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## TWO HERPETOFAUNAL SURVEYS IN SOUTHWESTERN MISSOURI

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*Abstract: As part of the ongoing management of natural resources on lands owned by the Missouri Army National Guard, amphibian and reptile inventories were conducted at two training sites in 2011-12. Camp Crowder, Newton County, Missouri was surveyed in 2011 and 14 species of amphibians and 16 species of reptiles were observed. Camp Clark, Vernon County, Missouri was sampled in 2012 and 8 species of amphibians and 15 species of reptiles were observed. Species occurrences at both sites were compared to known amphibian and reptile records for each respective county. At both sites, a high percentage of amphibians known to occur in each county were observed. Reptile observations, particularly snakes, were under-represented most likely due to the short duration of the sampling efforts. Repeated sampling efforts over time will continue to increase species occurrence information for amphibians and reptiles on both training sites.*

### INTRODUCTION

Considering the decline in amphibians and reptiles over the last few decades, Gibbons et al. (2000) suggested that herpetofaunal inventories become a standard part of any environmental assessment. Even in areas where species are well known, knowledge gaps exist and often decisions are made on incomplete data (Foster et al., 2012). Understanding distributions, particularly at a local scale, is important when trying to maintain continuity in populations and habitat (McDiarmid, 2012). This is particularly true when one considers that there may be considerable spatial and temporal variability in the occurrences of some amphibian and reptile species (Fitch, 1999; Fisher and Foster, 2012).

Detailed information about natural resources of Missouri Army National Guard (MOARNG) training sites is needed for planning and implementation of management, sustainability, and integration of biodiversity conservation and the MOARNG training mission. Biodiversity surveys (i.e., surveys of fauna, flora, and ecosystems) provide information needed for assessing resiliency and disturbance at training sites, past or potential impacts of training on biodiversity, military and land use impacts, training and testing capacity, and the need for ecological restoration or specific management and conservation.

The Army requires training sites conduct inventories and classify natural resources present

on training sites and their status (Army Regulation 200-3). In order to meet this requirement, we conducted amphibian and reptile surveys at Camp Crowder, Newton County, MO in 2011 and Camp Clark in Vernon County, MO in 2012.

### MATERIALS AND METHODS

#### *Site Descriptions*

Camp Crowder Training Site (1,764 ha) is located in Newton County, south-western Missouri. Situated in the Springfield Plateau of the Ozarks Highlands (Thom and Wilson, 1980; Omernik, 1987), Camp Crowder consists of gently rolling hills intersected by intermittent creeks and permanent streams. At least 15 vernal pools are scattered through the mesic oak-hickory forest, which is the dominant vegetation type at Camp Crowder. Lakes, ponds, wetlands, riparian forest, warm-season, and cool-season grasslands are also present.

Oak (*Quercus* spp.) were the most common trees in dry-mesic forests. Most dry mesic forest sites had dense understories of Hawthorn (*Crataegus* spp.) and Blackberry (*Rubus* spp.). We noted presence of four vine species: Virginia Creeper (*Parthenocissus quinquefolia*), and the invasive Amur Honeysuckle (*Lonicera maackii*) in sunny areas and along roads of dry-mesic forests; Poison Ivy (*Toxicodendron radicans*), and Wild Grape (*Vitis rotundifolia*) in the moister

bottomland and wet-mesic forests. Grassland forbs included Goldenrods (*Solidago* spp.), Spiderwort (*Tradescantia* spp.), Snakeroot (*Asarum* spp.), Morning Glory (*Convolvulus* spp.), clovers (*Trifolium* spp.) and Ticktrefoil (*Desmodium canadense*). Most common grasses were Tall Fescue (*Festuca arundinacea*), Big Bluestem (*Andropogon gerardii*), and Ryegrass (*Lolium* spp.).

Camp Clark Training Site (521 ha) is situated in the Osage Plains Region (Thom and Wilson, 1980) more specifically described as Wooded Osage Plains and Cherokee Plains (Omerik, 1987) of south-western Missouri near Nevada, MO, in Vernon County. During pre-settlement times, tall grass prairie covered 70% or more of the site, the remainder likely being covered by riparian forest. Currently, Camp Clark contains a mixture of native prairie, cool season grassland, savanna, mesic oak-hickory forest and riparian forest within the undeveloped portions of the site. Approximately 1/3 of Camp Clark is currently covered by grassland.

