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Mammals of Great Smoky Mountains National Park: 2016 Revision

Donald W. Linzey*

Abstract - The 1288-km² Great Smoky Mountains National Park (the Park) is one of the largest protected temperate forest ecosystems east of the Rocky Mountains. Because of its global ecological importance, the Park was designated an International Biosphere Reserve in 1976 and a World Heritage Site in 1983. The Park's rich biodiversity is the result of a deeply dissected landscape ranging in elevation from 259 m (850 ft) to 2026 m (6643 ft), high primary productivity, and diverse plant communities. These conditions, and the occurrence of several species at or near their southern range limit, favor high mammal diversity in the Park. Herein, I present the first comprehensive update on the Park's mammals in over 20 years. Since that 1995 publication, several new species have been recorded, additional distribution and other ecological data collected, 3 reintroductions (2 successful, 1 unsuccessful) transpired, and numerous taxonomic revisions have occurred. To the extent that data is available, the distribution, food, reproduction, pelage, hibernation, predation, parasites, measurements, and location of specimens are given for all 68 mammals in the Park. Four additional mammal species are listed as "probable" based on their known distribution in regions surrounding the Park. The Literature Cited along with the additional listed references provided in Appendix 1 together comprise the most complete bibliography ever assembled relating to mammals found in the Park.

Introduction

Periodic and comprehensive assessments of biodiversity can provide valuable information to protected-area managers, scientists, and the general public (Linzey and Linzey 1968). Inventories of fauna or flora can provide new data on the composition, distribution, taxonomy, and ecology of known, reintroduced, or newly discovered species within protected areas, identify general population trends as well as threats to species and community persistence, and document extirpations and describe their likely causes.

In 1968, a comprehensive technical report was published summarizing data on the mammals of Great Smoky Mountains National Park (hereafter referred to as the Park; Linzey and Linzey 1968). The paper compiled data on the 59 extant and 6 extinct Park species. In 1995, a second report provided updated species-account information, including an additional 7 species not previously reported for the Park (Linzey 1995). Significant changes in the mammal fauna have occurred during the past 21 years.

This revision contains accounts of 68 extant and 5 extinct species. Three species new to the Park have been recorded – *Nycticeius humeralis* Rafinesque (Evening

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Bat), *Lasiurus seminolus* Rhoads (Seminole Bat) and *Mustela nivalis* L. (Least Weasel), while 2 species have been successfully reintroduced: *Lontra canadensis* Schreber (Northern River Otter) and *Cervus canadensis* Erxleben (Wapiti or Elk). The reintroduction of a third species—*Canis rufus* Bartram (Red Wolf)—was unsuccessful. Many new locality and elevation records, as well as natural history data, have been recorded for species within the Park. The inclusion of the Foothills Parkway in the Park's jurisdiction has added one cave (Myhr Cave) and additional early successional habitat. Several species of mammals considered rare in the Park have been found in suitable habitat along the Parkway. Numerous taxonomic revisions have also occurred since 1995.

The purpose of the current monograph is to summarize all work that has been done on the mammals of the Park since 1930. Data from the 1968 and 1995 papers have been combined with more recent data to produce average body measurements and other results presented herein. In addition, a supplemental list of references is provided in Appendix 1, which when taken together with the sources listed in the Literature Cited comprise the most complete bibliography ever assembled relating to mammals found in the Park.

Study Area

GSMNP comprises ~1288 km² (800 mi²) of mountainous temperate forest. Elevations vary from 259 m along Abrams Creek in the western end of the Park to 2026 m on the summit of Clingmans Dome (Fig. 1). The topography of these mountains is complex and is comprised of 3 major rock types: sedimentary, igneous, and metamorphic. As the mountains were thrust upward during the Appalachian orogeny, streams were forced to follow their natural drainage patterns, cutting deep valleys and gorges separated by high ridges. The shaping of the landscape continues today with erosion being the dominant visible force reshaping and redefining the mountain peaks, ravines, ridges, and valleys. The Tennessee River drains most of this vast area. The watershed on the south side of Chilhowee Mountain that drains through Happy Valley is the only watershed on the entire perimeter of the Park where water flows into the Park instead of out. Rainfall ranges from an annual average of 140 cm in Gatlinburg to 216 cm on Clingmans Dome (Linzey 2008). As elevation increases, precipitation increases, but temperatures decrease at the rate of 1.24 °C (2.23 °F) for every 305 m increase in elevation.

Major habitat types include 5 major forest types (spruce–fir, northern hardwood, cove hardwood, pine–oak, and hemlock), meadows, balds, rock outcroppings, caves, rivers, streams, temporary ponds, and bogs. Currently, almost 95% of the Park is forested, and about 25% of that area has not been disturbed by logging or agriculture (Linzey 2008). An enormous variety of plant and animal life exists in the Park because of the varied topography, diversity of habitat types, and range of climatic conditions. Over 1600 species of vascular plants and almost 500 species of nonvascular plants occur in the Park, including 158 species of shrubs, 32 species of vines, and 137 species of trees. A detailed description of the Park's vegetation is given by Whittaker (1956).

The present distribution of mammal species in the Park is dictated by the interaction of topography, habitat availability and type, and climate, as well as historical factors. For example, plant and animal communities can greatly differ across the Park's wide elevational gradient. Due to the cooler, more humid conditions at higher elevations in the Park, the ranges of some northern species of mammals—*Sorex palustris* Richardson (American Water Shrew), *Tamiasciurus hudsonicus* Erxleben (Red Squirrel), *Glaucomys sabrinus* Shaw (Northern Flying Squirrel), *Microtus chrotorrhinus* Miller (Rock Vole), and *Mustela nivalis* L. (Least Weasel)—extend southward along the Appalachian Mountains and reach or approach their southern range limit in the Park.

Park Mammals: Late Pleistocene–1700

During the Pleistocene epoch of the last Ice Age, extensive sheets of ice covered most of Canada and much of the northern United States (Brown and Gibson 1983). As those regions cooled and glaciers formed, the ranges of many species of plants and animals were slowly displaced southward. Although the glacial advances halted far north of the Smokies, their presence caused the southern Appalachians and adjacent regions to become refugia for species that previously had more northern ranges (Brown and Gibson 1983). As the region subsequently warmed and the glaciers retreated, many of these northern species gradually reoccupied their more northern ranges. Some populations of these northern species (American Water Shrew, Red Squirrel, Northern Flying Squirrel, Rock Vole, and Least Weasel), however, continued to reside in high-elevation areas in the southern mountains where the climate was similar to those at lower elevations farther north; disjunct populations of these species continue to exist in the Park (Conaway and Pfitzer 1952, Linzey 1984).

The recorded history of anthropogenic impacts on the flora and fauna of the Smokies begins with the Cherokees, the first known human inhabitants. The Cherokees were an agricultural people, farming the valleys; cutting trees for cabins, dugout canoes, and firewood; and hunting in the forests. They lived by the thousands in villages along streams and rivers, many concentrated along the Little Tennessee River that flows along the current southeastern boundary of the Park. Evidence shows that Native Americans had been present in the Park since at least 8000 years before present (Linzey 2008). The peoples of the Archaic period had a diverse menu of wild mountain plants and hunted game. Over the next 5000 years, they shifted emphasis to wild seedy annuals that are typically found at lower elevations. By the time maize or corn was traded into the American Southeast, the woodland peoples of southern Appalachia were preadapted for farming (Bass 1977). By the mid-1600s, the Cherokees became increasingly committed to European trade. They began hunting more intensively, which led to the disappearance of *Bos bison* L. (American Bison) and Wapiti. By the 18th century, the Cherokees had begun trading furs with the English, which further reduced the populations of *Odocoileus virginianus* (Zimmermann) (White-tailed Deer), *Castor canadensis*

Kuhl (American Beaver), and Northern River Otter (Brimley 1945, Buckley 1859, Rhoads 1896).

Park Mammals: 1700–2015

During the mid- to late 1700s, major human-caused ecological changes began occurring within what is currently the Park boundary. It was during this time that European settlers cleared land for homesteads and cultivation, a pattern that steadily increased until land was acquired for the Park in the 1920s. Human disturbance was perhaps most intensive and widespread within the Park in the early 1900s when logging companies cut trees from huge tracts of land. By the time the Park was dedicated in 1940, it has been estimated that more than two-thirds of the land had been logged (Linzey 2008). These land uses fragmented a near-contiguous forest and increased the diversity of habitats available to mammals.

Some species were adversely affected by overexploitation, human-caused habitat loss and fragmentation, and associated disturbance caused by settlement and surrounding land uses. *Canis lupus* L. (Gray Wolf) and *Puma concolor* L. (Mountain Lion) were victims of predator control. The mountaineers ate the meat of White-tailed Deer, *Ursus americanus* Pallas (American Black Bear), *Sciurus* spp. (squirrels), and *Sylvilagus* spp. (rabbits). They sold pelts of *Vison vison* Schreber (American Mink), Northern River Otter, *Didelphis virginiana* (Kerr) (Virginia Opossum), *Procyon lotor* (L.) (Northern Raccoon), *Ondatra zibethicus* L. (Common Muskrat), and foxes. American Black Bears, Virginia Opossums, squirrels, Northern Raccoons, and foxes, however, were able to adapt to the pressures of hunting and trapping and maintain viable populations, and are present in the Park today.

The clearing of land at lower elevations in the Park created a different type of habitat, which allowed species preferring open areas or forest edges to extend their ranges into previously unoccupied areas. White-tailed Deer, for example, became fairly abundant during the 1800s (Linzey 2008). Human presence also provided suitable habitat for exotic, invasive species such as *Mus musculus* L. (House Mouse), *Rattus norvegicus* Berkenhout (Norway Rat), and *Rattus rattus* L. (Black Rat). Cultivated land that was later abandoned provided suitable habitat for species such as *Cryptotis parva* (Say) (Least Shrew), *Reithrodontomys humulis* Audubon and Bachman (Eastern Harvest Mouse), *Oryzomys palustris* Harlan (Marsh Rice Rat), *Ochrotomys nuttalli* Harlan (Golden Mouse), and *Sigmodon hispidus* Say and Ord (Hispid Cotton Rat). Currently, many of these areas have passed through early successional stages and are now covered by second-growth forest. *Andropogon virginicus* L. (Broomsedge) fields and orchards have nearly or completely reverted to their former forested condition within the Park, although the acquisition of land for the Foothills Parkway included land in earlier stages of succession. Certain types of disturbed habitats and their mammal inhabitants, which were not present prior to human settlement of the area, are either disappearing or may have already disappeared from the Park.

In the mid-1920s, many mammal species dependent on fall hard mast were severely affected by the decline of *Castanea dentata* L. (American Chestnut) caused

by *Cryphonectria parasitica* Murrill (Barr) (Chestnut Blight Fungus). These trees once served as a valuable food source especially for Black Bears and squirrels, but also for a variety of other mammals as well as for birds such as *Meleagris gallopavo* L. (Wild Turkey). By 1938, an estimated 85% of all American Chestnut trees in the Park had either been killed or were affected by the blight. Bears and squirrels were gradually forced to depend on acorns as their major food source in the fall. National Park Service data show that acorns continue to provide the major fall food of these mammals today (Linzey 2008). Currently, populations of *Cornus floridana* L. (Flowering Dogwood), *Abies fraseri* (Pursh) Poir (Fraser Fir), *Fagus grandifolia* Ehrhart (American Beech), and *Juglans cinerea* L. (Butternut) are declining due to a variety of factors including acid rain, insects, and rooting by *Sus scrofa* Gray (Wild Hog) (Linzey 2008). The loss of these important species of trees will affect many species of mammals that utilize them as food sources and/or nest sites.

The construction of campgrounds, picnic areas, visitor facilities, roads, and maintenance areas by the National Park Service has influenced the ecology of certain areas. The increasing development of roads and private lands adjacent to the Park has undoubtedly affected the movement patterns and populations of numerous species. Vegetation patterns along a section of the Park border near Cosby together with the effects of the Park border placement on the distribution and movements of small mammals were examined by Ambrose (1986). Komarek and Komarek (1938) noted that such changes would occur and stated that their study would serve as a basis for future studies comparing the effects of the reversion from field to forest upon the populations and distributions of mammals.

The legal protection afforded by the Park has benefitted some mammal species and has allowed their populations to increase. The Park serves as a source population from which species including American Black Bears, squirrels, Northern Raccoons, and foxes may disperse into surrounding areas. Although White-tailed Deer had become fairly abundant in the Park area in the 1800s due to the creation of open areas and forest edges, overhunting and other factors caused populations to decline almost to the point of extirpation just prior to the establishment of the Park (Linzey 2008). Since that time, the protection afforded by the Park has allowed the deer population to increase and spread to most areas of the Park.

Park Mammal Studies (1931–1995)

The first extensive survey of mammals from the area was undertaken by E.V. and Roy Komarek between 1931 and 1933. That study was done under the auspices of the Chicago Academy of Sciences and the University of Chicago and resulted in the publication of “Mammals of the Great Smoky Mountains” (Komarek and Komarek 1938). During the period from May 1934 to June 1935, Civilian Conservation Corps wildlife technician Raymond J. Fleetwood kept a daily journal of observations of mammals observed during extensive hiking trips. Fleetwood's journal is in the Park's archives. From 18 June to 5 July 1937, W.M. Perrygo and C. Lingebach of the United States National Museum worked in the Park as part of a

natural history study of Tennessee mammals. Most of their work was concentrated in the eastern section. Data from 112 specimens recorded by Perrygo and Lingebach were included in Kellogg's (1939) "Annotated List of Tennessee Mammals".

Arthur Stupka, former chief naturalist and Park biologist, kept a journal for 28 years (1935–1963). This journal included personal observations as well as substantiated reports of others and served as the basis of the Linzey and Linzey (1968) paper on the Park mammals. Copies of the journal reside in the Park archives and in the library of the United States Department of the Interior.

The author, who began working in the Park in 1963 as a Ranger-Naturalist, has recorded data from localities throughout the Park during all seasons for the past 53 years. This research has resulted in several publications (see Literature Cited and Appendix 1 at the end of this paper).

Michael Pelton (University of Tennessee – retired) has contributed a great deal to our knowledge of certain mammals through his research and that of his graduate students. Other researchers, including Michael Harvey, W. David Webster, Peter Weigl, Eric Britzke, Edward Pivorun, and Joy O'Keefe have also contributed valuable data. The National Park Service's establishment of the Twin Creeks Natural Resource Center within the Park in the early 1970s served to coordinate research efforts by visiting investigators. The Twin Creeks Science Center, completed in 2007, houses the Park's mammal collection, as well as other natural history collections, in a climate-controlled portion of the building.

The biggest impetus to mammal research in the Park came in 1998 with the initiation of the All-Taxa Biodiversity Inventory (ATBI; Nichols and Langdon 2007). The ATBI has been a concentrated effort to identify every species of plant and animal living within the Park within a relatively short time frame. It is the first comprehensive biological inventory ever undertaken in North America. Funding for a pilot program, which included mammals, began in Fall 2000. The author has served as the Chair of the Mammal portion of the ATBI since its inception.

Mammal Species Accounts

The following format was used in writing the species accounts. Orders, families, and genera are arranged in traditional phylogenetic sequence, but species within each genus are listed alphabetically. All scientific and common names follow Bradley et al. (2014). If data were not available, or if a particular topic did not apply to the species in question, that section was omitted. Field or lab specimen data collection efforts by the author occurred where no citation is listed.

Distribution: All counties within a state are arranged alphabetically. Localities within a county are generally arranged according to elevation (lowest to highest). In some cases, a specimen was recorded from a locality along the Tennessee–North Carolina state line, but the county was not noted by the collector or observer; these records are included in a separate category— State (TN–NC) line. If recorded, all elevations are those reported by the collector or observer. Localities and place names have been verified by using the USGS topographic maps entitled "Great Smoky Mountains National Park, Tennessee and North Carolina" (East Half and

West Half) (1958) and “Great Smoky Mountains National Park and Vicinity” (1961). A complete listing of localities mentioned is provided in Appendix 2.

Life-history categories include: *food*, *reproduction*, *pelage*, *hibernation*, *movements*, *predation*, *diseases*, and *parasites*. For reproductive data, numbers with “R” and “L” (e.g., 2R or 4L) indicate the number of embryos found in the right and left horn of the uterus, respectively

Measurements: Lengths are recorded in millimeters, and weights are given in grams (except for a few larger species), for both males and females. The number of specimens upon which the data for a particular metric is based, if different than the total number of individuals indicated, is provided in parenthesis. The average measurement is given first, followed by the range in parentheses. Only measurements of adult individuals have been included. Measurements of obviously injured specimens have been omitted.

Location of specimens: Standard abbreviations to identify collections housing mammals from the Park follow Yates et al. (1987). The following abbreviations have been used to designate the location of specimens referred to in this paper: ANSP = Philadelphia Academy of Natural Sciences, Philadelphia, PA; AMNH = American Museum of Natural History, New York, NY; CAS = California Academy of Sciences, San Francisco, CA; CHAS = Chicago Academy of Sciences, Chicago, IL; CM = Carnegie Museum of Natural History, Pittsburgh, PA; CSULB = California State University - Long Beach, Long Beach, CA; DMNH = Denver Museum of Natural History, Denver, CO; DWL = Private collection of D.W. Linzey, Blacksburg, VA; ETSU = East Tennessee State University, Johnson City, TN; GSMNP = Great Smoky Mountains National Park, Gatlinburg, TN; ISM = Illinois State Museum, Springfield, IL; IUP = Indiana University, Indiana, PA; KU = University of Kansas Museum of Natural History, Lawrence, KS; LACM = Natural History Museum of Los Angeles County, Los Angeles, CA; LNB = Private collection of Larry N. Brown, Thomasville, GA; LU = Liberty University, Lynchburg, Virginia; MSUMZ = Memphis State University Museum of Zoology, Memphis, TN; MSU = Michigan State University, The Museum, East Lansing, MI; NCSM = North Carolina State Museum of Natural History, Raleigh, NC; OMNH = Sam Noble Museum, Oklahoma Museum of Natural History, University of Oklahoma, Norman, OK; OSU = Department of Zoology, Oklahoma State University, Stillwater, OK; OU = Oklahoma Museum of Natural History, The University of Oklahoma, Norman, OK; RPN = Reading Public Museum, Reading, PA; TTU = Tennessee Technological University, Cookeville, TN; UCONN = University of Connecticut, Storrs, CT; UGAMNH = University of Georgia Museum of Natural History, Athens, GA; UIMNH = University of Illinois Museum of Natural History, Urbana, IL; UMMZ = University of Michigan - Ann Arbor, Museum of Zoology, Ann Arbor, MI; UNCW = University of North Carolina = Wilmington, Wilmington, NC; USNM = National Museum of Natural History, Washington, DC.

ORDER DIDELPHIMORPHIA – AMERICAN OPOSSUMS

FAMILY DIDELPHIDAE - OPOSSUMS

Didelphis virginiana Kerr (Virginia Opossum)

Distribution: Virginia Opossums are found throughout most of the Park, although they decrease in abundance at the higher elevations. The highest elevation at which an individual has been observed is 1890 m on Noland Divide.

Blount County - Cades Cove (534 m); Tremont; Sevier County - The Sinks (473 m); Foothills Parkway (458–519 m); Park headquarters; Greenbrier (610–854 m); Elkmont (763 m); Ramsey Prong (915 m); Clingmans Dome Road at Noland Divide (1890 m).

Food: Komarek and Komarek (1938) reported *Rubus allegheniensis* Porter (Allegheny Blackberry), *Phytolacca decandra* L. (American Pokeweed), *Vitis* sp. (wild grape), and *Diospyros virginiana* L. (American Persimmon) in late summer and fall feces. In his journals, Stupka recorded that the American Opossum consumed *Natrix sipedon* L. (Northern Water Snake), *Otus asio* Kaup (Eastern Screech Owl), *Carphophis amoenus* Say (Worm Snake), *Bufo americanus* Holbrook (American Toad), *Rana sylvatica* LeConte (Wood Frog), and a millipede in the Park.

Reproduction: Female opossums usually produce 2 litters annually. A female with 8 embryos was recorded on 23 February and another with 13 naked young about 24 mm long in her pouch was recorded on 18 March (Komarek and Komarek 1938). Stupka recorded a half-grown individual on 4 February; a dead female with 2 young in her pouch, the larger of which measured 13/16 of an inch, on 27 May; and a litter “about the size of half-grown house rats” on 11 September.

Parasites: Opossums examined by Komarek and Komarek (1938) were infested with larval *Ixodes* sp. (ticks), and most contained *Physaloptera turgida* Rudolphi white roundworms in their stomachs.

Measurements: 7 males: total length 784.0 mm (640–855 mm); tail 323.0 mm (295–362 mm); hind foot 66 mm (60–74 mm); weight (3) 2.85 kg (1.18–3.69 kg). 6 females: total length 700.1 mm (671–725 mm); tail 296.0 mm (285–310 mm); hind foot 61.8 mm (59–66 mm); weight (1) 1289.7 g.

Location of specimens: CHAS, DMNH, GSMNP.

ORDER SORICOMORPHA - SHREWS AND MOLES

FAMILY SORICIDAE - SHREWS

Sorex cinereus Kerr (Masked Shrew)

Distribution: In the southern Appalachians, this species is most commonly found among rocks and logs in both deciduous and evergreen forests above 915 m elevation. It accounted for 30% of all small mammals captured in a 1984 study in the spruce–fir forest between Newfound Gap and Clingmans Dome (Smith and Mouzon 1985). The Masked Shrew has, however, been taken as low as 436 m along the Foothills Parkway (Harvey 1991). On 7 December 1935, Stupka found 2 of

these shrews in Gatlinburg (397 m) outside the Park boundary. The Park is near the southern limit of the range of this shrew.

Cocke County - Rock Creek; Snake Den Ridge; Old Black Mountain (1922 m). Sevier County - Foothills Parkway (436–641 m); Buck Prong (763–1373 m); Greenbrier; Chimney Tops; Newfound Gap Road (1220 m); Buck Fork (1281–1373 m); Walker Prong (1327 m); near Rocky Spring Gap; Miry Ridge Trail (1403 m); Brushy Mountain; Indian Gap (1667 m); trail between Forney Ridge and Andrews Bald (1830 m); Mt. Guyot (2019 m). State (TN–NC) line - Indian Gap (1586 m); Mt. Kephart (1708–1891 m); Mt. Collins (1861–1887 m); Dry Sluice Gap; Clingmans Dome (1952–2026 m). Haywood County - Purchase Knob. Swain County - Smokemont (671 m); 8 miles northeast of Smokemont; Flat Creek (1495 m); Dry Sluice Trail (1678 m); Clingmans Dome.

Reproduction: “Reproductively active” individuals were observed from mid-August to mid-October in the spruce–fir zone (Smith and Mouzon 1985)

Measurements: 38 males: total length 100.5 mm (89–114 mm); tail 43.2 mm (38–48 mm); hind foot 11.8 mm (7–13 mm); weight (15) 4.0 g (3.0–5.9 g). 39 females: total length 99.1 mm (89–113 mm); tail 43.6 mm (37–50 mm); hind foot 12.1 mm (8–14 mm); weight (23) 3.90 g (3.1–5.6 g).

Location of specimens: CHAS, CU, DMNH, DWL, GSMNP, JEL, LNB, NCSM, TTU, UCONN, UGAMNH, UIMNH, UNCW, USNM.

Sorex dispar Batchelder (Long-tailed Shrew)

Distribution: This species was first collected in the Park in October 1932, when E.V. Komarek trapped a specimen he thought to be *Sorex fumeus* Miller (Smoky Shrew) on Clingmans Dome (2026 m); the specimen was not correctly identified until 1950. The Long-tailed Shrew is found primarily at the higher elevations in the Park, although several have been recorded in Greenbrier. Preferred habitat for these shrews includes talus slopes and rock slides in both deciduous and coniferous forests.

Sevier County - Greenbrier (671 m); Fort Harry Cliffs (976 m); along the West Prong of the Little Pigeon River (1129–1434 m); Trout Branch; Walker Prong (1342–1373 m); Newfound Gap Road, 0.25 mi. northwest of Newfound Gap. Swain County - Newfound Gap Road (1342 m); Forney Ridge parking area (1952 m); Clingmans Dome (2026 m).

Food: Examination of the stomachs and intestines of 6 shrews revealed the presence of Coleoptera and Arachnida (Conaway and Pfitzer 1952).

Measurements: 12 males: total length 131.8 mm (125–135 mm); tail 63.8 mm (60–67 mm); hind foot 15.2 mm (13.5–16.5 mm); weight (5) 5.4 g (5.0–5.8 g). 7 females: total length 128.9 mm (123–134 mm); tail 63.7 mm (62–67 mm); hind foot 15.0 mm (14.5–15.5 mm); weight (6) 5.3 g (3.8–7.0 g)

Location of specimens: GSMNP, LNB, UCONN, USNM.

Sorex fumeus Miller (Smoky Shrew)

Distribution: The Smoky Shrew is near the southern limit of its range in the Park. It is found at all elevations but is most abundant in cool, damp woodlands with a deep

layer of leaf mold on the ground. Streamsides, both in evergreen and deciduous forests, are a favored habitat. This species accounted for 12.6% of all small mammals captured in a study in the spruce–fir forest (Smith and Mouzon 1985).

Blount County - Spence Field (1525 m). Cocke County - Cosby CCC Camp (625 m); near Cosby Ranger Station (763 m); Rock Creek; Indian Camp Creek Trail (915 m); Albright Grove (1003 m); Low Gap (1037 m; 1294 m); Inadu Knob (1739 m); Old Black Mountain (1922 m). Sevier County - Foothills Parkway (336–732 m); Huskey Gap Trail (641 m); Greenbrier (671–1464 m); Sugarland Mountain; Newfound Gap Road (854–1525 m); Little River - Elkmont (885 m); Chimneys Campground; Fort Harry Cliffs (976 m); Eagle Rocks Creek (1068 m); Chapman Prong; Grassy Patch - Alum Cave parking area (1220 m); West Prong, Little Pigeon River (976–1220 m); Buck Fork (1281–1525 m); Walker Prong; Rocky Spring Gap; Trillium Gap Trail; Indian Gap (1586 m); Mt Guyot (1922 m). State (TN–NC) line - Appalachian Trail between Low Gap and Mt. Cammerer (1434 m); Dry Sluice Gap; Mt. Kephart; Clingmans Dome (1952 m). Haywood County - Walnut Bottom (928 m); Polls (Paul's) Gap (1556 m); Purchase Knob. Swain County - Smokemont; Ekaneetlee Creek (702 m); Beech Flats Prong at Rt. 441 (1159 m); Moore Springs Shelter (1449 m); Thomas Ridge (1464 m); Newfound Gap Road (1220 m, 1464 m); Welch Ridge (1540 m); Newfound Gap (1540 m); Hughes Ridge; Forney Ridge (1830 m; 1952 m); Clingmans Dome (1961 m).

