

The Ups
& Downs,
Hows &
Whys of

WILDLIFE Populations

By Colin Carpenter

You feel good as you load the fat four-point buck into the bed of your pickup. It's the Monday before Thanksgiving and you were only in the woods for two hours when the unsuspecting buck walked into your cross hairs. You're thinking about the work that lies ahead in processing the buck for the freezer as you pull into the game checking station. Several West Virginia DNR wildlife biologists are set up in the parking lot, taking measurements from a buck brought to the check station by a hunter ahead of you. As you pull up beside the other hunter, one of the biologists tells you that they'll check the deer for you and that they would like to take some measurements from your deer.

As you watch, the biologists weigh and age the deer and take a number of antler measurements. They explain that the data from the buck you've killed will be used to wisely manage West Virginia's white-tailed deer population. Scenes like this happen every fall throughout West Virginia and the entire range of the white-tailed deer. Wildlife biologists use these data to monitor the population dynamics of the species.

Many hunters who have harvested game in West Virginia have contributed to the management of the



species they hunt, whether it's deer, bear, turkey, grouse or migratory birds. Wildlife biologists collect data from harvested animals and from animals studied in research projects to determine birth rates and the impacts of hunting and natural mortality factors on the populations of different species. Simply put, population dynamics refers to all the changes in the number, sex and age that take place in a population during a given time period.

A myriad of factors influence the populations of a given species. Entire college courses are dedicated to the study of population dynamics, and many wildlife professionals devote their careers to this one topic. What follows is a crash course in the basics of population dynamics. Don't worry, there won't be a test at the end!



Mark Shrock

The number of fawns born per doe is an important statistic in managing deer populations.

The Four Main Factors that Control Populations

1. Natality

One of the first principles involved in determining the population dynamics of any species is estimating the number of animals born each year. The number of young born in a given unit of time is referred to as the birth rate or natality. Most big game species reproduce once a year, so biologists are interested in finding out how many young are born to each female on a yearly basis. The average number of young produced each year is often used to compare birth rates between populations of the same species. Birth rates can be difficult to measure because they are influenced on a yearly basis by factors such as number of females of breeding age in the population, natural food conditions during the previous year, mating habits of the species, and population density.

Wildlife biologists collect data about birth rates from both harvested animals and animals wearing radio transmitters during research projects. It is possible to determine the number of young that deer and bears would have produced by examining ovaries

from harvested animals and looking at developing embryos or placental scars. This technique has been used in the past for deer in West Virginia, but is not currently used because the vast majority of deer that biologists handle at check stations have been field dressed and had all of their organs removed.

Wildlife biologists do examine the reproductive tracts of harvested black bears to count either embryos or placental scars. If embryos are present in the reproductive tract, the bear was bred in the year of harvest and would have given birth in January or February of the next year. If placental scars are present in the reproductive tract, it means that the bear gave birth in the year of harvest. Female bears have cubs every other year. Although it is illegal to harvest a female black bear accompanied by cubs, females sometimes don't carry litters of cubs to term. If the female lost her litter after the breeding season, she would not be pregnant but placental scars would be visible.

2. Mortality

The next major factor that influences population dynamics is mortality, or the number of animals that die during a given period of time (deaths per year). People often ask wildlife biologists how long a certain species lives. The main problem with using published estimates of longevity is that the ages often come from animals in captivity that live much longer than animals in natural environments. Wildlife biologists are more interested in what causes death and the rates at which these mortality events occur.

Some of the most valuable data concerning mortality can be collected by determining the age at death for animals killed by hunters. Age at death information from hunter-harvested animals is widely used because large amounts of data can be collected cheaply during a short period of time. These data can then be inserted into what is called a life table (more accurately a death table) to “back-calculate” population size in previous years. As a population ages, there are fewer and fewer individuals in the oldest age classes due to death. Life tables also allow biologists to calculate survival rates of populations and study the interaction of the birth and death rate. Actuaries use human life tables to help calculate your life insurance premiums!

Wildlife biologists often use birth rate and mortality data collected during research projects using animals wearing radio transmitters to verify or add to the data generated by life tables. Animals wearing radio transmitters allow researchers to determine the actual number of young born, which can differ from the number of young determined by examining ovaries. In addition, animals wearing radio transmitters allow biologists to estimate natural mortality, which cannot be calculated with a life table.

3. and 4. Emigration and Immigration

Emigration and immigration are usually discussed together. Animals that leave a population and do not return are emigrants. Immigration is one-way movement into a new area or population. Wildlife biologists often assume that the effects of emigration and immigration cancel each other out, but this is not always the case.

