

Resource Recovery Plan
For
Torrey's Mountain Mint
Pycnanthemum torreyi **Bentham**
in Pennsylvania



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Pycnanthemum torreyi photographed by Christopher T. Frye
at Catoclin Mountain Park, Maryland, August 11, 2010

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Classification

The genus *Pycnanthemum*, in the family Lamiaceae (Mint Family), includes 15—20 species all of which occur naturally only in North America (Fernald 1950; Gleason and Cronquist 1991; Chambers and Chambers 2010).

Pycnanthemum torreyi Benth is one of seven species of mountain-mint that have been documented in Pennsylvania (Rhoads and Klein 1993; Rhoads and Block 2007).

Nomenclatural history of *Pycnanthemum torreyi*

Pycnanthemum torreyi was named by George Benth, a British botanist, based on a specimen collected by John Torrey near Princeton, New Jersey in 1831 (Figure 1)(Benth 1834). Although first published as *Pycnanthemum torrei*, the spelling of the epithet was recently changed to conform to provisions in the International Code of Botanical Nomenclature.

In 1899, commenting on the similarity of *P. torreyi* to *P. verticillatum*, Fernald justified recognition of *P. torreyi* as a distinct species based on its long-exserted stamens, and other characters including upper stem pubescence, leaf shape, and prolonged inflorescence bracts (Fernald 1899).

Meanwhile, in 1842 Asa Gray described *Pycnanthemum pilosum* Nutt. var. *leptodon* (Gray 1842). In 1878 this taxon was elevated to species status as *Pycnanthemum leptodon* A. Gray (Gray 1878).

In 1891 Kuntze transferred *P. torreyi* and *P. leptodon* to the earlier genus *Koellia* Moench (1794) (Kuntze 1891). However, the later genus name, *Pycnanthemum* Michaux (1803), which remained in wide use, was formally conserved under the International Code of Botanical Nomenclature (Greuter et al. 2000).

In 1941 Boomhour brought these two lineages together by reducing *P. leptodon* to variety status as *P. torreyi* Benth var. *leptodon* (A. Gray) Boomhour (Boomhour 1941). Although Boomhour's work was apparently never validly published, Fernald accepted it, listing the taxon *Pycnanthemum torreyi* Benth. var. *leptodon* (A. Gray) Boomhour in the eighth edition of *Gray's Manual of Botany* and citing *P. leptodon* A. Gray as a synonym (Fernald 1950).

Chambers and Chambers summed up the synonymy as: ***P. leptodon* A. Gray = *P. torreyi* Benth. var. *leptodon* (A. Gray) Boomhour = *P. torreyi* Benth** (Chambers and Chambers 2010).

Figure 1. Type specimen of *Pycnanthemum torreyi*, specimen #E00279747 Royal Botanical Garden Edinburgh. <http://www.rbge.org.uk/science/herbarium>.

