White-Tailed Deer

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From a public relations standpoint, the white-tailed deer (*Odocoileus virginianus*) is probably the most important wildlife species occurring on the Savannah River Site (SRS). The SRS deer herd has been the subject of more scientific investigations than any comparable deer population in the world, resulting in more than 125 published papers. Each year more than 5,500 people apply to be drawn for one of the public hunts, and with articles in hunting magazines such as *Buckmasters* (Handley 2000), hunters have applied from as far away as Alaska and Italy. In thirty-six years on the SRS, over 150,000 hunters have harvested over 40,000 deer. Each deer harvested in South Carolina brings an estimated $1,500 into state and local economies (U.S. Department of Interior et al. 1997).

The current SRS deer population grew from a few individuals that were present in 1950. Early workers realized that the study of a young, rapidly expanding population would provide invaluable insights into the basic biology of the species (Urbston 1967). Accordingly, researchers have collected a broad base of data on nutrition, reproduction, antler growth, parasites, genetics, and movement for this population since the early 1960s. Such a large database exists for no other deer population in the world.

Population History

When the Atomic Energy Commission, later Department of Energy (DOE) acquired the SRS during 1950 and 1951, deer were practically unknown in the area. Overworked farmland provided little suitable upland habitat, and continual pressure by the public had all but extirpated the species. In 1950, an estimated one to two dozen animals occupied the inaccessible portions of the Savannah River swamp (Jenkins and Provost 1964).

The DOE closed SRS to the public on December 14, 1952, and until 1965 there was no public use of the wildlife resources. Except from limited poaching, the deer population had complete protection. Deer habitat quickly improved, and by 1965, range conditions were considered excellent over most of the SRS (Urbston 1967). Land management converted farm fields to pine plantations, providing needed cover. Hardwood mast was readily available in the extensive bottomland hardwoods, along old fencerows, and at old house sites (Wiggers et al. 1978). In 1963, the deer population was approximately 1,400 animals (Jenkins and Provost 1964). Within fifteen years, deer had expanded to all areas of the SRS (Urbston 1967).

During the spring of 1965, estimated deer density exceeded 8 per km^2 (20 per mi^2) in some areas such as the river swamp (Payne, Provost, and Urbston 1966). Although sitewide numbers remained low, browse lines had developed in these areas, the physical condition of deer had declined, and there was an increase in deer-vehicle accidents on the site (Urbston 1967). As a result, SRS initiated public hunts on a limited area of the site during the fall of 1965. The hunts used dog drives (hereafter, dog-hunting), a traditional method of hunting deer in the South Carolina Low Country. Each hunt consisted of about 150 hunters and over three hundred dogs on units that averaged 1,851 ha (4,574 ac). Hunters harvested both sexes and all ages of deer with no bag limit (Payne, Provost, and Urbston 1966). Because of buck-only harvest laws elsewhere in the state, most hunters had never had the opportunity to shoot deer of any sex or age, and word spread about the number and quality of deer taken on the early SRS hunts. Dog-hunting effectively removed large numbers of deer from hunted areas in a short time. It also satisfied security and safety concerns, because SRS could control hunter location and hunters used shotguns instead of high-powered rifles.

In 1968, SRS initiated still-stalk hunts (hereafter, still-hunting) on two areas. Those areas, outside the fenced security areas, were on the north and southeast sides of the Site and included about 19,100 ha (47,200 ac). Two to three times each year, between two hundred and four hundred hunters were allowed one day to scout the area and the next three days to hunt. Although still-hunting was less efficient than dog-hunting (an 11 percent versus a greater than 25 percent hunter success rate; Novak et al. 1991), in 1980, SRS expanded it to most areas to reduce the personnel needed to run hunt operations. After a shooting accident during a hunt the following year, SRS eliminated still-hunting, however, and dog-hunting has been the only method used since.

During the still-hunting period, the number of hunters and the annual harvest varied yearly. Hunters removed more deer, and hunter success was much higher in the dog-hunted area than in the still-hunted area. In addition, with the initiation of dog-hunting in the previously still-hunted area, total harvest and hunter success increased to a level approximating that of the previously dog-hunted area (Scribner et al. 1985). From 1982 to 2000, the estimated prehunt population of the site fluctuated between 3,200 and 5,900 deer, with an average of 4,311. Annual harvest during the same period has ranged from 294 to 2,063, with an average of 1,180.

