ABSTRACT

A two-year study was made of the nesting ecology of the black duck (*Anas rubripes* Brewster), the gadwall (*Anas strepera* Linnaeus), and the blue-winged teal (*Anas discors orphna* Stewart and Aldrich), at their southern nesting limits along the Atlantic coast. Approximate production at Pea Island was: 1959—black duck 230, gadwall 348, blue-winged teal 105; 1960—black duck 144, gadwall 457, blue-winged teal 97. Production at Bodie Island, estimated only for 1960, was: black duck 111, gadwall 28, and blue-winged teal 48. The major rearing areas were the two man-made fresh-water impoundments on Pea Island (1020 acres of water and marsh) and the brackish pond on Bodie Island (500 acres water and marsh). Estimated juvenile mortalities were: black duck 31%, gadwall 48%, and blue-winged teal 23%. Major predators were feral cats (*Felis domesticus*) and snapping turtles (*Chelydra serpentina*). Comparison between the North Carolina coastal marshes and the mid-western duck-producing marshes revealed a striking vegetative similarity. Stabilization of the water levels at Pea and Bodie Islands, by impoundment, has increased this habitat similarity and apparently been of great importance in determining the location and success of the North Carolina gadwall colonies, which are disjunct by 1600-2200 miles from the major nesting areas of this species. The conditions supporting fairly high densities of nesting black ducks and blue-winged teal at the southern limits of their breeding ranges appear to be improved habitat and protection. The breeding biology of all three species was observed to be basically similar in North Carolina to that recorded for these birds in their major nesting regions.

SURVIVAL, RENESTING, AND RETURN OF ADULT WOOD DUCKS TO PREVIOUSLY USED NEST BOXES

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ABSTRACT

During 1961 adult female wood ducks (*Aix sponsa*) were removed from nest boxes on three ponds near Raleigh and banded with U. S. Fish and Wildlife Service leg bands. During the 1962 nesting season ducks were again removed from nests for banding and a large percentage of them were found to be ducks returning from the previous year.

An analysis of the first two years of the banding study revealed that (1) no nests were deserted as a result of banding during late incubation, (2) survival of adults as measured by the return of nesting birds was 47%, (3) there was a high rate (70%) of return of birds to individual boxes in which they had previously nested, and (4) some females produced two successful broods in a single season.

INTRODUCTION

During the past 25 years great interest has been shown in providing nesting sites for wood ducks. Most interest has been directed toward increasing production of this beautiful and important game bird. Much information has been obtained about nest box utilization, nesting dates, clutch sizes, and related nesting activities. Most studies have measured activities on a population level and few have attempted to measure the nesting of individual ducks. The study herein reported was conducted by banding incubating females in nest boxes and measuring their subsequent nesting.

REVIEW OF LITERATURE

Thousands of nest boxes have been erected for wood ducks in recent years primarily in northeastern United States. Some of these boxes have been used for studies on basic life history information about this bird. The Illinois Nat-

ural History Survey (Bellrose, 1953), the Massachusetts Division of Fisheries and Game (McLaughlin and Grice, 1952; Grice, 1960), and the Vermont Fish and Game Service (Miller, 1952), have conducted studies on individual birds by marking adult females or their young in nest boxes.

By studying banded females, Bellrose (1953) found that ". . . there was a definite homing of breeding hens to the nesting area used in previous years. Among the numerous records obtained, a remarkable example was the return in 1951 of four out of the seven hens banded on their nests in an area in which they had nested successfully the year before." He also found that when a nest was destroyed, the female would begin to lay again after about 13 days, but she would not renest in the same place. Usually the new nest site was within one-half mile of the old one, but in one instance the female moved 4.8 miles to renest.

Miller (1952) conducted a three-year study of wood duck nesting at the Sandbar Waterfowl Development Area in Vermont. He handled 7, 52, and 45 females on their nests in 1949, 1950, and 1951, respectively. He stated, "The handling of incubating females has shown that 17 birds nested in both 1950 and 1951, six of these birds nested in the same box each year. Only one bird is known to have nested for three successive seasons, but the sample handled in 1949 consisted of only 7 birds."

McLaughlin and Grice (1952) found through banding returns that the old females arrived in an early wave and occupied nesting boxes in the same area as in the previous year. The year-old females arrived in a later wave and occupied some of the remaining boxes in the area but also spread out in the surrounding region. Grice (1960) further stated, "On the few areas where we have continued to band the incubating females, we have found the old birds to have generally persisted at the rate of 50 per cent per year."

MATERIALS AND METHODS

The research project herein reported was undertaken on five ponds located within a 20-mile radius of Raleigh, North Carolina. These ponds were:

(1) *Hester's Pond.* This 8-acre pond owned by Dr. J. R. Hester was the primary study area. Wood ducks had been nesting in boxes here since they were first erected in 1954. The pond was located on a tributary stream about 200 yards from Little River, a small woodland stream, about 3 miles east of Wendell and 20 miles east of Raleigh. Thirty boxes were available on this pond in 1961 and 40 boxes in 1962.

(2) *Tarpley's Millpond.* This millpond, owned by Mr. J. W. Tarpley, was located on Little River about 1½ miles northeast of Wendell and about 1½ miles from Hester's Pond. This millpond was approximately 40 acres in extent and contained much aquatic vegetation, primarily emergent plants, buttonbush (*Cephalanthus occidentalis*) and ash (*Fraxinus caroliniana*) trees. Five boxes were available on this pond each year.

(3) *Raybon's Pond.* This small pond of about ½ acre, owned by Mr. James Raybon, was located about one mile north of Wendell. It contained very dense aquatic vegetation, especially alder (*Alnus serrulata*), buttonbush, and red maple (*Acer rubrum*). This pond was located on a tributary stream about one mile above Little River. Two boxes were erected here in 1962.

