Timber Rattlesnakes (*Crotalus horridus*) reach the northernmost extent of their range on the bluff prairies in Wisconsin.

Rattlesnakes on the Bluffs: Wisconsin Timber Rattlesnakes

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Photographs by R. Sajdak except where indicated.

The beeping kept getting stronger as I moved in, and inside my boots my toes were beginning to curl. It was my third day of radio tracking Timber Rattlesnakes, and my largest snake, a four foot male later to become famous as the Swamp Fox because of his love for a soggy patch of creek bottom, was almost certainly coiled up somewhere in the tangle of branches of a huge fallen oak tree. Over the ensuing weeks I would grow confident (and occasionally overconfident) in approaching venomous snakes hidden in tangles, but today I was nervous. — Rich Sajdak

Rattlesnakes are an essential bit of Americana, confined solely to the New World. The "*Belled Serpent*" was one of the most distinctive and frightening members of a fauna that confronted the pilgrims after their arrival in Massachusetts. Man and the rattlesnake have always had a checkered relationship — on one hand hated, feared, bountied, on the other, used as a sports logo to adorn baseball caps and once hoisted aloft by colonial militiamen over the motto, "Don't tread on me." Even today, in parts of the Appalachians, handling rattlesnakes as proof of faith is practiced in a few fundamentalist churches. Shamefully, in several parts of the country, rattlesnake roundups still attest to the uglier emotions the snakes elicit.

The Timber Rattlesnake (*Crotalus horridus*) is one of the largest and most widely ranging species of rattler. The Timber Rattlesnake ranged from southern Maine south through the Appalachians, along the coastal plain from Virginia to northern Florida, and westward to east Texas, Oklahoma, Kansas, and extreme southeastern Nebraska. In the Mississippi River Valley, the snake meanders north with the river into Wisconsin and Minnesota, making minor excursions along some of the larger tributaries. In Wisconsin, the Timber Rattler reaches the northernmost edge of its range, just barely below 45° N latitude, perhaps 20 miles north of historical records from Vermont and over a hundred miles farther north than current New York and Vermont populations.

