

then the efforts of the entire year are wasted.

Cropping should aim for a proper balance of solid seed and green forage in amounts to satisfy the number and species of waterfowl expected. Provision should be made for suitable resting areas on water, mudflats, or sandbars, preferably those that have no screens of timber to separate them from adjoining fields. Resting areas must offer reasonable security from disturbance.

FARMING FOR WATERFOWL is not without problems.

Crows, starlings, and blackbirds often make serious inroads on many plantings. They are attracted especially to grain sorghums and other small-seeded crops.

Deer, if they are numerous, can destroy sizable acreages of corn, soybeans, peas, and other legumes.

As with any other agricultural operation, insects, diseases, pest plants, and unfavorable weather are always hazards.

Once accustomed to using farm crops, waterfowl may engage in undue depredation, because they do not distinguish between crops on managed areas and crops on other lands. Birds, normally, are welcome by most landholders while hunting seasons are open; these same persons bemoan crop losses as soon as seasons close.

Occasionally some well-intentioned individual creates a private sanctuary by feeding a small flock of

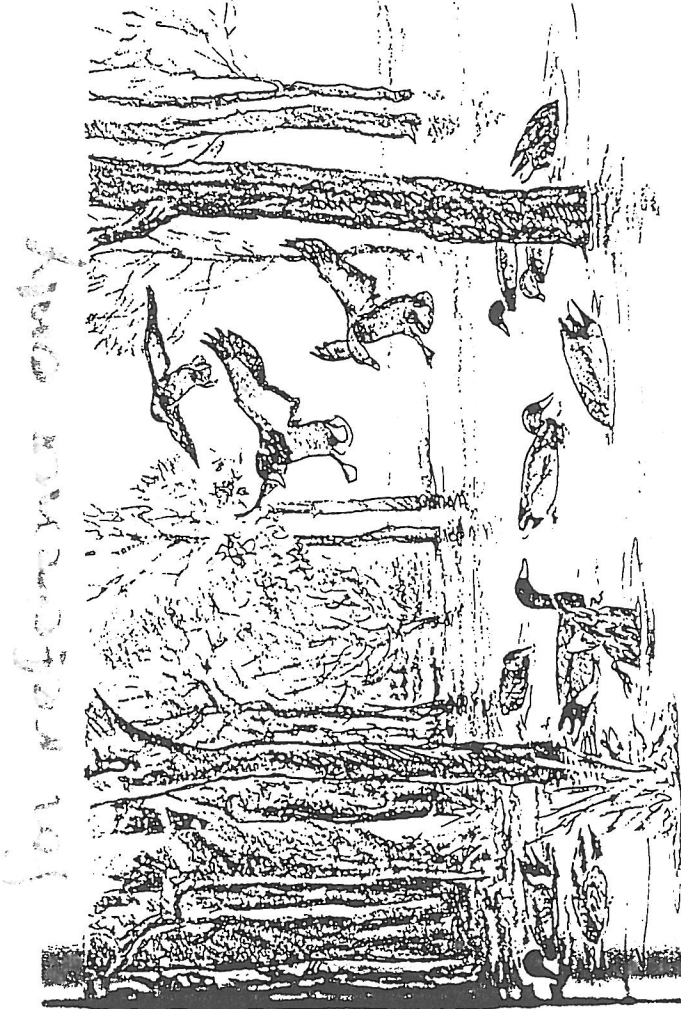
visiting geese, only to find, a few years later, that he is swamped by thousands of these birds that are beyond his means to support.

Farming for waterfowl is a method of proved effectiveness in reducing the number harvested by hunters; yet in other ways it can be equally effective in increasing the hunting take. It can concentrate large numbers of ducks and geese where that may be desirable or disperse them over wide areas to meet other objectives.

Farming for waterfowl can be done legally or illegally so it behooves the farm managers to know the difference.