The common trees in dry-mesic forests were oaks (*Quercus* spp.). Most dry mesic forest sites had dense understories of Hawthorn (*Crataegus* spp.) and Blackberry (*Rubus* spp.). We noted presence of vine species: Virginia Creeper (*Parthenocissus quinquefolia*) and the invasive Amur Honeysuckle (*Lonicera maackii*) in sunny areas and along roads. Poison Ivy (*Toxicodendron radicans*) and Wild Grape (*Vitis rotundifolia*) were common in the moister bottomland and wet-mesic forests. Wet bottomland forests along creeks were dominated by White Oak (*Quercus alba*), Pin Oak (*Quercus palustris*), Black Walnut (*Juglans nigra*), and Sycamore (*Platanus occidentalis*).

The dominant grass was Big Bluestem (*Andropogon gerardii*), but Indian Grass (*Sorghastrum nutans*), Switch Grass (*Panicum virgatum*), and other grasses were also present. Cool season Tall Fescue (*Festuca arundinacea*) was dominant near the western edge of the training area. Most of the native prairie at Camp Clark is invaded ( $\geq 20$  % ground coverage) by woody shrubs such as Sumac (*Rhus* spp.), oak (*Quercus* spp.), Blackberry (*Rubus* spp.), and Multiflora Rose (*Rosa multiflora*). Some of the more common grassland forbs included Blazing Star (*Liatris spicata*) Goldenrod (*Solidago* spp.), Ragwort (*Senecio* spp.), Spiderwort (*Tradescantia* spp.) various species of Asters (*Aster* spp.), Yellow Coneflowers (*Ratibida* spp.), Purple Coneflowers (*Echinacea* spp.), Morning Glory (*Convolvulus*

spp.), and Clovers (*Trifolium* spp) were common. Less common were Milkweeds (*Asclepias* spp.) and Indian Paintbrush (*Castilleja* spp.).

#### Sampling

Both Camp Crowder and Clark are active training sites for MOARNG. Subsequently, large windows of time were rarely available for sampling. Our approach was to use a broad array of sampling techniques to sample as many species of amphibians and reptiles as possible during the late spring and early summer.

Aquatic sites were sampled via auditory surveys and by seine. During each sampling period we would conduct 5 minute auditory samples at each aquatic site. We used a 4x10 feet (121 x 304 cm) minnow seine with 6 mm mesh to sample amphibian adults, larvae, and eggs in March and April, 2011 and 2012. At each of the aquatic habitats sampled, we dragged the seine on the bottom of the wetland or pond in a semi-circular motion. We sampled approximately 20 linear meters along the bank of each wetland, pond, or lake.

We also set aquatic turtle traps at both training sites. We utilized collapsible box traps purchased from Memphis Net and Twine ([www.memphis-net.net](http://www.memphis-net.net)). The box traps were 79 cm x 60 cm x 25 cm with a square mesh size of 1 cm, and had a 60-cm horizontal slit funnel on opposite ends of the long axis of the trap. The box traps were used for sampling shallow, heavily vegetated bodies of water. For deeper water bodies we used large hoop nets, also purchased from Memphis Net and Twine. The larger hoop consisted of three 88-cm diameter metal rings and one 31-cm diameter stretchable funnel. Overall trap length was 245 cm, and square mesh size was 2.5 cm. Traps were baited with sardines and checked once every 24 hours.

Terrestrial habitats were sampled utilizing trapping arrays consisting of 4-5 gallon buckets buried at ground level (i.e., pitfalls) joined by 3-6m silt fences staked into the ground. The lower edges of the 90 cm tall drift fences were buried, to force animals to travel along the fences and fall into the pitfalls. The trapping arrays were checked once every 24 hours for 6 consecutive days. Additionally, foot searches, and flipping of rocks and woody debris were conducted throughout each training site. We also road cruised during the late afternoon/early evening hours.

We recorded all species observed or heard during the course of our surveys. We then compared

species observed during the course of our survey to historical species occurrences for each respective county as reported in the Missouri Herpetological Atlas Project (<http://atlas.moherp.org/>). Camp Clark is located 27-km east of the Bourbon County, Kansas border. Camp Crowder is located 24-km east of the Ottawa County, Oklahoma border. As most herpetological inventories stop at political boundaries, we compared species occurrences during our surveys to known records for adjacent states in order to elucidate range extensions, or possible species of occurrence across state boundaries. Data from Oklahoma was taken from the Oklahoma Biological Survey's Distribution of Oklahoma Amphibian and Reptiles by Recorded Sightings (DOKARRS) (<http://www.biosurvey.ou.edu/dokadesc.html>) database, and for Kansas we used Collins et al., (2010).

