B A N I S T E R I A

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

ISSN 1066-0712

Published by the Virginia Natural History Society

The Virginia Natural History Society (VNHS) is a nonprofit organization dedicated to the dissemination of scientific information on all aspects of natural history in the Commonwealth of Virginia, including botany, zoology, ecology, archaeology, anthropology, paleontology, geology, geography, and climatology. The society's periodical *Banisteria* is a peer-reviewed, open access, online-only journal. Submitted manuscripts are published individually immediately after acceptance. A single volume is compiled at the end of each year and published online. The Editor will consider manuscripts on any aspect of natural history in Virginia or neighboring states if the information concerns a species native to Virginia or if the topic is directly related to regional natural history (as defined above). Biographies and historical accounts of relevance to natural history in Virginia also are suitable for publication in *Banisteria*. Membership dues and inquiries about back issues should be directed to the Co-Treasurers, and correspondence regarding *Banisteria* to the Editor. For additional information regarding the VNHS, including other membership categories, annual meetings, field events, pdf copies of papers from past issues of Banisteria, and instructions for prospective authors visit **http://virginianaturalhistorysociety.com/**

Banisteria 59: 181–191

RESEARCH ARTICLE

HOW WELL CAN A BIOBLITZ CAPTURE SPECIES RICHNESS? DOCUMENTING MAMMALIAN SPECIES RICHNESS AT SELU CONSERVANCY, MONTGOMERY COUNTY, VIRGINIA

ALSTON F. JONES, WILLIAM J. JUSTICE, AEROWEN L. BRYANT, JASPER E. BOYCE, CAROLYN K. ROSSMEISL, ALLISON R. OWENS, S. DRAVEN VANNOY, NICHOLAS A. BEACH, AND KAREN E. POWERS

Biology Department, Radford University, Radford, Virginia, 24142, USA

Corresponding author: Karen E. Powers (*kpowers4@radford.edu*)

Editor: T. Fredericksen | Received 24 November 2025 | Accepted 1 December 2025 | Published 2 December 2025

https://virginianaturalhistorysociety.com/2025/01/08/number-59-2025/

Citation: Jones, A. F., W. J. Justice, A. L. Bryant, J. E. Boyce, C. K. Rossmeisl, A. R. Owens, S. D. Vannoy, N. A. Beach, and K. E. Powers. 2025. How well can a bioblitz capture species richness? Documenting mammalian species richness at Selu Conservancy, Montgomery County, Virginia. Banisteria 59: 181–191.

ABSTRACT

Bioblitzes are short-term, high-effort surveys that aim to meet research, conservation, and education goals. Here, we use mammals as an example to determine how well a single bioblitz can capture species richness of a Montgomery Co., VA property with 18 years of survey data to which we can compare. We compared our bioblitz species richness metric to 6 weeks of targeted active and passive survey efforts for mammals following the bioblitz. We found 6 mammal species (4 seen/captured, wildlife sign of 2 more) during our bioblitz and incrementally added 18 more species over the next 6 weeks. We suggest that while bioblitzes for mammals are useful for goals that support education and public engagement, they are unlikely to capture accurate mammalian species richness values. Instead, longer-term active and passive surveys better reach documented species richness values for a particular landholding.

Keywords: Active survey, game camera, passive survey, targeted survey, Sherman trap.

INTRODUCTION

A bioblitz is defined as a short-term rapid surveying effort to document site-specific natural history data. Typically, bioblitzes are held for many reasons including: community engagement and educational efforts, gathering information for conservation efforts, and monitoring species counts over a long period of time (Gass et al., 2021). They increase student and public engagement by providing hands-on learning in trapping and species identification. Results may contribute to conservation efforts, providing species counts, relative abundance, and seasonality (Postles & Bartlett, 2018; Meeus et al., 2023).