The growing demands for land may well lead to shortages of suitable feeding areas for waterfowl. The growing numbers of people complicate the problem of providing a reasonable distribution of this cherished natural resource. Domestic crops, intensively managed, offer the prospect for producing great quantities of waterfowl food on a limited acreage. And in their eager acceptance of dryland crops, waterfowl lend themselves to management in many ways. The plow, disk, and drill are not likely to solve all the problems of waterfowl management, but this new technique, refined and better understood, is sure to find a place among intensive methods for managing waterfowl in the years ahead.—LAWRENCE S. GIVENS,

MARCUS C. NELSON and  
VERNON EKEDAHL.



MALLARDS

## Green Trees and Greenheads

**A**CORNS are a staff of life of many species of wildlife that live in woodlands. Deer relish them, and the knowing hunter seeks out stands of oak as the place to hunt when the acorns fall. Grouse gorge on them, as do raccoons and wild turkeys. Squirrels grow fat on the bounteous crops of mast.

And later, when fall and winter rains soak the ground and push creeks and rivers out of their banks, the extensive hardwood bottom lands of the South become overnight the feeding grounds of millions of mallards and wood ducks

and a magnet that draws hunters from the breadth of the continent. Some years the fall rains do not come or are too little or too late. Then the ducks, finding no water, go elsewhere to feed. And duck hunters, denied their sport, try to find a way to improve on Nature.

They found a way in the late thirties near Stuttgart in eastern Arkansas, a section already famous for mallards attracted by the Grand Prairie ricefields and seasonally flooded pin oak flats. Their idea was to flood the timberland artificially and so attract ducks on schedule. Such timberlands they

call "green tree reservoirs." Dead tree reservoirs preceded them; they were caused by irrigation reservoirs, which had been built to provide a water supply for rice production and had killed trees by submerging them during their growing season. Green tree reservoirs thus came into being for a double reason: They attracted ducks but they did not interfere with proper management of the timber resource.

Many of the 160-odd duck clubs, which control more than 53 thousand acres—primarily forested lowlands—in the Grand Prairie-Bayou Meto district near Stuttgart, depend on green tree reservoirs, because natural overflows generally occur late in the waterfowl season or do not flood the forestlands. It is a strategic location for green tree development, for it is in the mallard-rich Mississippi Flyway, and has extensive hardwood bottoms, an abundance of oaks, and good terrain. It is not uncommon around Stuttgart for timbered tracts of 100-200 acres to hold 25 thousand to 50 thousand mallards. Sometimes 250 thousand ducks may be temporarily concentrated on a few hundred acres. When both the developed areas and the overflow bottoms are watered-up by man and Nature, this type of habitat may winter the bulk of the mallards in the Mississippi Flyway.

GREEN TREE RESERVOIRS for a few years were unique to eastern Arkansas and helped to support Stuttgart's claim to be the mallard capital of the world. Word of their success began to spread. The Arkansas

Game and Fish Commission took an early lead in green tree development in conjunction with a vigorous land-acquisition program. Green tree reservoirs were in operation by the midfifties in a number of States in the lower Mississippi Valley.

The Missouri Conservation Commission developed a 600-acre green tree reservoir for public hunting on its Duck Creek Wildlife Area in southeastern Missouri in 1956.

Most States in the lower Mississippi Flyway had green tree reservoirs in operation by 1963. Several States in the Atlantic Flyway as far north as Maryland had small projects planned or in operation. Noxubee National Wildlife Refuge, near Starkville, in Mississippi, exemplifies what green tree development can do in an area previously considered of minor importance to ducks. Before its first green tree reservoir of some 400 acres was developed in 1955, the refuge had a peak duck population of 21 thousand. With initial operation of the reservoir during the 1955-1956 season, the number rose to 46 thousand. Since completion in 1958 of a second green tree reservoir of 340 acres, the peak duck population at Noxubee has twice exceeded 100 thousand.

A good gauge of green tree reservoirs as winter habitat is their total use by waterfowl. Before the developments at Noxubee, the maximum number of use-days recorded during any one season was 1.8 million. With 740 acres of green tree habitat in operation, the maximum number of use-days during a single season has been more than 6 million. This three-fold increase took

place during a period of declining mallard numbers in the flyway as a whole.

