

National Park Service  
U.S. Department of the Interior

Northeast Region  
Philadelphia, Pennsylvania



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## **Assessment of Hunting Impacts at New River Gorge National River, West Virginia**

Technical Report NPS/NER/NRTR—2006/051



**ON THE COVER**

View from main overlook at Grandview.

Photograph by: Courtesy of New River Gorge National River.

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# **Assessment of Hunting Impacts at New River Gorge National River, West Virginia**

Technical Report NPS/NER/NRTR—2006/051

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Philadelphia, Pennsylvania

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## Executive Summary

Congress authorized creation of the New River Gorge National River (NERI) in 1978, for the purpose of, "...conserving and interpreting outstanding natural, scenic, and historic values and objects in and around New River Gorge and preserving as a free-flowing stream an important segment of the New River in West Virginia for the benefit and enjoyment of present and future generations..." Congressional authorization included hunting as an acceptable recreational use of NERI. As part of the process to revise its General Management Plan for NERI, the National Park Service contracted with the Virginia Tech Department of Fisheries and Wildlife Sciences to assess the impacts of hunting on resources in the park. This report describes the findings of that assessment.

The assessment of hunting impacts included: 1) listing the hunted species that occur within the boundaries of NERI, 2) providing summaries of life history, habitats, abundance, and distribution of hunted species known to occur within the boundaries of NERI, 3) describing hunting regulations implemented by the State of West Virginia that apply to NERI as well as any applicable park hunting restrictions instituted by NPS, including legal methods of hunting and specific seasons and limits, 4) describing annual hunting patterns and the degree of hunting intensity within NERI by species, time, and place, 5) providing the best available information on the number of animals taken per species per year within the park since 1978, when the park first was established, 6) conducting a review of the extant literature regarding hunting impacts in the eastern United States, and 7) preparing a synthesis of findings from the assessment and description of known or anticipated ecological and recreational impacts of hunting within the NERI.

Fifty species of animals, including 14 mammals and 36 birds, are or could be hunted within the boundaries of NERI. Although migratory waterfowl comprise one-half of the hunted species that occur within the boundaries of NERI, many of these waterfowl species occur only infrequently or seasonally within the Park. Hunters commonly pursue 4 of the 50 species within the boundaries of NERI: black bear (*Ursus americanus*), white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), and Eastern gray squirrel (*Sciurus carolinensis*). At present levels, hunting conducted in pursuit of the remaining species does not appear to cause significant impacts to either other populations of the hunted species or to other resources in the park.

Harvest of white-tailed deer in the 3 West Virginia counties adjacent to NERI has increased dramatically over the last 25 years, a trend that is consistent with increasing populations of white-tailed deer throughout the eastern United States. White-tailed deer harvests in Fayette, Raleigh, and Summers counties, within which NERI is found, have increased from approximately 500 deer in 1978 to > 9,000 deer in 2003. Although deer populations and deer harvest have increased in recent years, the number of hunters and days of hunting participation nationally have decreased. Harvests have increased because state wildlife managers have manipulated seasons and limits in an attempt to maintain deer population densities at desirable (less than biological carrying capacity) levels. In general, wildlife managers have increased the number of days that hunting is allowed, increased opportunities to utilize specialized weapons, and raised the annual limits on the number of deer an individual may harvest. The literature provides substantial evidence to suggest that the impacts of hunting deer are far outweighed by

the biological impacts that overabundant deer (due to lack of hunting) cause to the ecosystem (e.g., loss of plant and animal species abundance, reduction in regeneration and maintenance of representative vegetation, and alteration of key ecological processes due to overbrowsing; reduction in infiltration and damaged aeration; increased wind and water erosion).

Populations of wild turkey and the harvest of turkeys also have increased dramatically since 1978. The harvest of wild turkeys within Fayette, Raleigh, and Summers counties, within which NERI is found, increased dramatically from 1978 until 1990 (i.e., 26 turkeys to over 1,000 turkeys). Wild turkey harvests have been relatively stable since 1990 and have remained around 1,000 turkeys. Wild turkeys have been translocated successfully throughout the U.S. and in West Virginia. Establishment of turkey populations in areas where they previously had been extirpated has resulted in substantial increases in hunting opportunities in West Virginia. Seasons and bag limits have been adjusted frequently in accordance with the West Virginia wild turkey management plan to achieve a balance between maximizing recreational opportunity and maintaining desirable population levels.

Although hunting for Eastern gray squirrels is a popular activity, harvest data in West Virginia are scant. Harvest surveys conducted in 1980 and 1985 estimated that 1.5 million to 2 million squirrels were harvested statewide and 250,000 to 350,000 were harvested in the West Virginia DNR district adjacent to NERI. We found no evidence in the literature of significant negative impacts of hunting on squirrel populations.

We conclude that hunting conducted in accordance with existing laws and regulations should have no adverse impact on the fauna and flora within the boundaries of NERI. This conclusion is based upon evidence from studies conducted throughout the eastern United States, and through consultation with noted experts on wildlife ecology. Numerous studies have shown that with their natural predators (Eastern cougar (*Felis concolor cougar*) and red wolf (*Canis rufus*)) extirpated from the region, man is the only remaining effective predator for white-tailed deer. White-tailed deer populations that are not controlled by predators alter forest ecosystems by reducing plant cover and diversity, altering carbon and nutrient cycling, and shifting succession patterns. The effects of these changes cascade throughout the forest ecosystem to affect insects, birds, and other mammals. Increasing populations, and in some cases expanding ranges, of the four most hunted species provide supporting evidence that hunting may not only have no adverse impact on these species, but may actually be necessary to maintain these species at sustainable population levels. Hunting potentially may affect other types of recreation adversely. Recreationists who perceive a personal risk while sharing the park with hunters may choose not to recreate in NERI during hunting seasons. Future research and monitoring efforts should be designed to fill the gaps about potential effects to populations, ecosystem functions, and recreation patterns specific to NERI.

## Acknowledgments

The assessment of hunting impacts of NERI would not have been possible without the help and guidance of many people. We wish to thank the National Park Service staff who assisted with many aspects of this assessment. Particularly, we would like to thank John Karish and Michele Batcheller, and the staff at NERI, including Cliff Bobinski, Mark Carrico, Deborah Darden, John Perez, Andy Steel, and Ken Stephens, all of whom provided oversight, review, comment, and invaluable guidance throughout this effort.

In addition, we would like to thank the staff at West Virginia Division of Natural Resources (WVDNR), including Larry Berry, Cliff Brown, Colin Carpenter, and Lt. C.W. Schollar for providing invaluable information on hunting in West Virginia. We also wish to thank the WVDNR licensing staff for locating and providing needed annual reports.



## Introduction

The New River Gorge National River was authorized by Congress through the National Parks and Recreation Act of 1978 and established by Public Law (PL) 95-625 (Simpson 1988). The purpose of NERI included "...conserving and interpreting outstanding natural, scenic, and historic values and objects in and around New River Gorge and preserving as a free-flowing stream an important segment of the New River in West Virginia for the benefit and enjoyment of present and future generations..." (Mahan 2004:3). In addition, the National Park Service (NPS) was directed to administer, protect, and develop NERI in accordance with the National Park Service Organic Act (Mahan 2004). An administrative requirement of NERI park personnel included the "determination and management of appropriate levels and type of recreation use" (Simpson 1988:2) to provide "a wide range of public recreation opportunities: (Simpson 1988:76). Within the National Parks and Recreation Act of 1978, Section 1106 authorized hunting as a public recreation activity. However, given the verbiage in the enabling legislation, NERI park personnel are required to determine the impacts of recreational activities such as hunting during the General Management Plan (GMP) process.

An accurate and up-to-date GMP is required of each unit in the NPS to guarantee that each unit "has a clearly defined direction for resource conservation and visitor use" (Mahan 2004:xi). In 2005, the NPS began the process to revise the NERI GMP. The revision process will include an assessment of issues related to hunting within NERI, and provide public, state agencies, and wildlife professionals an opportunity to participate in the assessment.

Heretofore, the information needed to properly and thoroughly assess the impacts of recreational hunting previously had not been gathered or summarized such that a complete description of hunting practices, outcomes, and impacts within NERI would be evident. As a result, information was gathered and summarized to complete the following objectives: 1) listing the hunted species that occur within the boundaries of NERI, 2) providing summaries of life history, habitats, abundance, distribution, and economic status of hunted species known to occur within the boundaries of NERI, 3) describing hunting regulations implemented by the State of West Virginia that apply to NERI as well as any applicable park hunting restrictions instituted by NPS, including legal methods of hunting and specific seasons and limits, 4) describing annual hunting patterns and the degree of hunting intensity within NERI by species, time, and place, 5) providing the best available information on the number of animals taken per species per year within the park since 1978, when the park first was established, 6) conducting a review of the extant literature regarding hunting impacts in the eastern United States, and 7) preparing a synthesis of findings from the assessment and description of known or anticipated ecological and recreational impacts of hunting within the NERI.

This report provides an assessment and description of historical trends and the current status of recreational hunting within NERI. The information contained in this report will provide much of the base knowledge used in the NERI GMP revision process.





## Study Area

New River Gorge National River is located along an 85.3 km (53 mi) stretch of the New River between Hinton and Fayetteville, in Fayette, Raleigh, and Summers Counties, West Virginia. The total land area within the authorized NERI boundary is 28,636 ha (70,762 acres), but the National Park Service (NPS) currently holds title to only 20,828 ha (51,468 acres) (Mahan 2004). Land cover types within NERI include forests, agricultural lands, wetlands, and developed lands. Dominant forest types include oak-hickory, mixed-mesophytic, rimrock pine, and Eastern hemlock forests (Mahan 2004).

NERI is best known for the existence of the New River Gorge. The gorge cliffs continue for 32.19 km (20 mi) along the New River. At their greatest depth, these nearly perpendicular rock cliffs reach 393.8 m (1292 ft) from the valley below.



## Methods

We developed a list of the hunted species that occur within the boundaries of NERI from extant literature sources and consultations with knowledgeable wildlife professionals familiar with NERI. Key literature sources included *A Biological Survey of the New River Gorge National River* (Buhlman and Vaughan 1987), *New River Bird Checklist* developed by the National Park Service (USDI n.d.), and *Mammals of West Virginia: A Field Checklist* (WVDNR 2001b). A tentative list, developed from these literature sources, was reviewed and amended by WVDNR wildlife biologists, Larry Berry (WVDNR District Biologist, pers. commun. 2004) and Colin Carpenter (WVDNR District Biologist, pers. commun. 2005), to produce the list presented in Table 1 in the Results section.

To accurately and completely describe hunting regulations for the State of West Virginia, we consulted the West Virginia Hunting and Trapping Regulations Summaries beginning with the 1978-1979 season on up to the present season. From these, we compiled a comprehensive overview, including a description of seasons, limits, and legal and illegal methods. In addition to these annual summaries, the West Virginia Code (WVC) (West Virginia Legislature n.d.), the Migratory Bird Hunting Regulations (WVDNR n.d.[k]), and the Code of Federal Regulations (CFR) (National Archives and Records Administration n.d.) were reviewed to provide further detail. The overview is provided in the Results section. The description of hunting seasons and bag limits is summarized in two tables in Appendix B.

A description of the annual hunting patterns and the degree of hunter intensity within NERI was developed using information gathered from literature sources as well as professional contacts. This description presents annual hunting patterns on both a national and a state level. The primary resources used to develop this description were the U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of Census, 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDI 1988), 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDI 1993), 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDI 1997), 1980-1995 Participation in Fishing, Hunting, and Wildlife-Watching: National and Regional Demographic Trends (USDI 1999), 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDI 2002), and Fishing and Hunting 1991-2001: Avid, Casual, and Intermediate Participation Trends (USDI 2004). These documents provide valuable information about hunting and hunting pressure, including hunter numbers, days spent afield, and hunting expenditures. Additional resources used included surveys conducted by Responsive Management (a nationally renowned survey research firm that focuses entirely on natural resource issues), data on hunting license sales and hunter education efforts from WVDNR, natural resource agencies' internet websites, and literature sources that report on natural resource trends. The complete description is provided in the Results section.

The WVDNR, Wildlife Resources Section, is “responsible for the management of the state’s wildlife resources for the use and enjoyment of its citizens” (WVDNR 2004a:78). Responsibility for managing wildlife resources also includes management of game animals, more specifically the collection of harvest and biological data for white-tailed deer (*Odocoileus virginianus*), black bear (*Ursus americanus*), wild turkey (*Meleagris gallopavo*), and bobcat (*Lynx rufus*) (WVDNR

2004a). Harvest data for big game species taken in West Virginia are reported annually in the West Virginia Big Game Bulletin, whereas the U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Harvest Surveys Section, is responsible for collecting harvest information on migratory bird harvests. Harvest records for small game species and continuous open species (i.e., those species that have a continuous open season and one without imposed bag limits), are not collected routinely by many state natural resource agencies. In addition, harvest information specifically from within the boundaries of NERI has not been collected until recently, and even here that information is limited to a select number of hunted species and is dependent upon hunters' recollection and knowledge. Information on the number of animals taken by species within the park since 1978 therefore was generated from harvest information collected and maintained by county (Fayette, Raleigh, Summers Counties) for white-tailed deer, black bear, wild turkey, and bobcat, and from state harvest estimates for migratory waterfowl. Statewide hunter surveys, small game bulletins, bowhunter surveys, and grouse cooperator reports were used to gather information on small game harvest. This harvest information is presented in the Results section.

Summaries of life history of hunted species known to occur within the boundaries of NERI were developed using extant literature sources. Each summary includes taxonomic (e.g., known subspecies), identification and descriptive, habitat, behavioral, reproductive, food habits, mortality, distribution, abundance, and economic information. Life history summaries are provided in the Results section.

We began our examination of the impacts of hunting by reviewing the extant literature on such impacts in the eastern United States and by focusing particularly on species found within NERI, on the hunting practices used in the pursuit of these species, and on the habitats within which these species exist. Our assessment also examines and describes known or anticipated impacts on ecological resources or processes and on other recreational endeavors conducted within NERI. To ensure a comprehensive review of the literature, we searched multiple sources that potentially could focus on this topic. We used electronic databases, referenced conference proceedings, journal articles, and websites for literature searches. Electronic databases used included Agricola<sup>®</sup>, Cambridge Scientific Abstracts<sup>®</sup>, Web of Sciences: Citation Databases<sup>®</sup>, and Wildlife and Ecology Studies Worldwide<sup>®</sup>. Additional searches were conducted using electronic search engines such as Google Scholar and Vivisimo. Information gathered from these sources was summarized and synthesized to facilitate a cogent and meaningful presentation of material on these topics. The synthesis of findings is provided in the Literature Synthesis section. In addition, we provide a description of known or anticipated ecological and recreational impacts of hunting within NERI and identify key unfilled information needs and research gaps; this information also is provided within the Literature Synthesis section of this report. References for literature reviewed and contacts made are provided in the Literature Cited section.

## Results

### Hunted Species that Occur within the Boundaries of NERI, West Virginia

The list of hunted species that occur within the boundaries of NERI (Table 1) is divided into commonly recognized groupings: big game species, small game species, continuous open season species, and migratory bird species. The first 3 groups are further subdivided by taxonomic category (i.e., birds and mammals). The latter group, migratory bird species, is subdivided into waterfowl, shorebirds, and upland game bird categories. The only species known to be hunted in West Virginia, but is not known to occur within the boundaries of NERI, is the snowshoe hare. The decision to omit the snowshoe hare from our list was based on discussions with and the professional judgment of WVDNR biologists.

Table 1. Hunted species that occur within the boundaries of the New River Gorge National River, West Virginia.

Scientific Name	Common Name	Scientific Name	Common Name
<b>Big Game Species</b>		<b>Waterfowl, Dabbling Ducks:</b>	
<b>Birds:</b>		<i>Anas rubripes</i>	American black duck
<i>Meleagris gallopavo</i>	Wild turkey	<i>Anas americana</i>	American wigeon
		<i>Anas discors</i>	Blue-winged teal
<b>Mammals:</b>		<i>Anas strepera</i>	Gadwall
<i>Ursus americanus</i>	Black bear	<i>Anas crecca</i>	Green-winged teal
<i>Odocoileus virginianus</i>	White-tailed deer	<i>Anas platyrhynchos</i>	Mallard
<i>Sus scrofa</i> <sup>1</sup>	Wild boar	<i>Anas acuta</i>	Northern pintail
		<i>Anas clypeata</i>	Shoveler
<b>Small Game Species</b>		<i>Aix sponsa</i>	Wood duck
<b>Birds:</b>		<b>Waterfowl, Diving Ducks:</b>	
<i>Corvus brachyrhynchos</i>	American Crow	<i>Nyroca valisineria</i>	Canvasback
<i>Colinus virginianus</i>	Northern bobwhite	<i>Aythya marila</i>	Greater scaup
<i>Bonasa umbellus</i>	Ruffed grouse	<i>Aythya affinis</i>	Lesser scaup
<b>Mammals:</b>		<i>Aythya americana</i>	Redhead
<i>Lynx rufus</i>	Bobcat	<i>Aythya collaris</i>	Ring-necked duck
<i>Sylvilagus floridanus</i>	Eastern cottontail		
<i>Sciurus carolinensis</i>	Eastern gray squirrel	<b>Waterfowl, Sea Ducks:</b>	
<i>Sciurus niger</i>	Fox squirrel	<i>Bucephala islandica</i>	Barrow's goldeneye
<i>Urocyon cinereoargenteus</i>	Gray fox	<i>Bucephala albeola</i>	Bufflehead
<i>Procyon lotor</i>	Raccoon	<i>Bucephala clangula</i>	Common goldeneye
<i>Vulpes vulpes</i>	Red fox	<i>Mergus merganser</i>	Common merganser
		<i>Lophodytes cucullatus</i>	Hooded merganser
<b>Continuous Open Season Species</b>		<i>Clangula hyemalis</i>	Long-tailed duck
<b>Birds:</b>		<i>Mergus serrator</i>	Red-breasted merganser
<i>Columba livia</i>	Pigeon		
<b>Mammals:</b>		<b>Waterfowl, Stiff-tailed Ducks:</b>	
<i>Canis latrans</i>	Coyote	<i>Oxyura jamaicensis</i>	Ruddy duck
<i>Didelphis virginiana</i>	Opossum		
<i>Mephitis mephitis</i>	Striped skunk	<b>Shorebirds:</b>	
<i>Marmota monax</i>	Woodchuck	<i>Fulica americana</i>	American coot
		<i>Capella gallinago</i>	Common snipe
<b>Migratory Birds</b>		<i>Porzana carolina</i>	Sora
<b>Waterfowl, Geese:</b>		<i>Rallus limicola</i>	Virginia rail
Branta bernicla	Brant		
Branta canadensis	Canada Goose	<b>Upland Game Birds:</b>	
Anser caerulescens	Snow goose	<i>Scolopax minor</i>	American woodcock
		<i>Zenaida macroura</i>	Mourning dove

<sup>1</sup>Boars present in the New River Gorge National River are not deemed part of the wild boar population established by West Virginia Division of Natural Resources.

## Summaries of Life Histories, Habitats, Abundance, and Distribution of Hunted Species Known to Occur within the Boundaries of NERI

The summaries of life history, habitats, distribution, and abundance of hunted species known to occur within the boundaries of NERI are divided into the following sections: big game species, small game species, continuous open season species, and migratory bird species. The first 3 sections are further subdivided by taxonomic category (i.e., birds and mammals). The latter section, migratory bird species, is subdivided into waterfowl, shorebirds, and upland game birds categories. Summaries of waterfowl species were developed using the following categories: geese, dabbling ducks, diving ducks, sea ducks, and stiff-tailed ducks.

### Big Game Species

Birds:

*Wild Turkey, Meleagris gallopavo*

#### Life History

**Taxonomy:** Wild turkeys are members of the order Galliformes, the family Phasianidae (Eaton 1992), and the sub-family Meleagridinae (Stangel et al. 1992). Five distinct subspecies of *Meleagris gallopavo* exist in North America. The eastern subspecies, *M. g. silvestris*, inhabits most of the eastern U.S. (Kennemar et al. 1992).

**Description:** Wild turkeys are large (90 – 120 cm) birds with long, sturdy legs, a long neck, and a fan-shaped tail. The wings are broad and rounded such that they allow these birds to produce powerful wingbeats and make rapid take-offs (Eaton 1992). Wild turkeys have a long, large bill, typical of most galliforms. The head and neck are sparsely feathered. Plumage on other areas of the body consists of metallic-iridescent feathers that are darker in males and tipped rusty or white in females. Males have a tuft of bristle-like feathers, called a beard, that hang from the breast (Rue 1973, Eaton 1992). A wart-like, fleshy appendage (the “caruncle”) extends from the middle of the forehead; the caruncle is larger in males than in females. A wattle drops downward from the neck. Both the caruncle and wattle vary in color from light gray to deep blue to red (Rue 1973). The legs also vary in color, the feet are unfeathered, and males sport a prominent spur on each tarsus (Rue 1973, Eaton 1992). Males weigh between 6.3 and 7.7 kg, whereas females weigh between 3.6 and 4.5 kg (Rue 1973). A more recent study noted the mean weight for male eastern wild turkeys was 9.6 kg (Pelham and Dickson 1992).

**Habitat:** In the eastern part of their range (including West Virginia), wild turkeys use a variety of habitats that span the successional gradient. Early successional stages of grasses and forbs provide important brood-rearing habitat (Wunz and Pack 1992). Wild turkeys often use mature stands of deciduous forests that have open canopies and allow the development of some understory and herbaceous growth (Wunz and Pack 1992, Buckelew and Hall 1994). During fall, winter, and spring, wild turkeys in the northeastern U.S. are found predominantly in deciduous forests, especially oak-hickory forests and forests comprised of red oak, beech, cherry, and white ash (Eaton 1992). Wild turkeys prefer forests with open understories, small clearings, or field edges where they can perform spring courtships. During summer months, openings in

the forest and field edges are used by hens with broods (Eaton 1992, Wunz and Pack 1992). In West Virginia, nest often are located in laurel and huckleberry thickets in the understory (Wunz and Pack 1992). Mature, unharvested chestnut oak and bottomland hardwood forests are important in West Virginia, as these forest types typically provide an open, sparsely vegetated understory with little cover to conceal predators (Swanson et al. 1994).

**Behavior:** Wild turkeys are gregarious birds that travel together in flocks, either as a family unit or in larger social groups. For protection, turkeys roost in trees, typically selecting the tallest trees in the area. Turkeys fly from the roost at dawn to feed. However, in inclement weather, they may remain in the roost until mid-morning. Foraging normally occurs in the morning and again in the afternoon. During winter, turkeys likely forage throughout the day due to increased energy demands and a scarcity of readily available food (Rue 1973).

The short, cupped wings of the wild turkey are designed for instant take-off, but not sustained flight. Turkeys exhibit a controlled flight and, surprisingly for a bird of this size, are quite capable of landing successfully on tree limbs. They can reach flight speeds of 72 to 80 km/hr over short distances. Despite their adequate flight capabilities, male turkeys prefer to run rather than take flight when escaping from predators or a disturbance (Eaton 1992). They can average 24 to 28 km/hr in a dead run. Females generally are not as agile flyers or runners as are the males. Wild turkeys are not migratory, but they do make seasonal shifts in range as the availability of food or environmental conditions (e.g., snow) dictate (Rue 1973).

**Reproduction:** Male wild turkeys are polygamous. One-year old males are capable of breeding, but they rarely are given the opportunity to do so because of the competition from the older, dominant males. In January and February, winter flocks of bachelor males begin to break up. Peak breeding activity occurs between March and April, yet colder weather may delay this activity somewhat. At first light, males begin gobbling and strutting with the tail fanned out vertically, the wings lowered so that the primaries drag on the ground, the feathers on the back elevated, and the head thrown back, all in the attempt to attract females (Rue 1973, Eaton 1992). After a female selects her mate, she will stay with that male, copulating frequently until egg-laying and incubation begins (Rue 1973). The average harem of a successful male will include 5 females.

Hens select nest sites based on undergrowth characteristics, rather than general habitat type (Holbrook et al. 1987). Within forested habitats, nests are placed within moderately dense, woody understories that conceal the nest, but allow the hen to view her surroundings from ground level (Healy and Dickson 1992). The nest is nothing more than a hollow scrape, occasionally lined with dead leaves (Rue 1973, Eaton 1992). Most hens lay their eggs in mid-April. One egg is laid daily until the clutch is complete and the average clutch is 8 to 15 eggs. The eggs are light brown, with a green tint, although some may be plain or spotted with dark flecks. The female incubates the eggs for approximately 28 days. Turkey poults are precocious and ready to leave the nest within hours of hatching, despite the fact that most will not eat during the first 48 hours. For the first 10 to 14 days, poults are covered with down. At 2 to 3 weeks, their wing feathers are developed sufficiently to allow them to escape from enemies by flying up into a tree. The family roosts together in trees when the poults are between 4 and 5 weeks old and the feathers are fully developed.



**Food Habits:** The diet of wild turkeys relies heavily on hard mast (e.g., acorns, beechnuts) (Hurst 1992, Wunz and Pack 1992). When mast crops are poor, they diet expands to include soft mast items from dogwood, cherry, black gum, crab apple, hawthorn, grape, huckleberry, and blackberry. Additional foods include seeds, green vegetation, tubers, bulbs, and invertebrate animals (Wunz and Pack 1992). In West Virginia, wild turkeys are known to have fed on tubers, bulbs, and rhizomes of spring beauty, dogtooth violet, and toothwort. In winter and where deep snows may accumulate, turkeys rely on ferns, fern fruiting heads, and other green forage available at springs and seeps, or the buds and stems of beech, sugar maple, and hophornbeam. The diet of poults is composed predominantly of insects, although the diet will vary with habitat type, vegetative conditions, poult age, and food abundance and availability. The diet of juveniles is similar to that of adults; food items consumed include grass seeds, fruits, insects, and green vegetation (Rue 1973, Hurst 1992).

**Mortality:** Many predators of adult turkeys exist, but biologists generally believe the impact of predation on adult birds is negligible (Rue 1973). One exception is the potential loss of females while incubating on the nest. The major predator of wild turkeys is man; all 48 contiguous states have at least a spring gobbler hunting season (Rue 1973). Predators of turkey eggs include crows, snakes, skunks, raccoons, opossums, and foxes. Predators of poults include bobcats, great horned owls, and eagles. Another important mortality factor is exposure to rain and low temperatures. In Pennsylvania, brood counts were correlated negatively with total rainfall (Eaton 1992). Over 60 parasites have been found in eastern wild turkeys (e.g., protozoans, trematodes, cestodes). Diseases that affect wild turkey population include blackhead, coli-granuloma, and avian pox (Eaton 1992). The average life span of a wild turkey is 8 years, though records of wild turkeys living for 12 years exist (Rue 1973).

### *Distribution and Abundance*

**Distribution:** The range of wild turkeys has expanded since the implementation of game management programs. Historically, wild turkeys were found from the Atlantic to the Pacific and from Mexico north to southern Canada, with the exception of the northwestern and the northern prairie states (Rue 1973). Wild turkeys have continued to be introduced throughout the United States since 1973. Today, the current range encompasses all states except Alaska; this current range includes ten states outside the historic range (Rue 1973; Kennamer et al. 1992).

**Abundance:** A 1989 estimate of the wild turkey population in West Virginia placed the population at >70,000 individuals (WVDNR 1989a).

### *Economic Status*

Throughout the United States, wild turkeys provide recreational opportunities for hunters and other outdoor enthusiasts. In 2001, a national survey estimated that 2.5 million hunters spent 23 million days afield hunting wild turkeys in the United States (USDI 2002). West Virginia has classified the wild turkey a big game species and has established a regulated hunting season for the species. Management of wild turkey populations is conducted primarily through harvest, as regulated by seasons, allowable hunting methods, and bag limits. In West Virginia, 79,000 hunters participated in wild turkey hunting for 0.7 million days (USDI 2002).

Mammals:

*Black Bear, Ursus americanus*

### Life History

**Taxonomy:** Black bears are members of the family Ursidae, which can be divided into 4 subfamilies: Ursinae, Agriotheriinae, Tremarctinae, and Ailuropodinae. Black bears are members of the subfamily Ursinae, genus *Ursus*, and species *americanus*. Approximately, 16 subspecies of black bears exist in North America (Hall 1981). The subspecies that occurs throughout the eastern United States, including West Virginia, is *Ursus americanus americanus* Pallas (Hall 1981).

**Description:** The black bear is the only bear species found in the eastern United States. It is a large bear with short, stout legs, a very short tail, and long, shaggy fur. In the East, they generally are glossy black with a brown muzzle. A white chest patch found on some individuals contrasts vividly with the dark coat. The fur appears glossy in winter, but ragged and dull in summer. The face is straight with small, brown eyes, and short, rounded, erect ears (Linzey 1998, Whitaker and Hamilton 1998). Their feet are broad and plantigrade, and each foot supports five clawed toes. The claws are long, sturdy, somewhat curved, and nonretractile. Total body length ranges from 1.4 to 1.8 m, and height at the shoulders ranges of 0.6 to 0.9 m. Weight can range from 90 to 180 kg; males usually are larger than females (Linzey 1998).

**Habitat:** The habitat used by black bears includes inaccessible terrain with thick understory, heavily wooded forests, and lowland swamps (Feldhamer et al. 2003). In West Virginia, bear habitat includes both coniferous and deciduous forests (McKeever 1956). Linzey (1998:236) recounted Handley's description of black bear habitat:

*“Ideal upland habitat includes rugged areas with boulders, rock outcrops, ledges, and rock slides; thickets of mountain laurel and rhododendron; scrubby forest with numerous small openings; and no human habitations. Forest in upland bear range typically contains several species of oaks, pines, hickories, red maples, black gum, black birch, and wild cherries, and small openings with blueberries and blackberries. Ideal swamp habitat has myrtle thickets, cane brakes, tupelo, red maple, and tulip poplar, and adjacent uplands with dense thickets of Smilax, brambles, poison ivy, and sweet gum.”*

Black bear habitat also must have sufficient escape cover, den sites, travel corridors, and food availability (VDGIF 2001a). In mountain habitats, laurel and rhododendron provide thick cover (Feldhamer et al. 2003).

**Behavior:** Black bears generally are solitary and crepuscular animals, except where bears have been conditioned to humans and their food and garbage. In these situations, black bears become diurnal and scavenge along roadsides or remain nocturnal, but raid campgrounds (Feldhamer et al. 2003). Diurnal behavior also can be influenced by temperature and food availability. Movements and foraging by bears primarily occur during the cool morning and evening hours. Exposure to direct sunlight may deter their use of large, open areas (Schmidt and Gilbert 1978).

As cold weather approaches, black bears enter a period of dormancy, not a true hibernation. In northern areas of their range, the dormant period may last for 5 to 6 months. They also may bed down for short periods during extremely cold weather. Winter beds are constructed of grasses, leaves, twigs, and bark. These homes are located in hollow trees or excavated cavities in the ground. Bears do not create permanent summer homes; they simply may sleep in a tree or on the ground (Linzey 1998). In western Virginia, 70% of all dens located were in hollow trees (VDGIF 2001a). Suitability of a tree den is determined by 3 characteristics: diameter, presence of appropriate hollows, and height of the hollow openings (Oli et al. 1997). In West Virginia, bears used ground dens, rock dens, auger holes, brush piles, log piles, tree root holes, and hollow trees (Larry Berry, WVDNR District Biologist, pers. commun. 2004).

Black bears maintain a well-defined home range. Actively used ranges are characterized by the presence of worn paths. Linzey (1998) concluded that the size of a home range varies with a bear's age and sex, the season, regional food availability, and local population density. The size and shape of a bear's home range also is determined by the area's ability to fulfill an individual's needs (Feldhamer et al. 2003). Home range of males may be 3 to 8 times larger than that of females and individual home ranges may overlap. Telemetry studies in the Pisgah National Forest, North Carolina, found home ranges averaged 61.0 km<sup>2</sup> for males and 16.9 km<sup>2</sup> for females (Linzey 1998). Home range size for females in Virginia's mountains varies between 2.6 and 132 km<sup>2</sup> whereas that for males was 25.9 and 758.8 km<sup>2</sup> (VDGIF 2001a).

Reproduction: Black bears have low reproductive rates due to slow subadult growth rate, small litter sizes, extended family relationships, and a 2- to 3-year period between litters. Reproduction is influenced by nutrition (Feldhamer et al. 2003). Both female and male black bears become sexually mature between 3 and 4 years of age, though many males may not yet be sexually mature until their third year. The first mating may take place at 3.5 years of age (Linzey 1998). Mating may occur as early as May and as late as mid-August (Feldhamer et al. 2003), but most matings occur in June or early July. Black bears in Virginia breed between June 20 and August 21 (VDGIF 2001a). Females remain in estrus until they breed or until the ovarian follicles begin to degenerate. Black bears are induced ovulators, which means that ovulation is induced by coital stimulation (Feldhamer et al. 2003). After fertilization, the eggs begin to develop, but then enter a dormant stage. Eggs actually implant in the fall (a biological process called delayed implantation) as a means to allow cubs to be born in the security of the winter den (VDGIF 2001a). The period of greatest physical development occurs during the last 6 to 8 weeks of the gestation period (Feldhamer et al. 2003). Cubs are born between January and early February after a gestation period of 200 to 210 days (Feldhamer et al. 2003). Cubs of black bears in West Virginia typically are born between January 10 and January 29 (WVDNR 1990). Alt (1989) states that black bear "litter size is normally 2-3 but four cubs are not uncommon; litters of five cubs are reported occasionally." Researchers of the WV Southern Bear Study, which began in 1999, visited 52 dens that contained cubs in Boone, Fayette, Kanawha, and Raleigh Counties and found these dens produced an average of 2.77 cubs, one of the highest reproductive rates in the United States (WVDNR 2003c). Generally, cubs weigh between 170 and 280 g at birth. Their eyes open between 25 and 30 days of age (Linzey 1998). Females are fully responsible for the cubs. Cubs stay with the female until 1.5 years of age. As an adult female enters estrus, cubs will leave the female to avoid conflict with adult males (Schmidt and Gilbert 1978). As a result, females breed every other year.

**Food Habits:** Although black bears are considered carnivores, their diet largely consists of herbaceous materials. In the spring, they feed on new shoots and leaves or mast that survived the winter. In the summer and fall, they feed on ripening fruits and nuts. A 5-year study in Virginia indicated that 62% of fall and winter diets consisted of acorns; blueberries, black gum, and greenbrier also were identified as key winter foods (Linzey 1998). Animal foods include ants, yellow jackets, bees and their honey, crickets and other insects, fish, frogs, small rodents, rabbits, fawns, bird eggs, and carrion (Linzey 1998). Much of the animal portion of their diet comes from carrion (Feldhamer et al. 2003).

**Mortality:** The life span of a black bear is 12 to 15 years. Linzey (1998) noted that Hellgren and Vaughan recorded a 16-year old male in Virginia. Virginia's Black Bear Management Plan noted that bears may live up to 30 years in non-hunted populations (VDGIF 2001a). Mortality in black bears is influenced strongly by human-related activities, including hunting, poaching, roadkills, and depredation control (Feldhamer et al. 2003). Mortality in black bears during the hunting season also is related to the availability of food; during food shortages, bears travel farther in search of food and hunters are more likely to encounter a bear and be successful (Noyce and Garshelis 1997). Automobile collisions or roadkills comprised 92% of the non-seasonal mortalities in 1992 (WVDNR 1992). In 2003, 87 black bear deaths occurred from vehicle collision in West Virginia (WVDNR 2003c). Other non-seasonal mortalities include illegal poaching and marauding bears (WVDNR 1985). A preliminary study in Virginia found the mortality rate of cubs to be approximately 20%, primarily due to predation from bobcats, foxes, coyotes, and other bears (VDGIF 2001a). Feldhamer et al. (2003) estimated the mortality rate of young bears to be as high as 35%. Adult black bears have very low natural mortality rates, <2%. Feldhamer et al. (2003) also concluded that the mortality rate of adult male black bears is twice that of adult females.

Ticks and internal parasites also may affect black bears. Bears from Virginia and West Virginia were examined for parasites and revealed the following parasite load: protozoans (*Sarcocystis* sp.), spiny-headed worms (*Marcroanthorynchus ingens*), and roundworms (*Arthrocephalus lotoris*, *Baylisascaris transfuga*, *Capillaria putorii*, *Cresnosoma* sp., *Cyathospirura* sp., *Gnathostoma* sp., *Gongylonema pulchrum*, *Molineus barbatus*, *Physaloptera* sp., *Strongyloides* sp.) (Linzey 1998). However, these parasites rarely affect survival of black bears (VDGIF 2001a). Neoplastic, rickettsial, viral, bacterial, and traumatic diseases have been reported in black bears, but biologists do not believe these diseases regulate the bear population (Feldhamer et al. 2003).

### Distribution and Abundance

**Distribution:** Black bears historically ranged from Alaska across Canada and throughout the United States. Their current range includes unsettled areas of the eastern United States; northern parts of the Great Lakes region; the mountains of New York, Pennsylvania, and the South Atlantic States; and forests and forested swamps of the Gulf and South Atlantic States (Linzey 1998, Whitaker and Hamilton 1998). Traditionally, black bear range in West Virginia was limited to the eastern mountains, but recent conservation successes and rapid population growth

have induced a range expansion into other areas of the state (WVDNR n.d.[a]). Over the past 10 years, black bears have reestablished much of their former range (WVDNR 2003c).

Abundance: Data from the West Virginia Division of Natural Resources Big Game Bulletin (2003c) indicates that black bears likely are common within the boundaries of New River Gorge National River. The boundaries of the national river occur within portions of three WV counties: Fayette, Raleigh, and Summers. Using the West Virginia Division of Natural Resources organization structure, these 3 counties are included in District IV. The total number of bears taken during the 2003-2004 hunting season for each county was 119, 79, and 2, respectively. These numbers account for 52% of the bears taken in District IV, and 10% of the bears taken for the entire state (WVDNR 2003c).

### Economic Status

The status of black bears varies from threatened to pest status across North America. Black bears provide many recreational opportunities, including hunting. Management of black bears has been accomplished primarily through establishment and modification of harvest regulations (i.e., hunting seasons, hunting methods, bag limits) (Feldhamer et al. 2003). In many regions of the United States, black bears are considered an important economic resource. A national survey in 2001 estimated 360,000 bear hunters spent 3,334,000 days hunting bear in the United States (USDI 2001). In West Virginia, black bears are a big game species and may be taken by licensed hunters during a regulated hunting season (WVDNR 2004b). Due to commercial trade on black bear body parts, such as gall bladders, paws, and hides, illegal harvests have been increasing (Parkhurst 1998). When food resources are limited, black bears may become nuisance animals in their search for food. With the adaptability of black bears, managers are challenged continuously to develop effective strategies to minimize human-bear interactions (Feldhamer et al. 2003).

### *White-tailed Deer, *Odocoileus virginianus**

#### Life History

Taxonomy: White-tailed deer are members of the Artiodactyla order, Ruminantia suborder, Cervidae family, and Odocoileinae subfamily. Approximately 30 subspecies exist in North and Central America (Schmidt and Gilbert 1978). Seventeen of the subspecies are found north of Mexico (Feldhamer et al. 2003). The original population of white-tailed deer in West Virginia included 2 subspecies: *Odocoileus virginianus virginianus* and *O. v. borealis*. After significant declines occurred in deer populations throughout the East, biologists have debated the exact composition of the remnant, but now revitalized populations. McKeever (1956) concluded that a mixture of subspecies has arisen due to the stocking program that was implemented in 1923. Between 1923 and 1947, 1329 deer were released, 507 of which were deer purchased from Michigan and Wisconsin (McKeever 1956). The subspecies currently recognized in West Virginia is *O. v. virginianus* (Schmidt and Gilbert 1978).

Description: The most distinguishing characteristic, and the origin of this animal's name, is the white fur on the underside and edges of the tail. The underside of the body and throat are white.

The back, sides, and limbs are covered with a reddish brown coat in the summer and a grayish brown coat in the winter. Fawns are reddish brown with white spots that remain for approximately 3 to 4 months (Schmidt and Gilbert 1978). White-tailed deer have numerous skin glands (interdigital, tarsal, metatarsal, forehead, preorbital, nasal, and preputial) that secrete a musky substance used to communicate presence and social status as well as to mark trails (Feldhamer et al. 2003). Males alter the substance secreted by the tarsal glands by urinating on these leg glands, a phenomenon called rub-urination (Feldhamer et al. 2003). Body length in adult deer ranges from 137 to 183 cm; height at the shoulder ranges from 76 to 106 cm (Linzey 1998). Adult males usually weigh between 56 and 113 kg; females weigh between 45 and 67 kg (Linzey 1998). Males have antlers that are shed every year, usually during the months of December, January, or February. New antlers begin to develop 2 to 6 weeks after shedding. New antlers are covered with a finely haired skin or velvet. In September, the velvet is shed, the antlers harden, and they lose their sensitivity (Linzey 1998).

**Habitat:** White-tailed deer typically inhabit dense woods and thickets as well as open meadows and forest glades. They also may be found in edge habitats, including those around orchards and farms. They are equally capable of adapting to artificial landscapes in urban areas (Linzey 1998, Whitaker and Hamilton 1998).

**Behavior:** White-tailed deer demonstrate crepuscular behavior; activity peaks during early morning and evening. They typically graze for about 4 hours after sunset in the winter and 6 to 7 hours after sunset in the summer. Activity decreases during periods of extreme weather conditions (Feldhamer et al. 2003). Daylight hours are spent bedded down in cover and concealment. Bedding areas are not permanent and deer usually do not stay bedded down for more than an hour and a half. Females form family or matriarchal groups consisting of an adult doe, her young from the current year, and female young from previous years (Feldhamer et al. 2003). Males remain solitary in the fall, but may congregate with other males in spring and summer (Linzey 1998). In forested habitats, these bachelor groups are generally comprised of 2 to 4 males while in open habitats larger groups of >5 males may occur. (Feldhamer et al. 2003, Demarais et al. 2000).

**Reproduction:** Breeding occurs in the fall, typically early October to late November; however, exact timing of breeding varies based upon a number of factors, including herd demographics and nutrition (Demarais et al. 2000). McKeever (1956) chronicled the main breeding season to be between November 14 and November 27 in West Virginia. The breeding season often is referred to as the "rut." The peak of breeding also depends on nutrition, age, exposure to mates, genetics, and environmental factors (Schmidt and Gilbert 1978, Feldhamer et al. 2003). Bucks mark and defend territories and make scrapes to attract does. Estrus lasts approximately 24 hours. A doe may enter into 2 to 7 estrous cycles, separated by 21 to 29 days if she was not successfully bred during previous cycles. One buck may breed with 3 to 4 does in a 28-day period (Schmidt and Gilbert 1978). The gestation period is variable due to potential nutritional, regional, or subspecies differences, but generally ranges from 187 to 222 days, after which the young are born in May or June (Demarais et al. 2000). The number of fawns born depends on the female's age and physical condition. Females in their first year typically only produce 1 fawn. In subsequent breeding seasons, she generally will produce twins (Linzey 1998). Females may reach sexual maturity as early as 6 or 7 months of age, but most attain sexual maturity at a

year and a half (Schmidt and Gilbert 1978). Breeding female fawns typically coincides with attainment of a critical mass (36 kg), which is found most often within high quality habitats. Poor habitats may result in delayed sexual maturity until 2 to 5 years in females (Demarais et al. 2000). Fawns breed later than adult does; yearling does that did not breed during the previous season may breed sooner than adult does. Males attain sexually maturity at 6 to 7 months (Feldhamer et al. 2003).

**Food Habits:** White-tailed deer consume between 2.25 and 4 kg of food a day. Their feeding habits are selective and diverse. The herbivorous diet consists of twigs, leaves, acorns, mushrooms, fruit, grasses, and weeds. Common species include greenbrier, sourwood, sassafras, maples, oak, honeysuckle, and wild grapes. In the fall, they rely heavily on mast (Linzey 1998). The fall diet includes acorns, bechnuts, persimmons, grapes, and apples (Feldhamer et al. 2003). Most browsing occurs in spring when vegetation is succulent (Linzey 1998). The spring diet includes blueberries, blackberries, raspberries, pokeberries, and cherries (Feldhamer et al. 2003).

**Mortality:** Mortality in white-tailed deer arises from disease and parasites, predation, habitat conditions, weather conditions, and relationships with humans. The life span of white-tailed deer varies with area habitat conditions, hunting seasons, and hunting methods. In Virginia, the maximum life span can reach 15 to 20 years, but seldom reaches 10 years (Linzey 1998). White-tailed deer are hosts to both internal and external parasites. Internal parasites include stomach worms, where infestation varies with deer population density. External parasites include ticks, lice, mites, and flies, which are mostly a nuisance to the host. White-tailed deer are host to over 20 species of ticks. Many diseases also affect white-tailed deer, but few reach epidemic proportions. Epizootic hemorrhagic disease (EHD) and blue tongue (BT) are viral diseases that may affect white-tailed deer populations (Feldhamer et al. 2003). EHD was first reported in 1974, but not confirmed until 1981 in West Virginia (WVDNR 1981). Chronic wasting disease (CWD), a transmissible spongiform encephalopathy, is another disease that has serious management implications (Feldhamer et al. 2003). WVDNR confirmed and announced the presence of CWD in a road-killed deer in Hampshire County, West Virginia, in September 2005. Upon confirmation, WVDNR activated their CWD response plan. After the initial confirmation and the activation of the CWD response plan, 3 additional free-ranging deer from Hampshire County tested positive for CWD (WVDNR n.d.[f]). The impacts associated with CWD in West Virginia are unknown. Infectious cutaneous fibromas (warts) also affect individuals (Feldhamer et al. 2003). In addition to parasites, predation also influences mortality. Predators include bobcats, bears, coyotes, and dogs. Linzey (1998) stated that hunters convey a specific influence on a population, as hunters are selective in taking deer first by sex and then by age. Natural predators convey similar influences on a population, but usually do so in reverse order. In West Virginia, automobile collisions and nuisance/damage control comprised over 90% of the non-seasonal (vehicle collisions and nuisance/damage control) mortality in deer in 1987 (WVDNR 1987). The number of deer carcasses picked up along roadways presently is used as the index to determine mortality associated with automobile collisions; this number most likely underestimates the total loss (WVDNR 1988). In 2003, non-seasonal mortality overall was 21,794 deer (WVDNR 2003c). Starvation, a result of poor habitat conditions, and weather are important factors for younger individuals (Linzey 1998; Schmidt and Gilbert 1978). Fencing and consumption of poisonous plants represent minor mortality factors (Linzey 1998).

### Distribution and Abundance

Distribution: White-tailed deer are native throughout North America and they presently inhabit every state. However, they are rare in Utah, Nevada, and California (Feldhamer et al. 2003). Linzey (1998) estimated the current population in the United States and Canada to be approximately 20 million deer. McKeever (1956) determined that deer were abundant throughout West Virginia, but more abundant in the eastern mountainous area.

Abundance: Throughout the East, market hunting and habitat destruction reduced white-tailed deer populations to <500,000 deer by the late 1800s. However, following the extirpation of most large, native predator species in the East, the implementation of strict hunting regulations, and the initiation of restocking programs, white-tailed deer populations rebounded and increased to >12 million animals by the 1980s (Robinson and Bolen 1989). As cited in the natural resource assessment for NERI (Mahan 2004), the West Virginia white-tailed deer population is estimated to be approximately 1 million individuals. Densities approach 13 deer/km<sup>2</sup> in District IV, the WVDNR administrative district that encompasses NERI.

### Economic Status

Throughout the United States, white-tailed deer provide recreational opportunities for hunters and other outdoor enthusiasts. In 2001, a national survey estimated 269,000 hunters spent 2,707 days hunting white-tailed deer in West Virginia (USDI 2001). The survey also estimated big game hunters spent \$132,607,000 annually, which averages \$528 per spender. The expenditure figure includes food, lodging, transportation, equipment, and other trip costs (USDI 2001). However, there also are negative economic impacts associated with deer populations that exceed social carrying capacity. When populations exceed social carrying capacity, deer no longer are viewed as a wildlife resource, but seen as pests (see page 124 for more information on carrying capacity). In high densities, white-tailed deer cause agriculture damage and alter forest vegetation and composition (Feldhamer et al. 2003). WVDNR (n.d.[d]) estimated the deer herd in West Virginia will increase 30 to 40% annually; this herd recruitment must be removed to maintain current population levels. Herd management currently relies on regulated hunting and damage control methods.

### *Wild Boar, *Sus scrofa**

#### Life History

Taxonomy: Wild boars or feral pigs are members of the order Artiodactyla and family Suidae (Linzey 1998). Wild boars originated from domestic hogs introduced by early settlers from Europe (Feldhamer et al. 2003).

Description: Wild boars are the result of years of crossbreeding between domestic swine and European wild boars. They are considered an intermediate between domestic hogs and European wild boars (Feldhamer et al. 2003). Descriptive characteristics vary with the amount of crossbreeding and length of time the feral population has existed in the wild. Characteristics also vary with the environment (Linzey 1998, Feldhamer et al. 2003). Common colorations include



black, black and white, black and brown, and brown. Generally, the hair of feral animals is coarser and denser than that of domestic swine (Linzey 1998, Whitaker and Hamilton 1998). They have an elongated skull. The canine teeth, prominent on both the upper and lower jaws, curve backward and outward. The lower canine teeth align in front of the upper canines. The canines in females are less prominent than those of males (Linzey 1998). The sense of smell is the most well developed of the senses. Boars have a round disk of cartilage that connects with the muscles of the snout to increase its flexibility. The eyes are located on the sides of the head, which tends to limit the range of vision. Ear shape varies from small and erect to low and flapping (Hruby 2002). Adults weigh between 31 and 150 kg (Linzey 1998).

