ILLINOIS NATURAL HISTORY SURVEY

TECHNICAL REPORT

Nesting Ecology of the Blanding's turtle, Emydoidea blandingii, at the Lockport Prairie Nature Preserve, Will County, Illinois

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INTRODUCTION

Although once common throughout much of the northern two-thirds of Illinois, the Blanding's turtle (*Emydoidea blandingii*), has declined with the loss of suitable wetland habitats (Rubin *et al*., 2001, 2004). Consequently, the Blanding's turtle is now listed as state threatened (Redmer and Kruse, 1998). Recovery and conservation efforts will require information on all key ecological traits, including nesting ecology. For example, availability of critical nesting habitat, nest site characteristics, clutch size, and clutch success are factors required for determining the viability of Blanding's turtle populations.

Blanding's turtles are primarily aquatic, preferring habitats with clean shallow water, organic substrates, and abundant vegetation (Ernst *et al*., 1994). However, critical terrestrial habitats, such as those used for nesting, need to be identified and included in future habitat conservation efforts. Even if protected areas offer adequate wetland habitats, remaining Blanding's turtle populations will continue to decline due to low recruitment if areas do not include suitable nesting habitats. Additionally, gravid females are known to travel up to 1 km to nest (Congdon *et al*., 1983) and may migrate outside the boundaries of protected areas in search of suitable nesting areas, increasing their vulnerability.

Clutch size and hatcling success, as well as the proportion of reproducing females in a population in a given year, are all important parameters required to accurately estimate population growth. This information aids in directing management decisions such as the feasibility of nest protection and head-starting programs.

Juvenile Blanding's turtles are typically rare and demographic classes are usually skewed towards adults (Gibbons, 1968; Graham and Doyle, 1977; Congdon *et al*., 1983; Kofron and Schreiber, 1985; Ross, 1989; Rubin *et al*., 2004). However, at Lockport Prairie, after two years of mark and recapture, we have found an equal adult to juvenile ratio (Banning *et al*., 2006). Hence, this site presents a great opportunity to study nesting ecology because it appears that this population is experiencing successful recruitment.

PROJECT OBJECTIVES

Meeting the objectives of this project will assist in management decisions and contribute to recovery of the Blanding's turtle in Illinois by:

1) Identifying nesting habitats at LPNP by radio-locating gravid females during nesting events.
2) Determining nest site characteristics by measuring habitat variables at each nest site.
3) Determining the proportion of reproducing females in a given year using reproductive and mark –recapture data collected in 2005, 2006, and 2007
4) Determining clutch size of all gravid females using x-ray photography.
5) Quantifying natural predation rates and clutch success by regularly monitoring nest sites.

PROJECT METHODOLOGY

Female Blanding's turtles were captured using hoop nets and by hand and transported to Curtis Road Animal Hospital located in Savoy, Illinois, where they were x-rayed to determine reproductive condition and clutch size. Gravid females were radio-located during evening hours from the first week of June through the first week of July to determine nesting locations. I noted the location of nesting attempts with minimal disturbance and returned to the nest site the following morning to record UTM coordinates (Map Datum, NAD 83) and habitat type. Coordinates were plotted on an aerial map in Arcview 3.2. I monitored nest sites regularly to determine predation rates and timing of emergence. In 2006 and 2007, I also recorded canopy cover, ground cover, vegetation height, vegetation composition and substrate characteristics at exact and approximate nest sites. Also, in 2006 and 2007, screen cages were placed over nests to prevent depredation and to assess hatching success. After emergence, nest chambers were inspected for any un-hatched eggs. All hatchlings were weighed to the nearest 0.1 gram and plastron and carapace length were measured to the nearest 0.01 mm.

PROJECT LOCATION

This project was conducted at the Lockport Prairie Nature Preserve (LPNP) in Will County, Illinois (Figure 1). LPNP is a 101 ha wetland prairie located in the Des Plaines River floodplain in northeastern Illinois. This preserve is an ecotonal wetland community composed of several habitat types including dolomite prairie, cattail marsh, sedge meadow, graminoid fen, floodplain forest, and successional culture and is occupied by at least eight freshwater turtle species, including the Illinois listed species, Blanding's turtle and spotted turtle, *Clemmys guttata* (Capler and Moll, 1988; Wilson, 1994, 2002; Banning *et al*., 2006).

RESULTS

***Proportion of reproducing females.* –** Since 2004, 21 adult female Blanding's turtles have been captured at LPNP but not all of these individuals were captured or radio-tagged in all three years of radio-telemetry. Fourteen gravid females (four in 2005, six in 2006, and four in 2007) were monitored during the three years of this study. In 2005, 2006, and 2007 four of 12 (33%), six of 14 (43%), and four of 11 (36%) females captured were gravid, respectively. Nine females were captured or radio-tagged the entirety of the 3-year study, four were tracked for two years, and three were tracked for only one year (Table 1). Only one female was gravid for the three consecutive years and two females were gravid in both 2006 and 2007 (Table 1).

***Timing of nesting and nest site characteristics.* –**Nesting in 2005 occurred from 9 June to 29 June and females began digging chambers between 2105 – 2210 hrs. Nesting attempts occurred near a hiking trail either adjacent to the path or along the trail embankment in dry-mesic dolomite prairie (Figure 2). One female attempted to nest in piles of old roofing material scattered along the trail and another female attempted to nest about 100 m west of the trail in sedge meadow habitat. At least two females made multiple nesting attempts in which turtles were observed excavating chambers but laying never occurred. One female that dug a second nest failed to dig a suitable chamber for accommodating her eggs and was unsuccessful in

completely burying them. All intact eggs from this nest were collected and placed in a plastic container with moistened perlite and incubated throughout the summer.

