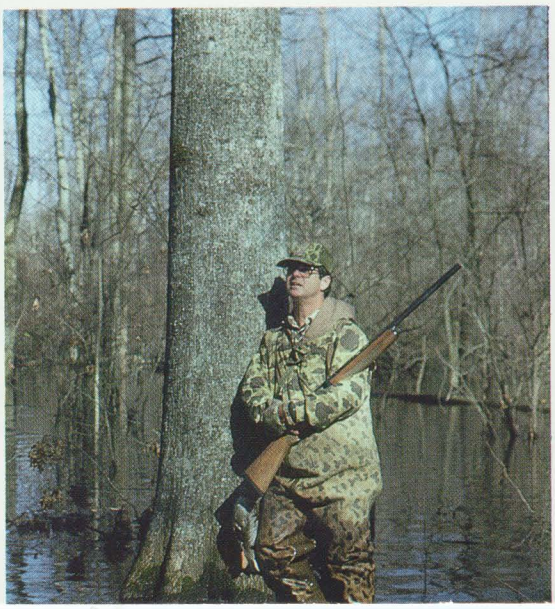
WATERFOWL HABITAT MANAGEMENT HANDBOOK
for the Lower Mississippi River Valley



DUCKS UNLIMITED, INC. • MISSISSIPPI COOPERATIVE EXTENSION SERVICE • ARKANSAS GAME & FISH COMMISSION

Purpose

To restore waterfowl populations to the levels of the 1970's, private landowners must provide additional wetland habitat. Because private landowners control approximately 74 percent of the wetlands remaining in the United States, their cooperation is essential to any significant effort to restore waterfowl populations in the Mississippi Flyway.

Many agencies and organizations have worked together for more than 15 years to develop waterfowl habitat management techniques and practices that work on private lands. Enough successes and mistakes have been made to justify the preparation of this management handbook to help guide further efforts. This publication is for private landowners in the Lower Mississippi River Valley who are interested in improving their lands for waterfowl. This is a reference landowners can use to get information about a particular aspect of waterfowl management. For example, the publication is designed to answer questions such as:

- How does managing my land help waterfowl?
- What are the benefits of managing my land for waterfowl?
- Who is available to help me manage my land for waterfowl?
- How do I manage water and plants to improve my land as waterfowl habitat?

This handbook answers these questions and many more. Knowledge is the first requirement for success in any venture, and this is especially true when managing waterfowl on private lands.

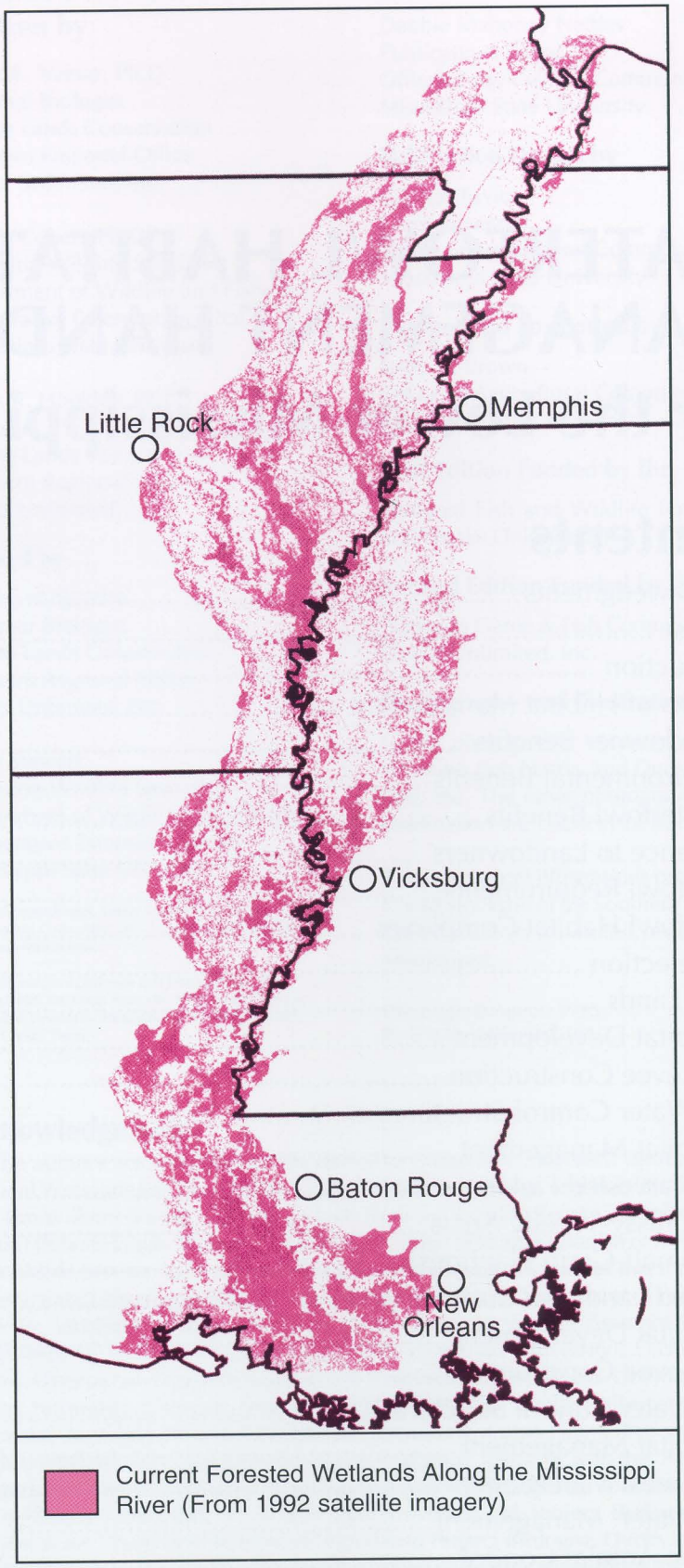
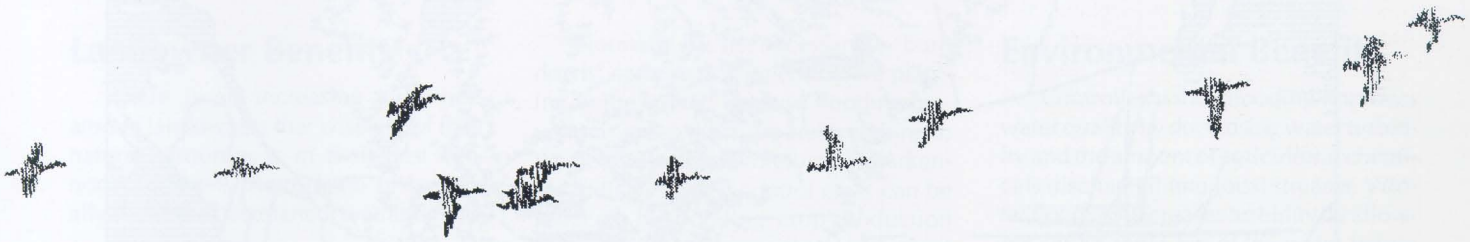


Figure 1. The Lower Mississippi River Valley Alluvial Plain (the Delta) showing remaining forested areas as of 1992. Map provided by the Lower Mississippi River Valley Joint Venture, U.S. Fish & Wildlife Service, Vicksburg, Mississippi.



Introduction

The Lower Mississippi River Valley, also known as the Delta, was created by the Mississippi River, which drains 41 percent of the land mass of the continental United States. The Delta extends 500 miles from Cape Girardeau, Missouri, to southern Louisiana, and it comprises more than 24 million acres in 7 states (Figure 1). The Delta ranges from 20 to 80 miles in width and once contained the largest expanse of forested wetlands in the United States.

