than annuals, but can provide good year-round cover for wildlife resting, nesting, and brooding. The foliage and rootstocks of perennial plants are eaten by waterfowl, wading birds, marsh birds, beavers, and muskrats. Perennial plants contribute significantly to the development of soil organic matter, which is critical for support of invertebrate populations.

Following seed maturation, sites should be re-flooded to coincide with the arrival of fall migrant waterfowl, usually September through November. Flooding the

site slowly over a period of 2 to 3 weeks allows new areas of food to become available with each change in water depth, and increases the duration of food availability. (Refer to Table 4 for the water depths preferred by various waterfowl and wading birds.)

Moist-soil areas do not require fertilizer. To the extent possible, pesticide use should be avoided to prevent harm to wildlife. (See page 6 for more information about controlling undesirable plants on shallow water sites.)

***Planting and flooding of annual food plots.*** Annual crops can provide desirable and high energy waterfowl food, but often for relatively short durations. De-water all or part of the site in late spring, and plant annual food crops such as browntop millet, buckwheat, Japanese millet, grain sorghum, or corn. Plant seeds using conventional farming equipment, or by broadcasting seeds on exposed soil after drawdown. Fertilize only if needed, as indicated by a soil test. To the extent possible, do not use pesticides on the crop to avoid harming wildlife. Annual weeds, such as ragweed, foxtail, and crabgrass, can be beneficial for providing wildlife food and cover.

After the crop has matured in late summer or early fall, flood the site slowly to coincide with the arrival of fall migrant waterfowl, usually September through November. Flooding the site slowly over a period of 2 to 3 weeks allows new areas of food to become available with each change in water level, and increases the duration of food availability. (Refer to Table 4 for the water depths preferred by various waterfowl and wading birds.)

*Table 3. Response of common moist-soil plants to drawdown dates (adapted from the Waterfowl Management Handbook, Fish and Wildlife Leaflet 13.4.6, 1991).*

| Moist-Soil Plants | | | | Drawdown Period | | |
|---|---|---|---|---|---|---|
| **Plant Family** | **Common Name** | **Scientific Name** | **Annual or Perennial** | **April 1 - April 30** | **May 1 - May 31** | **June 1 - June 30** |
| Grass | Swamp timothy | *Crypsis schoenoides* | Annual | + | +++ | + |
| | Rice cutgrass | *Leersia oryzoides* | Perennial | +++ | + | |
| | Sprangletops | *Leptochloa* spp. | Annuals | | + | +++ |
| | Crabgrasses | *Digitaria* spp. | Annuals | | +++ | +++ |
| | Panic grasses | *Panicum* spp. | Annuals & perennials | | +++ | ++ |
| | Wild millet | *Echinochloa crusgalli* var. *frumentacea* | Annual | +++ | + | + |
| | Wild millet | *Echinochloa walteri* | Annual | + | +++ | ++ |
| | Wild millet | *Echinochloa muricata* | Annual | + | +++ | + |
| Sedge | Red-rooted sedge | *Cyperus erythrorhizos* | Annual or perennial | | ++ | |
| | Chufa (Yellow nutsedge) | *Cyperus esculentus* | Perennial | +++ | + | |
| | Spikerushes | *Eleocharis* spp. | Mostly perennials | +++ | + | + |
| Buckwheat | Pennsylvania smartweed | *Polygonum pensylvanicum* | Annual | +++ | | |
| | Curltop ladysthumb | *Polygonum lapathifolium* | Annual | +++ | | |
| | Docks and sorrels | *Rumex* spp. | Mostly perennials | | +++ | + |
| Pea | Sweetclovers | *Melilotus* spp. | Annuals | +++ | | |
| | Sesbania | *Sesbania exaltata* | Annual | + | ++ | |
| Composite | Cocklebur | *Xanthium strumarium* | Annual | ++ | +++ | ++ |
| | Beggarticks | *Bidens* spp. | Annuals | + | +++ | +++ |
| | Asters | *Aster* spp. | Perennials | +++ | ++ | + |
| Loosestrife [2/] | Purple loosestrife [2/] | *Lythrum salicaria* | Perennial | ++ | ++ | + |
| | Toothcup | *Ammannia coccinea* | Annual | + | ++ | ++ |
| Morning glory | Morning glories | *Ipomoea* spp. | Annuals | ++ | ++ | |
| Goosefoot | Saltbushes | *Atriplex* spp. | Annuals | +++ | ++ | |

Notes: 1. + = fair response; ++ = moderate response; +++ = excellent response.
2. Purple loosestrife is an invasive plant. Manage the shallow water area to exclude it.

