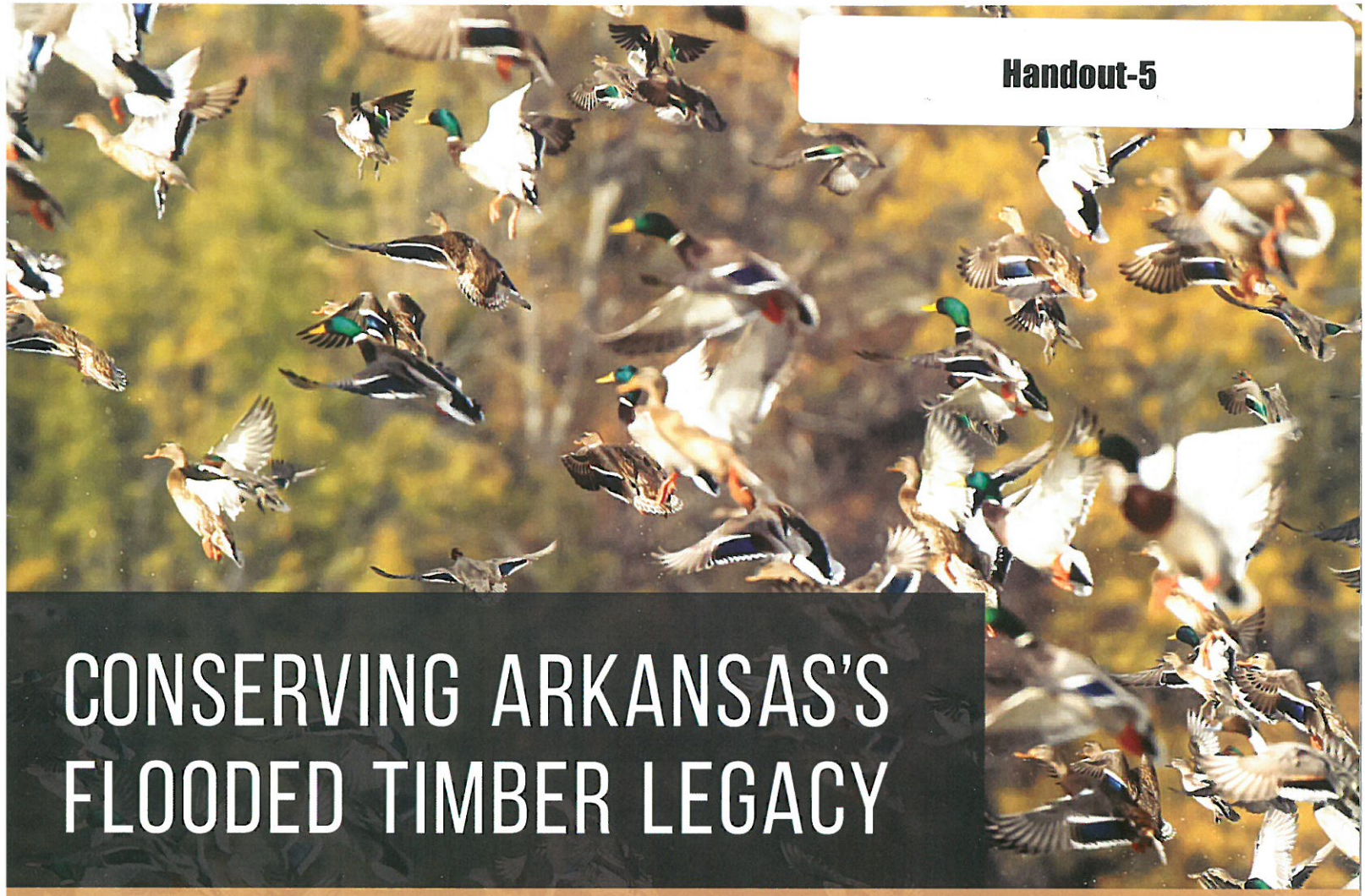
Handout-5



CONSERVING ARKANSAS'S FLOODED TIMBER LEGACY

The sight of mallards falling through the trees in Arkansas's flooded timber is a magical experience for duck hunters. At the turn of the 20th century, the Arkansas Delta and other river floodplains in the state boasted more than 5 million acres of bottomland hardwood forests. These forests regularly flooded with shallow water during winter and attracted leagues of migrating and wintering ducks, especially mallards and wood ducks. Abundant acorns, seeds and wetland insects offered a banquet for the ducks.

Changes in land and water use eventually destroyed or degraded more than 60 percent of this amazing bottomland ecosystem in Arkansas, but in a lucky coincidence, rice farmers accidentally created surrogates for these forests by creating irrigation reservoirs in uncleared stands of trees. These greentree reservoirs (GTRs), became common sights in the state, and by the 1950s their construction shifted from a water storage purpose to that of providing habitat and duck hunting opportunity. GTRs became a staple of duck hunting habitat on private duck clubs, as well as wildlife management areas owned by the Arkansas Game and Fish Commission.

But time has not always been kind to Arkansas GTRs. Flooding that favors duck season dates over the natural timing and frequency of flooding in bottomland hardwoods has slowly changed forest composition and health. In some cases, these changes have caused the loss of this valuable habitat and hunting opportunity. Scientific information gained during the last few decades encourages a more natural and sustainable management philosophy for GTRs. The AGFC is preparing a bright future for GTRs using this new information, but it will mean changes to flooding patterns to which hunters have become accustomed.

