Timber Rattlesnake (Crotalus horridus) Survey of Hanover Bluff: Habitat evaluation, Current 2004 Reproductive data including additional Gestating/Birthing sites, and Summary of 14 years of Observations

Brian Jay Bielema
21491 Lake Road
Morrison, Illinois 61270

Introduction

The timber rattlesnake (Crotalus horridus) is an Illinois endangered species whose numbers are declining. The northwestern Illinois Driftless region harbors a few surviving populations. Development and other human activities are causing irreversible habitat losses threatening to eliminate this historic and uniquely American species from this scenic area. The Hanover Bluff complex of state and privately protected lands is providing sanctuary for one of the few viable timber rattlesnake populations remaining. The combined efforts of the Illinois Department of Natural Resources (IDNR), The Nature Conservancy (TNC), Natural Land Institute (NLI), The Prairie Enthusiasts (TPE), and landowners are expanding the available habitat for the seasonal needs of this bluffland species. The lands being added to the Hanover Bluff complex are a mosaic of woodland and open field environments. This expansion, if not contributing directly to vital habitat needs, certainly creates a buffer zone of protection. One of the goals of this study was to survey the newly added parcels for timber rattlesnake habitat.

Included in this report are reproductive data from 2004 and a summary of 14 years of continuous observations on a timber rattlesnake population in the Hanover Bluff Nature Preserve. An exciting 2004 discovery was the use of a newly cleared rock outcrop for gestating/birthing by females known from previous reproductive events. This is important as it indicates that active management can result in habitat enhancement for reproduction. Historic gestating/birthing rocks now shaded over by the forest canopy may be opened and successfully utilized by gravid females.

Materials and Methods

From 1991-2004 a population of timber rattlesnakes (Crotalus horridus) was studied. For 13 of the 14 years of the study, the same gestating/birthing rookery was occupied by gravid females. This rookery and a new 2004 addition provide ideal opportunities to observe aspects of their reproductive lives. Reproductive cycles, lifetime events, young production, behavioral interactions, and ecdysis information were recorded.

In 2004 the Hanover Bluff complex was visited from 15 April through 10 October. A total of 39 trips were made with a total field time of 76.5 hours or about 2 hours per trip. These were spaced at approximately weekly intervals with additional visits as time allowed and activities at the rookery required. They were timed to take advantage of ideal basking conditions. The visits always included rookery observations, and in the period of April through June, and September through October, transient talus and den areas were searched. In all cases, individual snakes encountered were photographed and

their distinctive dorsal pattern characteristics recorded as viewing permitted. Sedentary females at the gestating/birthing rookeries after the June molting period and those seen at birth sites with neonates were presumed to be females (Keenlyne, 1972). No snakes were handled to keep disturbance to a minimum. All individual observations were conducted in a non- intrusive manner.

The Hanover Bluff restoration lands, including the preserve and the adjacent properties listed above, were evaluated for timber rattlesnake habitat by walking through the most promising areas. Some parcels were well known from prior years of research and recreational activities (Kopper Tract, NLI forest).

Results

Site description._ The Hanover Bluff Nature Preserve and the protected adjacent properties are located in Jo Daviess county in northwestern Illinois (N 42 degrees , W 90 degrees). The preserve consists of Mississippi River bluffland with upland forested areas, open hill prairies, and rock outcrops with varying degrees of canopy cover. The preserve contains the open canopy outcrops used by the rattlesnakes for hibernation, transient basking, and reproduction. The closed canopy preserve forest to the north and east provides foraging habitat. This habitat has been expanded by the addition of the NLI, TNC, TPE, and adjacent privately owned parcels. The Kopper Tract, owned and managed as a natural area by the IDNR, is probably at the far edge of the foraging range for the resident population. Wisconsin studies on similar Mississippi River bluff dens gave results indicating that timber rattlesnakes moved a maximum distance of less than 2km from the den (Sajdak, 2001). This would take them into the southern and western upland forests of the Kopper Tract above the Apple River, and into the forested parts of the TNC and NLI Easement properties north of the preserve, which include closed canopy timber, suitable for foraging for this ambush predator. Rock outcrops with open canopy were not found on any of these lands and the presence of a new den or gestating/birthing rookery is doubtful.

