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RESEARCH ARTICLE

SEASONAL LIMITATIONS TO DOCUMENTING SPECIES RICHNESS OF BIRDS AND HERPETOFAUNA AT SELU CONSERVANCY, MONTGOMERY COUNTY, VIRGINIA

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ABSTRACT

Bioblitzes are local, collaborative surveys designed to maximize species detection in a brief time. At Radford University's Selu Conservancy (Montgomery Co., VA), we compared avian and herpetofaunal species richness documented during a late-summer 2-d bioblitz to cumulative surveys in the proceeding 6 weeks. Comparing species richness counts of both survey efforts to long-term (18-y) species lists of the property, we quantified seasonal limitations of short-term events. Using active survey methods, including visual, auditory, and physical capture/release, we documented 35 of 85 known bird species (41.2%) and 9 of 21 known herpetofaunal species (42.9%) during the bioblitz. Over the next 6 weeks, we documented a total of 52 bird species (61.2%) and added just one reptile and one amphibian to our species lists (52.4% of known species). We suggest that bioblitz planners take weather limitations and migratory dynamics into consideration when setting realistic goals for bioblitzes. Despite low richness estimates for these taxa, bioblitz surveys remain a welcome avenue of engagement for experts, students, and citizen scientists.

Keywords: Bioblitz, amphibian, migration, reptile, weather.

INTRODUCTION

Repeated large-effort, limited-time surveys for vertebrates are common, and include national efforts to identify and count birds, like the Christmas Bird Count and Breeding Bird Survey (e.g., Robben & Tudor, 1973; Butcher et al., 1990; Link & Sauer, 1999). Similarly, the North American Amphibian Monitoring Program has been used to quantify amphibian populations (e.g., Weir et al., 2005). Two of these national events occur during the periods of greatest

reproductive activity, suggesting that seasonal, targeted surveys are imperative for animals that migrate, hibernate, or brumate. Across multiple taxa, local bioblitzes are common citizen science-driven events aimed to maximize natural history data collection in a brief time (Baker et al., 2014). Although taxon-specific surveys do take seasonality into consideration, bioblitzes may disregard seasonal limitations for the good of the educational and public benefits. Past assessments of bioblitzes suggest that a two-to-three-day survey, even when utilizing many volunteers and multiple active survey types, would likely fail to identify all species present in the area being studied. Foster et al. (2013) report that bioblitzes can document 38-87% of vertebrate species present, and the levels of success are taxon-specific. Surveys in late-summer or fall months must acknowledge limitations in documenting seasonally dynamic taxa, like birds, reptiles, and amphibians.

Bird species richness is fluid during the migratory period; temperate populations remain in a state of flux as individuals arrive and depart local areas (Somveille et al., 2015). Further, even when present, detection rates may be lower in the fall; because males are not actively defending territories, bird songs by which surveyors identify species are seasonally reduced (Williams, 2004). Additional factors like time of day may also affect detection, with song frequency at its maximum during early daylight hours (Robbins, 1981).

Similarly, amphibian calls are detected most often during the breeding season and nocturnally (Oseen & Wassersug, 2002) and general activity is affected by rain events (Ospina et al., 2013). Detection of non-calling taxa, like terrestrial reptiles, is most often driven by temperature, and they are markedly less active in the colder seasons, with many species entering brumation as temperatures fall (Hedley et al., 2018). Aquatic herpetofauna, like turtles, may remain detectable into fall months, basking so long as ambient temperatures exceed 10°C (Ernst, 1972). However, as ambient temperatures seasonally decline, detection probability declines, as well.

Given these acknowledged limitations to bird and herpetofaunal surveys in the late summer and early fall months, we asked how well a two-day bioblitz could estimate species richness for each group. Further, we questioned whether continued and directed surveys for these groups into fall months could better reach accurate estimates of species richness, or if seasonality and prevailing weather patterns were too great of a barrier to detection.

