



A unique species of *Triantha* (Tofieldiaceae) endemic to New Jersey, U.S.A. deserves a name

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Abstract

The genus *Triantha* (Tofieldiaceae) consists of four species, two of which, *Triantha glutinosa* and *Triantha racemosa*, have populations that are found in eastern North America. *T. glutinosa* has a primary distribution across Canada and into the northern United States, and is found in marshes, wet meadows, and on calcareous soil. *T. racemosa* primarily occurs on the Gulf Coast and in the southeastern United States in boggy areas, pine barrens, and savannas with acidic soils. The distribution of *T. racemosa* has never been known to extend beyond southern New Jersey. In the past, populations of *Triantha* found in New Jersey were identified as *Triantha racemosa*, though these plants have also been noted to exhibit some morphological characteristics associated with *T. glutinosa*. It has previously been hypothesized that the New Jersey populations are actually hybrids of *T. glutinosa* and *T. racemosa*, and that the two species may have had overlapping ranges at some point in the past. New Jersey populations are currently isolated from the nearest *T. glutinosa* and *T. racemosa* localities by hundreds of miles, too distant for gene flow to occur. Sequence analyses of the *trnH-psbA* intergenic spacer and *matK* gene region of chloroplast DNA (cpDNA), and the internal transcribed spacer (ITS) of nuclear ribosomal DNA and PCR-RFLP confirm the unique genetic identity of New Jersey populations of *Triantha*. Due to their unique genetic sequences, unique morphology, and a distribution that is isolated from extant *T. glutinosa* and *T. racemosa* populations, a new nothospecies, *Triantha* × *novacaesariensis*, is described for New Jersey populations of *Triantha*.

Key words: allopolyploid, endemic, homopolyploid, hybrid species, rare, *Tofieldia*

Introduction

The genus *Triantha* Nuttall (1818: 236), of the Tofieldiaceae Takhtajan (1995: 65), currently consists of four species (Packer 2002). *Triantha glutinosa* (Michaux 1803: 210) Baker (1879: 490), *Triantha occidentalis* (Watson 1879: 283) Gates (1918: 137), and *Triantha racemosa* (Walter 1788: 126) Small (1903: 249), all occur in North America, while *Triantha japonica* (Miquel 1867: 201) Baker (1879: 491), occurs in Japan. All are herbaceous perennials with rhizomatous underground growth. Of the three species found in North America, only two, *T. glutinosa* and *T. racemosa*, are found in the eastern United States, where they have an allopatric distribution.

Triantha glutinosa has a large, primarily northern distribution and is typically found on calcareous soil in marshes, wet meadows, stream banks, shores and rock ledges (Brumback 2001, Fernald 1950, Godfrey & Wooten 1979, Gleason & Cronquist 1991). Although widely distributed, the species is state-listed as critically imperiled (S1) or imperiled (S2), particularly throughout parts of its southern range (NatureServe 2024). *Triantha glutinosa* can be found across Canada and is listed in the provinces as follows: Yukon Territory (S3S4), Northwest Territories (S4), Nunavut (S2), British Columbia and Alberta (S5), Saskatchewan (S4), Manitoba and Ontario (S4S5), Québec (S4), Newfoundland (S5), New Brunswick and Labrador (S3S4), and Nova Scotia (S1). The taxa *Tofieldia glutinosa* subsp. *brevistyla* Hitchcock (1944: 495) and *Tofieldia glutinosa* subsp. *montana* Hitchcock (1944: 496) were previously applied to certain populations of the western range of *T. glutinosa* but have been transferred to *Triantha occidentalis* (Packer 1993). In the western U.S.A., *T. glutinosa* is found in Alaska (Packer 2002) and Oregon (SNA), and in the mid-west in Minnesota (S4S5), North Dakota (S1), Michigan (SNR), Wisconsin (S2S3), Illinois (S2), Indiana (S2S3), and Ohio (S2). In the eastern U.S.A., its distribution reaches into New York (S1), Connecticut (SNR), Vermont (S1),