Photo by Mike Wintroath

THE RISE OF GREENTREE RESERVOIRS

Ducks and rice fields go hand-in-hand, but Arkansas was rich with waterfowl long before the landscape changed to agriculture. The Big Woods of Arkansas were vast bottomland hardwoods that periodically flooded, providing shelter and food to migrating waterfowl during winter. Flooded areas within these forested wetlands typically varied each year, which prevented excessive flood damage to the trees. The Grand Prairie added even more food and cover for ducks in flooded grasses, rich with invertebrates and seed-producing plants.

Rice farming, however, inadvertently created the first GTRs in Arkansas.

According to the "Arkansas Duck Hunter's Almanac," written by Steve Bowman and Steve Wright, Vern Tindall built a 450-acre reservoir in 1926 on his farm a few miles outside Stuttgart. The reservoir, built on forested acreage that was otherwise worthless to him, was intended to store irrigation water and offset annual costs of pumping groundwater. When he flooded the shallow timber-laden area, he soon discovered that it was a magnet for waterfowl. Soon, other landowners interested in saving money on rice production and attracting waterfowl began building reservoirs on their forested property. However, in less than a decade, most realized that constant water on these bottomland hardwoods would kill the trees, leaving open water that was less valuable to waterfowl.

Most landowners interested in duck hunting turned to GTRs. The impoundments were left dry during most of the growing season and were consistently flooded during late fall and winter, when trees were presumed dormant. This practice was thought to offer the same flooded timber benefits while preserving the trees that offered the food and shelter to ducks. A boom in GTR construction dominated the 1930s and 1940s, adding a chapter to Arkansas's legacy as the duck-hunting capital of the world.

Greentree reservoirs sprang up on public lands, as well as on private farms. Continued expansion of farmland prompted conservation-minded commissioners and employees of the AGFC to secure large blocks of bottomland hardwoods that could be converted to GTRs to offer public hunting opportunity and waterfowl habitat. During the 1960s and 1970s, the AGFC laid the foundation for its "public land treasury" by creating Bayou Meto, Big Lake, Black River, Shirey Bay Rainey Brake and Hurricane Lake WMAs. All of these areas contained extensive acreage in GTRs built to benefit ducks and duck hunters.

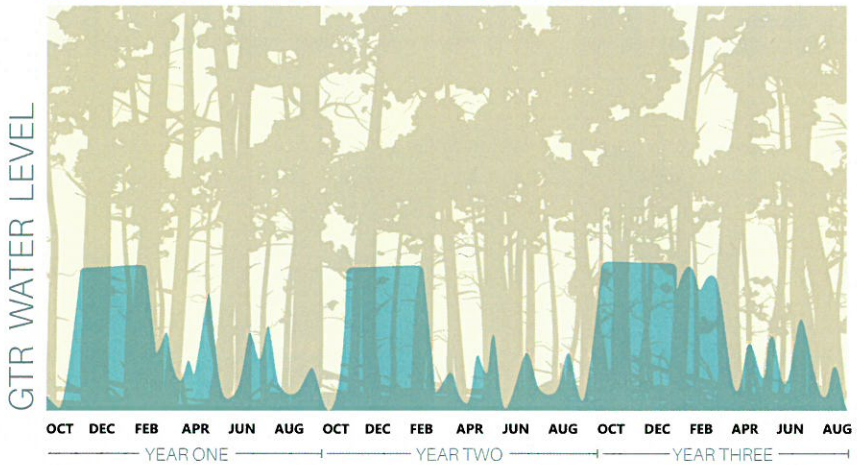
Photos by Mike Wintroath

CHANGING LANDSCAPE

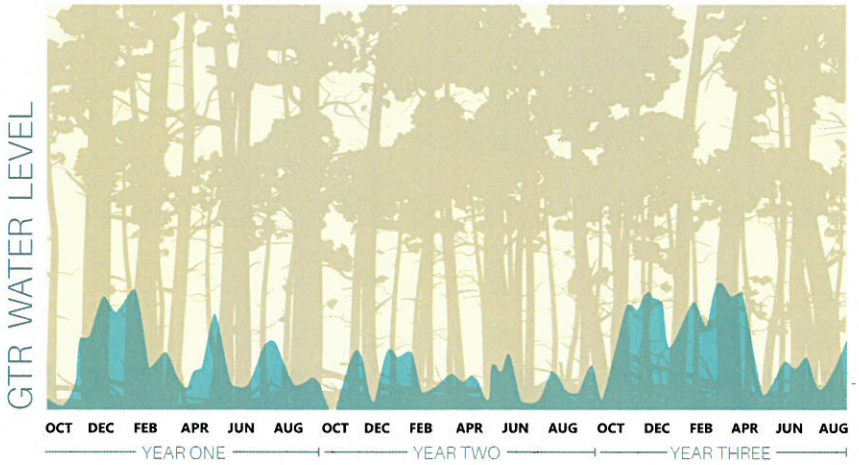
The primary objective of GTR management has been to replace the natural flooding cycle of bottomland hardwood forests into one that floods more reliably, providing consistent habitat for migrating waterfowl and waterfowl hunting opportunities in the short term.

