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Current Distribution of North American River Otters in Central and Eastern Oklahoma, with Seven New County Records

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Abstract

In 1984 and 1985, the Oklahoma Department of Wildlife Conservation reintroduced North American river otters (*Lontra canadensis*) from coastal Louisiana into eastern Oklahoma. Those reintroductions and immigration from Arkansas and possibly northeastern Texas allowed river otters to become reestablished in eastern Oklahoma. Our goals were to determine the contemporary distribution of river otters in central and eastern Oklahoma with voucher specimens, sign surveys, and mail surveys and to compare proportion of positive detections among watersheds. We report new distributional records with voucher specimens from seven counties (Adair, Bryan, Coal, Johnston, McIntosh, Okfuskee, Tulsa) in Oklahoma. We also provide locality information for specimens collected from four counties (Haskell, McCurtain, Muskogee, Wagoner) where river otters were described in published literature but no voucher specimens existed. During winter and spring 2006 and 2007, we visited 340 bridge sites in 28 watersheds in eastern and central Oklahoma and identified river otter signs in 16 counties where river otters were not previously documented in published literature or by voucher specimens. Proportion of positive sites within each watershed ranged 0–100%. Mail surveys suggested that river otters occurred in eight additional counties where they were not previously documented by published literature, voucher specimens, or sign-survey efforts.

Key words: county record, distribution, *Lontra canadensis*, northern river otter, Oklahoma, survey

Introduction

Prior to 1900, North American river otters (*Lontra canadensis*; hereafter "river otter") were documented throughout all of Oklahoma except in the Panhandle (Duck and Fletcher 1944). Because of habitat destruction, human settlement, unregulated harvest, and water pollution, river otter populations became severely depleted or extirpated in much of their historic range in North America by the early 1900s (Toweill and Tabor 1982). River otters were extirpated in seven states and severely depleted in nine other states including Oklahoma (Raesly 2001). As a result, river otters were protected by Oklahoma state law from 1917 to 2008;

limited trapping is now permitted. Between 1917 and 1971, there were only four documented accounts of river otters in Oklahoma (Hatcher 1984).

Despite historical reductions, habitat improvements, construction of reservoirs, wetland restoration, recent reintroduction efforts, and management have allowed river otters to return to 90% of their historical range in the United States (Melquist et al. 2003). Moreover, increases in populations of beaver (*Castor canadensis*) and associated creation of wetland habitats across the United States provide new habitat for river otters (Jenkins 1983). In Oklahoma, about 250,000 ponds and 145 major reservoirs have been constructed since the 1930s (Schackelford and Whitaker 1997). More than 130 wetlands in Oklahoma also have been restored by the Wetland Reserve Program of the U.S. Department of Agriculture's (USDA) Natural Resource Conservation Service in cooperation with other agencies. Ponds (Reid et al. 1988), reservoirs (Sheldon and Toll 1964), and restored wetlands (Newman and Griffin 1994) provide suitable habitat for river otters.

In 1984 and 1985, the Oklahoma Department of Wildlife Conservation (ODWC) released 10 river otters at Wister Wildlife Management Area (WMA) in Leflore County and seven river otters at McGee Creek WMA in Atoka County, both in southeastern Oklahoma (Base 1986); all translocated river otters were purchased in coastal Louisiana (Bayou Otter Farm, Theriot, Louisiana). During a two-year period throughout the mid-to-late 1990s, 22 river otters were released at the Wichita Mountains Wildlife Refuge (WMWR) in Comanche County. Six river otters reintroduced to WMWR were obtained from Louisiana (Bayou Otter Farm, Theriot) and 16 river otters were captured by USDA Animal and Plant Health Inspection Service (APHIS) employees near Tahlequah, Oklahoma. Since the mid-1970s, river otter numbers in Oklahoma apparently increased, probably due to immigration from increasing populations in Arkansas (Hatcher 1984) and possibly northeastern Texas and relocation efforts in Oklahoma. Dispersing river otters can move up to 42 km/day (Melquist and Hornocker 1983). Base (1986) reported that accidental trappings and observations of river otters commonly occurred along the Fouche Maline, lower Arkansas River tributaries, Mountain Fork, Poteau River, and Sans Bois Creek in southeastern Oklahoma. In general, the annual number of river otters accidentally captured in Oklahoma by APHIS employees pursuing beavers has increased (K. Grant 2005 in litt.).

