

man or predators may cause the ducklings' feathers to become water soaked. It would appear that even though they might escape immediate death or capture, subsequent mortality could occur due to exposure or reduced resistance to further predation.

It was concluded from this study that although brood survival rates may be estimated, more intensive research will have to be conducted before the specific causes of mortality are known.

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## NEST BOX PRODUCTION AND BROOD SURVIVAL OF WOOD DUCKS ON THE PIEDMONT NATIONAL WILDLIFE REFUGE

**1969\***

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#### ABSTRACT

Wood duck (*Aix sponsa*) nest box production and brood survival was studied during 1969 on Piedmont National Wildlife Refuge.

Of a total of 446 ducklings hatched in nest boxes in 1969, 397 (89%) were marked with consecutively numbered web tags before their exit from the nest box. Eighteen female wood ducks were color marked with nasal saddles so they could be identified with their respective broods throughout the nesting season. Subsequent trapping and observation provided insight into brood survival and total production of this species on Piedmont National Wildlife Refuge.

During the 157-day nesting season\* 46 successful hatches were recorded out of a total of 60 nesting attempts. The average number of ducklings leaving the nest box was 9.7. From the 194 available nest boxes there were 46 (24%) successful hatches. Six of the 194 boxes were used twice.

Brood size in the 4-7 week age class was reduced by nearly two-thirds.

\*This project was a cooperative effort between the Georgia State Game and Fish Commission Federal Aid Project (W-37) and the United States Bureau of Sport Fisheries and Wildlife.

\*Number of days from date of first egg laid to date of last hatch.

## INTRODUCTION

Nest boxes were erected in suitable areas on Piedmont National Wildlife Refuge in 1958 to encourage wood duck reproduction. Data collected on these boxes before 1969 have been spotty and inconclusive. Broods have often been observed on the area but little reliable data have been gathered on their survival or on nest box production.

Without this information it was difficult to accurately evaluate the success of the wood duck nest box program on the refuge. Piedmont's contribution to Georgia's wood duck population was not known.

Habitat alterations on P. N. W. R. have resulted in an annually increasing nesting population of wood ducks. Nest box checks by refuge personnel during 1968 brought up some interesting questions. Of a total of 57 hens that were caught on the nest, 19 (33%) were caught again on different nests. This left the fate of the first broods of these double nesting hens in question. They were either taken by predators or survived on their own while the hen renested.

It is known that pen-raised wood ducklings released at 3 to 6 weeks of age can survive on their own. One group of 36 such ducklings had a 50% recovery rate after reaching flight stage (Lane, Bond, and Julian, 1968). In many cases there was a six-week interval between the time the hen hatched her first brood and the beginning of incubation of a second clutch of eggs. This could easily have allowed enough time for the partial rearing of a first brood.

Recently, successful second nestings have been reported by Hester (1962) in North Carolina; Grice and Rodgers (1965) in Massachusetts; and McGilvrey (1966) in Maryland. Similar cases have been reported on the Mingo National Wildlife Refuge in Missouri (Rodgers and Hanson, 1967). Fates of first broods in all reported instances have been unknown.

## METHODS

### *Nest Box Checks*

Nest boxes were checked bi-monthly from February through July, 1969. Checks were made with a boat and ladder except in the beaver ponds, where heavy vegetation made it impossible to use a boat. Nest boxes in beaver ponds were checked on foot.

Data were collected on clutch size, nesting success, predation, competition, and length and dates of incubation. Care was taken to keep disturbance at a minimum. Whenever possible, occupied nest boxes were checked while the hen was off the nest. In most cases hens were not taken from the box for banding unless they were in the latter stages of incubation. During the last week of incubation, nests were watched closely so that the new broods could be web-tagged before making their exit from the box. Hens were banded and color marked during the last week of incubation.

### *Capture of Hens*

When a hen in early stages of incubation was present in a box it was checked at a later date. It was usually possible to drift away from the box without disturbing these hens. Bumping the box or loud, sharp noises would usually cause them to leave the box.