Large-scaled land clearing of frequently flooded areas did not occur in the Delta until the 1960's, and about one-third of the original wetland acreage was converted to farmland from 1950 to 1976. By 1991, only 4.9 million acres (20 percent) of forested wetlands remained, mostly in Louisiana, Arkansas, and Mississippi (Figure 1). The Delta is one of the most productive agricultural regions in the world because of its fertile soils, subtropical climate, abundant rainfall, and long growing season.

The Mississippi Flyway (Figure 2) is frequently referred to as the "mallard flyway," because more than 1 million mallards typically winter in its lower reaches. The majority of these mallards are produced in the Canadian provinces of Saskatchewan, Alberta, and Manitoba. They fly along two major migration corridors within the Mississippi Flyway to reach wintering grounds in the Delta states of Arkansas, Mississippi, Louisiana, and Tennessee.

Historically, mallards wintering in the Delta depended primarily on acorns found in extensive hardwood bottomlands to meet their nutritional needs. As acorn-producing forests were cleared, mallards began feeding in croplands planted in small grains. Although mallards have adjusted their feeding behavior to the loss of more than 80 percent of the forested wetlands in the Delta, their long-term well-being depends upon continued flooding of the remaining agricultural and natural wetlands.

Over the past several decades, populations of several waterfowl species, including mallards, declined partly due to loss of habitat on the wintering grounds. Bottomland conversion, development, and flood control efforts have reduced wintering waterfowl habitat in the Delta. Several million acres of agricultural fields historically flooded annually due to normal winter rainfall, but this habitat base continues to decline as additional flood control projects are completed. Public wildlife management areas and refuges still provide an important "safety net" of habitat for waterfowl during unusually dry years, ensuring a reasonable population of waterfowl will return to the northern breeding grounds to reproduce each year. However, federal and state wildlife conservation agencies have neither public funding nor support for the purchase of additional waterfowl wintering habitat in the Delta.

Mississippi Flyway

Figure 2. The migration route, known as the Mississippi Flyway, used by waterfowl to reach the Lower Mississippi River Valley (the Delta) and other areas along the Gulf of Mexico coast. From the North American Flyway Directory, 1996, U.S. Department of Interior, Fish & Wildlife Service.

Benefits of Habitat Management

Landowner Benefits

There is an increasing awareness among landowners that wise use of their natural resources is in their best economic interests. Restoration of seasonally flooded or permanent wetlands can:

- Decrease erosion;
- Decrease weed-control and the crop-production costs;
- Enhance soil qualities (e.g., tilth and moisture retention);
- Improve water management capabilities; and
- Provide valuable recreational opportunities.

Although soil loss from fall-tilled croplands in the Delta averages 3 to 4 tons per acre per year (based on estimates from the U.S. Department of Agriculture, Agricultural Research Service), controlled flooding of agricultural lands during the noncrop season can substantially reduce erosion. When water control structures are operated to provide winter habitat for waterfowl, silt settles out in the field behind the structure and fills in low spots.

Seeds, roots, and foliage of numerous agricultural pest plants, including red rice and various grasses, are eaten by waterfowl. Ducks and geese eat about 10 percent of their body weight daily in plant matter. Large seeds with a thin seed coat, e.g., red rice, will not sprout after passing through the digestive system of waterfowl.

Normally it is not necessary to "burn down" early season weeds before planting in the spring, because flooding prevents a "green flush" from developing in the fields. Research conducted in Arkansas indicates weed-control costs can be reduced by flooding crop-production fields during winter months so waterfowl can feed.

Planting costs are reduced when fields are flooded during winter because vegetation cannot grow; consequently, less land preparation is required to prepare a seedbed. Many farmers find they can use no-till or reduced-till planting strategies during the following crop year, thereby decreasing equipment maintenance and fuel, labor, and herbicide costs.

Soil texture is improved when crop stubble is incorporated into the soil by light disking and when fields are flooded during winter months. In rice fields, rolling the stubble is recommended. Winter flooding also increases soil moisture, enhances seed germination, and causes young plants to establish stronger root systems.

Landowners also can benefit by selling hunting and other recreational opportunities (e.g., birdwatching) or permitting the public to use the resource for free. Substantial public relation benefits can accrue to individual farmers, as well as the agricultural industry, from conservation activities of this nature.

Environmental Benefits

Controlled winter flooding improves water quality by decreasing water turbidity and the amount of agricultural chemicals discharged into local streams. Winter flooding decreases turbidity by allowing soil to settle out of the water before being discharged. Because agricultural chemicals bond to soil particles, chemical levels and their residual products in discharged water are also reduced. Groundwater recharge also occurs due to winter flooding.

Waterfowl Benefits

The frequency and intensity of rainfall generally increase in the Delta during November and December. When flooding occurs on private lands, waterfowl leave wildlife refuges and disperse widely into croplands to feed on native plant seeds and small grains left during harvesting. Waterfowl and other wetland-dependent wildlife benefit greatly when this additional wetland habitat becomes available. Waterfowl survival rates and body weights increase when extensive flooded areas are available during the winter. Furthermore, birds returning to the breeding grounds in better body condition are more likely to nest successfully, thereby increasing the number of waterfowl flying south in the fall.

Assistance to Landowners

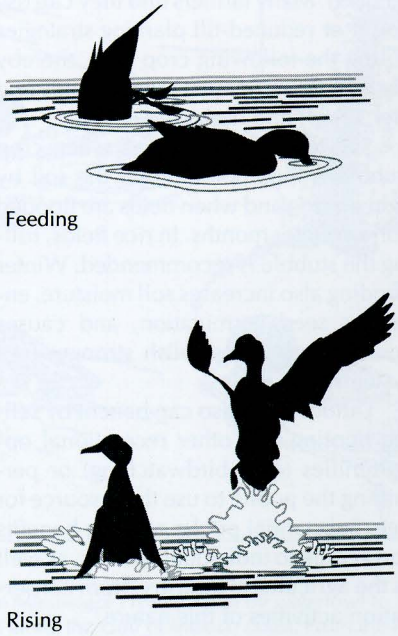
As part of a national cooperative effort to restore continental waterfowl populations, public and private conservation agencies and organizations have implemented private lands programs in several states in the Delta region. Agencies and organizations, such as Ducks Unlimited, Inc., U.S. Fish and Wildlife Service, Cooperative Extension Service, USDA Natural Resources Conservation Service (NRCS), and state wildlife agencies, provide wildlife management technical assistance. In some cases, where potential benefits to waterfowl are high and resources permit, an organization or agency may provide incentives to landowners who are willing to provide habitat for waterfowl.

In many states, financial assistance is available through the USDA Farm Services Agency (FSA) to restore waterfowl habitat. Farmers may enroll in cost-share assistance programs, such as the Wetland Reserve Program (WRP), to receive financial help in managing their lands for waterfowl.

Waterfowl Requirements

Ducks in the Mississippi Flyway can be classified into two major groups, dabbling and diving ducks. Dabbling ducks (mallards, gadwalls, blue-winged and green-winged teal, northern pintail, American wigeon, northern shoveler, and black duck) can walk well on land. They "tip up" to feed rather than dive, and they can take off vertically from land or water (Figure 3). Their preferred feeding habitats are flooded (6 to 12 inches deep) agricultural lands, forested wetlands, fresh marshes, and rivers. Although wood ducks are classified as perching ducks, they are found in many of the same habitats as dabbling ducks and feed similarly. Dabbling ducks eat about 10 percent of their body weight in food each day. They commonly feed on small grains (e.g., rice, soybeans, and corn) in addition to utilizing seeds and other parts from a variety of native plants (Appendix) and aquatic invertebrates (e.g., snails, crayfish, and insects). Some species of dabbling ducks, such as the gadwall and American wigeon, feed primarily on vegetation.