Our study focused on a mid-September bioblitz held at the Radford University's Selu Conservancy in Montgomery Co., Virginia. Since 2007, 13 spring or fall bioblitzes have been held here. Species lists were created by these bioblitz results, combined with longer-term surveys for amphibians (Francl et al., 2010; Powers et al., 2024; spring/summer), reptiles (M. Close, unpublished data; summer), and birds (Powers, unpublished data; summer, winter), as well as anecdotal faculty, staff, and student observations (Vannoy et al., 2025; J. Armistead, personal observation; R. Sheehy, personal observation). We compared these multi-season, multi-year species lists (Appendix 1, 2) to those we documented in the single 2025 bioblitz. We continued surveys for an additional six weeks post-bioblitz to determine the efficacy of fall surveys for birds, reptiles, and amphibians.

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. This gated property is managed in a conservation easement by the Virginia Outdoors Foundation. Available habitats on-property are second-growth mature deciduous forests that includes >20 sinkholes scattered across the northeast portion of the property, two vernal pools, riparian habitat along the Little River, and early successional habitats that are managed by prescribed fire or by annual bush-hogging. Numerous, maintained hiking trails border sinkholes and traverse the northern and eastern ends of the property. Well-maintained gravel roads lead to the Selu Observatory and research/retreat buildings, an overlook trail on the Little River, and a boat dock and boat launch at the river.

Field methods

Bioblitz surveys for birds and herpetofauna were conducted 12-13 September 2025, utilizing active (visual, audio, or capture) surveying techniques. Herpetofaunal efforts included: deployment of 8 hoop nets for turtles, each baited with an open can of tuna in oil (set 1730 h on 12 September, retrieved 1000 h on 13 September), set in the shallows of the Little River; and three bouts (one at 2000 h on 12 September, two at 0830 and 1015, lasting up to 2.0 h each) of active walking surveys for herpetofauna (turning over rocks and logs) in the eastern half of the property. Walks were led by 2-3 seasoned experts in herpetology and included 4-8 volunteers. Bird efforts at bioblitz consisted of opportunistic, anecdotal surveys by multiple avian experts on 12-13 September, plus a planned bird walk on 13 September at 0700 h (1.5 h). Expert birders identified birds by sight and by sound. We also utilized Cornell Lab's Merlin Bird ID (Ithaca, NY) acoustic detection app to alert the surveyors of bird species it detected. By focusing on species-specific calls, this method of surveying has potential benefits in acoustic surveys (Pérez-Granados & Traba, 2021). However, we chose not to use Merlin as a stand-alone identifier. We only included species for which bird experts could confirm visual or acoustic identification in real time.

From 16 September – 28 October 2025, we continued weekly bird surveys, adding bird species to our list while conducting intentional bird surveys (1-2 h/week) and documenting them anecdotally while completing other surveying activities. We completed team efforts of herpetofaunal surveys on three mornings in September (16, 23, 30; 60-90 min/survey with 4-7 surveyors per search), continuing to visit vernal pools, sinkholes, and riparian habitats. We ceased walking surveys when ambient temperatures were consistently below 10°C during potential survey times (Twomey et al., 2025). We redeployed four hoop nets in the Little River from 12-14 October 2025. Finally, game cameras, primarily set for mammal detection (Jones et al., 2025) could opportunistically document birds and herpetofauna.

RESULTS

We documented 52 bird species from 12 September to 28 October 2025; 35 of these species were documented during our hosted bioblitz, and 17 were added incrementally in subsequent surveys (Fig. 1; Appendix 1). Game cameras, in 493 trap-nights (Jones et al., 2025), documented

birds (Fig. 1), but no new bird species were added because of this effort. No reptiles or amphibians were discovered in camera analyses.

In ca. 6 h of walking surveys at bioblitz, we hand-captured six amphibian species and two reptile species (of 21 known species; Appendix 2). Further, hoop traps captured one adult ♂ and two adult ♀ painted turtles (*Chrysemys picta* [Schneider]) on 13 September. In September surveys after bioblitz (ca. 6 h, collectively), we captured one additional salamander species and found wildlife sign (carapaces) of three woodland box turtles (*Terrapene carolina* [L.]; Fig. 2). October hoop-trapping failed to capture turtles. We therefore documented 11 of 21 known amphibian and reptile species on the property.