Hens offered less resistance to capture when the checker reached through the entrance hole and pinned her wings behind her because very little light is let in using this method. When hens are caught by raising the lid on the box, they often become quite upset. This method often results in broken eggs and a very disturbed hen.

After a previously unbanded hen was caught she was immediately banded and color marked. Color marking consisted of fitting the hen with a brightly colored "nasal saddle" similar to those used by Sugden and Poston (1968).

(Application of these saddles has been described in detail by these authors.) Saddles of one color combined with washers of another color resulted in a number of different recognizable combinations.

Hens were returned to the box after banding and saddling. The box opening was stuffed with a rag and the hen was given several minutes to settle down. After she appeared to be settled the rag was removed and the boat was allowed to drift slowly away from the box.

### *Trapping*

Various types of traps were used in the retrap program including a cannon net used for trapping ducklings. No particular kind was very effective and re-trapping success was poorer than expected.

### *Marking Broods*

It was desirable to web tag as many nest box produced ducklings as possible during 1969 for the following reasons:

1. To attempt to keep track of first broods of double-nesting hens;
2. To study brood movements;
3. To obtain a ratio of tagged to untagged ducklings to be used in estimating Piedmont's resident wood duck population.

Hatching dates were predicted for all nests. Ducklings were tagged as soon as possible after hatching since at this time they are wet, weak, and much easier to handle. Before the ducklings were removed from the box the hen was caught and placed in a burlap sack. Sequentially-numbered web tags (number 1 monel tags) were used to tag ducklings. Both feet were tagged with identically-numbered tags. (Application of these tags has been previously described by Grice and Rodgers, 1965.)

After the hens and ducklings were returned to their boxes ample time was given them to settle down before leaving the box.

### *Brood Observations*

Observation of broods were made throughout the nesting season to learn more about brood survival. More brood sightings were made during the early morning and late evening of April and May.

Portable blinds were set up on heavily used rearing areas. Sightings were made with either a 15X to 60X variable spotting scope or 7 X 50 binoculars.

Broods observed were counted and their ages estimated. Those broods accompanied by a color-marked hen could be aged to the exact day. Most observations were made on Allison's Lake and Impoundment 2A — the two largest impoundments. These two areas seemed to be preferred rearing habitat offering good cover consisting primarily of willows (*Salix nigra*) and buttonbush (*Cephalanthus occidentalis*). Blinds placed on other, smaller ponds produced fewer sightings. No observations were made in beaver ponds because of dense vegetation.

## RESULTS AND DISCUSSION

### *Nest Box Production*

A total of 194 boxes were available on ten impoundments and four beaver ponds on P. N. W. R. during 1969. Table 1 summarizes production in these impoundments.

Sixty nesting attempts and an additional seven nest starts occurred in artificial nest boxes. A nesting *attempt* is a clutch of eggs which have started the process of incubation. A nesting *start* includes nests in which one or more eggs were laid. Seven nests containing small clutches of deserted eggs were destroyed before incubation. These nests probably represented interrupted

TABLE I  
1969 WOOD DUCK NEST BOX DATA  
PIEDMONT NATIONAL WILDLIFE REFUGE

<u>Impoundment</u>	<u>Acres</u>	<u>Starts*</u>	<u>Attempts*</u>	<u>Successful Attempts</u>	<u>Available Boxes</u>
21 A	9	1	1	1	8
9 A	8	3	3	3	8
11 A	7	1	1	1	12
6 A	8	7	7	7	18
2 A	34	11	9	7	29
11 B	5	2	2	1	12
22 A	6	3	2	1	5
7 A	2	2	2	2	4
21 B	0	0	0	0	2
Allison	36	29	29	20	41
B. P. #1		3	1	1	14
B. P. #2		1	0	0	15
B. P. #3	55	3	2	2	14
B. P. #4		1	1	0	6
Falling Creek	$\frac{1}{4}$	0	0	0	6
<b>TOTALS</b>	<b>170<math>\frac{1}{4}</math></b>	<b>67</b>	<b>60</b>	<b>46</b>	<b>194</b>

