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Habitat Selection of Male Eastern Wild Turkey (*Meleagris gallopavo silvestris*) in West Virginia

Jesse L. De La Cruz

**Thesis submitted to the
Davis College of Agriculture, Natural Resources, and Design
at West Virginia University
in partial fulfillment of the requirements
for the degree of**

**Master of Science
in
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**Division of Forestry and Natural Resources
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ABSTRACT

Habitat Selection of Male Eastern Wild Turkey (*Meleagris gallopavo silvestris*) in West Virginia

Jesse L. De La Cruz

Eastern wild turkeys (*Meleagris gallopavo silvestris*) have been the focus of widespread research throughout their range, but research on male wild turkey home range size and habitat resource selection is limited in West Virginia. To address this lack of knowledge, I proposed the quantification of home range within a region (second-order) and core home range within a periphery (third-order) resource selection. Home ranges estimates and regional vector sampling grids were modeled against anthropomorphic land use and landscape cover features, land fragmentation, slope, and aspect raster data within the Geospatial Modeling Environment (GME) to derive proportional resource use and availability data. These data were analyzed by compositional analysis (CA) for 2 study areas in West Virginia. I estimated statewide and District I Study Area (DISA), located in the counties of Harrison, Marion, and Taylor, 50% and 95% adult and juvenile UD home range sizes both annually and seasonally. Additionally, I analyzed statewide and DISA second- and third-order resource selection for adults and juveniles both annually and seasonally.

West Virginia Division of Natural Resources personnel monitored 55 radio-equipped male wild turkeys from September 2004 through August 2007 in West Virginia. I found that statewide adult ($\bar{x} = 1,409.9$ ha, SE = 180.3) and juvenile ($\bar{x} = 1,394.3$ ha, SE = 146.6) annual statewide 95% UD home ranges were similar ($P = 0.78$). I also found that statewide adult ($\bar{x} = 310.3$ ha, SE = 38.7) and juvenile ($\bar{x} = 320.6$ ha, SE = 190.3) annual 50% UD home ranges were also similar ($P = 0.56$). My analysis indicated that adult 50% UD home ranges were similar across seasons ($P = 0.68$) and averaged: fall - 220.2 ha, SE = 33.8, fall-winter - 241.8 ha, SE = 43.5, spring - 163.0 ha, SE = 12.7, spring-summer - 199.0 ha, SE = 26.9, and winter - 211.6 ha, SE = 56.7. I also found that adult 95% UD home ranges were similar across all seasons ($P = 0.54$) and averaged: fall - 858.2 ha, SE = 119.8, fall-winter - 1,046.6 ha, SE = 174.8, spring - 685.6 ha, SE = 66.3, spring-summer - 821.8 ha, SE = 106.3, and winter - 927.6, SE = 238.5. I found that juvenile 50% UD home ranges were similar between seasons ($W = 80$, $P = 0.08$) and averaged: spring - 142.1 ha, SE = 15.5 and spring-summer - 97.0, SE = 10.7. Juvenile 95% UD seasonal home ranges were also similar between seasons ($P = 0.17$) and averaged: spring - 800.2 ha, SE = 123.8 and spring-summer - 543.8 ha, SE = 85.0. Adult ($\bar{x} = 1,515.3$ ha, SE = 368.0) and juvenile ($\bar{x} = 1,323.3$ ha, SE = 190.1) annual DISA 95% UD home ranges were similar ($P = 0.59$). I also found that adult ($\bar{x} = 327.2$ ha, SE = 79.2) and juvenile ($\bar{x} = 310.8$ ha, SE = 46.1) annual DISA 50% UD home ranges were similar ($P = 0.69$). My home range results fell within those reported by other male eastern wild turkey studies, but particularly those located in heavily forested areas.

Annual statewide adult second-order land use and land cover resource selection was primarily for forest ($P = 0.001$) while juvenile selection was for forest roads ($P = 0.001$). My analysis also indicated annual statewide adult third-order land use and land cover resource selection was for forest ($P = 0.001$) while juvenile selection was for crop ($P = 0.001$). Seasonal adult statewide third-order land use and land cover resource selection was: spring - forest ($P = 0.12$), fall - forest ($P = 0.05$), winter - forest ($P = 0.79$), spring-summer - forest ($P = 0.02$), and fall-winter - forest ($P = 0.04$). I found that seasonal DISA juvenile third-order land use and land

cover resource selection was: spring – crop ($P = 0.003$), and spring-summer – crop ($P = 0.01$). I also found that both annual statewide adult ($P = 0.001$) and juvenile ($P = 0.001$) second-order land fragmentation resource selection was primarily for edge. The analysis indicated that annual statewide adult third-order land fragmentation resource selection was primarily for perforations ($P = 0.006$) while juvenile selection was still for edge ($P = 0.003$). Seasonal adult statewide third-order land fragmentation resource selection was: spring – edge ($P = 0.39$), fall – edge ($P = 0.03$), winter – perforations ($P = 0.64$), spring-summer – edge ($P = 0.51$), and fall-winter – edge ($P = 0.03$). I found that seasonal DISA juvenile third-order land fragmentation resource selection was: spring – perforations ($P = 0.003$), and spring-summer – perforations ($P = 0.006$). My analysis also indicated that annual statewide adult second-order slope resource selection was primarily for > 24 – 35% gradients ($P = 0.001$) and juvenile selection was for > 6 – 24% gradients ($P = 0.001$). Annual statewide adult third-order slope resource selection was for > 24 – 35% gradients ($P = 0.001$) and juvenile selection was still for > 6 – 24% gradients ($P = 0.02$). I found that seasonal adult statewide third-order slope resource selection was: spring – > 6 – 24% ($P = 0.19$), fall – > 6 – 24% ($P = 0.004$), winter – 0 – 6% ($P = 0.84$), spring-summer – > 6 – 24% ($P = 0.05$), and fall-winter – > 24 – 35% ($P = 0.21$). I found that seasonal DISA juvenile third-order slope resource selection was: spring – 0 – 6% ($P = 0.004$), spring-summer – > 6 – 24% ($P = 0.006$). My analysis indicated that annual statewide adult second-order aspect resource selection was not significant ($P = 0.20$) while juvenile was for westerly slopes ($P = 0.001$). Furthermore, my analysis showed that both annual statewide adult ($P = 0.53$) and juvenile ($P = 0.12$) third order slope resource selection was not significant. I found that seasonal adult statewide third-order aspect resource selection was: spring – west ($P = 0.28$), fall – west ($P = 0.79$), winter – east ($P = 0.40$), spring-summer – west ($P = 0.53$), and fall-winter – east ($P = 0.60$). While seasonal DISA juvenile third-order aspect resource selection was: spring – east ($P = 0.006$), and spring-summer – east ($P = 0.24$).

Within the DISA annual adult second-order land use and land cover resource selection was primarily for crop ($P = 0.02$) while juvenile was for pasture-field ($P = 0.001$). However, my analysis indicated that annual DISA adult third-order land use and land cover resource selection was insignificant ($P = 0.18$); juvenile selection was for crop ($P = 0.001$). I found that both annual DISA adult ($P = 0.02$) and juvenile ($P = 0.001$) second-order land fragmentation resource selection was for edge. Similarly, I found that annual DISA adult third-order land fragmentation select was also for edge ($P = 0.02$) while juvenile selection was for perforations ($P = 0.001$). My results indicated that annual DISA adult second-order slope resource selection was not significant ($P = 0.26$) while juvenile selection was for > 6 – 24% gradients ($P = 0.003$). Similarly, I found that annual DISA adult third-order slope resource selection to be not significant ($P = 0.09$) while juvenile selection was still for > 6 – 24% gradients ($P = 0.002$). I found that annual DISA adult second-order aspect resource selection was for easterly facing slopes ($P = 0.04$) while juveniles aspect selection was not significant ($P = 0.09$). However, I found that annual DISA adult third-order selection of aspect resources was marginally significant for westerly facing slopes ($P = 0.05$); juveniles showed a marginal selection of easterly facing slopes ($P = 0.05$). Despite the amount of contiguous forest in West Virginia, male wild turkeys are selecting more edge habitats than are proportionally available. Land managers should concentrate on providing such multilayer habitats through planting, cutting, mowing, or even passive management to provide diverse food sources, escape cover, travel corridors, and mating display areas for male wild turkey in West Virginia.

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“...and that he is the maker of his character, the moulder of his life, and the builder of his destiny, he may unerringly prove, if he will watch, control, and alter his thoughts, tracing their effects upon himself, upon others, and upon his life and circumstances, linking cause and effects by patient practice and investigation, and utilizing his every experience, even to the most trivial, everyday occurrence, as a means of obtaining that knowledge of himself which is Understanding, Wisdom, and Power.” - James Allen, *As a Man Thinketh*

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Chapter 1

Introduction and Justification for a Male Wild Turkey Home Range Estimate Based Resource Selection Study in West Virginia

Introduction and Justification

Eastern wild turkeys (*Meleagris gallopavo silvestris*) are an important game species to outdoor enthusiasts and as a prey species for natural predators throughout its range (Kennamer and Kennamer 1995). Between 1902 and 1925 in West Virginia, the peak era of logging activities, wild turkey could only be found in the most remote mountainous regions of the state (West Virginia Department of Natural Resources 1985). Despite being driven nearly to extirpation in the past by extreme logging practices and unregulated hunting, the wild turkey is now found in every county of West Virginia (West Virginia Department of Natural Resources 1985). Due to a successful reintroduction, all 55 counties currently hold a regulated spring bearded turkey (i.e., gobbler) season with certain counties, within the traditional mountainous range, providing fall either sex turkey hunting.

An understanding of habitat selection at multiple temporal and spatial scales for various age classes is vital for the management of wild turkey populations. Despite extensive scientific inquiry on wild turkey in West Virginia research on male turkey is lacking, including habitat selection at specific life stages. In attempts to better understand the dynamics of the wild turkey population, in September 2004, the West Virginia Division of Natural Resources and the Virginia Department of Game and Inland Fisheries initiated the Mid-Atlantic-Gobbler Study (MAGS). The primary goal of MAGS was to determine survival rates of male wild turkey and the impacts of hunting. Despite originally being designed as a study of mortality, MAGS

provided a unique opportunity to examine home ranges and their associated habitat resource composition. Starting in September 2004 and continuing to August 2007 radio telemetry locations were collected and later used to quantify home range estimates and habitat selection and use of male wild turkey throughout West Virginia.

The area in which an animal lives is its home range (Smith 1974). Habitat use and selection is not mere chance, Aebischer et al. (1993) explains that non-random movement “...determine(s) a trajectory through space and time; its habitat use is the proportion of the trajectory contained within each habitat...an extension of the trajectory is the home range.” Knowledge of home range use and selection is vital in establishing habitat requirements and for providing management recommendations. Furthermore, effective management requires sex and age specific understanding of habitat selection at multiple temporal and spatial scales (Tirpak et al. 2010). Past research of such mechanisms that affect the selection and continued use of home ranges has laid the foundation for current investigation. It is known that individuals that display wide-ranging movements within parts of an annual home range risk reduced survival and costly increased time required for relocation (Gauthreaux 1982, Ketterson and Nolan 1983, Badyaev et al. 1996a). However, better familiarity of an area can improve foraging efficiency, predator evasion, and reproductive success (Myers 1981, Ketterson and Nolan 1983, Schieck and Hannon 1989, Beletsky and Orians 1991, Badyaev et al. 1996a) and is often a key influence contributing to social dominance (Dhindsa et al. 1989, Koivula et al. 1993). Specifically, turkey social status is determined largely by age with young individuals being subordinate to older individuals (Healy 1992, Badyaev et al. 1996a) and inquiry into habitat use and selection should reflect this knowledge.

Anthropomorphic disturbance is at the heart of ever changing natural systems. The development of urban areas, ecological intervention, and an ever evolving system of values are the main reasons for today's dynamic landscape. Following the deforestation period of the early 1900s in the Eastern United States, for the production of timber and farmland, much of the wild turkey restoration movement took place in areas deemed uneconomical as agricultural land (Porter et al. 2011). These abandoned parcels thus reverted to a patchwork of second growth forest, dominated by resource-laden oak–hickory (*Quercus* spp.–*Carya* spp.) forest types, old fields, and shrub thickets providing a hospitable environment to the recovery of the wild turkey (Porter et al. 2011). However, due to recent forestry practices including fire suppression and low impact harvesting techniques along with the introduction of exotic diseases such as chestnut blight (*Cryphonectria parasitica*) and beech bark disease (*Nectria Cryptococcus–Neonectria* complex), forest canopies are closing and primarily converting to low mast producing forest types dominated by shade-tolerant species such as maples (*Acer* spp.) (Nowacki and Abrams 2008, Porter et al. 2011).

