Eastern Spadefoots in Virginia: Observations Made from Volunteer Herpetologists Around the State.

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Abstract: The Eastern Spadefoot is a secretive, fossorial, and explosive breeding frog for which much of its ecology and distribution is still relatively unknown in Virginia. For the past two and a half years we have collected distributional and phenological data on the Eastern Spadefoot from 58 volunteer herpetologists from around the state. Data collected includes activity dates, geographic locations, habitat associations, and other natural history information. The earliest recorded activity for spadefoots in Virginia was 12 January and the latest was 26 December. Spadefoot activity was observed in every month except March and November. The months of May and June had the largest frequency of spadefoot activity. Chorusing males were reported from 25 February to 8 September; May and June had the highest frequency of reported calling observations. We report 8 new county records, 1 new city record, and 24 confirmation county records for this species. One volunteer observed a domestic cat attacking a spadefoot and another volunteer observed an Eastern Hog-nosed snake preying on an Eastern Spadefoot. There is much that remains to be known about this species.

Key Words: *Scaphiopus holbrookii*, Biogeography, Phenology, Deformity, Domestic Cat, Citizen Science

INTRODUCTION

The Eastern Spadefoot is a medium sized frog characterized by two small round parotoid glands, vertical pupils, two yellow or white colored dorsal stripes, and cornified metatarsal tubercles on the bottom of each hind foot (Figure 1). The dorsum of this frog has numerous granular glands, many being reddish in coloration and the ventrum has a pair of granular pectoral glands. The cornified metatarsal tubercles are used to create a burrow or series of burrows which it uses for concealment. The spadefoot is

philopatric to these burrows and has an established home range of 8 - 10 m^2 (Pearson, 1955). Pearson (1955) found Eastern Spadefoots to be nocturnal and active only 29 nights a year in Florida. Breeding is triggered by substantial rain events and occurs in temporary wetlands. Reproduction is nocturnal and, in some years, may not occur at all. This collection of unique characteristics makes the spadefoot a rare frog to find.

Figure 1. Photograph of male Eastern Spadefoot.

The Virginia Department of Game and Inland Fisheries wildlife action plan rating for this species is Tier IVc. This rating means that there is moderate conservation needs and the managers have failed to identify "on the ground" actions or research needs that could benefit the species (Sevin and Kleopfer, 2015). Eastern Spadefoots were first documented for Virginia in 1916 (Fowler, 1918). It took another 11 years for the second record of this species to be found and recorded in 1927 (Trautman, 1931). Merkle (1977) was the first to publish a map of Eastern Spadefoots in Virginia. His map plotted spadefoots collected between 1916 and 1977. In total, only 13 records were recorded on his map. At that time most records came from frogs found in the coastal plain and ridge and valley physiographic provinces. By 1985, Tobey (1985) plotted 29 records for Eastern Spadefoots in the first herp atlas he compiled. Mitchell and Reay (1999) plotted 63 spadefoot locations in their herp atlas. Currently, there are 46 counties and cities with records of spadefoots and the most current and accurate map available is archived on the Virginia Herpetological Society's website (Figure 2, accessed 13 August 2019). This map includes records from Mitchell and Reay (1999), the Virginia Fish and Wildlife Information Service and records published in Catesbieana and Herpetological Review.

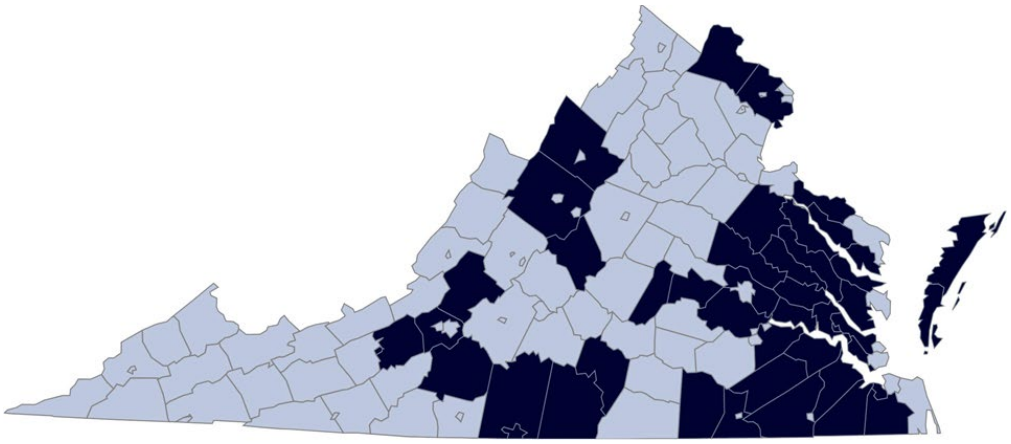

Figure 2. Most current county record map for Eastern Spadefoots in Virginia subsequent to this study. (Accessed 13 August 2019 https://www.virginiaherpetologicalsociety.com/amphibians/frogsandtoads/eastern-spadefoot/eastern_spadefoot.php)

