Wood Duck Broods in Dixie:

Striving to Survive Early Life

Towering bottomland hardwoods, impenetrable thickets, and countless wildlife, all nourished by braided rivers, overland flows, and fertile soils, stretched all the way from southern Missouri to the Gulf of Mexico in the Lower Mississippi River Valley (LMRV). This seemingly endless web of lowlands that Spanish explorers, like Desoto, encountered in the 1500s must have been daunting. Among the breath-taking sights, early explorers wrote of beautifully colored "summer ducks" perched on tree limbs draped in Spanish moss. The ducks seemed omnipresent, especially in late winter and spring when adorned by their Mardi Gras-like plumage. Today, we know the "summer duck" as the North American wood duck or *Aix sponsa*, which translates to "waterbird in bridal dress." What must have seemed like a vermin-filled and merciless environment to European settlers was an ecological utopia for wood ducks.

For most people, familiarity with wood ducks may be linked to man-made structures (*aka* nest boxes) in which the species readily nests. Wood ducks evolved to nest in natural tree cavities to escape predators and periodic flooding that still occurs today in lowland forests of the LMRV. Because over 80% of the original 25 million acres of bottomland hardwood forest in southeastern United States has been lost to development, wood duck nest box programs, most beginning in the 1930s, have significantly helped the recovery of local wood duck populations from near extirpation due to over-harvest and habitat losses. Many wetlands in this region contain nest boxes, and, according to Dr. Frank Bellrose, the Father of Wood Duck Ecology and Management, an estimated 300,000 wood duck ducklings successfully depart 100,000 nest boxes annually in North America.

Waterfowl biologists have long known that nest success is primarily important for sustaining duck populations. However, hatched ducklings comprise only one component of the equation; survival of ducklings after they exit nests also is critical. For several decades, biologists attempted to estimate survival of ducklings by equipping brood-rearing females with a radio transmitter; then, daily or weekly, they followed radio-marked females and attempted to count their ducklings. Duckling survival could then be estimated by dividing the number of ducklings observed on that day by the original number that exited the nest. However, this approach may be inaccurate, because exact counts of secretive wood duck broods in densely vegetated swamps is nearly impossible. Also, sometimes ducklings from one brood join others, increasing brood size and biasing survival estimates upwards. Moreover, without radio-marked individual ducklings, biologists cannot determine time and causes of deaths of ducklings.

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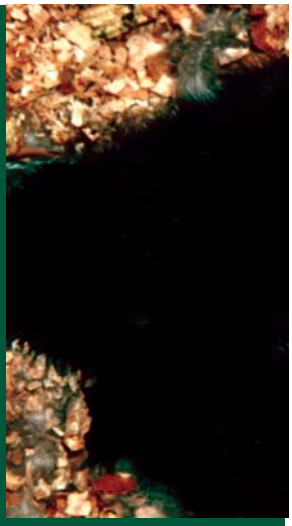

By the early 1990s, tiny radio transmitters (0.06 of one ounce each) became available, and waterfowl researchers surgically attached them to the backs of mallard and canvasback ducklings. This technology initiated an evolution in our understanding of duck brood ecology and management. In 1996, Mississippi State University began studies of the ecology and survival of wood duck ducklings and broods at Noxubee National Wildlife Refuge (NNWR, 1996-1999), Mississippi, and later in Alabama (1998-1999) at Aliceville Lake in the Tennessee-Tombigbee Rivers Waterway (TTRW).

Our study had some similarities to human medical research. For example, doctors that research cancer, heart, and other human diseases attempt to learn about factors that cause such maladies. For example, doctors may record age, gender, family history of the problem, personal diet and exercise routines, smoking and alcohol consumption, and other factors. Then, physicians assess these variables statistically to estimate a person's probability of surviving the disease.

Similarly, we measured certain characteristics of wood duck ducklings, their mother, and the environments they inhabited. For example, we determined age and body weight of hens that hatched ducklings, hatching date of the ducklings, duckling weight at hatch, initial brood size (i.e., number of ducklings that left nest boxes), distance traveled daily and types of habitats used, and minimum daily temperature and amount of rainfall. Because we were interested in duckling survival by habitat type, we conducted our study in sites that contained different habitats, including willow and buttonbush scrub-shrub, bottomland hardwood forest, cypress forest, and coves of rivers and reservoirs. Ultimately, we hoped this knowledge would improve managers' ability to help fledge wood ducks that hatched in nest boxes.

When we initiated the study, we posed several questions. Did survival of ducklings relate to their habitat use? Did cold spring and hot summer temperatures influence survival? Did larger broods mean more "duckling eyes" to detect predators and hence increase individual survival; or, were larger broods more easily detected by predators? Also, did ducklings' weight at hatch influence their survival? Would ducklings traveling shorter distances daily survive better than more mobile birds? Lastly, did date when ducklings hatched influence their survival? To answer these questions, we radio-marked 135 nesting females and 434 ducklings, and monitored them from March-July 1996-1999.