**Habitat:** Given the wide and varied distribution of wild boars, they occupy a variety of habitats (Whitaker and Hamilton 1998). In most parts of the species' range, suitable boar habitat typically includes a predominance of forest and shrub lands. In Texas, boar habitat also is characterized by the presence of forest openings (Natural Science Research Laboratory n.d.). In Virginia, wild boars are found in the back dune zone of barrier beaches and adjacent areas that are dominated by pines and live oaks and an understory that consists of blueberry, cat briar, and poison ivy (Linzey 1998).

**Behavior:** The literature suggests that, for most of the year, wild boars are nocturnal, with crepuscular periods of peak activity (e.g., Feldhamer et al. 2003). However, in reality, wild boars may be active any time, day or night (Linzey 1998, Hruby 2002). During warmer temperatures, they become less active during the day to avoid exposure to the heat. They often wallow in mud or water, where available, to prevent overheating (Linzey 1998, Hruby 2002). Where hunting pressure exists, a population may become more nocturnal, especially during winter months (Feldhamer et al. 2003). They are somewhat nomadic, where movements are dictated by the availability and distribution of food. Females with litters sometimes congregate in herds of up to 20 individuals. Juvenile males leave these groups soon after reaching maturity and remain solitary thereafter (Hruby 2002). Home range size varies with habitat, food, season, sex, body mass, and population density (Feldhamer et al. 2003).

**Reproduction:** In warmer regions, breeding may occur year-round. Females are capable of producing 2 litters a year under optimal conditions (Feldhamer et al. 2003). Breeding often is synchronized with the moist season. The breeding season can be a violent period due to competition between males for sows. Females are polyestrous (Feldhamer et al. 2003). The estrus period lasts 21 days, but females are receptive only for about 3 of those days (Hruby 2002). After a gestation period of 112 to 114 days, a litter of 5 to 8 young is born in the spring. The young are born in a depression in the ground that may or may not contain gathered bedding material. Weaning occurs at 3 to 4 months, but the young often remain with the female for 6 months or more. Males reach sexual maturity at 5 to 6 months, whereas females do so at 10 months (Linzey 1998). Though females attain sexually maturity at 10 months, they rarely breed until at least 12 to 18 months. The age at which individuals reach sexually maturity varies with nutrition and genetics (Feldhamer et al. 2003).

**Food Habits:** Boars are described as being omnivorous and opportunistic. The diet changes seasonally and reflects closely the availability of food (Feldhamer et al. 2003). The diet includes mast, roots, tubers, and other forms of herbaceous vegetation. It also contains animal products

such as dead fish, hibernating frogs, bird eggs, snakes, mice, and even manure (Linzey 1998, Hruby 2002). In spring, green herbaceous materials, such as grasses, stems, leaves, forbs, roots, and tubers, comprise a larger component of the diet. Soft and hard mast, roots, and tubers are staples during summer. During fall, the diet consists mainly of hard mast, roots, tubers, and corn. With the onset of winter, boars again increase their use of grasses and forbs. Researchers have yet to determine whether the animal content of the diet, as indicated from stomach content analysis, is derived from predation or scavenging (Feldhamer et al. 2003).

**Mortality:** The life expectancy of a wild boar is approximately 10 years, although some animals have lived up to 27 years (Linzey 1998). Mortality is affected greatly by hunting (can be recreational, poaching, or nuisance control) (Whitaker and Hamilton 1998, Feldhamer et al. 2003). Predation generally is not a major mortality factor in boars. Predators may include black bears, mountain lions, bobcats, and coyotes (Feldhamer et al. 2003). Wild boars or feral pigs often are infested with parasites such as lungworms, kidney worms, stomach worms, intestinal worms, and ticks (Linzey 1998). Diseases that affect wild boars include pseudorabies (herpes virus), brucellosis, and bovine tuberculosis. By increasing the mortality of young and inducing abortions in pregnant sows, pseudorabies potentially can impact wild population status. Brucellosis is a zoonotic disease caused by 5 species of *Brucella*; it is a debilitating disease that also has the potential to affect populations (Feldhamer et al. 2003).

#### *Distribution and Abundance*

**Distribution:** The distribution of feral pig or wild boar populations is sporadic across the eastern United States. In Virginia, they have been reported in Pulaski and Wythe Counties, on national forest lands, and in the central coast region. Due to expanding populations in North Carolina and Tennessee, boars have been reclassified as game species in these states (Linzey 1998). West Virginia Division of Natural Resources reportedly released European wild boars on private lands in several western counties (Schmidt and Gilbert, 1978). Currently, wild boars are found in 4 counties in southern West Virginia: Boone, Logan, Raleigh, and Wyoming Counties (WVDNR 2003c). Their original range encompassed a 518 km<sup>2</sup> area in these 4 counties (WVDNR 2003c). This range does not occur within the boundaries of NERI. However, wild boar or feral pigs are believed to have been released by private landowners in the general vicinity of the park (Larry Berry, WVDNR District Biologist, pers. commun. 2004). He also stated that the Division currently does not consider these animals to be a part of the state's managed population. Thus, there is a continuous open hunting season on these released animals.

**Abundance:** The state's "managed" population presently does not occur within the boundaries of NERI. However, individuals released by private landowners may be observed within its boundaries (Larry Berry, WVDNR District Biologist, pers. commun. 2004). Since 1979, hunter success on wild boar in WV has been low and has declined since the mid-1990s. Average annual harvest of wild boar since 1979 has been approximately 66 animals; however, recent harvest levels have been much lower. West Virginia hunters harvested only 5 and 7 boars during the 2003 and 2004 season, respectively, from portions of Logan County. The declining rate of harvest may indicate a general decline in the status of the managed boar population. To verify results from harvest rates, West Virginia biologists conducted a survey to determine presence or absence of wild boars in Boone, Logan, Raleigh, and Wyoming counties. The survey revealed a reduced population of <50 animals. Wildlife biologists attributed this decline to habitat

destruction associated with mountain top mining and logging operations. Predation, poaching, and a lack of genetic diversity also may be negatively influencing the boar population (WVDNR n.d.[1]).

### Economic Status

The economic status of feral hogs/wild boars depends in part on how this animal is classified (i.e., game animal or nuisance animal). Feral hogs cause approximately \$800 million annually in environmental and crop damage in the United States (Feldhamer et al. 2003). In West Virginia, boars are managed as big game species and hunted in only 4 counties (Boone, Logan, Raleigh, and Wyoming). Outside these counties, wild boars are considered nuisance animals (Larry Berry, WVDNR District Biologist, pers. commun. 2004).

### Small Game Species

Birds:

*American Crow, Corvus brachyrhynchos*

### Life History

Taxonomy: American crows are members of the order Passeriformes, and family Corvidae (Verbeek and Caffrey 2002).

Description: American crows are birds with iridescent black plumage (Rue 1973, Verbeek and Caffrey 2002) and the largest of 3 species of crows (Rue 1973). They have a glossy black bill, nares covered with bristle-like feathers, and, as adults, a brown iris. The tips of their wings, when folded, do not extend to the tip of the tail. Males and females resemble one another, except that males are slightly larger than females. In immature individuals (3 to 15 months old), the plumage is less glossy and the feathers of the back and tail fade to a brownish color. Juveniles (1 to 3 months post-fledging) are grayish black with little iridescence or gloss. Juveniles also have fluffier feathers than adults and a blue-gray iris. In the field, it can be difficult to distinguish between the sexes (Verbeek and Caffrey 2002).

Habitat: American crows utilize a variety of habitats, but they require open areas for feeding and the presence of scattered trees, woodlots, windbreaks, and forest edges for protection, loafing, nesting, and roosting (Verbeek and Caffrey 2002). They appear to survive well both in natural and human-created habitats; this breadth of use encompasses logged areas, agricultural fields, urban areas, farmland, pasture, refuse dumps, city parks, golf courses, cemeteries, residential yards, vacant lots, highway rights-of-way, feedlots, and the shores of rivers, streams, and marshes (Verbeek and Caffrey 2002). Their winter habitat is very similar to that used during breeding. In areas where snow reduces the availability of natural foods, crows may congregate on refuse dumps, feedlots, and in cities and towns (Verbeek and Caffrey 2002).

Behavior: During the breeding season, adults, yearlings, and fledglings roost on territories. Territory size and use by crows and displayed behaviors associated with territories (e.g.,

maintenance of territories, degree of exclusivity) vary considerably. Breeding males may leave the territory to join local communal roosts. Once the breeding season has ended, all crows gather into small, communal roosts. In the morning (before and after dawn), crows leave the roost in small groups to begin feeding and return to the roost in the afternoon before sunset. Roost sites may be used for many years (Verbeek and Caffrey 2002).

Crows are strong fliers, with an average flight speed of 32 to 48 km/hr (Rue 1973). Crows fly low to ground when flying into the wind. Crows display a pronounced waddle when walking on the ground, with their toes pointed slightly inward, and often hop rather than walk, a trait characteristic among the corvids (Verbeek and Gaffrey 2002). Crows are migratory, but they travel only short distances (Rue 1973). Crows usually withdraw completely from the northern parts of the breeding range. In other parts of the range, they persist throughout the winter as permanent residents (Verbeek and Caffrey 2002).

**Reproduction:** Crows select and remain with the same mate for years. The breeding season begins when the winter flock begins to break up in mid-March (Rue 1973). Pairs usually do not form until the second spring after hatching (Verbeek and Caffrey 2002). Male crows conduct courtship flights to impress females. Males also display near a female on a tree limb; the male puffs out his feathers, lowers his wings and tail, bows to the female, and makes a rattling sound in his throat as he approaches the female. If the female accepts the male, copulation occurs and nest building follows (Rue 1973). Nests are built in either evergreen or deciduous trees. Nests are comprised of twigs and sticks and lined with shredded bark (Rue 1973). The nest usually is well-hidden, but commonly placed in a crotch or on a horizontal limb of a tree or tall shrub. Within days, the female lays 4 to 6 eggs (Rue 1973). In Virginia, egg-laying occurs in early April. Typically, crows produce only 1 nest per season, but if the first nest is disturbed or fails, another nest is produced (Verbeek and Caffrey 2002). The eggs are bluish or olive green with brown or gray spots. Both the male and the female share incubation duties. At birth, the young are bare and appear pink. After 5 days, they appear bluish-gray as the tips of the feathers begin to emerge. After 10 days, the hatchlings begin to vocalize loudly for food. They begin to fly at 5 weeks (Rue 1973).

**Food Habits:** Crows are omnivorous birds and feed on a variety invertebrates (e.g., beetles, grasshoppers, crickets, moths, flies, ants), amphibians, reptiles, small birds, mammals (e.g., deer mice, voles), eggs (e.g., ground-nesting ducks), nestlings and fledglings, grain crops, seeds and fruits, carrion, and discarded human food (Rue 1973, Verbeek and Caffrey 2002).

**Mortality:** Several factors influence mortality of crows, including disease, parasites, and predation. Parasites reported in crows include blood parasites (e.g., *Trypanosoma ontarioensis*, *T. paddae*, *Isospora brachyrhynchi*), trematodes, nematodes, cestodes, blow flies, lice, and mites (Rue 1973, Verbeek and Caffrey 2002). Fungal and bacterial infections (e.g., avian cholera) have been reported in crows. Crows are susceptible to West Nile Virus (WNV). WNV, first discovered in U.S. in New York City in 1999, is a vector-borne disease transferred to birds by infected mosquitoes (Verbeek and Caffrey 2002). Great-horned owls are the primary predator of crows. Additional predators include other large owls and hawks. Eggs and young commonly are preyed on by raccoons, opossums, and black snakes. In the wild, crows live 4 to 7 years, yet individuals in captivity have lived up to 20 years (Rue 1973).

### Distribution and Abundance

Distribution: American crows are one of the most widespread birds in North America (Rue 1973, Verbeek and Caffrey 2002). Within the U.S., they are found in all 48 contiguous states. However, their numbers are restricted in prairie and arid areas by the lack of trees (Rue 1973).

Abundance: Data from the Breeding Bird Survey (BBS) show significant increases in crow populations throughout the U.S. during the period 1966–1996 (Verbeek and Caffrey 2002). The American crow was one of the most frequently reported birds in the West Virginia breeding bird atlas project (Buckelew and Hall 1994).

### Economic Status

In many areas of the U.S., crows are considered a nuisance. In 2003, American crows officially were designated a game species in West Virginia, with the following exception: “Nuisance crows committing depredations upon ornamental or shade trees, agricultural crops, home gardens, livestock, or wildlife, or when concentrated so as to constitute a health hazard and or other nuisance may be killed at any time” (WVDNR 2003b:2). The re-designation necessitated development and adoption of hunting regulations (seasons, hunting methods) as means to manage crow populations. The first recreational hunting season opens in early September and closes in late December, but hunting is restricted only to Thursdays, Fridays, and Saturdays. A second season opens in January and closes in February; during this season, hunting is not restricted. In addition, the season is open statewide and there are no daily or seasonal bag limits. Prior to this change, crows were considered a nuisance species with a continuous open season and no limits in West Virginia.

### *Northern Bobwhite, *Colinus virginianus**

#### Life History

Taxonomy: Northern bobwhites are members of the order Galliformes, and family Odontophoridae (Brennan 1999). Twenty-two subspecies of the northern bobwhite are recognized; most subspecies are found south of the U.S. (Brennan 1999).

Description: The northern bobwhite is a plump-bodied bird that weighs, on average, about 5 to 6 ounces. Males have a conspicuous white throat patch and a broad white stripe above their eyes that extends from the bill to the nape of the neck. Both the throat patch and eye stripe have a black or dark brown border. The breast, rump, wings, and tail are reddish brown with black markings (Rue 1973, Brennan 1999). The stomach and flanks have white feathers with brown edges, which give the northern bobwhite a scaled appearance. The bill, eyes, legs, and feet are black. Males and females resemble one another, except the throat patch and eye stripe of female are more yellowish and have dark brown borders. Females also are slightly smaller and lighter than males (Rue 1973, Brennan 1999). Juvenile plumage is similar to adults, but duller. Plumage and markings may vary with geographic location (Brennan 1999).

**Habitat:** The preferred habitat of northern bobwhites is best described as early successional lands. Examples include the borders of agricultural fields, fallow fields, ungrazed pastures, open grasslands, and open and mixed pine-hardwood forests. In recent years, the value of agricultural land to quail has been reduced due to changes in agriculture practices (e.g., increased field size, removal of hedgerows and fence lines) (Brennan 1999). Wildlife management regimes using prescribed fire are necessary to maintain quality habitat in southern pine forests. During the winter, woody cover prevents snow from covering the ground and provides access to forage on the ground (Brennan 1999).

**Behavior:** Northern bobwhites are highly social birds that form coveys during the non-breeding season (Brennan 1999). At night, northern bobwhites roost communally in coveys on the ground in a circle with tails pointing inward and beaks pointing outward (Brennan 1999).

Northern bobwhites are capable of walking and running quickly on the ground. They often run in short bursts when disturbed. However, when undisturbed, their movements are much slower and more deliberate (Brennan 1999). Northern bobwhites usually fly only short distances and close to ground (Brennan 1999). Because they are not migratory, they will reside in an area year-round, especially in areas of moderate- to high-quality habitat. However, seasonal movements between low-elevation wintering and high-elevation breeding habitats have been observed in the Southeast (Brennan 1999).

Northern bobwhites are known for the whistling of their name (Rue 1973); they have a wide variety of other calls (e.g., group movement calls, food finding calls, alarm calls) (Brennan 1999).

**Reproduction:** Northern bobwhites are monogamous (Rue 1973). However, new evidence suggests that an ambisexual polygamy mating system may exist in the species (e.g., both males and females incubate and raise broods with more than one mate during the breeding season) (Brennan 1999). In early spring (February and March), as the winter coveys begin to break up and scatter, males begin to conduct courtship displays to attract prospective female mates (Rue 1973, Brennan 1999). During this courtship, the male fluffs out his feathers, drops his wings until the tips touch the ground, spreads the tail, and cocks his head to the side before charging the female. This continues until the female accepts his advances, squats down, and submits to copulation. Once a pair bond is established, the male and female seek an area of their own. However, if temperatures drop, the pair temporarily may return to the covey. If weather permits, the pair begins nesting within a couple of weeks, usually between early March and early April (Rue 1973). The male is very devoted to the female and rarely leaves her side. The male selects a well-hidden area in tall grasses, scratches out an area in the earth, and lines the nest with grasses, leaves, and pine needles. The female lays 1 egg a day until a clutch of 12 to 15 eggs is produced. The female incubates the nest for approximately 23 days. The male remains in the area and will act as a decoy if a predator approaches the nest (Rue 1973). When born, the young are precocious and ready to leave the nest as soon as their down dries. Both the male and female continuously attend to the young; after 1 week, chances of survival increase (Rue 1973). One or both parents will feign injury to distract a predator. Upon hearing the alarm call, the young immediately blend into their surroundings (Rue 1973).

**Food Habits:** Northern bobwhites primarily are herbivorous and will consume the seeds of many different plants (e.g., ragweed, lespedeza, smartweed, corn, sorghum, acorns, cowpeas, sunflower, doveweed, panic grass). In addition to consuming seeds, they eat the leaves and stems of plants (Rue 1973, Brennan 1999). For the first 6 to 8 weeks, young feed almost exclusively on insects before their diet becomes herbivorous (Rue 1973, Brennan 1999). During the breeding season, females also consume insects (Brennan 1999).

**Mortality:** Important sources of mortality in northern bobwhites include changes in agriculture practices (Rue 1973), predation, parasites and diseases, and exposure (Brennan 1999). The greatest influence on northern bobwhite populations has been the change in agriculture practices that negatively affect available habitat. Predation can be important in northern bobwhites; in high quality habitats, predation is not a significant influence. In many cases, the nest and often the female are lost to predators (e.g., snakes, skunks, opossums, raccoons, weasels) (Rue 1973). Parasitic worms rarely cause mortality in wild northern bobwhites, but the presence of parasitic worms is associated with low body weight, which may influence survival (Brennan 1999). Other parasites include helminthes and nematodes. Diseases found in northern bobwhites include avian pox, ulcerative enteritis, quail bronchitis, and histomoniasis (Brennan 1999).

### *Distribution and Abundance*

**Distribution:** Historically, northern bobwhites ranged from Maine, west to the upper Mississippi River Valley, south to Texas, and throughout the eastern U.S. (Rue 1973, Brennan 1999). Originally, northern bobwhites were found in grassland areas and areas under a natural fire regime. However, with the expansion of early colonial agriculture, bobwhite populations increased (Rue 1973). Presently, bobwhites are found from eastern Massachusetts down the coast to New Jersey, across Pennsylvania to the Great Lakes, south to Texas, and east to Florida (Rue 1973).

**Abundance:** Despite the large distribution of northern bobwhites, they do not blanket the area (Rue 1973). Data from the Christmas Bird Count, the annual Breeding Bird Survey (BBC), and state game agencies indicate a decline in bobwhite populations throughout the U.S. Habitat loss is the primary cause of population declines.

### *Economic Status*

Within the sporting community, the northern bobwhite is one of the most esteemed and sought after game birds. There is a statewide northern bobwhite season in West Virginia, which opens in early November and closes in late February. From the 1978–1979 hunting season until the 1998–1999 hunting season, the daily bag limit was 7 birds and the possession limit was 21 birds. In 1999, the daily bag limit was changed to 3 birds and the possession limit to 9 birds (WVDNR 1999). A seasonal limit does not exist for northern bobwhites.

## *Ruffed Grouse, Bonasa umbellus*

### Life History

**Taxonomy:** Ruffed grouse are members of the order Galliformes, and family Phasianidae (Rusch et al. 2000). Fifteen subspecies of *Bonasa umbellus* are recognized; subspecies are identified using overall coloration, prominence, color of barring underneath, and extent of tarsal feathering (Rusch et al. 2000).

**Description:** Ruffed grouse are a small (40-48 cm) chicken-like bird. The plumage of the male and female is brown, black, and white; plumage varies from ash gray to almost black and from pale buff to dark brown (Rue 1973). Males have a continuous, black outer band on their tail, whereas the outer band on the female's tail is broken in the center by two brown bandless feathers (Rue 1973, Rusch et al. 2000). Males also have longer tail feathers and a dark complete ruff around the neck (Rue 1973). Females are slightly smaller than males (Rue 1973, Rusch et al. 2000). Both males and females seasonally produce comb-like pectinations that grow out of the sides of the toes, which allow them to walk on snow. In the spring, these pectinations are no longer needed and fall off (Rue 1973). Legs and feet of ruffed grouse are covered with feathers (Rue 1973).

**Habitat:** The distribution of ruffed grouse closely is related to the presence of certain forest types (Rue 1973). In northern and western U.S., ruffed grouse are found in areas associated with aspen. Habitat in the northeastern U.S. includes areas of mixed-deciduous forests. Aspen-dominated forests are used in the Midwest. In southern parts of their range, mixed-deciduous forests of oaks, hickories, and pines are used. Quality habitat provides both cover and food (Rusch et al. 2000).

**Behavior:** Ruffed grouse are known for their "drumming" to attract females. Males make the drumming sound by beating the air with cupped wings (Rue 1973).

During winter, ruffed grouse group into flocks of 4 to 8 individuals for protection and to capitalize on food availability. In the southern extent of the range, ruffed grouse roost in trees, usually conifers. In northern and central parts of their range, ruffed grouse roost in trees or beneath the snow (where deep enough) (Rue 1973).

Ruffed grouse generally are observed walking on the ground (Rusch et al. 2000), but are capable of flying at speeds >30 km/h mp; normal flight speed is between 14 and 30 km/h (Rusch et al. 2000). Ruffed grouse do not migrate, but instead make seasonal shifts in their movements, alter the size of the home range, and utilize different habitat types to accommodate the changing conditions (Rue 1973, Rusch et al. 2000).

**Reproduction:** Drumming by the male ruffed grouse signals the beginning of breeding season. Downed logs or other elevated platforms are used as a stage for these displays. The male will erect the neck ruff, fan out the tail, lowers the wings, and strut from one end of the platform to the other end. Females are summoned by the drumming and, if impressed by the display, she will accept his advances (Rue 1973). The nest usually is located against the base of a tree trunk, stump, or thicket of bushes to give the female some protection against threats that approach from



the rear. Nests are simple depressions formed in the leaves on the forest floor (Rue 1973). Average clutch size ranges between 9 and 12 eggs. The female lays 1 egg a day until the clutch is complete. Eggs are pale brown and blend well with the nest material (Rue 1973). Incubation is the female's responsibility. When brooding or incubating, the female often places sticks and leaves on her back. When danger approaches, the female remains still, but, if she fears detection, she will fly from the nest, letting the sticks and leaves settle down on the nest to camouflage its contents (Rue 1973). Incubation lasts 21 and 23 days, depending upon how much time the female spends away from the nest. After hatching, young are precocious and ready to leave the nest as soon as their down dries. The female herds her young to the edge of the forest to feed on insects (Rue 1973). If danger approaches, the female feigns injury and will lure the predator away from the helpless chicks (Rue 1973). The primary feathers grow fast and, within 4 or 5 days, the young begin fluttering around. Within a week, the young are capable of flying short distances and, only a few days later, they begin to roost in trees (Rue 1973).

**Food Habits:** Although the list of food items consumed by ruffed grouse exceeds 600 items, the bulk of the diet consists of plant material, including buds, leaves, berries, nuts, and grain (Rue 1973). The winter diet in northern portions of the range includes buds and twigs, whereas fruits, ferns, and leaves from herbaceous and woody plants are consumed in the southern winter range. The summer diet of ruffed grouse includes leaves of herbaceous plants, soft fruits, and acorns. Insects and other invertebrates are consumed by the fast-growing young and occasionally by adults (Rusch et al. 2000).

**Mortality:** Mortality factors for ruffed grouse include disease, predation, and hunting. Diseases caused by nutritional deficiency, toxins, viruses, bacteria, fungi, or parasitic infections have been reported, but rarely cause substantial mortality in ruffed grouse populations (Rusch et al. 2000). Predation is the largest source of mortality in ruffed grouse (Rusch et al. 2000). Predators include several species of owls (e.g., great horned owl, snowy owl, barred owl), goshawks, Cooper's hawks, sharp-shinned hawks, foxes, bobcats, and lynx. Predators of young and eggs include snakes, skunks, opossums, raccoons, weasels, and mink. Hunting mortality rarely plays a major role in population fluctuations. Ruffed grouse live for 3 to 4 years in the wild (Rue 1973).

### *Distribution and Abundance*

**Distribution:** Ruffed grouse are found in woodlands from the Atlantic Ocean to the Pacific Ocean; from Alaska down to California in the Cascade, Sierra, and Rocky Mountains; from Hudson's Bay south through Michigan and Wisconsin into Illinois; and from Labrador south to Tennessee and South Carolina along the Appalachian Mountains (Rue 1973).

**Abundance:** Abundance of ruffed grouse varies with habitat quality and condition, year, and geographic region. In areas of good habitat, densities of drumming males may reach 0.5 birds/ha. It is difficult to determine long term trends because of the current lack of consistent continental and region-wide data. Ruffed grouse populations in eastern U.S. are believed to be declining (Rusch et al. 2000).

### Economic Status

Ruffed grouse provide multiple recreational opportunities. One million grouse hunters spent 9 million days hunting grouse in 2001 (USDI 2002). The statewide grouse season in West Virginia opens in early November and closes in late February (WVDNR 1999).

Mammals:

*Bobcat, Lynx rufus*

### Life History

**Taxonomy:** Bobcats are members of the order Carnivora, and the family Felidae (Hall 1981). After much debate, bobcats and lynxes were included in the genus *Lynx* (Feldhamer et al. 2003). Twelve subspecies of bobcats exist in North America and Central America (Feldhamer et al. 2003).

**Description:** Bobcats are a medium-sized (60 – 73 cm), short-tailed (127 mm) felid. Bobcats have a broad face with a ruff of fur on the sides of the face. The ruff extends from the ear down to the lower jaw. Bobcats have distinct, pointed ears with short ear tufts (Linzey 1998, Whitaker and Hamilton 1998). The fur is brownish to yellowish interspersed with gray. The presence of tawny hairs tipped black and white produces the gray coloration. The chin and underparts are white. The belly is white with dark spots. The short tail, a distinguishing characteristic, has several black bars on the dorsal surface (Linzey 1998). The summer coat is reddish, whereas the winter coat is grayish, suggesting that bobcats molt twice annually (Feldhamer et al. 2003). Melanistic and albinistic individuals have been reported (Feldhamer et al. 2003). Bobcats have 5 toes on each front foot and 4 toes on each hind foot. Each foot has long, sharp, curved, retractile claws. Adult males weigh between 5.4 kg and 13.5 kg and adult females weigh between 4 kg and 9 kg (Linzey 1998). Though weight varies throughout their range, bobcats also exhibit sexual dimorphism; males are larger and heavier than females (Feldhamer et al. 2003).

**Habitat:** Bobcats are found in a variety of habitats that include mountainous habitats and timbered swamps (Linzey 1998, Whitaker and Hamilton 1998). In the Southeast, bobcats are found in second-growth deciduous forests with numerous clearings, swampy areas with grassy borders, and river bottom swamps (Linzey 1998). Habitat also includes rough, rocky areas with dense cover (Feldhamer et al. 2003). Bobcat habitat must produce an abundance of prey and allow bobcats to hunt by stalking or ambushing (Feldhamer et al. 2003). In West Virginia, bobcats are found in extensive deciduous and coniferous forests in higher elevations (McKeever 1956).

**Behavior:** Bobcats generally are considered to be solitary, nocturnal animals (Linzey 1998). However, peak activity occurs during crepuscular periods, though activity will vary among regions, sex, weather conditions, and individuals (Feldhamer et al. 2003). Bobcats are good climbers and often rest in trees. Though they dislike water, they are good swimmers (Linzey 1998). Males leave scrapes, marked with urine, along trails to establish territories. Bobcats have

excellent senses of sight, smell, and hearing. Though bobcats are quiet, vocalizations such as growls, howls, meows, screams, hisses, and spits may be used to communicate.

Bobcats establish a permanent den to raise their young in and may locate it under a log, in a hollow of a windfall, or in a rocky cave. Abandoned buildings and beaver lodges also may be used as den sites (Feldhamer et al. 2003). Resting sites away from the den may be used; these resting sites are found in thickets, beneath fallen trees, beneath fallen snags, or in hollow logs on the ground (Linzey 1998). The size of a bobcat's home range varies with availability of prey and hunting pressure (Linzey 1998). Home range size also varies with habitat quality (Feldhamer et al. 2003). Home ranges in northern latitudes are larger than home ranges in southern latitudes (Feldhamer et al. 2003) and ranges of males are 2 to 3 times larger than those of females (Feldhamer et al. 2003).

**Reproduction:** Bobcats are polygamous; female bobcats are polyestrus, which allows females to breed multiple times until successfully bred (Feldhamer et al. 2003). Some studies conclude bobcats are induced ovulators (i.e., ovulation is induced by copulation [Linzey 1998]) whereas other studies suggest bobcats may be spontaneous ovulators (Feldhamer et al. 2003). Breeding occurs year round for bobcats, but the majority of breeding effort takes place in February and March (Feldhamer et al. 2003). Breeding season may vary with latitude, longitude, altitude, climate, photoperiod, and prey availability (Feldhamer et al. 2003). In Virginia, breeding starts around January and extends into May and possibly into the summer. Most litters are born in April and May, after a gestation period of 50 to 70 days. Females who have produced an early litter may breed again that year. Average litter size in bobcats is 2 to 3 kittens, but litters may range from 1 to 5 kittens. Kittens are born with a mottled coat and their eyes closed. The birth weight of kittens averages 340 g. After 9 to 10 days, their eyes open. The young nurse for approximately 2 months, after which their diet begins to include meat. Once the kittens reach weaning age, the adult male may help provide food for the kittens. Young stay with the female throughout the fall and possibly through the winter. Females are capable of breeding when they are a year old (Linzey 1998). Males are capable of breeding during their second winter (Feldhamer et al. 2003).

**Food Habits:** Bobcats are primarily carnivorous (Feldhamer et al. 2003). Throughout their range, the diet is dominated by rabbits and, where present, hares (Feldhamer et al. 2003). However, gray and fox squirrels, white-tailed deer fawns, birds, opossum, field mice, woodchucks, chipmunks, and other small rodents, and grasses are also consumed (Linzey 1998). In 2 West Virginia studies, 52% (WVDNR 1981) and 49% (Fox and Fox 1982) of the bobcat stomachs examined contained deer. Reptiles, amphibians, insects, and eggs also are consumed (Feldhamer et al. 2003).

**Mortality:** Mortality is described most often in 3 distinct age periods: kitten, yearling, and adult (Feldhamer et al. 2003). The survival rate for kittens is influenced by malnutrition and parasitism. Mortality in yearlings and adults is influenced most by human factors, specifically legal and illegal hunting, and trapping (Feldhamer et al. 2003). Other mortality factors include starvation, predation, disease, and vehicle collisions. Predators of adult bobcats include coyotes, domestic dogs, and mountain lions (Feldhamer et al. 2003); foxes and great-horned owls may prey on young (Linzey 1998). Diseases reported in bobcats include rabies, feline panleukopenia

(feline distemper and feline infectious enteritis), rhinotracheitis, feline leukemia, feline calicivirus, and feline infectious peritonitis (Linzey 1998; Feldhamer et al. 2003). Bacterial diseases include sylvatic plague, tularemia, salmonellosis, leptospirosis, brucellosis, and tuberculosis (Feldhamer et al. 2003). Parasites include spiny-headed worms, flukes, tapeworms, roundworms, fleas, ticks, lice, and sarcoptic mites (Linzey 1998, Feldhamer et al. 2003).

### Distribution and Abundance

Distribution: Bobcats are the most widely distributed native felid in North America (Feldhamer et al. 2003). Their former range included Canada, much of the United States, and into central Mexico. Bobcats largely have been extirpated from areas of dense human populations. Bobcats currently are located in rugged areas from north to central British Columbia and south to Mexico (Feldhamer et al. 2003); distribution and abundance have changed with land use (Linzey 1998). Bobcats are found in all the contiguous U.S. states except Delaware (Feldhamer et al. 2003). McKeever (1956) stated that bobcats were present from McDowell County north to Monongalia County and east to Hampshire County, West Virginia. During the 1979-1980 season, 27% of the bobcat harvest was taken on state and federal lands in West Virginia (WVDNR 1980).

Abundance: In West Virginia, the loss of contiguous forests historically limited their abundance (McKeever 1956). Bobcats are more abundant in areas with lower human populations, but occur in every county in West Virginia (WVDNR 1980) and have been harvested in every county except Hanover County (Roger Anderson, WVDNR Wildlife Biologist, pers. commun. 2006).

### Economic Status

Historically, bobcats were not considered an economically important wildlife resource. Following the passage of the Endangered Species Act in 1970, the number of bobcats harvested annually increased noticeably. However, during the 1970s and 1980s, they became the center of intense political and ecological debate, which led to passage of legislation that governed the bobcat fur industry. Currently 38 states permit the harvest of bobcats (Feldhamer et al. 2003). Bobcats were considered a varmint by the public for many years in West Virginia. As late as 1962, many counties still paid a bounty on bobcats. In 1977, a mandatory tagging program was implemented for bobcats. In 1978, West Virginia implemented a seasonal bag limit for hunting and trapping (WVDNR 1978). Currently, bobcats are managed as a furbearer species under regulated hunting and trapping seasons (WVDNR 2004b).

### *Eastern Cottontail, Sylvilagus floridanus*

#### Life History

Taxonomy: Eastern cottontails are members of the order, Lagomorpha, and the family Leporidae (Feldhamer et al. 2003). Thirteen subspecies of *Sylvilagus floridanus* exist north of Mexico (Feldhamer et al. 2003). McKeever (1956) identified 2 subspecies of eastern cottontails in West Virginia: *S. f. mallurus* and *S. f. mearnsii*. However, he did not provide a specific geographic boundary for these subspecies. Another event that has affected current taxonomy of cottontails in West Virginia was the importation of 2,000 cottontails of the subspecies *S. f. alcer* from

Kansas in 1928 (McKeever 1956). In addition to the 2,000 imported cottontails, the Conservation Commission (West Virginia Division of Natural Resources) purchased and released 67,881 cottontails between 1934 and 1948 (McKeever 1956).

**Description:** Eastern cottontails are medium-sized (35 – 43 cm) rabbits with long ears, large hind legs and feet, and smaller front legs and feet. The nape of the neck is rusty and the upperparts vary from red-brown to gray-brown, with black peppering throughout. The ears are dark gray or tan with a black border and the underparts are grayish-white, except for the chest, which is brownish. Cottontails have a short, fluffy tail that is brown above and white below. As individuals run, the tail is held upright, exposing the white fur, hence, the origin of its common name (Linzey 1998, Whitaker and Hamilton 1998). They also may have a white spot on their forehead, which characteristically distinguishes them from *S. transitionalis* and *S. obscurus* (Feldhamer et al. 2003). Cottontails generally weigh between 0.9 and 1.8 kg (Linzey 1998).

**Habitat:** Eastern cottontails inhabit old fields, brushy clearings, weed and brier patches, hedgerows, and woodland borders. Habitat also may include orchards and cultivated fields that contain patches or borders of weeds, grasses, and brush (Linzey 1998). Habitat suitable for eastern cottontails often is described as disturbed, successional, and shrub-dominated (Feldhamer et al. 2003). McKeever (1956) noted that cottontails were most abundant in areas with shrubs, herbaceous vegetation, and grasslands mixed together.

**Behavior:** Most eastern cottontails are solitary, nocturnal animals and are most active from sunset until late morning. Daylight hours generally are spent in the burrow (Linzey 1998), but some individuals may remain active throughout the day (Feldhamer et al. 2003). Extreme weather conditions decrease activity (Feldhamer et al. 2003). Home range size varies with age, sex, and methods of estimation (Linzey 1998, Feldhamer et al. 2003). Eastern cottontails use a series of short jumps or hops to get around. Cottontails can reach speeds of 29 km/hr, but they cannot maintain this speed for >0.8 km. They have excellent senses of hearing and sight (Linzey 1998).

**Reproduction:** Cottontails breed throughout the year, except during the coldest months. In Virginia, they breed from mid-February to mid-August (Linzey 1998). Breeding may begin later in higher elevations (Feldhamer et al. 2003). The onset of breeding varies among populations and can be influenced by food availability and temperature from year to year (Feldhamer et al. 2003). Females are capable of producing several litters each year. The female will mate again immediately after giving birth, in some cases before the young are even a day old. The gestation period is 26 to 28 days. Average litter size is 2 to 6 young; the first and last litters of the year typically are smaller (Linzey 1998; Feldhamer et al. 2003). At birth, young rabbits are blind and helpless. Their eyes first open at 4 to 5 days. They begin to eat grass around 8 days. They leave the nest between 14 and 16 days and are weaned by 15 days (Feldhamer et al. 2003). The nest is a depression, lined with dry grasses and fur (Linzey 1998). Residual vegetation is the preferred nest material (Feldhamer et al. 2003). During the day, the female stays away from the nests to prevent drawing attention to the nest. She returns to the nest around sunrise to nurse the young. Most of these offspring will breed for the first time during the first spring following their birth (Linzey 1998).

Food Habits: Eastern cottontails are herbivores, so the diet is composed of vegetative material that varies with seasonal availability. The diet may include grasses, clovers, flowers, and crops. During the winter, the diet includes twigs and bark from fruit trees and ornamental shrubs (Linzey 1998, Whitaker and Hamilton 1998). Woody plants consumed during the winter included gray birch, red maple, apple, aspen, choke cherry, black cherry, blackberry, dewberry, willow, black alder, maleberry, and highbush blueberry (Feldhamer et al. 2003).

Mortality: Linzey (1998) noted that 80% of all cottontails die before they reach 1 year. Parasites common to cottontails include flukes, tapeworms, roundworms, fleas, ticks, mites, warbles, and flies (Linzey 1998, Feldhamer et al. 2003). Bacteria and viruses also can lead to mortality. Eastern cottontails are known carriers of tularemia (“rabbit fever”) (Linzey 1998; Feldhamer et al. 2003), which displays a near 100% fatality rate in infected rabbits (Linzey 1998). Other diseases include *Staphylococcus aureus*, eastern encephalitis, and papilloma virus (Feldhamer et al. 2003). Predation is a major cause of mortality (Feldhamer et al. 2003), as inflicted by skunks, opossums, weasels, mink, raccoons, foxes, snakes, crows, hawks, and owls on young rabbits and by foxes, mink, weasels, hawks, and owls on adult rabbits (Linzey 1998, Whitaker and Hamilton 1998).

### Distribution and Abundance

Of the North American rabbits, eastern cottontails are the most common and widespread (Linzey 1998, Whitaker and Hamilton 1998, Feldhamer et al. 2003). Eastern cottontails occur from southern Canada, throughout the United States, and into Mexico and further south (Feldhamer et al. 2003). In West Virginia, they are found throughout the entire state (McKeever 1956).

### Economic Status

Eastern Cottontails are one of the most important game animals in the United States. High reproductive rates have allowed the species to withstand intense hunting pressure. Rabbits, and their pelts, provide clothing and meat (Feldhamer et al. 2003). In West Virginia, eastern cottontails are managed as a small game species with a regulated hunting season (WVDNR 2004b). The recreational and economic benefits of sport hunting of eastern cottontails compensate for the minor damage done to crops, nurseries, and orchards (Feldhamer et al. 2003).

### Eastern Gray Squirrel, *Sciurus carolinensis*

#### Life History

Taxonomy: Eastern gray squirrels are members of the order Rodentia, and the family Sciuridae (Feldhamer et al. 2003). McKeever (1956) verified the presence of 2 subspecies: *Sciurus carolinensis carolinensis* and *S. c. leucotis* in West Virginia. He concluded most observed individuals displayed size characteristics of *S. c. leucotis* and color characteristics of *S. c. carolinensis*. However, all individuals have been assigned to the subspecies, *S. c. leucotis* (McKeever 1956).

**Description:** The gray squirrel is a medium-sized (20 – 25 cm) tree squirrel (Whitaker and Hamilton 1998, Feldhamer et al. 2003). The pelage of gray squirrels is less variable than that of fox squirrels. Its head, back, and sides are gray and its feet are tinged with yellowish-brown. A whitish ring around the eye is visible, as is the white on the backs of its ears. The chin and underside is white to silver-gray. Hairs on the tail are banded black and tan with white tips. The fur on the body is short, whereas hairs on the tail are long, which gives it a bushy appearance. Younger squirrels have more gray coloration than adults. Complete and partial variations of melanism and albinism also occur. Melanism is common in northern portions of the range (Feldhamer et al. 2003). Gray squirrels follow Bergman's Rule (i.e., larger body size occurs in northern latitudes) throughout their range (Feldhamer et al. 2003). Adults weigh between 360 and 650 g (Linzey 1998). They measure between 383 and 525 mm in total body length and 150 and 243 mm in tail length (Feldhamer et al. 2003).

**Habitat:** Gray squirrels prefer large stands of mature, mixed hardwood timber with dense understory growth (Flyger and Gates 1982, Merritt 1987, McKeever 1956). Feldhamer et al. (2003) noted gray squirrels have been observed in mixed-hardwood and white oak-red oak-hickory forest types in West Virginia. Linzey (1998) described their habitat as consisting of dense hardwoods and mixed conifer-hardwood forests characterized with ravines, slopes, and river bottoms. Linzey (1998) also noted their presence in urban parks and other developed areas.

**Behavior:** Gray squirrels are the most familiar of tree squirrels. Home range size varies with food availability and population densities (Linzey 1998). Merritt (1987) noted that densities can approach 50 individuals per ha. Derge and Yahner (2000) noted that the percent basal area of hickory and oaks was correlated directly to squirrel abundance. Home range size can vary with sex, age, and method of determination (Feldhamer et al. 2003). Linzey (1998) noted home ranges spanned from 0.5 to 20 ha, but most usually were <5 ha. Home ranges are largest during spring and summer. Gray squirrels are diurnal, as they exit the nest in the early morning and return to it after sunset. Peak activity occurs just before sunrise and again late in the afternoon. They are busiest in the fall as the nuts ripen, but remain active all year (Linzey 1998).

Gray squirrels are excellent tree climbers, and are capable of leaping up to 1.5 m. They can travel up 24 km/hr for short distances. While moving about in the trees, individuals may jump upward 1.8 m and downward 4.5 m (Linzey 1998).

Gray squirrels construct nests of leaves and twigs in the crotches of limbs and in hollows of trees. For nesting, bedding, and escape cover, squirrels use leaf and twig nests as well as dens in tree cavities (Edwards and Guynn 1995). Leaf nests are temporary structures and are seldom used longer than 1 season. Dens often are used for many years and have been found to be superior to leaf nests (Nixon et al. 1978, Brown and Yeager 1945) even though they can become infested with fleas. In West Virginia, leaf nests were found in 26 of 35 tree species identified in the study area; over half of the nests occurred in 3 species of oak (Feldhamer et al. 2003). Nests in hollows and cavities provide more protection from inclement weather and predators. Although tree cavities used by gray squirrels in West Virginia averaged 7.9 m above the ground, they used cavities located at various positions on a tree, including in the bole of a tree, at the base of a tree, and those associated with the limbs of trees (Feldhamer et al. 2003).

The tail of the gray squirrel has many uses: it provides balance and support when climbing, it provides shade from the sun, it provides warmth, and it provides a means to communicate with other squirrels. Gray squirrels are considered noisy and have a large vocabulary. They are alert and aware of their surroundings. The senses of touch, sight, hearing, smell, and taste are well developed in the species (Linzey 1998).

**Reproduction:** The onset of reproduction varies with latitude, environmental conditions, age, nutrition, and population densities. Gray squirrels are dioestrus, which means they typically breed twice annually (Feldhamer et al. 2003). McKeever (1956) noted females in West Virginia routinely produce 2 litters a year; the first litter coming in late March or early April and the second in July or August. Feldhamer et al. (2003) concluded that 40% of females produced 2 litters during years of abundant mast production. Linzey (1998) noted that most females in Virginia produced 2 litters a year; the first between February and April and the second between July and September. However, data from Virginia, West Virginia, and other states indicated that an average production of slightly >1 litter per year was expected (Linzey 1998). The gestation period for gray squirrels is approximately 44 to 45 days. Spring litters are slightly smaller than summer litters. Young are the responsibility of the female. At birth, squirrels are hairless, their eyes and ears are closed, and they weigh approximately 14 g. At 3 weeks, their hair begins to appear and their ears begin to open. At 35 days, the eyes fully open. At 8 weeks, the young are full grown with a full coat of fur and a bushy tail. Weaning of young generally occurs between 6 to 10 weeks. Juveniles stay with the family group for roughly 4 to 5 months (Linzey 1998). Individuals rarely breed before 10 months (Feldhamer et al. 2003). Females are capable of producing a litter at 1 year old (Linzey 1998). Juveniles reach maximum body mass between 8 and 9 months (Feldhamer et al. 2003).

**Food Habits:** The gray squirrel's diet includes acorns, nuts, buds, and fruits from oaks, hickories, black gum, and beeches (Linzey 1998). Hickory, oak, and beech mast was found to be the preferred forage for gray squirrels, comprising >73% of their overall diet (Korschgen 1981). Nixon and McCain (1969) noted a strong relationship between squirrel abundance and acorn crops. Yet seasonal variations in available food are the dominant factors in the species' diets (Nixon et al 1968). Squirrels eat a wide array of seasonal plant foods including fungi, buds and flowers, and berries (Nixon et al. 1968). In the summer, fall, and winter, their diet includes acorns, nuts, and fungi. During late winter, gray squirrels may consume stored nuts, bark, immature buds, and twigs. The spring diet includes buds, seeds, tender vegetation, and flowers of elms, oaks, and maples. During lactation, the diet of a female may include fruits, mushrooms, and corn. In addition, juveniles consume insects and insect larvae during spring and summer. Gray squirrels supplement their diet with shed deer antlers, cattle salt blocks, and soil as sources of minerals. Squirrels consume an average of 2 pounds of food a week (Linzey 1998, Whitaker and Hamilton 1998).

Stored nuts are buried individually and shared by the community. Squirrels may rely on memory, but mostly they rely on smell to locate stored nuts (Linzey 1998; Feldhamer et al. 2003).

**Mortality:** Mortality in adult gray squirrels ranges between 30% and 57% (Feldhamer et al. 2003). The life span of an eastern gray squirrel rarely is >6 years, although individuals up to



12.5 years have been recorded. Internal parasites include protozoans, roundworms, tapeworms, and flukes. Fleas, lice, ticks, mites, and flies are external parasites associated with gray squirrels. The most common external parasite is the botfly or “warble” (Linzey 1998). Botfly larvae are present during late summer and early fall. Mange or scabies is a disease that may affect squirrel populations. Other diseases reported in gray squirrels include California encephalitis, western equine encephalitis, skin tumors caused by pox virus, leptospirosis, tetanus, tularemia, cryptosporidiosis, and acute fatal toxoplasmosis. Rabies rarely affects gray squirrels (Feldhamer et al. 2003). Predators of squirrels include carnivorous animals such as raccoons, weasels, foxes, and mink. Birds and snakes also prey on squirrels, primarily the young of the year. However, humans are considered the primary predator of squirrels (Linzey 1998, Whitaker and Hamilton 1998).

### Distribution and Abundance

**Distribution:** Eastern gray squirrels inhabit forests of eastern North America (Whitaker and Hamilton 1998, Flyger and Gates 1982, Merritt 1987). Their distribution is related closely to the distribution of eastern hardwood forests, particularly the oak and hickory forests (Linzey 1998, Whitaker and Hamilton 1998). The range of the eastern gray squirrel extends further north than that of the fox squirrel. Gray squirrels have been introduced in California, Oregon, Washington, and Montana (Feldhamer et al. 2003).

**Abundance:** Population estimates do not exist for gray squirrel populations. However, approximately 40 million squirrels are estimated to be harvested annually in the U.S. (Feldhamer et al. 2003).

### Economic Status

The damage and economic losses caused by gray squirrels are considered by most to be minor or insignificant. They cause damage by chewing on trees, electrical wires, and buildings. Methods to remove damaging animals include trapping and shooting (Feldhamer et al. 2003). Gray squirrels are considered a popular game animal. In West Virginia, gray squirrels are managed as a small game species (WVDNR 2004b). Populations are managed through recreational hunting. Regulations are determined and set by taking into account a sustainable harvest, number of recreation days, hunter satisfaction, the acceptability of killing pregnant or lactating females, and the severity of botfly larvae infestation (Feldhamer et al. 2003).

### *Fox Squirrel, Sciurus niger*

#### Life History

**Taxonomy:** Fox squirrels are members of the order Rodentia, and family Sciuridae. Nine subspecies exist in North America (Feldhamer et al. 2003). McKeever (1956) identified 2 subspecies in West Virginia: *Sciurus niger rufiventer* and *S. n. vulpinus*.