While management of a wild turkey population incorporates many factors ranging from biological, economic, political, and social impacts, one biological parameter, food (mast), may be the most influential variable in the population dynamics of wild turkey (Kelley et al. 1988). During times of low food availability female turkeys traversed larger tracts of land in search of sustenance in Wetzel County, West Virginia (Swanson et al. 1994). Male turkeys have smaller home ranges in times of surplus mast conditions (Kelley et al. 1988). High turkey populations and small home ranges may be associated with diverse habitats (Kelley et al. 1988) while large home ranges may be linked with low population densities and heavily forested areas (Wigley et al. 1986, Exum et al. 1987, Kelley et al. 1988). Ryan et al. (2004) found a positive correlation

between mast failure and high fall big game harvest rates; conversely lower harvest totals occurred during high mast production. Data concerning influence of mast conditions on male wild turkey habitat use and selection in West Virginia are limited. It can be concluded that as food availability changes so too will turkey home ranges (e.g., size, composition) (Kelley et al. 1988). The variability of environmental conditions among regions makes it necessary to examine habitats at the local scale (Brown 1980) and previous analysis of habitat resource composition in established home ranges of wild turkey has proven a useful tool for land managers seeking to enhance property concerning the establishment of viable, sustainable population (Speake et al. 1975, Clark 1985 Hurst et al. 1991, Swanson et al. 1994). The ever changing and variable environment of the eastern wild turkey may be approaching its carrying capacity and demands further research to help address current population trends (Porter et al. 2011). From 2004–2009 North America’s Eastern wild turkey population has experienced a population decline of 300,751–385,751 with currently 4.8–5.0 million birds in the population (Tapley et al. 2011). West Virginia has experienced its own population decline, reporting the loss of 5% of its population during the 5 years of 2004–2009, down now to an estimated 100,000 birds (Tapley et al. 2011).

In this study, we examine the effects of various land matrices (e.g., fragmentation, core area) and topographical features (e.g., slope, aspect) on habitat selection and use of male wild turkeys in relation to season, ecological region, and age class in West Virginia. A better understanding of factors that influence the selection of habitat resources composing turkey home ranges will provide information concerning availability, use and selection of resources at the local scale. Information concerning current, local habitat selection will be useful in the management and conservation of turkey populations within West Virginia.

Goals and Objectives

My project goal is to quantify habitat selection of male wild turkeys in West Virginia.

The project objective is as follows:

1. Examine the selection of various land matrices (e.g., fragmentation, cover type) and topographical features (e.g., slope, aspect) of male wild turkeys in relation to season, spatial scale, and age class for 2 study areas in West Virginia.

Literature Review

Turkey Habitat

There are numerous recent, telemetry based studies detailing the home range of female (Swanson 1993, Swanson et al. 1994, Taylor 1997, Fearer and Pack 2003) and male (Rauch et al. 2011) wild turkey within West Virginia. Previous, non-telemetry based research addressed several topics including movement studies detailing visual observation of snow trails of flock from one roost to the next (Lewis 1963) and observation of wing-tagged birds (Bailey 1959, Speake et al. 1969, Davis 1973). However, few studies have directly quantified the proportion of land cover-types comprising home ranges in detail or selection of habitat types by individual male wild turkeys.

There have been studies that detail male wild turkey home ranges including those within a specific habitat type, in relation to season and age, and even describing the movements of restocking programs with all variables greatly impacting the area of habitat used. Home ranges have been examined within many different habitat types from the farmland regions of Ohio (Clark 1985) to loblolly pine (*Pinus taeda*) plantations in Mississippi (Hurst et al. 1991); Hurst et al. (1991) described home range size of male wild turkeys by season. Speake et al. (1975) sampled wild turkeys ($n = 20$) within the states of Alabama and Kentucky and found that

juvenile birds ($n = 4$) had smaller home ranges than adult birds ($n = 16$) in spring and summer within the pine forest of Alabama, but also found that turkeys had approximately equal home ranges in the hardwood forest of Kentucky showing both difference in age and region. The home ranges of translocated animals have been estimated (Carroll 1982) along with dispersal rates of restocked turkeys in east Texas (Hopkins et al. 1982).

Early dietary analyses helped elucidate the habitats selected by wild turkeys. In Pennsylvania acorns (*Quercus* spp.), grasses and sedges, wild grapes (*Vitis* spp.), dogwood (*Cornus* spp.), wild cherry (*Prunus* spp.), and snails were consumed throughout the year (Kozicky 1942). In Virginia the analysis of 524 stomach contents showed that acorns, dogwood, wild grape, and corn composed 54% of the total diet of wild turkeys in the state (Mosby and Handley 1943). Ten ‘foods of importance’ listed for the eastern mountainous counties of West Virginia: beech nuts (*Fagus gradifolia*), wild grape, blackberry (*Rubus* spp.), wild cherry, and dogwood as highly selected foods and beech buds, ferns, hemlock (*Tsuga canadensis*) leaves, bryophytes, and fungi as emergency foods (Glover and Bailey 1949).

Radio-equipped wild turkey hens selected all nesting habitats in proportion to their availability in northwestern West Virginia (Swanson et al. 1994). Of the 27 nests they located, 16 were in mixed mesophytic hardwoods, 7 in oak-hickory (*Quercus-Carya* spp.), 2 in unharvested bottomland hardwood stands, 1 in harvested chestnut oak (*Q. pinus*), and 1 in an unharvest white oak (*Q. alba*) stand (Swanson et al. 1994). Unharvested chestnut oak, harvested white oak, harvested bottomland hardwood, and nonforested habitats were not selected by hens for nesting (Swanson et al. 1994). Most nests ($n = 17$), were found in thick cover (limbs, tree tops, logging slash) with 6 nests being found under spicebush (*Lindera benzoin*) and 2 in thickets of blackberry and grape. During late summer hens were located most frequently in chestnut oak

forest types (characterized by sparsely vegetated understories) coinciding with huckleberry (*Gaylussacia* spp.) and blueberries (*Vaccinium* spp.) (Swanson et al. 1994). Chestnut oak types were not selected by hens with poults in southeastern West Virginia (Pack et al. 1980) but were considered important brood habitat in Pennsylvania (Ross and Wunz 1990).

Bottomland hardwood forests are excellent for the rearing of wild turkey poults because it supports ideal understory vegetation (Healy 1981). This habitat type described as being 60–100% covered in vegetation with >50% being herbaceous having an average canopy height of 20–60 cm (Swanson 1993). In Mississippi and eastern Texas bottomland hardwoods are important brood habitat (Phalen et al. 1986), but such habitats were avoided by hens with broods in southeastern West Virginia (Pack et al. 1980), South Dakota (McCabe and Flake 1985), and Alabama (Exum et al. 1987) due to low insect populations and overly dense vegetation.

Production, Survival, and Predation

It has been shown by modeling production (fertility, clutch size, nesting rates, hen success, and poult survival) and survival estimates (Pack et al. 1999) that areas of Virginia and West Virginia have population finite growth rates (Norman et al. 2001). Finite growth rates may be due to the primary forest types of oak, oak-hickory, oak-pine, yellow poplar (*Liriodendron tulipifera*), and northern hardwoods (beech, cherry, and maple, *Acer* spp.) in Virginia and West Virginia (Norman et al. 2001). The predominantly forested habitat conditions of these states lack extensive secondary food sources (i.e., agricultural crops) that may be related to the lower production rates of the region (Norman et al. 2001); higher production rates have been linked to secondary food sources in New York and Minnesota where there are mixed forest and agricultural habitats (Porter et al. 1980, Roberts et al. 1995). Production indices in Virginia and West Virginia are limited by nesting rates (Norman et al. 2001).

Additionally, fall turkey hunting seasons may potentially aid in population decline without higher production or survival (Norman et al. 2001, Alpizar-Jara et al. 2001). Because annual and regional variation in harvest and survival was greater (Pack et al. 1999) than the variation observed in production (Norman et al. 2001) it can be concluded that fall hunting affects population dynamics more than production. Alpizar-Jara et al. (2001) showed, through sensitivity analysis evaluated at various levels of removal, that fall harvest has the strongest negative effect on population growth and future male harvest. Increasing fall harvest survival would create greater increases in the population growth rate and the proportion of males in the population (Alpizar-Jara et al. 2001). However, increasing male survival rates will have no effect on population growth rates unless males are limiting in the population (Alpizar-Jara et al. 2001). Based on the simulations of Alpizar-Jara et al. (2001) a population of turkeys within the states of Virginia and West Virginia could only sustain 15% fall harvest mortality and remain stationary; a harvest of 10% would allow for population growth.

In the Ozarks of Arkansas nest predation strongly affected nest habitat selection (Badyaev 1995) and turkeys modified their habitat selection for renesting attempts in relation to those past experiences (Badyaev et al. 1996a); nest predation is the major source of breeding failure in the region (Badyaev 1994). Most annual mortality in the region was associated with prenesting movement; similar mortality was found in Alabama (Speake 1980, Everett et al. 1980), Minnesota (Porter 1978), Massachusetts (Vander Haegen et al. 1988), and Mississippi (Palmer et al. 1993). Extensive spring habitat searching was costly with the probability of nest success decreasing as the season progressed due to the finite amount of high quality nesting habitat (Badyaev 1995, Badyaev et al. 1996a, Badyaev et al. 1996b). Older female turkeys select cover types of greater complexity and variability in habitat structure (Badyaev 1995). These sites

were characterized by high understory density (shrubs, grasses) and visual obstruction (logs, rocks, slash) at or near the nest (Healy 1981, Ransom et al. 1987, Lutz and Crawford 1987, Schmutz et al. 1989, Day et al. 1991, Rumble and Hodorff 1993). Areas around roads and forest edges were commonly selected for nesting due to a desirable increase in understory density and also by aiding in movement efficiency (Speake et al. 1975, Holbrook et al. 1987, Wertz and Flake 1988). There was a strong age-bias in site fidelity with older female turkeys being more likely to return to previous nesting areas than younger females (Badyaev and Faust 1996). Returning females showed higher reproductive capabilities by producing larger clutches than in previous years and experiencing higher nest survival than non-returning females (Badyaev and Faust 1996); depredation rates did not differ between returning and non-returning females.

Areas selected for first nest attempt and renests have pronounced differences in structural composition; reneest areas are more variable and had greater complexity (Williams and Austin 1988, Schmutz et al. 1989, Day et al. 1991). First nest attempts are typically made in patches of large homogenous vegetation but switched to small patches for renests (Badyaev 1995); the switch aids in spatial heterogeneity. This change in cover type may aid in predator avoidance by increasing nest site variability (Storaas and Wegge 1987, Brittas and Willebrand 1991). Areas that contained greater protective nesting cover tended to attract turkeys for multiple years, whereas areas used for nesting that contained little nesting cover were typically abandoned the following spring (Badyaev and Faust 1996). Females selected clear-cuts, overgrown old fields, and pine stands with dense herbaceous understory because of greater nest concealment (Badyaev and Faust 1996); areas most often selected were characterized by dense understory and an open midstory. Cover was not the only important factor, females selected areas at least 80 m in diameter (Badyaev and Faust 1996).

Annual survival rates of eastern wild turkey are similar in the states of Missouri (Vangilder and Kurzejeski 1995), Mississippi (Hurst 1988, Palmer et al. 1993), and Iowa (Little et al. 1990). Populations are not always stable as shown in the states of Minnesota (Porter 1978), Massachusetts (Vander Haegen et al. 1988), and Iowa (Little et al. 1990) each having differential survival of adult and subadult hens. In Missouri daily survival rates were higher in the summer and fall and lower in the spring and winter (Vangilder and Kurzejeski 1995). Seasonal turkey survival has been linked to latitude. In Minnesota the highest mortality rates occur during the months of January, February, and March (Porter 1978). However, in Mississippi lower survival rates were reported for the fall and spring (Hurst 1988). Agricultural grains provide nourishment in winter that may lessen winter deaths (Vangilder and Kurzejeski 1995). In Massachusetts (Vander Haegen et al. 1988), Iowa (Little et al. 1990), and Minnesota (Porter et al. 1980) where turkey had access to grain crops populations had significantly higher survival rates during severe winters. Conversely, in New York (Austin and DeGraff 1975) and Pennsylvania (Wunz and Hayden 1975) where turkeys had limited access to agricultural foods death tolls were high during harsh winters.

In the Ozarks of Missouri predation was the greatest cause of hen loss (Vangilder and Kurzejeski 1995), an occurrence not uncommon in other studies of eastern wild turkeys (Everett et al. 1980, Exum et al. 1987, Vander Haegen et al. 1988, Little et al. 1990, Palmer et al. 1993). During one year in Missouri illegal kill of hens was the leading cause of mortality (Vangilder and Kurzejeski 1995); such events were associated with spring gobbler season and small-game hunting seasons. Major hen loss associated with spring gobbler season has been found in Kentucky (Wright and Speake 1975), Alabama (Fleming and Speake 1976), and Iowa (Little et

al. 1990). Factors that may help drive hen loss during spring gobbler season are gobbling activity, hunter density, and gobbler density (Vangilder and Kurzejeski 1995).

Habitat Selection

Male and female wild turkey selected habitats consistently in central Mississippi (Miller et al. 1999). Hardwood sawtimber was the most selected cover-type followed by a combination of early successional and sawtimber pine by nonreproductive females, unsuccessful females during preincubation, and females during fall-winter (Miller et al. 1999); mixed pine-hardwood habitat-types and open habitats were the least selected. Successful females had 7 highly selected habitat types at the within home range scale: 1) hardwood sawtimber, 2) pine sawtimber burned and thinned >3 years ago, 3) pine regeneration, 4) hardwood regeneration, 5) pine poletimber, 6) hardwood poletimber, and 7) pine sawtimber burned and not thinned within 3 years were all selected at equal rates (Miller et al. 1999). Males selected 1) pine sawtimber, 2) pine regeneration, and 3) hardwood sawtimber at equal rates during summer and fall-winter (Miller et al. 1999). Hardwood poletimber, hardwood regeneration, and mixed regeneration, and mixed sawtimber not burned within the 3 years were the least selected (Miller et al. 1999). During the spring hardwood sawtimber, pine sawtimber, and pine regeneration were selected most often (Miller et al. 1999).