Figure 1. Images of birds captured on game cameras or real-time personal observations at Selu Conservancy, Montgomery Co., VA in 2025: (A) American crow (*Corvus brachyrhynchos*), (B) red-tailed hawk (*Buteo jamaicensis*), (C) wild turkey (*Meleagris gallopavo*), and (D) great blue heron (*Ardea herodias*).

DISCUSSION

Efforts across amphibians, reptiles, and birds suggest that species richness is not accurately estimated in a 2-day bioblitz, and that continued surveys into fall months are limited for herpetofauna, especially, for myriad climate factors. Estimates of bird species richness were proportionally higher after 6 weeks of surveys (41.2% at biolitz, increasing to 61.2%) compared to herpetofauna (42.9% increasing to 52.4%). Avian species richness likely fluctuated with seasonal migrations, and surveys did not continue far enough into the autumn months to document the arrival of winter residents (e.g., northern juncos [*Junco hyemalis* (L.)], we anecdotally noted, arrived in mid-November).

Figure 2. Images of amphibians and reptiles documented at Selu Conservancy, Montgomery Co., VA in 2025: (A) American toad (*Anaxyrus americanus*; image courtesy of J. Gibson), (B) central ratsnake (*Pantherophis alleghaniensis*; image courtesy of J. Gibson), (C) Jefferson salamander (*Ambystoma jeffersonianum;* image courtesy of J. Gibson), (D) painted turtle (*Chrysemys picta*), (E) eastern red-backed salamander (*Plethodon cinereus*), and (F) eastern box turtle (*Terrapene carolina*).

Similarly, although the bioblitz was a substantial effort that recorded 9 of 21 herpetofaunal species, additional herpetofaunal surveys that continued 6 weeks after the conclusion of bioblitz did not substantially increase our species richness counts. Likely limitations to herpetological detection were moisture and temperature. The month of September was extremely dry, and southwest Virginia was in a period of drought (U.S. Drought Monitor, 2025). Trace amounts of rain were recorded ca. 8 d prior to and 11 d after bioblitz, and no substantial rain event occurred until 28-29 September (<2 cm rain event; Weather Underground, 2025). Only after this event did we capture eastern red-backed salamanders (*Plethodon cinereus* [Green]) on 30 September. Temperatures after 30 September remained <10 °C during property visits; the trade-off of effort versus success seemed counterproductive (Twomey et al., 2025).

We, therefore, conclude that bioblitzes and subsequent fall sampling do not adequately document species use for both birds and herpetofauna. Many factors are out of our control, like active migratory choices that drive avian detection and weather patterns (e.g., rainfall and ambient temperatures) that influence herpetofaunal detection. Therefore, when addressing these taxa, we suggest setting realistic goals for species detection in a bioblitz, rather than a goal of documenting all species in a location. Given the nature of bioblitz planning and preparation, the success of the effort is largely determined by the seasonal and daily environmental contexts. Further, leaders who organize such events are limited by those same variables and can only plan with knowledge of expected seasonal weather patterns.

If the goal is to maximize detection of each taxon, we suggest surveys during respective reproductive seasons to maximize acoustic detection of birds and amphibians (Oseen & Wassersug, 2002; Williams, 2004) and increased crepuscular or nocturnal surveys to document reptiles (Parris, 1999). Targeting riparian environments and adjacent areas may increase avian and amphibian detection (Peak & Thompson, 2006). Further, even in reproductive seasons, amphibian surveys should track rain events and temperature, increasing flexibility to meet weather patterns (Mazerolle et al., 2007).

Despite our inability to document more than one third of our birds and nearly half of our herpetofauna, our 2025 bioblitz surveys at the Selu Conservancy provided a welcome avenue of engagement for novice university students interacting with local experts in avian identification (local bird club members, retired faculty) and herpetology experts from regional universities. These interactions and learning opportunities provide unquantifiable benefits to students, and, indeed, participants of all ages and skill sets (Chikering & Gamson, 1987; Meeus et al., 2023). Further, because management decisions at the multi-use Selu Conservancy are driven by myriad stakeholder needs, our efforts to document avian and herpetofaunal species presence and persistence contribute necessary data to support educational and conservation goals.

