

REPORT OF ACTIVITIES
2008 TURTLE ECOLOGY RESEARCH REPORT
Crescent Lake National Wildlife Refuge
2 to 30 June 2008

A report submitted to Project Coordinator Steve Knode and Refuge Manager Neil Powers
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John B Iverson
Dept. of Biology
Earlham College

PURPOSE: To continue studies of the natural history and population biology of the turtles on the Crescent Lake National Wildlife Refuge, and the spiny softshell turtle near Blue Creek on the Peterson Ranch north of Oshkosh. At the request of the Refuge, this year I focused primarily on determining the diet and population estimates for snapping turtles in Island Lake.

METHODS: We did not erect our drift fences at Gimlet Lake this summer. Instead, we deployed fyke net arrays in Island Lake to sample snapping turtles, and we visually monitored nesting areas for painted turtles at Gimlet Lake and snapping turtles at Gimlet and Island Lakes.

CLIMATE BACKGROUND: April, May and June were each below the long term averages in temperatures for those months, and it was particularly cold in late May and early June (the usual beginning of turtle nesting season). This had the effect of delaying the start of nesting, and reduced trapping success in early June.

RESULTS:

Snapping turtles

GENERAL:

In order to capture snapping turtles in Island Lake for diet and population estimates, we trapped off the East Dock from 3 to 16 June, and then off the West Dock from 24 to 28 June. In each case we deployed six fykes nets in a nearly continuous line parallel to the shore and in about 2' of water. Fyke net traps were baited with pieces of carp provided by the NE Game and Parks Commission. Traps were checked each morning between 6 and 8AM, and again between 3 and 4PM, when they were rebaited. We also monitored potential nesting areas at the West and South Docks of Island Lake and the Dike Road area of Gimlet Lake every morning and night from 2 to 29 June. These efforts resulted in our capture and processing of 1228 kg (2702 pounds!) of snapping turtles.

A total of 87 snappers was trapped at the East Dock of Island Lake. 49 of them were euthanized on capture for dissection to determine diet. An attempt was made to evenly sample both sexes, small and large adults, and juveniles. The remaining 38 snappers were given by the Refuge to fisheries biologists with the Nebraska Game and Parks Commission for relocation to other suitable wetlands off the Refuge.

We also trapped and immediately marked 27 snappers in our fyke nets off the West Dock. These were released immediately for follow-up census in June 2009. In addition, we captured and marked another 16 female snappers as they nested at Island Lake (and 18 others at Gimlet Lake).

The sex ratio of the first 38 snappers trapped at the East Dock (i.e., before the female nesting migration) was 10 females to 28 males. The sex ratio for the 27 snappers trapped off the West Dock (after nesting season) was 10 females to 27 males. Together (20 females to 45 males) these counts suggest that the population in Island Lake is strongly biased in favor of males. Given that snapping turtles exhibit temperature-dependent sex determination (i.e., sex is determined by nest temperatures during the middle third of incubation), and that July soil temperatures average within the range that produces males, a male-biased sex ratio is not unexpected. However, males are larger on average than females, and hence may travel greater distances or enter traps more readily than females.

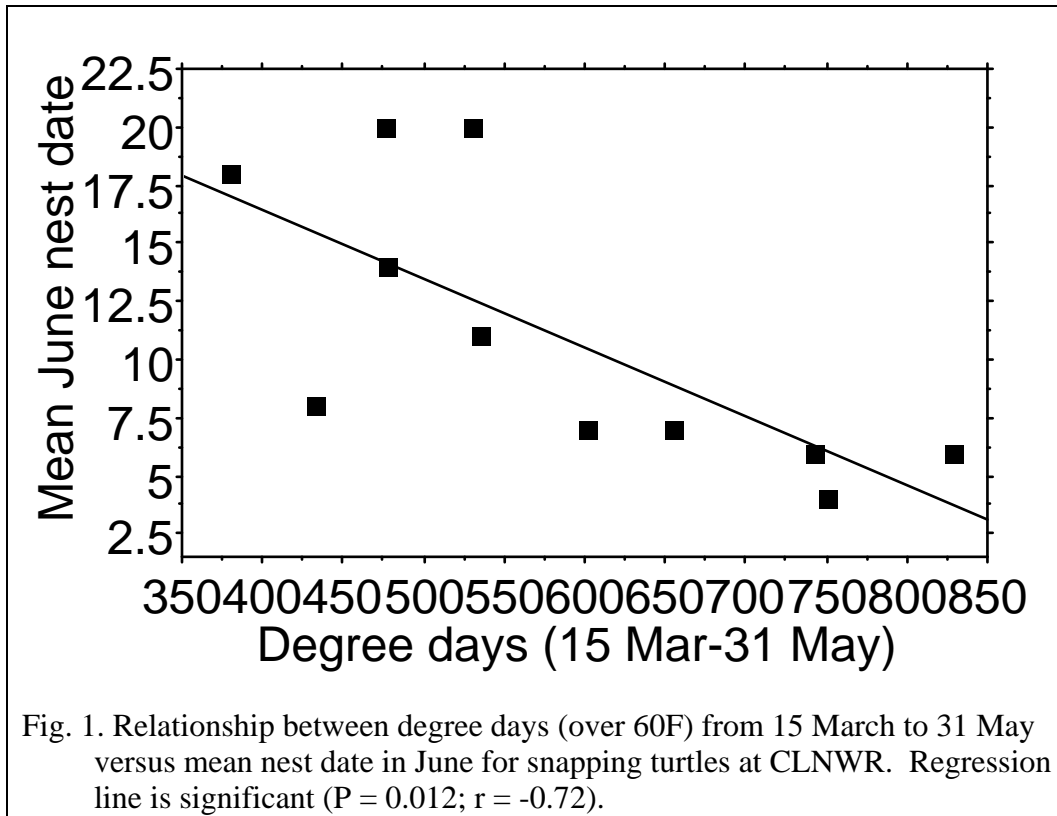
The snapping turtle nesting season was much later than normal this year because of the cold spring (Table 1; Fig. 1). Comparisons of this year's clutch size data across nesting areas (Table 2) suggested that clutch size might be highest at Gimlet Lake, although this is probably related to the larger average size of females at Gimlet Lake. There also seems to have been a small decline in average clutch size over the past 18 years (Table 1).