Food: Stomach analyses of 3 females taken at Cosby (732 m) during June (1) and July (2) revealed animals (millipedes [65.3%] and arachnids [33.3%]) comprising 98.6% of the total volume of food eaten (Linzey and Linzey 1973). The stomachs also contained a small amount of the fungus *Endogone* (0.7% volume).

Reproduction: Pregnant females have been taken at Greenbrier on 30 March (2R, 2L; Crown-Rump [CR] = 5.5 mm), at Chimneys Campground on 2 April (2R, 4L; CR = 4.5 mm.), along the Newfound Gap Road (1220 m) in North Carolina on 14 April (5 - half term), and along the Newfound Gap Road in Tennessee 1 mile west of Newfound Gap on 28 April (5 - near term). Nursing females have been recorded on 27 April (976 m), 29 April (1037 m), 2 May (1778 m), 1 July (763 m), 17 July (1294 m), and 12 October (1891 m). Males in breeding condition have been noted in August.

Pelage: Komarek and Komarek (1938) recorded specimens in gray winter pelage in February, March, April, and October.

Parasites: Lewis (2005) recorded the first case of a New World hantavirus in a shrew when it was detected in a Smoky Shrew from the Park.

Measurements: 57 males: total length 119.4 mm (106–133 mm); tail 47.5 mm (40–54 mm); hind foot 13.6 mm (12–15.5 mm); weight (20) 7.5 mm (5.2–10.1 mm). 67 females: total length 117.9 mm (99–137 mm); tail 48.6 mm (38–66 mm); hind foot 13.7 mm (11–15 mm); weight (40) 6.7 g (4.8–10.6 g).

Location of specimens: CAS, CU, CHAS, CM, DWL, GSMNP, JEL, KU, LNB, TTU, UCONN, UGAMNH, USNM.

Sorex hoyi Baird (American Pygmy Shrew)

Distribution: The range of the American Pygmy Shrew extends southward along the Appalachian Mountain chain into northern Georgia. This is one of the rarest shrews in the Park. It was not until 1968 that a previously unreported specimen was discovered in the collections of the University of Illinois Museum of Natural History (Hoffmeister 1968) collected on 6 September 1941, at Newfound Gap by Woodrow W. Goodpaster. No other individuals were recorded until 1991 when 6 shrews were taken along the Foothills Parkway (Harvey 1991).

Sevier County - Foothills Parkway (Cove Creek, 436 m.; King Hollow Branch, 519–549 m; Caney Creek, 549–641 m). Swain County - Newfound Gap.

Measurements: Specimen from Newfound Gap: total length 83 mm; tail 33 mm; hind foot 10 mm.

Location of specimens: GSMNP, UIMNH, USNM.

Sorex longirostris Bachman (Southeastern Shrew)

Distribution: Prior to 1991, only 3 Southeastern Shrews had been recorded within the boundaries of the Park. A male was found dead in a posthole in a field of Broomsedge at 488 m elevation in Greenbrier (Sevier County) on 5 June 1934, by R.J. Fleetwood. A second individual was taken inside a CCC Camp building in the same area on 4 February 1938, by M.S. Crowder. On 19 September 1950, a third specimen was obtained by D.W. Pfitzer near Park headquarters (Sevier County). In 1991, fifteen Southeastern Shrews were taken along the Foothills Parkway between Cove Creek and Maples Ranch (Sevier County) at elevations ranging from 436 to 732 m (Harvey 1991).

Although this species has been taken in a variety of habitats ranging from fields to forests throughout its range, it seems to prefer areas in early stages of succession and disturbed areas such as cultivated fields and abandoned fields with dense ground cover of *Lonicera* spp. (honeysuckles), grasses, and herbs. The gradual disappearance of early successional habitat is probably the chief factor responsible for the scarcity of this species within the boundaries of the Park.

Measurements: No measurements were recorded for the 1934 specimen. No sex determinations were made for the 1936 or 1950 specimens. Their measurements, however, were: total length 82 mm, 86 mm; tail 33 mm, 33 mm; and hind foot 9 mm, 10 mm.

Location of specimens: GSMNP, USNM.

Sorex palustris Richardson (American Water Shrew)
[Federally listed as a Species of Concern]

Distribution: The range of the American Water Shrew extends south in the Appalachian Mountains to Tennessee and North Carolina. It was first discovered in the Park in 1950 along the West Prong of the Little Pigeon River (Conaway and Pfitzer 1952), and has since been found living along Walker Prong and other tributaries of the Little Pigeon River from 1129 to 1464 m elevation. Individuals have also

been taken by the author in 1980 along a tributary of the Middle Prong of the Little Pigeon River in Greenbrier at an elevation of between 587 and 610 m, the lowest elevation ever recorded for this species in the Appalachians (Linzey 1984). The only North Carolina records from the Park were obtained by the author from Beech Flats Creek (1220 m) in Swain County in 1980 (Linzey 1984) and from Andrews Bald, Swain County in 2000 (Linzey et al. 2002).

Sevier County - Greenbrier (587–610 m); Walker Prong and other tributaries of West Prong of the Little Pigeon River (1129–1464 m). Swain County - Beech Flats Creek (1220 m); Andrews Bald (1769 m).

Food: Stomachs of 9 specimens examined by Conaway and Pfitzer (1952) all contained insect remains. Fragments of immature forms of Plecoptera, Ephemera, or Trichoptera were found in 5 of the 9 stomachs. The stomach of 1 female taken by the author along Walker Prong contained 85% Plecoptera larvae, 10% Ephemeroptera larvae, 3% nematodes, and 2% fruit skin, by volume (Linzey and Linzey 1973).

Reproduction: A female taken on 13 April 1969 (Newfound Gap Road, Sevier County, 1159 m) contained 6 small embryos (L.N. Brown). Three males and 6 females taken on 24 November and 3 December by Conaway and Pfitzer (1952) were young of the year and had immature reproductive tracts.

Measurements: 7 males: total length 144.7 mm (140–155 mm); hind foot 18.3 mm (18–20 mm); weight (3) 10.3 g (9.9–10.5 g). 10 females: total length 140.6 mm (136–148 mm); tail 60.5 (58–67 mm); hind foot 18.4 mm (16–20 mm); weight (6) 10.2 g (9.7–10.8 g).

Location of specimens: DWL, GSMNP, KU, LNB, TTU, USNM.

Blarina brevicauda Say (Northern Short-tailed Shrew)

Distribution: This shrew is one of the most widely distributed mammals in the Park, occupying almost all types of habitats at all elevations.

Blount County - Cades Cove; Spence Field (1525 m.). Cocke County - Cosby (534–763 m); Albright Grove; near Low Gap (1007–1037 m); Snake Den Mountain (1159 m); Cosby Knob Shelter (1464 m). Sevier County - Park headquarters (427 m); Foothills Parkway (336–732 m); Greenbrier (549–1434 m); Chimneys; Cherokee Orchard (732 m); Elkmont (763 m); Fish Camp Prong (833 m); Newfound Gap Road (915–1220 m); Big Branch (976 m); Fort Harry Cliffs (976 m); Alum Cave parking area - Grassy Patch (1159 m); Fish Camp Prong; near Rocky Spring Gap; Beech Gap; Horseshoe Mountain; West Prong of the Little Pigeon River (1220 m); Walker Prong (1449 m); Bullhead Trail; Indian Gap (1586 m); Mt. Guyot (1922 m); Mt. Le Conte. State (TN–NC) line - Laurel Tops (1723 m); Mt. Chapman (1754 m); Mt. Kephart (1830–1891 m); Silers Bald; Clingmans Dome (2026 m). Haywood County - Big Creek Ranger Station (488–915 m); 1 mile north of Mt. Sterling (519 m); Cataloochee Cove (793–824 m); Walnut Bottom (928 m); Pin Oak Gap (1068 m); Black Camp Gap (1388 m); Polls (Paul's) Gap (1556 m). Swain County - Kanati Fork (854 m); Indian Creek Trail near Deepflow Gap Trail; 7 miles east of Smoke-mont (915–946 m); Beech Flats Creek (1220 m); Moore Springs Shelter; Heintooga Overlook (1617 m); Silers Bald (1708 m); Pecks Corner Shelter (1678–1830 m);

Andrews Bald (1769 m.); Forney Creek Trail; Forney Ridge parking area (1952 m); Clingmans Dome (1952 m).

Food: The stomachs of 2 specimens examined by the Komareks contained the remains of a lepidopterous larva and a slug, respectively (Komarek and Komarek 1938). The percentage volume of major food items reported by Linzey and Linzey (1973) from 17 Northern Short-tailed Shrew taken within the Park included millipedes (32.8%), insects and insect larvae (13.0%), gastropods (10.3%), and earthworms (9.6%). Seasonal differences in food were apparent between summer and winter specimens. Major summer foods, by volume, were millipedes (41.4%), insects (19.4%), gastropods (13.0%), *Endogone* (5.9%), and earthworms (5.0%). Major winter foods, by volume, were millipedes (20.4%), earthworms (16.3%), gastropods (6.4%), and vegetation (5.0%).

The Northern Short-tailed Shrew is the only venomous mammal in North America. The venom is produced by the submaxillary glands and flows into the prey along grooves in the lower incisor teeth.

Reproduction: The author recorded a female with embryos (2R, 2L; CR = 13 mm) on 1 July. Nursing females have been reported in June, July, and September. A lactating female was recorded in the spruce–fir zone on 22 September (Smith and Mouzon 1985). Males in breeding condition have been found in March and September.

Predation: In his journals, Stupka recorded several instances of predation upon Northern Short-tailed Shrews. Remains of this shrew have been found in the stomach of *Pantherophis alleghaniensis* Holbrook (Black Rat Snake) and *Spilogale putorius* L. (Eastern Spotted Skunk), and in the pellet of *Strix varia* Barton (Barred Owl). On 8 April, a Barred Owl sighted along Little River above Elkmont was carrying one of these shrews (Stupka 1944).

Parasites: Fleas have been removed from 5 individuals. One flea removed by the author was identified as *Eptedia wenmanni testor* Rothschild. Komarek and Komarek (1938) found a small spiral worm between the skin and flesh of the shoulder in one specimen. The enterococcus *Enterococcus faecium* was recorded in fecal specimens by Mundt (1963).

Measurements: 51 males: total length 114.9 mm (99–130 mm); tail 24.6 mm (16–30 mm); hind foot (49); ear length 15.1 (12–16); weight (24) 17.0 g (12.1–27.1 g). 53 females: total length 113.4 mm (98–129 mm); tail 24.4 mm (16–31 mm); hind foot 14.5 mm (9–16 mm); weight (28) 15.8 g (11.8–21.1 g).

Location of specimens: CAS, CHAS, CU, DMNH, DWL, GSMNP, ISM, OMNH, OU, UCONN, UIMNH, MSU, USNM.

Cryptotis parva Say (Least Shrew)

Distribution: This shrew differs from other shrews in that it prefers dry, open, grassy fields. Komarek and Komarek (1938) found this shrew in moderately overgrown Broomsedge fields and in an open grassy patch along the forest margin. These types of habitats have been decreasing in the Park as cultivated areas yield to the regrowth of forest. Thus, the number of Least Shrews in the Park is undoubtedly

less now than prior to the establishment of the Park. This shrew has been taken at localities up to 833 m.

Blount County - Cades Cove (1706 ft.). Sevier County - Foothills Parkway - Cove Creek (436 m); Fighting Creek (440 m); Park headquarters (458 m); Greenbrier Cove (549 m); Fish Camp Prong (833 m).

Reproduction: A female that had just finished nursing was recorded on 16 October and 4 males in breeding condition were recorded on 20 October (Komarek and Komarek 1938).

Predation: A *Cryptotis* was recovered from the stomach of an Eastern Screech Owl (Stupka 1940).

Measurements: 11 males: total length 73.9 mm (69–76 mm); tail 18.1 mm (15–21 mm); hind foot 10.2 mm (10–11 mm); weight (6) 4.13 g (3.28–5.48 g). 9 females: total length 75.0 mm (70–84 mm); tail 18.1 mm (15–20 mm); hind foot 9.8 mm (9–10 mm); weight (10) 4.56 g (3.50–5.72 g).

Location of specimens: CHAS, CU, GSMNP.

FAMILY TALPIDAE – MOLES

Scalopus aquaticus L. (Eastern Mole)

Distribution: This species prefers moist, sandy, or loamy soil. Individuals have been recorded from 7 localities within the Park ranging in elevation from 534 to 824 m. Many individuals have been recorded from the field adjoining the Oconaluftee Pioneer Museum.

Blount County - Cades Cove (534 m). Cocke County - western slope of Low Gap (824 m). Sevier County - Greenbrier; Metcalf Bottoms (610 m); Grassy Patch. Haywood County - Cataloochee. Swain County - Oconaluftee Visitor Center (641 m).

Reproduction: A lactating female was recorded on 14 July at the Oconaluftee Ranger Station.

Predation: An Eastern Mole was found in the stomach of an *Agkistrodon contortrix* L. (Northern Copperhead) in the Cataloochee area.

Measurements: 4 males: total length 157 mm (154–161 mm); tail 27 mm (25–32 mm); hind foot 20 mm (19–22 mm). 3 females: total length 152 mm (151–153 mm); tail 24 mm (21–29 mm); hind foot 20 mm (19–21 mm).

Location of specimens: ANSP, GSMNP, UMMZ, USNM.

Parascalops breweri Bachman (Hairy-tailed Mole)

Distribution: This mole prefers well-drained areas with sandy loam soil and a good cover of vegetation. Specimens collected along Chapman Prong and Buck Fork under damp rocks in *Rhododendron* sp. thickets represented the first record of this species in Tennessee (Komarek and Komarek 1938). It has since been recorded in the Park at elevations ranging from 451 to 1952 m.

Blount County - Cades Cove (534 m.); Tremont (732 m); Bote Mountain Road (1098 m); Gregory's Bald (1495 m). Cocke County - Cosby (793 m). Sevier County

- Park headquarters (451 m); The Sinks (477 m); Sugarlands (610 m); Elkmont (671 m., 763 m); Huskey Gap Trail (763 m); Buck Fork (610 m); Rainbow Falls (915 m); Chapman Prong (976 m); Alum Cave Trail (1312 m); Newfound Gap Road (1373 m); Blanket Mountain; Miry Ridge Trail (1525 m); Mt. Kephart (1586 m). State (TN–NC) line - Gregory Bald (1495 m); Tricorner Knob; Spence Field (1525 m); Newfound Gap (1540 m); between Newfound Gap and Indian Gap; Mt. Buckley (1906 m). Swain County - Mt. Collins (1678 m, 1769 m); Andrews Bald (1739 m); Clingmans Dome (1952 m).

Predation: An individual found dead on the road between Newfound Gap and Indian Gap had apparently been killed by a fox, since fox scats were found beside the animal (Pfitzer 1950).

Measurements: 2 males: total length 153.5 mm (148–159 mm); tail 32.5 mm (27–38 mm); hind foot 19.0 mm (18–20 mm). 5 females: total length 146.0 mm (135–165 mm); tail 29.4 mm (27–33 mm); hind foot 18.4 mm (18–20 mm); weight (1) 37.6 g.

Location of specimens: CHAS, CSULB, CU, DMNH, ETSU, GSMNP, NCSM.

Condylura cristata L. (Star-nosed Mole)

Distribution: The range of this species in the Appalachian Mountains extends south to western South Carolina. The Star-nosed Mole is the rarest of the 3 mole species in the Park. It is semi-aquatic and prefers low, wet areas such as wet meadows, marshes, and low, wet ground near streams. It has been taken in the Park at elevations ranging from 488 to 1678 m.

Blount County - along Little River. Sevier County – 1.6 km (1 mile) below Metcalf Bottoms bridge (488 m); Rainbow Falls Trail (915 m); 3.6 km past junction of Bent Arm and Miry Ridge trails toward Buckeye Gap (1495 m); Appalachian Trail between Newfound Gap and Indian Gap (1617 m). State (TN–NC) line - near Charlies Bunion (1678 m). Swain County - Deep Creek (671 m); Smokemont; Kephart Prong Hatchery (854 m); Balsam Mountain Road at Ledge Creek.

Predation: Stupka (1950) found a *Condylura* in the stomach of a Corn Snake (*Elaphe guttata*). He also noted an instance of predation by *Felis catus* L. (Domestic Cat) (Stupka 1943).

Measurements: 1 male: total length 148 mm; tail 56 mm; hind foot 23 mm. 1 female: total length 160 mm; tail 65 mm; hind foot 23 mm; weight 30.7 g. 1 unsexed: total length 135 mm; tail 53 mm; hind foot 22 mm; weight 13.8 g.

Location of specimens: DMNH, DWL, GSMNP.

ORDER CHIROPTERA – BATS

FAMILY VESPERTILIONIDAE – VESPER BATS

Myotis leibii Audubon and Bachman (Eastern Small-footed Myotis)
[Formerly classified as *Myotis subulatus*]

Distribution: This species is found in caves, rock crevices, beneath bridges, and in buildings. The first individual was discovered in a cabin at Porters Flat

in Greenbrier Cove on 24 April 1970, at an elevation of approximately 671 m (Neuhauser 1971). On 19 June 1989, a second specimen was identified roosting in a building at Park headquarters; it was measured, photographed, and released. A maternity colony was located in a high-elevation (1447 m) historic cabin on property of the Eastern Band of Cherokee Indians in Swain County, NC, in July, 2008 (O’Keefe and LaVoie 2010). From July to September 2014, an intensive mist-netting study captured this species at a variety of sites (O’Keefe and Walters 2015).

Blount County - Near Twentymile; Cades Cove; Tremont. Sevier County - Greenbrier Cove (2200 ft.); Park headquarters; Sugarlands; Metcalf Bottoms; Porters Flat. Haywood County - Cataloochee. Swain County - Near Mingus Mill.

Parasites: *Trombicula (Leptotrombidium) myotis* (chiggers) were collected from the posterior margins of the ears of the Porters Flat specimen (Neuhauser 1971).

Measurements: 1 female: total length 78 mm; tail 40.2 mm; hind foot 6.9 mm; ear 13.3 mm; weight 3.1 g.

Location of specimen: UGAMNH.

Myotis lucifugus LeConte (Little Brown Myotis)

Distribution: During the summer, these bats are usually found in buildings, towers, hollow trees, beneath the loose bark of trees, in crevices of cliffs, and beneath bridges. During the winter, these colonial bats move into caves and abandoned mines where they either hang individually or in small clusters of 25 or 30. Little Brown Myotis have been recorded from 14 localities in the Park and along the Foothills Parkway.

Blount County - Whiteoak Blowhole Cave; Saltpeter Cave (534 m); Bull Cave; Calf Cave No 2; Scott Gap Cave; Tory Shields Bluff Cave; near Twentymile. Sevier County - Park headquarters; Myhr Cave (467 m); Elkmont; Greenbrier Cove (549–580 m). Haywood County - Cataloochee. Swain County - Hazel Creek Ranger Station; Raven Fork.

Measurements: 1 female: total length 94 mm; tail 32 mm; hind foot 9 mm; ear 12 mm.

Location of specimens: CHAS, GSMNP, OMNH, OU.

Myotis septentrionalis Trouessart (Northern Long-eared Myotis)

[Formerly classified as *Myotis keenii septentrionalis* (Keen’s Bat)]

Distribution: These bats are found in caves, mines, buildings, hollow trees, under loose bark, and behind shutters. They roost singly or in small colonies. Individuals have been recorded from 9 localities within the Park and along the Foothills Parkway.

Blount County - Whiteoak Blowhole Cave; Bull Cave; Scott Gap Cave; Tremont. Sevier County - Sugarlands; Myhr Cave; Greenbrier. Swain County - Near Mingus Mill; along the Noland Divide Trail.

Measurements: 4 males: total length 83.0 mm (78–88 mm); tail 36.5 mm (35–39 mm); hind foot 9.5 mm (8–11 mm); ear 14.3 mm (13–15 mm).

Location of specimens: GSMNP, MSU, OMNH.

Myotis sodalis Miller and Allen (Indiana Bat) [Federally listed as Endangered]
[Formerly known as Indiana Myotis]

Distribution: The Indiana Bat originally inhabited the eastern United States from central Vermont south along the Appalachian chain to northwestern Florida and west to southwestern Wisconsin and northeastern Oklahoma; however, this species has shown a drastic population decrease since 1950 and is now scarce in some parts of its range.

The Indiana Bat was first recorded at Park headquarters in 1937. The largest known population of this species in the state of Tennessee inhabits Blowhole Cave in Whiteoak Sink in Cades Cove. Humphrey (1978) listed this site as one of the 10 largest known winter hibernating colonies in the United States. The population in this cave has fluctuated over the years: 2242 in 1950; estimated 20,000 in 1972; 6050 in 1975; 10,760 in 1986–1987; 5383 in 1991; 3900 in 1993; 7259 in 1996–1997; 4548 in 2000–2001; 5564 in 2003; 7681 in 2005; estimated 10,000 in 2012; and <2000 in September 2014. Harvey (1991) noted that a small colony of approximately 200 Indiana Bats also hibernate in Bull Cave.

Blount County - Whiteoak Blowhole Cave; Bull Cave; Forge Creek; Parsons Branch; Scott Gap Cave (Wallace 1984). Sevier County - Park headquarters. Haywood County - Cataloochee.

Reproduction: The first 2 maternity colony sites in the southern United States were located in the Park by Britzke et al. (2003). That study was also the first to document the common use of conifers by maternity colonies. Both primary roosts were located in *Pinus* sp. (pine) snags—one in 2000, the other in 2001. The largest exit counts for the 2 colonies were 23 and 81 bats.

Measurements: 2 males: total length 84.5 mm (82–87 mm); tail 34.5 mm (34–35 mm); hind foot (1) 9.0 mm; ear (1) 12.0 mm. 1 female: total length 90 mm; tail 35 mm; hind foot 9 mm; forearm 40 mm.

Location of specimens: GSMNP, OMNH, OU.

Lasionycteris noctivagans LeConte (Silver-haired Bat)

Distribution: This solitary, migratory bat is most commonly found in hollow trees or beneath the bark of trees. Occasionally, individuals may be found in caves and in buildings. The Silver-haired Bat has been recorded from only 10 localities in the Park. In 1962, the only high-elevation record resulted from the discovery of a dead bat on the Appalachian Trail between Newfound Gap and Indian Gap.

Blount County - Whiteoak Sink; Cades Cove (610 m); Meig's Creek Trail (763 m). Cocke County - Cosby. Sevier County - Greenbrier; Park headquarters; Appalachian Trail between Newfound Gap and Indian Gap. Haywood County - Cataloochee. Swain County - Deep Creek Ranger Station (580 m); Smokemont Campground.

Measurements: 2 males: total length 95.0 mm (92–98 mm); tail 38.5 mm (35–42 mm); hind foot 11.0 mm. 2 females: total length 94.5 mm (92–97 mm); tail 34.5 mm (30–39 mm); hind foot 9.5 mm (8–11 mm).

Location of specimens: CHAS, GSMNP.

Perimyotis subflavus F. Cuvier (American Perimyotis)[Formerly classified as *Pipistrellus subflavus* (Eastern Pipistrelle)]

Distribution: American Perimyotis have been recorded in the Park and along the Foothills Parkway at elevations ranging from 467 m (Myhr Cave) to 824 m (Low Gap) and are among the smallest of the Park's bats. They are often found in buildings and in hollow trees during the summer, and in winter, they hibernate in caves and in rock crevices. Blowhole Cave contains one of the largest known winter colonies in the United States (Rabinowitz and Nottingham 1979).

Blount County - Whiteoak Blowhole Cave; Saltpeter Cave; Gregory Cave; Calf Cave No.1; Calf Cave No. 2; Scott Gap Cave; Tory Shields Bluff Cave; Bull Cave; near Twentymile; near Abrams Falls. Cocke County - Near Low Gap (824 m). Sevier County - Myhr Cave (467 m); Greenbrier; Sugarlands CCC Camp (549 m); Rainbow Falls Cave. Haywood County - Cataloochee. Swain County - Raven Fork; near Mingus Mill; Bradley Fork.

Hibernation: Rabinowitz (1981c) reported that American Perimyotis selected hibernating roosts in relatively remote areas of Park caves containing little or no air flow. Over 80% of the bats in these areas hibernated in places where the ambient temperature was 8–11 °C. Most bats avoided both highest and lowest temperature extremes.

Measurements: 12 males: total length 79.8 mm (73–84 mm); tail 35.9 mm (33–38 mm); hind foot (9) 10.3 mm (9–11 mm).

Location of specimens: CHAS, GSMNP, MSU, OMNH, USNM.

Eptesicus fuscus Beauvais (Big Brown Bat)

Distribution: The Big Brown Bat has been recorded from 15 localities within the Park ranging in elevation from 445 m (Park headquarters) to 1922 m (LeConte Lodge). With a wingspread of approximately 12 inches, this is one of the largest bats in the Park. It may be found in barns, churches, houses, and old stores. Hibernation usually occurs in buildings, although a few individuals may overwinter in caves.

Blount County - Whiteoak Blowhole Cave; Gregory Cave; Saltpeter Cave; along Forge Creek; near Twentymile. Cocke County - Cosby Ranger Station (534 m). Sevier County - Park headquarters (445 m); Greenbrier (580 m., 610 m); LeConte Lodge (1922 m). Haywood County - Cataloochee. Swain County - Hazel Creek Ranger Station; Smokemont; Bradley Fork; near Mingus Mill; Noland Divide Trail.

Reproduction: A male in breeding condition was taken by the author on 9 August.

Measurements: 12 males: total length 108 mm (101–116 mm); tail (1) 40 mm.

Location of specimens: CHAS, DWL, GSMNP, NCSM.

Nycticeius humeralis Rafinesque (Evening Bat)

Distribution: The Evening Bat was first discovered in the Park when a male was mist-netted near Parson Branch near the western Park boundary by Harvey and Britzke on 9 June 1999 (Linzey et al. 2002). Two additional males were captured

at the same site during July 2000. Extensive mist-netting between July and October 2014, revealed this species near Abrams Falls and along Forge Creek in Cades Cove, near Twentymile, in Sugarlands, and at Porter's Creek in Greenbrier (J.M. O'Keefe et al., Department of Biology, Indiana State University, Terre Haute, IN, unpubl. data).

Blount County - Cades Cove (near Parson Branch; near Abrams Falls; along Forge Creek); near Twentymile. Sevier County - Sugarlands; Porter's Creek in Greenbrier.