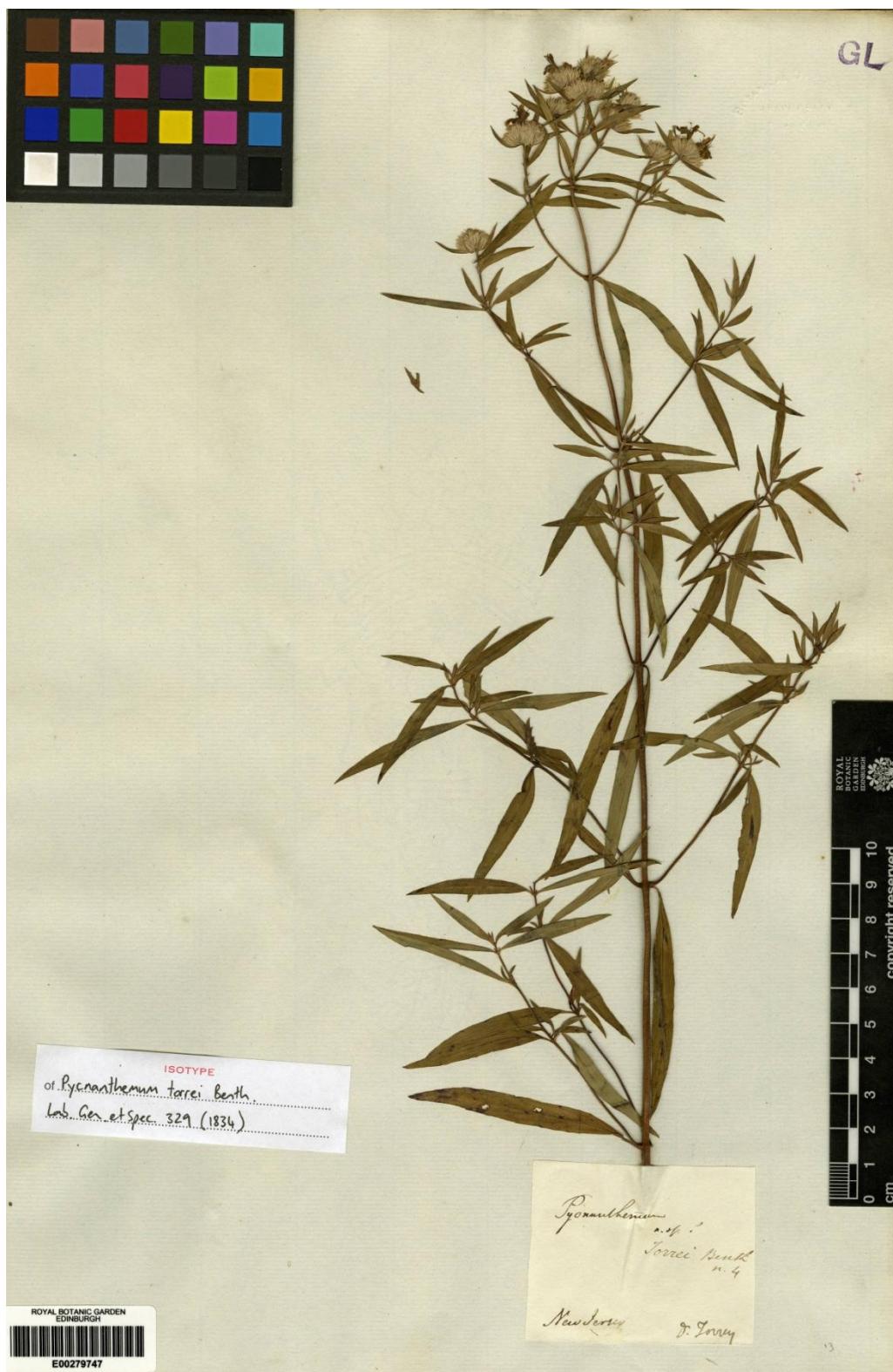
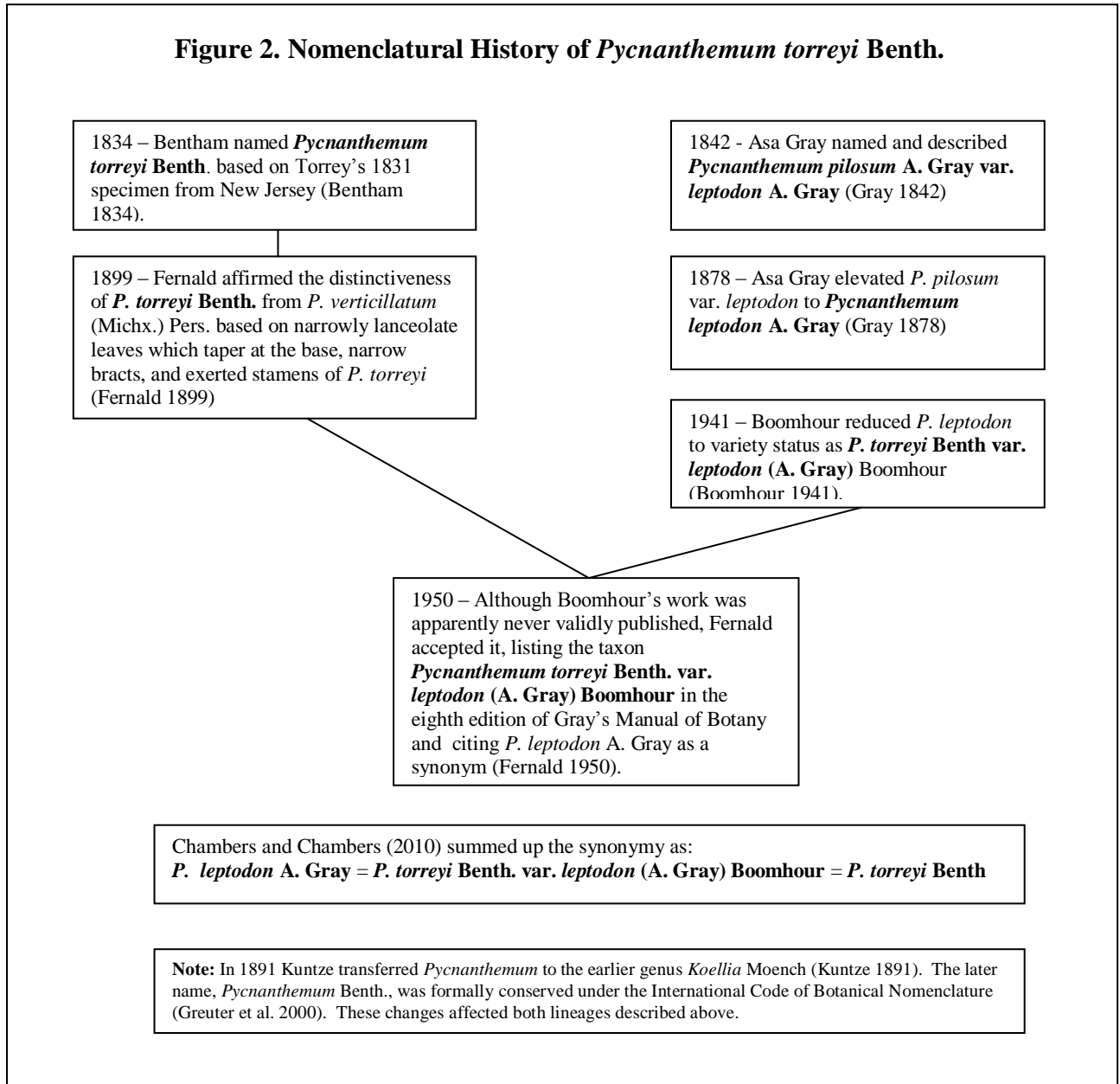


Figure 2. Nomenclatural History of *Pycnanthemum torreyi* Benth.



Recent Systematic Work

Botanists who have looked critically at *Pycnanthemum* over the years have inevitably encountered a bewildering range of variation in character states (Fernald 1899; Grant and Epling 1943; Chambers and Hamer 1992). *Pycnanthemum torreyi* sometimes appears to intergrade with *P. verticillatum*. Specimens that otherwise key to *P. torreyi* sometimes lack exerted stamens; in addition the density of pubescence varies greatly. The size of flowering heads also shows great variation.

Yetter carried out protein electrophoresis of 12 enzymes and 18 loci using three traditional species of the *P. virginianum* complex (*P. virginianum*, *P. verticillatum*, *P. tenuifolium*). His results were consistent with Chambers' conclusions regarding the presence of diploid species and a complex of allopolyploids and autopolyploids. *Pycnanthemum torreyi* was not included due to a lack of adequate material (Yetter 1989).

Williams (2005), working with samples of 53 plants representing 18 *Pycnanthemum* species collected throughout North America, produced evidence supporting a monophyletic origin for the genus. However Williams' results at the species level are marred by misidentified samples from sites in New York and Pennsylvania.

Chambers and Chambers (2008) concluded that the genus *Pycnanthemum* is a hybrid, polyploid, and partly agamosperous complex with nine diploid (or partly diploid) species at its core and a reticulate network of mostly tetraploid taxa of hybrid origin. In addition to their own work documenting chromosome numbers and hybrids (Chambers 1961; Chambers and Chambers 1971; Chambers 1993), they also drew on recent studies of molecular systematics in the genus *Pycnanthemum* by Yetter (1989) and Williams (2005).

In a treatment being prepared for Volume 16 of *Flora of North America*, *Pycnanthemum* will be divided into seven sections, each containing at least one diploid and one or more allopolyploid species that most resemble the diploid progenitor morphologically (Chambers and Chambers 2008; Chambers and Chambers 2010). *Pycnanthemum torreyi* will be included in Section *Brachystemon* with *P. muticum* (a diploid) and *P. floridanum* and *P. beadlei*, both tetraploids like *P. torreyi*.



