Surveys of Basking Turtles in the Rivers of Northeastern Oklahoma, with Emphasis on *Graptemys geographica* (Common Map Turtle)

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Abstract: I used binoculars and a spotting scope with a built-in digital camera to survey basking turtles at 29 sites on tributary drainages of the Arkansas River in four counties of northeastern Oklahoma and one county of southeastern Kansas. The predominant species recorded were *Graptemys ouachitensis* (Ouachita map turtle; 57% of all turtles) and *Trachemys scripta* (slider turtle; 25%), typical of results for rivers with similar assemblages of turtle species in the central United States. There were two notable results of the surveys. First, I photographed a male *Graptemys geographica* (common map turtle) twice at a site on the Spring River in Ottawa County; the record is only the third locality reported for the species in Oklahoma and is the first vouchered locality since the initial report of the species in Oklahoma in 1927. Prospects for finding additional localities for *G. geographica* in eastern Oklahoma are discussed, based on records in adjacent Kansas, Arkansas, and Missouri. Second, I observed *Apalone spinifera* (spiny softshell) at a higher frequency compared to basking turtle surveys that have been conducted elsewhere within its range.

Introduction

Management of biodiversity requires that data on occurrence, relative abundance, and absolute abundance be collected over time, to allow assessment of trends. This requirement represents a daunting task given the diversity of species and myriad habitats that exist. Because resources to support data collection are limited, efficiency is paramount. The need for rapid and efficient assessment is especially imperative when anthropogenic threats endanger biodiversity.

Many species of aquatic turtles are habitual baskers that sun themselves on emergent in-stream deadwood and along shorelines. In North America, the behavior is especially well-developed among the six genera of deirochelyine emydids and the trionychid genus *Apalone* (Lindeman 1998, 1999; Selman and Qualls 2009). Trapping aquatic turtle species is labor- and equipment-intensive, particularly in rivers. As a low-cost, high-yield alternative, surveying basking turtles with high-power binoculars or a spotting scope allows collection of large amounts of data from multiple sites relatively quickly (Vogt 2012). Basking surveys are particularly effective when information is sought on the distribution and relative abundance of rare species (Lindeman 1997, 1998, 1999; Selman and Qualls 2009).

In recent years, concerns over the exploitation of turtles for international trade in meat and live pets have placed a premium on information concerning the general distribution and abundance of turtle species, whether rare or common. In May 2008, the Oklahoma Department of Wildlife Conservation (ODWC) announced a three-year moratorium on commercial harvest of turtle species from public waters in order to study issues related to the international trade in turtles (ODWC 2014). The announcement cited a commercial harvest by licensed trappers of nearly 64,000 turtles in Oklahoma during 2007 and a lack of data by which to assess the population impacts of the harvest.

Table 1. Results of August 2009 turtle surveys in northeastern Oklahoma. Percent frequency of occurrence is percent of sites at which occurrence was detected over 1-3 surveys. Photographic vouchers (catalog numbers in the University of Florida Museum of Natural History) refer to species at a site marked with asterisks.