There is still a lot to be known about Eastern Spadefoots in Virginia. The biogeography of this species is still largely unknown, especially in the piedmont and western part of the state. The phenology of this species is also lacking many records for our state (Church, et. al., 2002; Sattler and Gibson, 2007; Gibson and Sattler, 2010). The purpose of this paper is to shed more light on the distribution and natural history of this animal.

MATERIALS AND METHODS

In order to gain a better understanding of the natural history and geographic distribution of this species, we enlisted the help of volunteer herpetologists around the state. To do this we designed and deployed an Eastern Spadefoot wanted poster (Figure 3). Our hope was to stimulate the herping community to share distributional and phenological data which would help fill some of the gaps in our knowledge of this species. The poster had a simple description of the Eastern Spadefoot, suggestions on where they might be found, an explanation of why we were conducting this project, and contact information for sending in observations. We advertised this wanted poster on the Virginia Herpetological Society's Facebook page. Additionally, John White (the VHS webmaster) created a spadefoot reporting link on the homepage of the VHS website. The wanted poster was also posted on the homepage of the Virginia Master Naturalists website. Over the course of this two-and-a-half-year project we answered more than 70 emails. For each email received we followed up thanking the individual and asked questions for clarification of the observation. Table 1 includes the date of observation, location, and observer name for each person submitting data for this project.

Why are we interested in this frog?
Very little is known about the distribution and habits of this species in Virginia. We think this frog is more common and more widespread than what is currently known. This is why we are asking for your help in increasing our knowledge about this secretive frog.

Identifying characteristics include:

- Vertical oriented pupils
- Brownish colored body (the color is highly variable)
- Two yellow lines running along the back
- 2-3 inches long
- For more pictures of Eastern Spadefoots and and look-alike toads visit the VHS website http://www.virginiaherpetologicalsociety.com/

Places to look

- Roads near wetlands
- Vernal pools (temporary bodies of water which dry up by the end of the summer)
- Ditches
- Swimming pools
- Flooded agricultural fields

When to look
After heavy rains, perhaps during any month of the year.

How can you assist in this project?
If you see, hear, or make any observation of an Eastern Spadefoot, then take several digital photos of it from a side view and a back view. You may also digitally record it calling. Please send digital photos, recordings, or any observation (including location information) to:

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Patrick HENRY Community College

Reynolds COMMUNITY COLLEGE

This project is a collaborative project of Patrick Henry Community College, Reynolds Community College, the Virginia Herpetological Society, and the Virginia Department of Game and Inland Fisheries.

Figure 3. Eastern Spadefoot wanted poster.

Table 1. Data collected from participants. Organized alphabetically by county.