Declining Populations

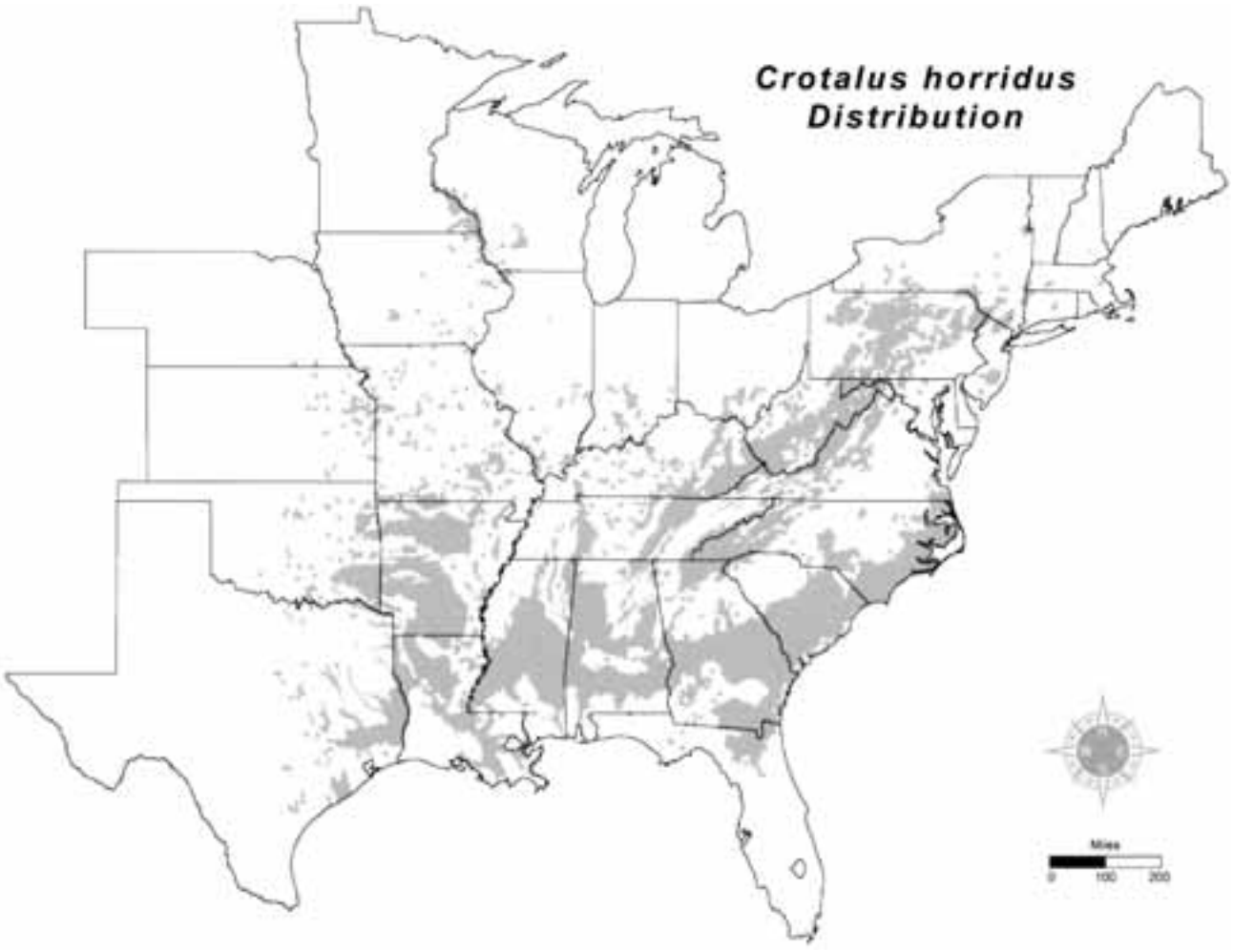
Ever since the arrival of Europeans, humans have been in incessant advance, the Timber in constant retreat. Originally known from 32 states and the province of Ontario, the snake has been extirpated in Delaware, Rhode Island, Maine, and Canada. It remains only in a bare handful of sites in New England. For another example, in Ohio, historical records are known from at least 20 counties, whereas current populations are known from only nine.

Beginning in the 1970s, some effort was made in various states to repeal bounties and enact protective legislation. In Wisconsin, a bounty was paid until 1973. Wisconsin bounty records themselves highlight the rattler's decline. In the county where our study was conducted, the number of bounties paid dropped from approximately 10,000 in 1965 to only 2,000 in 1972. Across the river in one Minnesota county, the number of bounties declined from 4,955 in 1980 to 191 in 1987.

Both of us have played a part in gaining protection for this snake. In 1973, Rich was part of the bounty repeal effort, attending public meetings and contacting people. In 1997, Craig, with David Sorensen from the Milwaukee County Zoo and Gary Casper and Robert Henderson from the Milwaukee Public Museum, petitioned the State of Wisconsin to list the snake as a "Threatened Species." However, politics being politics, listing a venomous snake as "Threatened" was not possible, but "Protected Wild Animal" was. Discretion being the better part of valor, in 1998, the Timber Rattlesnake became a protected species in Wisconsin.

During the 1980s and 90s, one of our rite-of-spring traditions was to drive across the state from Milwaukee one day each year in mid-May, climb the bluffs overlooking the river, and revel in the beauty of the place and the returning warmth and sun after a long winter, and to see if the rattlers were still at home. Like many other rattlesnake admirers, we were aware of

Rich Sajdak searching for a Timber Rattlesnake.



The gray areas indicate the current known distribution of the Timber Rattlesnake (*Crotalus horridus*). The species occurs sparingly along some streams on the Tifton Plateau in south-central Georgia. Also, notice the narrow corridor extending north along the Mississippi River, where prime rattlesnake habitat is associated with prairie habitats on bluffs overlooking the river.

the snakes' decline, and of new roads and new building encroaching and splintering their habitat. Over the years, the visits were slowly transformed into a very low energy effort to study the snakes.

