

Petition to DOWNLIST from endangered to threatened *Torreya taxifolia* • Florida Torreya

9 September 2018 • by Connie Barlow

JUSTIFICATIONS FOR DOWNLISTING are drawn from **15 years of accomplishments by citizen volunteers associating with Torreya Guardians**. The accomplishments serving as justifications are described and linked to references in five topical sections, as listed below.

TORREYA GUARDIANS is a self-organized group of naturalists, botanists, ecologists, and others with a deep concern for biodiversity protection, who have chosen to use the internet as a tool for discussing ideas, posting plans, and taking a variety of actions in behalf of our most endangered conifer tree: *Torreya taxifolia*. There are no by-laws, officers, board, staff, overhead costs, dues, formal organizational structure, or physical location to this organization.

CONNIE BARLOW founded Torreya Guardians in 2004 as an action-outcome of her 2004 paper published in *Wild Earth*, "Bring Torreya taxifolia North Now," with Paul S. Martin, coauthor. Because geographic translocation was not an action sanctioned by the official recovery plan of 1986, and because an "exception" for plants is in the statute, which enables citizen access to and management of seeds or seedlings generated by horticultural plantings, Barlow began recruiting volunteers with skills, knowledge, networks, and especially northward forested lands to begin the various steps leading toward translocation. In this petition, Connie Barlow speaks for herself alone. Other Torreya Guardians and landowners planting seeds donated by us will have their own views about the role the federal government and authorized institutions ought to play in bringing this subcanopy native tree into full recovery. Barlow, a retired science writer specializing in evolutionary ecology, published 4 books during her career, several peer-reviewed papers and book chapters, and a plethora of archived correspondence, information, documentation, and advocacy on the Torreya Guardians website, which she initiated and is still in charge of: <http://www.torreyaguardsians.org/> Her academic writings are accessible through Researchgate: https://www.researchgate.net/profile/Connie_Barlow/research

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OVERVIEW OF ACTIONS BY TORREYA GUARDIANS

Since 2005, Torreya Guardians has been planting this **climate-endangered "glacial relict"** northward. We do so **experimentally** in a wide range of habitats as well as latitudes. See, for example, linked lists of our plantings in **North Carolina**, **Tennessee**, and **Ohio**, locales proven to be conducive not only to Torreya's growth and maturation (unimpeded by serious disease setbacks) but that also easily produce seeds in natural outdoor settings.

We also experiment with plantings as far north as **Michigan** and **New Hampshire** and have documented an **historic planting of mature trees in Pennsylvania**. These northern-most states are testing the limits of Torreya's cold-hardiness in today's climate, while safeguarding opportunities for the tree to flourish at those latitudes in the later decades of this rapidly warming century.

We **document our results** openly (failures as well as successes) via our **website**. These results contribute to our own **learnings** and our honing of **best practices**. By featuring **photos and videos** of our projects, we hope that **academics**, horticulturalists, and seasoned naturalists anywhere in the world will engage in offering their own interpretations and advice, without having to personally visit the sites.

We have prioritized documentation of **the mature groves** planted in horticultural settings before the species was listed in 1984, as these plantings offer **ready-made, long-term experiments** for ascertaining the tree's ability to thrive — and reproduce — hundreds of miles north of where Torreya became stranded in Florida at the end of the Pleistocene glaciations. Botanists recognized Torreya as having been **stranded in a glacial refugium** as early as **1905**.

Our efforts have been recognized in the media, in book chapters, and in academic journals. In fact, we have been so successful in our efforts to assist the migration northward of this **climate-endangered "glacial relict" tree** that in December 2017 an **editorial** in one of the top science journals stated,

"... A common prediction for how plants will respond to climate change is that it is humans who got them into this mess and so it is humans who will have to get them out of it. That's why the idea of assisted migration of species, although often illustrated with the proposal to shift polar bears to the Antarctic, crops up more frequently in conversations about how to preserve iconic trees. Indeed, **in one of the only real-world examples of assisted migration so far, campaigners have planted the seeds of the critically endangered conifer *Torreya taxifolia* hundreds of miles north of its Florida home...**" — *Nature* 552, 5-6 (2017)

THE PROBLEM CAUSED BY ENDANGERED LISTING

Staff with the Fish and Wildlife Service have not been an impediment to our citizen initiative.

Indeed, the agency wrote into its 2010 recovery plan update: "Foster a working partnership between the Torreya Guardians, the Service, and other interested parties to help direct their managed relocation efforts." (p. 18). Five of our TorreyaGuardians.org webpages are listed as references (beginning with "http").

The endangered listing need not have been a problem. However, **the two botanical gardens that control seed harvest and distribution** are so adverse to our northward experimental efforts (and openly hostile to our citizen leadership) that rather than donating nonessential surplus seeds produced ex situ in northern Georgia, the seeds have been left for local squirrels to harvest. This we know because of a **Freedom of Information Act query** (FOIA) that Barlow was motivated to make in 2018, following a [University of Florida press release](#) announcing **intent to pursue a genetic engineering** initiative to implant disease resistance into the Torreya genome.

This turn of events prompted Barlow to directly challenge the assumed need for genetic engineering. That challenge is included in the last section of this petition, "Advocacy for translocation; against genetic engineering." Following a summary and references, page 22 of this report reasons that:

1. Any possible immediate need for **genetic engineering has been disqualified** by a combination of (a) Prof. Jason Smith's documentation of the canker pathogen at Biltmore Gardens NC and (b) Connie Barlow's subsequent documentation of original Torreyas and their offspring still in good health at the Biltmore.
2. The most reasonable hypothesis for northward health despite pathogen presence is that **the Fusarium causes serious injury to Torreya stems only in a climate zone as warm as Florida became by mid-20th-Century**.
3. The implication is that **no further effort or funds should be dedicated toward attempting to manipulate the Florida habitat or manipulate the Torreya genome** for the purpose of returning Florida Torreya to its peak-glacial refuge.
4. **Poleward translocation** (and supplementing existing Torreya groves in northward states) should thus become the core activity of all officially authorized parties.

THE VALUE OF DOWNLISTING

Downlisting would

- (a) **encourage citizens and organizations** to recognize that that they themselves can take responsibility for recovering endangered plants and that many private landowners would be grateful to be given an opportunity to nurture an endangered plant species. Simultaneously, it would
- (b) **quash the institutional trends toward cryopreservation of seed embryos in service of genetic engineering**. Countering a presumptive statement (at the 2018 "Torreya Symposium") that "extinction is imminent" by the documented success of citizen volunteers in boosting recovery would
- (c) draw the attention of **national conservation organizations and regional land trusts**. These nongovernmental organizations could then
- (d) **launch their own translocation experiments on citizen properties**, notably those with conservation easements. Once these mainstream conservation institutions are involved
- (e) Torreya Guardians could step aside. Once that happens
- (f) the **botanical gardens controlling seed distribution could be expected to cooperate in donating surplus seeds**. Finally, with citizen plantings underway and trusted institutions handling the organization and monitoring
- (g) **federal taxpayer money could be freed up** for recovering endangered species that aren't as easy to work with as putting seeds in a pocket and digging little holes in the forest.



PHOTOS: (L) Fred Bess with Ohio Champion Florida Torreya: a male in a cemetery near Cincinnati.
(R) Connie Barlow helps Fred Bess count 19 seeds on a female tree he planted (Cleveland)

ACCOMPLISHMENT 1

Documenting Historic Groves in Northward States

BENEFITS FOR RECOVERY:

Detailed documentation of **existing horticultural plantings in northward states** (1) can be regarded as well-established cores for nurturing supplemental populations, (2) present opportunities for discerning natural history and observing healthy growth and reproduction, and (3) confirm that northward translocations of this species are viable and noninvasive, while this large-seeded tree is incapable of long-distance dispersal without human assistance.

SUMMARY OF FINDINGS:

Torreyia Guardians have documented by online search, correspondence, and (where possible) by onsite visits a great number of **horticultural plantings of Florida Torreyia in states northward of Florida and Georgia** that preceded its 1984 listing as endangered. Special attention has been given to visiting sites where **seed production is documented**. Even more important are the **three sites where Florida Torreyia has fully "naturalized"** (two in North Carolina and one in Louisiana) — that is, where multi-aged seedlings and saplings have established near the parents with no human assistance. It is in these sites that the natural history of this subcanopy tree, in its healthy condition, can be discerned.

IMPLICATIONS FOR NEXT STEPS:

Documentation of full-scale naturalization fulfills the final threshold confirming **site suitability for this species in particular northward habitats and climate regimes (latitudes / elevations)**. In contrast, Florida Torreyia began struggling and lost reproductive capacity in its native habitat (a well known "peak glacial refuge") beginning in the 1950s. More than three decades of endangered species management has (a) failed to identify any specimen that can thrive in the native range and (b) failed to find a habitat modification strategy that can nurture the species back to health in Florida. **Translocation is thus the only horticulturally traditional approach for restoring this species to ecological success.**

Detailed explanations, justifications, and references for Accomplishment 1: Historic Groves

1A: Map and online reference of Historic Groves



Florida Torreyia

Ex-situ Specimens of Torreyia taxifolia



Paul Camire

September 18, 2018

ONLINE REFERENCES:

- "Historic Groves" webpage - <http://www.torreyaguardians.org/historic-groves.html>
- Map of all historic groves (above) - <http://www.torreyaguardians.org/historic-groves.html>
- "Ex situ Specimens of *Torreya taxifolia*" (27 pages) - <http://www.torreyaguardians.org/historic-list.pdf>

1B: The 1986 recovery plan called for documentation of historic groves

Action 5 of the 1986 original plan stated:

5. Establish experimental collections of *torreya* outside its native habitat.
 - 51. Inventory plantings at botanical gardens and arboreta.**
 52. Supplement existing plantings.
 53. Establish new plantings.

