

Final Report to Mn DNR Nongame, Region 4, 261 Hwy 15 S, New Ulm, MN 56073

Title: Blanding's Turtle Studies in Southwestern Minnesota in 2002

Location: SW Mn, Lincoln, Lyon, Pipestone, Murray, Rock, and Nobles Counties

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Period covered by this report: 1 April 2002-30 June 2002

Contract: Annual Plan Contract No. A30925 ; Vendor #200291293

Introduction

This project is a pilot study initiated by J.W. Lang as a follow-up to a WCRP proposal developed in collaboration with Lisa Gelvin-Innvaer, Nongame Wildlife Program (NWP), Mn DNR. The pilot study is designed to provide critical information on specific life history features of Blanding's turtles inhabiting remnant prairie wetlands in SW Mn. Productive region wide surveys of present-day turtle distribution and abundance depend initially on the identification of key habitat features associated with surviving turtle populations. This study provides important new information needed to identify these key features, and is the necessary first step in developing:

- (1) a region wide assessment of Blanding's turtles, and
- (2) a comprehensive plan for their conservation in SW Mn.

The Mn DNR NWP and the Nongame Research and Natural Area Program both have identified the Blanding's turtle as among priority species "in greatest conservation" need in SW Mn. Specific outcomes of this pilot study include:

- 1) addressing this need, as determined by the Minnesota State Legislature,
- 2) facilitating environmental review as well as broad landscape-level efforts to conserve and restore wetlands and adjacent wetlands within the region,
- 3) developing a state wide conservation plan for the species in Minnesota, and
- 4) contributing to strategies and long term goals of the Mn DNR (Directions 2000).

A specific example of the necessity for pertinent information with respect to environmental review (outcome 2, above) was evident recently. There was a recent request for "comment" on the potential impact of a proposed wind power facility located adjacent to known localities for the Blanding's turtle, based on the few records available in Rare Features database. In response to a request for input from the Regional Nongame Specialist for use in an agency response, I provided an initial assessment based on preliminary data from the present study (see Appendix A).

Background

The Blanding's turtle, *Emydoidea blandingii*, is listed as a Species of Concern/Species at Risk by the USFWS. Essentially a north temperate species, it prefers shallow marshes and swamps throughout eastern and central North America. Most populations are small and fragmented, and consequently considered to be either threatened or endangered. At several localities in the northeastern states, artificial wetlands and constructed nesting sites have been designed specifically for populations threatened with habitat loss, and these have been surprisingly effective. However, within its range, specific features of Blanding's turtle biology vary considerably from region to region, e.g., movement patterns, overwintering behaviors, and reproductive ecologies.

Consequently, studies elsewhere are of limited value in formulating long-term management strategies for a specific area, and detailed information from a particular locality is needed in order to conserve and manage Blanding's turtle populations.

In Minnesota, Blanding's turtle is listed as "threatened" and its state wide distribution is spotty. In the southeast, an exceptionally large population, estimated at more than 5000 turtles, inhabits Weaver Dunes and surrounding wetlands. In central Minnesota, a stable, low-density population persists in and around Camp Ripley. Recent, multi-year field studies at both localities highlight many significant differences. At Ripley, the turtles are larger (by 10-15%) and produce more eggs (30-40% more), but have much smaller activity areas, use fewer kinds of habitats, and range less widely (only 10% as far), in comparison with the turtles living at Weaver. Other localities where Blanding's turtles occur in Minnesota include various sites in and around the Twin Cities as well as additional populations in southeast Minnesota. Little is known about the species' current distribution and abundance in southwest Minnesota, though there are records from wetlands in the Missouri River drainage. A comprehensive plan for conservation and management that is applicable statewide will necessarily depend on an inventory and assessment of the species' status in southwest Minnesota.

Several key features of the species' natural history make it a sensitive ecological indicator, but also contribute to its vulnerability. Individual turtles are long-lived, have delayed reproduction, and move extensively during a lifetime between wetlands and uplands, typically over long distances. Natural mortality is very low, but human-induced mortality via roads and/or habitat loss jeopardizes the continued survival of many populations. Knowledge about the current status of particular populations is essential, including potential sources of mortality as well as levels of recruitment. At present, such information is not available for Blanding's turtles in the southwest.

In southwestern Minnesota, this state-listed "threatened" turtle occurs in shallow wetlands, particularly in prairie potholes and small ephemeral wetlands. Overland movements probably occur regularly, but turtles also likely depend on rivers, streams, channels, and ditches as movement corridors, as well as seasonal aquatic refugia. Connectivity among aquatic habitats may be critical, but identification and delineation of wetland habitats and how turtles use these habitats are necessary first steps in wetland as well as turtle conservation. In addition, daily activity and seasonal movements may very well be habitat-specific, as indicated by comparative studies of other Minnesota populations of Blanding's turtles. Unlike other regions in the state, few if any County Biological Surveys have been conducted in the southwest.

Objectives

The specific study objectives are:

- (1) to locate a study population in SW Mn representative of extant turtle populations, by (a) examining previous records, and (b) conducting field surveys
- (2) to identify critical habitats for all age/sex classes of the population; including hatchlings, juveniles, adult males, and adult females,
- (3) to delineate the spatial and temporal patterns of usage throughout the annual cycle for each group, including spring emergence, nesting, summer and fall feeding periods, and overwintering, including winter movements,
- (4) to assess parameters associated with the long-term viability of the population, particularly aspects of reproduction, survival, and growth
- (5) to formulate management recommendations based on 1-4 above, judged critical for the continued survival and conservation of this population and others in SW Mn.

Results

Reconnaissance at

WMAs

In March 2002, an initial review of available records of Blanding's turtles in SW Mn focused on potential study populations within Lincoln, Lyon, Pipestone, Murray, Rock, and Nobles Counties. Records reviewed included species occurrences from the Rare Features Database provided by the Natural Heritage and Nongame Research Program, Div. Ecological Services, Mn DNR, and particularly the extensive field notes of Tom Jessen from surveys he conducted for the Mn DNR in 1995 and 1996. Six specific areas were identified:

Tom Jessen suggested that the areas were likely the best candidate sites for an initial pilot study.

Field surveys were conducted in these WMA areas as well as in other WMAs in the region

in late April (11, 17, 23 April) through mid May (1, 6, 20, 22-23 May). Activity was limited to sight observations and did not include trapping. One dead road-killed Blanding's turtle was found on the gravel road thru the WMA, and the specimen was recorded and collected for the U. Mn reference collection. This specimen was a 4 yr. old juvenile apparently killed by a vehicle as the turtle crossed over the gravel road at a culvert under the road on the east side of the wetland valley. As a result of these initial field surveys at I decided to concentrate subsequent survey and reconnaissance work at the WMA, located (see Figure 1; location of WMA)

Study Area and Methodology

WMA is a state-owned property surrounded by agricultural cropland and dairy pasture. Wet meadow/fen vegetation, primarily calcareous seepage fen of the SW prairie subtype, occupies approximately 70 acres and is drained by a tributary creek flowing the Rock River

. Upland dry terraces comprising about 40 acres border the low-lying wetland to the northwest and southeast. The creek has a constant flow of water year-round, and is typically 0.25-0.5 m deep and 0.5-1.0 m wide. It flows in meandering channels through the 70 acre wetland, entering the property in the (see Figures 2 & 3; photos A-F).

Examination of air photos from 1962 and 1968 indicate that a series of "ponds" were excavated in the wetland area between these dates. These ponds are named with respect to the position of each within the WMA and are shown in Figure 9. At present, these ponds contain some open water surrounded by cattails or persist as cattail marshes with standing water. The current WMA wetland and upland acreage is little changed on air photos dating from 1938 to present. These air photos indicate that agricultural activities have surrounded this WMA during this entire period, more than 60 years, and likely have persisted without major changes in surrounding landscape. Gravel roads surround the WMA, but were not more extensive in the past years.

Reconnaissance for Blanding's turtles at WMA began during April (11, 17, 23 April) and early May (1, 6, 20, 22-23 May). Walking surveys resulted in no turtle

sightings until 23 May when an adult female (marked as BBC) was observed at the water's edge in the northwest corner of a cattail marsh (NWP). Early spring searches for turtles were concentrated in and around stationary water bodies (NWP, CPW, CPE, EC1, EC2, EC3, and EP on the area map; Figure 9; photos A,B,M,N). Searches were not conducted along the main creek channels nor any of the side channels. Copies of T. Jessen's field notes were not available until later in June. Consequently, these initial turtle searches at _____ WMA were based on my extensive fieldwork with this species elsewhere in Minnesota, at Camp Ripley and at Weaver Dunes. At these localities, Blanding's turtles typically overwinter in shallow, still water characteristic of wetland habitats such as shrub swamps, backwater pools, and ground water filled wet depressions.

