

[DRAFT v. 10]

**Trillium, as an indicator of deer density
Hanover Biodiversity Committee
October, 2017**

Rationale for this Report

Members of the lily family, such as *Trillium* and *Clintonia*, are among the favored foods of deer; 30 species of Trillium are found East of the Mississippi. The decline of these plants is mentioned in multiple publications¹ as one key indicator of deer over-abundance. Red Trillium (*Trillium erectum*), also called 'wake Robin', found in the north-east and is (or was) fairly common in many Hanover forested neighborhoods.

We suggest that monitoring this plant where it is (or once was) common demonstrates that deer density remains unsustainably high and future monitoring of the plant can help determine both the neighborhood density of deer and also serve as an indicator of change in deer density. Monitoring for this plant is easy, with just a small bit of training about the process.

This report suggests a serious decline in biodiversity in Hanover over the past 15 years, as indicated by impact on red Trillium at three sites. We believe that with a *focused* increase in hunting pressure, this and other declining native plants might recover. Red Trillium is a frequent member of typical 'rich mesic forests'² plant communities found in Hanover; other plants often found nearby are Virginia waterleaf, blood root, wild ginger, foam flower, blue cohosh, and certain other members of the lily family. Besides aggressive deer browse, these communities are also threatened in varying degrees by invasive plants: garlic mustard, Dame's rocket, wild parsnip, wild chervil and forget-me-not as well as the usual woody invaders. Of course disturbance such as early seasonal mowing, brush removal or forest fragmentation such as that caused by construction or certain logging practices can also contribute to declines of these plants.

Biology of Trillium³

- Member of the lily family: The plant is clonal, and can form large colonies with interconnected segmented rhizomes. Plants emerge from the newest segment at end of a rhizome.
- Habitat: Found in moist (mesic) Eastern hardwood forests, especially those with beech and maple trees. The plant tolerates many types of habitats.
- Typical appearance of mature plant: With an unbranched single stem, red Trillium is topped by a single 3-lobed leaf, just below a solitary maroon/red flower that has its own thin stalk (called a pedicel). The leaf can reach a width of 7" and blossoms a width of 2.5".
- Life cycle: After germination and root formation, the plant emerges in its second year with a single leaf-lobe, called a cotyledon; mature plants reach full height of 8" to 16". The plant finally blooms at an average age of 15 years; a healthy colony can persist for more than 30 years. A colony adds new plants from division of its rhizomes.
- Flowering: The plant's flower may droop down between the leaf lobes (see photo below). Factors that enable the plant to bloom is related to leaf area, root rhizome volume and density of mature colony. The expected blossom rate for a mature colony that has little deer pressure is about 50% of stems. For our NE version of red Trillium, population success requires pollination of at least 35% of plants⁴.
- Seed distribution: Ants are attracted to the seed's nutritious eliasomes, an oil-rich fleshy appendage. Dispersal by ants results in short-distance dispersal of up to 20 inches, and will establish new colonies. Chipmunks or other small mammals help distribute seeds. Thus, assuming seed set, the plant spreads slowly, by root division to enlarge a colony or by seed dispersal.
- Plant pollination: Carrion-eating flies are attracted by the plant's strong odor, described as the 'wet dog' smell. This smell gives the plant its nickname, "Stinking Benjamin". Plants do not self-pollinate; pollination success is helped by having other Trillium stalks and colonies nearby.