Table 1. Variation in nesting season and reproductive output of Nebraska snapping turtles.

Year	Nesting season (n)	Mean date	Clutch size range (n)	Clutch size mean
1990	11-28 June (7)	18 June	37-73 (6)	54.8
1993	12-28 June (36)	20 June	29-71 (23)	48.3
1994	1-13 June (32)	6 June	31-72 (28)	45.4
1998	6-23 June (14)	11 June	-----	---
1999	4-22 June (29)	8 June	9-82 (27)	51.5
2000	29 May-12 June (21)	7 June	37-76 (19)	55.9
2004	29 May-15 June (15)	6 June	35-71 (12)	56.7
2005	7-21 June (36)	14 June	12-76 (33)	49.6
2006	1-11 June (29)	4 June	26-66 (24)	43.2
2007	28 May-14 June (91)	7 June	22-71 (32)	43.7
2008	15-25 June (54)	20 June	20-79 (44)	44.4

Table 2. Snapping turtle clutch size data from 2008.

Location	Method	N	Mean	Range
Island Lake East Dock	Dissections	20	41.4	20-55
Island Lake (other docks)	Excavated nests	5	41.8	34-51
Gimlet Lake (Dike Road)	Excavated nests	19	48.3	23-79
All samples combined	---	44	44.4	20-79



We have rigorously monitored nesting at Island and Gimlet Lakes over the past several years (Table 3). The most notable pattern is the jump in nesting activity at Island Lake (but not Gimlet) in 2007. This may be related to the draw-down and renovation of Island Lake in the fall of 2006, but it is not clear why that activity would result in an increase in nesting at the West and South docks in the following year.

Table 3. Numbers of nests observed at three nesting areas over the past few years. Asterisks indicate locations not rigorously monitored. The Gimlet Lake site is along the Dike Road.

Year	Gimlet	Island West Dock	Island South Dock
2005	16	0*	2*
2006	9	7	11
2007	15	20	28
2008	21	4	11

DIET ANALYSIS

Forty-nine snappers were dissected immediately after euthanization and their digestive tracts removed and frozen for later examination. Stomach contents from all turtles were discarded because nearly all contained pieces of bait fish (carp) consumed in the fyke net traps. When the

rest of the gastrointestinal tracts were analyzed for content, only the presence and general abundance of food types was recorded. Quantitative volumetric analysis was not possible.

The diet of snappers is opportunistic and omnivorous, and includes insects, spiders, isopods, amphipods, crayfish, crabs, shrimp, water mites, clams, snails, earthworms, leeches, tubificid worms, planarians, freshwater sponges, fish (eggs to adults), amphibians, small turtles, snakes, birds, and mammals, as well as plants (including algae, duckweed, cattails, pondweeds, bulrush, and water lilies) (Ernst et al., 1994).

Our dissection results concur with previous published observations in that we found algae, snails, fish, crayfish (presumably the northern crayfish, *Orconectes virilis*), an adult neotenic tiger salamander, and birds in gastrointestinal tracts from Island Lake. However, over all tracts (Table 4), nearly all contained an abundance of algae. Snappers are known to consume algae, but the possibility exists that most of it is being secondarily ingested as turtles strike at other prey items.