Because river otters are capable of occupying many different aquatic environments (Melquist et al. 2003), it is likely that many of Oklahoma's water bodies are suitable habitat and capable of sustaining river otters (Caire et al. 1989). No formal study has been conducted to assess contemporary distribution of river otters in central and eastern Oklahoma. Shackelford and Whitaker (1997) examined habitat and relative abundance of river otters in the drainages of the Little River, Poteau River, and Sans Bois Creek in southeastern Oklahoma. Determining an animal's distribution is a fundamental part of conservation planning, and Macdonald (1990) noted that field surveys are an essential tool in designing conservation programs for otters.

Our goal was to determine the distribution of river otters in central and eastern Oklahoma through collection of voucher specimens, sign surveys, and mail surveys and to compare the proportion of positive detections among watersheds during sign surveys. We collected voucher specimens of river otters that were incidentally trapped and killed by APHIS employees and others opportunistically salvaged by ODWC employees. During winter and spring 2006 and 2007, we conducted sign surveys at bridges throughout 28 watersheds in eastern and central Oklahoma. Mail surveys were sent to state and federal natural resource employees, private organizations, and private and professional trappers in 2006.

METHODS

We used a combination of sign surveys, mail surveys, and carcass collection to assess the status of river otters. River otters are difficult to census, and most researchers recommend using more than one census method (Melquist and Dronkert 1987; Melquist and Hornocker 1983). Direct methods have included carcass collection (Polechla 1987), fecal DNA analysis (Hung et al. 2004), population models (Gallagher

1999), radiotelemetry studies (Reid et al. 1994), and radiotracer implants (Testa et al. 1994), and indirect methods have included sign surveys (Clark et al. 1987), aerial snow-track surveys (Reid et al. 1987), scent-station indices (Clark et al. 1987), latrine-site surveys (Newman and Griffin 1994), otter harvest surveys (Chilelli et al. 1996), and mail surveys (Blumberg 1993). In North America, presence of river otter sign has been used to determine distribution (Chromanski and Fritzell 1982), habitat preferences (Dubuc et al. 1990), population size (Reid et al. 1987), and relative abundance (Shackelford and Whitaker 1997).

Voucher specimen collection.—River otter "death reports" were mailed to ODWC regional biologists and game wardens that opportunistically collected carcasses. Death report questionnaires were designed to obtain data on river otter distribution and facilitate specimen collection. APHIS employees conducting damage control associated with beaver activity also received death reports. River otters are often harvested incidentally by trappers pursuing beavers (Bischof 2003) using non-selective Conibear 330 traps (Hill 1976). Voucher specimens revealing undocumented distributions and new county records were placed in the Oklahoma State University Collection of Vertebrates (OSUCOV). Death-report recipients were asked to report location (e.g., water body, nearest town, county).

Sign surveys.—Sign surveys were conducted at bridges (Shackelford and Whitaker 1997), low-water crossings, and locations where flowing water was adjacent to roadways or access points (Romanowski et al. 1996). Gallant (2007) demonstrated that examining only bridges does not affect the chances of detecting river otter presences. Sign surveys were conducted in 28 watersheds in central and eastern Oklahoma. Riparian vegetation varied from native grasses along prairie streams in central Oklahoma to forests of oak (*Quercus*) and hickory (*Carya*) further east. Stream substrates ranged from clay to bedrock with more rocky substrates in eastern Oklahoma.

Using ArcMap 9.1 (Environmental Systems Research Institute, Inc., Redlands, California), we selected sites along ≥3rd order streams (Kiesow and Dieter 2005); sites were ≥16 stream-kilometers apart (Shackelford and Whitaker 1997). Larger streams (i.e., streams with greater length and higher order) were given priority over smaller streams (Dubuc et al. 1990). Large rivers (e.g., ≥8th order) that were canalized and lacked suitable latrine sites (Romanowski et al. 1996) and watercourses with banks >45° (Gallagher 1999) and ≤16 km apart were not sampled (Shackelford and Whitaker 1997). Sites within residential areas were not sampled. No sites were sampled within three days of measurable precipitation (>0.2 cm) or a high-water event (Clark et al. 1987), and each site was visited once. Mean linear home range of reintroduced river otters in southeastern Oklahoma was >16 km (Base 1986). Therefore, it was likely that a home range would overlap with one or two sample points (Chanin 2003).