Name of the observer	County/City	Date of observation	VHS Archive Number	Count Record or Confirmation	Location
Brenda Poist	Accomack Co.	6/3/18		Confirmation	No location given
Paula Valentine	Accomack Co.	5/18/18		Confirmation	37.5618198, -75.8456031
Steven Johnson	Augusta Co.	10/8/16		Confirmation	37.9769093, -78.9964692
Kyle Harris	Bedford Co.	No date given		County Record	37.3718966, -79.4978535
Justin Reed	Bedford Co	No date given		County Record	No location given
Patricia Conner	Campbell Co.	February 2013		Confirmation	37.1147972, -79.2943383
Lauri Schular	Campbell Co.	12/26/15		Confirmation	37.334831, -78.9823247
Logan McDonald	Caroline Co.	5/18, 6/9, 6/26/15		Confirmation	38.0718281, -77.3301741
David Steinberger	Caroline Co.	6/3/18		Confirmation	38.1424211, -77.4416129
David Steinberger	Caroline Co.	7/25/19		Confirmation	38.0540955, -77.5256415
Karen Daniel	Chesterfield Co.	2/24/17		Confirmation	37.2482169, -77.4716407
Blake Neace	Chesterfield Co.	9/3/18		Confirmation	37.2361852, -77.4996975
Belinda Burwell	Clark Co.	No date given	531	County Record	39.062522, -78.003684
Liam McGranaghan	Clark Co.	5/15/14, 5/16/14, 5/27/15	532	County Record	Location withheld at request of observer.
Robert Simpson	Clark Co.	No date given		Confirmation	No location given
Joe Barron	Culpeper Co.	8/23/17		*County Record	38.5912, -77.9702
Seth Honsinger	Culpeper Co.	5/19/18		Confirmation	38.4639, -77.7859
Cher Brown	Cumberland Co.	7/10/18		Confirmation	37.657367, -78.226969
Dustin Branch	Dinwiddie Co.	6/6/16	530	County Record	37.1321893, -77.4555315
Matthew Ratcliffe	Fairfax Co.	4/29		Confirmation	38.769219, -77.237418
Matthew Ratcliffe	Fairfax Co.	5/12		Confirmation	38.769219, -77.237418
Jeromy Shaffer	Frederick Co.	8/23/18	537	County record	39.195862, -78.3491797
Ned Rose	Gloucester Co.	4/8/19		Confirmation	37.4338564, -76.5990316
Travis Anthony	Hanover Co.	6/8/19		Confirmation	37.5758972, -77.3020324
Natalie Cavalieri	Hanover Co.	5/9/19		Confirmation	37.876478, -77.5395937
David Kuhn	Hanover Co.	No date given		Confirmation	37.7854805, -77.5364122
Constance Lumpkin	Hanover Co.	10/2/18		Confirmation	37.7427801, -77.4124142
David Medici	Hanover Co.	5/18/18		Confirmation	37.7530027, -77.5000559
Catharine Tucker	Hanover Co.	7/25/18		Confirmation	37.733312, -77.3574737
Sandra Marr	Henrico Co.	9/24/18		Confirmation	37.5805015, -77.5891548
Jeff Parks	Henrico Co.	2015		Confirmation	37.4434989, -77.3712166
Jeff Parks	Henrico Co.	5/28/18		Confirmation	37.4419656, -77.3705879
Robert Wright	Henrico Co.	5/12/17		Confirmation	37.6407846, -77.3541727
Terri Cuthriell	Isle of Wight Co.	6/25/15		Confirmation	37.017349, -76.629432 and 37.027412, -76.644624
Laurel Harrington	Isle of Wight Co.	No date given		Confirmation	36.851244, -76.6827497
Courtney Check	James City Co.	6/12/17		Confirmation	No location given
Glenn Glass	James City Co.	7-7-19		Confirmation	37.2684158, -76.75728
Roger Gosden	James City Co.	5/31/16		Confirmation	37.255922, -76.748390
J.D. Kleopfer	James City Co.	7/30/18		Confirmaton	37.2204827, -76.7674812
Susan Yager	James City Co.	7/6/18		Confirmation	37.3986, -76.7489
Dean and Andrew Thompson	King George Co.	6/3/18	535	County Record	38.2215178, -77.1198413
Brian Munford	King William Co.	2/25/16		Confirmation	37.6687633, -77.2656145
Corrie Grimm	Lancaster Co.	6/2/18		Confirmation	No location given
Ty Smith	Lunenburg Co.	6-19-19	539	County Record	37.019086, -78.268606
Brent Cannon	Mathews Co.	7/23/18	536	County record	37.44789, -76.31899
Cindy Andrews	Middlesex Co.	8/4/18, 4/24/19		Confirmation	37.5298048, -76.4302231
Melissa Sayers	Newport News	6/4/15		Confirmation	37.1904687, -76.5503314
Christopher Bache	Northumberland Co.	No date given		Confirmation	37.954418, -76.390709
Elizabeth Gruben	Northumberland Co.	5/18/18		Confirmation	37.7441857, -76.3503448
Mike Clifford	Nottoway Co.	No date given		County record	37.20745, -78.16794
Robert Trench	Nottoway Co.	4/29/18	534	County Record	37.0098853, -77.9331829
Jackie Hall	Page Co.	6/3/18		Confirmation	38.618679, -78.4879128
Henry Molina	Page Co.	2014		Confirmation	No location given
Bill Barham	Pittsylvania Co.	5/2016		Confirmation	No location given
Hunter Young	Rockbridge Co.	12/18/17	533	County Record	37.74205, -79.3395
Maggie McCartney	Rockingham Co.	6/22/18		Confirmation	38.3737022, -78.6802552
Brian Munford	Southampton Co.	9/8/11		Confirmation	36.7936629, -77.1320877
Timmy Songer	Sussex Co.	1/12/18		Confirmation	36.8632277, -77.1880269
Katharina Bergdoll	Westmoreland Co.	10/8/18		Confirmation	38.0922301, -76.6660378
Troy Floyd	City of Richmond	7/7/19	540	City Record	37.4831299, -77.4894117