**Description:** The fox squirrel is the largest tree squirrel in the western hemisphere (Linzey 1998, Whitaker and Hamilton 1998, Feldhamer et al. 2003). It is similar to the gray squirrel, but larger

(25 – 38 cm) and more highly varied in pelage. A typical pattern is yellowish-orange on the underside of the body and on the tail, varying amounts of black on the face, and distinct white on the nose, eyes, and paws (Linzey 1998, Feldhamer et al. 2003). Three color phases exist in Virginia: gray, red or buff, and black. Individuals of the gray phase are light gray with black-tipped hairs. The tail is the same color, but with longer black hairs tipped with cream. The nose, ears, feet, and toes vary from cream to buff. The underparts are yellow-white, with some red at the base of the tail. Red or buff phase individuals are a mix of black and tawny colors, often viewed as rust. The tail is much brighter, with an orange-yellow border. The underparts and the feet are orange. Black phase individuals are predominantly black with cream-colored noses, lips, and ears. Melanism may occur in southern portions of their range (Feldhamer et al. 2003). The fox squirrel's fur overall is regarded as being coarse. Fox squirrels measure between 454 and 698 mm in total body length and 200 and 330 mm in tail length (Feldhamer et al. 2003). Adults generally weigh between 0.6 and 1.5 kg (Linzey 1998).

**Habitat:** McKeever (1956) stated that both subspecies of the fox squirrel prefer open oak and oak-hickory stands with large trees and an open forest floor (i.e., very little understory). Flyger and Gates (1982) and Brenner et al. (1989) also noted that Eastern fox squirrels prefer open woodlands with little understory in close proximity to fields and water. Linzey (1998) described fox squirrel habitat as consisting of open, mature stands of pine or mixed stands of pine, oak, hickory, and sweet gum. Linzey (1998) also indicated that fox squirrels show preference for stands having minimal underbrush. Feldhamer et al. (2003) found that fox squirrels in the East preferred upland-pine and pine hardwood forest types more than their mid-western counterparts.

**Behavior:** Fox squirrels remain active year round, but that activity is influenced by photoperiod and seasonal conditions. Studies in North Carolina reported individuals left the nest between 0900 and 1100 hr and returned by 1600 hr, though this activity began earlier and ended later from May through July (Linzey 1998). Like eastern gray squirrels, the size of the home range varies with food availability. In North Carolina, using telemetry technology and different methods of calculation, Linzey (1998) determined home range varied from 26.6 and 43.7 ha for males, and 17.2 and 25.0 ha for females. Home range size also depends on geographic region, sex, age, population densities, and method of determination (Feldhamer et al. 2003).

Fox squirrels do not possess the same arboreal agility as that demonstrated by gray squirrels, but, on the ground, they are fast and graceful runners. Like gray squirrels, fox squirrels nest in trees, either in trees cavities or outside leaf nests (Linzey 1998). Edwards and Guynn (1995) suggested tree cavities are a critical factor in litter survival and recruitment. Both fox and gray squirrels use tree cavities more during winter months, when they seek greater thermal protection from extreme weather (Edwards and Guynn 1995). Leaf nests are composed of an outer layer of leaves and twigs and an inner layer of dampened, compressed leaves lined with shredded leaves and bark (Linzey 1998). Leaf nests of fox squirrels often are positioned higher or located in taller trees with larger diameters than those of gray squirrels (Edwards and Guynn 1995). Separate structures are built for feeding and resting during the summer (Linzey 1998).

**Reproduction:** Onset of reproduction varies with latitude, environmental conditions, age, nutrition, and population (Feldhamer et al. 2003). Mating can occur in late winter and early

summer. Data from North Carolina suggested that females born in spring bred the following winter, whereas females born in the summer bred the following spring or summer (Linzey 1998). McKeever (1956) and Linzey (1998) noted that females rarely produced >1 litter per year, but where it did occur, it was highly dependent on food availability (Feldhamer et al. 2003). The gestation period of fox squirrels is approximately 44 to 45 days (Linzey 1998, Whitaker and Hamilton 1998). Young are born from February to March or August to September. Litter size can range from 1 to 6 young, but 2 to 4 is expected. Young are born with no fur and their eyes closed. At birth, average weight is 14 g. At 10 days, they have a fine coat of fur and at 14 weeks, their eyes open. At 8 weeks, they begin to consume solid food and soon will become independent (Linzey 1998). After 1 year, fox squirrels reach 92% of their maximum body mass (Feldhamer et al. 2003).

**Food Habits:** The diet of fox squirrels includes acorns, hickory nuts, insects, buds, twigs, bark, berries, fruits, corn, seeds, mushrooms, and green, immature pinecones (Linzey 1998, Whitaker and Hamilton 1998). Over 109 plant foods have been identified in the fox squirrel diet; 18 plants (11 hickory and 7 oak species) comprised 82.4% of all foods consumed (Linzey 1998). Like gray squirrels, fox squirrels store nuts and other foods, and then use their sense of smell to locate these caches (Linzey 1998).

**Mortality:** In Illinois, marked fox squirrels have lived up to 12.6 years in natural habitats (Linzey 1998). Parasites include mites, fleas, ticks, lice, and chiggers (Feldhamer et al. 2003). Internal parasites found in fox squirrels include several species of roundworms. Diseases reported in fox squirrels include California encephalitis, western equine encephalitis, skin tumors caused by pox virus, leptospirosis, tetanus, tularemia, cryptosporidiosis, and acute fatal toxoplasmosis. Like gray squirrels, rabies is rare in fox squirrels (Feldhamer et al. 2003). Predation is a minor factor in the mortality of fox squirrels (Whitaker and Hamilton 1998, Feldhamer et al. 2003), although young fox squirrels are preyed on by predatory birds, mammals, and snakes (Linzey 1998). Other predators include opossums, bobcats, coyotes, gray foxes, red foxes, raccoons, long-tailed weasels, mink, dogs, and cats (Feldhamer et al. 2003). The primary predator of adult fox squirrels is humans (Linzey 1998).

### Distribution and Abundance

**Distribution:** Fox squirrels are distributed widely throughout eastern North America. They were introduced into California and other western states (Linzey 1998). McKeever (1956) identified *Sciurus niger rufiventer* as the subspecies found from McDowell County to Monogalia County and all counties to the west in West Virginia, whereas *S. n. vulpinus* is the subspecies found in eastern counties, from Mercer County north to Preston and east to Jefferson County.

**Abundance:** McKeever (1956) noted that fox squirrels were present statewide, but most abundant in the Greenbrier Valley of West Virginia.

### Economic Status

The damage and economic losses caused by fox squirrels are considered minor to insignificant. These animals may cause minimal damage by chewing on trees, electrical wires, and buildings. Methods to remove damaging animals include trapping and shooting (Feldhamer et al. 2003).

Fox squirrels, like gray squirrels, are considered a popular game animal. In West Virginia, fox squirrels are managed as a small game species (WVDNR 2004b). Populations are managed primarily through recreational hunting. Factors contributing to how regulations are determined include the estimated sustainable harvest, number of recreation days, hunter satisfaction, public acceptability of killing pregnant or lactating females, and botfly larvae infestation (Feldhamer et al. 2003).

### *Gray Fox, Urocyon cinereoargenteus*

#### Life History

**Taxonomy:** Gray foxes are members of the order Carnivora, and the family Canidae. Seven subspecies exist in the United States and an additional 8 subspecies exist in Central and South America (Feldhamer et al. 2003).

**Description:** Gray foxes are medium-sized (53 – 74 cm) canids with a salt and pepper appearance. Compared to other foxes, gray foxes are stockier with shorter legs (Feldhamer et al. 2003). Their coat is blackish-gray with reddish brown underparts. They have white fur on the throat, chest, and along the middle of the abdomen. The feet, legs, back of the ears, and sides of the neck are brownish-yellow. The tail has a black stripe that ends at the tip of the tail (Linzey 1998). This black stripe is a diagnostic ridge of black guard hairs (Feldhamer et al. 2003). Morphologically, they are well adapted for tree climbing, in that they possess relatively short legs and strong feet, each sporting long, sharp, recurved claws, and forelegs capable of rotating to allow efficient climbing (Feldhamer et al. 2003).

**Habitat:** Gray foxes are common in deciduous forests of eastern, southern, and western United States (Linzey 1998, Whitaker and Hamilton 1998). Their habitat includes rough, hilly areas located near streams or wooded swamps. They rarely visit farmlands and show a distinct preference for wooded areas (Linzey 1998). However, in the East, they utilize habitats consisting of a mix of agriculture or old fields and woodland habitat (Feldhamer et al. 2003).

**Behavior:** Gray foxes are more nocturnal than red foxes. Although peak activity clearly occurs after sundown, they essentially are nocturnal during the summer, whereas some diurnal activity is common during the winter (Feldhamer et al. 2003). They are a woodland species and rarely come in contact with domestic animals. They climb trees readily when seeking protection from pursuers (Linzey 1998, Whitaker and Hamilton 1998).

Gray foxes construct dens in various locations, including abandoned scrap piles, hollow logs, areas under rocks, and in ground burrows. They normally have a single entrance and are located in secluded areas characterized by dense cover. Dens are lined with leaves, grass, fur, and other materials (Linzey 1998). Dens are used primarily for parturition and rearing, but gray foxes also may use a den to elude a predator (Feldhamer et al. 2003). Gray foxes rest in dense vegetation during the day (Feldhamer et al. 2003). Home range size varies with habitat quality and food availability. Most home ranges generally are elongate in shape. Home ranges of gray foxes in eastern North America are larger than those in western North America (Feldhamer et al. 2003). In West Virginia, average home range size was 97 ha for 3 males and 75 ha for 1 female (Linzey

1998). Unlike red foxes, gray foxes use only a fraction of their home range on a given night or during a given month (Haroldson and Fritzell 1984).

**Reproduction:** During the breeding season, gray foxes are monogamous, but they occasionally may be polygamous (Linzey 1998). Nationally, gray foxes can breed anywhere from January to April (Feldhamer et al. 2003), but in Virginia, they breed from late February to early April. After a gestation period of 51 to 63 days, 4 pups on average are born (Linzey 1998). Feldhamer et al. (2003) reported a gestation period between 53 and 63 days. At birth, pups weigh between 85 g and 113 g, but average about 86 g (Linzey 1998, Feldhamer et al. 2003). Their eyes open between 9 and 12 days (Linzey 1998; Feldhamer et al. 2003). Pups are weaned at approximately 8 to 10 weeks (Linzey 1998). At 3 months, the pups begin to accompany adults on foraging trips. At 4 months, the pups begin foraging on their own (Feldhamer et al. 2003). Juveniles reach adult size and weight between 5 and 7 months old (Linzey 1998; Feldhamer et al. 2003). Most gray foxes are capable of breeding at one year (Linzey 1998).

**Food Habits:** Gray foxes are omnivorous and consume a variety of food items (Linzey 1998, Whitaker and Hamilton 1998). During spring and summer, individuals consume large amounts of insects, particularly grasshoppers (Feldhamer et al. 2003). As summer progresses into fall, they begin to consume ripened nuts and fruits. During the winter, they shift to mammalian (e.g., rabbits, voles, mice, woodrats, pocket gophers, squirrels, opossums, and carrion) or avian prey (Feldhamer et al. 2003).

**Mortality:** Predation, disease, and harvest by humans are the major mortality factors for gray foxes. Predators include golden eagles, bobcats, mountain lions, and coyotes (Feldhamer et al. 2003). Pups may be taken by large owls and hawks (Linzey 1998, Feldhamer et al. 2003). Diseases reported in gray foxes include rabies, canine distemper, and sarcoptic mange. Distemper has been an important cause of mortality among populations of gray foxes in the southeastern United States. Sarcoptic mange is rare in gray foxes as they are thought to be resistant to the transmitting mite (Feldhamer et al. 2003). Parasites include tapeworms, ticks, fleas, and heartworms (Linzey 1998, Whitaker and Hamilton 1998, Feldhamer et al. 2003). Generally, gray foxes do not live >4 to 5 years; annual adult mortality is estimated at 50% (Feldhamer et al. 2003). Juveniles that survive the first summer often die during their first winter (Feldhamer et al. 2003).

### *Distribution and Abundance*

**Distribution:** Gray foxes inhabit woodlands and shrublands from southern Canada to South America. However, they historically did not inhabit the boreal regions of the United States and Canada (Feldhamer et al. 2003). Gray foxes are found throughout the eastern United States (Linzey 1998, Whitaker and Hamilton 1998). In West Virginia, they occur statewide (McKeever 1956).

**Abundance:** In West Virginia, gray foxes are more abundant than red foxes (McKeever 1956).

### Economic Status

The economic status of gray foxes is influenced by cultural and social values, which vary regionally. Throughout history, foxes have been considered “vermin” and were subjected to predator control programs and bounties (Feldhamer et al. 2003). Many states in the United States allow the harvest of gray foxes, but their fur is not as valuable as that of the other fox species. In the Southeast, there is a strong tradition of fox hunting with hounds (Feldhamer et al. 2003). In West Virginia, gray foxes are managed as a furbearer species with a regulated hunting and trapping season (WVDNR 2004b).

### *Red Fox, *Vulpes vulpes**

#### Life History

**Taxonomy:** Arguments exist over the current taxonomy and origin of red foxes. McKeever (1956) noted it is unknown whether red foxes in West Virginia are descendants of native stock or European stock. Individuals transported for hunting and fur farming have confounded local gene pools (Feldhamer et al. 2003). Kamler and Ballard (2002: 370) suggested that “native red foxes are a reportedly cold adapted species that occurs in boreal and montane habitats, whereas nonnative red foxes reportedly are a generalist species that occurs in a wider variety of habitats.” Despite Kamler and Ballard’s suggestion, taxonomists currently believe that the North American red fox and the European red fox are the same species, designating the species as *Vulpes vulpes* (Hall 1981, Whitaker and Hamilton 1998). Red foxes are included in the order Carnivora, and the family Canidae. Ten subspecies exist in North America (Feldhamer et al. 2003). The subspecies recognized in the eastern United States, including West Virginia, is *V. v. fulva* (Hall 1981).

**Description:** Red foxes are the largest of the North American foxes (Feldhamer et al. 2003). They are medium-sized (56 – 63 cm) canids with elongated muzzles and large, pointed, erect ears (Hall 1981). They have a long (35 – 41 cm), bushy tail with a white tip. The tail normally is as long as the head and body (Hall 1981, Linzey 1998). Pelage coloration ranges from reddish to reddish-yellow. The fur on the middle of the back is mixed with dark hairs. The back of ears, front of the legs, and feet are black. Giving contrast to the coat, the underparts are white or grayish-white. Three additional color phases exist: a “cross” phase, one that has a gray or yellow coat with a black cross (a dark stripe extending from the head to the haunches with another stripe across the shoulder) on the back; a “silver” phase, one that has a melanistic coat mixed with white; and a “black” phase, one that has a darker coat. Different color phases may arise within a single litter. Feldhamer et al. (2003) described a fourth color phase, the bastard phase, one that displays a bluish-gray pelage. Red foxes generally weigh between 2.7 and 6.7 kg; males typically are larger than females (Linzey 1998).

**Habitat:** Food availability and competition with other canids, such as coyotes, influence habitat selection (Feldhamer et al. 2003). As a result, red foxes inhabit a variety of different habitats, including farmlands with thin wooded areas, brushy areas, and marshy areas with water sources (Linzey 1998, Whitaker and Hamilton 1998). These habitats are sometimes referred to as being broken or unsettled areas. Suitable habitat also may include woodlots that are interspersed with croplands and pasture (Feldhamer et al. 2003).

**Behavior:** Red foxes largely are nocturnal with peak activity occurring during crepuscular periods (Linzey 1998; Feldhamer et al. 2003). The availability of prey governs their activity during the day. They do not hibernate or construct winter dens, but prefer to rest in the open. Red foxes normally travel at speeds of 9.6 km/hr, but, when pursued, they can reach speeds of 64 to 72 km/hr for short distances (Linzey 1998). They depend on maneuverability instead of speed to elude pursuers. They possess keen senses of sight, smell, and hearing. Communication is made through growls, barks, greetings or “coos,” whines, whimpers, chirps, shrill yaps, purrs, and hisses (Feldhamer et al. 2003). Red foxes play within family groups, and establish social hierarchies through vocalizations and play behavior (Linzey 1998). In North America, the family group (social unit) consists of the mated pair and the young from the current year. Occasionally, an additional reproductive female may join the social unit when food resources are abundant (Feldhamer et al. 2003). In Wisconsin, home range size varied from 57.5 to 161.9 ha (Linzey 1998). However, the size of a home range varies with season and habitat. Home ranges are larger in poorer habitat (Feldhamer et al. 2003). Red foxes designate home range boundaries using scent markings of urine and feces (Feldhamer et al. 2003). When the female travels within the range, she never wanders far from the den. In contrast, the offspring often move significant distances after leaving the den (Linzey 1998). Healthy red foxes are wary of humans and avoid contact (Feldhamer et al. 2003).

Dens are used primarily to bear and rear young (Feldhamer et al. 2003). Red foxes are very selective when choosing a den site (Linzey 1998), but often select a site located on a wooded slope. Woodchuck burrows frequently are assumed for use. Although the inside is kept clean, the area outside the den is littered with bones and discarded food. Dens also may have multiple entrances (Feldhamer et al. 2003). Usually, only 1 family occupies a den, but, during colder months, communal denning is not uncommon (Linzey 1998).

**Reproduction:** Red foxes will breed from late December to April, yet most activity occurs in January and February (Linzey 1998, Whitaker and Hamilton 1998, Feldhamer et al. 2003). In Virginia, mating may occur as early as the first week of January and may end by late February (Linzey 1998). In West Virginia, a pregnant female with 3 embryos was taken on February 20 (McKeever 1956). Pups are born in late March or early April, after a gestation period of 51 to 54 days (mean: 52 days) (Linzey 1998, Feldhamer et al. 2003). Litter size averages 4 to 7 pups. Data collected on dens near Blacksburg, VA, displayed an average of 4.4 pups per litter in 1957 (Linzey 1998). Litter size is influenced by food availability (Feldhamer et al. 2003). At 8 to 9 days, the pups’ eyes begin to open. They begin to walk at 3 weeks and the ears become erect at 4 weeks. Pups reach their adult size around 6 months and begin dispersing in early fall (Linzey 1998, Feldhamer et al. 2003). Males and females are capable of breeding in their first year (Feldhamer et al. 2003).

**Food Habits:** Red foxes are omnivorous, and feed on a variety of seasonally available animal and plant foods. When food is abundant and hunting is successful, individuals may bury food in the ground or under leaves (Linzey 1998). The diet consists largely of rodents and leporids (Whitaker and Hamilton 1998, Feldhamer et al. 2003). In Virginia, half the food consumed was rabbits and mice. Other prey items include gray squirrels, muskrats, quail, small birds, and insects. Plant foods include beechnuts, persimmons, apples, corn, and peanuts (Linzey 1998).

**Mortality:** The average life span of a red fox is 2 to 4 years (Linzey 1998). Feldhamer et al. (2003) noted red foxes typically do not live past 5 years. Mortality factors for red foxes include predators, disease, and human-caused incidents. Predators of red foxes include wolves, mountain lions, coyotes, lynx, bobcats, and dogs (Feldhamer et al. 2003). Diseases associated with red foxes include rabies, canine distemper, and sarcoptic mange. Feldhamer et al. (2003:533) described red foxes as “the most widespread natural reservoir of rabies in the world.” Sarcoptic mange, caused by a mite (*Sarcoptes scabiei*) can reduce red fox populations. Mange has been found to affect red foxes more than other species (Feldhamer et al. 2003). Other parasites associated with red foxes include cat fleas, dog fleas, ticks, heartworms, and tapeworms (Linzey 1998, Feldhamer et al. 2003). Mortality arising from hunting and collisions with vehicles may be important locally (Whitaker and Hamilton 1998, Feldhamer et al. 2003).

### Distribution and Abundance

**Distribution:** Red foxes are found throughout Alaska and much of Canada, except for the far northern reaches. The range within the United States extends from the Canadian border south in the Cascade-Sierra Nevada mountain chain to California, in the Rocky Mountain chain to southern New Mexico, and south and east of the Great Lakes. They also occur in central Texas, southern Alabama, and western Florida, but they typically are not native to the southern states. It is believed they were introduced from Europe in the 1700s and crossed with native red foxes to establish a population (Linzey 1998). However, recent evidence suggests that red foxes were native to North America, in the boreal and mixed-hardwood habitats north of 40-45° N (Feldhamer et al. 2003). Prior to European settlement, native red foxes were found in boreal forests of Canada and northern United States (Kamler and Ballard 2002). In West Virginia, they are found statewide, though they first occupied the mountains (McKeever 1956).

**Abundance:** Distribution and abundance in the East are influenced by interspecific competition, adaptability, habitat modification, and human activities (Feldhamer et al. 2003). Population increases have been associated with the extirpation of gray wolves and red wolves (Feldhamer et al. 2003), but population declines have occurred in areas now being shared with coyotes.

### Economic Status

The economic status of red foxes is relative, depending on one’s perspective and attitudes and on prevailing cultural and social values. For many years, people viewed foxes as “competitors for game, depredators of livestock and crops, disease carriers, valuable fur resources, recreational opportunities, important components of ecosystems, photography subjects, threats to endangered species, and endangered species themselves” (Feldhamer et al. 2003:535). West Virginia Division of Natural Resources classifies the red fox as a furbearer species and manages populations through use of specific trapping and hunting seasons (WVDNR 2004b). Red foxes may represent a management challenge relative to the spread and control of rabies. Current management options include distribution of oral vaccinations and targeted reductions of affected populations (Feldhamer et al. 2003).



## *Raccoon, Procyon lotor*

### Life History

**Taxonomy:** Raccoons are members of the order Carnivora, the family Procyonidae, and the subfamily Procyoninae (Hall 1981). *Procyon lotor* is 1 of 18 species in the family Procyonidae (Feldhamer et al. 2003). Over 25 subspecies of *Procyon lotor* exist in North America (Hall 1981, Feldhamer et al. 2003). The subspecies recognized in northeastern United States, including West Virginia, is *P. l. lotor* (Hall 1981).

**Description:** Raccoons are medium-sized (46 – 71 cm), heavily built, partially arboreal animals (Linzey 1998). They have a broad head with a pointed muzzle and prominent ears, which are erect and somewhat pointed (Linzey 1998). They have plantigrade feet with furless, smooth soles, and 5 long digits with nonretractile claws (Linzey 1998). The front feet are well adapted for grasping and manipulating objects. They are most recognized by their white bordered black mask, which extends across the eyes and down to the cheeks (Whitaker and Hamilton 1998). The long tail (20 – 30 cm) has 5 to 7 alternate banded blackish rings and is tipped in black. The spaces between the rings are gray or buff (Linzey 1998). The underparts are grizzled gray, brown, or black. The overall pelage may vary from light gray to dark black. Geographic variations in pelage occur; albinism also occurs as a result of a recessive gene (Feldhamer et al. 2003). The winter coat is shed in the spring, gradually or in patches and replaced with a thin coat of short hairs. In the fall, thick underfur and new guard hairs are produced (Feldhamer et al. 2003). Weight varies with geographic locations, season, and sex (Feldhamer et al. 2003). Raccoons weigh between 4.5 and 9 kg (Linzey 1998). Males generally are larger than females (Feldhamer et al. 2003).

**Habitat:** Raccoons are found in wooded areas statewide in West Virginia. Habitat includes deciduous forests with hollow trees or cliffs that provide potential den sites (McKeever 1956); they also use barns, attics, and other constructed structures (Linzey 1998). Raccoons prefer moist areas such as timbered swamps, river bottoms, and areas along streams and lakes (Linzey 1998, Whitaker and Hamilton 1998). Moist areas have been defined as those characterized by the presence of willows (*Salix spp.*), red osier dogwood (*Cornus stolonifera*), trembling aspen (*Populus tremuloides*), and narrowleaf meadowsweet (*Spiraea alba*) (Pedlar et al. 1997). Tree species common to the favored wooded areas include white ash (*Fraxinus americana*) and red maple (*Acer rubrum*) (Pedlar et al. 1997). A characteristic of raccoon habitat is the presence of water (Feldhamer et al. 2003). Studies indicate raccoons avoid pastures, grasslands, and croplands, although they often will use fence rows, shelter belts, and roads associated with these habitats as travel ways (Feldhamer et al. 2003). Fence rows characterized by the presence of raspberry (*Rubus idaeus*), Canada plum (*Prunus nigra*), pin cherry (*P. pensylvanica*), Manitoba spruce (*Acer negunda*), common buckthorn (*Rhamnus cathartica*), grape, and white elm are popular with raccoons (Pedlar et al. 1997).

**Behavior:** Raccoons primarily are nocturnal, given that they leave the den after sunset and remain active until morning (Linzey 1998, Whitaker and Hamilton 1998, Feldhamer et al. 2003). Nocturnal activities include foraging, walking, and running (Feldhamer et al. 2003). Daytime activity increases during the winter (Feldhamer et al. 2003). For long periods during winter, they sleep; however, raccoons do not den up or become completely inactive, except for short periods

during unusually cold weather (Linzey 1998). Although they swim well, raccoons prefer to wade in shallow water. Raccoons are excellent climbers and can descend either head first or tail first, but they prefer to walk on the ground (Linzey 1998). Their senses of hearing and sight are excellent, especially at night. Their sense of smell is good, but touch is better.

Dens are used during breeding season and as winter shelter. Den sites include hollow trees, fallen logs, old stumps, muskrat houses, deserted buildings, barn lofts, caves, and abandoned mines. Nesting materials are found entirely within the den as it exists; they do not add outside material to a nest or den. Home range size in raccoons varies with sex, season, food availability, and population density (Linzey 1998). Radio tracking studies suggest an average home range of 50 ha (Linzey 1998), although other estimates of home range size vary between 50 and 300 ha. Generally, the home range size of males is larger than that of females (Feldhamer et al. 2003).

Reproduction: Raccoons have been described in some accounts as induced ovulators, but Feldhamer et al. (2003) characterized them as spontaneous ovulators. Throughout most of North America, breeding occurs in February and March (Whitaker and Hamilton 1998, Feldhamer et al. 2003). In Virginia, breeding occurs from mid-January to early March (Linzey 1998). Mating may occur later in southern latitudes (Feldhamer et al. 2003). Day length also affects the timing of breeding (Linzey 1998; Feldhamer et al. 2003). After a gestation periods of approximately 63 days, a single litter is born between April and May. Litters may range from 2 to 5 young (Linzey 1998). Litter size varies by region, latitude, and age of female (Feldhamer et al. 2003). Young are born with black skin and yellow fur and weigh approximately 57 to 85g. At 2 weeks, they have a full coat of fur. Eyes open between 18 and 23 days. After 40 days, the young begin to eat solid food, yet most are not weaned fully until 3 or 4 months (Linzey 1998). The young remain with the female into late fall or early winter. Females are devoted parents. Males are polygamous and provide no care for the young. Males reach sexually maturity at around 15 months (Linzey 1998).

Food Habits: Raccoons are omnivorous and eat a variety of foods and plant materials (Whitaker and Hamilton 1998). Selection of food items is dictated largely by availability. A study of 520 raccoon stomachs in Maryland concluded 48% of the diet was plant material and 52%, animal material (Linzey 1998). During the summer, fall, and early winter, their diet consists primarily of plant materials, such as corn, wild grapes, black cherries, acorns, persimmon, pokeberries, and blackberries. In April and May, raccoons consume mostly animal material; over 100 animal species have been documented as prey items. During later winter and spring, the diet includes insects, crayfish, snails, amphibians, reptiles, fish, and rodents (Linzey 1998).

Mortality: Mortality in raccoons is associated closely with human-related activities such as hunting and trapping, vehicle collisions, and nuisance control (Feldhamer et al. 2003). Other mortality factors include predation, starvation, and infanticide (Feldhamer et al. 2003). Predators include foxes, bobcats, hawks, owls, and snakes (Linzey 1998). Predation likely is not a significant mortality factor, except in young raccoons (Feldhamer et al. 2003). Diseases reported in raccoons include canine distemper, feline distemper, rabies, pseudorabies, leptospirosis, Chaga's disease, histoplasmosis, and tularemia (Linzey 1998, Feldhamer et al. 2003). The strain of rabies found in raccoons is a significant source of mortality in West Virginia raccoon populations (Roger Anderson, WVDNR Wildlife Biologist, pers. commun. 2006). Parasites of

raccoons include fleas, lice, ticks, and mites (Linzey 1998; Feldhamer et al. 2003). Internal parasites include over 56 species, including protozoans, flatworms, nematodes, and spiny-headed worms (Linzey 1998, Feldhamer et al. 2003). Concern over one parasite, the raccoon roundworm (*Baylisascaris procyonis*) has developed in response to the conservation of rare mammals within NERI, including the Allegheny woodrat (*Neotoma magister*). The raccoon roundworm is a common large roundworm found in the small intestinal tract of raccoons. Although this parasite generally does not adversely affect the host raccoon (Kazacos and Boyce 1990), mortality results in lower mammals and birds infected by the parasite (Kazacos 1991). Schaffer et al. (1981) noted that translocated raccoons from the coastal plain region into the Appalachian Mountains by private hunting clubs harbored increased helminth parasites than resident raccoons. The affect of predation, diseases, and parasites on raccoon populations varies with geographic location, season, age, and sex (Feldhamer et al. 2003). Raccoons may live up to 13 to 16 years in the wild (Linzey 1998), but few live past 5 years (Whitaker and Hamilton 1998).

### Distribution and Abundance

Distribution: Historically, raccoons were rare in southern Canada, in parts of the Rocky Mountains, and in deserts (Feldhamer et al. 2003). Currently, raccoons range from Panama north through Mexico, across the United States, and into Canada (Linzey 1998, Whitaker and Hamilton 1998). Raccoon density increased during the 1940s; as a result, they now occur in mountain and desert habitats where they once were rare (Feldhamer et al. 2003).

Abundance: Sportsmen persuaded the Conservation Commission (West Virginia Division of Natural Resources) to purchase and raise raccoons to be released. In 1930, a program to release 10 raccoons per county was started. By 1949, most counties in West Virginia were involved in the program. In 1951, the Conservation Commission abandoned the project because of costs (McKeever 1956). Raccoons presently are considered fairly abundant in West Virginia. Twelve years of data from the West Virginia Raccoon Field Trial Survey indicate the highest densities of raccoons occur in northern, central, and western counties of West Virginia (Roger Anderson, WVDNR Wildlife Biologist, pers. commun. 2006).

### Economic Status

Historically, raccoons have been one of the more economically important animals in North America, both as a furbearer species and a game species. The harvest of raccoons constitutes the largest generated revenue among furbearers in North America. However, their economic status has shifted due to rabies and nuisance complaints. Raccoons remain an important economic resource, but managers are being forced to cope with and develop strategies to manage these drawbacks (Feldhamer et al. 2003). In West Virginia, raccoons are managed as a furbearer through regulated hunting and trapping seasons (WVDNR 2004b).

## Continuous Open Season Species

Birds:

*Rock Pigeon, Columba livia*

### Life History

**Taxonomy:** Rock pigeons are members of the order Columbiformes, and the family Columbidae. Nine subspecies of *Columba livia* are recognized (Johnston 1992).

**Description:** Rock pigeons are a medium-sized (33 cm) bird. Their plumage varies from bluish gray to bluish black with white under the coverts and a gray or white rump. Pigeons have two dark bars on their greater coverts and inner secondaries and a blue-black subterminal band on their tail. The bill is dark gray. Males typically weigh 369 g and females about 340 g (Johnston 1992).

**Habitat:** Pigeons commonly roost and nest in natural areas associated with open early successional habitats, agricultural operations, or human development, and in crevices and caves. Additional roosting sites include farm buildings, transportation infrastructure, and other urban buildings (Johnston 1992).

**Behavior:** Pigeons are able walkers, runners, and flyers. They display a strong and direct flight and can fly at great speeds for short periods. Typically, pigeons do not fly >70 m (Johnston 1992).

**Reproduction:** Pigeons are monogamous. Life pair bonds are established by assorted displays (e.g., bowing, cooing, nibbling); this bond formation can occur anytime between February and September (Johnston 1992). The female lays 1 or 2 eggs approximately 8 to 12 days after mating. Incubation averages 18 days. The male gathers and provides the female with nesting materials and guards the nest. The young begin leaving the nest between 4 to 6 weeks. After the first clutch leaves the nest, the female lays another clutch. Pigeons breed year round, although breeding peaks in spring and fall (Williams and Corrigan 1994).

**Food Habits:** Food items consumed include seeds, grains (e.g., oats, wheat, barley, millet), fruits (e.g., cherry, pokeberry), plants (e.g., goosegrass, crabgrass, poison ivy), and invertebrates. In urban areas, food items include bread, popcorn, peanuts, and cake (Johnston 1992).

**Mortality:** Predation, disease, and parasites influence mortality of pigeons, but much remains unknown about the significance of these factors. Common predators of adult pigeons include humans, raccoons, opossums, Eastern screech owls, great horned owls, prairie falcons, American crows, peregrine falcons, golden eagles, American kestrels, glaucous-winged gulls, and common ravens. Nest predators include raccoons, opossums, owls, crows, and ravens (Johnston 1992). Diseases and parasites are not common in pigeons. Infectious diseases found in adults include aspergillosis, coccidiosis, equine encephalitis, influenza, Newcastle disease, ornithosis, paratyphoid disease, toxoplasmosis, tuberculosis, arbovirus infections, and yersinosis; histoplasmosis can arise from accumulated droppings (Johnston 1992). In captivity, pigeons

may live up to 15 years; in the wild, the life span averages 3 to 4 years (Williams and Corrigan 1994).

### Distribution and Abundance

Distribution: Colonists introduced pigeons to North America in the early 17<sup>th</sup> century. Today, pigeons are found throughout the United States, especially around cities and towns, farms with livestock, and areas close to humans or agriculture (Johnston 1992).

Abundance: Formal censuses did not assess the status of breeding populations of pigeons until 1966. Largest numbers were recorded in the East region and the far western states (Johnston 1992). In West Virginia, the Breeding Bird Atlas reported pigeons in all populated areas of the state and in valleys with agricultural activities (Buckelew and Hall 1994).

### Economic Status

Pigeons commonly are considered a nuisance because of the significant damage they cause in rural, suburban, and urban areas. Droppings can deface, or certainly accelerate, the deterioration and maintenance costs of buildings and other physical structures. Large amounts of accumulated droppings also may kill vegetation. In agriculture settings, pigeons also consume and contaminate grain intended for human and livestock consumption. Pigeons may carry and spread diseases, and can create safety hazards around airports (Williams and Corrigan 1994). In West Virginia, pigeons are considered a continuous open season species. Given that, a continuous open season exists for pigeons and there are no limits on the taking of this species (WVDNR 2004b).

Mammals:

*Coyote, Canis latrans*

### Life History

Taxonomy: Coyotes are members of the order Carnivora, and the family Canidae (Hall 1981). Coyotes (*Canis latrans*) are 1 of 8 recognized species in the genus. Nineteen subspecies exist in North and Central America (Feldhamer et al. 2003).

Description: Coyotes often are confused with other canids (Whitaker and Hamilton 1998, Feldhamer et al. 2003). They are 81 – 94 cm in size, with a tawny gray or buff pelage; guard hairs are tipped in black. The sides are a dull tawny gray or buff color and the throat and stomach are white (Linzey 1998). The feet, legs, and ears are reddish. Overall, the coat is moderately long (Linzey 1998). However, the summer coat is shorter than the winter coat (Feldhamer et al. 2003). In Virginia, approximately 25% of all individuals are almost entirely black (Linzey 1998). A characteristic banding pattern in their fur contributes to the apparent variation observed in the appearance of the pelage (Feldhamer et al. 2003). They weigh between 9 and 16 kg (Linzey 1998). A Pennsylvania study found that coyotes in northeastern Pennsylvania ranged from 14.06 to 19.96 kg and averaged 15.88 kg (Trout et al. 2006). Adult

males typically are larger and heavier than adult females (Feldhamer et al. 2003). Eastern coyotes display the largest body size of any North American coyote population (Boer 1992).

**Habitat:** Coyotes inhabit open woodlands, woodland borders, prairies, and brushy areas (Linzey 1998). Coyote habitat may overlap with the habitat of foxes during summer months (Gosselink et al. 2003).

**Behavior:** Coyotes primarily are nocturnal (Linzey 1998), but they are known to be active during the day, especially in the early morning and around sunset (Feldhamer et al. 2003). A variety of hunting methods are displayed by coyotes, including cooperative hunting and playing dead. To enhance their hunting skills, coyotes make excellent use of their sharp senses of hearing, sight, and smell. Coyotes are capable of traveling at a high rate of speed to capture prey and to elude predators.

Coyotes in the East typically do not travel in large packs, but rather travel in family groups along hunting routes and paths. Movements in coyotes often are dictated by food availability. Studies in the western United States reported an average of 22.9 km between tagging and recapture, with the greatest distance traveled equaling 185 km (Linzey 1998). A home range study in Tennessee described an average home range of 31 km<sup>2</sup> for males and 60 km<sup>2</sup> for females. Except during the breeding season, males maintain a smaller home range than do females (Linzey 1998). Coyotes construct several dens and locate them in a variety of places, such as on brush-covered slopes or steep banks, under rock ledges, in thickets, and in hollow logs (Feldhamer et al. 2003). Although they may dig their own holes, they typically use the burrows of woodchucks, foxes, or skunks (Linzey 1998). Dens may have >1 entrance (Feldhamer et al. 2003).

**Reproduction:** The availability of a dependable food supply strongly influences reproduction in coyotes (Feldhamer et al. 2003). Breeding occurs between late winter and early spring. After a gestation period of 60 to 64 days, a litter of 5 to 7 pups, on average, is born between April and May (Linzey 1998). Litter size is influenced by population density and food availability (Feldhamer et al. 2003). Pups are born fully furred and with their eyes closed (Linzey 1998). Pups weigh between 240 and 275 g (Feldhamer et al. 2003). Pups are able to walk after 8 to 10 days, and at 10 to 12 days, their eyes open. Pups leave the den for the first time at 3 weeks of age (Linzey 1998). At 1 month, the pups begin to eat regurgitated solid food; at 3 months, pups are weaned. The adult male assists with feeding after weaning. Pups learn to hunt between 2 to 3 months (Linzey 1998). The family disperses in early fall and pups must find their own homes at that time (Linzey 1998). Coyotes reach adult size at approximately 9 months (Feldhamer et al. 2003). Pups are capable of breeding the following year (Linzey 1998).

**Food Habits:** The feeding habits of coyotes vary regionally and seasonally. Overall, coyotes are opportunistic, consuming a variety of food items. Common food items included poultry, persimmon, insects, rodents, cattle, rabbits, deer, woodchucks, goats, and watermelon (Whitaker and Hamilton 1998, Feldhamer et al. 2003). The diet of juveniles contains a higher proportion of vegetative matter such as persimmon (Linzey 1998). The winter diet typically includes a higher percentage of animal matter than does the summer diet (Feldhamer et al. 2003).

**Mortality:** Mortality is influenced strongly by food availability and direct human intervention (e.g., implemented control methods). In addition to human-induced mortality, other factors include starvation during food shortages, diseases, and parasites. Antibodies to a variety of diseases have been observed in coyotes, such as canine parvovirus, canine distemper, canine infectious hepatitis virus, tularemia, and leptospirosis (Feldhamer et al. 2003). Parasites associated with coyotes include fleas, ticks, mites, lice, flukes, tapeworms, intestinal worms, esophageal worms, hookworms, lungworms, kidney worms, spiny-headed worms, protozoans, and coccidia fungus (Feldhamer et al. 2003). Despite these identified mortality factors, coyotes may live for 13.5 to 14.5 years (Linzey 1998, Whitaker and Hamilton 1998). However, the average life span is 6 to 8 years in the wild (Feldhamer et al. 2003).

### Distribution and Abundance

**Distribution:** Prior to the European settlement of North America, the range of coyotes was restricted to southwestern North America (Feldhamer et al. 2003). Many coyotes were captured and transported by tourists; others probably escaped or were released (Linzey 1998). Their range expanded northward and eastward following the extirpation of gray wolves and the introduction of agriculture (Feldhamer et al. 2003).

**Abundance:** In 1956, coyotes were reported in West Virginia, but these individuals originally were believed to be escapees from captivity (McKeever 1956). However, a free-ranging specimen was killed by a deer hunter in a hardwood forest in northern West Virginia (McKeever 1956). Records indicate that coyotes from Kansas were imported and released in Lincoln and Greenbrier Counties, West Virginia (Linzey 1998). By the 1980s, coyotes were in the early stages of colonization in West Virginia (Boer 1992). Additional evidence indicates current coyote populations in West Virginia are the result of immigration and colonization by natural means (Roger Anderson, WVDNR Wildlife Biologist, pers. commun. 2006).

### Economic Status

Determining the economic status of coyotes is a complicated issue, due to their efficiency and effectiveness as predators (Feldhamer et al. 2003). West Virginia recognizes the coyote as a nuisance species, which allows for a continuous open season. However, West Virginia also manages the coyote as a game animal, and has established a regulated season that allows hunters to hunt coyotes at night (WVDNR 2004b).

## *Striped Skunk, Mephitis mephitis*

### Life History

**Taxonomy:** Striped skunks are members of the order Carnivora. Previously, they were placed in the family Mustelidae, but now have been reclassified and are included in the family Mephitidae, and the subfamily Mephitinae. Striped skunks are 1 of 13 species of the genus *Mephitis*. Thirteen subspecies of the species *Mephitis mephitis* are recognized (Feldhamer et al. 2003).

Description: Striped skunks are stout-bodied animals with short legs and are about the size of a house cat. They have a small, triangle-shaped head with small, short, rounded ears, small eyes, and a pointed muzzle with a somewhat bulging nose (Linzey 1998, Feldhamer et al. 2003). They are best known by the black body and the narrow white stripe that continues from the middle of the forehead to the tail. This stripe often divides into a 'V' over the shoulders (Linzey 1998, Whitaker and Hamilton 1998). There is great variation among striped skunks in outward pelage patterning; individuals may have a white chest patch or white stripes on the outsides of the front legs (Feldhamer et al. 2003). Striped skunks are semi-plantigrade and have long claws for digging on the front feet (Linzey 1998). The claws on the hind feet are shorter and straighter (Feldhamer et al. 2003). They weigh between 1.3 and 4.5 kg (Linzey 1998), though noticeable geographic variation exists in body size (Feldhamer et al. 2003). Males are about 10% larger than females.

Skunks possess 2 scent or musk glands on each side of the anus; sphincter muscles at the tail base control these glands (Linzey 1998, Feldhamer et al. 2003). When frightened or annoyed, skunks contract these muscles to squeeze the glands, which then emit a fine mist of scent. The glands may be expressed individually or together (Linzey 1998). The initial spray is the most powerful; the musk can be sprayed up to 3.5 to 4.5 m. Skunks typically spray only as a last resort. The musk has a sickening smell that is difficult to remove from clothing. The secretion can burn when it comes in contact with sensitive areas such as the eyes, nose, or mouth (Linzey 1998).

Habitat: Striped skunks are found in all habitat types except bogs and swamps. They are most abundant in pastures and meadows (McKeever 1956). Striped skunks also are found in brushy, sparsely wooded areas and agricultural areas (Linzey 1998) and have become prevalent in suburban and urban habitats as well.

Behavior: Striped skunks typically are nocturnal, yet peak activity often occurs during crepuscular periods (Feldhamer et al. 2003); daylight hours are spent sleeping in hollow logs, wood piles, burrows, and beneath abandoned buildings (Linzey 1998). Skunks may excavate their own dens or use burrows abandoned by other animals. The internal den is a nest composed of leaves pushed or pulled into the burrow (Linzey 1998). Den type varies with time of year, habitat, sex, and age of skunks (Feldhamer et al. 2003). Vocalizations include squeals, growls, hisses, churrings, and twitterings. Skunks make slow and deliberate movements and are not good climbers. They have a good sense of touch, but the other senses are rather poorly developed (Linzey 1998).

Home range size varies with population density (Linzey 1998), geographic area, habitat, sex, season, and weather (Feldhamer et al. 2003). Home range size averages 234 and 284 ha for juvenile females and males, and 378 and 512 ha for adult females and males (Whitaker and Hamilton 1998).

Reproduction: Linzey (1998) reported that striped skunks breed from late January to March, whereas Feldhamer et al. (2003) found breeding occurred from mid-February to mid-April. Breeding likely occurs later in northern latitudes (Feldhamer et al. 2003). Striped skunks are monestrous, and breed only once a year, although cases of 2 litters have been reported



(Feldhamer et al. 2003). Once a female has bred successfully, she will fight off any subsequent attempts from polygamous males (Feldhamer et al. 2003). Gestation averages 59 to 77 days. Litter size ranges between 3 to 10 young. Young are born with their eyes closed, a fine layer of fur, and functional claws; weight at birth is approximately 23 g (Linzey 1998). Females nurse the young for 6 to 7 weeks; the young begin to emerge from the den between 6 to 7 weeks and remain with the female until late summer (Linzey 1998).

**Food Habits:** Striped skunks are omnivorous and consume a wide variety of foods, including shrews, moles, bats, mice, chipmunks, and other small mammals, small birds, snakes, turtle eggs, frogs, fish, crayfish, insects, insect larvae, carrion, corn, and berries (Linzey 1998, Feldhamer et al. 2003). The summer diet includes fruits, small mammals, and insects such as grasshoppers, crickets, and caterpillars. Fall and winter diets include fruit, small mammals, carrion, grain, nuts, grasses, leaves, and buds. Occasionally, striped skunks may kill poultry and uproot plants in search of insects (Linzey 1998, Whitaker and Hamilton 1998).

**Mortality:** Predation, parasitism, and disease are factors that affect mortality in striped skunks. The primary predator of striped skunks is humans (Whitaker and Hamilton 1998, Feldhamer et al. 2003). Other potential predators include red foxes, coyotes, lynx, bobcats, badgers, mountain lions, fishers, domestic dogs, and especially great-horned owls (Linzey 1998, Feldhamer et al. 2003). Striped skunks have few enemies due to their spraying defense (Feldhamer et al. 2003). Parasites reported in striped skunks include fleas, lice, ticks, mites, protozoans, acanthocephalans, cestodes, nematodes, and trematodes (Linzey 1998, Feldhamer et al. 2003). Diseases reported in striped skunks include rabies, canine distemper, leptospirosis, and infectious canine hepatitis. Skunks are a major carrier of rabies (Whitaker and Hamilton 1998, Feldhamer et al. 2003). Other mortality factors include animal control methods, vehicle collisions, and winter starvation (Feldhamer et al. 2003). Striped skunks live up to 5 to 6 years in the wild (Linzey 1998).

### *Distribution and Abundance*

**Distribution:** Striped skunks are found throughout Canada, most of the United States, and northern Mexico. They are absent from the deserts of southwestern United States, except major river passages (Feldhamer et al. 2003), southeastern Louisiana, eastern North Carolina, and northeastern South Carolina (Whitaker and Hamilton 1998). Striped skunks are found statewide throughout West Virginia (McKeever 1956).

**Abundance:** Striped skunks are common throughout West Virginia (McKeever 1956).

### *Economic Status*

The economic status of striped skunks is related closely to their value to the garment industry. Their pelts are used for coats, jackets, muffs, scarves, and trim. Striped skunks also are propagated for use as pets and for their scent, which is used for musk derivatives. They are valuable to farmers and property owners because the amount of insects they consume. However, striped skunks may become a nuisance due to the damage they cause when digging and from the damage and costs associated with rabies control (Feldhamer et al. 2003). West Virginia Division

of Natural Resources (2004b) recognizes striped skunks as a nuisance species and maintains a continuous open hunting season on this species.

### *Virginia Opossum, Didelphis virginiana*

#### Life History

**Taxonomy:** The Virginia opossum is the only member of the family Didelphidae found north of Mexico (Whitaker and Hamilton 1998, Feldhamer et al. 2003).

**Description:** Opossums are the only naturalized marsupial in North America. They are a medium-sized (38 – 51 cm) mammal with long, coarse, dense, grayish-white fur (Linzey 1998). The body hairs are white with dark brown to black ends, whereas the guard hairs are long and entirely white (Feldhamer et al. 2003). The cheeks are white encircled by a gray to black eye stripe and eye ring (Feldhamer et al. 2003). The lower legs are black, but the feet are black with white toes (Feldhamer et al. 2003). The first toes of the hind feet are large and opposable (Feldhamer et al. 2003). They have a sharp, slender muzzle, large, thin but leathery, bluish-black ears, and a long, grasping, sparsely haired tail. The nose is pink and the eyes are black (Linzey 1998). Weight ranges between 1.3 and 4.5 kg (Linzey 1998). Males typically are larger than females (Feldhamer et al. 2003).

**Habitat:** Opossums can be found in nearly all habitat types (Whitaker and Hamilton 1998, Feldhamer et al. 2003), but they prefer low, damp, wooded areas along streams and lakes, swamps, and farms with hedgerows (Linzey 1998). McKeever (1956) noted that opossums are found in every habitat in West Virginia except the spruce forests of the higher mountains.

**Behavior:** Opossums are shy, secretive mammals. Although they den and feed alone, they may tolerate neighboring individuals (Linzey 1998, Whitaker and Hamilton 1998). Despite being nocturnal, they may take advantage of warmer daytime temperatures in winter (Feldhamer et al. 2003). During other seasons, daylight hours are spent in protective cover (Linzey 1998), such as hollow trees, fallen logs, brush piles, and ground burrows. Although opossums are active year-round, activity decreases during cold weather (Linzey 1998). Opossums primarily are terrestrial animals, yet they possess useful arboreal and aquatic capabilities (Feldhamer et al. 2003). According to Linzey (1998), they are able swimmers. They can climb quickly, and use their prehensile tail for balance and support. To elude predators, opossums “play dead” or “play possum,” a process triggered by their nervous system (Linzey 1998; Feldhamer et al. 2003). Opossums use 4 distinct vocalizations: clicking, hissing, growling, and screeching (Feldhamer et al. 2003).