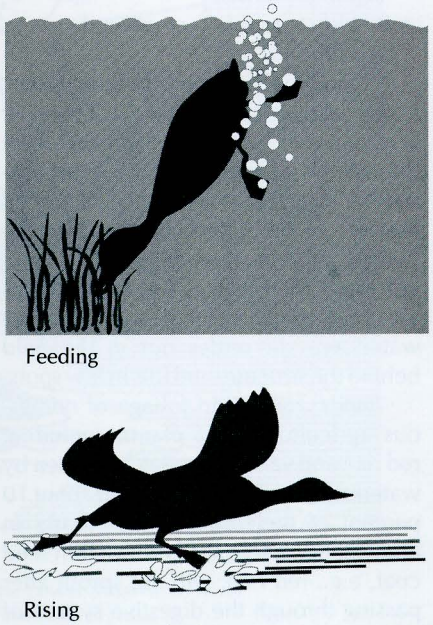
Diving ducks (lesser and greater scaup, ring-necked duck, bufflehead, canvasback, redhead, goldeneye, and ruddy duck) cannot walk well on land, dive to feed off the bottom or on submerged plants, and run along the surface of the water to become airborne (Figure 4). They generally congregate in large flocks and frequent lakes, rivers, coastal estuaries, and impoundments. Diving ducks also consume about 10 percent of their body weight in food daily, meeting their nutritional requirements by eating a variety of aquatic invertebrates (primarily snails and clams), plants, and seeds. Lesser scaup, goldeneye, ruddy ducks, and bufflehead feed primarily on animal matter (mollusks and crustaceans), while canvasbacks, redheads, and ring-necked ducks eat more aquatic plant parts. Private landowners in the Delta usually do not develop waterfowl habitat specifically for diving ducks because large, deep impoundments are required. Complexes of fish ponds, however, may be used by wintering diving ducks. Also, many projects developed for dabbling ducks often have within them deeper areas that provide suitable habitat for diving ducks.



Feeding

Rising

Figure 3. Dabbling ducks.



Feeding

Rising

Figure 4. Diving ducks.

Waterfowl Habitat Complexes

Waterfowl require several types of habitats and foods to meet their behavioral and nutritional needs during winter. Waterfowl tend to remain longer in areas with habitat complexes than in areas with single habitat types. Ideally, habitat complexes include:

- Small-grain-producing croplands to provide energy-rich food;
- Grassy-weedy areas with a diversity of water depths and native food plants to provide a nutritionally complete diet of plant and animal foods; and
- Forested wetlands (greentree reservoirs, shrub-scrub swamps, and baldcypress-tupelo gum and willow brakes) to provide resting sites and additional foraging areas.

Habitat diversity is the key to retaining waterfowl in an area during winter. If a landowner cannot provide the desired assortment of habitat types, the owner should consider cooperating with adjacent property owners to provide needed food and cover types to complete the habitat complex.

Forested wetlands and grassy-weedy areas are especially important to waterfowl, because they provide protection from predators, places to socialize, sources of natural foods, and cover during periods of extreme cold.

Continuous disturbance adversely affects waterfowl use; therefore, landowners should try to maintain at least 25 percent of their managed waterfowl habitat as a waterfowl sanctuary. Using forested wetlands and reservoirs as sanctuary areas is a particularly good way to develop resting and feeding habitats. Landowners should contact their county Extension agents for additional information on forming landowner cooperatives.

Disturbance also may be controlled by limiting the number of days per week and/or hours per day an area is hunted. Such management options give waterfowl ample opportunity to use a site and prevent "habitat burn-out" of any one area.

Site Selection

Poorly drained areas are usually chosen for developing wintering waterfowl habitats. Factors, such as long-term land use objectives, soil type, flooding frequency, accessibility, and freedom from disturbances, should be considered when selecting an area for development. It is especially important for landowners to determine long-term objectives for their properties, because it is unwise to invest in developing an area that cannot be flooded frequently or may be converted to an alternative use in the near future.

Special attention should be given to the soil type in any area considered for development into waterfowl habitat. Clay soils, commonly found at lower elevations in the Delta, are best suited for constructing levees because they tend to seal quickly when flooded. Local NRCS offices can provide engineering assistance in selecting and developing areas for waterfowl.

When selecting a site for development, landowners should choose areas that are subject to frequent, shallow flooding during the winter. Sites prone to deep flooding or flooding for extensive periods of time, however, should not be developed, because they will not produce waterfowl foods reliably and maintenance costs to repair levee damage may be excessive. Habitat sites should be accessible by farm equipment so landowners can produce food for wildlife, repair damaged levees, and maintain water control structures.

Areas located away from actively traveled roads are preferred by waterfowl, and landowners will generally find it easier to control access. Many set-aside lands, crop-production fields, and forested wetlands are suited for development as seasonally flooded waterfowl habitat.

Open Lands

Habitat Development

Although development of waterfowl habitat seldom conflicts with FSA crop program regulations, landowners should always inform the local FSA office of any intent to develop and manage seasonally flooded waterfowl habitat. Regulations regarding management of grassy-weedy areas on set-aside lands vary by state and county, but most FSA county committees encourage conservation activities of this nature.

When construction activities require earthmoving, landowners should also contact their local NRCS office and U.S. Army Corps of Engineers District to determine if a 404 permit is needed. Many agricultural activities in wetlands, however, are exempt from 404 permit requirements. **Note:** Waterfowl habitat development by private landowners normally does not create a jurisdictional wetland under current government regu-

lations or affect participation in crop-support programs. **Always check with the local FSA, NRCS, and district office of the Army Corps of Engineers before modifying an existing wetland to make sure you are in compliance with federal regulations.**

Levee Construction

On lands not already used for rice production, construction of low levees is often necessary to provide suitable habitat for waterfowl. It is especially important to remove woody vegetation from the levee site because it interferes with construction activities and may cause leakage. Standing water on the levee right-of-way should be drained so equipment can operate efficiently. The right-of-way should be thoroughly disked to assure that a tight seal is formed between the ground and deposited fill material. Levees should be constructed with clay soils, if possible, and the initial height of the levee should be 10 percent higher than the finished height to account for levee shrinkage.

Levees can be constructed with dirt wagons, terrace-building machines, terrace plows, tracked excavators, rubber-tired backhoes, bulldozers, or draglines. When good site conditions exist, however, dirt wagons are generally the most economical method of building levees and no borrow area (location from which fill material is removed) is created. Adjacent fields can be leveled by moving soil from higher elevations to the levee, and compaction of fill material deposited on the levee by dirt wagons is excellent.

Borrow areas created during impoundment construction should be located outside the impoundment and situated at least 10 feet away from the toe of the levee to prevent caving. After the fill material has dried, final shaping and compaction of the levee can be done with a bulldozer. A terrace-building machine and a sheep's foot roller can be used to economically construct medium-sized levees. A bulldozer can be used to construct smaller levees, but operating costs generally prohibit its use on larger projects. Many Soil and Water Conservation Districts throughout the Delta have purchased terrace plows that can be rented to construct small levees.