*Observer published this observation in Herp Review

We screened each possible county record against the Tobey atlas (1985), the Herp Atlas (Mitchell and Reay, 1999), the VHS species database, the Department of Game and Inland Fisheries VA Fish and Wildlife Information Service (VAFWIS), Vertnet.org, museum records from the Virginia Museum of Natural History, and the published

fieldnotes in Catesbeiana, and records in Herpetological Review.

RESULTS

From January 2017 until July 2019 we received more than 70 emails and Facebook messages regarding Eastern Spadefoot observations. Around a dozen of the submissions received reported old unpublished observations. The rest of the submission were reporting new observations. Fifty-eight people contributed data to this project (Please see the acknowledgement section at the end of this paper for a full listing of contributors). The earliest reported spadefoot observation was 12 January 2018 in Sussex County and the latest was 26 December 2015 in Campbell County. Observations were reported for every month except March and November. The months of May and June had the highest reported spadefoot observations (Figure 4). Eastern Spadefoots were reported calling from 25 February to 8 September (Brain Munford, personal communication) with May and June having the highest frequency of calling observations (Figure 5).

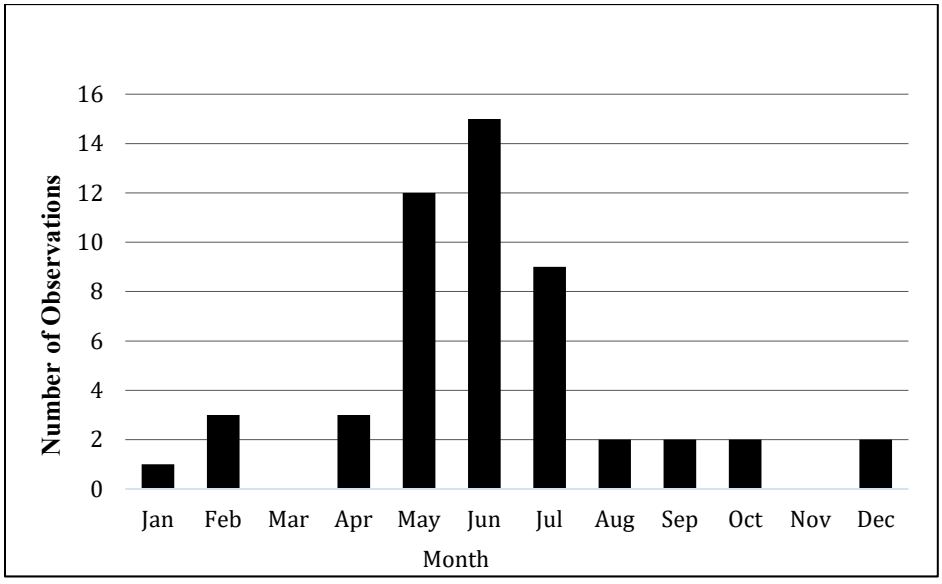

Figure 4. Reported spadefoot observations by month.