We soon realized from conversations and reading 'the literature' that next to nothing was known about these isolated upper-Mississippi River Valley rattlesnakes. Anecdotal reports, a few surveys, interviews with old bounty hunters, and extrapolation from studies by Bill Brown and Howard Reinert in New York and Pennsylvania were all we had. Bob Hay of the Wisconsin Department of Natural Resources' Bureau of Endangered Resources made it clear that, although he and others in the Bureau were concerned about the Timber Rattlesnake, limited resources and a plate full of more severely threatened species meant that funding for rattlesnake studies would remain on the back burner.

Studying Rattlesnakes

While Rich was Reptile Curator at the Milwaukee County Zoo, he put together a funding proposal to intensively study a rattlesnake population using radiolocation and tagging. The goal was to amass the basic ecological and behavioral data on Wisconsin populations. These would be necessary for the devel-

The largest threats to Timber Rattlesnakes in the upper Midwest are loss of bluff prairie habitat and development. Notice the thick growth of Red Cedar overgrowing prairie on the point. In the last two years, five roads and over one hundred vacation home lots have been cut along the bluff tops within a mile of our study site.

opment of future conservation management plans. Although the project was not funded by the time he left the zoo, Craig took over the curatorial position, and continued to push for the study. In 1998, the Zoological Society of Milwaukee County agreed to fund the project. Craig administered the grant, and Rich became the primary researcher. During the heat of the summer, Rich was free to spend five months a year living in a ratty old trailer, climbing 600-foot bluffs every day, and dodging swarms of mosquitoes, stinging nettles, and thunder storms. During the winter, Craig had the pleasure of treading through snow, tobogganing down hills on his backside, and fending off frostbite. Heaven! Of course, as often as possible, we shared each other's joys.

With Bob Hay's help, we began our study with six snakes, two large males, two gravid females, a juvenile male, and a juvenile female captured along rock ledges in open prairie habitat on high bluffs overlooking the Mississippi River. In Wisconsin, Iowa, Minnesota, and northern Illinois, these bluff prairies are classic rattlesnake habitat, and locations favored by old time bounty hunters. Many residents are surprised to find that the rattlesnakes leave this habitat. Our study site, on an extensive tract of state land, was relatively undisturbed, with huge ravines forested with oak trees and a large area of swamp and marsh habitat along a nearby creek.

As we followed the snakes through the first year, several things soon became apparent. The two gravid females confined themselves to relatively short movements within the prairie, moving between ledges and flat rocks. These open habitats were sunny, hot, and dry, and the females used the heat to maintain body temperatures over 5°C higher than those maintained by male snakes (29.7°C versus 24.4°C). This pattern is well known in gravid snakes and is thought to help embryonic development.

Bob Hay, Armund Bartz, and Craig Berg processing a rattlesnake in the field. The snake is restrained in a clear plastic tube for safety. Length and weight are measured, the snake is sexed, rattles counted and painted, tissue sample taken, PIT-tagged, and released.

Open bluff prairies are classic snake-hunter favorites. These prairies are not only critical as den and birthing locations, but reservoirs of rare prairie plants as well.

A large gravid female regulates her body temperature by adjusting how much of her body is exposed to the sun.

A clutch of neonates lies basking at the edge of the birth rock. The snakes are less than a day old, and have not yet shed.

While the females basked in the prairie, the big males moved off the bluff into the wooded ravines to hunt. One snake stayed in the ravines, while the "Swamp Fox" moved on into the creek bottom. Both snakes preferred cooler, more shaded conditions than the females, and, rather than rocks, they were most often found touching or close to logs.

The juveniles seemed intermediate in habitat preference. They were found in or near the prairie habitat, but in oak openings: areas with more oak trees and more closed canopy. While both males moved a mile or so from their capture location, the juveniles and females moved only about a quarter mile.