Trapping was initiated at _____ WMA, using a total of ten 2.5 ft dia aquatic hoop traps designed for turtles and an additional 15 aquatic rectangular (crab) traps modified for turtles (photos O,T,F). Trapping was continued for 22 days, from 22 May until 14 June. Traps were baited with sardines in oil, set with the top edge above water, in shallow water, and checked periodically (1-4 days). Initially, traps were set in _____

. After turtles were captured in _____ photo B), both types of traps were gradually shifted from the east locations to west locations in late May, particularly to NWP. By early June, all the traps were concentrated in NWP. Traps were removed on 14 June prior to nesting.

Captured turtles were measured and marked using a standard protocol. The markings on each turtle consisted of drilling holes (with 5 mm dia. bit=3/16") in particular marginal scutes as illustrated in Figure 4. The codes used for turtles marked at Burke in 2002 are shown in Figures 4 & 5. Recaptured turtles with existing file marks were drilled with an additional code; existing file marks were not altered. Representative turtles were outfitted with radio transmitters and temperature data loggers. Measurement and telemetry methodologies as well as other study methods followed standard protocols described in detail previously in reports on earlier studies on Blanding's turtles in Minnesota at Camp Ripley and at Weaver Dunes.

During April through June 2002, I spent a total of 24 days conducting field surveys and fieldwork on this project. I made 14 trips to _____ and spent an average of 6 hours in the field per trip (6 hrs/day X 14 days=84 hrs. in the field). Additional driving time was 10 hrs per trip (5 hrs each way from MSP, Nebraska, North Dakota). The dates of my visits to _____ were: 11, 17, 23 April; 1,6,20,22-23,28-29 May; 1-2, 4, 9, 14, 20-21, 29 June in 2002. Capture and telemetry dates are shown in Table 1.

Blanding's Turtles at _____ WMA

2002 Captures

From late May through June 2002, 19 turtles were captured and marked at _____. Three were hand caught on land (1) and in the water (2); the rest were trapped in hoop nets (HT=5) and crab traps (CT=11). Captured turtles included 1 juvenile female, 2 subadult females, 1 subadult male, 8 adult females, and 7 adult males. Individual measurements and characteristics are presented in Table 1. Five of these turtles were previously marked by Tom Jessen in 1995-1996, and were identifiable as individuals upon recapture, based on the 1995-1996 capture records. Additional comments on these recaptures are included in the discussion section (see below).

2002 Locations

In late May and early June, the turtles appeared to be concentrated in shallow ponds, particularly in NWP, on the A total of 15 were caught
in NWP, 1 in CPW, and 3 in CPE (Figure 9). For example, all of the adult males caught in 2002 were found in NWP within 8 days (between 28 May and 4 June). Searches of this wetland in late April and early May resulted in no earlier turtle sightings or captures. This observation, in turn, suggests that most, if not all, of these turtles moved into these ponds just prior to capture. Trapping on the east side of WMA in the
(EC1) and (EP) produced no evidence of Blanding's turtles in these ponds in early to mid May.

2002 Recaptures

Recapture data provided by continued trapping until mid June indicated that marked turtles were concentrated in these ponds, particularly (NWP)
during the first half of June. Of the 15 turtles initially marked in NWP, 8 individuals were subsequently retrapped in NWP in June (photo O). In addition, telemetry locations (see below) on 4 of these recaptured turtles (BBY, BBC, BBP, BBQ) verified that these turtles remained in NWP during early June. Taken together, location information on marked turtles via trap capture and/or telemetry suggest that many adult turtles in the population moved into these ponds and remained there in late spring and early summer. At present, there is no indication that the habitats utilized by juveniles, subadults, and adults differ appreciably in this population, but habitat comparisons are limited by the relatively few captures/recaptures of juveniles and/or subadults.

2002 Telemetry

To further document seasonal concentrations and habitat usage, a representative group of 13 turtles captured in 2002 were outfitted with radio transmitters to facilitate subsequent location via telemetry. The radioed turtles included a subadult female, 8 adult females, and 5 adult males. Included in this group were 3 adult females (CCI, BBY, and BBW) initially marked in 1995 and recaptured in 2002. Telemetry observations on all of the radioed turtles at at weekly intervals from late May
through June resulted in 46 radio locations. A summary of the capture locations is shown in Table 2.

Radio location data indicated several turtles moved in early June between shallow ponds, including a subadult female (BBJ) and an adult female (BBL), but these movements were limited to distances of 200-300m in each instance. During this period, an adult male (BBI) moved from NWP south along the creek, and then moved to CPE several weeks later, distances of approximately 250m and 400m respectively. The other radioed animals were located at or near their original capture sites, typically within 100m of previous positions.

During the last half of June, longer movements into adjacent wetlands along the creek and/or into uplands were made by radioed turtles. These movements appear to indicate a seasonal shift away from the shallow ponds frequented earlier in June, and dispersal in multiple directions into surrounding habitats. For example, several turtles (BBY and BBL) moved north and eastward along the creek into the northeast corner of the WMA, a combined distance of approximately 700-800m. Other females (BBC, BBW,

CCI, CCJ, BBP) moved south and west along the creek into the southwestern corner of the WMA, approximate distances of 200-300m. Movements by adult females during this period were likely related to nesting movements into adjacent uplands. Three of these females (BBC, BBW, and CCI) were observed to nest in a field southwest of the WMA on 20 June (see 2002 nesting, below).

By late June, none of the radioed males were located in the NWP. One male (BBI), as noted previously, moved through the south of the WMA along the creek, and then moved into the northeast of the WMA, a combined movement of approximately 1000m. Another male (BBH) moved south along the west of the WMA, a distance of 200-300m. Two other males (BBG and BBD) were not located anywhere in the WMA, and had apparently shifted onto private lands outside the boundaries of the WMA.

2002 Nesting

Observations of nesting were limited to evening and morning visits to the area on 20-21 June. At 2300 on 20 June, after afternoon and evening rains, three radioed females (BBC, BBW, and CCI) were observed nesting and their nest locations marked (Figure 10; photos G-L). All three nests were positioned within 100m of one another in a south field planted with alfalfa that was mowed periodically during the growing season (photo I & J). These nests were screened to deter predation, and staked for relocation (photo H). A letter was written to the landowner/resident subsequently to explain this activity on private land. Time constraints prevented additional fieldwork during the nesting period, but it is likely that other adult females nested within a week before and after these observations, based on studies of nesting behavior in other populations of Blanding's turtles elsewhere in Minnesota. As noted above, the seasonal shift in habitat use to locations along the creek in different areas of the WMA by other females was probably related to upland movements to nesting sites. Additional comments on nesting are included in the discussion (see below).

2002 Population Parameters

The Blanding's turtles captured at WMA included a juvenile female (1), a subadult male (1), subadult females (2), and adult males (7) and females (8) (Table 3). The presence of a juvenile female aged at 6 years based on clearly readable growth annuli on the plastron and carapace is evidence of recruitment. The subadult females, aged at 12 years, and a single subadult male, aged at 14 years, provide additional indications that younger age classes are present in the population. In both groups of adults, males as well as females, various aged individuals are present. These include turtles that showed evidence of continued growth, based on visible growth seams in the scutes on the plastron and/or visible growth rings on the scutes on the carapace. In addition, older individuals, including several marked as reproductive adults in 1995 (BBW, CCI) are still present in the population. A number of other adults of similar age (20-25 years plus), based on plastral wear, are also represented. These are likely individuals that were present at the time of earlier studies in 1995 and 1996, but were not captured and marked at that time.

The Blanding's turtles captured in 2002 at WMA are relatively large by comparison with adults of similar age in other populations. The size range for adult females is 228-243 mm. carapace length, and for adult males is 223-264 mm. These sizes approach those of the notably larger-sized turtles documented in the Camp Ripley population, and are considerably larger than comparably-aged turtles in the Weaver

Dunes population. The sizes of the juvenile and subadults captured in 2002 are consistent with this observation, and suggest that large size may be a specific feature that distinguishes this population. Additional comments on this life history feature of the Blanding's turtles living at _____ are included in the discussion section (see below).

Discussion

Prior Studies

In the vicinity of _____ WMA, Blanding's turtles have been documented to occur at the following localities, listed in order of proximity:

Observations of Blanding's turtles at the _____ WMA were made in 1988-89 by J. Schladweiler and J. Moriarty, and extensive fieldwork on the turtles there were conducted by Tom Jessen in 1995 and 1996.

In 1988, J. Schladweiler and DNR staff reported sightings of Blanding's turtles in the creek and adjacent wetlands. These turtles were encountered during routine work assignments on the WMA. In May 1989, J. Moriarty observed 3 adult females in fen wetlands between the _____ and _____ EC1-EC3. In addition, he discovered an adult male dead but undamaged along the edge of CPW, apparently a victim of winter kill, and also collected a weathered shell of a juvenile, aged at 5 years, in the same area.