Levees with 3:1 slopes (the width of the levee extends 3 feet for each foot of elevation) are recommended to provide safe operating conditions for grass-cutting and maintenance equipment (Figure 5). The crown of the levee should be at least 10 feet wide to provide access for maintenance equipment. Levees impounding more than 3 acres of water should have a 2-foot minimum freeboard

Terrace-building machine

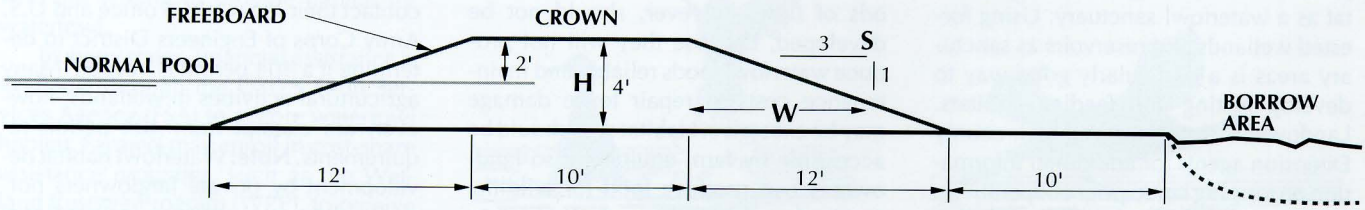


Figure 5. Cross section of an impoundment levee with a 3:1 slope used to hold water on areas managed for waterfowl. Reprinted from Mitchell and Newling (1986).

(the height of the levee above the maximum proposed water level). In most cases, an emergency spillway (25 feet wide and 2 feet lower than the settled height of the levee) should be constructed at the lowest end of all levees to reduce damage from overtopping. Contact your local NRCS office for engineering assistance when constructing levees and spillways.

Water Control Structures

Flashboard risers (Figure 6) made from steel or corrugated metal pipe are commonly used to vary the water levels on fields by installing or removing boards. Although the initial cost of water control structures fabricated from steel pipe is higher than corrugated pipe, they require little maintenance and have a much longer life expectancy. Flashboard risers are generally preferred to other types of water control structures, because they are self-regulating once the correct elevation of the boards in the intake structure has been determined. Water control structures fabricated from aluminum corrugated pipe or steel corrugated pipe protected with a bituminous protective coating also have a long life expectancy.

Control structures used to impound water on lands during the winter also function as drainage pipes when fields are in crop production. Thus, control structures do not interfere with agricultural operations, provided the drainage structures are large enough to carry the runoff from the impounded watershed (Table 1). The example shows how to interpret the data in Table 1. **Example:** A 12-inch-diameter pipe with an 18-inch half-round riser will drain 4 inches of water in 24 hours from a 12-acre field.

Schedule 80 PVC (polyvinyl chloride) water control structures (pipe drops) equipped with a drainage valve can also be used to control water levels. PVC pipe is widely available, requires little maintenance, and can be fabricated on the construction site; PVC pipe, however, is easily damaged by farming equipment.

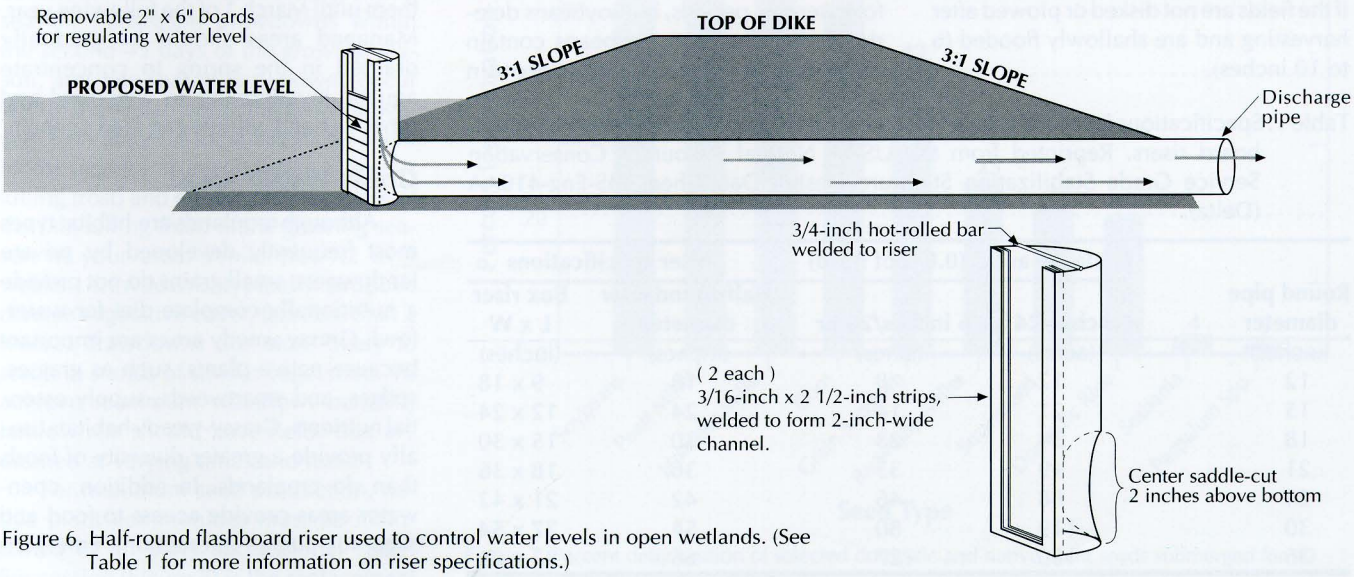


Figure 6. Half-round flashboard riser used to control water levels in open wetlands. (See Table 1 for more information on riser specifications.)

Habitat Management

Harvested Fields

Small-grain fields can provide important habitat for wintering waterfowl, and they are one of the most prevalent land uses in the Lower Mississippi Flyway. Agronomists estimate that 150-plus pounds per acre of rice, 50-plus pounds per acre of soybeans, 180-plus pounds per acre of corn, and 130-plus pounds per acre of grain sorghum are lost during harvesting. However, repeated disking and/or chisel plowing in the fall reduces by 80 percent the amount of waste corn and soybeans on the soil surface. Small-grain fields can provide substantial food resources for many species of waterfowl if the fields are not disked or plowed after harvesting and are shallowly flooded (6 to 10 inches).

Rice fields are especially important to waterfowl. Harvested rice fields are among the most economical areas to manage for waterfowl, because existing contour levees can often be repaired after the harvest is completed and the rice stubble shallowly flooded to provide excellent waterfowl habitat. In many areas, farmers have installed permanent levees that permit rice fields to be reflooded easily. Rolling lightly (preferred), disking, or chopping flooded rice stubble with a "water buffalo" often makes fields more attractive to waterfowl. Research indicates waterfowl feeding in rice fields also reduces the occurrence of red rice and other undesirable plants during the following production cycle.

Small grains decompose at different rates when flooded (Figure 7). Rice, sorghum, and corn persist well when flooded for extended periods, but soybeans deteriorate rapidly. Also, soybeans contain an enzyme that inhibits protein digestibility, lowering the nutritional value of soybeans to ducks when compared to other grains and weed seeds.

Ideally, 10 percent of the waterfowl management area should be flooded in mid-August to late-September to a depth of 2 to 6 inches to provide habitat for early migrants such as blue-winged teal. Waterfowl benefit most when water levels are increased gradually rather than immediately inundating the entire area. By increasing water levels slowly, new areas are flooded and additional food resources gradually become available to waterfowl. This practice conserves food for later in the winter and provides a range of water depths that attracts a variety of waterfowl. Taller grain crops to be left standing (corn or milo) can be planted in areas where water will be deeper.

Landowners should have fields flooded by November 15 and maintain them until March 1 of the following year. Managed areas should be gradually drained in the spring to concentrate aquatic invertebrates so waterfowl and other wetland wildlife can feed on them.

Table 1. Specifications for straight-pipe water control structures equipped with slotted-board risers. Reprinted from the USDA Natural Resources Conservation Service Grade Stabilization Structure Design Data Sheet MS-Eng-410AA (Delta).