Nesting in 2006 occurred from 16 June to 25 June and females began digging chambers between 2208 – 2350 hrs. Two females nested in dry-mesic dolomite prairie near the trail, one of which dug her nest in a pile of roofing material (Figure 3). The third female nested in wet-mesic dolomite prairie near sedge meadow and marsh habitat. The fourth female nested in an upland wooded area in substrate largely composed of asphalt debris from roofing material. While the exact location of the fifth female's nest is unknown, the general habitat in the area was wooded with substrate composed ash residue from brush clearing. The nest location for the sixth female is unknown due to possible failure of that turtle's radio transmitter. The four located nest sites were caged immediately after nesting or the following morning.

Nesting in 2007 occurred from 13 June to 3 July and females were observed digging chambers between 2130-2230. Two females nested in upland wooded areas, one in the south portion of the preserve and one along the east bluff near IL Route 53 (Figure 4). The first female also nested in the south wooded area in 2006. The other two females were observed nesting in dry-mesic dolomite prairie near the trail but I was unable to find the exact location of one of these nests. The three known nests were caged the morning following completion.

For nesting observations in 2006 and 2007, average air temperature was 23.9 °C, average substrate temperature was 22.4 °C, average humidity was 63.7%, and average wind speed was 0.4 m/s. Cloud cover did not seem to be an important factor as it varied from 0-100% among nesting observations. Nesting attempts generally occurred in rocky substrate with a few centimeters of soil and vegetation consisting of sparse grass and forb cover. Average vegetation height was 43 cm. Nests completed in prairie habitats (n=6) had zero canopy cover, whereas nests completed in wooded areas (n=3) averaged 41% canopy cover (range 11-77%). Ground cover was composed of 72% vegetation (primarily forbs and grasses), 27% bare ground, and 2% rock.

***Clutch Size and hatching success.* –** In 2005, clutch size could only be determined for the partially buried nest. Of 13 eggs, three were completely concealed but one was broken. Two others were partially covered but at the surface, and the remaining eight were deposited on the ground near the chamber. Intact eggs from this nest were incubated throughout the summer and five of the twelve eggs hatched in late August.

In 2006, radiographs and inspection of nests after emergence revealed average clutch size was 10.7 eggs (n = 6, range 8 to 12). Twenty-eight of the 43 eggs hatched for an average hatching success of 65% (range 33% to 100%). Eggs in four nests protected for the duration of incubation (excluding two eggs that were depredated prior to caging of one nest) had a hatching rate of 68% (28 of 41). The 28 hatchlings averaged, ± 1 standard deviation, 8.5 ± 0.7 in mass, 34.7 ± 1.6 mm CL and 30.9 ± 1.5 mm PL.

In 2007, radiographs and inspection of nests revealed average clutch was 11.3 eggs (n = 4, range 9 to 13). One of the four females failed to show eggs on her radiograph but was later determined to be gravid via palpation. Eggs are incubating at this time in the three protected nests and

emergence is expected to begin in September. A plot of clutch size for 2006 and 2007 combined, showed clutch size was positively correlated with female carapace length (Figure 5).

Hatchling Size. **–** In 2006, the 28 hatchlings averaged, ± 1 standard deviation, 8.5 ± 0.7 in mass, 34.7 ± 1.6 mm CL and 30.9 ± 1.5 mm PL.

Nest predation. **–** In 2005, one nest was depredated within 48 hours after completion by an unknown mammalian predator. In 2006 and 2007, predator exclusion cages were placed over known nests to prevent predation and increase recruitment rates.

In 2006, two eggs from one nest were depredated within 12 hours after completion before a predator exclusion cage could be placed over the nest. It can be assumed that this nest would have suffered complete depredation had it not been protected.

No nest depredation has been observed at this time for the 2007 season.

DISCUSSION

Females generally nest from late May to early July during evening hours and nests are usually complete by 2300hrs (Ernst et al., 1994). The nesting season observed at LPNP lasted approximately two-three weeks during each year of the project. For all three years, nesting was observed between 9 June and 3 July and generally ended by 2300hrs.

Proportion of reproducing females. **–** In Michigan, approximately 48% of female Blanding's turtles lay eggs in a year (Congdon et al., 1986) and 81% of females nested annually in a 2-year study conducted in Nova Scotia (McNeil et al., 2000). In this study, the percentage of radio-tracked females that were gravid in a given year ranged from 33% for to 43%. It is possible that our estimates using radio-tracked females to determine the percent of females that are reproducing are skewed. Gravid and non-gravid females may behave differently with respect to foraging or basking that may alter our ability to sample them with baited traps and visual encounter surveys. It is also possible that radio-tracking may have altered reproduction by disturbing potential mates of our radio-equipped turtles. However we do not believe this to be the case because numerous copulations in which at least one individual was radio-equipped were observed during this study.

