In examining first year recoveries following banding it was found that a higher percentage of birds banded as subadults were recovered in comparison with the percentage of subadults banded with the exception of the male redhead group in which class the recovered percentage of adults exceeded the banded percentage. Consequently, it appears that lesser scaup and canvasback in their second year may still be more vulnerable than older birds.

Calculations of average annual adult mortality rates by methods given below indicated only small differences between the three species. The redhead was highest with an adult mortality rate of 44 percent per year. The lesser scaup had a rate of 42 percent and the canvasback 38 percent (Table VI). These adult mortality rates were calculated after the manner used by Hunt et al (1958) working with hand-reared mallards in Wisconsin. By using the method of Bellrose and Chase (1950) with the same data, similar results were obtained. Hickey (1952) reports adult mortality rates for redheads as ranging from 47 percent to 54 percent using two groups of birds and two methods of analysis. Brakhage (1953) reports first year mortality rates of 80 percent and 94 percent for wild-trapped and hand-reared juvenile redheads respectively but presents no adult mortality rates. His figures for first year mortality rates disclose that those of the canvasback apparently approximate those of redheads. Comparable records of adult mortality rates for the lesser scaup and canvasback were not found in the literature. However, using mortality rates calculated for redheads in this study it appears that these mortality rates were slightly lower for this group of birds than those recorded elsewhere.

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# PLANNING FOR WILDLIFE ON WATERSHED PROJECTS


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Wildlife Management in reservoirs has been historically concerned with fish and wildlife resources as the result of developments by such public agencies as the Corps of Engineers, Bureau of Reclamation and TVA. With more recent interest in upstream flood prevention on farms in Soil Conservation Districts, we are now concerned—not with reservoirs of thousands of acres—but of those involving usually only 10 to 50 acres.

Three watershed programs are administered by the Soil Conservation Service. They are: (1) The Flood Control Act of 1944 involving 11 river basins; (2) The Pilot Watershed program involving 60 projects; and (3) Relatively small projects involving watersheds of less than 250,000 acres under the Watershed Protection and Flood Prevention Act authorized by Public Law 566, 1018, 85-624 and 85-865.

The problems of fish, waterfowl, upland game, furbearers, silt settlement, stream improvement, stabilization of streamflow, pollution control, and recreation are involved in part or in whole where watershed projects and flood control reservoirs are involved. Several species of wildlife are important, but fish and ducks receive the most attention.

## FISH MANAGEMENT

Several major problems exist in fish management—wild or trash fish already within the impoundment area, large stream flows that prevent proper fertilization, shallow areas often in the upper end which are subject to weed and brush growth, and determination of the best fish stocking ratios and species of fish to use.

The Soil Conservation Service, where practical, encourages landowners to eliminate the wild fish population from within the impoundment area by using rotenone. If excessive stream flow or lack of agreement among landowners prevents rotenoning, the reservoir may be filled or partially filled with water at the completion of construction. At the end of the spawning season the pool is then drained, all local water areas are rotenoned and immediately thereafter the pond is filled and stocked with fish. Another alternative would be to delay filling of the reservoir until after the spawning season. Unlike some other agencies, the Soil Conservation Service does not purchase any land in a watershed. Multiple ownership of a flood retarding reservoir frequently will prevent management practices from being carried out due to lack of agreement among individual property owners.

Flood retarding reservoirs are usually stocked wtih bass, bluegills, and red-ear sunfish on the basis of an unfertilized pond through the cooperation of the U. S. Fish and Wildlife Service or the State Fisheries Commissions in the Southeast. Landowners are encouraged not to fish the reservoirs until the bass have been stocked for a year and have shown evidence of successful spawning.

Field trials are being inaugurated to check on the advisability of introducing catfish into the stocking ratio. Brown bullhead fingerlings will be stocked in a few reservoirs at the same time that the bass are delivered to prevent as far as possible any overpopulation of catfish. Channel and white catfish will be stocked in other reservoirs. Determination will be made as to whether these stream catfish will spawn in the rapid creek water coming into the reservoir. If not, kegs, barrels, or milk cans will be tried in order to induce spawning.

Waterweeds and woody plant growths invariably show up in shallow water and in unfertilized pools. Chemical control must be repeated often and is therefore expensive if not followed by a good fertilization program.

Also of interest is the large increase in stream fishing due to the watershed program. Already we have observed very good stream fishing where none at all previously existed. This is due in part to the loss of fish from farm ponds and flood-retarding reservoirs during big rains, and in part from improvement of stream flow and stabilization.

Some of our most important watersheds are located in the high frequency rainfall area of the Appalachian Mountains. This is also trout stream country. Whenever a flood-retarding reservoir with a pool of water is constructed on a trout stream, the water will warm up. Trout water below a structure may be eliminated. It should be emphasized here that Watershed programs under PL 566 are a cooperative venture between the local landowners, Soil Conservation Districts, and the Soil Conservation Service. If the local people who own the land desire a structure with a conservation pool in preference to the trout stream, the reservoir, in most cases, will be built. If, on the other hand, the local people desire to keep the trout stream, several alternatives are possible.

A dry structure may be constructed. This involves disturbance only of the actual dam site. None of the trees and other sheltering vegetation within the impoundment are removed. High frequency rains will be retarded for short periods, and released at moderate rate which approximates a normal flow downstream.

Flood retarding structures in trout stream country normally will have impoundments of only four to six acres. Field trials will be conducted to check the feasibility of establishing trout ponds. If successful, this will offer an important addition to sport fishing.

Another alternative will be to draw water from the cold water strata of the impoundment and pass it downstream. This can be done by a siphon tube

in the overflow structure. Trout below the structure may or may not be adversely affected if this technique is used.

