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 2002-03**

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

Investigator: Dr. Jeffrey W. Lang, 2369 Bourne Avenue, St. Paul, MN 55108
cell ph 651 269 5604; jeff_lang@und.nodak.edu

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Introduction

This project is a continuation of 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 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. In this study, I provide important new information to identify these key features. It 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.

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 statewide 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 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.

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
WMA. Upland dry terraces comprising abut 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
(see Figures 5-9).

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.

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 in 2003 are shown in Figure 4; a complete set of diagrams for turtles marked in 2002 were included in the Final Report for 2001-2002. 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 July 2002 through February 2003, I spent a total of 18 days conducting field surveys and fieldwork on this project. I made 7 trips to , and spent an average of 8 hours in the field per trip (8 hrs/day X 8 days=64 hrs. in the field). Driving time was 10 hrs per trip (5 hrs each way from MSP, Nebraska, North Dakota). The dates of my visits to were: 24-25 August; 5-7 September; 14 October; 8-9 November 2002, 7 January, 22-23 February 2003. Additional dates for the spring-early summer period in 2003 were: 12 March, 15 April, 10 May, 16 May, 25 May, 31 May, 6 June, 19-20 June, 27-28 June, and 2 July. On these 10 trips, I spent an average of 6 hrs in the field per visit (10X6=60 hrs). Driving time was 10 hrs per trip from MSP, Nebraska. In total, during the contract period, I drove a minimum of 170 hrs to and from the study site, for a total mileage in excess of 11,050 miles. The total field time was at least 124 hrs on site, tracking turtles and/or setting and checking traps. Telemetry dates are shown in Table 2.

Blanding's Turtles at WMA

2002-2003 Captures

During Julv 2002 to end of June 2003, 11 additional turtles were captured and marked at .Two of these were hand caught in the water in early November. The other nine were caught in traps in May-June 2003. For the total of 30 turtles captured in 2002-03, individual measurements and characteristics are presented in Table 1. The total number of telemetered turtles followed during fall and winter 2002 was 15; ten were adult females, and five were adult males. In spring 2003, an additional 11 turtles were outfitted with radio transmitters, and previously attached transmitters replaced on a number of the initial turtles telemetered. As of July, 2003, 26 turtles are outfitted with radio transmitters. These include 12 adult females, 10 adult males, three subadult females, and one subadult male.

2002-2003 Locations

Trapping was limited to brief periods in the spring and early summer prior to nesting in both years. All of the other information on location and movements was based on data collectled from telemetered turtles. A summary table of the capture locations and subsequent locations for individual turtles is presented in Table 2.

In late summer and early fall, many of the telemetered turtles moved extensive distances downstream along the stream flowing through the WMA. The stream, identified on some maps as the , flows into the Rock River to the WMA, east of the crossing of the Rock River under . Of the twelve turtles telemetered in late summer, nine were located along the Rock River below the WMA and/or along the main channel of the Rock River. The specific localities for the telemetered turtles are listed in Table 2 and are shown for 2002 in Figure 5. All of the turtles found downstream from the WMA in late summer were subsequently located overwintering within WMA by early November (Figure 7). Monitoring the radioed turtles in early November provided additional opportunity to locate unmarked turtles, and two additional turtles were captured, and one previously marked was recaptured. All three of these individuals were outfitted with transmitters for monitoring during the overwintering period.

Turtles were monitored only infrequently during the winter months, but there was little evidence of appreciable movements from mid November thru mid March. On several occasions, marked turtles were observed on the stream bottom in stationary positions at specific sites during the winter. Contrary to expectations, the turtles moved out of the stream within several weeks of becoming active, and were located near the wetland marshes and ponds on the WMA by mid April. Repeated locations during May indicated that turtles were most often on land beneath dry grass and reeds, close to wetlands, but typically not in aquatic situations, with a few exceptions. Most of the trapping captures in 2003 occurred at the known wetland sites where turtles were captured in 2002. In several instances, telemetered turtles were located in marshes not previously recognized as such, and these locations led to new trapping sites in 2003.

2002-2003 Telemetry

To further document seasonal concentrations and habitat usage, a representative group of 15 turtles captured in 2002 were outfitted with radio transmitters to facilitate subsequent location via telemetry. The radioed turtles included 15 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. A summary of the locations of these females and an additional female, BBC, is shown in Figure 6. The overwintering sites for these turtles are shown in Figure 7.