			Total	Total turtles observed in combined surveys						Photographic
Drainage	Site	County, state	surveys	*G. geographica*	*G. ouachitensis*	*G. pseudogeographica*	*P. concinna*	*T. scripta*	*A. spinifera*	vouchers
Spring River	Old Hwy. 96, E of Crestline	Cherokee, KS	1		4					
	Empire Lake spillway, SE 70th St., Lowell	Cherokee, KS	1				4	2	1	
	Hwy. 400, N of Baxter Springs	Cherokee, KS	2		10			4	1	
	Hwy. 166, Baxter Springs	Cherokee, KS	3		11*		3	2	2	161176
	Bicentennial State Park, E 040 Rd.	Ottawa, OK	3	3*	2		4	14	8	161177
	Josephine Smith State Park, E 057 Rd.	Ottawa, OK	3		25		2	8		
	Mocassin Bend, Hwy. 10 E of Miami	Ottawa, OK	2		4	1				
Neosho River	E 060 Rd., W of Commerce	Ottawa, OK	1		6*					161178
	Riverview Park, Hwy. 125, Miami	Ottawa, OK	3		52*					161179
	Twin Bridges State Park, Hwy. 137	Ottawa, OK	1						1	
	Hwy. 10 overlook, SW of Kellyville[a]	Ottawa, OK	1		1			2		
	Hwy. 59, NW of Grove[a]	Delaware, OK	1		3		2	5	1	
Lost Creek	S645 Rd., Wyandotte	Ottawa, OK	1				1	8		
Elk River	Hwy. 10, SE of Turkey Ford[a]	Delaware, OK	1		1			2		
Honey Creek	Honey Creek State Park, Park Rd. off Hwy. 59[a]	Delaware, OK	1					1		
Verdigris River	E 0030 Rd. SE of South Coffeyville	Nowata, OK	2		9	1			3	
	Hwy. 10, E of Lenapah	Nowata, OK	1			1	1	5		
	Hwy. 28, SE of Delaware	Nowata, OK	2		28*	3*		5*		161180-82
Big Creek	Hwy. 28, SE of Childers	Nowata, OK	2		11	4	1	2		
	N4190 Rd., S of Childers	Nowata, OK	1			2				
Caney River	W3500 Rd., SE of Ramona	Washington, OK	1		4					
	W3200 Rd., NE of Ramona	Washington, OK	2		5*			1		161183
	W3000 Rd., S of Oglesby	Washington, OK	1		5			1		
	W2650 Rd., W of Oglesby	Washington, OK	2		17		5	9	3	
	W2400 Rd., S of Barlesville	Washington, OK	1		5	1		5		
	Hwy. 123, Bartlesville	Washington, OK	1		2			1		
	W1300 Rd., NW of Dewey	Washington, OK	1		6	1		4		
	W1100 Rd., SW of Copan	Washington, OK	2		4	1		1	3*	161184
Little Caney River	W1100 Rd., SW of Copan	Washington, OK	2		1	1*		13	1	161185
Total (N = 377)				3	216	16	23	95	24	
Percent frequency of occurrence				3%	79%	34%	31%	72%	34%	
Relative abundance				1%	57%	4%	6%	25%	6%	

[a]Impounded habitats of the Grand Lake O' the Cherokees reservoir

The moratorium was extended by two years in April 2011 (ODWC 2014).

The Oklahoma Natural Heritage Inventory (2014) lists *Graptemys geographica* (common map turtle) as a Category II Species of Special Concern. Category II species are those "identified by technical experts as possibly threatened with extirpation, but for which additional information is needed." There are only two previous records of *G. geographica* in Oklahoma. Ortenburger (1929) captured five specimens (OMNH 7272–7274 and 7276;

FMNH 13162) on the Elk River in Delaware County in 1927, six miles northwest of the town of Grove. That sampling site is now part of the Grand Lake O' the Cherokees Reservoir, constructed by damming the Neosho River in 1940. Riedle et al. (2009) captured a specimen of *G. geographica* (unvouchered) on Spring Creek near its confluence with the Neosho River in Mayes County in 1998. No other information exists on the species' occurrence in Oklahoma.

Both Oklahoma localities for *G. geographica* are tributary streams that drain southward into the mainstem Arkansas River. An extensive specimen database for the genus *Graptemys* (Lindeman 2013) suggests that there has been little collecting activity for riverine turtles in the northeastern corner of Oklahoma. Farther upstream in northern tributaries of the Arkansas drainage in Kansas, records for *G. geographica* exist for the Verdigris, Caney, and Spring drainages (KU 3267 and 3285, mapped by Collins 1993, plus recent sight records of Taggart et al. 2014). Hence the low number of localities for *G. geographica* in Oklahoma may be in part an artifact of low sampling effort in the state's northeastern streams.

I surveyed basking turtles in rivers in four counties of northeastern Oklahoma and one county in southeastern Kansas, with an emphasis on evaluating the status of *G. geographica* in Oklahoma. I report data on relative abundance, with emphasis on a new record for *G. geographica* in Oklahoma and prospects for finding additional localities for the species in the state.

Methods

I observed turtles 31 July−3 August 2009 from bridges and roadside pull-offs on the Spring, Neosho, Verdigris, and Caney rivers and their tributaries in Ottawa, Nowata, Washington, and Delaware counties, Oklahoma, and Cherokee County, Kansas. Surveys were conducted during warm, sunny conditions between 0900 and 1800 h. I used 18× Canon image-stabilizer binoculars and a Barska DSS60 spotting scope with 15−45× zoom magnification and built-in digital camera to identify turtles to species. Most turtles were basking when observed, but I also recorded several that were active at the water's surface. When I was able to get a good image, I took voucher photographs that have been deposited in the Florida Museum of Natural History Herpetology Department photographic archive.