Round pipe diameter	Drainage areas (0.0 foot head)		Riser specifications	
	4 inches/24 hr	6 inches/24 hr	Half-round riser diameter	Box riser L x W
(inches)	(acres)	(acres)	(inches)	(inches)
12	12	8	18	9 x 18
15	21	14	24	12 x 24
18	34	23	30	15 x 30
21	49	33	36	18 x 36
24	68	46	42	21 x 42
30	119	80	54	27 x 54
36	190	127	66	33 x 66

Grassy-Weedy Areas

Although croplands are habitat types most frequently developed by private landowners, small grains do not provide a nutritionally complete diet for waterfowl. Grassy-weedy areas are important because native plants, such as grasses, sedges, and smartweeds, supply essential nutrients. Grassy-weedy habitats usually provide a greater diversity of foods than do croplands. In addition, open-water areas provide access to food and sites for social interaction. Emergent

plants (plants rooted in the bottom but rising above the water's surface) also provide cover, isolation, and loafing sites.

Grassy-weedy areas are commonly located on set-aside lands and portions of fields too wet for consistent crop production. Despite annual tillage and herbicide applications, native plants quickly establish themselves in moist soil because their seeds are usually abundant in alluvial soils. Grassy-weedy areas are productive because native plants are adapted to flooding and drought, less frequently damaged by insects, and usually produce two to three crops of seed annually. In the spring, these areas also harbor greater densities of invertebrates than do habitats that are permanently flooded. Invertebrates are important to wintering ducks, especially females molting in preparation for reproduction.

Two of the most important factors to consider when managing native plants adapted to wet sites are the timing of the annual drawdown (Table 2) and the number of years since the area was tilled. Mid- and late-season drawdowns generally favor millets and other grasses preferred by waterfowl. Total seed production, however, is generally greater when impoundments are drained in early to midseason. Early season drawdowns occur within the first 45 days of the growing season, midseason drawdowns within the second 45 days of the growing season, and late-season drawdowns occur within the remainder of the growing season. Contact your local Extension agent for the beginning (average date of the last killing frost) and ending (average date of the first killing frost) of the growing season in your area. While slow (2 to 4 weeks) drawdowns typically produce diverse vegetative cover, fast (less than 2 weeks) drawdowns are more likely to result in stands of similar vegetation. To achieve maximum waterfowl benefits, landowners should have fields that are drained at varying times and rates.

For maximum seed production, native plant communities must be maintained in an early successional stage. Succession (Figure 8) is the replacement

Well-managed, moist-soil plant area

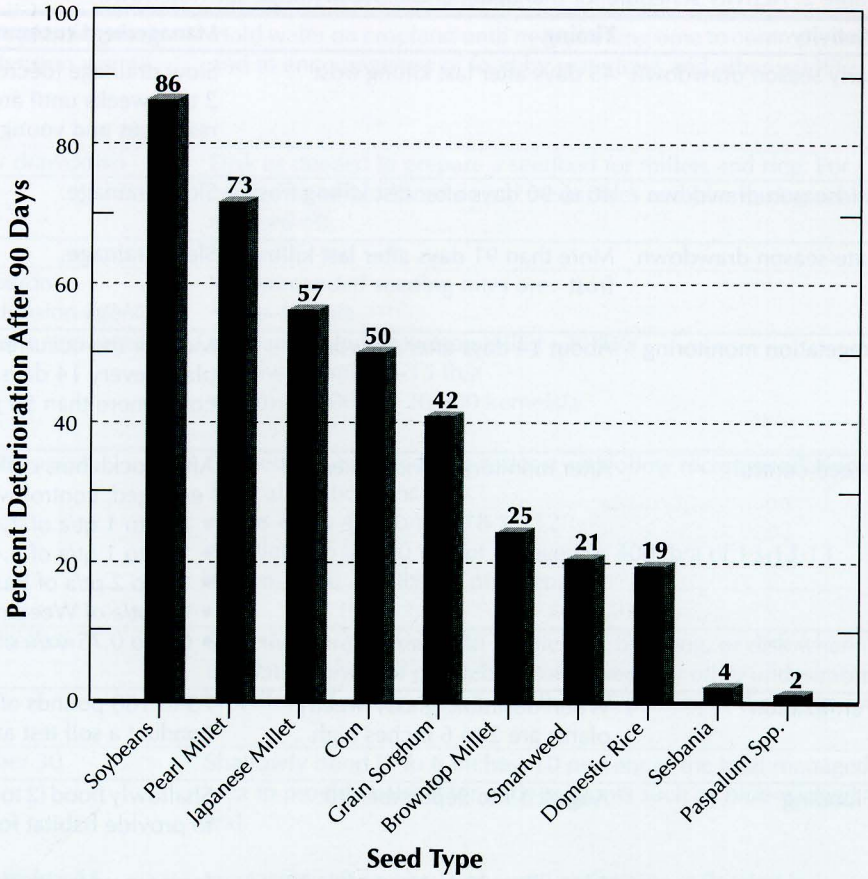


Figure 7. Percent deterioration of selected domestic and native plant seeds submerged for 90 days; after Neely (1956).

of one plant community by another, over time. The percentage of nonfood-producing-plant species generally tends to increase in each consecutive year an area is not disturbed. Soil disturbance greatly affects the response of native plants to different management techniques, and impoundments should be disked or burned at 2- to 3-year intervals to control invasion by undesirable plants (Table 2). Disking or burning should be done early to allow time for seed germination in the same spring.[3]

Areas managed for native plants or small-grain crops should be inspected weekly. Weeds, such as cocklebur and coffeeweed *(Sesbania),* can quickly develop a closed canopy and outcompete desirable plants. Several small (1/4 to 1/2 acre) patches of coffeeweed comprising less than 10 percent of the total area to be flooded are often desirable in managed habitats because they provide cover for waterfowl. If cocklebur and coffeeweed invade 50 percent of a management area, they should be controlled with herbicides or by clipping. Chemical control is especially desirable if lower growing, seed-producing native plants are already abundant on the area. Controlling undesirable plants by disking, clipping, herbicides, burning, or flooding requires only about one-third as much fuel as does conventional row cropping for domestic small grains.

[3]There are legal issues involving baiting if moist soil areas are hunted after they have been manipulated. Contact your local U.S. Fish & Wildlife Service law enforcement officer for the latest regulations.

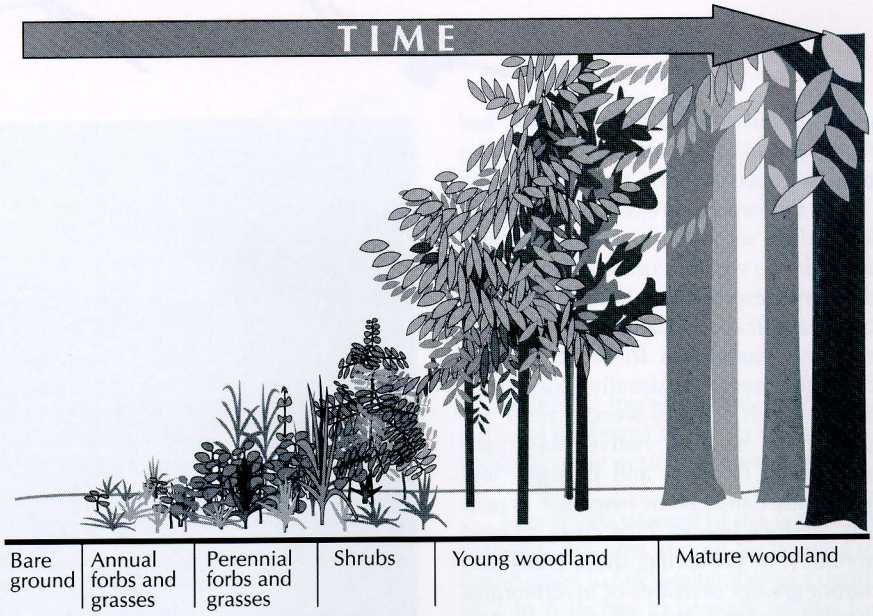


Figure 8. Typical plant successional stages in the Mississippi River Valley.