### RESULTS

At Camp Crowder we conducted auditory surveys and sampled via seine at 15 aquatic sites (wetlands, ponds, lakes, streams) in March, April, and May 2012. We ran 25 terrestrial sampling arrays between 27 May-2 June 2011. We conducted additional road cruising and foot searches, and turtle trapping between 18-20 June 2011. Total effort for turtle trapping was 12 trap nights with large box traps and 9 trap nights with large hoop traps.

We observed 14 species of amphibians and 16 species of reptiles at Camp Crowder, accounting for 70% of the amphibians and 43% of the reptiles known to occur in Newton County, MO (Table 1). No amphibian or reptile species observed on Camp Crowder represented a new county record for Newton County. There were seven species of amphibians and reptiles that occur in Ottawa County, OK, but not in Newton County, MO (Table 1). Twenty species of amphibians and reptiles have been reported from Newton County, MO that have not been recorded for Ottawa County, OK. (Table 1).

At Camp Clark we conducted auditory surveys and sampled via seine 7 aquatic sites (wetlands, ponds, lakes, and streams) in March, April, and May 2012. Nineteen terrestrial sampling arrays were sampled between 28 May-3 June, 2012. There were 20 net nights utilizing large hoop nets between 29 May-2 June, 2012.

We observed 8 species of amphibians and 15 species of reptiles at Camp Clark, accounting for 72% of the amphibians and 44% of the reptiles known to occur in Vernon County, MO (Table 2).

No new county records for Vernon County were observed on site, although the original voucher specimen for the Smallmouth Salamander, *Ambystoma texanum*, was missing for the county. One specimen was collected from this survey as a voucher. There were three species of amphibians and reptiles that have been recorded for Vernon County, MO but not in Bourbon County, KS, and 11 species recorded in Bourbon County, KS but not in Vernon County, MO (Table 2).

### DISCUSSION

Short-term herpetofaunal inventories at MOARNG in 2011 and 2012 resulted in the observation of a high percentage of amphibians but only a moderate number of reptile species (Tables 1-2) known to occur in each county. Based on our survey work, perceived absences are most likely due to the short duration of our sampling efforts and/or variation in microhabitat regimes between each individual training site and the surrounding county.

There is one spring-fed limestone cave on Camp Crowder, and two species of cave dwelling salamanders, Long-tailed Salamanders (*Eurycea longicauda*) and Cave Salamanders (*E. lucifuga*) were observed there. Grotto Salamanders, (*E. spelaea*) were not observed, but could occur there. Adult Grotto Salamanders are predominantly troglodytic, although larval individuals can be found in flowing streams at cave mouths (Rudolph, 1978). No larval Grotto Salamanders were observed during the course of both diurnal and nocturnal surveys. A notable anuran absence at Camp Crowder was the Pickerel Frog, *Lithobates palustris*. Although widespread throughout the Ozarks in Missouri (Johnson, 2000), Trauth et al. (2004) noted that their distribution can be quite sporadic. A lack of cool, wet thermal refugia, such as caves and mines on site may be a limiting factor (Heath et al., 1986; Johnson, 2000).

The dearth of snake observations at Camp Crowder may simply be due to the short duration of the survey, and continued survey work would most likely fill out the list of species found on site. The lizard species observed at Camp Crowder were representative of what should be found there based on habitat present. Ongoing glade restoration by MOARNG natural resource personnel may result in the future occurrence of Eastern Collared Lizards, *Crotaphytus collaris*. There is evidence that this species is capable of significant dispersals between glades (Hutchison and Templeton, 1999; Templeton et al., 2001).

Table 1. Amphibian and reptile species observed at Camp Crowder, Newton County, MO (2011) (*NOW*) and species historically reported for Newton County, MO (*THEN*), and Ottawa County, OK (*OT,OK*).