The gestating/birthing rookery (referred to as "Maternity rock"), observed for 14 years, is a partially buried slide rock with exposed ledge and crevice. This car sized boulder projects about 2m above the ground at its exposed face. The ledge and associated crevice are easily viewed from above and to the sides and wrap around the boulder at its west, north, and east sides. The south end of the rock is underground. The distance across the exposed face is approximately 5m. It is in an open field on the western side of the bluff and directly below it. The field is approximately 50m from north to south and the same east to west. It is being invaded by woody plants, which are being controlled to keep the canopy open.

Another gestating/birthing rookery was utilized for the first time since the study started. This outcrop consists of several smaller rocks below a large table rock located 15m south of the main rookery (referred to as "15m rocks"). It covers an area approximately 6m long by 6m wide. Suitable basking rocks with small crevices provide habitat for gravid females. In 2003 on 4 dates in May a known gravid female was seen in this outcrop. A large adult male was also seen there with her. The presence of several small trees shaded over this site by June and the snakes were no longer seen there. Later in the year the outcrop was cleared during management activities. In 2004 the rocks were

no longer shaded during the active season. Tangles of vines and some non- woody plants remain and provide cover for the snakes between the rocks.

A birth site was discovered approximately 30m upslope from 15m rocks in a talus run. This site consisted of a small crevice with an over story of forbs and very limited basking surfaces.

A talus area used in the spring and fall is located approximately 100m south of the rookeries in a forest opening at the base of the bluff. The den openings are located higher up on the bluff here.

Historically, the preserve land to the north was known to contain several dens, and many snakes were taken from there. Collectors from as far as Chicago were known to frequent the original den area taking snakes and morels in the spring. Today the canopy is mostly closed there, rendering it less suitable for basking. These historic dens are believed to be no longer in use, as searches in the early years of the study yielded no specimens. Before Hanover Bluff became a preserve, rattlesnake control measures by local residents included the burning of fields bordering the bluff to the north during the active season (personal communication from a former resident).

Rookery ("Maternity rock", "15m rocks") occupation._ In 2004 not only were the same female and male from 2003 seen at 15m rocks, but it was used by several adults throughout the active season. Some of these were known, multiple- event, gravid females having previously used Maternity rock for gestation and parturition. Four known adults (3 females and 1 male) and one new adult female, made trips from one rookery to the other during the course of the season. The area between these rookeries is open grass with forbs and patches of vines. Although no snakes were seen in transit, at least 8 trips were made. Three of the females made round trips accounting for 6 of the 8. Detailed accounts of the individual adults occupying the rookeries and moving from one to the other are as follows:

1. A 4- event female was identified at the original Maternity rock on 29 April. Then she was seen at 15m rocks on 9, 12, 22, and 26 May. She then returned to Maternity rock and was seen on 1, 18, and 28 June. Although expected to be gravid for a 5th time, she was not seen again and her reproductive condition was not determined. Having left just after normal molting time and having used Maternity rock for her other events, she probably was not gravid (see Discussion).
2. A 2-event female was identified at Maternity rock on 29 April and 4 May. She then moved to 15m rocks and was seen there on 12, 22, 26 May and 1, 18 June. She then returned to Maternity rock and was seen on 17 dates from 28 June through 12 September. She gave birth here for her 3rd reproductive event.
3. A 1-event female was identified at 15m rocks on 29 April, 4, 22, 26 May, and 1, 18 June. She then moved to Maternity rock and remained there until parturition. She was seen on 17 dates from 28 June through 12 September. This was her 2nd reproductive event. Her observation dates coincide with the prior female's return, possibly indicating that they both made the trip around or at the same time.
4. A new female was observed at 15m rocks on 29 April and 4 May. She then moved to Maternity rock and was seen there on 9, 12 May. She

then returned to 15m rocks and was seen there on 11 dates from 22 May through 6 September (Photo 2). She was seen with neonates in a postpartum condition making this her first observed reproductive event.

5. A large adult male, known from his presence here in 2003, was identified at 15m rocks on 12, 22 May. He then moved to Maternity rock and was seen on 18, 22, 26 May, and 1 June.