Sign surveys were conducted from January through May 2006 and January through June 2007 (Gallagher 1999) because river otter activity (corresponding to the mating season) was greatest during winter (Foy 1984) and spring (Melquist and Hornocker 1983). Using USGS Real-Time Water Data (http://waterdata.usgs.gov/ok/nwis/rt), efforts were made to sample streams and rivers when discharge was between the 25th and 75th percentile. We did not search sites where nonhydrophytic vegetation within or near the streambed was inundated or where no water was present.

We intensively searched both sides of streams for otter sign in four belt transects (5 m × 200 m; Elmeros and Bussenius 2002) upstream and downstream of each bridge, low-water crossing, or access point (Shackelford 1994). River otter scat, tracks, and latrines were recorded. Sites with bank dens and lodges of beavers (Swimley et al. 1998), beaver scent mounds (Karnes and Tumlison 1984), points of land (Dubuc et al. 1990), mouths of perennial streams (Newman and Griffin 1994), log jams (Melquist and Hornocker 1983), elevated debris-covered banks (Karnes and Tumlison 1984), and islands (Mowbray et al. 1976) were examined closely because river otters prefer such areas for latrines. River otters deposit feces, anal sac secretions, and urine on latrine sites (Swimley 1996). Personnel conducting sign surveys were trained by experienced employees from the Missouri Department of Wildlife Conservation (Evans 2006).

Presence or absence of river otters and first type of sign (e.g, scat, latrines, tracks) observed were recorded. Latrines were defined by the presence of greater than

one scat. Positive sites were identified as those where river otters were observed and/or sign was identified. Positive sites confirmed presence of river otters in the searched area. We used Pearson's chi-square analysis to examine differences in proportion of positive sites among watersheds. Analysis included watersheds completely surveyed and those that contained >5 examined sites ($n = 21$). Regression analyses were used to evaluate the relationship between years since initial capture by APHIS employees and the proportion of positive sites from each county. Stream habitat types were recorded at each identified latrine site. Sample sites were given a detectability rating based on the proportion of trackable substrate, such as exposed banks and sandbars, and searchability (Gallagher 1999). Trackability was determined by visual estimation of the percentage of trackable substrate (e.g., sand, bare soil) and was compared between negative and positive sites using a 2-tailed t-test ($n = 294$). Number of suitable latrine sites (see above for descriptions) at each sample location were recorded and compared between negative and positive sites using a 2-tailed *t*-test ($n = 126$). Search efforts at each sample site ended if river otters were observed or sign was detected; no efforts were made to quantify the amount of river otter sign because published research did not find a correlation between numbers of scats and European otters (*Lutra lutra*; Jenkins and Burrows 1980; Kruuk et al. 1986). Investigating and quantifying only scat can be problematic (Gallant et al. 2007), but regions with mild climates and limited snow fall do not permit use of other methods (e.g., snow track surveys). All statistical tests were conducted using SYSTAT 10 for Windows (SPSS Inc., Chicago, Illinois) and were considered significant at $P < 0.05$.

Mail surveys.—We developed a mail survey to obtain information on distribution of river otters in Oklahoma (Oklahoma State University Institutional Review Board Application No. AS061; Barrett 2008). Researchers have previously used mail surveys to examine distribution of river otters (Blumberg 1993) and other carnivores (Clark et al. 2002). Mail surveys are inexpensive and efficient when obtaining distributional data throughout a large area (Sommer and Sommer 1991). Some questions were modified from Pike's (1997) survey on mountain lions (*Puma concolor*; Pike et al. 1999). Survey recipients were asked to report sightings and sign of river otter that they observed during the last five years (2001–2005) and to identify locations of sightings by placing a symbol on an enclosed map.

Mail surveys ($n = 1,153$) were sent to individuals throughout Oklahoma with presumed interest in and knowledge of mammals: state and federal biologists and technicians (ODWC, US Fish and Wildlife Service, USDA Forest Service), ODWC game wardens, USDA APHIS employees, US Army Corps of Engineers lake managers and park rangers, and Nature Conservancy land stewards. Mail surveys also were sent to professional and recreational trappers who purchased a trapping license in 2004–2005 and lived east of Interstate 35. To increase participation, survey participants remained anonymous. Pre-paid postage and pre-addressed return envelopes also were included with the survey (Blumberg 1993). Returned surveys were organized by employer or affiliation (Pike et al. 1999). Because we could not identify nonrespondants, a follow-up reminder was sent to all survey recipients approximately two months after initial mailing (Filion 1978).