Timing of nesting and nest site characteristics. **–**At LPNP most nesting attempts occurred during warm evenings (23.9 °C air temp and 22.4 °C substrate temp) with light wind and intermediate humidity levels. Most nesting events were observed in sparsely vegetated areas in dolomite prairie along the hiking trail and its embankment. Wisconsin turtles primarily nested in grasslands with sedge cover in sandy loam or sand (Ross & Anderson, 1990). In Minnesota, nests were constructed in sunny exposed sites (Peipgras & Lang, 2000). Turtles in Nova Scotia were observed nesting in a gravel parking lot, a gravel pit, gravel roads, a slate cobble trail, and slate cobble lake islands (McNeil et al., 2000).

In all years, several nesting attempts were abandoned and one nest was left almost completely exposed after deposition. In Nova Scotia, females often abandoned attempts when they encountered large rocks or solid bedrock while digging (McNeil et al., 2000). Likewise, the

rocky, shallow substrate at LPNP may have inhibited females from digging adequately sized chambers. Additionally, although every effort was made to avoid it, some nesting females may have abandoned nesting attempts because they were disturbed by the researchers.

Although the hiking trail at LPNP is selected for nest sites, it provides low quality nesting habitat. The path may be frequently used by predators which increases the likelihood of nest predation. Additionally, we observed one female attempting to nest in discarded roofing material. The material in these mounds has a fine texture similar to that of sand which may appeal to gravid females and deter them from nesting in actual prairie substrates. While one nest in 2006 deposited in this material hatched successfully, we speculate that eggs could be exposed to unnaturally high temperatures and harmful compounds.

***Clutch Size and hatching success.* –** Based on a limited sample size, clutch size averaged 11 eggs at LPNP, which is within sizes reported throughout the species' range. Kuhns et al. (2007) reported a slightly larger average clutch size of 13 and a 79% hatching rate for turtles from another northeastern Illinois population at Spring Bluff Forest Preserve in Lake County, Illinois. In other studies, clutch size averaged 8.5 in Maine (Joyal et al., 2000), 10.6 eggs in Nova Scotia (Standing et al., 2000), and 17.7 eggs in Minnesota (Sajwaj et al., 1998), but usually averages between 10 and 15 eggs (Ernst et al., 1994).

***Hatchling Size*. –** The body size of hatchlings averaged 30.9 mm PL and 8.5 g in mass at LPNP. These measurements are comparable to those from the E. S. George Reserve, Michigan, which measured 35.3 mm PL and weighed 9.2 g (Congdon, 1991), Massachusetts, which measured 33.5 mm PL and weighed 9.9 g (Graham & Doyle, 1977), Maine, which averaged 32.7 mm PL and weighed only 6g (Joyal et al., 2000), and also in northeastern Illinois, which averaged 33.3 mm CL, 30.2 mm PL, and weighed 8.2 g. The average PL of incubated hatchlings upon emergence from a Minnesota population was 30.6 mm PL (Pappas et al., 2000).

***Nest predation.* –** Because we protected most Blanding's turtle nests with predator exclusion cages, we are unable to determine natural nest predation rates. However, two unprotected nests were at least partially depredated within 48 hours of completion. The partial depredation of the 2006 nest occurred between the time the nest was completed (~2300hrs) and the next morning (~0900hrs). High nest predation is common for Blanding's turtles. Congdon *et al.* (1983), in a 6-year study, observed an average predation rate of 67% (42-93%) and found that 84% of nests were destroyed within five days. Ross and Anderson (1990) observed 100% nest predation in Wisconsin. However, only three of approximately 18 nests were depredated in Nova Scotia (McNeil et al., 2000). In Michigan, the most common nest predators are raccoons, *Procyon lotor*, and foxes, *Urocyon cinereoargenteus* and *Vulpes vulpes* (Congdon et al., 1983) and in Wisconsin nests are frequently depredated by skunks, *Mephitis mephitis* (Ross & Anderson, 1990).

CONCLUSIONS

Previous turtle surveys at LPNP (1987-2002) have always produced a dozen or more Blanding's turtle captures per year representing all stages (Mauger, 1987; 1990; 2001; 2002). With the addition of our surveys beginning in 2004, we have documented that the population is in serious jeopardy of extinction over the long-term, around a 27% chance of extinction within 50 years

(Banning et al., 2006). However, there is evidence of successful recruitment of the Blanding's turtle population at LPNP. Studies from other natural areas in DuPage County have found that juvenile recruitment in Blanding's populations is low (Rubin, 2000). Past work at LPNP has demonstrated that juveniles comprise a large proportion of the population (Banning 2006). With respect to the other natural areas in DuPage County, only three juveniles and two hatchlings were captured over a five year period despite intensive trapping (Rubin, 2000). Thus, focusing on the ecology and life history of Blanding's in a population that is demonstrating recruitment can provide a strong basis for developing management recommendations that can be widely applied for this declining species in other areas of the Chicago region.

Because the threat of extinction is not immediate, there is time to enact conservation measures to stabilize or increase the population size. Results from the recent sensitivity analysis (Banning et al., 2006) demonstrate that it is more important to focus on mortality issues, specifically in the hatchling and juvenile age-classes. Specifically, reducing hatchling and juvenile mortality should be the focus of future management.