As August arrived, the males became more active, and were found courting females or copulating on several occasions. The gravid snakes continued to move from rock to ledge, leaving me to wonder each time whether this, finally, would be the birthing site. At last, on the 30th, one female gave birth, followed by the other two days later, each giving birth to six or eight foot-long babies. After only four or five days, the females had abandoned the neonates and the birth site, moving over the bluff top into the wooded ravine, searching for a meal in the few weeks before hibernation.

In succeeding years, we found that hunting females, unlike gravid ones, behaved like males, moving into wooded ravines or swamps to hunt. One female required two hunting seasons to gain enough weight to reproduce again (a three-year cycle), whereas the other needed four hunting seasons (a five-year cycle). Over the years, we found that females average a three-year reproductive cycle, although we have seen cycles as short as two or as long as five years. In 2004, four of six females in our study appeared to be gravid. One of the gravid snakes had not given birth in five years. This observation suggests that reproductive events may exhibit pulses that reflect variations in weather and food supply.

By early August, all hunting snakes had reached their maximum distances from the den, and had begun a slow trek back. By early September, snakes had begun entering the den. The last to enter were the two post-reproductive females, one entering during the last week of September, and the other in early October.

Since that start in 1999, we have radio-tracked 19 rattlesnakes, tagged over 100, and located seven dens. We found that, like their cousins in the northern reaches of the Appalachians, they have a very short activity period. Our snakes began emerging from dens in late April and May, although we have occasionally seen snakes out as early as 4 April or still in the

One of our radio-equipped rattlesnakes in classic ambush posture. Having picked up the odor of a chipmunk trail along the top of the log, the snake settles in, ready to strike as the rodent passes by. Snakes will maintain this position for days at a time.

A juvenile rattlesnake lying exposed in a rainstorm. Only extreme conditions, such as an unseasonable snowstorm, will make a hunting rattlesnake take cover.

den in mid-June. Rattlesnakes begin entering the dens in September or as late as 19 October. Oddly, Timber Rattlesnakes leave the den weeks later and enter the den weeks before Black Ratsnakes (*Elaphe obsoleta*) and Blue Racers (*Coluber constrictor*) using the same dens. Rattlers moved as much as a mile or mile and a half away from the dens. We found that, on our original study site, an extensive tract of relatively undisturbed state land, the snakes preferred hunting in oak woodland or swamp woodland habitats, and avoided entering agricultural fields or crossing highways. However, in other locations, on private land in areas closer to humans, Timbers utilized fields and even backyards, where they sometimes came to grief.

The snakes grow very slowly, taking at least seven years to reach maturity. In New York, Bill Brown has recaptured Timber Rattlesnakes he originally tagged over twenty years earlier, and believes they can approach a thirty-year life span. Our study is not of that duration, but, based on our recaptures, one of our big snakes like the "Swamp Fox" would have to be at least 15 years old. We suspect that we will eventually confirm a life span of well over 20 years.

In years past, we had often wondered if the denning behavior of Wisconsin snakes would prove to be very different from the rattlesnakes that Bill Brown was studying in up-state New York. The northernmost populations of Timber Rattlesnakes in Wisconsin are probably reproductively isolated from those in New England. One might expect to see differences in snakes that are following separate evolutionary paths. On the other hand, the severe winters in the north are likely to be an extremely important evolutionary constraint. Similar environmental challenges are likely to yield similar results. As we learned, the denning behavior of Wisconsin snakes is almost identical to those in New York.

Table. Comparison of denning behavior in Wisconsin and New York Timber Rattlesnakes.

	Wisconsin	**New York***
Earliest Emergence	6 April	8 April
General Emergence	7–21 May	7–21 May
General Ingress	14 September – 1 October	14 September – 1 October
Latest Ingress	19 October	16 October
Mean Body Temperature	10.8°C (51.4°F)(6 dens/1yr)	10.5°C (50.9°F)(1 den/3 yrs)

*From Brown (1992)

Due to its slope and exposure to the winter sun, this den is mostly free of snow even in February.