*Table 4. Timing and depths of water needed for wildlife. Key: ○ - fall/spring migration and non-breeding residency; ● - breeding, brooding, and rearing; ⦿ - approximate peak arrival of fall migrants.*

| Waterbird Group and Preferred Water Depth | Species | Time of Year in Maryland | | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | |
| Dabbling Ducks<br>3 - 8 inches | American Wigeon | | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | | | | These ducks are regular fall and spring migrants. Wood duck, mallard, and black duck are found statewide, and nest in Maryland. Blue-winged teal and gadwall nest on the Lower Eastern Shore. Black duck, mallard, and wood duck are the most common ducks in winter. Smaller numbers of widgeon, gadwall, pintail, green-winged teal, and shoveler also winter in Maryland. Green-winged teal and wigeon winter throughout the state, except in Western Maryland. Wintering gadwall, pintail, and shoveler are found mostly on the Coastal Plain. |
| | American Black Duck | ● | ○ | ⦿ | ○ | ○ | ○ | ○ | ○● | ● | ● | ● | ● | |
| | Blue-winged Teal | ○ | ⦿ | ○ | ○ | ○ | | | ● | ● | ● | ● | ● | |
| | Gadwall | ● | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○● | ● | ● | ● | |
| | Green-winged Teal | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | Mallard | ● | ○ | ⦿ | ○ | ○ | ○ | ○ | ○● | ● | ● | ● | ● | |
| | Northern Pintail | | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | Northern Shoveler | | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | Wood Duck | ● | ○ | ⦿ | ○ | ○ | ○ | ○ | ○● | ● | ● | ● | ● | |
| Diving Ducks<br>8 inches or more | Common Merganser | | | | ○ | ⦿ | ○ | ○ | ○ | ○ | | | | Found statewide during migration. Winter mostly on the Coastal Plain. Often found in open water. Hooded mergansers nest in Maryland in wooded swamps and floodplains. |
| | Hooded Merganser | ○ | ○ | ○ | ⦿ | ○ | ○ | ○ | ○● | ● | ● | ● | ● | |
| | Red-breasted Merganser | | | | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | | | |
| | Ruddy Duck | | | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | | | |
| Geese<br>0* - 3 inches | Canada Goose | ○ | ○ | ⦿ | ○ | ○ | ○ | ○ | ○● | ○● | ● | ● | ● | Statewide during migration. Winter mostly on the Coastal Plain. Populations of permanent resident Canada geese also occur statewide. |
| | Snow Goose | | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| Herons and Egrets<br>1 - 4 inches | Great Blue Heron, Great Egret, Black-crowned Night Heron | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | ● | ● | ● | ○ | Statewide during migration. Winter mostly on the Coastal Plain. Great blue heron and green heron breed statewide; other species nest on the Coastal Plain in localized colonies. The Great Blue Heron can easily feed in water up to 12 inches deep. |
| | Cattle Egret, Glossy Ibis, Green Heron, Snowy Egret | ● | ○ | ○ | | | | | ○ | ● | ● | ● | ● | |
| Marshbirds<br>0* - 3 inches | King Rail | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | ● | ● | Statewide during migration. Nesting primarily on the Coastal Plain, except snipe, which do not nest in Maryland. |
| | Virginia Rail | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | ● | ● | |
| | Sora | ○ | ○ | ○ | ○ | ○ | | | | ○ | ● | ● | ● | |
| | Common Moorhen | ○ | ○ | ○ | ○ | | | | | ● | ● | ● | ● | |
| | American Coot | ● | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | ● | |
| | Common Snipe | ○ | ○ | ○ | ⦿ | ○ | ○ | ○ | ○ | ○ | ○ | | | |
| Shorebirds<br>0* - 3 inches | Includes yellowlegs, sandpipers, and plovers. | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○● | ● | ● | Shorebirds are late summer, fall and spring, statewide migrants; winter residents, mostly on the Coastal Plain. Very few species nest in Maryland. |

* When there is 0 inches of surface water, the soil needs to be saturated to the surface (mudflat) to provide suitable feeding habitat.

