

Proposal to Arkansas Game & Fish Commission

a) Title:

Habitat selection and home range patterns of eastern spotted skunks in the Ozarks.

b) Project Summary

The eastern spotted skunk is a once common small carnivore that is not a species of significant conservation concern. In Arkansas the species is listed as S1, and federally the species was recently petitioned for listing as an endangered species under the Endangered Species Act. We have previously conducted extensive work on eastern spotted skunk home range size and use, habitat selection, survival analyses, ecological parasitology, survey methodology, and trend analyses, with much of this work conducted on populations inhabiting the Ouachita National Forest in Arkansas and the Ozarks forests of Missouri. Here we propose a two year study of eastern spotted skunk habitat and home range use in the Ozark forests of Arkansas, with a focus on understanding how oak woodland forest restoration efforts influence the spatial and habitat ecology of the species. We will use telemetry and non-invasive camera-trapping approaches to assess habitat selection, home range size and selection in the landscape, and den site selection. We will also use the opportunity afforded by capturing and radiocollaring skunks to assess exposure to viral pathogens, survival and reproduction, and feeding habits. The project leader and partner have extensive experience working with spotted skunks and addressing all aspects of the proposed work.

c). Project Leader:

Matthew Gompper, Professor, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211 (gompper@missouri.edu; 573-882-9424)

d). Project Partner

Joshua Millspaugh, Professor, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211 (millspaughj@missouri.edu; 573-882-9423)

e) Project budget

SWG amount requested: \$144,297
Match amount provided: \$51,147
Total amount of project: \$195,444

Problem Statement

a) Need The eastern spotted skunk (*Spilogale putorius*) was once common in the Midwestern United States. For reasons that remain unclear the species declined precipitously beginning in the 1940s and has not recovered. This decline is observable across the range of the species, including Arkansas. The species is currently listed as state endangered, threatened, or of 'conservation concern' in much of the Midwest. The species was petitioned for federal listing under the Endangered Species Act in 2012, underwent a 90 day review, and is currently undergoing a broader review to determine if listing is warranted. Thus, there is a critical need to obtain additional knowledge on the population ecology and status of the eastern spotted skunk in its core range, which includes the Ozark forests of Arkansas.

Knowledge of the ecology of eastern spotted skunks derives primarily from work (overseen by Gompper and Millsbaugh) conducted in Arkansas Ouachita Mountain habitats. However, the majority of the current range of the species in Arkansas is Ozark forests, and while we have also overseen some work conducted in such habitat, the ecology of the species in Ozark forests remains poorly understood. This is problematic not only because of the information-needs associated with the possible federal listing of the species, but also because the resource extraction (timber harvest) that is relatively common in Ozark forests may influence the local persistence of spotted skunks, and because extensive efforts are underway to restore Ozark forest regions, and such restoration has an unknown effect on spotted skunks. There is, therefore, a need to better understand the spatial and habitat ecology of eastern spotted skunks in the Ozark forests of Arkansas to inform management decisions.

b) Purpose and Objectives The purpose of this work is to gain an understanding of the home range size and use, as well as broader habitat selection, of eastern spotted skunks in Ozark forests of Arkansas.