RESULTS

Voucher specimens.—Although commonly captured by APHIS employees since the mid-1990s while controlling beaver, few voucher specimens of river otters exist to document their distribution in Oklahoma (Caire et al. 1989). We report new distributional records with specimens from seven counties where river otters were not previously documented in the published literature. Additionally, we provide locality information for specimens collected in four counties where river otters were described in the published literature but not associated with voucher specimens. Voucher specimens were obtained from incidental captures by APHIS employees or salvaged opportunistically (e.g., road kill) by ODWC employees. All specimens were catalogued in the OSUCOV (Table 1).

Table 1. Summary of 23 voucher specimens of northern river otter collected in 11 counties in central and eastern Oklahoma, 2005–2007, and deposited in Oklahoma State University Collection of Vertebrates (OSUCOV; new county records in bold).

County	OSUCOV	Sex	Collection date	Locality
Adair	13267	Female	23 February 2006	No information
	13268	Female	23 February 2006	No information
	13269	Male	2 March 2006	Near Eldon on Baron Fork
	13270	Male	29 November 2005	6.4 km N Procter on Tyner Creek
	13271	Male	3 February 2006	3.2 km E Proctor
	13272	Male	14 February 2006	4.8 km W Watts
Bryan	13273	Male	10 February 2006	8.0 km S and 6.4 km W Bokchito
Coal	13274	Female	31 October 2006	No information
	13275	Female	10 January 2006	9.7 km SE Stonewall on private pond
	13276	Male	14 January 2006	9.7 km SE Stonewall on private pond
Haskell	13277	Male	23 February 2006	8.0 km S Stigler
Johnston	13278	Female	9 February 2007	Tishomingo National Fish Hatchery adjacent to Pennington Creek
	13279	Female	9 February 2007	Tishomingo National Fish Hatchery adjacent to Pennington Creek
McCurtain	13280	Female	February 2006	No information
McIntosh	13281	Unknown	Unknown	9.7 km E Salem
Muskogee	13282	Male	20 January 2006	14.4 km S Muskogee on private pond adjacent to Spaniard Creek
	13283	Male	20 January 2006	14.4 km S Muskogee on private pond adjacent to Spaniard Creek
	13284	Male	18 May 2005	Near Porum on Canadian River
	13285	Male	18 January 2006	6.4 km SW Webbers Falls on private pond to Dirty Creek
Okfuskee	13286	Female	17 January 2006	3.2 km W Weleetka
	13287	Female	17 January 2006	3.2 km W Weleetka
Tulsa	13288	Female	24 February 2006	Tulsa International Airport
Wagoner	13289	Male	4 May 2007	2.4 km W Stones Corner on Arkansas River

Sign surveys.—We visited 340 riparian reaches in 28 different watersheds throughout central and eastern Oklahoma, but 43 of those sites were not examined because water was not present. We observed river otters or identified river otter sign at 159 of 297 (53.5%) examined sites. Of the 159 positive sites, we observed river otters at two sites, identified tracks at 20 sites, and latrines at 137 sites (Barrett 2008). Proportion of positive sites within each watershed ranged from 0 to 100% (Fig. 1). There was a significant difference ($\chi^2 = 123.81$; df = 20; $P < 0.001$) in proportion of positive sites among watersheds. During the sign surveys, we identified river otter sign in 16 counties (Carter, Cherokee, Choctaw, Cleveland, Creek, Kay, Hughes, Lincoln, Osage, Ottawa, Okmulgee, Pontotoc, Pottawatomie, Pushmataha, Rogers, Seminole; Fig. 2) where river otters have not been documented in previously published literature (Caire et al. 1989) or by voucher specimens. Sign surveys documented river otter presence in all counties where they were previously captured by APHIS employees.

