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Optimization of Camera Trapping Methods for Surveying Mesopredators in the Appalachian Foothills

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ABSTRACT

Optimization of camera trapping methods for surveying mesopredators

in the Appalachian foothills

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The global decline of apex predators has allowed mesopredator populations to increase, a phenomenon described by the mesopredator release hypothesis (MRH). Some mesopredator species, however, are of conservation concern, such as the eastern spotted skunk (*Spilogale putorius*). To assess camera deployment strategies and survey for the presence of eastern spotted skunks in the Appalachian Foothills, I conducted baited camera trap surveys in Kentucky, a state for which systematic methodological data is lacking. I surveyed 64 sites across 10 counties over more than 1,200 trap days from October 2017 to April 2018. I detected approximately 400 individual mesopredators of 9 different species. I evaluated effects of bait type (sardines vs. sardines + fatty acid scent tablet) and deployment duration (2 week vs. 4 week) by comparing mesopredator activity and species richness per trap day and species accumulation curves across deployment strategies. I found no significant differences in the effect of bait type nor deployment duration on mesopredator detections per trap day ($P > 0.05$), however, there was a significant interaction between bait type and deployment duration on species richness per trap day($P < 0.05$). Accumulation curves tended to reach asymptote more quickly in the deployment in traps using sardines and scent tablets than those using only sardines. My results suggest a 2-week duration with no scent tablet yielded results comparable to more time and resource-intensive options, however species-specific trapping rates must be considered when surveying as eastern spotted skunks were not recorded in my study until 6-21 days after deployment.

Keywords and phrases: camera trap, carnivore, detection rates, eastern spotted skunk, mesocarnivore, mesopredator, species accumulation, species richness

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Introduction

Mesopredators, small-to-mid-sized predators that are preyed on by apex predators, are an important part of ecosystems. Mammalian mesopredators, also referred to as mesocarnivores, can impact prey population sizes (Roemer et al. 2002, Prugh et al. 2009), influence plant and animal community composition (Norrdahl et al 2002; Hambäck et al. 2004), and even play an important role in seed dispersal (Jordano et al. 2007). The relationship between apex predators and mesopredators can be complex. The range of apex predators such as *Puma concolor* L. (Cougars), *Canis lupus* L. (Gray wolves), and *Canis lupus rufus* Audubon and Bachman (Red wolves) historically spread widely across parts of North America; however, following the settlement of humans and subsequent population growth, these apex predators were extirpated from much of their historical range (Reid 2006, Roemer et al. 2009). Apex carnivores can have cascading impacts on mesopredator populations (Levi and Wilmers 2012, Newsome and Ripple 2015) through mechanisms such as directly competing with mesopredators for shared resources (Creel and Creel 1996), predation (Reid 2006), and reducing competition between mesopredators species through facilitation of dietary specialization in dominant mesopredators (Yarnell et al. 2013, Sivy et al. 2017). With the decline of apex predators across North America, the top-down influence from apex predator predation is no longer present and mesopredator populations grow in response, a phenomenon explained by the Mesopredator Release Hypothesis (Crooks and Soule 1999). These newly robust mesopredator populations have a variety of impacts on ecosystems.

Evidence of the impacts of mesopredator population size is found in the California Channel Islands where *Spilogale gracilis amphiala* Dickey (Island spotted skunk) populations increased following the decline of *Urocyon littoralis* Baird (Island foxes) due to predation from a newly introduced predator, *Aquila chrysaetos* L. (Golden eagles) (Crooks and Van Vuren 1995, Roemer et al. 2002). On islands where the Island spotted skunk is absent, deer mice populations exploded in response to the decline in Island foxes (Roemer et al. 2002). These islands lack high species diversity, so the results of a change in the food web may be more noticeable than in other terrestrial systems, but similar consequences can be seen in trophic systems that are relatively more complex as well. In Venezuelan forest fragments with apex predators removed, densities of howler monkeys, iguanas, and other mesopredators were orders of magnitude greater than in areas where predators were still present (Terborgh et al. 2001). Additionally, Prugh et al. (2009) found the current mesopredator per apex predator ratio in North America to be far higher (up to 17 mesopredators per apex predator) than historic numbers, especially in ranges surrounding areas where apex predators no longer exist.

In eastern North America, one mesopredator species appear to not have benefitted from the decrease in apex predators. *Spilogale putorius* L. (Eastern spotted skunks) are omnivorous mammals native to southern parts of Canada, the Midwestern to eastern United States, and portions of Mexico (Kinlaw 1995). Once common throughout their range, populations have noticeably declined in the past 40 years despite their surprisingly adept ability to inhabit human-altered habitats (Gommper and Hackett 2005). The species is now listed as vulnerable on the

International Union for Conservation of Nature (IUCN) Red List (Gommper and Jachowski 2016). While the cause is not clear, population declines are hypothesized to be driven by the decrease of early successional and old-field habitats due to changing agricultural practices (Gompper and Hackett 2005; Lesmeister et al. 2009), popularization of pesticide use (Gompper and Hackett 2005), as well as increased competition with other mesocarnivores (Lesmeister et al. 2010). Eastern spotted skunks tend to be nocturnal and little is known about their ecological needs, thus sightings of this species are rare throughout most of their range (Lesmeister et al. 2009). In Kentucky, Eastern spotted skunks are classified as an S2 species, which means they are considered imperiled due to factors that make them vulnerable to extirpation from the state, such as restricted range or few populations (Kentucky Department of Fish and Wildlife 2005). Mesopredators such as *Didelphis virginiana* Kerr (Virginia opossum) and *Procyon lotor* L. (Common raccoon) are abundant throughout Kentucky and represent possible competitors to Eastern spotted skunks. Surveying for sympatric mesopredators is an important step in understanding the ecology of the Eastern spotted skunk. Camera-trap surveys have shown to be an effective method for detecting carnivores similar in size to spotted skunks such as Common raccoons, felids, and Virginia opossums (Gommper et al. 2006) and recently, Eastern spotted skunks have been the focus of multiple camera trap studies in the southeastern U.S. (Hackett et al. 2009, Wilson et al. 2016, Thorne et al. 2017, Sprayberry and Edelman 2018). Most mesopredator surveys have used varied, sometimes combined types of bait including sardines, scent tablets, and road-killed deer with varying rates of success; few standardized tests on the effect of bait on mesopredator detectability have been conducted. Additionally, little is known about the effect of trap deployment duration on mesopredator detection rates, as many studies have sampled opportunistically and cameras tend to operate for unstandardized amounts of time.