Several changes in the operation of the dog-hunts accompanied the cessation of still-hunting in 1982. The SRS increased the minimum distance between hunt stands from 122 to 183 m (400 to 600 ft). The number of standers and dog packs used in each hunt increased, as well as the number of hunts. In 1994, because of increased safety concerns, SRS again increased the distance between stands from 183 to 274 m (600 to 900 ft). In 1996, in an effort to raise efficiency and lower cost, the number of dog packs again increased, by as many as twenty-five on some hunts. Recent work indicates that deer rarely leave their home range when pursued by dogs, and those that do return within less than twenty-four hours (D'Angelo et al. 2003).

Population Dynamics

Data on the demographics of the SRS deer population help form management strategies. The extensive database from harvest records beginning in 1965 includes the location, age, sex, weight, antler development, lactation status, and in utero number of fawns (when discernible) for each deer harvested. Researchers have derived the age structure and sex ratio of the population, as well as location-, age-, and sex-specific fecundity rates (Payne, Provost, and Urbston 1966; Johns et al. 1977; Rhodes et al. 1985). Novak et al. (1991) derived the 1965 population size (the first year of the hunts); subsequently, using a life table model, Novak, Johns, and Smith (1999) retrospectively estimated population size for 1965 through the early 1990s. Since that time, researchers have used this model annually to predict the size of the prehunt population and thereby help formulate annual harvest strategies (figure 6.11).

The number of births relative to the number of deaths determines the size of the SRS deer population; immigration and emigration are negligible because of the size of the SRS (J. Novak, Savannah River Ecology Lab, pers. comm.). The number of births is determined by the sex ratio (i.e., used to derive number of does in the population), the age structure of the doe population, and age-specific fecundity rates. The sex ratio of 0.96 does per buck approaches evenness, represented by 1.0 (i.e., a 1:1 ratio). This is attributable to the either-sex harvest and has not varied significantly over time (Novak, Johns, and Smith 1999). In contrast, the age structure of the female component of the population shifted modestly between the

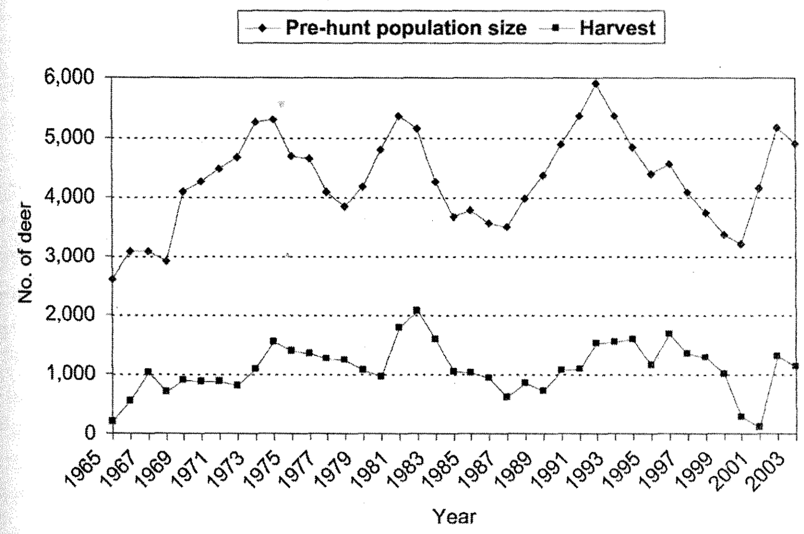

Figure 6.11. Estimated size of the deer population and number of deer harvested on the Savannah River Site, 1965–2003.