Additional records were obtained outside of our formal sign surveys. River otter sign was located along the Little River in Pottawatomie County off of the selected US Route 177 but beyond the standard 200-m transect. One latrine was identified opportunistically along the Arkansas River below Kaw Lake on the border between Kay and Osage counties. River otter signs also were identified opportunistically along the North Canadian River in McIntosh and Okfuskee counties near a bridge on Indian Nation Turnpike. Two sites were searched opportunistically within the Lower Cimarron Watershed, but no river otter sign was documented. Surveys of the Middle Washita River and Muddy Boggy Creek watersheds were not completed because of high water. River otter sign was documented on Caddo Creek within the Middle Washita River Watershed (Carter County) and also at three sites in the Muddy Boggy Creek Watershed.

Elk River and Bois D'arc Creek–Island Bayou watersheds in northeastern Oklahoma were not sampled. Because the majority of the Elk River Watershed occurs in western Arkansas, only one sample site was selected along the Elk River in Delaware County, Oklahoma, but it was not examined because water was not present. Bois D'arc Creek–Island Bayou Watershed, primarily in Bryan County, was not sampled because no suitable sample sites were located near bridges or access points. All streams within that watershed were small (i.e., <1 m) or highly entrenched (i.e., >45° banks). Because streams and rivers tended to be more entrenched further west within our study area, we located fewer suitable sample sites and, therefore, examined fewer sites in western watersheds. Over 150 sites were removed from sampled watersheds because steep banks dominated the shoreline.

Trackability of negative sites ($\bar{x} = 4.10$) and positive sites ($\bar{x} = 3.23$) differed ($t = 3.81$; $P < 0.001$). There was no difference ($t = 1.79$; $P > 0.05$) between number of suitable latrine sites located at negative and positive sites. Within positive sites, 56.5% of river otter sign occurred within the first 100 m ($\bar{x} = 93.3$ m) along transects. Less than 21% of latrines occurred after 150 m. Most latrines (59.2%) were located within 50 m of a transition between stream habitat types. Of latrines occurring within 50 m of a stream habitat transition, 75.6% occurred at a transition between pools (main channel, corner, lateral scour, and confluence) and other stream habitat types. Most commonly (74.6%), the transition occurred between pool and riffle (low and high gradient) habitats. Most latrines were located at the bankfull step (64.3%; Rosgen 1996) along straight shorelines (53.9%) with vertical (53.8%) or sloped (31.9%) banks. Latrines commonly occurred near slack water where detritus accumulated within the streambed (33.3%), areas inhabited by beavers (76.9%), and within ≤50 m of tributaries (21.2%). The mean stream width adjacent to latrines was 22.8 m.

Mail surveys.—Twenty-seven percent of 1,153 mail surveys were returned. Return rates among surveyed groups were 0–46%. Thirty-nine percent of all returned surveys reported observing river otters within the last five years (2001–2005). Twenty-eight percent of all returned surveys reported observing river otter sign within the last five years, and the proportion of positive responses among survey groups (trappers, ODWC, federal employees) did not differ ($\chi^2 = 1.17$; df = 2; $P > 0.10$). Overall, the number of river otter sightings and observations of sign among all groups increased from 22 to 89 and 11 to 62, respectively, during the past five years. Mail surveys revealed the possibility of river otters in eight additional counties