This study aims to survey for the presence of Eastern spotted skunks and other mesopredators at sites throughout central and eastern Kentucky. Additionally, I examined the detectability of mammalian mesopredators, focusing on forest edges, corridors, and trails as mesopredators prefer edge habitats and small forest fragments (Cervinka et al. 2011; Cove et al. 2014). Concurrent with surveying mesopredator communities, I assessed the effects of two camera deployment considerations, type of bait used (sardines only vs. sardines and a fatty acid scent tablet) and length of deployment (2 week vs. 4 week), on mesopredator detections and species richness per trap day in the Appalachian Foothills. Additionally, I examined the possible effect of these two surveying strategies on the accumulation of records of species in relation to survey effort. If deployment duration or bait type had an effect on mesopredator detections and species richness per trap day, I would expect surveys running for 4 weeks using the fatty acid scent tablets to have higher values of these response variables than those running for 2 weeks or only using sardines.

Field Site Description

I conducted mesopredator surveys at several field stations and nature preserves across ten counties in central and eastern Kentucky. I surveyed sites at Maywoods Environmental and Education Laboratory in Rockcastle and Garrard County; Maker's Mark Distillery in Marion County; Lily Mountain Nature Preserve in Estill County; Floracliff Nature Sanctuary in Fayette County; Lower Howard's Creek Nature and Heritage Preserve in Clark County; Hi Lewis Pine Barrens State Nature Preserve, James E. Bickford State Nature Preserve, and E. Lucy Braun State Park Nature Preserve in Harlan County; Lilley Cornett Woods Appalachian Ecological Research Station and Bad Branch Falls State Nature Preserve in Letcher County; and two unnamed sites managed by the Kentucky State Nature Preserves Commission in Wolfe County and Pulaski County. Maywoods, Maker's Mark Distillery, Floracliff, Lower Howard's Creek, and the Pulaski County site are found in the Interior Plateau ecoregion and the Wolfe County site is found in the Southwestern Appalachian ecoregion (Woods et al. 2002). Lily Mountain, Hi Lewis, Bickford, Lucy Braun, Lilley Cornett Woods, and Bad Branch Falls are located in the Central Appalachians ecoregion (Woods et al. 2002).

These natural areas provide a unique opportunity to explore diversity in mesopredator inhabitance based on ecoregional, successional, latitudinal, and longitudinal gradients. Latitudinal differences between the sites are relatively minor, but worth considering in combination with other variables. Most of the sites surveyed were secondary growth mixed hardwood forests, however 252 acres of Lilley Cornett Woods contains old growth forest (Eastern Kentucky University, n.d.).

Methods

I conducted baited camera trap surveys across 10 counties throughout the dormant season of 2017-18 (October to April). Deployment of cameras largely followed the guidelines of Wilson et al. (2016). I placed four camera traps, consisting of one Browning Strike Force camera and one bait station, within a site, defined as an area with a 1.5 km radius in the natural area, which is the average home range size of a male eastern spotted skunk (Lesmeister et al. 2009). By deploying four traps within this radius, I intended to optimize my chances of detecting any Eastern spotted skunks at my sites. Cameras were set to record 4 images in rapid succession when triggered with a 1-minute delay between triggering events. I deployed cameras on tree trunks ca. 0.5 m off the ground facing a bait station 2-3 m away (Fig. 1). All bait stations consisted of a 4-inch by 10-inch block of untreated pinewood (hereafter referred to as a bait board) ratchet strapped to a tree with a can of sardines in soybean oil nailed to it. I opened the sardine can slightly and poured the oil over the bait board to ensure the smell was present even if the sardine can was removed from the camera's site. I nailed the can opened-side against the bait board and made 4 holes in the can with a nail. Previous studies have identified dense understory or closed canopy cover as critical habitat characteristics typically chosen by spotted skunks in Arkansas and South Carolina (Lesmeister et al. 2009; Thorne et al. 2017; Wilson 2016), so I targeted these areas within each site for surveying. Of the four camera traps within a site, two of the cameras ran for 2 weeks and the remaining two ran for 4 weeks. As part of the study design, two of the bait stations (one in the 2-week deployment and one in the 4-week deployment) also included a plaster of Paris disk infused with fatty acid scent (USDA Wildlife Services, Catalog #WCSPSD-WS), hereafter referred to as a fatty acid scent tablet (FAST), enclosed in a small mesh pocket nailed to the bait board (Fig. 2).

I evaluated effects of bait type (sardines vs. sardines + FAST) and deployment duration (2 weeks vs. 4 weeks) by comparing mesopredator detections rates, species richness, and species accumulation curves of each deployment combination. After consultation with the Eastern Kentucky University IACUC, it was determined that an animal use protocol was not necessary for these camera-trapping methods (C. Elliott, pers. comm.). I compiled and sorted mesopredator images in Wild.ID v9.28, a software created for managing camera trap data and converting it to exportable files for statistical analysis (TEAM Network 2016). I identified all images to species, however only images of mesopredator species were used for analysis. I analyzed the effect of bait type and deployment duration on detection rates and species richness of mesopredators using general linear models of log-transformed data in SAS v9.3. Additionally, I used EstimateS v. 8.2

to generate species richness estimations, termed S(est), for comparisons between survey sites. I used estimations based on 1,000 randomizations at each site (Summerville and Crist 2005).

Results

In total, I conducted surveys at 64 locations across 10 counties over 1,452 trap days. I collected a total of 25,698 images, of which 10.15% were images of mesopredators (n=2,608). After adjusting data to only analyze within two or four weeks, some images were not useable in my study design. Ultimately, I analyzed detections of 430 mesopredators of 9 different species. Mesopredators were recorded at all locations (Appendix 1) and at all counties (Appendix 2). Mesopredators were recorded across all months during my surveys, save October (Appendix 3). Common raccoons and Virginia opossums were the most frequent mesopredator species I detected, comprising 53.5% and 24.9% of total detections (Table 1). I detected 45 *Canis latrans* Say (Coyotes; 10.5% of total detections) and 25 *Lynx rufus* Schreber (Bobcats; 5.8% of total detections) (Table 1). Rarer species comprised a combined 5.3% of total detections (Table 1). I detected 9 *Urocyon cinereoargenteus* Schreber (Gray foxes; 2.1%), 8 *Mephitis mephitis* Schreber (Striped skunks; 1,9%), 3 Eastern spotted skunks (0.7%), 2 *Vulpes vulpes* L. (Red foxes; 0.5%), and 1 weasel (*Mustela* sp.) I was unable to identify to species (0.3%) (Table 1). I detected Common raccoons and Virginia opossums in 100% and 90% of the counties I sampled respectively (Fig. 3). I detected both Coyotes in 70% and Bobcats in 50% of my sampled counties and all other mesopredators were detected in ≤30% of my sampled counties (Fig. 3).