The mature grove at **Biltmore Gardens** near Asheville, North Carolina, was mentioned in the original 1986 plan (diseases noted as present, but not lethally damaging there). In the 2010 plan update, the Biltmore grove was mentioned three times; two of which are in reference to Torreya Guardians actions:

The Biltmore Gardens harvested 300 seeds in 2009 and were distributed to interested parties (<http://www.torreyaguardians.org/2009-seeds.html>). .. In 1939 nearly a dozen specimens of *T. taxifolia* were planted at the Biltmore Gardens; 31 seedlings were planted in 2008 at two locations near Waynesville; and 10 seedlings were planted at Bt. Highlands and Franklin (<http://www.torreyaguardians.org/north-carolina.html>).

None of the Action 5 elements of the 1986 plan were maintained in the 2010 update. Nevertheless, **Torreya Guardians have been documenting historic groves in northward states.** Our actions can now be regarded as fulfillment of the 1986 Action 51. Our **"Historic Groves" webpage** (new in 2018) documents not only the Biltmore grove but also the nearly century-old grove at the historic **Harbison House near Highlands NC** and a number of other healthy horticultural plantings in northward states that pre-dated the species listing in 1984. Access the webpage not only for text data and interpretations but also for **onsite video documentations**, which enable other parties to view the sites and make their own interpretations.

ONLINE REFERENCES:

- 1986 Recovery Plan - <http://www.torreyaguardians.org/1986-usfws.pdf>
- 2010 Recovery Plan update - https://ecos.fws.gov/docs/five_year_review/doc3258.pdf
- "Historic Groves" documentation: <http://www.torreyaguardians.org/historic-groves.html>



ABOVE: Documenting old Torreyas: (L) Jack Johnston Harbison House 2015; (R) Michael Dowd Biltmore 2016

1C: Historic groves prove northward thrival of this species

The "Historic Groves" webpage documents results in three categories:

- A. Naturalized Groves (producing seeds and establishing seedlings) - 4 sites (NC, LA)
- B. Mature Trees Producing Seeds - 4 sites (NC, OH, TN, OR)
- C. Mature Trees Not Producing Seeds - 4 sites, usually lone trees (PA, OH, GA)

"Naturalized groves" offer indisputable evidence that this species is capable of thriving, reproducing, and expanding its population onsite (albeit slowly) with no further human assistance, **provided that founding populations of seeds or potted seedlings are translocated by humans into supportive wild habitats in geographic locales with health-inducing climates** (including drought-moderating deciduous canopy, slope drainage, adequate rainfall, and disease-killing winter freezes).

ONLINE REFERENCE:

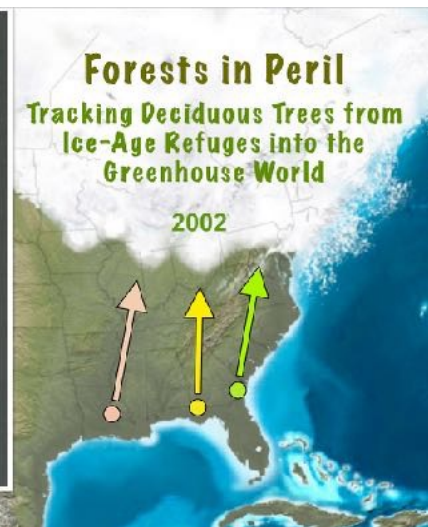
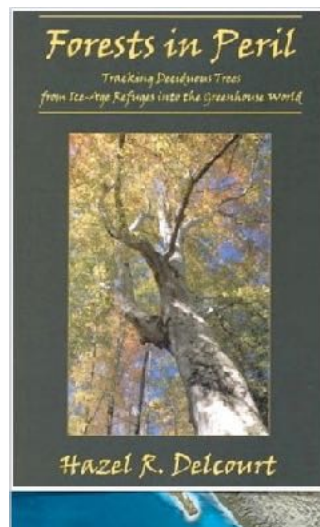
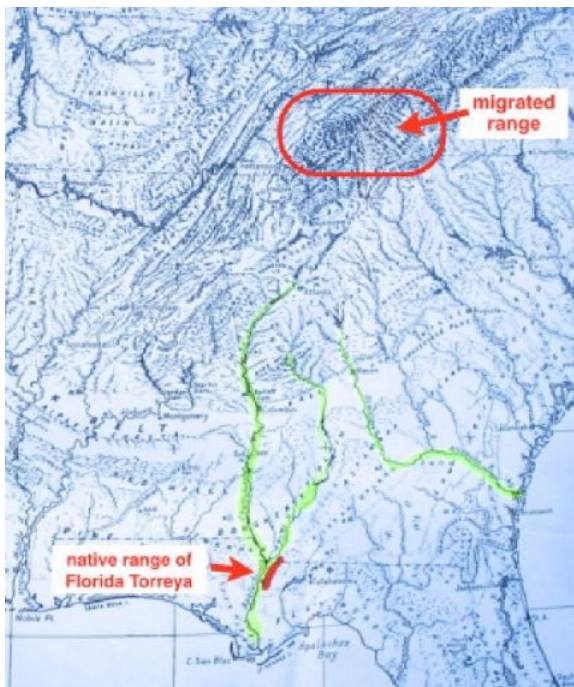
- "Historic Groves" documentation: <http://www.torreyaguardians.org/historic-groves.html>

1D: Florida *Torreya* is an undisputed "glacial relict"

As far back as 1905, botanists recognized the relictual status of Florida *Torreya*. H.C. Cowles wrote:

"In this association one finds two of our most notable endemic plants — *Torreya* and *Croomia*. It seems likely, then, that **we should regard *Torreya taxifolia* as a northern mesophytic left stranded to-day only in Florida....** It presumably is one of the plants that **failed to follow up the last retreat of the Pleistocene ice**, and is preserved here perhaps because of exceptionally favorable topographic conditions."

It is surprising, then, that the **implementing institutions (Atlanta Botanical Garden, State Botanical Garden of Georgia, and University of Florida)** all refrain from referring to this species as a "**glacial relict.**" No mention is made that its disease susceptibility in Florida (beginning in the 1930–1950 timeframe) likely arises from its having been "left behind" in its "glacial refugium" as the Holocene warmed. Perhaps this inattention to natural history arises from the task and demonstrated ability of botanical gardens to nurture species from around the world. Their emphasis thus is on finding how to manipulate an environment to support a species rather than to search out a geography, habitat, and natural ecological community wherein a species can thrive without any site manipulation.



Above: A 2002 book by paleoecologist Hazel Delcourt described the importance of 3 down-river sites in sheltering warm-temperate forest plants during glacial times — and the timings of tree species each finding ways back north.

Fortunately, the agency scientists in charge of all federal responsibilities for Florida *Torreya* have indeed paid attention to *Torreya*'s natural history (and, to some extent, its paleo history). Thus far **USF&WS documents have always characterized this ancient tree as a "glacial relict" and/or its native habitat as a "glacial refugium":**

- (undated) [Draft Environmental Impact Statement](#) - "... the bluffs and ravines served as a **refugium** when northern species **migrated southward during glacial times** and today the area has a high rate of endemism and unique vegetation."
- [1984 Federal Register](#) EXCERPTS: The Service determines *Torreya taxifolia* (Florida torrey) to be an endangered species pursuant to the Endangered Species Act. This plant is endemic to the Apalachicola River area in Florida and Georgia. It is endangered by a fungal disease, which kills trees before they reach seed-bearing size.... An evergreen tree reaching 18 meters tall, *Torreya taxifolia* (Florida torrey) was first discovered in 1834 and formally described in 1838. The Florida torrey and other endemics of the Apalachicola River system have received much attention from scientists and local residents. The **relictual nature of this area** accounts for the presence of many unique species (James, 1967). During recent **glaciations**, species migrated southward by way of the Apalachicola River system, which served as a **refugium during cooling periods**. The Apalachicola River is the only Deep River system that has its headwaters in the southern Appalachian Mountains. With the **receding of the glaciers**, cool moist conditions persisted on the bluffs and ravines of the Apalachicola River after climatic change rendered the surrounding area much drier and warmer. The entire Apalachicola River bluff system today is an extremely diverse and unique ecosystem, of which *Torreya taxifolia* is a part. ... All mature viable trees are located in botanical gardens and arboreta. The wild trees do not now have good long-term survival prospects. The initial focus of recovery will be to address controlling the disease. After the disease has been overcome, recovery efforts would address reintroduction of the species into the wild."
- [1986 "Florida Torreya Recovery Plan"](#) - EXCERPTS: *Torreya* is a genus of four or five species from Florida and Georgia, California, China, and Japan. The present geographic distribution of the genus is similar to the distributions of several other plant genera. The distributions, together with fossil evidence, suggest that **these genera had wide distributions during the Tertiary Period that were subsequently reduced by climatic changes during the Quaternary** (James 1961, Delcourt and Delcourt 1975).... The decline of *Torreya taxifolia* in its native habitat may ultimately be due to environmental factors that stressed the trees, including alteration of its forest habitat, alteration of vegetation above the ravines it inhabits, alteration of water seepage into the ravines, or droughts. The proximate causes of the decline are an assortment of fungal infections, resulting in stem cankers, stem and leaf blight, and possibly other problems (see p. 6). The decline has affected all wild Florida trees (Godfrey and Kurz 1962) and possibly all cultivated trees.... **The species may be restricted to the area because it failed to migrate northward at the end of the Pleistocene.**
- [2010 "Torreya taxifolia \(Florida Torreya\) 5-Year Review: Summary and Evaluation"](#) - "... **Based on fossil records, we can speculate that the geographical range of *T. taxifolia* included North Carolina** and perhaps, it was **forced south by glaciers**, and when they retreated, it became isolated in small areas of the southeastern United States." (p. 12)

ONLINE REFERENCES:

- *Forests in Peril*, by Hazel Delcourt, 2002 - <https://www.amazon.com/Forests-Peril-Tracking-Deciduous-Greenhouse/dp/0939923890>
- (undated) Draft Environmental Impact Statement - <https://play.google.com/books/reader?id=cy83AQAAMAAJ&printsec=frontcover&output=reader&hl=en&pg=GBS.PP2>
- 1984 Federal Register listing - https://ecos.fws.gov/docs/federal_register/fr789.pdf
- 1986 Recovery Plan - <http://www.torreyaguards.org/1986-usfws.pdf>