Opossums are not territorial nor do they maintain separate home ranges. Being solitary animals, they wander and rarely remain in an area over long periods of time, which makes estimation of home range size difficult (Feldhamer et al. 2003).

**Reproduction:** Opossums are considered promiscuous or polygamous; females are seasonally polyestrus (Linzey 1998) and may have 5 to 7 estrus cycles (Feldhamer et al. 2003). The reproductive season, defined as conception to weaning, begins in January and continues into

November (Feldhamer et al. 2003). However, breeding begins in late January and continues into late March; a second breeding season begins mid-May and continues into early July (Linzey 1998). Females are spontaneous ovulators, with ovulation occurring during estrus (Feldhamer et al. 2003). Females mate for the second time around the weaning of the first litter. After a gestation of 12 or 13 days (the shortest of any North American mammal), 7 young, on average, comprise the litter. At birth, the young climb into the pouch and attach to a teat (Linzey 1998). The size of the litter depends on the number of young that successfully reach the pouch and the number of functional teats (Feldhamer et al. 2003). Young remain attached for approximately 60 days. Their eyes open between 58 and 72 days. After 2 months, the young begin to leave the pouch. Weaning occurs between 80 and 100 days. Opossums reach sexual maturity at approximately 8 months (Linzey 1998).

**Food Habits:** Opossums are scavengers (Linzey 1998); they most likely use whatever the most abundant food sources are at the time (Feldhamer et al. 2003). They also are considered omnivores, even though they show preference for animal material. The diet consists of dewberries, blackberries, persimmon, pokeberries, wild grapes, apples, beetles, crickets, grasshopper, snails, millipedes, crayfish, rodents, shrews, birds, snakes, snakes, frogs, and salamanders (Linzey 1998). In addition, opossums eat grasses and other green vegetation, maggots from rotting carcasses, mushrooms, and may even cannibalize other individuals (Feldhamer et al. 2003).

**Mortality:** Factors that influence mortality in opossums include disease, parasitism, and predation. Diseases reported in opossums include rabies, though extremely rare, Chaga's disease (naturally), histoplasmosis, leptospirosis, and tularemia (Linzey 1998). Opossums are natural reservoirs for leptospirosis (Feldhamer et al. 2003). They also act as natural hosts of Rocky Mountain spotted fever and marine endemic typhus rickettsiae. Other diseases include arboviruses, tuberculosis, *Borrelia recurrentis* (relapsing fever), enteritis, typhoid fever, *bordetella*, *Staphylococcus*, *Proteus*, *Aerobacter*, and *Pseudomonas* (Feldhamer et al. 2003). Opossums can carry *Toxoplasma*, *Sarcocystis*, *Besnoitia*, *Coccidia*, *Trichomonas*, and *Trypanosoma* (Feldhamer et al. 2003). Parasites reported in opossums include flukes, tapeworms, roundworms, fleas, ticks, and mites (Linzey 1998). Feldhamer et al. (2003) found an unknown number of protozoans, 30 nematodes, and 26 trematodes occur in opossums. Predators of opossums include great-horned owls (Linzey 1998), other raptors, dogs, coyotes, foxes, raccoons, bobcats, and large snakes (Feldhamer et al. 2003). Dogs and great-horned owls pose the greatest threat to opossums (Whitaker and Hamilton 1998, Feldhamer et al. 2003). Hunting and trapping represent contributing mortality sources (Feldhamer et al. 2003). The average life span of opossums is 1.3 years, yet individuals have lived up to 7 years in captivity (Linzey 1998).

### Distribution and Abundance

**Distribution:** Virginia opossums are found from southern Ontario and British Columbia, Canada, into much of the United States and Mexico, and as far south as northwestern Costa Rica (Feldhamer et al. 2003). In 1775, opossums were not present in West Virginia; the range expanded into West Virginia after European settlement (McKeever 1956).

Abundance: Opossum are found statewide throughout West Virginia below 1066.8 m in elevation (McKeever 1956)

### Economic Status

The economic importance of opossums stems from their value as a wildlife resource. Opossum pelts are used by the fur industry, where the pelts are dyed and plucked to simulate other pelts. In many areas, opossums represent a food resource. Night hunting of opossums is popular in many regions (Feldhamer et al. 2003). In West Virginia, opossums are managed as a nuisance species, where a continuous open season has been established (WVDNR 2004b).

*Woodchuck, Marmota monax*

### Life History

Taxonomy: Six species of marmots exist in North America (Feldhamer et al. 2003). The woodchuck is a member of the order Rodentia, and the largest member of the Sciuridae family (Linzey 1998, Whitaker and Hamilton 1998). The woodchuck also is known as the groundhog, whistle pig, or whistler (Linzey 1998, Feldhamer et al. 2003). Nine subspecies of *Marmota monax* are recognized in North America (Feldhamer et al. 2003).

Description: Woodchucks have a heavy set body and a short, flattened tail. They have a broad head, a blunt nose, and round ears (Linzey 1998). They have small, rudimentary thumbs with flat nails and 4 strong claws on the front feet that are adapted for digging (Linzey 1998). The fur is long, coarse, yellowish-brown to brown, and renders a grizzled or frosted appearance from a distance. The underfur is soft and gray. The sides of the face, nose, lips, and chin are white or buff (Linzey 1998). The feet are dark brown to black. The color of the tail varies from black to brown (Linzey 1998). Melanistic individuals have been reported (Feldhamer et al. 2003). Males are larger than females. Woodchucks reach their maximum body mass before entering the burrow for hibernation (Feldhamer et al. 2003).

Habitat: Woodchucks inhabit the edges of brushy woodlands, open fields, fence rows, railroad and highway right-of-ways, and riparian areas along streams and lakes (Linzey 1998). Woodchucks also can be found in small clearings within the deciduous forest, meadows, pastures, rocky outcrops, or overgrown brushy areas throughout West Virginia (McKeever 1956).

Behavior: Woodchucks are diurnal and remain in their burrows at night. Peak activity occurs in early morning and late afternoon. Woodchucks are not sociable animals. During the day, they may climb into shrubs to feed or sun (Linzey 1998). Woodchucks walk with a waddling gait. They have great eyesight and have been known to occasionally swim (Linzey 1998). When alarmed, they use vocalizations such as loud, shrill whistles and teeth grinding. To communicate pleasure, woodchucks emit a low grunt or bark (Linzey 1998). Woodchucks hibernate during the winter (Linzey 1998). They enter the hibernation chamber sometime between early to late October and remain there for 3.5 to 5.5 months; the length of hibernation depends on geographic location (Feldhamer et al. 2003). The hibernation chamber is isolated from the rest of the burrow

by a dirt plug. Adult males commonly emerge from hibernation before juveniles and adult females (Linzey 1998).

Only about 3 of every 24 hours are spent outside of the burrow. Woodchucks dig their own burrows, which have a main entrance marked by a pile of dirt (Linzey 1998). Fresh dirt at the main entrance indicates an occupied burrow. Home range size for woodchucks varies with the availability of food near the burrow (Linzey 1998). Home ranges of males generally are larger than those of females (Feldhamer et al. 2003). The average home range for a female is 0.25 ha, whereas the average home range for a male is 1.6 ha (Feldhamer et al. 2003). Woodchucks seldom travel >90 m from the home burrow (Linzey 1998), but they may move between burrows (Feldhamer et al. 2003).

**Reproduction:** Breeding occurs soon after woodchucks emerge from hibernation in early spring (Linzey 1998, Feldhamer et al. 2003). After a gestation period 31 or 32 days, a litter of 3 to 5 young is born. The young are born in an underground nesting chamber (Linzey 1998, Whitaker and Hamilton 1998). At birth, the young are naked, blind, helpless, and weigh approximately 23.7 g (Feldhamer et al. 2003). The eyes open between 20 and 26 days. Weaning occurs at 4 to 5 weeks. The young remain with the female until mid-summer. Linzey (1998) noted that woodchucks reach sexual maturity at 1 year, but they generally do not breed until they are 2 years old. Feldhamer et al. (2003) noted that woodchucks may breed as yearlings (second summer of life).

**Food Habits:** Woodchucks are herbivores and consume primarily plant material. The diet includes clover, grasses, alfalfa, wheat, oats, hay, corn, soybeans, pumpkins, raspberries, blackberries, strawberries, apples, and cherries. Their choice of food items often conflicts with human desires and they can become a nuisance for farmers (Linzey 1998). Woodchucks in Pennsylvania were found to have consumed 46 species of plants, and displayed preference in selecting dicots over monocots (Feldhamer et al. 2003). On rare occasions, woodchucks may consume insects and snails (Linzey 1998).

**Mortality:** Mortality in woodchucks arises from disease, parasitism, and predation. Diseases reported in woodchucks include rabies (Linzey 1998), woodchuck hepatitis virus (WHV), Rocky Mountain spotted fever, tularemia, leptospirosis, and human encephalitis (Feldhamer et al. 2003). Woodchucks may be host to many parasites, including fleas, mites, ticks, tapeworms, roundworms, and protozoa (Linzey 1998, Feldhamer et al. 2003). Woodchucks are protected when in their burrows, but they are vulnerable to predators while away from the burrow. Predators include birds of prey, dogs, bobcats, bears, foxes, weasels, and rattlesnakes (Linzey 1998, Feldhamer et al. 2003). Human-related factors (e.g., vehicle collisions) do affect mortality of woodchucks (Linzey 1998, Whitaker and Hamilton 1998). The life span of a woodchuck is between 5 to 6 years in the wild (Linzey 1998, Whitaker and Hamilton 1998) and, in captivity, up to 9 years (Linzey 1998).

### *Distribution and Abundance*

**Distribution:** Among North American marmots, woodchucks are the most widely distributed. They are found from eastern Canada, south across the eastern United States and into northern Georgia and Alabama, and west to eastern Kansas and Nebraska (Whitaker and Hamilton 1998,

Feldhamer et al. 2003). Woodchucks occur statewide throughout West Virginia (McKeever 1956).

Abundance: Woodchucks are common throughout West Virginia at both low and high elevations (McKeever 1956).

### Economic Status

Historically, woodchuck pelts were used to make cheap coats and for patching leatherwork and straps. Woodchuck burrows often are used by other animals of economic importance. Woodchucks generally are viewed as a nuisance species, given its damage conveyed on a variety of crops (e.g., grains, clovers, alfalfa, hay grasses, beans, peas, corn, and apple trees). They may damage electrical wires and rubber hoses in vehicles by gnawing (Feldhamer et al. 2003). In West Virginia, woodchucks are managed as a nuisance species, for which there is a continuous open season (WVDNR 2004b).

### Migratory Bird Species

Waterfowl:

*Geese, Subfamily Anserinae*

### Life History

Taxonomy: Geese are members of the order Anseriformes, the suborder Anseres, the family Anatidae, the subfamily Anserinae, and the tribe Anserini. The Anserini tribe includes three genera (*Cereopsis*, *Anser*, *Branta*) and 15 species (Baldassarre and Bolen 1994). Three species of the Anserini tribe are hunted in West Virginia, and include the Canada goose (*Branta canadensis*), brant (*Branta bernicla*), and snow goose (*Anser caerulescens*).

Description: Canada geese vary in color from medium grayish-brown to very dark grayish-brown. They have a black head and neck, except for a white band under the chin that extends from each cheek to behind each eye. Canada geese also have a white forehead. Canada geese are large birds that weigh between 950 and 9000 g. Brants are similar in appearance to Canada geese, but they have a narrow, white collar on the black neck and no white cheek patch (Mowbray et al. 2002). They are smaller and darker than the Canada goose, have large wings, a short neck, and a small head. Male brants weigh, on average, 1470 g; females weigh 1340 g. Brants are unlikely to be confused with any other goose (Reed et al. 1998). Snow geese are medium-sized (63-75 cm) and have a distinctive blackish “grinning patch” or “smile” (Mowbray et al. 2000). Two color morphs exist in this species: a light, commonly white, morph, and a dark gray or brown morph (Mowbray et al. 2000). Male snow geese weigh, on average, 2485 g; females weigh 2181 g (Mowbray et al. 2000).

Habitat: Breeding habitat of Canada geese is diverse and may include treeless and forested areas, prairies, arctic coastal plains, and high mountain meadows. In the southern extent of the breeding range, habitat includes marshes, agricultural lands, and urban areas (Mowbray et al.

2002). Brants prefer salt marshes and estuarine deltas with abundant vegetation (Reed et al. 1998). The breeding habitat of snow geese includes subarctic or arctic areas near the coast that are characterized by bare terrain, along the shores of ponds, lakes, and streams, and on islands (Mowbray et al. 2000). Canada geese winter on lakes, slow-moving river, freshwater marshes, saltwater marshes, bays, mud and sand tidal flats, brackish ponds, grassy fields, pastures, and agricultural fields (Mowbray et al. 2002). During winter months, brants inhabit intertidal mudflats associated with shallow marine waters (Reed et al. 1998). Wintering habitat of snow geese is similar to that of Canada geese; it includes estuarine marshes, marine inlets and bays, shallow tidal waters, freshwater and brackish waters along the coast, inland grasslands, inland freshwater marshes, coastal prairies, and agricultural fields (Mowbray et al. 2000).

**Behavior:** Geese are strong walkers and runners, and can travel easily over terrestrial habitats (Mowbray et al. 2002). During the breeding season, brants become more terrestrial (Reed et al. 1998). Canada geese, brants, and snow geese are capable swimmers and divers, but they do not dive for their food (Reed et al. 1998, Mowbray et al. 2000, Mowbray et al. 2002). All 3 species are strong fliers. Brants are capable of flying at speeds of >99 km/h, but average 80 km/h (Reed et al. 1998). The 3 species are considered medium to long distance migrants. For Canada geese and snow geese, spring migration begins as early as late January and continues into mid-February (Mowbray et al. 2000, Mowbray et al. 2002). Brants do not begin their movement north until April and May (Reed et al. 1998). Fall migration occurs between August and September for all species (Reed et al. 1998, Mowbray et al. 2000, Mowbray et al. 2002).

**Reproduction:** All members of the subfamily Anserinae mate for life, but they do not attain sexual maturity until 2 or 3 years. Pair formation begins in winter while still on the wintering grounds. The female is responsible for building the nest whereas the male guards the female as she incubates. Both parents participate in brooding of the young (Baldassarre and Bolen 1994). Clutch size ranges between 3 and 5 eggs in Canada geese (Mowbray et al. 2002), 2 and 8 eggs in brants (Reed et al. 1998), and 2 and 6 eggs in snow geese (Mowbray et al. 2000). Incubation lasts for 23 to 27 days. Young are precocial and are ready to leave the nest within 24 hours. Like most waterfowl, young grow rapidly (Reed et al. 1998, Mowbray et al. 2000, Mowbray et al. 2002).

**Food Habits:** Members of Anserini are primarily vegetarians that graze in uplands and feed on waste grains. Agricultural crops, such as corn, are primary foods of Canada geese (Baldassarre and Bolen 1994). Specific diet items of Canada geese include grasses, sedges, and other green monocots (Mowbray et al. 2002). Brants feed on marine plants, and native grasses, mosses, and forbs (Reed et al. 1998). Snow geese feed on rhizomes, tubers, and roots as well as tender shoots of aquatic agricultural plants (Mowbray et al. 2000).

**Mortality:** Mortality factors for Canada geese and brants include exposure, predation, and human-related activities. Exposure causes high rates of mortality in newly hatched young. Egg predators include foxes, herring gulls, glaucous gulls, Iceland gulls, glaucous-winged gulls, long-tailed jaegers, parasitic jaegers, ravens, crows, brown bears, and black bears (Reed et al. 1998, Mowbray et al. 2000, Mowbray et al. 2002). Predators of adult Canada geese include coyotes, gray wolves, snowy owls, and golden eagles (Mowbray et al. 2002). In addition to the predators noted for Canada geese, other predators on adult brants include wolverines and minks (Reed et

al. 1998). Major causes of mortality reported in snow geese include hunting, collisions with power lines, predation, and lightning. Egg predators of snow geese include foxes, herring gulls, and glaucous gulls, parasitic jaegers, caribou, bears, gray wolves, ravens, and sandhill cranes. Adults and juveniles are preyed on by gulls, foxes, owls, bears, wolves, and eagles (Mowbray et al. 2000).

### Distribution and Abundance

Distribution: Canada geese will breed and overwinter throughout the U.S. wherever suitable habitat can be found (Mowbray et al. 2002). Breeding range for brants includes the low arctic to extreme high arctic; wintering range includes coastal area of the U.S. from Massachusetts south to central North Carolina (Reed et al. 1998). Snow geese breed in Alaska and Canada, and overwinter throughout the U.S. and along the Atlantic coast from Massachusetts to North Carolina (Mowbray et al. 2000).

Abundance: Populations of resident Canada geese have been increasing since the 1940s; in 2001, the population was estimated at >5 million individuals (Mowbray et al. 2002). In West Virginia, resident populations of Canada geese are increasing (Buckelew and Hall 1994). Brant populations demonstrate fluctuations in population size, but recent surveys suggest that populations are increasing (Reed et al. 1998). Due to their colonial and gregarious habits, density estimates of snow geese notoriously are inaccurate. Still, biologists believe that populations of snow geese are increasing. In 1997, the snow goose population was estimated to be around 5 million individuals (Mowbray et al. 2000).

### Economic Status

Geese, like many migratory birds, provide abundant recreational opportunities. In West Virginia, hunting for Canada geese, brants, and snow geese, is regulated via season within management zones (WVDNR n.d.[k]). The abundant recreational opportunities associated with geese often are dismissed because of the negative impacts of resident goose populations. Negative impacts include property damage (i.e., damage to agriculture crops, residential laws, gold courses), and public health and safety concerns (i.e., fecal contamination of water sources; personal, economic, and mechanical losses associated with airplanes and geese) (French and Parkhurst 2001).

### Dabbling Ducks, Subfamily Anatinae, Tribe Anatine

#### Life History

Taxonomy: Dabbling ducks are members of the order Anseriformes, the suborder Anseres, the family Anatidae, the subfamily Anatinae, and the tribe Anatini. The primary genus embodied within this tribe is *Anas* (Baldassarre and Bolen 1994). Members of the tribe that are hunted in West Virginia include American black duck (*Anas rubripes*), American wigeon, (*Anas americana*), blue-winged teal, (*Anas discors*), green-winged teal, (*Anas crecca*), gadwall, (*Anas strepera*), mallard, (*Anas platyhynchos*), Northern pintail, (*Anas acuta*), shoveler, (*Anas clypeata*), and wood duck, (*Aix sponsa*).



Description: The dabbling ducks comprise a diverse group of ducks. All display sexually dimorphic plumage (Baldassarre and Bolen 1994). American black ducks are large (53-63 cm), dark brown ducks (Longcore et al. 2000). American wigeons are medium-sized (45-58 cm). The breeding plumage of adult males includes a distinctive white forehead, white crown, and a dark green patch surrounding the eye, whereas that of the female is rusty brown with brownish-black crown. The winter plumage of males and females is similar (Mowbray 1999). Blue-winged teal are small (38-40 cm), and have a light blue patch on the upper wing (Rohwer et al. 2002). Green-winged teal are the smallest (37 cm) dabbling duck. Its small size distinguishes it from other dabbling duck species (Johnson 1995). The gadwall is medium-sized (48-58 cm) and lacks distinctive coloration (LeSchack et al. 1997). The mallard is the most familiar of the dabbling ducks; it is medium- to large-sized (50-70 cm) and probably the most obviously sexually dimorphic (Drilling et al. 2002). Northern pintails are large (65-75 cm) and are readily distinguished from other dabbling ducks by their slim profile, the long narrow neck, and the pointed tail (Austin and Miller 1995). The Northern shoveler, a medium-sized (43-50 cm) dabbler, is distinguished from other waterfowl species by the elongated and wide bill (DuBowy 1996). Wood ducks are small- to medium-sized (43-51 cm) with a crested head and a large, rectangular-shaped tail (Hepp and Bellrose 1995).

Habitat: Dabbling ducks are associated with freshwater habitats, particularly during the breeding season. Many of the dabbling ducks overwinter on coastal bays or brackish marshes (Baldassarre and Bolen 1994, Longcore et al. 2000). Wintering habitat of wigeons also includes rivers, lakes, impoundments, and estuaries (Mowbray 1999). Preferred breeding habitat of blue-winged teals includes ponds with abundant invertebrates (Rohwer et al. 2002). Green-winged teals prefer to breed in wooded ponds of deciduous parklands and to winter in shallow wetlands (Johnson 1995). Gadwalls prefer prairie habitats for breeding (LeSchack et al. 1997); they too migrate toward the coasts in winter. Preferred habitat of the shoveler includes wetlands with submergent vegetation and nearby grasslands or rangelands for nesting (DuBowy 1996). Wood ducks frequently inhabit the mature woodlands along creeks, river, and bottomland wetlands (Hepp and Bellrose 1995).

Behavior: Dabbling ducks are capable of diving, but the more forward position of the legs (relative to diving ducks) inhibits strong propulsion (Baldassarre and Bolen 1994). Dabbling ducks are able walkers, runners, and swimmers (Johnson 1995, LeSchack et al. 1997, Mowbray 1999, Longcore et al. 2000, Drilling et al. 2002, Rohwer et al. 2002). The preferred modes of travel for Northern shovelers are swimming and flying (DuBowy 1996). Wood ducks walk faster and in a more upright position than other dabblers (Hepp and Bellrose 1995). Due to their heavy body and large, broad wings, American black ducks have a slower wing beat than most dabbling ducks (Longcore et al. 2000). The flight of wigeons appears erratic; wigeons beat their wing rapidly, giving them an appearance of great speed, but they rarely exceeding 30 mph (Mowbray 1999). Northern pintails are graceful flyers, capable of fast and vigorous sustained flights (Austin and Miller 1995). In flight, Northern shovelers exhibit a "hunched-back" appearance due to the downward position they hold their head and bill (DuBowy 1996).

For dabbling ducks, northward migration begins as early February and continues into early April. For most dabbling ducks, fall migration occurs in September and October (Johnson 1995, LeSchack et al. 1997, Longcore et al. 2000). However, wigeons begin their nocturnal migration

south as early as mid-August (Mowbray 1999). Blue-winged teals depart from the wintering grounds later than most dabbling ducks in the spring; departure occurs from February to May. They also depart to the wintering grounds before most dabbling ducks, leaving as early as August and extending through to October (Rohwer et al. 2002). Shovelers depart late in the spring and early in the fall (DuBowy 1996). Mallards and northern pintails are some of the earliest spring migrants, and they actually may arrive on the breeding grounds during the spring thaw (Austin and Miller 1995, Drilling et al. 2002). Mallards have a prolonged fall migration; they typically do not migrate until the first snow or the water freezes (Drilling et al. 2002). Northern pintails typically depart from their winter habitat in March (Austin and Miller 1995). The timing of spring migration is not well known in wood ducks; fall migration occurs between September and November (Hepp and Bellrose 1995).

Reproduction: Nesting occurs in or near wetlands; however, nests often are placed in the upland areas on the ground or in cavities. For the most part, dabbling ducks reach sexual maturity at 1 year, except for mallards, who do not breed until 2 years (Baldassarre and Bolen 1994). Male dabbling ducks perform elaborate courtship displays to attract females, and some females may display to elicit response from males. Copulation occurs on the water. After copulation, males often continue to display for a period of weeks (Longcore et al. 2000). Clutch size among the dabblers is variable: American black ducks average 9 eggs (Longcore et al. 2000); wigeons and Northern pintails range from 3 to 12 eggs and average 8 eggs (Austin and Miller 1995, Mowbray 1999); blue-winged teals and wood ducks average 10 eggs (Rohwer et al. 2002, Hepp and Bellrose 1995); green-winged teals average 8 eggs (Johnson 1995); gadwalls range from 7 to 12 eggs (LeSchack et al. 1997); mallards produce 1 to 13 eggs (Drilling et al. 2002); shovelers average 10 eggs (DuBowy 1996). The female in most dabblers incubates the eggs for 22 to 28 days (Austin and Miller 1995, LeSchack et al. 1997, Mowbray 1999, Longcore et al. 2000, Drilling et al. 2002). Incubation lasts 19 to 29 days in blue-winged teal (Rohwer et al. 2002) and 20 to 23 days in green-winged teal (Johnson 1995), whereas in wood ducks, incubation lasts 25 to 37 days (Hepp and Bellrose 1995). At hatching, young are precocial and most leave the nest once the down has dried (Mowbray 1999, Longcore et al. 2000, Rohwer et al. 2002). American black duck females continue to brood young for 43 to 48 days (Longcore et al. 2000). Female wigeons brood their young until 6 to 7 weeks (Mowbray 1999). Blue-winged teal females brood until the young are 2 weeks (Rohwer et al. 2002). Brooding in gadwalls continues for up to 14 days after hatching (LeSchack et al. 1997). Female mallards remain with the young until they are capable of flying (Drilling et al. 2002). Brooding continues 4 to 6 weeks after hatching in northern pintails (Austin and Miller 1995), but only 2 weeks post-hatching in wood ducks (Hepp and Bellrose 1995).

Food Habits: Dabbling ducks, as their name suggests, feed in shallow water by skimming the surface for food or by tipping their heads and necks under water (Baldassarre and Bolen 1994). Dabbling ducks primarily are vegetarian, and they feed on the stems and leafy parts of aquatic plants, upland grasses, and clovers. Dabbling ducks also consume seeds of agricultural crops (Austin and Miller 1995, Mowbray 1999). American black ducks consume animal food such as aquatic insects, crustaceans, mollusks, and fish (Longcore et al. 2000). The diet of blue-winged teals also includes aquatic invertebrates (Rohwer et al. 2002). Mallards and green-winged teal are more opportunistic than most dabbling ducks and their diet reflects the seasonal availability

of both natural and agricultural foods (Johnson 1995, Drilling et al. 2002). Primary food items of shovelers include small, swimming invertebrates and seeds (DuBowy 1996).

**Mortality:** Exposure and predation are both causes of mortality in dabbling ducks. Nests are vulnerable to flooding caused by tides and rains in estuarine and riparian habitats (Longcore et al. 2000). Prairie nests of Northern pintails are vulnerable to late snowfall (Austin and Miller 1995). Predators of adult dabbling ducks include hawks, owls, raccoons, foxes, mink, badgers, and coyotes. Nest predators include crows, raccoons, snakes, and mink. Young are preyed on by snapping turtles, pickerel, northern pike, bullfrogs, hawks, snakes, and foxes (Johnson 1995, Mowbray 1999, Longcore et al. 2000). Blue-winged teal are susceptible to several diseases, including botulism, avian cholera, duck viral enteritis (DVE), and aspergillosis (Rohwer et al. 2002). Mallards and Northern pintails also may be susceptible to some of these waterfowl diseases (Austin and Miller 1995, Drilling et al. 2002). Various parasites have been associated with dabbling ducks (Austin and Miller 1995, DuBowy 1996, Mowbray 1999, Longcore et al. 2000, Drilling et al. 2002). Parasites reported in dabbling ducks include trematodes, cestodes, nematodes, ectoparasites, and species of *Ancanthocephala* (Johnson 1995).

### *Distribution and Abundance*

**Distribution:** The breeding range of most dabbling ducks extends to many areas of Canada and the U.S. American black ducks breed in Minnesota, Wisconsin, Michigan, Ohio, West Virginia, Maryland, Delaware, Virginia, and North Carolina and winter along the southern portion of breeding range south into the Gulf Coast and Florida (Longcore et al. 2000). Wigeons breed farther north than most dabbling ducks. Hence, the primary breeding range of wigeons is centered in northwestern North America and secondarily in local areas of eastern North America. Wigeons often share wintering grounds with American black ducks (Mowbray 1999). Blue-winged and green-winged teal breed in many areas of North America and winter in southern North America, Central America, and South America (Johnson 1995, Rohwer et al. 2002). The historical breeding range of gadwalls was centered in western North America; however, gadwalls currently are breeding locally in areas of eastern North America. Wintering range of gadwalls is extensive, extending from Alaska and Ontario, south to Mexico, and along the Atlantic, Pacific, and Gulf Coasts (LeSchack et al. 1997). The breeding and wintering ranges of mallards, Northern pintails, and wood ducks overlap with many of the aforementioned dabbling ducks (Austin and Miller 1995, Hepp and Bellrose 1995, Drilling et al. 2002). Shovelers breed mostly in western North America and locally in eastern North America, whereas they overwinter throughout North and Central America (DuBowy 1996).

**Abundance:** The continental population of American black ducks is approximately half its historical size. As a result, restrictive regulations were implemented in 1983 and the population of black ducks today has stabilized at approximately 300,000 individuals (Longcore et al. 2000). The annual Breeding Population and Habitat Survey (BPHS) estimated the breeding population of wigeons at >3 million individuals, but breeding densities vary widely among geographic regions (Mowbray 1999). In 2000, blue-winged teal became the second most abundant duck in North America; however, populations fluctuate considerably given their strong link to wetland abundance and condition (Rohwer et al. 2002). In 1990, the breeding population of green-winged teal was estimated to be approximately 3 million (Johnson 1995). In recent years, gadwall populations have increased substantially; the breeding population of gadwalls is

estimated at 3 million individuals (LeSchack et al. 1997). In 2000, the mallard population was estimated at 9.5 million individuals (Drilling et al. 2002). Northern pintails are one the most abundant waterfowl species in North America, but they also demonstrate dramatic population fluctuations compared to other species (Austin and Miller 1995). In 1995, the breeding population of Northern shovelers included >2.5 million individuals (DuBowy 1996). Accurate population estimates for wood ducks are not available, but biologists believe that population trends are stable (Hepp and Bellrose 1995).

### Economic Status

Waterfowl, like many migratory birds, provide many recreational opportunities. In 2001, there were 3.0 million migratory bird (i.e., geese, ducks) hunters in the U.S. (USDI 2002). In addition, participation in duck hunting increased 37% from 1991 to 2001 (USDI 2004) to 1.6 million hunters. Duck hunters devoted 18 million days to duck hunting in 2001 (USDI 2002). Dabbling duck species hunted in West Virginia include: American black duck (*Anas rubripes*), American widgeon (*Anas americana*), blue-winged teal (*Anas discors*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), mallard (*Anas platyrhynchos*), Northern pintail (*Anas acuta*), Northern shoveler (*Anas clypeata*), and wood duck (*Aix sponsa*). Zone One, which includes the NERI, has a split season. The first segment of the season in Zone One opens in early October and closes in mid-October. The second segment opens in early December and closes in mid-January. The daily bag limit is 6 ducks. This bag limit for restricted species may include 1 pintail, 1 black duck, 2 wood ducks, and 4 mallards, of which only 2 may be hens. The daily bag limit for unrestricted species is 6 per day. The legal possession limit is twice the daily bag limit. Shooting hours for ducks begin ½-hour before sunrise and continue until sunset. Hunting for pintail is permitted only during the last 30 days of the second half of the duck season. The daily bag limit is 1 duck and the possession limit is 2 ducks (WVDNR n.d.[k]).

### *Diving Ducks, Subfamily Anatinae, Tribe Aythyini*

#### Life History

Taxonomy: Diving ducks are members of the order Anseriformes, the suborder Anseres, the family Anatidae, the subfamily Anatinae, and the tribe, Aythyini. The Aythyini tribe contains 4 genera and 17 species; 12 of the species are in the genera, *Aythya* (Baldassarre and Bolen 1994). Members of the tribe that are hunted in West Virginia include the canvasback (*Aythya valisineria*), greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), redhead (*Aythya americana*), and ring-necked duck (*Aythya collaris*).

Description: Diving ducks are medium-sized (38 – 60 cm) ducks with sexually dimorphic plumage (Baldassarre and Bolen 1994). Greater scaup are moderately large and have a distinct white wing stripe. Males have a white midsection and a green reflective sheen on the head. Females are brown except for a white face patch (Kesser et al. 2002). Lesser scaup often are difficult to distinguish from greater scaup in the field. Lesser scaup have a smaller head and a narrower bill (Austin et al. 1998). Canvasbacks are largest duck in this group and have a characteristic wedge-shaped head and stout neck. Adult males sport a reddish-brown head, black chest, white back and long, black bill (Mowbray 2002). Redheads are a medium-sized diving

duck. During breeding season, males display a rufous-colored head and neck (Woodin and Michot 2002). Ring-necked ducks are small- to medium-sized and are easily distinguished from other diving ducks by the white bill markings and short crest that gives the head an angular profile (Hohman and Eberhardt 1998).

Habitat: Habitat preferences among the diving ducks vary. Greater scaup prefer still waters such as lake and ponds (Kesser et al. 2002), whereas lesser scaup inhabit fresh and brackish wetlands and lakes with emergent vegetation. They also may use habitats associated with river impoundments (Austin et al. 1998). Habitat of canvasbacks includes small lakes, deep marshes, sheltered bays of freshwater and brackish lakes, ponds, and river impoundments (Mowbray et al. 2002). Redheads do not demonstrate clear preference among habitats, but rather inhabit a variety of wetland types (Woodin and Michot 2002). Like many of the other diving ducks, ring-necked ducks inhabit freshwater wetlands during both the breeding and wintering seasons (Hohman and Eberhardt 1998).

Behavior: Although the greater scaup is clumsy and uncoordinated on land, it is a very strong and swift swimmer, diver, and flyer (Kesser et al. 2002). In fact, most of the diving ducks are excellent swimmers and divers, and strong flyers (Hohman and Eberhardt 1998, Mowbray 2002, Woodin and Michot 2002). Canvasback ducks rarely travel far on land (Mowbray 2002). Among the divers, the lesser scaup perhaps is the most coordinated on land (Austin et al. 1998). Like canvasbacks, redheads (Woodin and Michot 2002) and ring-necked ducks (Hohman and Eberhardt 1998) rarely leave the security of water or are observed on dry land.

For greater scaups, fall migration occurs between September and October (Kesser et al. 2002). Fall migration of lesser scaups and canvasbacks occurs later than other diving ducks; departure occurs between October and November (Austin et al. 1998, Mowbray 2002). Spring migration of lesser scaup begins in early March (Kesser et al. 2002), whereas that of the canvasback begins in February (Mowbray 2002). Departure for the breeding ground varies greatly, but most head north from early February to May (Austin et al. 1998). Spring migration of redheads begins in late January and February; fall migration occurs between August and October (Woodin and Michot 2002). Fall migration of ring-necked ducks occurs from late September to early December; spring migration begins February and continues through March (Hohman and Eberhardt 1998).

Reproduction: Greater scaups, like most diving ducks, are seasonally monogamous (Kesser et al. 2002). Diving ducks attain sexual maturity at 1 year (Baldassarre and Bolen 1994). Pair formation begins in later winter while still on the wintering grounds and continues throughout February and April. Males and females participate in displays before copulation occurs. Copulation occurs over water (Kesser et al. 2002). Nests of diving ducks are constructed of vegetative materials gathered from around the immediate nest site (Austin et al. 1998), with the exception of canvasbacks; the canvasback nest is a large bulky construction (Mowbray 2002). Redheads construct the most stable nest of the diving ducks (Woodin and Michot 2002). Clutch size of greater scaup and ring-necked ducks averages 8 to 9 eggs (Hohman and Eberhardt 1998, Kesser et al. 2002), lesser scaups average 8 to 10 eggs (Austin et al. 1998), canvasbacks average 7 eggs (Mowbray 2002), and redheads produce an average clutch of 10 eggs (Woodin and Michot 2002). Female diving ducks assume total responsibility for incubation as the males

depart immediately after the onset of incubation. Incubation lasts, on average, about 21 to 27 days (Austin et al. 1998, Hohman and Eberhardt 1998, Kesser et al. 2002, Mowbray 2002, Woodin and Michot 2002). At hatching, the young are precocial and most leave the nest within 24 hours or as soon as the down has dried (Austin et al. 1998, Hohman and Eberhardt 1998, Kesser et al. 2002, Mowbray 2002). Lesser scaup females brood their young for approximately 2 to 5 weeks after hatching (Austin et al. 1998). The length of brooding varies in canvasbacks (Mowbray 2002). Redheads abandoned their young sooner than any of other diving duck species; females often abandon young as early as 3 weeks post-hatching (Woodin and Michot 2002). Female ring-necked ducks generally remain with their young until they are fully fledged (49 to 56 days), although some individuals depart earlier (Hohman and Eberhardt 1998).

**Food Habits:** Diving ducks consume both animal and plant material. Specific preferred food items of greater scaups and canvasbacks include snails, crustaceans, aquatic insects and larvae, and seeds and other vegetative aquatic plant parts (Kesser et al. 2002, Mowbray 2002). Lesser scaup primarily feed on aquatic invertebrates, crustaceans, and mollusks (Austin et al. 1998). Canvasbacks primarily consume plants and plant materials only during migration; however, they will take other food items such as snails, caddisfly larvae, damselfly and dragonfly nymphs, mayfly nymphs, and midge larvae (Mowbray 2002). Diets of redheads and ring-necked ducks are similar to other diving duck species (Hohman and Eberhardt 1998, Woodin and Michot 2002).

**Mortality:** Causes of mortality in diving ducks include exposure, predation, and human-caused activities. Young scaup are susceptible to inclement during the first week after hatching (Kesser et al. 2002). Collisions or grounding during inclement weather are reported causes of mortality in lesser scaup (Austin et al. 1998). Mortalities resulting from cold, stress, and food shortages associated with inclement weather are reported in canvasbacks (Mowbray 2002). Predators of young and adult diving ducks include northern pike, skunks, foxes, gulls, hawks, owls, crows, snapping turtles, and mink (Kesser et al. 2002). Ravens are common nest predators (Austin et al. 1998, Kesser et al. 2002). The role of predation in greater scaup (Kesser et al. 2002), redhead (Woodin and Michot 2002), and ring-necked duck (Hohman and Eberhardt 1998) mortality is not well documented. Hunting is a major mortality factor in many diving duck species. Parasites (i.e., helminths, trematodes, nematodes) also are reported in diving ducks (Austin et al. 1998, Kesser et al. 2002).

### *Distribution and Abundance*

**Distribution:** The breeding range of greater scaup is restricted primarily to an area including the Aleutian Islands and Alaskan Peninsula, northern Alaska, northern Yukon Territory, and Northwest Territories (Kesser et al. 2002). Wintering range includes marine waters along the Pacific and Atlantic coasts (Kesser et al. 2002). Lesser scaup breed throughout Alaska and Canada, and locally in the western U.S. Winter range includes Louisiana, Florida, both Pacific and Gulf of Mexico Coasts; lesser scaup also winter along the Pacific and Atlantic Coasts of the U.S. (Austin et al. 1998). Breeding distribution of canvasbacks is centered in northwestern North America; wintering range is scattered throughout the U.S. and Mexico, and includes areas such as Mississippi River delta, Chesapeake Bay, Currituck and Pamlico Sounds in NC, lakes in southern Louisiana, and San Francisco and San Pablo Bays, CA (Mowbray 2002). Redheads breed primarily throughout the western U.S. and Canada, but especially in the Prairie Pothole

Region. Winter distribution is concentrated along the Gulf of Mexico (Woodin and Michot 2002). Breeding range of ring-necked ducks includes subarctic deltas, taiga, boreal forests, aspen parklands, and prairie regions of Canada and the U.S. Winter distribution is concentrated along the Gulf Coast of Mexico and southern Atlantic Coast of the U.S. (Hohman and Eberhardt 1998).

Abundance: Breeding population estimates of greater scaup include populations of lesser scaup. Lesser scaup are the most abundant diving duck in North America. Combined populations of scaup averaged >5 million individuals during a period of 40 years. Lesser scaup are believed to comprise almost 90% of the population (Austin et al. 1998). Population densities of canvasbacks vary geographically and within habitats; highest breeding densities occur in the prairies of the southern Prairie Provinces of Canada, whereas the highest wintering densities occur in the Chesapeake Bay, Currituck Sound in North Carolina, lakes in southern Louisiana, and San Francisco and San Pablo Bays, CA (Mowbray 2002). In North America, redhead populations have not experienced any significant decreasing or increasing linear trend over the last 40 years; however, redhead populations have fluctuated (Woodin and Michot 2002). Current continental populations of ring-necked ducks are considered stable or increasing; however, population estimates are not precise (Hohman and Eberhardt 1998).

#### Economic Status

Waterfowl, like many migratory birds, provide many recreational opportunities. In 2001, there were 3.0 million migratory bird (i.e., geese, ducks) hunters in the U.S. (USDI 2002). In addition, participation in duck hunting increased 37% from 1991 to 2001 (USDI 2004) to 1.6 million hunters. Duck Hunters devoted 18 million days to duck hunting in 2001 (USDI 2002). In West Virginia, Zone One, which includes the NERI, has a split season. The first segment of the season in Zone One opens in early October and closes in mid-October. The second segment opens in early December and closes in mid-January. The daily bag limit is 6 ducks. This bag limit for restricted species may include 1 pintail, 1 canvasback, 4 long-tailed ducks, 3 scaup, 1 black duck, 2 wood ducks, 2 redheads, 4 scoters, and 4 mallards, of which only 2 may be hens. The daily bag limit for unrestricted species is 6 per day. The legal possession limit is twice the daily bag limit. Shooting hours for ducks begin ½-hour before sunrise and continue until sunset. Canvasback and pintail hunting is permitted only during the last 30 days of the second half of the duck season. The daily bag limit is 1 duck and the possession limit is 2 ducks (WVDNR n.d.[k]).

#### *Sea Ducks, Subfamily Anatinae, Tribe Mergini*

#### Life History

Taxonomy: Sea ducks are members of the order Anseriformes, the suborder Anseres, the family Anatidae, the subfamily Anatinae, and the tribe Mergini. The Mergini tribe contains 20 species in 10 genera (Baldassarre and Bolen 1994). Members of the tribe that are hunted in West Virginia include the Barrow's goldeneye (*Bucephala islandica*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), common merganser (*Mergus merganser*), hooded

merganser (*Lophodytes cucullatus*), red-breasted merganser (*Mergus serrator*), and long-tailed duck (*Clangula hyemalis*).

Description: Barrow's goldeneye ducks are medium-sized (53 cm), where males weigh, on average, 1278 g and females weigh 818 g. They are a compact duck with a short neck, a round body, a large head, and a short gray-black bill (Eadie et al. 2000). Common goldeneyes and Barrow's goldeneyes often are mistaken for one another, but can be distinguished by the more sloped forehead of common goldeneyes (Eadie et al. 1995). Buffleheads easily are distinguished from other sea ducks by their small size (33-38 cm). Bufflehead males weigh, on average, 450 g; females weigh 325 g (Gauthier 1993). Mergansers are large sea ducks. Common merganser males weigh on average 1700 g; females weigh 1230 g (Mallory and Metz 1999). Red-breasted mergansers weigh between 800 to 1350 g (Titman 1999). Hooded mergansers are the smallest of the merganser species (Dugger et al. 1994). Mergansers are known for their strong, sexual dimorphism. This sexual dimorphism is responsible for the brilliant contrasting plumage in males (i.e., greenish-black head and white neck of male common mergansers; flashy white, fan-shaped crest bordered by black in male hooded mergansers) (Dugger et al. 1994, Mallory and Metz 1999). Red-breasted mergansers resemble common mergansers except they have a crested head, a red breast, gray sides, and red eyes (Titman 1999). Long-tailed ducks are a small- to medium-sized duck. Males weigh on average 800 g; females weigh 700g (Robertson and Savard 2002). The most distinguishing feature of long-tailed males is their 2 slim, elongated tail feathers that stream behind them (Robertson and Savard 2002).

Habitat: Barrow's goldeneyes inhabit lakes in northern parkland areas, subalpine and alpine lakes, and beaver ponds during the breeding season. They winter within coastal marine habitats and occasionally on open, inland rivers (Eadie et al. 2000). Common goldeneyes prefer inland wetlands, lakes, and rivers that are bordered by mature forests where suitable tree cavities exist for breeding. Like Barrow's goldeneyes, common goldeneyes migrate to marine habitats (i.e., coastal bays, estuaries, harbors) for the winter (Eadie et al. 1995). Buffleheads occupy permanent freshwater ponds during the breeding season and move to sheltered marine and estuarine habitats during the winter (Gauthier 1993). Like common goldeneyes, common mergansers prefer lakes and rivers bordered by mature forests that provide suitable tree cavities (Mallory and Metz 1999). They winter in large lakes, reservoirs, rivers, coastal bays, estuaries, and harbors (Mallory and Metz 1999). Hooded mergansers prefer forested wetlands throughout their range during breeding season, but prefer to winter in shallow, freshwater and brackish bays, estuaries, and tidal creeks and ponds (Dugger et al. 1994). During the breeding season, red-breasted mergansers frequent tundra and boreal forests of fresh, brackish, and saltwater wetlands not far from the coast (Titman 1999). They primarily winter in marine habitats (Titman 1999). Long-tailed ducks prefer to breed in sub-arctic and arctic wetlands, and tundralike habitats of higher elevations. Coastal marine waters and freshwater lakes are preferred winter habitats of long-tailed ducks (Robertson and Savard 2002).

Behavior: Goldeneyes only occasionally travel over land, but, when they do, it usually is from their nest to water (Eadie et al. 1995, Eadie et al. 2000). Like goldeneyes, buffleheads, mergansers, and long-tailed ducks rarely travel on land (Gauthier 1993, Dugger et al. 1994, Mallory and Metz 1999, Titman 1999, Robertson and Savard 2002). Sea ducks are excellent swimmers and divers and spend most of their time in the water (Gauthier 1993, Eadie et al. 1995,



Mallory and Metz 1999, Titman 1999, Eadie et al. 2000, Robertson and Savard 2002). Goldeneyes are capable of strong flight and can reach a sustained speed of 72 km/h (Eadie et al. 1995, Eadie et al. 2000).

Fall migration for sea ducks typically occurs from October to December. Spring migration extends from February to May. Timing of migration often varies with geographic location (Gauthier 1993, Dugger et al. 1994, Eadie et al. 1995, Mallory and Metz 1999, Titman 1999, Robertson and Savard 2002).

Reproduction: Sea ducks are monogamous. Pair bonds are established during winter and early spring and will persist until the male abandons the female at the onset of incubation. Courtship behavior in sea ducks is complex. Both males and females participate in courtship displays. After the elaborate displays, copulation occurs on the water. The female initiates construction of the nest, which often coincides with the onset of egg-laying (Eadie et al. 2000). Many sea ducks are cavity nesters. Female Barrow's and common goldeneyes locate and construct a nest bowl in a suitable cavity, then line it with breast down-feathers (Eadie et al. 1995, Eadie et al. 2000). The bufflehead is an obligate cavity nester, but it can not create a new cavity on its own. As such, it must rely on the availability of cavities excavated previously by Northern flickers and pileated woodpeckers (Gauthier 1993). Unlike other sea ducks, red-breasted mergansers nest on the ground (Titman 1999). Long-tailed ducks build a shallow nest of grasses and sedges on the ground in preparation for a clutch of six to eight eggs (Robertson and Savard 2002). Clutch size in goldeneyes ranges from 6 to 12 eggs (Eadie et al. 2000). Clutch size in common mergansers ranges from 6 to 17 eggs (Mallory and Metz 1999). Females are responsible for incubating the eggs, a process that lasts approximately 30 days in goldeneyes and buffleheads (Gauthier 1993, Eadie et al. 1995, Eadie et al. 2000). Mergansers have a slightly longer incubation periods that averages 32 days (Dugger et al. 1994, Mallory and Metz 1999, Titman 1999). Long-tailed ducks incubate their nests for approximately 26 days (Robertson and Savard 2002). Sea ducks are precocial when born and ducklings may leave the nest within 24 or 36 hours after hatching (Gauthier 1993, Dugger et al. 1994, Eadie et al. 1995, Titman 1999, Eadie et al. 2000, Robertson and Savard 2002). Female goldeneyes, buffleheads, and mergansers abandon their young before they are able to fly (5 to 6 weeks) (Gauthier 1993, Dugger et al. 1994, Eadie et al. 1995, Mallory and Metz 1999, Titman 1999, Eadie et al. 2000).).

Food Habits: The diet of goldeneyes largely includes aquatic invertebrates (i.e., insects, mollusks, crustaceans) and fish eggs. Vegetative material, such seeds and tubers, occasionally are consumed (Eadie et al. 1995, Eadie et al. 2000). The bufflehead diet does not differ from that of goldeneyes (Gauthier 1993). The primary food item of common mergansers is fish; however, they also consume aquatic invertebrates, frogs, small mammals, birds, and plants (Mallory and Metz 1999). Hooded mergansers prefer aquatic insects, fish, and crustaceans (Dugger et al. 1994). Red-breasted mergansers also consume fish as well as worms, insects, and amphibians (Titman 1999). The diet of long-tailed ducks varies across its range, but primarily consists of animal material (Robertson and Savard 2002).

Mortality: Little is known about the causes of mortality in Barrow's goldeneyes, common goldeneyes, buffleheads, mergansers, and long-tailed ducks. Potential causes likely include exposure, predation, hunting, and diseases. Predation affects incubating females and young

(Eadie et al. 1995, Eadie et al. 2000). Inclement weather after hatching likely increases mortality of young buffleheads (Gauthier 1993) and mergansers (Mallory and Metz 1999, Titman 1999). Freezing and inclement weather prevent long-tailed ducks from feeding, ultimately resulting in their starvation (Robertson and Savard 2002).