In 1995 and 1996, Tom Jessen visited the _____ WMA during June, July, and August (only in 1996) and conducted extensive fieldwork on the Blanding's turtle population there. In 1995, he was there on 12, 13, 19-22 June, on 16-24, and 26 July. In 1996, he was there 28-31 May, on 4-6, 11-12, 17-18, 20 June and on 7-8, 18, 30 July, and on 1 and on 7-9 August. During these repeated visits, he documented numerous turtle sightings, hand caught and trapped turtles, and marked and released a total of 16 turtles. His detailed, well-illustrated field notes, photos, and data sheets carefully document the status of the turtle population at that time, and provide a solid basis for comparisons with the present study.

A summary of T. Jessen's data on the turtles he marked and studied is presented in Table 4, in a format designed to facilitate such a comparison. Additional observations are included in his field notes and are referenced here where relevant. In particular, he described turtle activity and behavior, including encounters with nesting females, and recorded locations and movements of marked individuals.

In 1997, on 18 June, Perry Loehring found a marked Blanding's turtle recorded as notched on marginal scutes 23, 18, and 16; this pattern does not accord with any marks made by T. Jessen (Figure 11). However, it is likely that this turtle, with three file notches, was TJ 2008, an adult marked on scutes 23, 15, 17. Specific location of this turtle was not recorded, but it was found on the WMA.

Turtle Abundance and Density

The total number of turtles inhabiting the wetland habitats at _____ WMA may be estimated, based on preliminary capture-recapture data from T. Jessen's study as well as the 2002 study. Obvious survey biases related to the method of collecting and/or capture are not evident in either study, despite the reliance on hand-captures in

the 1995-1996 study and the emphasis on trapping in the 2002 study. In both samples, adults comprise about 75%, subadults represent 20%, and juveniles make up about 5%. Adult females outnumber adult males in both samples, possibly related in part to nesting activity during June when most collecting was done (Table 5).

Jessen noted relatively few recaptures of marked turtles, possibly related to a methodology relying on hand captures vs. trapping. In 1995, two recaptures were made within 1-4 days of the initial captures, totaling 7 turtles. In 1996, 1 of these turtles marked in 1995 was recaptured and an additional 9 new unmarked individuals were marked in 1996. A simple Lincoln Index, based on the single recapture in 1996, estimates the population size at 70 turtles in the study area in 1995-1996.

Calculation of a Lincoln Index, using 2002 recaptures of 5 turtles marked in 1995-1996, produces an estimate of 67 turtles in the study area in 2002 (Table 5). An additional recapture (a hypothetical total of 6 recaptured turtles) would reduce the estimated total population to 59; one fewer recapture (a hypothetical total of 4 recaptured turtles) increases the estimated population size to 80 turtles. Taken together, these estimates indicate that the likely number of turtles living at _____ WMA range from 59-80, with the most reliable estimates at 67-70 turtles. This number should be viewed only as a preliminary estimate, and subject to revision with additional sampling.

Because Blanding's turtles have relatively long adult life spans (30-60+ yrs) and typically experience low adult mortality, it is realistic to estimate the total number of turtles marked at _____ to date. Assuming all of the marked turtles are still alive and residing in the study area at _____, the present population of marked turtles numbers 30, consisting of 1 juvenile, 3 subadults, and 26 adults. If estimates of 67-70 turtles are reliable, then 30-40% of the total individuals captured in the near future should have been marked previously, in 1995-1996 and in 2002 (Table 5).

A preliminary density estimate, assuming a total wetland acreage of 70 acres, is one turtle per acre or 2.5 turtles per hectare (ha). If the study area is restricted further to 35-50 acres where collecting and trapping were concentrated, the estimated densities range from 3.5 to 5 turtles per hectare or 1.5 to 2 turtles per acre. These density estimates, calculated on the basis of inhabited wetlands, are slightly higher than the low values observed for Blanding's turtle populations at Camp Ripley (maximum density 1.4 turtles/ha). Yet the estimated density is lower than densities reported for the species elsewhere (6.3 turtles/ha to 55 turtles/ha, in Massachusetts vs. Missouri, respectively). A low density population such as at _____ may be particularly sensitive to loss of habitat as well as to factors such as road mortality and nest predation.

Habitat Usage

In 2002, turtles were not encountered until late May in shallow ponds. On the bases of trapping and telemetry, most remained seasonally concentrated within available wetland habitats in these ponds, particularly NWP, through the first half of June. In the last half of June, turtles dispersed into adjacent wetlands over distances ranging from 200 to 1000m. In addition, several radioed males apparently moved off the _____ WMA onto private lands.

Fidelity from year to year and over a 7 year interval (1995-2002) indicated by the recapture locations of the 5 turtles marked in 1995-1996 and recaptured in 2002. Three of these turtles were outfitted with radio transmitters for relocations via telemetry. The

locations occupied by each of these recaptured turtles are shown in Figure 10, including nest sites and/or nesting movements in 1995 and/or 2002.

In 1995, BBW (=TJ 2003) was initially captured just east of the _____, as it wandered into the upland southwestern field, apparently attempting to locate a nest site. In 2002, BBW was recaptured in NWP in late May where it remained until mid June. This female nested on 20-21 June, at the location in a cropfield, south of the _____ WMA. She was then relocated along the creek in the SW corner of the WMA (Figure 10). The recapture record for CCI extends over three years, with captures in 1995, in 1996, and again in 2002. In 2002, she was found nesting near BBW in a cropfield south of the _____ WMA, after a capture near CPE earlier in May. She was initially captured in CPW in 1995, and later recaptured near Big Pool along the creek in 1996 (Figure 10).

A third adult female (BBY) exhibited limited movement (<100m) between the initial capture location in 1995 and subsequent relocation in 2002. A subadult male (BBU) was recaptured in 2002 in NWP, 200-300m from his initial capture site at CPW in 1995. A juvenile female (BBX) marked in 1996 in NWP was recovered in the same marsh as a subadult in 2002 (Table 10). These observations across a number of years during which the juvenile female reached subadult size, and the subadults matured into reproductive individuals, provide further support for the lack of habitat segregation among distinct age/size classes.

Additional observations of nesting were made in 1995 when two adult females were encountered moving south into the crop field directly south of the southern boundary of the _____ WMA, as noted in Figure 10. One of these marked turtles, TJ 2006, was found several days later along the creek, north of her nesting location. These data provide further evidence that adjacent cropland is used as nesting habitat by the Blanding's turtle population at the _____ WMA.

Taken together, the spatial information available to date at _____ WMA indicates that the wetlands within the WMA are inhabited during the late spring and early summer. In particular, the seasonal concentration of adult males and females are likely seasonal breeding assemblages. Subsequent dispersal into adjacent wetland habitats is also indicated and is likely associated with upland movements to nesting sites by reproductive females. Both males and females may disperse further into wetland upstream and/or downstream of the _____ WMA.

Late summer locations as well as fall and winter seasonal habitats are not yet identified for this turtle population. For example, are there extensive upstream or downstream movements by turtles during late summer and/or early fall? Where do these turtles overwinter? Are overwintering sites located within the _____ WMA? Or do these turtles overwinter elsewhere on private lands?

Population Parameters

The observations at _____ for 1988-2002 indicate the continued presence of juvenile turtles, e.g., 5-6 year old individuals documented in 1989, 1996, and 2002, in the population over 24 years. Approximately the same proportion of subadults (20% of the turtles captured) was evident in 1995-1996 and in 2002 (Table 5). In addition, the estimated ages of adults, based on countable annuli on plastral scutes, range from younger individuals recently matured, as well as older turtles, characterized by well-worn plastral annuli and/or smooth plastrons without annuli evident. Taken together,

the presence of these varied age/size classes in the study population, in approximate proportions as noted in other studies suggest that this population is a viable one, and that there is recruitment in addition to successful nesting, at least in some years, by reproductive females.

At this juncture, it is not possible to assess levels of nesting success. Likewise, other reproductive parameters are not yet documented. For example, do reproductive females nest every year? What is the reproductive frequency? What is the clutch size? How do egg parameters (size, weight) vary with clutch size? When does hatching typically occur? Answers to these questions are important in an assessment of the overall health and viability of the population. Furthermore, these reproductive features are known to vary considerably among different populations of Blanding's turtles in different regions. Certain related features, such as body size and growth, also vary in systematic ways in populations from various localities across the species' range.

The Blanding's turtles at appear to exhibit a suite of life history characteristics that distinguish this population from the Weaver Dunes population in southeastern Minnesota, and from populations of the species studied elsewhere, e.g., Nebraska. With respect to overall body size, the turtles are large in comparison with all other populations except those at Camp Ripley in north central Minnesota.

Adult body sizes, as well as younger body sizes, are shown for turtles measured in 2002 and in 1995-1996 (Table 4). Carapace lengths (mm) range from 223 to 267 for adult males, 222 to 243 for adult females, 184 to 215 for subadult males, 178 to 203 for subadult females, and 140-141 for juveniles. These values are only marginally smaller (<5%) than turtles measured at Camp Ripley, a population documented to be 15-20% larger in body size than Blanding's turtles at Weaver Dunes. So, turtles measure 10-15% larger than those from all other populations (except the population at Camp Ripley).