Although bioblitzes provide many benefits in civic engagement and education, a typical two-day window of surveys presents obvious limitations. The level of expertise in completing the surveys, the degree of community involvement, unpredictable weather events, and seasonal activity and detection probability all affect survey success (e.g., Foster et al., 2023; Gigliotti et al., 2023; Meeus et al., 2023).

The availability of survey types also varies across events and depends on observer expertise. For mammals, typical survey techniques include visual observations of mammals that are diurnal or crepuscular and less secretive (e.g., tree squirrels [*Sciurus* spp.], white-tailed deer [*Odocoileus virginianus* (Zimmermann)]), live-capture Sherman traps for rodents and occasionally shrews (H.B. Sherman, Inc., Tallahassee, FL), tomahawk (Tomahawk Live Trap, Hazelhurst, WI) traps for meso-predators, mistnets for bats, and collection and identification of wildlife signs. Each survey method presents particular benefits and drawbacks or biases in detection. Sherman traps allow for a wide range of data collection while typically being non-fatal (Eccard & Klemme, 2013). However, unless used in concert with additional trap types, Sherman traps underestimate species richness and inherently skew towards adult mice (e.g., *Peromyscus* spp.) and smaller sciurids and underestimate insectivores and immature rodents (Stephens & Anderson, 2014). Visual documentation allows for the detection of species without equipment or technological aid; however, accurate identification relies heavily on individual knowledge of the target animals and should be supported by several concurrent opinions of trained volunteers or with confirmation from an expert (Roberts, 2011). Wildlife signs, such as scat and tracks, require skilled identifiers and may document past, but not current, use of the habitat by the mammalian species (Rhodes et al., 2010).

When these techniques are utilized in concert for many years - whether in a bioblitz-type fashion or through longer-term surveys, mammalian species richness can be estimated for a property. Such is the case for the Selu Conservancy (Montgomery Co., VA), which has been surveyed by co-author Powers since 2007. Thirteen bioblitzes since 2007 plus similar short-term trapping events as part of zoology courses and summer surveys combine to provide a well-established estimate of mammalian species richness (Appendix 1). This situation, therefore, created an opportunity to compare the number of species detected in a two-day bioblitz to the known mammalian richness accumulated over nearly two decades of survey efforts. Once the bioblitz was concluded, we asked if, how, and with how much targeted efforts we could fully document mammalian species richness on the property.

MATERIALS AND METHODS

Study site

The Selu Conservancy (37.0872 °N, 80.5603 °W) is a ca. 154-ha landholding in Montgomery Co., VA owned by the Radford University Foundation and managed in a conservation easement by the Virginia Outdoors Foundation. A multiuse facility, habitats include second-growth mature deciduous forest, grasslands maintained either by prescribed fire or bush-hogging, and riparian habitats and cliffs along the Little River, a tributary to the New River. While the western portion of the tract is primarily unremarkable contiguous mature forest, the forested northeastern portion of the tract includes >20 sinkhole habitats, maintained hiking trails, and a ropes course. Buildings on the property include a 1930s-style farmhouse and outbuildings, a campground, retreat center, and research space that includes an observatory.

Field methods

During the 12-13 September 2025 bioblitz, participants set 302 Shermans for one night. Traps were set in fields, riparian habitats, hillsides, along fencerows, at the campground, and in mature secondary forest (Fig. 1A). As part of mammalian species richness counts, we also included mammal species we observed and for which we found wildlife signs. No passive mammalian trapping was part of bioblitz activities. Due to many observers keeping species detection lists, we combined detections from both dates and reported them all on 13 September.

Active surveying methods continued after the bioblitz with two additional rounds of Sherman trapping: 160 Shermans set 22-23 September, and 240 set 12-14 of October (Fig. 1A; total trapnight effort post-bioblitz: 640 trapnights). We continued to opportunistically look for wildlife signs.