The 15 turtles trapped in 2003 were found in both 2002 and 2003 trapping sites, and included five turtles not previously marked, and four previously marked by T. Jessen in 1995-96. In addition, a number of turtles marked in 2002, but not immediately telemetered were recaptured in 2003, and outfitted with radios. These included several subadults. The capture locations of all of these trapped turtles, including those previously caught in 2002, the "new" captures, and the recaptures are shown in Figure 8. A number of turtles were found in the NE corner of the WMA in a new marsh denoted as "NEE msh" on the map. It lies on the eastern edge of the WMA, and may be outside the eastern refuge boundary, but is contiguous with other wetland marsh habitat adjacent to the stream flowing from the of the WMA (see map location in Figure 8; and photo in Figure 22, bottom).

Telemetry tracking provided additional data on likely nest sites of reproductive female overwintering residents at WMA. As in 2002, all of the nest sites located were on private property. In 2002, three nests were located just south of the south boundary of WMA in an alfalfa field that adjoins the WMA to the SW. In 2003, nest sites were also located on private property. These consisted of a nest site in a corn field to the north of the north boundary, another two nests to the south near a cow tank on the south edge of the SW alfalfa field, and a nest in a soybean field east of the east boundary of the WMA. In addition, a nest site was likely located on the slopes of the Rock River main channel, in the vicinity of the bridge. A map showing these locations is included here as Figure 9.

In addition to the nest sites found outside the WMA, a number of turtles were tracked at considerable distances from the WMA boundaries, particularly along the Rock River tributaries and the main channel. These off-site locations were suspected last season, because a number of turtles "disappearred" in late June, and then reappeared in late summer or fall. In particular, the sites on private property used by turtles extend from 0.5 to 2.0 mi to the east, south, and west of the WMA. As of mid summer 2003, no records of movements to the north of the WMA, with the exception of the nesting foray by CCJ, have been documented. Of interest with respect to these sites is that they include modified aquatic habitats of various kinds, including sections of the main channel of the Rock River, as well as drained and channeled wetlands. Presumably, the turtles using these areas are moving along the stream channels to access these new sites, but some considerable overland movements are also likely involved. For instance, the turtles moving into the main channel of the Rock River are likely moving downstream along the east tributary that flows through , but the turtles using the south cow tank and the southeast wetland are likely moving overland to these sites. In one instance, BBY female was tracked enroute to the south cow tank, from a position along the stream near the main overwintering site at .

Discussion

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. This scenario, based on 2002 data, was strengthened in 2003, with the additional siting of a number of winter residents at various localities to the east, south, and west on private properties, and adjacent wetlands as well as the main channel and other tributaries of the Rock River.

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 disperse further into wetland upstream and/or downstream of the WMA. The most extensive movements in spring 2003 were made by a female, BBP who was located to the SW and S along the Rock River.

Late summer locations as well as fall and winter seasonal habitats were identified during this phase of the study. A majority of turtles resident on the WMA early in the season moved downstream and off the WMA during late summer and early fall. However, these turtles moved back upstream into the WMA, and were located at overwintering sites within the WMA by early November. Most had returned close to their eventual overwintering sites by mid October. The overwintering sites were all located within the stream channel, and were concentrated in two areas, SSW where 10 turtles overwintered, and NNE where 5 turtles overwintered.

Population Parameters

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 3). 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 3).

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. In addition, several turtles known to be reproductive in 2002 were determined to be gravid and/or were observed making nesting movements during 2003. This suggests that at least some of the adult females in this population reproduce annually, rather than less frequently, but further data are needed.

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 30 turtles were captured and marked. Turtles(26) have been outfitted with radios and data loggers, and are 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 weeks 2 &3 of June in adjacent uplands utilized for croplands. All of documented nests are located on private lands, and included farmland cultivated for corn, soybeans, and hay.

(5) Recaptured turtles, including 5 adult females, a subadult female, and 3 adult males, marked in 1995-1996 were relocated in 2002 and 2003 near their original locations.

(6) The number of turtles at is estimated to be about 50 turtles, based on 1995-1996 and 2002-2003 mark-recapture record.

(7) The total number of marked turtles at is 37, if all turtles marked in 1995-1996 and 2002-2003 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. A number of telemetered turtles moved off the WMA by end of June.

(10) Seasonal usage of stream habitats, including the tributary and main channel of the Rock River to the WMA, was documented in the majority of turtles telemetered during August and September. In spring and early summer 2003, additional turtles moved off the WMA into surrounding wetlands, including the river and tributaries. By mid October and early November, all of the turtles located outside the WMA had returned to the wetlands within WMA boundaries.

(11) All of the overwintering turtles were located in similar underwater habitats, primarily deep pools concentrated in two sections of the stream within the WMA.