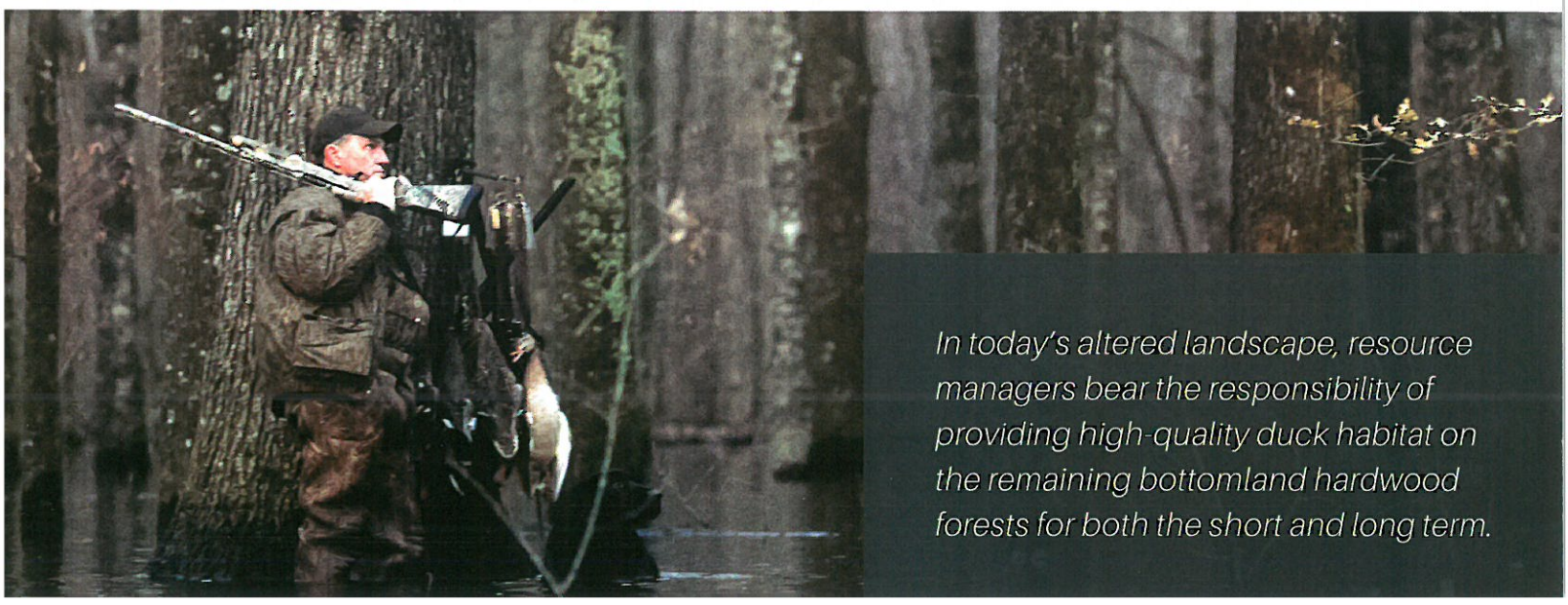
In today's altered landscape, resource managers bear the responsibility of providing high-quality duck habitat on the remaining bottomland hardwood forests for both the short and long term. Arkansas's WMAs represent the core of remaining managed bottomland hardwood habitat in the state. Fortunately, government habitat protection and restoration programs (notably the Wetlands Reserve Program and Conservation Reserve Program) have restored more than 250,000 acres of bottomland hardwood forests in the last 30 years, and the U.S. Fish and Wildlife Service has protected many acres of remnant and restored bottomland hardwoods through national wildlife refuges. Even so, the AGFC shoulders the greatest portion of future management responsibility as the agency with ownership of the majority of managed bottomland hardwood habitat in Arkansas. Improving and maintaining the quality of waterfowl habitat on AGFC land, including GTRs, must play a pivotal role in maintaining wintering duck populations and waterfowl hunting opportunity for the long term.

CURRENT GTR WATER LEVELS



NATURAL GTR WATER LEVELS





In today's altered landscape, resource managers bear the responsibility of providing high-quality duck habitat on the remaining bottomland hardwood forests for both the short and long term.

WHICH FOODS DO DUCKS SEEK IN FLOODED FORESTS?

Historically, ducks arriving early in fall saw relatively dry conditions in Arkansas. They fed on seeds and invertebrates in flooded moist-soil habitat found on temporarily flooded portions of the Grand Prairie, on flooded plants found in forest openings in the lowest parts of river systems, and on invertebrates in other deep-water systems such as sloughs, oxbows and natural lakes. Today, flooded moist-soil habitat and agricultural fields still provide energy- and protein-rich foods for ducks during this time. Natural weather patterns call for relatively dry conditions in September and October, with rainfall increasing later. Widespread flooding normally did not occur in the Arkansas Delta until December and January. This matches the long-term pattern of the arrival of migrating mallards, the chief species relying

NOT ALL OAKS EQUAL

Arkansas is home to 29 native species of oaks as well as non-native species that were introduced. They may all be "oaks," but the variety of habitats in which they thrive and the types of acorns they produce is extremely diverse. Oak species in Arkansas's bottomland hardwood forests typically include red oaks, such as Nuttall, willow (commonly misidentified as "pin oak," cherrybark and water oaks. Overcup oaks are the predominant member of the white oak family in bottomland hardwoods, and are much more tolerant of flooding than red oak species.