Location of specimens: No preserved specimens from the Park are known to exist.

Lasiurus borealis Müller (Eastern Red Bat)

Distribution: These migratory bats have been recorded in the Park at elevations ranging from 467 m (Myhr Cave) to 1464 m (Thomas Ridge). Red Bats are solitary and normally roost in trees and shrubs. Stupka (1943) observed an individual sleeping in an oak sapling on Thomas Ridge.

Blount County - Whiteoak Blowhole Cave, near Abrams Falls, and along Forge Creek in Cades Cove; Twentymile Creek; Fontana Dam; Tremont; near Metcalf Bottoms. Cocke County - Near Cosby Ranger Station (488 m). Sevier County - Myhr Cave (467 m); Sugarlands (488 m); Greenbrier (488 m, 915 m). Haywood County - Cataloochee. Swain County - Kephart Prong; Bradley Fork; Raven Fork; Thomas Ridge (1464 m); Noland Divide Trail.

Reproduction: The author found an immature female on 29 July 1964. The Park mammal collection contains 2 Red Bats that were in copulation when taken on 5 April (Love 2009).

Measurements: 3 males: total length 97 mm (94–99 mm); tail (2) 45 mm (43–47 mm); hind foot (2) 28 mm (25–30 mm); weight (1) 10.9 g. 1 female: total length 110 mm; tail 52 mm; hind foot 10 mm.

Location of specimens: CHAS, CM, DWL, GSMNP.

Lasiurus cinereus Beauvois (Hoary Bat)

Distribution: The Hoary Bat is a tree-roosting bat. During the summer, it is normally found in areas of northern coniferous forests where it roosts in *Tsuga canadensis* L. (Carriere) (Eastern Hemlock), *Picea* spp. (spruce), and *Abies* spp. (fir) trees. In the fall, it migrates to warmer regions. Rick Varner, a Park biologist, reported observing 2 Hoary Bats in the Park—1 that had been hit by a car and a live bat in a small cave in Whiteoak Sink in Cades Cove. Both observations were in 1988–1989. On 24 September 1992, a male Hoary Bat was found dead at the home of Lucinda Ogle on Ski Mountain Road in Gatlinburg adjacent to the Park boundary; none of these specimens were preserved. In 2014, Hoary Bats were taken in mist nets set in Cataloochee and Cades Cove (O'Keefe et al., unpubl. data).

Blount County - Cades Cove. Sevier County - the Park boundary along Ski Mountain Road in Gatlinburg. Haywood County - Cataloochee.

Location of specimens: No preserved specimens from the Park are known to exist.

Lasiurus seminolus Rhoads (Seminole Bat)

Distribution: The Seminole Bat ranges from southeastern Virginia south along the Atlantic coast to Florida and west to eastern Mexico. On 25 August 1993, a bat resembling a Seminole Bat was captured in a Gatlinburg motel and brought to the Park by Park biologists Bill Stiver and Rick Varner. The bat was compared to the photograph of a Seminole Bat in Harvey (1992) and was almost identical in appearance (W. Stiver, NPS, Gatlinburg, TN, October 1993 pers. comm.). The bat was subsequently released in the Park headquarters area. It was not until 2 September 2014, that the first definite record of a Seminole Bat in the Park was recorded. An adult male was mist-netted at the entrance to Parsons Branch Road near Forge Creek in Cades Cove (O’Keefe et al., unpubl. data).

Location of specimens: No preserved specimens from the Park are known to exist.

Corynorhinus rafinesquii Lesson (Rafinesque’s Big-eared Bat)

[Formerly classified as *Corynorhinus macrotis* and *Plecotis rafinesquii*]

Distribution: Rafinesque’s Big-eared Bats are one of the most common bats in the Park and have been recorded from elevations ranging from 467 m (Myhr Cave) to 732 m (Forney Creek CCC Camp). The largest known hibernating colony (570 bats), as well as smaller maternity colonies, occupy the abandoned mines in the southwestern section of the Park (Harvey 1991). Rafinesque’s Big-eared Bats roost in hollow trees, caves, mines, and buildings. Twenty-two individuals were found roosting in a discarded boiler 3.4 m in diameter and 1.4 m long lying on its side on a hillside near Eagle Creek.

Blount County - Whiteoak Blowhole Cave; Gregory Cave; Scott Gap Cave; Calf Cave No. 2; Twentymile. Sevier County - Myhr Cave (467 m); Sugarlands; Greenbrier. Haywood County - Cataloochee. Swain County - Hazel Creek Ranger Station; Sugar Fork Mine #102; Eagle Creek Mines #107, #109, #110, and #111; Forney Creek CCC Camp (732 m); Bradley Creek.

Reproduction: Three female bats, each with a single young that was almost half as large as the parent, were observed on 8 July. On 16 July, a female was observed carrying a juvenile that was more than half its size (Stupka 1950).

Measurements: 10 males: total length 98 mm (90–105 mm); tail 46 mm (43–49 mm); hind foot (2) 10 mm; forearm (8) 32.5 mm (30–35 mm); ear (6) 28 mm (27–28 mm). 6 females: total length 102 mm (99–107 mm); tail 49 mm (46–50 mm); forearm 33.5 mm (32–35 mm); ear (4) 29 mm (28–30 mm).

Location of specimens: CHAS, CSULB, GSMNP, USNM.

ORDER LAGOMORPHA – HARES AND RABBITS

FAMILY LEPORIDAE

Sylvilagus floridanus Allen (Eastern Cottontail)

Distribution: The Eastern Cottontail is found in a variety of habitats including old fields, brushy clearings, brier patches, hedgerows, orchards, and along the

edges of woodlands. Komarek and Komarek (1938) found this species most often in open woods and Broomsedge fields. Although Kellogg (1939) found 1 individual in a rhododendron thicket in hemlock woods, he noted that they were most abundant in abandoned farm fields overgrown with Broomsedge, weeds and brush, brier patches, and thickets bordering deciduous woods and small streams. This species has been recorded at all elevations in the Park.

Blount County - Cades Cove (534–580 m). Cocke County - Near Low Gap (824 m). Sevier County - Park headquarters; Greenbrier (549–915 m); Little River Road near Elkmont (580–610 m).

Because *Sylvilagus obscurus* Chapman (Appalachian Cottontail) also occurs in the Park and looks very similar to the Eastern Cottontail, the following sight records may apply to either species:

Cocke County - Low Gap Trail (1190 m.). Sevier County - Mt. Le Conte (2011 m). State (TN–NC) line - Collins Gap (1830 m); Clingmans Dome. Swain County - Noland Divide (1769 m).

Reproduction: Young cottontails (*Sylvilagus* sp.) have been observed in May and June, while half-grown individuals have been noted in July and September. Three young cottontails whose eyes had just opened were observed on 20 May by Stupka (1937). A nest containing young was discovered on the summit of Mt. Le Conte.

Predation: Black Rat Snakes have been observed feeding on young cottontails in the Park. The stomachs of *Crotalus horridus* L. (Timber Rattlesnake) taken in July and September contained half-grown cottontails (Savage 1967; Stupka 1942, 1947).

Parasites: *Haemophysalis leporis-palustris* Packard (Rabbit Tick), fleas, and *Cuterebra* sp. (botfly) larvae were recorded by Komarek and Komarek (1938).

Measurements: 2 males: total length 415 mm (407–423 mm); tail 36 mm (26–45 mm); hind foot 95 mm (90–100 mm). 2 females: total length 419 mm (419–420 mm); tail 43 mm (40–47 mm); hind foot 93 mm (90–97 mm).

Location of specimens: CHAS, GSMNP, USNM.

Sylvilagus obscurus Chapman (Appalachian Cottontail)

[Formerly known as *Sylvilagus transitionalis* (New England Cottontail; Linzey and Linzey 1968). It was reclassified by Chapman et al. (1992).]

Distribution: The Appalachian Cottontail is a forest-dwelling rabbit that occurs “only within the Appalachian Mountain chain, its marginal plateau, and mountain balds from the Hudson River southwest through Pennsylvania, Maryland, West Virginia, Virginia, Tennessee, North Carolina, South Carolina, Georgia, and Alabama” (Chapman et al. 1992). Komarek and Komarek (1938) did not record this secretive, forest-dwelling species, although it had been taken in the mountains both north and south of the Park. They stated: “Local people asserted that two kinds of rabbits are found in the park and that one of these which inhabits the higher region is called the ‘woods rabbit’.” Kellogg (1939) recorded the first specimen from the Park near Low Gap. Only 2 other verified individuals, 1 from Pine Knot Branch in 1957 and 1 from the Alum Cave parking area in 1960, have ever been recorded. This species

inhabits woods as well as shrubby and brushy areas and prefers thicker wooded cover than the Eastern Cottontail.

Cocke County - Near Low Gap (1007 m). Sevier County - Pine Knot Branch near Elkmont (641 m); Alum Cave parking area (1159 m). Sight records listed under *Sylvilagus floridanus* (Allen) may also pertain to this species.

Reproduction and Predation: See *Sylvilagus floridanus*.

Measurements: 1 female: total length 411 mm; tail 42 mm; hind foot 86 mm.

Location of specimens: GSMNP, USNM.

ORDER RODENTIA – RODENTS

FAMILY SCIURIDAE – SQUIRRELS

Tamias striatus L. (Eastern Chipmunk)

Distribution: Eastern Chipmunks have been recorded from all elevations in the Park, although they are much less abundant in the spruce–fir forests than in the deciduous woodlands. They prefer deciduous hardwood forests, especially rocky areas, the edges of grass balds and clearings, and farmlands.

Blount County - Abrams Creek; Bull Cave; Cades Cove; Gregory Bald Trail; Thunderhead; Russell Field. Cocke County - Cosby; near Low Gap (824 m). Sevier County - Greenbrier Cove (549–1068 m); Mill Creek (610–732 m); Elkmont (763 m); Fort Harry Cliffs (976 m); Horseshoe Mountain (1068 m); Chapman Prong (1068 m); Eagle Rocks Creek; Sugarland Mountain (1342 m); Mt. Guyot; Mt. Le Conte; near Newfound Gap (1556 m). Haywood County - Black Camp Gap; Pin Oak Gap (1373 m). Swain County - Deep Creek; Forney Creek; Smokemont; Sunkata Ridge; Welch Ridge; Richland Mountain; Clingmans Dome (1983 m).

Food: Chipmunks in the Park have been observed feeding on oak acorns, American Chestnut nuts, and the mast of such trees as *Halesia carolina* L. (Greene) (Carolina Silverbell) and American Beech. A pile of opened land snails was found at the entrance to a chipmunk burrow near Bull Cave in Cades Cove in March (Stupka 1935).

Reproduction: A lactating female with 4 embryos was recorded on 21 August 1984 (Ambrose 1986).

Pelage: An albino chipmunk was observed at Newfound Gap during September (Stupka 1944).

Predation: An Eastern Chipmunk that had been struck by a Timber Rattlesnake was found along the Little River (Stupka 1943). The stomach of a Timber Rattlesnake taken near Pin Oak Gap (1373 m) contained the remains of a chipmunk (Stupka 1949). Savage (1967) recorded chipmunks in 4 Timber Rattlesnakes.

Measurements: 17 males: total length 233.6 mm (218–278 mm); tail 81.0 mm (70–92 mm); hind foot 33.8 mm (30–40 mm); weight (7) 94.3 g (78.0–112.4 g). 8 females: total length 232.7 mm (208–248 mm); tail 85.5 mm (72–105 mm); hind foot 34.5 mm (33–36 mm); weight (3) 76.8 g (71.5–79.5 g).

Location of specimens: CHAS, CSULB, DMNH, GSMNP, UCONN, USNM.

Marmota monax L. (Woodchuck)

Distribution: In the Park, Woodchucks have been seen from the lowest elevations up to approximately 2013 m (Mt. Le Conte). They are most abundant in the open meadowlands and along the mowed roadsides at the lower elevations and are rare in dense forests and in the spruce–fir region. Population estimates of 814, 1735, and 1351 Woodchucks in Cades Cove for 1976, 1977, and 1978, respectively, were reported by Taylor (1979). Woodchucks are probably less plentiful now than formerly due to the ecological changes occurring as the Park reverts to a more forested condition.

Blount County - Cades Cove (534 m). Sevier County - Park headquarters (458 m); Greenbrier (610–671 m); Fighting Creek Gap (763 m); Sugarlands (763 m); Newfound Gap Road (763 m, 915 m); Mt. Le Conte (2011 m). State (TN–NC) line - Collins Gap (1379 m). Haywood County - Black Camp Gap (1379 m); Little Bald Knob. Swain County - Smokemont; Deep Creek; Newfound Gap Road; Bunches Creek; Three Forks; Clingmans Dome Road (1861 m); Forney Ridge (1922 m).

Food: Woodchucks have been observed feeding on clover (Komarek and Komarek 1938) and on the bark of a silverbell tree (Fleetwood 1934).

Parasites: The enterococcus *Enterococcus faecalis* was recorded from fecal specimens by Mundt (1963).

Reproduction: Woodchucks usually give birth during April and May. Young individuals that were approximately one-quarter to one-third grown have been observed in May, while a half-grown Woodchuck was noted in August (Komarek and Komarek 1938).

Hibernation: Woodchucks hibernate during the colder winter months. During mild winters, however, the Park records confirm that active Woodchucks have been observed during every month of the year. Active Woodchucks have been observed in Cades Cove even with about 7.5 cm of snow on the ground and temperatures of approximately -7 °C (20 °F; V.R. Bender, NPS, Gatlinburg, 15 February 1967 pers. comm.).

Predation: Stupka (1938) found a Woodchuck that had recently been killed by a Bobcat (*Lynx rufus*) above Big Cove (976 m), an area just outside the Park boundary.

Measurements: 3 males: total length 553 mm (475–595 mm); tail 126 mm (115–135 mm); hind foot 78 mm (62–87 mm). 2 females: total length 622 mm (614–630 mm); tail 120 mm (92–148 mm); hind foot 94 mm (90–98 mm).

Location of specimens: CHAS, GSMNP, MSU.

Sciurus carolinensis Gmelin (Eastern Gray Squirrel)

Distribution: The distribution of the Eastern Gray Squirrel is closely correlated with the distribution of eastern hardwood trees, especially oak, hickory, and, prior to its decimation by blight, chestnut. Gray squirrels have been observed at all elevations in the Park, but they are rare in the spruce–fir zone. They are most frequently seen in deciduous forests, especially oak and beech woods, at the lower elevations.

Blount County - Cades Cove (534–778 m); Parson Bald; Russell Field. Cocke County - Cosby; Indian Camp Creek; Snake Den Mountain (1098 m); Inadu Knob

(1525 m). Sevier County - Park headquarters; Greenbrier (519 m, 610 m); Ramsey Prong; Newfound Gap Road (610 m); Copeland Creek; Fighting Creek; Cove Mountain; Injun Creek; Jakes Creek (915 m.); Horseshoe Mountain (1068 m); Mt. Guyot; Mt. Le Conte. State (TN–NC) line - Spence Field (1464 m). Haywood County - Big Creek; Cataloochee; Mt. Sterling. Swain County - Deep Creek; Eagle Creek; between Cooper Creek and Indian Creek; Bradley Fork; Twentymile Creek; Smokemont; near mouth of Mingus Creek; Forney Creek; Huggins Creek; Round Bottom; Hughes Ridge; Hyatt Ridge; Jenkins Ridge; Locust Ridge Trail; Pilot Knob; Richland Mountain; Shuckstack Ridge; Flat Creek (1434 m); Noland Divide; Forney Ridge.

Food: In the Park, Eastern Gray Squirrels have been observed feeding on acorns, walnuts, beechnuts, chestnuts, berries of *Ilex opaca* Aiton (American Holly), and the fruits of dogwood, silverbell, *Aesculus* sp. (buckeye), and *Carpinus caroliniana* Walter (American Hornbeam) trees. In February and March, Gray Squirrels have been seen cutting the flowering twigs of *Acer saccharum* Marshall (Sugar Maple) and *Acer rubrum* L. (Red Maple) twigs with bursting buds, oak twigs with flowers and young leaves, and pine twigs.

Enterococcus faecalis and *Enterococcus faecium* were recorded from fecal specimens by Mundt (1963).

Reproduction: Female Eastern Gray Squirrels usually produce 2 litters annually. Nursing females have been reported on 11 March (Komarek and Komarek 1938), 15 May (Stupka 1937), 28 August, and 2 October (Stupka 1944). Two males in breeding condition and 2 half-grown individuals were taken in October by Komarek and Komarek (1938). Half-grown young have also been seen in mid-April (Stupka 1937).

Pelage: An albino individual was collected on the south shore of Fontana Reservoir, opposite Forney Creek on 31 October (Stupka 1958). A melanistic specimen was observed by Fleetwood (1935) near Parson Bald on 26 March.

Predation: Adult Eastern Gray Squirrels have been recorded from the stomachs of a Timber Rattlesnake taken on 24 June at Cataloochee (Stupka 1951) and from a *Lynx rufus* Schreber (Bobcat) found dead along the Newfound Gap Road (NC; 2600 ft.) on 6 December (Stupka 1953).

Parasites: Komarek and Komarek (1938) reported heavy infestations of fleas on Eastern Gray Squirrels taken during all seasons. The author recorded the flea *Orchopeas howardii* Baker (Squirrel Flea) from a squirrel found dead along the Newfound Gap Road, 610 m (Sevier County, TN) in December (Linzey and Linzey 1973).

Measurements: 12 males: total length 451.7 mm (440–463 mm); tail 195.8 mm (140–250 mm) hind foot 64.4 mm (50–69 mm); weight (3) 461.4 g (371.9–612.5 g). 12 females: total length 450.1 mm (413–477 mm); tail 197.4 mm (144–234 mm); hind foot (11) 65.1 mm (62–68 mm); weight (3) 454.9 g (376.8–533.0 g).

Location of specimens: CHAS, CSULB, DMNH, DWL, GSMNP, OMNH.

Sciurus niger L. (Eastern Fox Squirrel)

Distribution: Eastern Fox Squirrels are the largest tree squirrels in the Park. They prefer higher ground and larger trees than Gray Squirrels. They are most often found

in open, mature stands of pine or in mixed stands of pine and deciduous trees that usually have little underbrush. Although recorded from elevations up to 1220 m, Eastern Fox Squirrels are not commonly seen in the Park. No specimens were taken by Komerek and Komarek (1938). In 1936, a Park Ranger's report noted that the fox squirrel "occurs but is uncommon" in the vicinity of Walnut Bottom. The Park's mammal collection contains one skull of a specimen taken along the Foothills Parkway in 1991. The only museum specimen from the Park area in the collection was taken at Wear Cove (Sevier County) just outside the Park boundary.

Sevier County - Route 73 between Park headquarters and Fighting Creek Gap; Mill Creek (610–732 m). Haywood County - Walnut Bottom. Swain County - Bradley Fork (763 m); between Eagle and Hazel Creeks (near Proctor); near Shuckstack Tower (1220 m).

Food: Stupka (1940) reported observing an Eastern Fox Squirrel eating *Morus* sp. (mulberry) fruits along Bradley Fork on 6 July.

Location of specimens: GSMNP.

Tamiasciurus hudsonicus Erxleben (Red Squirrel)

Distribution: The fairly common Red Squirrel, known locally as the "mountain boomer", has been observed at all elevations in the Park. Like many other species, Red Squirrel populations tend to fluctuate depending on the available food supply.

Cocke County - Cosby; Indian Camp Creek; Snake Den Mountain (1373 m); Inadu Knob (1373–1800 m). Sevier County - Park headquarters (442 m); Sugarlands (549 m); Elkmont; Greenbrier (519–1434 m); Chimneys; Buck Fork (915–1220 m); Dry Sluice Gap; Fort Harry Cliffs; Jakes Creek; Newfound Gap Road (1373 m); Horseshoe Mountain; Indian Gap (1586 m); Sugarland Mountain Trail near the Appalachian Trail (1830 m); Mt. Guyot (1983 m); Mt. Le Conte (2011 m); Clingmans Dome. State (TN–NC) line - Double Springs Gap; Sheep Pen Gap; Newfound Gap (1525 m); Mt. Collins (1800 m); Mt. Kephart (1891 m); Old Black Mountain. Haywood County - Big Creek; Cataloochee; Mt. Sterling. Swain County - Deep Creek; Ravensford; Smokemont (915–1464 m); Forney Creek; Jonas Creek; Round Bottom; Pin Oak Gap; Richland Mountain.

Food: Red Squirrels in the Park have been observed feeding on the fruits of *Magnolia acuminata* L. (Cucumber Tree), *Ilex montana* Torrey and A. Gray (Mountain Holly), Carolina Silverbell, American Beech, *Aesculus octandra* Solander (Yellow Buckeye), *Amelanchier* sp. (serviceberry), *Juglans nigra* L. (Eastern Black Walnut), American Chestnut, and *Rubus* sp. (blackberry); seeds of *Acer spicatum* Lam (Mountain Maple), Eastern Hemlock, and various species of pine; cones of fir and spruce; mushrooms; the buds of *Rhododendron maximum* L. (Great Rhododendron) and the buckeye; and garbage from roadside cans. One Red Squirrel was observed feeding on the sap of *Betula alleghaniensis* Britton (Yellow Birch) in April (Stupka 1938). Grimes (1952) reported an individual near Newfound Gap eating a nestling *Sitta canadensis* L. (Red-breasted Nuthatch).

Reproduction: Six young Red Squirrels were found in a nest in a hollow limb of a large Yellow Birch tree (1373 m) on 22 August. The young were less than half the size of adults. Within 4 days after their discovery, the young squirrels had their

eyes open. A female containing 4 embryos was recorded on 17 July at Clingmans Dome. Komarek and Komarek (1938) recorded a half-grown squirrel on 9 October.

Pelage: Two melanistic individuals were seen at Cosby in 1934 (Komarek and Komarek 1938).

Predation: Red squirrels have been found in the stomachs of 2 Timber Rattlesnakes found at Mt. Sterling Bald (Stupka 1939) and at Sheep Pen Gap (J. Tanner, University of Tennessee, Knoxville, TN, pers. comm. to Stupka 1949).

Parasites: Fleas, lice, and mites were recorded from this species by Komarek and Komarek (1938).

Measurements: 29 males: total length 315.6 mm (291–340 mm); tail 131.5 mm (111–150 mm); hind foot 48.5 mm (43–51 mm); weight (3) 178.1 g (150.7–191.8 g). 28 females: total length 317.4 mm (293–340 mm); tail 129.2 mm (116–169 mm); hind foot 48.0 mm (42–51 mm); weight (7) 195.7 g (169.0–224.8 g).

Location of specimens: CHAS, CU, DMNH, GSMNP, LACM, MSU, UCONN, UIMNH, UMMZ, USNM.

Glaucomys volans L. (Southern Flying Squirrel)

Distribution: The Southern Flying Squirrel is a common resident in areas of the Park with large deciduous trees, although some individuals have also been taken in mixed deciduous–pine woodlands. Squirrels have been recorded at elevations ranging from approximately 458 m (Foothills Parkway) to 1434 m (Snake Den Mountain). In December, 1940, 26 Southern Flying Squirrels were found in 1 hollow chestnut tree by Stupka (1960b).

Blount County - Abrams Branch; Cades Cove (549 m). Cocke County - Snake Den Mountain (1434 m). Sevier County - Buena Vista along Foothills Parkway (458–488 m); Greenbrier (763 m); Blanket Mountain. Haywood County - Big Creek; Little Cataloochee; Walnut Bottom (946 m). Swain County - Deep Creek (671 m); Smokemont (915 m).

Reproduction: Female Southern Flying Squirrels apparently produce 2 litters annually in the Park. A female collected on 4 August in Cades Cove contained 4 nearly full-term embryos. A nest discovered by the author at Deep Creek on 30 August contained 4 nursing young that still had their eyes closed.

Predation: The stomach of a Timber Rattlesnake taken near Gatlinburg in August contained a Southern Flying Squirrel (Savage 1967, Stupka 1960).

Measurements: 2 males: total length 228 mm (227–228 mm); tail 102 mm (100–103 mm); hind foot 31 mm; weight (1) 65 g. 3 females: total length 242 mm (232–250 mm); tail 103 mm (93–109 mm); hind foot 31 mm (31–32 mm); weight (1) 97.6 g.

Location of specimens: CHAS, GSMNP, USNM.

Glaucomys sabrinus Shaw (Northern Flying Squirrel) [Endangered]

Distribution: South of Pennsylvania, the Northern Flying Squirrel only occurs in disjunct populations and is an uncommon inhabitant of the spruce–fir and mixed

conifer–northern hardwood forests of the Park. It was first discovered in the Park on 20 February 1935, when a specimen was taken on Blanket Mountain, southwest of Elkmont (Handley 1953). Handley stated that this squirrel is “irregularly distributed at high elevations in the spruce and balsam cloud forests of the southern Appalachian Mountains.” The specimen from Blanket Mountain, however, was found in a deciduous forest “at least seven airline miles from the nearest spruce and fir” (Handley 1953). In 1980, the author erected 40 nest boxes in 5 areas from Newfound Gap to Clingmans Dome and in 2 areas on Balsam Mountain to determine the status of this species in the Park (Linzey 1984). The boxes were used by Southern Flying Squirrels and Red Squirrels but not by Northern Flying Squirrels. However, Dr. Peter Weigl was successful in capturing, marking, and releasing 8 Northern Flying Squirrels near Indian Gap during 1987 and 1988 (Weigl et al. 1992). In November 2000, a male was captured and released on Clingmans Dome (Linzey et al. 2002).

The subspecies of Northern Flying Squirrel inhabiting the southern Appalachians is the Carolina Northern Flying Squirrel (*Glaucomys sabrinus carolinensis*) and is listed as an endangered species by the US Fish and Wildlife Service.

Sevier County - Blanket Mountain (1220 m); near Walker Prong; Newfound Gap. State (TN–NC) line - Indian Gap. Swain County - Clingmans Dome.

Reproduction: A nursing female was found near Walker Prong on 22 August.

Measurements: 2 females: total length 280 mm (263–296 mm); tail 134 mm (132–136 mm); hind foot 39 mm (38–39 mm).

Location of specimens: GSMNP.