Results

I identified 377 turtles in 46 counts made at 29 sites (Table 1). The two predominant species, *Graptemys ouachitensis* (Ouachita map turtle; N = 216, 57% relative abundance) and *Trachemys scripta* (slider turtle; N = 95, 25%), each occurred at more than 70% of sites. Four other species (*Apalone spinifera*, spiny softshell; *Pseudemys concinna*, river cooter; *Graptemys pseudogeographica*, false map turtle; and *G. geographica*) each occurred at between 1 and 10 sites and each comprised no more than 6% of the total sample. Turtles not identified (because they were too far away, or because my view of identifying characteristics was obstructed, or because they jumped into the water before I could identify them) were a small proportion of all turtles seen (<10%) and are not included among totals.

All three observations of *G. geographica* were of a male basking on the same fallen tree on the Spring River in Bicentennial State Park. I photographed the turtle on the first and third occasions (Fig. 1). Examination of head markings in several photographs taken each day suggest it was the same animal. The second observation was of a male that emerged briefly on the same branch where the male was photographed on the third observation, hence it is possible that all three observations were of the same animal.

On the upper Grand Lake O' the Cherokees Reservoir, turtle numbers were low overall, except in two small coves adjacent to the bridge on Hwy. 59. Predominant species were *T. scripta* and *G. ouachitensis*, the same species that predominated on the streams farther north.

Figure 1. A male *Graptemys geographica* basking in the Spring River at Bicentennial State Park, Ottawa County, Oklahoma. The upper picture was taken on 1 August 2009 and the lower picture on 3 August 2009.

Discussion

The record of *G. geographica* for Bicentennial State Park is only the third locality record in Oklahoma and the first to be vouchered since the species was first recorded in the state 82 years earlier by Ortenburger (1929; Fig. 2). The total historical record for the species in Oklahoma thus consists of Ortenburger's five specimens from a portion of the Elk River in Delaware County that is now submerged by impoundment, a specimen captured in Spring Creek near its confluence with the Neosho River in Mayes County (Riedle 2001, Riedle et al. 2009), and my photographed specimen from the Spring River in Ottawa County. All the records are from tributaries of the Arkansas drainage that flow southward toward the mainstem river. Additional records are from further upstream in the Verdigris, Caney, and Spring drainages in southeastern Kansas and Jasper County in southwestern Missouri (Fig. 2; Collins 1993; Daniel and Edmond 2013; Taggart et al. 2014).

Clearly *G. geographica* is an exceptionally rare species in Oklahoma. All species of *Graptemys* are habitutal baskers, and while their absolute abundance in basking surveys may vary seasonally, dramatic changes in relative abundance of species in turtle assemblages have not been described (Lindeman 2013), hence it is unlikely that the low relative abundance of the species was a result of the short time-frame of the present study. The total number of recorded specimens of three species of *Graptemys* from the Arkansas River and its northern tributaries in northeastern Oklahoma, compiled from a combination of museum collections, the trapping study of Riedle et al. (2009), and the present basking surveys, is 454 (Table 2), with *G. ouachitensis* being strongly predominant (89% of all records).

In other parts of its shared range with *G. ouachitensis* and *G. pseudogeographica*, the preferred habitat of *G. geographica* has been described as being rocky streams (DonnerWright et al. 1999, Fuselier and Edds 1994). Further searches for *G. geographica* in northeastern Oklahoma should concentrate on more extensive searches on the Spring River, the Elk River above the Grand Lake O' the Cherokees Reservoir, and the mainstem Arkansas River.

The Spring River was a target of special interest in the present study because of a record of the species several river kilometers further upstream in Jasper County, Missouri (Fig. 2; USNM 55698, collected in 1906; Daniel and Edmond 2013). The Spring River's rocky stream bottom would seem to offer a more suitable habitat than the muddier Neosho and Verdigris rivers to the west, based on habitat studies of *G. geographica* in Kansas, Minnesota, and Wisconsin (DonnerWright et al. 1999, Fuselier and Edds 1994). Subsequent to the surveys reported herein, in 2013 a *G. geographica* was photographed near the confluence of the Spring River and Shoal Creek in Cherokee County, Kansas, ca. 16 river km upstream of the Bicentennial State Park site where I recorded the species (Taggart et al. 2014). In my 15 visits to 7 sites