Figure 3. *Pycnanthemum torreyi* inflorescence, photographed by Christopher Frye at Catocin Mountain Park, MD August 23, 2010

Description

P. torrei; leaves shortly petiolate, oblong-lanceolate, acute linear, scarcely serrate, narrowed at the base, distal subglabrous; verticillasters subcorymbose, thick, oblong; bracts subulate, aristate, subequalateral; calyx teeth subulate; corolla pubescent within.

Bentham 1834

Sub-equilateral calyx toothed, teeth subulate; bracts turning white-pubescent; leaves linear-oblong-lanceolate to linear, glabrous, scarcely serrate, acute at the base of the petiole, [petiole] very short, gradually narrowed to a pubescent stem.

Gray 1842

Morphology

Pycnanthemum torreyi is an herbaceous, rhizomatous perennial with 4-angled stems to 1.5 m that are glabrous below and finely pubescent toward the apex. The leaves are short-petioled, narrowly lanceolate, acute to acuminate, entire or with a few low teeth, and glabrous. Flowers are in head-like clusters (pseudocapitula) located at the stem apices and upper leaf axils and subtended by lance-acuminate floral bracts. The outer bracts are 4—5 mm long, glabrous, and have a subulate tip; inner bracts are closely appressed, puberulent, and ciliate. The bilabiate corolla is 3.5—5 mm long and pale purple or white with purple spots. The calyx is actinomorphic or nearly so, with five acuminate teeth that are 1—1.5 mm long; the four stamens are strongly exerted. The bicarpellate, 4-lobed ovary matures to form four small nutlets or mericarps. The entire plant is strongly aromatic.

Important distinguishing characteristics include linear-lanceolate leaves that taper at the base to short petioles, glabrous outer floral bracts, tight flower clusters, exerted stamens, and a radially symmetrical calyx with acuminate teeth 1—1.5 mm long.

Phenology

Flowering occurs from late June to October; fruits mature from late July through October



Figure 4. *Pycnanthemum torreyi* corollas with exerted stamens. Photograph courtesy of Christopher Frye, MD DNR.

Reproduction

Pollination

The inflorescence of *Pycnanthemum* constitutes a pseudocapitulum in which tightly compacted individual flowers have exerted corollas with extended stamens and styles that are “brushed” by pollinators (Huck 1992). Chambers (1961) has shown that pollination sometimes occurs between flowers in the same head. No information is available on specific pollinators, but several species of bees and wasps are known to visit *Pycnanthemum* flowers (Hill 2007; Yetter 1989).

Breeding Systems

The genus *Pycnanthemum* has been described as a polyploid complex with nine diploid species and 11—12 polyploid taxa (Chambers and Chambers 2008). The base 2N chromosome number is 36—40 (Chambers and Chambers 1971).

Two chromosome counts have been reported for *P. torreyi*: tetraploid, 2N=80 and hexaploid, 2N=120 (Chambers and Chambers 1971; Chambers 1993). Despite its polyploid origin, *P. torreyi* is characterized by well-developed anthers and abundant pollen (Chambers 1961). Whether *P. torreyi* is self-fruitful has not been studied, however self-compatibility is widespread in the family Lamiaceae (Owens and Uebera-Jiménez 1992).

Pycnanthemum verticillatum (2N=76—80), *P. virginianum* (2N=80), and polyploid *P. muticum* (2N=80—108), which are characterized by abortive stamens, exhibited normal seed-set in both bagged and un-bagged inflorescences, providing evidence for agamospermy in the genus (Chambers and Chambers 2008).

Seed Dispersal

Mature nutlets are held within the cup-like calyx. Shaking of the stems by wind or passing animals may assist in distributing seeds locally; some seeds may remain within the dry calyx as long as the stems remain standing. In addition, some *Pycnanthemum* nutlets develop a mucilaginous surface when wet, a condition known as myxocarpy. Myxocarpy may facilitate seed dispersal by causing nutlets to adhere to the fur of mammals or the feathers of birds (Bauman and Meeuse 1992; Meeuse 1992).

Seed Germination

No information is available on seed germination requirements.

Soil-banking Potential

Although no data are available for *Pycnanthemum*, 22 genera in the Lamiaceae are known to form persistent seed banks (Baskin and Baskin 1998).

Vegetative Reproduction

Agamospermy results in asexual seed production in some species; vegetative reproduction is also a factor; *Pycnanthemum* is strongly rhizomatous and many localized populations may actually be clones.

Ecology

Range

Pycnanthemum torreyi has been documented from New Hampshire to Georgia and west to Kansas (NatureServe 2012). It seems to be concentrated in the area between southern New York and Virginia.

Habitat

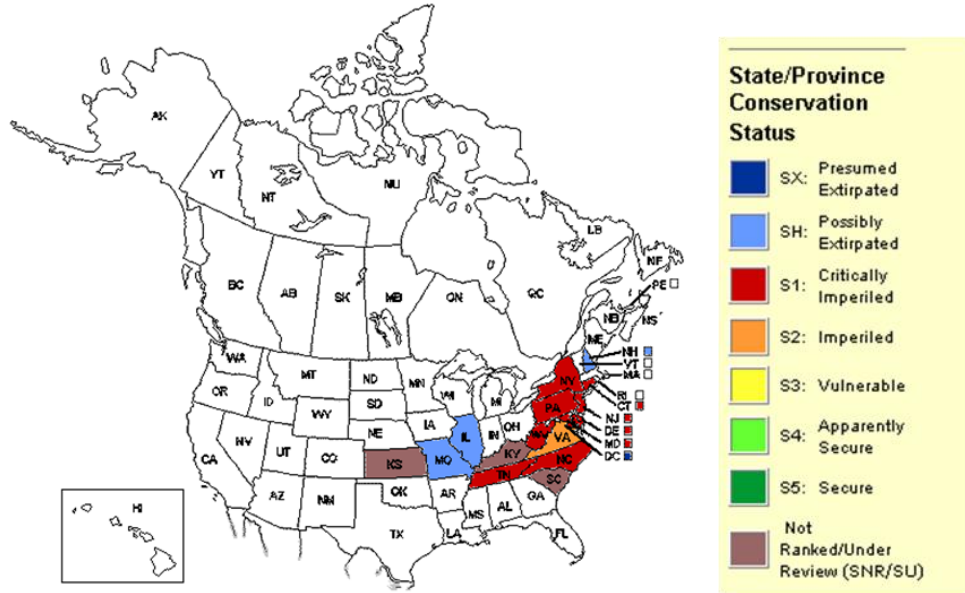
Habitat of *P. torreyi* is primarily upland, including dry to mesic upland oak-hickory forests, forested banks, rocky woods, fields, rocky hillsides, alluvial banks and thickets, cedar glades on limestone, sandstone barrens, and dry powerline corridors (Hill 2007). It has been reported on a variety of geological substrates including serpentinite, sandstone, basalt, gabbro, traprock (diabase), and limestone.