(12) Overwintering turtles remained stationary during the dormancy period, from November through March. No movements were detected by telemetered turtles.

(13) turtles are 10-15% larger in body size than other turtles, e.g. Weaver Dunes.

(14) Additional life history features unique to turtles, as well as other populations living in SW Mn, may be rapid growth and/or accelerated maturation.

(15) 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, but are not yet documented in these turtles.

Future Studies

Fieldwork to be conducted during the remainder of 2003 will focus on (1) continued tracking of radioed turtles, and (2) additional efforts to trap and capture turtles within the WMA. Capture efforts during 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. **The mid and late summer locations, that make up the remainder of the activity season wetlands have now been determined 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 appears to be extensive, but their prevalence are not yet determined for the majority of turtles. **Similarly, the overwintering wetland habitats required by these turtles have now been determined, and include stream habitats inside 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 have been located outside the WMA.** Habitat requirements of juveniles and subadults are yet to be determined.

Wetland Threats: At , the Blanding's turtles rely on wetland habitats associated with the creek tributary that flows through the WMA upstream of the Rock River. 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 be 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
2002-03

code	age	sex	wt gms	cl mm	pl mm	wd mm	ht mm	gr	gs	annuli	day	capture dt	loc	cap	rcp 02	rcp 03	rad 02	rad 03	nest 02	nest 03	1995-96	
BBK	J	F	381	141	137	94	56	y	y	6	148	28may02	CPE	HT								8
BBCK	SA	F	863	189	186	123	74	y	y	11	148	28may03	CPE	HT		R		27				24
BBJ	SA	F	981	195	192	131	75	y	y	12	148	28may02	CPE	HT			12	21				7
BBX	SA	F	1026	195	190	134	77	y	y	12	149	29may02	NWP	CT	R	R	40	23			TJ2009	12
BBN	SA	M	1199	215	196	137	78	y	y	14	160	9june02	NWP	HT								18
BBCX	SA	M	1507	228	213	141	84	y	y	14	151	31may03	NEE	HT				4R				26
BBCY	A	F	1603	226	215	145	92	y	y	17	151	31may03	NEE	CT				5		nest		27
BBCG	A	F	1748	226	213	146	94	y	y	17+	311	7nov02	CK.NNE	HC			29	25				20
BBCV	A	F	1707	227	222	149	93	n	n	20+	157	6june03	NEE	HT				29			TJ2006	29
BBY	A	F	1575	228	221	140	91	y	y	16+	149	29may02	NWP	CT	R		46	7		nest	TJ2002	10
BBCU	A	F	1844	228	221	146	93	n	n	20+	160	9June03	CPE	HT							TJ2011	30
BBC	A	F	1684	230	220	145	94	n	n	21	143	23may02	NWP	HC	R		16A		nest			1
BBL	A	F	1707	230	218	149	93	y	y	19	149	29may02	CPW	HC			48	8				9
BBW	A	F	1707	230	225	152	91	n	n	20+	149	29may02	NWP	CT	R		4A	2	nest	nest	TJ2003	11
CCI	A	F	1902	232	225	153	94	n	n	20+	148	28may02	CPE	HC			9A	13	nest		TJ2001	5
CCJ	A	F	1843	233	224	145	89	n	n	20+	165	14june02	NWP	CT			12R	12	?n	nest		19
BBCW	A	F	1920	236	223	152	99	y	n	13+	151	31may03	CPW	HT				16R					28
BBP	A	F	1930	236	234	155	97	n	n	20+	153	2june02	NWP	CT	R		50			?n		16
BBQ	A	F	1852	243	224	145	96	y	y	18	153	2june02	NWP	CT	R		40	6				15
BBU	A	M	1326	223	197	141	82	y	y	21	153	2june02	NWP	HT	R			14			TJ2005	14
BBI	A	M	1466	223	199	140	86	y	y	21	148	28may02	NWP	HT			(74)					6
BBV	A	M	1612	231	219	151	90	y	y	17+	149	29may02	NWP	CT		R		13				13
BBCJ	A	M	1725	238	218	151	90	y	y	17	145	25may03	NWP	CT		R		11			TJ2017	23
BBH	A	M	1780	241	232	148	94	n	n	20+	148	28may02	NWP	CT	R		58	10				4
BBCH	A	M	1675	244	212	146	84	y	y	19+	311	7nov02	CK.SW	HC			10					21
BBO	A	M	1934	249	223	148	89	y	y	18+	155	4june02	NWP	CT			24	15				17
BBG	A	M	1870	250	223	158	92	n	n	20+	148	28may02	NWP	CT	R		60	8				3
BBCL	A	M	1944	257	223	163	87	n	n	20+	148	28may03	NWP	HT				6			TJ2010	25
BBCI	A	M	2084	258	235	168	93	n	n	20+	145	25may03	CK.SW	HT				7				22
BBD	A	M	2179	264	235	159	96	n	n	20+	148	28may02	NWP	CT			53					2