periods 1985–1989 and 1995–1998, with a decrease in the number of fawns (0.5-year) and yearlings (1.5-year) and a concomitant increase in the number of 2.5-year-old does (Novak, Johns, and Smith 1999). Long-term averages for age-specific fecundity rates (fawns per pregnant female) are 1.06 for 0.5-year-olds, 1.56 for 1.5-year-olds, 1.73 for 2.5-year-olds, and 1.76 for 3.5+-year-olds (Rhodes et al. 1985). With the exception of the swamp population during the 1960s, these figures have varied little across the population levels that have existed at SRS (Rhodes et al. 1985). Nearly 100 percent of adult females (1.5+ years) conceive. However, the most important factor that has influenced the ability of the population to sustain high levels of harvest and to recover from overharvest has been the conception rate of doe fawns (i.e., 0.5 years old). As the population size decreases, the number of fawns that breed increases (Johns et al. 1977). At high population levels, fewer fawns breed; whereas at low levels, the incidence of fawn breeding approaches 40 to 50 percent (Urbston 1967). As fawns may account for as much as 34 percent of the doe population (Novak, Johns, and Smith 1999), their breeding can have a significant impact on total annual production.

The number of deaths in the population is largely determined by harvest level, as Novak et al. (1991) found that natural mortality is minimal. Harvest has been able to control the SRS deer population (figure 6.11).

Due to a misunderstanding of certain effects, some hunt units were overharvested during the mid to late 1970s. The population had increased between 1952 and 1974, but in 1975 it began a decline that continued through 1978. After 1978, SRS reduced dog-hunting effort and did not hunt some units for a couple of years. With more still-hunts over the next three years (1979–1981), the population increased, due to the lower efficiency of that hunt method. However, with the return to dog-hunts as the sole method of harvest in 1982, combined with the belief that the population could not be overharvested, the number of both stand and dog-hunters increased. As a result, by 1987, the population had declined to levels not observed since the late 1960s. By lowering the total number of hunts and skipping hunts in certain units in 1987, the population began to increase once more. In 1989, hunts resumed at previous levels, with two to five units "rested" (i.e., not hunted) each year. Under that system, the population increased until 1992 and remained fairly high until the mid-1990s. In 1995, SRS again increased the number of dog packs used per hunt in an effort to remove more deer. This strategy was so efficient that by 2000, the deer population had again declined to mid-1960s levels. During the 2000 season, all hunts except two that targeted high deer-vehicle accident areas were buck-only. Within two years, the population increased by 61 percent.

Thus, knowledge of reproduction and harvest facilitate estimation of population size. Given the current year's prehunt population size, managers can predict next year's prehunt population by determining the number of bucks and does in the population, subtracting the harvest of each, and adding the expected reproduction. Annual reproduction is simply the sum of age-specific productivity, determined by multiplying the number of does in each age class by the age-specific fecundity rates. Without annual harvest, the SRS deer population is theoretically capable of more than doubling in two years.

In recent years, two factors may have complicated the methods described above for estimating population size. First, coyotes colonized the SRS during the late 1980s and 1990s and now are common. Although predation of adults is probably rare, together with bobcats, they could affect fawn survival. Second, the region experienced severe drought from 1999 to 2002. The extent to which drought conditions may have affected habitat quality, and hence productivity, is unknown. However, although Novak et al. (1991) determined that nonhunting mortality was insignificant in the SRS population prior to their study, the recent changes in predator populations and possible changes in habitat conditions conceivably could have impacted annual recruitment. The only data available to evaluate that possibility are annual spotlight surveys conducted on SRS. In recent years, population estimates derived from the spotlight counts have been somewhat lower than the predicted population size. Spotlight estimates are based on actual counts of deer, but spotlight censusing includes some potential biases. The predictive model is based on robust statistical procedures and sound data, but it does not consider nonhunting mortality. Whether recent low spotlight estimates reflect normal sampling error or true population declines resulting from depressed recruitment is unknown. However, if the latter is true, harvest guidelines (which are based on population model predictions) may have been excessive, further compounding the problem. This issue warrants further investigation.

An interesting characteristic of the SRS population is the difference between river-swamp and upland deer. During the mid to late 1960s, the river swamp that had served as a refuge for the founding individuals became overpopulated, and Urbston (1967) noted evidence of decreased body condition. However, on the remainder of the SRS, the population was still expanding and had not reached carrying capacity when intensive hunting began (Urbston 1967). The deer in the swamp differed demographically and genetically from those in the upland (Urbston 1967, 1976; Urbston and Rabon 1972; Johns et al. 1977; Dapson et al. 1979; Ramsey et al. 1979). For example, fecundity, body size, and antler development were lower in the swamp than in the upland. Most of these differences occurred during the early expansion phase of the herd, and though some still exist, they have decreased over time. Seasonal home range size of adult does at SRS averages 188 ha (465 ac; D'Angelo et al. 2004).