In Alabama, wild turkeys selected 0.5–12 year old pine plantations less than their availability, whereas natural pine stands >21 years old were selected more than their availability (Kennamer et al. 1980). An avoidance of young pine stands and the selection of older ones may reflect a reluctance of turkey to enter overly dense vegetation; dense understory has been described as unsuitable turkey habitat (Bailey and Rinell 1967, Holbrook and Lewis 1967). In the Piedmont of Virginia, wild turkeys selected pine plantations, leave strips, and large blocks of

mature hardwood stands in proportion to their availability effectively showing no direct selection of a specific cover-type (Holbrook et al. 1987). The conversion of hardwood stands to loblolly plantations did not eliminate wild turkey habitat (Holbrook et al. 1987). However, it is recommended that ‘quality’ habitat is maintained in corridors on intensively managed pine forest (Gehrken 1975); interconnecting hardwood leave strips insure interspersions between pine and hardwood cover types (Holbrook et al. 1987). Edges created by corridors between pine and hardwood stands create quality nesting and early brood rearing habitat (Holbrook et al. 1987).

In Arkansas, female wild turkeys selected short-leaf pine (*P. echinata*) and mixed pine-hardwood timber over other overstory cover-types (Thogmartin 2001). Selection of pine and mixed pine-hardwood stands was associated with reproduction (Thogmartin 2001). Scarcity of suitable nesting areas in pine stands forced subordinate females to nest in bottomlands, a less suitable nesting habitat type (Thogmartin 1999), increasing both distance moved and home range size (Thogmartin 2001). Home range size as a function of nest site availability differs from prevailing ideas that foraging habitat is the determinant of home range size (Kurzejeski and Lewis 1990). Thogmartin (2001) also found that blackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*) and white oak (*Quercus alba*) were highly selected understory cover-types.

Rio Grande Wild Turkey Habitat Selection

In Texas, Rio Grande wild turkeys (*Meleagris gallopavo intermedia*) select areas of high habitat interspersions (Phillips et al. 2011a). Selected roost sites consisted of live oaks ≥ 9.0 m tall and canopy coverage of $\geq 56\%$; roost sites have higher amounts of oaks than random landscapes (Phillips et al. 2011a). Roosting areas also displayed higher oak-edge density with turkeys using this cover to move to and from roost sites (Phillips et al. 2011a). Roost sites typically displayed 37% woody protective cover whereas random sites contained only 22% total woody cover

(Phillips et al. 2011a). Both male and female and dispersing and resident turkeys select habitat resources at similar rates (Phillips et al. 2011b). Groups displayed selection of riparian areas, trees, >4 m structure, and edge at greater rates than other habitat resources (Phillips et al. 2011b). However, residents and dispersers both displayed seasonal movements from winter to summer ranges during spring and may be linked to the similarity in selection between the groups (Phillips et al. 2011b). Tree height is the best explanatory variable for winter roost predication in Texas (Swearingin et al. 2011); mean tree height (17 m) was greater than on non-roost sites (12.5 m). Tree diameter on roost sites (49.4 cm) is also greater than on non-roost sites (43.66 cm) and may be an important factor because larger trees often have more limbs of suitable roosting size (Swearingin et al. 2011). Intuitively, mean litter cover (roost = 56%; non-roost = 40%) was higher in roost sites while mean shrub cover (roost = 11%; non-roost = 15%) was higher on non-roost sites (Swearingin et al. 2011). The eastern cottonwood (*Populus deltoids*) was often a dominant tree species on roost sites and was utilized for its greater height (18.6 m) and diameter (54.4 cm) (Swearingin et al. 2011).

Compositional Analysis

The desire for a better understanding concerning wildlife use of resources is as old as the wildlife profession (Manly et al. 1993). A topic of interest has been the quantification of the “selection” of certain resources (Johnson 1980); do animals use resources more frequently than would be expected by chance given their relative availability? It should be noted that there is no widely accepted definition of habitat selection or a single hypothesis test that completely describes the concept of animal selection of a particular resource (Pendleton et al. 1998). Resource selection analysis methods include estimation of selection indices, hypothesis testing, and regression approaches (Manly et al. 1993, Pendleton et al. 1998).

Based on the theory developed by Aitchison (1986), compositional analysis was first proposed for the analysis of habitat data by Aebischer et al. (1993). Study designs of types II and III, as described by Manly et al. (1993), can be appropriately described by compositional analysis if individual estimates have been made concerning habitat use and either the combined or separate estimates of habitat availability (Pendleton et al. 1998). Aebischer et al. (1993) discussed 4 problems associated with the analysis of habitat use: (1) determination of sample units (animals rather than individual point locations), (2) nonindependence of habitat proportions, (3) differential use patterns by identifiable groups of animals, and (4) arbitrary definition of availability. Use of animals, rather than individual locations, eliminates biased estimates of average use proportions when the number of sample locations differs among animals (Aebischer et al. 1993, Pendleton et al. 1998).

The proportional use of various habitats is not independent for an individual animal (Pendleton et al. 1998); if the proportional use of a habitat changes invariably the proportional use of one or more separate habitats must decrease (“unit sum” constraint) (Pendleton et al. 1998). Analyses of habitat use should account for this interdependence within the set of habitat use proportions (Pendleton et al. 1998). Animals in habitat use studies are generally placed in identifiable groups (e.g., age, sex, season of observation) with intent to examine habitat use patterns among groups (Pendleton et al. 1998).

Geographical Information Systems (GIS) data can arise from various sources but because compositional analysis requires only estimates of habitat use and availability proportions for each animal it is well suited to handle these types of data. Data may be collected in GIS via data points, lines due to continuous monitoring of movement, portions of mapped use area, or

volumes obtained from integrating under a utilization surface (Pendleton et al. 1998). All of these data types can be used to produce a proportion of habitats therein.

Determining which habitat classes are and are not selected might be revealed by hypothesis testing approaches like compositional analysis even though animals may not distinguish between some habitat classes we define (Pendleton et al. 1998); degree of selection, with confidence intervals, for each habitat class are computed with this approach. It should be noted that habitats that may be selected at a higher rate than expected due to chance are not necessarily essential for the species' continued presence (Pendleton et al. 1998). Also, it does not directly follow that avoided habitats could not support the species if it were the only habitat available (Pendleton et al. 1998). It is possible that individual fitness may be low in heavily used habitats if use is affected by social structure in the population (Van Horne 1983, Pendleton et al. 1998). Regardless, habitat modification decisions are made based on use and availability data and analysis (Pendleton et al. 1998). However, decisions do not come directly from these test but are extensions of them based on additional assumptions (i.e., selection = necessary; avoidance = unsuitable) (Pendleton et al. 1998); such assumptions may be correct but should still be viewed as assumptions.

Analysis of Home range: Fixed Kernel Method

Wildlife habitat is often determined from radio-telemetry points alone and is often the primary source of information detailing habitat use and selection (Kernohan et al. 1998). Habitat use and selection determined from relocation points only have, however, been generally disregarded as a means of quantifying habitat composition or use because of locational error and inconsistent sample strategies (Kenward 1992, Kernohan et al. 1998). Fixed- and adaptive-kernel density estimators are fairly new home range estimating techniques used in the quantification of

utilization distribution of an organism's home range (Worton 1989, Seaman and Powell 1996). The adaptive kernel method has been compared to the traditional method of telemetry relocation points as a method of a home range estimator; no difference was found between the 2 methods ($P > 0.05$) (Kernohan et al. 1998). However, Worton (1995) and Seaman and Powell (1996) determined that the fixed kernel provides the least biased results. It is vital to select the proper smoothing parameter or bandwidth (h) when determining home range with a kernel density estimator (Worton 1995); Seaman and Powell (1996) concluded that selecting h by least squares cross-validation performed well. The use of fixed kernel used within GIS may negate inherent error in radio-telemetry data such as locational error and sample strategies of point relocations (Worton 1989). Such a refined home range estimator calculates home range contours and computes and compares probability densities (Worton 1989). Similar patterns in habitat use can be identified from areas of home ranges concerning relocation point data (Kernohan et al. 1998).

Study Area

Two study areas were used in West Virginia: 1) statewide and 2) Harrison, Marion, and Taylor counties (Figure 1) in north-central West Virginia – District I Study Area (DISA). West Virginia is 78% forested of which 71% is comprised of the oak-hickory forest type (Griffith and Widmann 2003). The state is mountainous with elevations ranging from 73–1,524 m. These variations in elevation cause noticeable changes in vegetation from region to region. West Virginia has a state-wide spring gobbler season (bearded turkeys only) and a 4-week either-sex fall wild turkey season in the traditional fall hunting counties (Rauch et al. 2011).

Forest vegetation in the state is broken into 3 physiographic provinces: Eastern Ridge and Valley, Allegheny Mountain and Upland Section, and Western Hill Section (Strausbaugh and Core 1978). The Western Hill Section, adjacent to the Ohio River, is primarily comprised of

Central Hardwood Forest (xeric), Cove Hardwoods or Mixed Mesophytic Forest (mesic), and Flood Plain communities (hydric). Central Hardwood Forests are a mix of Oak-Pine (*Quercus* spp. – *Pinus* spp.) and Oak-Hickory (*Quercus* spp. – *Carya* spp.). In the highest elevations of the state, the Allegheny Mountain and Upland Section, the Northern Hardwoods forest type dominates. This forest type is comprised primarily of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and yellow birch (*Betula alleghaniensis*), and red spruce (*Picea rubens*) at the highest elevations. The Eastern Ridge and Valley is made up of an oak-hickory-pine forest type. Due to habitat factors that directly or indirectly affect the distribution of vegetation and alter both annual mast conditions and game harvest, West Virginia has been divided into 6 ecological regions (Figure 2) to manage game populations accordingly (Uhlig and Wilson 1952). A better understanding of the habitat selections of wild turkeys across the variable landscape of West Virginia is vital for their sound management and conservation.

The District I study area (DISA) is located within the Central Allegheny Plateau an area comprised primarily of Cove Hardwoods; Harrison, Marion, and Taylor counties comprise the DISA and are located in region 4 (Central). Topography of the DISA is primarily mountain ranges with aspects generally in the northeast-southwest orientations. These mountains have steep to very steep hillsides and narrow valleys (Beverage and Yoakum 1980). The area averages 59.5% forested of which 62.2% is comprised of oak-hickory (Griffith and Widmann 2003). Turkeys sampled in the DISA were also included in the statewide analysis of habitat selection.

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Figure 1. West Virginia Statewide Study Area and District I Study Area, 2004–2007.

Figure 2. Ecological regions of West Virginia, 2004–2007.

Chapter 2^a

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RH: De La Cruz et al. • Male Turkey Habitat Selection

Habitat Selection of the Male Eastern Wild Turkey in West Virginia

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ABSTRACT: Eastern wild turkey (*Meleagris gallopavo silvestris*; hereafter wild turkey) vary in their selection of home range habitat resources temporally, spatially, and according to specific life-stage needs. We studied the home range size and habitat selection of 55 radio-equipped male wild turkeys from September 2004–August 2007 in West Virginia. Wild turkey displayed variable habitat resource selection particularly between age classes. We found that annual statewide adult regional home range and core home range spatial scale selections of land use and land cover habitat resources were primarily for forested areas. However, juvenile land use and land cover selection was for forest roads at the regional level but for cropland at the core home

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range spatial scale. In addition, at both spatial scales juvenile land fragmentation resource selection was primarily for edge habitats. However, the annual statewide adult land fragmentation resource selection was for edge at the regional scale but for forest perforations at the core home range scale. Our analysis also indicated that at both spatial scales adults consistently selected for steeper >24–35% gradient slopes compared to >6–24% gradient slopes selected by juveniles. Our finding suggest that land managers should provide a diverse mosaic of forest, forest perforations, edges, pasture-fields, and if possible, hay cropland to aid in the management of male wild turkey in West Virginia.

KEY WORDS compositional analysis, eastern wild turkey, fixed kernel density, habitat selection, home range, *Meleagris gallopavo silvestris*, West Virginia.

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Historically wildlife biologist thought that the eastern wild turkey (*Meleagris gallopavo silvestris*; hereafter wild turkey) needed large tracts (i.e., $\geq 6,000$ ha) of continuous forest (Mosby and Handley 1943, Kozicky and Metz 1948, Latham 1956) with the interspersions of forest to open land considered unfavorable (Bailey 1973). Quality habitat was thought to be 60–80% oak forest, 10–15% conifer, and openings of <1 ha (Kozicky and Metz 1948). However, during the 1970s, 1980s, and early 1990s many radio telemetry studies demonstrated that wild turkey could survive in areas of <15% forest cover (Porter 1978, Hecklau et al. 1982, Kurzejeski and Lewis 1985, Kurzejeski and Lewis 1990). Furthermore, the work of Glennon and Porter (1999) showed that variation in wild turkey abundance could be attributed to edge and patch density and suggested that high interspersions of forest and agriculture increased habitat quality. Specifically, in New York high habitat quality was associated with forest, open, and shrubland habitat-types at a 1:1:1 ratio (Fleming 2003, Porter and Gefell 1996).

The perception of habitat quality has also changed over time in the Appalachian range of the eastern wild turkey. Like in most of its range, the concept of optimum turkey habitat was described as remote and large areas of contiguous tracts of mast producing hardwood forest (Wunz and Pack 1992). For example, in West Virginia areas containing >0.6 km of road/km² resulted in reduced turkey abundance (Bailey and Rinell 1968). However, in Pennsylvania, turkeys selected forest with open understories less than smaller tracts of early successional forest presumably for their rich understory (Wunz 1971). Although mature forest may be a key component of turkey habitat, areas of pioneer shrubs and trees associated with herbaceous openings or cropland are also important due to their often more reliable food production (Wunz and Pack 1992).

