

Trends from Six Years of Spotlight Surveys for American Alligators in Southeastern Oklahoma

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Annual nocturnal spotlight surveys for American alligators have been conducted at Red Slough Wildlife Management Area (RSWMA) in McCurtain County since 2004. We conducted a single survey annually from 2004 - 2010, during which 10-13 observers drove along levees and boated within wetland units, noting the number, location, and approximate size of each alligator detected. In 2010, we also conducted four baseline surveys on each of four lakes on the Little River National Wildlife Refuge (LRNWR). At RSWMA, we detected a total of 60 alligators, mean = 10/year, range = 4 - 19), and mean annual catch per unit effort (CPUE) was 0.28 alligators/hour (range = 0.07 - 0.49). A total of seven alligators were detected at LRNWR, and frequency of occurrence was similar between LRNWR and RSWMA. At RSWMA, the total number of alligator detections and CPUE varied considerably among survey dates, and there was no relationship between search effort (observer-hours) and the number of alligators detected. The greatest number of detections and highest frequency of occurrence were consistently seen at Ward Lake and a channel associated with Wetland Unit 16 at RSWMA, and on Pine Lake at LRNWR. © 2010 Oklahoma Academy of Science.

INTRODUCTION

The American alligator *Alligator mississippiensis* is found in the southeastern US, with populations in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Texas, and Oklahoma (US Department of the Interior 1987). Hunting pressure and wetland loss greatly reduced alligator populations during the nineteenth and twentieth centuries (Webb et al. 2009), causing alligators to be listed as endangered in 1967 (US Department of the Interior 1987). Populations rebounded during the next twenty years and Ameri-

can alligators were formally downgraded to threatened in 1987 (US Department of the Interior 1987). Currently, several states include controlled harvest as part of their alligator management programs.

Although alligators have long been known to occur in Oklahoma, little has been published about them in this state. The first record of an alligator from Oklahoma is of one killed in McCurtain County in 1866 (Heck 2006). There was only a single additional record during the nineteenth century when multiple alligators were recorded in Johnston County in 1871 (Heck

2006). During the twentieth century there are only two published accounts of alligators in Oklahoma; one in Cleveland County in 1909 (Lane 1909) and one in McCurtain County in 1949 (Blair 1950). Heck (2006) interviewed residents of southern McCurtain County who suggested that alligators were present but rare in the 1930s, 1940s, and 1950s. Heck (2006) also mentions that four nuisance alligators were relocated to Little River National Wildlife Refuge (LRNWR) in McCurtain County between 1989 and 1993, and alligators are seen there with some level of regularity.

The presence of alligators in Oklahoma represents the northwestern-most extent of their range. However, the paucity of alligator reports in Oklahoma suggests that these animals have likely been scarce and localized in this state. For example, while Joanen and McNease (1989) provide population estimates for nine of the ten states where alligators occur, no population estimates are provided for Oklahoma. Joanen and McNease (1989) further note that states on the fringe of the range will not hold alligator densities characteristic of coastal states. Currently, alligators are thought to occur in McCurtain, Choctaw, Bryan and Love Counties (Sievert and Sievert 2005). It wasn't until 2005 that the first alligator nest in Oklahoma was documented at Red Slough Wildlife Management Area (RSWMA) in McCurtain County (Arbour and Bastarache 2007), and alligators have been verified as breeding at this location in 2005, and annually during 2007-2010 (US Forest Service and Oklahoma Department of Wildlife Conservation, unpublished data). Further, several nuisance and unwanted pet alligators have been released at RSWMA, as were a clutch of captive-reared alligators (raised by TP), and sightings of alligators there are not uncommon (US Forest Service and Oklahoma Department of Wildlife Conservation, unpublished data). Thus, while it is generally acknowledged that alligators may be found in several southeastern Oklahoma counties,

they may be most abundant on RSWMA and LRNWR, but published data are lacking to confirm this.

Given the lack of published information on the status of the American alligator in Oklahoma, there is an urgent need to document population parameters of this species in this area. The goals of our study were fourfold. First, we wanted to document trends of this species through time at RSWMA. Secondly, we wanted to rank wetland units on RSWMA in terms of alligator detection rates. Third, we wanted to determine whether alligators were still present at LRNWR. Finally, we wanted to provide recommendations for additional surveys.