Population Management

Deer management on SRS is an ever evolving process. Prior to 1991, SRS conducted the hunts—as in most locations—without information on the population's size. Harvest was occasionally adjusted, as described above, based on perceived changes in population density, as well as in response to numbers of deer-vehicle accidents, but no long-term goal existed for population size. By 1991, estimates of population size had become available, and the SRS deer management team developed a long-term goal of five thousand deer in the prehunt population. The current SRS Deer Management Plan (U.S. Forest Service–Savannah River 2000, unpublished) states that the purpose is "to maintain the population at a level that minimizes both the number of deer-vehicle accidents and damage to the SRS landscape (i.e., native plant communities, timber plantations), yet supports a quality hunt program that benefits the economies of local communities." This plan prescribes a long-term prehunt population goal of four thousand deer.

The adjustment of the population goal from five thousand to the current figure of four thousand resulted from a combination of factors. The primary objective of the deer hunts at SRS has always been to minimize the number of deer-vehicle accidents on site. The original population goal was based on two assumptions: that hunting controls population size and that the number of deer-vehicle accidents is a function of the population size. The first assumption has largely been valid at SRS. Recent analyses, however, indicate problems with the second assumption. Population size explains only 34 percent of the annual variation in the number of deer-vehicle accidents (figure 6.12a). Although low population levels occasionally result in fewer accidents and high population levels occasionally result in more accidents, the relationship does not hold at intermediate population levels. Therefore, other factors affect the number of deer-vehicle accidents per year. For example, the size of the SRS workforce (as an index to traffic volume) explains 42 percent of the variation in accident numbers (figure 6.12b), indicating that workforce size is at least as good a predictor of the number of accidents as deer population size. Although an extremely low deer population may result in fewer accidents, such a population would not support an annual harvest sufficient to attract enough hunters to control the population over the long term. Therefore, management for such a small population is undesirable.

The current long-term management goal may result in slightly fewer accidents while allowing for a long-term sustainable harvest of approximately nine hundred deer, assuming maintenance of the historical even sex ratio. Such a harvest would allow a more stable long-term population well below the carrying capacity of the habitat, allowing for maximum productivity of does and quality antler and body development of bucks. A prehunt population size of 4,000 approximates the long-term mean of 4,285 for the period 1965–2000.

Deer-Vehicle Accidents

The annual number of deer-vehicle accidents reported on SRS has ranged from 16 to 104, with an average of 53 during the period 1965–2003. Comparison of accident figures over time, is problematic, however. For