- 2010 Recovery Plan update - https://ecos.fws.gov/docs/five_year_review/doc3258.pdf
- 1905 H.C. Cowles paper - <http://www.torreyaguards.org/extinction.html#classic>
- State Botanical Garden of Georgia (torreya) - <https://conifersociety.org/conifers/reference-gardens/ga-state-botanical-garden-of-georgia>
- Atlanta Botanical Garden (torreya) - <https://erabg.org/project/84/>
- University of Florida - <http://blogs.ifas.ufl.edu/news/2018/04/05/uf-lead-team-of-scientists-outlines-novel-approach-to-save-endangered-tree/>
- USF&WS Torreya taxifolia Record of Actions: <https://ecos.fws.gov/ecp0/reports/implementation-activity-status-ore-report?documentId=600127&entityId=1191>

1E. Glacial relicts are severely threatened by climate warming unless assisted in moving poleward

By definition, a "glacial relict" plant has already had to cope with the scale of warming that occurred from glacial times of the Pleistocene to the fairly steady warmer climate of the past 10,000 years of the Holocene. That **glacial relicts may be among the first to show additional signs of climate distress** is thus to be expected. Climate distress (notably as evidenced in vast expanses of conifer forests in the western USA) is apparent when a species undergoes diminished capacity to fight off native diseases and/or when a native disease is able to gather strength because of climate warming. Both aspects have been confirmed for bark beetle tree kills in the pine and spruce forests of our Rocky Mountains.

Crucially, the **1986 Recovery Plan** made clear the distinction between PROXIMATE (disease agent) and ULTIMATE (environmental deterioration) causes:

... The decline of *Torreya taxifolia* in its native habitat may **ULTIMATELY be due to environmental factors** that stressed the trees, including alteration of its forest habitat, alteration of vegetation above the ravines it inhabits, alteration of water seepage into the ravines, or droughts. The **PROXIMATE causes of the decline** are an assortment of fungal infections, resulting in stem cankers, stem and leaf blight, and possibly other problems (see p. 6). The decline has affected all wild Florida trees (Godfrey and Kurz 1962) and possibly all cultivated trees. (p. 2, emphases and caps added)

ONLINE REFERENCES:

- "Glacial relict" wikipedia page - https://en.wikipedia.org/wiki/Glacial_relict
- 1986 Recovery Plan - <http://www.torreyaguards.org/1986-usfws.pdf>
- "The Broad Footprint of Climate Change," by Brett Sheffers et al., 2016, *Science* - https://www.researchgate.net/publication/309959821_The_broad_footprint_of_climate_change_from_genes_to_biomes_to_people
- Douglas-fir and Ponderosa Pine - <http://www.torreyaguards.org/assisted-migration.html#douglas>

ACCOMPLISHMENT 2

Establishing New Plantings in Northward States

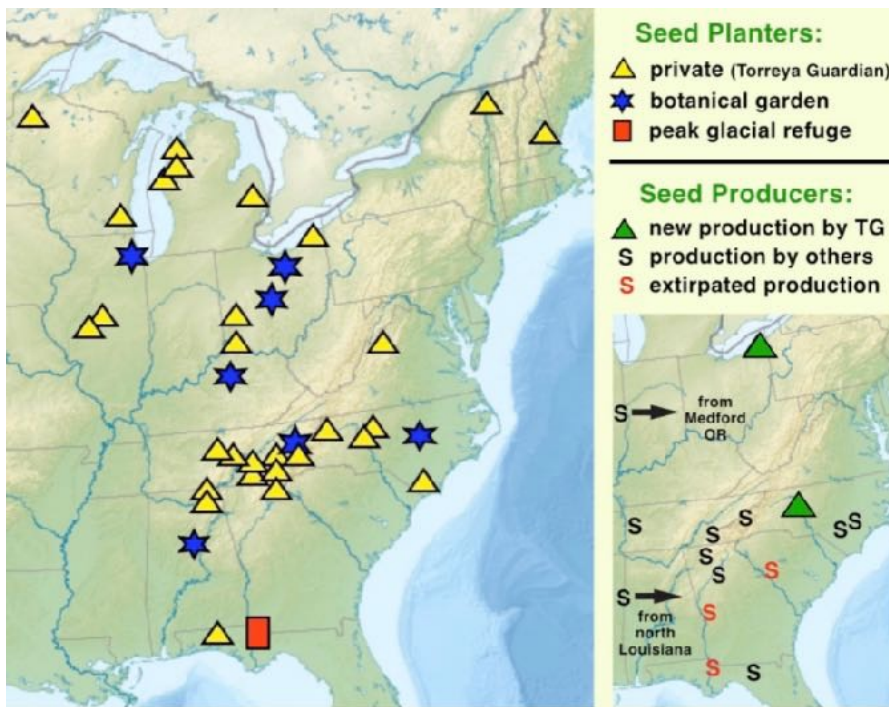
BENEFITS FOR RECOVERY:

Action 5 of the original 1986 plan stated:

5. Establish experimental collections of torreya outside its native habitat.
 51. Inventory plantings at botanical gardens and arboreta.
 52. Supplement existing plantings.
 53. **Establish new plantings.**

SUMMARY OF NEW PLANTINGS:

The homepage of TorreyaGuardians.org gives direct access to each of the states where we have documented existing horticultural plantings and/or initiated new plantings of our own (via private landowners volunteering their properties for such use). Most of our plantings are in the Southern Appalachians, as the likely home habitat of Torreya species prior to glacial onset.



Left: Graphic of our plantings is online here: <http://www.torreyaguardians.org/save.html#citizen>

Below: Ravine sections of forest where one of our Torreya landowners in Tennessee free-planted 400 seeds directly into forest soil in 2015.



ONLINE RESOURCES:

- 1986 Recovery Plan - <http://www.torreyaguardians.org/1986-usfws.pdf>
- Torreya Guardians homepage - <http://www.torreyaguardians.org/>
- "Summary of Seed Distributions & Seed Source Documentation" - <http://www.torreyaguardians.org/guardians.html#seeds>
- "Deep Time Lags: Lessons from Pleistocene Ecology," chapter by Connie Barlow in, *Gaia in Turmoil*, Eileen Crist, ed., 2010, <http://thegreatstory.org/deep-time-lags.pdf>
- "Map of Torreya Guardians Project Sites" - <http://www.torreyaguardians.org/save.html#citizen>
- Tennessee Torreya planter (Spring City) - <http://www.torreyaguardians.org/tn-cumberland.html>

IMPLICATIONS FOR NEXT STEPS:

Since 2016, Torreya Guardians have been denied access by two Georgia botanical gardens to seeds grown in any of the ex situ groves in northern Georgia that produce seeds in accordance with the federal recovery plan. Whether or not we ever regain access, we have set a **replicable precedent for conservation organizations and land trusts to take over the task of utilizing nonessential seeds for supplementing existing and establishing new plantings in northward states.**

Because federal taxpayer money has in part supported the establishment of the ex situ groves, the **federal government can reasonably require that a specified portion of annual seed production be returned to the agency or its designee.**

The amount of seed production is not insubstantial. There is evidence that, prior to the development of "somatic embryogenesis" as a technique for long-term cryo-preservation, the institutions in charge of the ex situ orchards preferred **local squirrels to acquire the seeds** (undocumented in numbers but likely approaching 10,000 annually), rather than us. In 2018, Barlow launched a **Freedom of Information Act query that confirmed 2007–2017 lack of documentation of seed numbers and "ultimate destinations."**

ONLINE REFERENCES:

- Patrick Shirey et al., 2013, "Commercial trade of federally listed threatened and endangered plants in the United States," *Conservation Letters* - <http://www.torreyaguardians.org/assisted-migration.html>
- 1986 Recovery Plan - <http://www.torreyaguardians.org/1986-usfws.pdf>
- "Summary of Seed Distributions & Seed Source Documentation" - <http://www.torreyaguardians.org/guardians.html#seeds>
- FOIA seed documentation query by Barlow (and results) - <http://www.torreyaguardians.org/foia.html>

Detailed explanations, justifications, and references for Accomplishment 2: New Plantings in Northward States

2A. History of new plantings by Torreya Guardians

Although Torreya Guardians has never been a formally organized group, our first actions were initiated and carried out by Lee Barnes, who arranged for a seed donation from Biltmore Gardens in 2005, which he then divided into packages distributed almost entirely to botanical gardens. **Botanical garden plantings** are important for any number of reasons.

However, with the exception of very large gardens (notably, the Biltmore), few have a wild forest onsite such that horticultural plantings could potentially give rise to new and expanding populations that would qualify as contributing to "species recovery" (rather than simply "preventing extinction" and/or "safeguarding genetics"). Hence, **establishing new plantings on northward private forested properties is a conservation priority** for working toward actual recovery sufficient for delisting.

ONLINE REFERENCES:

- "Early History of Torreya Guardians" - <http://www.torreyaguardians.org/guardians.html#early-history>
- "Summary of Seed Distributions & Seed Source Documentation" - <http://www.torreyaguardians.org/guardians.html#seeds>
- "Background Documents for Navigating Toward a Resolution of the Conflict between Atlanta Botanical Garden and Torreya Guardians," by Connie Barlow, 2018 - <http://www.torreyaguardians.org/foia/torrey-proposal-to-abg.pdf>
- Barlow comment on proposed regulation amendments for USF&WS implementation of the Endangered Species Act, 2018 - <http://www.torreyaguardians.org/cb-comment-esa.pdf>

2B. Freedom of Information Act (FOIA) query results confirm botanical garden wastage of ex situ seed production, refusal to undertake translocation experiments, and hostility toward Torreya Guardians activities

An unfortunate consequence of Torreya's seed being "recalcitrant" and thus unable to survive whole-seed dry or cryo storage is that **thousands of seeds produced in ex situ plantings of north Georgia (possibly beginning in 2007 and continuing through today) have been left uncounted and uncollected.** The **FOIA results** failed to turn up any documentation of annual seed production numbers and "ultimate destinations" by the two botanical gardens in charge of those plantings: **Atlanta Botanical Garden** and **State Botanical Garden of Georgia**. Because the institutions had not discovered how to manipulate habitat within the native range of Florida in ways that would offer any likelihood of survival into maturity, seeds and potted seedlings could not responsibly be outplanted to the native range. In light of an explicit **policy to keep Georgia seed production within Georgia** (thus prohibiting seed uses for experimental northward plantings), seed wastage was inevitable.