Though a single bioblitz is a snapshot in time, their collective tallies paint a long-term picture of species use and relative activity. Given that our cumulative species lists were built on a backbone of 13 spring and fall bioblitzes since 2007, we emphasize that repeated and varied-season bioblitzes have present and potential value. Implementation of the citizen science activities that can be flexible with start and end dates (e.g., Great Backyard Bird Count, 2025) may elucidate that these surveys are increasingly important in future conservation efforts (Parker et al., 2018). Collective and collaborative efforts like these continue to keep taxon experts, students, and citizen scientists engaged and contributing to conservation efforts on a large scale.

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previous permits issued to Powers (née Francl, in permits prior to 2013) through VDWR since 2007.

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Appendix 1. List of bird species documented at Selu Conservancy, Montgomery Co., VA since 2007 (N=85). Date each species was first documented in 2025 surveys listed. We documented 35 species during bioblitz (12-13 September 2025) and cumulatively, 52 species through 28 October 2025 surveys. N/D = not detected in 2025 surveys. Taxonomy follows AOU standards (Chesser et al., 2025).

Family	Scientific name	Common name	First detection date
Order Pelecaniformes			
Ardeidae	*Ardea alba* L.	great egret	N/D
Ardeidae	*Ardea herodias* L.	great blue heron	12-13 Sep
Ardeidae	*Butorides virescens* (L.)	green heron	N/D
Order Anseriformes			
Anatidae	*Branta canadensis* (L.)	Canada goose	12-13 Sep
Anatidae	*Mergus merganser* L.	common merganser	N/D
Order Falconiformes			
Falconidae	*Falco sparverius* L.	American kestrel	N/D
Order Accipitriformes			
Accipitridae	*Buteo jamaicensis* (Gmelin)	red-tailed hawk	12-13 Sep
Accipitridae	*Buteo lineatus* (Gmelin)	red-shouldered hawk	7 Oct
Accipitridae	*Buteo platypterus* (Vieillot)	broad-winged hawk	N/D
Order Cathartiformes			
Cathartidae	*Cathartes aura* (L.)	turkey vulture	12-13 Sep
Cathartidae	*Coragyps atratus* (Bechstein)	black vulture	21 Oct
Order Galliformes			
Phasianidae	*Meleagris gallopavo* L.	wild turkey	12-13 Sep
Order Charadriiformes			
Charadriidae	*Charadrius vociferus* L.	killdeer	21 Oct
Order Columbiformes			
Columbidae	*Zenaida macroura* (L.)	mourning dove	N/D
Order Cuculiformes			
Cuculidae	*Coccyzus americanus* (L.)	yellow-billed cuckoo	23 Sep
Order Strigiformes			
Strigidae	*Megascops asio* (L.)	eastern screech-owl	12-13 Sep
Order Apodiformes			
Apodidae	*Chaetura pelagica* (L.)	chimney swift	N/D
Trochilidae	*Archilochus colubris* (L.)	ruby-throated hummingbird	N/D
Order Coraciiformes			
Alcedinidae	*Megaceryle alcyon* (L.)	belted kingfisher	12-13 Sep
Order Piciformes			
Picidae	*Colaptes auratus* (L.)	northern flicker	12-13 Sep
Picidae	*Dryobates pubescens* (L.)	downy woodpecker	12-13 Sep
Picidae	*Dryobates villosus* (L.)	hairy woodpecker	21 Oct
Picidae	*Dryocopus pileatus* (L.)	pileated woodpecker	12-13 Sep