### Distribution and Abundance

Distribution: Sea ducks are limited to sub-arctic and northern latitudes (Baldassarre and Bolen 1994). The breeding distribution of Barrow's goldeneyes extends west of the Rocky Mountains from central Alaska to northern California, through Canada, and occasionally in eastern North America. During the winter months, Barrow's goldeneyes are found along the Pacific Coast from Alaska to California (Eadie et al. 2000). Common goldeneyes are found within the boreal tree line across North America during the breeding season. Winter distribution extends along the Pacific and Atlantic Coasts (Eadie et al. 1995). The breeding distribution of buffleheads is concentrated in boreal forest and aspen parklands of Canada and Alaska. Wintering distribution includes areas along the Pacific and Atlantic coasts (Gauthier 1993). Common mergansers are found within the boreal forest tree line across North America (Mallory and Metz 1999). They are one of the northernmost wintering sea ducks in North America; how far north they remain depends on open water availability (Mallory and Metz 1999). Hooded mergansers are restricted to the continent; breeding distribution includes the U.S. and the Pacific Northwest. They winter in areas of southeastern and northwestern U.S. (Dugger et al. 1994). Both the breeding and the wintering distributions of red-breasted mergansers are similar to that of common mergansers, except red-breasted mergansers frequent salt water habitats more often (Titman 1999). Long-tailed ducks are found in sub-arctic and arctic areas of Alaska and Canada during the breeding seasons and along the coasts of North America and the Great Lakes during the winter months (Robertson and Savard 2002).

Abundance: Many of the available population estimates for Barrow's goldeneye ducks are dated. Breeding population surveys indicated a decreasing trend for Barrow's goldeneye populations. More than 90% of the entire population is found along the Pacific Coast (Eadie et al. 2000). Population estimates of common goldeneyes vary regionally, but most indicators suggest that populations of common goldeneyes are stable (Eadie et al. 1995). In 1992, the continental population of buffleheads was estimated at >1 million individuals (Gauthier 1993). Reliable population estimates for mergansers do not exist, but data suggests the population of 3 species combined approaches 1.5 million (Mallory and Metz 1999). Population estimates have been difficult to obtain for long-tailed duck populations, but obtained information indicates the population is stable (Robertson and Savard 2002).

### Economic Status

Waterfowl, like many migratory birds, provide ample recreational opportunities. In 2001, there were 3.0 million migratory bird (i.e., geese, ducks) hunters in the U.S. (USDI 2002). In addition, participation in duck hunting increased 37% from 1991 to 2001 (USDI 2004) to 1.6 million hunters. Duck Hunters devoted 18 million days to duck hunting in 2001 (USDI 2002). Duck species within this tribe that are hunted in West Virginia include: Barrow's goldeneye (*Bucephala islandica*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), and long-tailed duck (*Clangula hyemalis*), Management Zone One, which includes the

NERI, has a split season. The first segment of the season in Zone One opens in early October and closes in mid-October. The second segment opens in early December and closes in mid-January. The daily bag limit is 6 ducks. This bag limit for restricted species may include 4 long-tailed ducks. The daily bag limit for unrestricted species is 6 per day. The legal possession limit is twice the daily bag limit. Shooting hours for ducks begin ½-hour before sunrise and continue until sunset (WVDNR n.d.[k]).

Mergansers hunted in West Virginia include: common merganser (*Mergus merganser*), hooded merganser (*Lophodytes cucullatus*), and red-breasted merganser (*Mergus serrator*). Hunting of mergansers is regulated by a split season in both zones as well. The first segment of the season opens and closes in October. The second segment of the season opens in early December and closes in mid-January. The daily bag limit for mergansers is 5 birds and the possession limit is 10 birds. The bag limit can include only 1 hooded merganser and the possession limit can include only 2 hooded mergansers. Shooting hours for mergansers begin ½-hour before sunrise and continue to sunset (WVDNR n.d.[k]).

#### *Stiff-tailed Ducks, Subfamily Anatinae, Tribe Oxyurini*

##### Life History

**Taxonomy:** Ducks in this group are members of the order Anseriformes, the suborder Anseres, the family Anatidae, the subfamily Anatinae, and the tribe Oxyurini (Baldassarre and Bolen 1994). The only member of the Oxyurini tribe hunted in West Virginia is the ruddy duck, *Oxyura jamaicensis*. Based on differences in breeding ranges and migratory behavior, 2 subspecies of *O. jamaicensis* are recognized (Brua 2001).

**Description:** Ruddy ducks are small (38 – 40 cm), stocky ducks. They have a thick neck and a fan-shaped tail that often is held erect (Brua 2001). Males are seasonally dichromatic, which means they go through a dramatic change in outward appearance between the breeding and non-breeding seasons (Baldassarre and Bolen 1994, Brua 2001). During the breeding period, males have a bright blue bill, white cheeks, black cap and nape, reddish-brown upper body, silvery-white stomach, and blackish-brown wings with white undersides. The non-breeding plumage of males predominantly is composed of shades of dull brown and gray. Females are somewhat dichromatic, but clearly not as dramatic as males. The breeding and non-breeding plumages of females are similar to those of males, but muted overall. They have a distinct cheek stripe and the body is speckled with light and dark bars (Brua 2001). Males are slightly larger than females.

**Habitat:** Breeding habitat includes marsh systems, ponds, reservoirs, and natural basins. Winter habitat is similar to breeding habitat, but brackish coastal bays, marshes, and tidal estuaries are used more heavily at this time of year (Brua 2001).

**Behavior:** Ruddy ducks are truly aquatic and are considered among the least mobile of the North American waterfowl. Walking on land is difficult for ruddy ducks. However, ruddy ducks are capable swimmers and divers; the feet are positioned far back on the body, which enhances their diving abilities considerably. Ruddy ducks are classified as being a medium distant migrant.

Northward or spring migration begins in early February and continues into May. Ruddy ducks begin the fall migration earlier than most other duck species; they begin leaving the breeding areas in late August and movement south may continue well into December (Brua 2001).

Reproduction: Ruddy ducks are monogamous and establish breeding pairs after their arrival at the breeding grounds. Females begin building a nest 3 to 5 weeks after arrival. Nests are constructed out of dry, dead plant material, although some green material may be added later. Their eggs are the largest of any ducks. Clutch size averages 7 eggs. The female incubates the nest for approximately 24 days. Young are precocial and ready to leave the nest within 24 hours (Brua 2001). The male abandons the female during early incubation, so the female assumes full responsibility of parental care. The female typically abandons her young just before they are capable of full flight (Brua 2001).

Food Habits: The diet of ruddy ducks includes aquatic insects, crustaceans, zooplankton, and other invertebrates. Small amounts of vegetative material also may be consumed (Brua 2001).

Mortality: Little is known about the causes of mortality in ruddy ducks, but exposure and predation are likely factors. Young are particularly susceptible to exposure because females do not brood. Avian predators of adults include hawks and owls; mammalian predators include mink, raccoons, and red foxes. Young may be preyed on by night-herons, gulls, mink, and raccoons. Egg predators include magpies, crows, mink, long-tailed weasels, and raccoons (Brua 2001). Avian tuberculosis, enteritis, pneumonia, aspergillosis, avian botulism, and avian cholera are found in ruddy ducks. Parasites of ruddy ducks include trematodes and cestodes (Brua 2001).

### Distribution and Abundance

Distribution: The breeding range of ruddy ducks includes large areas of Alaska and Canada. In the contiguous 48 states, the breeding range extends south to southern California, southern Arizona, New Mexico, eastern Colorado, Nebraska, South Dakota, Iowa, and western Minnesota. Ruddy ducks breed irregularly in scattered locations in Indiana, Illinois, Ohio, Pennsylvania, Maryland, Delaware, Arkansas, Louisiana, North Carolina, South Carolina, and Florida (Brua 2001). In portions of the western U.S., ruddy ducks are resident year-round. The wintering range includes the southern Atlantic and Pacific coasts, the Gulf coast, and inland wetlands and waterways of the lower Mississippi watershed in the U.S., southern Mexico, Guatemala, El Salvador, West Indies, and Bermuda (Brua 2001).

Abundance: Estimates of ruddy duck populations in the U.S. indicate that the population is stable or increasing (Brua 2001).

### Economic Status

Ruddy ducks, like many migratory birds, provide recreational opportunities. In West Virginia, hunting for of ruddy ducks is regulated via a split season in management Zone One (WVDNR n.d.[k]).

Shorebirds:

*American Coot, Fulica americana*

### Life History

**Taxonomy:** American coots are members of the order Gruiformes, and family Rallidae. Two subspecies of *Fulica americana* are recognized (Brisbin et al. 2002).

**Description:** American coots are easy to identify. They are a chicken-like bird with a white bill and a white frontal shield (Rue 1973, Brisbin et al. 2002). The bill has a small, dark ring near the tip. The head, neck, and breast are black. The rest of the body and the wings are dark gray or slate blue. The outer tail coverts and the edges of the secondaries are white. It has long greenish-yellow legs and lobed toes (Rue 1973). Males and females have similar plumage; males are slightly larger than females. Coots weigh between 427 and 848 g (Brisbin et al. 2002). Juveniles have ash brown upperparts and pale underparts (Brisbin et al. 2002).

**Habitat:** Breeding habitat of the American coot includes freshwater wetlands with stands of emergent aquatic vegetation along a portion of the shoreline and standing water within stands of vegetation (Brisbin et al. 2002). Wintering habitat includes freshwater wetlands, coastal bays, lagoons, and other brackish habitats. Other inland bodies of water such as impoundments that remain ice-free also may be used as wintering habitat (Brisbin et al. 2002).

**Behavior:** American coots are very sociable birds (Rue 1973). They are capable of walking and running on land or across water. Their movement across water is known as splattering or spattering; it is characterized by beating the surface of the water noisily with their wings and feet (Brisbin et al. 2002). Spattering is required to become airborne. American coots are strong and direct flyers, but they rarely fly >5 m above the surface of the water. Except for migration, flights are short (Brisbin et al. 2002). Fall migration begins in August and continues to November. The peak of the fall migration occurs from mid-September to mid-October. American coots begin to depart for breeding grounds in February and March (Rue 1973, Brisbin et al. 2002).

**Reproduction:** American coots often have paired by the time they arrive at the breeding grounds. The nest site is selected by the male, who will patrol that area repeatedly and drive off grebes and other ducks. During a courtship display, the male extends his head and neck out over the water and swims slowly toward the female. As the male gets close, he turns around and elevates his wings and tail to present his white rump and then slowly swims away (Rue 1973). When the female accepts the male, she follows after him and both begin to preen one another. The female assumes a prone position and copulation occurs. The nests are well-hidden floating constructions built from available native materials and fastened to plants. Common nest materials include rushes, weeds, and other aquatic plants. Nests are lined with fine dry plant materials (Rue 1973). Clutch size ranges from 6 to 10 eggs (Rue 1973) or 8 to 12 eggs (Brisbin et al. 2002); average clutch size is 8 eggs. The eggs are buff-colored with dark brown spots. Incubation responsibilities are assumed by both the male and the female. Incubation lasts 21 or 22 days. While the female incubates, the male guards the nest and attempts to drive off anything that approaches the nest. Young hatch at different times because the female begins incubating

the nest before the entire clutch is laid. The female continues to incubate the nest while the male tends the newly hatched young (Rue 1973). Young are black, except for their head, throat, and bill, which are light orange to bright red. The young grow fast, except for their wings. As a result, young rely on their swimming ability to escape from danger. After 60 days, young are able to fly (Rue 1973).

**Food Habits:** American coots consume vegetative material such as aquatic plants, algae, grasses, grains, and terrestrial plants. Occasionally, animal material is consumed, and may include aquatic invertebrates (e.g., aquatic beetles, crustaceans, mollusks) and vertebrates (e.g., fish, tadpoles) (Rue 1973, Brisbin et al. 2002).

**Mortality:** Factors influencing mortality of American coots include exposure and predation. Exposure to severe weather may cause late winter or early spring mortality; susceptibility to mortality resulting from exposure appears to be related to body size (Brisbin et al. 2002). Predation also influences mortality. Common predators of eggs include American crows, black-billed magpies, pied-billed grebes, and Forster's Terns (Brisbin et al. 2002). Avian predators of adults and juveniles include Northern harriers, great horned owls, bald eagles, golden eagles, great black-backed gulls, and California gulls (Rue 1973, Brisbin et al. 2002). Mammalian predators include coyotes, foxes, skunks, and raccoons (Rue 1973, Brisbin et al. 2002). American coots host a variety of internal and external parasites; however, none have been reported to adversely affect individual hosts (Brisbin et al. 2002). The life span of American coots averages 7 to 8 years (Rue 1973), but the oldest bird from banding reports was at least 22 years old (Brisbin et al. 2002).

### Distribution and Abundance

**Distribution:** American coots are plentiful throughout the U.S. The breeding range extends from British Columbia east to Quebec, south to Texas, and west to California. Very few American coots nest east of the Mississippi River. The wintering range often depends on weather; coots may stay as far north as weather permits. Some migrate to the southern U.S., Mexico, and Central America (Rue 1973, Brisbin et al. 2002). The West Virginia Breeding Bird Atlas reported a possible record of an American coot in Hardy County (Buckelew and Hall 1994).

**Abundance:** Densities of American coots vary geographically, among habitat types, and with seasonal precipitation. In 1999, the USFWS and Breeding Bird Survey (BBS) estimated the breeding population of American coots to be around 3 million. American coots were one of the most abundant waterfowl species in North America; declines are likely the result of loss of wetlands and overhunting between 1870 and 1930 and after World War II (Brisbin et al. 2002).

### Economic Status

American coots, like many migratory birds, provide many recreational opportunities. In 1999, hunters harvested >700,000 coots (Brisbin et al. 2002). In West Virginia, hunting for coots (*Fulica americana*) is regulated via a split season in both management zones. A complete description of these hunting zones is presented in the 2004-05 West Virginia Migratory Bird Hunting Regulations (WVDNR n.d.[k]). Zone One contains the New River Gorge National River (WVDNR n.d.[k]).

*Sora, Porzana carolina*

Life History

Taxonomy: Soras are members of the order Gruiformes, and family Rallidae. Soras are the only member of the genus *Porzana* in North America (Melvin and Gibbs 1996).

Description: Soras are short-necked, grayish-brown birds with a short, dark-tipped, yellow beak, and red eyes (Rue 1973, Melvin and Gibbs 1996). The crown of the head, front of the face, and the throat are black. The rest of its face and neck and its breast are ash gray. The flanks and stomach of soras are dark gray with vertical white barrings. The back and wings are greenish-gray with discontinuous white horizontal barrings. The top of its tail is black; the underside is white (Rue 1973). The legs and toes are greenish-yellow (Rue 1973, Melvin and Gibbs 1996). Males and females resemble one another, except that the face and throat markings are more subdued in the female. Females also are slightly smaller than males and have darker bills (Melvin and Gibbs 1996). Immature soras are similar to adults, but have duller plumage (Rue 1973). Immatures do not have black on the face and throat; they have a white chin and buff-colored throat (Melvin and Gibbs 1996). Soras weigh between 71.9 and 88.0 g (Melvin and Gibbs 1996).

Habitat: Breeding habitat of soras includes freshwater wetlands with emergent vegetation, such as cattails, sedges, burreeds, and bulrushes. Soras also use crop fields adjacent to inland wetlands and the brackish or salt marshes located along the Atlantic Coast (Melvin and Gibbs 1996). Winter habitat includes freshwater, brackish, and salt marshes. Quality winter habitat is characterized by its ability to provide good interspersions of shallow water and emergent vegetation. Soras have been observed wintering in vegetated canals, rice fields, impoundments, mangroves, wet pastures, overgrown and cultivated fields, and small ponds and rivers (Melvin and Gibbs 1996).

Behavior: Soras are the smallest and most elusive of the rails and primarily are nocturnal (Rue 1973, Melvin and Gibbs 1996). When feeding, they walk fast, twisting about to pick up food (Rue 1973). They prefer to move by walking and running through and over vegetation (Melvin and Gibbs 1996). Soras are capable flyers, but rely on running for escape. When flushed, they display a labored flight that carries them just over the tops of the reeds and rushes. Soras are migratory birds and peak movement occurs at night. When migrating, soras fly close to the ground swiftly in straight paths in small groups. Spring migration to the breeding grounds occurs between March and May (Rue 1973, Melvin and Gibbs 1996). Fall migration begins in September and continues to the end of November (Rue 1973, Melvin and Gibbs 1996).

Reproduction: Males and females begin pairing as soon as they reach the breeding ground in late April and early May (Rue 1973, Melvin and Gibbs 1996). Nests typically are found in dense vegetation such as cattails and in areas surrounded by water and mud (Rue 1973). Average clutch size ranges from 10 to 12 eggs, but as many as 18 eggs have been reported (Rue 1973, Melvin and Gibbs 1996). Eggs are cream to olive with reddish-brown spots. Eggs are placed in 2 layers in the nest to facilitate incubation. Eggs begin hatching in approximately 14 days, but, because this species does not display synchronous hatching, additional time is needed for the entire clutch to fully hatch. Normally, the female begins incubating after laying the first couple

of eggs (Rue 1973). Incubation is a shared responsibility (Melvin and Gibbs 1996), yet the female assumes a much greater share of that responsibility because the male tends to the newly hatched young (Rue 1973). At hatching, the young are covered with black down. They are precocious and immediately leave the nest and plunge into the water. The young remain black until their first molt in August (Rue 1973).

**Food Habits:** Primary food items consumed include seeds of aquatic vegetation and aquatic invertebrates (Rue 1973, Melvin and Gibbs 1996). Preferred vegetation includes the seeds of sedge, wild rice, bulrush, paspalum, smartweed, spike rush, wild millet, duckweed, algae, panic grass, and pondweed (Rue 1973).

**Mortality:** Causes of mortality in soras include predation, exposure, hunting, and collisions with towers. Predation is the primary cause of egg loss; predators include marsh wrens, grackles, crows, striped skunks, coyotes, and raccoons. Predators of adults and juveniles include coyotes, bobcats, feral cats, Northern harriers, Cooper's hawks, red-shouldered hawks, peregrine falcons, barn owls, great-horned owls, and short-eared owls (Rue 1973, Melvin and Gibbs 1996). Exposure can be devastating to young soras (Melvin and Gibbs 1996). The effects of hunting on sora populations are unknown; an overall lack of interest among hunters and the difficulty associated with hunting sora suggest that the annual harvest is well below that needed to jeopardize sustainable populations (Melvin and Gibbs 1996). Collisions with tall, lighted towers and overhead wires have been cited as causes of mortality (Melvin and Gibbs 1996). Nematodes and cestodes have been found in soras, but parasites appeared to have limited consequences on observed individuals (Melvin and Gibbs 1996). No information exists on the life span of soras (Melvin and Gibbs 1996), but they are believed to live for 3 to 5 years in the wild (Rue 1973).

### *Distribution and Abundance*

**Distribution:** Soras are found throughout the 48 contiguous states and much of Canada. The breeding range extends from the Atlantic Ocean to the Pacific Ocean (Rue 1973). The southern limit of the breeding range includes southern Pennsylvania, south central Ohio, central Illinois and Nebraska, eastern Colorado, eastern and southern New Mexico, central and northwestern Arizona, southern Nevada, central Kansas, northeastern West Virginia, and northwestern Virginia. The winter range extends south to Georgia, throughout Florida, west along the Gulf Coast to Texas, New Mexico, Arizona, Nevada, Utah, and throughout Mexico, Central America, the Caribbean, and South America. Soras also winter off the coast of southern Oregon and California (Melvin and Gibbs 1996).

**Abundance:** Soras are considered to be the most abundant of the rails, but population size has not yet been estimated accurately (Melvin and Gibbs 1996). The West Virginia Breeding Bird Atlas identified soras as breeding in the eastern panhandle of West Virginia (Buckelew and Hall 1994).

### *Economic Status*

Soras, like many migratory birds, provide recreational opportunities for humans. The tradition of hunting soras is recognized in the coastal marshes of Connecticut, New Jersey, Maryland, and Virginia. However, in recent years, hunter participation has declined (Melvin and Gibbs 1996).



In West Virginia, a statewide open season on soras currently exists. The season opens in early September and closes in early November (WVDNR n.d.[k]).

### *Virginia Rail, Rallus limicola*

#### Life History

**Taxonomy:** Virginia rails are members of the order Gruiformes, and family Rallidae. One subspecies of *Rallus limicola* is recognized in North America (Conway 1995).

**Description:** Virginia rails are brown with a reddish-brown, slight recurved bill (Rue 1973, Conway 1995). Virginia rails have a black head, a gray face, and deep red eyes. In front of the eyes, Virginia rails have white line. The throat patch also is white. The neck and breast are dark brown and the lower breast and stomach are a lighter shade of brown. The back, the top of the tail, and the upper wing coverts are red-brown with heavy, black horizontal streaks. The flanks, the lower part of the stomach, and the underside of tail are white with heavy, black vertical streaks. The wing primaries, legs, and toes are dark reddish-brown (Rue 1973, Conway 1995). Females are almost identical to males, except they are smaller, have a paler plumage, and have a larger white throat patch (Rue 1973). Adults weigh between 55 and 124 g (Conway 1995). Immature Virginia rails are dark-colored with a dark green bill, black bead, and dark gray face. The throat and upper breast are white. The rest of an immature Virginia rail's body is gray-black with black horizontal streaks (Rue 1973).

**Habitat:** Virginia rails prefer freshwater wetlands for breeding, but occasionally will use salt marshes. Virginia rails use areas of the marsh that are higher and drier than those sought by sora rails. Within a marsh, Virginia rails will occur where stands of emergent vegetation are present. Important features of Virginia rail habitat include shallow water, emergent cover, and substrate with high invertebrate abundance (Conway 1995).

**Behavior:** Virginia rails normally are nocturnal birds, but peak activity often occurs at dusk and dawn (Rue 1973). Virginia rails walk and run on the ground; their long toes allow them to walk on floating marsh vegetation without sinking (Conway 1995). Although rails are capable flyers, they prefer to run from danger and rely on their speed and stealth to elude danger. Other than during migration, Virginia rails rarely fly (Conway 1995). When forced to fly, they fly the shortest distance possible (Rue 1973). Virginia rails are migratory and start their migration north to breeding ground in April (Rue 1973). Fall migration departure dates vary with latitude and elevation, but fall migration typically occurs between late September and mid-October (Conway 1995).

**Reproduction:** Male Virginia rails arrive on the breeding grounds before the females (Rue 1973, Conway 1995). By the time females arrive, the males already will have established territories. Females then select the mate and his territory that most appeals to her. To impress the female, the male woos her with intricate displays. The male raises his wings over his body, wildly flicks the tail, and runs around the female in a tight circle. Each time the male passes in front of the female, he stops, stretches upward, and bows to her. The male continues to circle the female until the female bows back to the male. After accepting the male, the female allow the male to

mount her and copulation occurs. Nests usually are built in dryer portions of the marsh. Some nests are located in open areas whereas others may be hidden amongst the dense vegetation. Nests are constructed of dried pieces of vegetation; cattails are a preferred nesting material. Females lay an average of 8 to 11 eggs. Eggs are off-white to pinkish-buff with spots on the larger end. The male helps the female incubate until the first egg hatches in about 15 to 18 days, usually near the end of May or the beginning of June. The eggs hatch successively and follow the order in which they were laid (Rue 1973). Upon hatching, the young have black down, a yellow bill, and a wide black band around their middle. As soon as the down dries, the young leave the nest and follow the male, who assumes responsibility of the young while the female continues to incubate the remaining eggs (Rue 1973, Conway 1995). Both parents are attentive when caring for the young. Males and females act as decoys when danger approaches (Rue 1973). Pairs may have 2 broods in some areas (Conway 1995).

**Food Habits:** The diet during the breeding season includes small aquatic invertebrates, beetles, snails, spiders, true bugs, diptera larvae (Rue 1973, Conway 1995). Invertebrates, aquatic plants, and seeds of emergent plants are consumed during the winter (Conway 1995).

**Mortality:** Exact causes of mortality in Virginia rails are unknown. Predation on young and adults likely occurs from predators such as snakes, turtles, alligators, crows, gulls, ravens, hawks, eagles, rats, opossums, skunks, weasels, mink, otter, foxes, coyotes, and bobcats (Rue 1973, Conway 1995).

### *Distribution and Abundance*

**Distribution:** Virginia rails are found throughout all 48 contiguous states and the lower provinces of Canada (Rue 1973). The breeding range of Virginia rails extends from the Atlantic Ocean to the Pacific Ocean from Virginia southwest across to southern California, north to British Columbia and Alberta, around the Great Lakes, and encompassing Maine and Canadian Maritime Provinces. Their winter range includes the brackish or saltwater marshes of British Columbia south to Mexico in the west, and from New Jersey south along the Atlantic and Gulf Coasts south to Mexico in the east (Rue 1973, Conway 1995).

**Abundance:** The abundance of breeding Virginia rails depends on habitat quality. Density varies from 0.1 pairs/ha to 8.9 pairs/ha (Conway 1995). Although West Virginia is at the southern periphery of the primary Virginia rail breeding range, these birds should be expected anywhere in West Virginia where suitable habitat exists (Buckelew and Hall 1994).

### *Economic Status*

Virginia rails, like many migratory birds, provide recreational opportunities. In West Virginia, a statewide open season exists. The season opens in early September and closes in early November (WVDNR n.d.[k]).

*Wilson's Snipe, Gallinago delicata*

Life History

**Taxonomy:** The Wilson's snipe is a member of the order Charadriiformes, and the family Scolopacidae (Mueller 1999). Wilson's snipe, *Gallinago delicata*, originally was considered a subspecies of the common snipe, *Gallinago gallinago*, but it now is recognized as a separate species (Mueller 2005).

**Description:** Wilson's snipe is a medium-sized (28 to 30 cm) sandpiper with a long (8 cm) straight bill (Mueller 2005). Its upper body is light brown, buff, and black with white streaks and stripes. The stripes start at the base of the bill and extend over the crown and face to the tail (Rue 1973). The throat, stomach, and flanks are white. The breast has many rows of dark spots and the flanks have dark bars. Its upper tail is rusty red with black stripes and white edges (Rue 1973). Its bill is dark brown at the tip and reddish-brown at the base (Mueller 2005). Its legs and feet are greenish yellow or bluish black (Rue 1973, Mueller 2005).

**Habitat:** Breeding habitats of the Wilson's snipe include sedge bogs, swamps, and marshy edges of ponds, rivers, and brooks. Quality breeding habitat is characterized by the presence of soft soils rich in food organisms and well distributed clumps of low vegetation that provides protection while the bird is on the ground. Wintering habitat is very similar to breeding habitat, and may include marshes, swamps, wet meadows, wet pastures, wet fields, and marshy edges of streams and ditches (Mueller 2005).

**Behavior:** Snipe have long, strong, sharply tapered wings that are characteristic of long-distance fliers (Rue 1973). Under normal circumstances, they fly in a straight and direct manner and are capable of reaching speeds of 95 to 105 km/h. However, when flushed, they will fly in a zigzag manner (Rue 1973, Mueller 2005). Wilson's snipes are migratory birds, and move primarily at night except when over the ocean. Spring migration north begins in late February and ends in early June. Migrants may begin to arrive on the breeding grounds as early as March. Fall migration begins in August and continues into November (Mueller 2005).

**Reproduction:** Males arrive at the breeding grounds almost 2 weeks before females in early March (Mueller 2005). Males begin to attract females by making a series of swoops and climbs while flying in a large circle. During this flight, the male flaps its wings as it flies, then partially closes its wings and dives. While diving, air rushes through the fanned out tail feathers and produces a whirring sound. The male climbs again, vocalizes, and then dives toward the ground. If the female approves, copulation occurs (Rue 1973). Nests usually are constructed in a well-hidden tangle of vegetation (Rue 1973). The female produces a shallow scrape and lines the area with grass (Mueller 2005). Like most shore birds, the average clutch consists of 4 eggs; their pyriform shape prevents them from rolling out of the nest (Rue 1973). The eggs are olive-buff with dark brown spots. Both the male and female share incubation duties, which last approximately 18 to 20 days (Rue 1973, Mueller 2005). After hatching, the young leave the nest as soon as their down dries (Mueller 2005). Females are very attentive to the young, and will act as a decoy should danger approach. Primary wing feathers of the young develop rapidly and, within 8 days, they are capable of making short flights. Within 2 weeks, they are capable of full, sustained flight.

**Food Habits:** The diet of Wilson's snipes includes larval insects, crustaceans, earthworms, and mollusks. Plant foods such as seeds of smartweed, bulrush, panic grass, burreed, bristlegrass, ragweed, and pondweed also are consumed (Rue 1973, Mueller 2005).

**Mortality:** Mortality in Wilson's snipes arises primarily from parasites, predation, exposure, and relationships with humans. Diseases and parasites found in Wilson's snipes include nematodes, cestodes, and trematodes (Mueller 2005). Predators of their eggs include raccoons, crows, and ravens. Adults are preyed on by great horned owls, peregrine falcons, merlins, northern goshawks, Cooper's hawks, and northern harriers (Rue 1973, Mueller 2005). Exposure to cold temperature reduces the breeding population in many areas (Mueller 2005). Hunting as a source of mortality has negligible effects on populations (Mueller 2005).

### *Distribution and Abundance*

**Distribution:** The breeding range of the Wilson's snipe extends throughout Alaska, south into western North America. In eastern North America, the breeding range includes northern Iowa, south-central Wisconsin, southern Michigan, southern Ontario, northern Pennsylvania, east-central New York, southern New Hampshire, and southern Maine. Additional local breeding range includes western Massachusetts, southeastern New York, southwestern Pennsylvania, northeastern West Virginia, and northeastern Ohio (Mueller 2005). Wintering range extends along the coast of southeastern Alaska, British Columbia, into northern Idaho, western Montana, Wyoming, central Nebraska, southeastern Minnesota, southern Wisconsin, northern Indiana, northern Ohio, southern Pennsylvania, northern New Jersey, and along the Atlantic Coast north to Massachusetts. Wintering range also includes local areas of southern Ontario and along the Atlantic Coast from Nova Scotia to southeastern Newfoundland. Southern areas of winter range include areas throughout North and Central America to northern South America (Mueller 2005).

**Abundance:** Population estimates for Wilson's snipe do not exist; however, harvest data suggest populations of Wilson's snipes to be between 47 million and 82 million. Population estimates based on harvest data may be high due to low hunter interest. Wilson's snipes are not surveyed adequately by the annual Breeding Bird Survey (BBS), so it is difficult to assess population trends (Mueller 2005). In West Virginia, populations of Wilson's snipe have been found in the Canaan Valley in wetlands along the Black River, in Altona Marsh in Jefferson County, and at Mount Storm Lake in Grant County (Buckelew and Hall 1994).

### *Economic Status*

At one time, Wilson's snipe provided many recreational opportunities for hunters. Due to a decline in hunting participation, programs are being developed to increase participation in snipe hunting (Mueller 2005). Currently, a snipe season does exist statewide in West Virginia (WVDNR n.d.[k]).

## Upland Game Birds:

### *American Woodcock, Scolopax minor*

#### Life History

**Taxonomy:** The American woodcock is a member of the order Charadriiformes, and family Scolopacidae (Keppie and Whiting 1994).

**Description:** The American woodcock is an odd-looking bird with large, protruding eyes set far back on the head. It is a plump bird with a long (6.4 to 7.6 cm) bill (Rue 1973, Kletzly 1976, Keppie and Whiting 1994). It has broad, strongly cupped wings. The plumage consists of various shades of brown; the back is splotched noticeably with brown, black, and white (Rue 1973). Females are larger than males. Females weigh between 151 and 279 g, whereas males weigh between 116 and 219 g (Keppie and Whiting 1994).

**Habitat:** American woodcock habitat varies with activity, time of day, and season. Ideal habitat is a mixture of young mesic forest and abandoned farmland. Openings and clearings are necessary as singing and display grounds for males during courtship. Wintering habitat includes a variety of forest types (e.g., bottomland hardwoods, upland mixed pine-hardwoods, longleaf pine forests) (Keppie and Whiting 1994).

**Behavior:** Woodcock are nocturnal birds that show peak activity at twilight and at dawn (Rue 1973). In flight, an adult woodcock is much slower than a ruffed grouse. Unless open corridors are present, woodcock often rise vertically to clear the tree tops before flying forward horizontally (Rue 1973, Keppie and Whiting 1994). American woodcock are migratory birds; migration occurs in a solitary fashion at night (Rue 1973). Fall migration begins in September and continues into November; peak migration occurs in October (Kletzly 1976, Keppie and Whiting 1994). Spring departure back to the breeding grounds depends on the weather; during warm years, spring migration may begin as early as January, but normally occurs in late February (Kletzly 1976, Keppie and Whiting 1994).

**Reproduction:** During the first and second week of April, woodcock arrive on the breeding area. Each evening males perform courtship displays for the females. In a clearing or opening, males spring into the air, begin a spiraling ascent, make a musical calling, and flutter down to the ground, where they will continue to vocalize. This display will be repeated every 5 minutes, until a female sneaks into the clearing and copulation occurs. After copulation, the female retires to her nest and the male continues his display (Rue 1973). The nest typically is a shallow depression in leaves (Rue 1973, Keppie and Whiting 1994). The average clutch is 4 buff-brown eggs with reddish-brown blotches. Both the male and female share incubation duties. Incubation lasts an average of 21 days (Rue 1973, Keppie and Whiting 1994). At hatching, the young are precocious and leave the nest as soon as the down dries. Because their wing primaries are slow to develop, it may take a week or more before the young chicks are able to flutter off the ground (Rue 1973).

**Food Habits:** The primary food item consumed is invertebrates, particularly earthworms. Grubs, insect larvae, and plant foods also may be consumed (Rue 1973, Keppie and Whiting 1994).

**Mortality:** The exact causes or forms of mortality in American woodcock populations are unknown (Keppie and Whiting 1994), but factors certainly include predation and hunting. Predators include skunks, weasels, raccoons, opossums, foxes, bobcats, lynxes, feral cats, dogs, snakes, hawks, and owls (Rue 1973). Hunting has been thought to influence American woodcock populations, but supporting evidence for such does not exist. Over 49 types of parasites have been observed in woodcock populations, including various protozoans, trematodes, and cestodes, yet no confirmed adverse effects associated with parasites have been reported (Keppie and Whiting 1994). The life span of an American woodcock averages 5 years (Rue 1973), although a maximum life span of 8 years has been reported (Keppie and Whiting 1994).

### Distribution and Abundance

**Distribution:** American woodcock are found primarily in the eastern U.S., where the western boundary of the species' range includes the states that border the west bank of the Mississippi River. The breeding range extends from southern Manitoba to New Brunswick, Canada, south to New Jersey, and west to Missouri (Rue 1973). American woodcock have been observed breeding as far south as Florida (Keppie and Whiting 1994). The wintering range extends from southern New Jersey, southern Maryland and eastern Virginia south to the coastal marshes of the Gulf Coast states, and as far south as San Luis Potosi, Mexico (Keppie and Whiting 1994).

**Abundance:** Very little data exists on the abundance of the American woodcock. Singing ground data collected from 1968 to 2005 indicate an overall decline in breeding population in most states. However, short-term trends indicate an increase in breeding populations in West Virginia (Kelley and Rau 2005). West Virginia Breeding Bird Atlas volunteers located American woodcock in the Allegheny Mountains region, the lower Ohio Valley region, and the northern panhandle of West Virginia (Buckelew and Hall 1994).

### Economic Status

The American woodcock is a popular game bird. An estimated 700,000 hunters spent 3.5 million days hunting woodcock in 1985 (USDI 1988). A statewide season for hunting American woodcock exists in West Virginia (WVDNR 2004b).

### *Mourning Dove, Zenaida macroura*

#### Life History

**Taxonomy:** Mourning doves are members of the order Columbiformes, and family Columbidae. Five subspecies of *Zenaida macroura* are recognized (Mirarchi and Baskett 1994).

**Description:** Mourning doves are about 30 cm in length and have a small head, slender black bill, and brown eyes (Rue 1973, Mirarchi and Baskett 1994). The crown of the head and the bare patch around their eyes are bluish-gray. The cheeks are olive and the throat buff-colored. The back, rump, and tail feathers are olive-brown; the outer edges of the tail feathers are white. The underparts and the wing coverts are a bluish-gray. The primary feathers and secondaries are dark

blue-black; black spots are found on both scapulars and wing coverts. The lower sides of neck are iridescent. The legs and feet are a dull red color. The plumage of the females resembles that of males, but is muted. Females also are smaller than males (Rue 1973). Mourning dove nestlings and fledglings have whitish or buffy tips on the feathers of the wings and back. The edges of the wing coverts are white or a buff-color in immatures (Mirarchi and Baskett 1994).

**Habitat:** Mourning doves prefer open woodlands and the edges between forest and prairie areas for nesting. Trees and shrubs in suburban and urban areas also are utilized. Winter habitat includes small to medium-sized woodlots that offer protection from the elements (Mirarchi and Baskett 1994).

**Behavior:** Mourning doves become wary in the fall, especially near and during the hunting season. However, this wariness decreases with the closure of hunting season (Rue 1973).

Mourning doves are capable of flying up 96.5 km/hr (Rue 1973). Between September and October, mourning doves migrate south from Canada into the U.S. and south into Mexico and Central America (Rue 1973). Mourning doves in the Eastern Management Unit migrate south and winter within the unit (Mirarchi and Baskett 1994). Spring migration begins in March and lasts through April (Rue 1973).

**Reproduction:** Mourning doves are monogamous and usually mate for life. During the breeding season, males are extremely aggressive, and rely on this aggressiveness to establish large breeding territories. However, as more males ultimately migrate into the area, any single male becomes less and less successful in maintaining a large territory (Rue 1973). Males perform a ritualistic courtship display to attract females. The male dove struts with his neck elongated and the neck feathers puffed up, his wings touching the ground, and his tail fanned out. He claps his wings together over his back, springs into the air, and spirals downward again. The male repeats the display until copulation occurs (Rue 1973). After copulation, the female constructs a loose, somewhat haphazard nest of twigs and sticks gathered and provided by the male. The nest is constructed on top of a branch near the trunk. Evergreens are preferred for nesting, but others may be used. Occasionally, female mourning doves use the abandoned nests of robins and blue-jays (Rue 1973). If the nest is destroyed, the female immediately will begin building another nest. In the northern extent of the range, mourning doves raise 2 broods a year; in the southern extent of the range, mourning doves may raise 3 to 5 broods a year. When the male and female are ready to start a new brood, the female initiates nest building. If the old nest is to be used again, the female simply relines it with new twigs (Rue 1973). Pair bonding and nest building continues from February to October, except in the Gulf Coast region, where bonding and nest building occurs throughout the year (Mirarchi and Baskett 1994).

The average mourning dove clutch is 2 eggs, but 3 or sometimes 4 eggs are not uncommon (Rue 1973, Mirarchi and Baskett 1994). Both the male and female share responsibility for incubating the eggs, a process that lasts approximately 14 or 15 days. The male normally incubates during the day. Prior to hatching, both the male and female begin producing crop milk. At hatching, mourning doves are altricial (i.e., completely helpless), covered in white down, the eyes are closed, and the beak appears swollen (Rue 1973, Mirarchi and Baskett 1994). Parents share responsibilities of attending the young. After 3 days, primary feathers begin to protrude and the

eyes begin to open. The eyes are fully open and they are able to climb out of the nest after 6 days. At 8 to 10 days, the adults no longer produce crop milk and young are fed a seed diet. At 9 days, the young are sufficiently feathered to fly short distances from the nest if disturbed. They are capable of full flight at 12 to 14 days, but they usually remain in the nest area to continue to be fed (Rue 1973).

**Food Habits:** The diet of mourning doves consists mainly of plant items. Preferred cereal grains include corn, sorghum, millet, buckwheat, and peanuts. Non-agricultural food items include the seeds of grasses, spurges, goosefoots, saltbushes, composites (e.g., sunflowers), pokeweed, poppies, amaranths, smartweeds, hemp, purslanes, and pines (Rue 1973, Mirarchi and Baskett 1994).

**Mortality:** Mortality in mourning doves arises from diseases and parasites, predation, exposure, and relationships with humans. Diseases and parasites found in mourning doves include avian pox, various protozoans, helminths (e.g., nematodes, cestodes, trematodes), lice, and mites (Mirarchi and Baskett 1994). Adults and young are preyed on by raptors (e.g., Accipiter hawks), mammals (e.g., raccoon, domestic cats and dogs), and reptiles (e.g., rat snakes) (Mirarchi and Baskett 1994). High winds, heavy rains, and severe winter weather can cause mortality in mourning doves. Losses due to hunting (e.g., harvest, crippling or wounding loss) were estimated at 70 million birds annually or approximately 15% of the fall population. However, non-hunting mortalities are estimated to be 4 or 5 times greater than hunting mortality (Mirarchi and Baskett 1994).

### *Distribution and Abundance*

**Distribution:** Mourning doves are the most widespread of wild doves and pigeons (Rue 1973, Mirarchi and Baskett 1994, Dolton and Rau 2005). In the 1989 Breeding Bird Survey (BBS), mourning doves were the second most encountered bird species on these established routes (Mirarchi and Baskett 1994). Its wintering range includes most of the U.S. and extends south into Panama, whereas the breeding range includes all 48 contiguous states, Mexico, and southern Canada (Rue 1973).

**Abundance:** In the 1970s, migratory bird experts estimated the mourning dove population in the U.S. to be around 475 million. Currently, the mourning dove population in the U.S. is estimated at >400 million. In West Virginia, the BBS reported an average of <10 doves per route during the 2004-2005 survey. Analysis of BBC data for the Eastern Management Unit did not indicate a significant decrease or increase among states that permitted or did not permit hunting (Dolton and Rau 2005).

### *Economic Status*

Mourning doves provide recreational hunting opportunities. National surveys estimated 1.9 million dove hunters spent 9.5 million days hunting doves in 1991 (USDI 1993) and 1.6 million hunters spent 8.1 million days in 1996 (USDI 1997). A mourning dove season is open statewide in West Virginia. The season is split into three different segments: one that opens in early September and closes in early October, one that opens in late October and closes in early November, and one that opens in mid-December and closes in late January. The daily bag limit



is 12 birds. The possession limit is 24 birds, but 24 birds cannot be in possession while leaving the field. There is no season limit for doves (WVDNR n.d.[k]).



## Hunting Regulations Implemented by West Virginia that Apply to NERI as well as any Applicable Park Hunting Restrictions Instituted by the National Park Service (NPS), including Legal Methods of Hunting and Specific Seasons and Limits

Information on hunting regulations in the State of West Virginia was obtained primarily from the West Virginia Division of Natural Resources (WVDNR) Hunting and Trapping Regulations Summaries, beginning with the July 1978 – June 1979 season and continuing to the July 2004 – June 2005 season. In addition, the West Virginia Code (WVC) (West Virginia Legislature n.d.), the Migratory Bird Hunting Regulations (WVNDNR n.d.[k]), and the Code of Federal Regulations (CFR) (National Archives and Record Administration n.d.) were used as sources for information on hunting regulations relevant to NERI. We have structured our presentation in a format similar to that used in the West Virginia Hunting and Trapping Regulations Summary.

Under WVC §20-1-7.30, the Director has the authority to promulgate rules and regulations in accordance with the provisions of WVC §29-1-1a (C.W. Schollar, WVDNR Conservation Officer, pers. commun. 2005). In addition to the Director, the Natural Resources Commission (NRC) participates in the regulation process. In January of each year, recommended changes to seasons and bag limits are presented to the Director and the NRC. Feedback from the public about these recommendations is obtained through questionnaires and regional public meetings. The Director and NRC then review the recommendations and public comments before making a decision, which must be made prior to the printing of the hunting regulations in July. A similar process occurs for changes that pertain to methods and checking and tagging requirements. However, these changes must go through a legislative rule making and approval process (Wilson 2004.).

As provided in CFR §36.2.2, hunting on federal lands within NERI shall be in accordance with regulations established by WVDNR and WVC or in accordance with posted National Park Service safety zone signs. (Note: in the following sections, information obtained from the Code of Federal Regulations is *italicized*.)

### General Regulations

WVDNR describes the following as being illegal (WVDNR 2004b):

#### Property Offenses

- To hunt in state parks, in safety zones in state forests or wildlife management areas, and in Harpers Ferry National Historic Park. (*At Grandview, hunting is permitted only within the portion of the former state park that lies between Royal Road and the New River, as posted. Hunting is not permitted within the Burnwood environmental education area (from the north rim of the New River Gorge along the western and northernmost boundary and south along U.S. 19 to the rim of the gorge, as posted)*) (CFR §36.2.2).
- To shoot, hunt, or trap upon the fences or posted grounds or lands of another person without having in your possession written permission from the landowner (WVC §20-2-7).

- To shoot a firearm within 400 feet of a school or church, or within 500 feet of a dwelling, or on or near a park or other place where persons are gathered for pleasure (WVC §20-2-58).

#### Method Offenses

- To use or take advantage of artificial light in hunting, locating, attracting, or trapping wild birds or wild animals while in possession or control of a firearm, whether cased or uncased, bow, arrow, or other implement suitable for taking, killing, or trapping a wild bird or animal. However, lights ordinarily carried on person may be used for taking raccoon, skunk, and opossum. Coyotes may be hunted using amber colored artificial light during the open season (WVC §20-2-5.3).
- To use poisons, chemicals, or explosives in taking any furbearing animal, game animal, game bird or protected song or insectivorous bird, provided groundhogs may be controlled on private land by landowners, their resident children or resident parents, or a resident tenant from April 1 through September 30.
- To catch or kill, or attempt to do so, by seine, net, bait, trap, deadfall, snare, or like device, any bear, game bird, protected bird or mammal, or wild boar (WVC §20-2-5.6).
- To hunt deer, bear, or boar between ½ hour after sunset and ½ hour before sunrise.
- To shoot at a deer or boar while it is in water.
- To shoot an animal unless it is plainly visible (WVC §20-2-5.1).
- To smoke wildlife from its den or place of refuge, except as provided by law or regulation (WVC §20-2-5.2).
- To bait or feed bear.

#### Vehicle Offenses

- To get out of a motor vehicle along a public road and shoot a bow or firearm, unless at least 25 yards from the vehicle.
- To hunt or shoot at wild animals or birds from an airborne conveyance, from a vehicle or other land conveyance, from a motor-driven water conveyance, or from or across a public road, unless specifically authorized to do so by law or regulation. You may shoot from a motorized watercraft if the motor has been completely shut off and progress from the motor has ceased (WVC §20-2-5.4).
- To have a loaded firearm or a firearm with an attached magazine from which all shells have not been removed in or on any vehicle or conveyance or its attachments (WVC §20-2-5.9).

## Weapons Offenses

- To carry an uncased or loaded gun after 5 a.m. on Sunday in counties that prohibit Sunday hunting except at a regularly used firearm range, or except as provided in the trapping regulations (WVC §20-2-5.10). (Note: Sunday hunting is not allowed in Fayette, Raleigh, and Summers Counties).
- To carry an uncased or loaded firearm in the woods, except during open firearms hunting seasons; or to have a bow in the woods during closed season on game animals and non-migratory birds (WVC §20-2-5.8).
- To hunt with a fully automatic firearm.
- To be afield with a gun and bow, or with a gun and any arrows (WVC §20-2-5.19).
- To carry an uncased gun in or on a vehicle between 5 p.m. and 7 a.m. E.S.T. from October 1- June 30; and between 8:30 p.m. and 5 a.m. E.S.T. from July 1 – September 30 (WVC §20-2-5.9).
- To hunt or fish with a modified bow without a special permit issued by the Director of West Virginia Division of Natural Resources.
- To hunt with a crossbow or have a crossbow afield (WVC §20-2-5.20).
- To hunt between ½ hour after sunset and ½ hour before sunrise with any firearm larger than .22-caliber rimfire, a shotgun using solid ball ammunition, or shot shells larger than No. 4 shot.

## Miscellaneous Offenses

- To hunt while under the influence of alcohol (WVC §20-2-5.11).
- For anyone under the age of 15 to hunt on public land or the lands of another unless accompanied by a licensed adult who remains close enough to render advice and assistance.

## Sunday Hunting Regulations

Hunting is prohibited on Sundays except on privately owned lakes, ponds, or impoundments and private land located in counties where Sunday hunting has not been prohibited by local governments. Sunday hunting has not been permitted in Fayette, Raleigh, and Summers counties since the inception of NERI (WVDNR 2004b).

### Tagging and Transporting Regulations

No person may transport or possess wildlife killed by another hunter, unless the wildlife or parts thereof are accompanied by a paper tag filled out legibly bearing the signature, address, date of kill, hunting license number (if required), and the official game checking tag number (if required) of the hunter who killed the animal. The tag also shall specify the species and quantity of wildlife (WVDNR 2004b).

### Pistol Laws and Regulations

Individuals who possess a valid concealed carry permit may carry a concealed handgun while afield hunting, hiking, camping, fishing, or in or on a motor vehicle for purposes of self-defense only (WVC §20-2-6a). Other specific regulations that pertain to pistols include:

- Only pistols with a barrel at least 4 in (10.16 cm) in length are legal for hunting (WVDNR 2004b).
- A pistol may be used for hunting only during established hunting seasons (WVDNR 2004b).
- It is legal to hunt groundhogs in open fields with a pistol (WVDNR 2004b).