FAMILY CASTORIDAE – BEAVERS

Castor canadensis Kuhl (American Beaver)

Distribution: American Beaver formerly ranged along streams and lakes throughout most of North America but was extirpated over much of its former range primarily as a result of over-trapping; however, the species has been successfully reintroduced in many places, and populations are increasing. No evidence existed of its historic occurrence within the area now encompassed by the Park until 1966. In 1896, Rhoads stated: “It is not likely that any beavers now exist in the eastern half of the State [Tennessee].” In discussing the status of the American Beaver in North Carolina, Brimley (1945) stated that it was “apparently extinct”, being last recorded from Stokes County about 1897. Hamnett and Thornton (1953) noted that it was exterminated throughout North Carolina by the early 1900s. However, a colony of American Beavers was found inhabiting Alarka Creek in Swain County, NC, in 1962. Alarka Creek flows into Fontana Reservoir approximately 3 miles south of the Park boundary. American Beaver dams were discovered in April 1966 in a small branch of Eagle Creek within the Park boundary (Park News and Views 1966). An American Beaver was seen near the mouth of Pinnacle Creek on Eagle Creek on 7 April 1968; others were observed along the lower reaches of Hazel Creek (Park News and Views 1968). Since 1968, American Beaver sightings, cuttings and/or dams have been observed in Noland Creek, the Oconaluftee River, Deep Creek, and

Fontana Lake. Singer et al. (1981) reported scattered American Beaver sign and one dam on the Tennessee side of the Park at Metcalf Bottoms in 1970, Little River in 1975, Greenbrier in 1978, and Panther Creek in 1979. The first American Beaver sign along Abrams Creek in Cades Cove was recorded on 18 January 1990. The occurrence of American Beaver in the North Carolina portion of the Park is probably the result of introductions made in western North Carolina by the North Carolina Fish and Game Department.

Singer et al. (1981) stated: "In 1979, Beaver occupied 31 km of 5 major drainages on the North Carolina side of Great Smoky Mountains National Park. Their reinvasion averaged 0.4 drainages and 2.4 km of waterway per year. Another 113 km of potentially habitable waterways exist for beaver, 17.4 in the North Carolina and 95.8 in the Tennessee portions of Great Smoky Mountains National Park. The major limitation for Beaver range in the park is the steep gradients of the streams. Within the 5 occupied drainages, resident populations occur where the average percent slope of the stream is 2.2% (range = 1.5–3.0, SD = 0.7), and transient use occurs where the average slope is 3.4% (range = 3.1–40 [sic], SD = 0.4). Even in the range of 2%, the streams are too fast for dams, and except in occasional slow side tributaries, all Beaver live in bank dens or burrows."

Blount County - Abrams Creek. Swain County - Eagle Creek; Hazel Creek; Noland Creek; Deep Creek; Oconaluftee River; Fontana Lake.

Food: American Beaver utilize a great diversity of deciduous trees and shrubs. Singer et al. (1981) found that American Beavers in the North Carolina section of the Park showed the highest preference for *Betula lenta* L. (Black Birch) and *Cornus florida* L. (Flowering Dogwood). In addition, relative use was also high for *Liriodendron tulipifera* L. (Yellow Poplar), Yellow Birch, oaks, *Platanus occidentalis* L. (Eastern Sycamore), Ironwood, American Beech, *Hamamelis virginiana* L. (Witch Hazel), Eastern Hemlock, and *Alnus serrulata* Aiton (Smooth Alder).

Location of specimens: No preserved specimens from the Park are known to exist.

FAMILY CRICETIDAE – NEW WORLD MICE, RATS, AND VOLES

Oryzomys palustris Harlan (Marsh Rice Rat)

Distribution: Only one Marsh Rice Rat has been recorded from the Park. An immature female was found dead on the sill of an old barn near a marshy creek at Greenbrier (671 m) on 3 April 1931 by the Komareks. Komarek and Komarek (1938) stated: "This record is unique in that there seem to be no records of this species occurring above 1000 feet. Its distribution was apparently extended into the mountains as a result of agricultural activities of local residents."

Sevier County - Greenbrier (671 m).

Location of specimen: CHAS.

Reithrodontomys humulis Audubon and Bachman (Eastern Harvest Mouse)

Distribution: Prior to 1991, only 7 Eastern Harvest Mice had ever been recorded from the Park. All were taken below 549 m elevation in Sevier County,

TN (Komarek and Komarek 1938). Six were taken in small cleared areas beneath apple trees in a moderately overgrown Broomsedge field. The seventh was taken in a similar field along Laurel Branch in Greenbrier. Komarek and Komarek (1938) stated that this species was “locally distributed in a few isolated places” in the Park. In 1991, six individuals were taken along the Foothills Parkway (Harvey 1991).

Sevier County - Foothills Parkway (Cove Creek – 436 m.; Cove Spring Hollow – 458 m; King Hollow Branch (519–549 m)); Greenbrier (534–549 m).

Food: Komarek and Komarek (1938) reported unidentified seeds in the stomach of one individual.

Reproduction: A female with enlarged mammary glands was taken on 18 October.

Measurements: 3 males: total length 116 mm (113–122 mm); tail 54 mm (52–57 mm); hind foot 14.6 mm (14–15 mm). 3 females: total length 120 mm (113–134 mm); tail 55 mm (50–64 mm); hind foot 14.6 mm (14–15 mm); weight (1) 12.4 g.

Location of specimens: CHAS, GSMNP.

Peromyscus gossypinus LeConte (Cotton Deermouse)

Distribution: The Cotton Deermouse is found from southeastern Virginia to southern Florida and west to southeastern Oklahoma and eastern Texas. Although found principally on the Coastal Plain, this species does extend into the Piedmont region and into the foothills of the mountains. Cotton Deermice are most commonly found around logs, stumps, hollow trees, stone walls, and piles of rocks in timbered swampland along the floodplains of streams and rivers and in brushy areas near water. The author has frequently taken this species in a floodplain along Cosby Creek. Komarek and Komarek (1938) stated that it was frequently found “in the open woodlands and field margins at low elevations where farming activity has produced brush growth and open forest situations.” Cotton Deermice have been recorded in the Park at elevations ranging from 427 m (Roaring Fork) to 854 m (Greenbrier).

Blount County - Cades Cove (534 m). Cocke County - Cosby Campground (625 m); Cosby Creek (525 m). Sevier County - Roaring Fork near Gatlinburg (427 m); near Park headquarters (458 m); Fighting Creek near Gatlinburg; Little River at The Sinks (477 m); Laurel Creek (549 m); Greenbrier (519–854 m). Haywood County - Big Creek (519 m).

Reproduction: Komarek and Komarek (1938) recorded 2 females, each containing 3 embryos, on 14 March. The author recorded a nursing female (placental scars 1R, 2L) on 26 August, and males in breeding condition in August, September, and October.

Pelage: On 30 March, the author recorded a female that had almost completed molting.

Predation: See discussion under *Peromyscus maniculatus* Wagner (North American Deermouse).

Parasites: Komarek and Komarek (1938) found roundworms in the stomachs of several individuals. The author removed a flea, *Peromyscopsylla hesperomys* Baker, from one specimen.

Measurements: 19 males: total length 183.0 mm (160–204 mm); tail 78.5 mm (65–97 mm); hind foot 24.0 mm (21–26 mm); weight (4) 34.6 g (30.3–38.2g). 14 females: total length 179.9 mm (156–206 mm); tail 79.6 mm (63–90 mm); hind foot 22.9 mm (20–24 mm); weight (4) 32.6 g (24.4–39.3 g).

Location of specimens: CHAS, DWL, GSMNP, IUP, LACM, OMNH, OU.

Peromyscus leucopus Rafinesque (White-footed Deermouse)

Distribution: In the Park, the White-footed Deermouse is most abundant at the lower elevations but has been recorded up to 1983 m (Clingmans Dome). (Also see discussion under North American Deermouse).

Blount County - Cades Cove (534 m); Whiteoak Sink (534 m). Cocke County - near Cosby Ranger Station (519–763 m); Indian Camp Creek. Sevier County - Roaring Fork near Gatlinburg (427 m); Twin Creeks; Foothills Parkway between Wear Valley and Gatlinburg (336–732 m); Sugarlands (549 m); Greenbrier (625–976 m); Porters Flat (686–732 m); Little River, 2 miles above Elkmont (824 m); Fish Camp Prong (833 m); Ramsey Cascades; former Chimneys Campground; Clingmans Dome (1830 m). Haywood County - Big Creek; Cataloochee; Ledge Bald; Polls (Paul's) Gap. Swain County - Big Cove Road adjacent to Blue Ridge Parkway; Forney Creek; Jonas Creek Trail; Kephart Prong; Black Camp Gap (1373 m); Thomas Divide; Moore Springs Shelter; Andrews Bald (1769 m); Clingmans Dome (1983 m).

Food: Major food items, by volume, found in the stomachs of 40 *Peromyscus leucopus* (Rafinesque) taken during the summer were insects (42.3%), fruit skins (17.5%), insect larvae (9.0%), and millipedes (5.9%) (Linzey and Linzey 1973). Seeds constituted only 2.2% of the total volume, while animal foods amounted to 51.4%. These findings are in marked contrast to the summer diets of *Peromyscus maniculatus* Wagner (North American Deermouse) in which seeds comprised 57.7% and animal foods comprised 22.2% of the total volume. Further research may shed light on the possible ecological significance of this apparent displacement, since the 2 species overlap considerably in their habitats and altitudinal distributions (Komarek and Komarek 1938, Linzey and Linzey 1968).

Reproduction: Females produce several litters annually from early spring until fall. A nest containing 4 half-grown young was found in a trail register box at the former Chimneys Campground on 31 October. From June to September, numerous pregnant and nursing females and males in breeding condition were recorded by the author in the Cosby area. Three females, each containing 4 embryos, were recorded on 5 and 19 August 1984 (Ambrose 1986). A nursing female and 2 males in breeding condition were noted by the author on 8 and 9 September at Cataloochee. A female gave birth to 4 young in a live-trap on 22 August in the spruce–fir zone (Smith and Mouzon 1985).

Pelage: Molting individuals have been recorded by the author in June (1 male) and July (1 male, 2 females). Eight other mice observed during these 2 months were not molting.

Predation: See discussion under North American Deermouse.

Parasites: Single botfly larvae (*Cuterebra* sp.) were removed from 2 specimens by the author on 15 July and 12 August. A flea was taken from a female in June.

Measurements: 62 males: total length 153.5 mm (142–194 mm); tail 73.5 mm (62–94 mm); hind foot 21.0 mm (19–24 mm); weight (40) 20.3 g (12.4–26.9 g). 28 females: total length 160.3 mm (138–181 mm); tail 73.1 mm (62–87 mm); hind foot 20.9 mm (18–23.5 mm); weight (17) 18.7 g (14.8–26.7 g).

Location of specimens: CAS, CHAS, CSULB, CU, DWL, GSMNP, IUP, OMNH, OU, UMMZ, UCONN, USNM.

Peromyscus maniculatus Wagner (North American Deermouse)

Distribution: This species and the White-footed Deermouse are probably the most abundant of the Park's mammals. The North American Deermouse prefers cool, moist forests and is found most abundantly at the higher altitudes, while the White-footed Deermouse tends to occur in greater numbers at the lower elevations, although it has been recorded as high as 1983 m, an altitudinal division noted in areas surrounding the Park. Within the Park, these species become sympatric at about 915 m (Komarek and Komarek 1938) and are frequently taken in adjacent traps.

Blount County - Forge Creek; Russell Field (1312 m); Spence Field (1464–1525 m); Thunderhead Mountain. Cocke County - Near Cosby Ranger Station (519–763 m); Crying Creek; Indian Camp Creek (808 m); Low Gap (824–1294 m); Snake Den Mountain (1129–1373 m); Appalachian Trail between Low Gap and Mt. Cammerer (1294–1495 m); Inadu Knob (1373–1739 m); Old Black Mountain (1922 m). Sevier County - Roaring Fork near Gatlinburg (427 m); Twin Creeks; Greenbrier (595–1434 m); Ramsey Prong (915 m); Horseshoe Mountain (763 m); Brushy Mountain (824–1498 m); Brushy Gap (915–1498 m); Newfound Gap Road (946–1220 m); Chapman Prong (915–1068 m); Chimneys Campground; Eagle Rocks Creek (1068 m); Fish Camp Prong; Grassy Patch (1068–1220 m); Buck Fork (1281–1373 m); Walker Prong at Route 441 (1449 m); Dry Sluice Trail (1464 m); Lost Fork; Newfound Gap (1495–1586 m); Mt. Kephart (1678 m); Three Forks; Thunderhead Mountain; Russell Field; Silers Bald (1678–1714 m); Mt. Guyot (2019 m.); Mt. Le Conte. Haywood County - Big Creek (519–671 m); 1 mile north of Mt. Sterling (519 m); Cataloochee (793 m); Walnut Bottom (928 m); Black Camp Gap (1373 m); Cosby Knob Shelter (1464 m); Polls (Paul's) Gap (1556 m). Swain County - Smokemont (671–915 m); Forney Creek (732 m); Kanati Fork at Route 441 (854 m); Thomas Divide (915 m); Beech Flats Creek at Route 441 (1220 m); Mingus Mill Creek (1220 m); Moore Springs Shelter (1449 m); Silers Bald (1708 m); Pecks Corner Shelter (1678 m); Indian Gap; Thunderhead Mountain; Tricorner Knob (1800 m); Mt. Collins (1861–1887 m); Mt. Kephart (1891 m.); Clingmans Dome (1922–2025 m.); Forney Ridge (1952 m).

Food: Examination of the stomachs of 105 *Peromyscus maniculatus* Wagner taken in various portions of the Park during July (26), September (3), and December (76) revealed seeds, fruit, and vegetation as the principal food items by volume (Linzey and Linzey 1973). Animal food (chiefly insects) constituted slightly <10% of the total food. A comparison of summer and winter food volumes from 4

localities showed that seeds apparently form a substantial portion of the diet regardless of the season or habitat, ranging from 57.5% to 67.5%. Insects form a larger portion of the diet in summer than in winter. Since the sample was dominated by winter specimens (76 to 29), the over-all figure of 10% volume of animal foods is probably lower than it would have been if the specimens had been taken at evenly distributed times throughout the year.

Reproduction: Females with embryos or placental scars have been recorded during the following months: February (1), March (5), April (1), July (10), August (3), September (2), and December (7) (Komarek and Komarek 1938, Linzey and Linzey 1968). The average number of embryos per female (14) was 3.5 (2–4). Nursing females have been recorded on 14 March and 2 June. Males examined during March (1), July (11), September (2), and December (6) were in breeding condition. Mice kept in captivity by the author and his wife have produced litters in every month, and it is probable that the wild population also reproduces throughout the year.

Pelage: Molting individuals have been recorded in December (2), June (3), and July (2). Non-molting mice have been taken in March (10), April (16), June (12), July (13), and December (8).

Predation: All instances of predation involving *Peromyscus* sp. are reported in the account of *Peromyscus maniculatus* because remains of mice of this genus found in the stomachs of predators have not been identified to species. *Peromyscus* sp. have been found in the stomachs of 3 Timber Rattlesnakes taken near Laurel Creek, Trilium Gap, and Gregory Bald (Stupka 1945, 1947, 1954), in 21 of 44 (48%) Timber Rattlesnakes examined by Savage (1967), in a Bobcat killed along the Newfound Gap Road in Tennessee (Stupka 1952), and in 2 Screech Owls found at the Tremont Y and near Park headquarters (Stupka 1938, 1949). A Long-tailed Weasel seen on Mt. Le Conte near LeConte Lodge was carrying a *Peromyscus*.

Parasites: Tapeworm cysts of a species not determined and nematodes (*Longistriata* sp. and *Oxyuris* sp.) were found in the intestines and cecae of specimens examined by Komarek and Komarek (1938). Pfitzer (1950) removed a large number of fleas (*Peromyscopsylla* sp., *Orchopeas* sp., and *Ctenophthalmus* sp.) from this species. The author has recorded the following fleas: *Stenoponia americana* Baker, *Orchopeas leucopus* Baker, *Epitedia wenmanni testor* Rothschild, and *Peromyscopsylla hesperomys*.

In 1993, *Hantavirus sin nombre virus* (Sin Nombre strain of Hantavirus) caused a much-publicized cluster of human deaths in the Four Corners region of the southwestern United States. In 1994–1995, rodent populations were surveyed in 39 national parks, including the Park (Mills et al. 1998). Sampling in the Park was limited to only 3 nights of trapping with 50 rodents captured. Two out of 27 (7.6%) *Peromyscus maniculatus* tested were antibody positive for a hantavirus that cross-reacted with Sin Nombre antigen (Mills et al. 1998). From 2000 to 2004, researchers from the Department of Comparative Medicine at the University of Tennessee College of Veterinary Medicine surveyed rodent populations in the Park and confirmed the presence of a strain of hantavirus. The strain was named Newfound Gap Virus (NGV) (Lewis 2005). Testing for viral prevalence by using a

variety of techniques produced positive results in the North American Deermouse, White-footed Deermouse, *Myodes (Clethrionomys) gapperi* Vigors (Southern Red-backed Vole), and Smoky Shrew. Negative reactivity of sera occurred in the Masked Shrew, Southeastern Shrew, Northern Short-tailed Shrew, *Microtus ochrogaster* (Wagner) (Prairie Vole), *Synaptomys cooperi* (Baird) (Southern Bog Lemming), Hispid Cotton Rat, and *Neotoma magister* (Baird) (Allegheny Woodrat). Other than for *Peromyscus* sp., sample sizes for other species were small (Lewis 2005).

Measurements: 141 males: total length 172.4 mm (142–206 mm); tail 89.0 mm (60–114 mm); hind foot 21.0 mm (18–23 mm); weight (101) 16.7 g (10.3–21.8 g). 135 females: total length 175.1 mm (146–203 mm); tail 89.1 mm (68–111 mm); hind foot 20.7 mm (18.0–22.5 mm); weight (84) 17.7 g (11.5–30.0 g).

Location of specimens: CAS, CHAS, CM, CU, DWL, GSMNP, IUP, KU, NCSM, OMNH, OU, UIMNH, UCONN, UNCW, USNM.

Ochrotomys nuttalli Harlan (Golden Mouse)

Distribution: The Golden Mouse occurs in the Park in highly localized populations up to approximately 915 m elevation. Preferred habitat consists of wooded areas having an extensive understory of *Smilax* sp. (greenbrier) or *Lonicera* sp. (honeysuckle). Komarek and Komarek (1938) recorded them along the edges of Broomsedge fields, brier patches, and old fences in the Park. Such disturbed areas are becoming scarcer as ecological succession proceeds and the Park reverts to a more forested condition. The ecology, home range, and population dynamics of *Ochrotomys* in the Park were the subject of an intensive study by the author (Linzey 1966, 1968; Linzey and Linzey 1967a, b).

Prior to 2000, the Golden Mouse had been recorded at elevations up to 915 m (Greenbrier Cove) in the Park. On 11 April 2000, a female Golden Mouse was reportedly captured alive and released in a seepage bog on Andrews Bald (1772 m) (Linzey et al. 2002; E. Pivorun, Clemson University, January 2015 pers. comm.). If it was identified correctly, this record represents the highest elevation for this species in the Park.

Cocke County - Cosby (525–763 m). Sevier County - Cove Creek (436 m); Fighting Creek (440 m); Greenbrier (458 m); The Sinks; Greenbrier Cove (512–915 m); King Hollow Branch (519–549 m); Cherokee Orchard (763 m); Porters Flat (763 m); Couches Creek; Little River, 3.2 km above Elkmont (824 m). Haywood County - Big Creek (519 m); Smokemont. Swain County - Deep Creek.

Food: Seeds (greenbrier and blackberry) and insects were the most frequent food items identified in the stomachs and intestinal tracts of 54 Golden Mice (Linzey 1966, 1968). *Prunus* sp. (plum), *Cornus* (dogwood), and greenbrier seeds were most frequently found in an examination of 44 nests of this species.

Reproduction: The breeding season of this species in the Park extends from mid-March to early October, with peaks occurring in late spring and early fall. This determination is based on data obtained from juvenile and immature mice observed in the field, the presence or absence of embryos and placental scars in autopsied females, the presence of males in breeding condition, and from data gathered

from the birth of 145 litters in captivity (Linzey 1966, Linzey and Linzey 1967b). Growth and development, longevity, and seasonal variation in growth are discussed in Linzey and Linzey (1967b).

Pelage: Individuals undergo a maturational molt as well as spring (April–June) and fall (October–December) molts (Linzey and Linzey 1967a).

Parasites: The following parasites have been recorded from this species by the author: Bacteria - *Grahamella* sp., *Escherichia coli* Migula; Cestoda - *Taenia rileyi* Loewen, Nematoda - *Longistriata* sp., *Rictularia* sp.; Mites - *Eulaelaps stabulari* Koch, *Androlaelaps Glasgow* Berlese, *Androlaelaps casalis* Berlese, *Labidophorus* sp., *Lasioseius* sp., *Melichares dentriticum*, *Myocoptes musculus* Koch, *Laelaps alaskensis* Grant; Fleas - *Epitedia wenmanni*, *Orchopeas leucopus*, *Ctenophthalmus pseudagyrtis* Baker, *Doratopsylla blarinae* Fox; Lice - *Hoplopleura hesperomydis* Osborn. Ticks - *Dermacentor variabilis* Say (American Dog Tick). Diptera - *Cuterebra* sp. A more detailed discussion of these parasites and their abundance can be found in Linzey (1966, 1968).

Measurements: 23 males: total length 171 mm (152–193 mm); tail 78 mm (73–93 mm); hind foot 19.6 mm (18.0–20.0 mm); weight (17) 21.6 g (15.2–27.6 g). 19 females: total length 167.7 mm (150–189 mm); tail 80.7 mm (60–91 mm); hind foot 19.3 mm (18.5–20.0 mm); weight (15) 20.9 g (15.7–25.5 g).

Location of specimens: CHAS, DWL, GSMNP, LACM, OMNH.

Sigmodon hispidus Say and Ord (Hispid Cotton Rat)

Distribution: The preferred habitat of the Hispid Cotton Rat consists of grassy fields, brushy pastures, ditches, marshes, and along the brushy borders of cultivated fields. Komarek and Komarek (1938) recorded Hispid Cotton Rats at Greenbrier in a heavily overgrown Broomsedge field. Fleetwood (1935) took this species in a swampy meadow at Big Creek. Komarek and Komarek (1938) noted that the Cotton Rat's distribution had been extended into the mountains due to agricultural activities. Keeler (1978a, b) recorded taking Cotton Rats in traps set for *Mephitis mephitis* Schreber (Striped Skunk) in Cades Cove. Until 1991, this species had been recorded from only 4 localities in the Park. In 1991, 13 individuals were taken along the Foothills Parkway. In August, 1994, the author recorded this species at Tremont, and in June 2010, a previously unknown population was discovered by the author and a student along Copeland Creek (Kumar et al. 2013). Several specimens have been taken just outside the the Park boundary (Sevier County - Gum Stand below Gatlinburg; along Gnatty Branch near the Foothills Parkway; Swain County - Cherokee Indian Reservation at 610 m). The Swain County specimen was taken by the author in a brushy field.

Blount County - Cades Cove; Tremont. Sevier County - Cove Creek (436 m); Cove Spring Hollow (458 m); Greenbrier Cove (519–534 m); Copeland Creek. Haywood County - Big Creek (519 m); Mt. Sterling.

Measurements: 4 males: total length 233 mm (207–252 mm); tail 98 mm (92–108 mm); hind foot (3) 31 mm (29–32 mm). 4 females: total length 217 mm (197–256 mm); tail 95 mm (87–112 mm); hind foot 28 mm (26–30 mm).

Location of specimens: CHAS, GSMNP.

Neotoma magister Baird (Allegheny Woodrat)

Distribution: Allegheny Woodrats are most often found in caves and rocky cliffs, but may also be found in wooded bottomlands, swamps, and in outbuildings and abandoned structures. Several woodrats have been found living in the rocky cliffs and fissures near The Sinks on the Little River. In addition, many individuals and their nests have been discovered in and around old buildings in the Park. *Neotoma* occurs from the lowest elevations up to 763 m (Cataloochee).

Blount County - Abrams Creek Ranger Station (275 m); Cades Cove; Twentymile Creek; Happy Valley Ranger Station; Little River between The Sinks and the Park boundary; Tremont CCC Camp (587 m). Sevier County - Vicinity of The Sinks bridge (442 m, 477 m); Sugarlands (549 m, 610 m). Haywood County - Big Creek (488–534 m); Cataloochee (763 m). Swain County - Chambers Creek, 2.4 km above Fontana Reservoir.

Food: Individuals taken in October were found to have fed on berries of *Phytolacca* sp. (pokeweed). A woodrat found dead along Little River Road in October had in its mouth a 5-cm sprig with berries of *Toxicodendron radicans* L. (Kuntze) (Poison Ivy).

Reproduction: An Allegheny Woodrat was frightened from a nest located 3 m above ground in a dense growth of privet near Chambers Creek (Stupka 1961). A nest found at Abrams Creek Ranger Station on 13 September contained a nursing female and 2 young approximately 10 days old. Nursing females have also been taken on 24 April and 14 August. A half-grown individual and 2 very small immature specimens were collected at Big Creek between 1–4 October 1950.

Parasites: Eight Allegheny Woodrats examined during October 1950 were infested with fleas. Fleas have also been found in several nests.

Measurements: 7 males: total length 384 mm (325–405 mm); tail 174 mm (142–194 mm); hind foot 39 mm (37–40 mm); weight (5) 263.5 g (228.8–319.4 g). 6 females: total length 378 mm (349–413 mm); tail 173 mm (160–188 mm); hind foot (7) 37 mm (35–40 mm); weight (5) 235.7 g (180.9–275.5 g).

Location of specimens: GSMNP, USNM.

Myodes gapperi Vigors (Southern Red-backed Vole)

[This species was formerly classified as *Clethrionomys gapperi*.]

Distribution: The Southern Red-backed Vole is common to abundant in the spruce–fir forests, although the author has also collected it in deciduous woodlands. Cool, damp areas are preferred, including moss-covered logs and rocks, deep crevices among boulders on hillsides, along small boulder-strewn streams, and in rhododendron thickets. Komarek and Komarek (1938) frequently found *Myodes* among mossy rocks in humid forests, but they also took specimens at the bases of isolated shrubs on top of Spence Field, a grassy bald. In the Park, *Myodes* has been recorded at elevations ranging from 534 m (Sutton Ridge) to 2026 m (Clingmans Dome).