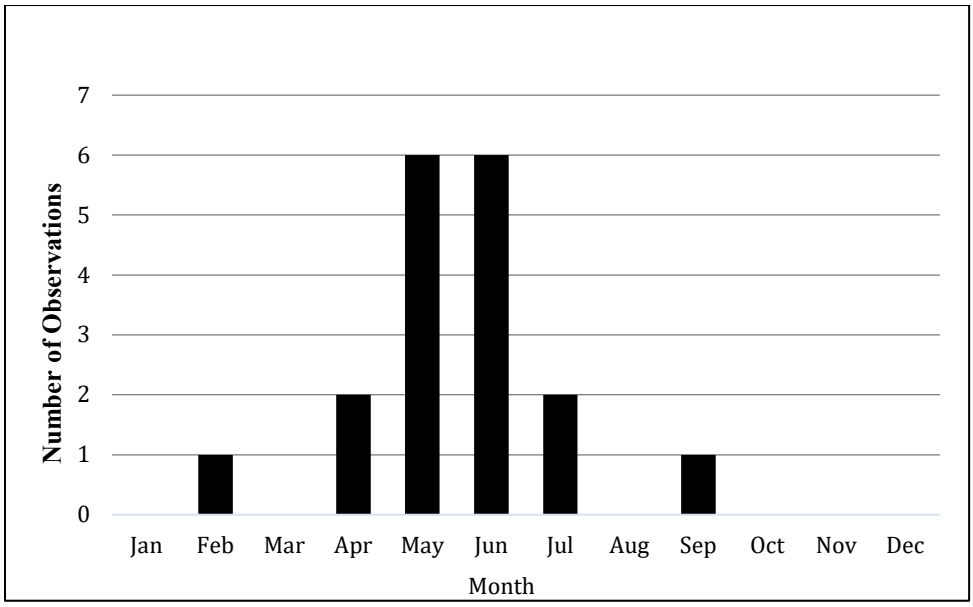

Figure 5. Frequency of calling spadefoots by month.

People reported finding spadefoots in vernal pools, alive on roads (AOR), in old and active swimming pools, in a flooded agricultural field, on baseball and soccer fields, on driveways, in residential yards, in soil, in a well house, and one was reported 10 feet underground in an underground stormwater vault (Figure 6).

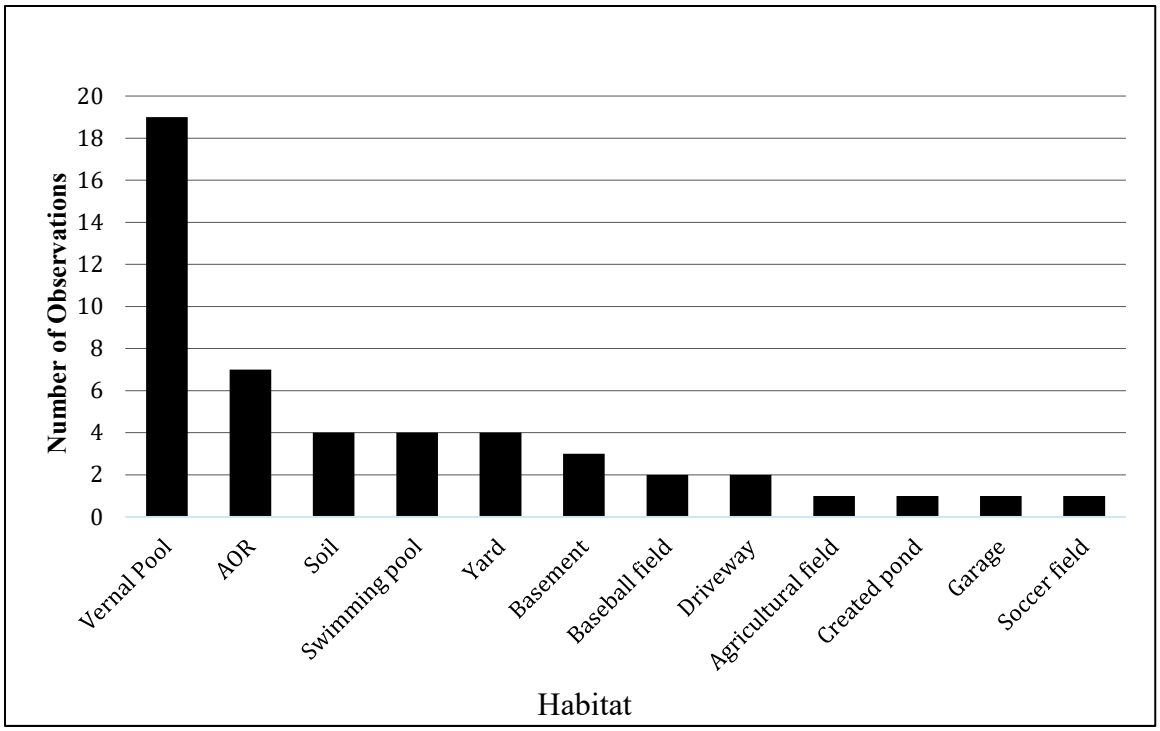

Figure 6. Frequency of spadefoot observations by reported habitat.