I found no significant difference in the effect of type of bait or deployment duration on the rate of mesopredator detections per trap day ($F_{3,1423} = 1.25$, $P = 0.29$; Fig. 4). The mean ± SE rate of mesopredator detections for all deployment combinations was 0.30 ± 0.03 mesopredators per trap day (Table 2). The effects of bait type and deployment duration on species richness were slight ($F_{3,1423} = 2.61$, $P = 0.05$), with only the interaction between predictors being significant ($F_{3,1423} = 5.34$, $P = 0.02$; Fig. 5). The mean ± SE species richness detection rate was 0.16 ± 0.01 species detected per trap day (Table 2).

The rate at which species detections accumulated varied subtly by deployment type. The accumulation curve for camera traps deployed for 2 weeks with only sardines reached asymptote 12-15 days into the deployment (Fig. 6), and cameras deployed for 2 weeks with both sardines and a FAST similarly began to plateau 11-15 days into the deployment (Fig. 7). In contrast, camera traps deployed for 4 weeks appeared to take longer to reach asymptote; spanning 24-29 days after deployment for cameras with only sardines (Fig. 8) and 21-29 days for cameras with both sardines and a FAST (Fig. 9). The mean ± SE species accumulated in 2-week sardines only deployments was 1.67 ± 0.19, 2-week sardines + FAST was 1.36 ± 0.18, 4-week sardines only was 2.31 ± 0.41, and 4-week sardines + FAST was 1.78 ± 0.26 (Fig. 10).

Discussion

Contrary to my hypothesis, the data showed no significant effect of bait type or deployment duration on mesopredator detection rates per trap day. Although I expected the addition of a FAST would increase mesopredator activity, there were no trends to suggest this additional bait attracted more mesopredators than sardines alone. There was a significant effect of bait and duration on species richness per trap day, but only the interaction between bait and deployment duration was significant. However, this interaction is only causing a small fractional difference in the number of species detected per trap day, as mean species richness per trap day only ranged from 0.12 to 0.18. Practically, this equates to a difference of less than one mesopredator species (0.84) over a 2 week survey. These results suggest that surveys running for 2 weeks using only sardines are the most efficient trapping method and yield results comparable to more time-and-resource intensive options. When deciding whether or not to use a FAST, knowledge of other predators within the study area may help inform the decision as sites with high *Urus americanus* Pallas (American black bear) activity may benefit from the addition of a FAST in order to mitigate the loss of sardines. Black bears in my study tended to find bait stations quickly (occasionally on the day of deployment) and easily remove sardines from the camera trap, but they did not disturb FASTs aside from 1 instance when the entire bait station was removed from the tree. Additionally, species-specific trapping rates need to be considered; Eastern spotted skunks in my study were not detected until 6, 15, and 21 days after deployment, suggesting longer deployments may be necessary to capture rare species in mesopredator communities. Using data of incidental captures of Eastern spotted skunks from baited camera trap surveys in West Virginia, Wilson et al. (2016) remark a camera trap running for 14 days would have a 90% probability of Eastern spotted skunk detection in the Appalachian region. This discrepancy in capture rates of Eastern spotted skunks highlights the importance of occurrence surveys for these poorly understood predators.

Although species accumulation curves showed minimal differences between deployment types, camera traps utilizing a FAST tended to reach an asymptote quicker than traps only using sardines. Using a FAST in combination with the 2 week deployment may ensure the camera trap will detect the maximum number of species. Although previous studies have not tested the effect of multiple baits types on species richness, these results are in line with mesopredator surveys conducted in south-western Europe where Ferreras et al. (2017) created mesopredator species accumulation curves of 30 day deployments and found deployments of 20 trap days to be the most efficient time frame for maximizing species richness, rather than the full deployment length. In addition, accumulation curves of 2 week deployments in my study frequently over-lapped one another while accumulation curves of 4 week deployments were much more variable. This suggests that camera traps running for 4 weeks have varying rates of species richness and, due to increased sample size, may be more indicative of actual rates of species accumulation.

Surprisingly, while detections rates of Bobcats were relatively rare (5.8% of total detections) they were detected in 50% of the counties sampled, suggesting they are widespread but not necessarily as abundant as other mesopredators such as Common raccoons or Coyotes. The low rate of occurrence of Striped skunks, Red foxes, Eastern spotted skunks, and weasels in 10 different counties all within central/eastern Kentucky highlights the variability in detectability of common and rare species across geographically similar areas. This high variability in detection rates of different mesopredators was also detected in mesopredator surveys conducted in Missouri where researchers detected the same common mesopredators in comparable numbers (Cove et al. 2012).

Ultimately, this study provides a baseline for future research on mesopredator communities in the Appalachian region. There is a need for much more research on the activity, relative abundances, and species richness of mesopredator communities, especially concerning threatened carnivores like the Eastern spotted skunk. Previous Eastern spotted skunks surveys in the Appalachian Mountains found forest structure, rather than forest composition, greatly influences likelihood of Eastern spotted skunk occurrence (Reed and Kennedy 2000, Diggins et al 2015, Wilson et al. 2016, Sprayberry and Edelman 2018). Therefore, future surveys for Eastern spotted skunk locations in the Appalachian Foothills region of Kentucky will utilize these results and mesopredator habitat selection of these camera trapping sites will be assessed using ArcGIS data layers to determine preferred site characteristics, thus allowing targeted, more efficient camera trapping efforts in the future and the examination of mesopredator communities and Eastern spotted skunk occupancy across a successional gradient. Future studies should aim to assess the occupancy of mesopredator species at local sites and utilize multi-season and multi-year survey efforts to gain a more encompassing understanding of mesopredator ecology in the Appalachian region.

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Figures

Figure 1. Example of a baited camera trap deployment used for surveying mesopredators in the Appalachian Foothills, October 17-April 2018. Cameras were deployed on tree trunks ca. 0.5m off the ground facing a bait station 2-3 m away.

Figure 2. Example of a bait station used in camera trap surveys in the Appalachian Foothills, October 2017-April 2018. A can of sardines in soybean oil was nailed to piece of uncured pinewood in all deployments and, in addition, a fatty acid scent tablet placed in a mesh pocket was used in half of the deployments.