\*Start: Nest with one or more eggs laid

Attempt: Incubation has begun

NOTE: From observations on 46 nests, avg. clutch size = 13.5

From observations on 46 nests, avg. hatch size = 9.7

Hatchability =  $9.7/13.5 = 71.9\%$

laying rather than distinct nesting attempts (Hammond and Forward, 1956). One hooded merganser (*Laphodytes cucullatus*) successfully nested and hatched 11 ducklings.

Forty-six (23.7%) successful attempts were made resulting in the production of 446 wood ducklings. Average brood size at hatching was 9.7. Average clutch size was 13.5. Distribution of clutch sizes is shown in Table II. Forty per cent of all nests contained from 11 to 13 eggs. Large dump nests were uncommon on the study area.

Eight wood duck hens successfully hatched two broods. Both broods of these "double nesting" hens were web-tagged. (Histories of these eight hens are presented in TABLE IV.) One hen was found to have surviving members of both her first and second brood. Hen #685-62758 hatched her first brood on April 5 and brought off another brood on June 23. On July 27 ducklings #84 and #87, survivors from this hen's first brood, were captured on Impoundment 2A. This may have involved the loss of the first brood by accidental separation from the female as suggested by Rodgers and Hanson (1967). Beard (1967) stated that a noticeable deterioration of the bond between hen and brood occurs when young are about five weeks of age. Fate of the first broods of the seven other double nesting hens is unknown.

The renesting interval of double-nesting hens averaged 40 days and ranged from 27 days to 68 days. This interval compares favorably with the 28 to 43 day interval reported by Rodgers and Hanson (1967) in Missouri. Other investigators report shorter intervals. Grice and Rodgers (1965) reported inter-

**TABLE II**  
**DISTRIBUTION OF WOOD DUCK CLUTCH SIZES\***

<u>Clutch Size</u>	<u>Number</u>	<u>Per Cent</u>
7 or less	2	3.3
8 - 10	14	23.3
11 - 13	24	40.0
14 - 16	10	16.8
17 - 19	5	8.3
20 or more	<u>5</u>	<u>8.3</u>
<b>TOTALS</b>	<b>60</b>	<b>100%</b>

\*Clutch size refers to the number of eggs at hatching — not necessarily the number of eggs hatched.

The first egg was layed on February 7, 1969.

Time elapsed between the first successful hatch (March 23) and the last hatch (July 13) was 113 days. During this time two peaks of nesting activity were clear. (See graph in TABLE III.) April was the most productive month, having a total of 16 out of 46 hatches (35%).