Despite their own **onsite seed wastage** for perhaps as long as a decade, botanical gardens and F&WS agency representatives signed a memo of understanding 5 May 2016 that (a) implied that Torreya Guardians may have been responsible for the alleged theft of (an unspecified number) of seeds from the Smithgall Woods ex situ orchard, and that therefore (b) "GPCA members and Botanical Guardian volunteers are **advised to be cautious when speaking to any members of Torreya Guardians.**" Barlow (and the other TG leaders) were unaware of this memo until the new conservation director at Atlanta Botanical Garden (Emily Coffey) attached it in a harsh response to an otherwise naive inquiry/request made by Barlow (ref: 2018 correspondence between Barlow, Radcliffe, and Coffey). Barlow's core request in the initial email (14 February 2019) was this:

2. POSSIBILITY FOR ABG + TORREYA GUARDIANS COLLABORATION. I imagine that one commitment we all share is to **not let any precious seeds go to waste.** As they cannot be stored long-term, that means they must be grown ex situ on an official site or somehow distributed to volunteer planters. For a variety of reasons, I am the most strenuous proponent for "free-planting" Torreya seeds directly into regrowth forests, skipping the potted stage. Obviously, that can only happen when seeds are abundant — which they used to be for us until 2016. Do know that **we now have a big circuit of volunteers in northward states who would be happy to plant as many seeds as we give them.** Obviously, some will be predated by rodents if free-planted, but we have recent evidence that planting seeds 6 inches deep may be even better protection than placing flat rocks over them. My experience at our 2008 Waynesville site, in contrast, is that the trees really struggle if they are rootbound, so I would encourage ABG to never let your seedlings stay too long in the pot before getting them, somehow, into the ground.

Barlow then received a reply from Emily Coffey, the body of which in its entirety was:

I was forwarded your message by Carrie Radcliffe. I would like to take the opportunity to introduce myself and explain our work with Torreya. I am the new Vice President of Conservation and Research at ABG and took over the position in August. My team currently works with USFWS, Florida Park Service, University of Florida, and GPCA to conduct research and provide safeguarding for Torreya taxifolia.

We feel we need to clarify our stance and the work related to Torreya taxifolia. ABG and all of our GPCA partners work within strict scientifically driven conservation parameters. I am attaching a statement released by GPCA and the Botanical Guardians of Georgia from 2016 on Torreya as well as the GPCA in situ and ex situ policy. These documents summarize the collective viewpoint and policy of the GPCA, which resolutely opposes assisted migration of Torreya.

Regarding the paleoecological argument, as a conservation paleontologist by training (I went to University of Oxford, UK where I studied long-term ecology under Professor Kathy Willis), I have found no scientifically sound evidence that can support Torreya

taxifolia as a northern species during the Pleistocene - no sedimentary evidence has been shown and based on the plants biology/physiology/habitat requirement it is not suited for northern climates including the Appalachia Mountains. Non-sanctioned introduction of this species into a novel ecosystem, outside of its natural range, could have catastrophic consequences and is staunchly opposed by the USFWS.

The argument that outplanting action should be taken prior to rigorous scientific experimentation and conformation is truly shocking and reckless. We do not under any circumstances condone the assisted migration of *Torreya taxifolia* or the outplanting of a Federally listed species on public or private lands without proper permitting and approval from the USFWS. Furthermore if we find evidence of any individual removing propagules or any plant material from local, state, or federal lands in GA or elsewhere, without appropriate state and federal approvals we will involve the authorities. This includes you and your affiliates, additionally, the transportation of seed or seedlings across state lines without proper permissions would also involve the authorities.

GPCA is aware of previous trespassing to illegal harvest seed followed by illegal transporting and selling of *Torreya* across state lines. Further actions of this nature will not be ignored. ABG strongly opposes the sale of Federally Listed Endangered Species - this kind of activity can only hurt the native populations and careful work we and our collaborators are conducting. We encourage that these un-permitted activities cease, as they are harmful and undermine official research and safeguarding efforts. Please review the attached documents for additional information.

We take the conservation and long-term survival of this species very seriously as well as the health of all other conifers in the eastern US. ABG has spent over 17 years actively working on in situ and ex situ conservation of this species and we work within a stringent scientifically driven methodology taking into account the most recent and up to date research.

We hope you will seriously take into account the current scientific findings for this species and reconsider your position on assisted migration or 'free-planting' of *Torreya taxifolia*. Please feel free to read the most recent article published by Dr. Jason Smith. We all wish to save this important species however we must do so within the appropriate legal parameters and with the full weight of current scientific knowledge.

Barlow responded to Coffey on February 20, in full:

Dear Dr. Coffey,

Thank you for your quick response to my February 14 query (at bottom), and especially for attaching the May 2016 multi-agency memo, "*Torreya* caution statement to GPCA". **The memo helps me understand why my attempts to communicate with ABG in recent years have gone unanswered.** I now see that of course you were led to be "cautious" in communicating with us, as *Torreya* Guardians was regarded by GPCA institutions as the likely suspect for an apparent theft of seeds from the Smithgall Woods ex situ orchard.

Please know that **seeds donated to us within Georgia have entirely come from the Experiment Station in Blairsville (not from Smithgall Woods), on a year-by-year basis, always subject to whether a bona fide institutional project would have a use for the seeds.** Allowing *Torreya* Guardians access was regarded as a step up from just leaving unharvested seeds to the local squirrels, and we are grateful for that. **My records show that we gained from the fall 2014 seed production at Blairsville about 4,000 seeds and from the fall 2015 production almost more seeds than we could responsibly distribute: 7,000.** In July 2016, an email from the new superintendent at the Blairsville station informed us that our access to seeds had ended, which was not unexpected. I am heartened to know that ex situ safeguarding of this species by GPCA institutions (and affiliated botanical gardens) has finally reached the

point that good homes/projects/experiments are now assured for the full production of seeds each year. None will be left behind.

I personally know how difficult it can be to find a sufficient number of good homes when the seeds we are responsible for number in the thousands. It is also a stretch for volunteers to maintain full documentation such that monitoring of results (especially those that can help ascertain habitat preferences, species interactions, and climate tolerances) can follow for many years to come. I know, too, how crucial it is to get seeds into the soil (natural or potted) in a timely fashion, as moisture conditions that are too dry or too wet will spell their demise. GPCA's own research confirms that long-term seed storage is not feasible for this species. Finally, our experience with planting potted seedlings in 2008 at Waynesville NC confirms that seedlings of this taprooted species that are left too long in the pot (hence, root-bound) will require either ideal conditions (planting near a waterfall) or will need to revert to regrowth from basals. **Overall, serving well this unusual species requires a great deal of attention and openness to learnings.**

We have been grateful not only to private landowners who accept seeds for planting and monitoring but also to **local nurseries who are willing to accept seeds from us that we simply cannot find homes for.** Thanks to Shirey et al. 2013 "Commercial Trade of Federally Listed Threatened and Endangered Plants in the United States," the terms are very clear by which nurseries can also participate, **commercially and openly, in striving for all seeds to find a home,** although they cannot document and monitor results in the fullness that our own group strives to achieve. My (albeit limited) understanding is that the nurseries we have donated seeds to have been complying well with the law. As you know, **our historic assisted migration plantings of T. taxifolia in the area of Waynesville NC in 2008 were only possible because of the mutualistic role for nurseries established by the Endangered Species Act. We purchased potted seedlings from a nursery; their business benefited from that sale. Then we transported and donated the seedlings to private landowners.**

Everything we do is by donation of our time and effort. We are dedicated volunteers. The result is that, however the science eventually unfolds in determining whether T. taxifolia's ultimate threat is an exotic pathogen or that it was merely left behind in its peak glacial refuge and needs some human assistance in moving north, my sense is that the **ex-situ plantings we ourselves have made possible through the years are (a) clearly not endangering native plants in the recipient ecosystems, (b) will continue to offer observational and possibly empirical insights into the species' preferred habitats and cold-adaptation limits, and (c) extend the documented ex-situ plantings that offer security, genetic preservation, and possibly ideal new habitat in this century of anthropogenic climate warming.**

Finally, the Torreya Guardians website is not meant to tie ourselves to the official recovery program (nor imply that official agencies approve of our actions and experiments). Rather, the site is largely a clearinghouse of Torreya information taken from public/government resources and open-source internet articles. We know that this knowledge is appreciated by our volunteer planters, and we hope that someday our documentation of results and learnings will also assist those working to fulfill the promise of the official recovery plan.