The concept of dispersal is tied to both emigration and immigration. Dispersal is defined as the movement of an animal away from the area where it was born into a new area. Dispersal is a regular occurrence in wildlife populations and often occurs more frequently when population densities are high. In many wildlife species, males disperse farther than females. Increased dispersal distance often leads to higher mortality rates for males. Researchers speculate that males disperse farther than females as an adaptation that prevents inbreeding.



David Welman

WVDNR and the Virginia Department of Game and Inland Fisheries completed a gobbler survival study in which biologists trapped and equipped birds with radio transmitters to determine harvest rates and other mortality factors.

Legally harvested bears, such as this one taken by the author, are considered as additive mortality and are factored into bear management decisions.

Additional Concerns for Hunted Populations

Compensatory Mortality

Population dynamics are difficult to study in populations that are not hunted. Adding hunting to the equation makes studying population dynamics even more challenging. One of the questions that wildlife biologists have asked themselves about hunted species since the beginning of the wildlife management profession is, “Is hunting mortality compensatory or additive?”

The concept of compensatory mortality assumes that one kind of mortality replaces another kind of mortality in a population. An animal dying from one cause, such as disease or predation, cannot die from another cause such as hunting or starvation. In a population where compensatory mortality is present, the total mortality rate will not be greatly influenced by changes in any one single cause of death. If death due to predation in one year is 10 percent and death due to disease is 25 percent, the total mortality is 35 percent. If in the next year, death due to predation is 25 percent and death due to disease is 10 percent, the effect of predation is compensatory. It’s important for wildlife biologists to know whether hunting mortality is

compensatory because the total annual mortality rate may remain unchanged with or without legal hunting.

In general, wildlife populations that produce multiple litters of multiple young each year such as rabbits and squirrels display compensatory mortality, so mortality due to hunting just removes individuals that would have died from other causes. In some wildlife populations, however, hunting mortality is considered compensatory only up to a certain level. Biologists have determined that rates of hunting mortality for female wild turkeys in some populations can reach 10 percent and still be considered compensatory. In addition, biologists studying ruffed grouse in West Virginia and Virginia found that the rates of hunting mortality observed in their study were compensatory.

Additive Mortality

The concept of additive mortality assumes that the effect of one kind of mortality is added to other sources of mortality. If predation takes 25 percent of a population in one year and disease takes 15 percent, the total mortality for the year is 40 percent. If in the next year, predation takes 25 percent of a population and disease takes 20 percent, the total mortality for the year is 45 percent. In this case, the two death causes are additive. In populations where additive mortality is present, hunting can be viewed as an additional source of mortality that will increase total annual mortality.

In most populations, black bears suffer very low rates of natural mortality (less than 10 percent total mortality). The vast majority of black bear deaths in a given year can be attributed to humans through legal hunting mortality, vehicle collisions, and killing of bears for nuisance behavior. Therefore, these human-caused



Steve Wilson

If deer populations are not managed at levels suitable for the habitat, density dependent factors may affect the population.

deaths are considered additive to total mortality. However, a conservative hunting season structure designed to protect adult females has allowed black bear populations to grow.

Density Dependence

Many wildlife populations are influenced by density-dependent factors. A density-dependent factor acts in proportion to the number of animals per acre or square mile within a population. Natality and mortality often fluctuate with changes in density. Some diseases are density-dependent, meaning a higher percentage of the population becomes infected as density increases. White-tailed deer populations often exhibit density-dependent reproduction. As white-tailed deer populations grow, less food is available to feed all animals in the population. A reduction in food leads to delayed sexual maturity for females, decreased reproductive rates, and a lower rate of fawn survival. This is why wildlife biologists encourage the harvesting of antlerless deer. Deer populations that are in balance with the amount of natural food that the habitat can support will consist of healthier animals.

A density-independent factor is a factor that operates independently of population density. Wildlife biologists usually have no control over density-independent factors. Droughts, hurricanes, floods and severe winter storms are examples of density-independent factors. Although wildlife biologists cannot control Mother Nature, they can help to lessen the impacts of density-independent factors by keeping wildlife populations in balance with the habitat.



Photo by Mark Shock

Carrying Capacity

Two kinds of carrying capacity interest wildlife biologists. The first is called biological carrying capacity. Biological carrying capacity is the maximum number of animals that a particular habitat can support over a sustained period without causing damage to the habitat. Biological carrying capacity can change on a yearly basis due to weather and food conditions. Wildlife populations in West Virginia greatly depend on hard and soft mast crops on a yearly basis for survival and reproduction. In most cases, reproductive output and survival of young are negatively impacted following a mast failure. The opposite is true following a good mast year.