References: Iliff, MJ, RF Ringler and JL Stasz. 1996. *Field List of Birds of Maryland*, 3rd Ed. Maryland Ornithological Society.
Poole, A. (Editor). 2005. *The Birds of North America Online*, http://bna.birds.cornell.edu/BNA/. Cornell Laboratory of Ornithology, Ithaca, NY.
Webster, D., personal communication, June 5, 2008.

***Flooding of crop residue.*** There are former wetland areas within many agricultural fields that can be seasonally flooded to provide migratory and wintering habitat for waterfowl and wading birds. Flooding of crop fields can be used to provide seasonal shallow water habitat without taking cropland out of annual production.

Plant and harvest annual crops as usual. To the extent possible, minimize the use of pesticides on crops to avoid harming wildlife that will be using the shallow water area. Flood the crop residue and waste grains slowly after harvest, to coincide with the arrival of fall migrants, usually September through November. Flooding the site slowly over a period of 2 to 3 weeks allows new areas of food to become available with each change in water level, and increases the duration of food availability. (Refer to Table 4 for the water depths preferred by various waterfowl and wading birds.) De-water the site in the spring, early enough to allow the site to dry out before the normal crop planting season.

## OTHER MANAGEMENT CONCERNS

### Embankments and Water Control Structures

Inlet and outlet pipes and related structures should be inspected periodically, and replaced or repaired, if necessary. Trash and other obstructions that may reduce water flow should be removed. Berms and ditch plugs should be inspected for evidence of erosion, burrowing by muskrats, or other structural problems. At a minimum, sites should be inspected at least once per year and after each major storm.

### Buffers

In most locations, shallow water areas will benefit from having permanent vegetative buffers. Buffers of grasses, wildflowers, shrubs, or trees can reduce the amount of sediment entering a shallow water site, and also provide additional food and cover for wildlife.

Woody growth can be controlled by infrequent spot mowing or burning (not more than once every two to three years). To protect wildlife, disturbance of buffers should be delayed as late as possible into the fall or winter, depending on management objectives. At a minimum, buffers should not be disturbed during the primary nesting season (April 15 to August 15).

### Control of Undesirable Plants

Plants that are considered “undesirable” are those that tend to “take over” a site, to the exclusion of other plants. Undesirable plants in Maryland include cocklebur, reed canarygrass, phragmites (common reed), cattails, and all noxious weeds. These plants should be controlled by spot treatment, using mechanical methods or approved herbicides. Control of noxious weeds (specifically, Johnsongrass, shattercane, and various thistles) is required by state law.

The best approach for dealing with undesirable plants is to inspect sites periodically during the growing season and control undesirable invaders before they colonize a large area. Nearby stands of undesirable plants should be removed prior to the development of a shallow water area. If they are not removed, site managers should remain alert to potential invasions.

Once well-established, most undesirable plants are difficult to control. Cutting, burning, and herbicide applications can be used for control, but may result in damage to desirable plants. Removal by hand is a possible solution if the undesirable plants occupy only a small portion of the site. However, plants with extensive root systems, such as cattails, may be difficult to remove by digging. Hand-pulling of phragmites is not recommended because the root systems are extensive and can easily re-sprout.

Water management techniques can sometimes be used to reduce problems with nuisance plants. Seeds of reed canarygrass, phragmites, and cattails germinate best on moist soils, but not under several inches of water. Maintaining high water levels in the spring will help to discourage seed germination of these undesirable plants. If cocklebur volunteers on a moist-soil site, it usually can be controlled by a brief period of re-flooding.

Undesirable woody vegetation can be controlled by infrequent spot mowing or burning (not more than once every two to three years).