Overcup oak acorns develop within a large, woody cap that may cover as much as three-quarters of the acorn. Deer, squirrels and other wildlife with teeth can crack through the large cap to get to the acorn's meat, but birds must swallow acorns whole. The overcup acorn, with its cap, often is too large and difficult for ducks to swallow. Smaller acorns with small caps are preferred by ducks, and the most preferred by mallards tend to be Nuttall and willow oak acorns.

Additionally, many acorns may look fine on the outside, but are underdeveloped, rotten or infested with worms on the inside. A healthy, viable acorn sinks to the bottom, while flawed acorns typically float at the water's surface. An area full of large acorns floating in the water may have relatively little benefit to ducks if there are no usable acorns on the bottom of the water within their reach.

on bottomland hardwood systems in Arkansas. It also coincides with peak acorn drop in red oak species preferred in bottomland hardwood systems.

It is no accident that peaks of mallard migration (mid-December and mid-January) typically occur during the same time as historic peaks in flooding and acorn drop. Mallards are "hard-wired" to recognize and respond to increasing food and habitat throughout the Arkansas Delta and other key regions of the state. Properly flooded hardwoods help mallards meet their late-fall and winter food needs. The acorns available in newly flooded hardwood forests provide large amounts of energy needed for the stress of winter and flight north. The shelter of these areas provides important isolation habitat to strengthen pair bonds. Flooded hardwoods also contain protein-rich invertebrates to meet the needs of female mallards in particular, which use the nutrients for feather molt and egg-laying.

Photos by Mike Wintroath

Properly flooded hardwoods help mallards meet their late-fall and winter food needs. The acorns available in newly flooded hardwood forests provide large amounts of energy needed for the stress of winter and flight north.

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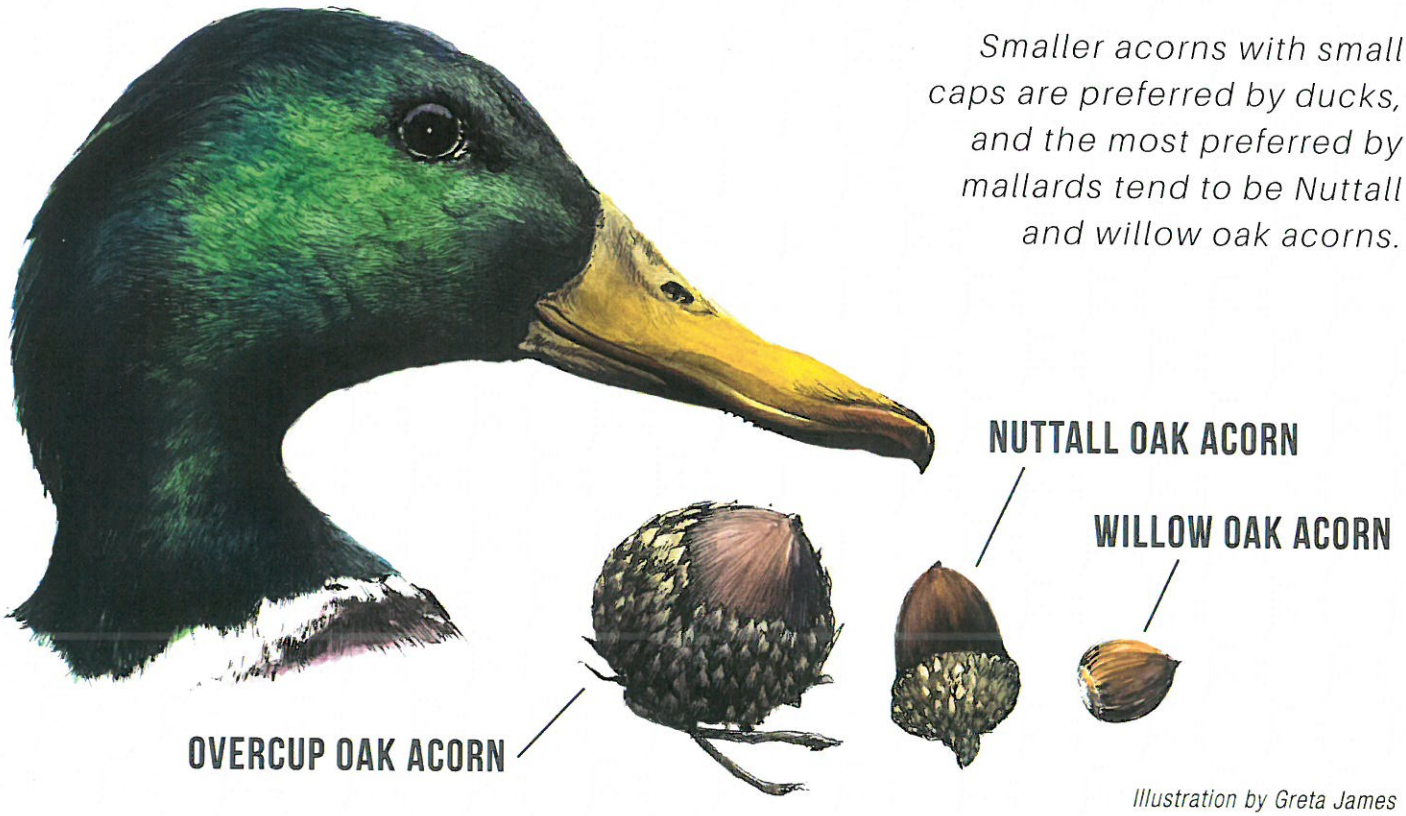