New Hampshire (S1), and Maine (S3S4) (Brouillet *et al.* 2010+, NatureServe 2024, USDA-NRCS 2024). There are also rare, disjunct occurrences in the Appalachian regions of Georgia (SH), North Carolina (S1), Virginia (S1), West Virginia (S1) and Tennessee (S1). There is no published record of *T. glutinosa* ever being found in New Jersey (NJ) (Kartesz 2015, USDA-NRCS 2024). A single New Jersey specimen in the herbarium at The Academy of Natural Sciences of Drexel University (PH), was collected and labeled as *T. glutinosa* by John Harshberger (*Harshberger s.n.* 29 July 1913, PH00587397) although Harshberger only mentioned *T. racemosa* in his work *The Vegetation of the New Jersey Pine Barrens* (1916).

Triantha racemosa has a distribution across the southeastern U.S.A. and is found primarily along the Atlantic and Gulf coastal plains in boggy areas, pine barrens, and savannas (wet meadows) with sandy-peaty acidic soils (Fernald 1950, Godfrey & Wooten 1979, Gleason & Cronquist 1991, Packer 2002, NatureServe 2025a). Its range has never been reported further north than southern New Jersey (Kartesz 2015, USDA-NRCS 2024, NatureServe 2025). There are historical records of *T. racemosa* in Maryland and Delaware (from a single location) but the plant is now Presumed Extirpated (SX and SX.1, respectively) from these states (Tatnall 1946, Maryland Natural Heritage Program 2021, McAvoy 2024, NatureServe 2024). It is listed as Critically Imperiled (S1) in Tennessee, possibly Extirpated (SH) in Virginia, Vulnerable-Imperiled (S2S3) in Louisiana, Apparently Secure (S4) in North Carolina, Florida, and Mississippi, and is not ranked (SNR) in South Carolina, Georgia, Alabama, and Texas (NatureServe 2024).

Specimens of *Triantha* found in New Jersey have historically been identified as *T. racemosa*. This species is currently ranked as Critically Imperiled (S1) and listed as an endangered species in the state (NJNHP 2024a). New Jersey also lists the species as LP (taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction) and HL (taxa or ecological communities protected by the Highlands Water Protection and Planning Act within the jurisdiction of the Highlands Preservation Area (NJNHP 2024a).

Although colonial era botanists such as Pehr Kalm, John and William Bartram, and early, post-colonial botanists including Frederick Pursh, Constantine Rafinesque, Thomas Nuttall, among others, did explore and document the flora of the Pine Barrens of New Jersey, they did not record the presence of any *Triantha* species. Pursh (1813) and Nuttall (1818) were familiar with the genus *Tofieldia* and did list personal observances of *Triantha racemosa* as *Tofieldia pubescens* Persoon (1805: 399) in Virginia and Carolina, and in Sussex County, Delaware, respectively. The earliest documentation of *Triantha* (as *Tofieldia*) in New Jersey was by Dr. P.D. Knieskern in Gray (1848) and who published an early catalogue of Ocean and Monmouth Counties and listed, “*Tofieldia pubens*, *Ait. Near Manchester in a swamp, rare, O. [Ocean Co.]*” (Knieskern 1857). Subsequent publications on the New Jersey flora also cited Knieskern’s record (Willis 1874, Britton 1881, 1890, Taylor 1915).

Stone (1911) gave a more detailed account of the species’ discovery and its whereabouts in New Jersey: “*Bogs in the heart of the pine barrens, local. This plant is limited to the same area that the Abama [=Narthecium americanum Ker Gawl.] inhabits, but is much rarer. It was originally discovered in the State by Dr. P.D. Knieskern at Manchester (=Lakehurst). The older botanists, as well as Canby, A.H. and C.E. Smith, who were familiar with the Abama, never found the Tofieldia, and curiously enough Knieskern apparently never succeeded in finding the former. After forty years the plant had not been found again, and Dr. Britton could only quote Knieskern’s record. On July 4, 1899, however, Mr. C.F. Saunders collected it between Tuckerton and Atsion on a savanna near Symme’s Place. On July 4, 1904, after reading Mr. Saunders’ account, Mr. H. L. Coggins and I visited a spot near High Bridge, over the Wading River, where I thought conditions were favorable to its growth, and sure enough the minute we entered on the flat savanna land bordering the river, the white spikes of starry flowers, like miniature Turkey-beard, were seen on either hand, their heads reaching just above the grass and sedge. The following day, below Speedwell, we found it again, and on Pole Branch that afternoon a great patch of it was found mingled with the yellow spikes of the Abama, a truly wonderful sight, and not content with the sandy bog, individual plants had established themselves in damp spots in the middle of the old road, as if they knew that they had little to fear from passing traffic.*”

Since that time additional locations with *Triantha* have been located, all within Burlington County (NJNHP 2024b).