Blount County - Bote Mountain (1434 m). Cocke County - Sutton Ridge near Cosby Ranger Station (534 m); Low Gap Trail (1151 m); Low Gap (1294 m); Appalachian Trail between Low Gap and Mt. Cammerer (1403–1495 m); Inadu Knob (1739 m); Old Black Mountain (1922 m). Sevier County - Newfound Gap Road (946 m, 1220 m); Trout Branch; West Prong of the Little Pigeon River (1037 m, 1220 m); Chimneys; Walker Prong; Buck Prong (1068–1525 m); Eagle Rocks Creek (1098 m); Greenbrier Cove (1251–1403 m); Buck Fork (1281–1403 m); Chapman Prong (1525 m); Indian Gap (1464 m, 1586 m); Sugarland Mountain Trail near the Appalachian Trail; Silers Bald Shelter; Mt. Guyot (1830–2019 m); Clingmans Dome (2026 m). State (TN–NC) line - Mt. Collins (1525 m); Mt. Kephart (1891 m); Spence Field. Haywood County - Black Camp Gap (1434 m); Cosby Knob Shelter (1464 m); near Polls (Paul's) Gap (1556 m). Swain County - Kanati Fork (854 m); Newfound Gap Road (1373 m); Indian Gap (1667 m); Pecks Corner Shelter (1678 m); Noland Divide Trail; Collins Gap (1769 m); Tricorner Knob (1800 m); Andrews Bald (1769 m); Mt. Collins; Clingmans Dome (1922–2025 m); Forney Ridge parking area (1952 m).

Food: Examination of the stomachs of 27 *Myodes* taken during July (19) and December (8) revealed vegetation forming the bulk of the diet (64.8% of the total volume; Linzey and Linzey 1973). Seeds amounted to nearly 12%, while animal food comprised only 4.4% of the total volume.

The enterococci *Enterococcus faecalis* and *Enterococcus faecium* were recorded in fecal specimens by Mundt (1963).

Reproduction: The breeding season in the Park probably extends from early spring until fall. Nursing females or females with embryos have been recorded on the following dates: 25 April (nursing); 30 April, 4 (CR = 5 mm); 4 July, 4 (CR = 25 mm); 4 July, pregnant; 4 July, nursing; 17 July, 2 (2R, 0L; very small); 17 July, 2 (1R, 1L); 17 July, 3 (2R, 1L); 17 July, placental scars 1R, 3L; nursing; 21 July, 4 (3 with CR about 13 mm; 1 very small); 31 July, 3 (CR = 16.5 mm); and 29 August (nursing). No embryos or placental scars were recorded for 7 females in July or 2 in December. Eleven males in breeding condition were noted during July. Half-grown individuals have been taken on 31 July and 23 August (Komarek and Komarek 1938, Linzey and Linzey 1968). Smith and Mouzon (1985) recorded many males in breeding condition and pregnant and lactating females from mid-August to mid-October in the spruce–fir zone.

Pelage: Molting individuals have been recorded in April (11), June (10), July (11), and December (5).

Predation: This species has been found in the stomach of a Timber Rattlesnake in the Park (Savage 1967).

Parasites: Komarek and Komarek (1938) found *Cuterebra* sp. (warbles) to be common in this species. They were found most frequently in males and almost always near the testes. *Cuterebra* was also recorded by Pfitzer (1950). The author has recorded 3 flea species, including *Ctenophthalmus pseudagyrtes* Baker, *Peromyscopsylla catatina* Jordan, and *Catallagia borealis* Ewing, and the tick *Ixodes angustus* Neumann. Lewis (2005) recorded the first evidence of hantavirus detected in *Myodes*.

Measurements: 87 males: total length 146.7 mm (123–177 mm); tail 44.4 mm (35–55 mm); hind foot 20.0 mm (18–22 mm); weight (44) 25.4 g (14.7–37.5 g). 68 females: total length 143.8 mm (123–162 mm); tail 44.3 mm (30–55 mm); hind foot (53) 19.9 mm (17–22 mm); weight (39) 23.9 g (15.0–39.9 g).

Location of specimens: CAS, CHAS, CU, DWL, GSMNP, LACM, NCSM, OMNH, OSU, OU, UMMZ, UIMNH, TTU, UCONN, USNM.

Microtus pennsylvanicus Ord (Meadow Vole)

Distribution: The Meadow Vole is a northern species whose eastern range extends southeastward to eastern Tennessee, northern Georgia, South Carolina, and the west-central coast of Florida. Meadow Voles are most often found in old fields, orchards, and low, moist areas near streams and lakes. This species was not taken in the Park until December 1965 when the author and his wife recorded a juvenile female in a marshy field along the Oconaluftee River, 0.8 km northwest of the Smokemont Campground at an elevation of 671 m (Linzey and Linzey 1967). Dominant plants were *Carex* sp. (sedges) and *Scirpus* sp. A total of 548 trap nights in the immediate vicinity failed to secure any additional specimens. However, during September and October 2000, additional specimens were recorded by the author from this population, which remains the only known population in the Park. In 2002, the federal government deeded 144 acres of the land where this species occurs to the Eastern Band of Cherokee Indians who constructed schools and parking areas on a portion of this site. At this time (2015), it is unknown whether this species continues to exist within the Park.

Food: The stomach of the Smokemont specimen contained finely chewed vegetation (volume = 100%) and pebbles (trace) (Linzey and Linzey 1973).

Measurements: 1 male: total length 165 mm; tail 50 mm; hind foot 20 mm. 5 females: total length 165.2 mm (155–170 mm); tail 53.6 mm (40–75 mm); hind foot 20.9 mm (19–22 mm); weight (1) 41.8 g.

Location of specimen: DWL.

Microtus chrotorrhinus (Miller) (Rock Vole)

Distribution: Disjunct populations of the Rock Vole occur south of Pennsylvania in the southern Appalachian Mountains. This species is most often found among the mossy rocks and logs in the high elevation humid forest, often in association with the Southern Red-backed Vole. It has, however, also been taken from a rocky talus slope with no grasses, in an open grassy area, in a birch–beech forest, and amid scattered rocks along a stream. It is fairly common at elevations above 915 m.

Blount County - Spence Field (1525 m); Thunderhead (1647 m). Cocke County - Indian Camp Creek Trail (808 m). Sevier County - Fort Harry Cliffs (976 m); Newfound Gap Road (976–1525 m); Chapman Prong (976 m); Lost Fork; Eagle Rocks Creek (1068–1220 m); former Chimneys Campground; Ramsey Prong; Greenbrier Cove (1068–1434 m); Grassy Patch (1220 m); Buck Fork (1281–1586 m); Walker Prong (1449 m); West Prong of the Little Pigeon River; Rocky

Spring Gap; Indian Gap (1586 m); Sawtooth (1678 m); Silers Bald (1714 m); Mt. Le Conte. State (TN–NC) line - Newfound Gap (1525 m); Thunderhead (1647 m); Spence Field (1678 m); Mt. Kephart (1891 m). Swain County - Kanati Fork (854 m); Bradley Fork (976 m); Smokemont (915–976 m); Newfound Gap Road (1068 m, 1159 m, 1373 m); Oconaluftee River (1159 m); Mingus Mill Creek (1220 m); Pecks Corner Shelter (1678 m); Andrews Bald (1769 m); Clingmans Dome (1961 m).

Food: Komarek and Komarek (1938) recorded blackberry seeds from the stomach of one individual. Stomach analyses of 3 Rock Voles taken by the author in September from Indian Camp Creek and in December from Walker Prong and Kanati Fork were virtually identical. Vegetation composed 99.7% of the volume (frequency = 100%) with the fungus *Endogone* composing 0.3% (frequency = 33.3%), hair just a trace (frequency = 66.7%), and pebbles just a trace (frequency = 33.3%) (Linzey and Linzey 1973).

Reproduction: Nursing females or females with embryos have been taken on the following dates: 3 March, 3 (near birth); 31 March (nursing); 13 April, 3 (“medium embryos”); and 29 April, 4 (3R, 1L; CR = 10 mm; nursing). Males in breeding condition have been noted in March (2), July, and August. Immature individuals have been found in July (1), August (1), September (1), and October (2).

Predation: Rock voles have been recorded in the stomachs of 8 Timber Rattlesnakes and 1 Northern Copperhead (Savage 1967). A Bobcat killed by a car in August 1952 along the Newfound Gap Road (TN; 1129 m) contained 5 Rock Voles.

Parasites: Approximately 65% of the voles collected by Komarek and Komarek (1938) were infested with warbles. One individual had several *Ixodes* sp. (ticks) attached about its nose; the mites *Laelaps microti* (Ewing) and *Neoschongastia signator* Ewing were also collected, and *Cheirapteranema* sp. (nematodes) were found in the intestines and cecae. Linzey and Linzey (1973) recorded the flea *Ctenophthalmus pseudagyrtes* and the mite *Laelaps kochi* Oudemans from one vole taken at Kanati Fork in December.

Measurements: 25 males: total length 158.6 mm (136–177 mm); tail 47.2 mm (37–57 mm); hind foot 21.3 mm (19–24 mm); weight (17) 32.0 g (23.4–46.9 g). 33 females: total length 156.7 mm (137–175 mm); tail 45.8 mm (37–56 mm); hind foot 20.7 mm (17–22.5 mm); weight (18) 29.1 g (26.1–36.0 g).

Location of specimens: AMNH, CHAS, CM, CU, DWL, GSMNP, JEL, KU, LACM, LNB, OMNH, TTU, UIMNH, UCONN, UNCW, USNM.

Microtus pinetorum LeConte (Woodland Vole)

Distribution: In the Park, Komarek and Komarek (1938) took Woodland Voles in open deciduous woods in Cades Cove where the voles had runways under a layer of dead leaves. In Greenbrier Cove, specimens were taken by the Komareks in an apple orchard and in a small marshy area at the edge of the woods. At Deep Creek, Woodland Voles were taken in a sedge field bordered on one side with pines and on the other with oaks and shrubs. Most records are below 610 m elevation; however, the Woodland Vole has been taken as high as 1525 m on Spence Field.

Blount County - Cades Cove; Spence Field (1525 m). Cocke County - Near Cosby Ranger Station (534 m); Cosby Campground (625 m). Sevier County - Foothills Parkway - Cove Creek (436 m), Cove Spring Hollow (458 m), King Hollow Branch (519–549 m); Park headquarters; Greenbrier Cove (549–763 m); Cherokee Orchard (732 m); Elkmont. Haywood County - Cataloochee (793–824 m). Swain County - Juney Whank Branch near Deep Creek (610 m); Indian Creek (610 m).

Food: Komarek and Komarek (1938) found pieces of grass, decomposed apples, and kernels of corn in the runways of this vole. Linzey and Linzey (1973) examined the stomachs of 7 Woodland Voles taken in September at Cataloochee and 4 taken in December at Cherokee Orchard. Vegetation comprised 78.5% of the total volume and was present in all animals (frequency = 100%). Seeds formed 20.6% of the total volume (frequency = 36.4%) and the fungus *Endogone* comprised 0.4% of the volume (frequency = 54.5%). When the food of the groups of voles from each locality were examined separately, it was found that the voles from Cherokee Orchard were feeding almost entirely on vegetation (volume = 99.5%), while animals from Cataloochee depended on both vegetation (volume = 66.6%) and seeds (volume = 32.4%). No seeds were found in Cherokee Orchard voles, and only 1 out of the 4 contained the fungus *Endogone*, as opposed to 5 out of 7 from Cataloochee. These differences may reflect differences in habitat or differences in season.

Reproduction: Woodland Voles may breed throughout the year in the Park. Nursing females or females containing embryos or placental scars have been recorded on the following dates: 16 March, 3 (well developed); 24 March, 2 (well developed); 8 September, 2 (1 R, 1L); 9 September, 2 (1R, 1L; CR = 25 mm; near term); 14 December, 3 (1R, 2L; very small; nursing); and 15 December, 2 (1R, 1L; nursing). Males in breeding condition have been noted in September. An immature vole was taken in March.

Pelage: Three of 6 individuals examined by the author in September and all 4 voles taken in December were molting.

Predation: Woodland voles have been found in the stomachs of 4 Northern Copperheads in the Park (Savage 1967). They have also been recorded from *Pantherophis guttatus* L. (Corn Snake).

Measurements: 7 males: total length 123 mm (114–128 mm); tail 23 mm (21–27 mm); hind foot 17.3 mm (16.0–18.5 mm); weight (5) 27.8 g (20.7–32.3 g). 9 females: total length 125 mm (122–127 mm); tail 24 mm (18–28 mm); hind foot 17 mm (16–18 mm); weight (5) 31.2 g (25.1–38.6 g)

Location of specimens: CHAS, CU, DWL, GSMNP, LACM, OMNH, OU.

Synaptomys cooperi Baird (Southern Bog Lemming)

Distribution: The Southern Bog Lemming ranges south along the Atlantic Coast to Virginia and in the Appalachian Mountains to western North Carolina. Komarek and Komarek (1938) recorded *Synaptomys* from “small, scattered grassy patches throughout the mountains”, while the author has found this species in marshy meadows at Cataloochee and among rocks along a swiftly flowing mountain

stream. Komarek and Komarek (1938) collected 26 individuals between 1931 and 1934. Between 1934 and 2000, only 8 additional individuals were recorded in the Park. On 19 June 2000, a ninth specimen (juvenile) was recorded from the Heintooga Bald trail in Swain County (Linzey et al. 2002). A tenth specimen was taken on Andrews Bald in September 2002 (Clemson University Museum). Localities range in elevation from 427 m (Greenbrier Cove) to 1769 m (Andrews Bald).

Blount County - Spence Field (1525 m). Sevier County - Greenbrier Cove (427–1373 m); Laurel Creek (534–549 m); Ramsey Prong; Roaring Fork; Buck Prong (1373 m); Little River above Elkmont (885 m); Grassy Patch (1220 m); Indian Gap (1586 m). Haywood County - Cataloochee (793–824 m.). Swain County - Between Forney Creek and Jonas Creek (732 m); Kanati Fork (854 m); Newfound Gap Road (1220 m); Silers Bald (1647–1714 m); Heintooga Bald trail; Andrews Bald (1769 m).

Food: The stomachs of several individuals examined by Komarek and Komarek (1938) contained finely chewed grass. The author examined the stomach contents of 2 females taken in September at Cataloochee and 1 male taken in December along Kanati Fork (Linzey and Linzey 1973). Stomach analyses by volume (percentage frequency in parentheses) are: very finely chewed vegetation, 99.7% (100%); *Endogone* sp., 0.3% (33.3%); gravel, trace (33.3%); and hair, trace (33.3%). The fungus *Endogone* was present in one of the specimens from Cataloochee.

Reproduction: Breeding may occur throughout the year. Females with embryos have been recorded on the following dates: 12 March, 4 (well developed); 17 March, 1 (near birth); 19 March, 3 (half developed); 23 March, 1 (well developed); 5 July, 3 (9 mm.); and 9 September, 2 (OR, 2L). An immature *Synaptomys* was taken on 31 October.

Pelage: Molting was recorded in 1 of 2 females taken by the author in September and in a male in December.

Parasites: The author recorded an unidentified louse, 2 *Androlaelaps glasgowi* (Ewing) mites, and a previously undescribed species (Linzey and Linzey 1968). The undescribed species was subsequently described as *Laelaps stupkai* Linzey and Crossley (Linzey and Crossley 1971, Linzey and Linzey 1973). Three specimens of *L. stupkai* were removed from a male *Synaptomys* taken along Newfound Gap Road at Kanati Fork, 854 m (Swain County, NC) in December.

Measurements: 11 males: total length 125.0 mm (113–136 mm); tail 19.9 mm (12–27 mm); hind foot 19.5 mm (17–21 mm); weight (7) 31.4 g (27.0–38.1 g). 12 females: total length 122.5 mm (111–133 mm); tail 20.3 mm (15–27 mm); hind foot 19.7 mm (18–21); weight (4) 34.8 g (25.9–36.0 g).

Location of specimens: CHAS, CU, DWL, GSMNP, LACM, LNB, NCSM, OMNH, OSU, OU, UIMNH, UCONN, USNM.

Ondatra zibethicus L. (Common Muskrat)

Distribution: In the Park, Common Muskrats are found primarily in the larger streams near the periphery of the Park. They are fairly common below 732 m elevation, although there have been 2 high-elevation records. A young Common Muskrat

was observed on the Rainbow Falls Trail (1617 m) in April 1949 (J. Tanner, University of Tennessee, 28 April 1949 pers. comm. to A. Stupka). In March 1951, an individual was found dead by Stupka on the Tennessee side of the Newfound Gap Road (1373 m).

Blount County - Mouth of Abrams Creek; West Prong of the Little Pigeon River (488 m); Cades Cove (549 m). Cocke County - Cosby Campground along Cosby Creek (~732 m). Sevier County - Greenbrier Cove (412 m); Elkmont; near Gatlinburg; Newfound Gap Road (1373 m); Rainbow Falls Trail (~1617 m). Swain County - Deep Creek; Indian Creek; Forney Creek; Ravensford; 3.2 km up Bradley Fork and Oconaluftee River from Smokemont.

Food: Komarek and Komarek (1938) reported muskrats feeding on *Salix* sp. (willow). A large patch of corn was destroyed by this species near Ravensford. A Common Muskrat reportedly captured and carried off a *Campostoma anomalum* Rafinesque (Stoneroller Minnow) near Gatlinburg (Stupka 1961).

Reproduction: Immature Common Muskrats have been recorded on 27 April and 29 August.

Pelage: An albino Common Muskrat with snow-white fur and pink eyes was recorded along Cosby Creek.

Measurements: 2 males: total length 606 mm (596–615 mm); tail 284 mm (275–293 mm); hind foot 83 mm (80–85 mm).

Location of specimens: CHAS, GSMNP.

FAMILY MURIDAE - Old World Mice and Rats

Rattus rattus L. (Black Rat)

Distribution: The Black Rat is found primarily around human habitations and is abundant in the southeastern United States. This non-native species was reported to be abundant around barns in Greenbrier by Komarek and Komarek (1938), but it is now an uncommon resident of the Park. Individuals have been reported up to 1922 m (Mt. Le Conte).

Sevier County - Park headquarters; Little River near Metcalf Bottoms (549 m); Greenbrier (512–610 m); Elkmont (656 m); Mt. Le Conte (1922 m). Swain County - Smokemont (671 m).

Pelage: White-spotted phases were reported by Komarek and Komarek (1938) in Greenbrier, but no specimens were secured.

Measurements: 1 male: total length 315 mm; tail 157 mm; hind foot 38 mm. 1 female: total length 372 mm; tail 174 mm; hind foot 35 mm.

Location of specimens: CHAS, GSMNP.

Rattus norvegicus Berkenhout (Norway Rat)

Distribution: Norway Rats are found nearly everywhere humans have settled. Also known as the Brown Rat or House Rat, this species may be found wherever food and shelter are abundant. Komarek and Komarek (1938) recorded this species commonly around buildings and occasionally in rock fences bordering

corn fields; however, 1 individual was recorded by the Komareks 8 km from the nearest habitation along Eagle Rocks Creek (1159 m). Due to a more limited food supply than in pre-GSMNP days, this non-native species has become less abundant in the Park.

Sevier County - Greenbrier Cove (534 m); Elkmont (763 m); Eagle Rocks Creek (1159 m). Haywood County - Big Creek (519 m). Swain County - Clingmans Dome Road (1830 m).

Reproduction: A half-grown individual was taken along Clingmans Dome Road in July (Stupka 1957).

Measurements: 4 males: total length 351 mm (314–368 mm); tail 169 mm (168–173 mm); hind foot 41 mm (39–43 mm).

Location of specimens: CHAS, GSMNP.

Mus musculus L. (House Mouse)

Distribution: The House Mouse now has a worldwide distribution due to accidental introductions. It is the only non-native mouse occurring in the Park. These mice are often common in cultivated fields and in and around human habitations. Komarek and Komarek (1938) frequently took this species around cabins and barns. Individuals have been found at elevations as high as 824 m (Low Gap). The House Mouse is probably less common now than in pre-GSMNP days due to a more limited supply of food and shelter.

Blount County - Cades Cove (534 m). Cocke County - Near Low Gap (824 m). Sevier County - Park headquarters (458 m); Greenbrier Cove (519–610 m); Elkmont (763 m). Swain County - Forney Creek.

Measurements: 4 males: total length 154 mm (144–168 mm); tail 76 mm (71–78 mm); hind foot 18 mm (16–19 mm). 3 females: total length 144 mm (140–149 mm); tail 71 mm (68–75 mm); hind foot 17 mm (15–20 mm).

Location of specimens: CHAS, CSULB, GSMNP, USNM.

FAMILY DIPODIDAE – Jumping Mice

[Jumping mice were formerly classified in the Family Zapodidae.]

Zapus hudsonius Zimmermann (Meadow Jumping Mouse)

Distribution: Meadow Jumping Mice occur in localized populations and are seldom abundant. This mouse inhabits open grassy areas and is one of the rarer species in the Park. The first Park record was in 1935 at Noland Creek (NC). The first Tennessee specimen was recorded by the author near Cosby on 3 August 1964 in an area of high weeds completely surrounded by deciduous woodland (Linzey and Linzey 1966). A total of 26,269 trap nights in the area failed to secure additional specimens. On 13 April 1968, a specimen was taken in a grassy meadow along the Newfound Gap Road (Sevier County, 1159 m) (LNB). In 1984, a *Zapus* was trapped near the Cosby entrance to the Park (Ambrose 1986). Twelve Meadow Jumping Mice were recorded along the Foothills Parkway at Cove Creek in 1991 (Harvey 1991).

Cocke County - Near Cosby entrance: northeast of Cosby Creek near the Cosby Ranger Station (525 m). Sevier County - Cove Creek (436 m); Newfound Gap Road (1159 m). Swain County - Deep Creek (534 m); Noland Creek (~885 m).

Hibernation: Several hibernating individuals were dug out of a loose clay bank along Noland Creek on 7 November 1935. Each was located in a separate compartment lined with dry leaves, ~45 cm below ground level. On 7 February 1941, near Deep Creek, a single hibernating mouse was found 10 to 15 cm below the surface of a clean road fill (Linzey and Linzey 1968).

Measurements: 2 males: total length 186.3 mm (182.0–190.5 mm); tail 112.2 mm (110.0–114.3 mm); hind foot 29.9 mm (28.0–31.75 mm); weight (1) 13.2 g. 1 female: total length 224.0 mm; tail 149.0 mm; hind foot 31.0 mm.

Location of specimens: DWL, GSMNP, LNB.

Napaeozapus insignis Miller (Woodland Jumping Mouse)

Distribution: The range of the Woodland Jumping Mouse extends south in the Appalachian Mountains to eastern Kentucky and northern Georgia. Within the Park, it occurs in localized populations at all elevations. It has been taken in deciduous as well as spruce–fir forests. Many individuals have been taken along the rhododendron-covered shores of mountain streams; others, however, have been taken near streams in dense woods with little or no underbrush.

Blount County - Tremont CCC Camp (976 m). Cocke County - Near Cosby Ranger Station (534 m); Cosby Campground (763 m) near Low Gap (824 m); Low Gap (1294 m); Appalachian Trail between Low Gap and Mt. Cammerer (1294–1479 m.). Sevier County - Park headquarters (488 m); King Hollow Branch (519–549 m); Mill Creek (610 m); Elkmont (763 m); Greenbrier Cove; Buck Fork (915 m); former Chimneys Campground; Bullhead Trail; Alum Cave parking area (1159 m); Eagle Rocks Creek (1159–1220 m); Grassy Patch (1220 m); West Prong, Little Pigeon River (1220 m); Walker Prong (1449 m); Indian Gap (1586 m). Haywood County - Big Creek (671 m); near Polls (Paul's) Gap (1556 m). Swain County - Kephart Prong Hatchery (885 m); Forney Ridge (1922 m).

Food: Whitaker (1962) examined a single *Napaeozapus* taken at Indian Gap (Sevier County) in June, 1930, and noted that 50% of the food in its stomach was composed of the fungus *Endogone*. The stomachs of 16 Woodland Jumping Mice taken near the Cosby Ranger Station (Cocke County) during summer and 2 individuals taken along the Appalachian Trail near Low Gap during July were examined by the author (Linzey and Linzey 1973). The most interesting aspect of the food habits of *Napaeozapus* is their apparent dependence on the fungus *Endogone*. Seventy-eight percent of the animals examined by the author contained *Endogone* spores, which amounted to almost 40% of the total food volume. Although *Endogone* was recorded in 2 shrews and 6 other species of mice, only in 2 of these species (*Blarina*, 4.9%; White-footed Deer Mouse, 4.2%) did it comprise more than 4.0% of the total volume of food. In the rest, *Endogone* never amounted to more than 1.0% of the total food volume. Plant materials formed approximately 76% of the total volume of *Napaeozapus* stomachs, while animal foods comprised 21.5% of

the total food volume. Lepidoptera larvae comprised over half of the animal food (11.6%). The diet of the 2 individuals from the Appalachian Trail was markedly different from that of the Cosby specimens. These mice were feeding primarily upon seeds (volume = 89.5%), while insect remains accounted for only 1.5% of the total volume. *Endogone* was absent.

Reproduction: Nursing (or lactating) females, females with placental scars, or females with embryos have been recorded on the following dates: 29 June (lactating); 4 July (lactating); 5 July (placental scars 1R, 3L); 10 July (5 embryos, 7 mm.); 11 July (7 embryos); 17 July (placental scars 0R, 3L; nursing); 28 August (lactating); 31 August (placental scars 3R, 1L; nursing); and 10 September (lactating). Males in breeding condition have been noted in June (3), July (1), and August (3). Immature mice have been recorded in June (2) and September (3).

Pelage: A single molting male was recorded in September.

Hibernation: During the winter, these mice hibernate. Seasonally, the latest record of an active individual in the Park is 27 November. The earliest recorded observation of an active individual in the Park is 2 February.

Predation: *Napaeozapus* has been recorded from the stomachs of 9 Timber Rattlesnakes (Savage 1967), a Bobcat found dead along the Newfound Gap Road (Sevier County) (Stupka 1952), and a Screech Owl found near Smokemont (Stupka 1950).

Parasites: Pfitzer (1950) removed 2 fleas (*Eptedia* sp. and *Ctenophthalmus* sp.) from a male Woodland Jumping Mouse. The author has removed mites (unidentified) from 3 males.

Measurements: 40 males: total length 226.0 mm (201–255 mm); tail 137.9 mm (125–166 mm); hind foot (41) 31.1 mm (29–35 mm); weight (22) 19.2 g (14.1–23.4 g). 24 females: total length 226.0 mm (208–239 mm); tail 141.4 mm (130–151 mm); hind foot 30.3 mm (29–32 mm); weight (13) 22.3 g (13.69–29.0 g).

Location of specimens: CAS, CHAS, DWL, GSMNP, LNB, NCSM, OMNH, OSU, OU, UIMNH, UCONN, UNCW, USNM.

