Life (and Death) in a Nest Box

by Whit Gibbons and Kimberly Andrews

Rat snakes, along with other predators, can devastate populations of field mouse populations, but how much long-term harm do they cause?
When Robert Kennamer looks into an active wood duck box, he doesn’t always see eggs in the nest. Sometimes they may be out of sight under the hen, but hens often fly when he starts his climb up the ladder. When Kennamer does not see eggs in an active nest, it can mean they are inside a rat snake. However, even though he’s a wildlife ecologist studying wood ducks, his response is not “so long, snake.” Rather than facilitating the snake’s untimely end or transplanting it to a faraway location, Kennamer includes it in a long-term study on the relationship between a natural predator and its prey.

Kennamer is a research coordinator at the University of Georgia’s Savannah River Ecology Laboratory (SREL). During the past twenty-four years, he has put out more than 275 wood duck boxes and counted more than 31,000 eggs in the cypress/gum swamps, Carolina bays and other protected wetlands on the U.S. Department of Energy’s Savannah River Site (SRS), formerly a nuclear production facility near Aiken. His purpose is in part to enhance population levels of wood ducks, the only duck that commonly nests in the southeastern Atlantic coastal plain. But he has another objective as well, one that could bring far-reaching, long-term benefits to wood ducks and those who hunt them. Kennamer hopes his research will provide better understanding of nesting success for this highly prized game species. Part of that success is related to predation on the eggs and chicks by other animals that inhabit the same environments as wood ducks, especially predators that focus on artificial nesting sites such as wood duck boxes.

As an ecologist, Kennamer knows the importance of understanding a biological system before trying to manage it. As he says, “I decided to conduct the research necessary to find out the levels of impact that rat snakes have on wood duck populations in a region. Do they really do enough damage to cause concern, or are the snakes just a part of the natural ecosystem whose effects on wood

**Most common among native duck species nesting in South Carolina wetlands, wood ducks rely on artificial nest sites such as boxes placed in appropriate habitats.**
Kennamer’s techniques for monitoring wood duck nesting success are similar to those used elsewhere in the Southeast. He begins checking the boxes in early January to see if hens have begun to occupy the artificial nest cavities. By early February, the tedious but gratifying egg counting begins. As many as 85 percent of the boxes may have nesting wood ducks in a year, and when nest boxes are scattered over a 300-square-mile area of woodlands and wetlands, the days can be long.

Wood ducks in this region of South Carolina lay eggs as early as mid-January or as late as early July. The incubation period, which begins around the time the last egg is laid, averages about thirty-one days but may range from twenty-seven days to more than five weeks. This duration means that young ducklings may leave the nest cavity as early as the last week of February and as late as the middle of August. In years when it stays unseasonably cold into March, females that start nesting early have the advantage of avoiding some of the predation from rat snakes, but by late March in almost all years, the reptiles have begun to prowl.

How does the story begin? Wood ducks aren’t the only animals for which a duck box represents a hole in a tree. Anything might crawl in. During nearly two decades of checking inside the boxes, Kennamer has found screech owls, flying squirrels and even raccoons, a scary thought when you might be twenty feet up the side of a cypress tree. In fact, his list of species in the boxes has soared over the years and includes hooded mergansers, a variety of smaller birds and red wasps, which, he says, are “not my favorite thing to find in a wood duck box.” But during his first year of study, finding nineteen rat snakes in the boxes where wood duck eggs were, or had been, sparked an idea. Rather than remove the snakes, why not find out more about their behavior? Thus began what has become a classic study of rat snakes as predators on wood duck eggs.

Upon finding a snake in a box, Kennamer removes it temporarily and injects a tiny microchip known as a PIT tag into its abdomen. “PIT” stands for passive integrated transponder, and the tag will be carried...
by the snake as a permanent source of identification. Using a hand-carried reader, the researcher can scan a snake and, if a tag is inside, read the code number. The process is similar to scanning bar codes in a grocery store. Thus, once a rat snake is captured and tagged, it will have a unique identification code for life. Prior to 1994 when PIT tags were first used, Kennamer would mark snakes by clipping unique combinations of ventral scales from the snakes with scissors. If a snake has the bulges characteristic of one that has eaten duck eggs, the specimen is returned to SREL and X-rayed. The eggs are readily visible inside a snake and can be counted. The snake is then returned to the wetland where it was caught and is released.