Species.....	NOW.....	THEN.....	OT,OK	Species.....	NOW.....	THEN.....	OT,OK
<b>Caudata</b>				<b>Speckled Kingsnake.....</b>			
Central Newt .....	X.....	X.....	X	Milk Snake .....	X.....	X.....	X
Grotto Salamander.....		X.....	X	Texas Rat Snake.....	X.....	X.....	X
Long-Tailed Salamander .....	X.....	X.....	X	Eastern Hog-Nosed Snake .....		X.....	X
Cave Salamander .....	X.....	X.....		Western Worm Snake .....		X.....	X
Oklahoma Salamander .....		X.....	X	Ring-necked Snake.....	X.....	X.....	X
Ozark Zigzag Salamander .....			X	Flat-headed Snake.....		X.....	X
Spotted Salamander .....	X.....	X.....		Plain-bellied Water Snake.....		X.....	
Smallmouth Salamander.....			X	Northern Water Snake .....		X.....	X
Eastern Tiger Salamander .....		X.....		Western Ribbon Snake .....	X.....	X.....	
Common Mudpuppy.....		X.....		Common Garter Snake .....		X.....	
Western Slimy Salamander.....	X.....	X.....	X	Copperhead .....	X.....	X.....	X
<b>Anura</b>				<b>Cottonmouth.....</b>			
American Toad .....	X.....	X.....		Timber Rattlesnake .....		X.....	
Crawfish Frog.....		X.....	X	<b>Chelonia</b>			
American Bullfrog.....	X.....	X.....	X	Common Snapping Turtle .....	X.....	X.....	X
Green Frog.....	X.....	X.....	X	Alligator Snapping Turtle.....			X
Pickerel Frog.....		X.....		Common Musk Turtle.....		X.....	X
Southern Leopard Frog.....	X.....	X.....		Eastern River Cooter.....		X.....	X
Blanchard's Cricket Frog.....	X.....	X.....	X	Eastern Box Turtle.....	X.....	X.....	X
Grey Treefrog (complex).....	X.....	X.....	X	Ornate Box Turtle.....		X.....	X
Northern Spring Peeper .....	X.....	X.....		Slider.....		X.....	X
Boreal Chorus Frog.....	X.....	X.....		Spiny Softshell Turtle .....		X.....	X
Eastern Narrowmouth Toad .....	X.....	X.....	X	<b>Sauria</b>			
<b>Serpentes</b>				Coal Skink.....		X.....	X
Brown Snake.....		X.....	X	Five-Lined Skink.....	X.....	X.....	X
Northern Red-Bellied Snake .....	X.....	X.....		Broad-Headed Skink.....	X.....	X.....	
Ground Snake .....			X	Southern Prairie Skink .....			X
Rough Earth Snake.....		X.....		Great Plains Skink.....		X.....	
Smooth Earth Snake.....		X.....		Ground Skink .....	X.....	X.....	X
Rough Green Snake .....	X.....	X.....	X	Eastern Collared Lizard.....			X
Coachwhip .....		X.....	X	Texas Horned Lizard .....			X
Eastern Racer .....		X.....	X	Prairie Lizard .....	X.....	X.....	X
Prairie Kingsnake.....	X.....	X.....		Six-Lined Racerunner .....	X.....	X.....	X
				Western Slender Glass Lizard .....	X.....	X.....	

Habitat for aquatic turtles on Camp Crowder was limited to man-made ponds, so several species were expected to be absent from the site. It was surprising that no Sliders, (*Trachemys scripta*), were captured or observed. Additional sampling effort may yet reveal both sliders and the Common Musk Turtle, (*Sternotherus odoratus*), at Camp Crowder.

Camp Clark is roughly one-third the size of Camp Crowder and subsequently has more intensive anthropomorphic impacts, including higher densities of buildings and roads, and more foot traffic. This high human use and increased fragmentation may be a causal factor for the low numbers of species observed on site. Notable amphibian absences at Camp Clark included the

Plains Leopard Frog, (*Lithobates blairi*), and the Great Plains Narrowmouth Toad, (*Gastrophryne olivacea*). Habitat for both species is present (Johnson, 2000; Collins et al., 2010) and both may turn up with additional survey work. The Crawfish Frog, (*L. areolatus*) is a grassland species that has experienced declines throughout its range from agricultural and successional conversion of its prairie habitat (Parris and Redmer, 2005). While no individuals of this species were observed during our surveys, Camp Clark has seen considerable grassland restoration work. Grassland restoration sites include wet prairie and abundant populations of Grassland Crayfish, (*Procambarus gracilis*), whose burrows could be utilized by Crawfish Frogs.

Table 2: Amphibians and reptiles observed at Camp Clark, Vernon County, MO (2012) (NOW) and species reported historically for Vernon County, MO (THEN) and Bourbon County, KS (BB,KS).