In other populations (including the population at Camp Ripley), large body size is associated with rapid growth, accelerated maturation, large egg size, and increased clutch size. Whether these two latter features are characteristic of the turtles is not yet known. However, the available measurements of the 30 turtles marked to date and growth increments from recaptured turtles provide limited data on growth and maturation. For example, a juvenile (BBX) aged at 6 years by T. Jessen showed a carapace length increase of 55 mm during the intervening 6 years, and measured 195 mm at 12 years of age in 2002. Evidence of equivalent or increased growth is evident among the subadults of comparable ages (Table 4).

Consequently, the turtles are large at a given age, relative to their counterparts in other regions, and may mature at a larger size but the same age or at a larger size and younger age. Reproductive females observed making nesting movements or observed nesting ranged in size from 222 to 240 mm, carapace length. It is likely that the youngest of these, 222-229 mm carapace length, were at least 15 years of age. This is the minimum age of reproduction reported for the species, based on populations from other regions.

Conclusions to date

- (1) Reconnaissance in late April and early May 2002 resulted in the selection of WMA as a suitable study site for Blanding's turtles in southwestern Minnesota
- (2) A population was sampled, and 19 turtles were captured and marked. Turtles(13) were outfitted with radios and data loggers, and monitored periodically.
- (3) Turtles were concentrated in shallow ponds in late May and dispersed into adjacent wetlands by late June. Most of these were located on the WMA, but some were not.
- (4) Reproductive females nested during the third week of June in adjacent uplands utilized for croplands. All of documented nests are located on private lands.
- (5) Recaptured turtles, including 3 adult females, a subadult male, and a juvenile, marked in 1995-1996 were relocated in 2002 near their original capture locations.
- 3) The number of turtles at _____ is estimated to be 67-70 (59-80), based on 1995-1996 and 2002 mark-recapture record.
- 4) The total number of marked turtles at _____ is 30, if all turtles marked in 1995-1996 and 2002 have survived to date.
- (8) Preliminary density estimate is 1 turtle/acre or 2.5 turtles/ha, using 70 acres as potential wetland habitat. Smaller wetland acreage yields higher turtle densities.
- (9) Seasonal usage of wetlands within the boundaries of _____ is evident in late May and June. At least several telemetered turtles moved off the WMA by end of June.
- 3) _____ turtles are 10-15% larger in body size than other turtles, e.g. Weaver Dunes.
- 4) Additional life history features unique to _____ turtles, as well as other populations living in SW Mn, may be rapid growth and/or accelerated maturation.
- 5) Reproduction occurs in females as small as 229 mm carapace length, at least 16 years of age. Reproductive features may include large egg size and/or large clutch number, suggested by large body size, are not yet documented in these turtles.

Future Studies

Fieldwork to be conducted during the remainder of 2002 and early spring and summer of 2003 will focus on (1) continued tracking of radioed turtles, and (2) additional efforts to trap and capture turtles within the _____ WMA. In particular, the late summer, fall, and winter locations of turtles marked previously will provide the necessary data to establish the seasonal habitats used by the turtle population at _____. Further capture efforts throughout the remainder of 2002 and early 2003 will further establish the validity of turtle abundance and density estimates for this population. Little is known about the habitats utilized by juveniles and subadults turtles at _____, and further information on this feature is needed for effective management. Nesting may be dependent on movement onto private lands in all directions, not just to the fields south of the WMA. Additional information is needed to identify nesting habitats. Reproductive features are not described, and likely differ from populations elsewhere.

Interim Management Recommendations

Based on our prior studies in Minnesota, Blanding's turtles require three habitats:

- 1) **activity season wetlands**, encompassing a variety of wetland types and sizes that are typically occupied for various periods during the spring, summer, and fall
- 2) **overwintering wetlands**, comprising specific wetlands that provide refuge from lethal winter temperatures and protection from predators during inactivity
- 3) **nesting uplands**, characterized by exposed, well-drained soils, utilized largely during the reproductive season by reproductive females and emerging hatchlings.

Currently, on the basis of available data, the activity season wetland utilized by the turtle population is located at least in part in the wetlands and associated water surrounding the creek tributary flowing through the WMA. **At present, the mid and late summer locations, that make up the remainder of the activity season wetlands are not yet known for these turtles.** Circumstantial evidence, based on movements of some turtles off the WMA, suggests that at least some of the turtles move either up or down the creek during the activity season. At present, the extent of these movements and their prevalence are not yet determined for the majority of turtles. **Similarly, the overwintering wetland habitats required by these turtles are not known, and may include habitats outside the WMA.** The known nesting habitats are not located on the WMA, but are located on private cropland and pasture south of the WMA boundary. **Additional nesting habitats may be located outside the WMA.** Little is known about specific habitat requirements of juveniles and subadult turtles.

Wetland Threats: At , the Blanding's turtles rely on wetland habitats associated with the creek that flows through the WMA. Loss or alteration of wetlands on private property could severely impact turtles at . In addition, road construction and water level regulation that affects water flow in the watershed could pose lesser threats to the turtle wetlands area-wide.

Strategies: Concerted efforts must be made to protect and preserve any wetlands in the watershed, regardless of size or type. In particular, water levels or drainage patterns should not be altered. Wetlands should be protected from road or lawn chemical run-off, and other forms of pollution. Roads should not be upgraded or constructed in ways that affect water flow or existing wetlands.

Upland Threats: At , distances from existing roadways is certainly a key element in the survival of the turtle population to date. The major threat in uplands is that existing or additional roads will be upgraded or constructed in the region, within 1-3 miles of the WMA. For example, the development of windmill installations in the area would increase traffic during construction, and probably result in roadwork in the area. This activity could have disastrous effects on the existing turtle population. For specific comments in this regard, see comments included here as Appendix A.

Strategies: Concerted efforts must be made to limit and restrict road access in the immediate vicinity of the WMA. Any fieldwork or cropping within the existing WMA should be re-evaluated in light of the likelihood that these areas are potentially sites where females lay eggs, eggs incubate for several months, and hatchlings utilize when moving from nest sites to surrounding wetland habitats. Fieldwork within the WMA, such as weed control, should be scheduled and located to have minimal impacts on the existing turtle population.

Blandings Turtles 2002

code	age	sex	wt gms	cl mm	pl mm	wd mm	ht mm	gr	gs	annuli	day	date	loc	cap	rcp	radio	nest	1995-96
BBK	J	F	381	141	137	94	56	y	y	5	148	28may	CPE	HT				
BBJ	SA	F	981	195	192	131	75	y	y	11	148	28may	CPE	HT		12		
BBX	SA	F	1026	195	190	134	77	y	y	11	149	29may	NWP	CT	R			TJ2009
BBN	SA	M	1199	215	196	137	78	y	y	13	160	9june	NWP	HT				
BBY	A	F	1575	228	221	140	91	y	y	16+	149	29may	NWP	CT	R	46		TJ2002
BBC	A	F	1684	230	220	145	94	n	n	20	143	23may	NWP	HC	R	16A	nest	
BBL	A	F	1707	230	218	149	93	y	y	18	149	29may	CPW	HC		48		
BBW	A	F	1707	230	225	152	91	n	n	20+	149	29may	NWP	CT	R	4A	nest	TJ2003
CCI	A	F	1902	232	225	153	94	n	n	20+	148	28may	CPE	HC		9A	nest	TJ2001
CCJ	A	F	1843	233	224	145	89	n	n	20+	165	14june	NWP	CT		12R	?n	
BBP	A	F	1930	236	234	155	97	n	n	20+	153	2june	NWP	CT	R	50		
BBQ	A	F	1852	243	224	145	96	y	y	17	153	2june	NWP	CT	R	40		
BBI	A	M	1466	223	199	140	86	y	y	20	148	28may	NWP	HT		74		
BBU	A	M	1326	223	197	141	82	y	y	20	153	2june	NWP	HT	R			TJ2005
BBV	A	M	1612	231	219	151	90	y	y	17+	149	29may	NWP	CT				
BBH	A	M	1780	241	232	148	94	n	n	20+	148	28may	NWP	CT	R	58		
BBO	A	M	1934	249	223	148	89	y	y	18+	155	4june	NWP	CT				
BBG	A	M	1870	250	223	158	92	n	n	20+	148	28may	NWP	CT	R	60		
BBD	A	M	2179	264	235	159	96	n	n	20+	148	28may	NWP	CT		53		

Table 1. Summary of individual details for 19 Blanding's turtles collected at WMA during May-June 2002. Turtles were marked with an individual code (see Figs. 4, 5), identified as a juvenile (J), subadult (SA), or adult (A), sexed (F=female; M=male), weighed (in grams), measured (cl=carapace length; pl=plastron length; wd=width, at bridge; ht=height), aged (gr=growth rings visible on carapace; gs=growth seam visible along plastral midline; annuli=counted on individual plastral scutes). The day (Julian date) and date of capture, and location recorded
Fig. 9) is included, as well as method of capture (HC=hand capture; HT=hoop trap; CT=crab trap) and whether recaptured (R=recapture during 2002). Radio channel noted for turtles with radios, and nesting noted for females. Five turtles captured in 2002 were recaptures marked by T. Jessen in 1995-1996, noted with "TJ" identification code (see Fig. 8).