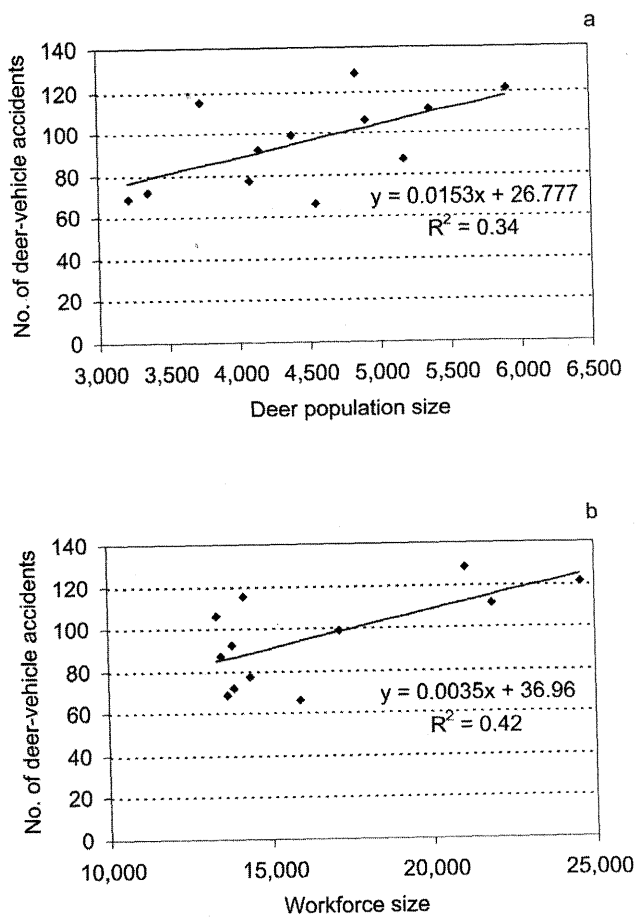

Figure 6.12. Relationship between the number of deer-vehicle accidents and (a) the estimated size of the deer population and (b) the size of the workforce on the Savannah River Site, using comprehensive accident data 1992–2003.

example, factors such as the number of roads open to traffic and the particular roads monitored for accidents confound assessment of potential trends, so the data are not exactly comparable among years. Also, the proportion of total number of accidents actually reported has fluctuated dramatically, according to changes in insurance reporting laws. Thus, long-term accident figures underrepresent the true number of accidents that occurred each year by an unknown and variable percentage. Therefore, since 1991, the Savannah River Ecology Laboratory has recorded all known deer-vehicle accidents on SRS, including those for which no official accident report was prepared. During the period 1992–2003 (which included some of the highest and lowest population levels recorded on SRS), the number of known accidents per year has ranged from 69 to 128, with an average of 95 (Johns, unpublished data). The number of accidents reported underestimates the actual number of accidents by at least 34 percent.

This more comprehensive database also has identified several patterns in the incidence of deer-vehicle accidents. For example, most accidents occur around dawn (50 percent) and dusk (30 percent), and more than half of all accidents occur during the fall (53 percent), when the rut occurs. Thus, accidents tend to be most frequent when peak traffic volumes (due to shift change) coincide with high deer activity. During this period, mature bucks cause 71 percent of the accidents. Accident "hot spots" shift from year to year along any given stretch of roadway, indicating that localized placement of deer crossing signs may not reduce the number of accidents. Thus, factors that affect the number of accidents include the number of vehicles on the road, the pattern in time of traffic flow, the particular roads open to traffic, and the demographic structure and spatial distribution of the deer population.

The number of accidents increases in areas where hunters are farthest from roadways. The area of the SRS contained in the unhunted 274-m (300-yd) safety buffer along either side of roadways is 8,425 ha (20,819 ac), or 10.5 percent, of the entire area of the SRS. Since deer densities may be higher in corridors along roadways as a result of the safety buffer, experimental hunts along three SRS roads during 2000–2002 specifically targeted the protected buffers by closing roads during hunts. Current research (C. Comer, University of Georgia) is examining whether SRS deer exhibit a social structure that might allow this intensive localized removal to result in a reduced density along roads that is sustainable over the long term. If so, such hunts might ultimately reduce the number of deer-vehicle accidents. This work may also explain why the occasionally heavy removal of deer in areas away from roadways, while necessary to control the sitewide population level, has little impact on the number of deer-vehicle accidents.

Radiological Concerns

Some hunters have voiced concerns over the health risk of consuming venison taken from the site. Deer at SRS generally exhibit radiation levels (i.e., radiocesium, ^{137}Cs) no higher than normal background levels in

deer from similar pine-hardwood habitats across the southeastern United States (Jenkins and Fendley 1971; Savannah River Ecology Laboratory 1999). The primary source of radiocesium in southeastern deer comes not from SRS operations, but rather from fallout from the above-ground nuclear weapons testing that has occurred worldwide since the 1950s (Haslow 1991; Wentworth 1998).

All animals harvested on SRS hunts are monitored for radiological contamination, and the radiocesium levels of all deer taken by an individual hunter are tracked over the course of each hunting season. No hunter is allowed to receive a cumulative dose of more than 100 millirem (mrem) of cesium. Thus, SRS confiscates any deer harvested by a hunter that would put that individual over the 100-mrem limit for the year. This threshold dose level for confiscation is more stringent than the guideline set by the Environmental Protection Agency for consumption of fresh meat (U.S. Environmental Protection Agency 1989). Of more than forty thousand deer harvested at SRS, only one has ever been confiscated (Savannah River Ecology Laboratory 1999). No other deer have even approached radiocesium levels that would trigger confiscation.