While early research in eastern hardwood forest observed the importance of herbaceous forest openings (Mosby and Handley 1943) their effects and optimal amounts, as it pertains to turkey populations, is highly variable between, and often inconsistent within, different regions of Appalachia (Wunz and Pack 1992). In Pennsylvania turkeys could inhabit areas of only 26% forest with selected forested areas being as small as 51 ha (Wunz 1985). Wunz and Pack (1992) estimated that areas with 10% openings promoted adequate amounts of herbaceous and invertebrate food sources to help sustain turkey populations within eastern hardwood forest types. Porter et al. (2011) concluded that due to the many dimensions of habitat suitability, and with the influence of ever changing land-use over large geographic regions, it will be important to continue building our understanding of turkey habitat selection, use, and needs and to not succumb to complacency due to current turkey abundance.

Due to the high variability in regional wild turkey home range composition, it is important to understand what habitat resources are available to turkeys and which are being most

commonly selected for to assure the conservation and maintenance of local, quality turkey habitat. Therefore, our objectives were to: 1) estimate annual and seasonal home range size of adult and juvenile male wild turkey and 2) determine resource availability and use as it pertains to anthropomorphic land use and landscape cover, land fragmentation, slope, and aspect at multiple temporal and spatial scales in West Virginia, USA.

STUDY AREA

We conducted this research over 2 study areas in West Virginia: 1) statewide and 2) the District I Study Area (DISA) which is comprised of Harrison, Marion, and Taylor counties in the Central Region of West Virginia (Figure 1). West Virginia is a mountainous state, with elevations ranging from 73–1,524 m. These variations in elevation cause noticeable changes in vegetation from region to region. West Virginia has a state-wide spring turkey season (bearded turkeys only) and a 4-week either-sex fall wild turkey season in the traditional fall hunting counties which are generally located within the mountainous region of the state (Rauch et al. 2011).

West Virginia is 78% forested of which 71% is comprised of the oak-hickory forest type (Griffith and Widmann 2003). The state is classified into 3 physiographic provinces: Eastern Ridge and Valley, Allegheny Mountain and Upland Section, and Western Hill Section (Strausbaugh and Core 1978). The Western Hill Section, adjacent to the Ohio River, is primarily comprised of Central Hardwood Forest (xeric), Cove Hardwoods (mesic), and Flood Plain communities (hydric). Central Hardwood Forests are a mix of Oak-Pine (*Quercus* spp. - *Pinus* spp.) and Oak-Hickory (*Quercus* spp. - *Carya* spp.). In the highest elevations of the state, the Allegheny Mountain and Upland Section, the Northern Hardwoods forest type dominates. This forest type is comprised primarily of sugar maple (*Acer saccharum*), American beech (*Fagus*

grandifolia), and yellow birch (*Betula alleghaniensis*). The Eastern Ridge and Valley is comprised of an oak-hickory-pine forest type. The DISA is located within the Central Allegheny Plateau an area comprised primarily of Cove Hardwoods. Topography of the DISA is primarily mountain ranges with aspects generally in the northeast-southwest orientations. The DISA is described as having steep to very steep mountains hillsides and narrow valleys (Beverage and Yoakum 1980); the area averages 59.5% forested of which 62.2% being comprised of oak-hickory (Griffith and Widmann 2003). Cropland of West Virginia is composed of 89% hay crop, 9% grain crops (e.g., corn, soybean), and only 1% of both wheat and fruit crops (e.g., apples, peaches) (King and Lemmon 2008).

METHODS

Trapping and Radio Telemetry

From September–November and January–March of 2004–2007 personnel with the West Virginia Division of Natural Resources trapped wild turkey at 29 sites baited with cracked or whole corn with use of rocket nets or rocket boxes (Kurzejeski and Vangilder 1992). We aged and sexed individuals (juvenile or adult) by the use of feather coloration and pattern (Pelham and Dickson 1992). We followed the methods of Healy and Nenno (1980) to age and sex juvenile turkeys; we aged yearling turkeys (12–16 months) caught in early September by tenth primary feather (Larson and Taber 1980). We weighed all wild turkeys with a spring scale and fitted each with a uniquely numbered aluminum leg band. We assessed and recorded physical condition. Only male wild turkeys with a mass >1.6 kg and having a physical condition of good (minor feather loss, minor scalping) or excellent (no feather loss, no injuries) were used for radio tracking. We released turkeys at the capture site and trapping locations were recorded in Universal Transverse Mercator (UTM) Coordinates.

We fitted turkeys with backpack transmitters (Advanced Telemetry Systems Inc. (ATS) Isanti, MN) weighing 80 g attached by 4.8 mm nylon shock cord (Norman et al. 1997). We set transmitter frequencies between 150 and 152 MHz and each transmitter included a motion-mortality sensor (Rauch 2009). We located male wild turkey at least once a week through radio triangulation (Cochran and Lord 1963) with at least 2 directional azimuths to determine location (Andelt and Gipson 1979, Nams and Boutin 1991, Wallingford and Lancia 1991, Zielinski et al. 2004). When only 2 intersecting azimuths were recorded, we only used locations separated by $\geq 60^\circ$ and $\leq 120^\circ$ (Kurzejeski and Lewis 1990, Sisson and Speake 1994, Miller et al. 2001). We only used locations generated by ≥ 2 azimuths recorded ≤ 20 minutes apart in the analysis (Rauch et al. 2011). We also located turkey a minimum of twice per week during peak hunting pressure days, which included the first week of squirrel (*Sciurus* spp.), white-tailed deer (*Odocoileus virginianus*) (archery, buck-only firearms, antlerless, and muzzleloader), and spring and fall wild turkey hunting seasons (Rauch et al. 2011). We estimated telemetry error by placing 2.0 L bottles, filled with a saline solution, with an attached radio transmitter in the forest at the average height of a male wild turkey (46 cm: Townsend et al. 2007). We estimated telemetry error to be 6° (SE = 0.84) with a mean distance from transmitter location to receiving location of 458.9 m (SE = 59.12) ($N = 18$: White and Garrott 1990). We computed a 95% confidence ellipse of 7.7 ha (SD = 89) associated with telemetry error (White and Garrott 1990) in the program LOCATE III (Pacer Computing, Truro, NS, Canada) (Rauch et al. 2011). We only used turkeys with a minimum of 30 locations in home range estimations (Seaman et al. 1999). We pooled telemetry data for each male wild turkey across years and only male wild turkey with a ≥ 9 month period of locations were used. We used Program LOCATE III to generate UTM coordinates (X and Y coordinates) of the locations associated with telemetry data (Rauch et al. 2011).

Cover Type Mapping

We used the plug-in toolset Feature Analyst for geographic information systems (GIS) in the delineation of National Agriculture Imagery Program (NAIP) 2007 aerial photography creating unique land use and land cover raster data. We created land use and land cover raster data that delineated the land features of forest, pasture-field, barren-urban, open water, roads, and crops; because open water (WVDEP), roads (U.S. Census Bureau), and crops (USDA) could not be accurately identified by means of computer delineation and predictive learning, we added them to raster maps by converting polygon features to raster data to generate a new raster mosaic by combining these with the features created using Feature Analyst. To assure the highest level of accuracy possible, we also mitigated for false positives or clutter by labeling the features from the previous classification as either positive or negative, the negative instances are considered incorrect and are masked out (Opitz and Blundell 1999).

Fragmentation Calculations

We used the Landscape Fragmentation Tool v2.0, which classifies land cover into the 4 categories of patch, edge, perforations and core, to create a land fragmentation raster data set (Vogt et al. 2007). We described core forest pixels to be any forest pixels that are more than 100 m from the nearest field or non-forest pixel, deriving values from our previously created land use and land cover raster data; the core category was divided into small (<100 ha), medium (100–200 ha), and large (>200 ha) core based on the area of the tract (Vogt et al. 2007). We used an edge width of 100 m and defined edge pixels as areas along the outside portion of forest tracts; the edge width indicates the distance over which a fragmenting land cover (i.e., field, non-forest) can degrade the land cover of interest (i.e., forest) (Vogt et al. 2007). We defined perforations pixels as areas along the edge of small forest gaps and as being part of a tract containing core pixels;

perforations pixels are within 100 m of field or non-forested pixels. We defined patch pixels as small forest fragments that do not contain any core forest pixels (Vogt et al. 2007).

Home Range Estimation

We constructed home range estimates using the Gaussian, fixed kernel method with least squares cross-validation for the smoothing parameter (h) in the program Geospatial Modeling Environment (GME) 0.6.0.using the function *kde*; we constructed the associated 50% and 95% utilization distributions using the function *isopleth* and regional 100 ha sampling blocks using the function *genvecgrid*. The fixed kernel density estimator (KDE) is the most widely accepted method of home range estimation (Kernohan et al. 2001) and generates a continuous intensity surface of an animal's utilization distribution by smoothing the point pattern of animal locations (Silverman 1986, Worton 1989). We used an automated string of code within GME in conjunction with all 50% and 95% home range utilization distributions and 100 ha regional sampling blocks to extract environmental raster data via the function *isectpolyrst* (Beyer 2010); percent composition of each category was extracted at each spatial scale. We use the extracted data from raster images detailing our unique land use and land cover and land fragmentation data along with previously constructed slope and aspect raster data as the basis of our compositional analysis.

Habitat Selection

We constructed Gaussian kernel density estimations of 95% and 50% utilization distributions (UD) and 100 ha regional sampling blocks for male wild turkeys using GME to find annual, seasonal, and regional home range within a region (second-order) and core home range within a periphery (third-order) resource selection. We used the 95% UD to describe the periphery home range exploited by an individual, while the purpose of computing a 50% UD was

to provide an estimate of core utilization of home range (Dickson and Beier 2002). Although the 95% utilization distribution can be used to describe the total home range, Dickson and Beier (2002) and Seaman et al. (1999) describe it to be of little biological significance and unreliable, regardless of the home range estimator used; because of the nature of the 95% periphery UD we only viewed it as the cover-types available to and potentially selected by an animal within a given second-order, micro-regional scale.

To determine the presence of second-order habitat selection (i.e., home range within a region) we used an assessment of regional resource availability by summarizing environmental variables that comprised 100 ha sampling blocks, generated using GME, across study areas containing turkey home ranges. We sampled 2,587 statewide and 639 DISA 100 ha vector grids to assess second-order habitat resource selection. We used the results of regional environmental variable assessments as the proportional data defining “available cover-types composition” which were compared in relation to the proportion “used cover-types composition” defined by the 95% utilization distributions to assess selected habitat of male wild turkeys at the second-order level, regional scale, via compositional analysis (Johnson 1980, Aebischer et al. 1993, Tirpak et al. 2010). In addition, we used the 95% utilization distributions as the proportion of “available cover-types composition” which was compared in relation to the proportion “used cover-types composition” defined by the core 50% utilization distributions to assess third-order, core habitat within a periphery, selected habitat of male wild turkeys (Johnson 1980, Aebischer et al. 1993, Tirpak et al. 2010).

Statistical Analysis

We followed the framework developed by Johnson (1980) and Aebischer et al. (1993), in which animals select resource use at hierarchical stages, specifically selection of home range

within a region (second-order selection) and core home range within a periphery (third-order selection). We used the term “habitat composition” in reference to proportions of habitat-types (as defined by vegetation types and other classifying entities) used by or available to an animal (Dickson and Beier 2002); habitat composition sums to 100%. The compositional analysis used the individual animal, not the radio location, as the sampling unit and avoids statistical problems arising from the non-independence of proportions within a habitat composition (Aebischer et al. 1993). Our habitat compositional analysis followed the methodology of Aebischer et al. (1993) which involved the proportional habitat use by individual animals as a basis of analysis. Compositional analysis is comprised of nonstandard multivariate data which encompasses all multivariate analysis of variance (MANOVA) and multivariate analysis of covariance (MANCOVA) linear models (Aebischer et al. 1993).

In most instances we did not have enough telemetry points to look at yearly variation in habitat selection. However, we believe we are justified in pooling data across years. We had $n = 7$ adult turkeys with enough points to adequately calculate a home range for more than one year (two years $n = 5$; three years $n = 2$) an assessment of yearly home range overlap was conducted. Home range overlap averaged 87.3% (SE = 4.08) for the 50% core and 85.7% (SE = 4.78) for 95% total home ranges across years. During 2004–2006 total mast indices were relatively stable ($\bar{x} = 42$, SE = 3.0; Rauch 2009) and because our overlap analysis suggest consistent home range use between years, we examined home range composition for both age classes (juvenile and adult) across the entire state using total (all point locations) home ranges. We totaled within-group variation of adult and juvenile dependent 50% and 95% UD home range sizes by independent seasonal and regional classes using a Kruskal-Wallis 1-way analysis of variance and between-group age class variation was examined by Wilcoxon signed rank test; juvenile within-

group seasonal home range variation by Wilcoxon signed rank test because the seasonal analysis contained only 2 categories. We examined differences in the dependent habitat-type variables across the independent variables age (adult, juvenile) and ecological regions using MANOVA and MANCOVA in compositional analysis (Aebischer et al. 1993, Pendleton et al. 1998). We also examined statewide home range composition for both age classes at the following temporal scales: total annual (all point locations), annual spring (March–May), annual spring-summer (points from March–August per bird), annual fall (September–November), and annual fall–winter (points from September–February per bird) (Kelley et al. 1988, Fearer and Pack 2003). We ranked habitat-types according to relative use and significance between-rank differences. Compositional analysis was performed in the statistical program R in the “adehabitat” package. The “adehabitat” package was developed to study the space use and habitat selection by wildlife (Calenge 2006) including the compositional analysis of habitat cover-types (Johnson 1980, Aebischer et al. 1993).