In addition there were sightings at each rookery of other known and new adults as follows:

1. A 1-event female was identified at 15m rocks on 22 May, 8, 12, 16, 30 July, 7, 17, 29 August, and 4, 6 September. This was her 2nd reproductive event.
2. A 2-event female was identified at 15m rocks on 3, 16, 21, 30 July, and 7, 17, 29 August. She was not seen with neonates and probably gives birth away from the rookery. This was her 3rd reproductive event (see Discussion).
3. A new sub adult was seen at Maternity rock on 22 May.
4. A known adult (seen in the transient talus in the spring of 2003) was identified at 15m rocks on 21, 27, 30 July. No determination was made on its reproductive status but it appeared to be a female.
5. A new adult was seen at 15m rocks on 30 July and 29 August. It appeared to be a female. It possessed a 7- segment, tapering rattle.
6. A known adult seen briefly in May of 2002 at Maternity rock was identified on a single date, 30 July, at 15m rocks.
7. A new sub adult was seen at Maternity rock on 1 June.
8. A 1-event adult female, apparently gravid in 2003, was identified on 9 May at Maternity rock. She was obviously postpartum with visible loose skin folds.
9. Two new sub-adults were seen at 15m rocks on 7 and 17 August.

Note._The viewing conditions at 15m rocks were not as good as at Maternity rock. Amorphous piles of 4 or more snakes combined with many crevices and tangles of vines made identifications difficult. The above results do not include the observations of unidentified individuals, which were numerous. As many as 6 individuals (non- neonate) were observed at 15m rocks on several visits.

Reproduction._ Neonates were seen at 3 sites in 2004. Not only did they appear at the two rookeries, but also at a nearby birth site. Maternity rock neonates were seen from 4 September (3) through 18 September (1) with a peak number of 7 on 6 September. All were in pre-molt condition. These represent the efforts of two multiple event females, one having her 3rd and the other her 2nd event. At 15m rocks neonates were seen from 4 September (6) through 12 September (2) with a peak number of 10 on 6 September. All were pre-shed. These represent the efforts of two females, one having her 1st observed event and the other her 2nd. The upslope birth site neonates were seen from 18 September (3) through 26 September (5) with a peak number of 5 on 26 September. A single adult was present. Adding the peak numbers from the 3 sites yields 22 neonates. At least one and possibly more gravid females seen at 15m rocks left prior to parturition.

Cycles of multiple event females._ Three multiple event females had 2- year cycles with their prior efforts in 2002. The fourth had a 3- year cycle being gravid in 2001.

Ecdysis._ One adult molt was seen at Maternity rock and one at 15m rocks on 14 June and one additional molt was seen at Maternity rock on 18 June. They could not be

retrieved to identify the snakes. A number of neonate molts were first seen on 12 September at 15m rocks with additional ones seen on 18 September. The molts from the Maternity rock group and the upslope site neonates were not seen but may have been concealed in the crevices.

Den and talus sightings._ Den openings are high up on the bluff above the rookeries and talus. On 4 and 9 May one adult and a smaller sub adult were seen here. No identifications were made. A talus outcrop, occupied in the spring for pre-molt basking and in the late summer/fall for pre-ingress staging yielded sightings as follows:

1. A small sub adult was seen on 12, 18, and 26 May.
2. An adult (the 15m rocks first event female) was seen on 26 September. She had last been seen with neonates on 6 September at the 15m rocks rookery.

Blue racer (Coluber constrictor) sightings._ Blue racers are commonly seen in the den and talus areas. Sightings in 2004 of several adults were made on 29 April at the den level and talus site and again on 3 October at the talus site. None were seen at the rookeries.

Rain drinking behavior._ On 3 July the 2-event gravid female at Maternity rock was observed on the ledge during a rainstorm drinking raindrops (Photo 1). This has been witnessed in prior years with other gravid females, also. The snake orients its head almost vertically to the surface and draws up the drops from the rock. It also was seen positioning its head to drink drops from the dorsal surface of its body. The sedentary snakes are thus provided with water and do not have to leave the rookery. Dew may also be used but this has not been observed.