**Table 2 removed from document:
contains location information**

BT age-size comparison							
code	age	sex	wt gms	cl mm	annuli +1=age	gro nest	marked
2009	J	F		140*	6	+	
BBK	J	F	381	141	6	+	
2002	SA	F		178*			
BBJ	SA	F	981	195	12	+	
BBX	SA	F	1026	195	12	+	2009
2017	SA	F		203*	11		
2005	SA	M		184*			
BBN	SA	M	1199	215	14	+	
2006	A	F		222*		nest	
BBY	A	F	1575	228	16+	+	2002
2001	A	F		229*	20+		CCI
2003	A	F		229*		nest?	BBW
2011	A	F		229*			
BBC	A	F	1684	230	21	N nest	
BBL	A	F	1707	230	19	+	
BBW	A	F	1707	230	20+	N nest	2003
CCI	A	F	1902	232	20+	N nest	2001
CCJ	A	F	1843	233	20+	N nest?	
2012	A	F		235*			
2014	A	F		235*			
BBP	A	F	1930	236	20+		
2004	A	F		240*		nest	
BBQ	A	F	1852	243	18	+	
BBI	A	M	1466	223	21	+	
BBU	A	M	1326	223	21	+	
BBV	A	M	1612	231	17+	+	
2007	A	M		235*			
BBH	A	M	1780	241	20+	N	
2013	A	M		241*			
BBO	A	M	1934	249	18+	+	
BBG	A	M	1870	250	20+	N	
2008	A	M		254*			
BBD	A	M	2179	264	20+	N	
2010	A	M		264*	25		
2018	A	M		267*			

*=estimated carapace length

Table 3. Size-age features of Blanding's turtles from WMA, measured in 2002 and in 1995-1996. Turtle code, age, sex, weight, as noted in legend in Table 1. Carapace length (mm) was measured directly in 2002, and indirectly estimated for 1995-1996 based on curved measurements, taken by T. Jessen in inches. Age based on readable annuli on plastral scutes; growth indicated by growth rings on carapace and/or presence of growth seam (+=growth; N=no growth evident). Certain females were observed nesting. Measurements of turtles recaptured in 2002 are tabled with earlier measurements taken in 1995-1996.

Blandings Turtles 1995-96
marked by T. Jensen

TJcode	age	sex	cl est	annuli +1=age	date	loc	cap	scutes	nest	R95	R96/97	2002	loc	date02
2001	A	F	229	20+	12june95	CPW	HC	13			1aug96	CCI	CPE	28may
2002	SA	F	178		13june95	NWP	HC	23-14				BBY	NWP	29may
2003	A	F	229		19june95	PKG.S	HC	23-15	nest?			BBW	NWP	29may
2004	A	F	240		19june95	S.FLD	HC	23-16	nest					
2005	SA	M	184		20june95	CPW	HT	23-17				BBU	NWP	2june
2006	A	F	222		20june95	S.FLD	HC	23-18	nest	21june				
2007	A	M	235		20july95	CPE	HC	23-13,18		24july				
2008	A	M	254		04june96	NWP	HT	23-15,17			18june97			
2009	J	F	140	5-6	04june96	NWP	HC	23-16,17				BBX	NWP	29may
2010	A	M	264	25	12june96	CPW	HC	23-12						
2011	A	F	229	20+	12june96	CK.SW	HC	23-13,12						
2012	A	F	235		13june96	CK.SW	HC	23-14						
2013	A	M	241		18june96	CK.BP	HC	23-15,12						
2014	A	F	235		18june96	CPE	HC	23-16,12						
2017	SA	F	203	10	18july96	CPW	HC	23-13,12,18						
2018	A	M	267		31july96	EC1	HC	23-15,17,12						

Table 4. Summary of individual details for 16 Blanding's turtles collected at 1995-1996 by T. Jensen. Features as noted in Table 1. Locations include:

were marked with file notch, as shown in Fig. 8. Recaptures of 1995 turtles in 1995, and in 1996 and 1997 are noted; 1997 recapture summarized in Fig. 11.

Scutes

BT capture summary marked turtles									
season	N	juvenile	subadult females	subadult males	adult females	adult males	recapture 1995	recapture 1996	
1995	7		1	1	4	1	2		
1996	9	1	1		3	4	1	1	
95-96	16	1	2	1	7	5	3	1	
2002	19	1	2	1	8	7	4	1	
total marked	30	1	2	1	13	13			
30	=total marked based on 2002 plus 1995-96 ?extant								

Lincoln Index Jessen 1/10=7/N N=70 estimated pop size
 TJ+02 5/19=16/N N=67 (59-80) est pop size
 2003 ?/10=30/70 recaps=43% of total captures

Table 5. Summary of Blanding's turtles marked at WMA in 1995-1996 and in 2002. Recaptures are noted (right columns), as well as the total number of marked turtles extant (bottom row). Lincoln Index calculations are shown for population estimates, based on the proportion of marked turtles recorded in subsequent recaptures. See discussion section on turtle abundance and density.

**Figures 1-3 removed from document:
they contain location information.**

Figure 4. Diagrams showing key (left, top) and drill hole patterns used to mark Blanding's turtles coded BBC through BBX in May-June 2002. Recaptures for 1995-1996 are circled; file marks indicated with a "V". Key for 1995-1996 file marks used by T. Jensen shown in Fig. 8.