FUTURE WORK AND RECCOMENDATIONS

Creating Additional Nesting Habitat. **–**Although turtles and their critical habitats are protected within LPNP, Blanding's appear to be nesting in less than suitable habitat such as upland forest and discarded roofing material along the south trail, suggesting that suitable nesting habitat is limited at the site. The upland forest nests may not receive enough sunlight because of high canopy cover, and thus may result in cooler nest temperatures that do not facilitate egg development. For example, the upland forest nest in 2006 gave only a 33% hatching rate. To create additional nesting habitat, I recommend removing patches of trees from the south upland forested area as well as the east bluff of the south portion of the preserve. This would provide upland areas with lower canopy allowing greater sunlight penetration and warmer nest temperatures. Further, turtles may more readily nest on the trail embankment if the substrate was deeper so I also recommend filling degraded areas or those composed of roofing material with sand or loam substrate. This would provide more suitable nesting habitat with out disrupting intact prairie habitat or harming sensitive plant species that occur at the site such as lakeside daisy and prairie leafy clover. Finally, as an extra precaution, I recommend closing off the south hiking trail to visitors in June during peak nesting activity. Radioed females are sometimes encountered by preserve visitors while on nesting forays along the trail (W. Banning pers. obs.).

Increasing Hatchling Survivorship. **–**A sensitivity analysis for Blanding's turtles produced by Banning et al. (2006) revealed that reducing hatchling mortality below 52% could stabilize the declining population. Before extremely manipulative measures are attempted (such as head-starting programs), nest protection appears to be a simpler and less expensive alternative. Seigel and Dodd (2000) recommend a stepwise approach to conservation of turtle populations. In their scheme, the least manipulative tactics for hatchlings are habitat protection and public education. In the case of LPNP, harm is not done to nests by the public and the habitat is protected, therefore, we should proceed to the next level which is nest protection. Nest protection at LPNP was 100% effective once cages were in place. Further, over a ten year study of Blanding's turtles in Nova Scotia, 101 nests were protected and only one (<1%) was depredated (Standing *et al.*, 2000). Comparatively, of the 23 nests that were not protected, 15 (65%) were depredated (Standing *et al*., 2000). Additional modeling can determine how long nest protection would need

to be maintained so costs of the conservation measure can be assessed. Also, what nest protection would be required at LPNP, how much it might cost and who would do the work needs to be decided. The best approach would be a collaborative partnership between the FPDWC, IDNR, INHS and possibly others to ensure adequate funding was available to pursue such endeavors.

Maintaining High Levels of Adult Survivorship.– As with most turtle species, maintaining high adult survivorship is crucial to viability. Any conservation measure enacted that does not include an adult component will, at best, only maintain stability. Research indicates that slight increases in adult mortality will overcome the benefits of strategies for long-lived turtle species (Heppell et al., 1996; Congdon et al., 1994). Additionally, conservation efforts aimed at reducing adult mortality are most likely to stabilize populations (Heppell, 1998). When a conservation program is selected, population viability analysis can be used to determine what level of adult mortality would cause the population to remain in decline despite nest protection. At LPNP, six adult mortalities (14% of the estimated population) have been reported since 2002 (Banning, 2006). Five of these deaths occurred on roadways or railroad tracks bordering the preserve. There are some precautionary measures that can be enacted to reduce the potential mortality of adults such as building walls to prevent turtles from entering the roadway or additional turtle crossings or culverts along the railroad tracks bordering the preserve.

Although we are providing a firmer understanding of the structure of Blanding's turtles at LPNP, additional surveys are necessary. First, additional captures will increase the precision of our estimates of population sizes, densities, and biomass. Further, with the large number of individuals marked, we will be able to gain inference into mortality, survivability, and recruitment rates specific to the site. Finally, we can use more reliable methods of growth based on mark/recapture data. Thus, obtaining more detailed demographic data will eventually play a role in improving future population viability.