Green tree reservoirs need not be on such a large scale to be effective. Even small reservoirs containing desirable oak mast and properly flooded will attract both greenheads and woodies if they are anywhere in the neighborhood.

THE KINDS OF DUCKS that use green tree reservoirs are much the same in different parts of the country. The mallard is the major species on green tree reservoirs in the Mississippi Flyway. In Arkansas, mallards comprise about 90 percent of the ducks in flooded green timber, and wood ducks, most of the remaining 10 percent.

Mallards account for about 75 percent and wood ducks about 15 percent of the total use by ducks in the green tree reservoirs at the Noxubee Refuge. The remaining use is primarily by ring-necked ducks, black ducks, hooded mergansers, and green-winged teal, but all species wintering at Noxubee, except canvasback, have been seen in the flooded green timber.

On the basis of known use on existing reservoirs and the general wintering distribution of mallard feeding ducks, it is not difficult to predict which species might use green tree developments. King mallard will reign in most sections of the Mississippi Flyway, but local and migrant wood ducks will often monopolize these reservoirs in October or early November before the main flights of mallards arrive.

No one species will dominate the

use of the reservoirs in the Atlantic Flyway. Green tree developments in the southern end of the Atlantic Flyway can be expected to attract wood ducks primarily, along with smaller numbers of mallards, ring-necked ducks, and blacks. A flooded stand of good oaks anywhere between South Carolina and Maryland is almost sure to attract woodies, blacks, and mallards, any one of which may be the dominant species.

Mast-producing trees, suitable terrain and soils, water, and ducks—these are the basic components of a successful green tree reservoir. The finished product can be large or small, cheap or expensive, good or bad, depending on the quality and quantity of the components and how they are mixed.

FEW STATEMENTS can hope to match the success of green tree developments in eastern Arkansas, where pin oak flats occur on impervious clay soils of terrace lands almost as flat as a table top. Low levees, relatively inexpensive to construct under such conditions, can impound several inches of water over large tracts. Natural streams and rice irrigation systems provide a dependable water supply. The mallard, like other puddle ducks, is inclined to be lazy about his feeding, and in the pin oak flats it is often unnecessary for him to tip-up to fill his crop with bite-size acorns.

In the selection of a site for a green tree reservoir, the basic requirements—mast, suitable terrain and soils, and water—should be given almost equal consideration.

The quality and quantity of each may vary, but they are all essential if the reservoir is to be successful in attracting ducks.

Few studies of food habits have been directed specifically toward ducks on green tree developments. Crop and stomach contents of 20 mallards and 9 wood ducks collected at Noxubee Refuge showed that acorns made up almost 100 percent of the food taken. Acorns were a major food item of mallards, pintails, ring-necked ducks, and wood ducks in Missouri one fall. An examination of the crops of 583 mallards killed by hunters near Stuttgart revealed that acorns comprised 29 percent by volume of the total foods taken. This will vary each year, however, depending on availability of feed in ricefields and other factors.

OAKS HEAD THE LIST of mast species that are desirable in a green tree reservoir managed primarily for waterfowl. Bottom land oaks with small acorns are the best source of feed, but little research has been done to determine which species are preferred.

In Missouri, the pin oak seemed to be the main species used by ducks, presumably because of its widespread occurrence as pure stands in areas close to water or subject to flooding. At Noxubee Refuge, both mallards and wood ducks preferred acorns of cherrybark oak over water oak or willow oak, although all three species were abundant.

The more desirable bottom land oaks for waterfowl include pin oak,

water oak, willow oak, cherrybark oak, Nuttall oak and Shumard oak. Pin oak is a local term used in Arkansas to include all species of oaks that have small acorns. Many other oaks with small and large acorns are utilized by ducks to some extent and may be important in some localities.

While the oaks we mentioned are most desirable, most areas considered for development will contain a mixed stand of these and other species. A number, notably blackgum, sweetgum, baldcypress, and hickory, are taken by woodland ducks and may be of value in supplementing oak mast, particularly in years when few acorns are produced.