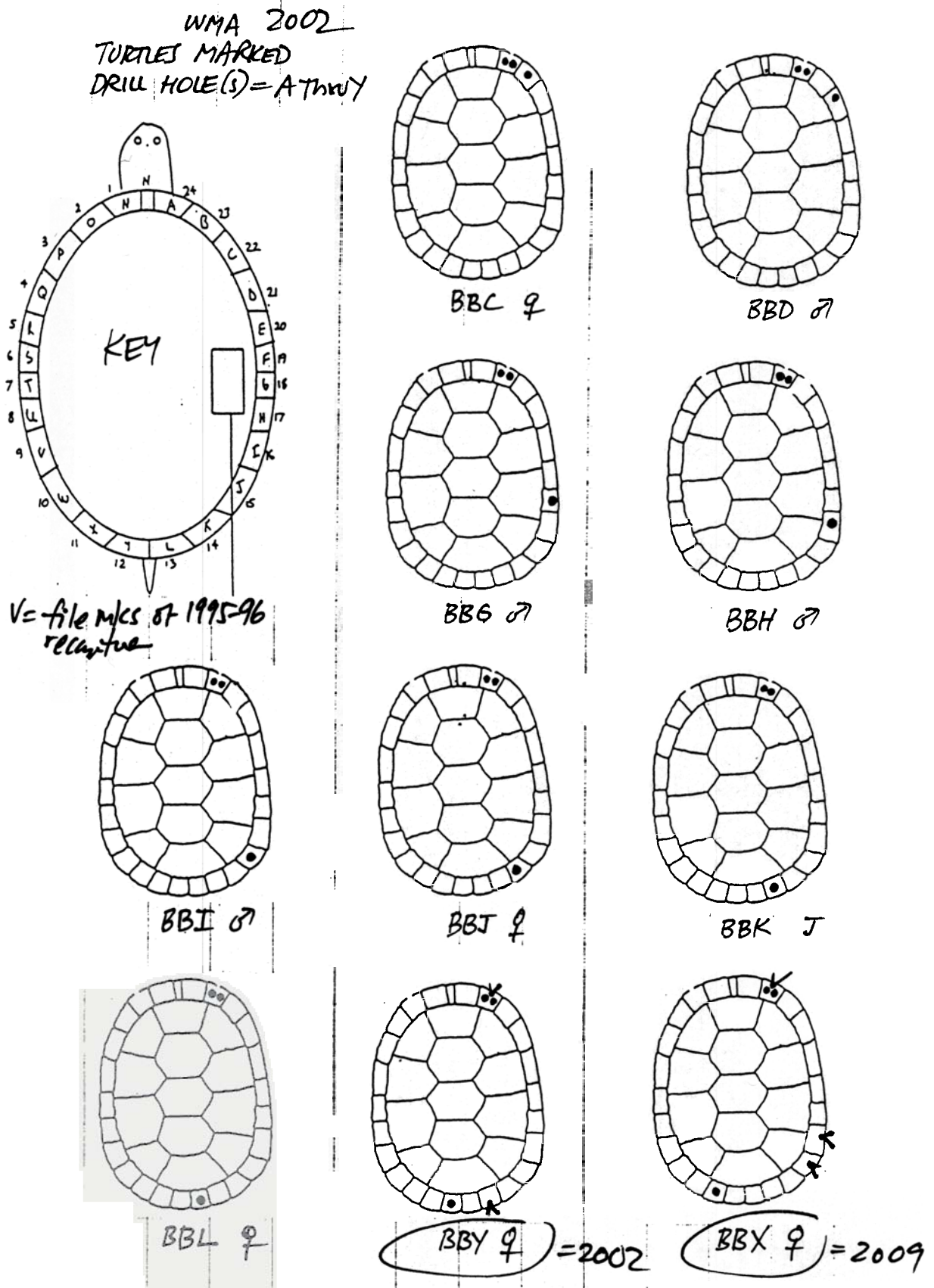
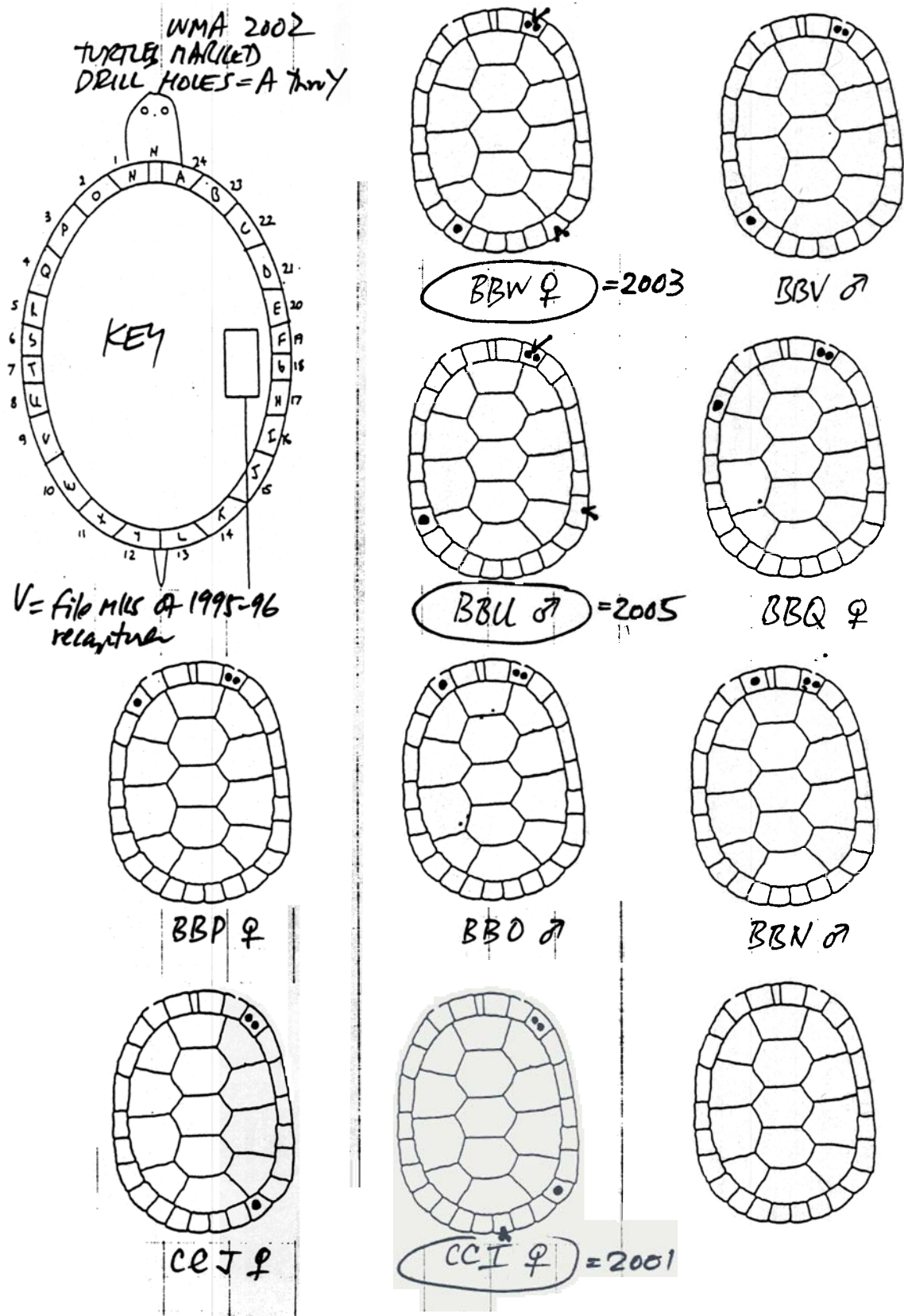


Figure 5. Diagrams showing key (left, top) and drill hole patterns used to mark Blanding's turtles coded BBW through CCI in May-June 2002. Recaptures for 1995-1996 are circled; file marks indicated with a "V". Key for 1995-1996 file marks used by T. Jensen shown in Fig. 8.



SW MINNESOTA 2002 BLANDING'S TURTLE STUDY

DATE 5/22/02

TIME

PLACE

HABITAT

ID#

BEHAVIOR

CODE

RADIO
TEMP LOGGER

CL
CW
PL
PW
HT

INJURIES, SCARS

DOR

no measurement taken
yet, but aged by
scutes as 4 yr. old.

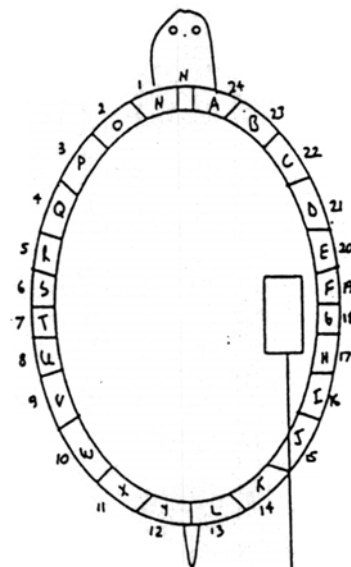
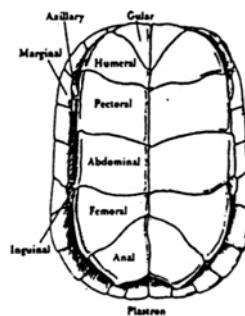
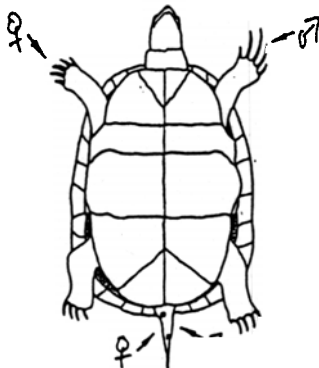
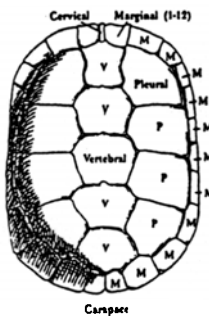
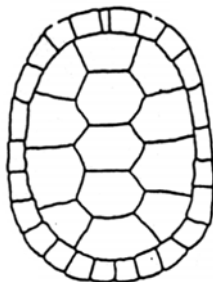
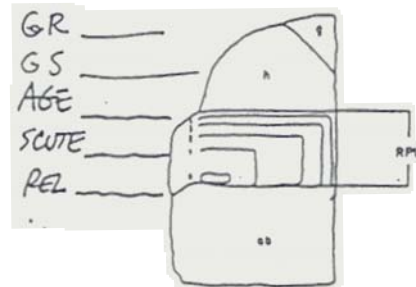


Figure 6. Data sheet illustrating turtle features recorded during 2002 study. This record contains specific locality information for a juvenile, aged 4 years, that was collected as a roadkill in the the SE corner of WMA, road east.

MINNESOTA 2002 BLANDING'S TURTLE STUDY

2001
TJ 6-12-95

DATE 5/28/02 148

TIME 1300-

PLACE

HABITAT BASKING ON LAND

ID#

BEHAVIOR

CODE CCI

WT. 67.0

CL 232

SEX ♀

CW 153/162

T-C 47

PL 275

SAMPLE

PW 128

S-C +2

HT 94

RADIO 150.09
TEMP LOGGER 272896

released 5/29/02

INJURIES, SCARS

CONCAVITY. —

basking on land @ 1300

no annuli
visible

GR —

GS —

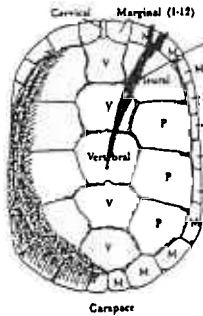
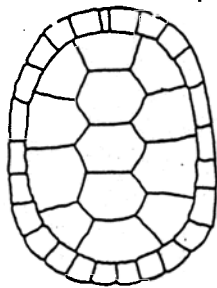
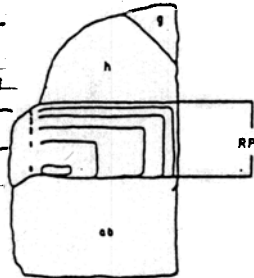
AGE 20+

SCUTE —

REL —

released 5/29/02 12 NOON

Plastron
worn smooth



scar
from
old
injury

can't use
"BB" as
code
used
"CC"