Cont.			
Picidae	*Melanerpes carolinus* (L.)	red-bellied woodpecker	12-13 Sep
Picidae	*Melanerpes erythrocephalus* (L.)	red-headed woodpecker	12-13 Sep
Picidae	*Sphyrapicus varius* (L.)	yellow-bellied sapsucker	7 Oct
Order Passeriformes			
Bombycillidae	*Bombycilla cedrorum* Vieillot	cedar waxwing	12-13 Sep
Cardinalidae	*Cardinalis cardinalis* (L.)	northern cardinal	12-13 Sep
Cardinalidae	*Passerina cyanea* (L.)	indigo bunting	12-13 Sep
Cardinalidae	*Piranga olivacea* (Gmelin)	scarlet tanager	12-13 Sep
Cardinalidae	*Piranga rubra* (L.)	summer tanager	N/D
Cethiidae	*Certhia americana* Bonaparte	brown creeper	N/D
Corvidae	*Corvus brachyrhynchos* Brehm	American crow	12-13 Sep
Corvidae	*Corvus corax* L.	common raven	16 Sep
Corvidae	*Cyanocitta cristata* (L.)	blue jay	12-13 Sep
Fringillidae	*Haemorhous mexicanus* (Müller)	house finch	21 Oct
Fringillidae	*Spinus pinus* (Wilson)	pine siskin	N/D
Fringillidae	*Spinus tristis* (L.)	American goldfinch	12-13 Sep
Hirundinidae	*Tachycineta bicolor* (Vieillot)	tree swallow	23 Sep
Icteridae	*Agelaius phoeniceus* (L.)	red-winged blackbird	N/D
Icteridae	*Icterus galbula* (L.)	Baltimore oriole	N/D
Icteridae	*Molothrus ater* (Boddaert)	brown-headed cowbird	N/D
Icteridae	*Quiscalus quiscula* (L.)	common grackle	N/D
Icteridae	*Sturnella magna* (L.)	eastern meadowlark	N/D
Mimidae	*Dumetella carolinensis* (L.)	gray catbird	12-13 Sep
Mimidae	*Mimus polyglottos* (L.)	northern mockingbird	12-13 Sep
Mimidae	*Toxostoma rufum* (L.)	brown thrasher	12-13 Sep
Paridae	*Baeolophus bicolor* (L.)	tufted titmouse	12-13 Sep
Paridae	*Poecile carolinensis* (Audubon)	Carolina chickadee	12-13 Sep
Parulidae	*Leiothlypis peregrina* (Wilson)	Tennessee warbler	23 Sep
Parulidae	*Seiurus aurocapilla* (L.)	ovenbird	N/D
Parulidae	*Setophaga coronata* (L.)	yellow-rumped warbler	12-13 Sep
Parulidae	*Setophaga palmarum* (Gmelin)	palm warbler	21 Oct
Parulidae	*Setophaga petechia* (L.)	yellow warbler	23 Sep
Parulidae	*Setophaga pinus* (L.)	pine warbler	N/D
Parulidae	*Setophaga tigrina* (Gmelin)	Cape May warbler	16 Sep
Passerellidae	*Junco hyemalis* (L.)	dark-eyed junco	N/D
Passerellidae	*Melospiza melodia* (Wilson)	song sparrow	16 Sep
Passerellidae	*Pipilo erythrophthalmus* (L.)	eastern towhee	12-13 Sep
Passerellidae	*Spizella passerina* (Bechstein)	chipping sparrow	N/D
Passerellidae	*Spizella pusilla* (Wilson)	field sparrow	N/D
Passerellidae	*Zonotrichia albicollis* (Gmelin)	white-throated sparrow	12-13 Sep
Passeridae	*Passer domesticus* (L.)	house sparrow	N/D
Polioptilidae	*Polioptila caerulea* (L.)	blue-gray gnatcatcher	23 Sep
Regulidae	*Regulus satrapa* (Lichtenstein)	golden-crowned kinglet	N/D
Sittidae	*Sitta carolinensis* Latham	white-breasted nuthatch	12-13 Sep

Cont.