The second most common food type was birds (45% of guts). Feathers were the most common evidence of birds in the guts, and were generally small, suggesting the consumption of small birds. Those tracts that contained larger feathers and/or legs or bones were all from coots. Snails, fish, and crayfish were also common food items, each being found in 20-25% of guts (Table 4).

Table 4. Summary of food types present in the guts of snapping turtles from Island Lake in various size and sex categories. Question marks indicate uncertainty about the identification of small vertebrae in some samples.

Category	Sample size	birds	fish	crayfish	snails	algae
Big males	10	5	2	4	2	10
Big females	10	7	1	1	2	8
Small males	11	7	4?	3	1	8
Small females	10	2	2	2	2	9
Juveniles	8	1	1	0	5	5
Total	49	22	10?	10	12	40

It is clear from my dissections that (at least during June) birds are a very important food item for snappers. It is also clear that birds do not become common in the diet until snappers reach a body size of about 325 mm carapace length (Table 5). Of 22 snappers below 325 mm CL, only 4 (18%) contained bird parts, whereas of 27 snappers over 325 mm CL, 18 (67%) had eaten birds. Although there is little question that snapping turtles are significant predators on wetland birds, it is uncertain whether they impact waterfowl species that are hunted or specially managed on the Refuge.

Table 5. Frequency of occurrence of birds in the guts of snapping turtles of various size categories (mm carapace length).

Size category	Frequency	Size category	Frequency
250-275	1 of 6	325-350	7 of 9
275-300	1 of 7	350-375	6 of 9
300-325	2 of 9	375-400	3 of 5
		400-425	2 of 4

POPULATION ESTIMATES

Estimating the number of snappers in a lake as large and complex as Island Lake is a difficult challenge. It is compounded by our lack of knowledge of home range size at this site and the fact that females are known to make pre-nesting migrations of up to 11 km in other populations (Obbard and Brooks, 1980). For example, at our trapping array off the East Dock, we captured 38 snappers in the first 10 days of trapping (through 13 June), and the capture rate had slowed significantly (only two each on 11-12 June, and 3 on 13 June), suggesting that we had captured almost all of the turtles in the area. However, it was clear that the nesting migration began thereafter, since we captured 10 snappers on the 14th and 24 more on the 15th (26 of the 34 were females). The first female attempted to nest at Island Lake on the 15th! We have no idea how far females may have migrated to the East Dock area, but it is clear that these migrations confound population estimates.

Preliminary estimates:

A. Assumptions: Hammer (1969) estimated only 1.2 snappers per hectare on the La Creek NWR in South Dakota. This is an extremely low density for snappers. Island Lake covers 720 acres (298 ha), and we might assume that only 70% of the Lake (208.6 ha; that area less than 4' in depth) is habitable by snappers. This would suggest an estimate of 1.2×208.6 , or 250 subadult and adult snappers in Island Lake. This estimate is impossibly low. For example, we trapped 87 snappers in 14 days at the East Dock, 27 more in only four days at the West Dock, and we hand-captured another 16 females at nest sites [total = 130 alone in those small parts of the lake].

B. Assumptions: Based on standing crop biomass data for snappers in Michigan (20.6-21.6 kg/ha) and South Carolina (15.9-33.9 kg/ha), a minimum standing crop biomass might be about 20 kg/ha. If 208.6 ha of Island Lake are habitable (see above), then it could support 4172 kg of snappers (208.6×20). Mean body mass of 148 snappers captured and weighed by us this year was 8.298 kg. Thus, at an average body mass of 8.3 kg, this would estimate 503 ($4172/8.3$) adult and subadult snappers in Island Lake. I also believe that this estimate is much too low.

C. Assumptions: In the only available study of home range in radiotelemetered snapping turtles, Obbard and Brooks (1981) calculated an average home range of 3.44 ha (3.79 for females; 3.21 for males) and found it unrelated to turtle body size. If this home range was circular, it would represent an area with a radius of 105 m. Our fyke net array spanned 66' x 6 nets = 396' or 120.7 m. The perimeter of Island Lake is approximately 27720' or 8449 m. Let us assume that the 38 snappers trapped at the East Dock before the nesting migration were from the shore along the nets plus 105 m more (mean home range radius) past each end of the array (total shoreline sampled = 331 m). Therefore, the total population would be $(8449/331) \times 38$ or 970 adult and subadult snapping turtles in Island Lake. This estimate would be a realistic minimum because snappers certainly occupy more than a narrow band around the perimeter of the Lake.

D. Assumptions: Iverson et al. (2000) reported a density of 50.7 snapping turtles per ha and a standing crop biomass of 242 kg/ha in a 0.71 ha Sandhills pond in Garden County; however, the 36 snappers they captured averaged only 6.72 kg each, whereas those trapped in Island Lake averaged 8.3 kg each. Assume that Island Lake covers 720 acres (298 ha), and that only 70% of

the Lake (208.6 ha; that less than 4' in depth) is habitable by snappers. If the standing crop biomass of snappers in Island Lake was 242 kg/ha, Island Lake could support 50481 kg of snappers. At an average body mass of 8.3 kg, that would estimate 6082 snappers in Island Lake.