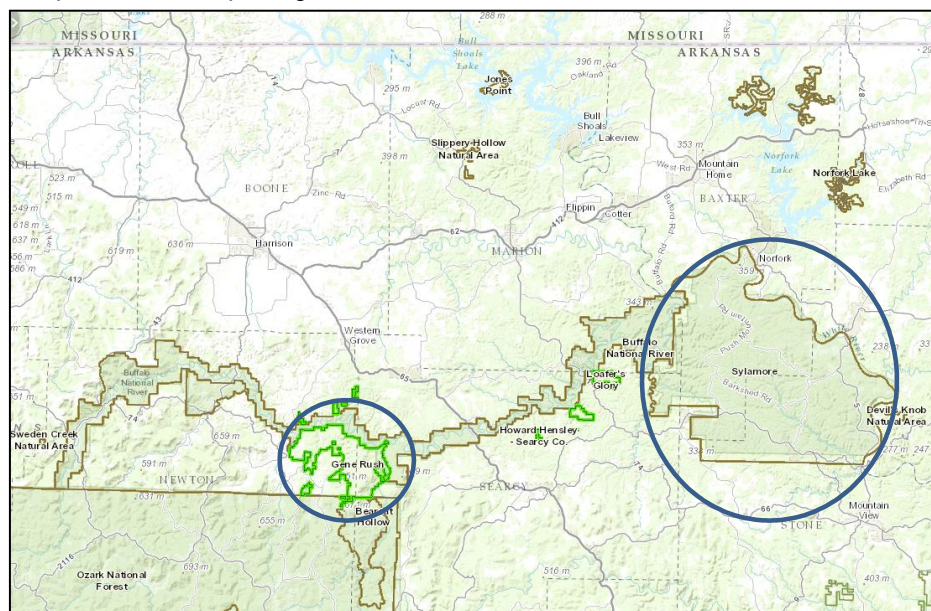
Primary objectives include:

1. Determine home range size and movement dynamics in an Ozarks forest ecosystem.
2. Identify multi-scale habitat selection patterns in the Ozarks, including habitat selection in relation to oak woodland restoration efforts.

Working towards primary objectives will facilitate opportunities to address additional issues that are poorly understood. *Secondary objectives include:*

3. Assess spotted skunk exposure to viral pathogens.
4. Assess spotted skunk survival and reproduction in the Ozarks.
5. Assess the diet of eastern spotted skunks inhabiting Ozark forest landscapes.

c) Location Given interest in evaluating skunk response to oak-woodland restoration efforts, we will focus on two localities: Gene Rush (Newton, Searcy



County) and Sylamore (Baxter, Marion, Searcy, and Stone County) WMAs. Both sites are undergoing restoration of large continuous oak woodland and glade habitats. Camera-trapping will occur at both sites, while telemetry components of the work will focus on one of the localities. Selection of telemetry site will be made following consultation with the AGFC Nongame Mammal/Furbearer Program Leader, federal biologists and district rangers, and other potential partnering stakeholders.

d) Approach Field work will incorporate two basic approaches: radiotelemetry and camera-trapping. We have previously used both approaches extensively in our studies of spotted skunks in the Ouachitas. These approaches will also allow us to address secondary objectives.

Live-trapping We will live-capture 30 spotted skunks and fit them with radiotransmitters. Our sample will consist of a roughly equal number of males and females. Skunks will be captured using baited #204 Tomahawk box traps. Sides and backs of traps will be covered with burlap and traps will be checked 1-2X/day while in operation. Locations of captured individuals will be recorded using NAD83 datum UTM coordinates. Skunks will be anesthetized on site with an intramuscular injection of a combination of a general anesthetic (ketamine hydrochloride) and a sedative (acepromazine) to smooth induction and recovery of a Stage III, Plane II anesthesia. Thereafter, skunks will be weighed and measured, ear tagged (#1 Monel), sampled for blood, ectoparasites and feces, and radiocollared with ATS Model 2900 transmitters. Animals will be returned to the trap and allowed to fully recover prior to release.

Telemetry, Home Range Assessment and Survival We will obtain daytime (den and rest site) locations every weekday (ca 20 days/month) from approximately October 2015 through September 2017. We will also attempt to obtain night-time locations every other night (ca 10-15 days/month). All locations will be collected using triangulation, with an associated detailed telemetry error study, or homing (for identifying the exact locations of den and rest sites). We will use 95% fixed kernel home ranges with least-squares cross validation to delineate ranges for each skunk by season and year. Only those animals with 30 locations will be used given the potential bias associated with home range estimations based on small sample sizes. To assess overlap among individuals, we will use the Volume of Intersection (VI) Index statistic. To evaluate differences in home range size among males and females, we will use ANOVA and linear contrasts to compare mean home range sizes between pairs of seasons and years. We will use two-way ANOVA to test for seasonal and yearly differences in home range sizes. Animal fidelity will be assessed by evaluating the degree of overlap in UDs of each animal across seasons and during the same season in different years using the VI Index. We will use Program MARK to estimate survival rates by age and sex class, and develop models to assess the relative importance of various factors in explaining skunk survival rates.