METHODS

Study Areas

The RSWMA lies within the Red River floodplain and is a collaborative management project between the USFS, ODWC, and the Natural Resources Conservation Service. The land was formerly used for agriculture, but reclamation as wildlife habitat began in approximately 1996. Total area is 3,157 ha, including approximately 1,295 ha of wetland units and 160 ha of reservoirs (Oklahoma Department of Wildlife Conservation 2010). Of these, 17 wetland units and 7 reservoirs appear to provide alligator habitat and were targeted for survey efforts, as were canals and two creeks that provide connectivity between habitats (Figure 1). The remaining land coverage is primarily bottomland hardwood forest and shrub/scrub habitat. Because of the abundant coverage by wetland units, shallow reservoirs, canals, and lowland creeks, RSWMA appears to provide relatively high quality habitat for alligators.

The LRNWR is 6,070 ha and dominated by bottomland hardwood forests (US Fish and Wildlife Service). In addition to the Little River, there are ten lentic water bodies, ranging in size from 0.7 - 6.5 ha. These water bodies include oxbow lakes, relatively shallow reservoirs, and flooded lowland areas,



Figure 1. Locations at Red Slough Wildlife Management Area, McCurtain County, Oklahoma, where we conducted spotlight surveys for American alligators, 2004 – 2010. Alligator detection rates were relatively high in black shaded areas, moderate in hash-marked areas, low in gray areas, and no detections were made in white areas. It should be noted that alligators associated with Unit 16 were in a canal associated with the wetland unit, and not detected throughout the area in black.

thereby providing relatively high quality habitat for alligators. Because of their status as state and/or federal lands, RSWMA and LRNWR may be relatively protected from poaching and illegal harvest of alligators.

Surveys

Previous studies have indicated that spotlight surveys can be useful for monitoring crocodilians (Woodward and Marion 1978; Wood et al. 1985; Hutton and Woolhouse 1989; Woodward et al. 1996; Subalussy et al. 2009). We conducted nocturnal spotlight surveys on RSWMA from 2004

- 2010. Because methods used in 2004 were substantially different than those of subsequent years, analyses and discussion are based on 2005 – 2010 surveys. A single survey per year was conducted between April 26 and May 5, air temperature was between 60 and 75 F during all years except 2007 (temperature was 52 F at 12:00 am), and surveys were only conducted when skies were clear and winds were calm or slight. Of the 26 water bodies considered to be suitable alligator habitat at RSWMA, we surveyed 22 - 26 each year, except that only 13 were searched in 2006 (Table 1). Each

Table 1. Number of juvenile and adult American alligators detected, and catch per unit effort (CPUE, measured as number of alligators detected per observer-hour of search time) via annual (2005 – 2010) spotlight surveys at Red Slough Wildlife Management Area, McCurtain County, Oklahoma.

Year	No. of Observers	Hours searched	Observer-hours	No. of Juveniles	No. of Adults	Total CPUE
2005	12	6.0	72.0	1	9	0.14
2006	10	2.5	25.0	2	10	0.48
2007	10	3.5	35.0	2	6	0.23
2008	13	4.5	58.5	0	4	0.07
2009	11	2.5	27.5	0	7	0.25
2010	11	3.5	38.5	8	11	0.49

survey effort included 10 – 13 observers, all surveys began between 8:30 and 9:00 pm, and all but one ended between 11:30 pm and 1:00 am (the 2005 survey ended at 3:00 am). Each survey involved driving vehicles (trucks or ATV's) along the levees of wetland units and some reservoirs, and boating in reservoirs that provided enough depth for outboard motors, while 2-3 observers/vehicle searched for alligators with a spotlight (usually initially detected by eye-shine). Once an alligator was sighted, an effort was made to get as close as necessary to be confident in the sighting, and to estimate length. Location and estimated length were recorded. To examine trends in abundance, we calculated catch per unit effort (CPUE, calculated as the number of alligators detected per observer-hour of search effort), and we examined the relationship between total effort (observer-hours of search time) and alligator detections using linear regression.

We conducted preliminary surveys at LRNWR during May and June, 2010. Among the 10 lakes available, we selected four because they are visible from a road, and we used only road surveys for this effort. Each lake was surveyed twice during May and twice during June. Surveys were conducted from 9:00 pm – 1:00 am, and once an alligator was detected, we recorded location and estimated length.

RESULTS

Red Slough Wildlife Management Area.