RESULTS

Monitoring Statistics

From September 2004 through August 2007 197 male wild turkeys were radioed in West Virginia (representing all 6 ecological regions); 32 were monitored in the DISA. Of the total sample, we used 55 total individuals (22 in the DISA) in the analysis of home range size throughout the state. From these individuals we classified 29 as juveniles (11 were also later included in the adult analysis) and 37 adults from ecological regions 1–4 and 6 (Rauch et al. 2011).

Home Range Resource Selection

Annual Adult Second-order Selection. – Annual adult ($n = 37$) 95% UD home ranges (Table 1) were similar ($\chi^2_{4,37} = 8.04$, $P = 0.090$) across 5 ecological regions in West Virginia (Figure 1). Adult male wild turkey did not use habitat resources in proportion to their availability at the second-order spatial scale (Figure 2). Turkeys selected for forest, pasture, roads, and crop at higher rates than barren and water (Table 2; Wilks' $\lambda = 0.27$, $P = 0.001$). Adults also selected for edges, perforations, and < 100 ha core areas at higher rates than larger patch size categories (Table 3; Wilks' $\lambda = 0.11$, $P = 0.001$). Turkeys selected for 0–35% slopes at higher rates than slopes >35% (Table 4; Wilks' $\lambda = 0.59$, $P = 0.001$). Adults did not display a disproportionate second-order selection of aspect (Table 5; Wilks' $\lambda = 0.87$, $P = 0.200$).

Annual Juvenile Second-order Selection. – Annual juvenile ($n = 29$) 95% UD home ranges (Table 1) were not different ($\chi^2_{4,29} = 3.34$, $P = 0.500$) across 5 ecological regions in West Virginia (Figure 1). Juvenile male wild turkey did not use habitat resources in proportion to their availability at the second-order spatial scale (Figure 2). Turkeys selected for roads, forest, and pasture at higher rates than other land use and land cover habitat resources (Table 2; Wilks' $\lambda = 0.100$, $P = 0.001$). Turkeys also selected for edges at higher rates than other land fragmentation categories (Table 3; Wilks' $\lambda = 0.11$, $P = 0.001$). Turkeys selected for areas of primarily >6–24% gradients at higher rates than other slopes (Table 4; Wilks' $\lambda = 0.33$, $P = 0.001$). Juveniles also selected for west and east cardinal facing slopes at higher rates than north and south aspects (Table 5; Wilks' $\lambda = 0.47$, $P = 0.001$).

Annual Adult Third-order Selection. – Unlike adult 95% UD home ranges ($\chi^2_{4,37} = 8.04$, $P = 0.090$), 50% UD home ranges ($n = 37$) varied ($\chi^2_{4,37} = 12.00$, $P = 0.020$) (Table 1) across 5 ecological regions in West Virginia (Figure 1). Adult male wild turkey did not use habitats in

proportion to their availability at the third-order spatial scale (Figure 3). Turkeys selected for forested areas at higher rates than other land use and land cover categories (Table 6; Wilks' $\lambda = 0.53$, $P = 0.002$). Adults also selected for perforations and edges at higher rates than other land fragmentation habitat resources (Table 7; Wilks' $\lambda = 0.24$, $P = 0.006$). Turkeys selected for areas of >6–35% gradients at higher rates than other slope (Table 8; Wilks' $\lambda = 0.41$, $P = 0.001$). Adult did not display a disproportionate third-order selection of aspect (Table 9; Wilks' $\lambda = 0.94$, $P = 0.550$).

Annual Juvenile Third-order Selection. – Along with juvenile 95% UD home ranges ($\chi^2_{4,29} = 3.34$, $P = 0.500$), 50% UD home ranges ($n = 29$) were similar ($\chi^2_{4,29} = 5.71$, $P = 0.220$) (Table 1) across 5 ecological regions in West Virginia (Figure 1). Juvenile male wild turkey did not use habitats in proportion to their availability at the third-order spatial scale (Figure 3), but selected crop, forest, and pasture at higher rates than other land use and land cover habitat resources (Table 6; Wilks' $\lambda = 0.34$, $P = 0.001$). Juveniles also selected edges, perforations, ≤ 200 ha core at higher rates than other land fragmentation categories (Table 7; Wilks' $\lambda = 0.13$, $P = 0.003$). Turkeys selected for 0–35% slopes at higher rates than slopes >35% (Table 8; Wilks' $\lambda = 0.70$, $P = 0.020$). Like adults, juvenile did not display a disproportionate third-order selection of aspect (Table 9; Wilks' $\lambda = 0.79$, $P = 0.120$).

Statewide Adult Seasonal Third-order Selection. – Adult seasonal 50% ($\chi^2_{4,60} = 3.10$, $P = 0.540$) and 95% ($\chi^2_{4,60} = 2.32$, $P = 0.680$) UD home ranges (Table 1) were similar across 5 ecological regions in West Virginia (Figure 1). Adult male wild turkey did not use habitats in proportion to their availability in relation to seasons (Figures 4–5). Adult ($n = 9$) turkeys selected forest at marginally higher rates than other land use and land cover habitat resources in the fall (Table 6; Wilks' $\lambda = 0.05$, $P = 0.050$). Turkey selected for edges at higher rates than other land

fragmentation categories during fall (Table 7; Wilks' $\lambda = 0.23$, $P = 0.030$). Adults also selected for areas of >6–24% gradient at higher rates than other slopes in the fall (Table 8; Wilks' $\lambda = 0.05$, $P = 0.004$). However, turkeys did not display a disproportionate selection of aspect during the fall (Table 9; Wilks' $\lambda = 0.84$, $P = 0.790$). Adult ($n = 17$) selected for forest habitats at higher rates than other land use and land cover habitat resource during fall-winter (Table 6; Wilks' $\lambda = 0.42$, $P = 0.040$). Turkeys also selected for edges and perforations at higher rates than other land fragmentation categories during fall-winter (Table 7; Wilks' $\lambda = 0.20$, $P = 0.030$). However, adults did not display disproportionate selection of either slope (Table 8; Wilks' $\lambda = 0.73$, $P = 0.210$) or aspect (Table 9; Wilks' $\lambda = 0.86$, $P = 0.600$) habitat resources during fall-winter. Turkeys ($n = 9$) did not display disproportionate selection for land use and land cover (Table 6; Wilks' $\lambda = 0.19$, $P = 0.120$), land fragmentation (Table 7; Wilks' $\lambda = 0.61$, $P = 0.390$), slope (Table 8; Wilks' $\lambda = 0.45$, $P = 0.170$), or aspect (Table 9; Wilks' $\lambda = 0.55$, $P = 0.280$) in the spring. Adults ($n = 17$) did, though, select for forest and pasture-field at higher rates than other land use and land cover categories during spring-summer (Table 6; Wilks' $\lambda = 0.37$, $P = 0.020$). However, adults did not display a disproportionate selection for land fragmentation (Table 7; Wilks' $\lambda = 0.05$, $P = 0.510$), slope (Table 8; Wilks' $\lambda = 0.62$, $P = 0.050$), or aspect (Table 9; Wilks' $\lambda = 0.85$, $P = 0.530$) habitat resources during spring-summer. Adult ($n = 8$) also did not display disproportionate selection for land use and land cover (Table 6; Wilks' $\lambda = 0.46$, $P = 0.790$), land fragmentation (Table 7; Wilks' $\lambda = 0.71$, $P = 0.640$), slope (Table 8; Wilks' $\lambda = 0.77$, $P = 0.840$), or aspect (Table 9; Wilks' $\lambda = 0.59$, $P = 0.400$) in the winter.

DISA Juvenile Seasonal Third-order Selection. – Juvenile seasonal 50% ($W = 80$, $P = 0.080$) and 95% ($W = 75$, $P = 0.17$) UD home ranges were similar in the DISA (Figure 1). Juvenile male wild turkey did not use habitats in proportion to their availability in relation to

seasons (Figures 6). Juveniles ($n = 11$) selected for crop at higher rates than other land use and land cover categories in the spring (Table 6; Wilks' $\lambda = 0.002$, $P = 0.003$). Turkeys also selected for perforations at higher rates than other land fragmentation habitat resources during the spring (Table 7; Wilks' $\lambda = 0.05$, $P = 0.003$). Turkeys selected for 0–35% slopes at higher rates than slopes >35% (Table 8; Wilks' $\lambda = 0.01$, $P = 0.004$). Turkeys also selected for eastward facing slopes at higher rates than other aspects (Table 9; Wilks' $\lambda = 0.10$, $P = 0.006$). Juveniles ($n = 10$) selected for crop and forest at higher rates than other land use and land cover categories during spring-summer (Table 6; Wilks' $\lambda = 0.06$, $P = 0.010$). Turkeys selected for perforations at higher rates than other land fragmentation habitat resources during spring-summer (Table 7; Wilks' $\lambda = 0.17$, $P = 0.006$). Juveniles selected for 0–24% gradients at higher rates than other slopes during spring summer (Table 8; Wilks' $\lambda = 0.004$, $P = 0.006$). Juveniles did not display a disproportionate selection of aspect during spring-summer (Table 9; Wilks' $\lambda = 0.59$, $P = 0.240$).

DISA Annual Second-order Selection. – Adult and juvenile 95% ($W = 74$, $P = 0.590$) UD home ranges (Table 1) were similar in the DISA (Figure 1). Both adult and juvenile male wild turkeys did not use habitats in proportion to their availability at the second-order spatial scale (Figures 7). Adults ($n = 9$) selected for crop, pasture-field, and road (Table 2; Wilks' $\lambda = 0.02$, $P = 0.020$) while juveniles ($n = 19$) selected for pasture-field, road, crop, forest, and barren (Table 2; Wilks' $\lambda = 0.01$, $P = 0.001$) at higher rates than other land use and land cover habitat resource. Adults also selected for edges, forest patches, and ≤ 200 ha core areas (Table 3; Wilks' $\lambda = 0.11$, $P = 0.020$) while juveniles selected for edges (Table 3; Wilks' $\lambda = 0.27$, $P = 0.001$) at higher rates than other land fragmentation categories. Adults did not display a disproportionate second-order selection of slope habitat resources (Table 4; Wilks' $\lambda = 0.40$, $P = 0.260$); however, juveniles selected for 0–24% gradients (Table 4; Wilks' $\lambda = 0.40$, $P = 0.003$) at higher rates than

other slopes. Adult selected for easterly facing slopes at higher rates than other aspects (Table 5; Wilks' $\lambda = 0.27$, $P = 0.040$); however, juveniles did not display a disproportionate second-order selection of aspect (Table 5; Wilks' $\lambda = 0.67$, $P = 0.090$).

DISA Annual Third-order Selection. – Adult and juvenile 95% ($W = 74$, $P = 0.590$) and 50% ($W = 77$, $P = 0.690$) UD home ranges (Table 1) were similar in the DISA (Figure 1). Both adult and juvenile male wild turkeys did not use habitats in proportion to their availability at the third-order spatial scale (Figure 8). Adults ($n = 9$) did not display a disproportionate third-order selection of land use and land cover habitat resources (Table 6; Wilks' $\lambda = 0.16$, $P = 0.120$); however, juveniles ($n = 19$) selected for crop, forest, and pasture-field (Table 6; Wilks' $\lambda = 0.21$, $P = 0.001$) at higher rates than other land use and land cover categories. Adults selected for edges perforations, and ≤ 200 ha core areas (Table 7; Wilks' $\lambda = 0.15$, $P = 0.020$) and juveniles selected for perforations and edges (Table 7; Wilks' $\lambda = 0.29$, $P = 0.001$) at higher rates than other land fragmentation habitat resources. Adults did not display a disproportionate third-order selection of slope habitat resources (Table 8; Wilks' $\lambda = 0.40$, $P = 0.260$); juveniles selected for 0–24% gradients (Table 8; Wilks' $\lambda = 0.40$, $P = 0.003$) at higher rates than other slopes. Adult displayed a marginal selection of westerly facing slopes (Table 9; Wilks' $\lambda = 0.28$, $P = 0.050$) and juveniles displayed a marginal selection of easterly face slopes of aspects (Table 9; Wilks' $\lambda = 0.64$, $P = 0.050$).

DISCUSSION

Home Range Estimates

Our home range estimations fell within the range of various male wild turkey home range studies. However, comparing our home range estimates with other studies is difficult and questionable due to the variation in home range estimation methodologies, the pooling of adults

and juveniles, and ecological variation between regions of the country. Although we did observe variation in male wild turkey home range size in this study, only adult core home ranges varied significantly. However, home range size variations may be influenced by many factors including study length, sample size, monitoring techniques, local habitat composition, and the home range estimation technique used (Kelley et al. 1988, Everett et al. 1979). Our home range estimates are comparable to some of the largest home ranges reported especially those described in areas dominated by forest with few fields (Wigley et al. 1986, Kelley et al. 1988, Hurst et al. 1991, Miller et al. 1997), which is the case in our study.