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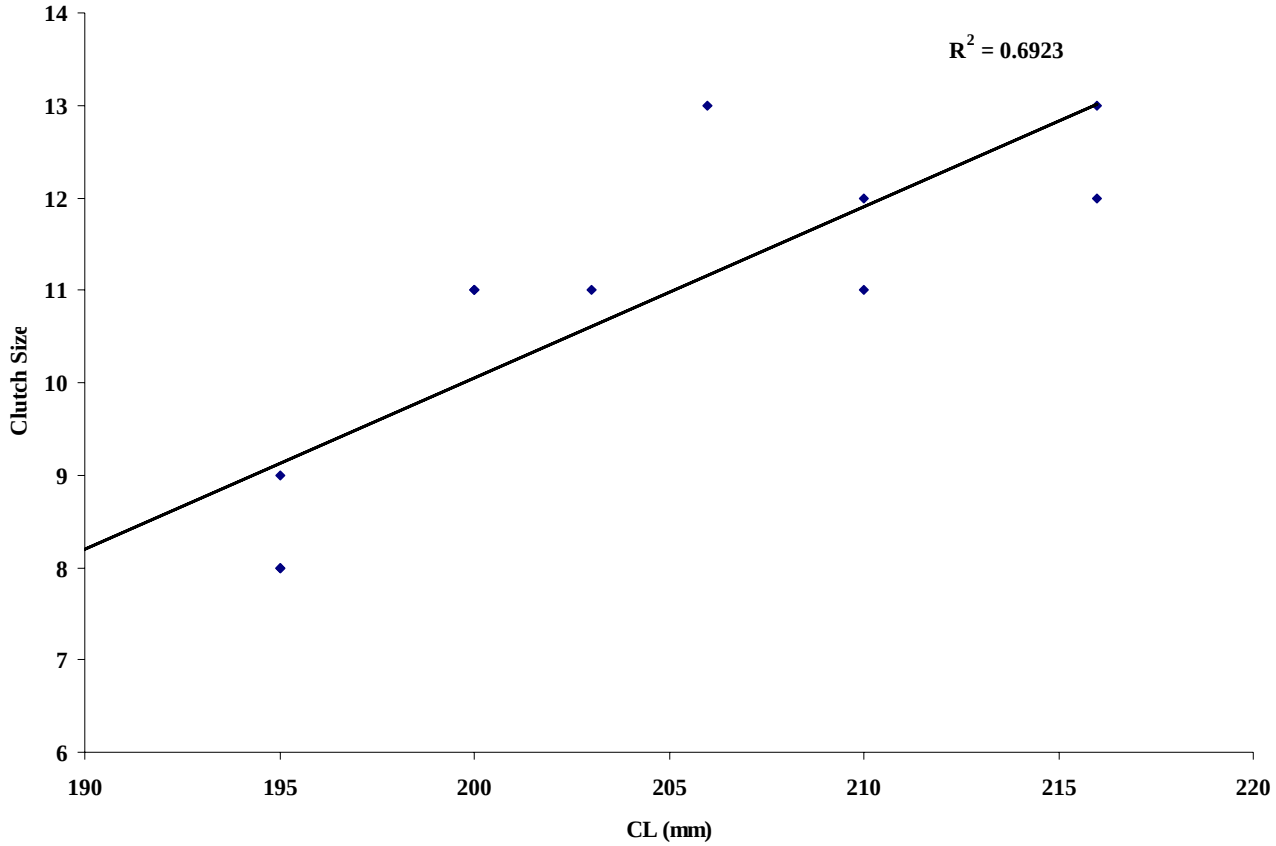
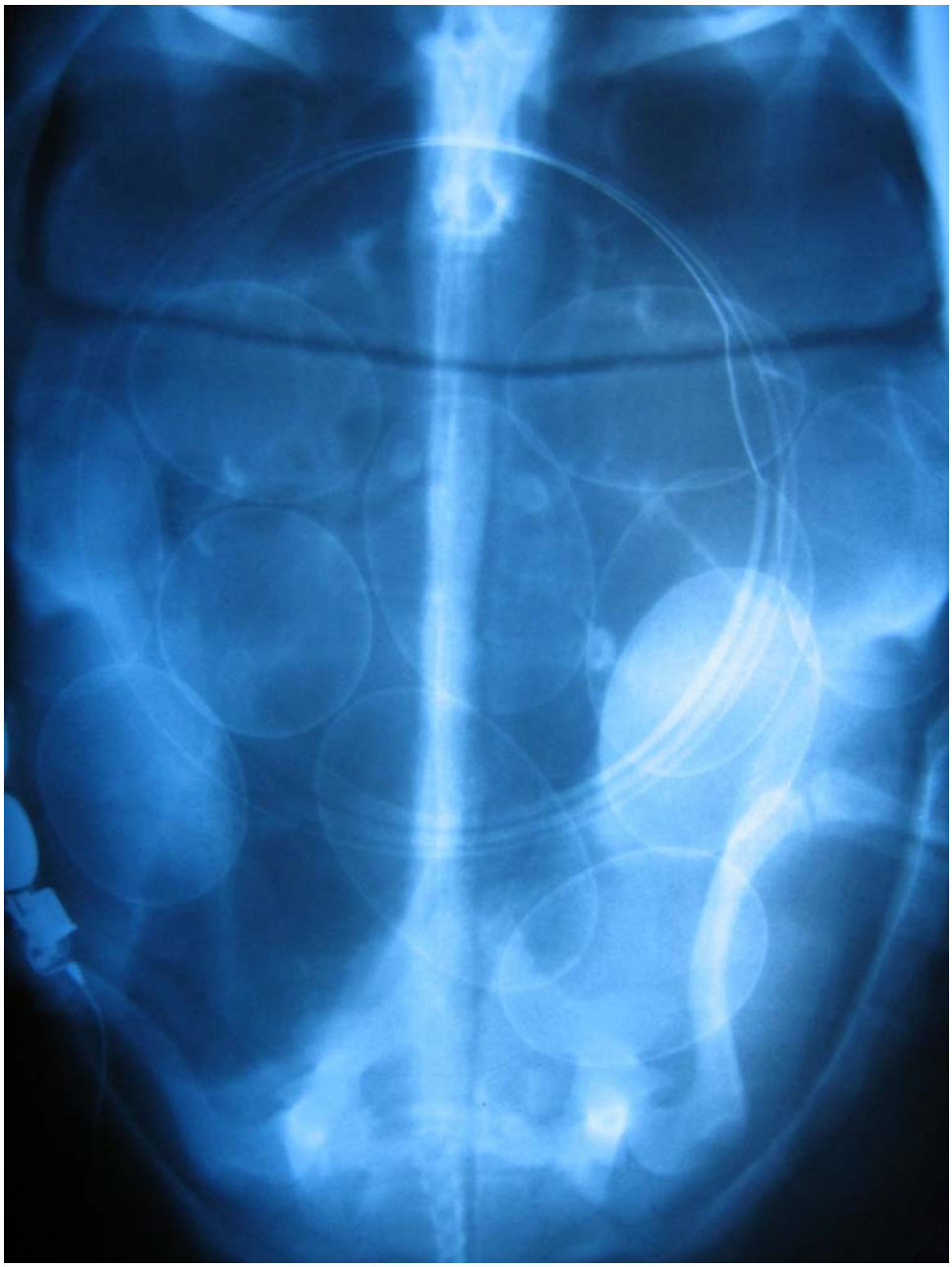


Figure 5. Plot of carapace length (CL) mm versus clutch size for Blanding's turtles in 2006-2007 at Lockport Prairie Nature Preserve, Will County, Illinois.