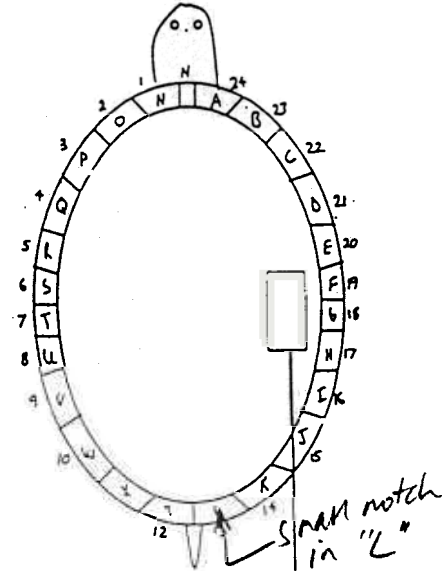
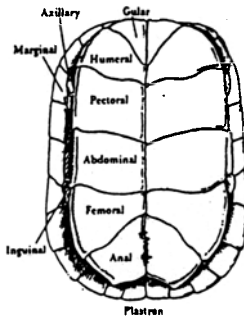
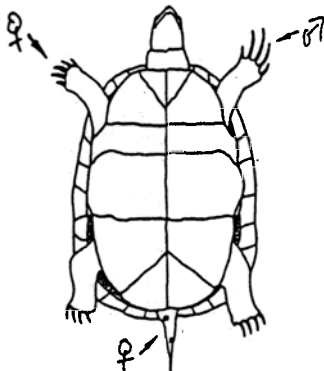


Figure 7. Data sheet for turtle CCI, captured at WMA in 2002. This turtle was a recapture of #2001 marked by T. Jessen in 1995 (see Fig. 8). Note diagram sketch showing a major scar on carapace from an old injury. Compare this sketch with "scar" sketched on T. Jessen's entry for #2001 (see Fig. 8).

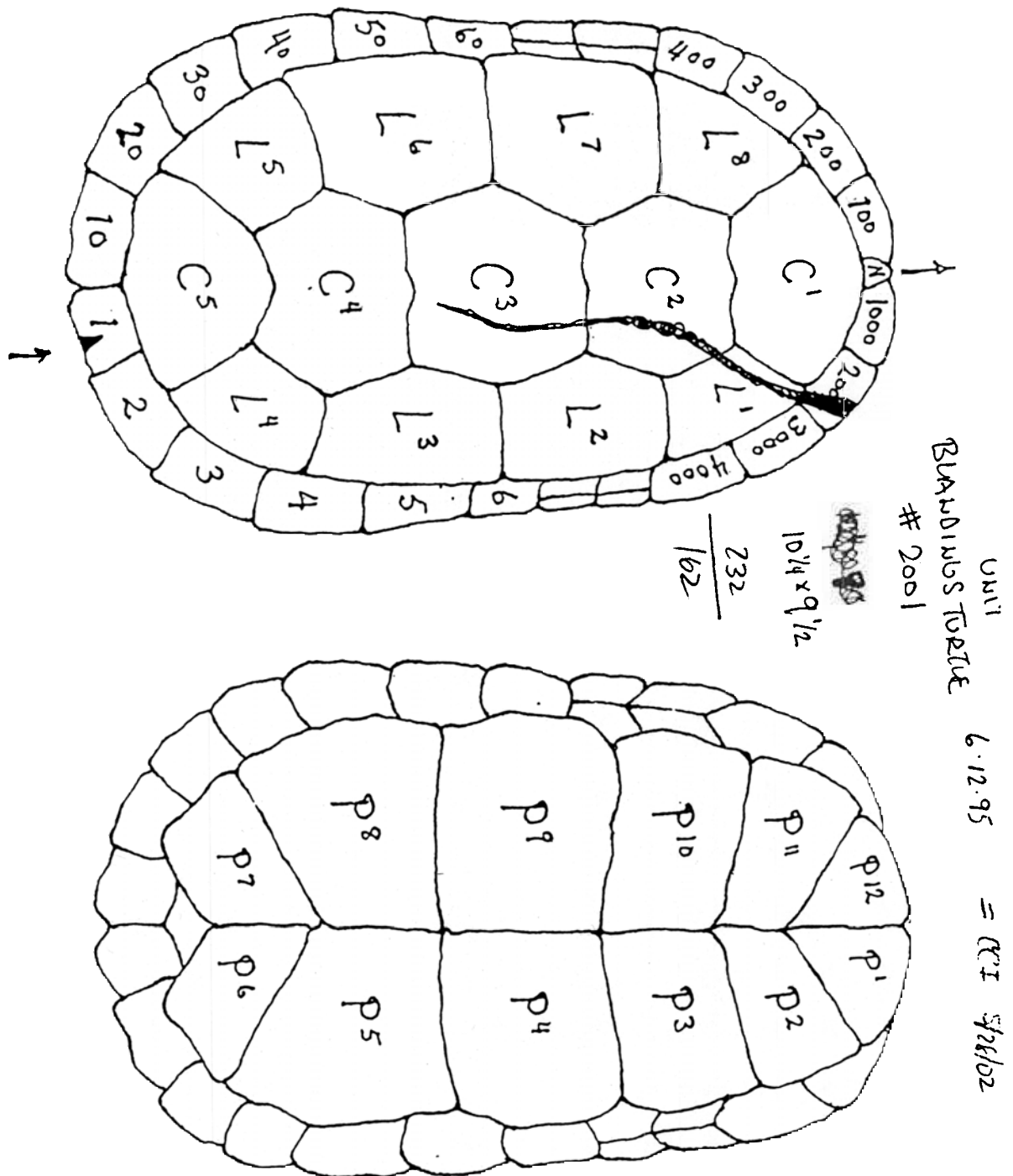


Figure 8. Data sheet for turtle #2001, captured at WMA in 1995. This turtle was collected by T. Jessen on 12 June 1995, and marked with a file mark on a rear marginal scute corresponding to "1" on his coding diagram. Other features noted included "rounded" (=curved) Measurements of the carapace, front to back and side to side.

DEPARTMENT :

STATE OF MINNESOTA

SF-00006-05 (4/86)

Office Memorandum

DATE: 6-18-97
TO: Joel Anderson
FROM: Perry Loegering

PHONE :
SUBJECT: Blundings Turtle Sighting

I found a Blundings Turtle on WMA
on 6-18-97, County The shell
was marked as shown in the diagram

Schlad knows
all about these

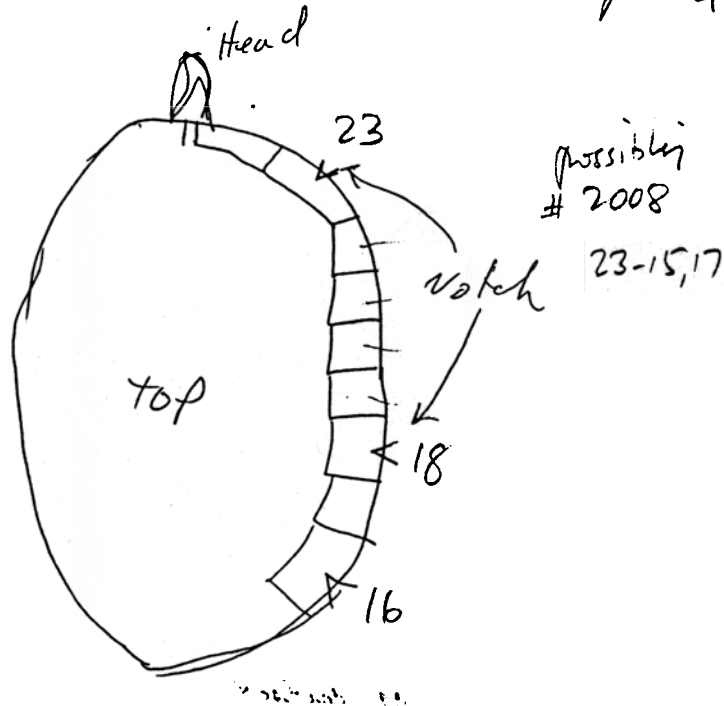


Figure 11. Memo noting 1997 recapture of Jessen-marked turtle at WMA, found 6-18-97 by Perry Loegering. File marks interpreted to denote the capture of #2008; see Fig. 8 for key.

Appendix A: Comments by J. Lang on Blanding's turtles living in the vicinity of proposed Wind Power facility in NW Murray County.

To: Lisa Gelvin-Innvaer <lisa.gelvin-innvaer@dnr.state.mn.us>
From: jeff lang <jeff_lang@und.nodak.edu>
Subject: Blanding's & Wind Power
Cc:
Bcc:
X-Attachments:

Lisa

Thanks for sending the various materials relating to the Windpower Plant proposed in Pipestone and Murray counties. I was able to download your map, and don't have any specific occurrence records to add for Blandings turtles based on our work in this area during 2002. Most of our work was concentrated on the population, located on your map in the WMA about . This population of Blandings turtles is estimated to contain at least 25-50 adults, and possibly 2-4X that number, based on animals we marked last summer and other individuals marked during 1995-1996 by Tom Jesson. This estimate is based on our recaptures of some of Tom's animals, and the well documented long life span of this species. In addition, we have evidence of successful reproduction, including nesting, hatchling emergence, and the capture of juvenile turtles at the site.