For more information about controlling specific weeds, contact the local office of Maryland Cooperative Extension, or the local Maryland Department of Agriculture weed control specialist.

### Control of Undesirable Animals

Shallow water sites are intended to attract wildlife, but some wildlife is less welcome than others. Beavers can significantly change a site's water regime and vegetation, and can cause structural failure by raising water levels above the intended design. They are difficult to discourage, and may need to be removed in accordance with state hunting and trapping regulations.

Muskrats can be beneficial because they control cattails and help maintain open water areas. However, muskrats can also cause structural failures by burrowing into berms. Burying chain link material into the berm immediately above and below the waterline can

help to discourage burrowing. Damage can also be minimized by designing berms with gentle slopes (at least 5:1) to the waterline, and with a shallow bench adjacent to the berm at the waterline. Muskrats seem to prefer steep banks to burrow in, with an approach that is safely under water. A few steeply banked islands in the water will provide habitat where muskrats can safely burrow. If necessary, muskrats can be removed from a site in accordance with state hunting and trapping regulations.

Geese can be discouraged by making the shallow water area and buffer less attractive to them. Geese generally prefer areas of open water and low vegetation for easy access into and out of a site. To discourage geese, manage shallow water areas to minimize open water and favor the growth of tall, dense herbaceous vegetation. In the buffer, tall vegetation will be much less attractive to geese than a well-manicured lawn.

For more information about controlling nuisance animals, contact the local office of the Maryland Department of Natural Resources, Wildlife and Heritage Service.

**Water Quality**

Management activities, especially those involving water level management and soil disturbance, have the potential to affect water quality in both the shallow water area and receiving waters. The following management practices support water quality protection:

- Leave vegetation and soil in an area around the outlet undisturbed;
- Avoid using fertilizer in shallow water areas. Shallow water areas typically receive enough nutrients from runoff for adequate plant growth;
- Conduct slow drawdowns, over a period of a few weeks, to lessen the rate of nutrient release, and reduce the turbulence effects of flowing water;
- Conduct drawdowns so a portion of the shallow water area is not actively de-watered (i.e., drawdown to a level above the bottom of the shallow water area). This will provide storage for storm runoff, enhance sediment retention, and maintain the saturated conditions required for denitrification;
- Maintain permanently vegetated buffers where runoff enters the shallow water area.

**Disturbances**

Human activities in and around a shallow water area can have a significant impact on the behavior of wildlife. Disturbances cause water birds to move to other feeding grounds, and may lower productivity of nesting or brooding.

Loud activities conducted in or over the water cause the most disturbance, while quiet shoreline activities cause the least. Mechanized vehicles (e.g., mowing equipment or recreational vehicles) should be kept off of a site when water birds are present. Screened buffer zones can be established to separate unavoidable disturbances (e.g., busy roads) from the site.

Livestock, dogs, and cats, to the extent possible, should be prevented from accessing a site.

Trash and debris should be promptly removed. To the extent possible, do not allow sediment, chemical contaminants, or nutrients to enter the site.

**Disease**

Mass die-offs of waterfowl can occur at a particular site due to disease. A common disease that occurs around shallow water areas is avian botulism. It can be rapidly transmitted from dead birds to healthy birds by infected maggots. Prompt removal and disposal of dead birds and fish can control the spread of the disease. Summer flooding of sites that have been dry for a long time is generally not recommended, except for the purpose of shorebird management. Under these conditions the bacterium that causes botulism can flourish.

## SUGGESTED ADDITIONAL READING

U.S. Fish and Wildlife Service, *Waterfowl Management Handbook*. This is a collection of fact sheets with detailed information about various waterfowl management topics. Available free on the internet at: http://www.mesc.usgs.gov/.

University of Maryland, Cooperative Extension, *Wildlife Management Fact Sheet Series*. This is a collection of fact sheets not only about managing for waterfowl, but also for rabbits, quail, pheasants, squirrels, songbirds, and other wildlife. Available free on the internet at: http://pubs.agnr.umd.edu/.

 *Written by Anne Lynn, State Resource Conservationist, NRCS, Maryland, and revised by Steve Strano, State Biologist, NRCS, Maryland.*