For Torreya and its future,

Connie Barlow, founder and volunteer with Torreya Guardians

Two more pieces of correspondence are part of this series: Jason Smith (University of Florida) to Barlow (Feb 20) and Radcliffe to Barlow Feb 28. Both are archived here: <http://www.torreyaguardsians.org/foia.html#event-2>

As Coffey noted, it is true that the work of Torreya Guardians in publicly and successfully conducting northward "assisted migration" of this endangered tree is sometimes conflated as being indistinguishable from the actions and results achieved by the officially implementing institutions, notably Atlanta Botanical Garden and the State Botanical Garden of Georgia, managers all ex situ plantings in northern Georgia. I was unaware that such conflation was viewed in a negative way until I was so informed by Emily Coffey. As the international journal *Nature* is highly regarded, I surmise that Coffey's harsh mention of this issue may have been triggered by an editorial that appeared in the 6 December 2017 issue of that journal, which stated:

"A common prediction for how plants will respond to climate change is that it is humans who got them into this mess and so it is humans who will have to get them out of it. That's why the idea of **assisted migration** of species, although often illustrated with the proposal to shift polar bears to the Antarctic, crops up more frequently in conversations about how to preserve iconic trees. Indeed, **in one of the only real-world examples of assisted migration so far, campaigners have planted the seeds of the critically endangered conifer Torreya taxifolia hundreds of miles north of its Florida home.**"

ONLINE REFERENCES:

- FOIA seed documentation query by Barlow (and results) - <http://www.torreyaguardians.org/foia.html>
- "Policy Statement Regarding in situ and ex situ Plant Conservation Between Members of the Georgia Plant Conservation Alliance," 2008, <http://www.torreyaguardians.org/foia/2008-gpca.pdf>
- 2018 correspondence bt Barlow, Radcliffe, Coffey - <http://www.torreyaguardians.org/foia.html#event-2>
- Barlow's email to Radcliffe, 14 Feb 2018 - <http://www.torreyaguardians.org/foia/barlow-to-radcliffe.pdf>
- Coffey's reply to Barlow, 15 Feb 2018 - <http://www.torreyaguardians.org/foia/coffey-to-barlow.pdf>
- Barlow's reply to Coffey, 20 Feb 2018 - <http://www.torreyaguardians.org/foia/barlow-to-coffey.pdf>
- Patrick Shirey et al., 2013, "Commercial trade of federally listed threatened and endangered plants in the United States," *Conservation Letters* - <http://www.torreyaguardians.org/assisted-migration.html>

2C. Barlow's closing statement following FOIA results proposes recovery actions that could lead to "delisting"

The core of Barlow's closing statement (29 August 2018) is the following:

I now sense that the USF&WS and I are on the same team. We all want to see the endangered Torreya taxifolia well served under the guidance of the ESA and possibly with the free help of volunteer citizens like myself who are eager to host "nonessential, experimental" seeds on our own forested properties within states northward of the tree's historic range in Florida. I personally will continue to document (and report on our TorreyaGuardians.org website) what we learn about the exact micro-habitats where the species seems to do best "in the wild" at this stage of ongoing climate change.

What I personally have learned thus far leads me to conclude that *Torreya taxifolia* can be de-listed soon. This stage would entail botanical gardens continuing their excellent work and we citizens continuing ours. Notably, the ex situ "orchard" plantings by Atlanta Botanical Garden and University of Georgia that have been **producing seeds prolifically at the Blairsville and Smithgall Woods sites demonstrate that such plantings in or near the southern Appalachian Mountains easily "prevent extinction".**

As well, **horticultural plantings from long ago** that established specimens at a cemetery in Ohio (now the "national champion" *Torreya taxifolia*) and in Pennsylvania **attest to the species' ability to thrive in latitudes well north of the historic range in Florida.**

Crucial too are the near-century old groves planted in North Carolina: at **Biltmore Gardens near Asheville and Harbison House near Highlands**. Both have been producing seeds for quite awhile. Moreover, the multi-age seedlings and saplings naturally established nearby attest to the species' ability to thrive and expand its population without becoming invasive in the recipient ecosystems. Thanks to these two historic groves, "recovery" clearly is possible for this species (and with no need for genetic engineering toward disease resistance), so long as the locales chosen for seed distribution reflect the scientific understanding that *Torreya taxifolia* is a "glacial relict" — unable to move north from its peak-glacial refuge in Florida at the end of the Ice Age.

Documentation of **Torreya's ability to thrive in northern states** and the "naturalization" of century-old groves in North Carolina can be found at this webpage on the Torreya Guardians website: <http://www.torreyaguardians.org/historic-groves.html>.

The long-understood recognition of **Torreya taxifolia as a glacial relict** can be accessed here: <http://www.torreyaguardians.org/extinction.html>.

The scholarship and news reports on the climate-change adaptation strategy known as "**assisted migration**" is here: <http://www.torreyaguardians.org/assisted-migration.html>.

The history of Torreya Guardians actions and what others have written about us is here: <http://www.torreyaguardians.org/guardians.html>.

Our ongoing **learnings about how to plant and nurture Torreya** is here: <http://www.torreyaguardians.org/propagate.html>.

Finally, if you are curious about **how deeply concerned I am about the problem of climate change overall** (and thus my insistence on moving a glacial relict northward), here is a video of a guest sermon I delivered this past Sunday:

VIDEO: [Grief and Gratitude in a Time of Climate Change \(Barlow\)](#).

ONLINE REFERENCES:

- Barlow's closing statement of FOIA process, 29 August 2018 - <http://www.torreyaguardians.org/foia.html#barlow-closing>
- FOIA seed documentation query by Barlow (and results) - <http://www.torreyaguardians.org/foia.html>

2D. Barlow posts comment on proposed regulation amendments for USF&WS implementation of Endangered Species Act. Docket ID: FWS-HQ-ES-2018-0006

Below are excerpts drawn from Barlow's comment of 24 September 2018 that are relevant to this downlisting petition. The entire comment is archived on the Torreya Guardians website at: <http://www.torreyaguardians.org/cb-comment-esa.pdf>

Florida Torreya Tree as Case Study for Endangered PLANTS - We document our results openly (failures as well as successes) via our website. These results contribute to our own learnings and our honing of best practices. By featuring photos and videos of our projects, we hope that academics, horticulturalists, and seasoned naturalists anywhere in the world will engage in offering their own interpretations and advice, without having to personally visit the sites.

Recently, we have put more effort into documenting (including photos and videos) plantings of Torreya taxifolia around the USA, featuring those northward of Florida. We pay special attention to the mature groves planted in horticultural settings before the species was listed in 1984, as these plantings offer ready-made, long-term experiments for ascertaining the tree's ability to thrive — and reproduce — hundreds of miles north of where Torreya became stranded in Florida at the end of the Pleistocene glaciations. Botanists recognized Torreya as having been stranded in a glacial refugium as early as 1905.

Because **we operate outside the bounds** and strictures of the official recovery plan for *Torreya taxifolia*, we easily attract volunteers who value biodiversity and are **concerned that climate change will further distress endangered species**. Citizens who do not accept the reality of climate change are unlikely to volunteer. This is an advantage we hold as a citizen cooperative that **the federal government lacks**. American citizens and elected leaders do not all have to agree on climate change in order for some of us to step ahead and use **our liberties** to aid endangered plants. Please do **review our results**; I suggest that we are really good at it — and **we cost taxpayers nothing**.

In 2010 the Fish & Wildlife Service **invited the advisory panel** for *Torreya taxifolia* to **consider launching an assisted migration "pilot project"** as a component of the recovery plan update. That project was voted down (**list of participants**, p. 22). The **two Torreya Guardians** included in the panel's deliberations were **the only commenters to vote "yes."** Thus, while the vote could not limit Torreya Guardians from continuing northward plantings, it seems to have **halted the agency and the institutional implementers from even beginning to experiment** these past eight years with using the simple, inexpensive, and **legal tool** that Torreya Guardians regularly employs to recover Florida Torreya: **"assisted migration"**.

Note: **Two law review articles** (2015 and 2017) posit that the Endangered Species Act and regulations (unamended) already allow officials to move ahead with "assisted migration" with no need for modification.

Critical Habitat - Designation of Unoccupied Areas (section 424.12) - ... Our experience with Torreya is that, **the less bureaucracy the better**. Our **volunteer landowners are thrilled to host the species**, especially since they know that their efforts may contribute not only to full recovery but that their monitoring and suggestions could enhance management in the future: honing **best practices** for where and how to plant seeds and ways to ongoingly encourage species success. If these volunteers were required to accept "critical habitat" designation as part of the deal, I'm not sure that all would agree. Ideally, **local and regional land conservancies will some day take the lead in recruiting volunteer planters and documenting results**, while offering conservation easements as a possibility, too. Easements would ensure that plantings would be maintained when the property is sold. Note: Our **Torreya planter in northern Michigan** not only planted seeds within her conservation easement; she wrote the forest plan for the property.

"Known distribution of a species" (section 424.12) - All endangered plants (not just "glacial relicts") would likely **benefit in this century of rapid climate change** if the "known distribution of a species" were interpreted in a more expansive way. To begin, consider that the Endangered Species Act was **intentionally written** in a way that offered a great deal of **freedom for individuals to host an endangered plant** on their properties **far beyond the plant's native range**. *It made no sense for the Act to require arboreturns and estates to remove a species from their grounds upon its listing as endangered.* Indeed, the nearly century-old Torreya groves at the **Biltmore Gardens** (Asheville NC) and **Harbison House** (Highlands NC) do more than produce genetically valuable seeds. These **groves are scientifically precious for what they teach us** about Torreya's (a) cold-hardiness, (b) ability to thrive within different types of forest settings; (c) reproductive strategies (we were the **first to document** that both male and female branches may be found on the same specimen), and (d) many other aspects of **natural history**.

RECOMMENDATION: A new regulation should require that plant listings and recovery plan updates must include **an additional category of "known distribution": horticultural settings**. This approach could bypass the contentious issue of "foreseeable future." The **controversy over "assisted migration"** would be substantially lessened as well. Simply, at which horticultural locations is the species healthiest right now? Why is it thriving there — perhaps even better than in its range in the wild? **Experimental plantings in wild** or semi-wild settings *beyond the current native range* could then, over time, clarify preferred habitats and plant associations, ultimately leading to **population expansion** and thus delisting. Had that expanded form of "known distribution" been considered for Florida Torreya when the first recovery plan was adopted in **1986**, the ex situ plantings for "safeguarding genetic material" and "preventing extinction" (see **here** and **here**) would surely be located in the southern Appalachian mountains. **Highlands NC** would likely have been designated as the **geographic center for recovery plantings**. Perhaps, too, this species could have been delisted by now.