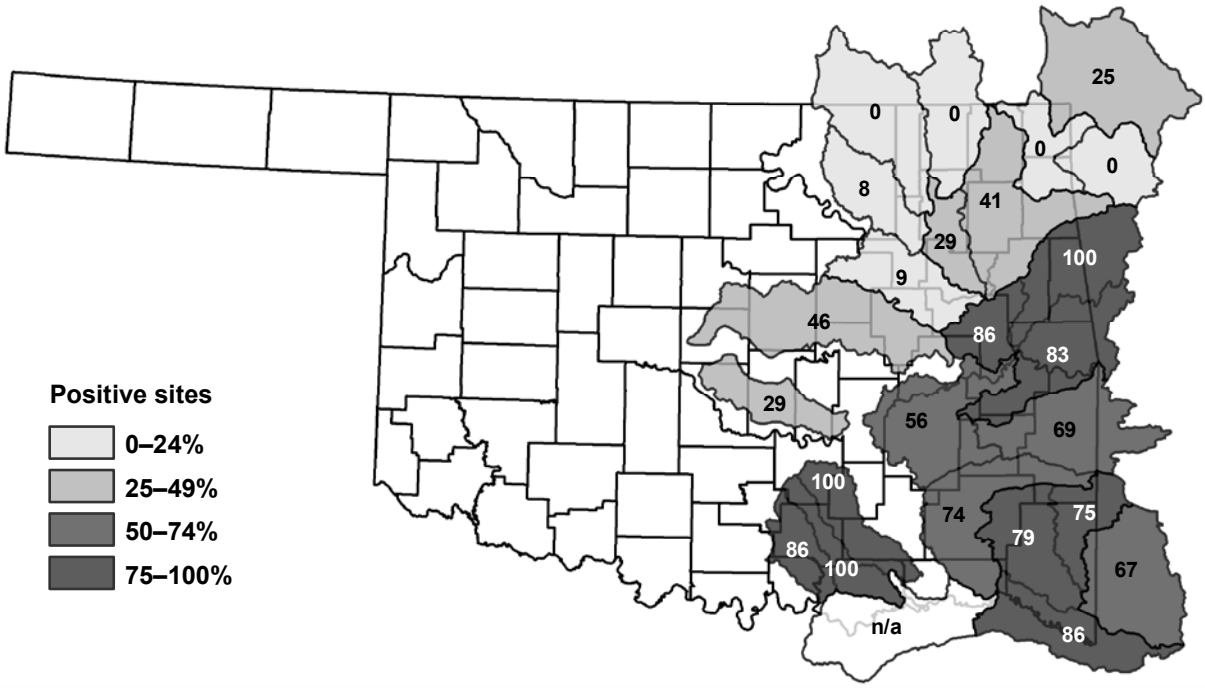

Figure 1. Percentage of positive sites by watersheds in eastern and central Oklahoma for river otters during sign surveys, winter and spring, 2006–2007.

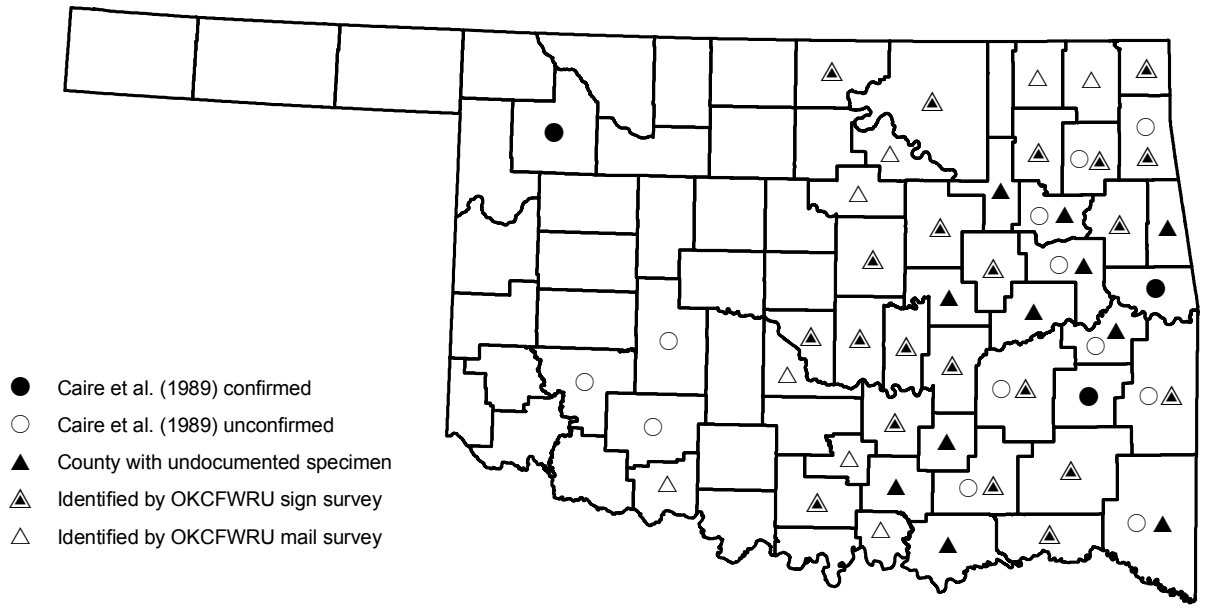

Figure 2. County records of river otters by type in Oklahoma through 2007.