Table 1. Summary of individual details for 30 Blanding's turtles collected at WMA in 2002-03. Turtles were marked with an individual code, 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 is included, as well as method of capture (HC=hand capture; HT=hoop trap; CT=crab trap) and whether recaptured (R=recapture during 2002 and 2003). 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; an additional four marked by TJ were found in 2003. A total of nine "new" turtles, not caught in 2002, were found in 2003.

Table 2 removed from document:
contains location information

BT
age-size comparison

no.	code	age	sex	wt gms	cl mm	age	gro	nest	marked
11	2009	J	F		140*	6	+		
8	BBK	J	F	381	141	6	+		
10	2002	SA	F		178*				
24	BBCK	SA	F	863	189	11			
7	BBJ	SA	F	981	195	12	+		
11	BBX	SA	F	1026	195	12	+		2009
14	2005	SA	M		184*				BBU
23	2017	SA	M		203*	11			BBCJ
18	BBN	SA	M	1199	215	14	+		
26	BBCX	SA	M	1507	228	14	+		
29	2006	A	F		222*			nest	
20	BBCG	A	F		226	17+	+		
27	BBCY	A	F	1603	226	17	+	nest?	
29	BBCV	A	F	1707	227	20+	N	nest?	2006
10	BBY	A	F	1575	228	16+	+		2002
30	BBCU	A	F	1844	228	20+	N	nest?	2011
5	2001	A	F		229*	20+			CCI
12	2003	A	F		229*			nest?	BBW
30	2011	A	F		229*				BBCU
1	BBC	A	F	1684	230	21	N	nest	
9	BBL	A	F	1707	230	19	+		
12	BBW	A	F	1707	230	20+	N	nest	2003
5	CCI	A	F	1902	232	20+	N	nest	2001
19	CCJ	A	F	1843	233	20+	N	nest?	
	2012	A	F		235*				
	2014	A	F		235*				
28	BBCW	A	F	1920	236	13+	+		
16	BBP	A	F	1930	236	20+	N		
	2004	A	F		240*			nest	
15	BBQ	A	F	1852	243	18	+		
6	BBI	A	M	1466	223	21	+		
14	BBU	A	M	1326	223	21	+		
13	BBV	A	M	1612	231	17+			
	2007	A	M		235*				
23	BBCJ	A	M	1725	238	17	+		
4	BBH	A	M	1780	241	20+	N		
	2013	A	M		241*				
21	BBCH	A	M	1675	244	19+			
17	BBO	A	M	1934	249	18+	+		
3	BBG	A	M	1870	250	20+	N		
	2008	A	M		254*				
25	BBCL	A	M	1944	257	20+	N		
22	BBCI	A	M	2084	258	20+	N		
2	BBD	A	M	2179	264	20+	N		
25	2010	A	M		264*	25			
	2018	A	M		267*				

*=estimated carapace length

Table 3. Size-age features for 30 Blanding's turtles from WMA, measured in 02-03 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 captured in 2002-03 are tabled with earlier measurements taken in 1995-1996.

BT
capture summary
marked turtles

season	N	juvenile	subadult females	subadult males	adult females	adult males	recap 995	recap 996	recap 2002
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	21	1	2	1	9	8	4	1	
mkd 96+02	32	1	2	1	14	14			
2003	15		3	1	6	5	2	3	5
total marked	37	1	3	2	16	15			