What did we discover? Overall, survival of wood duck brooding females was great at 91%. However, overall survival of ducklings only ranged from 15-28%. What variables contributed to duckling survival? Nearly all that we measured influenced duckling survival at NNWR. For example, we found that ducklings brooded by yearling females were 1.8 times more likely to die than those having an older, more-experienced mother. Also, the probability of duckling mortality decreased by 1.4% for each day that hatching was delayed. Surprisingly, this finding contradicted studies of nesting ducks in northern environments, where early-hatched ducklings tend to survive better than ones hatched late in spring. Another interesting discovery was that, as brood size increased by a single duckling, duckling mortality increased by 3.7%. Basically, ducklings in larger broods (i.e., >14 ducklings) did not survive as well as ducklings in smaller broods (i.e., <6 ducklings). Interestingly, mobility of broods was important; when ducklings traveled nearly a mile each day, their risk of dying decreased by 69%. This seemingly counterintuitive result may have been related to the broods'

seeking certain habitats during their daily movements. We'll talk more about this issue later.

How did weather affect survival of ducklings? Survival of ducklings in warmer temperatures (>70° F) was 38%, whether the day was rainy or not. In contrast, we found that cold and rain together decreased duckling survival slightly. When low temperatures of 30-40° F and rain occurred, duckling survival was approximately 16%. During low temperatures without rain, survival of ducklings increased slightly to 19%.

Perhaps our most interesting discovery concerned habitat-related duckling survival. Despite the overall low survival rate of ducklings (about 20%), we discovered that when broods traveled, sometimes nearly 2 miles from their nest-box hatching site, to scrub-shrub and bottomland hardwood forested wetlands that did not contain nest boxes, duckling survival was approximately 60%. In contrast, survival of ducklings ranged from 12-43% in wetlands containing congregations of nest boxes. Although there may be several explanations, scrub-shrub sites away from nest boxes may have supported decreased abundance and diversity of predators. And, these "jungle-like" habitats may reduce capture efficiency by predators.

At our Alabama study area, we found that 2 variables were primarily related to duckling survival; i.e., daily distance moved and brood size. Similar to NNWR, for nearly every mile traveled daily by ducklings, their risk of dying decreased by 98%. Also, ducklings survived better in smaller broods at TTRW. Lastly, duckling survival rates and patterns at TTRW were similar to those at NNWR. Duckling survival ranged from 22-39% in floating aquatic and emergent vegetation, such as giant lotus, water hyacinth, and water primrose. However, duckling survival was 71% in scrub-shrub and forested habitat that did not contain nest boxes.

Why were these variables important at both study areas? Perhaps older breeding female wood ducks were more effective at guiding their young to more suitable habitats--those habitats with greater protection from, or fewer, predators, and perhaps better food and other resources. Late-hatching ducklings may have had a survival advantage because, early in the breeding season (March-April), air and water temperatures were cold, wetlands lacked cover, and trees had few or no leaves. Wetland vegetation may have helped ducklings maintain body warmth, avoid detection by predators, and aquatic insects, the principal food of ducklings during their early life, often cling to vegetation in shallow wetlands.

Perhaps fewer ducklings survived in large versus small broods because females could not provide adequate care for each offspring. Or, perhaps predators may have detected large broods more easily. Greater survival of more mobile than sessile ducklings seemed surprising; one might expect ducklings to perish from long-distance travel. We'll never know for certain; however, perhaps moving to secluded habitats without nest boxes and reduced numbers and diversity of predators was a more successful survival strategy.

By now, you are probably wondering what was responsible for the relatively low survival of ducklings? The answer was PREDATION! We discovered 13 causes of death and tallied 324 mortalities of ducklings. Other birds and aquatic predators devoured 46% and 23% of all radio-marked ducklings, respectively. We found that red-shouldered hawks, barred and great-horned owls, great-blue herons, and a bald eagle caught and ate ducklings. Important aquatic predators of ducklings included spotted gar, snapping turtles, alligators, and several unidentifiable critters. One of the most interesting predators was the cottonmouth snake. This species killed 21 ducklings! In

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21 ducklings! In 1998, we captured one duckling-eating serpent that weighed 5.5 lbs. In addition to these predators, we suspected that bobcat, river otter, and other mammals (possibly mink) killed ducklings. Although mammals, particularly mink, are important predators of ducklings in northern wetlands, mammals depredated only 5% of wood duck ducklings in our study.

Apparently, a variety of critters prey on baby wood ducks. Therefore, what management actions should we take to enhance survival and recruitment of wood ducks? Some factors that negatively influenced duckling survival, such as effects of cold and low body weight of ducklings, rest with Mother Nature. However, because duckling survival was greater in wetlands without nest boxes, management intervention seems needed. For example, we have traditionally placed nest boxes conspicuously and often in congregations of varying density. Although conspicuousness and easy accessibility of nest boxes appeal to wood ducks and managers, it also may cause predators to "key" on groups of boxes and establish "ecological traps" for ducklings. Historically, natural nest cavities may have been more widely dispersed throughout lowland forests, and there may have been more extensive scrub-shrub habitats than nowadays. Thus, it is possible that hens and their broods were better able to disperse themselves and avoid detection by predators in the past, compared to today in smaller and more fragmented habitats. Much like historical times, we may enhance wood duck duckling survival by dispersing nest boxes within and among forested habitats, especially scrub-shrub habitat, such as buttonbush and willow. Likewise, establishing and maintaining scrub-shrub habitats adjacent to existing nest boxes may help lessen predation of ducklings. Finally, our research indicated that (1) using conventional large rather than small nest boxes (see FWRC Research Advances 3, No. 1, February 1998), and (2) removing unhatched eggs and nest down from boxes after the first peak of successful nests significantly increased subsequent use of boxes by wood ducks and duckling production. Indeed, we hope researchers and managers implement and evaluate our suggested management strategies throughout the breeding range of North American wood ducks to determine their broad-scale applicability.

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