Mean effort/survey was 43 observer-hours (range = 25 – 72). At RSWMA, a total of 60 detections were made among all years combined, and 4 - 19 alligators were seen each year (Table 1, Figure 1); this includes 0-8 juveniles (arbitrarily defined as those less than 4'), and 4-11 adults each year (Table 1). Mean catch per unit effort (CPUE, measured as number of alligators seen per observer-hour) among years was 0.28 (range = 0.7 – 0.49) (Table 1, Figure 1). Among the 26 water bodies, all were surveyed 4-6 times except wetland units 5 and 7 (Table 2). Among the remaining 24 water bodies, alligators were detected in 11, and the frequency of occurrence among these (percent of times in which an alligator was detected in a water body that was searched) was 17 – 100%. Among the 11 water bodies in which alligators were detected, Ward Lake and a channel associated with wetland unit 16 had the highest frequency of occurrence (100% and 83%, respectively) and total number of alligators detected (22 and 16, respectively), accounting for 63% of all alligators detected (Table 2). Pintail Lake, Bittern Lake, and wetland unit 31 were relatively intermediate with respect to detection rates, with a total of 4 – 6 alligators detected in each (Table 2). One – two alligators were detected in each of six water bodies, and no alligators were

Table 2. Results of annual (2005 – 2010) spotlight surveys for American alligators on 26 water bodies (17 wetland units, two creeks, seven lakes) at Red Slough Wildlife Management Area, McCurtain County, Oklahoma. Frequency of occurrence refers to percent of times a survey resulted in the sighting of at least one alligator. An X indicates the water body was surveyed; numbers in parentheses indicate the number of alligators detected. Water bodies are ranked in order of total number of alligator detections.

Water body	2005	2006	2007	2008	2009	2010	Frequency		Percent of all alligators seen	
							Number of surveys	Number of occurrence		
Ward Lake	X(2)	X(5)	X(1)	X(1)	X(1)	X(12)	6	100	22	37
Unit 16 channel	X(5)	X(3)	X(5)	X(1)	X(2)	X	6	83	16	27
Pintail Lake	X	X(1)	X	X(1)	X(1)	X(3)	6	67	6	10
Unit 31	X	X(2)	X(1)	X	X(1)		5	60	4	7
Bittern Lake	X	X	X	X	X(1)	X(3)	6	33	4	7
Unit 30	X(1)	X	X(1)		X		4	50	2	3
Lotus Lake	X(1)	X	X	X	X	X(1)	6	33	2	3
Unit 47	X		X	X(1)	X	X	5	20	1	2
Stork Lake	X	X	X	X	X	X(1)	6	17	1	2
Unit 27A	X	X(1)	X	X	X	X	6	17	1	2
Unit 52	X(1)	X	X	X	X		5	2	1	2
Unit 5					X		1	0	0	0
Unit 7					X		1	0	0	0
Unit 21	X		X	X	X	X	5	0	0	0
Unit 27B	X		X	X	X	X	5	0	0	0
Unit 37	X		X	X	X	X	5	0	0	0
Unit 38	X		X	X	X	X	5	0	0	0
Unit 40	X		X	X	X	X	5	0	0	0
Unit 42			X	X	X	X	4	0	0	0
Unit 44	X		X	X	X	X	5	0	0	0
Unit 48	X		X	X	X	X	5	0	0	0
Unit 50	X	X	X	X	X		5	0	0	0
Push Creek	X	X	X	X	X	X	6	0	0	0
Norwood Creek			X	X	X	X	4	0	0	0
Otter Lake	X	X	X	X	X	X	6	0	0	0
Teal LakeX		X	X	X	X		5	0	0	0
Total	10	12	8	4	7	19			60	

detected in the remaining 15 water bodies surveyed (Table 2).

Little River National Wildlife Refuge. A total of seven alligators were detected among all surveys combined, including five at Pine Lake and two at Forked Lake; no alligators were detected at Duck and Yanubbee Lakes. Frequency of occurrence was 75% and 25% on Pine and Forked Lakes, respectively (Table 3).

DISCUSSION

Red Slough Wildlife Management Area.

At RSWMA, the total number of alligators seen per year and CPUE varied widely. Following, we discuss five possible explanations for this variability. (1) The size of the alligator population may vary among years. However, alligators are relatively long-lived, living up to 80 years (Saalfeld et

Table 3. Number of alligators detected via spotlight surveys conducted on four lakes at Little River National Wildlife Refuge, May – June 2010, McCurtain County, Oklahoma.

Date	Number of Observers	Pine Lake	Duck Slough	Yanubbee Lake	Forked Lake
May 8	4	1	0	0	2
May 21	2	0	0	0	0
June 11	2	1	0	0	0
June 25	2	3	0	0	0