WVDNR describes the following as illegal within its pistol laws and regulations (WVDNR 2004b):

- To take migratory birds with a pistol.
- To hunt between ½ hour after sunset and ½ hour before sunrise with a pistol larger than .22 caliber rimfire.
- To hunt bear, deer, or wild boar with a pistol using a straight-walled case of less than .357 magnum cartridge or a bottle-necked case of less than .24 caliber.
- To hunt bear or wild boar with a muzzleloading pistol of less than .38 caliber.

### Dog Training Regulations

Persons training dogs shall not have a firearm or other implement for the taking of wildlife in their possession during closed seasons on wild animals and birds. Any person participating in the training of dogs must have the appropriate hunting licenses (WVC §20-2-24).

Residents may train dogs and hold field trials on wild animals and birds, except deer and wild turkeys, on private land with the landowner's written permission, or on public lands, at any time (WVC §20-2-24, WVC §20-2-56).

Nonresidents may train dogs during the legal small game hunting season, or, if their resident state offers WV hunters reciprocal dog training privileges, they may train dogs on raccoons from August (date varies each year) through the end of small game season (WVC §20-2-24).

### Regulations Specific to Wildlife Management Areas (WMA) and State Forests (Including NERI)

Rules and regulations governing hunting and trapping on state owned or state leased lands are the same as on adjacent private lands except for the following additional regulations (WVDNR 2004b):

- Use of All-Terrain Vehicles (ATV) and snowmobiles is prohibited. ATV means any vehicle designated for off-road use not subject to the vehicle registration requirements of Chapter 17A of the West Virginia Code. *All park roads are closed to all vehicles that are designed for off-highway use (CFR §36.1.5).*
- Driving a vehicle, ATV, or snowmobile to harass or chase wildlife is prohibited.
- Maximum speed limit for vehicles on WMAs and state forests is 30 mph (83 km/hr), unless otherwise posted. All traffic signs and directions must be observed.
- Driving a vehicle in a manner that creates a nuisance to other persons by repetitive or continuous cruising is prohibited.
- Only portable tree stands may be used on public lands.

### Big Game Species Regulations

#### Wild Boar

##### *Summary of Wild Boar Regulations*

West Virginia Division of Natural Resources manages wild boar (*Sus scrofa*) as a big game species. The original wild boar season opened in Boone, Logan, and Wyoming Counties in 1979. In 1986, the open season was extended to include Raleigh County (WVDNR 1986). The open season included an archery season and a general firearms season. The archery season historically was open for 2 weeks in October. In 1989, the archery season was extended to the end of December. The general firearms season historically was open for 3 days in November. In 1989, the general firearms season was split into 2, 3-day seasons, 1 in November and 1 in December (WVDNR 1989a). In 2003, the general firearms season became 1 5-day season in late October or early November (WVDNR 2003b). Traditionally, a permit was needed to participate in the wild boar season. This permit was obtained by submitting an application to local licensing agents. In 2004, license requirements were changed; hunters now only need a hunting license and do not need to submit an application (WVDNR 2004b). The daily bag, possession, and season limit are one wild boar. The wild boar regulations are not applicable to property within the boundaries of the New River Gorge National River. Wild boars currently found within these

boundaries were released by private landowners on lands adjacent to the boundaries and are not part of the state-managed population. A continuous open season with no possession or season limits currently exists for wild boar found within the boundaries of NERI (Larry Berry, WVDNR District Biologist, pers. commun. 2004).

WVDNR recognizes the following regulations during wild boar season (WVDNR 2004b):

- Wild boar must be taken during the firearms wild boar season with a bow or with a firearm, using ammunition legal in West Virginia for taking deer.
- A field tag must be completed and attached to the animal within one hour or in any case prior to its removal from the site where it was killed.
- All boar killed must be taken to an official game checking station or a conservation officer in the county of kill within 24 hours for retagging.
- The use of dogs and/or bait is prohibited.
- Concurrent hunting of small game, using a shotgun or a bow, is permitted during wild boar seasons. Concurrent hunting of deer and bear, in counties where legal, also is permitted during boar seasons.

Hunting licenses required to hunt wild boar in West Virginia are restricted to residents of West Virginia only (WVDNR 2004b).

## White-tailed Deer

### *General Regulations*

WVDNR describes the following as illegal during deer season (WVDNR 2004b):

- To hunt deer with a shotgun using ammunition loaded with more than one solid ball, or a rifle using rimfire ammunition of less than 0.25 caliber.
- To hunt deer with a fully automatic rifle, shotgun, or handgun.
- To hunt deer with a handgun using a straight-walled case of less than 0.357 magnum cartridge or a bottle-necked case of less than 0.24 caliber.
- To hunt deer with a muzzleloader of less than 0.38 caliber during the muzzleloader deer season.

Other restrictions applicable to deer season include (WVDNR 2004b):

- After a person has killed his/her legal daily bag limit of deer, that individual may not participate further in hunting deer with a bow or a firearm for the remainder of the day.



- After killing the legal limit of deer, a hunter shall not be afield with any firearm with solid ball ammunition or shot shells containing shot larger than No. 4 shot unless legally hunting bear.

Field tagging, checking, and transporting requirements include (WVC §20-2-22):

- Each person killing a deer must, within one hour and before moving the carcass from where it was killed, complete and attach the game field tag supplied with his or her license.
- The game field tag must include: hunter's name, address, hunting license number (if required), and the date, time, and county of kill.
- The tag must remain on the carcass until it is dressed for consumption.
- The unskinned carcass or the fresh skin and head of each deer must be delivered to a conservation officer or an official checking station for checking and retagging before it is transported beyond the county adjacent to the county of kill or within 72 hours from when it was killed or 24 hours from the close of the respective season, whichever comes first.
- Deer killed outside of Logan, McDowell, Mingo, or Wyoming Counties may not be checked within this four county area.
- A hunter may not continue to hunt deer until the day after any previously killed deer have been checked, except for the portion of the antlerless deer season during which two deer may be taken on the same day on private land, provided the first deer has been legally checked.

White-tailed deer (*Odocoileus virginianus*) hunting seasons include four seasons: archery, bucks-only firearms, antlerless, and muzzleloader. WVDNR has implemented a youth deer hunt to provide deer hunting opportunities for youth.

### *Archery Season*

#### *Summary of Archery Regulations*

The archery season is open throughout the State of West Virginia. During the archery season, a bow may be substituted for a firearm during any season for which firearms are legal, except during muzzleloading firearms deer season. Archery season opens on a Saturday in the middle of October and closes at the end of December. From the 1978–1979 to the 1984–1985 hunting season, the archery season bag limit was 1 deer of either sex with a stipulation that during the bucks-only firearms season, only antlered deer may be taken with a bow. Beginning with the 1985–1986 hunting season, the archery season bag limit increased to 2 deer with a daily bag limit of 1 deer. “Deer of either sex may be hunted statewide with a bow except that bucks only may be hunted statewide with a bow during the bucks-only season. An additional deer – antlered

only – may be taken ... during the archery season” (WVDNR 1985:2). In 1991, WVDNR modified the special regulation: “An additional deer of either sex may be taken...during the archery season in those counties or portions of counties open to the taking of antlerless deer as provided in the special antlerless deer season; provided that only antlered deer be taken in the counties or portions thereof not open to antlerless hunting” (WVDNR 1991:2). In 2000, the special regulation was modified again to increase the season bag limit to 3 deer in selected counties. One of the additional deer must be antlerless (WVDNR 2000). This special regulation modification included Summers County, Fayette County (North and East of the New River, North of the Kanawha River), and Raleigh County (East of Rt. 19 and South of Rt. 41). A seasonal bag limit of 2 deer remained in effect for the other areas of Fayette and Raleigh Counties. For the 2003–2004 hunting season, this special regulation was modified again to include all of Raleigh County (WVDNR 2003b). As of the 2004–2005 hunting season, Fayette County (North and East of the New River and East of the Gauley River), Raleigh County, and Summers County all have a seasonal bag limit of 3 deer for the archery season. The area South and West of the New River and South of the Kanawha River of Fayette County remains under a 2-deer season bag limit (WVDNR 2004b). The current statewide daily bag limit is 1 deer for the archery season.

WVDNR describes the following as illegal during archery season (WVDNR 2004b):

- To hunt deer with arrows having less than two sharp cutting edges, measuring less than  $\frac{3}{4}$  of an inch in width (WVC §20-2-5.21).
- To use an arrow with an explosive, drug-laced, or poisoned head or shaft (WVC §20-2-5.22).
- To hunt with a locking device capable of holding a bow at full draw, except with a modified bow permit issued by the Director of the West Virginia Division of Natural Resources.

### *Bucks-only Firearms Season*

#### *Summary of Bucks-only Firearms Regulations*

From the 1978–1979 hunting season to the 1979–1980 hunting season, the bucks-only firearms season was open for two weeks in Fayette County (north of the New River) (WVDNR 1978 and WVDNR 1979). However, in Raleigh and Summers Counties, and south of the New River in Fayette County, the season was open for only one week. Then, in 1980, the 2-week season was modified to include the entire state, except for 4 counties in southwest West Virginia (WVDNR 1980). This modification included Fayette County (south of the New River), Raleigh County, and Summers County. The 2-week bucks-only firearms season opens in late November and closes in early December. Prior to the 1985–1986 hunting season, the season limit was one deer. In 1985, the season limit was increased to 2 deer with a daily bag limit of 1 deer (WVDNR 1985). Two deer may be taken during the bucks-only firearms season with the appropriate license. A hunter may not hunt deer until the day after any previously killed deer has been checked (See field tagging, checking, and transporting requirements).

Legal firearms for hunting deer during the bucks-only season include (WVDNR 2004b):

- A rifle using center-fire ammunition,
- A rifle using 0.25 caliber or larger rimfire ammunition,
- A muzzleloading rifle with or without a scope and a muzzleloading pistol of 0.38 caliber or larger,
- A handgun using a straight-walled case of 0.357 magnum cartridge or larger, or a bottle-necked case of 0.24 caliber or larger,
- A shotgun loaded with solid ball ammunition, or
- A combination rifle-shotgun.

During bucks-only firearms season, only deer having one or both antlers 3 in (7.62 cm) or more in length above the hairline may be taken (WVDNR 2004b).

Concurrent hunting is prohibited during the first 3 days of bucks-only season. However, it is legal to hunt waterfowl during this period on lakes, rivers, and waterways during the open waterfowl season and to hunt bear in specified counties (WVDNR 2004b).

### *Antlerless Season*

#### Summary of Antlerless Regulations

From the 1978–1979 to the 1988–1989 hunting seasons, the special antlerless deer season opened the first Friday and Saturday following the close of the bucks-only firearms season. Originally, only West Virginia residents were eligible to apply for the appropriate hunting licenses. Residents were required to apply for a hunting permit at local licensing agents. Counties open to the special antlerless season were published in state and local newspapers. In 1989, the 2-day season was extended to 3 days in counties open to the special antlerless season (WVDNR 1989a). In 1996, the antlerless season with limited licenses available included Fayette County (North and East of the New River and North of the Kanawha River) and Summers County (South of Rt. 3) (WVDNR 1996). An application was needed to participate in this 3-day antlerless season. The season limit in these counties was 1 antlerless deer. In 1998, the antlerless season in these counties was extended to 6 days; the area also was expanded to include Raleigh County (East of Rt. 19 and South of Rt. 41) (WVDNR 1998). In 2001, an application no longer was needed to hunt during the antlerless season in Summers County and the season limit was increased to 2 deer with a daily bag limit of 1 deer (WVDNR 2001c). In 2002, the season limit increased to 3 deer in Summers County. In 2003 in Summers County, the season limit increased to 4 deer and the daily bag limit increased to 2 deer, provided the first deer was checked prior to hunting a second antlerless deer. In Fayette and Raleigh Counties, an application no longer was required to participate in the antlerless season, but the season limit

remained at 1 deer in these counties (WVDNR 2003b). Obviously, the trend in recent years has been to increase the daily bag limit for deer.

Antlerless deer are defined as any deer having no antlers or having both antlers <3 inches in length above the hairline (WVDNR 2004b).

Concurrent hunting for small game hunting is legal. However, no hunter except those legally participating in the antlerless deer season shall be afield with any type of gun with solid ball ammunition or shot shells larger than No. 4 shot. If using a rifle-shotgun combination, rifle ammunition must be in possession. Concurrent bow hunting also is allowed during the special antlerless deer season (WVDNR 2004b).

No hunter may participate in the special antlerless deer season unless he/she has the appropriate license (WVDNR 2004b).

### *Muzzleloading Season*

#### *Summary of Muzzleloading Regulations*

A 3-day muzzleloading season was created in 1979. The muzzleloading season was open in all counties open to the bucks-only firearms season, but only on state-owned or state-leased public hunting areas and state forests. The new season contained the following stipulation: “No person may legally take under any conditions more than three deer per calendar year. One deer may be taken by bow during archery season; one by bow or gun during the bucks-only season (or one by muzzleloader during the muzzleloading season if one was not taken during the bucks-only season); and one by either bow or gun during the antlerless season” (WVDNR 1979:2).

Muzzleloading season opened immediately following the close of bucks-only firearms season. In 1984, the season was restricted to 1 day with the following stipulation: “If a hunter has killed more than one deer this season, he or she is ineligible to participate in the muzzleloading season. Deer of either sex may be taken during this season with muzzleloading rifles in all counties or portions of counties open for the taking of antlerless deer as provided in the special antlerless deer season. Antlered deer only may be taken in all other counties having a regular season for the taking of deer with firearms” (WVDNR 1984:2). In 1989, the muzzleloading season was extended to 6 days with the following stipulations: “Muzzleloading rifle hunting is permitted in all counties open to bucks-only firearms season. If a hunter has killed more than one deer this season, the hunter may hunt for and kill only antlered deer with a muzzleloading rifle. If a person had killed no more than one deer this year prior to the muzzleloading rifle season, antlered deer only may be taken during the first four days of this season; deer of either sex may be taken during the last two days of this season with muzzleloading rifles in all counties or portions of counties open for the taking of antlerless deer as provided in the special antlerless deer season. Antlered deer only may be taken in all other counties having a regular season for the taking of deer with firearms. ...” (WVDNR 1989a:2). In 1982, all counties open for the bucks-only firearms season were opened to the muzzleloading season (WVDNR 1982a). During the 1995–1996 hunting season, the muzzleloading season was open to both residents and nonresidents for 6 days with a season limit of 1 deer in Fayette, Raleigh, and Summers Counties; only antlered deer could be taken during this season (WVDNR 1995). During the 1996–1997 hunting season, muzzleloading season was open to bucks-only for 6 days for residents and

nonresidents in Fayette County (South and West of the New River and South of the Kanawha River), Raleigh County, and Summers County (North of Rt. 3); deer of either sex could be taken in Fayette County (North and East of the New River and North of the Kanawha River) and Summers County (South of Rt. 3) (WVDNR 1996). In 1997, deer of either sex could be taken throughout Summers County (WVDNR 1997). In 1998, only antlered deer could be taken in Raleigh County (West of Rt. 19 and North of Rt. 41); deer of either sex could be taken East of Rt. 19 and South of Rt. 41 (WVDNR 1998). In 2000, the season limit increased to 2 deer with a daily bag limit of 1 deer in Summers County; both may be deer of either sex (WVDNR 2000). In 2003, deer of either sex could be taken throughout Raleigh County (WVDNR 2003b).

Special muzzleloading deer season regulations currently in effect include (WVDNR 2004b):

- Only single shot muzzleloaders, including “in-lines,” of 0.38 caliber or larger are legal.
- A muzzleloader with a telescopic sight is legal.
- A firearm that has been converted into a muzzleloader by using a plug, or a double-barreled or swivel-barreled muzzleloader is **illegal** for hunting deer during muzzleloader season.
- When being transported or in a vehicle, a muzzleloader is considered unloaded when uncapped or when the priming charge is removed from the pan.
- A bow cannot be substituted for a muzzleloader during the muzzleloading season.
- Concurrent archery season is permitted during muzzleloading season as permitted by archery deer hunting regulations.
- Except for those persons legally hunting bear, it is illegal for a person to be afield with solid ball ammunition or shot larger than No. 4 during the muzzleloader season.
- It is illegal to hunt small game with 0.22 caliber or smaller rimfire during the muzzleloader season.

### *Youth Hunt*

#### *Summary of Youth Hunt Regulations*

In 1999, WVDNR implemented a 1-day deer season for youth hunters on 20 wildlife management areas. Youth hunters were permitted to take 1 antlerless deer, which did not count toward the youth hunter’s annual limit (WVDNR 1999). In 2000, the youth hunt deer season was opened to include any private lands open to antlerless deer hunting (WVDNR 2000). In 2001, the special season was split: a 1-day season in late October and 2-day season in late December, allowing youth hunters to take 1 deer per day (WVDNR 2001c).

Special youth hunt deer season regulations currently in effect include (WVDNR 2004b):

- Youth hunters must be at least 10 years old, but no more than 14 years old on opening day of the season.
- Youth hunters must be accompanied by an adult at least 21 years old.
- The accompanying adult cannot carry a gun or bow.
- The accompanying adult must remain close enough to the youth hunter to render advice and assistance.

## Black Bear

### *Summary of Archery and Gun Regulations*

In 1991, archery and gun seasons for black bear (*Ursus americanus*) opened in Fayette and Raleigh Counties. The archery season opened in mid-October and closed in mid-November. A 1-day gun season opened in December. The use of dogs was prohibited during both seasons. The annual bag limit was 1 bear; only 1 bear per year may be killed with either a gun or bow (WVDNR 1991). In 1994, the archery season was extended to include Summers County. The 1-day gun season also increased to a 3-day gun season in 1994 (WVDNR 1994). In 1997, the 3-day gun season increased to 6 days in December (WVDNR 1997). In 1999, the gun season opened in early December and closed in late December in Fayette County (West of I-77) and Raleigh County (West of I-77). East of I-77 in both counties, the season remained closed (WVDNR 1999). In 2001, the gun season included Fayette County and Raleigh County (West of I-77) and now permitted the use of dogs (WVDNR 2001c). In 2002, the archery season was open statewide and the gun season was modified to a split season. The use of dogs was permitted during the 3-day gun season in early November and during the gun season in December in Fayette County and Raleigh County (West of I-77). During the 5-day gun season in late November to early December, the use of dogs was not permitted in Fayette County and Raleigh County (West of I-77) (WVDNR 2002b). In 2003, a 5-day gun season opened in Summers County in December; this season did not permit the use of dogs (WVDNR 2003b). In 2003, the use of dogs was permitted in Fayette and Raleigh Counties during the early November gun season and throughout the December gun season. In 2003, the use of dogs was not permitted in Fayette and Raleigh Counties during the late November gun season.

WVDNR describes the following as illegal during bear season (WVDNR 2004b):

- To hunt bear with a shotgun using ammunition loaded with >1 ball (WVC §20-2-22a.c.2A).
- To hunt bear with a rifle of less than 0.25 caliber using rimfire ammunition (WVC §20-2-22a.c.2B).
- To hunt bear with muzzleloading pistol less than 0.38 caliber.

- To hunt bear with a pistol or revolver using a straight-walled case of less than 0.357 magnum or a bottle-necked case of less than 0.24 caliber.
- To take or attempt to take bear with steel traps.
- To shoot or kill a cub bear or any bear accompanied by such a cub (WVC §20-2-22a.c.4).
- To organize for commercial purposes, to professionally outfit a bear hunt, or to give or receive any consideration whatsoever or any donation in money, goods, or services in connections with a bear hunt (WVC §20-2-22a.c.10).
- To pursue a bear, after the chase has begun, with dogs not in use at the beginning of the hunt.
- For nonresidents to hunt bear with dogs, except in certain designated counties during the bear gun season.
- To use dogs while bow hunting for black bears, except during the bear firearms season (exception is only for counties where dogs are legal) (WVC 20-2-22a.c.8).

Field tagging, checking, and transporting requirements for bear include (WVC §20-2-22a):

- Each person killing a bear must, within 1 hour and before moving the carcass from where it was killed, complete and attach the game field tag supplied with his or her license.
- The tag must remain attached to the carcass until it is dressed for consumption.
- Within 24 hours after the kill, a person killing a bear must transport the bear or its fresh skin to a conservation officer or an official game checking station for checking and retagging.
- A checking tag must be attached to the bear before any part of it may be transported more than 75 mi (120 km) from the place of kill and shall remain on the skin until the skin is tanned or mounted.

## Wild Turkey

Hunting wild turkey (*Meleagris gallopavo*) is conducted in three established seasons: fall season, spring gobbler season, and spring gobbler youth hunt.

### *Fall Season*

In 1997, 1998, and 2001, the fall season was open in Summers County by permit only (WVDNR 1997; WVDNR 1998, WVDNR 2001c). All residents except landowners were required to apply

for a permit. During the fall season, 1 turkey of either sex could be taken. Currently, a fall season does not exist in Fayette, Raleigh, and Summers Counties (WVDNR 2004b).

### *Spring Gobbler Season*

WVDNR describes the following as illegal during spring gobbler season (WVDNR 2004b):

- To have an uncased firearm or a bow in your possession in the woods after 1 p.m.
- To hunt with dogs.
- To use electronic calls.
- To hunt with the use of bait.

Shooting hours for spring gobbler season are between ½ hour before sunrise to 1 p.m. (WVDNR 2004b).

Spring gobbler season is open statewide, opening in April and closing in May. The daily bag limit is 1 bird. During spring gobbler season, the season limit is 2 bearded birds. However, if 1 bird was taken during the fall season, only 1 bird can be taken legally during spring gobbler season (WVDNR 2004b).

### *Spring Gobbler Youth Hunt*

For the 2005 spring gobbler season, WVDNR has opened a youth hunt to be held the Saturday before the opening of the regular spring gobbler season. During this season, the bag limit is 1 bearded turkey and the harvested bird counts toward the youth hunter's annual bag limit. During this season, only shotguns using shot size 4, 5, or 6 are legal. Youth hunters participating in the season must be between 10 and 14 years old. Youth hunters must be accompanied by an adult at least 21 years old. The accompanying adult is not permitted to carry a gun or bow and must remain close enough to render advice and assistance (WVDNR 2004b).

Field tagging, checking, and transporting requirements for wild turkey include (WVC §20-2-22):

- Each person killing a turkey must, within one hour and before moving the carcass from where it was killed, complete and attach the game field tag supplied with his or her license.
- The tag must remain attached to the carcass until it is dressed for consumption.
- The carcass of each turkey must be delivered to a conservation officer or an official checking station for checking and retagging before it is either skinned or transported beyond the county adjacent to the county of kill or within 72 hours from when it was killed or 24 hours from the close of the respective season, whichever comes first.



## Small Game Species Regulations

### Squirrel

Certain species of squirrels are designated small game species by the WVDNR. WVDNR recognizes both the gray squirrel (*Sciurus carolinensis*) and the fox squirrel (*Sciurus niger*) as hunted species, but makes no distinction in the regulations between these species or any color variations that occur in these 2 species. All other species of squirrels are considered non-game species. The statewide squirrel season typically opens in October and continues until the first of January. However, in 1999, WVDNR extended the season until the end of January (WVDNR 1999). In 1999, WVDNR also created a youth squirrel hunt, which occurs the Saturday before the regular squirrel season opens. Youth are permitted to take 6 squirrels during the youth hunt (WVDNR 2004b). Youth participating in the hunt must be no more than 14 years old and accompanied by an adult 21 years of age or older. The accompanying adult is not permitted to carry a gun or bow, and must remain close enough to the youth to render advice and assistance. The daily bag limit for squirrels is 6. The possession limit is 24 squirrels; 24 may be possessed legally at any given time. No season limit for squirrels exists in West Virginia.

### Ruffed Grouse

The statewide ruffed grouse (*Bonasa umbellus*) season in West Virginia opens in the middle of October and closes in late February. The daily bag limit is 4 birds and the possession limit is 16 birds. No season limit for ruffed grouse exists. There have not been any changes to the ruffed grouse season or limits since 1978 (WVDNR 2004b).

### Northern Bobwhite

The statewide bobwhite quail (*Colinus virginianus*) season in West Virginia opens in early November and closes in late February. From the 1978–1979 hunting season until the 1998–1999 hunting season, the daily bag limit was 7 birds and the possession limit was 21 birds. In 1999, the daily bag limit was changed to 3 birds and the possession limit to 9 birds (WVDNR 1999). No season limit currently exists for bobwhite quail.

### Eastern Cottontail

A statewide cottontail rabbit (*Sylvilagus floridanus*) season exists in West Virginia, which opens in early November and closes in late February. The daily bag limit is 5 rabbits and the possession limit is 20 rabbits. No season limit for cottontail rabbits exists in West Virginia. There have not been any changes to the cottontail rabbit season or limits since 1978 (WVDNR 2004b).

### Raccoon

A raccoon (*Procyon lotor*) season is open statewide in West Virginia. The 1978–1979 season opened in the middle of October and closed in late February (WVDNR 1978). For the 1979–1980 hunting season, the closing date changed to late January (WVDNR 1979). For the 1980–1981 hunting season, the opening date changed to November 1 (WVDNR 1980). Then,

beginning with the 1981–1982 hunting season and continuing today, the raccoon hunting season opens in mid-October and closes in late January. In 1999, season modifications included extending the raccoon hunting season to close in late February (WVDNR 1999). On opening day, the season begins at 6:00 p.m. From the 1978–1979 hunting season to the 1998–1999 hunting season, the daily bag limit was 2 raccoons. During this time period, the possession limit was defined as “the bag limit during any 11-hour period beginning at 6:00 p.m. and ending at 5:00 a.m. is 2 raccoons for each person or group of persons as a party...” (WVDNR 1978: 3); the season limit was 20 raccoons. In 1999, the daily bag limit and the possession limit both changed to 3 raccoons and the season limit increased to 30 raccoons (WVDNR 1999). The current daily bag limit and possession limit is 4 raccoons and no season limit exists; implementation of the current limits occurred in 2003 (WVDNR 2003b; WVDNR 2004b).

### Red Fox and Gray Fox

The West Virginia regulations for fox hunting pertain to both the gray fox (*Urocyon cinereoargenteus*) and the red fox (*Vulpes vulpes*). In 1978, the fox season opened in October and closed in February (WVDNR 1978). In 1979, the closing date changed to the end of January (WVDNR 1979). Today, the season opens in early November and closes in late February; implementation of the current season occurred in 1980 (WVDNR 1980). From the 1978–1979 hunting season to the 1999–2000 hunting season, the daily bag limit, possession limit, and the season limit were 25 foxes. That limit increased to 30 foxes in 1999 (WVDNR 1999). Current regulations, implemented prior to the 2004–2005 hunting season, do not specify a daily bag limit, possession limit, or season limit for foxes. Regulations concerning season opening and closing dates as well as bag, possession, and season limits do not distinguish between the hunting and trapping seasons.

### Bobcat

A bobcat (*Lynx rufus*) season is open statewide in West Virginia. In 1978, the bobcat season opened in October and closed in February (WVDNR 1978). In 1979, the closing date changed to the end of January (WVDNR 1979). Current regulations on season, which have been in effect since 1980, stipulate an opening in early November and closing in late February (WVDNR 1980). The daily bag limit, possession limit, and season limit all are 2 bobcats. All bobcats harvested must be checked at an official checking station. There have not been any changes to the regulations concerning limits since 1978. However, regulations detailing these limits do not distinguish between hunting and trapping seasons.

### American Crow

In 2003, American crows (*Corvus brachyrhynchos*) were designated a game species with the following stipulation, “Nuisance crows committing depredations upon ornamental or shade trees, agricultural crops, home gardens, livestock, or wildlife, or when concentrated so as to constitute a health hazard and or other nuisance may be killed at any time” (WVDNR 2003b:2). The new designation created a split season. The first season opens in early September and closes in late December, provided that hunting only occurs on Thursday, Friday, and Saturday. A second season opens in January and closes in February; during this season, hunting is not restricted to Thursday, Friday, and Saturday. A crow season is open statewide. No limits during the hunting

seasons exist. Prior to this change, crows were considered a nuisance species with a continuous open season and no limits.

## Coyote

In 1993, the coyote (*Canis latrans*) was designated a nuisance species. As a nuisance species, the season is open continuously with no limits. In 2004, a night hunting season was created, which opens in early January and closes in late July (WVDNR 2004b). A continuous open season remains for daylight hours. No limits exist for both day and night. A trapping season also exists for coyotes.

## Continuous Open Season Species Regulations

Skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), woodchucks/groundhogs (*Marmota monax*) and pigeons (*Columba livia*) all are considered continuous open season species in West Virginia. A continuous open season exists for these species. There are no limits for these species as well. There have not been any changes to the seasons or limits since 1978. For skunks and opossums, a trapping season exists (WVDNR 2004b).

## Migratory Bird Species Regulations

The West Virginia Division of Natural Resources and the US Fish and Wildlife Service divide the Commonwealth of West Virginia into 2 zones for the purpose of hunting migratory game birds. A complete description of these hunting zones is presented in the 2004-05 West Virginia Migratory Bird Hunting Regulations (WVDNR n.d.[k]). Zone One contains the New River Gorge National River (WVDNR n.d.[k]). Federal regulations associated with migratory birds are found in Title 50, Code of Federal Regulations, Part 20.

WVDNR and USFWS recognize the following as being illegal during any migratory game bird seasons:

- To take migratory birds with a trap, snare, net, crossbow, rifle, pistol, swivel gun, shotgun larger than 10-gauge, punt gun, battery gun, machine gun, fishhook, poison, drug, explosive, or stupefying substance (CFR §20.21[a]).
- To hunt migratory birds with a shotgun capable of holding more than three shells, unless it is plugged with a 1-piece filler that is incapable of removal without disassembling the gun (CFR §20.21[b]).
- To hunt migratory birds from a sinkbox. A sinkbox is a device that allows hunters to be concealed below the water surface or ground level (CFR §20.21[c]).
- To hunt from or with the aid or use of a car or other motor driven land conveyance (CFR §20.21[d]).

- To hunt from any motorboat or sailboat unless the motor has been shut off completely or the sails furled, and its progress has ceased. A motorboat or sailboat may be used to retrieve dead or crippled birds (CFR §20.21[e]).
- To hunt using live birds as decoys. It also is illegal to take wild birds from an area where tame or captive birds are present (CFR §20.21[f]).
- To hunt using records or tapes of migratory bird calls or sounds, or electronically amplified imitations of bird calls (CFR §20.21[g]).
- To drive, rally, or chase birds with any motorized conveyance or any sailboat to put them within range of hunters (CFR §20.21[h]).
- To hunt with the aid of baiting. An area is considered baited for ten days after the removal of the bait (CFR §20.21[i]).
- To hunt migratory birds with or while possessing shot other than steel shot, bismuth-tin shot, tungsten-iron shot, tungsten-polymer shot, tungsten-matrix shot, tungsten-nickel-iron shot, tungsten-iron-nickel-tin shot, or such shot approved as non-toxic (CFR §20.21[j]).

### Mourning Dove

A mourning dove (*Zenaida macroura*) season is open statewide in West Virginia. The season is split into 3 different segments: one that opens in early September and closes in early October, 1 that opens in late October and closes in early November, and 1 that opens in mid-December and closes in late January. Shooting hours for doves begin at 12:00 noon and continue until sunset during the first segment. During the last 2 segments, shooting hours begin ½-hour before sunrise and continue until sunset. The daily bag limit is 12 birds. The possession limit is 24 birds, but 24 birds cannot be in possession while leaving the field. There is no season limit for doves.

### Sora and Virginia Rail

A statewide open season on sora (*Porzana Carolina*) and Virginia rail (*Rallus limicola*) exists in West Virginia. The season opens in early September and closes in early November. The daily bag limit is 25 birds; the possession limit, not the field possession limit, also is 25 birds. Shooting hours for rails begin ½-hour before sunrise and continue until sunset.

### Common Snipe

A common snipe (*Capella gallinago*) season is open statewide in West Virginia. The season opens in early September and closes in mid-December. The daily bag limit is 8 birds and the possession limit, not the field possession limit, is 16 birds. Shooting hours for snipe begin ½-hour before sunrise and continue until sunset.

## Woodcock

A statewide season for hunting woodcock (*Scolopax minor*) exists in West Virginia. The season opens in late October and closes in mid-November. The daily bag limit is 3 birds and the possession limit, not the field possession limit, is 6 birds. Shooting hours for woodcock begin ½-hour before sunrise and continue to sunset.

## Ducks (except Canvasback and Pintails)

Duck species found within NERI include: American black duck (*Anas rubripes*), American widgeon (*Anas americana*), Barrow's goldeneye (*Bucephala islandica*), blue-winged teal (*Anas discors*), bufflehead (*Bucephala albeola*), canvasback (*Nyroca valisineria*), common goldeneye (*Bucephala clangula*), gadwall (*Anas strepera*), greater scaup (*Aythya marila*), green-winged teal (*Anas crecca*), lesser scaup (*Aythya affinis*), long-tailed duck (*Clangula hyemalis*), mallard (*Anas platyrhynchos*), Northern pintail (*Anas acuta*), redhead (*Aythya americana*), ring-necked duck (*Aythya collaris*), ruddy duck (*Oxyura jamaicensis*), shoveler (*Anas clypeata*), and wood duck (*Aix sponsa*). Zone One, which includes the NERI, has a split season. The first segment of the season in Zone One opens in early October and closes in mid-October. The second segment opens in early December and closes in mid-January. The daily bag limit is 6 ducks. This bag limit for restricted species may include 1 pintail, 1 canvasback, 4 long-tailed ducks, 3 scaup, 1 black duck, 2 wood ducks, 2 redheads, 4 scoters, and 4 mallards, of which only 2 may be hens. The daily bag limit for unrestricted species is 6 per day. The legal possession limit is twice the daily bag limit. Shooting hours for ducks begin ½-hour before sunrise and continue until sunset. Canvasback and pintail hunting is permitted only during the last 30 days of the second half of the duck season. The daily bag limit is 1 duck and the possession limit is 2 ducks.

## American Coot

Hunting for coots (*Fulica americana*) is regulated via a split season in both management zones. In Zone One, the first segment of the season opens in early October and closes in mid-October. The second segment of the season opens in December and closes in January. The daily bag limit is 15 birds and the possession limit, not the field possession limit, is 30 birds. Shooting hours for coots begin ½-hour before sunrise and continue until sunset.

## Mergansers

The mergansers found within NERI include the following: common merganser (*Mergus merganser*), hooded merganser (*Lophodytes cucullatus*), and red-breasted merganser (*Mergus serrator*). Hunting of mergansers is regulated by a split season in both zones as well. The first segment of the season opens and closes in October. The second segment of the season opens in early December and closes in mid-January. The daily bag limit for mergansers is 5 birds and the possession limit is 10 birds. The bag limit can include only 1 hooded merganser and the possession limit can include only 2 hooded mergansers. Shooting hours for mergansers begin ½-hour before sunrise and continue to sunset.

## Canada Goose

A Canada goose (*Branta Canadensis*) season is open statewide for approximately two weeks in early September. It also is open for a 2-week period in early October. It opens again in early December and closes in mid-January. During the statewide open season, the daily bag limit is 5 birds and the possession limit is 10 birds. During the seasons open in Zone One, the daily bag limit is 3 birds and the possession limit is 6 birds. Shooting hours begin ½-hour before sunrise and continue until sunset.

## Brant

A brant, *Branta bernicula*, season exists in both zones. The season in Zone One opens in early December and closes in late January. The daily bag limit is 2 birds and the possession limit is 4 birds.

## Snow Goose

A split season exists in both zones for the snow goose (*Anser caerulescens*). In Zone One, the first segment opens in early October and closes in mid-October. The second segment opens in early December and closes in late January. The daily bag limit is 5 birds and the possession limit is 10 birds.

## Annual Hunting Patterns and the Degree of Hunter Intensity within NERI by Species, Time, and Place

Cocheba (1987:275) defined hunting as “the act of pursuing wildlife with the intention of killing the quarry; if the primary purpose is recreational enjoyment, it is recreational hunting.”

However, hunting is more than a recreational activity; it is part of the culture, a means to obtain food, and a means used by wildlife agencies to manage wildlife (Brown et al. 2000).

Understanding annual hunting patterns and the degree of hunter intensity is important to constituents with an interest in the NERI. Hunter intensity or hunting pressure is “a measure of the amount of hunting” (State University System of Florida 2000). The amount of hunting can be measured in hunter numbers, days afield, and hunting expenditures. Natural resource agencies monitor hunting patterns to assess progress toward their management goals. It also is important to examine annual hunting patterns and hunter intensity within NERI to assess impacts of recreational hunting. However, as stated in a natural resource assessment for NERI (Mahan 2004), no research has yet been conducted to determine annual hunting patterns and hunter intensity within the boundaries of NERI. Therefore, information about hunting patterns and hunter intensity must be based on existing national and state data and literature as well as reputable personal knowledge. Brown et al. (2000) identified 3 potential sources to obtain useful information on hunting patterns and hunter intensity: USFWS national surveys, annual license sales, and annual hunter education course registrations. For the purpose of describing hunting patterns and hunter intensity within NERI, the USFWS surveys were the primary sources examined. Secondary sources included surveys conducted by WVDNR and conversations with law enforcement personnel from the NPS and the WVDNR.

The U.S. Fish and Wildlife Service and U.S. Census Bureau provide valuable information about hunting and hunting pressure, including hunter numbers, days afield, and hunting expenditures. Since 1955, this cooperative effort has produced a comprehensive survey every 5 years. This effort also has provided additional reports that compare these 5-year surveys and supplied constituents and natural resource professionals with information on hunting trends. In addition, these surveys help professionals develop environmental impact statements and legislative proposals (USDI n.d.[d]).

### National Data

#### Hunter Numbers

The 2001 national survey reported 13 million hunters in the U.S. (USDI 2002). In 1999, the cooperative effort between the U.S. Fish and Wildlife Service and the U.S. Census Bureau produced a report that examined trends associated with hunting from 1980 to 1995. The report revealed an 8% decline in hunting participation during the period 1980 to 1995. However, upon closer examination, this decline actually occurred between 1990 and 1995; hunting participation remained stable between 1980 and 1990 (USDI 1999). The subsequent 2004 report concluded that hunting participation declined 1% from 1991 to 1996 and an additional 7% from 1996 to 2001 (USDI 2004). The first report and the second report differ on several key components: 1) 6 to 15 year olds were included in the 1990-1995 trend analysis, but not in previous reporting periods and 2) the 1991-1996 trend reflects changes in hunting regulations, weather conditions, and economic situations (USDI 1999).

In 1980 and 1985, there were 12.7 million and 13.6 million big game hunters respectively in the U.S. (USDI 1993). By 2001, the number of big game hunters had declined to 10.9 million hunters (USDI 2002). It is important to note that, in the 1993 and all previous surveys, “big game” was defined as including deer, elk, antelope, moose, bear and wild turkey. However, in the 2001 report and the 1991-2001 trend analysis, the definition of “big game” had changed to include only deer, elk, bear, and wild turkey. Although big game hunting as a whole did not endure any significant increases or decreases in participation rates, the 1991-2001 trend analysis identified deer hunting as the most popular of big game hunting activities with a stable participation of 10.3 million hunters. During the same period, participation in wild turkey hunting increased 46% to 2.5 million hunters. In 2001, 360,000 hunters participated in bear hunting (USDI 2002, USDI 2004).

Small game hunting includes hunting for rabbits, squirrels, pheasants, quail, and grouse. According to the 1991-2001 trends analyses, participation in small game hunting declined 29% (USDI 2004) and there were 5.4 million small game hunters in 2001 (USDI 2002). In 1980 and 1985, small game hunters totaled 13.3 million and 11.8 million hunters, respectively (USDI 1988, USDI 1993). Individually, participation in squirrel hunting, pheasant hunting, and rabbit hunting declined 25%, 41%, and 47%, respectively from 1991 to 2001 (USDI 2004). The 1991-2001 trend analysis did not include participation rates for other small game species. The 2001 national survey reported 2.1 million squirrel hunters, 1.7 million pheasant hunters, 2.1 million rabbit hunters, 1 million grouse hunters, and 991,000 quail hunters (USDI 2002).

In 2001, there were 3.0 million migratory bird (i.e., geese, ducks) hunters in the U.S. (USDI 2002). This perpetuates the downward trend in the number of migratory bird hunters from 5.6 million hunters in 1980 and 5.4 million hunters in 1985 (USDI 1993). Although participation in migratory bird hunting overall decreased, participation in duck hunting increased 37% from 1991 to 2001 (USDI 2004) to 1.6 million hunters. Whereas participation in duck hunting increased, participation in dove hunting declined 22% from 1991 to 2001 (USDI 2004); dove hunters numbered 1.5 million in 2001 (USDI 2002). There were 1 million goose hunters in 2001 (USDI 2002); goose hunting participation increased 13% from 1991 to 2001 (USDI 2004).

Other species for which data on hunting were amassed in the national surveys and reports included raccoons, groundhogs, foxes, and coyotes. Participation in hunting for these species fell 26% between 1991 and 2001 (USDI 2004). Participation in hunting these species has varied substantially over the last 2 decades (2.8 million hunters in 1980, 3.1 million hunters in 1985, 1.8 million hunters in 1990 (USDI 1993), 1.5 million hunters in 1996 (USDI 1997), and 1 million hunters in 2001 (USDI 2002)).

### Days Afield Hunting

In 2001, hunters devoted a total of 228 million days to hunting and participated in 200 million hunting-related trips (USDI 2002). The average number of days afield per hunter increased from 17 to 18 days during the period 1991 to 2001 (USDI 2004). The trends present in days afield mirror participation trends. In 2001, big game hunters spent 153 million days afield, and participated in 114 million hunting trips, for an average of 14 days afield per hunter (USDI 2002). Days afield among big game hunters increased 19% between 1991 and 2001 (USDI 2004). The number of days afield devoted to big game hunting has been increasing for several



years; hunters spent 114 million days in 1980 and 123 million days in 1985 pursuing big game (USDI 1993). From an analysis of days afield, deer hunting remains the most popular big game activity. In 2001, hunters spent 113 million days hunting deer, 23 million days hunting wild turkey, and 3 million days hunting bear (USDI 2004).

The number of days afield by small game hunters decreased 22% between 1991 and 2001 (USDI 2004). In 2001, small game hunters spent 60 million days afield on 46 million hunting trips, averaging 11 days per hunter in the field. Hunters spent 23 million days hunting rabbits, 22 million days hunting squirrels, 13 million days hunting pheasants, 9 million days hunting grouse, and 8 million days hunting quail (USDI 2002). Days afield in pursuit of migratory birds increased 32% between 1991 and 2001 (USDI 2004), reaching 29 million days or an average of 10 days per hunter in 2001. Hunters devoted 18 million days to duck hunting, 11 million days to goose hunting, and 9 million days to dove hunting. Hunters spent 19 million days hunting other animals (i.e., raccoons, groundhogs, foxes, and coyotes), or an average of 18 days per hunter (USDI 2002).

The 1991-2001 trend analysis questioned whether the overall increase in the average number of days afield occurred among all groups or whether one group of hunters was responsible for this increase (USDI 2004). To answer this question, the report measured avidity, using days afield. Avidity was divided into 3 groups: avid, intermediate, and casual hunters. Avid hunters are classified as hunters who hunt >41 days/year. As so categorized, there were 1.2 million avid hunters, who comprised 10% of all hunters in 2001. This group averaged 70 days afield per hunter, which comprised 40% of all days afield (USDI 2004). Avid hunters were present in all hunting options, including big game, migratory bird, small game, and other animal hunting. Other animal (i.e., raccoons and groundhogs) hunting, which contained the largest group of avid hunters, totaled 34% of other animal hunters. In 2001, intermediate hunters, the largest subgroup, include hunters who hunt between 2 and 41 days a year (USDI 2004). Intermediate hunters represented 76% of all hunters and 59% of all days afield, averaging 14 days per hunter in 2001 (USDI 2004). Intermediate hunters represented the largest percentage of hunters in each hunting type (i.e., big game hunting, small game hunting). Casual hunters include hunters who hunt < two days/year. This subgroup represented 13% of hunters in 2001, 11% in 1996, and 16% in 1991. Casual hunters contributed 1% of all hunting days in 2001, compared to 2% in 1991 (USDI 2004).

### Hunting Expenditures

Trends in hunting expenditures mirror the trends observed in hunting participation and days afield. Hunting expenditures remained stable between 1980 and 1990; 1980, 1985, and 1990 expenditures totaled \$12.6 billion, \$10.9 billion, and \$11.7 billion respectively (USDI 1993). Trip-related expenditures increased 23% during the period 1991 to 1996 (USDI 1997). Decoys and game calls, muzzleloaders and other primitive weapons, and hunting dogs and associated costs were the primary factors that contributed to the increases noted between 1991 and 1996 (Brown et al. 2000). In 2001, hunters spent \$20.6 billion on hunting or hunting-related trip expenses, such as food, lodging, and transportation, and on equipment such as guns and rifles, camping supplies, and clothing. Unlike previous reports, costs to lease or own land used for hunting, licenses, and tags now were included in the 2001 expenditure report (USDI 2002). Big game hunters accounted for \$10.1 billion, or close to half of all 2001 expenditures. Small game

hunters, migratory bird hunters, and other animal (i.e., raccoons, groundhogs, foxes, and coyotes) hunters spent \$1.8 billion, \$1.4 billion, and \$0.2 billion, respectively (USDI 2002).

### Hunting License Sales

Monitoring trends in annual hunting license sales is another method used to determine change in hunting participation. Brown et al. (2000) examined hunting license sales data gathered by the U.S. Fish and Wildlife Service from 1970 to 1997. They determined license sales peaked in 1983 and have been decreasing ever since. By 1997, annual hunting license sales had declined to the lowest point recorded during their study. Although hunting license sales have been declining at the national level, license sales at the state level exhibited much variation. Sales in South Carolina, North Dakota, Colorado, and Alaska reached record peaks in 1997, whereas other states experienced sharp declines. In 1997, California hunting license sales had declined 43% from its peak (Brown et al. 2000). Responsive Management (2004) determined approximately 15 million people purchased hunting licenses in 2002. From 1980 to 2002 the number of people who purchased licenses decreased slightly. The number of people purchasing licenses differs from the number of people who participated in hunting (as reported in national surveys) (Responsive Management 2004), indicating that people who purchase a license may not necessarily actively participate in a hunt.

### Hunter Education

Another index of hunting participation and hunter recruitment is information gathered from state hunter education programs. Although most hunter education programs were created in the 1970s, some state hunter education programs arose much earlier. Hunter education program certification is required to purchase a hunting license in all states except Alaska (Brown et al. 2000). From 1985 to 1997, the number of hunters graduating from hunter education programs remained stable nationally. In the East (Bureau of Census regions), the number of graduates from hunter education programs declined 10% between 1991 and 1997. The southern Atlantic states also experienced a 15% decline in graduates during the same period. Other regions experienced increases in the number of hunter education program graduates between 1991 and 1997. The west North Central states experienced an increase of 30% between 1985 and 1997 (Brown et al. 2000).

### Public Land Use

Hunting participation on public-owned land is another important index to examine. In 1991, 2.1 million hunters hunted on public lands exclusively, whereas >4 million hunters used both public and private lands. In 1991, >6 million participants hunted 65 million days on public lands (27% of all days) (USDI 1993). In 2001, 1.9 million hunters used public lands exclusively. Over 5 million hunters hunted 60 million days on public lands (26% of all days) (USDI 2002). The recreational hunting use of public lands follows other hunting trends. For example, in 1991 and 2001, 43% and 37%, respectively, of big game hunters used public land, but only 34% and 35% of small game hunters used public land (USDI 2004). The rate of use of public land by migratory bird hunters was similar to that of small game hunters; 29% and 35% of migratory bird hunters used public land in 1991 and 2001, respectively. Other animal hunters used public-

owned the least of the groups (USDI 2004). Over this 10-year period, overall hunter use of public lands has declined.

## West Virginia Data

### Hunter Numbers

Hunters in West Virginia closely follow national hunter participation trends. In 1991, 342,000 participants hunted in West Virginia; 271,000 resided in West Virginia (USDI 1997). In 1996, 369,000 hunters participated in hunting in West Virginia of which 257,000 resided in West Virginia. In 2001, 284,000 hunters participated in hunting in West Virginia; of this, 235,000 were residents of West Virginia (USDI 2002). Participation in big game hunting in West Virginia declined 13% between 1991 and 2001 (USDI 2004). However, deer hunting remained the most popular hunting activity in West Virginia. In 1996 and 2001, West Virginia deer hunters accounted for 343,000 of 352,000 and 259,000 of 269,000 big game hunters, respectively. In 1996, 117,000 hunters participated in wild turkey hunting in West Virginia; 79,000 did so in 2001. Small game hunters in West Virginia totaled 194,000 and 123,000 in 1996 and 2001, respectively (USDI 1997, USDI 2002). Of the small game hunters in West Virginia, squirrel hunters represented the largest group with 181,000 participants in 1996 and 109,000 in 2001. In 1996 and 2001, 45,000 and 50,000 hunters, respectively, participated in rabbit hunting in West Virginia (USDI 1997, USDI 2002). The number of non-big game hunters declined 36% between 1991 and 2001 (USDI 2004). Sample sizes were too small to determine the exact change in the number of migratory bird and other animal hunters. Responsive Management (2004) reported 33% of a sample of West Virginians (400-person sample size) considered themselves to be a hunter when responding to a survey conducted for the Northeast Conservation Information and Education Association. In contrast, 56% of respondents stated that, in the past five years, either they or someone in their household had gone hunting in West Virginia (Responsive Management 2004).