From 16 September - 28 October, also deployed several passive recording devices. We set game cameras (Reconyx HyperFire. Model HC500, Holeman, WI; Bushnell Trophy Cam HD, Model 119739, Overland Park, KS; Stealth Cam Model STC-G45NGX, Grand Prairie, TX) across the property, moving them weekly or bi-monthly (Fig. 1B). Camera effort per week varied from 5 - 20 cameras deployed at a time, with camera trapnights (1 camera set for 1 night = 1 trapnight) totaling 493 across the study. As our species accumulation curves progressed, we selected locations, habitats, and baiting methods that might document mammalian species not yet detected. For example, game cameras set ca. 2 m from suet blocks (attached to trees) are suitable attractants for southern flying squirrels (*Glaucomys volans* [L.]; Wogsland, 2020).

On 16 September 2025, we also deployed two Songmeter SMZC (Wildlife Acoustics, Maynard, MA) units that contained internal, omnidirectional microphones. We set one songmeter at the farmhouse (southeast portion of property), and one in the riparian zone of the Little River, recording continuously from sunset to sunrise until 30 September 2025 (28 songmeter trapnights).

We used Kaleidoscope Pro software (version 5.7.0; Wildlife Acoustics, Maynard, MA) to auto-identify bats, following the regional parameters set by Delacruz et al. (2024). To be conservative, we limited species identification options to 10 species known to be present (i.e., not extremely rare or accidentals) in the central Valley and Ridge physiographic region of Virginia (Reynolds & Fernald, 2015). Further, Powers hand-verified calls from species with <15 identified call files across the 14-night surveying effort and only included species with a statistically significant nightly MLE (maximum likelihood estimate; $P < 0.05$) for hand-verified calls.

We documented first-detection dates of each mammalian species, making note of the technique that detected each species first. Because our goal was simply species accumulation, rather than density or relative abundance estimates, subsequent detections of the same species were not noted.

RESULTS

Across all survey types, we documented 24 mammalian species from 13 September to 28 October 2025; 6 of these species were documented during our hosted bioblitz, and 18 were added in subsequent surveys. When broken down by survey type at bioblitz, visual and acoustic efforts