In his treatment of *Triantha* for the Flora of North America Project, Packer (2002) observed that New Jersey material sometimes exhibited morphology similar to that of *T. glutinosa* and proposed that: “*in the past the two species had overlapping ranges in this northeastern region where they no longer are found, and that some hybridization between T. glutinosa and T. racemosa has occurred. The Burlington County population is a surviving disjunct remnant with attributes of both species. The specimens [NY 3731027, 3731028, 3731029, 3731030, 3731031, 3731032, 3731033, 3731034; 3731035 have this detailed explanation] have been annotated ‘T. glutinosa × T. racemosa’, and New Jersey is omitted from the list of states in which T. racemosa is found.*”

Although *T. glutinosa* and *T. racemosa* have been documented as sympatric in some states (GA, VA, TN, NC, SC) there is no instance of co-occurring populations, or even occurrences in the same counties, as documented by herbarium specimens or literature records. The New Jersey populations of *Triantha* are currently isolated from the nearest *T. glutinosa* and *T. racemosa* localities by hundreds of miles, beyond a reasonable distance for gene flow to occur.

To further evaluate and clarify the taxonomic status of *Triantha* populations in New Jersey, the morphological characteristics of herbarium specimens were evaluated. Direct sequence analyses of the *trnH-psbA* intergenic spacer and *matK* gene regions from the chloroplast genome (cpDNA), the internal transcribed spacer (ITS) of nuclear ribosomal DNA, and PCR-restriction length polymorphism (PCR-RFLP) were conducted using plant tissue collected in the field from populations of *T. glutinosa*, *T. racemosa*, and New Jersey *Triantha* populations.

Methods

Taxon sampling and plant material

Samples representing *Triantha glutinosa* populations in Maine, New York, and New Brunswick, Canada, *T. racemosa* populations in Alabama, Georgia, and Florida, and *Triantha* populations in New Jersey were collected for genetic analyses (Table 1, Fig. 1). A total of 42 field-collected samples were included in the study. Sites were primarily chosen by reviewing herbarium records from *Global Biodiversity Information Facility* GBIF (2026a, 2026b), *The Consortium of Northeastern Herbaria* (CNH Portal 2026) and by corresponding with herbarium curators, collection managers, and field botanists. New Jersey specimens were collected with appropriate permissions from Warren Grove Gunnery Range, Franklin Parker Preserve, and other localities in the New Jersey Pine Barrens. Herbarium voucher specimens are deposited at the Academy of Natural Sciences of Drexel University herbarium (PH) in Philadelphia. Herbarium specimens of *T. glutinosa* and *T. racemosa*, collected from across their distribution ranges, as well as additional New Jersey *Triantha* specimens housed at BKL, CHRB, NY, P, PH, and WV were examined for locality data and morphological characteristics (specimens examined listed in Appendix 1).

TABLE 1. Collection localities of New Jersey *Triantha*, *Triantha glutinosa* and *Triantha racemosa* populations analyzed for chloroplast DNA and nuclear DNA variation.