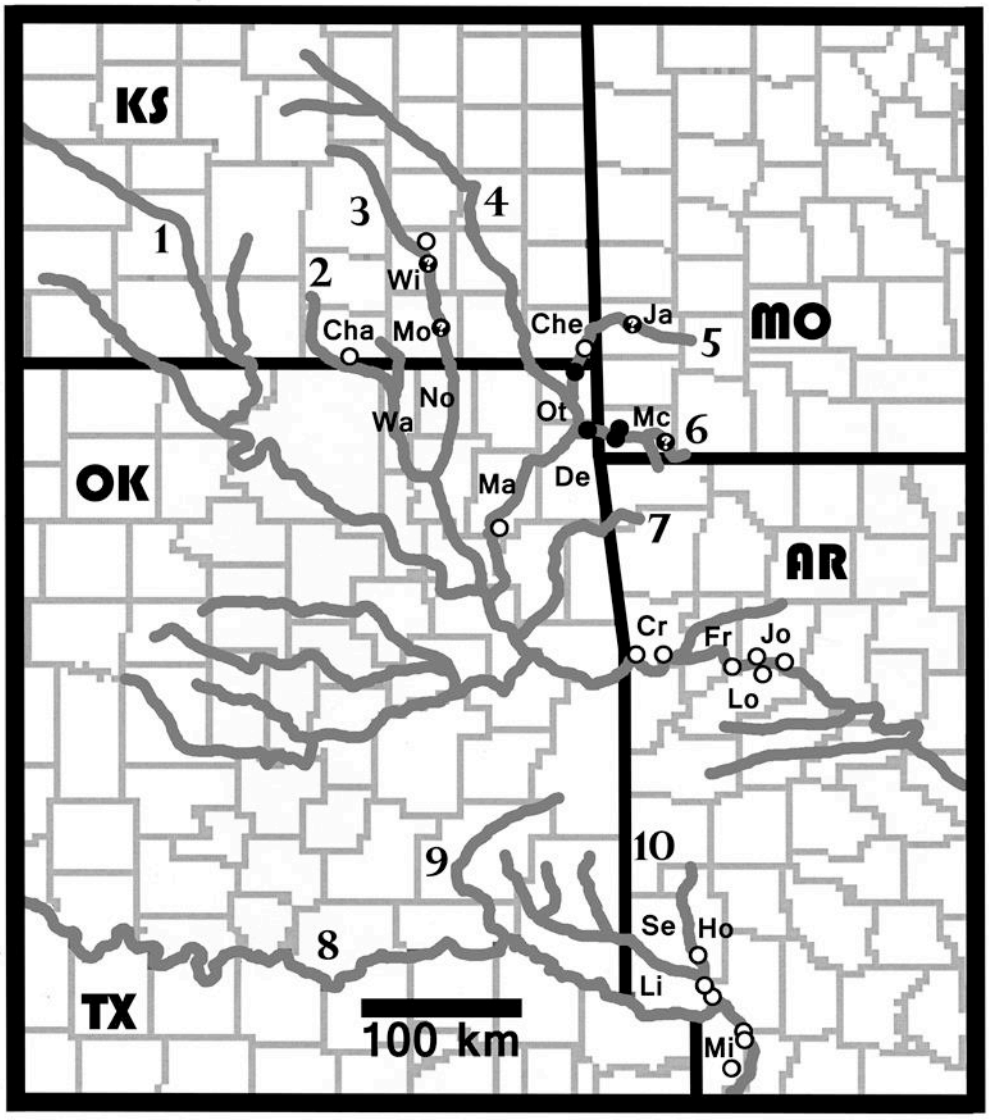

Figure 2. Detail of the Arkansas River drainage and the Red River drainage in eastern Oklahoma and adjacent states, showing the three Oklahoma localities for *Graptemys geographica* and localities for the species in adjacent portions of Kansas, Missouri, and Arkansas. Solid symbols represent vouchered specimens with precise localities, symbols with question marks are vouchered specimens with imprecise localities, and open symbols are unvouchered records from trapping or visual surveys. Labelled counties are as follows: Oklahoma, De = Delaware, Ma = Mayes, No = Nowata, Ot = Ottawa, and Wa = Washington; Kansas, Cha = Chatauqua, Che = Cherokee, Mo = Montgomery, and Wi = Wilson; Missouri, Ja = Jasper and Mc = McDonald; and Arkansas, Cr = Crawford, Fr = Franklin, Ho = Howard, Jo = Johnson, Li = Little River, Lo = Logan, Mi = Miller, and Se = Sevier. Rivers discussed in the text are numbered as follows: 1 = mainstem Arkansas, 2 = Caney (with Big Caney and Little Caney tributaries), 3 = Verdigris, 4 = Neosho, 5 = Spring, 6 = Elk, 7 = Illinois, 8 = mainstem Red, 9 = Kiamichi, 10 = Little (with Glover and Mountain Fork tributaries in Oklahoma and Saline tributary in Arkansas).

Table 2. Records of *Graptemys* from the Arkansas River and its major northern tributaries in northeastern Oklahoma.

	G. geographica				*G. ouachitensis*				*G. pseudogeographica*			
Drainage	Museum specimens	Riedle et al. (2009) trapping	Present basking surveys	Percent of all records	Museum specimens	Riedle et al. (2009) trapping	Present basking surveys	Percent of all records	Museum specimens	Riedle et al. (2009) trapping	Present basking surveys	Percent of all records
Arkansas River[a]	—	—	—	—	9	70	—	95	—	4	—	5
Illinois River	—	—	—	—	2	8	—	67	5	—	—	33
Spring River	—	—	3[b]	7	—	7	31	88	—	1	1	5
Elk River	5	—	—	83	—	—	1	17	—	—	—	—
Neosho River	—	1	—	1	2	33	62	95	—	4	—	4
Verdigris River	—	—	—	—	2	15	48	83	2	—	11	17
Caney River	—	—	—	—	—	62	49	87	—	12	4	13
Total	5	1	3	2	15	195	191	89	7	21	16	10

[a]Includes sites on smaller tributaries near their confluences with the Arkansas River.

[b]All three observations are believed to be of a single male (see text).