Another supplemental source of food may be herbaceous plants on the forest floor. Various smartweeds, grasses, and sedges are recognized value to ducks are common in forest openings and may be of significance after logging operations, when soil disturbance and increased sunlight improve conditions for their germination and growth.

THE TOPOGRAPHY of a green tree site should be such that a large area can be flooded to a small depth at reasonable cost. The lack of such an ideal site need not discourage the prospective developer, however, for successful reservoirs can be developed in a variety of situations, depending on the landowner's interest and resources.

Dikes may be of the simple type of contour levees used for ricefields. They are spaced to provide a series of small impoundments. Or, the dikes may be substantial, perma-

ment ones engineered to impound hundreds of acres. An important consideration in bottoms subject to natural overflows is to design the dikes low and wide to avoid or reduce damage when flood waters overtop them.

The type and size of the water-control structures will depend primarily on the size of the reservoir and the volume of water that must be handled. Structures may be of any type that will permit impoundment at the desired level as well as complete drainage.

To protect the dikes, spillways should be provided for the automatic release of water above the desired level. Spillways may be low sections of the dike, ripped to withstand erosion, or natural elevations at the ends of the dike to prevent overtopping.

ANY OF SEVERAL methods may be used to flood green tree developments. A dependable and adequate water supply is desirable but is not always possible. Storage reservoirs from which water can be released by gravity flow into green tree areas are the ideal arrangement.

At the Duck Creek Wildlife Area, the Missouri Conservation Commission developed an 1,800-acre permanent reservoir, which is a source of water for flooding the adjacent 600-acre green tree reservoir managed for public hunting.

At Noxubee National Wildlife Refuge, an ample water supply was assured by developing green tree reservoirs downstream from an existing thousand-acre lake.

Many of the commercial green

tree developments near Stuttgart get their water from the sources used for rice irrigation. A less convenient water supply generally is available in other places.

Permanent streams sometimes can be diverted to provide a dependable water supply. This method is particularly adaptable where small streams enter terraces and well-drained forest bottoms. It involves the placement of a gate or stop-log structure in the streambed. Closing the structure permits diversion of the streamflow into the reservoir. A diversion ditch usually is necessary. Excellent water control is obtained, but the cost of the control structure may be rather high, except on very small streams.

Pumping is another method that allows complete water control. The source may be a well, stream, or lake. Because the annual cost of operating the pump may be prohibitive on large acreages, pumping sometimes is used as a supplemental or emergency method of obtaining water.

If a more dependable source is not available, rainfall and runoff sometimes are stored. In much of the Southeast, however, precipitation in the fall normally is low and not dependable. The watershed must be relatively large in relation to the size of the reservoir if one is to make the most of fall rains.

UNDER NATURAL CONDITIONS, most bottom-land hardwoods are flooded irregularly for brief periods during the winter and spring. Since the development of the green tree idea, a major matter of concern has been

the possible effects that prolonged fall and winter flooding may have on the survival and vigor of trees, mast production, and regeneration. Although some dead tree reservoirs testify to the hazards of early trials and errors, general guidelines for the management of water levels have been developed.