End wastage of seeds in ex situ plantings - In 2005 Torreya Guardians initiated its seed distribution to landowners and botanical gardens, thanks to **donations of seeds to us from the Biltmore Gardens**

(NC). Rapidly, we had more landowners asking for seeds than we had seeds to distribute. A breakthrough came in 2011. From then through autumn of 2015 we had cooperation with the **Blairsville GA location of ex situ seed production**, culminating in our receiving 4,000 seeds in 2014 and 7,000 in 2015. In 2016 **Frank Callahan donated 3,900 seeds** to us from a bumper crop at his **horticultural planting in Medford OR**. In 2017 we had no donations of seeds. An abundance of seeds donated to Torreya Guardians for six years thus made possible experimentation with putting seeds directly into forest soil (rather than into pots), **while learning best practices** to curtail rodent predation. Our volunteer with the greatest acreage and with early success in having **seeds germinate in wild forest** is the owner of a 232-acre "stewardship forest" on the Cumberland Plateau of Tennessee, with results documented ongoingly. **Management of seed production** at the other ex situ location (**Smithgall Woods State Park, GA**) by recovery plan implementers declined to donate seeds to Torreya Guardians. Results of a **Freedom of Information Data Request** I submitted March 2018 confirmed their failure to count and record seed quantities produced annually from 2007 to 2017 at Smithgall Woods. And there is no documentation of seeds being distributed and to whom during that time.

Given that **Torreya Guardians is the first example of dedicated volunteerism** in making use of the plant exception in the ESA to assist climate adaptation of an endangered species, I regard the management disagreements and **conflicts (2014 and 2018)** that arose between we citizens and the institutions/agency implementing the recovery plan as unavoidable (yet valuable) learnings. The mis-steps evident in this trial run for ramping up citizen involvement (and hence more success and less cost for recovery) can clear the way for improved partnerships to evolve and perhaps for additional plant species to benefit. (See my **proposal to the Atlanta Botanical Garden**, dated 7 August 2018: **Part 1** and **Part 2**.) **Let us congenially discuss** our successes and failures. Let us see if a partnership might emerge to **launch a new phase of recovery** that aims to turn around the **"extinction is imminent"** assumption at the 2018 "Torreya Symposium" — which led to the shocking announcement that **genetic engineering** is a necessary next step (see 3B below).

RECOMMENDATION: "No Seed Left Unsown" is a possible name for a project that would **play to each of our strengths**: the official program's great success in generating seeds and our group's success in enlisting private landowners to plant seeds and report results. Together we could guide Florida Torreya recovery to **align with the bottom-up and cost-cutting imperatives** manifesting in America now, while ensuring that management **keeps clear of the conservation hot-button issue of genetic engineering**. All this could of course be accomplished during the 2019 update of the recovery plan. But here is possible language if it makes sense to write it into the Regulation amendments:

PROPOSED LANGUAGE FOR THE REGULATION: When implementation of recovery plans for listed plants have progressed to the point that, in any year, seeds produced in ex situ collections exceed the numbers deemed necessary for recovery actions under the official plan, the excess seeds will be made available for citizens to plant on their own properties. Responsibility for inviting and administering citizen involvement, for submitting a species-specific recovery plan, for documenting results, and for communicating results in a publicly accessible form and to the federal agency will be handled by sponsoring organizations, such as land trusts, garden clubs of botanical gardens, and conservation organizations

2E. Humans need be no more fearful of misplacing seeds northward than were Passenger Pigeons while carrying seeds of oaks in their crops and Shasta Ground Sloths while depositing seeds of Joshua Tree in their poop

Paleoecologists have ascertained that plants recovered their northward habitats post-glacial on an individual basis (not as intact plant communities moving in sync). **Some large-seeded trees are still lagging behind their northward-trending climate zones**. Researchers ascertained that plants native to the eastern USA that have been moved by horticulturalists to other locations in the eastern USA have only rarely become invasive. Yet, ever since Barlow and Martin 2004 advocated "Bring Torreya taxifolia North Now," others have warned that translocation might be so successful that this endangered species becomes invasive in the recipient ecosystems.

Documentation by Torreya Guardians of the near-century-old Torreya grove at Harbison House, Highlands NC, should finally defuse this concern. Natural seed dispersal (presumably by gravity and squirrels) has produced next generation specimens at distances less than 40 yards from the parent

trees. Clearly, 40 yards per century is far from invasive. Indeed, a much greater concern is that even if the species is translocated successfully northward, it will need continuing human assistance to keep it moving in sync with a climate that will likely keep changing for at least another century, maybe more.

ONLINE REFERENCES:

- "Forests in Peril: A Review of 2002 book by Hazel Delcourt, 2004, *Wild Earth* - <http://www.torreyaguardians.org/delcourt-forests-in-peril.html> • also, <http://www.torreyaguardians.org/hazel-delcourt-forests.pdf>
- "[An Assessment of Invasion Risk from Assisted Migration](https://www.researchgate.net/publication/5279382_An_Assessment_of_Invasion_Risk_from_Assisted_Migration)", by Jillian M. Mueller and Jessica J. Hellmann, *Conservation Biology*, 28 June 2007 - https://www.researchgate.net/publication/5279382_An_Assessment_of_Invasion_Risk_from_Assisted_Migration
- "Bring *Torreya taxifolia* North Now," by Connie Barlow and Paul S. Martin, 2004, *Wild Earth* - <http://www.torreyaguardians.org/barlow-martin.pdf>
- "Conservationists Should Not Move *Torreya taxifolia*," by Mark Schwartz, 2004, *Wild Earth* - <http://www.torreyaguardians.org/schwartz.pdf>
- Torreyas at Harbison House webpage: <http://www.torreyaguardians.org/highlands.html>
- "Becoming Passenger Pigeon", VIDEO by Connie Barlow, 2014 - <http://youtu.be/uPYDDsGaktk>



Torreya Guardians VIDEO series (above)

CONNIE BARLOW POSTS 2 VIDEO SERIES

"Climate, Trees, and Legacy" VIDEO series (below)



ACCOMPLISHMENT 3

Expanding Knowledge of Natural History and Best Propagation Practices

BENEFITS FOR RECOVERY:

Because the official implementing institutions have retained for more than three decades a strict focus on studying, manipulating, and attempting to improve conditions for *Torreya* recovery *within its peak-glacial refuge in Florida*, they have made no documented attempt to learn about the natural history of *Torreya*'s growth patterns and resiliency when it is provided healthy environments for growth. In contrast, **Torreya Guardians has documented the natural history of *Torreya* in northward historic plantings** (where it is still healthy and reproductive), while also establishing new plantings in experimental locations in the southern Appalachian Mountains, Cumberland Plateau, and northward. Because we have also documented our observations, hypotheses, and learnings, a much fuller understanding of the healthy natural history of Florida *Torreya* is now available for others to access and thus for forming their own interpretations and recommendations. As well, thanks to seed donors from 2014–2016 (Blairsville GA in 2014 and 2015; Frank Callahan in Medford OR 2016) we finally had a substantial seed surplus beyond the numbers that volunteers were willing to plant in the usual way: in wire-protected beds, pots, or greenhouses. This enabled Connie Barlow to initiate and recruit volunteer landowners for **"free-planting" experiments** — planting seeds directly into regrowth forests, with no expectation that transplanting would be necessary. Through trial and error, we now have knowledge to share as to best habitats and, crucially, **how to minimize in-ground seed predation**. Landowner volunteers can increasingly step forward to participate, knowing that **seed-planting time will be minimal, and there is no need for them to invest in pots or enclosed cages**.

SUMMARY OF EXPANDED KNOWLEDGE: Our acquired knowledge is so vast that three distinct webpages on the Torreya Guardians website will be pointed to here. Each is arranged into sections and illustrated for easy reference and access:

- LEARNINGS (chronological by year) - <http://www.torreyaguardsians.org/learnings.html>
- FREE-PLANTING TORREYA SEEDS directly into forest habitats - <http://www.torreyaguardsians.org/freeplanting.html>
- GERMINATING, PLANTING, and NURTURING - <http://www.torreyaguardsians.org/propagate.html>

IMPLICATIONS FOR NEXT STEPS: The actions of our citizen group, Torreya Guardians, have pioneered the way for **traditional conservation groups (ideally, land trusts) to step up to engage in their own translocation projects** for which they would then formally request seeds from the agency. It is time for traditional conservation establishments to make poleward assisted migration a core practice for plant climate adaptation — crucial for all "left-behind" glacial relicts, such as Florida *Torreya*. Following the FOIA seed results, Barlow attempted to initiate communication with several high-level staff people at **The Nature Conservancy**. None responded. Perhaps elements of my email correspondence may be useful for others who also wish to advocate for translocational uses of nonessential seeds. Key para is below. Full text at: <http://www.torreyaguardsians.org/foia/cb-to-tnc-scarlett-sept-10.pdf>

TNC role: Recommend that plants currently on "life support" (words of Senate Chair in July ESA hearing) be screened (by TNC, using its own funds) as to whether they are "glacial relicts". For each species so judged, suggest that USF&WS offer to TNC and other land trusts opportunities to forge their own recovery plans for poleward experimentation toward recovery — using existing private conservation easements for experimental plantings. USF&WS would contribute seeds and seedlings deemed "non-essential and experimental."