The second type of carrying capacity that is important to wildlife biologists is sociological carrying capacity. Sociological carrying capacity refers to the maximum number of animals that the human population living in a given area will tolerate. In most cases, biological carrying capacity is higher than sociological carrying capacity. The disparity between the two types of carrying capacity is increased as suburban



Kim Shomo

Biologists must consider sociological carrying capacity when managing deer populations in West Virginia, particularly near urban areas.

The Importance of Long-Term Data Collection

Wildlife populations are constantly changing in response to both environmental factors and social factors within the population. The fact that these populations are dynamic makes it difficult for wildlife biologists to say anything with certainty about how these populations fluctuate. In most cases, wildlife biologists do not have techniques to determine the exact number of animals in a population. Therefore, wildlife biologists study trends in data. They need to know whether the population is stable, increasing or decreasing. Wildlife biologists collect data on wildlife populations, the hunters that pursue the populations, and natural food conditions to analyze the impacts of these factors on one another. The complexity of biological systems requires the collection of data on a continuing basis. As data sets become larger, trends within the data become easier to detect.

An example of the importance of long-term data collection can be illustrated with the recently-completed study of black bear population ecology in West Virginia. Information concerning black bear survival, reproduction and home ranges had been collected in the eastern mountain counties in West Virginia since the early 1970s using radio-collared bears. In response to a perceived increase in the black bear population in the southern coalfields, Wildlife Resources Section personnel placed radio collars on additional black bears beginning in 1999. The southern study was originally planned to run five years, but was extended for another five years to collect additional data.

sprawl puts humans into direct contact with wildlife. In many cases, the introduction of human development into forested habitat increases biological carrying capacity. In the case of deer, it increases the variety of food by creating more diverse vegetative communities. For another example, suburban sprawl means bears have easier access to food because people either feed the bears on purpose (a bad idea!) or unintentionally feed them by leaving dog food, trash or other edibles unsecured.

Sociological carrying capacity is very important for wildlife biologists to monitor. In order to maintain support for wildlife management programs, citizens must be assured of reasonable protection from property damage or bodily harm caused by wildlife. Negative attitudes about wildlife caused by overpopulation contribute to society devaluing the wild animals that we strive to manage.



DNR photo

Wildlife Resources Section personnel collect data from a hunter-harvested deer at a game check station.

Reproductive rates for adult female black bears on the southern study area were three cubs per female during the first five years of the study, significantly higher than for bears in the northern study area. However, after analyzing 10 years of reproductive data, reproductive rates on the southern study area for adult females were 2.85 cubs per female which was not significantly different than those in the northern study area (2.71 cubs per adult female). If wildlife biologists had only collected five years of data, conclusions regarding population growth potential may have been overestimated.

The Costs of Data Collection

Wildlife Resources Section personnel spend a considerable amount of time and money collecting biological data to manage wildlife populations on a yearly basis. A major goal of both wildlife biologists and wildlife administrators is to identify the most cost-effective methods of monitoring wildlife populations. Therefore, wildlife biologists regularly evaluate their data collection needs and the costs associated with collecting the data.

A recent example illustrating an analysis of the costs associated with data collection comes from the Black Bear Research Project. Wildlife biologists have

collected data concerning black bear reproductive rates and survival rates using radio-collared animals in addition to teeth and reproductive tracts collected from bears killed by hunters. Analysis of long-term data sets collected by both methods indicated that the number of cubs produced per female and survival rates did not differ between the two methods of data collection. The estimated yearly cost of collecting data from radio-collared animals was \$216,918, while the estimated yearly cost of collecting and processing bear teeth and reproductive tracts was \$33,271. Wildlife biologists can collect the same data from hunter-harvested animals as they do from radio-collared animals at a much reduced cost. This illustrates the importance of teeth and reproductive tracts submitted by successful hunters in managing West Virginia's black bear population. However, radio telemetry studies yield a greater variety of statistical information which biologists can use to manage the bear populations wisely.

The Take Home Message

The DNR Wildlife Resources Section devotes a great deal of time and money each year to collect biological and sociological data used to manage wildlife populations. In many cases, data supplied by successful hunters is critical in detecting trends in wildlife populations and in setting future seasons and bag limits. Hunters are and will continue to be an integral part of wildlife conservation efforts.

Each fall as hunters take to the field, wildlife biologists will be ready to collect data from the animals that are harvested. Hunters can be assured that the data they supply will be used to wisely manage wildlife populations and to continue providing the recreational opportunities they enjoy.

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