Table 2. Activity schedule for managing grassy-weedy areas for waterfowl.

Activity	Timing	Management recommendations
Early season drawdown	45 days after last killing frost	Slow drainage (decrease water levels in 6-inch increments over 2 to 4 weeks until area is drained); permits wildlife to use food resources and young wood ducks to fledge.
Midseason drawdown	46 to 90 days after last killing frost	Slow drainage.
Late-season drawdown	More than 91 days after last killing frost	Slow drainage.
Vegetation monitoring	About 14 days after drawdown	Monitor the occurrence of cocklebur, coffeeweed, and woody plants every 14 days, and implement control when these species cover more than 50 percent of the ground.
Weed control	After monitoring and as needed	After cocklebur, coffeeweed, and other broadleaves have emerged, control with one or more of the following: • 1 pt to 1 qt/a of 2,4-D • 1 pt to 1 qt/a of 2,4-DB • 1.5 to 2 pt/a of Basagran and 2 oz/a of 2,4-DB • 1.5 pt/a of Weedmaster • 0.5 to 0.75 oz/a of Classic
Fertilization	When desirable grassy-weedy plants are 2 to 6 inches high	75 to 100 pounds of urea/a; or for maximum seed production, conduct a soil test and follow recommendations.
Flooding	August 15 to September 30	Shallowly flood (2 to 6 inches) 10 percent of the total managed area to provide habitat for early migrants, such as blue-winged teal.
	September 30 to November 15	Increase water levels slowly until entire area is flooded by November 15.

Small-Grain Plantings

Set-aside areas[4] can also be planted with small grains such as Japanese millet, Chiwapa millet, browntop millet, corn, and rice (Table 3). These plants typically produce high yields of seed and are eaten by most waterfowl species. Soybeans are not recommended for use in waterfowl areas because they deteriorate quickly when flooded and are nutritionally incomplete. Landowners considering planting small grains in waterfowl management areas should consult local Extension agents to determine the best planting date for your specific location.

Browntop, Chiwapa, and Japanese millets should be broadcast on a well-prepared seedbed and harrowed to assure good germination. Because millets are in the grass family, they are hardy plants and normally require minimal care. Japanese and Chiwapa millets are adapted to the heavy wet soils commonly found at lower elevations in the Delta. Although they cannot establish themselves on a flooded seedbed, they will tolerate shallow flooding after becoming established. Japanese millet can be direct-seeded on mud flats. Its short (60 days) germination period makes it a good choice for use in early harvested crop fields that are to be flooded for the season's first migrating waterfowl. Browntop millet is better adapted to drier upland soils or bottomland soils where the water table is less than 4 inches below the surface from June to September. Heavy infestations of armyworms during the early stages of plant development in small-grain fields should be controlled with insecticides.

Rice is an excellent crop to plant in waterfowl management areas because:

- It is adapted to clay soils;
- It tolerates flooding;
- It produces several thousand pounds of seed per acre; and
- Its seeds persist well when flooded during the winter.

Rice seed planted for waterfowl does not have to be certified or treated with a fungicide. To prevent straight heading and to insure maximum seed production, rice should only be planted in areas where irrigation is possible. When rice plants are 6 inches tall, they should be shallowly (2 to 4 inches) flooded, but not submersed, to suppress weed growth and promote tillering. Rice should be kept flooded, through the growing season and until March 1 of the following year.

Corn is also an excellent crop for waterfowl because it is high in energy. Although it does best on well-drained loam or light-clay soils, corn can be grown on moderately drained soils. Early drawdowns (during the first 45 days of the growing season) are necessary when planting corn because of its long maturation period, and stands planted later in the growing season may develop severe insect problems. Corn should be drilled in 36-inch rows on a well-prepared seedbed, or broadcast and covered with 1 inch of topsoil.

[4]There are legal issues to consider when planting small grains on set-aside lands. Contact your local FSA office to stay abreast of the latest USDA regulations.

Table 3. Activity schedule for producing and managing small grains for waterfowl.

Activity	Timing	Management recommendations
Spring drainage	About 2 weeks before planting dates recommended by Extension agents for crop grown	Hold water on cropland until near planting time to control weeds and to encourage use of food by waterfowl and other wildlife.
Ground preparation	14 days or more after drawdown	Disk as needed to prepare a seedbed for millets and rice. For corn, disk or use "burn down" herbicides and plant using no- or reduced-till.
Planting	After seedbed preparation; consult your local Extension agent for best planting dates in your area	Recommended seeding rates are: • rice–90 lb/a • Japanese and browntop millet –20 lb/a • Chiwapa millet –15 lb/a • corn –12,000 to 26,000 kernels/a
Fertilization	Consult local Extension agent for dates to apply	For best results, conduct a soil test and follow recommendations. Typical applications are: • rice–up to 400 lb/a of 18-18-12 • millets–up to 100 lb/a of nitrogen or 400 lb/a of 13-13-13 • corn–up to 200 lb/a of nitrogen.
Weed control	Early part of growing season	Selectively treat areas with herbicides, bushhog, or disk when infestation levels of cocklebur, coffeeweed, or other undesirable broadleaved plants cover more than 25 percent of the ground.
Flooding	August 15 to September 30	Shallowly flood (2 to 6 inches) 10 percent of the total managed area to provide habitat for early migrants such as blue-winged teal.
	September 30 to November 15	Increase water levels slowly until entire area is flooded by November 15.

Forested Lands

Habitat Development

Forested wetlands fulfill special waterfowl habitat requirements not provided by open lands. Wooded habitats produce nutritious foods for waterfowl and provide them with secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation following pair formation.

Two broad categories of forested wetlands are usually managed as waterfowl habitat in the Delta:

1) Greentree reservoirs, tracts of hardwood forest that can be artificially flooded during winter months, and

2) Baldcypress-tupelo brakes, willow brakes and shrub-scrub sloughs, and beaver ponds that normally remain flooded throughout most of the year.

Both types of wetlands are important to waterfowl because they provide habitat diversity in a wintering area primarily composed of open, agricultural lands.

Levee Construction

Developing managed habitat for waterfowl in wet, forested areas requires several construction phases. **Please note, however, it is necessary to acquire a 404 permit from the US. Army Corps of Engineers (contact your local NRCS office) before constructing waterfowl habitat projects in wooded areas.** Construction of levees in permanently wet habitat often requires the use of a tracked excavator or dragline working from wooden support mats. Wide (100 to 120 feet) rights-of-way are required for this type of project to allow equipment to operate. In the first phase, a right-of-way is cleared and the slash removed from the borrow area. Right-of-way slash should be piled outside the impoundment (well away from the proposed levee) and burned, or backfilled into the borrow area and covered.

In the second phase, fill material is dredged from the borrow area within the cleared right-of-way and stacked to form an unfinished levee. Borrow areas should be located outside the area to be impounded and at least 10 feet away from the base of the levee to prevent caving.

In the third phase, the unconsolidated dredged material is allowed to dry as long as one year, and, when it will support the weight of a bulldozer, is shaped into a finished levee. Levee shrinkage averages 20 percent in this type of construction because of the extremely wet nature of the fill material. Shrinkage may be as high as 40 percent when spoil has a high organic content. For information on levee design, refer to **Levee Construction** in the **Open Lands** section.