(Cotton, Craig, Marshall, McClain, Murray, Nowata, Pawnee, Payne) where they were not documented previously by voucher specimens, sign-survey efforts, or in the published literature (Fig. 2). Mail-survey participants identified all counties where river otters were identified by voucher specimens or sign surveys except Creek and Seminole counties. Locations of river otter sightings and observation of sign were similar among survey groups. Most sightings and/or signs occurred in localized areas (e.g., reservoirs) with high accessibility.

DISCUSSION

Indirect signs (e.g., sign surveys) are often effective tools to study wildlife species (Stephens et al. 2006). Nevertheless, caution should be used when interpreting river otter sign data (Rostain 2000) because several factors can affect detection; for example, areas sampled may not have been recently frequented by a resident otter making its detection impossible. Presence can often be determined, but absence is impossible to discern. Others have reported that there is not always a relationship between number of scats and number of river otters (Melquist and Hornocker 1983). Furthermore, sites with fewer scat could be an indication of fewer suitable latrine areas, not fewer river otters. In contrast, we determined that no difference occurred between the number of suitable latrine sites at positive and negative sites.

Because of time constraints and high water levels, we could not sample the Lower Canadian River and Walnut Creek and Lower North Canadian River watersheds, but mail surveys, death reports, and APHIS records documented river otters in those drainages. Sign surveys were conducted within the Little River Watershed, a tributary to the Canadian River in central Oklahoma. River otter sign was documented along the Little River in Pottawatomie County and below Lake Thunderbird in Cleveland County. To reach these locations, river otters likely have moved along the Canadian River above Eufaula Lake. Within the Lower North Canadian River Watershed, we collected one river otter carcass and identified river otter signs above Eufaula Lake along the North Canadian River in McIntosh and Okfuskee counties.

We examined three sites within the Muddy Boggy Creek Watershed that contained river otter sign. Most likely river otters have become well established throughout this watershed because of reintroduction efforts (McGee Creek WMA), suitable habitats, and neighboring watersheds (Clear Boggy Creek Watershed, Kiamichi River Watershed) with relatively high proportions of positive sites (Fig. 1).

Mail surveys allowed us to obtain additional specific locations of river otters throughout Oklahoma, but these data need to be interpreted cautiously. Some researchers surveyed only natural-resource professionals because responses from outdoorsmen were considered unreliable (McBride et al. 1993). Nevertheless, even natural resource professionals can be inaccurate when identifying animal sign unless properly trained (Evans 2006). Regardless of who is surveyed, researchers must account for issues regarding access and human visitation; locations commonly visited by outdoorsmen and inaccessible areas could influence distributional data (Stubblefield and Shrestha 2007). Van Dyke and Brocke (1987) noted that human-based surveys should not be used alone to describe distribution of mountain lions. Mail-survey information should only be used to generally estimate mammalian distribution (Blumberg 1993).

Since the 1970s, river otters have become more prevalent throughout eastern Oklahoma and continued to spread westward, recolonizing parts of their historic range (Hatcher 1984). By the early 1990s, APHIS employees reported catching river otters within most counties in southeastern Oklahoma (Fig. 3; K. Grant 2005 in litt.). Because fewer perennial habitats occur in central Oklahoma, it is unlikely that river otters occur at high densities throughout watersheds west of Blue River, Clear Boggy Creek, and Lower Washita River watersheds and east of WMWR. Mail surveys and APHIS harvest records showed few accounts of river otters in central Oklahoma (K. Grant 2005 in litt.). Furthermore, sign surveys within Little River Watershed (central Oklahoma) showed relatively low proportions of sites containing river otter sign (29%). Similarly, only 29% of examined sites along upper portions of the Deep Fork Watershed were positive.