ORDER CARNIVORA – Carnivores

FAMILY CANIDAE – Dogs, Foxes, and Wolves

Canis latrans Say (Coyote)

Distribution: Coyotes originally inhabited the region from Central America through Mexico, the western United States, and western Canada to Alaska. This adaptable and mobile carnivore has greatly expanded its range during this century. Until the early 1900s, its range extended only as far east as northern Wisconsin and central Texas (Nowak 1978), but human extirpation of Gray Wolves and Red Wolves together with habitat modification permitted Coyotes to gradually move into eastern North America. Coyotes prefer open woodlands, woodland borders, and brushy areas. The clearing of forested land created a lot of “edge-effect” where the fields go up to fence rows that increased the habitat for rodents and rabbits, common prey for Coyotes. Besides natural migrations, fox hunters introduced

adult Coyotes for training hounds as well as introducing Coyote pups that were mistakenly thought to be *Vulpes vulpes* L. (Red Fox) pups. The US Fish and Wildlife Service has documented 20 different points in the southeastern United States where Coyotes were released by people who planned to run them with hounds, as well as several incidences where Coyotes have escaped from captivity (Trani et al. 2007). Hill et al. (1987) reported 3 releases and/or escapes in Tennessee, 1 in North Carolina, and 1 in Virginia.

Coyotes were first observed in the Park in 1982. Charles Remus made the first sighting on 6 June in Cades Cove. Based on sightings and scats, Coyotes currently inhabit all parts of the Park. They are often seen foraging at night along the edges of Highway 441 and Little River Road. Population estimates ranging from 1 Coyote per 12.9 km² in Cades Cove to 1 Coyote per 39.7 km² outside of Cades Cove were reported by Crawford (1992). These estimates were based on howling responses, observations of animals, and trapping. Although no additional studies have been done in the Park since that time, based on sightings by National Park Service wildlife biologists, these population estimates have undoubtedly increased.

Blount County - Cades Cove; Parsons Branch; Dalton Ridge. Sevier County - Sugarlands; Elkmont; Little River; Fighting Creek Gap; Laurel Falls; Laurel Creek; Roaring Fork. State (TN-NC) line - Gregory Bald; Double Springs Gap; Spence Field. Haywood County - Cataloochee; Palmer Branch. Swain County - Hazel Creek; Mingus Mill; Eagle Creek.

Food: A Coyote was observed chasing a medium-sized bear near Hazel Creek in August 1988. Coyotes in Cades Cove have been observed carrying a Woodchuck (April 1992) and a rabbit (June 1992) in their mouths. Coyotes have also been observed chasing deer and feeding on deer carcasses. In past years, they were responsible for killing newborn *Bos taurus* L. (Cow) calves in Cades Cove (Linzey 1995b). Wherever Coyotes establish themselves in large numbers, Red Foxes disappear, in contrast to *Urocyon cinereoargenteus* Schreber (Gray Fox) which may coexist more easily with Coyotes (Leopold and Chamberlain 2001). The Coyote may suppress fox population growth by aggression and competition for food (Whitaker and Hamilton 1998).

Reproduction: Young Coyotes have been observed in Cades Cove and in Sugarlands in 1992.

Location of specimens: OMNH.

Canis lupus L. (Gray Wolf) [Extirpated]

Distribution: The National Park Service recognizes the Gray Wolf, Red Wolf, and Coyote as distinct species that currently inhabit, or once inhabited, the Park even though hybridization has been reported elsewhere (Trani et al. 2007). Reports from the 1800s noted in this account are considered by the National Park Service to be Gray Wolves.

The Gray Wolf once occurred in the Great Smoky Mountains in fair numbers but became increasingly less common as more of the land was settled. Buckley (1859) reported that wolves were “troublesome” to the mountain farmers of North

Carolina and Tennessee. In 1887, C.H. Merriam (1888) noted that wolves “still occur” in the Great Smokies. John Oliver, a former resident of the Park, remembered hearing wolves howling in Cades Cove when he was a boy (1880–1890). A resident of Gatlinburg recalled seeing one of these animals that had been caught in a bear trap near the Sugarlands during the 1890s; he also heard 2 wolves howling near the area that was formerly Chimneys Campground (Linzey and Linzey 1971). Brimley (1944) wrote that wolves were “apparently finally exterminated in or about 1890, up to which time they still occurred sparingly in the mountains.” Hamnett and Thornton (1953) stated: “In the Mountain Region ... wolves existed in the more remote sections until the late 1800s and possibly until the very early 1900s.”

There have been occasional unconfirmed reports of wolves in the mountains after 1900. The Knoxville *News-Sentinel* (Brewer 1964) printed a column indicating that wolves were seen on Mt. Le Conte as late as 1925. Ganier (1928) speculated that a few might still be present in the “wilder mountainous sections”. An animal that was reported to be a Gray Wolf was killed near Waynesville, Haywood County, NC, on 27 February 1933 (Linzey and Linzey 1971). Official verification is lacking for all of these reports.

Canis rufus (Bartram) (Red Wolf) [Extirpated; Reintroduced]

Distribution: The former historical distribution of the Red Wolf encompassed most of the southeastern United States. Although there are no specific records of its occurrence in the Park, remains have been recovered from archaeological sites in West Virginia, southwestern Virginia, and northern Alabama (Nowak 2002).

On 12 November 1991, two adults and 2 female pups were released in Cades Cove. This was an experimental release to determine if the Smokies could provide suitable habitat for the permanent reintroduction of Red Wolves at a later date. In January 1992, the adult male was recaptured, and the adult female was recaptured in August 1992; both wolves were translocated to the Alligator River National Wildlife Refuge in eastern North Carolina. Their 2 female offspring were recaptured, paired with males, and re-released in the Park. A second family group consisting of a male, a female, and 4 pups was released in Cades Cove in October 1992, and had the distinction of being the first family of Red Wolves to be reintroduced into any national park in the United States. An additional pair with 4 pups was released in the Tremont area in the fall of 1992. A total of 37 Red Wolves were introduced into the Park between 1991 and 1998. Eight litters consisting of 33 pups were born in the Park, but only 2 pups were confirmed to have survived into the fall. Many of these wolves left the Park presumably in search of prey, and some of those that remained succumbed to disease, parasites, and starvation. The lack of survival of wild litters, and the difficulty of keeping wolves within the Park caused the US Fish and Wildlife Service to terminate the Smokies project in October 1998. All remaining animals were recaptured and moved to the Alligator River National Wildlife Refuge, currently the only free-living population of Red Wolves.

Food: Red Wolves were known to kill deer in the Park. They were also known to have killed a juvenile Black Bear and a Woodchuck in Cades Cove, and a wolf pup

is known to have killed a fox (K. DeLozier, NPS Wildlife Biologist, Gatlinburg, TN, 1993 pers. comm.).

Vulpes vulpes L. (Red Fox)

Distribution: The Red Fox, which prefers sparsely settled country, has been observed at all elevations in the Park. Farmland mixed with sparsely wooded areas, brushland, and streams provides ideal habitat. Sightings have been much less frequent since the Coyote population has grown and expanded (W. Stiver, NPS Biologist, Gatlinburg, TN, 2010 pers. comm.).

Blount County - Spence Field (1525 m). Cocke County - Cosby. Sevier County - Park headquarters; Greenbrier Cove; near Metcalf Bottoms; Dudley Creek; Boulevard Trail; Indian Gap; Mt. Le Conte. Haywood County - Walnut Bottom; between Big Creek and Davenport Gap; Little Bald Knob; Spruce Mountain. Swain County - Along Forney Creek Road; Straight Fork; between Bryson Place and the Tennessee-North Carolina line; Becks Bald (1403 m).

Food: Stupka recorded *Schistocerca* sp. (grasshoppers) in the stomachs of 2 foxes found at Indian Gap and along the Boulevard Trail in December. On 12 September, 7 freshly killed Northern Short-tailed Shrews were noted along 2.4 km of the Appalachian Trail just prior to the observation of a Red Fox by a group of hikers (Stupka 1944).

Reproduction: Two half-grown foxes were observed by Stupka on 22 June 1943. Stupka also observed a two-thirds-grown fox on 23 July 1937, and an individual between two-thirds and three-quarters grown on 21 September 1951.

Pelage: An "entirely black" individual was reported along Forney Creek Road on 17 December.

Location of specimens: CHAS, GSMNP.

Urocyon cinereoargenteus Schreber (Gray Fox)

Distribution: The Gray Fox is a common inhabitant of the lower elevations in the Park. Unlike the Red Fox, this species prefers forested areas. The highest locality recorded is Newfound Gap where a Park employee observed an animal believed to be a Gray Fox (Stupka [YEAR?]).

Blount County - Cades Cove (549 m, 610 m). Sevier County - Park headquarters; Elkmont (763 m). Haywood County - Big Creek. Swain County - Smokemont; Cooper Creek; Pilot Ridge.

Food: A Gray Fox found near Smokemont in August 1934 contained the following food items in its stomach (% volume in parentheses): 5 (54%) of the dung beetle *Dichotomus carolinus* L., 14 (26%) grasshoppers (Locustidae), 16 grasshoppers (Acrididae), 22 (18%) eggs, 1 (1%) *Necrophorus* sp. (carion beetle), 12 (1%) poke-weed seeds, 1 (<1%) of the dung beetle *Acanthus legarusi* (L.), and 1 (<1%) spider. The stomach of a young male found near Smokemont on 30 October 1939 contained several persimmon seeds, an acorn, a maple seed, and the fur of a small mammal. The stomach of a third specimen found near Smokemont in late September 1950

contained 95% camel crickets and 5% other insects and centipedes (Pfitzer 1950). An individual found between the Park boundary and Townsend, TN, on 13 September 1950, contained 70% invertebrates and 30% vegetation (Pfitzer 1950).

The enterococci *Enterococcus faecalis* and *Enterococcus faecium* were recorded from fecal specimens by Mundt (1963).

Reproduction: A nursing female was found along the Cades Cove Road on 14 May. A young male, weighing 4.3 kg, was found at Smokemont on 30 October (Stupka 1939)

Measurements: 4 males: total length 927 mm (900–950 mm); tail 333 mm (300–360 mm); hind foot 129 mm (125–130 mm); weight (1) 4.3 kg.

Location of specimens: AMNH, DMNH, GSMNP.

FAMILY URSIDAE – Bears

Ursus americanus Pallas (American Black Bear)

Distribution: The American Black Bear once ranged from Alaska across Canada and throughout the United States but has been extirpated in many parts of its former range. It is the largest native mammal inhabiting the Park and is found at all elevations. Currently, about 1600 American Black Bears inhabit the Park with a density of approximately 2 per square mile (W. Stiver, NPS Wildlife Biologist, Gatlinburg, TN, February 2015 pers. comm.). The population fluctuates with food availability. The following list includes only localities from which actual specimens have been taken. In addition, an adult was found in the upper entrance room of Tory Shields Bluff Cave in 1979.

Sevier County - Greenbrier Cove (1220 m); near Elkmont; Ramsey Prong; Alum Cave parking area; Newfound Gap Road (various elevations). State (TN–NC) line - Newfound Gap. Swain County - Hazel Creek.

Food: Beeman and Pelton (1977) reported that plant foods composed 81% of the volume and animal foods composed 11% of the volume of the total diet of American Black Bears in the Park and surrounding areas. Artificial foods and debris comprised the remaining part of the diet at 6% and 2%, respectively. In the spring, 90% of the diet was composed of grasses and other herbaceous stems and leaves. The remaining 10% of the spring diet was composed of *Conophylus americana* L. (Wall-roth) (Squawroot), a parasite that grows abundantly on the roots of trees, especially oaks. Fruits of Squawroot, blackberry, *Vaccinium* sp. (blueberry), huckleberry, and *Prunus serotina* Ehrhart (Black Cherry) composed most of the summer diet. Black cherries constituted almost 25% of the early fall diet with lesser amounts of huckleberries, blackberries, and blueberries consumed. Acorns, hickory nuts, and beechnuts formed a substantial portion of the fall diet. Animal foods consisted primarily of beetles, yellow jackets, wasps, hornets, and ants. Wood-eating roaches, poultry, livestock, carrion, and garbage are also known to be consumed by the Park bears. There are many records of bears raiding yellow jacket nests from late July to October. Bears have also been recorded chewing the bark of various conifers, Red Maple, hickory, Red Oak, and Yellow Poplar trees.

The enterococci *Enterococcus faecalis* and *Enterococcus faecium* have been recorded from fecal specimens by Mundt (1963).

Reproduction: The average minimum reproductive age of female bears in the Park is 4.8 years (range = 3–6 years) (McLean 1991); thereafter, females usually breed every second year with mating occurring in June or early July. Cubs, typically weighing less than 0.45 kg each, are born in late January or February while the female is in her winter den.

Litters range from 1 to 6 cubs with 2 being most common size. Females with more than 3 cubs are unusual but not rare in the Park. During the summer of 1963, two female bears each with 4 cubs were observed by the author—one near the Chimneys Parking Overlook on the Newfound Gap Road, and the second in the Cosby Campground. The latter bear, with 2 of the cubs, returned to the Cosby area during the summer of 1964. In May 1967, a female with 4 cubs was again recorded at Cosby (Linzey and Linzey 1968). A female with 4 cubs was observed near Park headquarters on 8 December 1993. Within the past several years, females with 5 cubs have been observed in Wear Valley as well as in Gatlinburg.

The cubs and their mother usually emerge from their den in late March or early April. The earliest recorded observation of a cub away from the den was 4–10 March 1962, when a 2.5- to 4.5-kg cub was seen several times in the Parson Branch area. Stupka (1960b) recorded a 2.85-kg cub on 8 April 1960 at Metcalf Bottoms. Very small cubs have also been observed on 17 December near Fighting Creek Gap (Stupka 1954) and on 27 July near Park headquarters (Stupka 1963). Stupka recorded the weights of 3 cubs: 14 July 1942 (10.8 kg), 8 August 1948 (10.4 kg), and 20 September 1942 (11.7 kg).

Hibernation: Although American Black Bears enter into a deep sleep during the colder months, their general metabolism is maintained at nearly normal levels; thus, they are not true hibernators. Their body temperature is reduced only 7 to 8 °C, their metabolism is reduced 50 to 60%, and their heart rate drops from 40 to 50 beats per minute to 8 to 10 beats per minute (Wilson and Ruff 1999). Bears usually select denning sites during middle and late December (Johnson and Pelton 1979). The denning period in the Park averages 94 days (range = 56–119 days), with most bears entering dens between the last week in December and the first week in January and emerging between the last week in March and the first week in April (Johnson 1978). The average date of den entrance was 31 December for adult females, 4 January for adult males, and 13 January for subadults of both sexes. Emergence was in the reverse order—subadults first, then males, and finally females (Johnson 1978).

A bear den site may be inside a hollow log, under an overhanging rock ledge, beneath a fallen evergreen tree, or any other spot that will shelter the bear from the cold winds, rain, and snow. A female and at least 2 cubs were found in their hibernaculum beneath the roots of a fallen spruce tree on 28 March 1939 (Stupka 1939). Stupka (1947) recorded a “sleeping” bear under large rocks along a tributary of Forney Creek (854 m.) on 31 March 1947. When the bear was disturbed, it shifted its position but did not leave its bed. Pelton and Beeman (1975) found 7 of 10 den sites in large (0.92 m in diameter) trees such as Eastern Hemlock, *Quercus alba* L. (White Oak), and *Acer* sp. (maple), 6 to 18 m above the ground at a location on the

tree where wind or lightning had caused a large limb to break off and resulted in the formation of a cavity. Such sites afford greater protection from weather and humans than ground sites.

A variety of factors are involved in causing an American Black Bear to begin denning. Foremost among these is a circannual, or endogenous, rhythm. In addition, increasing precipitation, lower temperatures, and food availability may all be supplemental causative factors (Johnson 1978).

Just prior to denning, bears eliminate all food from their digestive tract and form fecal plugs. Fecal plugs of Park bears have been found to consist of bear hair and a variety of debris including wood chips, twigs, leaf fragments, and small roots that may have been ingested during collection of bedding material (Johnson 1978).

Movements: Relocated nuisance bears often return to the vicinity of their point of capture (homing), and commonly return to their home-range area after being transported many kilometers from their original capture point (Stiver 1991). The greatest homing distance in the Park was an adult male that returned 64 km. The greatest homing distance of 3 females was 19 km (Beeman and Pelton 1976).

Parasites: Cook and Pelton (1978) serologically tested American Black Bears for antibodies to the following infectious diseases: brucellosis, canine distemper, and leptospirosis. Sera from 109 bears were tested for antibodies to *Brucella canis* Carmicheal and Bruner; no reactors were found. Forty-seven bear sera samples were negative for canine distemper antibodies. One hundred and nine bears were tested for leptospirosis. Twenty-five were seropositive for a serovar of *Leptospira interrogans* Weil: 11 for *L. canicola*, 13 for *L. icterohaemorrhagiae*, and one for *L. pomona*. Two bears exhibited titers to more than one serovar. Bears were seronegative for serovars *L. grippotyphosa* and *L. hardjo*. Fifty-four of 60 bears (90%) were found to be infected with the larval microfilarial form of the nematode parasite *Dirofilaria ursi* Yamaguti.

Measurements: Pelton and Beeman (1975) recorded the average weight of adult males and females as 112 and 47 kg (250 and 104 lbs), respectively. The largest male and female captured during their study weighed 230 and 90 kg (510 and 200 lbs), respectively. A bear weighing 248 kg (550 lbs) and another weighing between 158 and 180 kg (350 and 400 lbs) have been recorded at Elkmont (Park News and Views 1966, 1967). A dumpster-feeding bear weighing 279 kg (620 lbs) was illegally shot along the Park boundary near Gatlinburg (W. Stiver, 2015 pers. comm.).

Location of specimens: CHAS, DWL, GSMNP, MSU.

FAMILY PROCYONIDAE - Raccoons

Procyon lotor (L.) (Northern Raccoon)

Distribution: Northern Raccoons occur throughout the Park at all elevations. They are found mainly in moist, forested areas such as timbered swamps and along the banks of streams, rivers, and lakes. They are sometimes found in barns and other buildings. Home-range size varies depending on sex, age, season, food availability, and population density. Keeler (1978a, b) recorded an average home

range of 31.0 ha for 5 males and 11.3 ha for 3 females in Cades Cove during 1973–1974. Rabinowitz (1981a) recorded an average home range of 7.5 km² for 6 males and 3.0 km² for 8 females in Cades Cove during 1979–1980. Population density was approximately 1 Raccoon per 17.5 ha in Cades Cove (Keeler 1978a, Rabinowitz 1981a).

Blount County - Cades Cove; Tory Shields Bluff Cave; Twentymile Creek area; Tremont (458 m). Cocke County - Maddron Bald Trail. Sevier County - Metcalf Bottoms (512 m); Greenbrier Cove (763 m); Laurel Creek; Elkmont; Sugarlands (732 m); Newfound Gap Road (1342 m); Alum Cave Bluffs; Mt. Le Conte (1922 m). State (TN–NC) line - Appalachian Trail (1678 m); Indian Gap. Haywood County - Cataloochee (793 m); Walnut Bottom; Mt. Sterling. Swain County - Twentymile Creek area; Hazel Creek at Proctor Creek; near Bryson Place; Round Bottom (976 m); Walker Creek; Forney Ridge (1922 m).

Food: Northern Raccoons are omnivorous, and their food is determined largely by availability. Komarek and Komarek (1938) recorded wild grapes, pokeberries, salamanders, and other aquatic animals from stomach analyses and feces of Park Raccoons. There are 2 records of Raccoons killing many *Lithobates sylvatica* (LeConte) (Wood Frog) in the Park. A three-legged Raccoon reportedly captured a *Gallus gallus domesticus* L. (Chicken) in a hen house in the Elkmont area.

The enterococci *Enterococcus faecalis*, *Enterococcus faecium*, and *Streptococcus bovis* Orla-Jensen were recorded from fecal specimens by Mundt (1963).

Reproduction: Breeding generally occurs in early spring with females producing a single annual litter. Parturition in Cades Cove occurs in early June with an average litter size of 2.8 young (Rabinowitz 1981a, b). Rabinowitz recorded an average longevity of 30 months and a maximum longevity of approximately 86 months. Half-grown young have been recorded along the Appalachian Trail on 3 October and along the Newfound Gap Road in Tennessee on 30 September.

Pelage: Rabinowitz (1981a) reported 1 black and 3 blond Northern Raccoons in Cades Cove.

Predation: Major predators in Cades Cove were stray *Canis lupus familiaris* (Domestic Dog) (Rabinowitz 1981a).

Parasites: Komarek and Komarek (1938) recorded *Ixodes* sp. (ticks) and fleas. Rabinowitz (1981a) and Rabinowitz et al. (1983) recorded the American Dog Tick, *Ixodes texanus* Banks, and *Ixodes cookei* Packard from Northern Raccoons in Cades Cove. Rabinowitz et al. (1985) recorded microfilariae of *Tetrapetalonema llewellynii* Price in the blood of 108 of 145 (75%) Raccoons from Cades Cove. One Northern Raccoon also contained a microfilaria of *Dipetalonema procyonis* Price. A canine distemper epizootic reduced the Cades Cove Northern Raccoon population an average of 67.9% from March 1973 to March 1974 (Keeler 1978a). Blood serum samples from 117 Cades Cove Raccoons were tested for antibodies to 5 viruses (Rabinowitz and Potgieter 1984). No antibodies to rabies virus, pseudorabies virus, or canine distemper virus were detected. Two Raccoons had low levels of serum antibody to canine parvovirus, and 3 had low serum antibody levels to canine hepatitis virus.

Measurements: 3 males: total length 693 mm (635–784 mm); tail 219.7 mm (205–244 mm); hind foot 103.3 mm (95–108 mm); weight (1) 2.5 kg. 1 female: total length 600 mm; weight (1) 2.46 kg.

Keeler (1978a) provided the following averages for Cades Cove Raccoons: 30 males - total length 755 mm; tail (29) 231 mm; hind foot 101 mm. 50 females - total length 721 mm; tail 228 mm; hind foot 97 mm.

Rabinowitz (1981a) recorded the following measurements and weights from Cades Cove: 57 males - total length 768 mm (640–990); tail 228 mm (190–270 mm); hind foot (58 mm) 99 mm (80–110 mm); weight (85) 4.2 kg (1.4–7.7 kg). 77 females - total length 760 mm (440–900 mm); tail 238 mm (110–320 mm); hind foot 96 mm (65–107 mm); weight (111) 3.5 kg (0.68–5.9 kg).

Location of specimens: CHAS, DMNH, GSMNP.

FAMILY MUSTELIDAE – Weasels and Otters

Pekania pennanti Erxleben (Fisher) [Extirpated] [Formerly classified as *Martes pennanti*]

Distribution: The native range of the Fisher is presently across Canada and south into the New England states and New York. Miller and Kellogg (1955) noted that this animal was found as far south as North Carolina, but it is uncertain whether the Fisher ever occurred in the area encompassed by the Park. This range was extended by Parmalee (1960), who found the jawbone of a Fisher in Bartow County, GA. Audubon and Bachman (1846) stated: “We have seen several skins procured in east Tennessee”. During a journey of several hundred miles through the mountains of Tennessee and North Carolina during the summer of 1887, Merriam (1888) found no trace of the Fisher, which he refers to as the “Pekan”.

The Fisher was successfully reintroduced into West Virginia in 1969. The animals are reproducing and several have been observed in western Virginia (Chapman 2007). In October 2001, the Tennessee Wildlife Resources Agency secured 20 Fishers from northern Wisconsin (Extirpated Species Foundation 2015) and released 11 females and 9 males in the Catoosa Wildlife Management Area on the Cumberland Plateau (Morgan, Cumberland, and Fentress counties). During October 2002, twenty additional Fishers from Wisconsin were released at the same Catoosa site. As of January 2015, all Fishers were doing well. Recent information from TWRA indicates the Fisher has expanded its range from Crossville, TN, northward into southern Kentucky and eastward to Norris Lake (Extirpated Species Foundation 2015). The possibility of reintroducing the Fisher to the the Park was discussed in 1993. After examining various aspects of the animal’s biology and its potential effects on other species, especially the endangered Northern Flying Squirrel, the decision was made not to pursue Fisher reintroduction.

Mustela frenata Lichtenstein (Long-tailed Weasel)

Distribution: The Long-tailed Weasel is a fairly common resident of the Park and has been recorded at all elevations. It is found in a variety of habitats including farmland, swamps, and forests.

Sevier County - along Little River (427 m); near Park headquarters (458 m); Sugarlands (488 m); Lower Ramsey Branch; near head of Noisy Creek; Newfound Gap Road (885 m, 1220 m); Greenbrier Cove (915–1068 m); Greenbrier Pinnacle (1373 m); Mt. Le Conte (1992 m, 2011 m). Haywood County - Cataloochee. Swain County - Clingmans Dome Road (1708 m).

Food: A Long-tailed Weasel was observed on Mt. Le Conte carrying a deer-mouse in its mouth in June 1944.

Reproduction: A nest of this species was discovered in late April in a building near LeConte Lodge. The nest contained 5 or 6 young, each about 10 cm (4 in) long and with their eyes not yet open (Stupka 1961).

Predation: In July, a 40-cm weasel was discovered in the stomach of a large Timber Rattlesnake taken near Caldwell Fork in the Cataloochee area (Savage 1967, Stupka 1953). Several weasels have been found dead along Park roads.

Measurements: 9 males: total length 382 mm (346–420 mm); tail 125 mm (110–147mm); hind foot 44 mm (40–48 mm); weight (1) 1.92 kg. 1 female: total length 300 mm; tail 89 mm; hind foot 33 mm; weight 0.94 kg.

Location of specimens: CHAS, GSMNP.

Mustela nivalis L. (Least Weasel)

Distribution: The Least Weasel is primarily a northern species whose range extends south in the Appalachian Mountains to Tennessee, North Carolina, and Georgia. It is the smallest carnivore in North America and the rarest carnivore in the Park. On 22 February 1997, an adult female was killed by a *Felis catus* L. (Domestic Cat) along Beech Branch Road in Gatlinburg, Sevier County, TN (Linzey et al. 2002) within 3.2 km of the boundary of the Park along the Gatlinburg Spur (US Route 441). The first Park record occurred in September 2014 when a specimen was recorded from the Andrews Bald Trail near the Clingmans Dome parking area (Linzey and Hamed 2016). This animal was in a weakened condition and succumbed a short time later.

Measurements: 1 male: total length 160 mm; tail 22 mm; hind foot 20 mm; weight 25 g. 1 female: total length 140 mm; tail 27 mm; hind foot 14 mm; weight 23 g.

Location of specimens: DWL, GSMNP.

Vison vison Schreber (American Mink)

Distribution: American Mink inhabit forested, log-strewn, or brushy areas in swamps and along the banks of streams, rivers, and lakes. They are not often seen in the Park, although they have been recorded at all elevations. Komarek and Komarek (1938) stated that American Mink apparently frequent lower, more-open situations in winter and retreat into the deeper forest in spring and summer to rear their young.