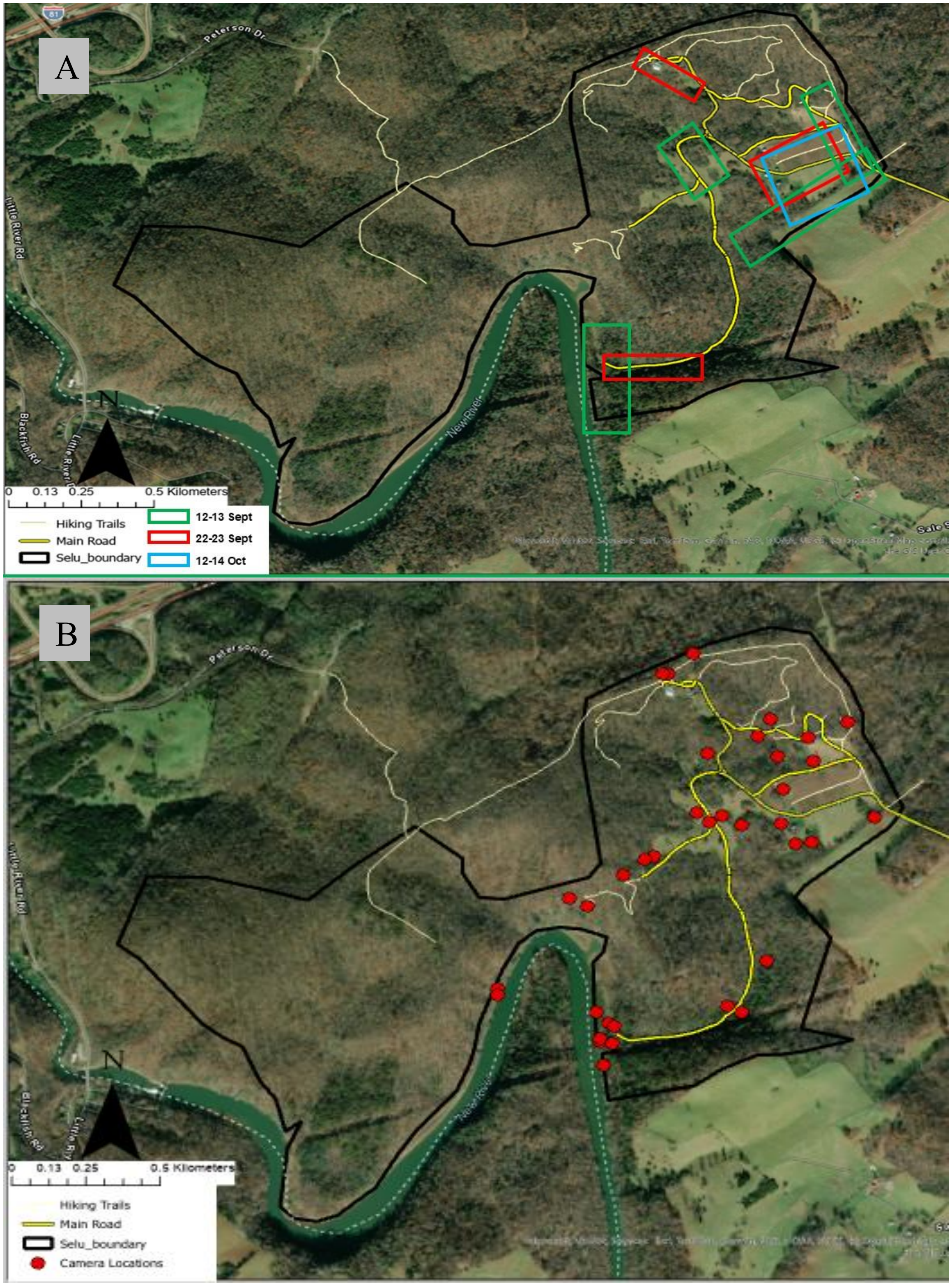

Figure 1. Map of Selu Conservancy, Montgomery Co., VA, as demarcated by property boundary lines (solid black). The Little River borders the south-central and southwest portion of the property. (A) Locations of Sherman live trap deployment areas in September and October 2025, with dates noted in legend. (B) Location of game camera deployment (red circles), with each location surveyed for 1-2 weeks from 16 September – 28 October 2025.

discovered 4 species, Sherman traps documented 1 species, and we found wildlife sign strongly suggestive of 1 more (Appendix 1). Post-bioblitz, Shermans captured 4 more mammal species (Fig. 2), and we incrementally tallied 10 additional species on images from game cameras (Fig. 3). Acoustic surveys for bats accounted for 4 additional species (Appendix 1). We created a species accumulation curve documented by discovery date (Fig. 4). Species not previously on the long-term mammalian species list included muskrats (*Ondatra zibethicus* [L.]), and 2 bat species: hoary bat (*Lasiurus cinereus* [Beauvois]) and silver-haired bat (*Lasionycteris noctivagans* [Le Conte]).

Figure 2. Images of mammalian species captured in Sherman traps in September-October 2025 surveys at Selu Conservancy, Montgomery Co., VA: (A) northern short-tailed shrew (*Blarina brevicauda*); (B) white-footed deermouse (*Peromyscus leucopus*); (C) house mouse (*Mus musculus*), and (D) eastern harvest mouse (*Reithrodontomys humulis*).

DISCUSSION

Our bioblitz accounted for 6/28 (21.4%) of recognized mammalian species, emphasizing the limited utility of such events to fully capture species richness. Our targeted surveys in the subsequent 6 weeks were able to reach 24/28 (85.7%) of initial species richness, and add 3 new species to our list, primarily due to additional passive survey efforts not employed during the bioblitz.