ACCOMPLISHMENT 4

Educating and Networking for Translocation Awareness

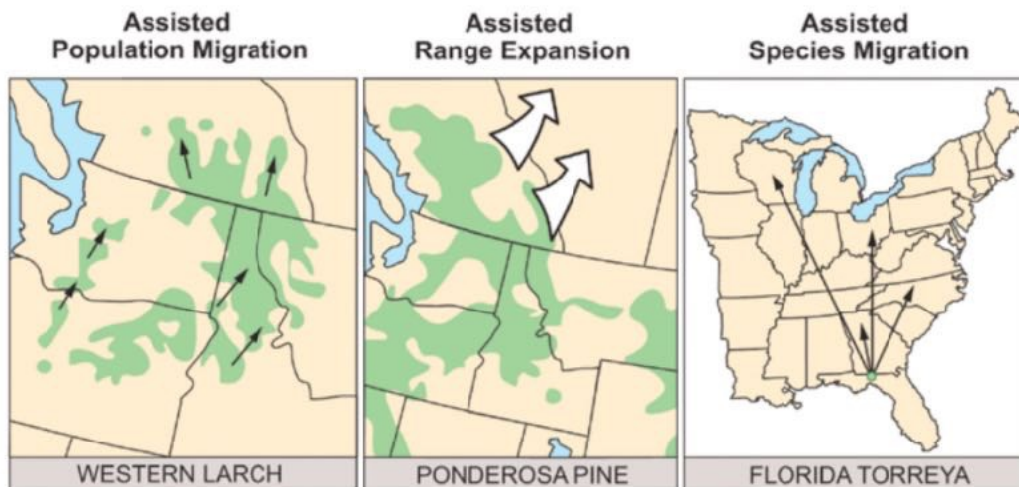
BENEFITS FOR RECOVERY:

It is crucial to remember that **the Endangered Species Act almost was enacted without including plants for endangered listings**. Plants require far fewer skills, equipment, and material costs to safely handle and propagate than do animals. More, because so many potential plant species that might qualify for listing (including Florida Torreya) were already well represented in horticultural plantings far beyond native ranges, plants would need to be given an "exception" allowing for ownership and handling (and distribution of offspring/seeds) not applied to listed animal species. It was this exception that enabled Torreya Guardians to do anything at all on our own to assist recovery of this endangered tree. Unfortunately, **because of the sad legacy of horticulturally introduced "invasive species"** (almost always imported from other continents), there is strong resistance to the idea of translocating native plants to presumed poleward habitats (on this same continent) that they are known by fossil evidence or imputed to have been likely to occupy during previous warm epochs. Thus, **educating citizens and professionals about shifting climate zones, paleoecological history, and the intent of the plant exception in the ESA statute** has been and still is a crucial activity.

SUMMARY OF ACCOMPLISHMENTS: Key accomplishments in educating and networking center on Barlow's actions in creating and maintaining an "[Assisted Migration Scholarly Links](http://www.torreyaguardsians.org/assisted-migration.html)" webpage and responding to [journalist and other media inquiries](#), as well as collegial correspondence with authors of academic papers on this topic. Our "Volunteer Reports" webpage is also valuable for education, given its illustrated and chronological format:

- "**Assisted Migration Scholarly Links**" - <http://www.torreyaguardsians.org/assisted-migration.html>
- "**Torreya Guardians in the Media**" - <http://www.torreyaguardsians.org/guardians.html#media>
- "**Reports by Torreya Volunteers**" - <http://www.torreyaguardsians.org/comments.html>

Other high-level networking by Barlow is contributing to early and ongoing communications of scientists (in the U.K. and Canada) who are still in the beginning stages of founding an international "**Plant Translocation Network**." Torreya Guardians are regularly portrayed internationally as the foremost case study in plant assisted migration. See for example, "Review of science-based assessments of species vulnerability: Contributions to decision-making for assisted migration," by Tannis Bearmore and Richard Winder, 2011, *The Forestry Chronicle*. Also, this widely used illustration in forestry journals:



ACCOMPLISHMENT 5

Advocacy for Translocation; Against Genetic Engineering

*Note: Unlike the previous four accomplishments, which are all proactive, this final action is attempting to shut-down a **surprise and extreme project promoted by official institutions beginning in 2018**. This fifth, rear-guard action is almost entirely the effort of Connie Barlow.*

BACKGROUND:

Beginning in the **March 2018 invitation-only "Torreya Symposium"** (led by the University of Florida, but also Atlanta Botanical Garden, and State Parks Florida), a high-level **declaration of "extinction is imminent"** was reported. This was a shock to Barlow, as Torreya Guardians have been documenting and contributing to the extraordinary health and vigor of this species in northward horticultural or translocational plantings. Such a declaration is surely necessary for there to be any scientific rationale to begin exploring **genetic engineering for infusing water-mold disease resistance** (likely from a cultivated wheat plant) into large numbers of **cryo-preserved embryos of wild-stock generated seeds**, as a first step toward replacing the entire remnant population of wild specimens in Florida suffering from recurrent stem dieback (proximate cause being a stem-canker disease). There is not even a hint in the current (2010) recovery plan of genetic engineering as a possible action for preventing extinction and building toward recovery. Unfortunately, **media portrayal of this measure as near or underway** does not give voice to any cautionary statement solicited from an agency authority. Thus far, Barlow has found no opportunity for voicing protest other than through webpages on the Torreya Guardians website — and now also through this petition.

HOW THE GENETIC ENGINEERING PROPOSAL PROMPTS THIS PETITION:

The year 2018 made clear that Atlanta Botanical Garden (ABG) was steadfastly against allocating seeds from ex situ orchards in Georgia for northward translocation experiments. ABG was also hostile (and accusatory) toward citizens connected with Torreya Guardians actions and advocacy. We also learned in 2018 that cryo-preservation equipment purchased by ABG would be used for storing mere embryos, not entire seeds. Embryos could not be unfrozen and then planted in traditional ways; hence **no seeds destined for cryopreservation surgery would ever be available again for simple, inexpensive translocation plantings**. In contrast, embryos were crucial material for genetic manipulation, as proposed that same year by University of Florida forest pathologist Jason Smith. Thus the possibility of a joint ABG / UFI genetic engineering project was suddenly at the forefront of new proposals being put forth by any of the official implementing institutions.

Barlow concluded: *Something has to be done to stop this assault on traditional modes of conservation for recovering endangered species. If downlisting can be achieved by this petition, then it will be a clear signal that the agency does not agree that "extinction is imminent."* Rather, recovery is not only possible, it is well underway. **The conservation tool of geographic translocation must be attempted in its fullness before any proposal for engineering the Torreya genome is considered.** The **"Precautionary Principle"** would demand it. If downlisting can be achieved, then it would be clear that no further talk about proceeding with early steps of genetic engineering is appropriate at this time.

ONLINE REFERENCES:

- "Scientists choose genetic manipulation for Torreya; ignore assisted migration," post by Connie Barlow on Torreya Guardians website, March 2018 - <http://www.torreyaguardsians.org/comments.html#symposium>
- "Atlanta Botanical Garden opens Southeastern Center for Conservation this summer", 9 June 2019, *Atlanta Journal Constitution* - <https://www.ajc.com/lifestyles/environment/saving-the-world-one-plant-time/QdJDsvISNYMRbqHa8TTSWO/>

- "Florida Statewide Plant Conservation Grant, Annual Report 2010-2011 FDACS Contract 016711, by Jennifer Cruse-Sanders (ABG), delivered as a product of the FOIA process - <http://www.torreyaguardsians.org/foia/foia-results-aug-23-b.pdf>
- "Recovery of the Florida Torreya - one of the rarest conifers in the world," by Atlanta Botanical Garden, January 2019 - <https://erabg.org/project/84/>
- President's message, by Mary Pat Matheson, Official News Publication for Members of the Atlanta Botanical Garden, 2019, p. 2 - https://issuu.com/atlantabotanicalgarden/docs/clippings_may-august_2019
- "The Precautionary Principle (with Application to the Genetic Modification of Organisms)," by Nassim Taleb et al., 2014, Report of the Extreme Risk Initiative NYU School of Engineering Working Papers - <https://arxiv.org/pdf/1410.5787.pdf>

SUMMARY OF RESULTS AND IMPLICATIONS:

1. Any possible immediate need for **genetic engineering has been disqualified** by a combination of (a) Jason Smith's documentation of the canker pathogen at Biltmore Gardens NC and (b) Connie Barlow's subsequent documentation of original Torreyas and their offspring still in good health at the Biltmore.
2. The most reasonable hypothesis for northward health despite pathogen presence is that **the Fusarium causes serious injury to Torreya stems only in a climate zone as warm as Florida became by mid-20th-Century**.
3. The implication is that **no further effort or funds should be dedicated toward attempting to manipulate the Florida habitat or manipulate the Torreya genome** for the purpose of returning Florida Torreya to its peak-glacial refuge.
4. **Poleward translocation** (and supplementing existing Torreya groves in northward states) should thus become the core activity of all officially authorized parties.

Detailed explanations, justifications, and references for Accomplishment 5: For Translocation; Against Genetic Engineering

5A. A newly identified stem canker of Torreya was the impetus for the genetic engineering proposal

The same forest pathologist, Jason Smith, who announced/proposed CRISPR genetic engineering of Florida Torreya during and immediately follow the **Torreya Symposium** in March 2018 is the author or coauthor of **a set of papers** published in previous years that isolated the water-mold causing lethal stem cankers in the Florida habitat and proposed it as a new species, *Fusarium torreyae*. The combination of isolating a new disease agent, speculating that it might be an exotic species (with the implication that it might also be able to severely damage Torreya specimens even in far northern horticultural plantings), and that genetic engineering was thus the only option remaining for saving Florida Torreya is reported, linked, and critiqued in detail by Connie Barlow on the **"Endangerment causes"** webpage of the Torreya Guardians website.