Photo 1. Rain drinking

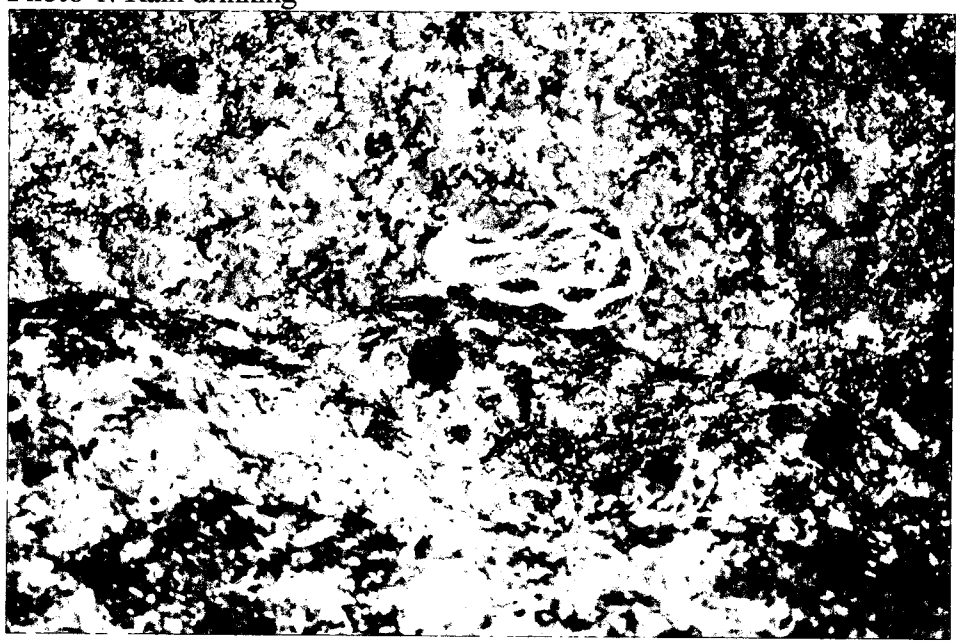

Photo 2. Gravid female at 15m rocks.

Discussion and 14Year Summary

Table 1. Observed Timber Rattlesnake Birthing Rookery Occupation at Maternity Rock (MR), 15m Rocks (15m), and Alternate Birth Sites.

Gravid Female Occupation (N)	Neonate Occupation (N)
1991 12 June- 31 August (2) a. MR	1991 19 August- 31 August (4)
1992 27 May- 23 August (1) MR	1992 31 August- 13 September (9)
1993 17 May- 30 September (3) MR	1993 11 September-12 October (12)
1994 9 May-22 August (1) b. MR	1994 b.
1995 13 May-14 September (7) c. MR	1995 5 September-14 September (1)
1996 21 July-16 September (1) d. MR	1996 15 September-16 September (5)
1997 1 June- 14 September (1) MR	1997 14 September- 23 September (11)
1998 4 May- 23 August (2) MR	1998 23 August- 28 August (8)
1999 e.	1999 e.
2000 4 May- 3 September (5) MR	2000 28 August- 7 September (6)
2001 3 May- 6 September (2) MR	2001 22 August- 16 September (7)
2002 6 May- 4 September (8) MR	2002 21 August- 9 September (20)
2003 17 June-12 September(1) f. MR	2003 14 September (1)
2003 Alternate site not known (1) g.	
2004 29 April- 12 September (2) MR	2004 4 September- 18 September (7)
2004 29 April- 12 September (3) 15m	2004 4 September- 12 September (10)
2004 18 September- 23 September (1) h.	2004 18 September- 26 September (5)
Total 41 events	Total 106 neonates

Notes.

a. The rookery was discovered on 12 June and probably was occupied earlier.

b. This female also moved from the rookery prior to parturition in 1991.

c. Six (6) of the 7 left between 7 August and 5 September. Although only 1 neonate was observed, remnants of 2-3 molts were seen in the crevice on 14 September.

d. The site was not visited after 16 September so the abandonment probably was as much as 10-14 days later.

e. Rookery not occupied this year.

f. A 6 May sighting was not the resident gravid female.

g. A gravid female was identified on 15, 20, 23, and 29 May 2003 in the 15m rocks location before the site was cleared. This female was not seen again until it was at the den on 7 October 2003 in a postpartum condition. In 2004 it was seen at Maternity rock on 9 May after over wintering, still very thin with loose skin folds. It previously had been seen at Maternity rock on 9 July 2000 and 15, 21 May 2002.

h. Birthing site 30m upslope from 15m Rocks. Unidentified female.

Table 1 represents the efforts of 22-23 individuals. The 2004 upslope site female was not identified and may be a known individual previously gravid at the rookery.