Figure 3. Images of mammalian species captured on game cameras set September-October 2025 at Selu Conservancy, Montgomery Co., VA: (A) eastern fox squirrel (*Sciurus niger*), (B) bobcat (*Lynx rufus*), (C) white-tailed deer (*Odocoileus virginianus*), (D) muskrat (*Ondatra zibethicus*), (E) striped skunk (*Mephitis mephitis*), and (F) coyote (*Canis latrans*).

Our finding of muskrats in the Little River is not unexpected but likely would not have been documented but for targeted game camera deployment. Our lack of traps deployed for muskrats, combined with their nocturnal activity makes their detection unlikely through other means. Camera placement and seasonal timing may also explain why we failed to detect North American river otters (*Lontra canadensis* [von Schreber]), which were documented once through long-term (>2 mo.) camera deployment at the Little River dock in 2020 (R. Sheehy, personal communication).

The addition of 4 bat species via acoustic detection is typical of this survey technique, as it can document species less likely to be captured in mistnets (Mac Aodha et al., 2018). However, we acknowledge that species confirmation of these bats detected acoustically could only be accomplished through live captures. In our surveys, only big brown bats (*Eptesicus fuscus* [Beauvois]) were detected and confirmed visually, due to audible crepuscular vocalizations from the eaves of a farmhouse on property, and scat pellet size at the base of the eaves, as confirmed by Powers.

We were unable to confirm the presence of two rodents and one insectivore during our surveys. Meadow voles (*Microtus pennsylvanicus* [Ord]) were surprisingly absent from the field habitats, which may be attributed to their cyclic population cycles (Sullivan & Sullivan, 2010). Southern flying squirrels (*Glaucomys volans* [L.]) had only been captured in three trapping events (2 individuals in 2007, 1 in 2021) since 2007. We did deploy three camera traps in October with blocks of suet tied to trees (Wogsland, 2020) and also targeted Sherman traps in locations where they'd previously been captured. We suspect this species is uncommon on the Selu property. Masked shrews (*Sorex cinereus* Kerr) also are represented by a single capture from 2007 along the western property boundary, where we did not focus surveys (Powers, unpublished permit report). Similarly, due to their scarcity of detection, additional undetected canids and felids are not suspected of being common residents of the property. Finally, our discovery of rat poison boxes around established buildings on the property led us to suspect that non-target species could be negatively impacted (Brakes & Smith, 2005).