Taxon	Country	State	Location
<i>T. racemosa</i>	USA	Alabama	Solon-Dixon Forest
<i>T. racemosa</i>	USA	Alabama	Conecuh National Forest
<i>T. racemosa</i>	USA	Florida	Rt 167 near 75
<i>T. racemosa</i>	USA	Florida	West side of RT 65
<i>T. racemosa</i>	USA	Georgia	CR 136 N of Cleary
<i>T. racemosa</i>	USA	Georgia	RT 301 N of Folkston
<i>T. × novacaesariensis</i>	USA	New Jersey	Franklin Parker Preserve, Burnt Bridge
<i>T. × novacaesariensis</i>	USA	New Jersey	Tulpehocken Creek
<i>T. × novacaesariensis</i>	USA	New Jersey	Warren Grove Gunnery Range
<i>T. glutinosa</i>	USA	New York	Bergen Swamp
<i>T. glutinosa</i>	Canada	New Brunswick	Nashwaak River
<i>T. glutinosa</i>	Canada	New Brunswick	Little S.W Mirimichi River
<i>T. glutinosa</i>	USA	Maine	St. John River W of Ft. Kent

Genetic analysis

Immediately upon collection, fresh leaves were placed in silica gel, and the desiccated samples were subsequently stored at -80°C. A sample consisting of 0.2 mg of dried frozen leaf material was homogenized in a BeadBug Microtube homogenizer (Benchmark Scientific, Edison, NJ), and DNA was extracted using the DNAeasy Plant Mini Kit (Qiagen

Inc., Valencia, Ca) according to the manufacturer's instructions. The internal transcribed spacers (ITS) of the nuclear ribosomal DNA repeat and the plastid *trnH-psbA* and *matK* regions of the extracted DNA were amplified using Polymerase Chain Reaction (PCR) and sequenced to compare sequence data between specimens. Primers and PCR mix protocols for ITS and *trnH-psbA* followed those of Fazekas *et al.* (2012). The *matK* region was amplified and sequenced using primers TM1F and TM7R (Azuma & Tobe 2011). The PCR amplification of *matK* was performed in a volume of 9 μ L consisting of 3.5 μ L molecular grade water, 1.7 μ L 5% trehalose buffer, 1 μ L 10 \times buffer, 0.5 μ L MgCl₂, 0.2 μ L of dNTP mix, 1 μ L of each primer, 0.1 Taq polymerase, and 1 μ L DNA extract. PCR products were cleaned using ExoSAP-IT following the manufacturer's protocol (USB-Affymetrix, Cleveland Ohio) prior to sequencing by Genewiz LLC (South Plainfield, NJ). Sequences were aligned using the built-in MUSCLE program feature in MEGA version 6.06 (<http://www.megasoftware.net/>).