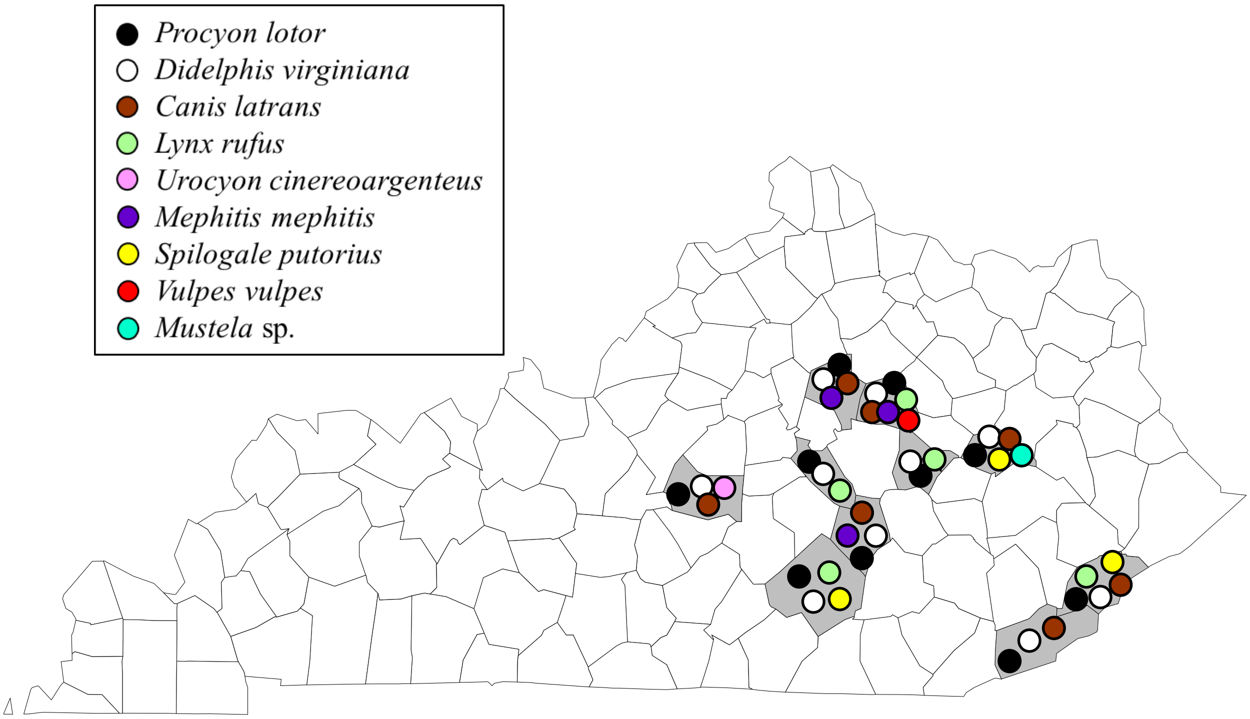

Figure 3. Map of outlined counties in Kentucky with mesopredators detected October 2017-April 2018.

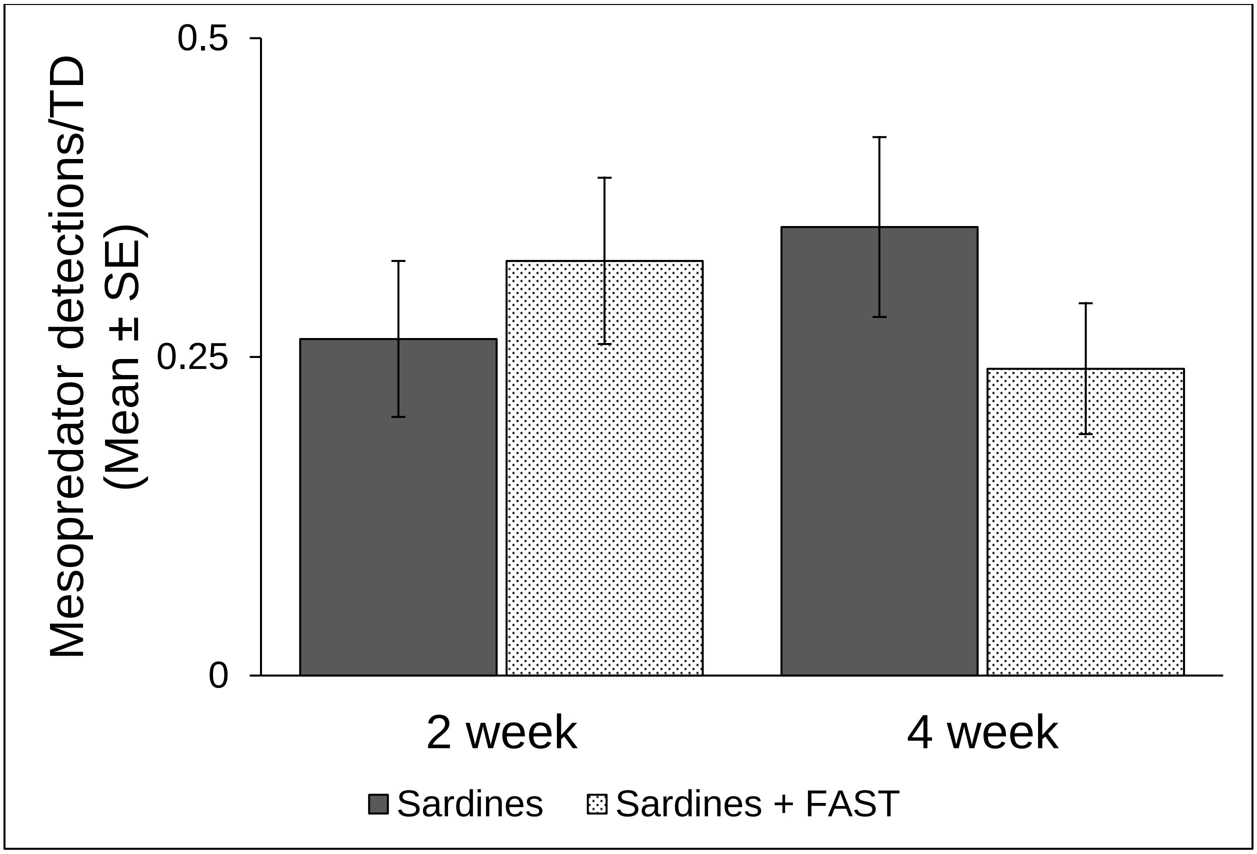

Figure 4. Mean mesopredator detections per trap day by deployment duration and bait type in the Appalachian Foothills region of Kentucky, October 2017- April 2018. No significant differences were detected between deployment duration nor type of bait used ($F_{3,1423} = 1.25$, $P > 0.05$).