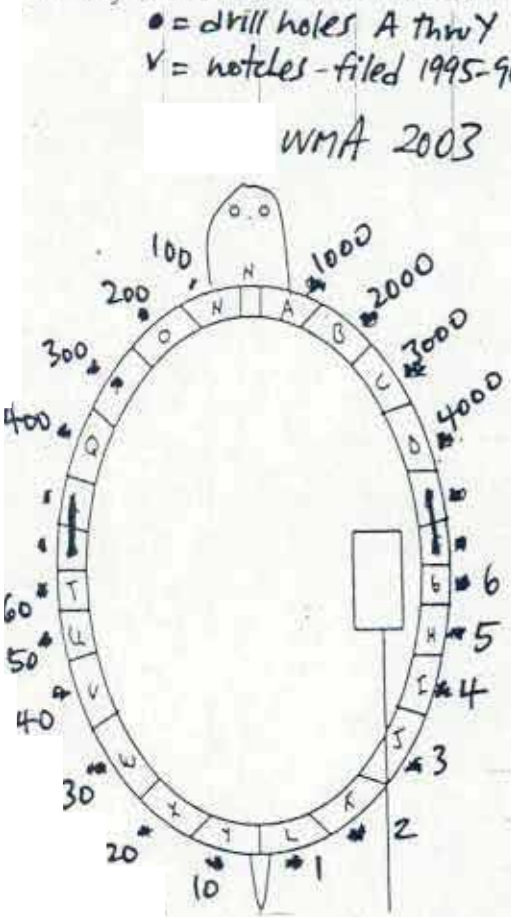
37 =total marked based on 02-03 plus 1995-96 ?extant

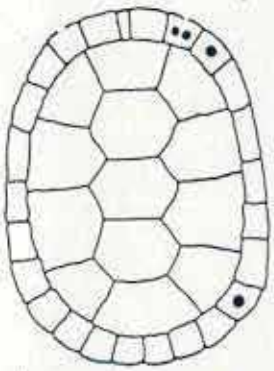
Lincoln Index	Jessen 1/10=7/N	N=70	estimated pop size
	TJ+02 5/21=16/N	N=67 (59-80)	est pop size
	TJ+03 10/15=32/N	N=48 (44-53)	est pop size

Table 4. Summary of Blanding's turtles marked at WMA in 1995-1996 and in 02-03. 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.

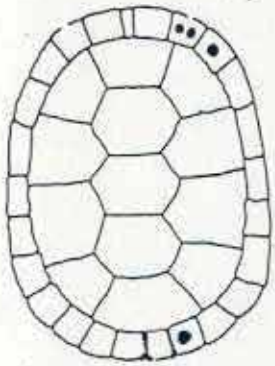
Figures 1-3 removed from document: they contain location information.

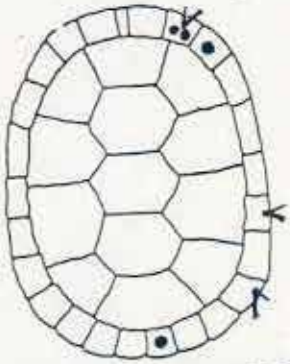
Figure 4. Diagram showing key (left, top) and drill hole patterns used to mark blanding's turt
collected during May-June 2003. Recaptures for 1995-96 are noted; file marks indicated with a
"V". Key for 95-96 file marks conversions to number codes used by T. Jessen noted below.




BBCI ♂


BBCJ ♂ (= 2017)

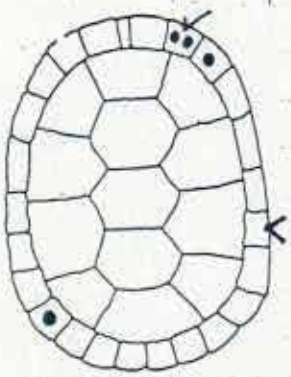

BBCK ♀


BBCL ♂ (= 2010)


BBCX ♂


BBCY ♀


BBCW ♀


BBCV ♀ (= 2006)


BBCU ♀ (= 2011)

Figures 5-10 removed from document: they contain location information.

Figure 11. (top) View of female Blanding's turtle BBC showing general appearance, temporary paint markings, and permanent marginal coding (visible as drill holes in marginals). (bottom) The radio transmitter with antenna and "Tidbit" data logger are affixed to rear of carapace with 5-minute epoxy (Devcon epoxy), and remain attached for 6-15 months.

Figure 12. (top) View of from south parking overlook in late August 2002, showing multiple vehicle tracks across wetlands fringing the stream. Herbicide spraying is conducted annually to eradicate weeds by DNR staff as part of management plan. (bottom) Blanding's turtle, BBI, on land in dairy pasture adjacent to WMA in late August 2002. During late summer and early fall, Blanding's turtles spend increasing amounts of time on land foraging in wet meadows.

Figure 13. (top) View of SW corner of WMA in August 2002, looking NE, showing fence line, stream aspect, and vegetation in WMA (far side of fence) and adjacent pasture (foreground). (bottom) View of stream looking SSW from same location (shown above), across pasture (foreground) and alfalfa field (in distance, beyond fenceline).