on the Spring River, including sites I visited in southeastern Kansas, I observed *G. geographica* at only one site (three times, but possibly all the same animal), hence even in the Spring River the species does not appear to be abundant.

There are also several specimen records for *G. geographica* further upstream in the Elk River and its tributaries in McDonald County, Missouri, that date from 1936−1977 (Fig. 2; KU 91327; AUM 12410−12418; CM 61498−61499, 87510−87518, and 87525). A short segment of the Elk River in Oklahoma (ca. 3 km), between Ortenburger's (1929) historical locality and the localities for the Missouri specimens, is not impacted by impoundment and may still harbor a small population of *G. geographica* within Oklahoma. Impoundments do not appear to be good habitat for the species (e.g., Lindeman 1998, 1999).

The Arkansas River mainstem has not been extensively surveyed for turtles in Oklahoma, except in the vicinity of the Robert S. Kerr Reservoir near the Arkansas border (Riedle et al. 2008). Across the border downstream in the state of Arkansas, there are numerous records of *G. geographica* in small tributaries near their confluences with the Arkansas River mainstem (Fig. 2; 34 specimens captured from six creeks in Crawford, Franklin, Johnson, and Logan counties, Trauth et al. 2004). The records are based on turtle surveys conducted by the Arkansas Game and Fish Commission in 1993 and were not vouchered with specimens or photographs (S. Trauth pers. comm. 2009). Survey efforts along the mainstem Arkansas and lower reaches of its tributary creeks in Oklahoma may prove similarly fruitful for finding additional localities for *G. geographica* in the state.

It is possible that *G. geographica* may also be found in the southeastern corner of Oklahoma. Trauth et al. (2004) mapped localities for *G. geographica* in the Red and Little river drainages of Arkansas that extend to within about 30 km of the Oklahoma state line (Fig. 2; also unvouchered specimens from the 1993 surveys, S. Trauth pers. comm. 2009). Records of *Graptemys* in the Red and Little drainages in southeastern Oklahoma to date (N = 62) include no *G. geographica*, however (Table 3), thus the species is probably at best a rare component of the turtle assemblage in southeastern Oklahoma streams.