TABLE III

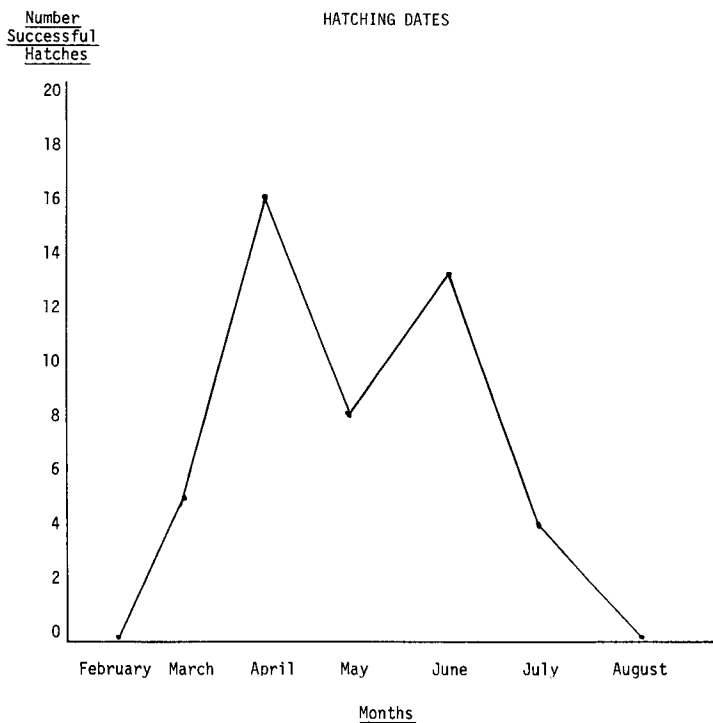


TABLE IV  
CLUTCH HISTORIES OF DOUBLE NESTING HENS

Band #	Date of 1st Hatch	Web Tag # s	Date of 2nd Hatch	Web Tag # s
685-62758	4-5	83-90	6-23	346-355
685-74576	4-29	214-224	6-26	359-362
725-55504	4-27	203-213	7-4	390-396
685-62547	4-5	72-82	7-13	405-408
685-62929	3-23	1-11	6-7	288-299
635-71525	3-30	54-71	6-13	300-307
685-62546	4-7	104-115	6-21	326-340
595-58734	4-9	125-134	6-14	308-315

vals ranging from 5 days to 25 days. Bellrose (1955) noted a 13-day interval. It is possible that some of these hens made second attempts in natural cavities before returning to an artificial nest box.

The average renesting interval of 4 hens that had unsuccessful first nests and then renested was 34 days.

Most hens were very persistent nesters and were very attached to their clutch. Three nests (6.5%) were known to have been abandoned due to excessive disturbance when they were checked. Two of these three were jarred by the boat.

During April, unusually heavy rains flooded many of the boxes on Allison's Lake. Three of the submerged boxes were occupied by setting hens nearing the hatching date. These hens continued to sit until the water level reached the eggs. As soon as the water level receded the hens returned to sit on the cold eggs. One nest of 18 eggs had one duckling hatch while the other two nests were ruined by the water. These two hens continued to sit on these cold eggs well beyond the hatching date. Finally, the eggs were removed from the nest to allow these hens to nest again.

Thirty-four hens were caught in nest boxes. Eight of these successfully nested twice. Four hens were not captured on the nest. Of those 34 hens that were captured on the nest, 14 (41%) were return nesters from 1968. Four of these 14 returned to the same nest box, while the others all returned to the same pond to nest. Two other return nesters were unsuccessful in nesting during 1968.

#### *Predation*

From a total of 60 nesting attempts, 14 (23%) were unsuccessful in 1969. Five of these 14 failures were attributed directly to predation. Snakes were responsible for three of these destroyed nests and pecking birds were responsible for the destruction of two more.

Grey rat snakes (*Elaphe obsoleta*) were often seen on the area. On one occasion a five-foot grey rat snake was caught in a nest box during a nest check. Five of ten eggs had been eaten. On another occasion a large rat snake was observed sunning himself on top of one of the flat-type predator guards. Neither conical or flat predator guards offered any protection from large rat snakes. A larger guard of either type should be successful in keeping these snakes from entering nest boxes.

Flickers (*Colaptes auratus*), starlings (*Sturnus vulgaris*), and red-winged blackbirds (*Agelaius phoeniceus*) were probably responsible for most of the puncturing of eggs. (Usually, hens would tolerate one or two broken or punctured eggs before abandoning the nest). However, no direct observation was

made of puncturing. On one occasion a pair of red-winged black birds were observed to harass a nesting hen. They made repeated dives at her as she left the nest box. Bluebirds (*Sialia sialis*), crested flycatchers (*Myiarchus crinitus*), screech owls (*Otus asio*), and three swallows (*Iridoprocne bicolor*) also used the boxes.

Raccoons (*Procyon lotor*) were plentiful, particularly near the beaver ponds, but seldom interfered with nesting hens. Though several attempts were made to get to boxes by raccoons, in most instances the predator guard was sufficient in keeping them out.