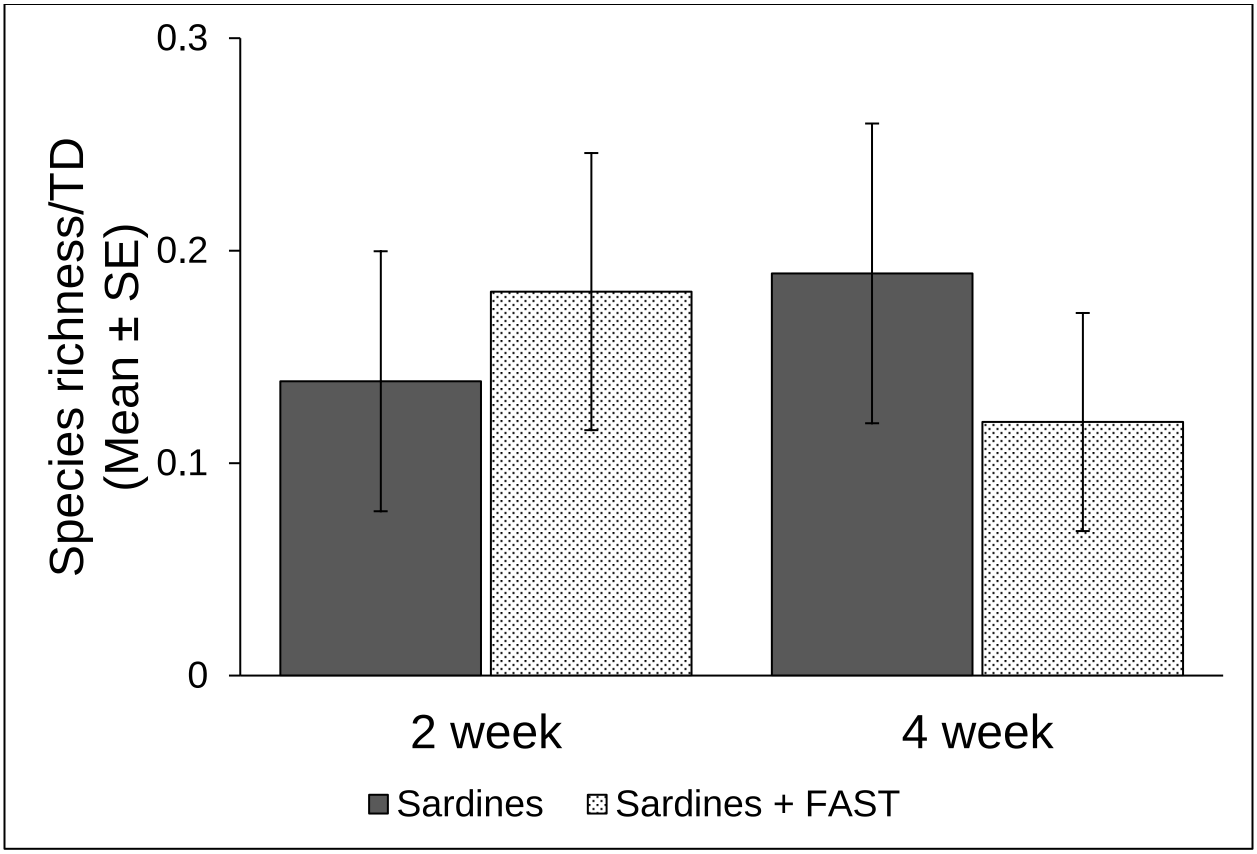

Figure 5. Mean mesopredator species richness per trap day by deployment duration and bait type in the Appalachian Foothills region of Kentucky, October 2017- April 2018. The interaction between duration and bait type was significant ($F_{3,1423} = 5.34$, $P = 0.02$).

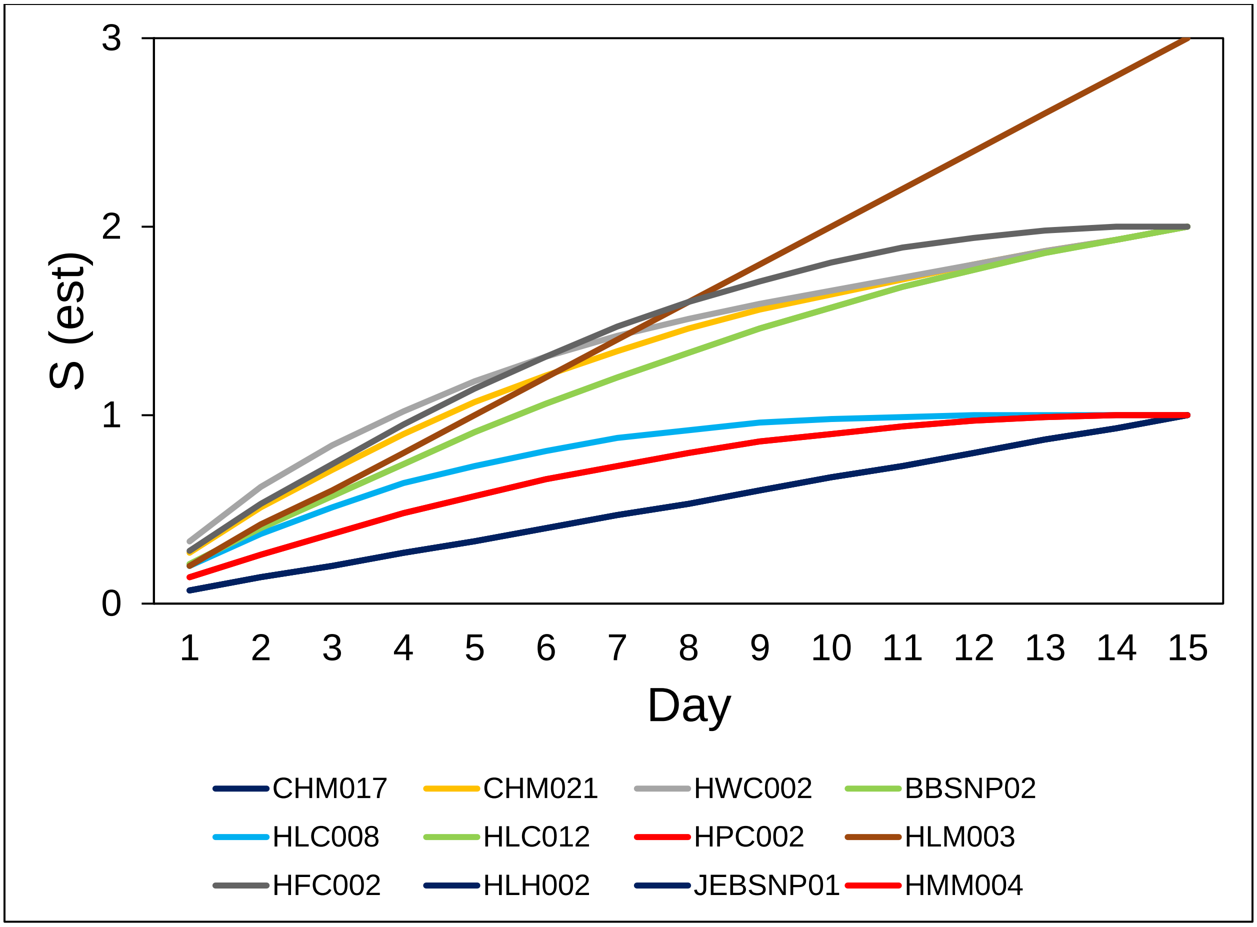

Figure 6. Mesopredator species accumulation curves of camera trap surveys conducted over two weeks baited with sardines only in the Appalachian Foothills of Kentucky, October 2017-April 2018. Individual curves represent specific camera trap locations.