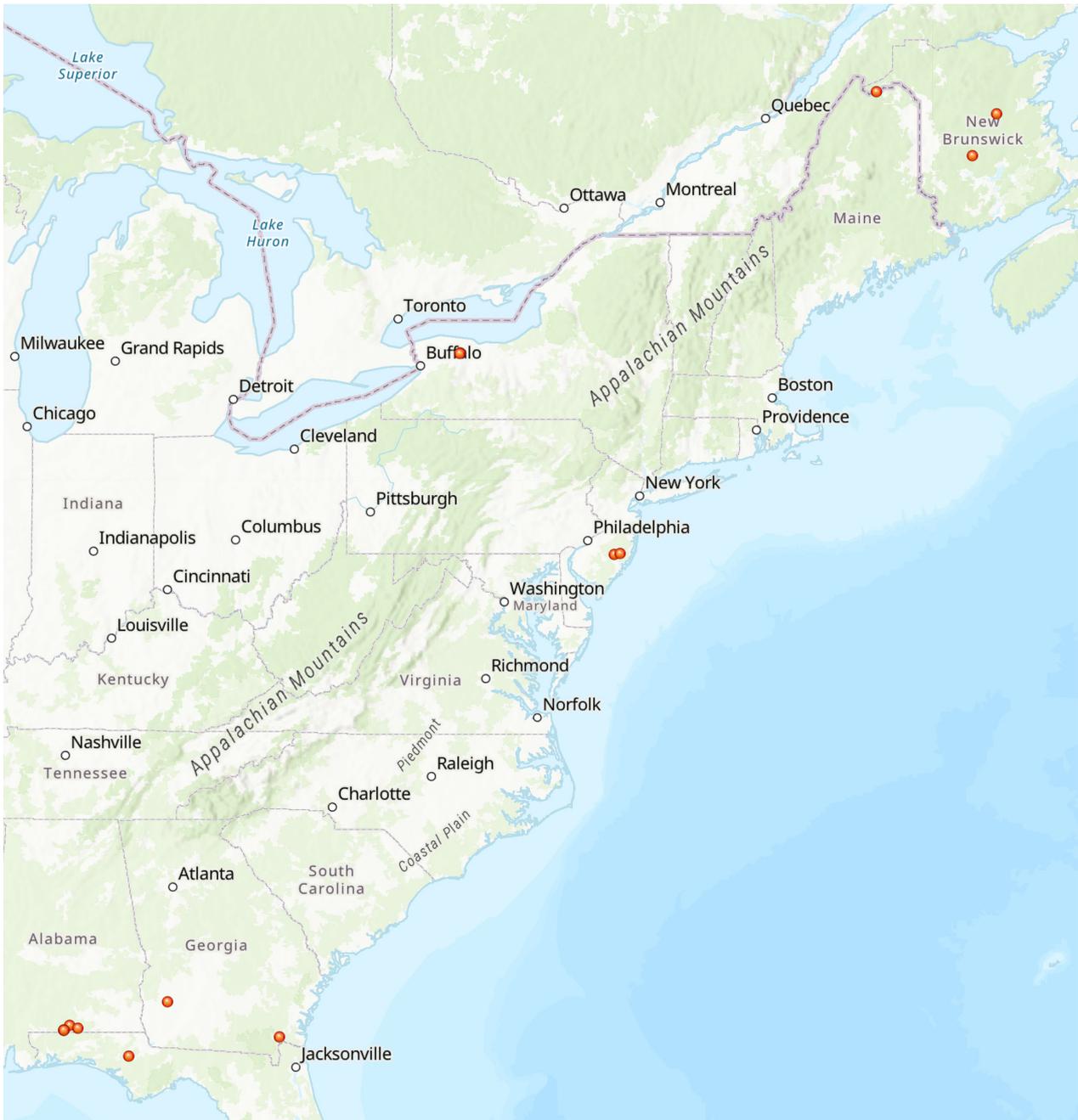


FIGURE 1. Map of collection localities for *Triantha* samples used in the genetic analysis.

Restriction fragment length polymorphism analysis of *matK* and *trnH-psbA* PCR product (PCR-RFLP) was used to document and confirm the results of the direct sequencing for these regions. For PCR-RFLPs to generate patterns that show shared sequence variation, restriction enzymes (New England Biolabs Incorporated, Ipswich, MA) were selected based on the variable sites found in the sequences. Restriction digests were performed with 5 μ L of purified

PCR product, 5 μ L CutSmart® Buffer buffer, 1 μ L of *Bst*UI (*matK*) or *Stu*I (*trnH-psbA*), and 39 μ L of molecular grade water. Products were separated on a 1% agarose gel in 1x TBE buffer using SYBR® Safe DNA gel stain and BlueJuice™ gel loading buffer and visualized at 470 nm with a Safe Imager™ 2.0 Blue-Light Transilluminator (ThermoFisher Scientific, Waltham, MA).

Results

Thirteen specimens of *Triantha glutinosa*, 11 specimens of New Jersey *Triantha* populations, and 18 specimens of *T. racemosa* were sequenced for each DNA region (nuclear ITS, and plastid *matK* and *trnH-psbA*). All sequences showed low variability. Final *matK* sequences were 641 bases long without gaps in the sequence, with a single nucleotide polymorphism at site 291. Only the NJ and *T. racemosa* specimens sharing the same base and digestion fragments (Fig. 2). Final *trnH-psbA* sequences were 159 bases long without gaps in the sequence, with a single nucleotide polymorphism at site 151. Only the NJ and *T. racemosa* specimens shared the same base and digestion fragments (Fig. 3). Final ITS sequences were 641 bases long without gaps in the sequence, and sites 149, 211, 257, 469, and 472 were variable sites in which the NJ and *T. glutinosa* specimens shared the same bases, while ITS site 543 had a shared variation for NJ and *T. racemosa* specimens (Table 2). No observations were made of polymorphic peaks (two overlapping peaks) at these variable sites within the same individual sample sequence.