Conservation Status

Pycnanthemum torreyi is classified as imperiled at the global and national levels (G2, S2); it is known from 17 eastern and Midwestern states. It is ranked SH (possibly extirpated) in three states (New Hampshire, Illinois, Missouri) and the District of Columbia and S1 (critically imperiled) in nine states (Connecticut, Delaware, Maryland, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, and West Virginia). In Virginia *P. torreyi* is ranked S2 (imperiled); it is unranked in Kansas, Kentucky, and South Carolina (NatureServe 2012).

Figure 5. Conservation Status of *Pycnanthemum torreyi*

Source: NatureServe (2012)



Herbarium Studies

In order to evaluate the status of *Pycnanthemum torreyi* in Pennsylvania and adjacent states we borrowed specimens from seven herbaria within the region. Altogether we examined 84 specimens, 65 of which we confirmed to be *P. torreyi* based on morphology (Appendix A).

Table 1. Herbaria from which Specimens Were Obtained

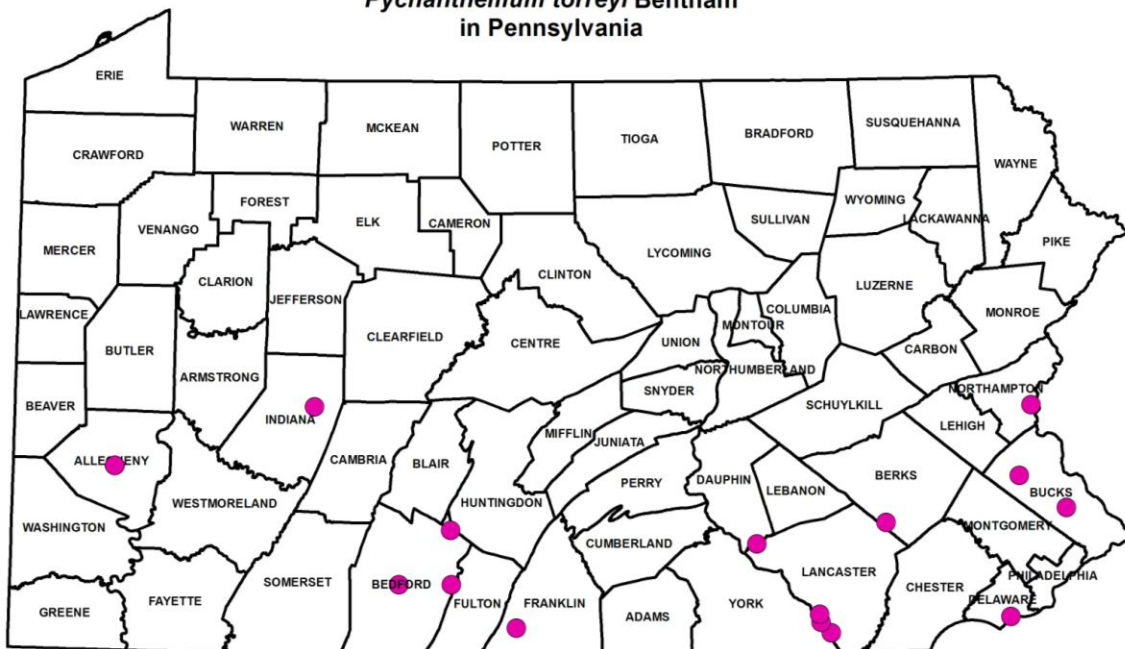
NY	New York Botanical Garden*	Bronx, NY
PH	Herbarium of the Academy of Natural Sciences	Philadelphia, PA
CM	Carnegie Museum Herbarium	Pittsburgh, PA
PSU	Pennsylvania State University Herbarium	State College, PA
CHRB	Chrysler Herbarium of Rutgers University	New Brunswick, NJ
NYS	New York State Museum Herbarium	Albany, NY
TAWES	Herbarium of the Maryland Natural Heritage Program	Annapolis, MD

*loan included an isotype collected by Torrey in 1831.

Pennsylvania

Of the 20 specimens of *P. torreyi* collected in Pennsylvania, half of were from a single location in Lancaster County in a four year period between 1888 and 1892. The earliest collection of *P. torreyi* in Pennsylvania (1861) was also from Lancaster County. Additional sites were in Allegheny, Bedford, and Franklin counties. The most recent collection was from Berks County in 1938 (Table 2; Figure 6)).

Figure 6. Historical Occurrence of *Pycnanthemum torreyi* Bentham in Pennsylvania



Current and Recent Records - There are no documented extant populations of *Pycnanthemum torreyi* in Pennsylvania. Specimens collected in 2002 from two sites in the vicinity of Graceville, Bedford County (S. Grund 2988, S. Grund 2990) were determined by the collector as *P. torreyi*. After much study, we annotated those specimens as *P. verticillatum*. Our determination was based on comparison with the *P. torreyi* isotype and keys and descriptions submitted to Flora of North America for inclusion in Volume 16 (Chambers and Chambers 2010). Critical characteristics of the specimens in question included acute but not acuminate calyx lobes less than 1 mm in length, leaves to 1.7 cm in width, and abortive stamens.