Although a definitive estimate of population size in Island Lake would require thorough random sampling across the entire lake, the last two of these preliminary estimates realistically suggest that between 1000 and 6000 adult and subadult snappers are present.

Next year we will continue monitoring nesting areas at Island and Gimlet Lakes, individually marking all females we capture nesting. This will provide some additional qualitative information about female numbers. In addition, we will deploy our six fyke net settings off the West Dock of Island Lake and continue the mark and recapture study there. This will provide us with additional population size data for that part of Island Lake, but obtaining more accurate estimates of population size in Island Lake would require lake-wide surveys, and telemetry to determine home range sizes and migration distances. These surveys, coupled with telemetry work would be an ideal master's thesis project for a young student.

If the Refuge staff decides that further reduction of the snapping turtle population is appropriate, I would recommend three potential strategies. First, every male encountered during airboat surveys could be removed. Since an individual male can fertilize many females, this would have minimal long-term impact on the success of the population. A second more intensive strategy would be to remove all snappers encountered during airboat surveys. The lake is too large and there is too much area that can't be covered by airboat, and thus, this strategy would still leave a viable population in the lake. Finally, the intensive strategy would be the removal of all snappers encountered from the airboat as well as all females that could be captured at the nesting areas. This strategy would drastically reduce the population, but I do not believe it would jeopardize the persistence of the population in the long-term. Of course, the Refuge could consider involving an independent contractor to undertake a vigorous trapping and removal program.

Painted turtles

From 28-30 March 2008, we visited the Refuge to excavate the 18 painted turtle nests that we mapped and protected the previous summer. We determined that four of these nests (22%) were depredated despite the wire screens. The remaining 14 nests originally contained a total of 161 eggs. 136 of those eggs hatched during the fall of 2007 (84.5%) and entered the 07-08 winter in their nests. This compares to only 45.7% hatching success the year before. The coldest part of the winter produced nest temperatures between -5 and -10C. A total of 93 hatchlings survived the winter (68.3%; compared to only 39.9% the previous, very cold winter). Thus, a record 57.8% of the original eggs hatched and survived the winter, compared to only 18.2% the previous year.

Reflecting the cold late spring, painted turtles did not begin nesting until 10 June. Despite the late start, we captured 55 females (21 previously unmarked) during their nesting forays. However, we were only able to locate 37 nests from these females. Each

of these nests was covered immediately on completion with a wire screen to reduce depredation, but nine were already destroyed by hognose snakes before we left for the season. We have never experienced hognose depredation at this level in the past, and it must reflect an unexplained peak in numbers for this snake. Hognose snakes were able to dig under our wire screens one to seven days (1, 1, 2, 2, 2, 4, 5, 5, and 7 days; mean 3.2 days;) after they were laid and covered. Their amazing olfactory capabilities are evident.

We mapped all 37 nests for over-winter monitoring; a miniature temperature logger was buried next to each nest to record nest temperatures through incubation and through the coming winter. As in the past, these nests will be excavated next March (2009) to determine hatchling and overwintering success.

Yellow mud turtles and Ornate box turtles

Because of our time commitment to snapping turtles, we did no work with either of these species this summer.

Spiny softshell turtles

We were only able to trap for softshell turtles for six days (19-24 June) in the Blue Creek drainage near the Myron and Kay Peterson ranch (Campstool Cattle Company, NNE of Oshkosh). We captured only four softshells in Rattlesnake Pond in our six 50' fyke net settings. Our most exciting result was the recapture of two juveniles that we had hatched from eggs in August 2004, injected with PIT tags (microchips), and released (by the Petersons) into Rattlesnake Pond as hatchlings in September 2004. Measurements suggest that these turtles are growing about an inch (25-30 mm) a year for the first few years of life. No other data have been published on growth in softshell turtles based on actual recaptures of juveniles in the field. We are hopeful that this PIT tag marking method will allow us to capture more juveniles (and eventually adults) of known age in the future.

LITERATURE CITED

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FUTURE PLANS:

- 2009: - late March [JBI and Sheila Iverson to Refuge for 3 days to check nest survivorship from 2008 nests; stay in Old Bunkhouse if available]
- ca. 1 June to 1 July [JBI and wife to Refuge to monitor painted turtle and snapping turtle nesting seasons, and census softshells; stay in Trailer if available]
- 2010: - late March [JBI to Refuge for 3 days to check nest survivorship from 2009 nests]
- Timing of summer field work in 2010 is still uncertain but will probably be confined to June