At the end of the spring nesting period in 2004, Robert Kennamer had caught 176 rat snakes in and around his wood duck boxes since 1980. Of these, forty-three have been subsequently recaptured and identified by their PIT tag codes or scale clips. Including multiple captures of several individuals, Kennamer and colleagues have recaptured a total of eighty-one of the SRS rat snakes. He notes that the most frequently captured rat snake so far has been “a large male that we affectionately refer to as Stumpy because of his partially missing tail.” Stumpy was caught nine times over a seven-year period in one of the Carolina bays on the SRS. Kennamer is not certain how many wood duck eggs this snake might have consumed over the years, but he knows of at least twenty-two.

The largest rat snake Kennamer has caught was seven feet eleven inches in length (only a few inches below the national record), but the real record holder was a six-foot four-inch snake with ten wood duck eggs in its stomach. Rat snakes have been documented to live for more than twenty years in captivity, but few such records exist on those in the wild. In addition to Stumpy, Kennamer has recaptured one of his specimens after eight years and another after eleven. Both were already more than four feet long when first captured, suggesting that they were several years old at the time. The information also indicates that the same rat snake will come back to a particular wood duck box for many years.

A duck hunter might ask, Why not kill the rat snakes and protect the eggs in a nest? Robert Kennamer has at least two good reasons: “First, a dead snake provides absolutely no further information about the relationship between the predator and wood duck eggs. Second, rat snakes are a natural part of ecosystems and help maintain stability in population sizes of all their prey species, especially undesirable types of rodents.”

In regard to gathering information and understanding the biology of rat snakes, Kennamer has acquired potentially the largest data set available on their relationship with wood ducks. Determining the persistence of individual snakes to return to a box year after year gives insight into the abilities of the snakes as calculating predators. How do rat snakes find the nests and eggs? Although snakes can pick up chemical cues with their forked tongues, they probably find nests by sight. One observer reported seeing rat snakes crawl along the ground looking up for holes in trees, then climbing the tree.

Rat snakes have been reported to move more than three quarters of a mile in some studies. By learning how far the snakes move during a season and how often they return to the same box in different years, Kennamer is gathering additional information that will be useful in wood duck management. For example, he has found the same snake visiting as many as three different boxes in the same year, moving distances of more than a hundred yards between boxes, and he knows some have moved even farther. Thus, wildlife managers can be advised that, in terms of rat snake predation, dispersing nest boxes may be a more viable strategy than clustering them in an area.

Because they are cavity nesters, wood ducks have high nesting successes of 60 to 90 percent (of the nests hatching one or more young) in most regions of the country compared to ground- or open-nesting birds, which often have nesting successes below 30 percent. On the SRS, Kennamer has observed annual nest success ranging from 40 to 70 percent, with rat snakes being responsible for 10 to 80 percent of the failed

Kennamer’s X-ray photography reveals a rat snake’s appetite for wood duck eggs, this image showing nine eggs in the snake’s belly.
Few forget their first sight of a wood duck in the wild—the speeding flash of green, blue and gold, like a jewel against the grey-brown backdrop of a winter wetland. With their bright colors and clear, whistling call, these popular game birds attract waterfowl watchers and hunters alike to wetlands statewide. South Carolinians have always loved wood ducks, and now landowners who wish to enhance nesting opportunities on their property have a renewed opportunity to do so.

South Carolina has abundant wood duck habitat—enough forested wetlands, lakes, ponds, beaver habitat and coastal marshes to meet the needs of thousands of wintering and migrating “woodies.” The ducks' wide distribution and general abundance allow hunters to harvest them, and waterfowl enthusiasts to enjoy watching them, in all forty-six counties of South Carolina.

Amazingly adaptable, some wood ducks migrate south, and others may stay in South Carolina year-round, using a variety of wetland habitats from rapidly flowing creeks to ponds, swamps and marshes. We still see them in the Palmetto State in summer, long after most other waterfowl have flown north for breeding, so South Carolinians often call them summer ducks.