Species.....	NOW.....	THEN....	BB,KS	Species.....	NOW.....	THEN....	BB,KS
<i>Caudata</i>				Speckled Kingsnake.....	X.....	X.....	X
Central Newt .....			X	Milk Snake .....			X
Smallmouth Salamander.....	X.....	X.....	X	Gopher Snake .....	X.....	X.....	X
Common Mudpuppy.....			X	Eastern Hog-Nosed Snake .....	X.....		X
<i>Anura</i>				Western Worm Snake .....			X
American Bullfrog.....	X.....	X.....	X	Ringneck Snake.....	X.....	X.....	X
Crawfish Frog.....			X	Flathead Snake.....			X
Blanchard's Cricket Frog.....	X.....	X.....	X	Copperhead .....	X.....	X.....	X
Great Plains Narrowmouth Toad .....			X	Timber Rattlesnake .....			X
Grey Treefrog (complex) .....	X.....	X.....	X	Massasauga.....			X
Plains Leopard Frog.....			X	<i>Chelonia</i>			
American Toad .....	X.....	X.....	X	Common Snapping Turtle .....	X.....	X.....	X
Spring Peeper .....	X.....	X.....	X	Common Musk Turtle .....	X.....	X.....	X
Boreal Chorus Frog.....	X.....	X.....	X	Western Painted Turtle.....	X.....	X.....	X
Southern Leopard Frog.....	X.....	X.....	X	Common Map Turtle.....			X
Fowler's Toad.....			X	Eastern River Cooter.....			X
<i>Serpentes</i>				Eastern Box Turtle.....	X.....	X.....	X
Brown Snake.....	X.....	X.....	X	Ornate Box Turtle .....	X.....	X.....	X
Lined Snake .....			X	Slider .....	X.....	X.....	X
Rough Green Snake .....			X	Spiny Softshell Turtle .....	X.....	X.....	X
Common Gartersnake.....	X.....	X.....	X	<i>Sauria</i>			
Western Ribbon Snake .....			X	Southern Coal Skink .....	X.....	X.....	
Plain-bellied Water Snake.....	X.....	X.....	X	Five-Lined Skink.....	X.....	X.....	X
Diamond-backed Water Snake .....			X	Broad-Headed Skink.....			X
Northern Water Snake .....	X.....	X.....	X	Great Plains Skink.....			X
Graham's Crayfish Snake .....			X	Ground Skink .....	X.....	X.....	X
Coachwhip .....			X	Six-Lined Racerunner .....	X.....	X.....	X
Eastern Racer .....			X	Texas Horned Lizard .....			X
Great Plains Rat Snake.....			X	Prairie Lizard .....	X.....	X.....	
Texas Rat Snake.....	X.....	X.....	X	Eastern Collared Lizard.....			X
Prairie Kingsnake.....			X	Western Slender Glass Lizard .....	X.....	X.....	X

Very few snake species were observed on Camp Clark, although the lack of available cover on site (very few rocks, downed woody debris, or old building materials) may have made detection difficult. Several individuals of water snake were observed, but only one species, the Plain-bellied Water Snake (*Nerodia erythrogaster*) has been verified at this time. Turtle species occurrences were representative based on the available habitat on site (man-made ponds) (Table 2). Western Painted Turtles, (*Chrysemys picta*) may eventually be observed at Camp Clark, although the large number of Sliders currently present in the ponds may preclude their occurrence (Dreslik and Phillips, 2005; Dreslik et al, 2005).

Comparison of cross-border records revealed data needs for providing a more complete picture of local species distributions. It was clear when comparing cross-border distributional re-

ords that while considerable distributional work on amphibians and reptiles has been done in Kansas and Missouri, more effort is needed in Oklahoma. Missouri has an active herpetological atlas program (<http://atlas.moherp.org/>), with the most recent update, as of this writing, being 28 August 2012. Kansas has had a long history of herpetological inventories (see Collins et al., 2010), and also has an active online atlas project (<http://webcat.fhsu.edu/ksfauna/herps/>). Based on information on the home page for the Oklahoma Biological Survey site (<http://www.biosurvey.ou.edu/dokadesc.html>), no entries have been made since 1998.

Amphibian and reptile inventories at MOARNG training sites in western Missouri, while short in duration, provided important baseline information required for habitat management and restoration. Comparisons between our surveys and historical surveys at the county level show

that much additional work needs to be done at these sites to obtain a more complete picture on amphibian and reptile community composition at each training site. Gunzbuger (2007) found that detection probability of amphibians varied across a range of techniques depending on species and life-stage. An extreme example of temporal variability in species encounters was a 50-yr snake study conducted by Fitch (1999) in Douglas, Jefferson, and Leavenworth counties in northeastern Kansas. During the course of this 50-yr study, the Smooth Earth Snake (*Virginia valeriae*) was only observed 3 times. It is hoped that repeated surveys over time will allow for the growth in our knowledge of the community composition at all MOARNG training sites.

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