Illustration by Greta James

WATER DEPTH

The depth at which bottomland hardwoods are flooded is critical to their health, as well as their attractiveness to ducks. Dabbling ducks, and mallards in particular, require shallow water to feed. Mallards can rarely feed in water deeper than 12 inches, with an optimal depth of 2 to 8 inches. Quite simply, if a dabbling duck cannot tip its head down and reach the bottom of the water, it cannot reach the acorns, seeds and invertebrates lying on the forest floor.

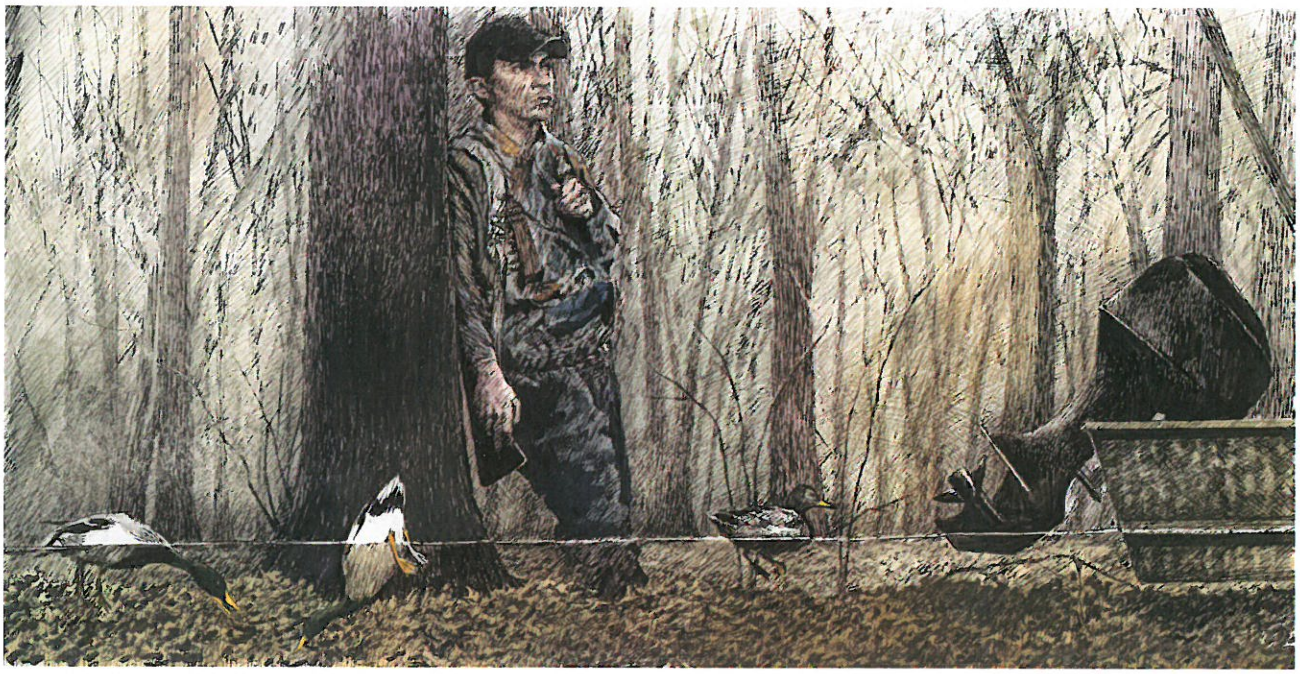
Water depth not only affects the ability of ducks to reach the food, but it also changes the amount of some food sources important to ducks. Studies of invertebrates in bottomland hardwoods have shown that during winter, invertebrate abundance was greatest in water depths ranging from 4 to 8 inches. The amount of invertebrates declined as water depth increased. Water in deeply flooded hardwoods can become stagnant, which does not support

SLOW DEATH

In theory, GTR management is not detrimental to bottomland hardwood forests. Trees are flooded only after they enter dormancy and floodwaters are removed before spring growth begins. However, duck hunting popularity has increased pressure to provide public duck hunting areas, threatening the objectives of providing sustainable duck habitat.

Prolonged flood conditions and the consistency at which many GTRs have been flooded have caused inadvertent damage to the trees. Those specifically at risk are the red oak species providing the most benefit to ducks, such as Nuttall and willow oak.

Photo by Mike Wintroath



the diverse range of invertebrates available in dynamic systems that temporarily flood and recede.

Before large-scale land conversion of forests to row crops in the Delta during the last half of the 20th century, ducks could easily secure needed resources as they became available. With over 8 million acres of wetlands historically present in the state, shallowly flooded habitat was available somewhere throughout the wintering period in all but the driest of years. By 1985, only 11 percent (875,000 acres) of these forested wetlands remained, and shallowly flooded forests are much less prominent. This increases the importance of managing the AGFC's GTRs more effectively for duck habitat.