Our studies of adults outfitted with radio transmitters and activity loggers indicated that adults, both males and females are moving extensively in the surrounding wetlands and farmlands, including upland areas used for nesting. The fact that this many turtles have managed to survive and utilize the WMA, just over 100 acres in extent, is probably directly linked to the absence of roads, particularly black top surfaced roads, in the immediate area where they are concentrated. A number of the turtles we found were scarred with evidence of major injuries from either farm vehicles or road traffic, even though most are not living immediately adjacent to a hard surface road.

With respect to the proposed Windpower Plant, the greatest immediate threat is the increase in traffic that this activity would entail. In addition, some of the upland may be within range of nesting turtles. Any wetlands within the project should be surveyed for turtles, particularly where such wetlands intersect any traffic areas or roads. Assuming that the major source of increased traffic on area roads would be associated with establishing, rather than maintaining the project, the greatest threat to any Blandings turtles living in and around the project would likely come during the building phase, rather than later, during the operation phase.

The fact that the project boundaries lie very close to existing WMAs, most of which have not been adequately surveyed for turtles as of fall 2002, within 0.5 to 3-4 miles in many instances, suggests the very real likelihood that Blandings turtles will be found living or moving within the project boundaries. This suggestion is supported by our recent studies at with telemetered turtles. These turtles routinely moved within a mile of the WMA, and on occasion moved distances of 1-2 miles. Our data indicate that these were regular seasonal movements that occur annually by turtles that typically live for 30-50+ years.

At this point, a survey of whether Blandings turtles do occur within the proposed project boundaries should be done prior to developing the project any further, or at least a survey should be done next season to work out how to accommodate the turtles within the scope of project as it is developed. The major focus should be on 1) avenues of travel between critical habitat components which include the various wetland areas, some with possibly upland connections--entailing overland movements by turtles, and 2) roads and their likely impact on turtle travel and mortality.

It is quite clear, based on our limited, pilot study at the WMA during 2002, that significant populations of Blandings turtles still persist in suitable habitats in SW Minnesota, as improbable as that sounds, but their continued survival is precarious and dependent on specific information about where they occur and how they are currently utilizing available habitats. It is very likely that there are additional populations not yet identified which could survive with effective management, but will be lost unless we find and protect them.

Thanks for the update and for giving me a chance to add this brief comment, and let me know if I can help any further with this assessment.

Jeff

Appendix C: Letter to resident/landowner of Southwest Field, nesting sites 02

27 June, 2002

Mr.

Dear Mr. :

I would like to introduce myself, unfortunately long-distance by mail. I am a biologist at the University of North Dakota, and have been studying Minnesota turtles in recent years. I enclose some information and articles about turtles and the work we have done recently at Camp Ripley in central Minnesota and at Weaver Dunes in SE Mn near Wabasha and Winona along the Mississippi River. I don't work for the Mn. DNR, but they have provided some partial funding for turtle studies.

I am writing to you because I believe you are a neighbor to the WMA, located at the According to the information I received from the Cty Directory, you farm the property to There is an alfalfa field there that drops down to the stream that runs west and south to the Rock River.

I am doing a pilot study of the Blandings turtles in this area, and have attached small radios to some of these turtles, and painted letters on their shells. My hope is to follow them as they move around the wetland. The one time they tend to move onto land for any distance is when they nest, which should be finishing by the end of June.

About a week ago, I tracked three of the turtles into the alfalfa field late in the evening, and at least two of them nested there. I placed stakes and flags to mark the spots for my reference, and also tacked a small piece of hardware cloth over each nest to protect them from predators.

Normally, I would introduce myself beforehand, and ask permission to track the turtles on private property, and certainly before I would stake or flag locations. I apologize for not doing this ahead of time. I would like to request permission to track the turtles, and if it doesn't interfere with your field activities, continue to mark the spots where the nests are located. If this is a problem or you would prefer that I not track the turtles, please let me know at your convenience.

I may be contacted by phone at 402 376 2895 or 651 269 5604 (cell). I am working in the NWR on another population of Blandings turtles, and have periodically visited the site at weekly or biweekly intervals, and hope to continue to do so thru the rest of the summer. I will make an effort to stop by and introduce myself in person when I am in the area next. In the meantime, if you have any concerns or would like contact me, please do so. Thanks for your consideration.

Sincerely,

Jeffrey W. Lang,
Professor of Biology



- A. (top) View of _____ from NE position looking SW. Two woodlots on _____ which _____ leading into _____ May 2002
- B. (bottom) View of NWP _____ in foreground, filled with cattail stalks, looking SE from NW corner of NWP. Wetlands and creek extend through low-lying area beyond marsh. _____ with vehicle parked (tiny speck on horizon, slightly right of center) is visible in distance. May 2002.



- C. (top) View directly west along south boundary of _____ WMA from position just west of _____. To right, wetlands associated with _____ creek are visible in bottomland, with fields rising to tableland in far distance. To left, the alfalfa field labeled as southwest field on map, is area where three female Blanding's turtles nested in 2002. Photo taken in AM after nesting, 21 June 2002.
- D. (bottom) View from _____, looking NNW across wetlands and creek. Creek meanders visible in distance as changes in vegetation just above figure walking in center of photo. May 2002.



- E. (top) View from _____, looking to NE across wetlands and creek in bottomlands below. Telemetry receiver with antenna is being held by J. Lang while taking readings of turtle positions utilizing radio transmitters affixed to individual turtles. June 2002
- F. (bottom) View from creek _____ looking across wetlands at NWP, just beyond figure in distance. Traps were being carried back to vehicles from sets in NWP by figure on left. Hoop trap with poles used to extend trap visible in foreground. The field on the NW corner of the _____ WMA in the distance, rises above the NWP just in front of the lower tree line. June 2002.



- G. (top) View of BBW at nesting site, completing nest excavation after egg laid on evening of 20 June, at 2300. Sparse alfalfa vegetation evident, with sand and gravel till forming the upper layer of soil.
- H. (bottom) View of BBW nest being screened in rainstorm next morning 0830, 21 June. Stake marked nest and reflector attached to stake allowed nest position to be located in the dark at night. Turtle BBW had moved to creek SW in SW area of WMA at this time.



- I. (top) Another view of BBW nest in alfalfa crop in southwest field, 0900, 21 June 2002, looking westward from position 200m SW of . Creek wetlands and bottomlands visible in distance, as well as area on private land utilized as dairy pasture along stream.
- J. (bottom) View of BBW nest, taken in late August with alfalfa crop mowed at least once subsequent to nesting. Screen covering nest marked with orange flags. August 2002.



K. (left) View of CCI nesting site at 2300, 20 June 2002. Stake located at nest site near completion when turtle found. Alfalfa crop was 12-18" in height in southwest field, south of southern boundary of WMA at time of nesting.



L. (right) View of CCI with radio transmitter and temperature logger clearly visible on right side of turtle carapace. Wet earth on either side of nest excavation is visible, and marks the bottom edges of nest. Nesting nearly completed at 2300, 20 June 2002 when photo taken.



M. (left) View of center portion of NWP from north central position, looking southeastward. Marked turtles ready for release visible in foreground, morning of 29 May 2002.



N. (right) View looking NW across NWP, filled with cattails, water depth 2-4'. Lisa Gelvin-Innvaer in foreground with trapped Blanding's turtle; J. Lang in background, left, checking traps. 14 June 2002.



- O. (left) View of collapsed rectangular (crab) trap, showing trapped turtles, BBW and BBY, recaptured in trap in NWP. Plastic bottle provides float to keep corner of trap emergent, and rubbermaid container used for bait (sardines in oil). Trap set in water so only top edge is emergent. 14 June 2002.
- P. (right) View of CCJ just after removal from trap in NWP. 14 June 2002.



Q. (left) View of BBW showing rear of carapace with radio transmitter (rectangular object next to "B" marking) affixed by epoxy to rear of carapace. Yellow button-like object is temperature data logger, set to record ambient temperature at 1 hr. intervals for a two year period. J. Lang holding turtle, photo taken 14 June 2002.



R. (right) View of Blanding's turtle caught in trap, 14 June 2002. Tom Jessen holding turtle, pointing to plastral pigment pattern. Note authentic field gear reminiscent of eccentric artist-musician garb from era of 1960s and 1970s.



S. (left) View of turtles (BBX, BBV, BBY) measured and outfitted with radio transmitters, ready for release at NWP, in northwest corner of WMA. 29 May 2002.



T. (right) View of rectangular (crab) trap used to trap turtles in NWP and other localities, 14 June 2002. Trap collapses for ease in transport, and opens into rectangle, 36"X18"X12" high, with angled entrances on either side of long axis.