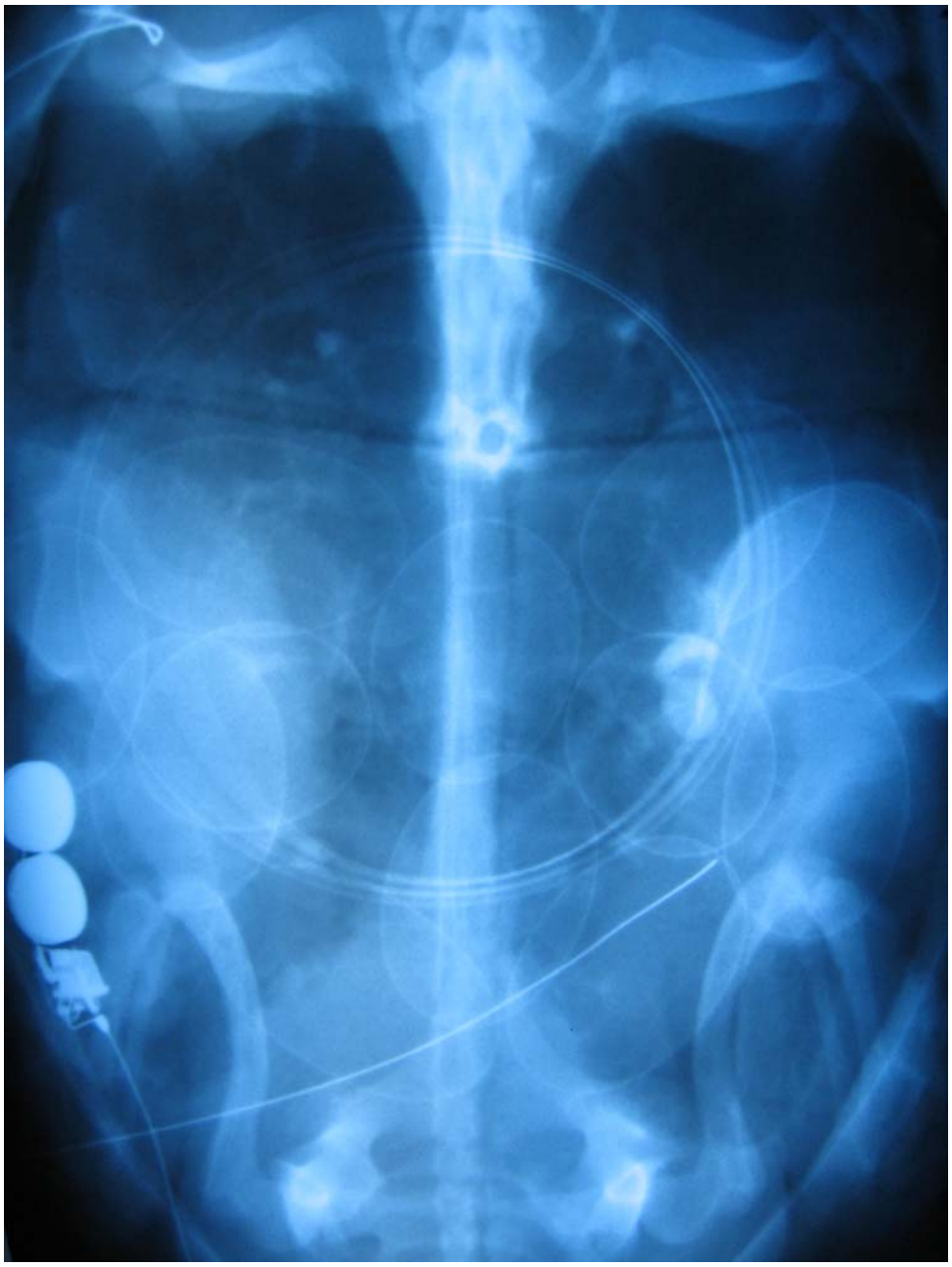
APPENDIX I
Radio-graphs of Gravid Females
2006