### Days Afield Hunting

Hunters in West Virginia spent 6.1 million, 6.2 million, and 5.1 million days afield in 1991, 1996, and 2001, respectively (USDI 1997, USDI 2002). West Virginia hunters averaged 17 days afield per hunter in 1996 and 18 days afield per hunter in 2001. Days afield in pursuit of big game declined 6% between 1991 and 2001 (USDI 2004). However, despite the decrease, West Virginia hunters preferred to hunt for big game over all other hunting endeavors, as reflected by days afield hunting, specifically hunting for deer. Hunters in West Virginia spent 3.0 million days hunting deer in 1996 (USDI 1997) and 2.7 million days in 2001 (USDI 2002). Hunters pursuing wild turkeys hunted 0.7 million days in 1996 and 0.3 million days in 2001. The sample size of bear hunters from the national survey was too small to report hunting participation data reliably. However, days afield data for black bear hunting exist for Virginia. Hunters in Virginia spent 102,687 days afield hunting black bear during the 1999-2000 season (VDGIF 2001b); a decrease from 138,931 days afield during the 1994-95 season (Wright and McFarland 1996). The exact cause of the decrease is unknown. A similar trend is expected in West Virginia because of similarities in hunting regulations and black bear habitat. However, hunter effort studies are needed to confirm the trend and to determine the exact cause. Days afield hunting small game totaled 1.7 million days in 1996 and 1.9 million days in 2001. According to

data on days afield, most small game hunters participated in squirrel hunting, spending 1.3 million days afield in 1996 (USDI 1997) and 0.9 million days afield in 2001 (USDI 2002). However, by 2001, rabbit hunting was an equally popular activity, accounting for 0.9 million days afield. Samples sizes were too small to reliably report days afield information for other animal and migratory bird hunting (USDI 2002). Overall, the number of days spent hunting species other than big game declined 11% between 1991 and 2001 (USDI 2004). In West Virginia, the total number of days spent afield hunting is declining, but there have been increases in days afield within certain individual hunting options.

### Hunting Expenditures

Hunting expenditures in West Virginia do not follow national trends. In 1996 and 2001, West Virginians spent \$204 million and \$175 million on hunting, respectively (USDI 1997; USDI 2002). While total expenditures decreased, West Virginia hunters averaged \$652 per spender in 2001 (USDI 2002), an increase of \$591 per hunter over the 1996 average (USDI 1997). Among all hunting expenditures, big game hunters spent the most (\$160 million in 1996, \$132 million in 2001) (USDI 1997, USDI 2002). Small game hunters in West Virginia spent \$26.9 million in 1996 and \$29 million in 2001 (USDI 1997, USDI 2002). Almost half of all hunting expenditures were spent on hunting equipment in both 1996 and 2001. Hunting equipment included guns and rifles, ammunition, archery equipment, telescopic sights, decoys and game calls, and hunting dogs and associated costs (USDI 1997).

### Hunting License Sales

Responsive Management (2003) estimated that approximately 300,000 people purchased West Virginia hunting licenses in 2001. According to this report (Responsive Management 2003), hunting license sales fluctuated between 260,000 and 340,000 during the period 1980-2001. In 1980, 322,534 hunting licenses were purchased, whereas in 1985, 312,320 hunting licenses were purchased (WVDNR 1989b). Brown et al. (2000) reported that West Virginia license sales peaked between 1980 and 1989. By 1997, West Virginia license sales fell to between 75% and 84% of their historic peak (Brown et al. 2000). In 2001, West Virginians spent \$45 million on other equipment, including licenses, stamps, tags, and permits (USDI 2002). For the 2003-2004 fiscal year, West Virginia residents purchased 304,383 hunting licenses, which included general hunting licenses (Class A), antlerless deer hunting licenses (Class N), boar hunting licenses (Class P), additional deer-gun licenses (Class RG), additional deer-bow licenses (Class RB), archery licenses (Class U), muzzleloader licenses (Class V), turkey licenses (Class W), bear damage stamps (Class DS), and migratory waterfowl licenses (Class MW) (WVDNR 2004a). The number of licenses purchased during the 2003-2004 fiscal year is less than the number purchased the previous fiscal year (WVDNR 2003a), but is more than the number of licenses purchased during both the 2001-2002 (WVDNR 2002a) and 2000-2001 fiscal years (WVDNR 2001a). Non-residents of West Virginia purchased 102,346 licenses in West Virginia, including 6-day hunting permits and 3-day small game shooting preserve hunting permits (WVDNR 2004a). Hunting license sales data from 1993-2003 is reported in Appendix C in Tables 1 and 2. Sales have decreased for many resident hunting licenses such as general hunting licenses (Class A), archery-deer licenses (Class U), muzzleloader-deer licenses (Class V), and turkey licenses (Class W). However, license sales have increased during the 10-year period for the following licenses: antlerless deer licenses (Class N), additional deer-gun licenses (Class RG), additional

deer-bow licenses (Class RB), bear damage stamps (Class DS), and migratory waterfowl licenses (Class MW). Non-resident hunting license sales experienced similar trends during the 10-year period.

### Hunter Education

West Virginia has a mandatory hunter education program; all hunters born on or after January 1, 1975 are required to complete the hunter education course before purchasing a license (WVDNR n.d.[g]). During the 2003-2004 fiscal year, WVDNR graduated 8,554 students from 318 classes. According to the annual report, this number of graduates represented an increase in hunter education program participation from the previous year (WVDNR 2004a). During the 2002-2003 fiscal year, 8,194 students graduated from the program (WVDNR 2003a). Over 360,000 students have completed the course since its creation in 1968 (WVDNR n.d.[g]).

### Public Land Use

In West Virginia, public land available for recreational hunting opportunities includes state wildlife management areas, U.S. Forest Service lands, U.S. Fish and Wildlife Service lands, and National Park Service lands. State wildlife management areas encompass 1.4 million acres or 8% of the state land base (WVDNR n.d.[j]). U.S. Forest Service lands include approximately 900,000 acres, much of which is located in the Monogahela National Forest (USDAFS n.d.). The Fish and Wildlife Service offers recreational hunting opportunities at Canaan Valley National Wildlife Refuge, which provides opportunities on approximately 15,000 acres (USDI n.d.[c]). National Park Service lands (Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River) provide opportunities for hunters on approximately 43,000 acres (USDI 2003). In 1996, 51,000 hunters were estimated to exclusively have used public land in West Virginia for hunting (estimate based on small sample size), whereas 122,000 hunters were estimated to have used both private and public lands in West Virginia. About 1.2 million days were spent hunting on public lands in West Virginia in 1996 (USDI 1997). In 2001, 18,000 hunters hunted exclusively on public lands in West Virginia (estimate based on small sample size), whereas both public and private lands were used by an estimate of 52,000 hunters. In 2001, hunters spent 761,000 days hunting in West Virginia on public lands (USDI 2002).

### New River Gorge National River

#### Hunting Patterns and Degree of Hunter Intensity

Mahan (2004) recently stated that no research has yet been conducted to determine hunting patterns and hunter intensity within the boundaries of NERI. However, observed national and state hunting trends as well as information provided by NERI personnel provide useful indications about trends for recreational hunting in NERI. National and state trends suggest big game hunting is more likely to occur than small game hunting within the boundaries. Deer hunting probably is the most popular activity, based in part on historical and current hunter numbers, days afield hunting, and hunting expenditures. National and state trends also suggest that squirrel hunting is the most popular small game activity. Due to small sample sizes within the national surveys, extant information is not sufficient to make firm conclusions about

preferences or intensity of migratory bird hunting and other animal hunting within the boundaries of NERI. Carrico (NPS Law Enforcement Officer, pers. commun. 2005) believed that archery and general firearms seasons were more popular deer hunting activities than were the antlerless and muzzleloader seasons. Carrico (NPS Law Enforcement Officer, pers. commun. 2005, 2006) further suggested that there has been an increase in bear, squirrel, grouse, and rabbit hunting within NERI. Despite the information obtained from these national and state trends surveys and reputable personal knowledge, additional research is required to determine specific hunting patterns and hunter intensity within the boundaries of NERI.

Best Available Information on the Number of Animals Taken per Species per Year within the NERI since 1978, when the Park Was Established (See Appendix D for Tables)

### White-tailed Deer

Estimates of the white-tailed deer harvest are generated via a mandatory checking process. The WVDNR requires hunters to deliver “the unskinned carcass or the fresh skin and head of each deer” to a conservation officer or an official checking station within 72 hours of harvest (WVDNR 2004b:9). Hunters complete a check card, which provides pertinent information to wildlife managers on place or locality of kill (i.e., counties, national forests, or other public lands). However, validity of the check card data relies on the integrity and knowledge of the hunter, specifically knowledge of the differences among public lands and their boundaries. Beginning in 1993, WVDNR provided an option on the check card for hunters to designate the locality of kill as NERI. However, the usefulness of this data relies on the integrity of reporting by the individual and the accuracy of that person’s knowledge of where the boundaries for NERI are located. White-tailed deer harvest estimates typically are reported for the counties within which NERI exists. Table 1 provides white-tailed deer harvest estimates by county for all seasons. The harvest information in Table 1 illustrates an overall increase in white-tailed deer harvests in Fayette, Raleigh, and Summers Counties, except for the 2003 harvest total. The 2003 decrease may be attributed to declines in hunter effort, poor weather conditions, or poor mast conditions; the exact cause is undetermined. Table 2 provides the best estimate of white-tailed deer harvests within the boundaries of NERI. These estimates are calculated using the percentage of county area that falls within NERI and county harvest as a means to extrapolate the percentage of that county’s harvest within NERI’s boundaries. The calculated estimates also have been adjusted to include changes in percentage due to new land acquisitions (See Appendix D). Table 3 provides the total white-tailed deer harvest estimates from Table 1 per season for the 3-county area (Fayette, Raleigh, and Summers Counties). Harvest information in Table 3 illustrates the same trend observed in Table 1, namely that harvest increased until 2003. However, the harvest of antlerless deer continued to increase. This may be a result of WVDNR’s encouragement of hunters and landowners to focus more on antlerless deer harvests as means to promote a healthy, productive deer herd (WVDNR 2003c). Tables 4, 5, 6, and 7 display estimates of the white-tailed deer harvest by county and by hunting season. Tables 4, 5, and 6 reveal an increasing trend in white-tailed deer harvest until 2003. In Table 7, harvest data for antlerless deer in Fayette and Raleigh Counties increases overall, whereas this harvest in Summers County increases only until 2003.

### Black Bear

Estimates of black bear harvest also are calculated through a checking and reporting process. WVDNR requires hunters to transport “the bear or its fresh skin” to a conservation officer or an official checking station within 24 hours of harvest (WVDNR 2004b:25). Table 8 provides a summary of harvest estimates for black bear during the archery season in Fayette, Raleigh, and Summers Counties, whereas Table 9 provides similar information for the firearms season. This data indicates an overall increase in black bear harvests during both the archery and the firearms seasons. Low mast production and availability may have been a contributing factor to the increase in black bear harvests as black bears are known to concentrate in areas of food abundance during such periods of shortage, thereby increasing hunter accessibility (WVDNR

2003c). An overall increase in the size of the statewide black bear population also may be contributing to the increase in harvest. Black bear populations have increased throughout the eastern United States during the past 25-years as a result of harvest management controls, reforestation, public land purchases, and bear restoration efforts (VDGIF 2001a).

### Wild Turkey

Estimates of wild turkey harvest also are calculated through a checking and reporting process. WVDNR requires hunters to deliver the carcass “to an official checking station or a conservation officer before it is either skinned or transported beyond the boundaries of the county adjacent to that in which the kill was made and within 72 hours from when it was killed” (WVDNR 2004b: 22). Table 10 provides a summary of wild turkey harvest by county for the spring gobbler season. This data indicates that wild turkey harvests increased until 2002, when the harvest started decreasing. Both harvest information and biological indicators suggest the wild turkey population in West Virginia is no longer increasing rapidly (WVDNR 2003c). Table 11 provides estimates of wild turkey harvest from within the boundaries of NERI. These estimates are calculated using the percentage of county area within NERI as a means to extrapolate county harvests to determine the percentage of county harvest that occurred within the boundaries of NERI. These estimates have been adjusted to account for changes in acreage percentage due to NPS land acquisitions (See Appendix E).

### Bobcat

WVDNR requires hunters to check all bobcats taken during the hunting season at an official checking station, thereby allowing biologist to estimate overall bobcat harvest (WVDNR 2004b). Table 12 provides estimates of the annual bobcat harvest by county for both hunting and trapping. In West Virginia, hunting accounts for approximately 60% of the annual harvest (Brown 2005). This data reveal fluctuations in the harvest over time, but the exact cause of these fluctuations remains undetermined at this time.

### Small Game Species

Estimates of the small game harvest were calculated by WVDNR from the statewide hunter surveys conducted during the 1980-1981 and 1985-1986 hunting seasons (WVDNR 1982b, WVDNR 1989b). These surveys solicited information on the following small game species: squirrel, rabbit (includes eastern cottontail and snowshoe hare), ruffed grouse, fox, and raccoon. Table 13 provides estimates of the statewide harvest, whereas Table 14 provides estimates of harvest for only District IV, which includes NERI. These data suggest that the harvest of squirrels, rabbits, and ruffed grouse all decreased between the 1980-1981 and the 1985-1986 hunting seasons, whereas the harvest of raccoons and foxes increased during this period. Within District IV, harvest of all species increased during this period (Table 14). Unfortunately, WVDNR has not conducted a statewide hunter survey for almost 20 years, so up-to-date information on small game harvest is limited. Despite this lapse in direct survey data, other sources can provide useful information about small game species. The West Virginia Bowhunter Survey, conducted annually since 1995, provides useful information about several of the small game species. This survey reported a downward trend in squirrel populations based on observation rates. This downward trend may be the result of habitat alteration or loss, but



additional long-term studies are needed to fully document the trend and to determine any underlying causes (Warner et al. 2000). This survey also reported a decline in observations of foxes; again, exact cause of this decline was not reported. No significant changes in raccoon observations were reported, but the data displayed an increase in observations of rabbits. In contrast, the bowhunter survey also revealed a decline in ruffed grouse sightings, perhaps attributed to low brood production (Warner et al. 2000). Extended periods of wet weather in spring and early summer months are known to contribute to low brood production (Evans 2003).

### Migratory Waterfowl

The U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Harvest Surveys Section, collects harvest information for migratory waterfowl through the use of annual hunter surveys and mandatory reporting procedures (e.g., the HIP Program). Table 13, 14, and 15 provide annual estimates of the statewide harvest of migratory waterfowl by species. Due to the small sample size of reports received from West Virginia, this data provides no reliable indication of detectable change in migratory waterfowl harvest and hunting trends.



## Synthesis of Literature Regarding Hunting Impacts in the Eastern United States, Focusing on the Same or Similar Species, Hunting Practices, and Habitats as Found in NERI

### Literature Synthesis

This synthesis of the literature examines key components related to the topic of recreational hunting, and focuses specifically on identifying and assessing what, if any, impacts can be attributed directly to recreational hunting in the eastern United States, and particularly to hunting in New River Gorge National River (NERI). Recreational hunting can be defined as the act of pursuing wildlife for recreational enjoyment (Cocheba 1987). However, hunting is more than just a recreational activity; it is part of one's culture, a means to obtain food, and a tool used by wildlife agencies to manage wildlife populations (Brown et al. 2000). The definition of hunting, the motivations for hunting, and the impacts of hunting have been debated by wildlife professionals, wildlife activists, and hunters. Yet, in recent years, both the scope of the debate and the number and type of participants (a.k.a. stakeholders) involved in the debate have grown, which has added new breadth to the discussion.

We begin our examination of this topic by reviewing the extant literature on impacts of hunting in the eastern United States, focusing particularly on species found within NERI, hunting practices used in the pursuit of these species, and the habitats within which these species exist. We then summarize impacts of recreational hunting on both game species and on non-target species, principally those arising from accidental take. Our review of impacts expands to include an examination of interspecies effects, such as predator-prey relationships and competition for resources. In addition, we examine impacts on plant species and vegetative communities that arise where recreational hunting is allowed or, conversely, precluded or eliminated (e.g., what are the implications of dealing with overabundant wildlife populations?). Finally, we investigate impacts of recreational hunting on other recreational activities (e.g., social conflicts, safety, noise). A thorough assessment of these focal areas is critical to promoting greater understanding of the known and/or anticipated ecological and recreational impacts of hunting within NERI.

We initially provide a brief summary of the literature regarding harvest theory and cultural carrying capacity as means to promote a more thorough understanding of the other information we present and on wildlife management theory in general. To facilitate use of this information, we have constructed our presentation of findings into the following summaries: impacts of hunting on big game, impacts of hunting on small game, impacts of hunting on migratory birds, impacts of hunting on non-target species, and the impacts of hunting on other recreational activities. Each summary includes a review of the literature regarding the impacts of hunting on individual game species, interspecies effects (i.e., predator-prey relationships, competition for resources), and plant and vegetative communities where hunting is allowed or, conversely, precluded or eliminated. To provide a comprehensible review of the associated literature, we separately address the impacts of hunting on non-target species and the impacts of recreational hunting on other recreational activities.

## Harvest Theory

Hunting is a highly visible form of wildlife mortality, one that generates a number of concerns to certain stakeholders. Of particular relevance is concern expressed about the ecological impacts of hunting on individual wildlife species. Wildlife managers and proponents of hunting rely, in part, upon harvest theory to support the practice of hunting, arguing that hunting removes the annual surplus that would die regardless. Robinson and Bolen (1989:172) discuss the underlying principle of harvest theory as follows:

*“Without harvest, growth and recruitment of the population are balanced by natural mortality. ...Hunting reduces the population, but the loss also increases the growth rate. The increase in growth rate is the consequence of higher birth rates and lower death rates, which result from decreased competition for food and resources. ...Thus, the accelerated growth rate provides a surplus of animals beyond the number required for replacing the losses – a surplus that can be harvested.”*

Given this perspective, managers have argued that a regulated harvest provided them the means to avoid driving a species to extirpation (via uncontrolled harvest) and, at the same time, not allow wildlife populations to become overabundant (via adoption of liberal harvest limits). Where human intervention has altered the environment significantly (e.g., alteration or destruction of vegetation, removal of buffer species, elimination of predator species), managers argue that hunting, as expressed through harvest theory, is a necessary form of wildlife management that helps restore balance to these increasingly difficult, yet human simplified, communities (Robinson and Bolen 1989).

Wildlife management that relies upon recreational hunting as the means to harvest animals has been subject to a preponderance of trial and error approaches. Caughley and Sinclair (1994:279) provide additional insight into the underlying principle of harvest theory when they stated

*“...details of sustained yield harvesting differ with whether or not the population’s key resources are renewable or not, how the population uses these resources, and various interactions between the resources and the population.”*

Caughley and Sinclair further discuss methods used to manage the harvest, such as by 1) placing a quota on harvest or 2) regulating harvest effort. Most wildlife management agencies today have adopted regulations that impose harvest quotas because they offer direct control of yield or harvest. Managers typically employ a conservative approach – estimating a maximum sustainable yield (MSY) by using available data, refining these estimates as often as possible, and keeping harvest below MSY, which favors underharvest rather than overharvest (Robinson and Bolen 1989, Caughley and Sinclair 1994). These approaches have worked well with certain species (e.g., species with high growth rates) – many of these species today are classified as game species (Caughley and Sinclair 1994).

Hunter and Runge (2004) discussed harvest theory from the perspective of maximizing harvest for recreational hunting. The prevailing assumption has been that populations can be managed with the intent to harvest the annual surplus, or that MSY will be achieved by a population at equilibrium. However, Hunter and Runge (2004) argue that most naturally-occurring

populations may never attain or function at equilibrium. Instead, they argue for the concept of a state dependent strategy (SDS), one defined as “a set of decisions that define the management action to be taken at each system state (e.g., population state) (Hunter and Runge 2004:585). They believe that an SDS is similar to an MSY approach when the management objective is focused on maximizing the harvest. However, when the wildlife population strays away from equilibrium, the adoption of an SDS approach allows a manager to reduce the uncertainties that arise from imperfect knowledge about the system (structural uncertainty), imperfect monitoring (partial observability), unpredictable environmental effects (environmental variability), and imprecise control of management actions (partial controllability) (Hunter and Runge 2004). Ultimately, by reducing these uncertainties, the manager can minimize costs associated with lost hunting opportunities, stabilize population levels, avoid inconsistent or unnecessary management regulations, and manage the variability with harvest returns (Hunter and Runge 2004).

Historically, wildlife managers shaped management programs around a philosophy of maintaining wildlife populations at or near their biological carrying capacity (BCC), or the maximum level at which a wildlife population in an area is sustainable (Decker and Purdy 1988, Conover 2002). However, recent research efforts in the human dimensions area of wildlife management have led to the development of a more comprehensive and adaptive approach to wildlife management. This approach incorporates a concept of wildlife acceptance capacity (WAC) (Decker and Purdy 1988) or cultural carrying capacity (CCC) (Conover 2002). These concepts are defined as the maximum population level society will accept in a specific area (Decker and Purdy 1988), or the level at which compatible coexistence occurs between a wildlife population and a local human population (Minnis and Peyton 1995). The concept requires that stakeholder acceptance thresholds can be determined based on a variety of available indices, such as tolerance for wildlife damage or nuisance problems associated with a specific species, perceived issues such as competition with other species of interests, or concerns about disease transmission from wildlife species to domestic species. The approach also requires that human values (i.e., economic, aesthetic) associated with specific species be determined (Decker and Purdy 1988) and that sensitivity of local communities to a particular wildlife species be identified (USDA-APHIS 2002). Today, wildlife managers strive to achieve a balance between the use of biological carrying capacity and cultural carrying capacity to increase the effectiveness and acceptance of wildlife management programs (Decker and Purdy 1988, USDA-APHIS 2002).

## Impacts of Hunting on Big Game

### Wild Boar

Wild boars that occur in NERI currently are not considered a part of the managed boar population established by the West Virginia Division of Natural Resources (WVDNR), but instead are viewed as feral domestic animals released by private individuals (Larry Berry, WVDNR District Biologist, pers. commun. 2004, Colin Carpenter, WVDNR District Biologist, pers. commun. 2005). From 1995 to 2000, the number of boars harvested declined from 158 to 46 boars. The number of boars harvested continues to decline. West Virginia hunters harvested only 7 boars during the 2004 season, all from an area within Logan County (WVDNR n.d.[i]). Such a decreasing harvest rate may suggest a decline in the managed boar population, reduced

interest or participation in hunting boar by hunters, or some combination. To ascertain what was driving the falling harvest rate, West Virginia biologists conducted a survey to determine presence or absence of wild boars in Boone, Logan, Raleigh, and Wyoming counties. The survey found that the managed population today was composed of <50 animals. Wildlife biologists attributed this decline to habitat destruction from mountain top mining and logging. They also identified predation, poaching, and a lack of genetic diversity as negative influences on the boar population. However, wildlife biologists did not consider legal recreational hunting to be a contributing factor in the decline (WVDNR n.d.[i]).

Regarding the impacts of recreational hunting of boar on interspecies relationships or plant and vegetative communities, most available evidence examines only the effects that arise when recreational hunting of wild boars is precluded or eliminated. In the Great Smoky Mountains National Park, several studies concluded that unmanaged feral hog populations will alter native plant communities (Bratton 1974; Huff 1977). Wild boars also will compete successfully with native wildlife for available food items (Huff 1977). According to Baron (1982), the presence of unmanaged or competing boar populations makes it difficult to preserve natural ecosystems.

Given this status and the management perspective currently held by WVDNR for this species, we conclude that the impacts of hunting a managed wild boar population in West Virginia, and specifically in NERI, are negligible. Available evidence suggests that interspecies relationships and vegetative communities are not affected negatively by current managed populations. However, the literature strongly suggests that unmanaged (i.e., where harvest is precluded or eliminated) wild and feral boar populations can and do have substantial negative implications on native species and communities of plants and animals.

### White-tailed Deer

Throughout the East, market hunting and habitat destruction reduced white-tailed deer populations to <500,000 deer by the late 1800s. However, following the extirpation of most large, native predator species in the East, the implementation of strict hunting regulations, and the initiation of restocking programs, white-tailed deer populations rebounded and increased to >12 million animals by the 1980s (Robinson and Bolen 1989). As this restoration of white-tailed deer populations was underway, numerous research studies focused on the effects of hunting on white-tailed deer. Early studies examined the effects of hunting on deer movement and most concluded that the spatial distributions of deer did not change during an intensive firearms hunt (e.g., Autry 1967). Other studies examined factors that affect a deer's response to intensive firearms hunting. Pilcher and Wampler (1982) suggested that factors such as rutting behavior, decreasing food sources, and dispersal mechanisms contributed to the expansion of daytime use areas. Other studies (e.g., Dasmann and Taber 1956; Robinette 1966; Whittington 1966; Root et al. 1988) revealed that specific habitat conditions, such as the amount and distribution of cover, dictate how deer respond to hunting. For example, Root et al. (1988) suggested that a deer's response to hunting will vary with location and habitat condition (i.e., the presence of heavy cover allows for more hunters to be accommodated on a parcel and without a corresponding detectable increase in deer response than would occur on a parcel with less cover). VerCauteren and Hygnstrom (1998) examined the effects of muzzleloader hunting on home range size and movement of female white-tailed deer and found that females remained within the original home range during the muzzleloader season, but shifted their pattern of daily use to more restricted

areas that provided the greatest protective cover. Recent studies examined the effects of archery hunting on deer movement patterns, especially in reference to home range. In Connecticut, Kilpatrick and Lima (1999) compared white-tailed deer activity, home range size, daily core-area use, and fidelity to home range between hunted and non-hunted deer before and during a 9-week archery season and found that home range size of hunted and non-hunted deer was unaffected by archery hunting. They also concluded that white-tailed deer retained fidelity to their annual home range even when exposed to hunting pressure; however, they did note that deer shifted daily core-area use to those areas of the range that experienced little or no hunting pressure (Kilpatrick and Lima 1999). Westerhold et al. (1996), when examining the effects of raccoon hunting with hounds on movement and harvest availability of white-tailed deer, found no evidence that this type of raccoon hunting affected the movement, daily core-area use, or harvest availability of deer.

WVDNR recognizes 2 equally important components of white-tailed deer management: harvest management and habitat management. Wildlife managers use deer population indicators (i.e., harvest sex ratios, harvest age ratios, antler size) to adjust the harvest of bucks or does each year to meet management objectives (WVDNR n.d.[d]). In recent years, white-tailed deer populations have exceeded management plan objectives in much of West Virginia, which has led the agency to lengthen seasons and increase bag limits (Wilson 2004).

The literature regarding the impacts of hunting white-tailed deer on interspecies effects (i.e., predator-prey relationships, competition for resources) is not abundant. Our examination of the literature provided little information on the specific identified impacts on interspecies effects attributable directly to hunting white-tailed deer. However, as was discussed in the Introduction, evidence does exist that suggests one can and should anticipate impacts where hunting is precluded or eliminated, especially on interspecies effects. This potentially has important consequences for NERI.

Understanding the potential impacts stemming from the curtailment of hunting deer on the interactions with and between other species is dependent upon an understanding of the processes that occur within ecosystems. Interspecies relationships include both predator-prey relationships and interactions that result from competition for resources (i.e., food, cover). Caughley and Sinclair (1994) defined predation as involving interactions between trophic levels with one species negatively affecting another species. Robinson and Bolen (1989) and Miller et al. (2001) discussed the role of predators in controlling prey populations and concluded that the removal of a predator species and the absence of hunting often initiate complex chain reactions that cause prey populations to expand. In the past, management objectives often included efforts to reduce predator numbers as a means to maintain artificially high numbers of desired game species (e.g., white-tailed deer) (Miller et al. 2001). Locally abundant (perhaps overabundant) prey populations (e.g., white-tailed deer) can arise due to changes in land-use (Martin and Baltzinger 2002), the removal of predators, or the elimination of hunting (Robinson and Bolen 1989; Miller et al. 2001). This new increase in abundance also can and often will influence the distribution and abundance of other species (Martin and Baltzinger 2002). Elevated competition for resources occurs when the needs of wildlife populations, specifically overabundant populations, exceed the availability of resources (Caughley and Sinclair 1994). Klein (1981) found that the declines in diet quality and a decrease in body size associated with overabundant white-tailed

deer populations ultimately increased the vulnerability of these populations to disease, parasites, starvation, and predation. In addition to influencing their own populations, McShea and Rappole (2000) labeled the white-tailed deer a dominant or keystone species because, in addition to the influence they have on their own populations, they also exert a strong trophic effect on other species and communities in the ecosystem. They concluded that protected populations of white-tailed deer, as they become overabundant, significantly can change the composition and abundance of forest bird communities, and thus restructure the entire forest ecosystem (McShea and Rappole 2000).

Our examination of the literature regarding impacts on plants and vegetative communities directly attributed to the hunting of white-tailed deer produced no information. However, we did find information on impacts on plant species and vegetative communities where the hunting of white-tailed deer is precluded or eliminated (i.e., creating overabundant deer populations). Moy-Neir (1981) examined the effects of trampling by overabundant populations of white-tailed deer and identified a number of modifications to soils that arose as a result, such as reduced infiltration and damaged aeration in clay and loam soils, wind and water erosion in sandy soils, and reduced plant re-establishment and growth. Healy et al. (1997; 259) defined white-tailed deer “as overabundant when they limit the abundance or occurrence of other resources or interfere with some valued ecosystem process or human activity.” They believe that the impacts of overabundant deer population are a function of deer densities and forage availabilities. Many studies (e.g., Frost et al. 1997, Shafer and Nolan 1997, Williams et al. 2000) identified heavy browsing by overabundant white-tailed deer populations as a key factor that affects the integrity and species composition of forest ecosystems in the eastern United States. These studies further concluded that heavy browsing by deer also contributed to the potential loss of plant and animal species abundance, a reduction in regeneration and maintenance of representative vegetation, and the alteration of key ecological processes such as nutrient cycling. McShea and Rappole (2000) identified specific changes in species composition and relative abundance of herbaceous and woody plant species that occurred within forested ecosystems where deer were classified as being overabundant. Waller and Alverson (1997) and Martin and Baltzinger (2002) documented changes in absolute and relative abundance of woody plant species as a direct consequence of overabundant white-tailed deer populations. Frost et al. (1997) observed an increase in herbaceous cover and the ability to successfully cultivate historical crops at Gettysburg National Military Park only after a white-tailed deer reduction program was implemented. Brown et al. (2000), in discussing the management of overabundant deer populations, recommended that managers should focus recreational hunting on antlerless deer and conduct site-specific hunts in areas characterized by limited land access.

Management objectives associated with overabundant white-tailed deer populations often become difficult to fulfill as hunting participation and/or effort declines and where participant access to deer populations becomes more restricted or no longer available (e.g., through increased posting of private lands). Reductions in participation brought on by public concern about chronic wasting disease (CWD) have wildlife agencies concerned about their ability to meet management goals (Vaske et al. 2004). CWD, a fatal neurological disease of deer and elk, belongs to a family of diseases known as transmissible spongiform encephalopathies (TSE) (WVDNR n.d.[e]). The similarities between CWD and other TSE diseases (e.g., bovine spongiform encephalopathy or mad cow’s disease) stimulated new research to determine the



extent to which known and potential CWD prevalence, distribution, and human health risks influence hunting participation (e.g., Miller 2004, Needham et al. 2004, Vaske et al. 2004). Research on hunters in 8 states found that if a 5% prevalence of CWD occurred in deer and elk, such a prevalence level would cause some hunters to stop hunting those species in their state (Needham et al. 2004). In Wisconsin, Vaske et al. (2004) found that about half of the licensed hunters in 2001 who did not participate in the 2002 season did so because of concerns about CWD. A survey of Illinois hunters revealed that many might change their hunting behavior due, in large part, to increased caution when hunting in counties adjacent to counties where CWD has been confirmed (Miller et al. 2004).

WVDNR confirmed the presence of CWD in a road-killed deer in Hampshire County, West Virginia, in September 2005. Upon confirmation, WVDNR activated their CWD response plan. The goals of the response plan include 1) determining the prevalence and distribution of CWD, 2) communicating with the public and coordinating with other agencies to address issues relating to CWD, and 3) initiating management actions to control the spread of CWD, prevent further introductions, and possibly eliminate CWD (WVDNR n.d.[b]). After the initial confirmation and activation of the CWD response plan, 3 additional free-ranging deer from Hampshire County tested positive for CWD. With the confirmation of CWD in free-ranging deer, WVDNR now has intensified efforts to collect deer within the surveillance area (WVDNR n.d.[f]).

The literature suggests that when hunting is conducted in accordance with established regulations, whether specifically targeting white-tailed deer or concurrent hunting for other species, there are negligible impacts on white-tailed deer populations. The current white-tailed deer management plan, as administered by the WVDNR, is designed to ensure that hunter-caused mortality of deer within the boundaries of NERI remains well below the level that would jeopardize population stability. However, throughout the mid-Atlantic region and many areas of West Virginia, overabundance of white-tailed deer has become more problematic than scarcity of deer. The literature also suggests that the full impacts of CWD on West Virginia's white-tailed deer population and on hunting participation are unknown at this time. Specific and detailed data on the harvest and population status of deer within NERI are scarce and imprecise; there is a special need for such information. The natural resources assessment for NERI (Mahan 2004) also identified this lack of population and harvest information for white-tailed deer as an important gap in knowledge. Such research would enable NPS personnel to assess potential impacts stemming from an overabundant white-tailed deer population, including the potentially greater impact that may arise should hunting participation continue to decline, or decline more rapidly as a direct result of CWD.

## Black Bear

Many research studies focused on the effects of hunting on mortality and/or survival of black bears. In a study of black bears in Alaska, Mollroy (1972) determined that environmental factors, such as the availability of food and cover, affect the vulnerability of black bears to hunting. Hunting is recognized as the primary form of mortality for bears, given that bears have few natural enemies, other than con-specifics (Bunnell and Tait 1981, Waddell 1984, J. Higgins 1997). Many research efforts (e.g., Kolenosky 1986, Ryan 1997, J. Higgins 1997) reported higher harvest rates of males than females. Because the harvest pressures on females is reduced, the effects of hunting mortality on bear populations overall are minimized (Ryan 1997). J.

Higgins (1997) identified larger home ranges, dispersal patterns (especially among young males), and innate curiosity of males as reasons for a higher harvest rate for males. Ryan (1997) also reported that harvest rates of males were skewed toward juvenile males, which confirmed earlier results from Collins (1973). Increased vulnerability of juvenile males to hunting arises as these individuals disperse after the family unit breaks up (Elowe and Dodge 1989). Ryan (1997) concluded that the long-term effects on the population as a whole of harvesting a greater portion of males (i.e., adults and juveniles) are unknown. K. Higgins (1997) reported that survival rates of female black bears in a hunted population are similar to the survival rates displayed in non-hunted populations in Virginia, suggesting that hunting mortality is not additive in black bears. K. Higgins (1997) speculated that the reluctance of hunters to harvest female bears may explain partially why hunting does not appear to be additive in this species. Research also suggests that the pursuit of black bears with dogs, a practice common to the mid-Atlantic and Southeast regions, has negligible effects on the species (Massopust and Anderson 1984, K. Higgins 1997).

The West Virginia Black Bear Monitoring and Research Study (WVDNR n.d.[a]) relies on demographic information (i.e., reproductive rates) for black bears and forms the basis for how WVDNR establishes and modifies hunting seasons in the state. In WVDNR Districts 4 and 5, wildlife personnel recently increased efforts to assess the effects of newly implemented season modifications. Data from the 2004 harvest indicate that 11 of 35 male research bears and no female research bears were taken (WVDNR n.d.[a]); these reported harvest rates equate favorably with those reported by Ryan (1997) and J. Higgins (1997). The West Virginia Monitoring Study also revealed that the greatest harvest of tagged bears in 2004 (n =12) occurred during the early November dog season. Outside that special season, hunters harvested only 3 tagged bears during the archery season, 0 tagged bears during the late November season without dogs, and 1 tagged bear during the late December season (WVDNR n.d.[a]).

Direct impacts attributed to the hunting of black bear on both interspecies effects (i.e., predator-prey relationships, competition for resources) and on plants and vegetative communities are not reported in the literature. However, there are reports in the literature of impacts on plant species and vegetative communities when hunting of black bear is precluded or eliminated (e.g., overabundant bear populations). Much of the literature focuses on agricultural crop damage attributed to black bears (e.g., Maddrey and Pelton 1995, Garshelis et al. 1999). During periods of food scarcity, black bears use available food sources (i.e., agriculture crops) often causing damage to personal property in their search for food (Parkhurst 1998).

The literature suggests that the hunting of black bears, when conducted in accordance with established regulations, has negligible impacts on black bear populations. The West Virginia Monitoring Study, as administered by the WVDNR, is designed to determine appropriate hunting seasons and to ensure that hunter-caused mortality of bear within the boundaries of NERI remains well below the level that would jeopardize population stability. Specific and detailed data on the harvest and population status of bear within NERI are scarce; there is a special need for such information. The natural resources assessment for NERI (Mahan 2004) also identified this lack of population and harvest information bear as an important gap in knowledge. Such research would enable NPS personnel to assess and minimize the potential impacts associated with existing and future growing black bear populations (i.e., potential conflicts between bears and visitors).

## Wild Turkey

By the 1930s, wild turkeys were extirpated from most of their geographic range. Wildlife managers attempted, but failed, to restore turkey populations during initial restocking efforts because the released breeding stocks were deemed unfit. Success ultimately was attained when managers used wild turkeys that possessed the appropriate genetic lineage adapted to prevalent habitat conditions. Once wild turkey populations successfully were reestablished in the East, wildlife managers exercised extreme caution when setting hunting regulations for this species (Robinson and Bolen 1989). The wild turkey represents an important wildlife resource to West Virginians, as both hunters and non-hunters in West Virginia recognize turkey hunting traditions that date back to the first fall season in 1903 (Pack et al. 1999). However, debate exists over whether hunting directly affects wild turkey populations. Many studies (e.g., Porter et al. 1990, Kurzejeski and Vangilder 1992, Pack et al. 1999, Alpizar-Jara 2001, Norman et al. 2004a) have investigated the effects of hunting on turkeys, but most looked at only fall hunting on wild turkeys. Pack et al. (1999) investigated the outcomes from adopting 3 different harvest management strategies for wild turkey: 1) maximize spring harvest, 2) maximize fall harvest, or 3) some modification or combination of these 2 harvest options. They concluded that, if the goal of a state management agency is to maximize the growth of wild turkey populations and to maximize spring hunting (when hunting pressure is likely to be heavy or lands available for hunting are limited), a permit system may be necessary to regulate harvest during the fall turkey season. Alpizar-Jara (2001) found that a 10% harvest rate during the fall hunt produced the greatest long-term annual yield as well as the greatest seasonal yield. Norman et al. (2004), in their investigation of the effects of fall hunting on wild turkeys, concluded that fall hunting mortality was not additive for male wild turkeys in Virginia and West Virginia.

In addition to assessing the effects of fall hunting on wild turkey populations, some research also focused on the effects of white-tailed deer hunting on the behavior of wild turkeys. When examining the effects of deer hunting on the behavior of wild turkeys, Fold and Marchinton (1980) found no evidence to support the hypothesis that high numbers of deer hunters adversely affected wild turkeys.

West Virginia research and management efforts historically focused on trapping and relocating turkeys to areas with suitable habitat to offset the impacts of predation and illegal hunting. Their efforts resulted in the relocation of 2251 turkeys to 32 counties. Since these efforts, turkey populations have expanded to an additional 7 counties (WVDNR n.d.[h]). In April 2000, the West Virginia Natural Resources Commission approved regulations for fall turkey hunting in traditional and non-traditional counties; traditional counties are those having historical turkey populations or those having a tradition of fall hunting. In these counties, harvest management includes a spring season and a general fall season where hunter numbers are not limited unless turkey populations decline. If a decline occurs, harvest management options include 1) a 1- or 2-week reduction in the fall season length, or 2) use of the non-traditional county form of harvest management. A non-traditional county is one where a wild turkey population arose as the direct result of restoration, the turkey population arose as a result of expansion of an adjoining natural population or a restored population in an adjoining county, or a county that has a turkey population that is too low to withstand unlimited hunter numbers or hunting pressure. Harvest management in non-traditional counties focuses on maximizing spring hunting by limiting fall hunting. Regulations for non-traditional fall-hunted counties provides criteria on when to open a

fall season, how to calculate the number of permits, and when to open a general fall season in a county (WVDNR n.d.[c]). For specific county regulations and seasons, see the West Virginia Hunting and Trapping Regulations Summary.

The literature provided no pertinent information regarding the impacts of hunting wild turkey on interspecies effects (i.e., predator-prey relationships, competition for resources) nor on plants and vegetative communities.

The literature suggests that the hunting of wild turkey, when conducted in accordance with established regulations, has negligible impacts on wild turkey populations. The detailed management plan, as administered by the WVDNR, is designed to ensure that hunter-caused mortality of wild turkey within the boundaries of NERI and elsewhere in the state remains well below the level that would jeopardize population stability. Specific and detailed data on the harvest and population status of wild turkey within NERI are non-existent; there is a special need for such information. The natural resources assessment for NERI (Mahan 2004) also identified this lack of population and harvest information wild turkey as an important gap in knowledge. Such research would enhance understanding and management of the wild turkey program in West Virginia.

### Impacts of Hunting on Small Game

We examined the literature regarding the impacts of hunting on small game. Examined literature focused on the following species: squirrels, raccoons, ruffed grouse, and northern bobwhites. We found no literature regarding the impacts of hunting small game on interspecies effects or on plants and vegetative communities.

#### Squirrel

Historically, gray squirrels were one of the most hunted small game species in the eastern United States (Mosby et al. 1977) and, as a result, much research has been conducted on this species. Although the majority of studies (e.g., Uhlig 1956, Mosby 1969, and Mosby et al. 1977) added much to our understanding about the ecology and habitat needs of these species, these works offer no evidence that legal hunting adversely affects squirrel populations.

#### Raccoon

Hodges (2000) identified raccoon hunting as an important recreational activity in the mid-western and southeastern United States. Summer chase-only seasons exist to increase raccoon hunting recreational opportunities. Recently, proposals have been raised to establish a summer hunting season that would allow harvest at a time when conflicts with other overlapping hunting seasons (i.e., fall white-tailed deer seasons and fall raccoon seasons) could be avoided. Many studies (e.g., Hasbrouck et al. 1992, Chamberlain et al. 1999, Mankin et al. 1999) have investigated the effects of harvest on raccoon populations and most found hunter-caused mortality accounted for over half of total mortality in the species. When investigating the effects of hunting on raccoon behavior and movement, Cantrell (1989) reported that a summer chase-only season did not affect female raccoon movements. Similarly, Hodges (2000) found that

summer hunting (both chase and harvest seasons) did not adversely affect home range demographics of raccoons.

### Ruffed Grouse

Wildlife managers first proposed a compensatory mortality hypothesis for ruffed grouse in the 1930s. Since then, researchers (e.g., Monschein 1974, Kubisiak 1984, Clark 2000, Devers 2005) have debated the nature of hunter-caused mortality in ruffed grouse populations. In recent years, researchers have attempted to provide an explanation for low population levels of ruffed grouse in the Central and Southern Appalachians. In collaboration with the Appalachian Cooperative Grouse Research Project (Norman et al. 2004b), Devers (2005) investigated the effects of hunting on ruffed grouse and reported that harvest mortality accounted for about 12% of total mortality in grouse here in the Appalachian region, indicating that hunting mortality is not additive in this species. Devers (2005) concluded that a harvest rate of  $\leq 20\%$  in the southern and central Appalachian region is compensatory. He also acknowledged that rates of harvest reported in the mid-Atlantic region were much lower than harvest rates cited in other studies (e.g., DeStefano and Rusch 1986, Small et al. 1991). Devers (2005) suggested that wildlife managers and agencies could maintain current rates of harvest in the region, but recommended that efforts to modify hunting seasons or regulations to facilitate an increase in harvest rates should be held in check. Whittaker (2003) reported that, although the regulated harvest alone did not affect ruffed grouse survival directly, it may cause grouse to avoid higher quality habitats, thereby instigating indirect effects attributable to hunting (e.g., risks of increased predation, reduced body condition, decreased survival). Given that grouse populations in the region already are low due to poor habitat quality, Whittaker (2003) and Devers (2005) both recommended that management should focus on improving habitat quality and interspersed as a means to increase food abundance and nest and brood cover.

### Northern Bobwhite

In recent decades, wildlife managers have documented a dramatic decline in northern bobwhite populations. Hunters and non-hunters alike presumed that hunting was responsible for the decline, and many have argued in support of additional hunting restrictions or harvest limitations (Peterson 2001). Historically, bobwhite managers operated under the assumption that hunting mortality for northern bobwhites was compensatory. Research that examined hunter effort revealed that bobwhite hunters tend to wax and wane synchronously with bobwhite abundance, suggesting the presence of a self-regulating response at the state level (Guthery et al. 2004a). Quail managers often assumed that, below some threshold level of harvest, harvest did not affect survival or reproduction (Burger et al. 1995). However, Burger et al. (1995) and Guthery et al. (2004a) believe that hunting, particularly during the late season, is more additive than compensatory. Peterson (2001), in an examination of regulatory changes made in daily bag limits in Texas, found that the outcome from these modifications produced exactly the opposite desired effect—harvest increased when hunting restrictions were needed most whereas harvest tended to be restricted when bobwhites were abundant. Guthery et al. (2004b) believe that harvest is not self-regulating because the ratio of hunters to quail, the efficiency of the average hunter, and the harvest rate all increase when bobwhite abundance declines. It is unlikely that hunting alone is responsible for the observed population decline (Peterson 2001). However,

harvest regulations for northern bobwhite may require further examination if harvest is to be optimized and other management objectives met (Cox et al. 2004).

WVDNR manages small game (i.e., squirrels, raccoons, ruffed grouse, northern bobwhites) populations based on the management philosophy that hunting has little impact on these populations. Despite periodic fluctuations in population numbers associated with habitat quality and food availability, and weather conditions, high reproductive rates in these species typically have minimized any detectable impacts of hunting. Current small game regulations (e.g., bag limits) have allowed more hunters to share in the harvest and discouraged wasting harvest (Wilson 2004).

The literature suggests that legal recreational hunting, conducted in accordance with established regulations, has negligible impacts on small game populations. The current management strategies used by WVDNR, and the results from recent research that examine effects of hunting specifically (i.e., Appalachian Cooperative Grouse Research Project) are designed to ensure that hunter-caused mortality of small game populations within the boundaries of NERI remains well below the level that would jeopardize population stability. Nevertheless, because specific and detailed data on harvest and population status of small game species within NERI are scarce, there is a special need for such information.

### Impacts of Hunting on Migratory Birds

We examined the literature regarding the impacts of hunting on migratory birds. We found no literature that specifically discussed the impacts of hunting migratory birds on interspecies effects or on plants and vegetative communities.

#### Waterfowl

Controversy has existed over the impacts of hunting on duck populations in Canada and the United States for many years (Nieman et al. 1987). Much research effort (e.g., Conroy and Eberhardt 1983, Burnham et al. 1984, Nichols et al. 1984, Hall 1987, Kremenz et al. 1987, Kremenz et al. 1988, Francis et al. 1998) has focused on determining the nature of hunter-caused mortality in mallard and black duck populations. Nichols et al. (1984) reviewed 9 studies and concluded that hunter-caused mortality was compensatory for certain age and sex groups in mallards. Burnham et al. (1984) reported that harvest in males was compensatory, but data for females was inconclusive. Nichols and Hines (1983) concluded that hunter-caused mortality of young female mallards was not consistent with the compensatory hypothesis, but cautioned that it was inappropriate to conclude that hunting represented an additive form of mortality for young female mallards. Burnham and Anderson (1984), in their discussion of additive and compensatory hypotheses for hunting mortality, rejected the hypothesis that hunting mortality was completely additive for mallards. Kremenz et al. (1987, 1988), in their investigations of the role of hunter-caused mortality in black duck populations, concluded that more research was needed to fully evaluate current management strategies for duck populations before making any amendments. Conroy and Eberhardt (1983) believed that hunter-caused mortality in ring-necked duck populations may be partially compensatory, but other factors that may affect mortality cannot be determined adequately through banding studies. Francis et al. (1998) recently

suggested that managers currently lack sufficient evidence to predict how compensatory thresholds may change as a result of varying population densities and available habitat. In a study on the distribution of harvest and harvest regulations, Otis (2004) found that liberal harvest regulations in one geographic location may adversely affect breeding populations of mallards in other geographic areas.

Research on the Canada goose is extensive, but work that examines hunting impacts specifically is limited. Lindberg and Malecki (1994) suggested that populations of resident geese experienced greater vulnerability to hunters than migrant geese, and concluded that imposition of an early season may be appropriate where greater reductions of local goose population are desired on local populations (this study defined “local geese” as those geese that nest south of the 47<sup>th</sup> parallel). Ankney (1996) also supported opening seasons earlier to manage overabundant populations of local geese. Calvert and Gauthier (2005) found that population growth was highly sensitive to changes in adult survival and thus suggested that managers use hunting regulations wisely to manipulate vital rates.