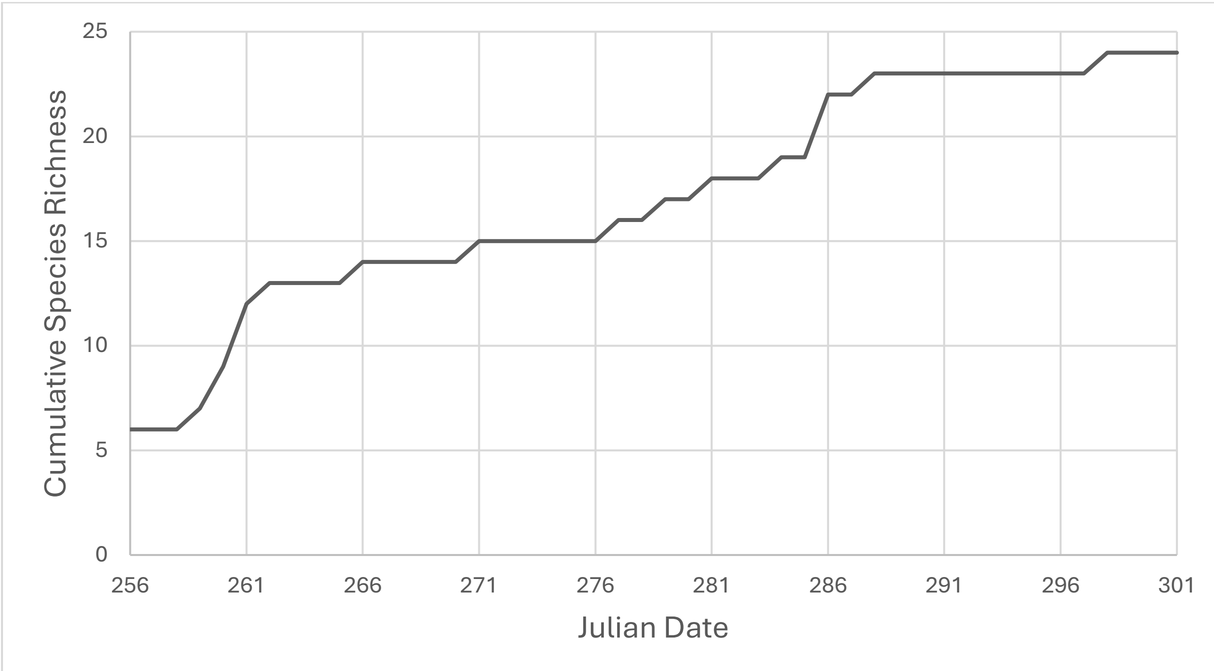

Figure 4. Mammalian species accumulation curve for surveys completed 12 September - 28 October 2025 (JD 255 – 301) at Selu Conservancy, Montgomery Co., VA. Cumulative number of species plotted by Julian date of first discovery for each species. Bioblitz finds on 12-13 September are all reported on 13 September (JD 256).

Despite failing to find these few mammalian species, we were fairly successful in efficiently discovering a wide range of larger carnivores, meso-predators, and rodents across our surveys. Documenting nearly every species on property in just 6 weeks emphasizes the value of targeted surveys and the utility of concurrent passive and active surveying efforts. We nearly accomplished in this concerted effort what 18 y of surveys discovered. Therefore, if managers wish to survey for or manage for all mammalian species, we emphasize the utility of first casting a wide net and then following up with targeted surveys to fill in the blanks. For those aiming to focus on one species, we advise jumping to taxon-specific methods to maximize efficiency (Goodenough & Perks, 2025).

Bioblitzes are beneficial for the purpose of collecting site-specific data at quicker paces than typical studies. They remain multi-functional events that can encompass research, education and public engagement (Parker, 2018). At the Selu Conservancy, nearly annual bioblitzes remain a priority tactic to engage students and welcome the general public to the property. In recent years, the Radford University administration has aimed to increase utilization of the property by university courses and by hosting field days in which the public can explore the oft-gated property. While we recognize that bioblitzes remain a snapshot in time, their collective management value remains high. Interpretation of single-year or collective data across decades provide qualitative and quantitative metrics about mammals. Management decisions depend on a solid understanding of the wildlife that use the property as seasonal or residential inhabitants - and our continued and varied survey efforts support educational and conservation goals.

ACKNOWLEDGEMENTS

The Radford University Foundation owns the Selu Conservancy, and the property's conservation easement is managed by the Virginia Outdoors Foundation. Radford University's Biology Department supported this work as part of our vertebrate zoology course in fall 2025. Multiple members of the Virginia Natural History Society co-hosted the bioblitz and assisted with bioblitz events. We appreciate R. Reynolds (DWR) confirming muskrat image identification. We thank W. M. Ford (USGS Co-op at Virginia Tech) for running the bat calls through Kaleidoscope software. We completed mammalian surveys under Powers' scientific collecting permit through the Virginia Department of Wildlife Resources (VWDR) and report data from previous permits issued to Powers (née Francl, in permits prior to 2013) through VDWR since 2007.

REFERENCES

Brakes, C. R., & R. H. Smith. 2005. Exposure of non-target small mammals to rodenticides: Short-term effects, recovery and implications for secondary poisoning. Journal of Applied Ecology 42(1): 118–128.

De La Cruz, J. L., R. J. Reynolds, W. Orndorff, T. Malabad, K. Kosič Ficco, K. E. Powers, & W. M. Ford. 2024. Seasonal activity patterns of northern long-eared bats at hibernacula in western Virginia. Journal of the Southeastern Association of Fish and Wildlife Agencies 11: 196–205.