Figure 14. (top) View of stream at overwintering site of BBW, BBCH, and CCI. Turtles were located in this pool in early November 2002 and remained at the same locations through late February 2003. This photo was taken 7 Janaury 2003; note partial ice block in pool and lack of snowcover in midwinter).
(bottom) View of next pool downstream from above locality (to the west of pool shown in above photo) where two turtles, CCJ and BBY overwintered in 2002-03. Turtles were positioned underwater in deeper sections of pool, up against the streambank (visible in foreground).

Figure 15. (top) View of elongate pool located 50-100 m. downstream from pools shown in Fig. 7. (bottom) In January, 2003, turtle BBQ was stationary on the bottom substrate, in 1m of water, with carapace lettering visible (center of photo). Note lack of ice and/or snow in region.

Figure 16. (top) View of ice-covered pool in stream , same location as in Fig. 7, overwintering site of BBW, BBCH, and CCI, in late February 2003. In distance (at center; stake and figure), stakes mark other pools downstream that were used by other turtles for overwintering (see Fig. 8).
(bottom) View looking north from east parking overlook, showing wetlands surrounding stream as it enters WMA in . Five telemetered turtles overwintered in this section of the WMA in 2002-03.

Figure 17. (top) View of as it flows through WMA. looking eastward from position immediately downstream of pool where BBW, BBCH, and CCI overwintered (see map location-Fig.7). Area burned in early May 2003 shown within two weeks of burn in mid-May on right; vegetation on streambank, shown on left, not subject to burning. (bottom) View looking westward from the same location shown above. Burned area prepared for tree planting shown in center. Cows graze just beyond SW corner of WMA boundary; plowed and planted cornfield on private property visible in upper left, south of WMA boundary line.

Figure 18. (top) View of on WMA looking NW at pool used by CCJ and BBY for overwintering (below stakes shown visible streamside). Burned area shown on left of stream, and unburned area visible on right bank. In center is tree plot, and beyond is unburned wet meadow north of stream channel.
(bottom) Another view of stream WMA) in vicinity of overwintering sites of marked turtles in 2002-03. Burned and plowed areas visible on left (SW) and unburned areas visible on right (NE); view looking NW toward NWP on distant edge of bottomlands.

Figure 19. (top) Additional views of burned and plowed fields immediately adjacent to overwintering sites in stream used by Blanding's turtles during winter of 02-03. Stakes visible mark sites where individual turtles with radio transmitters were located in stream, and remained from Nov02-Mar03. (top, looking south at BBP/BBC sites; bottom, looking east from same location).