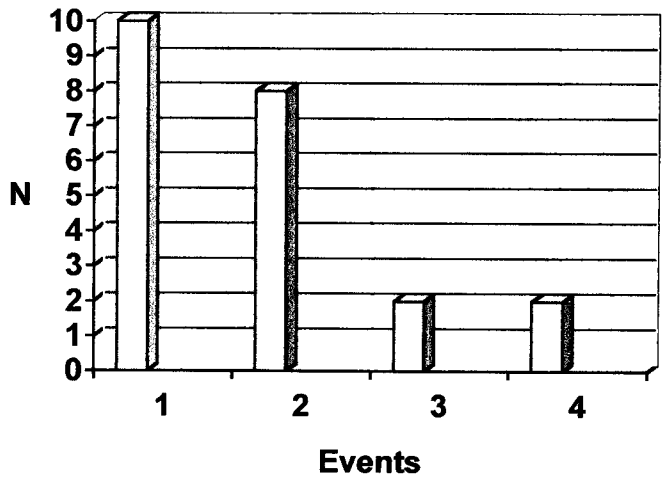

Figure 1. Reproductive Events for 22 Female Timber Rattlesnakes

Note._ For Table 1 and Figure 1, parturition was not verified for all due to rookery departures prior to giving birth. The 2004 upslope female's event was not included in Figure 1 as it could not be identified.

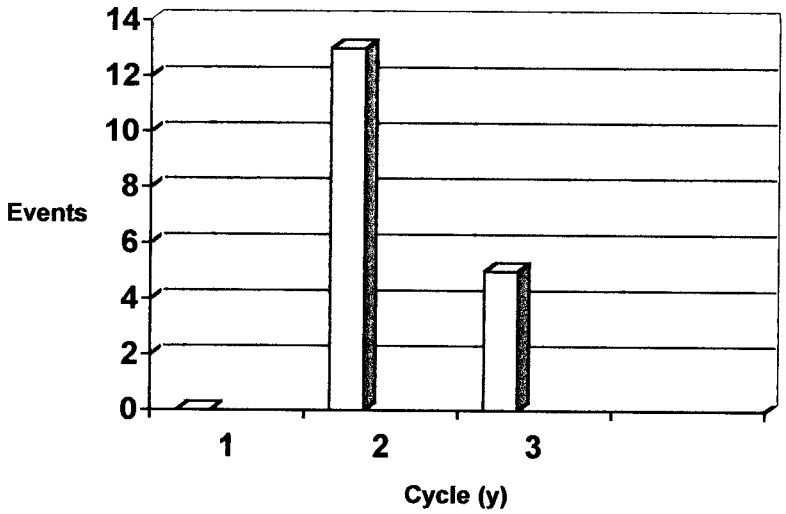

Figure 2. Reproductive Cycles for 18 events

Note._ Figure 2 includes events for 12 multiple event females (Two females each had one 3 and three 2 year cycles).

As shown in Figure 1, approximately 46% of the gravid females had only 1 event, 36% had 2 events, 9% had 3 events, and 9% had 4 events. There were 40 events for 22 females. This yields 1.8 efforts per female. As Brown (1997) stated, these figures are subject to time slice errors. He calculated 1.8 to 2 as average values for lifetime events,

Neonates observed over the 14year study totaled 106. This number is not representative of the total effort by all females observed as many left the rookeries prior to parturition. For some single resident female rookery seasons, accurate numbers of neonates could be determined. One female had 11 young. Two other females had 5 and 9. The 2004 upslope birth site yielded 5 neonates for this female. Multiple female seasons made it difficult to link neonates with mothers at the rookeries. Neonates from 3 selected single female sites were seen for 9, 10, and 14 days. After this period the first molt occurs and most of the newborn snakes leave. In 2004 there were no post-molt neonates seen at the birth sites. In previous years there have been times when pre-molt and post-molt newborn young were seen together.

The importance of the rookery as a social center was demonstrated by a mating event in 2001, and subsequent gravid condition of this female in 2002. Males have been seen at the rookery 26 August- 4 September 1997, 26 July- 15 August 1998, 22 August- 23 August 2001, 20-23 May 2003 (at pre-cleared 15m rocks), 12 May-22May 2004 (15m rocks-same male as 2003), and 18 May-1 June 2004 (Maternity rock-same 2003 male). Different males were seen each year except for the 2003 and 2004 sightings. Males were often in close proximity to the resident gravid females. Frequently they would be resting in contact with them. The males were much larger than any of the resident females both in girth and length. They permitted neonates to crawl over them and paid no mind to them. The male that was seen with the female on 20 and 23 May 2003 just south of the rookery was lying on top of it in a coiled position on the 20th and next to it on the 23rd.This female was apparently gravid, as it was obviously postpartum when sighted at the den on 7 October 2003 and at Maternity rock on 9 May 2004. This male was in close contact with several adult females at 15m rocks and was last seen next to the 4-event matriarch at Maternity rock on 1 June 2004. Non-gravid females commonly use the rookeries for pre-molt basking up until late June. Also many stop there on the return trip for fall ingress. In 2004 there were 4 spring non-gravid females and 5 in late summer. Some of these were smaller snakes probably not yet mature. The rookery as a focal point for male/female contact is another important contribution beyond its value as a gestation/parturition site. This underscores the importance of these open canopy rocks to the viability of a timber rattlesnake population.