(4) *Reedy Creek Lake.* This 19-acre lake surrounded by woodland was owned by the North Carolina Division of State Parks and was located in the Reedy Creek State Park about 7 miles northwest of Raleigh. This was a new lake when 4 boxes were erected on cedar posts in 1961. All vegetation had been removed prior to flooding.

(5) *Lake Sycamore.* This 21-acre lake, owned by the North Carolina Division of State Parks, was located about 9 miles northwest of Raleigh. This lake was several years old, but was composed of open water except for a small island 50 feet in diameter which contained mature pine (*Pinus spp.*) trees. Four boxes were erected on these trees and two boxes were placed on cedar posts over open water in 1961.

During the 1961 nesting season, female wood ducks nested at Hester's Pond, Tarpley's Millpond, and Reedy Creek Lake. No wood ducks nested during 1961 at Lake Sycamore and no boxes were available at Raybon's Pond. Detailed

records were kept as to the progress of each nest, and by allowing 30 days for incubation an estimated hatching date was obtained. The females were removed from their nests during the last week of incubation and banded with U. S. Fish and Wildlife Service leg bands. They were returned to the boxes immediately after banding.

During the 1962 nesting season, female wood ducks were again removed from nest boxes. During the late winter months, Reedy Creek Lake was drained and the boxes were not used by the ducks in 1962. Boxes on the other four ponds were used and the females were captured for banding.

Some summer banding was done with bait traps at Hester's Pond in 1961 and at both Hester's Pond and Tarpley's Millpond in 1962.

RESULTS

Every female which was successful in producing a brood in either year was captured and banded. In 1961, 30 adult females were removed from their boxes and banded. Twenty-four of these were at Hester's Pond, 4 at Reedy Creek Lake, and 2 at Tarpley's Millpond.

In 1962, 25 females were removed from their boxes for banding. No nests were deserted in either year as a result of banding during the last week of incubation. Of the 25 females removed in 1962, 14 (47%) had been banded in nest boxes the previous year, 3 (2 young and 1 adult) had been banded in bait traps the previous summer, and 8 were non-banded. A further analysis showed that 7 of the 14 banded females were in the same box which they had used successfully the previous year.

The rate of return of specific females to individual boxes was higher than it first appeared. Boxes previously used by 4 females were not available when they returned in 1962 (2 boxes were at Reedy Creek Lake which had been drained, 1 box apparently had been stolen from Tarpley's Millpond, and 1 box at Hester's Pond was moved after the dead tree to which it was attached had fallen). Each of these 4 females was found nesting in a box within two miles of her original nest. The two females returning to Reedy Creek Lake, which had been drained, nested in boxes at Lake Sycamore about 2 miles away. The duck which had nested in the box no longer available at Tarpley's Millpond moved about 1½ miles to a box at Hester's Pond, and the one which had nested in the box relocated at Hester's Pond was in an adjacent box.

Of the 10 females which had their previously used nest boxes available to them during the 1962 season, seven birds returned to the same box. The remaining three ducks each moved to a different box but remained on the same pond.

The 1961 nesting season was very long and extended from mid-February until mid-summer. The first nest was begun on February 19 and other nests were started throughout the spring and early summer months. The last successful nest was begun on June 28 with an exodus of young on August 8. A later nest was established by a female which laid eggs daily from July 15 through 24 and then incubated them beyond the normal incubation period without success.

During this long nesting season three ducks each produced two successful broods and a fourth one made an unsuccessful attempt at a second nest after producing one brood. No information was available as to the survival of the early broods beyond the nest exodus, but the time interval between nests was sufficiently long in two of the four cases to allow the early brood to reach flight before the second nest was begun. The time interval from the exodus of the first brood to the commencing of the egg-laying of the second nest was 28, 41, 84, and 89 days for the four females.

Of the four females which each attempted two nests in 1961, three returned in 1962 and each produced one successful brood. Box utilization by these three ducks was varied. One female nested in the same box twice in 1961 and once in the following year. Another female changed boxes for her second nest in 1961 and returned to the second box in 1962. The third female nested in a different box each of the three times she nested.

The banding of nesting wood ducks offers unique opportunities for research. Migration, minimum survival, homing behavior, and re-nesting are important aspects of wood duck biology which can be determined only in this way. In-

formation can be obtained from a large percentage of the birds which are banded. Those which are killed and reported by hunters serve to indicate migration routes and wintering areas, while those which survive are available for additional study when they return to the nesting area. The primary deficiency in information obtained from this type of study is that no breeding record of an individual female is obtained unless she completes 3 weeks of incubation.

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MOVEMENTS OF JUVENILE WOOD DUCKS AS MEASURED BY WEB-TAGGING

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INTRODUCTION

In recent years much emphasis has been placed upon the use of nest boxes as a means of increasing wood duck (*Aix sponsa*) populations. Many states have carried out extensive programs of box erection, but few studies have measured the specific habitat requirements of young. The present study was undertaken to obtain information about this important aspect of wood duck biology. A 2-year study concerning wood duck brood movements was conducted near the town of Wendell, North Carolina, during 1961 and 1962. Newly hatched broods were web marked for later recognition, returned to their nest boxes, and subsequently recaptured in traps.

REVIEW OF LITERATURE

Stewart (1958) intensively studied local movements of wood ducks. He found that the first movement of newly hatched ducklings, after leaving the nest, was toward water with a closely allied second movement toward those water areas which contained concealing vegetative cover. Stewart (1958) concluded that ducklings went to water areas nearest the hatching site provided vegetative cover was present. Vegetative cover has been considered by many (Hawkins and Bellrose, 1940; Leopold, 1951; Mumford, 1952; Klein, 1955; and Decker, 1959) to be a necessary requirement for broods.

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