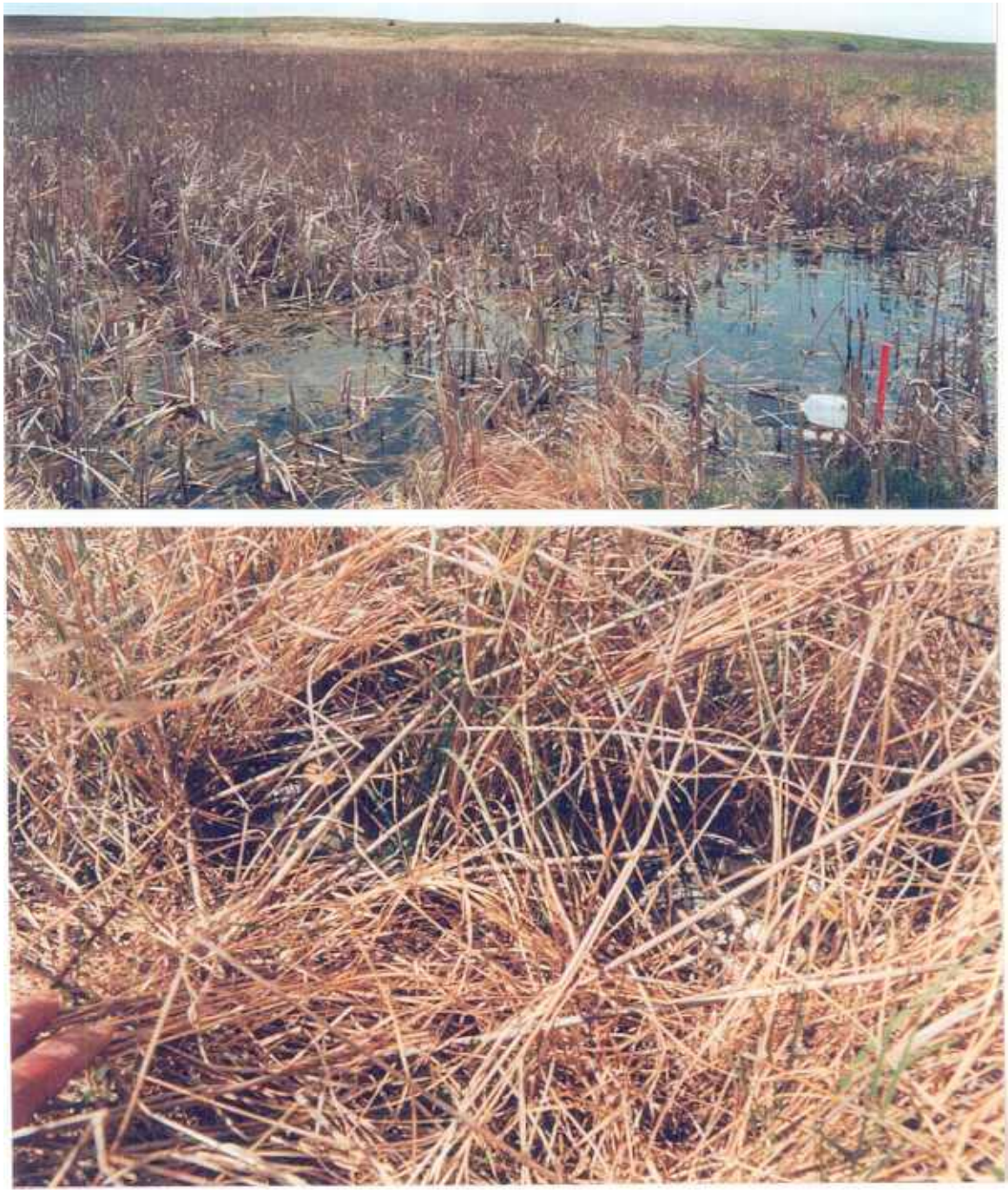


Figure 20. (top) View of CPE, from north shore looking south. Truck is parked (visible as speck on horizon) at . In early May when these photos were taken, turtles usually remained on land during most of the day, and sheltered in dry grass adjacent to the wetlands.
(bottom) Two telemetered turtles are shown nearly invisible in a typical position characteristic of turtles located at WMA during late spring/early summer (May-June).

Figure 21. Another view of dry grass habitats frequented by adult turtles in May-June at WMA. View (left) of site where turtles located (dark patch in foreground) on west corner of wetland. Turtles typically remained motionless at such sites, and were largely invisible to observers (right; turtle in center of photo beneath dry reeds).

Figure 22. (top) View of SW alfalfa field directly south of main overwintering sites along used by turtles on WMA (location shown on overwintering map-Fig.7).
(bottom) View looking north from east overlook parking area, WMA. Northern fence boundary visible in upper left, south of farm buildings. Wetland marsh (labeled as NEE msh on location map-Fig 8) is visible at upper right center. This wetland site may not be within the boundaries of the WMA, but may be on private property to the east.

Figure 23. (top) View of cow tank in SW field, south of south overlook. This modified wetland on private property was used by at least two telemetered turtles during May-June 2003. Two gravid females, BBW and BBY, presumably nested in the vicinity of this wetland where they remained during the nesting period. They remained at this site in late June (location in Fig.10). (bottom) This wetland has been modified to drain by a sump which directs flow from the tank into a concrete discharge, shown on the right of earthen dam, center of photo. Cows were grazing at this site when the turtles were located here. This site is approximately 0.5 mile from the WMA.