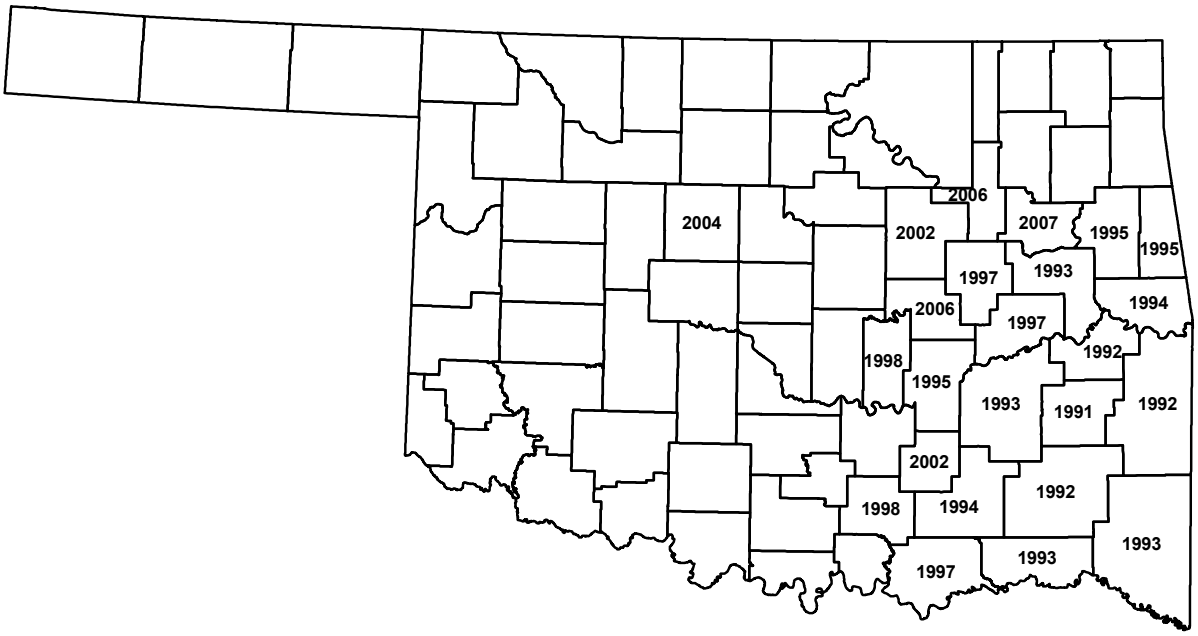

Figure 3. Oklahoma counties where river otters have been captured by USDA Animal and Plant Health Inspection Service (APHIS) employees; year within each county (1991–2007) represents first year of capture. Some dates provided by APHIS did not coincide with Hatcher (1984).

Broad comparisons among large watersheds can be made from the proportion of positive sites within a watershed (Macdonald and Mason 1987), but management decisions should not be based solely on sign indices (Gallagher 1999). Most importantly, sign surveys can be used to monitor areas throughout time to document range expansion and/or reduction (Swimley and Hardisky 2000). Large reductions in population size may be more evident when baseline data have been recorded previously. For example, sign surveys were used to document decline of European otter in France (Lode 1993) and range expansion and recolonization in Poland (Romanowski 2006). State wildlife agencies such as in Texas regularly use sign surveys of river otters to monitor their distributions (Boyd 2006; Evans 2006).

Large watersheds in Oklahoma, such as Arkansas River, Canadian River, Red River, Cimarron River, and Washita River, may continue to facilitate westward dispersal and expansion of river otters. Conducting ongoing systematic sign surveys to document river otter expansion and/or reduction will enhance effective management and conservation efforts (Elmeros and Bussenius 2002). Studies using indirect sign to examine river otter populations need to consider detectability and repeated visits to determine river otter presence or absence (MacKenzie 2005). Observer skill also needs to be evaluated using standardized methods (Evans 2006). At locations where suitable latrine sites do not exist, European researchers have created artificial latrine sites to increase effectiveness of monitoring efforts (Chanin 2003). Chanin (2003) recommended that sign surveys should be conducted annually for 10 years, and then sampling should occur at intervals of two or three years. As baseline data and populations become established, sampling intervals can be repeated less frequently.

River otters have become well established and commonly occur throughout most of eastern Oklahoma. As determined by voucher specimen collection, sign surveys, mail surveys, and published literature, river otters have returned to >60% of their historic range within Oklahoma. All results combined, we recorded river otters in 31 new counties where river otters were not formerly documented (Fig. 2; Caire et al. 1989). Although voucher specimen collection and sign surveys are valuable, mail surveys documented river otters in more counties than any other method.

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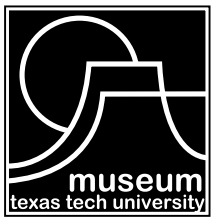

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