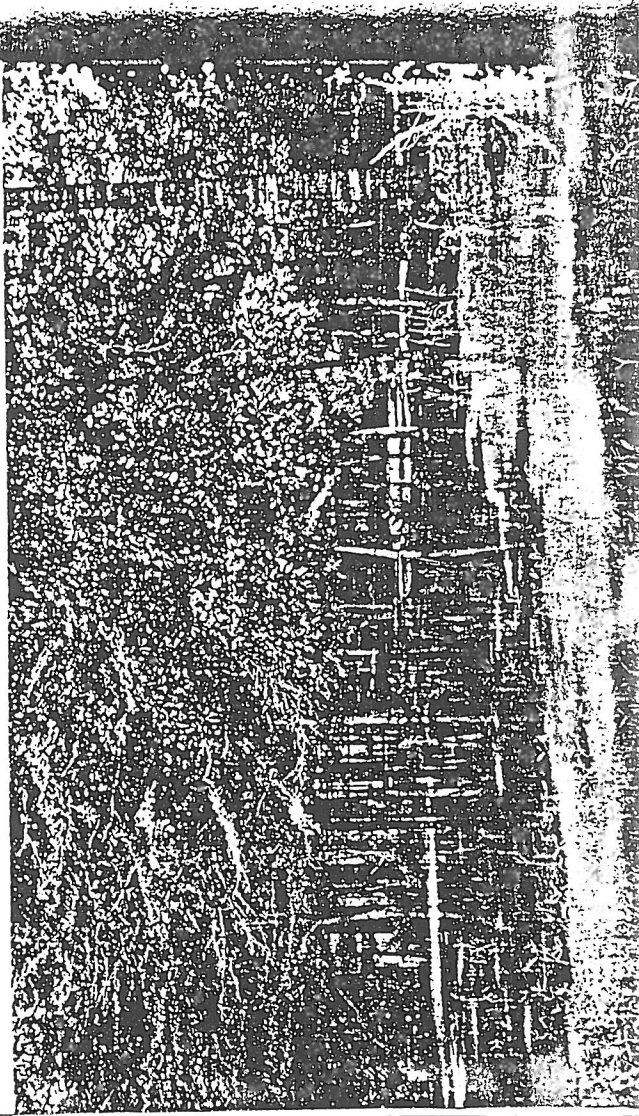
Flooding can be started safely in the fall just as the leaves begin to turn color. The woods still look green, but dormancy is beginning. In early spring, when the buds begin to swell and the twigs start to brighten in color, it is time to start draining. The period of safe flooding extends from early October to February in most of the South.

The ideal depth of flooding is 1 to 18 inches. Mast in deeper water will not be easily available to

puddle ducks. It is not necessary, however, that the ground be completely covered, for slight ridges supporting good mast species may remain dry and still be utilized. Sometimes, particularly in the larger reservoirs, where excessive depths occur at the maximum level, it is desirable to flood gradually, so that the water creeps over new territory each day. Ducks are attracted to the feather edge, and maximum utilization of mast crops can be achieved. There is some indication in Arkansas that a drop in water levels may cause ducks to leave a reservoir—possibly because of a lessened food supply in the flooded zone.

Manipulation of water levels may help prevent depletion of the acorn crop by grackles, squirrels, and other

*Controlled flooding of mast-producing timber provides excellent habitat for mallards and wood ducks. After the ducks leave such winter quarters, the flooded timber must be drained or the trees will die.*



animals before ducks arrive in the fall. On refuges and hunting areas managed primarily for waterfowl, competition for acorns by these other species may be serious; complete initial flooding early in the fall will eliminate much of it. Periodic lowering of water levels during the fall and winter may prove necessary to obtain full use of the acorns by ducks.

COMPLETE DRAINAGE before the growing season is important, for summer flooding can damage or kill desirable mast species. Sites for green tree reservoirs, because of their flat terrain and heavy soils, are difficult to drain. Complete drainage may be further complicated by beaver activity. At Noxubee Refuge, beaver seem to be attracted by flooding of the green tree impoundments. They do no particular damage in the fall and winter but cause trouble when they attempt to impede drainage in the spring. Their ponds may kill desirable mast trees in one season.

Several studies to determine the effects of reservoir management have shown that flooding, when properly done, not only is harmless but actually is beneficial to timber production. W. M. Broadfoot, of the Delta Branch Experiment Station in Stoneville, Miss., studied 16 timbered impoundments in Arkansas and Mississippi, representing a variety of flooding conditions. He found that hardwoods in bottom lands can be flooded from September or early October to April without damage to trees.

Mr. Broadfoot emphasized the

adverse effects of delayed draw-downs and summer flooding, but he concluded that winter flooding increases the amount of soil moisture carried over into the summer and enhances growth rates and the production of acorns. Another benefit is the complete fire protection afforded during the impounded period, which coincides with the time of greatest fire hazard.