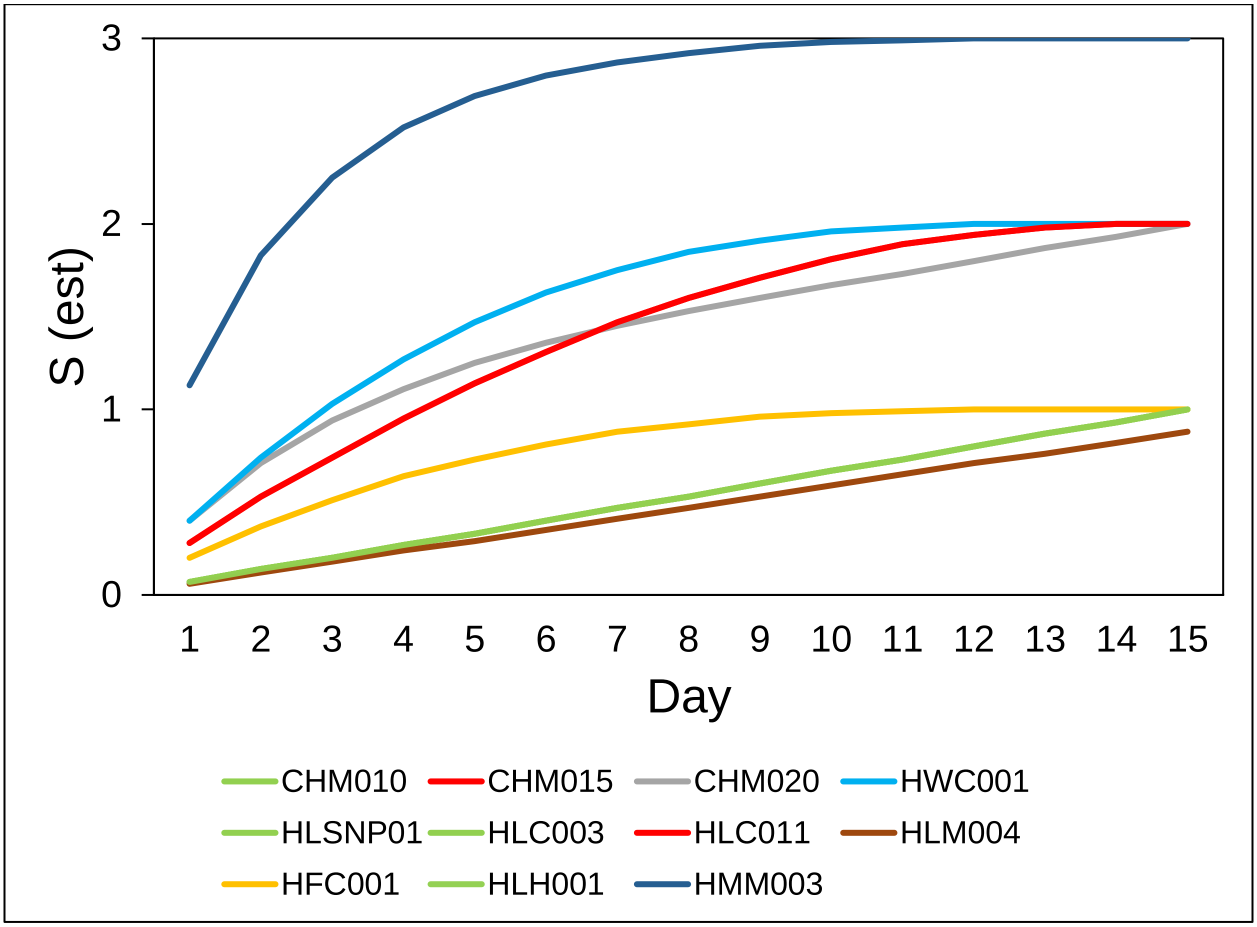

Figure 7. Mesopredator species accumulation curves of camera trap surveys conducted over two weeks baited with sardines and fatty acid scent tablets (FAST) in the Appalachian Foothills of Kentucky, October 2017-April 2018. Individual curves represent specific camera trap locations.