Habitat Resource Use and Camera Trapping For telemetry data, we will use a case-control model to evaluate resource use by skunks. The case-control model estimates a true probability of use rather than a relative probability, which facilitates utility and interpretation of map projections. In this procedure, habitat use is defined by the resources at skunk locations. The radio locations are used to estimate the bounds on the total range area and resource availability is determined by randomly sampling points within that area. We will use a two-stage analysis procedure: home range selection within the study area (Johnson's second order) and resource selection within the home range (Johnson's third order). Range sizes will be determined using fixed kernel utilization distributions with smoothing via plug-in bandwidth procedures. Use of the case control model requires an estimate of prevalence which will be determined using camera trap data. At larger spatial scales, camera trapping will be used to assess habitat use over broader spatial scales. Similar to approaches used in the Ouachitas we will survey for spotted skunks at 50-100 locales

and use the resulting data to model occupancy as a function of landscape-level habitat factors to examine how management and restoration practices influence the occurrence of spotted skunks. Camera trapping at den sites will also facilitate understanding reproductive output.

Pathogen Survey and Feeding Ecology Blood samples will be collected from all individuals and preserved in heparin and EDTA. Diagnostic work will be carried out by Gompper's laboratory (which has considerable experience with serological surveys), or when necessary at other diagnostic labs. Serology will focus on antibodies to pathogens recognized as potential concerns for skunks: canine distemper virus, feline parvovirus, mink virus enteritis and Aleutian mink virus. Dietary patterns will be determined through scat analysis. Scat will be obtained from trapped animals and from dens of radiocollared individuals. Prey determination will be performed by microscopic examination of remains and identified to the lowest possible taxonomic level by comparing to reference collections housed at the University of Missouri.

Timetable

Oct 2015–Dec 2016: Hiring of MS student, field technician; permitting; supplies acquisition.
 Dec 2015–May 2016: Live-trapping and radio-collaring of focal individuals.
 May 2016–Jun 2016: Virology laboratory analyses.
 Jan 2016–Jun 2017: Telemetry-based field work
 Apr 2016–Jun 2017: Laboratory analysis of fecal-borne parasites and dietary analyses.
 Jan 2016–Sep 2017: Data analyses; submission of manuscripts and final report.

e) Expected Results and Benefits Following project completion a detailed report will be submitted to the AGFC. This report will detail our findings on home range size and habitat selection spotted skunks, as well as results of the viral, dietary and survival analyses. A copy of skunk capture and radiotelemetry location datasets will be provided in Microsoft Excel format and final maps will be provided in a format compatible with ArcMap GIS software. In addition to the final report, a PowerPoint presentation about the study will be provided to the Commission. Results will also be published in peer-reviewed journals. The eastern spotted skunk is a species of conservation concern in Arkansas, and is under federal review. As such, information on its ecology will be fundamentally important for identifying the impact of land management practices on the species and for better describing its status in Arkansas.

f) Budget

Category	SWG Yr 1	SWG Yr 2	Univ MO Yr 1	Univ MO Yr 2	Total
Student Stipend	16500	16500	0	0	33000
Student Fringe	10690	10690	0	0	21380
Salary	21500	10750	15000	15000	62250
Fringe	7832	3916	5465	5628	22841
Travel	5200	2600	0	0	7800
Supplies	22000	3000	0	3000	28000
Total Direct Costs	83722	47456	20465	23628	175271
Indirect Costs	8372	4746	3274	3780	20173
Total	92095	52202	23739	27408	195444

Budget includes support for a MS student and field technician (18 mo), travel (fuel), Supplies (primarily radiocollars and camera traps), and 10% indirect costs. Match includes Gompper & Millspaugh salary, supplies (serology) and waived indirect costs. Existing available equipment and supplies (e.g. vehicle, ATV, traps, receivers, additional cameras) are not included.