R. E. McDermott and Leon S. Minckler carried out a 4-year study of stand and mast characteristics of pin oak on the Duck Creek Wildlife Area and Mingo National Wildlife Refuge in southeastern Missouri. They concluded that stands of pin oak were not adversely affected by 4 consecutive years of flooding from early October to February. Fall and winter flooding brought greater yields of sound acorns and less insect infestation.

The average stand of hardwoods in the South contains a high percentage of cull trees and inferior species, the result of many years of fire, irresponsible cutting, and other abuses. The stand must be improved if such tracts are to have maximum value for green tree reservoirs or for timber production. The aims in improving a hardwood stand for ducks and timber production are essentially the same. The goal for waterfowl management is to achieve a forest with a preponderance of vigorous, large-crowned, mast-producing species.

The desirable commercial hardwood species include a large number of important producers of mast. Cherrybark oak, water oak, willow oak, Nuttall oak, and Shumard oak

are species that may be given high priority in timber management and waterfowl management. Numerous other species of high to moderate commercial value are also of value to ducks and other wildlife. In mixed stands with the more preferred oaks, they provide a well-balanced wildlife habitat. In this group are sweetgum, baldcypress, swamp chestnut oak, overcup oak, white oak, and yellow-poplar.

Practices helpful in improving hardwood stands in bottom lands for waterfowl include several of basic importance in timber management. Cull trees which are not needed for mast production or nesting wood ducks should be removed. Stagnated and slow-growing stands of desirable trees should be thinned to give the crowns a chance to grow. The canopy should be opened up. Inferior or unwanted species may be eradicated by chemicals.

If waterfowl management is the primary aim, preferred mast species will be favored. If commercial production of hardwood is the primary objective, the species of greatest commercial value will be favored. In either case, the broad overlap of desirable mast species and commercial species permits the development of effective green tree reservoirs.

The alluvial valleys of the lower Mississippi and its tributaries, with their extensive hardwood bottoms, offer notable opportunities for green

tree development. Similar but less extensive opportunities exist on any number of Southeastern river systems—the Pearl, Pascagoula, Tombigbee, Alabama, Altamaha, Ogeechee, Combahee, Cape Fear, and Roanoke, to name a few. Tributaries extending well into the upper Coastal Plain and the Piedmont have many suitable sites. If only a portion of these hardwood bottoms were developed as green tree reservoirs, their capacity for attracting and holding ducks would be enormous.

Federal and State agencies, large timber companies, and private landowners have shown more and more interest in green tree reservoirs to attract waterfowl. State game departments see them as opportunities for providing public hunting. Private landowners use them for recreation and as a source of income through the sale or lease of hunting rights. To timber companies they are opportunities for increasing timber production, developing multiple use, and providing recreation to employees and customers. The Bureau of Sport Fisheries and Wildlife recognizes their value as quality wintering habitat for an important segment of the migratory waterfowl resource. Without a doubt, green tree reservoirs will do much to advance the distribution, utilization, and preservation of wintering woodland ducks.

—ROYSTON R. RUDOLPH and  
CARL G. HUNTER.



## Matches and M

**FIRE**, a destroyer, is also a helper, when it is wisely employed to keep waterfowl marshes from becoming brushy bogs or wooded swamps. It is a destroying angel, whose ecological mission is to cleanse.

This accumulation of marshlands is disposed by ice, spring floods, winds, and other forms of cleansing. In the south, however, where long-fisted sons leave heavy matted growth, drastic measures are needed to keep the marshes from being smothered in their own growth. Hurricanes work of clearing away tall lations. Fire, usually

is also a helper, when it is wisely employed to keep waterfowl marshes from becoming brushy bogs or wooded swamps. It is a destroying angel, whose ecological mission is to cleanse.

Cleansing is often necessary, sometimes to keep plants from killing themselves by their own vigorous growth. Marsh grasses and sedges are low-growing plants, whose blade-like foliage can dominate a marsh. Nevertheless, they are in constant danger of being overwhelmed by taller vegetation. Potential competitors, such as broad-leaved or woody plants, have difficulty gaining a foothold in