Table 2. Pennsylvania Specimens Examined During this Study

Sources: PH=Herbarium of the Academy of Natural Sciences of Philadelphia; NY=New York Botanical Garden Herbarium; CM=Carnegie Museum Herbarium

<i>species</i>	<i>year</i>	<i>county</i>	<i>location</i>		<i>collector</i>	<i>source</i>
<i>Pycnanthemum torreyi</i>	1869	Allegheny			Knipe, SW	NY
<i>P. verticillatum</i> *	1880	Delaware	Chester		Trimble, Wm	PH
<i>Pycnanthemum torreyi</i>	1888	Lancaster	Conewago	near	Small, JK	PH
<i>Pycnanthemum torreyi</i>	1889	Lancaster	Conewago		Small, JK	NY
<i>Pycnanthemum torreyi</i>	1889	Lancaster	Conewago	vicinity of	Small, JK	NY
<i>Pycnanthemum torreyi</i>	1889	Lancaster	Conewago	vicinity of	Small, JK	NY
<i>Pycnanthemum torreyi</i>	1889	Lancaster	Conewago		Porter, Thomas C.	PH
<i>Pycnanthemum torreyi</i>	1890	Lancaster	Conewago	vicinity of	Small, JK	NY
<i>Pycnanthemum torreyi</i>	1890	Lancaster	Conewago	vicinity of	Small, JK	PH
<i>Pycnanthemum torreyi</i>	1890	Lancaster	Conewago	vicinity of	Small, JK	PH
<i>P. verticillatum</i> *	1890	Lancaster	Conewago	vicinity of	Small, JK	PH
<i>P. verticillatum</i> *	1892	Lancaster	Conewago		Heller, AA	PH
<i>Pycnanthemum torreyi</i>	1892	Lancaster	Conewago		Heller, AA	NY
<i>Pycnanthemum torreyi</i>	1892	Lancaster	Conewago	vicinity of	Small, JK	PH
<i>P. verticillatum</i> *	1893	Bucks	Mozart		Woodman, Agnes	PH
probably <i>P. torreyi</i>	1904	Lancaster	Fites Eddy	above	Crawford, Jos.	PH
<i>Pycnanthemum torreyi</i>	1904	Bedford	Bedford Springs		Patterson, BH	CM
<i>Pycnanthemum torreyi</i>	1904	Lancaster	Fites (Eddy)	above	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	1904	Lancaster	Fites Eddy	above	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	1904	Lancaster	Tucquan Cr.	mouth of	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	1904	Lancaster	Tucquan Cr.	mouth of	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	1915	Berks	Virginsville	Ontelaune Cr	Long, Bayard 12813	PH
<i>Pycnanthemum torreyi</i>	1938	Berks	Alleghenyville	1 mi S	Travis, Mildred 1020a	PH
<i>P. verticillatum</i> *	1954	Indiana	Starford		Streams, Frederick	PSU
<i>P. verticillatum</i> *	2002	Bedford	Graceville	3.7 km SSW	Grund, S. et al.	CM
<i>P. verticillatum</i> *	2002	Bedford	Graceville	5.1 km SSW	Grund, S. et al.	CM
<i>P. verticillatum</i> *		Delaware	Chester		Trimble, Wm	PH

* specimens originally identified as *P. torreyi* but annotated as shown by Block and Rhoads

Connecticut

Pycnanthemum torreyi is classified as endangered in Connecticut (Connecticut Department of Energy and Environmental Protection 2012). We have examined two specimens from the New Haven area from 1910 and 1914 (Appendix A). We have not seen any specimens documenting recent occurrences.

Delaware

Pycnanthemum torreyi is ranked S1 - critically imperiled in Delaware (Delaware Natural Heritage Program 2012). Four specimens of *P. torreyi* were collected in Delaware by William Canby between 1867 and 1872 from locations in Kent and New Castle Counties (Appendix A). However, no extant populations are known (W. McAvoy, personal communication). *P. torreyi* is described as an upland species of powerline rights-of-way, roadsides, and old fields in the Piedmont and Coastal Plain (McAvoy and Bennett 2001).

Maryland

Pycnanthemum torreyi is classified S1 (highly state rare) and Endangered (at risk of extirpation) by the Maryland Natural Heritage Program (2010). A 2010 specimen from Frederick County (Frye 6004) and a 1997 Baltimore County specimen (Fleming 970904) are the only evidence of extant populations (Appendix A).

Chris Frye, Maryland State Botanist, reports two additional unconfirmed records and four historical records (C. Frye personal communication). Deer browse has been cited as a threat to *P. torreyi* in Maryland (Miller and Bratton 1992).

New Jersey

Pycnanthemum torreyi is classified as endangered in New Jersey, it is also listed as endangered by the Pinelands Commission and protected under the Highlands Water Protection and Planning Act (New Jersey Natural Heritage Program 2012).

We examined 12 specimens of *P. torreyi* from New Jersey including an isotype which was collected near Princeton in Mercer County in 1831 by John Torrey (Figure 1). Other historical collections of *P. torreyi* are from Bergen, Essex, Hunterdon, and Morris Counties in the north and Gloucester County in the south over the period 1861—1919 (Table 3).

Recent populations reported growing in dry, rocky glades in oak-hickory forests on south-facing slopes underlain by gneiss and diabase in Bergen and Passaic Counties in northern New Jersey (Snyder 1994) could not be confirmed. We did not have a chance to examine a 1931 specimen from Passaic County (Svenson 4530, GH) cited by Snyder (1994). Nor have we seen Snyder's 1990 collection from the same location or material from the Ramapo Mountains in 1991 (Snyder 1994). We have determined that a 1931 specimen from Hunterdon County (CHRB 22086) cited by Snyder, is *P. verticillatum*.

Table 3. New Jersey specimens examined during this study

<i>species</i>	<i>year</i>	<i>county</i>	<i>location</i>	<i>collector</i>	<i>herbarium**</i>
<i>Pycnanthemum torreyi</i>	1831	Mercer	Princeton	Torrey, J	NY
<i>Pycnanthemum torreyi</i>	1861	Bergen	Palisades	Parker, CF	CHRB
<i>Pycnanthemum torreyi</i>	1883	Bergen	Ft. Lee	Edwards, Harry	PH
<i>Pycnanthemum torreyi</i>	1887	Hunterdon	Kingwood	Porter, T. C. (label of)	PH
<i>Pycnanthemum torreyi</i>	1889	Hunterdon	Milford	Ruth, HF	PH
<i>Pycnanthemum torreyi</i>	1897	Gloucester	Swedesboro	Lippincott, CD	PH
<i>Pycnanthemum torreyi</i>	1916	Essex	Milburn	Miller, Waldron DeWitt 1608	CHRB
<i>Pycnanthemum torreyi</i>	1916	Essex	Milburn	Miller, Waldron DeWitt 1608	NY
<i>Pycnanthemum torreyi</i>	1919	Morris	Hibernia	Mackenzie, KK	NY
<i>Pycnanthemum verticillatum*</i>	1922	Camden	Laurel Springs	Long, Bayard 26093	CHRB
<i>Pycnanthemum verticillatum*</i>	1931	Hunterdon	Byram, 1 mi N	Loughridge, GA; Chrysler, MA	CHRB
<i>Pycnanthemum torreyi</i>		Essex	Orange Mtns.	not given	CHRB
<i>Pycnanthemum torreyi</i>		Essex	Orange Mtns.	not given	NY
<i>Pycnanthemum torreyi</i>				Durand, E	PH
<i>Pycnanthemum verticillatum</i>				Carey, J	NY