Illustrations by Greta James

Even before the current boom of duck populations and duck hunters, many managers wanted GTRs completely flooded by the beginning of duck season each year. In one 1989 study, land managers purposely tried to flood 95 percent of their reservoirs every year. The average date by which managers wanted Arkansas GTRs to flood was Nov. 1. Additionally, pools of water would remain on 79 percent of these GTRs when the trees began to enter the spring growth stage.

Prolonged flood conditions and the consistency at which many GTRs have been flooded have caused inadvertent damage to the trees. Those specifically at risk are the red oak species providing the most benefit to ducks, such as Nuttall and willow oak. These trees become stressed when their roots and trunks are repeatedly covered with water during the growing season.

The symptoms of flood damage begin with tip die-back in the tree's crown. Dead twigs and a lack of leaves will be apparent at the very edges of the tree's outermost branches during the growing season. As the damage increases, larger branches will fall victim to the die-back. As the stress is repeated, the tree continues to deteriorate until it finally dies. Unfortunately, many indicators of dieback are apparent only during spring and summer, when tree crowns are full. During fall and winter, when most duck hunters are in these habitats, leaves have fallen and bare limbs are expected.

The obvious damage from flood stress is above ground, but prolonged soil saturation during the growing season often damages root systems long before there is visible evidence above the surface. Anaerobic conditions can cause roots of less water-tolerant species to die-back, similar to the crown. Saturated soil, coupled with decreased root mass, also makes trees susceptible to windthrow, or blowdown, particularly in shallow-rooted species such as willow oak (one of the most desirable trees for producing waterfowl forage). Gaps in the canopy from crown dieback, tree mortality and windthrow also increase the chance of surviving trees falling victim to uprooting by windthrow.