al. 2008). Consequently, it is unlikely that the population has fluctuated as widely as our data suggest over the six-year time span of this study. (2) Variability in search effort may have lead to variability in detection rates. If this were true, we would expect to see a significant relationship between search effort (e.g., observer hours spent searching) and number of alligators detected. However, we saw no such relationship. (3) Conditions (e.g., environmental and observer experience) under which the surveys were conducted may have lead to variability in detection rates. This explanation also seems unlikely, as almost all surveys were conducted within a narrow range of dates and environmental conditions, and we used a consistent core of trained observers to conduct the surveys (all inexperienced surveyors were teamed with experienced surveyors). The only survey that fell outside of a narrow range of environmental conditions was in 2007, during which the temperature was substantially lower than during other surveys. However, the number of alligators detected and CPUE during 2007 was similar to average values over the entire six-year survey period, suggesting that temperature did not hinder detections. (4) Variability in detections may be due to a low number of alligators, and (5) variability in detection rates may be due to low probability of detection of alligators. We have listed these two possible explanations together because either would lead to low detection rates. If total detection rates are low (due to either a small population or low detectability), small variations

in numbers of detections will have a large effect on total number of alligators seen and on calculations of CPUE. For example, a deviation of 5 alligator detections would have a much larger impact on calculations of CPUE when 10 total alligators are seen than when 50 total alligators are seen. Similarly, a small number of organisms present or low probability of detection (i.e., when sample sizes are small), may lead to high variability in the data, such as we saw. This would also explain the counter-intuitive observation that there was no relationship between total time searched (observer-hours) and number of alligators detected. Low detection rates, due to either low numbers of alligators or low probabilities of detection, would affect this relationship similarly.

Regardless of the source of variability in total number of alligators detected and CPUE, the variability prevents us from being able to describe a trend in the number of alligators at RSWMA. Additionally, the apparent upward trend in 2010 was largely driven by the relatively large number of juvenile alligators (eight) detected (these juveniles were approximately 2.5 feet in length). A single successful reproductive event and/or a single year of relatively high recruitment could have made such a difference. Further, the lack of a relationship between total search effort and numbers of alligators seen suggests our search efforts would not likely detect a trend over a six-year period. Accordingly, our data do not allow us to describe a definitive trend in abundance of alligators on RSWMA.