* specimens originally identified as *P. torreyi* but annotated as shown by Block and Rhoads

New York

Pycnanthemum torreyi is classified as endangered in New York (New York Natural Heritage Program 2011; Young 2010). Six historical records were collected between 1841 and 1899. Two sheets, collected by Torrey, lack date and location information. The remaining four specimens, which date from 1894—1897, are from Manhattan Island and the Bronx; all are considered extirpated.

In 2000 several *Pycnanthemum* stands that were described as mixed populations of *P. torreyi* and *P. clinopodioides* were located in Rockland County, NY on the Palisades escarpment along the Hudson River (Lamont and Fitzgerald 2001). There are no voucher specimens from the Palisades population(s) making it difficult to verify the identification. Photographs taken in 2000 and 2011, provided by Steve Young, clearly show exerted stamens, but this characteristic is common to both *P. torreyi* and *P. clinopodioides* (Chambers and Chambers 2010). Pressed material is needed to evaluate leaf and calyx characteristics and the density of the pseudocapitula. The population is declining and is threatened by an infestation of black swallowwort (*Vincetoxicum nigrum*) (Steve Young, personal communication).

In 2003 a population of about 200 *Pycnanthemum* plants was discovered along a busy highway at Kreisler Hill on Staten Island (Lamont and Young 2004; Lamont and Young 2006). Although initially identified as *P. torreyi*, specimens from this location (Young, S. 2399 and Lynch, R.T. 8/5/2003) lack exerted stamens and have been re-identified as *Pycnanthemum verticillatum* by Block and Rhoads. This location is very close to the site of two historical collections of *P. torreyi* from 1864 and 1869 (Lamont and Young 2004).

Table 4. New York Specimens Examined During this Study

<i>species</i>	<i>year</i>	<i>location 1</i>	<i>location 2</i>	<i>collector</i>	<i>herbarium</i>
<i>Pycnanthemum torreyi</i>	1841	Bronx	Kingsbridge	Carey, J	NY
<i>Pycnanthemum torreyi</i>	1893	Manhattan Island	Inwood	Bicknell, EP	NY
<i>Pycnanthemum torreyi</i>	1893	Manhattan Island	Inwood	Bicknell, EP	PH
<i>Pycnanthemum torreyi</i>	1897	Manhattan Island	Inwood	Bicknell, EP	PH
<i>Pycnanthemum verticillatum*</i>	2003	Richmond	Kreischer Hill	Lynch, RT	NYS
<i>Pycnanthemum verticillatum*</i>	2003	Richmond	Kreischer Hill	Young, S 2399	NYS
<i>Pycnanthemum torreyi</i>		New York state		Torrey, J	NY
<i>Pycnanthemum torreyi</i>		New York state		Torrey, J	NY

* specimens originally identified as *P. torreyi* but annotated as shown by Block and Rhoads

Virginia

Pycnanthemum torreyi is ranked S2 (imperiled) in Virginia. Historically it is known from 11 locations, eight of which have been confirmed, or reconfirmed, since 1992. Most populations are small, less than 35 stems and restricted to a few square meters. Only two sites are described as having more than 50 plants. We have seen specimens from only one of the sites listed in Table 5.

Habitats range from roadsides and powerline rights-of-way to grassy barrens, meadow, savannah, calcareous seepage area, rocky deciduous woods (Virginia Natural Heritage Program 2012).

Pycnanthemum torreyi is described as a very problematic species with Virginia material needing critical evaluation (Digital Atlas of the Virginia Flora. 2012).

Table 5. *Pycnanthemum torreyi* Records from Virginia Natural Heritage Program

<i>year</i>	<i>location</i>	<i>habitat</i>	<i>population</i>
1997	Seneca Creek uplands	dry, rocky deciduous woods	few
2000	Wildcat Mountain	dry meadow, breccia ledge	many, dense colony
1940	Raccoon Creek N of Mill Neck*	rich woods and thickets	specimen collected
2005	Elk Lick Run	powerline right-of-way	20+ stems
1963	Waverly, SW	roadside	specimen collected
1993	Fort Pickett Military Reservation	dryish grassy savanna	10—15 plants
1994	Brier Mountain	woodland on ultramafic rock	10+ plants
2003	Dismal Creek	roadside and calcareous seepages	25—25 plants
1995	Rocky Mill Bridge, Meherrin River	powerline right-of-way	15 plants
1995	Foxtail Bogs	powerline right-of-way	20 plants
2003	Elklick Diabase Flatwoods	level upland with diabase boulders	6 stems
2011		grassy barren with <i>P. incanum</i>	1 stem
2005		powerline right-of-way	

* voucher specimens at NY and PH

West Virginia

Pycnanthemum torreyi is ranked S1 (critically imperiled) in West Virginia. It was cited as occurring in Fayette County with the comment “a coastal plain species not known to occur elsewhere in the Appalachians” (Strausbaugh and Core 1973). Habitat of *P. torreyi* in WV is described as dry openings of woods and flatrock exposures (hard sandstone) along streams (NatureServe 2012).

We were not able to obtain any information about the current status of *P. torreyi* in West Virginia.

Critical Management Issues

What is *Pycnanthemum torreyi*?

A comprehensive study of the genus using modern molecular techniques is desperately needed. Confusion and contradiction over the identification of species within *Pycnanthemum* has been cited again and again over the years. Radford et al. (1968) lumped *Pycnanthemum torreyi*, *P. torreyi* var. *leptodon*, and *P. clinopodioides* with *P. verticillatum*. A hybrid origin for *P. torreyi* involving *P. muticum* and *P. tenuifolium* has also been suggested (Radford et al. 1968).