Sturnidae	*Sturnus vulgaris* L.	European starling	N/D
Troglodytidae	*Thryothorus ludovicianus* (Latham)	Carolina wren	12-13 Sep
Troglodytidae	*Troglodytes hiemalis* Vieillot	winter wren	N/D
Turdidae	*Catharus guttatus* (Pallas)	hermit thrush	N/D
Turdidae	*Hylocichla mustelina* (Gmelin)	wood thrush	12-13 Sep
Turdidae	*Sialia sialis* (L.)	eastern bluebird	12-13 Sep
Turdidae	*Turdus migratorius* L.	American robin	12-13 Sep
Tyrannidae	*Contopus virens* (L.)	eastern wood-pewee	16 Sep
Tyrannidae	*Empidonax trailli* (Audubon)	willow flycatcher	N/D
Tyrannidae	*Empidonax virescens* (Vieillot)	Acadian flycatcher	12-13 Sep
Tyrannidae	*Myiarchus crinitus* (L.)	great crested flycatcher	N/D
Tyrannidae	*Sayornis phoebe* (Latham)	eastern phoebe	7 Oct
Tyrannidae	*Tyrannus tyrannus* (L.)	eastern kingbird	N/D
Vireonidae	*Vireo flavifrons* Vieillot	yellow-throated vireo	12-13 Sep
Vireonidae	*Vireo griseus* (Boddaert)	white-eyed vireo	12-13 Sep
Vireonidae	*Vireo olivaceus* (L.)	red-eyed vireo	N/D

Appendix 2. List of amphibian (N=12) and reptile (N=9) species documented at Selu Conservancy, Montgomery Co., VA since 2007. Date each species was first documented and method of detection (hand capture, hoop net, visual/not captured, or wildlife sign) in 2025 surveys listed; six amphibian species and three reptiles were documented during the bioblitz surveys (12-13 September). Cumulatively, we found seven amphibians and four reptiles in subsequent surveys through 14 October 2025. Taxonomy follows SSAR 9th ed. standards (Nicholson [ed.], 2025).

Family	Scientific name	Common name	First detection date	First detection method
Class Amphibia				
Order Caudata				
Ambystomatidae	*Ambystoma jeffersonianum* (Green)	Jefferson salamander	12-13 Sep	Hand capture
Plethodontidae	*Plethodon cinereus* (Green)	eastern red-backed salamander	30-Sep	Hand capture
Plethodontidae	*Plethodon cylindraceus* (Harlan)	white-spotted slimy salamander	12-13 Sep	Hand capture
Plethodontidae	*Plethodon jacksoni* Newman	Blacksburg salamander	12-13 Sep	Hand capture
Salamandridae	*Notophthalmus viridescens* (Raf.)	eastern newt	N/D	
Order Anura				
Bufonidae	*Anaxyrus americanus* (Holbrook)	American toad	12-13 Sep	Hand capture
Hylidae	*Dryophytes versicolor* (LeConte)	gray treefrog	N/D	
Hylidae	*Pseudacris crucifer* (Wied-Neuwied)	spring peeper	12-13 Sep	Hand capture
Ranidae	*Lithobates catesbeianus* (Shaw)	North American bullfrog	N/D	
Ranidae	*Lithobates clamitans* (Latreille)	North American green frog	12-13 Sep	Visual/image
Ranidae	*Lithobates palustris* (LeConte)	pickerel frog	N/D	
Ranidae	*Lithobates sylvaticus* (LeConte)	wood frog	N/D	
Class Reptilia				
Order Testudines				
Chelydridae	*Chelydra serpentina* (L.)	North American snapping turtle	N/D	
Emydidae	*Chrysemys picta* (Schneider)	painted turtle	12-13 Sep	Hoop net
Emydidae	*Terrapene carolina* (L.)	eastern box turtle	16-Sep	Sign
Order Squamata				
Colubridae	*Carphophis amoenus* (Say)	eastern worm snake	N/D	
Colubridae	*Diadophis punctatus* (L.)	ring-necked snake	N/D	
Colubridae	*Pantherophis alleghaniensis* (Holbrook)	central ratsnake	12-13 Sep	Hand capture
Colubridae	*Nerodia sipedon* (L.)	common watersnake	N/D	
Colubridae	*Thamnophis sirtalis* (L.)	common gartersnake	12-13 Sep	Hand capture
Viperidae	*Agkistrodon contortrix* (L.)	eastern copperhead	N/D	