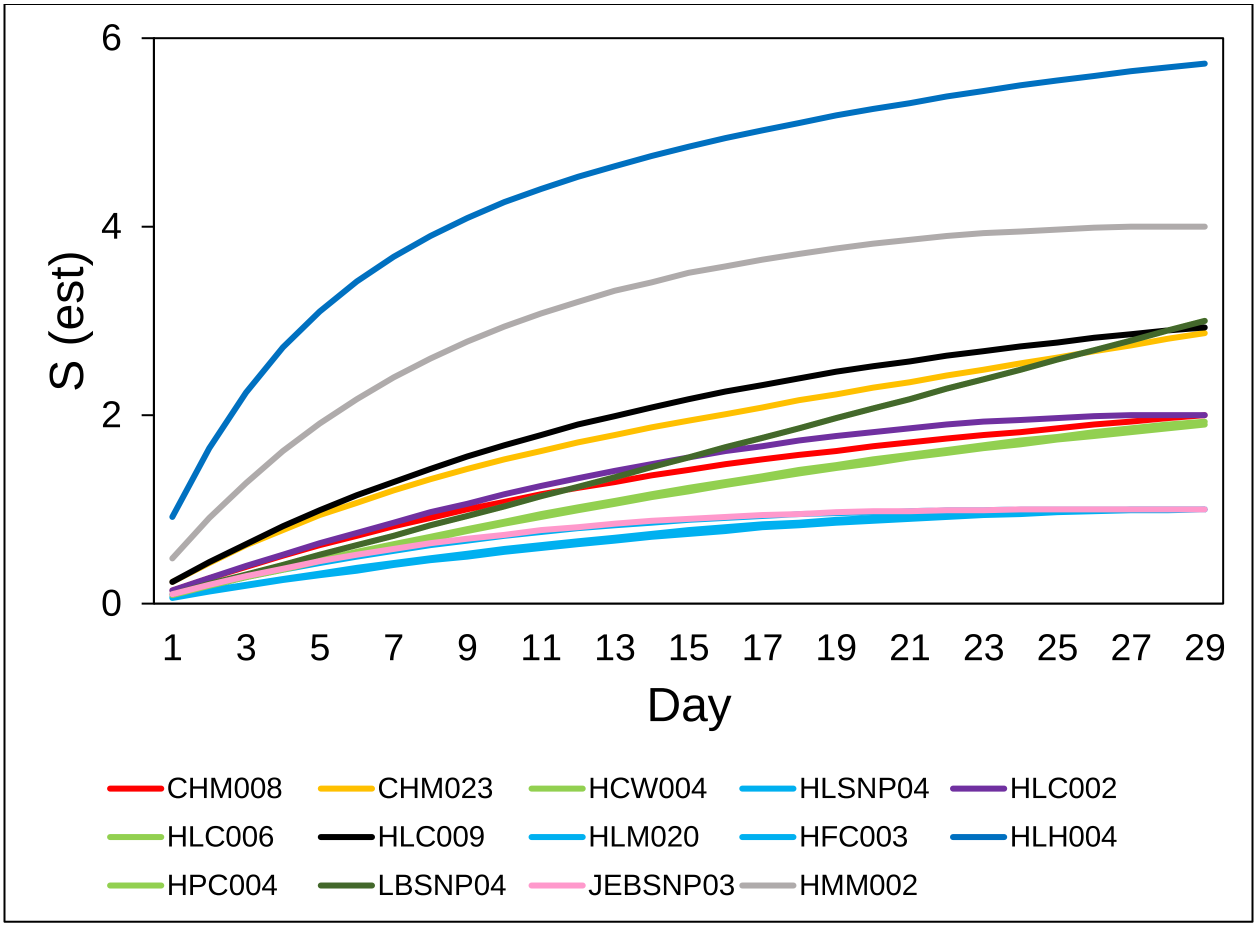

Figure 8. Mesopredator species accumulation curves of camera trap surveys conducted over four weeks baited with sardines only in the Appalachian Foothills of Kentucky, October 2017-April 2018. Individual curves represent specific camera trap locations.

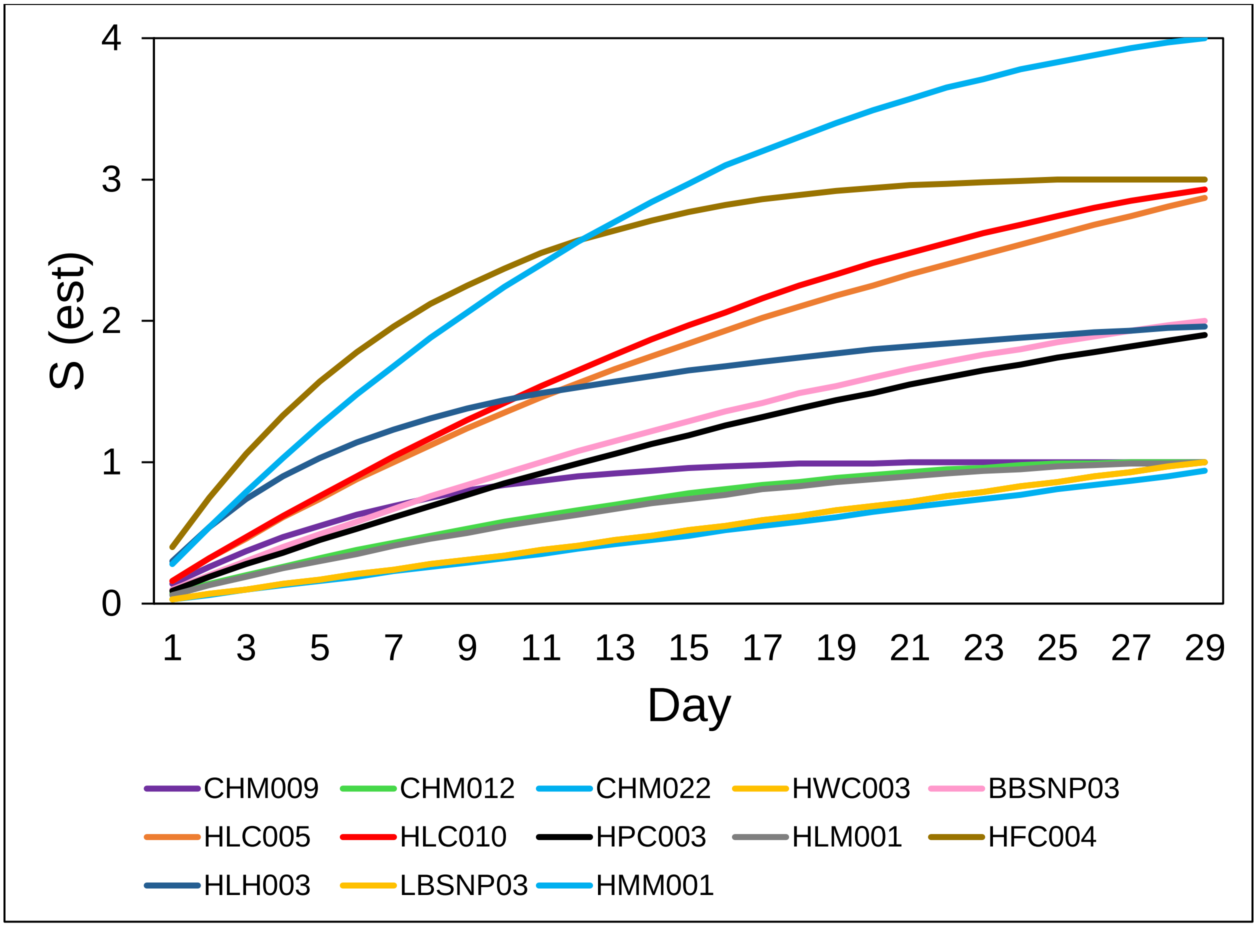

Figure 9. Mesopredator species accumulation curves of camera trap surveys conducted over four weeks baited with sardines and fatty acid scent tablets (FAST) in the Appalachian Foothills of Kentucky, October 2017-April 2018. Individual curves represent specific camera trap locations.