Implanting a transmitter into one of our anesthetized females at the University of Wisconsin Veterinary Hospital.

Although we do not know what the inside of a Timber Rattlesnake den looks like, a recent observation does lead to interesting speculation. Might Timber Rattlesnakes hibernate in pools of water found in the rocky recesses of their dens? During this past winter (2004–2005), we had to bring two large males into the lab. During the month of November, when they would normally be moving deeper into their dens, both animals spent a considerable amount of effort trying to push their way through the bottoms of their drinking bowls. This behavior had not been seen in two previous months of captivity. Could they have been trying to hibernate underwater?

Several tantalizing clues suggest that this might be the case. In the Pine Barrens of New Jersey, Timber Rattlesnakes do hibernate underwater. Also, Timber Rattlesnakes frequently emerge from hibernation bearing fungal sores similar to those found on Fox Snakes (*Elaphe vulpina*), another species known to hibernate underwater.

Rattlers and Local Residents

One of our biggest surprises and unexpected rewards came not from the snakes, but from local residents. We had initially planned to keep as low a profile as possible, to avoid stirring up trouble. We had visions of some of the angry opponents we remembered from the bounty repeal and rattlesnake protection meetings deciding that a visit to the study site would end this nonsense. The problem, of course, was that our effort to keep the work secret was impossible. Also, if people don't know what's going on, they will imagine the worst — and the fact that the "usual suspect " drove a vehicle sporting New York license plates didn't help! Within a month, we heard of rumors that snakes were being moved and introduced onto private lands. The vow of silence was broken. Casual discussions revealed that, while people didn't exactly *LIKE* the snakes, they had a great deal of curiosity about them.

Additionally, we had cut ourselves off from a lot of information and help. We met several snake hunters from the bounty days, who told us about other dens and things they had seen. Likewise, they were surprised by many of the things we were discovering. Most of their work was done at the dens or nearby ledges and rocks. Rattlesnakes hunting in the woods are so scattered and so well camouflaged that these hunters, despite years of experience, knew almost nothing about the biggest parts of a rattlesnake's life. One man first said that the project was a waste of time because "lots of Timbers" were still around. A week later, he mentioned that he had been talking with some friends, and

A controlled burn: Without periodic burns and selective cutting, most bluff prairies would become overgrown with Red Cedar and Buckthorn, eliminating rare prairie plants and degrading rattlesnake habitat.

ARMUND BARTZ

Several of our radio-equipped snakes made forays into bushes and trees. Here, "Kirk's snake" courts a pre-shed female. His head lies on top of hers.

that, while a lot of snakes were still around, many places where they used to find snakes don't have them anymore.

Kirk soon became a friend. He showed us new locations, and joined us in tracking Timbers in the swamps and woods. In 2000, we put a transmitter into a rattlesnake that spent weeks at a time in junk piles right behind his barn. The snake became "Kirk's snake," and the rattlesnakes gained an advocate. Other locals would call Kirk or us if they found a snake, so we could remove it.

We have come to believe that for any conservation effort to succeed, especially those involving feared and despised species, the education and support of local residents is an essential component. Just last year, we heard about a school bus full of kids that came upon a Timber Rattlesnake crossing the road, a sure recipe for a dead snake in past years. The kids and driver got out to see if it was one of our study snakes, which have painted rattles. They let it crawl off to bask another day. Now that's success!

Acknowledgments

Funding for the study was provided by the Zoological Society of Milwaukee County and the Milwaukee County Zoo. Robert Hay and the Bureau of Endangered Resources, Wisconsin Department of Natural Resources gave invaluable support. John Sealy and W. H. Martin provided the distribution map. Bob Hay, John Kivikoski, Armund Bartz, and many others contributed gallons of sweat and many days in the field. Lester Flick provided hard-won experience. Kirk Holliday gave us his time, sweat, good will, and home. Rich's wife, Linn, was long-suffering and always supportive.

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