Eccard, J. A., & I. Klemme. 2013. Reducing mortality of shrews in rodent live trapping- A method increasing live-trap selectivity with shrew exits. Annales Zoologici Fennici 50(6): 371–376.

Foster, M. A., L. I. Muller, S. A. Dykes, R. P. Wyatt, & M. J. Gray. 2013. Efficacy of bioblitz surveys with implications for sampling nongame species. Journal of the Tennessee Academy of Science 88: 56–62.

Gass, S., A. Mui, P. Manning, H. Cray, & L. Gibson. 2021. Exploring the value of a bioblitz as a biodiversity education tool in a post-secondary environment. Environmental Education Research 27(10): 1538–1556.

Gigliotti, F. N., T. P. Franzem, & F. B. Ferguson. 2023. Rapid, recurring, structured survey versus bioblitz for generating biodiversity data and analysis with a multispecies abundance model. Conservation Biology 37(2): e13996. DOI: 10.1111/cobi.13996

Goodenough, A. E., & S. J. Perks. 2025. Using non-invasive and minimally-invasive methods to inform conservation of terrestrial mammals: A review of novel techniques and new applications. Journal for Nature Conservation 88: 127049. DOI: 10.1016/j.jnc.2025.127049

Kerr, J., & L. Packer. 1997. Habitat heterogeneity as a determinant of mammal species richness in high-energy regions. Nature 385: 252–254.

Mac Aodha, O., R. Gibb, K. E. Barlow, E. Browning, M. Firman, R. Freeman, & K. E. Jones. 2018. Bat detective—Deep learning tools for bat acoustic signal detection. PLoS Computational Biology 14: e1005995. DOI: 10.1371/journal.pcbi.1005995

Mammal Diversity Database. 2025. Mammal Diversity Database (Ver.2.3). Zenodo. DOI: 10.5281/zenodo.17033774 (Accessed 20 November 2025).

Meeus, S., I. Silva-Rocha, T. Adriaens, P. Brown, N. Chartosia, B. Claramunt-López, A. Martinou, M. Pocock, C. Preda, H. Roy, E. Tricarico, & Q. Groom. 2023. More than a bit of fun: The multiple outcomes of a bioblitz. BioScience 73(3): 168–181.

Parker, S. S., G. B. Pauly, J. Moore, N. S. Fraga, J. J. Knapp, Z. Principe, B. V. Brown, J. M. Randall, B. S. Cohen, & T. A. Wake. 2018. Adapting the bioblitz to meet conservation needs. Conservation Biology 32(5): 1007–1019.

Postles, M., & M. Bartlett. 2018. The rise of bioblitz: Evaluating a popular event format for public engagement and wildlife recording in the United Kingdom. Applied Environmental Education and Communication 17: 365–379.

Reynolds, R. J., & R. T. Fernald. 2015 A Guide to the Bats of Virginia. Special Publication No. 5. Virginia Department of Game and Inland Fisheries, Henrico, VA. 40 pp.

Rhodes, J. R., D. Lunney, C. Moon, A. Matthews, & C.A. McAlpine. 2010. The consequences of using indirect signs that decay to determine species' occupancy. Ecography 34(1): 141–150.

Roberts, N. J. 2011. Investigation into survey techniques of large mammals: Surveyor competence and camera-trapping vs. transect-sampling. Bioscience Horizons 4(1): 40–49.

Stephens, R. B., & E. M. Anderson. 2014. Effects of trap type on small mammal richness, diversity, and mortality. Wildlife Society Bulletin 38(3): 619–627.

Sullivan, S. P., & D. S. Sullivan. 2010. Forecasting vole population outbreaks in forest plantations: The rise and fall of a major mammalian pest. Forest Ecology and Management 260(6): 983–993.

Wogsland, J. R. 2020. Diel activity patterns of southern flying squirrels (*Glaucomys volans*). M.S. thesis, Tennessee Technological University, Cookeville, TN. 47 pp.