Blount County - Little River, 1 mile below The Sinks (458 m); Cades Cove. Cocke County - Maddron Bald Trail. Sevier County - Little River at Tremont; Met-calf Bottoms; Sugarlands; Greenbrier; Little River above Elkmont (885 m); Mt. Le

Conte (2011 m). Haywood County - Big Creek; Cataloochee; Mt. Sterling Creek (1220 m). Swain County - Along the Oconaluftee River; Cliff Branch.

Food: Several American Mink were observed by Fleetwood fighting over a 20-cm trout in the Cataloochee area.

The enterococcus *Enterococcus faecalis* was reported from fecal specimens by Mundt (1963).

Reproduction: Females produce a single annual litter. Young American Mink have been observed in the Park during May, June, and July. A 6- to 8-week-old individual was found near Cliff Branch on 22 May 1948. An adult and 6 young were observed in the Cataloochee area on 15 June 1935 (Fleetwood). Four young individuals were seen playing together along the Little River on 15 July 1959.

Measurements: 2 males: total length 615 mm (530–700 mm); tail 179 mm (162–195 mm); hind foot 64 mm (62–65 mm).

Location of specimens: GSMNP.

Lontra canadensis Schreber (Northern River Otter)

Distribution: Northern River Otters were reported to be common in the rivers of eastern Tennessee, including the Tellico River, by Lt. Henry Timberlake in 1762 (Williams 1927). Buckley (1859) reported that otter skins were among those bought by traveling fur merchants in the Smokies. As late as 1896, Rhoads considered the Northern River Otter to be “a rare but constant inhabitant of all the larger streams in the State [Tennessee].” By the 1930s, however, when the Park was created, uncontrolled trapping had nearly eliminated the Northern River Otter from the area. A group of 3 Northern River Otters was observed in Cataloochee in 1927. An otter was trapped on Cataloochee Creek in 1930, a pair was seen near Mount Sterling in 1931, and 1 was seen several different times at the same location near Elkmont in 1934. The last reliable sighting was an individual seen in Cataloochee Creek in 1936 (Stupka 1935–1963, King 1934–1938).

The National Park Service began an otter reintroduction program in 1986. Between 26 February and 31 March, 11 Northern River Otters were obtained from North Carolina and released in Abrams Creek (Griess 1987). Beginning in December 1988, 14 additional otters from South Carolina and Louisiana were released in Little River (Miller 1992). In 1992, six otters were released in Cataloochee Creek, 4 in Hazel Creek, and 2 in the Little River (K. DeLozier, NPS Wildlife Biologist, Gatlinburg, TN, December 1993 pers. comm.). Most of the reintroduced Northern River Otters established home ranges within the Park. Three of the otters released in the Little River crossed the mountains and established their home ranges on the North Carolina side of the Park. During January 1994, the National Park Service released 100 additional Northern River Otters into the following Park streams: West Prong and Middle Prong of the Little Pigeon River, Big Creek, Cataloochee Creek, Abrams Creek, Little River, Twentymile Creek, Tab Cat Creek, Oconaluftee River, Deep Creek, Eagle Creek, Forney Creek, Pilkey Creek, Chambers Creek, and Noland Creek. These releases concluded the Northern River Otter reintroduction program.

Blount County - Abrams Creek; Gregory Bald. Sevier County - Sugarlands; Greenbrier; Little River. Haywood County - Big Creek; Cataloochee; Mt. Sterling. Swain County - Bear Creek above Bryson Place; Hazel Creek.

Food: Northern River Otters released in the Park feed mainly on crayfish and fish (Griess 1987, Miller 1992). The most frequently eaten fishes are *Hypentelium nigricans* Lesueur (Northern Hogsucker), *Catostomus commersoni* Lacépède (White Sucker), and Stoneroller Minnows. Other foods include aquatic crustaceans, insects, and frogs.

Reproduction: Female otters produce a single annual litter following an extended gestation caused by delayed implantation of the embryo. Young Northern River Otters have been sighted on numerous occasions indicating that previously released otters are successfully reproducing in the wild.

FAMILY MEPHITIDAE - Skunks

Spilogale putorius (L.) (Eastern Spotted Skunk)

Distribution: The Eastern Spotted Skunk is the smaller and less common of the 2 skunk species inhabiting the Park and has been recorded at up to 885 m elevation (Greenbrier Cove). It is often found in crevices in cliffs and in rock slides in forested and brushy areas. This species may also be found around agricultural regions.

Blount County - Cades Cove. Sevier County - Park headquarters (458 m); Sugarlands; Chimneys picnic area; Greenbrier Cove (885 m). Haywood County - Cataloochee; Big Creek (854 m); Walnut Bottom near the mouth of Mouse Creek (854 m). Swain County - Twentymile area (427 m); Forney Creek.

Food: Pfitzer (1950) examined the stomach contents of a specimen found near Park headquarters in November and reported the remains of *Hyla crucifer* Wied-Neuwied (Spring Peeper), a Short-tailed Shrew, one katydid, one camel cricket, several clover leaves, and miscellaneous arthropods.

Parasites: Approximately 24 acanthocephala, 2 tapeworms, and several nematodes were removed from the specimen taken near Park headquarters by Pfitzer (1950).

Measurements: 2 males: total length 465 mm (455–475 mm); tail 150 mm (135–165 mm); hind foot 50 mm (49–51 mm); weight (1) 494.5 g. 1 female: total length 438 mm; tail 164 mm; hind foot 45 mm; weight 386.7 g.

Location of specimens: CHAS, GSMNP.

Mephitis mephitis Schreber (Striped Skunk)

Distribution: The Striped Skunk is widely distributed throughout the Park up to 1586 m elevation (Indian Gap) but is most common in the open fields and cutover woodlands of the lower elevations. These skunks prefer agricultural areas with their brushy or wooded edges, old fields, and sparsely wooded regions. Goldsmith (1981) reported a resident Striped Skunk population of 31 ± 4 skunks in the Cades Cove campground and picnic area. Drainage culverts in the campground were used extensively as den sites from July through October.

Blount County - Cades Cove (549 m); Spence Field (1525 m). Sevier County - Little River Road, 1.6 km below Elkmont (610 m); Sugarlands (610 m); Greenbrier Cove (824–915 m); Indian Gap (1586 m). State (TN–NC) line - Newfound Gap (1539 m). Haywood County - Walnut Bottom; Pin Oak Gap. Swain County - Smokemont; Mingus and Cooper Creek Divide (1068 m).

Food: In February 1935, Fleetwood recorded a Striped Skunk following a plow on Messer Fork and eating grubs. On 26 November, Stupka (1937) found seeds and pulp of persimmon, insect remains (grasshopper, Hemiptera, and larvae), and the feathers of a small bird in the stomach of an individual found near Elkmont.

Predation: Palmer (1954) noted that “practically every Horned Owl in the skunk’s range smells of skunk—one of its staple foods.” Stupka recorded 2 occasions on which *Bubo virginianus* Gmelin (Great Horned Owl) smelled strongly of skunk.

Parasites: Komarek and Komarek (1938) recorded individuals heavily infested with ticks (*Ixodes* sp.), lice (*Neotrichodectes* sp.), and tapeworms (*Oocharistica* sp., probably *mephitis* Skinner).

Measurements: 39 males: total length 588.6 mm (481–670 mm); tail 215.6 mm (140–266 mm); hind foot 65.1 mm (60–77 mm); weight (31) 2.17 kg (1.2–3.6 kg). 60 females: total length 578.0 mm (422–641 mm); tail 225.0 mm (160–294 mm); hind foot 60.0 mm (54–76 mm); weight (65) 1.73 kg (0.9–2.9 kg).

Location of specimens: CHAS, GSMNP.

FAMILY FELIDAE – Cats

Puma concolor L. (Mountain Lion) [Likely extirpated]

Distribution: The Mountain Lion (more commonly known as “panther” or “painter” in the southern Appalachians) once had the widest distribution of any species of native mammal in the Western Hemisphere, although it is now extirpated from much of its range in the United States, with the only remaining recognized eastern US population occurring in southern Florida. The first record of this species in the Park dates back to 1840–1850 when John Oliver reported that he heard of 2 “panthers” being killed in Cades Cove. In 1859, Buckley noted that the “panther” was troublesome to the mountain farmers of North Carolina and Tennessee, destroying their sheep and hogs. Brimley (1944), writing about the mammals of North Carolina, recorded the Cougar (Mountain Lion) as being “apparently extinct”, the last specimens having been killed near Highlands and in Craven County, NC, about 1886. After a journey through the Great Smoky Mountains during the summer of 1887, Merriam (1888) reported that the panther was “unknown”. Between 1895 and 1905, a “panther” was reportedly seen by Wm. Barnes on Big Creek. There are reports that 2 Mountain Lions were killed about 1899—one near Smokemont and the other in the Greenbrier area. The last report of a Mountain Lion being killed in the Great Smokies comes from the winter of 1920 (Brewer 1964): Tom Sparks was attacked by a Mountain Lion while herding sheep on Spence Field. He inflicted a deep wound in its left shoulder. Several months later, a Mountain Lion was killed

near what is now Fontana Village, and its left shoulder blade had been cut in two. It was believed to be the same cat that Sparks had wounded. Several years later, Ganier (1928) reported that the panther was extinct in Tennessee, “save possibly a half dozen individuals in the Great Smokies.”

Hamnett and Thornton (1953), in discussing the status of this cat in North Carolina, stated that it is “now believed to be extinct ... Last positive records for the State were from the Coastal Region ... in the early 1900s ... Until positive proof of the cougar’s existence is furnished ... we must continue to regard this animal as virtually extinct in North Carolina.”

Culbertson (1977) examined the status and history of this species in the Park. Twelve sightings were reported for the years 1908–1965 and 31 sightings for the years 1966–1976. Culbertson stated: “The number of lion sightings through the years suggest that the mountain lion may never have actually been extinct in the Great Smoky Mountains area. The lion may have been able to maintain itself in small numbers in the more inaccessible mountainous regions in or around the park. The present lion population could be derived in part from this small reservoir ... It is believed that there were three to six Mountain Lions living in the park in 1975, and other lions were reported to the southeast and northeast of the park as well. Lions were seen most frequently near areas of high deer density.”

GSMNP files contain many interesting reports of purported Mountain Lion sightings. Every year, several additional reports are received. If, in fact, the animals being observed are Mountain Lions, they may be part of the original population as Culbertson suggested or, more likely, they may be captive animals that have either escaped or been released. Neither Tennessee nor North Carolina residents may legally possess captive western Mountain Lions. Mountain Lions that have been found in eastern states have shown signs of being in captivity (tattoos, defanged, declawed, etc.). In 2014, the author spoke with a resident of Happy Valley whose neighbor told him that he had released his defanged and declawed captive Mountain Lion into the Park.

Since 1998, the author has been working intensively in an attempt to ascertain whether a viable population exists in the Park. Trail cameras, rubbing pads, and a scat-sniffing dog have all been employed. Five to 10 reported sightings are recorded most years. All reliable reports are plotted on a map of the Park with color-coded pins. What constitutes a reliable report? The reported sighting of a Mountain Lion on the Cherokee Orchard Road by the Park’s air quality specialist in 2001; the reported sighting in June 2002 of a Mountain Lion crossing the Newfound Gap Road by a veterinarian who treats Mountain Lions in his practice; a sighting along Little River Road in May 2002 by a wildlife photographer followed by a sighting in the same area by a Park visitor approximately 2 weeks later, and 2 subsequent sightings in the same area several years later; an adult Mountain Lion lying on a hillside along Cherokee Orchard Road for approximately 5 minutes that was seen and photographed by 15 to 20 Park visitors in August 2008; two sightings by residents of Gatlinburg within 0.8 km of each other several days apart in 2013 in the Roaring Fork area. Kittens have been reported in the Park on 2 occasions—both in the

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1970s. Small tracks accompanying large tracks were observed in the Cataloochee area. A female with 2 kittens was observed by a large group of visitors (including Mr. O'Harris, a retired animal trainer who trained big cats for 55 years), at the Old Chimneys Campground (now the Chimneys picnic area) in December 1975. His description of the event in the words of a Park employee he spoke with is as follows: "The cats crossed the road and went down to the river. Then he followed the cats upriver [West Prong of the Little Pigeon River] to the bridge at the picnic area. The cats then turned around and came back down the river, and he followed them downriver for ½ mile sometimes getting within 25 yards of the animals. Mr. O'Harris said the kittens played all the way down the river, but the mother cat kept an eye on him all the time".

In addition, the author possesses 3 photographs of Mountain Lions taken by Park visitors—one from Greenbrier in January 2001, one from Cades Cove in August 2003, and one from the Ramsey Cascades Trail in 2004.

Lynx rufus Schreber (Bobcat)

Distribution: The Bobcat, whose range formerly extended from southern Canada throughout most of the United States south to central Mexico, has been extirpated from densely settled areas and from much of the central portion of the United States. Though rarely observed because of its solitary and nocturnal habits, it is a fairly common resident at all elevations throughout the Park. Its preferred habitat consists of forests with considerable undergrowth and numerous clearings.

Blount County - Cades Cove. Sevier County - Park headquarters (464 m); along Little River Road; Greenbrier; Cliff Branch near Newfound Gap Road (793 m); Chimneys picnic area (854 m); Pinnacle Mountain (915 m); Newfound Gap Road (1129 m); Alum Cave Bluffs (tracks); Brushy Mountain (feces and tracks); Appalachian Trail between Newfound Gap and Clingmans Dome (feces and tracks); Mt. Guyot (feces and tracks); Mt. Le Conte (2011 m). State (TN-NC) line - Indian Gap. Haywood County - Heintooga. Swain County - Couches Creek; Twentymile area (610 m); Smokemont (671 m); Newt Prong at head of Jakes Creek; Clingmans Dome.

Food: Bobcats feed primarily on rabbits and rodents. A *Turdus migratorius* L. (American Robin) was found in the stomach of a Bobcat found near the Park boundary in Wears Cove in March (Stupka 1941). Hamilton (1943) recorded beetles, rabbits, and a small *Terrapene carolina* L. (Eastern Box Turtle) in the stomachs of a few animals taken from the "Smoky Mountains of North Carolina". Examination of the stomach of an adult Bobcat killed by a car on the Newfound Gap Road in Tennessee (1129 m) revealed 8 shrews (*Sorex* sp.), 6 Woodland Jumping Mice, 5 Rock Voles, 1 deer mouse, and 1 small bird (Stupka 1952). An individual found dead near Cliff Branch (792 m) in December 1953 had eaten an Eastern Gray Squirrel (Stupka 1953). In January 1938, a freshly killed, partially eaten Woodchuck covered with leaves was found by Stupka above Big Cove (976 m) near the Park boundary. Many Bobcat tracks were present in the snow nearby. A Bobcat with a *Bonasa umbellus* L. (Ruffed Grouse) in its mouth was observed on Clingmans Dome Road in 1990.

A statewide winter food habits study of Bobcats in North Carolina revealed rabbits, birds, Hispid Cotton Rats, White-tailed Deer, small rodents, Eastern Gray Squirrels, Raccoons, and Virginia Opossums as the main food items by frequency of occurrence (King et al. 1983). Small numbers of reptiles, amphibians, fish, and insects were also identified.

Reproduction: Females may produce either 1 or 2 litters annually. Most litters are born in the Park in April and May. Stupka (1959) found a dead yearling weighing 2.25 kg along the Little River Road in February.

Parasites: Bobcats taken by Komarek and Komarek (1938) were heavily infested with fleas.

Measurements: 1 female: total length 760 mm; tail 145 mm; hind foot 152 mm.

Location of specimens: CHAS, GSMNP.

ORDER ARTIODACTYLA – Even-toed Ungulates

FAMILY SUIDAE – Pigs

Sus scrofa Gray (Feral Pig, European Wild Hog, Wild Hog)

Distribution: This non-native member of the Park fauna is found at low densities at all elevations. It utilizes a variety of habitats including forests and grass balds. It is not known exactly how or when the European Wild Hog came to the Park. Thirteen young boars, weighing 27–34 kg arrived in Murphy, NC (approximately 64 km south of the Park) in April 1912 destined for a game preserve on Hooper Bald where they were released (Stegeman 1938). It is believed that the animals had been purchased through an agent in Berlin, who said they came from Russia. About 1920, an estimated 100 boars escaped from the preserve. As they dispersed, they hybridized freely with feral domestic pigs. Thus, the official National Park Service designation for these animals is “Wild Hog”. Kellogg (1939) stated: “so far as known to Arthur Stupka, Park Naturalist, no Wild Boars have come into the Great Smoky Mountains National Park. He believes that the Little Tennessee River, which separates the GSMNP from the Cherokee National Forest, may constitute a real barrier against the northward spread of this introduced species.”

Unfortunately, the hogs managed to cross the river and made their way into the Park. According to Jones (1957), it is believed that they entered the southwestern quadrant of the Park near Calderwood in the late 1940s. However, the Park mammal collection contains a specimen taken along Hesse Creek north of Cades Cove on 15 January 1945. Since the 1940s, the invasion has steadily spread from west to east (Fox and Pelton 1977) averaging approximately 2.75 km per year (Singer 1981).

Hog depredations were first noted on Gregory Bald and along the state line in 1958. In 1959, it was found that these animals were concentrated in the area between Cades Cove and Fontana Lake. Trapping began during August 1959, at which time there were an estimated 500 hogs in the Park. The estimated population increased to approximately 1500 in 1980 (Singer and Ackerman 1981). In 1979, hog densities in the northern hardwood forests in the western half of

the Park were estimated to be 79 animals per square kilometer from April to July (Singer 1981). During the period 1959–2014, a total of 13,037 hogs were removed from the Park, of which 7135 (54.7%) were from the North Carolina side and 5808 (44.5%) were from the Tennessee side (W. Stiver, February 2015 pers. comm.). Of these, 4006 hogs were donated to the North Carolina Wildlife Resources Commission (NCWRC) and to the Tennessee Wildlife Resources Agency (TWRA) to be relocated to state game lands. However, because of the concern of transporting hog-related diseases, the states of Tennessee and North Carolina terminated the relocation of Wild Hogs from the Park. Several wetlands with unique habitats and rare species as well as a high-elevation beech gap have been fenced (exclosures) to exclude Wild Hogs.

Blount County - Parson Branch; Ledbetter Ridge; Gregory Bald; Parson Bald.
Swain County - Twentymile area; near Fontana Reservoir; Welch Branch.

Food: Wild Hogs are seasonal in their feeding habits (Singer et al. 1978). In March and April, they move to the ridges at elevations above 1220 m where they feed and rear their young in the northern hardwood forests. In August, they move back to lower elevations and feed primarily on mast, invertebrates, and small vertebrates. During the spring and early summer in the northern hardwood forest, the diet consists of corms of *Claytonia virginica* L. (Eastern Spring Beauty) (58%), leaves and stems from mesic herbs (28%), other roots (11%), macroinvertebrates (2%), and leaves of shrubs (1%). On some of the grassy balds, large areas of bare soil have been exposed where the sod has been uprooted by the hogs in their search for food. Approximately 70% of the diet is subterranean in origin (Singer 1981).

Huff (1977) reported that rooting by hogs stimulates vegetative reproduction of American Beech, with root suckers in such areas 4–44 times more numerous than in undisturbed plots. Studies of high-elevation gaps in the Park show that rooting by Wild Hogs also seems to result in increased height growth of American Beech. The shoots of beech trees in moderately and severely rooted sites were significantly longer than those for trees in lightly rooted sites (Lacki and Lancia 1986). Bratton (1974) reported that herbaceous cover is drastically reduced in hog-disturbed sites when compared to undisturbed sites.

A study of seasonal food habits in the Park (Scott and Pelton 1975) revealed invertebrates such as walking-sticks, hellgrammites, beetles, caterpillars, fly larvae, millipedes, centipedes, snails, earthworms, and crayfish present in almost every stomach, but their volume is low. Likewise, the frequency of vertebrates is high, but the percent volume is low. Salamanders, particularly the endemic *Plethodon jordani* Blatchley (Red-cheeked Salamander), are common at the higher elevations. Scott and Pelton (1975) recorded an average of 1.75 salamanders per hog stomach. In late summer, hard mast (*Quercus* sp., *Carya* sp.) normally comprises 60 to 85% by volume of the Wild Hog diet.

The enterococci *Enterococcus faecalis* and *Enterococcus faecium* were recorded from fecal specimens by Mundt (1963).

Reproduction: Breeding in the Park occurs year-round with peaks in late fall–early winter and late spring–early summer. Duncan (1974) recorded an average

litter size of 3.2 (range = 1–5). Singer et al. (1978) recorded an average pre-natal litter size of 4.75 (range = 3–7) and an average post-natal litter size of 3.03 (range = 1–5). Farrowing normally occurs 2 to 3 times a year.

Measurements: 20 males: total length 1727.0 mm (1625–1870 mm); tail 276.5 mm (range not available); hind foot 294.8 mm (265–340 mm); weight (18) 90.1 kg (68.0–120.7 kg). 24 females: total length 1649.4 mm (1550.0–1775.0 mm); tail 270.3 mm; hind foot 272.5 mm (180.0–290.0 mm); weight (12) 67.6 kg (43.1–98.0 kg).

The heaviest individual ever recorded in the Park weighed 136 kg (303 lb) and was taken on Welch Branch in September 1962 (Linzey and Linzey 1971).

Location of specimens: GSMNP, LU, NCSM, UCONN.

FAMILY CERVIDAE – Deer

Cervus canadensis Erxleben (Wapiti; Eastern Red Deer)

Distribution: Although Wapiti (known as “Elk” by the National Park Service and by the general public) roamed throughout the mountains in former times, the species has become extirpated in the region. In 1896, Rhoads stated: “At the beginning of the present century, this noble animal was probably a visitant to every county in the State [Tennessee].” Ganier (1928) reported that the last one in eastern Tennessee was shot in 1849.

In discussing the status of this mammal in North Carolina, Hamnett and Thornton (1953) reported that it “once inhabited at least a portion of North Carolina including the northern Piedmont and Mountain counties. It is doubtful if they were ever very numerous, however, since this region was near the southern limits of their range.” They stated further that “... it probably was present in the Mountain Region until the late 1700s.” Brimley (1945) recorded that Elk (Wapiti) occurred in colonial times in the mountains of North Carolina until at least 1750. Cope (1870) noted that horns of Elk were found in the Black Mountains in western North Carolina in the early 1800s.

The feasibility of Wapiti restoration in the Park had been under consideration since the late 1980s. A feasibility assessment was completed which concluded that the Park had sufficient potential Wapiti habitat to justify an experimental re-introduction, and a 5-year research proposal was developed to answer questions necessary to determine the future of Wapiti in the Park.

The first 25 Wapiti (13 males, 12 females) arrived from the US Forest Service’s Land Between the Lakes in western Kentucky on 25 February 2001. They were placed in a 2.4 ha (6-acre) acclimation pen in Cataloochee Valley, NC, and held for 2 months to acclimate them to the area. Two weeks prior to their release, the Wapiti were processed and instrumented with radio-collars to monitor their movements. They were released on 2 April 2001, when natural foods were more available. In January 2002, an additional 27 Wapiti (19 females, 8 males) from Elk Island National Park in Alberta, Canada, were released in Cataloochee (Murrow 2007). The first Wapiti calf born in the Park was born on 22 June 2001. The birth of 3 additional calves was confirmed during 2001.

Most Wapiti have a fairly small home range of several km² and have stayed close to where they were released, and those born in the Park tend to stay close to where they were born. Most Wapiti movements have been confined in or near the Park: these areas include Balsam Mountain, Oconaluftee, Qualla Boundary, and the White Oak community east of Cataloochee, although 1 female Wapiti was located as far as Glenville, NC. A number of male Wapiti have moved from North Carolina into Tennessee (National Park Service).

Reproduction: Biologists continue to monitor a portion of the herd. Radio collars and receivers have been used to track the newborn calves and 5 new adult females each year. Since their release, 203 births have been recorded to radio-monitored cows. Wapiti calving season in 2012 resulted in 14 known calves born within the Park with only 1 fatality. Twenty-four calves were born in 2013 with 19 surviving to 1 year of age. Twenty-four calves were also born in 2014 with 17 surviving as of January 2015. As of January 2014, the Park's herd (not including those outside of the Park) numbered at least 80 animals (J. Yarkovich, National Park Service Elk Biologist, Gatlinburg, TN, February 2015 pers. comm.).

Predation: The Wapiti that were originally released into the Park had never dealt with American Black Bears as predators and, as a result, during the early years of the Wapiti reintroduction, calf survival was low (Yarkovich 2009). Black Bears were relocated during calving season as a method to reduce predation on the Wapiti calves (Yarkovich 2009). Survival rates for calves has increased over the years (Yarkovich 2009), so it seems that over time, the Wapiti have learned to deal with bears and to hide and defend their newborns against them. Coyotes also prey on Wapiti calves (Yarkovich 2009).

Odocoileus virginianus (Zimmermann) (White-tailed Deer)

Distribution: White-tailed Deer were once common in some sections of the area now included in the Park. However, due to a combination of factors—persistent hunting, running by dogs, disease, and predators—they decreased in numbers, almost disappearing from the Park by about 1930. Superintendent Eakin stated in a letter dated 13 July 1931, “From the best information I can gather on the ground there is not one deer left.” The formation of the Park at that period provided a refuge for these animals, and they have been increasing ever since. They remained scarce until the late 1940s, when small herds of 7 or 8 animals were reported in Cades Cove. By the middle 1950s, the herd in Cades Cove had built up considerably and, since that time, they are commonly observed there. By the early 1960s, White-tailed Deer were being reported from many places in the Park. At present, deer exist in low densities throughout much of the Park. They prefer areas where dense woods and thickets alternate with open meadows and forest glades. They continue to be most common in the western third of the Park and are uncommon in the spruce–fir region. During the period 1983–1985, spotlight counts in Cades Cove yielded an estimate of 0.38 deer per ha (2.63 ha per deer), while monthly mark–recapture estimates averaged 0.23 deer per ha (4.4 ha per deer) (Wathen and New 1989). The average annual home range was 147 ha.

Blount County - Abrams Creek; Cades Cove; Parson Branch; Gregory Ridge Trail; Gregory Bald. Cocke County - Cosby; Ground Hog Creek. Sevier County - Greenbrier; near Fighting Creek; Roaring Fork. Haywood County - Big Creek; Cataloochee. Swain County - Deep Creek; Collins Creek; Fontana Lake; Hazel Creek; Noland Creek; Russell Field; Heintooga.