Wood ducks seek out naturally occurring cavities in forested areas to nest, and they rear broods of young ducklings near selected nest sites, usually in wetlands where emergent plants give them cover, and insects provide abundant, rich food. Researchers have documented wood duck nesting activities in isolated wetland areas, as well as suburban and even urban sites. But waterfowl biologists worry that loss of forested wetlands in South Carolina could leave wood ducks, one of only a few waterfowl that reproduce in the state, without enough naturally occurring cavity trees to meet their needs.

To protect wood ducks from declining habitat challenges, a program was begun by the S.C. Department of Natural Resources in 1982 to build and distribute wood duck nest boxes to concerned property owners. Since its inception, this popular project has provided some 30,000 nest boxes to nearly 4,000 landowners across South Carolina. As part of the deal, landowners voluntarily collected nesting information and reported back to DNR biologists. More than 500,000 wood ducks emerged from those boxes between 1982 and 2004.

Budget difficulties and a restriction of State Duck Stamp funds put the DNR’s nest box program on hold in 2003, meaning no new nest boxes were constructed and issued, but a new partnership has revitalized this popular project. The Governor’s Wood Duck Project will benefit the conservation and management of waterfowl, specifically wood ducks, by pooling resources of two agencies and a Lowcountry conservation organization.

The DNR, the S.C. Department of Corrections and the Historic Ricefields Association are partnering for the Governor’s Wood Duck Project, combining efforts on behalf of South Carolina’s “summer ducks.” The program uses private funds raised by HRA to purchase materials, such as wood, metal for predator guards, posts and hardware, to build nest boxes. DOC provides the labor to construct the nest boxes and fabricate predator guards. DNR encourages landowners to apply for wood duck boxes for appropriate areas on their property and to participate in annual maintenance, inspection and documentation of nesting activity. Participating landowners will receive technical assistance where needed. DNR will use the nesting information collected by landowners to analyze the impact of the nesting boxes and to publish their findings. Ducks Unlimited provided most of the funding for The Governor’s Wood Duck Project during 2004.

Wood ducks prefer forested wetland habitat for food, cover and brood rearing. If you have permanent freshwater ponds, lakes, streams or swamps on your property, you can help wood ducks by placing nesting boxes in these areas. Applications are accepted year-round and reviewed in the fall in order of receipt. Approved landowners must agree to install and maintain boxes, which are distributed in December, and to collect and submit data on nesting activity.

For more information or to receive an application, write Wood Ducks, 420 Dirleton Road, Georgetown, SC 29440; call (843) 546-9489; or e-mail DNR Waterfowl Biologist Bob Perry at perryb@dnl.sc.gov.  

Male wood duck.
The extreme variability in annual egg predation by rat snakes is a consequence of rat snake abundance, wetland conditions in the spring, and other environmental variables. Clearly, wood ducks have some very productive years when nest success is on the high end and predation by rat snakes and other predators is low; in other years, the reverse is the case, which achieves a balance that sustains populations of both the rat snakes (as a predator species) and the wood ducks (as a prey species). Interestingly, Kennamer has found that rat snakes sometimes eat only a few of the eggs in a clutch and leave the remainder unharmed. In many of these instances, the female duck then returns and successfully incubates the remaining eggs.

When asked about other predators, he notes, “Raccoons are also significant predators on the SRS, as well as in other areas where wood ducks nest, and often account for the majority of unsuccessful nests during some years.” In fact, raccoons usually destroy all of the eggs in a nest. Other predators include large fish, snapping turtles, mink, crows and a variety of birds of prey. Kennamer even found web tags of wood ducks in an alligator that had been accidentally killed.

Pre-fledging mortality rates are naturally high in most years and many, or perhaps even most, young never survive the fifty-day period as ducklings because they die from other natural causes. Kennamer believes that exposure of young ducklings to inclement weather is responsible for a great part of the loss. Studies by Kennamer and his colleagues at SREL show that of almost 13,500 eggs that hatched during the study periods, only about seven hundred of the ducklings survived to adulthood.

Rat snakes are never likely to have a major impact on wood ducks on a regional scale or on a long-term basis. In fact, without them around as predators, the wood duck's increased productivity would likely reach unsustainable levels. Rat snakes and wood ducks both have a place in the natural ecosystems of southern wetlands and represent a classic predator-prey relationship. Robert Kennamer may be closer than anyone else to understanding exactly what that relationship is.