Three nests were lost to high water and six more were abandoned for unknown reasons.

### *Trapping*

Retrap success was very disappointing throughout the study. Floating traps, Ohio traps, walk-in traps, and the cannon net resulted in a total capture of 67 immature wood ducks, of which 59 were large enough to band. Of these, 20 were previously web-tagged woodies and represented 13 different broods, of which 14 were large enough to band. This would seem to indicate a larger number of ducklings being produced in natural cavities than was suspected.

### *Web-Tagging Broods*

Three-hundred ninety-seven of 446 (89%) nest box produced ducklings were web-tagged. Four broods were missed upon hatching. Tag retention appeared to be very good. Only one duckling out of 20 that were recaptured had a tag missing; the tag on its other foot was still intact.

Two web-tagged ducklings from a first brood were captured after the hen had brought up a second brood. No other web-tagged ducklings from first broods were captured after the hen had renested.

### *Color Marking*

Eighteen previously unbanded females were fitted with brightly-colored nasal saddles for identification in the field. A total of 25 usable observations of "saddled" hens was recorded. These 25 observations included 10 different broods. Many observations were made in which saddle coloration could not be determined because of the distance of the brood from the observer. In these cases, the brood was counted and their ages estimated. Sightings had to be made at close range, particularly sightings of those hens that were marked with bi-colored saddles.

Three hens were caught near the end of the nesting season that had lost their saddles. In each case the nylon cord was pulled through the portion of the bill between the nares. None of the hens appeared to have suffered any ill effects. It is not known how the saddles were lost. They were fitted well and should not have been caught in vegetation while feeding. Sugden and Poston (1968) observed these markers did not appear to handicap ducks or affect their behavior in any way.

### *Movement of Broods*

Movement of broods did not cover great distances, but definitely involved movement from the smaller nesting ponds to the larger impoundments for rearing. This trend toward movement from smaller to larger ponds has been noted by others (Berg, 1956). Many broods were suspected of moving to the larger beaver ponds because they offered the best brood habitat on the area. It would be desirable to create openings in the dense, matted vegetation that is found in some of the beaver ponds. Vegetation in some areas is dense enough to restrict brood movement. Optimum brood habitat should contain a minimum of 25% open water (McGilvrey, 1966). Beaver ponds are probably more important as rearing areas since only 3 or 46 (6.5%) successful nests were

found in the beaver ponds. Forty-one nest boxes were available in the beaver ponds (21%). Hens preferred the wide-open ponds for nesting purposes.

### Brood Survival

Brood observations resulted in a total of 53 usable sightings. Twenty-five observations were of broods accompanied by a color-marked hen. Twenty-one of these observations were usable. Four observations of a color-marked hen could not be used; she had nested again in a natural cavity and the age of this second brood was unknown. These twenty-one broods could be aged exactly. Thirty-two observations were made of broods accompanied by unmarked hens. Ages of these broods were estimated.

Brood size of ducklings 4 to 7 weeks old was reduced by nearly two-thirds (see TABLE V).

TABLE V  
BROOD SURVIVAL PIEDMONT NATIONAL WILDLIFE  
REFUGE 1969

Brood Age (Weeks)	No. Broods Observed*	Ave. Brood Size	Survival
At hatching	46 (46)	9.7	100%
0 - 2	16 (10)	6.3	66.0%
2 - 4	19 ( 7)	3.7	38.17%
4 - 7	18 ( 4)	3.1	32.0%

\* ( ) Known age broods

Reports of brood survival has varied widely among investigators. Almond (1965) estimated that 50 to 60% of each brood was lost to unknown causes before reaching flight stage. Grice and Rodgers (1965) gave an average brood size over a three-year period of 5.8. From an average of 10.7 hatched, Baker (1969) observed an average brood size of 5.6 in Mississippi. In New York, Klein (1955) found 3.8 ducklings per brood.