Appendix 1. List of mammalian species documented at Selu Conservancy, Montgomery Co., Virginia from 12 September - 28 October 2025. Included is date first documented and method of detection (visual, acoustic-active [active acoustic detection by observer], acoustic-passive [Songmeter bat detector], and game camera). Species marked "N/D" were detected in previous surveys but not in this current project. Taxonomy follows ASM's Mammal Diversity Database (2025).

Family	Species	Common name	First detection date	First detection method
Order Didelphimorphia				
Didelphidae	*Didelphis virginiana* (Kerr)	Virginia opossum	18 Sep	Game camera
Order Eulipotyphla				
Soricidae	*Blarina brevicauda* (Say)	northern short-tailed shrew	13 Oct	Sherman
Soricidae	*Sorex cinereus* Kerr	masked shrew	N/D	
Order Chiroptera				
Vespertilionidae	*Eptesicus fuscus* (Beauvois)	big brown bat	12 Sep	Visual + Acoustic-active
Vespertilionidae	*Lasiurus borealis* Müller	eastern red bat	16 Sep	Acoustic-passive
Vespertilionidae	*Lasiurus cinereus* (Beauvois)	hoary bat	18 Sep	Acoustic-passive
Vespertilionidae	*Perimyotis subflavus* (F. Cuvier)	tricolored bat	28 Sep	Acoustic-passive
Vespertilionidae	*Lasionycteris noctivagans* (Le Conte)	silver-haired bat	17 Sep	Acoustic-passive
Order Rodentia				
Cricetidae	*Microtus pennsylvanicus* (Ord)	meadow vole	N/D	
Cricetidae	*Ondatra zibethicus* (L.)	muskrat	11 Oct	Game camera
Cricetidae	*Peromyscus leucopus* (Raf.)	white-footed deermouse	13 Sep	Sherman
Cricetidae	*Peromyscus maniculatus* (J. A. Wagner)	eastern deermouse	23 Sep	Sherman
Cricetidae	*Reithrodontomys humulis* (Audubon &	eastern harvest mouse	13 Oct	Sherman
Muridae	*Mus musculus* L.	house mouse	13 Oct	Sherman
Sciuridae	*Glaucomys volans* (L.)	southern flying squirrel	N/D	
Sciuridae	*Marmota monax* (L.)	woodchuck	6 Oct	Game camera
Sciuridae	*Sciurus carolinensis* J. F. Gmelin	eastern gray squirrel	13 Sep	Visual
Sciuridae	*Sciurus niger* L.	eastern fox squirrel	17 Sep	Game camera
Sciuridae	*Tamias striatus* (L.)	eastern chipmunk	19 Sep	Game camera
Order Carnivora				
Canidae	*Canis latrans* Say	coyote	13 Sep*/ 22 Oct	Wildlife sign*/Game camera

Cont.

Canidae	*Vulpes vulpes* (L.)	red fox	15 Oct	Game camera
Canidae	*Urocyon cinereoargenteus* (von Schreber)	northern gray fox	N/D	
Felidae	*Felis catus* L.	domestic (feral) cat	N/D	
Felidae	*Lynx rufus* (Schreber)	bobcat	4 Oct	Game camera
Mustelidae	*Lontra canadensis* (von Schreber)	North American river otter	N/D	
Mephitidae	*Mephitis mephitis* (von Schreber)	striped skunk	8 Oct	Game camera
Procyonidae	*Procyon lotor* (L.)	raccoon	18 Sep	Game camera
Ursidae	*Ursus americanus* Pallas	black bear	25 Oct	Game camera
Order Lagomorpha				
Leporidae	*Sylvilagus floridanus* (J. A. Allen)	eastern cottontail	13 Sep	Visual
Order Artiodactyla				
Cervidae	*Odocoileus virginianus* (Zimmermann)	white-tailed deer	13 Sep	Visual

*Wildlife sign (scat) confidently identied as coyote, but 100% confirmation date from camera also noted