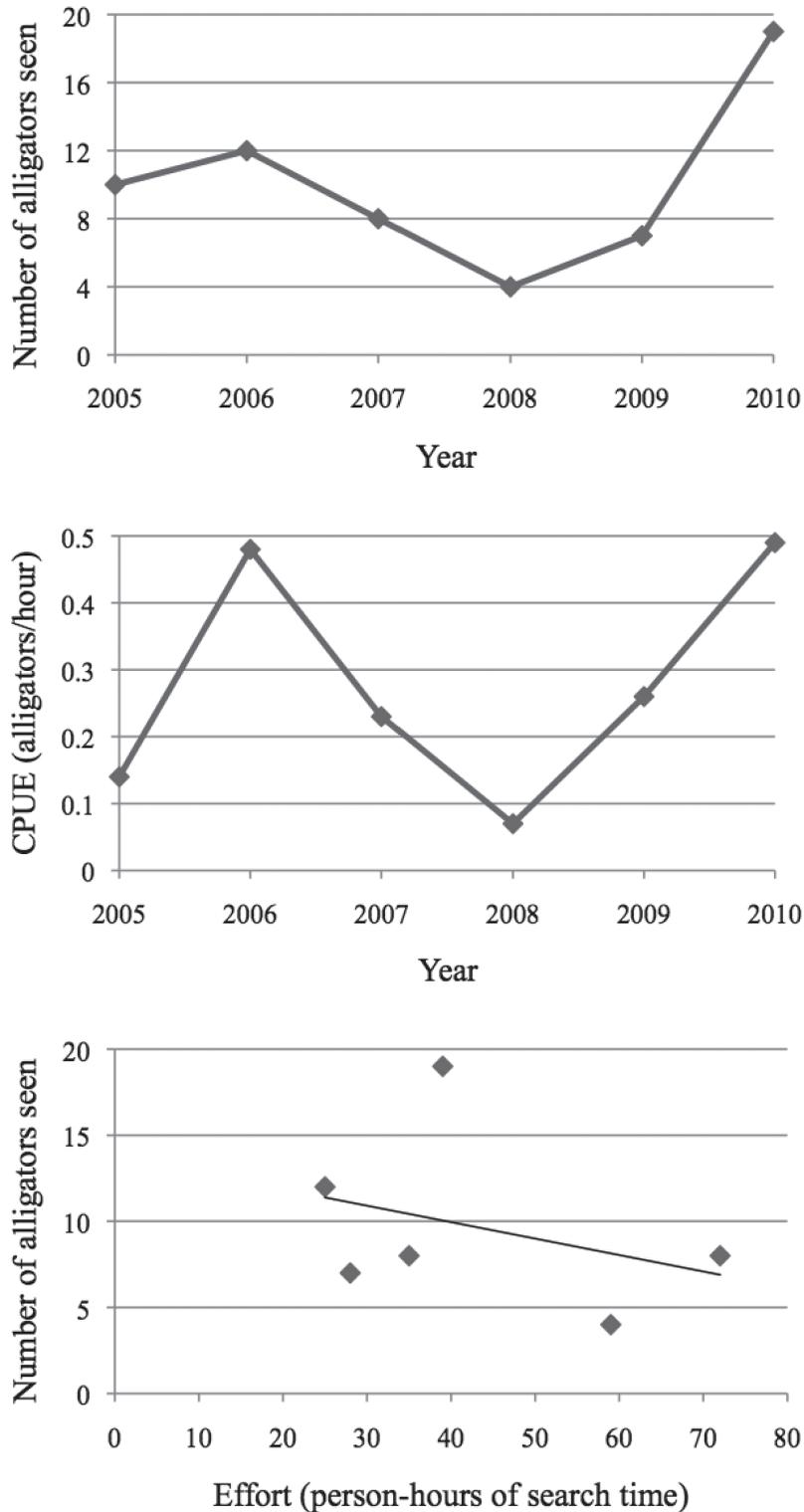


Figure 2. Results of alligator spotlight surveys conducted on Red Slough Wildlife Management Area, McCurtain County, Oklahoma, 2005 – 2010. Number of alligators seen (top) catch per unit effort (CPUE, measured as number of alligators seen per person-hour of search time)(middle) and relationship between search effort and number of alligators seen (bottom).

We detected alligators in 11 of the 26 water bodies surveyed, though it should be noted that not all water bodies were surveyed during all six years. Nevertheless, among the water bodies in which alligators were detected, we are able to rank them in terms of total number of alligators detected and frequency of occurrence. Based on these criteria, Ward Lake and a channel associated with wetland unit 16 ranked high; Pintail lake, wetland unit 31, and Bittern Lake ranked intermediately, six water bodies ranked low, and no alligators were detected in the remaining 15 water bodies. These results may help prioritize management actions among the reservoirs, and may also help prioritize future survey efforts. For example, holding water in areas with high alligator detection rates may be important. It is noteworthy that Ward Lake does not lie within RSWMA; approximately 1/3 of it is on USFS land, with the remaining 2/3 on private lands. This may make the alligators on Ward Lake more vulnerable to illegal killing; for example, several alligators were reported to have been killed on Ward Lake in 2010, though this case is under investigation at the time of this writing.

Little River National Wildlife Refuge. Alligators were detected on half of the lakes surveyed on LRNWR, and mean frequency of occurrence of alligators among all surveys combined was 25% (range = 0 – 75%). These values are similar to those calculated for RSWMA. Though our total efforts at LRNWR are low compared to those at RSWMA, these baseline data suggest that alligators may be somewhat abundant at LRNWR. The paucity of data combined with our results suggests that this area warrants additional surveys and annual monitoring, similar to the efforts made on Red Slough WMA.

Recommendations for additional surveys. Additional surveys are needed to add to the existing understanding of alligators throughout southeastern Oklahoma. That these alligators represent the northwestern-most distribution of the species makes the

results of our surveys, and any other population-based studies on alligators in this area, particularly interesting. We believe the existing survey protocol is generally adequate, and is useful for calculating frequency of occurrence and CPUE, however, we need additional surveys in an effort to reduce variability before trends in total number of alligators can be elucidated. This may require several years of additional annual surveys, or increasing effort to more than one survey/year. Multiple surveys/year would allow for the calculation of mean detection rates/site/year, which would presumably reduce variability in any trend analysis. Previous studies have shown that temperature is an important factor in determining detection rates (Woodward and Marion 1978; Wood et al. 1985; Hutton and Woolhouse 1989; Woodward et al. 1996). However, by approximately mid-late June, emergent vegetation becomes tall enough, and water levels low enough, to greatly restrict the ability to see alligators and use boats for surveys (pers. obs; Subalusky et al. 2009). Water level may also play a role in detectability of crocodylians (Woodward and Marrion 1978; Wood et al. 1985; Hutton and Woolhouse 1989). For example, if water levels are low, alligators may be restricted to a smaller area, thereby affecting rates of detection. Accordingly, we recommend continuing the existing protocol, but increasing the number of surveys to 3-5/year, and adding a methodology for recording water level and vegetation density at the time of the surveys, or incorporating a range of acceptable water levels and vegetation densities during which the surveys can be undertaken. We also recommend continued surveys on LRNWR, following the same protocol used on RSWMA, and increasing the number of observers, incorporating the use of boats for survey efforts, and increasing the total number of lakes surveyed.

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