ONLINE REFERENCES:

- "Scientists choose genetic manipulation for Torreya; ignore assisted migration," post by Connie Barlow on Torreya Guardians website, March 2018 - <http://www.torreyaguardsians.org/comments.html#symposium>

- Listed, linked, and excerpted papers on the Torreya canker disease, (2011-2016 includes Jason Smith as an author) - <http://www.torreyaguardians.org/extinction.html#canker>
- "At the Brink of Extinction — Why" (Endangerment causes webpage) - <http://www.torreyaguardians.org/extinction.html>

5B. The newly identified stem canker of Torreya is not a proven exotic

In 2011, Prof. Jason Smith, forest pathologist at the University of Florida, **distinguished a particular water mold** that had previously been grouped within *Fusarium lateritium* to not only be a distinct (and newly named) species, *Fusarium torreyae*, but that it was the cause of perpetual stem dieback of the remaining rootstock of Florida Torreya in its small glacial refugium along the Apalachicola River of the Florida Panhandle. In **2016 a multi-author paper** (Smith as a coauthor) attempted to trace whether its genetics indicated its being native to North America or potentially native to Asia. The 2016 paper concluded:

... Molecular clock estimates place the divergence of the FTOSC in the mid-Eocene , 40 Mya (O'Donnell et al. 2013), but **it remains an open question whether this clade first evolved in the Old or New World. Furthermore, it remains to be determined whether F. torreyae is native to North America and restricted to T. taxifolia.** Surveys for *F. torreyae* on Torreya endemic to China are warranted because it is the modern area of diversity of this genus (Li et al. 2001) and because the putative Asian origin of the CDZB pathogens could indicate that the most recent common ancestor of the FTOSC evolved in Asia....

ONLINE REFERENCES:

- "Two novel Fusarium species that cause canker disease of prickly ash (*Zanthoxylum bungeanum*) in northern China form a novel clade with *Fusarium torreyae*," by Zhou et al., 2016, *Mycologia* - <https://pdfs.semanticscholar.org/ba47/01ae6ac988db68c5ef51439fbc1cf9adba3d.pdf>
- Listed, linked, and excerpted papers on the Torreya canker disease, (2011-2016 includes Jason Smith as an author) - <http://www.torreyaguardians.org/extinction.html#canker>

5C. Exotic or not, what matters is that the canker is documented as present (but not seriously harmful) at a northward site already — Biltmore Gardens NC

By the 1950s one or more of a number of documented diseases was consistently resulting in stem dieback of a great proportion of Torreya specimens in their native Florida habitat. **Until 2010, the posited disease agents were multiple (and included below-ground diseases that perhaps weakened the plant enough to undermine its evolved ability to fight off native water molds, including the then-identified stem-canker agent, *Fusarium lateritium*). Beginning in 2010, a single canker disease agent was the focus of Prof. Jason Smith's inquiry.** This led to today's widely reported conclusion that *Fusarium torreyae* is itself the cause of stem dieback today, and presumably was the cause in the 1950s too. The crucial observation — that **the Fusarium is already present at a northward site** — was reported by Jason Smith (in an **email to Barlow**, 20 February 2018). Smith wrote:

There is no doubt in my mind that the primary driver in the mortality of the trees is the pathogen. It is reasonable to assume that it is easily moved around. Furthermore, my M.S. Student, Aaron Trulock, completed a study that demonstrated that several conifer species native to the southern Appalachians are susceptible (<http://eds.a.ebscohost.com/eds/detail/detail?vid=1&sid=cf6e73e9-f3f7-4642-a162-c10aa1db5243%40sessionmgr4008&bdata=JnNpdGU9ZWZrZLWxpdmU%3d#AN=ufl.03144772 8&db=cat04364a>), with a couple of species being highly susceptible (Fraser fir,

hemlock)..... This raise a flag of caution that any planted material there should come from disease-free trees and every effort should go into not introducing it. **We did confirm that the trees at Biltmore Estate in Asheville already are infected**, for example... *[the ellipsis was in the original]*

Several **previous text sources also mention stem canker as present at the Biltmore Gardens** in North Carolina, so the pathogen has presumably had more than three decades to manifest serious injuries. Page 3 of the 1986 original recovery plan states:

Mature torreya trees exist in cultivation at the Biltmore House and Gardens near Asheville, North Carolina, but even there, seedlings and young trees show blight symptoms similar to those seen in trees in Florida. There has been no testing or identification of pathogens from the trees at Biltmore. **The 14 large trees, approximately 40 years old, show occasional lesions but appear to be healthy. They may have escaped more serious symptoms because they suffer little water stress in the cool, moist climate** (Barnes 1983a, Turnage 1985).

Note: In the passage above, a publication by Lee Barnes is cited. Barnes joined Barlow in the earliest phase of Torreya Guardians translocation actions, including acquiring seed donations from the Biltmore.

ONLINE REFERENCES:

- "At the Brink of Extinction — Why?", webpage by Connie Barlow - <http://www.torreyaguardsians.org/extinction.html#overview>
- Jason Smith email (2/20/19) - <http://www.torreyaguardsians.org/foia/smith-to-barlow-feb.pdf>

5D. Torreya Guardians have documented by photos and videos (viewable online) the continuing health of the original specimens and their seedling and sapling offspring

Torreya Guardians have repeatedly documented healthy stems and cone production on original and naturalizing specimens at the Biltmore. Photographs and videos posted online enable other parties to view and interpret this conclusion. If our declaration of health is corroborated by Biltmore horticultural staff, and if others so interpret by viewing the photos and videos, then **northward translocation is a well-supported strategy for species recovery**. Moreover, existing and potential translocations comprise **a far less controversial approach than does genetic manipulation** aimed at inserting disease resistance (from a different plant taxon) so that the peak-glacial refuge might be restocked with engineered embryos that could possibly cope with a too-warm (and still warming) climate zone.



PHOTOS ABOVE: Barlow's **onsite documentation of healthy torreya specimens** (first-year female cones left; ripening second-year female cones right) took place 9 months after Jason Smith wrote, "We did confirm that the trees at Biltmore Estate in Asheville already are infected."

Barlow posted a new discovery during her autumn 2018 visit: an apparent squirrel-dispersed seed upslope had grown into a sapling bearing 23 ripening seeds. The species remnant still surviving in Florida has been incapable of such a feat for perhaps half a century. Serious study of the Biltmore Torreya trees and their descendants is warranted. So is serious study of the growing population of multi-generation Torreyas at Harbison House near Highlands NC, which also produces seeds.

ONLINE REFERENCES:

- 1986 original Recovery Plan for Florida Torreya - <http://www.torreyaguards.org/1986-usfws.pdf>
- "Part 2: Ascertaining the Ultimate Cause of Proximate Disease" - <http://www.torreyaguards.org/extinction.html#ultimate>
- "Florida Torreya at Biltmore Gardens" - <http://www.torreyaguards.org/biltmore.html>
- "90-Year-Old Grove in Highlands, NC" - <http://www.torreyaguards.org/highlands.html>

5E. Fear of translocated plants spreading disease is overwrought

Based on **a master's thesis** by Aaron Trulock, supervised by Prof. Jason Smith at University of Florida, media accounts have sometimes quoted or indicated that actions by Torreya Guardians in moving seeds and potted seedlings northward might contaminate the ecosystems with *Fusarium torreyae*, which then could be even more **destructive of Fraser Fir and Red Spruce**, which are currently climate-challenged in their own refugial holdouts at the highest peaks of the southern Appalachians.

As mentioned above, Jason Smith has reported that the *Fusarium* already exists at Biltmore Gardens. It is very unlikely that they arrived there by way of Torreya Guardians. More, three Torreya specimens at Biltmore are growing right next to a sidewalk; if the *Fusarium* has spread, it is likely that visitors to the garden have been walking away with it on their shoes for several or more decades.

Getting practical, it is important to note that **cleaned seeds washed in a mild bleach are widely recognized as being pretty much free of water mold contamination**, and therefore seed-cleaning specifications should be adopted by all parties. As to potted seedlings, however, **arbuscular mycorrhizal symbionts are crucial for seedling vigor, so fumigation would be harmful if applied**. The original 1986 recovery plan stated (page 11):

"... However, the coarse, thick roots of *Torreya* suggest that vesicular-arbuscular mycorrhizae may be very important to *Torreya*. Wide spectrum fungicides probably harm beneficial mycorrhizal fungi which could accentuate stress on the trees and further predispose them to fungal infection."

Overall, **it is clean seeds, rather than potted seedlings, that should be priorities for translocation projects**. Even so, the **fear-mongering** induced by the final paragraph in the Aaron Trulock non-peer-reviewed thesis (and with a minimal methodology section suggestive of laboratory application of heat and cold differences rather than the full northward ecosystem expression of winter freezes) is an **unwelcome labeling of misconduct** for those of us engaging in simple translocation experiments. The final paragraph in the 2012 thesis by Aaron Trulock is:

... We have identified both that *F. torreyae* can infect tree species in the southern Appalachian Mountains (Chapter 2), and that it both grows well and sporulates in the average summer and fall temperatures. It may even perform better in the conditions common in the southern Appalachian Mountains than in average temperatures in the native range of *T. taxifolia*. *Fusarium torreyae* can also take advantage of wounds already formed on *A. fraseri* and *Ts. Canadensis* from BWA and HWA infestations. Introducing a vascular canker disease on top of acute adelgid infestations could expiate the demise of

these two species. *Fusarium torreyae* appears to have the ability to complete its lifecycle if moved to a new, cooler location and would not be limited by the new environment. The movement of infected *T. taxifolia* plants into the southern Appalachian Mountains may spread this pathogen to a new area, to stressed, injured susceptible hosts and create a new epidemic. What is the value in moving one species to potentially imperil others?

ONLINE REFERENCES:

- "Host Range and Biology of *Fusarium torreya*, Causal agent of canker," by Aaron J. Trulock, 2012, Master's thesis, University of Florida - https://ufdcimages.uflib.ufl.edu/UF/E0/04/51/42/00001/TRULOCK_A.pdf
- Jason Smith email (2/20/19) - <http://www.torreyaguardians.org/foia/smith-to-barlow-feb.pdf>
- 1986 Recovery Plan - <http://www.torreyaguardians.org/1986-usfws.pdf>
- Comment by Torreya Guardian Founder Connie Barlow (on Trulock 2012) - <http://www.torreyaguardians.org/extinction.html#ultimate>

END OF PETITION for Downlisting Florida Torreya from Endangered to Threatened
by Connie Barlow

A handwritten signature in blue ink that reads "Connie Barlow". The signature is fluid and cursive, with a long horizontal stroke extending to the right.