WILLOW OAK IN SUMMER

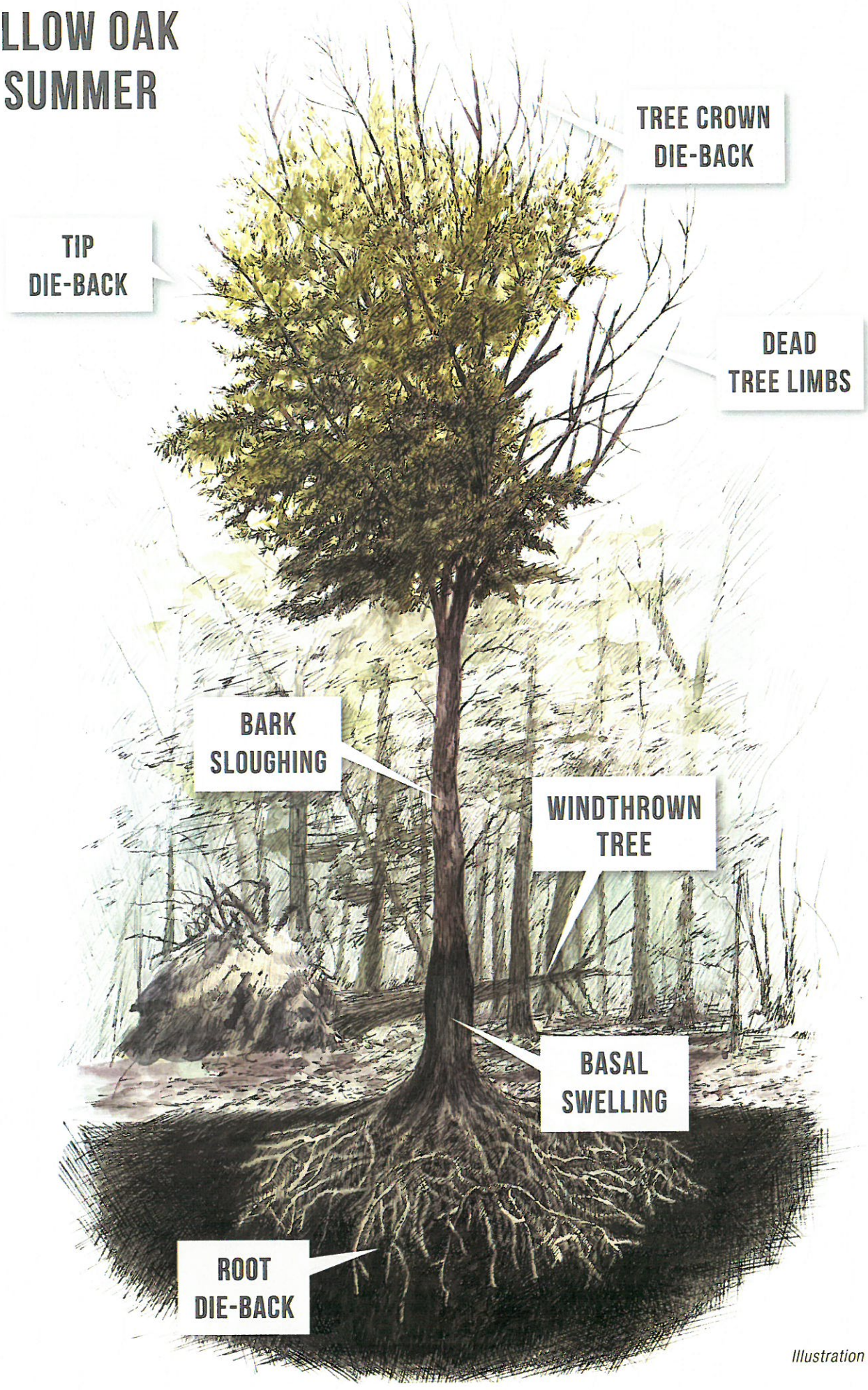


Illustration by Greta James

GRADUAL CHANGE

The bottomland hardwood forests on most AGFC GTRs originally existed under much drier conditions. Decades of stress and tree mortality have gradually shifted the forest composition to favor more water-tolerant species, such as overcup oak, water hickory, water elm and buttonbush. These species are less beneficial to ducks than the red oaks they are replacing. Research indicates larger trees, the greatest mast producers, are more susceptible to flood-induced mortality, as well as windthrow. Once those trees have fallen or died, the next generation of beneficial red oaks cannot take their place. In addition to killing existing trees, flooding during the growing season often overtops beneficial oak seedlings, smothering the next generation of desirable red oaks and replacing them with the less-beneficial, water-tolerant species.

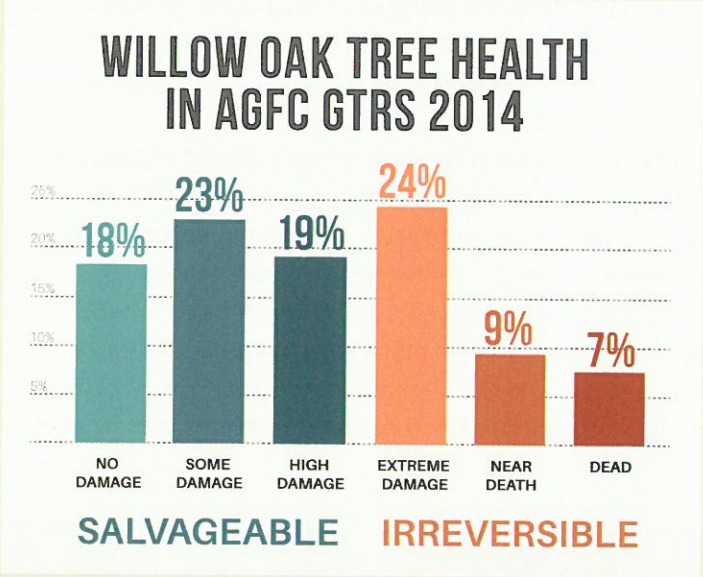
This gradual change can go relatively unnoticed, but many examples of damage from prolonged flooding have been documented in Arkansas in the last decade.

EXAMPLES OF THE PROBLEM

A study conducted at Felsenthal National Wildlife Refuge completed in 2010 revealed many impacts from two decades of GTR management. In 1990, roughly 75 percent of the primary tree species in the GTR were in good condition, but a gradual decline in tree vigor was noted from 1990 to 2001. By 2006, less than 5 percent of the trees remained in good condition. Half of the Nuttall oaks in the low-elevation plots and one-third of the Nuttalls in higher elevation plots died from constant flooding. Willow oaks suffered the worst of any species, with two-thirds in low-elevation areas being killed. Between 30 and 50 percent of trees originally rated in good or fair condition and all trees rated in poor condition are expected to die within 15 years.

Mickey Heitmeyer conducted a study in 2004 on private and public GTRs in the Bayou Meto Basin, comparing forest composition changes in GTRs and stands at the edges of the flooded areas or on natural levees in the basin. Regeneration of elm, hickory and red oak species was good along the edges and natural levees, while less-desirable overcup oak and green ash dominated regeneration within private and public GTRs.

AGFC staff periodically conduct forest health assessments on all AGFC GTRs, the most recent of which was completed in 2014. Trees were ranked ranging from no damage to dying and dead. Previous forest health assessments showed a strong declining trend in the health of all oaks, but particularly willow, Nuttall and other desirable red oak species. Forty percent of willow oaks within GTRs have already reached critical stages of damage that likely cannot be reversed. An additional 42 percent of willow oaks have notable damage.



NEED FOR CHANGE

AGFC-managed GTRs still provide a valuable resource to ducks and duck hunters, but how they are managed must change if we wish to continue enjoying good duck hunting on these areas and the AGFC is to provide long-term waterfowl habitat. Each GTR is unique in its location, topography, water-control capabilities, flow patterns and current forest composition. The AGFC will evaluate and develop detailed plans for each AGFC-managed GTR in coming years. All plans will follow a more natural flood plan than the current system of holding water at a constant, high level targeted for the opening of duck season. The AGFC is planning changes in infrastructure, including the redesign of water-control structures and levees to better manage intentional flooding and removal of water. Selectively cutting timber within the GTRs also will take place to reduce the amount of overcup oaks and enable red oaks to regenerate from the opened canopy.