Complications, and perhaps faulty assumptions, are becoming evident where management decisions are being made based solely on the use of banding data to estimate harvest. Trost (1987) recognized that, without an assessment of the validity and accuracy of band-reporting by hunters, band-recovery rates likely are not being adjusted to account for non-reporting by hunters and thus they represent only an index to harvest rates. Nieman et al. (1987) and Trost (1987) both recognized that current estimates of harvest are confounded by the problem of how to handle crippling or wounding loss statistics. Many studies (e.g., Bellrose 1953, Geis and Crissey 1973, Anderson and Burnham 1976, Neiman et al. 1987) have attempted to estimate crippling loss in the United States. Anderson and Burnham (1976) estimated crippling loss to be equal to 20% of the retrieved harvest. Neiman et al. (1987), investigating the relationship between hunter behavior and crippling loss, found that pass shooting (where hunters attempt to shoot birds at extreme distances) crippled more birds than did shooting over decoys. Norton and Thomas (1994) suggested agencies should focus on improving hunter behavior and hunting competency to reduce crippling losses. However, definitive recommendations on how to consistently accommodate crippling or wounding loss into development of sound harvest management remains elusive.

The USFWS uses a system of resource monitoring, data analyses, and rule making to establish waterfowl hunting regulations. Annual monitoring activities include aerial surveys of waterfowl breeding and wintering grounds and hunter questionnaires that provide information on harvest levels, population size, and habitat conditions (USFWS n.d.[a], USFWS n.d.[b]). For example, the USFWS, Division of Migratory Bird Management, Harvest Surveys Section, annually collects harvest information for migratory waterfowl through hunter surveys and a mandatory reporting procedure (the Harvest Information Program [HIP]). However, the setting of appropriate waterfowl harvest regulations remains an inexact science (Nichols and Johnson 1989) and several factors contribute to the uncertainty inherent in this process: 1) the number and complexity of regulations nationwide make it difficult to adequately monitor the effects of any one element of these regulations, 2) the inability to precisely separate harvest effects from environmental effects, especially when regulations are based primarily on prevalent population and habitat conditions, and 3) the limitations of “reductionist science.” To reduce some of this

uncertainty, waterfowl managers have adopted an Adaptive Harvest Management (AHM) strategy. Key components of AHM include: regulatory alternatives available for decision makers and managers, population models that use significance hypothesis testing, reliability measures for each model, and mathematical descriptions or objective functions to evaluate regulatory options (USFWS n.d.[a], USFWS n.d.(b)).

To date, the impacts associated with the hunting waterfowl in West Virginia are unknown. Further, it is very apparent that specific and detailed data on legal harvest and current population status of waterfowl within NERI are scarce to non-existent. Because the number of waterfowl hunters in West Virginia is small overall and the resulting sample size of harvest reports received from West Virginia is equally small, relative to other states, the ability to detect and/or document reliable change in migratory waterfowl populations, based on harvest data and hunting trends, is questionable. With the adoption of the AHM strategy, managers may be better positioned to establish appropriate hunting seasons and ensure that hunter-caused mortality of waterfowl remains well below the level that would jeopardize population stability. Without doubt, this is an area where there is a special need for further research to determine population status and harvest information.

#### Mourning Dove

As cited by Dolton and Rau (2005), both Dunks et al. (1982) and Tomlinson et al. (1988) estimated that mourning dove populations peaked in the 1970s at approximately 475 million individuals. Current USFWS estimates place the national dove population at slightly >400 million birds (Dolton and Rau 2005). Few studies specifically have examined the effects of hunting on mourning doves. In fact, the USFWS (2005) recently restated its concern that reliable harvest estimates are needed to adequately determine the impacts of hunting on mourning dove populations. As means to begin addressing this shortcoming, the USFWS, in cooperation with state wildlife agencies, implemented the HIP in 1992 to provide annual estimates of mourning doves harvests (Dolton and Rau 2005).

Scott et al. (2004) examined harvest rates from urban and rural dove populations in Ohio and found that harvest rates of doves banded in rural areas were greater than harvest rates of doves banded in urban areas.

The literature suggests that we know little about the impacts of hunting on mourning dove populations. Legal recreational hunting, conducted in accordance with established regulations, appears to have negligible impact on the status of mourning doves. Current management programs for mourning doves, which attempt to assess population status, regulate harvest, and improve habitat availability and quality, are designed to establish appropriate hunting seasons and ensure that hunter-caused mortality of mourning doves remains well below the level that would jeopardize population stability. As with most other species discussed previously, specific and detailed data on the current harvest and population status of mourning doves within NERI are scarce; there is need for such information.



## American Woodcock

The primary management objective of the USFWS for the American woodcock is to increase population size to meet both consumptive and non-consumptive demands. The need for dependable population estimates, harvest estimates, and recruitment and distribution data is obvious, yet managers currently are encountering many difficulties when trying to collect this information. Kelley and Rau (2005) identify several important difficulties, but found the inability to locate and count individuals due to their cryptic coloration, their small size, and their preference for densely vegetated habitats as being the most problematic. In the 2005 American Woodcock Population Status Report, singing-ground surveys indicated that woodcock populations were not declining in the eastern region (Kelley and Rau 2005). Annual breeding population indices suggested the actual number of singing males per route were higher than the predicted value (Kelley and Rau 2005).

Legal recreational hunting, when conducted in accordance with established regulations, appears to have negligible impacts on woodcock populations. Management policies adopted by state and federal agencies for woodcock today are based on the best available assessment of population status and regulation of harvest and habitat improvements to ensure that hunter-caused mortality of woodcock remains well below the level that would jeopardize population stability. However, there is much about the American woodcock that are unknown. Specific, detailed data on harvest rates and population status of woodcock, both nationally and within NERI, are not readily available; there is a special need for such information.

### Implications of Lead Shot Contamination in Migratory Birds

Research on the effects of lead shot used for hunting (e.g., Bellrose 1959, Anderson and Sanderson 1987, Rattner et al. 1989, Brewer 2003) has led to regulatory change over the last decade. Bellrose (1959) estimated that 2-3% of all waterfowl died from lead poisoning associated with ingesting spent lead shot. As a result, the USFWS banned the use of lead shot for waterfowl hunting in the U.S. in 1991 (Ringleman et al. 1993, Kelley et al. 1998, USFWS 1999). Further studies (Samuel and Bowers 2000, Stevens et al. 2004) revealed that exposure to residual lead remaining in the environment continued well after the implementation of the non-toxic shot requirements. Stevens et al. (2004) found the incidence of elevated lead contamination in ducks and American woodcock had not yet fallen to zero and provided 3 potential explanations: 1) 100% compliance with non-toxic shot regulations has not been reached, 2) lead shot spent prior to the change in regulations still is available to waterfowl, and 3) sources of lead other than lead shot are responsible for the detected exposures. Additional studies (e.g., Kendall et al. 1996, Thomas 1997) expressed concern that birds in terrestrial ecosystems are exposed to spent lead shot. Kendall et al. (1996) found that ingestion of spent lead shot was a common means of lead exposure for mourning doves. Documented effects of lead exposure include increased mortality, neurological dysfunction, immune suppression, and reproductive impairment (Kendall et al. 1996). Both studies recommended conducting further analysis on non-waterfowl bird population to conclude whether regulatory change is warranted.

### Impacts of Hunting on Non-target Species

Information on direct impacts of hunting on non-target species was not available. Citing this lack of data about the effects of hunting on non-target species, Hofer et al. (1996) concluded that the detection of any sustained impacts attributed to hunting would require a detailed analysis of population trends, demographic parameters, and patterns over time. To date, such analyses have not been conducted. As a result, we must conclude that the impacts of hunting on non-target species remain unknown. Management plans adopted by wildlife agencies and hunter education programs are designed to ensure that the impacts of hunting on non-target species are minimized or avoided. Data on specific impacts attributed directly to hunting on non-target species within NERI do not exist and efforts to generate such information would fill these needs. Accurate estimates of hunter effort would allow NPS personnel to identify any potential impacts and/or impact areas associated with hunting on non-target species.

### Impacts of Hunting on Other Recreational Activities

To gain better understanding of the potential impacts of hunting on other recreation activities, we focused attention on recreation conflicts and conflict management. Numerous studies (e.g., Jacob and Schreyer 1980, Jackson and Wong 1982, Hammitt 1988, Ramthun 1995) have attempted to define recreation conflict and identify factors that influence such conflicts. Jacob and Schreyer (1980: 369) defined recreation conflict as “goal interference attributed to another’s behavior” and start with the base assumption that people recreate to accomplish some desired goal. Hammitt (1988) defined multiple levels of recreation conflict (i.e., visitor to visitor, visitor to management, visitor to community, etc.). According to Hammitt (1988), the factors that underlie recreation conflict include those associated with 1) the recreational activity (i.e., type and style, specialization, mode of travel), 2) the resource (i.e., crowding, possessiveness, and affiliation with resources or resource character), and 3) experience (i.e., user behavior, use patterns, participation motives).

Little research has focused specifically on recreation conflicts associated with hunting. Several studies (e.g., Devall and Harry 1981, Schneider and Hammitt 1995, Vaske et al. 1995, Watson 2001) investigated management implications associated with conflict and provided approaches to identify potential conflict. Devall and Harry (1981) found that recreationists participate in clusters of activities (e.g., shore fishing-boat fishing-hunting-camping) and that conflict arose more often between clusters rather than within clusters. Vaske et al. (1995) and Watson (2001) found that managers often lacked understanding of the social values associated with different users, and the resulting conflicts. Vaske et al. (1995) investigated the frequency and magnitude of conflict (i.e., simple competition over resources, incompatibilities among groups) on Mt. Evans, CO. Their study concluded that natural visual barriers and established hunting regulations (i.e., regulations that prohibit hunting adjacent to roads) minimized interpersonal conflicts between hunters and non-hunters and that conflict associated with hunting-associated events arose primarily from differences in social values. To reduce the likelihood of interpersonal conflict, Vaske et al. (1995) recommended the use of zoning to separate potentially incompatible recreationists. To manage conflict associated with differing values or norms, Vaske et al. (1995) believed that educational programs that focus on enhancing all users’ understanding of wildlife population management may be necessary.

Legal recreational hunting, when conducted in accordance with established regulations and taking full advantage of existing physical and/or visual barriers, is unlikely to impact other recreational activities. However, there are no specific and detailed data on hunting participation, hunter effort (by area within the park), or on documenting conflicts within NERI; there is a special need for such information. The recent natural resources assessment for NERI (Mahan 2004) similarly found a lack of information on hunting participation and hunter effort and deemed this to be an important gap in knowledge. Such research would enable NPS personnel to assess potential conflicts associated with hunting.



## Discussion and Final Synthesis

### General Findings

Since “modern” wildlife management policies and regulations that placed restrictions on recreational hunting first were developed, adopted, and implemented in the early 1920s, there has been no reliable documentation since that any wildlife species that is hunted has been placed in jeopardy or suffered permanent irreparable harm over their range as a direct result of that exploitation. The abolition of some previously common and accepted practices, such as market hunting and year-round harvest without limits, has eliminated significant factors that, in the past, did inflict demonstrated negative effects on population health and stability. However, this is not to say that modern wildlife management is a perfect or exact science, or that issues of some consternation do not exist. The regulatory constraints, primarily in the form of season or area restrictions and bag limits, purposefully are set to err on the conservative side. As has been noted frequently in this document, the underlying foundation of data on which these restrictions and regulations are based comes not from an abundance of readily available field measurements and detailed sampling. Instead, this information often arises from population reconstructions based on harvest data, hunter survey tallies, and other metrics that track population trends rather than actual population status. To conduct the necessary field studies and gather the requisite data annually to establish actual population presence, abundance, and status for all hunted species would require more funds and personnel than any agency currently has access to, assuming that this level of measurement is even possible. Thus, managers must rely upon the best available science and data as they develop and adjust these regulations. Given the track record of agencies to date, this conservative approach, in nearly all cases, has proven to be an effective strategy despite the inherent shortcomings.

Still, there is ample indication that managers have need for better specific and timely data on the status and abundance of hunted species, but especially those that do not attract a high number of hunting participants and those that, by the nature of their behavior, range over wide geographic areas. Without area specific information appropriate to the management unit (often the county level), managers often must rely on available information amassed from general statewide assessments, and that data may not accurately reflect current conditions on a particular local unit. Such is the case with NERI, where this unit is distributed over several counties, each with separate and distinct management goals and objectives and associated regulations. Until only recently, there was no mechanism in place that would allow retrieval of a site-specific tally of harvest from within NERI and, currently, that mechanism is restricted only to white-tailed deer. For all other species, there presently is no effort being made to accurately separate hunter harvest metrics (i.e., species taken, number harvest, effort expended, etc.) achieved within NERI from the broader county-wide reportings. Until such time as a mechanism is developed and implemented, it may impossible to assess with any confidence the exact effects that presently occur within this facility.

An effective assessment of hunting impacts would not be complete if it did not examine the implications associated with available data related to trends in hunter participation and effort and link that data to other emerging patterns. Several areas with special implications are the ability of agencies to meet desired management goals and issues related to access and the amount and

location of lands available to hunting. Clearly, the data indicate that, with several exceptions, the total number of active hunters has declined in recent decades, due in part to the aging of participants, fewer new recruits being attracted to this form of recreation, and people having less ability to participate (less time, economic constraints, etc.). For managers who rely on the recreational hunter to help the agency achieve defined population and management goals and objectives, primarily by fulfilling harvest thresholds, there is concern. The aforementioned regulations are designed with the dual intents of assuring the protection and sustainability of populations while providing recreational opportunity and to balance populations with available prevailing habitat conditions. Seasons and limits can be liberalized as means to increase take, if so desired. However, when the number of participants declines, there is a threshold at which further liberalization will fail to achieve a sufficient take. At that point, managers must find other non-traditional means (i.e., controlled hunts, fertility control methods) to meet population objectives. Although it appears that we have not yet attained that critical level for most managed species, this is a trend that many agencies are watching very closely and they fully understand the implications if and when that point is reached. A complicating, but associated, factor is the current trend of declining access to or availability of lands on which participants can pursue this form of recreation. Postings of private lands, acquisition and/or conversion of lands from those that were hunted in the past to non-hunting uses today, and the continuing spread of human development that precludes safe hunting all contribute to a decline in the amount of area open and available to this recreational activity. In many cases, although the form or type of habitat may change as a direct consequence of these actions, that habitat itself may not be eliminated and healthy wildlife populations can be sustained in these areas. As a result, the ability of managers to successfully achieve desired site-specific objectives becomes more and more difficult where access is limited. Further, this process is placing greater demands on the lands that remain open and accessible, which often are the public lands. Obviously, there are direct implications down the road for NERI given these emerging patterns.

There are two key areas related to impacts from hunting where additional study and thoughtful policy adjustment may be required in the near future, but where we currently lack sufficient knowledge, understanding, or clear direction. These issues are the presence and impact of spent lead in the environment and the measurement and effects of crippling or wounding losses. As was noted in the review of the literature, there is a large body of information about the origin and presence of lead in aquatic environments and on management strategies to cope with the consequences of this material. This is what led to the significant change in policy in waterfowl and shorebird hunting regulations in recent years (i.e., the requirement for use of non-toxic shots). Despite this change, and although the incidence of lead poisoning in aquatic species clearly has declined, recent research suggests that the problem with lead exposure has not abated, given the amount of accessible spent shot still in the environment. The situation in terrestrial habitats, though not as well documented, may be equally serious and likely conveys the same implications to upland species as has been noted in ducks and geese, particularly in areas where hunting is concentrated (e.g., dove hunting). Several researchers have amassed data on terrestrial species that indicate significant lead loads exist and effects are being demonstrated in the health of individuals. However, the links to hunting, versus other lead sources in the environment, are not clear.

The issue of crippling loss is not a new concern. It persists as an issue with no easy answers, yet one that presents many significant challenges, all with potential serious implications. There is no readily available and cost-efficient way to document accurately the extent of crippling or wounding losses by species. Clearly, without such information, estimates of harvest (including other forms of loss) that provide the foundation of hunting regulations will be compromised. Managers traditionally have used what they believe are conservative over-estimates for this form of loss when designing the populations models. However, there is no clear evidence today that these estimates are accurate, particularly across all the species that are hunted. Until such time as biologists are able to more precisely assess the true extent of crippling loss, management policy must remain very conservative. The fact that the sustainability and health of any exploited populations have not been or currently are not jeopardized indicates that this conservative approach has been effective so far. Within NERI, given that waterfowl hunting represents a minor component of the hunting effort overall, and that waterfowl hunting is where most crippling loss has been documented, this likely is an insignificant problem. However, there is much room for improvement and further understanding in this arena.

### Implications for NERI

Based on our review of the extant literature, reports from the WVDNR, information provided by federal natural resource agencies, and information collected through personal communications with NERI and WVDNR personnel knowledgeable about hunting within NERI, it is our conclusion that recreational hunting, when conducted in accordance with all applicable regulations and policies adopted by the responsible management agencies, has not caused any adverse effects on any of the 50 species of mammals or birds that are or may be hunted and that currently occur within the boundaries of NERI. Similarly, we find no evidence to support the position that any other species found within the boundaries of NERI have been affected adversely by hunting. However, our conclusion that hunting has negligible effects on wildlife within the boundaries of NERI is based more upon indirect evidence and professional judgment than upon actual field or research data specific to NERI.

Despite this lack of site-specific data on hunting effort or harvest within NERI, all available indicators point to negligible impacts of hunting. As noted earlier in this report, surveys conducted by the U.S. Fish and Wildlife Service reveal that the number of big game hunters statewide throughout West Virginia declined 13% since 1991 and the number of small game hunters declined 36% during the same time period. Similarly, hunting effort declined 6% for big game and 11% for small game during the period 1991 to 2001. Clearly, with only a few exceptions, the trend for the amount of pressure being exerted on wildlife populations in West Virginia, as a whole, has declined and appears to be continuing to decline. There are no accurate data that reflect trends for participation or effort within NERI specifically, but it is our conclusion that the existing pattern elsewhere in the state likely exists within NERI.

Only 3 of the 50 species that are or may be hunted within NERI currently are being pursued by enough hunters to render some indications of impact, these being white-tailed deer, wild turkey, and Eastern gray squirrel. The increasing abundance of white-tailed deer over the last 50 years throughout the East and the inherent difficulties associated with these increasing populations are well documented. Thus, over-abundance of white-tailed deer represents a more significant problem than scarcity. Therefore, the impacts of *not* hunting deer (e.g., negative impacts on

vegetative communities and some species of birds) are far more likely to be significant than are the impacts attributed to hunting deer. Wild turkey populations also have increased in abundance, both statewide and locally in the vicinity of NERI, due to active management practices for that species, which suggests a lack of obvious impacts attributable to hunting. Although exact population data for squirrels are lacking, there is no credible evidence to suggest that hunting has adversely affected their populations.

Although hunting does not appear to convey any significant impacts on the wildlife resources found within NERI, it potentially may have adverse effects on other types of recreation. Recreationists who perceive that they may be in danger when they share the woods with hunters may choose not to hike, watch wildlife, or engage in other forms of outdoor recreation (Legislative Budget & Finance Committee, Pennsylvania General Assembly 2005). However, reported hunting accidents are rare and, when they do occur, most often they involve members within a hunting party rather than other non-hunting individuals. Given the physiographic arrangement of resources within the park and where the type of activities pursued by recreationists is likely to be located, there appears to be a natural separation between many of the constituent groups. Water-based recreational activities, which are significant in this system, occur well below and, in many cases, are isolated from the areas where hunting would occur, thereby alleviating at least some of the potential conflict. However, conflicts that may arise among other recreationists at NERI are no different or more extensive than those observed elsewhere on public lands.

In summary, it is our conclusion that recreational hunting has negligible impacts on the fauna and flora that exists within the boundaries of NERI. However, there are clear and obvious needs for additional new research and management planning that will produce reliable data that allows managers to adequately assess and monitor populations and ecological systems and fills the existing gaps in our knowledge and understanding of conditions specific to NERI.



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Appendix A. Definition of selected terms used throughout West Virginia hunting regulations (WVDNR 2004b).

*Bait* includes any feed or edible enticement.

*Baiting* is the direct or indirect placing or exposing of bait to attract or entice wildlife to an area where hunters are attempting to take them. An area is considered to be baited for 10 days after bait is removed.

*Big Game* species in West Virginia include *Black Bear, Deer, Wild Turkey, and Wild Boar.*

*Bow* refers to a longbow, a recurve bow, or a compound bow capable of being handdrawn, hand-held and held at full draw without the aid of any mechanical device. Triggering devices or release aids are legal.

*Concurrent hunting* refers to hunting of the same and/or other species during a legally prescribed season.

*A modified bow* is a longbow, a recurve bow, or a compound bow that has been modified to hold the bow at full draw to accommodate a physical impairment of the user.

*A nonresident* is a person who does not meet the requirements of a resident.

*Possession* refers to game that is in any way under the hunter's control. The *possession limit* is the number of animals a hunter can possess at any given time.

*Private lands* are lands owned by an individual(s), partnership, heirship, club, organization or company and/or not qualifying as public land.

*Protected* species have a closed season. Hunting at any time for protected wildlife species is illegal.

*Public lands* are state or federal lands owned, leased, licensed to, or under the control of West Virginia for wildlife management purposes.

*A resident* of West Virginia is a person who has been a domiciled resident continuously in West Virginia for 30 consecutive days or more immediately prior to the date of application for license or permit. This includes members of the U.S. armed forces stationed outside the state who were West Virginia residents at the time of entry into the service or students enrolled full-time in a college or university of West Virginia. However, nonresident students of West Virginia colleges are not eligible to apply for lifetime licenses. Absentee ownership of land in West Virginia does not constitute legal residence.

*Resident landowner* privileges only apply to West Virginia residents who own land in West Virginia, their resident children and parents, or resident tenants. Resident tenants must permanently live on the land.





Appendix B. West Virginia hunting regulations summary tables.

Table 1. Summary of hunting regulations for non-migratory species from the 2004-05 West Virginia Hunting and Trapping Regulations Summary (WVDNR 2004b).

Species	Opening Date <sup>3</sup>	Closing Date <sup>3</sup>	Daily Bag Limit	Possession Limit	Season Limit
Wild Boar within NERI <sup>1,4</sup>	<i>Continuous Open Season</i>	<i>Continuous Open Season</i>	None	None	None
Deer (Archery) <sup>1</sup>	October	December	1	3	3
Deer (Bucks Only) <sup>1</sup>	November	December	1	2	2
Deer (Antlerless) (Split Season) <sup>1</sup>	November/December	December/December	1 <sup>2</sup>	4 <sup>2</sup>	4 <sup>2</sup>
Deer (Muzzleloading) <sup>1</sup>	December	December	1	2 <sup>2</sup>	2 <sup>2</sup>
Bear (Archery) <sup>1</sup>	October	November			
Bear (Gun) <sup>1</sup>	November/December	November/December	1	1	1
Turkey (Spring) <sup>1</sup>	April	May	1	2	2
Squirrel	October	January	6	24	None
Ruffed Grouse	October	February	4	16	None
Bobwhite Quail	November	January	3	9	None
Cottontail Rabbit	November	February	5	20	None
Ring-necked Pheasant	November	January	2	2	None
Raccoon	October	February	4	4	None
Gray Fox, Red Fox	November	February	None	None	None
Bobcat (Hunting and Trapping)	November	February	2	2	2
Crow (Thurs., Fri., Sat.)	September	December	None	None	None
Crow	January	February	None	None	None
Coyote (day)	<i>Continuous Open Season</i>	<i>Continuous Open Season</i>	None	None	None
Skunk, Opossum, Woodchuck, Pigeons	<i>Continuous Open Season</i>	<i>Continuous Open Season</i>	None	None	None

<sup>1</sup>Must be checked at an official checking station.

<sup>2</sup>See West Virginia Hunting and Trapping Regulations Summary for further detail.

<sup>3</sup>See current Hunting and Trapping Regulations summary for specific dates.

<sup>4</sup>See West Virginia Hunting and Trapping Regulations Summary for statewide regulations.

Table 2. Summary of hunting regulations for migratory bird species from the West Virginia Migratory Bird Hunting Regulations. (WVDNR n.d.[k]).

Species	Area	Opening Date <sup>1</sup>	Closing Date <sup>1</sup>	Daily Bag Limit	Possession Limit
Mourning Dove	Statewide	September/ October/ December	October/ November/ January	12	24
Sora & Virginia Rail	Statewide	September	November	25	25
Common Snipe	Statewide	September	December	8	16
Woodcock	Statewide	October	November	3	6
Ducks (except canvasback and pintails)	Zone 1	October/ December	October/ January	6 <sup>2</sup>	6 <sup>2</sup>
Coots	Zone 1	October/ December	October/ January	15	30
Mergansers	Zone 1	October/ December	October/ January	5 <sup>2</sup>	10 <sup>2</sup>
Canada Goose	Statewide	September	September	5	10
Canada Goose	Zone 1	October/ December	October/ January	3	6
Snow Goose	Zone 1	October/ December	October/ January	5	10
Brant	Zone 1	December	January	2	4

<sup>1</sup>See current West Virginia Migratory Bird Hunting Regulations for specific dates.

<sup>2</sup>See West Virginia Migratory Bird Hunting Regulations for further detail.

Appendix C. West Virginia hunting license sales.

Table 1. West Virginia resident hunting license sales by class<sup>1</sup>.

Hunting Licenses <sup>2</sup>	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Hunting (Class A) <sup>3</sup>	72554	70130	65413	63129	N/A <sup>4</sup>	56366	54556	51415	50410	67436	45001
Antlerless Deer (Class N)	93964	75261	76878	90037	N/A	112754	117638	103045	103351	120398	119016
Boar Hunting (Class P)	2503	3236	2917	3088	N/A	2913	2612	2886	181	2053	1093
Additional Deer-Gun (Class RG)	58858	55153	48603	62863	N/A	67711	67642	68982	69365	68734	64704
Additional Deer-Bow (Class RB)	22996	22923	18826	22632	N/A	25741	27263	34516	34452	37661	37859
Archery-Deer (Class U)	11022	10181	9322	8713	N/A	7558	7863	7226	6363	5760	5692
Muzzleloader-Deer (Class V)	3417	3575	3353	3636	N/A	3379	3274	2956	2916	2904	2909
Turkey (Class W)	3347	3148	2849	2497	N/A	1756	1641	1552	1458	1345	1230
Bear Damage Stamp (Class DS)	12094	13385	13591	14566	N/A	17414	19087	20046	23403	24992	26161
Migratory Waterfowl (Class MW)	1053	1453	1521	1536	N/A	1879	2040	1994	2084	1915	1948
Total	281808	258445	243273	272697	N/A	297471	303616	294618	293983	333198	305613

<sup>1</sup>See current Hunting and Trapping Regulations summary for specific license requirements.

<sup>2</sup>Hunting license information does not include combination licenses such as Hunting and Fishing (Class AB).

<sup>3</sup>Hunting (Class A) license refers to hunting and trapping.

<sup>4</sup>License information not available (N/A).

Table 2. West Virginia nonresident hunting license sales by class<sup>1</sup>.

Nonresident Hunting Licenses	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Hunting (Class E)	43166	41619	40532	44204	N/A <sup>2</sup>	42168	41621	39995	42389	42300	41017
Hunting: 6-day (Class H)	1891	1686	1660	1521	N/A	1535	1627	3078	1660	1692	1407
Antlerless Deer (Class NN)	7450	4512	5363	7040	N/A	13916	17284	16089	17208	19589	21223
Bear (Class EE)	220	274	268	299	N/A	250	378	494	471	432	511
Additional Deer- Gun (Class RRG)	12263	11060	11824	13673	N/A	12249	12081	13542	13246	13342	13038
Additional Deer- Bow (Class RRB)	3596	3073	2851	3173	N/A	2973	2916	3336	3365	3457	4008
Archery-Deer (Class UU)	12521	11549	11071	11646	N/A	10063	9793	9293	10327	9658	9524
Muzzleloader-Deer (Class VV)	6822	6649	6276	6459	N/A	5108	4736	4354	4673	4602	4448
Turkey (Class WW)	8386	8800	9224	9637	N/A	7137	6497	6853	6456	6696	6123
Bear Damage Stamp (Class DS)	247	287	207	302	N/A	273	392	330	471	432	541
Migratory Waterfowl (Class MW)	105	121	106	127	N/A	142	169	211	189	162	239
Total	96667	89630	89382	98081	N/A	95814	97494	97575	100455	102362	102079

<sup>1</sup>See current Hunting and Trapping Regulations summary for specific license requirements.

<sup>2</sup>License information not available (N/A).

Appendix D. Game harvest estimate tables for West Virginia, 1978-2003.

Table 1. White-tailed deer harvest by county for all seasons as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Harvest
1978	165	73	270	508
1979	168	64	278	510
1980	172	81	318	571
1981	251	87	428	766
1982	328	115	598	1041
1983	359	137	555	1051
1984	370	159	571	1100
1985	412	195	530	1137
1986	506	222	822	1550
1987	635	378	964	1977
1988	629	334	914	1877
1989	797	396	1017	2210
1990	1079	641	1829	3549
1991	1033	527	1438	2998
1992	1393	807	1571	3771
1993	1469	944	2231	4644
1994	1854	906	1644	4404
1995	1841	1048	1599	4488
1996	2745	1185	2429	6359
1997	3042	1295	2867	7204
1998	2232	1441	2200	5873
1999	2652	1648	2435	6735
2000	2297	1592	2755	6644
2001	2928	1798	3300	8026
2002	4011	1957	5301	11269
2003	3522	2507	3528	9557

Table 2. White-tailed deer harvest by county for all seasons and the proportion of county harvest attributed to NERI (calculated by multiplying percentage of county within NERI for each year by county harvest to determine county [NERI] harvest).

Year	Fayette	Fayette (NERI)	Raleigh	Raleigh (NERI)	Summers	Summers (NERI)	Total Harvest <sup>1</sup>	Total Harvest <sup>2</sup>	Total Harvest <sup>3</sup>
1978	165	12	73	4	270	7	508	23	28
1979	168	12	64	3	278	7	510	23	29
1980	172	12	81	4	318	8	571	26	32
1981	251	18	87	4	428	11	766	34	43
1982	328	24	115	6	598	16	1041	47	59
1983	359	26	137	7	555	14	1051	49	59
1984	370	27	159	8	571	15	1100	52	62
1985	412	30	195	10	530	14	1137	56	64
1986	506	37	222	12	822	22	1550	72	88
1987	635	47	378	21	964	26	1977	94	112
1988	629	48	334	19	914	27	1877	95	110
1989	797	61	396	22	1017	30	2210	114	130
1990	1079	83	641	37	1829	54	3549	175	209
1991	1033	79	527	30	1438	43	2998	153	176
1992	1393	107	807	46	1571	47	3771	201	222
1993	1469	113	944	54	2231	66	4644	234	273
1994	1854	142	906	52	1644	49	4404	244	259
1995	1841	141	1048	60	1599	47	4488	250	264
1996	2745	263	1185	68	2429	72	6359	405	426
1997	3042	292	1295	75	2867	86	7204	453	482
1998	2232	214	1441	83	2200	66	5873	363	393
1999	2652	254	1648	95	2435	73	6735	423	451
2000	2297	220	1592	92	2755	82	6644	395	445
2001	2928	281	1798	104	3300	99	8026	484	537
2002	4011	401	1957	113	5301	159	11269	673	777
2003	3522	352	2507	145	3528	105	9557	603	659

<sup>1</sup>Reported in Table 1.

<sup>2</sup>Calculated by summing columns 3, 5, and 7.

<sup>3</sup>Calculated using the 3-county total acreage and NERI acreage within area to determine percentage; multiplied by Total Harvest<sub>1</sub>.

Table 3. Total white-tailed deer harvest per season for the Fayette, Raleigh, and Summers Counties area as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Firearms Total	Archery Total	Muzzleloading Total	Antlerless Total	Total Harvest
1978	446	62	N/A <sup>1</sup>	N/A	508
1979	441	69	N/A	N/A	510
1980	439	132	N/A	N/A	571
1981	644	122	N/A	N/A	766
1982	846	195	N/A	N/A	1041
1983	856	195	N/A	N/A	1051
1984	919	181	0	0	1100
1985	855	281	1	0	1137
1986	1141	326	27	54	1550
1987	1393	449	28	107	1977
1988	1323	422	26	106	1877
1989	1599	430	78	103	2210
1990	2398	742	108	301	3549
1991	1846	767	111	274	2998
1992	2635	1104	32	0	3771
1993	2579	1403	174	488	4644
1994	2306	1314	457	327	4404
1995	3161	1284	43	0	4488
1996	3065	2056	758	480	6359
1997	3491	1984	863	866	7204
1998	2584	1737	502	1050	5873
1999	2985	1968	612	1170	6735
2000	3300	1877	591	876	6644
2001	4044	2239	680	1063	8026
2002	4074	2782	1305	3539	11269
2003	2882	2113	825	3737	9557

<sup>1</sup>N/A designates a year when the season did not exist.

Table 4. White-tailed deer harvest by county for firearms season as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Firearms Harvest	Total Harvest
1978	158	67	221	446	508
1979	149	59	233	441	510
1980	151	62	226	439	571
1981	226	72	346	644	766
1982	275	99	472	846	1041
1983	305	116	435	856	1051
1984	323	135	461	919	1100
1985	309	153	393	855	1137
1986	403	175	563	1141	1550
1987	499	266	628	1393	1977
1988	487	253	583	1323	1877
1989	618	319	662	1599	2210
1990	842	470	1086	2398	3549
1991	747	374	725	1846	2998
1992	1002	525	1108	2635	3771
1993	965	587	1027	2579	4644
1994	883	553	870	2306	4404
1995	1307	640	1214	3161	4488
1996	1207	645	1213	3065	6359
1997	1379	756	1356	3491	7204
1998	969	622	993	2584	5873
1999	1183	712	1090	2985	6735
2000	1187	810	1303	3300	6644
2001	1474	863	1707	4044	8026
2002	1532	897	1645	4074	11269
2003	1087	753	1042	2882	9557



Table 5. White-tailed deer harvest by county for archery season as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Archery Harvest	Total Harvest
1978	7	6	49	62	508
1979	19	5	45	69	510
1980	21	19	92	132	571
1981	25	15	82	122	766
1982	53	16	126	195	1041
1983	54	21	120	195	1051
1984	47	24	110	181	1100
1985	103	42	136	281	1137
1986	96	46	184	326	1550
1987	135	111	203	449	1977
1988	141	81	200	422	1877
1989	167	73	190	430	2210
1990	233	166	343	742	3549
1991	282	149	336	767	2998
1992	379	275	450	1104	3771
1993	489	346	568	1403	4644
1994	516	345	453	1314	4404
1995	514	395	375	1284	4488
1996	840	524	692	2056	6359
1997	795	528	661	1984	7204
1998	665	528	544	1737	5873
1999	757	631	580	1968	6735
2000	676	607	594	1877	6644
2001	884	677	678	2239	8026
2002	1119	816	847	2782	11269
2003	911	666	536	2113	9557

Table 6. White-tailed deer harvest by county for muzzleloading season as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Muzzleloading Harvest	Total Harvest
1978	N/A <sup>1</sup>	N/A	N/A	N/A	508
1979	N/A	N/A	N/A	N/A	510
1980	N/A	N/A	N/A	N/A	571
1981	N/A	N/A	N/A	N/A	766
1982	N/A	N/A	N/A	N/A	1041
1983	N/A	N/A	N/A	N/A	1051
1984	0	0	0	0	1100
1985	0	0	1	1	1137
1986	5	1	21	27	1550
1987	1	1	26	28	1977
1988	1	0	25	26	1877
1989	12	4	62	78	2210
1990	4	5	99	108	3549
1991	4	4	103	111	2998
1992	12	7	13	32	3771
1993	15	11	148	174	4644
1994	295	8	154	457	4404
1995	20	13	10	43	4488
1996	491	16	251	758	6359
1997	437	11	415	863	7204
1998	235	88	179	502	5873
1999	324	101	187	612	6735
2000	300	87	204	591	6644
2001	290	115	275	680	8026
2002	637	213	455	1305	11269
2003	320	202	303	825	9557

<sup>1</sup>N/A designates a year when the season did not exist.

Table 7. White-tailed deer harvest by county for antlerless season as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports. N/A (non-applicable) designates a year when the season did not exist.

Year	Fayette	Raleigh	Summers	Total Antlerless Harvest	Total Harvest
1978	N/A <sup>1</sup>	N/A	N/A	N/A	508
1979	N/A	N/A	N/A	N/A	510
1980	N/A	N/A	N/A	N/A	571
1981	N/A	N/A	N/A	N/A	766
1982	N/A	N/A	N/A	N/A	1041
1983	N/A	N/A	N/A	N/A	1051
1984	N/A	N/A	0	0	1100
1985	N/A	N/A	0	0	1137
1986	N/A	N/A	54	54	1550
1987	N/A	N/A	107	107	1977
1988	N/A	N/A	106	106	1877
1989	0	0	103	103	2210
1990	0	0	301	301	3549
1991	0	0	274	274	2998
1992	0	0	0	0	3771
1993	0	0	488	488	4644
1994	160	0	167	327	4404
1995	0	0	0	0	4488
1996	207	0	273	480	6359
1997	431	0	435	866	7204
1998	363	203	484	1050	5873
1999	388	204	578	1170	6735
2000	134	88	654	876	6644
2001	280	143	640	1063	8026
2002	723	310	2506	3539	11269
2003	1204	886	1647	3737	9557

<sup>1</sup>N/A designates a year when the season did not exist.

Table 8. Black bear harvest by county for archery season as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Archery Harvest
1988	Closed	Closed	Closed	Closed
1989	Closed	1	Closed	1
1990	Closed	Closed	Closed	Closed
1991	6	5	Closed	11
1992	4	1	Closed	5
1993	6	7	Closed	13
1994	8	6	Closed	14
1995	13	5	Closed	18
1996	13	6	Closed	19
1997	28	26	Closed	54
1998	10	6	Closed	16
1999	21	6	Closed	27
2000	20	11	2	33
2001	23	17	1	41
2002	34	11	4	49
2003	36	15	2	53

Table 9. Black bear harvest by county for firearms season as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Firearms Harvest
1988	9	10	Closed	19
1989	Closed	6	Closed	6
1990	1	Closed	Closed	1
1991	2	1	Closed	3
1992	2	1	Closed	3
1993	10	9	Closed	19
1994	7	9	Closed	16
1995	7	3	Closed	10
1996	9	10	Closed	19
1997	1	2	Closed	3
1998	21	14	Closed	35
1999	17	9	Closed	26
2000	21	26	Closed	47
2001	24	21	Closed	45
2002	51	29	Closed	80
2003	83	64	Closed	147

Table 10. Wild turkey harvest by county for spring gobbler as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports.

Year	Fayette	Raleigh	Summers	Total Harvest
1978	3	2	21	26
1979	7	0	32	39
1980	19	8	42	69
1981	37	19	71	127
1982	38	45	105	188
1983	67	48	131	246
1984	72	69	155	296
1985	160	104	209	473
1986	167	121	271	559
1987	165	150	299	614
1988	254	197	305	756
1989	235	222	337	794
1990	339	265	503	1107
1991	331	335	487	1153
1992	363	343	464	1170
1993	359	381	428	1168
1994	330	377	458	1165
1995	376	423	550	1349
1996	347	464	466	1277
1997	319	336	441	1096
1998	303	294	351	948
1999	275	253	352	880
2000	275	300	345	920
2001	408	387	368	1163
2002	344	318	302	964
2003	309	294	254	857

Table 11. Wild turkey harvest by county for spring gobbler season and the proportion of county harvest attributed to NERI (calculated by multiplying percentage of county within NERI for each year by county harvest to determine county [NERI] harvest).

Year	Fayette	Fayette (NERI)	Raleigh	Raleigh (NERI)	Summers	Summers (NERI)	Total Harvest <sup>1</sup>	Total Harvest <sup>2</sup>	Total Harvest <sup>3</sup>
1978	3	0	2	0	21	1	26	1	1
1979	7	1	0	0	32	1	39	1	2
1980	19	1	8	0	42	1	69	3	2
1981	37	3	19	1	71	2	127	6	4
1982	38	3	45	3	105	3	188	8	6
1983	67	5	48	3	131	4	246	11	7
1984	72	5	69	4	155	4	296	13	9
1985	160	12	104	6	209	6	473	23	12
1986	167	13	121	7	271	7	559	27	15
1987	165	12	150	8	299	8	614	29	17
1988	254	20	197	11	305	9	756	40	18
1989	235	18	222	13	337	10	794	41	20
1990	339	26	265	15	503	15	1107	57	30
1991	331	25	335	19	487	15	1153	60	29
1992	363	28	343	20	464	14	1170	62	27
1993	359	28	381	22	428	13	1168	63	25
1994	330	25	377	22	458	14	1165	61	27
1995	376	29	423	25	550	17	1349	70	32
1996	347	33	464	27	466	14	1277	74	31
1997	319	31	336	19	441	13	1096	63	30
1998	303	29	294	17	351	11	948	57	24
1999	275	26	253	15	352	11	880	52	24
2000	275	26	300	17	345	10	920	54	23
2001	408	39	387	22	368	11	1163	73	25
2002	344	34	318	18	302	9	964	62	21
2003	309	31	294	17	254	8	857	56	18

<sup>1</sup>Reported in Table 10.

<sup>2</sup>Calculated by summing columns 3, 5, and 7.

<sup>3</sup>Calculated using the 3-county total acreage and NERI acreage within area to determine percentage; multiplied by Total Harvest<sub>1</sub>.

Table 12. Bobcat harvest by county for both hunting and trapping as collected by the West Virginia Division of Natural Resources and reported in the West Virginia Division of Natural Resources Annual Big Game Reports and for hunting only (adjusted).

Year	Fayette		Raleigh		Summers		Total Harvest	
	Total	Adjusted <sup>1</sup> (60%)	Total	Adjusted <sup>1</sup> (60%)	Total	Adjusted <sup>1</sup> (60%)	Total	Adjusted <sup>1</sup> (60%)
1979	33	19	37	22	19	11	89	52
1980	39	23	27	16	13	7	79	46
1981	17	10	13	7	13	7	43	24
1982	50	30	38	22	21	12	109	64
1983	24	14	24	14	6	3	54	31
1984	24	14	23	13	11	6	58	33
1985	32	19	30	18	13	7	75	44
1986	21	12	47	28	15	9	83	49
1987	47	28	22	13	24	14	93	55
1988	17	10	14	8	5	3	36	21
1989	13	7	8	4	3	1	24	12
1990	18	10	6	3	7	4	31	17
1991	6	3	0	0	1	0	7	3
1992	9	5	3	1	10	6	22	12
1993	8	4	17	10	7	4	32	18
1994	22	13	23	13	7	4	52	30
1995	20	12	16	9	7	4	43	25
1996	36	21	9	5	10	6	55	32
1997	21	12	11	6	10	6	42	24
1998	14	8	10	6	15	9	39	23
1999	24	14	13	7	16	9	53	30
2000	18	10	16	9	17	10	51	29
2001	43	25	27	16	21	12	91	53
2002	46	27	28	16	17	10	91	53
2003	39	23	30	18	32	19	101	60

<sup>1</sup>An estimate of percent of harvest attributed to hunting (Cliff Brown , WVDNR Wildlife Manager, Personal Communication).

Table 13. Estimates of West Virginia small game harvest, as derived from West Virginia Division of Natural Resources statewide hunter surveys and small game bulletins.

Species	1980 Harvest	% Error <sup>1</sup>	1985 Harvest	% Error <sup>1</sup>
Squirrel	1,833,966	2	1,639,331	1.03
Rabbit	493,336	4	404,061	2.02
Ruffed Grouse	188,738	5	138,327	2.22
Fox	12,534	15	12,783	6.05
Raccoon	105,637	9	132,269	3.3

<sup>1</sup>The estimate  $\pm$  percent error yields a 95% confidence level.

Table 14. Estimates of District IV small game harvest, as derived from West Virginia Division of Natural Resources statewide hunter surveys and small game bulletins.

Species	1980 Harvest	% Error <sup>1</sup>	1985 Harvest	% Error <sup>1</sup>
Squirrel	253,133	6	353,804	5.05
Rabbit	92,699	9	93,694	9.68
Ruffed Grouse	29,737	12	39,869	10.27
Fox	961	42	1,246	72.10
Raccoon	17,321	19	28,685	14.19

<sup>1</sup>The estimate  $\pm$  percent error yields a 95% confidence level.



Table 15. Migratory waterfowl harvest by species in West Virginia as collected by the Harvest Surveys Section, Division of Migratory Bird Management, U.S. Fish and Wildlife Service.

Year	American Wigeon	Black Duck	Black X Mallard	Blue-winged/Cinnamon Teal	Bufflehead	Canada Goose	Canvasback	Domestic Mallard	Gadwall
1978	78	1518	65	516	104	118	0	111	83
1979	55	1635	36	626	60	242	0	97	0
1980	32	820	32	382	40	315	0	72	0
1981	32	1212	138	0	64	747	75	477	32
1982	35	486	0	390	20	372	20	188	35
1983	0	476	0	396	28	274	0	17	73
1984	37	339	40	98	74	657	0	131	81
1985	19	666	19	19	0	417	0	38	73
1986	25	683	0	128	80	820	0	129	25
1987	20	469	8	40	44	528	0	8	28
1988	0	360	0	0	0	1076	0	0	24
1989	42	178	0	30	67	1974	0	49	11
1990	18	508	75	18	0	896	0	230	0
1991	22	50	31	9	0	910	0	137	9
1992	0	199	0	66	0	2160	0	22	0
1993	55	253	27	0	0	3647	0	27	0
1994	0	411	71	179	71	5863	0	71	71
1995	0	203	0	797	0	3181	0	44	32
1996	54	320	24	263	24	4325	0	0	0
1997	79	48	24	1878	0	7339	0	0	397
1998	0	178	0	178	0	7734	0	0	178
1999	0	26	69	161	23	5985	0	46	115
2000	171	555	0	207	42	4375	0	85	85
2001	60	275	30	301	0	7307	0	0	0
2002	38	609	114	152	0	5200	0	74	0
2003	21	403	21	63	21	4200	21	0	21

Table 15. Migratory waterfowl harvest by species in West Virginia as collected by the Harvest Surveys Section, Division of Migratory Bird Management, U.S. Fish and Wildlife Service (continued).

Year	Goldeneyes	Greater Scaup	Green-winged Teal	Hooded Merganser	Lesser Scaup	Mallard	Northern Pintail	Northern Shoveler	Other Ducks
1978	137	32	71	32	32	3402	32	0	0
1979	0	0	91	91	0	1995	352	18	0
1980	40	325	585	0	186	1783	72	0	0
1981	70	0	287	0	32	2957	70	0	0
1982	0	0	40	0	99	1538	70	0	0
1983	68	0	90	0	45	1592	0	0	17
1984	0	0	77	57	168	1531	20	37	0
1985	19	0	58	27	46	752	0	0	0
1986	0	0	52	107	51	1988	0	0	26
1987	28	8	110	8	8	1256	20	0	20
1988	0	0	121	73	0	1462	0	0	0
1989	0	19	42	54	23	842	11	0	0
1990	74	0	113	57	0	2157	0	0	0
1991	0	0	22	67	0	875	0	0	0
1992	0	0	22	44	0	1092	0	0	0
1993	0	0	82	55	0	1900	0	0	0
1994	0	0	270	0	0	1829	0	89	0
1995	0	0	133	44	0	1778	0	0	0
1996	0	65	29	144	0	1836	0	0	0
1997	0	0	350	24	87	2986	48	111	0
1998	0	0	300	0	0	2343	0	0	0
1999	0	0	185	92	23	2151	0	0	0
2000	0	0	128	42	0	2737	12	0	0
2001	0	0	0	0	129	3496	0	0	0
2002	0	0	342	38	0	3883	0	0	0
2003	42	0	84	0	21	2484	21	0	0

Table 15. Migratory waterfowl harvest by species in West Virginia as collected by the Harvest Surveys Section, Division of Migratory Bird Management, U.S. Fish and Wildlife Service (continued).

Year	Other Geese	Other Merganser	Redhead	Ring-necked Duck	Ruddy Duck	Scoter	Snow Goose	White-footed Goose	Wood Duck
1978	0	0	71	0	0	0	0	0	2676
1979	0	0	0	0	0	121	0	0	4720
1980	0	0	0	40	0	157	0	105	5073
1981	0	105	0	75	0	0	0	0	4432
1982	0	0	0	253	0	0	0	0	4028
1983	0	17	17	56	0	0	0	0	3176
1984	0	0	0	267	20	0	0	0	3984
1985	0	0	0	19	0	0	0	0	1951
1986	0	148	0	25	0	0	0	0	2244
1987	0	0	0	48	20	8	0	0	2226
1988	0	0	0	24	0	0	67	0	2569
1989	0	30	0	58	0	0	0	0	2407
1990	0	18	0	0	0	0	0	0	2741
1991	0	0	0	9	37	0	0	0	1864
1992	0	22	0	0	0	0	0	0	2147
1993	0	0	88	0	0	0	0	0	2864
1994	0	0	0	0	0	0	0	0	2010
1995	0	0	0	0	0	0	0	0	2235
1996	0	0	0	54	0	0	0	0	1592
1997	64	0	0	0	0	0	0	0	6120
1998	0	0	0	0	0	0	0	0	4674
1999	46	0	0	0	0	0	0	0	2151
2000	28	12	0	214	0	0	0	0	2151
2001	0	0	30	30	0	0	0	0	2187
2002	0	38	0	0	0	0	0	0	2208
2003	0	0	21	0	0	0	0	0	1550



Appendix E. Acres of land within the boundary of New River Gorge National River in Fayette, Raleigh, and Summers Counties, WV.

Counties	1978-1987	1988-1995	1996-2001	2002-Present
Fayette	31932	32647	40734	42457
Raleigh	21835	22550	22758	22758
Summers	6233	6947	6974	6974



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