Predation has been shown to be quite severe, particularly during the first two weeks of a duckling's life, (Grice and Rodgers, 1965) and (Baker, 1969). This appears also to be the rule on P. N. W. R. Reasons for this mortality are not known. Snapping turtles (*Chelydra serpentina*) are quite abundant on the area and probably took some ducklings. One large snapping turtle caught on Allison's Lake in 1967 was found to contain the remains of a wood duckling. Water snakes (*Natrix* sp) were abundant on the area but never seemed to bother ducklings. On several occasions large snakes were observed to swim within one or two feet of a young brood without causing any disturbance. No fear of the snake was shown by hens or broods.

Largemouth bass (*Micropterus salmoides*), bullfrogs (*Rana catesbeiana*), hawks (*Accipiter* sp.), foxes (*Urocyon cinereoargenteus*) and (*Vulpes vulpes*), and raccoons also may have been responsible for duckling mortality.

Botulism outbreaks (*Clostridium botulinum*) occurred in 1968 and 1969 on Impoundment 2A. Although only a few dead ducklings were found, many more probably succumbed to this disease.

Movement from nesting pond to rearing pond probably increased the duckling vulnerability to predators. Observations of broods were made as far as one-half mile from any water. An attempt should be made to provide better rearing habitat on small impoundments. This could reduce excessive brood movement and might also reduce brood mortality.



## CONCLUSIONS

Based on knowledge gained during this study, the following conclusions are made:

1. First nests of double-nesting hens probably contribute very little to overall wood duck production since most are probably lost to natural causes.
2. Predation on eggs while in the nest box is not severe. Grey rat snakes are the greatest threat and an effective deterrent should be installed on all boxes to prevent their entrance.
3. Brood survival is low on Piedmont but could be increased by providing more cover on all ponds, thereby reducing duckling vulnerability to predators.
4. A total of 194 nest boxes produced 446 wood ducklings resulting in an average hatch of 9.7.
5. Twenty-three and seven-tenths per cent of hatching year birds that were retrapped were previously web-tagged, indicating good production in natural cavities on the area.

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## HABITAT PREFERENCE AND SURVIVAL OF FLORIDA DUCK BROODS<sup>1</sup>

by

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### ABSTRACT

Florida Duck broods were captured and banded by nightlighting in fresh, salt, and brackish water habitats. Ducklings were most frequently observed in brackish water areas. Duckling survival as determined by brood size observations was lower than in other mallard subspecies. Most duckling mortality occurs immediately after hatching. Ducklings are very terrestrial, a behaviorism that reduces exposure to an abundance of predators associated with Florida's aquatic environments.

### Introduction

Data regarding population parameters and ecology of the Florida Duck (*Anas platyrhynchos fulvigula*) are virtually nonexistent. Lotter (1969) and LaHart (1970) effectively report existing autecological knowledge. This nonmigratory subspecies of Mallard is confined largely to peninsular Florida from Alachua County south to Cape Sable and Key Largo (Johnsgard 1961).

Florida Duck brood ecology was studied as part of a banding operation utilizing nightlighting in 1969. Data were collected from 35 broods in three basic habitat types.

### Brood Habitats

Coastal salt marsh habitat is characteristic of many areas along the Florida coast. Indicator plants include red mangrove (*Rhizophora mangle*), black mangrove (*Avicennas nitida*) and salt grass (*Distichis spicata*). In sheltered sites dense areas of widgeon grass (*Ruppia maritima*) may occur. At Sanibel Island, Florida Duck broods used this habitat extensively in the impoundments and in the Gulf. A freshwater ditch (Sanibel River) flows through the middle of the island, but no Florida Duck broods were found using it. This suggests a preference by broods for saltwater habitat at Sanibel.

At Merritt Island, brood preference was not as clearly defined. The Banana River is a tidal stream that flows from the interior of Merritt Island into the Indian River. Before the construction of the Kennedy Space Center, the Banana River drained extensive portions of the island. The habitat along its edges is typical of the coastal salt marsh. Lying to the north and running

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