Reproduction: Female White-tailed Deer produce a single annual litter. In the Park, breeding normally occurs from November to mid-December. Fawns are usually born from late May through early July. Mating deer were observed in Cades Cove on 1 November (Stupka 1956). A doe and a newly born fawn were observed on 20 June (Stupka 1956). The tracks of an adult and a fawn were seen along the Gregory Ridge Trail (1281 m) on 17 June (Stupka 1939), while several does with fawns were noted near Hazel Creek in August 1963. Wathen and New (1989) reported fawn-at-heel counts (fawns:does) ranging from 18:100 in 1984 to 20:100 in 1985 for the Cades Cove deer herd, suggesting a low rate of productivity.

Predation: Wathen and New (1989) reported female fawn mortality rates of approximately 25%. Predation was one of the major (27%) causes of death, with stray dogs or Coyotes suspected as being the major predators. Park Service biologists have observed Black Bears preying on Park deer.

Parasites: Seventy-nine of 127 deer (62%) from Cades Cove were infested with lice. *Tricholipeurus parallelus* Osborn was found on 51 deer (40%), and *Tricholipeurus lipeuroides* Megnin was found on 36 deer (28%) (Hribar et al. 1986). One doe also harbored *Solenopotes ferrisi* Fahrenholz. Blood samples were collected from 518 deer in Cades Cove between 1980 and 1985 (Wathen and New 1989). Antibodies were recorded for hemorrhagic disease viruses, leptospirosis, bovine virus diarrhea (BVD), infectious bovine rhinotracheitis (IBR), and anaplasmosis. No antibodies were recorded for brucellosis.

Location of specimens: GSMNP.

FAMILY BOVIDAE – Bison

Bos bison L. (American Bison) [Extirpated]

Distribution: American Bison were probably extirpated in this part of the country during the late 18th century. Brimley (1945) recorded that these mammals originally ranged over much of North Carolina, but were exterminated about 1760.

Dr. J.A. Allen (1876) summarized information regarding the history of this animal in Tennessee. He noted that they formerly passed over the Cumberland and Great Smoky Mountain ranges by way of the Holston and French Broad Rivers to and from the Valley of East Tennessee; however, the majority were confined to the Cumberland Valley and its tributaries. He concluded that the point of greatest abundance was undoubtedly in the “blue-grass region” of the vicinity of Nashville and reported that the “hills and coves of the Allegheny Mountains in Tennessee”, which were covered with large tracts of native grasses, attracted the American Bison from the lowlands in the summer.

Kellogg (1939) noted that the number of American Bison in eastern Tennessee was never very great but they were “present in some numbers” in the western part

of the state. He quoted Ramsey (1853), who stated that in 1783 a locality in Cumberland County was a “vast upland prairie, covered with a most luxuriant growth of native grasses, pastured over as far as the eye could see, with numerous herds of deer, elk, and buffalo.”

Apparently, some American Bison were still present in the region around Nashville in June 1795 and in Putnam County in December 1799. In 1823, Haywood stated that “at this time there is not one in the whole State of Tennessee.”

Mammals of Surrounding Regions

The following list of 4 “probable” species is based on their known distribution in regions surrounding GSMNP. It seems likely that in the future, some or all of these species may be recorded within the Park. Linzey and Linzey (1968) included 12 “probable” species; 4 are now members of the Park fauna. Linzey (1995) included 8 “probable” species; 4 of these are also now members of the Park fauna.

Myotis grisescens A.H. Howell (Gray Myotis) [Federally endangered]

This cave bat has been recorded from several sites in Tennessee, Alabama, and Kentucky (Whitaker and Hamilton 1998); from Grigsby Cave in Scott County, VA, just 13 miles north of the Tennessee–Virginia line (Holsinger 1964); and from Asheville, NC (Tuttle and Robertson 1969). Choate et al. (1994) includes the Tennessee portion of the Park in the map depicting the range of this species.

Corynorhinus townsendii Cooper (Townsend’s Big-eared Bat)
[Federally endangered]

[This species was formerly classified as *Plecotus townsendii*.]

GSMNP lies just south of the range of several disjunct populations of this species (Kunz and Martin 1982, Reid 2006, Whitaker and Hamilton 1998). Neither Kellogg (1939) nor Smith et al. (1960) reported any specimens from Tennessee and North Carolina, respectively. Recently, however, this species has been recorded from one site in western North Carolina (Harvey 1992).

Lepus americanus Erxleben (Snowshoe Hare)

The Snowshoe Hare has been reported as occurring in the Park in former times, but no specimens have ever been taken. In 1888, C.H. Merriam reported that this species was unknown from the Smokies. However, Kellogg (1939) included *Lepus* in the Park fauna on the basis of information received from local residents. They reported that hares were formerly present in the mountainous district extending from Mt. Guyot to White Rock (Mt. Cammerer), Cocke County, TN. These hares were said to turn white in winter and to make long jumps when chased in the snow by dogs. They were usually “jumped” from rhododendron thickets near the summits of the peaks. Kellogg’s record is listed by Hall (1981) as a marginal record for the species. Blair et al. (1957) also gives the range as extending “south in Appalachian

chain to eastern Tennessee”, while Smith et al. (1960) state that this species probably occurs in open brushy areas in mixed forests in the mountains of Virginia and Tennessee. Arthur Stupka (NPS Biologist, Gatlinburg, TN, 1967 pers. comm.), however, believed that this hare was not present in the park as of the late 1960s and had not been in the Great Smoky Mountains area for decades prior to that.

As recently as 1982, Bittner and Rongstad reported the hare’s range as “extending south through the Allegheny Mountain Range into North Carolina and Tennessee.” Whitaker and Hamilton (1998) stated: “It is now rare in the Great Smoky Mountains.” Wilson and Ruff (1999) not only show the range of this species to include the Park but specifically state that the range of *Lepus americanus virginianus* extends from southern Quebec, Ontario, and Massachusetts to Tennessee and North Carolina. Reid (2006) shows the Park as being within the range of this species.

Erethizon dorsatum L. (North American Porcupine)

Merriam (1888) reported that this species was unknown in the Smokies. The nearest records are from Giles County, VA (Linzey 1998), and Spruce Knob in West Virginia (Hall 1981), although Reid (2006) indicated that its historical range extended through the mountains as far south as northern Alabama. Jawbones of North American Porcupines have been recovered from archaeological sites west of Chattanooga in Marion County, TN (Parmalee and Guilday 1966).

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Appendix 2. Localities referred to in text.

- ABRAMS CREEK 261–938 m (857–3075 ft). Near western boundary of Park (TN)
- ABRAMS CREEK RANGER STATION 366 m (1200 ft). Western boundary of Park (TN)
- ALUM CAVE BLUFFS 1495 m (4900 ft). South slope of Mount Le Conte (TN)
- ALUM CAVE PARKING AREA 1159 m (3800 ft). Along Newfound Gap Road (TN)
- ALUM CAVE TRAIL 1159–1922 m (3800–6300 ft). South slope of Mount Le Conte (TN)
- ANDREWS BALD 1769 m (5800 ft). South of Clingmans Dome (NC)
- APPALACHIAN TRAIL mostly 1525–1830 m (5000–6000 ft). Approximately along TN–NC state line
- BECKS BALD 1532 m (5022 ft). Near southeastern boundary, west of Hughes Ridge (NC)
- BEECH FLATS CREEK 1220 m (4000 ft). Stream crossing Newfound Gap Road, Swain County, NC
- BIG COVE 763 m (2500 ft). Cherokee Indian Reservation, east of Smokemont, NC
- BIG CREEK approximately 458–1495 m (1500–4900 ft). Near northeastern boundary of Park (NC)
- BLACK CAMP GAP 1379 m (4522 ft). Near southeastern boundary of Park (NC)
- BLANKET MOUNTAIN 1406 m (summit) (4609 ft). Southwest of Elkmont (TN)
- BOTE MOUNTAIN approximately 1464 m (summit) (4800 ft). East of Cades Cove (TN)
- BOULEVARD TRAIL, THE 1830–2011 m (6000–6593 ft). Mount Kephart (TN–NC) to Mount Le Conte (TN)
- BRADLEY FORK approximately 671–915 m (2200–3000 ft). Tributary of Oconaluftee River north of Smokemont (NC)
- BRYSON PLACE 735 m (2411 ft). Along Deep Creek, north of Bryson City (NC)
- BUCK FORK approximately 900–1632 m (2950–5350 ft). Greenbrier area, branch of Middle Prong of Little Pigeon River (TN)
- BUCKHORN AREA 458 m (1500 ft). North of Park boundary, east of Gatlinburg (TN)
- BUENA VISTA 458–488 m (1500–1600 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)
- BULL CAVE 580 m (1900 ft). Northern boundary of Park, near Rich Mountain (TN)
- BUNCHES CREEK approximately 732–1342 m (2400–4400 ft). Flows along southeastern boundary of Park near Black Camp Gap (NC)
- CADES COVE mostly 549–580 m (1800–1900 ft). Western part of Park (TN)
- CANEY CREEK 436 m (1430 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)
- CATALOOCHEE approximately 793 m (2600 ft). Cove near eastern boundary of Park (NC)
- CHAMBERS CREEK approximately 519 m (mouth) (1700 ft). Tributary of the Tuckasee-gee River, west of Bryson City (NC)

CHAPMAN PRONG approximately 1052–1571 m (3450–5150 ft). Tributary of Ramsay Prong, in Greenbrier section (TN)

CHARLIES BUNION 1639 m (5375 ft). On Appalachian Trail, northeast of Newfound Gap (TN–NC)

CHEROKEE approximately 580 m (1900 ft). Town on Cherokee Indian Reservation adjacent to southern boundary of Park (NC)

CHEROKEE ORCHARD 793 m (2600 ft). Four miles southeast of Gatlinburg (TN)

CHILHOWEE MOUNTAINS approximately 458–824 m (1500–2700 ft). Outside Park, just beyond northwestern boundary (TN)

CHIMNEYS PICNIC AREA 824 m (2700 ft). Along Newfound Gap Road, 6 miles south of Gatlinburg (TN)

CLIFF BRANCH approximately 793–1159 m (2600–3800 ft). Tributary of Oconaluftee River, north of Thomas Divide (NC)

CLINGMANS DOME 2026 m (summit) (6643 ft). Along state line at head of Forney Ridge, highest point in park (TN–NC)

CLINGMANS DOME ROAD 1537–1925 m (5040–6311 ft). From Newfound Gap to Clingmans Dome Parking Area (NC)

COLLINS CREEK approximately 732–1388 m (2400–4550 ft). Tributary of the Oconaluftee River above Smokemont (NC)

COLLINS GAP 1745 m (5720 ft). Between Indian Gap and Clingmans Dome (TN–NC)

COOPER CREEK approximately 580–1415 m (1900–4640 ft). Along southern boundary of Park near Thomas Divide (NC)

COSBY approximately 427 m (1400 ft). Town north of Park boundary near northeast corner of Park (TN)

COSBY CAMPGROUND approximately 732 m (2,400 ft). Northeast corner of Park (TN)

COSBY CREEK approximately 503–1281 m (1650–4200 ft). Near northeastern boundary of Park (TN)

COSBY RANGER STATION 534 m (1750 ft). Near northeastern boundary of Park (TN)

COUCHES CREEK approximately 625–1129 m (2050–3700 ft). Tributary of Oconaluftee River near Smokemont (NC)

COVE CREEK 436 m (1430 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)

COVE SPRING HOLLOW 458 m (1500 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)

DEEP CREEK approximately 547–1220 m (1792–4000 ft). North of Bryson City (NC)

DEEP CREEK RANGER STATION 580 m (1900 ft). North of Bryson City (NC)

DRY SLUICE GAP 1639 m (5375 ft). Between Charlies Bunion and the Sawteeth on state line, east of Newfound Gap (TN–NC)

DRY VALLEY 366–458 m (1200–1500 ft). Area between northern boundary of Park and Townsend (TN)

DUDLEY CREEK approximately 427–1068 m (1400–3500 ft). Flows along northern Park boundary, east of Gatlinburg (TN)

EAGLE CREEK approximately 519–763 m (1700–2500 ft). North of Fontana Lake (NC)

EAGLE ROCK CREEK approximately 991–1510 m (3250–4950 ft). Tributary of Middle Prong of the Little Pigeon River in Greenbrier area (TN)

ELKMONT 655 m (2146 ft). On Little River, southwest of Park headquarters (TN)

FIGHTING CREEK approximately 440–991 m (1442–3250 ft). Tributary of the West Prong of the Little Pigeon River (TN)

FIGHTING CREEK GAP 708 m (2320 ft). On Little River Road, 6.4 km west of Park headquarters (TN)

FISH CAMP PRONG approximately 839–1418 m (2750–4650 ft). Tributary of Little River, southeast of Elkmont (TN)

FLAT CREEK approximately 1220–1525 m (4000–5000 ft). South of Heintooga Overlook, near southeastern boundary of Park (NC)

FONTANA DAM approximately 519 m (1700 ft). Near southwestern boundary of Park (NC)

FONTANA LAKE between 519–549 m (1700–1800 ft). Along southwestern boundary of Park (NC)

FONTANA VILLAGE approximately 610 m (2000 ft). Along southwestern boundary of Park (NC)

FORGE CREEK 549–580 m (1800–1900 ft). Near Cades Cove Visitor Center (TN)

FORNEY CREEK approximately 488–1739 m (1600–5700 ft). Flows southwest from vicinity of Clingmans Dome to Fontana Reservoir (NC)

FORT HARRY CLIFFS 976 m (3200 ft). Rock cliffs along Newfound Gap Road near Chimneys picnic area (TN)

GATLINBURG 394 m (1293 ft). Town on north-central boundary of Park (TN)

GATLINBURG SPUR 336–397 m (1100–1300 ft). Branch of Foothills Parkway near Gatlinburg (TN)

GNATTY BRANCH approximately 336 m (1100 ft). Tributary of West Prong of Little Pigeon River; flows along Foothills Parkway between Gatlinburg and Pigeon Forge (TN)

GRASSY PATCH (see Alum Cave Parking Area)

GREENBRIER 512 m (1680 ft). Approximately 16 km east of Gatlinburg (TN)

GREENBRIER PINNACLE 1466 m (summit) (4805 ft). East of Greenbrier, near northeastern boundary of Park (TN)

GREGORY BALD 1509 m (4948 ft). On state line ridge, southwest of Cades Cove (TN–NC)

GREGORY RIDGE TRAIL 589–1403 m (1930–4600 ft). From near Cades Cove to state line ridge (TN)

GUM STAND approximately 336 m (1100 ft). Outside Park boundary between Gatlinburg and Pigeon Forge (TN)

HAPPY VALLEY 406 m (1332 ft). On western boundary of Park near Chilhowee Mountain (TN)

HAZEL CREEK approximately 641–1571 m (2100–5150 ft). Flows into Fontana Reservoir between Eagle Creek and Forney Creek (NC)

HEINTOOGA OVERLOOK 1624 m (5325 ft). Terminus of Blue Ridge Parkway spur that leaves Parkway at Mile 458.2; vicinity of southeastern boundary of Park (NC)

INADU KNOB 1812 m (5941 ft). On state line ridge, north of Mount Guyot; in northeastern part of Park (TN–NC)

INDIAN CAMP CREEK approximately 564–1479 m (1850–4850 ft). North of Old Black Mountain in northeastern section of Park (TN)

INDIAN CREEK approximately 580–1327 m (1900–4350 ft). Tributary of Deep Creek near boundary of Park, north of Bryson City (NC)

INDIAN GAP 1606 m (5266 ft). West of Newfound Gap, along road to Clingmans Dome (TN–NC)

JONAS CREEK approximately 732–1472 m (2400–4825 ft). Tributary of Forney Creek between Welch Ridge and Forney Ridge (NC)

KANATI FORK approximately 930–1324 m (3050–4340 ft). Tributary of Oconaluftee River, north of Thomas Divide (NC)

KEPHART PRONG approximately 854–1647 m (2800–5400 ft). Tributary of Oconaluftee River, above Smokemont (NC)

KING HOLLOW BRANCH 519–549 m (1700–1800 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)

LAUREL BRANCH approximately 747–1190 m (2450–3900 ft). Tributary of Middle Prong of Little Pigeon River in Greenbrier section (TN)

LAUREL CREEK approximately 366–549 m (1200–1800 ft). Tributary of the Middle Prong of Little River; along spur road to Cades Cove (TN)

LECONTE LODGE approximately 1922 m (6300 ft). Near summit of Mount Le Conte, at junction of trails (TN)

LITTLE RIVER approximately 336–1632 m (1100–5350 ft). Originates north of Mount Buckley; leaves Park at northwestern boundary near Townsend (TN)

LITTLE RIVER ROAD approximately 336–708 m (1100–2320 ft). From Sugarlands Visitor Center to vicinity of Townsend (TN)

LOW GAP 1294 m (4242 ft). On state line, north of Cosby Knob, in northeastern part of Park (TN)

LOW GAP TRAIL 763–1294 m (2500–4242 ft). Trail from Cosby Campground to Low Gap (TN)

MADDRON BALD TRAIL 946–1678 m (3100–5500 ft). Between Indian Camp Creek and Snake Den Mountain in Cosby section of Park (TN)

MAPLES RANCH 519–580 m (1700–1900 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)

MEIGS CREEK approximately 427–1007 m (1400–3300 ft). Tributary of Little River, joining Little River between The Sinks and the Townsend Y (TN)

MESSER FORK approximately 885–1434 m (2900–4700 ft). Tributary of Rough Fork, southwest of Cataloochee (NC)

METCALF BOTTOMS 512 m (1679 ft). Picnic area along Little River, 3.2 km above The Sinks bridge (TN)

MIDDLE PRONG OF LITTLE PIGEON RIVER 419–512 m (1374–1680 ft). Flows from Greenbrier to Emerts Cove (TN)

MILL CREEK 610–732 m (2000–2400 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)

MINGUS and COOPER CREEK DIVIDE approximately 1068 m (3500 ft). Ridge between Mingus and Cooper Creeks near southern boundary of Park (NC)

MOORES SPRING SHELTER 1434 m (4700 ft). Along Appalachian Trail east of Gregory Bald (TN–NC) (No longer exists)

MOUNT BUCKLEY 2008 m (summit) (6582 ft). 1.6 km west of Clingmans Dome on state line (TN–NC)

MOUNT CAMMERER 1533 m (summit) (5025 ft). Near state line in extreme northeast corner of Park (TN)

MOUNT COLLINS 1888 m (summit) (6188 ft). On state line between Indian Gap and Clingmans Dome (TN–NC)

MOUNT GUYOT 2019 m (summit) (6621 ft). On state line east of Greenbrier (TN–NC)

MOUNT KEPHART approximately 1891 m (summit) (6200 ft). On state line 4.8 km north-east of Newfound Gap (TN–NC)

MOUNT LE CONTE 2011 m (summit) (6593 ft). Third highest peak in Park; southeast of Gatlinburg (TN)

MOUNT STERLING 1780 m (summit) (5835 ft). Near eastern boundary of Park; south of town of Mt. Sterling (NC)

MOUNT STERLING BALD approximately 1769 m (5800 ft). Near summit of Mount Sterling (NC)

MOUNT STERLING CREEK approximately 1056–1495 m (3464–4900 ft). Drains Mount Sterling Ridge north of Mount Sterling Gap (NC)

MYHR CAVE 467 m (1530 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)

NEWFOUND GAP 1537 m (5040 ft). Highest point on Newfound Gap Road; on state line and along Appalachian Trail (TN–NC)

NEWFOUND GAP ROAD 397–1537 m (1300–5040 ft). Road from Gatlinburg, TN, to Cherokee, NC, via Newfound Gap (TN–NC)

NEWT PRONG approximately 856–1360 m (2808–4460 ft). Tributary of Jakes Creek, above Elkmont (TN)

NOISY CREEK approximately 473–1098 m (1550–3600 ft). Tributary of Webb Creek, flowing between Greenbrier Pinnacle and US Route 321 (TN)

NOLAND CREEK approximately 793–1586 m (2600–5200 ft). Between Forney Ridge and Noland Divide (NC)

NOLAND DIVIDE 610–1830 m (2000–6000 ft). From east of Clingmans Dome to Deep Creek Campground (NC)

OCONALUFTEE RIVER approximately 595–930 m (1950–3050 ft). Flows along Newfound Gap Road to southern boundary of Park at Cherokee (NC)

OCONALUFTEE VISITOR CENTER approximately 640 m (2100 ft). Along Newfound Gap Road, 3.2 km north of Cherokee (NC)

OLD BLACK MOUNTAIN 1939 m (summit) (6356 ft). On state line, 1.6 km (1 mile) north of Mount Guyot (TN–NC)

PARK HEADQUARTERS 445 m (1460 ft). Area 3.2 km south of Gatlinburg (TN)

PARK HEADQUARTERS BUILDING 445 m (1460 ft). Administration building, 3.2 km south of Gatlinburg (TN)

PARSON BALD 1443 m (4730 ft). On state line west of Gregory Bald (TN–NC)

PARSONS BRANCH approximately 412–808 m (1350–2650 ft). Between Hannah Mountain and southwestern boundary of Park (NC)

POLLS GAP approximately 1373 m (4500 ft). Vicinity of southeastern boundary of Park (NC)

PECKS CORNER approximately 1708 m (5,600 ft). On state line east of Charlies Bunion (TN–NC)

PILOT RIDGE approximately 915 m (3000 ft). Along southern boundary of Park near Forney Creek (NC)

PIN OAK GAP 1351 m (4428 ft). On Balsam Mountain, north of Heintooga Overlook (NC)

PINE KNOT BRANCH approximately 915–1098 m (3000–3600 ft). Tributary of the Little River arising near Cove Mountain (TN)

PINNACLE CREEK 546–1190 m (1791–3900 ft). Tributary of Eagle Creek, between Thunderhead and Fontana Reservoir (NC)

PROCTER 519 m (1700 ft). Abandoned town north of Fontana Lake along Hazel Creek (NC)

PROCTER CREEK approximately 933–1373 m (3060–4500 ft). Flows from near Appalachian Trail to Hazel Creek (NC)

RAINBOW FALLS TRAIL 787–1922 m (2581–6300 ft). From Cherokee Orchard to Mount Le Conte via Rocky Spur (TN)

RAVENSFORD 640 m (2100 ft). Near junction of Raven Fork and Oconaluftee River; in vicinity of Oconaluftee Visitor Center (NC)

ROARING FORK approximately 397 m (mouth) (1300 ft). Enters West Prong of Little Pigeon River in Gatlinburg; originates north of Cliff Top on Mount Le Conte (TN)

ROUND BOTTOM 922 m (3022 ft). On Straight Fork, at junction with Round Bottom Creek; southeastern part of Park (NC)

SALTPETER CAVE 534 m (1750 ft). Near Park boundary, between Dry Valley and Whiteoak Sink (TN)

SCHOOLHOUSE GAP approximately 610 m (2000 ft). On northern boundary of Park on old road between Whiteoak Sink (vicinity) and Dry Valley in Tuckaleechee Cove (TN)

- SHEEP PEN GAP 1406 m (4610 ft). On state line west of Gregory Bald (TN–NC)
- SHUCKSTACK TOWER 1166 m (3824 ft). Fire tower north of Fontana Lake (NC)
- SILERS BALD 1714 m (5620 ft). On state line west of Clingmans Dome (TN–NC)
- SINKING CREEK approximately 1144–1540 m (3750–5050 ft). Tributary of Big Creek, east of Mount Guyot (TN)
- SINKS, THE (or The Sinks bridge) 477 m (1565 ft). Along Little River Road below Metcalf Bottoms (TN)
- SMOKEMONT (and Campground area) 670 m (2198 ft). On Newfound Gap Road above Oconaluftee Visitor Center (NC)
- SNAKE DEN MOUNTAIN approximately 1678 m (summit) (5500 ft). West of Cosby Campground (TN)
- SPENCE FIELD approximately 1525 m (5000 ft). Just west of Thunderhead on state line (TN–NC)
- SPRUCE MOUNTAIN approximately 1078 m (summit) (5600 ft). Near Heintooga Ridge (NC)
- STRAIGHT FORK approximately 732–1220 m (2400–4000 ft). Tributary of Raven Fork, between Hyatt Ridge and Balsam Mountain, in eastern part of Park (NC)
- SUGAR CAMP BRANCH 549–610 m (1800–2000 ft). Along Foothills Parkway between Wear Valley and Gatlinburg (TN)
- SUGARLAND MOUNTAIN 1745 m (summit) (5720 ft). Between Little River and West Prong of Little Pigeon River (TN)
- SUGARLANDS 458–824 m (1500–2700 ft). Valley from near Sugarlands Visitor Center to Chimneys picnic area (TN)
- SUTTON RIDGE 762 m (2500 ft). Dry, exposed ridge along Lower Mt. Cammerer Trail 2.25 km north of Cosby Campground (TN)
- TAPOCO 336 m (1100 ft). Town just outside southwestern boundary of Park (NC)
- THOMAS RIDGE mostly 1220–1525 m (4000–5000 ft). Main divide west of the Oconaluftee River (NC)
- THUNDERHEAD 1687 m (summit) (5530 ft). On state line southeast of Cades Cove (TN–NC)
- TOWNSEND 336 m (1100 ft). Town in Tuckaleechee Cove, 2 miles north of Park boundary (TN)
- TOWNSEND Y 351 m (1150 ft). Junction of Little River and Middle Prong of Little River (TN)
- TREMONT 587 m (1925 ft). On Middle Prong of Little River near junction with Lynn Camp Prong (TN)
- TRILLIUM GAP 1439 m (4717 ft). Between Mount Le Conte and Brushy Mountain (TN)
- TROUT BRANCH approximately 1098 m (3600 ft) (mouth). Tributary of West Prong of Little Pigeon River; along Newfound Gap Road above the Loop Tunnel (TN)
- TWENTYMILE CREEK 400–1266 m (1313–4150 ft). Flows into Cheoah Lake on Park boundary west of Fontana Dam (NC)

WALKER CREEK approximately 991–1426 m (3250–4675 ft). Tributary of Hazel Creek (NC)

WALKER PRONG approximately 1449 m (4750 ft) (mouth). Tributary of West Prong of Little Pigeon River (TN)

WALNUT BOTTOM 928 m (3042 ft). On Big Creek in northeastern part of Park (NC)

WEAR COVE 443 m (1454 ft). On Park boundary north of Cove Mountain (TN)

WEST PRONG OF LITTLE PIGEON RIVER (same as West Fork of Little Pigeon River) approximately 397–1403 m (1300–4600 ft). Main stream along Newfound Gap Road from Gatlinburg, Tennessee, to near Newfound Gap (TN)

WHITEOAK SINK approximately 534 m (1750 ft). Small cove just inside Park boundary, northeast of Cades Cove (TN)

WHITE ROCK (see Mount Cammerer)