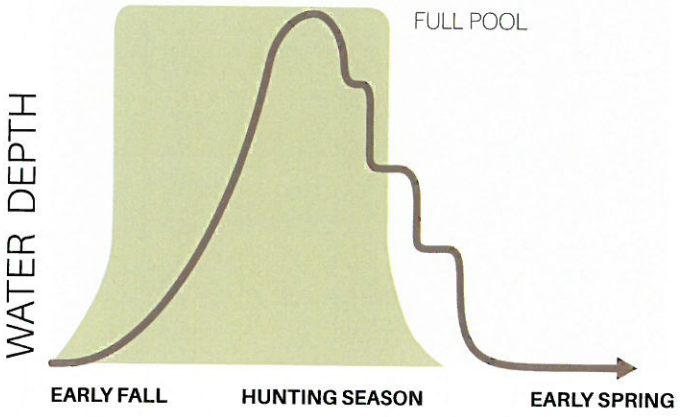
However, the most notable change must be in the timing, depth and frequency at which we intentionally flood GTRs. To this end, the AGFC will revise all water-management dates for existing GTRs and implement these revisions beginning with the 2017-18 waterfowl hunting season.

Good bottomland hardwood forest habitat in Arkansas historically formed around a five- to seven-year flooding cycle. Every seven or so years, the system experienced one year of very dry conditions, one year of very wet conditions, and other years being much more variable. A critical component in mimicking this pattern is the requirement to never intentionally flood an impoundment at the same depth or for the same duration in consecutive years. Additionally, delaying intentional flooding as long as possible in the fall will allow trees to become dormant and avoid excessive water stress. Finally, management plans focused on sustainable health calls for a "dry" year – a year when no flooding takes place – at least once within each five- to seven-year cycle. Inherent in any water-management plan is the reality that "full pool" in the majority of managed habitat must be only about 12 inches deep to maximize value to foraging waterfowl.

Flexibility is key in any water-management plan, and natural wet and dry cycles will dictate water management in GTRs. A naturally dry year may suffice for the designated dry period within the plan. Similarly, a naturally wet year may dictate a wet year in the management plan. Re-establishment of desirable red oak species in some areas also may influence intentional flood regimes. Infrastructure and water-management plans should allow for staged flooding of GTRs so that new, shallow-water habitat becomes available throughout the wintering period. Regardless of this flexibility, the two main goals of future water management remain: no intentional flooding earlier than mid-November, and each year's intentional flood conditions being different than the last. Greentree reservoirs on AGFC wildlife management areas represent especially critical habitat that must be managed to benefit the wildlife and hunters now and for the future. The benefit of GTRs and their ability to compensate for losses of critical habitat can be sustained only if steps are taken to protect tree species most valuable to wintering waterfowl.

Photo by Mike Wintroath

YEAR ONE



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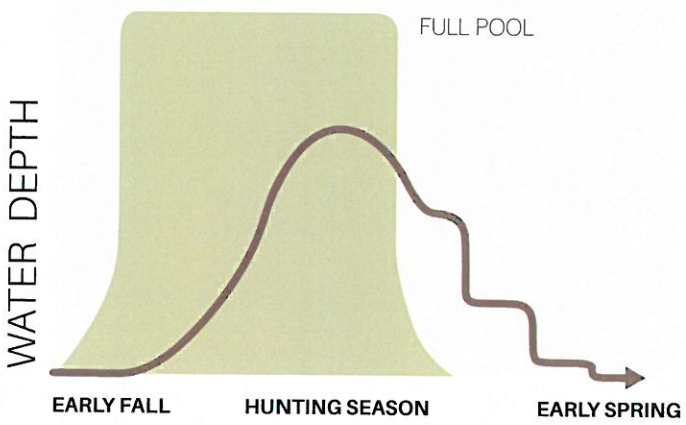
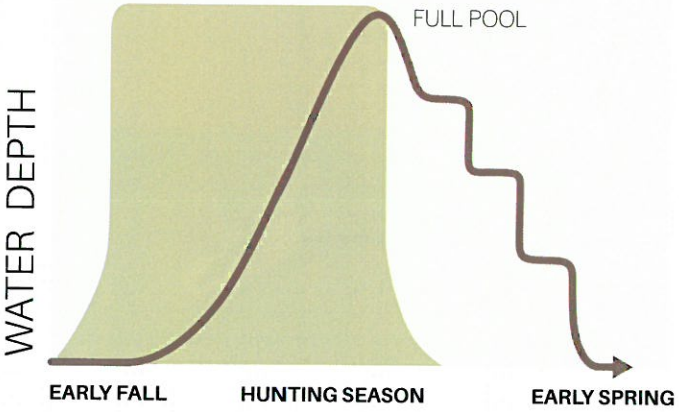


YEAR THREE

YEAR FOUR



CURRENT GTR FLOODING REGIME → **MULTI-YEAR WATER MANAGEMENT PLAN**

KEY CHANGES IN FUTURE GTR MANAGEMENT:

1. *Revisions to water-management plans, including variation in timing, level and duration of intentional flooding.*
2. *Development of detailed infrastructure changes to mimic more natural flooding patterns and flow.*
3. *Reduction of overcup oak trees and re-establishment of more beneficial red oak species.*

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This publication was produced by the Arkansas Game and Fish Commission in 2017. It is a condensed version of a larger scientific report prepared by the AGFC Wildlife Management Division. The full version is available at www.agfc.com.

Cover photo by Mike Wintroath

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