Specifically, Wigley et al. (1986) reported annual home ranges in Arkansas to be 1,423 ha (minimum area method [MAM]), results similar to our own (1,410 ha). Our results were also similar to Smith et al. (1988) who in Louisiana reported annual adult minimum convex polygon (MCP) home ranges to be 1,473 ha. Our home range estimates were equally comparable to Kelley et al. (1988) who in Mississippi reported annual adult home ranges to be 1,418 ha (convex polygon method [CMP]). However, Kelley et al. (1988) reported juvenile home range estimates of 2,204 ha (CPM), a figure 1.6 times larger than our estimate. Additionally, our fall-winter home range estimates were similar to the 1,134 ha assessments made by Godwin et al. (1995) in Mississippi. However, Godwin et al. (1995) reported adult home ranges that were 1,941 ha (MCP) which is 1.4 times the size of our own estimations. Furthermore, the 711 ha and 607 ha spring adult and juvenile home ranges of Miller et al. (1997) are similar to ours; however, they reported a slightly smaller winter home range estimate of 810.

Although our results show general variation in wild turkey home range sizes among age and season, only adult 50% core UD home ranges were significantly different among groups; however, sample sizes may have been insufficient in some instances and probably weakened

testing. Our results could suggest that this variation in adult 50% core UD home ranges may be due to a function of regional habitat variation. Fearer and Pack (2003) observed differences in female wild turkey home range sizes among ecological regions in West Virginia. Specifically, Fearer and Pack (2003) estimated annual and seasonal home ranges of 315 female wild turkeys in West Virginia using the adaptive kernel home range estimation method. They reported annual adult female mean home range sizes to be 1,823 ha, a figure about 1.3 times larger than our own. Fearer and Pack (2003) also estimated adult female spring and winter mean home ranges to be 994 ha and 947 ha respectively, results similar to our research. However, they estimated juvenile female wild turkey annual home ranges to be 5,296 ha, an estimate 3.8 times larger than our juvenile male wild turkey home ranges.

Habitat Selection

Neither second- or third-order selection of home range resources by male wild turkey is random in West Virginia. The concordance of overall male second- and third-order selection annually and seasonally between land use and land cover, land fragmentation, slope, and aspect data suggest that our results are not artifacts of features functioning at 1 spatial scale (e.g., anthropomorphic or conspecific avoidance) distorting selection at another scale. Rather, home range size and habitat selection of wild turkey within West Virginia are probably, like in many other studies, affected primarily by life-stage needs and available food resources within specific regions of the state (Mosby and Handley 1943, Porter et al. 1983, Kurzejeski and Lewis 1990). While statewide second-and third-order spatial trends are somewhat stable in terms of resource selection annually for male wild turkey this selection often differs proportionally at seasonal temporal scales concerning age. These results show the adaptive nature of wild turkey to their

environment and simultaneously demonstrate their use of said environment at specific life-stages (Dickson et al. 1978).

Our results may suggest that juvenile male wild turkey are more selective than are adults whom consistently display selection of forested areas independent of both temporal and spatial scale. Our results agree with Crim (1981) who suggested that adult male wild turkey home ranges are less variable and include less selection of cropland than do juvenile home ranges. Croplands not bordered by mature timber stands were seldom used and never exhibited consistent use in northern Missouri (Kurzejeski and Lewis 1990) and may have contributed to their adult selection status in West Virginia. Additionally, turkeys prefer acorns to crop (Korschgen 1967) which may also help explain the lack of adult male wild turkey selection of cropland in West Virginia. Because cropland of West Virginia is composed of 89% hay crop (King and Lemmons 2008) selection is probably driven by insect forage instead of grain waste. Crops also do not seem to be selected for during winter in West Virginia as in other states probably due to the small percentage (9%) of grain crop production (King and Lemmons 2008). It should be noted that the lack of cropland in densely forested areas, as in West Virginia, combined with highly variable mast production has the potential to limit turkey density (Vander Haegen et al. 1988, Little et al. 1990, Porter et al. 1980).

Our results may show, as in Hurst and Stinger (1975) and Pack et al. (1980), the selection of specific habitat type needed during the early life stages of male wild turkey in West Virginia. At both second- and third-order spatial scales juvenile and adult male wild turkeys differed in their annual selection of slope. Adults consistently used at both spatial scales steeper (>24–35%) gradients than did juvenile birds; juveniles selected for >6–24% gradients at both spatial scales. Juvenile seasonal selection of slope in the DISA differs from their annual selection with a higher

proportional use of 0–6% slope; this selection is probably in accordance with their temporal selection of cropland. Also, at both second- and third-order spatial scale juvenile and adult male wild turkeys differed in their annual selection of land fragmentation features with adults selecting for forest perforations and juveniles selecting for edges; this is consistent with their respective selection of land use and land cover features. Our data may suggest that juveniles are selecting for more open habitat types of cropland- and pasture-field- forest, road edges than are adults. Furthermore, our results indicate that at the second-order spatial scale juvenile wild turkeys are selecting for roads, primarily forested road edges, at greater rates than are proportionally available. This finding follows numerous studies in which hens with young poults select for such habitat for their diverse herbaceous vegetation, higher insect abundance, and prevalent escape cover (Hurst 1981, Pack et al. 1988, Sisson et al. 1991). Our juvenile selection of similar land features may just be an artifact of these brood patterns or a deliberate selection of highly productive, safe habitats. Selection of aspect for either age group at both various spatial and temporal scales is often insignificant and variable and may be negligible.

The DISA is somewhat unique in its features compared to the rest of the state and resource selection of turkeys there should not be overlooked. Unlike the statewide annual analysis, birds within the DISA selected for more pastures-fields and crops than was available at the second-order spatial scale. Only juveniles in the statewide annual analysis were found to select for crop but in the DISA both adults and juveniles selected for crop on at least one spatial scale. Likewise, statewide third-order selection of land fragmentation favored forest perforations but in the DISA both adults and juvenile wild turkeys were more associated with edges and forest perforations. Our results may suggest that birds within the DISA select for more pasture, field, and cropland habitats than do other male wild turkey in the state.

It has been well documented that mast abundance and distribution affects home range characteristics like size and habitat composition (Burhans et al. 2000). Kelly et al. (1988) suggested that when mast is abundant turkeys move shorter distances to find food and thus have smaller home ranges. However, when mast is poor wild turkeys expand their range in search of supplemental foods (Kurzejske and Lewis 1990, Healy 1992) which may be found in edge, forest perforations, pastures and fields, and croplands (Healy 1985, Peoples et al. 1996). Kelley et al. (1988) suggested that home ranges size is a mechanism of habitat diversity and large home ranges are often associated with homogeneous, largely forested areas (Wigley et al. 1986, Exum et al. 1987, Kelley et al. 1988), which our analysis supports.

While forest is often the highest ranking resource selection of wild turkey in West Virginia, animals used more edge and forest perforations and < 100 ha core areas annually than was proportionally available. Due to recent forestry practices like fire suppression and low impact harvesting techniques along with the introduction of exotic diseases like chestnut blight (*Cryphonectria parasitica*) and beech bark disease (*Nectria Cryptococcus-Neonectria* complex), forest canopies are closing and are composed primarily of low mast producing forest types dominated by shade-tolerant species such as maples (*Acer* spp.) (Nowacki and Abrams 2008, Porter et al. 2011). Such forest types with fewer oaks and hickories may leave turkeys without necessary food source levels for long periods of time (McShea et al. 2007). The general loss of young forest in the eastern U.S. means turkeys now exist in more mature forest that provide highly variable foods (Porter et al. 2011). Edge, perforation, and smaller core forest areas may be selected for in West Virginia by adult male wild turkey because of their high productivity and resource diversity (Bucks and Bledsoe 2011) and the current successional and forestry trend that have led to potentially less productive forest habitats (Porter et al. 2011).

MANAGEMENT IMPLICATIONS

Despite West Virginia being 78% forested, our results show that selected forest habitats are often areas characterized as fragmented, having high proportions of edges and interior perforations. Such openings and edges within the forest provide much greater invertebrate abundances than do large expanses of mature forest, and active management may be the key to maintaining their proper functionality (Backs and Bledsoe 2011). Furthermore, our data suggest that edges and perforations at the third-order spatial scale, often created by forest roads, are features significantly selected for by juvenile male wild turkey; other forest openings and edges that were not directly quantified by this study include haul-roads, log-landings, and utility right-of-ways. Landowners are encouraged to use these areas only as necessary, being aware that higher amounts of traffic may negatively affect turkey use (McDougal et al. 1990). Forest edges and openings provide multilayer, “complex edge” habitats which offer diverse food sources (e.g., seeds, insects, fruits), escape cover, travel corridors, and mating display areas (Speake et al. 1975, Holbrook et al. 1987, Wertz and Flake 1988) that can be improved or maintained through planting, cutting, mowing, or even passive management for wild turkey (Backs and Bledsoe 2011, McCord and Harper 2011). Like interior forest perforations and edges, pasture-fields are important habitats in West Virginia because of their herbaceous structure and associated high resources abundance; such habitats are maintained by variations of mowing, grazing, and burning techniques (Backs and Bledsoe 2011, McCord and Harper 2011). At the core home range level land managers should attempt to provide 15% forest perforations and 18% pasture-field cover types to help provide the habitat needs of both adult and juvenile wild turkey. Management of turkey habitat should be concentrated primarily to slopes of $\leq 24\%$ gradients with

little regard to aspect because of the often variable and insignificant selection of the landscape feature.

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Table 1. Annual 95% and 50% utilization distributions (UD) for Gaussian fixed kernel density estimations (KDE) home ranges, smoothing parameter (h) determined by least squares cross validation, of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007

Study Area	Age	Season	n	Home range (ha)							
				95% UD				50% UD			
				$\bar{x}$	SE	Min	Max	$\bar{x}$	SE	Min	Max
Statewide	Adult	Annual	37	1,409.9	180.3	287.4	4,768.4	310.3	38.7	74.6	1,089.8
Statewide	Juvenile	Annual	29	1,394.3	790.8	148.9	2,865.7	320.6	190.3	22.9	669.4
District I Study Area	Adult	Annual	9	1,515.3	368.0	700.1	3,447.3	327.2	79.2	111.0	778.0
District I Study Area	Juvenile	Annual	19	1,323.3	190.1	148.9	2,422.5	310.8	46.1	22.9	644.4
Statewide	Adult	Spring	9	685.6	66.3	426.3	838.3	163.0	12.7	98.7	214.1
		Fall	9	858.2	119.8	380.1	1,356.8	220.2	33.8	77.7	347.5
		Winter	8	927.6	238.5	392.3	2,137.3	211.6	56.7	63.9	457.1
		Spring-Summer	17	821.8	106.3	390.8	1,953.9	199.0	26.9	74.6	473.1
		Fall-Winter	17	1,046.6	174.8	326.0	3,228.4	241.8	43.5	75.4	870.6
District I Study Area	Juvenile	Spring	11	800.2	123.8	303.3	1,188.6	142.1	15.5	73.1	188.1
		Spring-Summer	10	543.8	85.0	148.9	855.6	97.0	10.7	22.9	125.5

Table 2. Second-order land use and land cover resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
						Forest	Pasture	Crop	Road	Barren	Water
Statewide	Adult	Annual	37	0.27	0.001	1A	2A	4A	3A	5A	6A
Statewide	Juvenile	Annual	29	0.10	0.001	2A	3A	5A	1A	4A	6A
District I Study Area	Adult	Annual	9	0.02	0.020	4B	2A	1A	3AB	5C	6D
District I Study Area	Juvenile	Annual	19	0.01	0.001	4AC	1A	3ABC	2AB	5ABC	6D

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Table 3. Second-order land fragmentation resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
						Edge	Perforations	Patch	<100ha	100–200ha	>200ha
Statewide	Adult	Annual	37	0.11	0.001	1A	2A	4BC	3AB	6D	5 BC
Statewide	Juvenile	Annual	29	0.12	0.001	1A	2B	3B	4B	5C	6C
District I Study Area	Adult	Annual	9	0.11	0.020	1A	4BC	2ABC	3ABC		
District I Study Area	Juvenile	Annual	19	0.27	0.001	1A	3B	4B	2B		

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993). Blank spaces in a row indicate that resources were not available for analysis.