Eight county records and one city record (City of Richmond) were vouchered with digital photos (see Table 1 for the VHS photo archive numbers). In addition, two people reported finding spadefoots in two different locations in Bedford County but neither submitted photos. Tobey (1985) included a record for spadefoots in Bedford County, but neither Mitchel and Reay (1999) or the VHS website report any records for this species in this county. The observations made in Bedford County thus serves as a confirmation to what was reported by Tobey. We also report 24 confirmation county and city records collected during the survey time period. For many of these counties this is only the second record ever reported. See Figure 7 for a map of the new county records and confirmation county records.

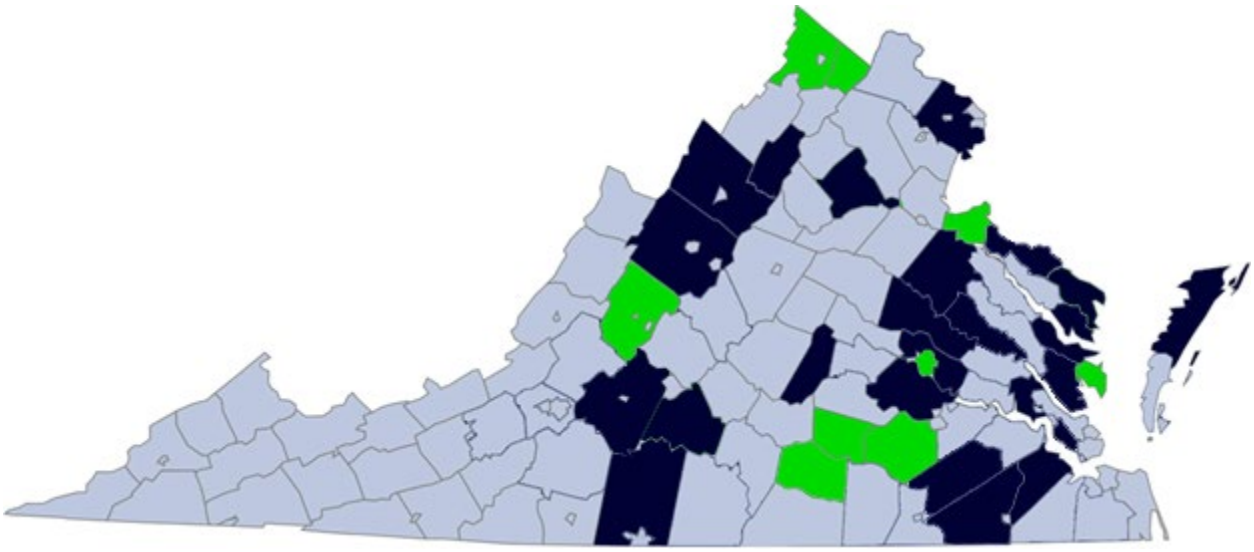

Figure 7. Map showing new county records (green) and county record confirmations (blue) collected during this study.

Injuries, malformations, or deformations such as reported here are generally lacking for this species (Palis, 2005; Dodd, 2013). One frog was reported with a front foot with only two digits (Figure 8). Another contributor reported an Eastern Spadefoot being eaten by an Eastern Hog-nosed Snake. This is not a new observation but rather confirms what was reported for the diet of this snake in Mitchell (1994). There was even a report from the Wildlife Center of Virginia of a domesticated cat attacking an adult Eastern Spadefoot. The spadefoot did survive the attack and was released at the site of capture.

Figure 8. Eastern Spadefoot with only 2 digits (Photo taken by Susie Yagar)

DICUSSION

Within this account, we were able to report observations on Eastern Spadefoots from around Virginia from 58 participants. The use of a wanted poster published on the VHS website led to 9 new county/city records and 24 confirmation county records within a two-and-a-half-year period. Two additional county records in Culpeper County and Fauquier County were reported to us; the submitter decided to publish his results separately in Herp Review (Barron et al., 2018). Early and late dates of activity, activity frequency and calling frequency, habitat associations, and a few additional natural history observations were recorded. The late activity date of 26 December reported here does not appear to be the latest date for Virginia. A museum specimen (VMNH - HER 6148) was collected on 27 December 1986 in Isle of White County. This appears to be the latest date of activity for the spadefoot in Virginia.