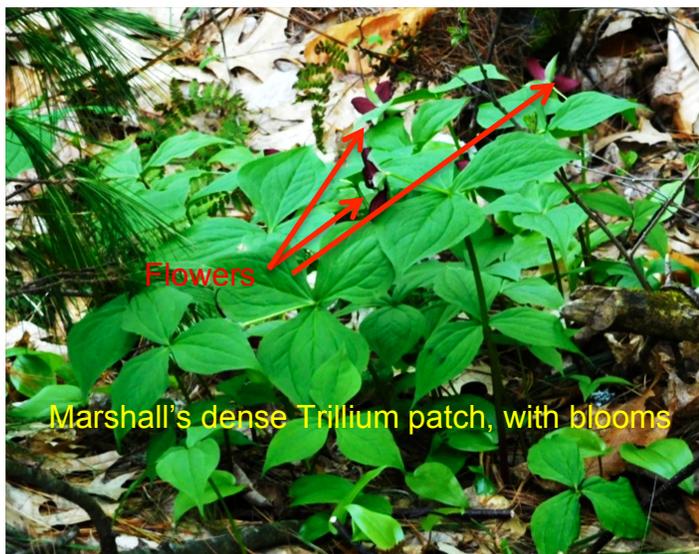
- Effects of deer on the plant: Deer tend to browse the tallest stalks, and seem to prefer flowering stalks; often, all that is left of the plant is a sap-oozing stalk. This treatment may kill the plant, depending on time of year and frequency of defoliation. The following year, surviving defoliated plants will have a shorter stalk and less leaf area in the years after defoliation, and may not bloom again for seven (or more) years. Eventually the colony will not set seed at all with persistent browse, since there are no flowers nearby for successful pollination. Picking the flowers of this plant is illegal in NY, OR, MI and MN.
- Key leaf attributes: A Trillium plant can easily be confused with Jack-in-the-Pulpit when not in flower, since both have a single stalk topped by a 3-lobed leaf. Trillium differs in that it has *three longitudinal veins* (see photo below); the Jack only has one such vein.

Trillium Observations in Hanover: 2017

General observations: It is clear that the areas studied have had Trillium colonies for some time. One of these areas (Tanzi) is located in-town and the others (Hayes and Hayfield) are well outside the town center. In all three cases, blossoms were found *only* in cramped places where deer were unable to browse: stone walls, fallen logs, branches from adjacent shrubs (barberry, honeysuckle). For the most part, for all three locations most plants were very small, with most well under 5"; many were only 2" tall. Given severe deer browse, we can assume that few of the plants are juvenile.

ONE: Hayes

Marshall's property: On May 13, four volunteers from the Hayes Stewardship Committee found two dense colonies adjacent to the Hayes property on Elizabeth and Matt Marshall's land, each colony with about 50 plant stems: one without blossoms but moderately tall stalks (about 6" or so), and the other with 22 blossoms (a bloom rate of ~ 44%), and almost all blooming stalks were taller than 8". We could use these two colonies as examples for healthy populations, since one was flowering at a heavy rate and both had tall stalks greater than 5". The second colony probably was heavily browsed at some point, since it was in a more open area and there were no blossoms;



since these stalks were tall, perhaps there has not been much repeated browse pressure, or the plants were not browsed early in season.

NOTE: Sadly, the colony with blossoms had been browsed by late June. Only 4 shorter stalks had leaves, and many stems were oozing sap; deer had finally discovered them and ignored barriers. It will be interesting to see if there are blooms in 2018.

Stone-wall area: We located 21 small colonies along the stone wall near fork to black ash swamp.

Counts: Two areas: One with 6 small colonies had 16 stems with 5 blooms. The second area had 15 colonies and 68 stems with 5 blooms.

Totals: 84 stems. 10 blossoms. Bloom rate: 12%

We did not measure height of tallest plant in each colony.

Problems: aggressive rhizomatous grasses (not herbaceous plants) are threatening the colony survival. A continued threat comes from Japanese barberry that has re-sprouted despite brush control measures with flame torch.

NOTE: Until the town purchased the property in 2010, it was regularly hunted, so this date may determine the start of Trillium decline at Hayes. Since then, there has been a serious push against invasive plants; this would encourage Trillium blossoms, if deer were not so numerous.

TWO: Tanzi

On June 1, a circle with a radius 20' was set up in an area with a good number of Trillium colonies nearby and several other members of the lily family: blue-bead lily (*Clintonia borealis*), Indian cucumber root (*Medeola virginiana*), wild oats (also called sessil-leaved bellwort, *Uvularia sessilifolia*), Canada mayflower (*Maianthemum canadense*), false Solomon's seal (*Maianthemum racemosum* ssp. *racemosum*). The circle of roughly 1200 sf, was divided into 12 pie-shaped areas, with counts of Trillium plants, with a note of Canada mayflowers or other lily plant in the sector.