Water Control Structures

Because water control structures in forested wetlands are subject to damage from beaver control operations and the cost of replacing them is high, they should be fabricated from steel pipe. A full-round flashboard riser (Figure 9) equipped with an intake trash rack is recommended to prevent beavers from building a dam inside the water control structure. The riser should also have a steel lid, because beavers are less likely to dam water control structures if they cannot hear running water. In any area where beavers are present, risers should be inset into the levee where they can be reached with a backhoe or other equipment to remove beaver dams.

Habitat Management

Forest Management

Waterfowl management plans for greentree reservoirs should increase the number and quality of red oaks (pin, water, willow, Nuttall, cherrybark, and Shumard) in the stand and encourage

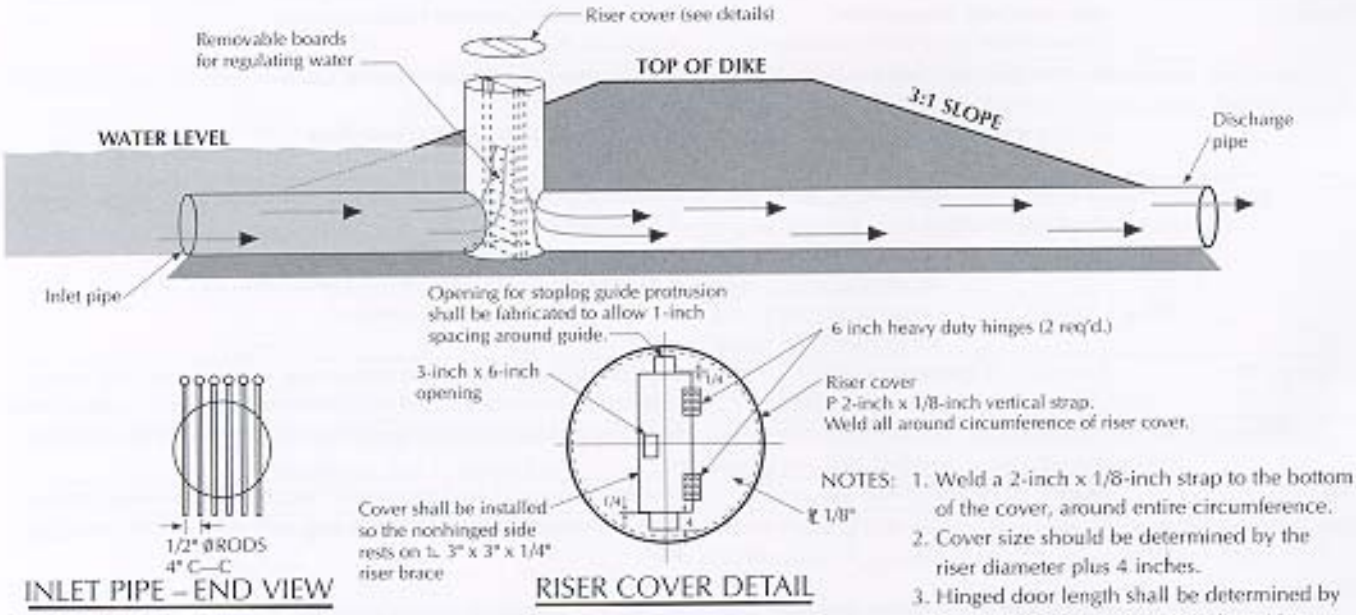


Figure 9. Full-round flashboard riser used to control water levels in forested wetlands.

crown development that increases acorn (mast) production. Selectively cutting or employing herbicides to remove some nonmast-producing-tree species can be used to simultaneously alter stand composition and release the crown of mast-producing species, thereby increasing acorn production. Group cuts (small clearcuts of 3 acres or less) promote red oak regeneration, and the open water attracts mallards. Because of the potential value of the timber involved, it is always advisable to secure the services of a professional forester when manipulating hardwood forest tracts.

Average acorn production (127 pounds per acre) in oak stands is less than the seeds lost in most harvested croplands or produced in seasonally flooded wetlands. Oaks with a diameter at breast height of 14 to 30 inches produce large amounts of acorns. A basal area of 40 to 80 square feet of desirable species per acre should be maintained. In addition, landowners should maintain a good age-class (seedlings, young woodland, and mature woodland) distribution of a variety of oaks to ensure continued mast production. Large trees with cavities also should be retained at a rate of one cavity per acre for cavity-nesting wildlife. The role of greentree reservoirs as food-producing habitat for waterfowl in the Delta is difficult to assess, because mast production in bottomland forests is highly variable, and waterfowl consume many other animal and plant foods also found in forested wetlands.

Water Management

Prolonged annual flooding of bottomland hardwood forests during winter months may cause changes in the forest type. In stands that are flooded every year, regeneration by desirable mast-producing oaks is generally reduced, and mature trees may be replaced by more water-tolerant species, such as willow, bald cypress, American elm, ashes, red maple, waterlocust, and overcup oak. Although permanent timber damage may occur within 1 to 2 years if forests remain flooded after trees leaf out in the spring, it may not be visible to the landowner for 4 to 5 years. **Hardwood forests should not be flooded until their leaves change color in the fall; also, they should be drained as soon as tree buds begin to swell in the spring.** To avoid timber damage and to enhance regeneration of desirable tree species, forested impoundments should be gradually flooded 6 to 18 inches deep no more frequently than every other year.

Wooded brakes and shrub-scrub sloughs that are permanently flooded produce less food for waterfowl than greentree reservoirs. When these flooded habitats are drained in the summer (mid-June to early July), they produce good crops of waterfowl food plants such as sedges and smart weeds. In flooded areas where extensive stands of scrub brush or tall, emergent aquatic plants exist, waterfowl use can be increased by using chemicals to create small openings (1 acre or larger).

Beavers provide waterfowl habitat in areas where landowners are willing to control them and tolerate damage resulting from their activities. Beaver ponds provide excellent nest sites (because of the high number of dead trees with cavities), brood habitat, and roosting cover for wood ducks. Permanently flooded areas, like beaver ponds, frequently do not provide abundant food for waterfowl. If landowners are willing to control water levels by breaking dams and installing drains, beaver ponds can be improved for waterfowl. In June and July, beaver dams should be broken where the water is deepest, and a three-log drain (Figure 10) or Clemson beaver pond leveler (Figure 11) installed to control water levels. Beaver ponds can then be drained, and mud flats can be planted (using a hand-seeder or aircraft) with Japanese millet at a rate of 20 pounds per acre. Although Japanese millet will not establish itself in standing water, good stands often result when soil is moist during the growing season.

Beaver ponds can also be managed (refer to **Grassy-Weedy Areas** in the **Open Lands** section) to produce excellent stands of grassy-weedy plants. Beaver dams and drains should be checked frequently during the growing season to ensure vegetation has not been reflooded. Drains should be removed and beavers allowed to rebuild the dam in October so vegetation will flood.

Aquatic Animal Control

To reduce annual levee maintenance costs, control muskrat and nutria throughout the year by selective shooting and trapping. Muskrats cause more damage than nutria because they tend to construct extensive tunnels and dens in levees. A depredation permit must be obtained and/or the state wildlife conservation agency notified before implementing control procedures.

Beaver can be trapped with Conibear No. 330-2 body grip traps, Victor No. 3 leghold traps, or self-locking wire snares. The Cooperative Extension Service, state wildlife agency, Natural Resources Conservation Service, and USDA Animal Damage Control personnel can provide additional information on controlling furbearers.