In the process of confirming our county records we discovered several museum records for Campbell County (USNM 529918 – USNM 529921), Northumberland County (NCSM-Herp 70783), Mecklenburg County (VMNH - HER 6807), and the city of Hopewell (CM-Herps 34035) which do not appear in Tobey (1985), Mitchell and Reay (1999), nor the VHS Eastern Spadefoot species map. We did confirm the presence of spadefoots in Campbell and Northumberland Counties in this study.

One common trend we noticed in the reported data was the proximity of finding spadefoots near large streams and rivers. Of 52 reported locations 20 (38%) were found within 1.6 km of large streams or rivers (average distance = .67 km, min .13 – max 1.62, n = 20). Spadefoots need soft pliable soil in order to dig burrows and thus are likely to be found near floodplain river corridors where these types of soils are common. These floodplains appear to be important to this species by allowing them the right habitat to allow for migration into the interior of the state. One puzzling aspect of spadefoot distribution is the lack of piedmont records. By viewing the most current map (Figure 9) this observation becomes readily apparent.

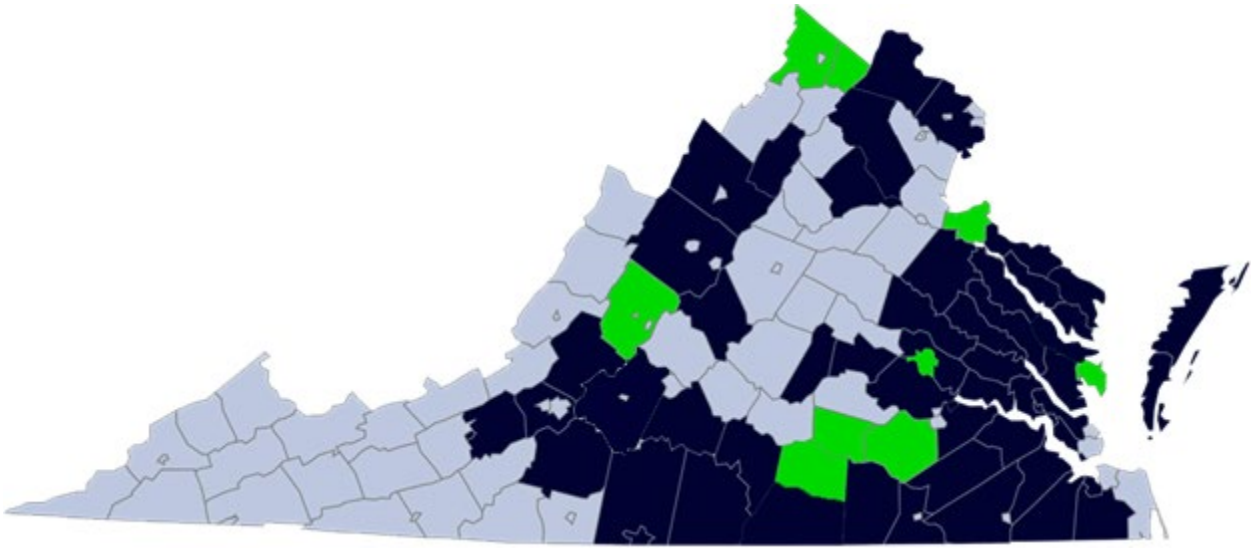

Figure 9. The most current county record map of Eastern Spadefoots in Virginia.

There is no discernable reason why this species is not found in every piedmont county. For every major river watershed, excluding the ones found in the extreme western part of the state, there are spadefoot records for both the coastal plain and the ridge and valley provinces. According to their habitat requirements, spadefoots should occupy floodplain areas in between. The lack of piedmont county records is most likely due to the secretive nature of this frog and the lack of people looking in these counties. Searching for spadefoots on the road and listening for spadefoot breeding choruses in places with vernal pools and within the floodplains of major watersheds during the months of May and June will most likely begin to yield new piedmont county records. Surveys around vernal pools in the summer months may also reveal the presence of this species since its metamorphs are more active on the surface than adults.

More work needs to be done. We have very little or no knowledge on spadefoot parasites, prey, diseases, egg laying dates, number of eggs laid per season, and the impact humans are having on this species (Palis, 2005; Dodd, 2013). We plan to continue this project in the hopes that we will gain a better understanding of where this species is located and other aspects of this species' natural history. In order to better understand this species one person cannot do all the work. We strongly encourage anyone with unpublished information on this species to please publish your data. To quote Joe Mitchell, "if it isn't published then it never happened."

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