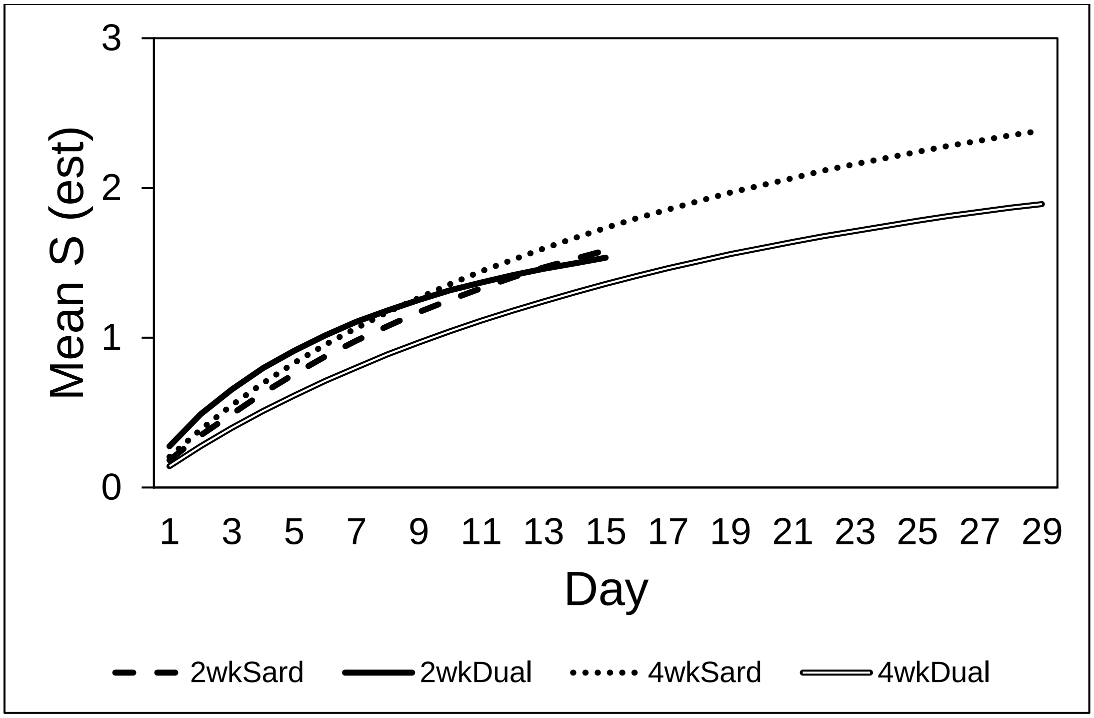

Figure 10. Mean mesopredator species accumulation curves of camera trap surveys conducted in the Appalachian Foothills of Kentucky, October 2017-April 2018. One line represents the mean estimated S value for all sites of a given deployment type.

Tables

Table 1: Mesopredator species detected in the Appalachian Foothills region of Kentucky, October 2017-April 2018.

Species	**Proportion of Total Detections (%)**	**Proportion of Counties Detected (%)**
Procyon lotor	53.5	100
Didelphis virginiana	24.9	90
Canis latrans	10.5	70
Lynx rufus	5.8	50
Urocyon cinereoargenteus	2.1	10
Mephitis mephitis	1.9	30
Spilogale putorius	0.7	30
Vulpes vulpes	0.5	10
Mustela sp.	0.2	10

Table 2. Mean mesopredator detections per trap day and species richness per trap day by deployment type in the Appalachian Foothills of Kentucky, October 2017-April 2018.

Deployment Type	**Mesopredator Detections/TD (Mean ± SE)**	**Species Richness/TD (Mean ± SE)**
2 Week Sardines Only	0.26 ± 0.06	0.14 ± 0.02
2 Week Sardines + FAST	0.33 ± 0.07	0.18 ± 0.03
4 Week Sardines Only	0.35 ± 0.07	0.12 ± 0.02
4 Week Sardines + FAST	0.24 ± 0.05	0.12 ± 0.02

Appendices

Appendix 1: Total mesopredator detections in the Appalachian Foothills region of Kentucky, October 2017 – April 2018, by site name. Abbreviations are as follows: BBSNP (Bad Branch Falls State Nature Preserve), Floracliff (Floracliff Nature Sanctuary), HLSNP (Hi Lewis Pine Barrens State Nature Preserve), JEBSNP (James E. Bickford State Nature Preserve, LCW (Lilley Cornett Woods Appalachian Ecological Research Station), LBSNP (E. Lucy Braun State Park Nature Preserve), LHC (Lower Howard's Creek Nature and Heritage Preserve), Lily Mtn (Lily Mountain Nature Preserve), MEEL (Maywoods Environmental and Education Laboratory), MM (Maker's Mark Distillery), Pulaski (site in Pulaski County, KY managed by the Kentucky State Nature Preserves Commission), and Wolfe (site in Wolfe County, KY managed by the Kentucky State Nature Preserves Commission).

	Canis latrans	*Didelphis virgniana*	*Lynx rufus*	*Mephitis mephitis*	*Mustela* sp.	*Procyon lotor*	*Spilogale putorius*	*Urocyon cinereo-argenteus*	*Vulpes Vulpes*
BBSNP	16	0	1	0	0	1	0	0	0
Floracliff	3	15	0	3	0	19	0	0	0
HLSNP	2	0	0	0	0	6	0	0	0
JEBSNP	4	0	0	0	0	0	0	0	0
LBSNP	1	0	0	0	0	4	1	0	0
LCW	10	19	3	0	0	19	0	0	0
LHC	3	10	13	1	0	118	0	0	2
Lily Mtn	0	1	3	0	0	5	0	0	0
MEEL	1	36	4	4	0	16	0	0	0
MM	4	20	0	0	0	20	0	9	0
Pulaski	0	2	1	0	0	6	1	0	0
Wolfe	1	4	0	0	1	16	1	0	0
	45	107	25	8	1	230	3	9	2

Appendix 2: Total mesopredator detections in the Appalachian Foothills region of Kentucky, October 2017 – March 2018, by county.

	Canis latrans	*Didelphis virginiana*	*Lynx rufus*	*Mephitis mephitis*	*Mustela* sp.	*Procyon lotor*	*Spilogale putorius*	*Urocyon cinereo-argenteus*	*Vulpes vulpes*
Clark	3	10	13	1	0	118	0	0	2
Estill	0	1	3	0	0	5	0	0	0
Fayette	3	15	0	3	0	19	0	0	0
Garrard	0	18	4	0	0	8	0	0	0
Harlan	7	0	0	0	0	10	1	0	0
Letcher	26	19	4	0	0	20	0	0	0
Marion	4	20	0	0	0	20	0	9	0
Pulaski	0	2	1	0	0	6	1	0	0
Rockcastle	1	18	0	4	0	8	0	0	0
Wolfe	1	4	0	0	1	16	1	0	0
	45	107	25	8	1	230	3	9	2

Appendix 3: Total mesopredator detections in the Appalachian Foothills region of Kentucky, October 2017 – March 2018, by month.

	Canis latrans	*Didelphis virginiana*	*Lynx rufus*	*Mephitis mephitis*	*Mustela* sp.	*Procyon lotor*	*Spilogale putorius*	*Urocyon cinereo-argenteus*	*Vulpes vulpes*
October	0	0	0	0	0	0	0	0	0
November	0	0	3	0	0	13	0	0	0
December	5	42	14	6	0	99	0	0	0
January	24	38	7	2	0	66	0	0	2
February	9	6	0	0	1	27	2	0	0
March	7	21	1	0	0	25	1	9	0
	45	107	25	8	1	230	3	9	2