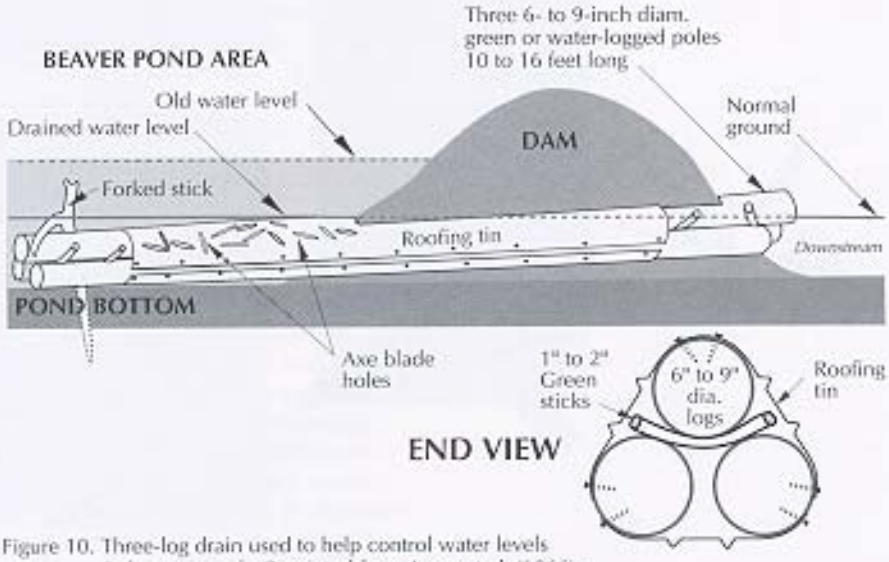
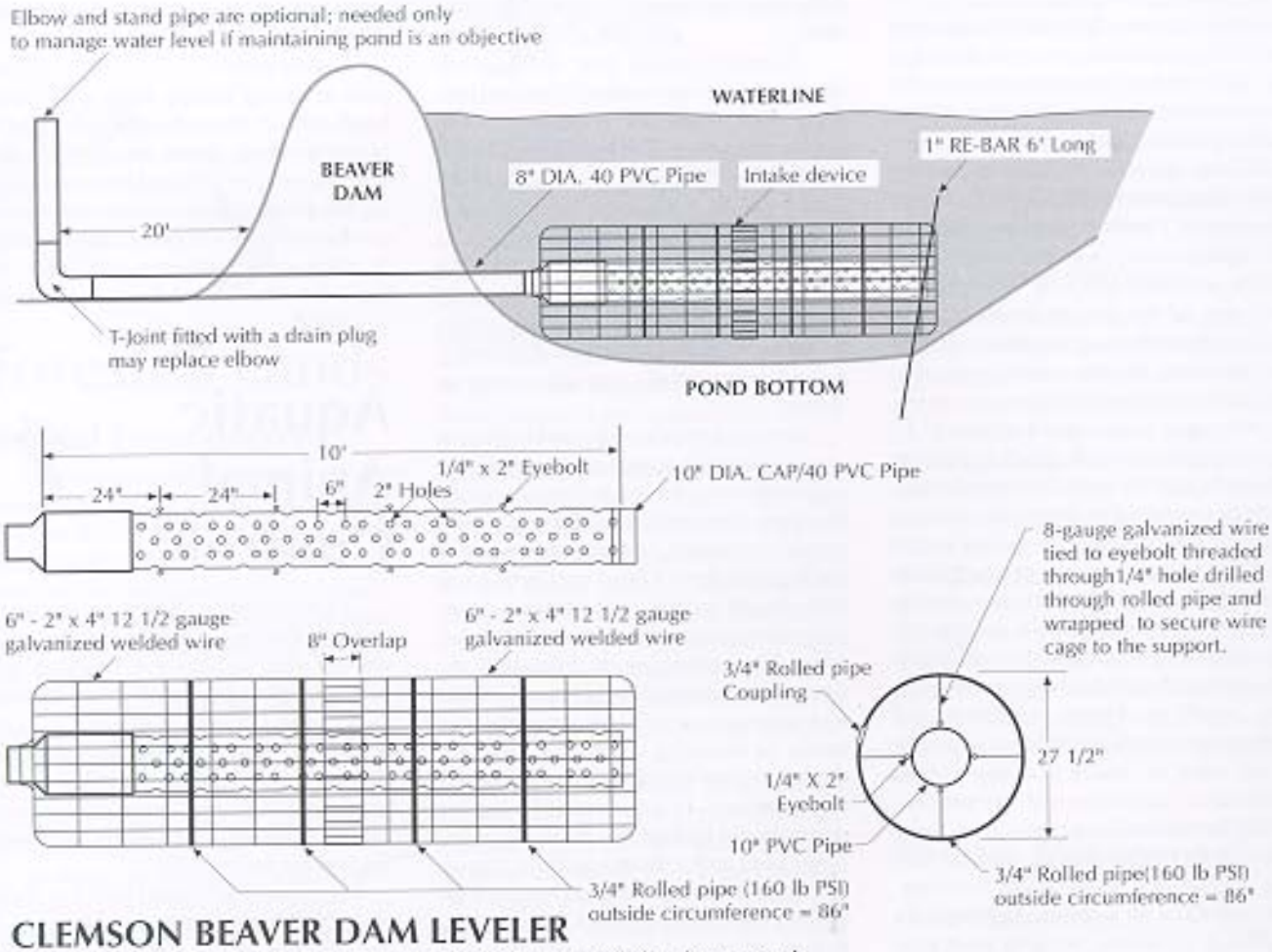


Figure 10. Three-log drain used to help control water levels in beaver ponds. Reprinted from Arner et al. (1966).



CLEMSON BEAVER DAM LEVELER

Figure 11. Clemson beaver pond leveler used for controlling water levels in beaver ponds.

References

Arner, D.H., J. Baker, and D.E. Wesley. 1966. The management of beaver and beaver ponds in the southeastern United States. Water Resources Research Institute, Mississippi State University. 18 pp.

Cross, D.H. 1988. Waterfowl management handbook. U.S. Department of the Interior, Fish and Wildlife Service. Fish and Wildlife Leaflet 13. Washington, DC.

Fredrickson, L.H., and D.L. Batema. 1992. Greentree reservoir management handbook. University of Missouri, Gaylord Memorial Laboratory, Puxico, MO. 88 pp.

Fredrickson, L.H., and T.S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Service Resource Publication 148. 29 pp.

Mitchell, W.H., and C.J. Newling. 1986. Greentree reservoirs. U.S. Army Corps of Engineers Wildlife Resources Management Manual, Technical Report EL-86-9, Section 5.5.3, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. 22 pp.

Neely, W.W. 1956. How long do duck foods last under water? Transactions of the North American Wildlife Conference. 21:191-198.

Powers, K.D., R.E. Noble, and R.H. Chabreck. 1978. Seed distribution by waterfowl in southwestern Louisiana. J. Wildl. Manage. 42(3):598-605.

Reinecke, K.J., R.M. Kaminski, D.J. Moorhead, J.D. Hodges, and J.R. Nassar. Mississippi Alluvial Valley. Pages 203-243, In L.M. Smith, R.L. Pederson, and R. M. Kaminski, eds. 1989. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock. 560 pp.

Smith, L.M., R.L. Pederson, and R.M. Kaminski. 1989. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock. 560 pp.

Appendix

Important Native Waterfowl Food Plants


Red Rice


Wild Millet


Fall Panicum


Bearded Spangletop


Paspalum


Savannah Panicum


Broadleaf Signalgrass


Teal Lovegrass


Smartweed


Spikerush


Cutgrass


Sedge