Tally: 32 Trillium plants, one blossom, and tallest plant was 9" (with blossom), for a bloom rate of 3%. Most Trillium plants were less than 4" tall. The Trillium colonies were small and feeble. One of the non-flowering stalks in the study area did bloom in 2016, but was defoliated by the end of May.

NOTE: Near the Trillium study area is a cage with a protected *Clintonia* colony, that started as four pairs of leaves in 2015, it has 20 pairs of leaves in 2017. Another cage has protected a cluster of Trillium plants. These cages have been in place since 2015; in both cages the plants are now taller than their neighbors outside the cages, but none have blossomed yet.

THREE: Hayfield Lane neighborhood

On May 18, five neighbors (2 adult, 3 children) counted the Trillium found adjacent to stone walls in the SE corner of the common hayfield; length of area with Trillium is approximately 120 yards, with depth 20'. We believe that within the past ten years the number of blossoms in these colonies has been in steep decline, but we have no historical record (photo or otherwise) of this; just a memory of masses of the plant in bloom within past 10 years. Again, the tallest plants found this year had flowers, and were found in spaces where deer would have difficult access, for example under a large honeysuckle shrub.

Tally: There were 18 colonies, a total of 457 plant stalks, and 18 flowers for a bloom rate of ~ 4%. The tallest plant was 12" tall; the average height of the 18 tallest plants is 7.4".

A Possible Protocol for Monitoring Deer Browse in Other Areas:

Choose an area with evidence of Trillium and other related plants. If there are several obvious colonies choose several within about 1000 sf of each other. Flag each colony and record the count of stems, the number of blossoms, and note height of tallest stem-to-leaf in each colony. Since height is a good indicator for likely blossoms, it might be good to record how many taller plants are occurring, and if height of tallest changes from year to year.

Observations⁵ of Trillium within a deer enclosure compared with those in an unfenced area, shows rapid recovery, with increased blossoms and height occurring after 4-8 years of enclosure. In a recent study of the impact of controlled hunting, Royo⁶ records the recovery of key species, including Trillium, after 4 years of focused hunting in the 117 sq mi Kinzua Quality Deer Cooperative (KQDC) adaptive management demonstration area in western PA, owned by public and private cooperators. During this period an extra 6750 tags were issued.

Recommendations

Several researchers⁷ have suggested the use of *Trillium* or *Clintonia* as indicators of deer impact. We suggest that Hanover establish neighborhood benchmarks for Trillium monitoring, so that we can detect changes in browse intensity. This would require cooperation of individuals who live nearby, and may encourage neighbors to support controlled hunting nearby.

The USGS document⁸ suggests that for Trillium colony survival: "*Based on these results, a height-to-leaf threshold that translates into approximately 33% of the plants in bloom, might be used as an initial target for when to begin or cease culling of deer as a means of protecting red trillium populations*".

Based on our small informal survey, Hanover has a long way to go in deer herd reduction to reach this level of blooms in our red Trillium population.

¹ Key background sources for this report:

- Rawinski, Tom 2014 [White-tailed Deer in Northeastern Forests: Understanding and Assessing Impacts](http://www.na.fs.fed.us/pubs/2014/NA-IN-02-14_WhitetailedDeerNEForestsWEB.pdf)
URL: http://www.na.fs.fed.us/pubs/2014/NA-IN-02-14_WhitetailedDeerNEForestsWEB.pdf
- [VT report to Legislature on deer damage \(2012\)](#) Appendix A of this report has an excellent chart of plants susceptible to deer browse and associated increasing levels of damage, from minor to extreme. URL <http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111619>
- Anderson, R.C. 1994. *Height of white-flowered trillium (Trillium grandiflorum) as an index of deer browsing intensity*. Ecological Applications 4:104-109
- Balgooyen, CP and Waller, DM. 1995. *The use of Clintonia borealis and other indicators to gauge impacts of white-tailed deer on plant communities in northern Wisconsin, USA*. Natural Areas Journal 15(4): 308-318
- Augustine, DJ and Frelich, LE. 1998. *Effects of whitetail deer on populations of an understory forb in fragmented deciduous forests*. Conservation Biology 12(5): 995-1004
- Hanzawa, FM and Kalisz, S. 1993. *The Relationship between Age, Size, and Reproduction in Trillium grandiflorum (Liliaceae)*, American Journal of Botany, Vol. 80, No. 4 pp. 405-410
- Jules, ES. 1998. *Habitat Fragmentation and Demographic Change for a Common Plant: Trillium in Old-Growth Forest*. Ecology, Vol. 79, No. 5 pp. 1645-1656
- Kawano S, Ohara, M and Utech, FH. 1986. *Life history studies on the genus Trillium (Liliaceae), II. Reproductive biology and survivorship of four eastern North American species*. Plant Species Biology, v. 1, p. 47–58. This reference is the source for survival threshold of 35 percent flowering for *Trillium erectum*.
- Kirschbaum, CD and Anacker, BL. 2005. *The utility of Trillium and Maianthemum as phyto-indicators of deer impact in northwestern Pennsylvania, USA*. Forest Ecology and Management 217:54-66
- Knight, TM, 2004, *The effects of herbivory and pollen limitation on a declining population of Trillium grandiflorum*: Ecological Applications, v. 14, p. 915–928.
- Knight, TM, 2007 *Population-Level Consequences of Herbivory Timing in Trillium grandiflorum*. American Midland Naturalist, Vol. 157, No. 1, pp. 27-38
- Koh S, Bazely DR, Tanentzap AJ, Voigt DR, Da Silva E, 2010. *Trillium grandiflorum height is an indicator of white-tailed deer density at local and regional scales*. Forest Ecology and Management 259 pp 1472–1479
NOTE: quote in the abstract for this study: “In 16 additional sites with locally high deer populations, the mean maximum height of *T. grandiflorum* appeared to be a more reliable indicator of deer density than estimates based on hunter returns across the broader regional scale of the Wildlife Management Unit.”
- Rooney, TP and Waller, DM. 2001 *How Experimental Defoliation and Leaf Height Affect Growth and Reproduction in Trillium grandiflorum*. Journal of the Torrey Botanical Society, Vol. 128, No. 4, pp. 393-399
- Royo AA, Stout SL, deCalesta, D, and Pierson, TG. 2010. *Restoring forest herb communities through landscape-level deer herd reductions—Is recovery limited by legacy effects?* Biological Conservation 143, p. 2425–2434
- Webster, CR, Jenkins, MA and Rock, JH. 2005. *Long-term response of spring flora to chronic herbivory and deer exclusion in Great Smoky Mountains National Park, USA*. Biological Conservation 125: 297-307.

² Sperduto D, Kimball B. 2011. *The Nature of New Hampshire: Natural Communities of the Granite State*, pp 133-139. University of New Hampshire Press.

³ Sources same as footnote #1

⁴ Pavlovic NB, Leicht-Young SA, and Grundel R, 2014. *Impacts of White-Tailed Deer on Red Trillium (Trillium recurvatum): Defining a Threshold for Deer Browsing Pressure at the Indiana Dunes National Lakeshore*. A USGS publication.

⁵ Pavlovic et al (2014), pages 29-34. From conclusion: ‘Flowering ranged from 1 to 27 percent outside the enclosure and 11 to 46 percent inside the enclosure’.

⁶ Royo AA, Stout SL, deCalesta, D, and Pierson, TG. 2010. *Restoring forest herb communities through landscape-level deer herd reductions—Is recovery limited by legacy effects?* Biological Conservation 143, p. 2425–2434

⁷ Kirschbaum and Anacker (2005), Koh et al (2010)

⁸ Pavlovic NB, Leicht-Young SA, and Grundel R, (2014) – conclusions pages 34-35