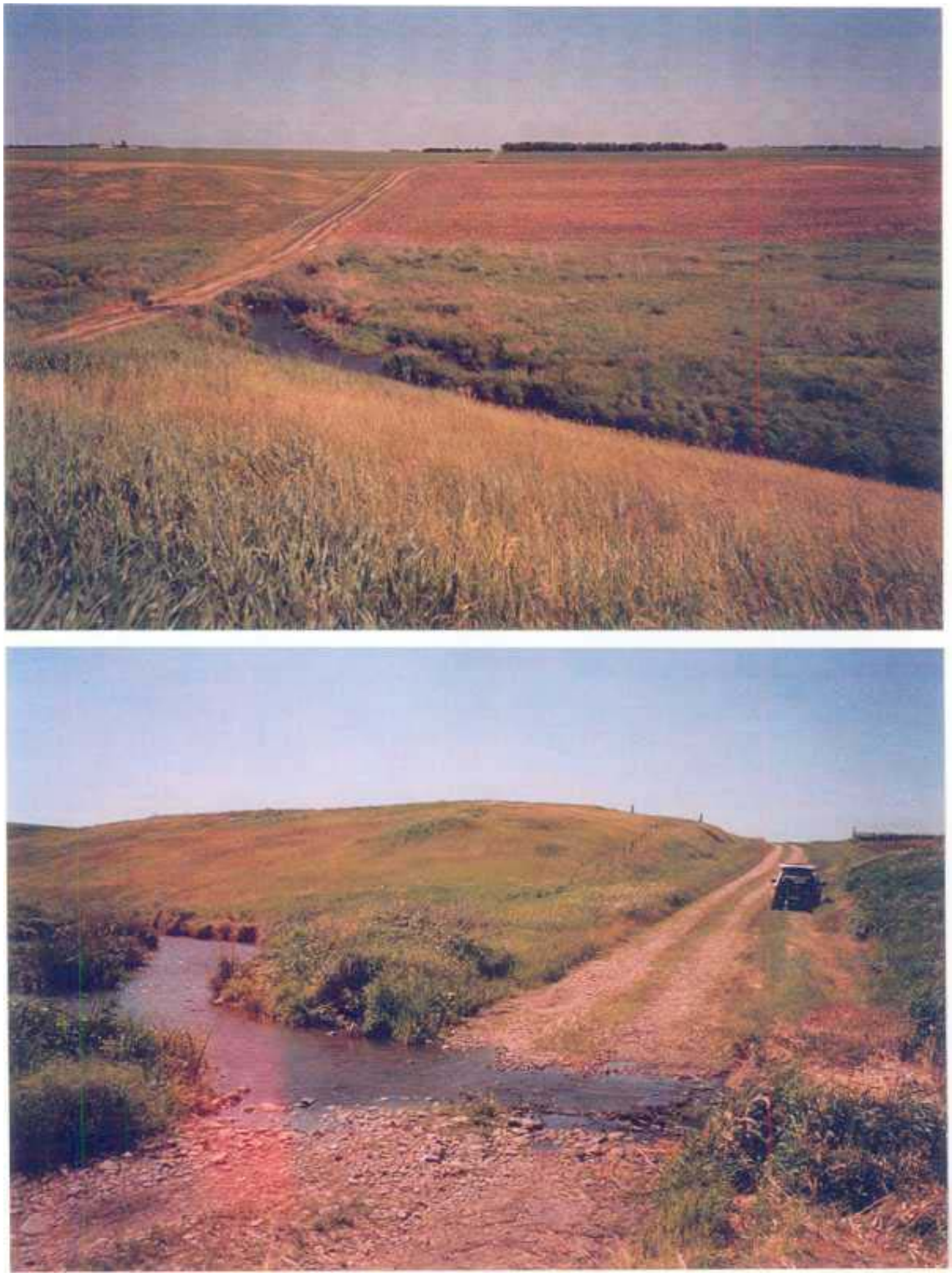


Figure 24. (top) View of south wetland along Streets, looking north; visible at tree line on horizon, at WMA. This is wetland occupied by BBG male in June, shown at location in Figure 10. (bottom) Another view of wetland shown above, looking south down Minimum Maintenance Road that runs along wetland. Water flows from this site into main channel of Rock River, within a mile to the west (shown in Fig 26). This wetland is on private property, and lies approximately 0.5 mi WMA.

Figure 25. (top) View looking north along fence line along : A telemetered adult female, BBP, was observed basking on a piece of concrete in the main channel at this site (shown in bottom photo). Location is directly , and west of wetland shown in Figure 24. It is approximately WMA.

Figure 26. (top) View of Rock River, near site shown in Fig. 25, looking southwest near junction of stream draining south wetland (shown in Fig. 24) . Note dissected streambanks and lack of fringing vegetation along stream.
(bottom) Another view of Rock River, looking north toward area shown above, at bridge directly WMA . Note cattle grazing in distance, and

Figure 27. (top) View of Rock River, directly WMA, . Note overflow pipe draining wetland to east, directly into f river. A telemetered turtle, BBD male, was located just south of the bridge (visible in bottom photo). Turtle was located in channel, visible to left center, in late June, and several days later, was located 200m downstream of this position along the

Figure 28. (top) Gravel mining at site immediately adjacenct to
Telemetered turtles, including three adults, BBW, BBP, and BBCI,
frequented the and streambanks on either side of the bridge on

(bottom) Another gravel operation was active on the west side of of Rock
River; gravel piles are visible in upper left horizon, looking WSW

Figure 29. View of boundary of WMA, looking westward from . toward of WMA. Visible in foreground and on hillside (center) are ATV tracks that crisscrossed southern edge of WMA when visited on 3 June 2003.