Sport fishing in the water impounded by flood retarding structures has become an important natural resource. Several landowners are collecting fees from fishing. In at least one case, the land is yielding more money per acre from fishing than it did from farming.

Food-fish farming and minnow farming offer excellent opportunities for landowners participating in watershed projects. Quite often sites on flat land below a reservoir are ideally suited for profit making ventures in fish and minnow farming. Landowners in a proposed flood control and irrigation project in South Georgia are interested in converting several of the reservoir sites to growing golden-shiner minnows. Where catfish are introduced as part of the stocking ratio of flood retarding reservoirs, they offer a good potential as a food fish that may be trapped either for home use or for sale.

## WILDLIFE MANAGEMENT

Watershed programs offer an almost unlimited opportunity for many and diverse wildlife management programs. Probably the most important will be concerned with waterfowl management (especially ducks.) Other programs offer good opportunities for furbearers, deer, wild turkey, rabbits and quail. In other parts of the United States, such species as pheasants are benefited.

The effectiveness of waterfowl management programs have already been demonstrated by the cooperative efforts of the Soil Conservation Service and Fish and Wildlife Service. There is considerable natural waterfowl food produced in flood retarding reservoirs, such as barnyardgrass, smartweeds, naiad and various potamogetons. However, food can be produced in greater quantity by using the so-called "duck-window." This is a slot in the overflow structure which enables the structure owner or owners to draw the permanent pool down about 30 inches thus exposing shoreline areas. The amount of area exposed is directly in relation to the topography. Due to steeply sloping banks some structures are not suited to this type of management.

Field trials have been conducted using browntop millet, Japanese millet, Texas millet, Chilcken corn, and several smartweeds. All have produced at times good seed crops but Japanese millet, Chicken corn, and the smartweeds offer the most promising potential due to minimum amount of ground preparation necessary. For successful browntop millet, a good seedbed must be prepared by farm machinery. Frequently ground preparation in reservoirs is not practical due to boggy conditions. One of the most important principles to remember is to plant the crop so it will produce the maximum amount of feed. If planted too early, the mature seed will be lost before the waterfowl arrive. If planted too late, an early frost may prevent the seed from maturing. In Georgia the water is drawn down in June and the millet and Chicken corn planted in late June or early July. Smartweeds must be seeded during the winter to secure successful germination.

The most effective technique and also the most promising in waterfowl management will not be within the structure but on relatively flat land below the reservoir. The technique involves selecting several acres of flat land and constructing a low dike around the area. Water is supplied by the nearby flood retarding reservoir. By using the best agricultural methods (including fertilizer), a high yielding crop, such as corn, millet or sorghum is produced. If preferred, any combination of the crops listed may be grown. A slight modification of this technique is being carried out on the flood plains of the Etowah River in Cherokee County, Georgia. Small clearings have been made and seeded to browntop and Japanese millet. Most acorn-producing oak trees have been left in other areas to provide additional food.

Already good broods of wood ducks produced during the summer and good concentrations of wintering ducks have been seen. Many flood retarding reservoirs offer excellent natural wood duck nesting habitat. Where wood duck nesting boxes have been erected, excellent usage has been observed. Boxes have been erected both directly over the water and on trees growing on ground near the water. This type of program offers potential for coopera-

tion by Boy Scouts, FFA, 4-H, and other organizations active in conservation programs.

Muskrats have moved into the reservoirs as fast as they are completed. Their populations build up rapidly and trapping operations by farm boys naturally follow.

Several flood control structures have been constructed in the vicinity of good deer and turkey populations. Both deer and turkey have been attracted by the available water supply and have been observed on numerous occasions.

Critical erosion areas are planted as an essential part of a watershed program to stabilize these areas against high-frequency runoff. When bicolor lespedeza seedlings are available, in our case from the Georgia Game and Fish Commission, we have established them on the critical areas thus accomplishing two important objectives, (1) establishment of stabilizing vegetation, and (2) providing good food and cover conditions for Bobwhite quail. This program has shown remarkably good results. Within a short time after establishment of the bicolor patches, a covey of quail will begin using the area for the food and cover that is available.

An interesting addition to the common birds of an area are species of Egrets, Herons, Ibises and Swallows. Flood-retarding structures and farm ponds have attracted these birds in large numbers. The water areas being built provide feeding and resting areas for numerous water birds not normally seen in interior habitats.

Planning for wildlife on watershed projects is a new field for game and fish technicians with special problems and opportunities. Throughout the country landowners are moving into game and fish management as a business or an adjunct to farm income. A watershed program draws neighbors close together and starts them working together, sometimes for the first time. Here then may be an opportunity for a watershed association to develop the hunting and fishing potential of a relatively large area and provide better recreation for all—both the landowner and the city dweller.

## FIRE AND QUAIL MANAGEMENT AT FORT CAMPBELL, KENTUCKY

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### INTRODUCTION

Prescribed burning has long been recognized as a sound silvicultural practice in the pine forests of the southern coastal plain. Stoddard (1931) and Rosene (1954) found that burning was also an excellent quail management practice in the southeast. However, the use of fire as a forest and quail management practice in the hardwood region to the north has been neglected. It is the purpose of this paper to demonstrate the potentials of prescribed burning as a management tool in military land management, quail management and, to a limited degree, silvicultural usage in the establishment of pine plantations. These potentials will be demonstrated by the use of results obtained on a military reservation in this hardwood region.

### DESCRIPTION OF AREA

The Fort Campbell Military Reservation consists of approximately 101,000 acres of land located in Kentucky and Tennessee. The reservation is located 16 miles south of Hopkinsville, Kentucky and 8 miles north of Clarksville, Tennessee. The topography is generally flat and rolling land except for the western portion of the post where the topography becomes more broken. Generally speaking, soils are limestone derived and consist mainly of the