Turtle 01
Clutch Size: 11

Turtle 16
Clutch Size: 11



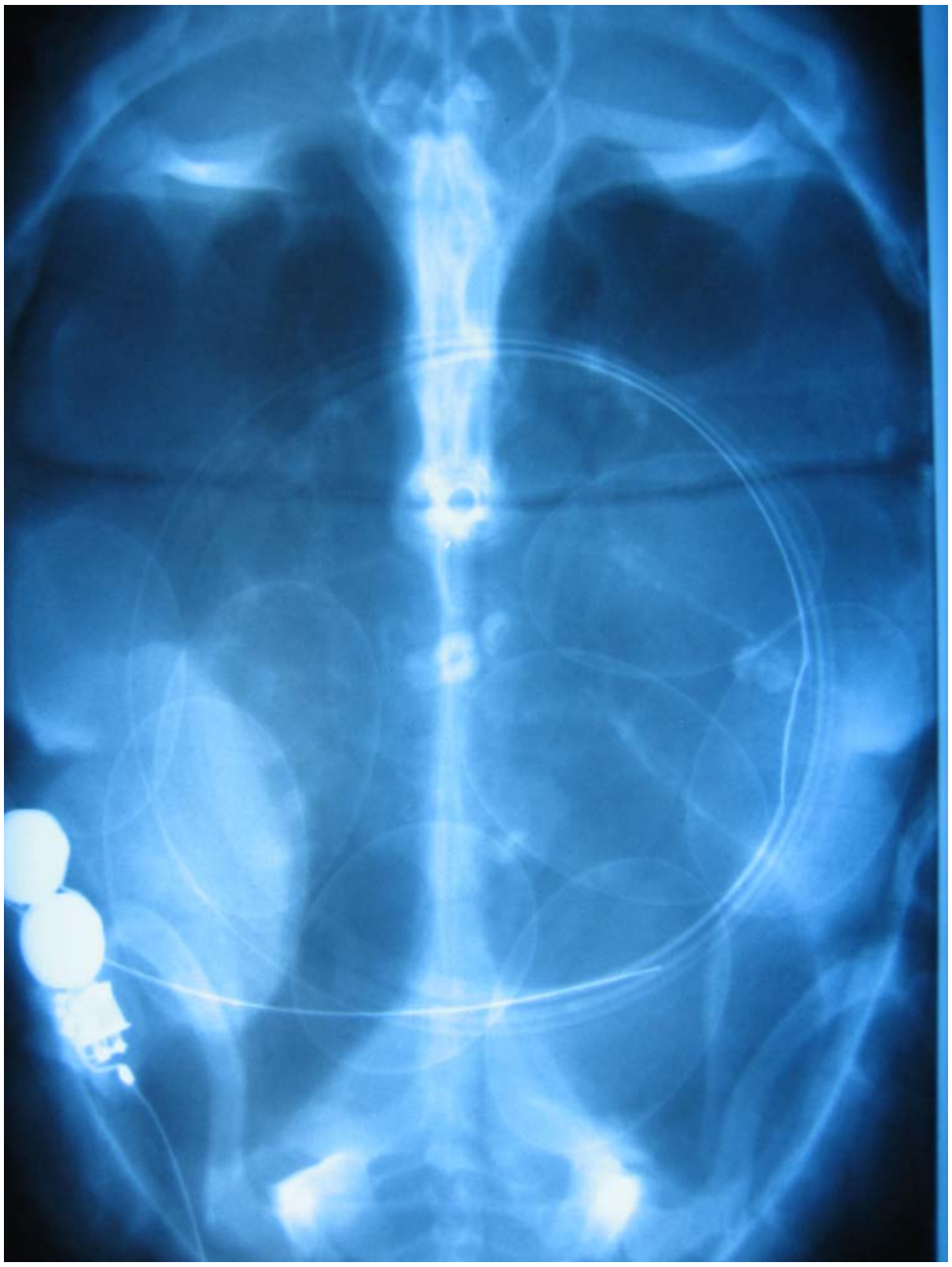
Turtle 25
Clutch Size: 12



Turtle 35
Clutch Size: 11

Turtle 36
Clutch Size: 12

Turtle 63
Clutch Size: 8