Grant and Epling (1943) also commented on the similarity of *P. verticillatum* to *P. torreyi*, which they distinguished mainly by the “longer and sharpened calyx teeth and more flaccid, less veiny leaves”. However, they refer to “specimens which are difficult to define, particularly in Pennsylvania” citing especially collections by Small and Heller in Lancaster County.

Two ploidy levels have been reported for *P. torreyi*: tetraploid, $2n=80$ and hexaploid $2n=120$ (Chambers and Chambers 1971; Chambers and Hammer 1993). It is not known whether these are allopolyploids or autopolyploids. Although exerted stamens with ample pollen have been described (Chambers 1961), there are no data on seed production, nor is it known if the plants are self-fruitful. Whether agamospermy occurs in *P. torreyi* is unknown; it has been documented elsewhere in the genus.

Why has *Pycnanthemum torreyi* declined throughout its range?

Pycnanthemum torreyi appears to have disappeared from many historical sites. All of the 43 confirmed *P. torreyi* specimens we examined from New York, New Jersey, Delaware, and Pennsylvania were collected more than 76 years ago. Some of the decline is likely due to habitat loss due to suburbanization, or displacement by natural succession. Limited mobility due to a reliance on clonal growth may also be a factor.

Conclusions

Research Needs

Taxonomic status - There is a critical need to clarify the status of *Pycnanthemum torreyi*.

Whether the plants identified as *P. torreyi* on the basis of morphology are all the same biological entity is not known. The genus *Pycnanthemum* is known to encompass diploids and polyploids; within *P. torreyi* two different ploidy levels occur. Hybridization occurs in the genus. Asexual reproduction, including agamospermy, is also known.

Decline - *Pycnanthemum torreyi*, as we understand it based on morphology, once occurred at scattered sites in 17 states from New Hampshire to Georgia and west to Kansas. It has declined throughout much of its range to the point that it is classified as imperiled globally and nationally. It is ranked as possibly extirpated in three states, critically imperiled in nine, and imperiled in one. It is unranked in three others.

The most recent confirmed specimen of *P. torreyi* in Pennsylvania was collected in 1938; there is no evidence that extant populations are present in the state at this time. However, it is possible that continued searching of suitable habitat in the vicinity of historical populations would result in discovery of extant populations. Unfortunately many early records are vague about the exact location or the nature of associated vegetation.

Habitat is typically described as dry, upland oak-hickory forest/woodland, cedar glades, successional old fields, barrens or utility rights-of-way on a variety of geological substrates.

Potential for Re-introduction

The only extant populations of *Pycnanthemum torreyi* that we have been able to confirm in the region are in Maryland, one is within 5 miles of the Pennsylvania border. If seeds or vegetative propagules could be obtained from these populations it might be possible to re-introduce the species to Pennsylvania. Suitable habitat would have to be found.

Measures of Success

- **Clarification of the nature of *P. torreyi* using techniques of modern molecular systematics**
- **Discovery of one or more extant populations of *P. torreyi* in Pennsylvania**
- **Propagation of *P. torreyi* plants from seeds or vegetative material from existing out-of-state populations**
- **Establishment of viable populations(s) of *P. torreyi* in Pennsylvania**

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Appendix A.
Herbarium Specimens Studied During Preparation of this Report

<i>species</i>	<i>state</i>	<i>year</i>	<i>county</i>	<i>location</i>	<i>collector</i>	<i>source*</i>
<i>Pycnanthemum pilosum</i>	AK			Fayetteville	Harvey, FL 64	NY
<i>Pycnanthemum torreyi</i>	CT	1910		New Haven	Bissell, CH	NY
<i>Pycnanthemum torreyi</i>	CT	1914		New Haven	Woodward, RW	NY
<i>Pycnanthemum torreyi</i>	DE	1867		Felton	Canby, WM	NY
<i>Pycnanthemum torreyi</i>	DE	1872		Harrington	Canby, WM	NY
<i>Pycnanthemum torreyi</i>	DE	1874		Felton	Canby, WM	NY
<i>Pycnanthemum torreyi</i>	DE	1874		Felton	Canby, WM	NY
<i>Pycnanthemum torreyi</i>	DE	1874		Felton	Canby, WM	PH
<i>Pycnanthemum torreyi</i>	GA	1893	Rabun	Estatoah Falls	Small, JK	NY
<i>Pycnanthemum torreyi</i>	GA	1893	Rabun	Estatoah Falls	Small, JK	NY
<i>Pycnanthemum torreyi</i>	GA	1893	Rabun	Estatoah Falls	Small, JK	PH
<i>Pycnanthemum torreyi</i>	IL	1877		Oquawka	Patterson, HN	NY
<i>Pycnanthemum torreyi</i>	KS	1896	Wyandotte	Rosedale	Mackenzie, KK	NY
<i>Pycnanthemum torreyi</i>	MD	1997	Baltimore	Rockdale Meadows	Flemming, Chris 970904	TAWES
<i>Pycnanthemum torreyi</i>	MD	2010	Frederick	Catoctin Mountain Park	Frye, CT, 6004	TAWES
<i>Pycnanthemum torreyi</i>	MO	1892	Dauphin		Bush, BF	NY
<i>Pycnanthemum torreyi</i>	NC	1841	Ashe	Ashe Co.	Gray, A, Carey, J	NY
<i>Pycnanthemum torreyi</i>	NC	1841	Ashe	Ashe Co.	Gray, A, Carey, J	NY
<i>Pycnanthemum torreyi</i>	NC	1934	Haywood	Lake Junaluska	Oosting, HJ 34661	PH
<i>Pycnanthemum torreyi</i>	NJ	1831	Mercer	Princeton	Torrey, J	NY
<i>Pycnanthemum torreyi</i>	NJ	1861	Bergen	Palisades	Parker, CF	CHRB
<i>Pycnanthemum torreyi</i>	NJ	1883	Bergen	Ft. Lee	Edwards, Harry	PH
<i>Pycnanthemum torreyi</i>	NJ	1887	Hunterdon	Kingwood	Porter, Thomas C. (label of)	PH
<i>Pycnanthemum torreyi</i>	NJ	1889	Hunterdon	Milford	Ruth, HF	PH
<i>Pycnanthemum torreyi</i>	NJ	1897	Gloucester	Swedesboro	Lippincott, CD	PH
<i>Pycnanthemum torreyi</i>	NJ	1916	Essex	Milburn	Miller, Waldron DeWitt 1608	CHRB
<i>Pycnanthemum torreyi</i>	NJ	1916	Essex	Milburn	Miller, Waldron DeWitt 1608	NY
<i>Pycnanthemum torreyi</i>	NJ	1919	Morris	Hibernia	Mackenzie, KK	NY
<i>P. verticillatum</i>	NJ	1922	Camden	Laurel Springs	Long, Bayard 26093	CHRB
<i>P. verticillatum</i>	NJ	1931	Hunterdon	Byram	Loughridge, GA; Chrysler, MA	CHRB
<i>Pycnanthemum torreyi</i>	NJ		Essex	Orange Mtns.		CHRB
<i>Pycnanthemum torreyi</i>	NJ		Essex	Orange Mtns.		NY
<i>Pycnanthemum torreyi</i>	NJ				Durand, E	PH
<i>P. verticillatum</i>	NJ				Carey, J	NY
<i>Pycnanthemum torreyi</i>	NY	1841	Bronx	Kingsbridge	Carey, J	NY
<i>Pycnanthemum torreyi</i>	NY	1893	Manhattan Island	Inwood	Bicknell, EP	NY
<i>Pycnanthemum torreyi</i>	NY	1893	Manhattan Island	Inwood	Bicknell, EP	PH
<i>Pycnanthemum torreyi</i>	NY	1897	Manhattan Island	Inwood	Bicknell, EP	PH
<i>P. verticillatum</i>	NY	2003	Richmond	Kreischer Hill	Lynch, RT	NYS
<i>P. verticillatum</i>	NY	2003	Richmond	Kreischer Hill	Young, S 2399	NYS
<i>Pycnanthemum torreyi</i>	NY				Torrey, J	NY
<i>Pycnanthemum torreyi</i>	NY				Torrey, J	NY
<i>Pycnanthemum torreyi</i>	PA	1845	Franklin	Mercersburg		PH