3. Qualifications

Matthew Gompper is Professor of Mammalogy and Director of the Conservation Biology Program at the University of Missouri. Joshua Millspaugh is the Pauline O'Connor Distinguished Professor of Wildlife Management. Both are both broadly trained ecologists with expertise covering all aspects of this study.

Gompper has worked extensively with small and mid-sized carnivores. He has practical experience studying carnivore population and behavioral ecology, home range use, carnivore community structure, and carnivore disease ecology. Gompper also has extensive experience with the techniques associated with the capture and handling of small carnivores, with non-invasive survey approaches, with occupancy modelling, and with the analysis of dietary and pathogen survey data.

Millspaugh has extensive experience with small and large mammals. He has published extensively on the design and analysis of telemetry data, on the analysis of occurrence data, and on population demographics. Millspaugh has also carried out extensive research on wildlife diseases and wildlife stress physiology.

Gompper and Millspaugh jointly advised Damon Lesmeister, who as a MS student worked on the habitat ecology and home range use of spotted skunks in Arkansas. Gompper was also the advisor to Mundy Hackett, whose doctoral work examined the temporal decline in eastern spotted skunk fur harvests, field approaches for detecting spotted skunks, and the use of occupancy models to predict the distribution of spotted skunks in the Missouri Ozarks.

Of direct relevance to the proposed research, Gompper and Millspaugh have published the following peer-reviewed papers on eastern spotted skunks:

- Lesmeister, D.B., R.S. Crowhurst, J. J. Millspaugh, and M.E. Gompper. (2013). Landscape ecology of eastern spotted skunks in habitats restored for red-cockaded woodpeckers. Restoration Ecology 21: 267-275.
- Lesmeister, D.B., J. J. Millspaugh, M.E. Gompper, and T.W. Mong. (2010) Eastern spotted skunk (*Spilogale putorius*) survival and cause-specific mortality in the Ouachita Mountains, Arkansas. American Midland Naturalist 164:52–60.
- Lesmeister, D.B., M.E. Gompper, & J. J. Millspaugh (2009) Habitat selection and home range dynamics of eastern spotted skunks in the Ouachita Mountains, Arkansas. Journal of Wildlife Management 73:18-25.
- Lesmeister, D.B., J.J. Millspaugh, S.E. Wade, and M.E. Gompper (2008) A survey of parasites identified in the feces of eastern spotted skunks (*Spilogale putorius*) in Western Arkansas. Journal of Wildlife Diseases 44:1041-1044.
- Lesmeister, D.B., M.E. Gompper, & J. J. Millspaugh. (2008) Summer resting and den site selection by eastern spotted skunks (*Spilogale putorius*) in Arkansas. Journal of Mammalogy 89:1512–1520.
- Hackett, H.M., D.B. Lesmeister, J. Desanty-Combes, W.G. Montague, J.J. Millspaugh, and M.E. Gompper. (2007) Detection rates of eastern spotted skunks (*Spilogale putorius*) in Missouri and Arkansas using live-capture and non-invasive techniques. American Midland Naturalist 158:123-131.
- Sasse, D.B. and M.E. Gompper (2006) Geographic distribution and harvest dynamics of the eastern spotted skunk in Arkansas. Journal of the Arkansas Academy of Science 60:119-124.
- Gompper, M.E. and Hackett, H.M. (2005) The long-term, range-wide decline of a once abundant carnivore: the eastern spotted skunk (*Spilogale putorius*). Animal Conservation 8:195-201.