2007

Turtle 16
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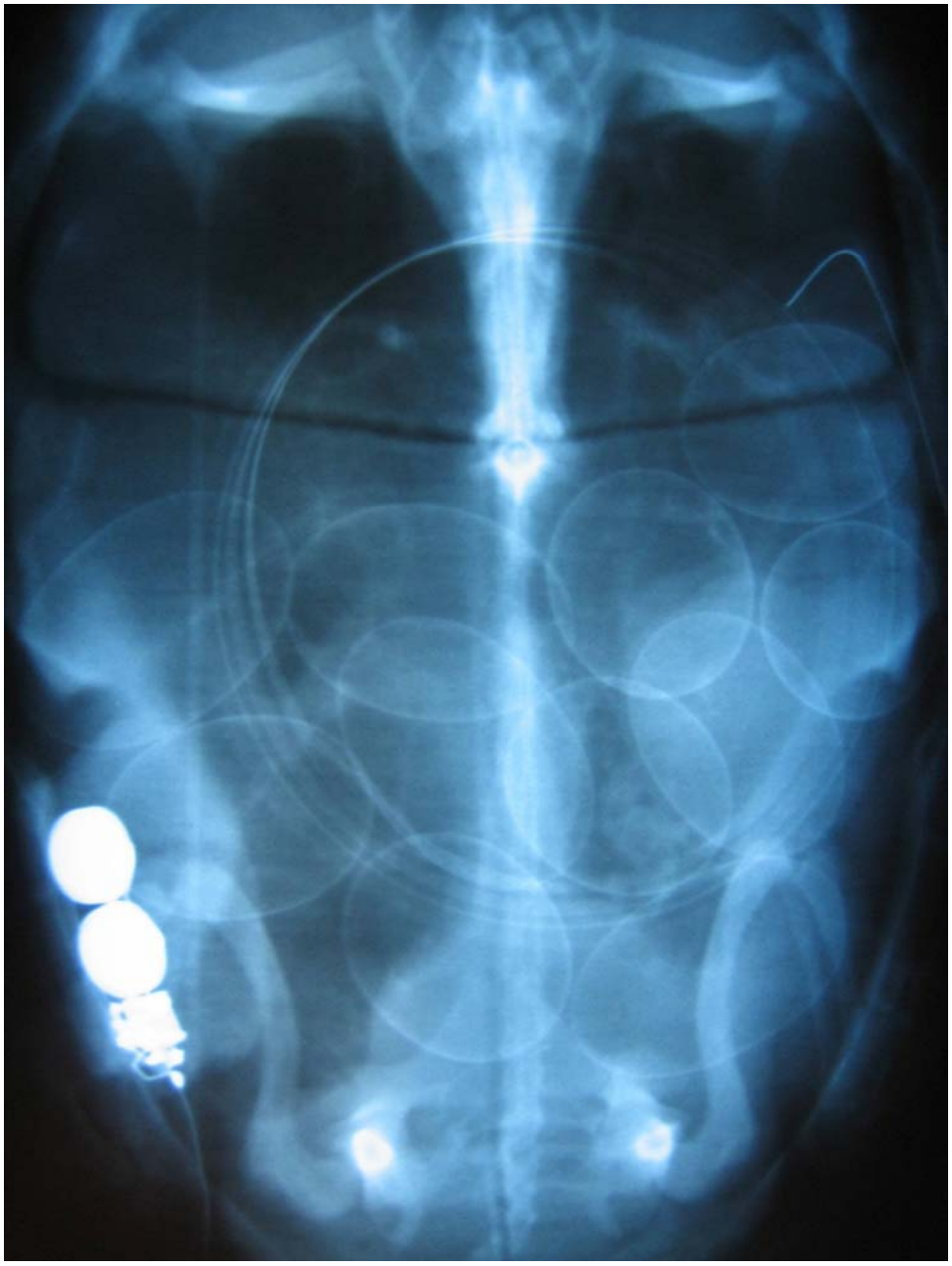
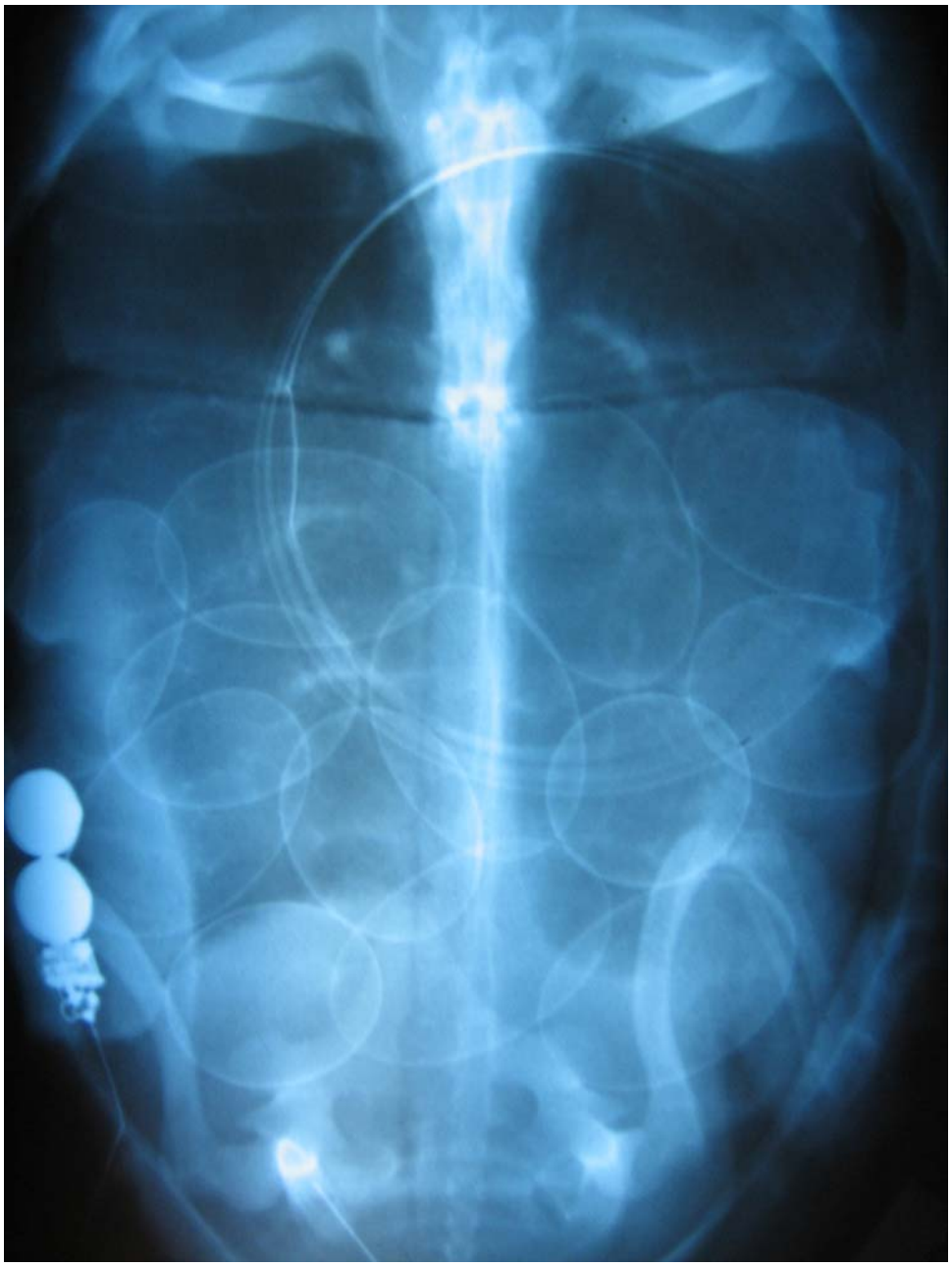


Turtle 25
Clutch Size: 13



Turtle 36
Clutch Size: 11