<i>Pycnanthemum torreyi</i>	PA	1861	Lancaster	Mt. Nebo	Porter, Thomas C.	PH
<i>Pycnanthemum torreyi</i>	PA	1869	Allegheny		Knipe, SW	NY
<i>P. verticillatum</i>	PA	1880	Delaware	Chester	Trimble, Wm	PH
<i>Pycnanthemum torreyi</i>	PA	1888	Lancaster	Conewago	Small, JK	PH
<i>Pycnanthemum torreyi</i>	PA	1889	Lancaster	Conewago	Small, JK	NY
<i>Pycnanthemum torreyi</i>	PA	1889	Lancaster	Conewago	Small, JK	NY
<i>Pycnanthemum torreyi</i>	PA	1889	Lancaster	Conewago	Small, JK	NY
<i>Pycnanthemum torreyi</i>	PA	1889	Lancaster	Conewago	Porter, Thomas C.	PH
<i>Pycnanthemum torreyi</i>	PA	1890	Lancaster	Conewago	Small, JK	NY
<i>Pycnanthemum torreyi</i>	PA	1890	Lancaster	Conewago	Small, JK	PH
<i>Pycnanthemum torreyi</i>	PA	1890	Lancaster	Conewago	Small, JK	PH
<i>P. verticillatum</i>	PA	1890	Lancaster	Conewago	Small, JK	PH
<i>P. verticillatum</i>	PA	1892	Lancaster	Conewago	Heller, AA	PH
<i>Pycnanthemum torreyi</i>	PA	1892	Lancaster	Conewago	Heller, AA	NY
<i>Pycnanthemum torreyi</i>	PA	1892	Lancaster	Conewago	Small, JK	PH
<i>P. verticillatum</i>	PA	1893	Bucks	Mozart	Woodman, Agnes	PH
probably <i>P. torreyi</i>	PA	1904	Lancaster	Fites Eddy	Crawford, Jos.	PH
<i>Pycnanthemum torreyi</i>	PA	1904	Bedford	Bedford Springs	Patterson, BH	CM
<i>Pycnanthemum torreyi</i>	PA	1904	Lancaster	Fites (Eddy)	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	PA	1904	Lancaster	Fites Eddy	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	PA	1904	Lancaster	Tucquan Creek	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	PA	1904	Lancaster	Tucquan Creek	Crawford, Joseph	PH
<i>Pycnanthemum torreyi</i>	PA	1915	Berks	Virginsville	Long, Bayard 12813	PH
<i>Pycnanthemum torreyi</i>	PA	1938	Berks	Alleghenyville	Travis, Mildred 1020a	PH
<i>P. verticillatum</i>	PA	1954	Indiana	Starford	Streams, Frederick	PSU
<i>P. verticillatum</i>	PA	2002	Bedford	Graceville	Grund, S; Kunsman, J; Hoff, M	CM
<i>P. verticillatum</i>	PA	2002	Bedford	Graceville	Grund, S; Kunsman, J; Hoff, M	CM
<i>P. verticillatum</i>	PA		Delaware	Chester	Trimble, Wm	PH
<i>Pycnanthemum torreyi</i>	VA	1876		Warm Springs	Nedfield, ?	PH
<i>Pycnanthemum torreyi</i>	VA	1937	Giles	Bane	Fogg, JM 13393	PH
<i>Pycnanthemum torreyi</i>	VA	1938	Giles	Bane	Fogg, JM 14721	PH
<i>Pycnanthemum torreyi</i>	VA	1940	Southampton	Mill Neck Church	Fernald, ML; Long, B	NY
<i>Pycnanthemum torreyi</i>	VA	1940	Southampton	Mill Neck Church	Fernald, ML; Long, B	PH
<i>Pycnanthemum torreyi</i>					Parker, CF	PH
<i>Pycnanthemum torreyi</i>				Salem?	Schweinitz herbarium	PH
<i>Pycnanthemum torreyi</i>						PH
<i>P. verticillatum</i>						PH
<i>P. virginianum</i>						PH

* CHRHB=Chrysler Herbarium of Rutgers University, CM=Carnegie Museum Herbarium, NY=New York Botanical Garden Herbarium, NYS=New York State Museum Herbarium, PH=Herbarium of the Academy of Natural Sciences of Philadelphia, PSU=Penn State University Herbarium, TAWES=Herbarium of the Maryland Natural Heritage Program.