Table 4. Second-order slope resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
						0–6%	> 6–24%	> 24–35%	> 35%
Statewide	Adult	Annual	37	0.59	0.001	3AC	2AB	1A	4C
Statewide	Juvenile	Annual	29	0.33	0.001	2B	1A	3B	4C
District I Study Area	Adult	Annual	9	0.55	0.260	3A	2A	1A	4A
District I Study Area	Juvenile	Annual	19	0.40	0.003	2AB	1A	3B	4C

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Table 5. Second-order aspect resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
						North	East	South	West
Statewide	Adult	Annual	37	0.97	0.200	2A	4A	1A	3A
Statewide	Juvenile	Annual	29	0.74	0.001	4C	2AB	3BC	1A
District I Study Area	Adult	Annual	9	0.27	0.040	4B	1A	2B	3B
District I Study Area	Juvenile	Annual	19	0.66	0.090	3A	1A	4A	2A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Table 6. Third-order land use and land cover resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
						Forest	Pasture	Crop	Road	Barren	Water
Statewide	Adult	Annual	37	0.55	0.001	1A	2B	6D	4CD	3C	5DC
Statewide	Juvenile	Annual	29	0.35	0.001	2A	3A	1A	4B	5C	6C
District I Study Area	Adult	Annual	9	0.16	0.120	1A	2A	4A	3A	5A	6A
District I Study Area	Juvenile	Annual	19	0.21	0.001	2A	3A	1A	4B	5BC	6C
Statewide	Adult	Spring	9	0.19	0.120	1A	2A	5A	3A	4A	6A
		Fall	9	0.05	0.050	1A	3A	5AB	2A	4A	6B
		Winter	8	0.46	0.790	1A	3A	6A	5A	4A	2A
		Spring-Summer	17	0.37	0.020	1A	2AB	5BCD	3C	4C	6D
		Fall-Winter	17	0.43	0.040	1A	2B	5B	6B	4B	3AB
District I Study Area	Juvenile	Spring	11	0.002	0.003	2B	3C	1A	4D	6D	5CD
		Spring-Summer	10	0.06	0.010	2A	3B	1A	4C	6D	5D

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Table 7. Third-order land fragmentation resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
						Edge	Perforations	Patch	<100ha	100–200ha	>200ha
Statewide	Adult	Annual	37	0.24	0.006	2AB	1A	3C	5C	6C	4BC
Statewide	Juvenile	Annual	29	0.13	0.003	1A	2AB	5C	3AC	4ABC	6BC
District I Study Area	Adult	Annual	9	0.15	0.020	1A	2AB	4B	3AB		
District I Study Area	Juvenile	Annual	19	0.29	0.001	2A	1A	3B	4B		
Statewide	Adult	Spring	9	0.61	0.390	1A	2A	4A	3A		
		Fall	9	0.23	0.030	1A	4B	2AB	3AB		
		Winter	8	0.71	0.640	3A	1A	4A	2A		
		Spring-Summer	17	0.05	0.510	1A	2A	4A	3A	6A	5A
		Fall-Winter	17	0.20	0.030	1A	2A	3B	4AB		5AB
District I Study Area	Juvenile	Spring	11	0.05	0.003	2B	1A	3C	4BC		
		Spring-Summer	10	0.17	0.006	2AB	1A	3AC	4BC		

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993). Blank spaces in a row indicate that resources were not available for analysis.

Table 8. Third-order slope resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
						0–6%	> 6–24%	> 24–35%	> 35%
Statewide	Adult	Annual	37	0.41	0.001	3B	2A	1A	4B
Statewide	Juvenile	Annual	29	0.70	0.020	3A	1A	2A	4B
District I Study Area	Adult	Annual	9	0.35	0.090	3A	1A	2A	4A
District I Study Area	Juvenile	Annual	19	0.34	0.002	3C	1A	2B	4D
Statewide	Adult	Spring	9	0.45	0.190	3A	1A	2A	4A
		Fall	9	0.05	0.004	3B	1A	2B	4C
		Winter	8	0.77	0.840	1A	2A	4A	3A
		Spring–Summer	17	0.62	0.050	3AB	1A	2A	4B
		Fall–Winter	17	0.73	0.210	1A	2A	3A	4A
District I Study Area	Juvenile	Spring	11	0.01	0.004	1A	2AB	3AC	4D
		Spring–Summer	10	0.004	0.006	2AB	1A	3B	4C

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Table 9. Third-order aspect resource selection significance and rank of male eastern wild turkeys from 2 study areas in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Study Area	Age	Season	n	Wilks' λ	P	Rank ^a			
						North	East	South	West
Statewide	Adult	Annual	37	0.94	0.530	2A	1A	3A	4A
Statewide	Juvenile	Annual	29	0.79	0.120	2A	1A	3A	4A
District I Study Area	Adult	Annual	9	0.28	0.050	3B	4B	2B	1A
District I Study Area	Juvenile	Annual	19	0.64	0.050	3A	1A	4AC	2AB
Statewide	Adult	Spring	9	0.55	0.280	4A	3A	2A	1A
		Fall	9	0.84	0.790	3A	4A	2A	1A
		Winter	8	0.59	0.400	3A	1A	2A	4A
		Spring-Summer	17	0.85	0.530	4A	3A	2A	1A
		Fall-Winter	17	0.86	0.600	2A	1A	4A	3A
District I Study Area	Juvenile	Spring	11	0.1	0.006	4B	1A	2AB	3AB
		Spring-Summer	10	0.59	0.240	2A	1A	4A	3A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Figure 1. West Virginia Statewide Male Eastern Wild Turkey Study Area and the District I Study Area, 2004–2007.

Figure 2. Mean annual statewide adult ($n = 37$) and juvenile ($n = 29$) male wild turkey second-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 95% UD home ranges ($\bar{x} = 1,409.9$ ha, $SE = 180.3$; $\bar{x} = 1,394.3$ ha, $SE = 146.6$) and availability was derived from a proportional summary and weighted average of 2,587 100 ha blocks ($\bar{x} = 51,740$ ha, $SE = 12,983.2$) within 5 ecological regions of West Virginia, 2004–2007.

Figure 3. Mean annual statewide adult ($n = 37$) and juvenile ($n = 29$) third-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 50% ($\bar{x} = 310.3$ ha, $SE = 38.7$; $\bar{x} = 320.6$ ha, $SE = 190.3$) and availability proportions were derived from 95% ($\bar{x} = 1,409.9$ ha, $SE = 180.3$; $\bar{x} = 1,394.3$ ha, $SE = 790.8$) UD home ranges within 5 ecological regions of West Virginia, 2004–2007.

Figure 4. Mean fall ($n = 9$), fall-winter ($n = 17$), and winter ($n = 8$) adult wild turkey third-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 50% ($\bar{x} = 220.2$ ha, $SE = 33.8$; $\bar{x} = 241.8$ ha, $SE = 43.5$; $\bar{x} = 211.6$ ha, $SE = 56.7$) and availability proportions were derived from 95% ($\bar{x} = 858.2$ ha, $SE = 119.8$; $\bar{x} = 1,046.6$ ha, $SE = 174.8$; $\bar{x} = 927.6$, $SE = 238.5$) UD home ranges within 5 ecological regions of West Virginia, 2004–2007.

Figure 5. Mean spring ($n = 9$) and spring-summer ($n = 17$) adult wild turkey third-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 50% ($\bar{x} = 163.0$ ha, $SE = 12.7$; $\bar{x} = 199.0$ ha, $SE = 26.9$) and availability proportions were derived from 95% ($\bar{x} = 685.6$ ha, $SE = 66.3$; $\bar{x} = 821.8$ ha, $SE = 106.3$) UD home ranges within 5 ecological regions of West Virginia, 2004–2007.

Figure 6. Mean spring ($n = 11$) and spring-summer ($n = 11$) juvenile wild turkey third-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 50% ($\bar{x} = 142.1$ ha, $SE = 15.5$; $\bar{x} = 97.0$, $SE = 10.7$) and availability proportions were derived from 95% ($\bar{x} = 800.2$ ha, $SE = 123$; $\bar{x} = 543.8$ ha, $SE = 85.0$) UD home ranges within the District I Study Area of West Virginia, 2004–2007.

Figure 7. Mean annual adult ($n = 9$) and juvenile ($n = 19$) wild turkey second-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 95% ($\bar{x} = 1,515.3$ ha, $SE = 368.0$; $\bar{x} = 1323.3$ ha, $SE = 190.1$) UD home ranges and availability proportions were derived from 639 100 ha sampling blocks within the District I Study Area of West Virginia, 2004–2007.

Figure 8. Mean annual adult ($n = 9$) and juvenile ($n = 19$) wild turkey third-order land use and land cover, land fragmentation, slope, and aspect proportions; use proportions were derived from 50% ($\bar{x} = 327.2$ ha, $SE = 79.2$; $\bar{x} = 310.8$ ha, $SE = 46.1$) and availability proportions were derived from 95% ($\bar{x} = 1,515.3$ ha, $SE = 368.0$; $\bar{x} = 1,323.3$ ha, $SE = 190.1$) UD home ranges within the District I Study Area of West Virginia, 2004–2007.

APPENDICES

Appendix A. Ia – CCXCIVa: Adult and juvenile 50% and 95% probability contours of the annual and seasonal Gaussian fixed kernel home range utilization distribution (UD) for 55 male wild turkeys in West Virginia, 2004–2007. Smooth parameter (h) determined by least squares cross validation (land use and land cover, land fragmentation, aspect, and slope raster data used for map backgrounds).

Appendix Ia. 10001 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix IIa. 10001 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix IIIa. 10002 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix IVa. 10002 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix Va. 10003 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix VIa. 10003 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix VIIa. 10005 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix VIIIa. 10005 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix IXa. 10006 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix Xa. 10006 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XIa. 10007 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XIIa. 10007 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XIIIa. 10008 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XIVa. 10008 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XVa. 10009 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XVIa. 10009 (adult, annual) - 50% core and 95% periphery probability contours of the annual fixed Gaussian kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XVIIa. 10010 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XVIIIa. 10010 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XIXa. 10011 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXa. 10011 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXIa. 10012 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXIIa. 10012 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXIIIa. 10014 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXIVa. 10014 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXVa. 10015 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXVIa. 10015 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXVIIa. 10016 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXVIIIa. 10016 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXIXa. 10017 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXXa. 10017 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXXIa. 10018 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXXIIa. 10018 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXXIIIa. 10019 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXXIVa. 10019 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXXVa. 10021 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXXVIa. 10021 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXXVIIa. 10022 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XXXVIIIa. 10022 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XXXIXa. 10023 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XL*a*. 10023 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XLIa. 10024 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XLIIa. 10024 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XLIIIa. 10025 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XLIVa. 10025 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XLVa. 10026 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XLVIa. 10026 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XLVIIa. 10027 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XLVIIIa. 10027 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XLIXa. 10029 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix La. 10029 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix L1a. 10030 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LIIa. 10030 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LIIIa. 10031 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LIVa. 10031 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LVa. 10032 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LVIa. 10032 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LVIIa. 10033 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LVIIIa. 10033 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LIXa. 10034 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXa. 10034 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXIa. 10036 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXIIa. 10036 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXIIIa. 10037 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXIVa. 10037 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXVa. 10038 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXVIa. 10038 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXVIIa. 10039 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXVIIIa. 10039 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXIXa. 10040 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXa. 10040 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXIa. 10041 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXIIa. 10041 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXIIIa. 10043 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXIVa. 10043 (adult, fall) - 50% core and 95% periphery probability contours of the fall Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXVa. 10044 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXVIa. 10044 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXVIIa. 10045 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXVIIIa. 10045 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXIXa. 10046 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXXa. 10046 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXXIa. 10047 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXXIIa. 10047 (adult, winter) - 50% core and 95% periphery probability contours of the winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXXIIIa. 10048 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXXIVa. 10048 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXXVa. 10050 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXXVIa. 10050 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXXVIIa. 10051 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix LXXXVIIa. 10051 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix LXXXIXa. 10053 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XCa. 10053 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XCIa. 10054 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XCIIa. 10054 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XCIIIa. 10055 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XCIVa. 10055 (adult, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XCVa. 10056 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XCVIa. 10056 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XCVIIa. 10057 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix XCVIIIa. 10057 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix XCIXa. 10059 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix Ca. 10059 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CIa. 10060 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CIIa. 10060 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CIIIa. 10061 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CIVa. 10061 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CVa. 10063 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CVIa. 10063 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CVIIa. 10064 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CVIIIa. 10064 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CIXa. 10066 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXa. 10066 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXIa. 10067 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXIIa. 10067 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXIIIa. 10068 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXIVa. 10068 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXVa. 10069 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXVIa. 10069 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXVIIa. 10071 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marrion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXVIIIa. 10071 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXIXa. 10072 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marrion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXa. 10072 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXIa. 10074 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marrion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXIIa. 10074 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXIIIa. 10075 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXIVa. 10075 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXVa. 10076 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXVIa. 10076 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXVIIa. 10078 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXVIIIa. 10078 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXIXa. 10079 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXXa. 10079 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXXIa. 10080 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXXIIa. 10080 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXXIIIa. 10082 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXXIVa. 10082 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXXVa. 10083 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXXVIa. 10083 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXXVIIa. 10085 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXXXVIIIa. 10085 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXXXIXa. 10086 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXL*a*. 10086 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXLIIa. 10087 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXLIIa. 10087 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXLIIIa. 10088 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXLIVa. 10088 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXLVa. 10090 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXLVIa. 10090 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXLVIIa. 10091 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXLVIIIa. 10091 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXLIXa. 10093 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLa. 10093 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CL1a. 10094 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLIIa. 10094 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLIIIa. 10095 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLIVa. 10095 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Harrison/Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLVa. 10097 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLVIa. 10097 (juvenile, spring) - 50% core and 95% periphery probability contours of the spring Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLVIIa. 10098 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLVIIIa. 10098 (juvenile, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Marion/Taylor County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLIXa. 10099 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Pendleton County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXa. 10099 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Pendleton County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXIa. 10100 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Hardy County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXIIa. 10100 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Hardy County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXIIIa. 10101 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXIVa. 10101 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXVa. 10102 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Hardy County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXVIa. 10102 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Hardy County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXVIIa. 10103 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Hardy County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXVIIIa. 10103 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Hardy County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXIXa. 10104 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXa. 10104 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXIa. 10105 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXIIa. 10105 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXIIIa. 10106 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXIIa. 10106 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXVa. 10107 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXVIa. 10107 (adult, fall-winter) - 50% core and 95% periphery probability contours of the fall-winter Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXVIIa. 10108 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXVIIIa. 10108 (adult, spring-summer) - 50% core and 95% periphery probability contours of the spring-summer Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXIXa. 10109 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXXa. 10109 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXXIa. 10110 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXXIIa. 10110 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXXIIIa. 10111 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXXIVa. 10111 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lewis County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXXVa. 10112 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXXVIa. 10112 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXXVIIa. 10113 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CLXXXVIIIa. 10113 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CLXXXIXa. 10114 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXCa. 10114 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXCIa. 10115 (adult, spring) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXCIIa. 10115 (adult, spring) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXCIHa. 10116 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXCIVa. 10116 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXC*Va*. 10117 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXCVIa. 10117 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXC VIIa. 10118 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CXCVIIIa. 10118 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CXCIXa. 10119 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCa. 10119 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCIa. 10120 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCIIa. 10120 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCIIIa. 10121 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCIVa. 10121 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCVa. 10122 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCVIa. 10122 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCVIIa. 10123 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCVIIIa. 10123 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCIXa. 10124 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXa. 10124 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXIa. 10125 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXIIa. 10125 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXIIIa. 10126 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXIVa. 10126 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXVa. 10127 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXVIa. 10127 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXVIIa. 10128 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXVIIIa. 10128 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXIXa. 10129 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXa. 10129 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXIa. 10130 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lincoln County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXIIa. 10130 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lincoln County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXIIIa. 10131 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lincoln County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXIVa. 10131 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Lincoln County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXVa. 10132 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXVIa. 10132 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Summers County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXVIIa. 10133 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXVIIIa. 10133 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXIXa. 10134 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXXa. 10134 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXXIa. 10135 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXXIIa. 10135 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXXIIIa. 10136 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXXIVa. 10136 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXXVa. 10137 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXXVIa. 10137 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXXVIIa. 10138 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXXXVIIIa. 10138 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Mason County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXXXIXa. 10139 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXL*a*. 10139 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXLIIa. 10140 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXLIIa. 10140 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXLIIIa. 10141 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXLIVa. 10141 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXLVa. 10142 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXLVIa. 10142 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXLVIIa. 10143 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXLVIIIa. 10143 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Randolph County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXLIXa. 10144 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLa. 10144 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCL1a. 10145 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLIIa. 10145 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLIIIa. 10146 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLIVa. 10146 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLVa. 10147 (adult, spring) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLVIa. 10147 (adult, spring) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLVIIa. 10148 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLVIIIa. 10148 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLIXa. 10149 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXa. 10149 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXIa. 10150 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXIIa. 10150 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXIIIa. 10151 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXIVa. 10151 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXVa. 10152 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXVIa. 10152 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXVIIa. 10153 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXVIIIa. 10153 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXIXa. 10154 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXa. 10154 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXIa. 10155 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXIIa. 10155 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXIIIa. 10156 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXIV*a*. 10156 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXVa. 10157 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXVIa. 10157 (adult, fall) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXVIIa. 10158 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXVIIIa. 10158 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXIXa. 10159 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXXa. 10159 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXXIa. 10160 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXXIIa. 10160 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXXIIIa. 10161 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXXIVa. 10161 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXXVa. 10162 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXXVIa. 10162 (adult, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXXVIIa. 10163 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCLXXXVIIIa. 10163 (adult, fall-winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCLXXXIXa. 10164 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXC*a*. 10164 (juvenile, annual) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXCIIa. 10165 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXCIIa. 10165 (adult, spring-summer) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix CCXCIIIa. 10166 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (land use and land cover, land fragmentation maps).