In 1999 a gravid female used the quarry rim as a gestation site but did not give birth there. Both this snake and the postpartum 2003 one, described above, have never been identified at the rookery as resident gravid females. The 2003 individual may have used a micro site near 15m rocks for gestation/parturition since it was seen there on two days in May before over-shading took place.

The upslope birth site discovered in 2004 was significant as it was the first time during the 14 years of the study that one was found away from the rookery. Many of the gravid females leave the rookeries to give birth but their parturition sites were never discovered. Although no identification of the female was made, the proximity of the rookeries indicates that it probably was one of the snakes seen there. Several attempts were made to observe the birth site from concealed positions to identify the female. A scope was also employed to remotely view it, but the vegetation and its precarious location resulted in failure.

The structure of the expanded 15m rocks rookery resulted in several observations of groups of 4 or more adults partially covered by vines and resting in spaces between

rocks. On warm, cloudy days aggregations of several adults could be seen on top of open canopy rocks from distances over 25m away. When the snakes were scattered throughout the rookery rocks, identifications were difficult. The single ledge of Maternity rock allows easier identifications, as all present are either on it, in the associated crevice, or on the ground adjacent to it.

The talus rock outcrop, located below the den openings, is used for post-emergence pre-molt basking. It also serves as a pre-ingress staging area in late summer/fall. In 2004 a postpartum female, last seen 20 days earlier at the 15m rocks rookery with neonates, was seen here on 26 September.

The common presence of blue racers (Coluber constrictor) in the den and talus areas may indicate that they hibernate in the same crevices as the rattlesnakes. Although they include snakes in their diet, they have not been observed to prey on the rattlesnakes.

Habitat requirements for the timber rattlesnake include den rock crevices for hibernation, open canopy rocks for spring/fall transient basking, open canopy rookery rocks for gestating/birthing, and closed canopy forest with many fallen logs for foraging. The Hanover Bluff complex provides all of these habitat needs. As stated in the introduction, the newly added lands provide some foraging habitat but certainly are equally as important as buffer zones. The population's range includes the area bounded by Hanover Hill Road to the north, Whitton Road to the west, Crazy Hollow Road to the south and east, and the Apple River to the east. As important as the newly protected areas are to the north, it is of equal or more importance to safeguard the movements south and east. A new quarry has been active south of the preserve, which is a threat from increased truck traffic along Whitton Road and destruction of possible den sites. This quarry site has never been surveyed and may include gestating/birthing rocks as well as hibernacula. Local residents along Crazy Hollow Road have seen rattlesnakes on the road alive and dead. All the private lands south and east of the preserve bounded by Crazy Hollow Road are within the normal foraging summer range. A long- term goal should be to protect the forested area to the east and south of the preserve to create a timber rattlesnake sanctuary of a size that would ensure future viability.

The importance of the open canopy rookery and transient rock habitat to the survival of the colony cannot be overestimated. The loss of this vital habitat could dramatically affect the future of the population. Throughout the northwestern Illinois timber rattlesnake range, the rock outcrops are being hidden by the forest and threatened by development. It is important to the survival of this species that all remaining populations are found and critical habitat protected and managed. Fire certainly must be used as a tool to keep these areas from being lost. The continued active management of the woody plants in the Hanover Bluff rookery field, den, and talus areas is necessary to maintain their suitability. As seen in 2004, rock outcrops may be cleared to provide additional reproductive habitat. This technique may be applied to more of the blufflands to promote the movement of gravid females into historic gestating sites now overgrown. The irreversible decline of the few remaining Driftless area colonies will continue without this active management.

The timber rattlesnake is truly an indicator species of the historically and biologically significant blufflands. These rugged palisades are diminished without the chance encounter of this unique form. Revered by Native Americans as " Grandfather ",

and depicted by early white Americans as a symbol of their independence, the timber rattlesnake deserves to find sanctuary in its remaining haunts.

Acknowledgments

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Timber
rattlesnake
neonates

Multi-event gravid
female Timber
Rattlesnake

Timber
rattlesnake group
at 15m rocks