The predominance of *G. ouachitensis* and *T. scripta* in northeastern Oklahoma is similar to what I reported for the Tennessee River and its major impoundment, Kentucky Lake, in western Kentucky, where virtually the same turtle fauna occurs (Lindeman 1998, 1999). In replicated basking surveys, 49% of turtles identified to species in Kentucky were *T. scripta* and 29% were *G. ouachitensis*. Also similar to the present study, in Kentucky *G. pseudogeographica* was considerably less abundant (17%) than *G. ouachitensis* and *G. geographica* was much rarer yet, being sighted only once. In trapping studies, *G. ouachitensis* likewise outnumbers *G.*

Table 3. Records of *Graptemys* from the Red River and its major northern tributaries in southeastern Oklahoma[a].

	G. geographica			*G. ouachitensis*			*G. pseudogeographica*		
Drainage	Museum specimens	Riedle et al. (2009) trapping	Percent of all records	Museum specimens	Riedle et al. (2009) trapping	Percent of all records	Museum specimens	Riedle et al. (2009) trapping	Percent of all records
Red River	—	—	0	18	5	100	—	—	0
Little River	—	—	0	1	1	67	1	—	33
Mountain Fork River	—	—	0	10	—	77	2	1	23
Glover River	—	—	0	11	2	81	3	—	19
Kiamichi River	—	—	0	1	1	100	—	—	0
Uncertain[b]	—	—	0	3	—	60	2	—	40
Total	—	—	0	44	9	85	8	1	15

[a]Choctaw, McCurtain, and Pushmataha counties

[b]Specimens from McCurtain County with no further locality data

pseudogeographica in most reported cases (reviewed in Lindeman 2013). In northern Louisiana, however, *G. ouachitensis* outnumbered *G. pseudogeographica* in basking counts on only one of the three drainages where they were observed to co-occur and the latter was seen at more of the lotic survey sites (74% vs. 23%; Carr 2001). *Graptemys pseudogeographica* is more mollusk-dependent in its diet while *G. ouachitensis* is a narrow-headed species that feeds on softer-bodied invertebrates and algae (Lindeman 2000a, b, 2013). It is typical that species of narrow-headed *Graptemys* are substantially more abundant than their sympatric broader-headed congeners (Coleman and Gutberlet 2008, Godwin 2003, Ilgen et al. 2014, Lindeman 1999, Selman and Qualls 2009, Shively 1999, Shively and Jackson 1985).

The high incidence of *A. spinifera* (6% of turtles identified, seen at 34% of sites) is unprecedented in basking surveys within its range. The species was less than 1% of turtles seen in western Kentucky and two rivers in southern Mississippi (Lindeman 1998). It was recorded at 20% of sites on the Pearl drainage but only 5% of sites on the Pascagoula and Tennessee drainages (P.V. Lindeman unpubl. data), despite greater replication of survey effort (i.e., most sites were visited eight times) than in the present study. In northern Louisiana, <1% of turtles seen at river and bayou sites were *A. spinifera* and it was seen at 5% of sites (Carr 2001). In the Mobile Bay drainages of Alabama, <1% of turtles seen were *A. spinifera* and it was seen in 11% of surveyed river reaches (Godwin 2003). In basking surveys on the Bogue Chitto River in southeastern Louisiana, *A. spinifera* and *Apalone mutica* LeSueur (smooth softshell) were not differentiated, but together the two species constituted <3% of turtles seen (Shively 1999). Similarly, the two species constituted <5% of turtles seen and were observed at 21% of survey sites on the Pascagoula drainage in southeastern Mississippi (Selman and Qualls 2009, W. Selman pers. comm. 2010). Further studies would be necessary to determine whether the late-season, warm-weather timing of my Oklahoma surveys contributed to the high incidence of *A. spinifera* or whether the species is simply more abundant in upper Arkansas drainage tributaries than elsewhere.

Visual surveys provide rapid, wide-ranging assessments of the status of turtle species that commonly engage in basking, such as *Graptemys* spp. (Vogt 2012). To generate sample sizes of captured turtles comparable to those of the present four-day study, several weeks of trapping would have been necessary,

given the time-intensive nature of putting in a boat to set and check traps at a site. Naturally, trapping studies are essential to estimates of abundance and collection of data on various biological parameters of a species, but relying solely on trapping, given limited time and resources available, may limit the number of sites sampled, thereby possibly causing locality records for rarer species to be missed. Future studies employing visual surveys should investigate species-specific detection probabilities and their environmental correlates as well as inherent detection biases among species and their impact on relative abundance data.

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