Appendix CCXCIVa. 10166 (adult, winter) - 50% core and 95% periphery probability contours of the annual Gaussian fixed kernel home range utilization distributions. Smoothing parameter (h) determined by least squares cross validation, Greenbrier County, West Virginia, 2004–2007 (aspect and slope maps).

Appendix B. Regional male wild turkey land use and land cover, land fragmentation, slope, and aspect habitat resource selection in regions 2, 3, 4, and 6 in West Virginia, 2004–2007. Due to small sample size and lack of data regions 1 and 5 were not used in regional habitat selection analysis.

Appendix B.

Regional Male Second-order Selection. – Statewide annual adult ($\bar{x} = 1,409.9$ ha, SE = 180.3) and juvenile ($\bar{x} = 1,394.3$ ha, SE = 790.8) 95% home ranges ($n = 66$) were similar in West Virginia ($W = 515$, $P = 0.780$). Male wild turkey 95% UD home ranges were not significantly different between ecological regions 2, 3, 4, and 6 ($\chi^2_{3,63} = 2.78$, $P = 0.430$). Turkeys ($n = 16$) selected forested areas at higher rates than other land use land cover habitat resources in region 2 (Wilks' $\lambda = 0.02$, $P = 0.001$). Turkeys also selected for perforated and edges at higher rates than other land fragmentation categories (Wilks' $\lambda = 0.01$, $P = 0.001$). Turkeys selected for ≥ 6 –35% gradients at higher rates than other slope categories in region 2 (Wilks' $\lambda = 0.22$, $P = 0.001$). Turkeys also selected east and west at higher rates than north and south facing aspects (Wilks' $\lambda = 0.39$, $P = 0.007$).

Male wild turkeys ($n = 6$) selected for pasture and crop at marginally higher rates than other land use and land cover habitat resources in region 3 (Wilks' $\lambda = 0.0001$, $P = 0.050$). However, turkeys did not display a disproportionate selection of land fragmentation (Wilks' $\lambda = 0.0002$, $P = 0.170$), slope (Wilks' $\lambda = 0.08$, $P = 0.090$), or aspect (Wilks' $\lambda = 0.03$, $P = 0.070$) resources in region 3. Turkeys ($n = 35$) selected for pastures and forests at higher rates than other land use and land cover habitat resources in region 4 (Wilks' $\lambda = 0.12$, $P = 0.001$). Turkeys selected for edge habitats at higher rates than other land fragmentation categories in region 4 (Wilks' $\lambda = 0.13$, $P = 0.001$). Turkeys selected for slopes $\leq 24\%$ (Wilks' $\lambda = 0.69$, $P = 0.006$). There was no significant selection of aspect in region 4 (Wilks' $\lambda = 0.80$, $P = 0.060$). Turkeys ($n = 6$) did not displayed a disproportionate selection of land use and land cover (Wilks' $\lambda = 0.006$, $P = 0.210$), land fragmentation (Wilks' $\lambda = 0.005$, $P = 0.380$), slope (Wilks' $\lambda = 0.19$, $P = 0.150$), or aspect (λ Wilks' = 0.37, $P = 0.420$) in region 6.

Appendix B cont.

Regional Male Third-order Selection. – Statewide annual adult and juvenile ($n = 66$) 95% ($\bar{x} = 1,409.9$ ha, $SE = 180.3$; $\bar{x} = 1,394.3$ ha, $SE = 790.8$) ($W = 515$, $P = 0.780$) and 50% ($\bar{x} = 310.3$ ha, $SE = 38.7$; $\bar{x} = 320.6$ ha, $SE = 190.3$) ($W = 491$, $P = 0.560$) home ranges were similar in West Virginia. Both male wild turkey 95% ($\chi^2_{3,63} = 2.78$, $P = 0.43$) and 50% ($\chi^2_{3,63} = 5.49$, $P = 0.140$) UD home ranges were not significantly different between ecological regions 2, 3, 4, and 6 in West Virginia. Turkeys ($n = 16$) selected for forest and pasture at higher rate than other land use and land cover habitat resources in region 2 (Wilks' $\lambda = 0.24$, $P = 0.006$). Male wild turkeys also selected for < 100 ha core, edge, patch, perforated, and 100–200 ha core at higher rates than >200 ha core areas (Wilks' $\lambda = 0.09$, $P = 0.002$). Although turkeys did not display a disproportionate selection of slope (Wilks' $\lambda = 0.70$, $P = 0.180$) birds did selected for east facing slopes at higher rates than other aspect categories in region 2 (Wilks' $\lambda = 0.17$, $P = 0.001$).

Male wild turkeys ($n = 6$) did not display a disproportionate selection of land use and land cover (Wilks' $\lambda = 0.004$, $P = 0.150$), land fragmentation (Wilks' $\lambda = 0.007$, $P = 0.330$), slope (Wilks' $\lambda = 0.10$, $P = 0.090$), or aspect (Wilks' $\lambda = 0.76$, $P = 0.890$) habitat resources in region 3. Turkeys ($n = 35$) selected forest at higher rates than other land use and land cover habitat resources in region 4 (Wilks' $\lambda = 0.50$, $P = 0.002$). Turkeys also selected for areas of 6–24% gradients at higher rates than other slope categories (Wilks' $\lambda = 0.43$, $P = 0.001$). However, turkeys did not display a disproportionate selection of land fragmentation (Wilks' $\lambda = 0.04$, $P = 0.760$) or aspect (Wilks' $\lambda = 0.95$, $P = 0.720$) in region 4. Likewise, turkeys ($n = 6$) displayed no disproportionate selection of land use and land cover (Wilks' $\lambda = 0.50$, $P = 0.780$), land fragmentation (Wilks' $\lambda = 0.28$, $P = 0.790$), slope (Wilks' $\lambda = 0.74$, $P = 0.850$), or aspect (Wilks' $\lambda = 0.91$, $P = 0.970$) within region 6.

Appendix C. Regional 95% and 50% utilization distributions (UD) for Gaussian fixed kernel density estimations (KDE) home ranges, smoothing parameter (h) determined by least squares cross validation, of male eastern wild turkeys in West Virginia, 2004–2007.

Region	n	Home range (ha)							
		95%				50%			
		$\bar{x}$	SE	Min	Max	$\bar{x}$	SE	Min	Max
1	3	2,102.2	345.8	1,446.0	2,610.4	469.3	34.5	401.4	513.2
2	16	1,196.9	160.5	510.4	2,915.4	265.9	34.5	133.9	657.0
3	6	890.0	249.2	464.2	2,099.5	179.1	66.9	86.6	511.7
4	35	1,589.8	196.1	148.9	4,769.4	356.5	43.4	22.9	1,089.8
6	6	1,023.9	110.6	705.1	1,353.2	259.9	41.5	138.2	410.1

Appendix D. *Id – VIII d*: Second- and third-order resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA)

Appendix Id. Second-order land use and land cover resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
				Forest	Pasture	Crop	Road	Barren	Water
2	16	0.02	0.001	1A	4AC	5AC	2BC	3BC	6D
3	6	0.0001	0.050	3B	1A	2AB	4BC	6BD	5ABC
4	35	0.12	0.001	2AB	1A	3B	4BC	5C	6BD
6	6	0.006	0.210	2A	3A	5A	1A	4A	6A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Appendix II*d*. Second-order land fragmentation resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
				Edge	Perforations	Patch	<100ha	100–200ha	>200ha
2	16	0.02	0.001	2AB	1A	4BC	5ABC	6C	3B
3	6	0.0002	0.170	2A	3A	4A	5A	6A	1A
4	35	0.13	0.001	1A	3B	4B	2B	6C	5C
6	6	0.005	0.380	3A	1A	4A	2A	6A	5A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Appendix III*d*. Second-order slope resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
				0–6%	> 6–24%	> 24–35%	> 35%
2	16	0.22	0.001	4B	2A	1A	3B
3	6	0.08	0.090	2A	1A	3A	4A
4	35	0.7	0.006	2AB	1A	3B	4C
6	6	0.19	0.150	3A	2A	4A	1A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Appendix IVd. Second-order aspect resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
				North	East	South	West
2	16	0.22	0.007	4C	1A	3BC	2AB
3	6	0.03	0.070	3A	2A	1A	4A
4	35	0.81	0.060	2A	3A	4A	1A
6	6	0.37	0.420	4A	2A	3A	1A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Appendix Vd. Third-order land use and land cover resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
				Forest	Pasture	Crop	Road	Barren	Water
2	16	0.24	0.006	1A	2AB	4AB	5AB	3B	6B
3	6	0.004	0.150	2A	1A	6A	3A	4A	5A
4	35	0.49	0.002	1A	2B	3BC	4C	5CD	6D
6	6	0.5	0.780	1A	2A	4A	5A	3A	

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993). Blank spaces in a row indicate that resources were not available for analysis.

Appendix VI*d*. Third-order land fragmentation resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a					
				Edge	Perforations	Patch	<100ha	100–200ha	>200ha
2	16	0.09	0.002	2B	4ABC	3C	1ABC	5BD	6D
3	6	0.007	0.330	3A	2A	4A	6A	5A	1A
4	35	0.04	0.760	4A	2A	5A	6A	1A	3A
6	6	0.28	0.790	2A	3A	1A	5A		4A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993). Blank spaces in a row indicate that resources were not available for analysis.

Appendix VII*d*. Third-order slope resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
				0–6%	> 6–24%	> 24–35%	> 35%
2	16	0.69	0.180	3A	4A	1A	2A
3	6	0.1	0.090	4A	3A	1A	2A
4	35	0.43	0.001	3B	1A	2B	4C
6	6	0.74	0.850	3A	1A	2A	4A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).

Appendix VIII*d*. Third-order aspect resource selection significance and rank of male eastern wild turkeys from 4 ecological regions in West Virginia, 2004–2007. Use proportions derived from 95% home range utilization distributions (UD) and availability derived from 100 ha block regional proportional summaries; proportions were analyzed using compositional analysis (CA).

Region	<i>n</i>	Wilks' λ	<i>P</i>	Rank ^a			
				North	East	South	West
2	16	0.16	0.001	3B	1A	2B	4B
3	6	0.76	0.890	3A	4A	2A	1A
4	35	0.95	0.720	2A	1A	4A	3A
6	6	0.91	0.970	2A	3A	1A	4A

^a The same letters following each rank within a row indicates no difference ($P > 0.05$) by compositional analysis (Aebischer et al. 1993).