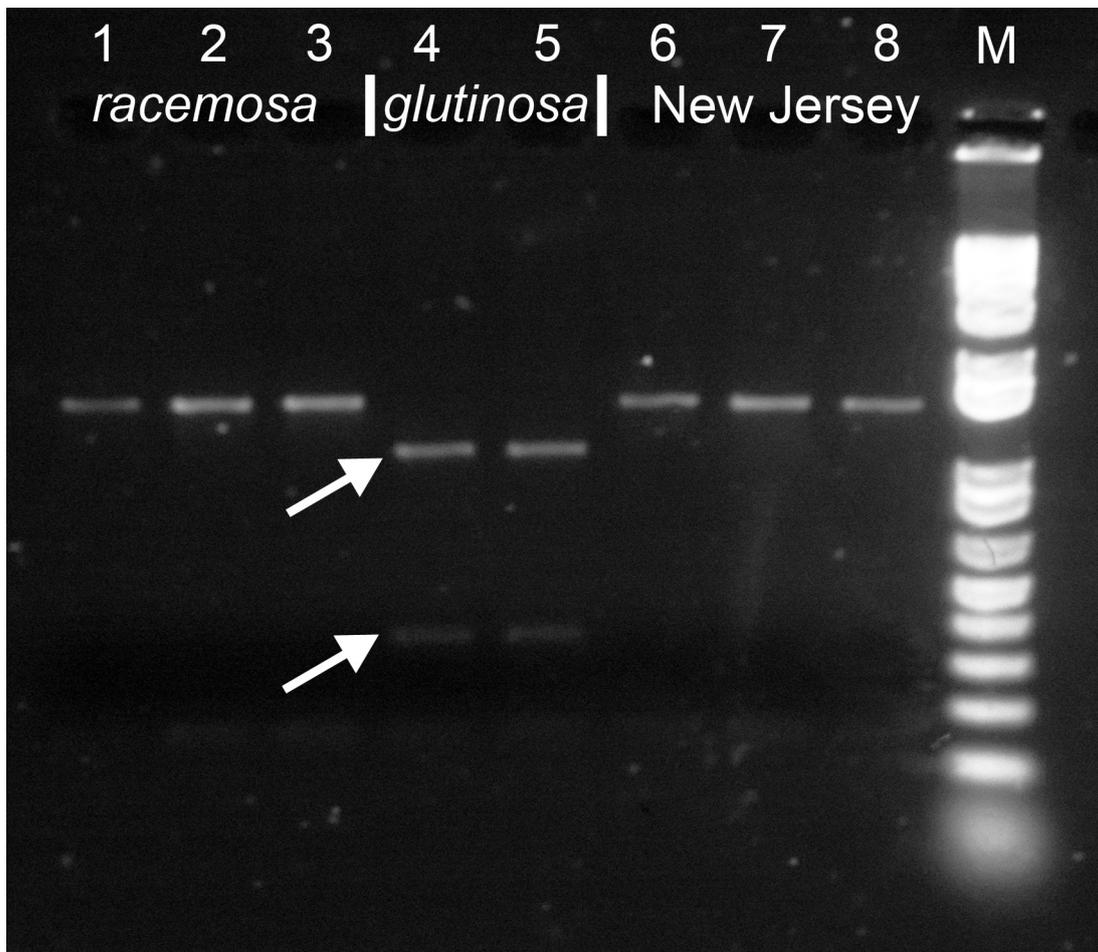


FIGURE 2. RFLP of *matK* PCR product using *Bst*UI restriction endonuclease. *Triantha glutinosa* had a single point mutation that differed from both New Jersey *Triantha* populations and *Triantha racemosa*, the latter of which had identical sequences.

TABLE 2. Shared ITS polymorphisms within New Jersey *Triantha* populations and *T. glutinosa* or *T. racemosa*. The New Jersey populations shared 5 unique polymorphisms with *T. glutinosa* and 1 polymorphism with *T. racemosa*.

Species	Position in alignment					
	147	209	255	467	470	541
<i>T. glutinosa</i>	T	C	C	G	C	T
<i>T. racemosa</i>	G	T	T	A	T	C
NJ populations	T	C	C	G	C	C

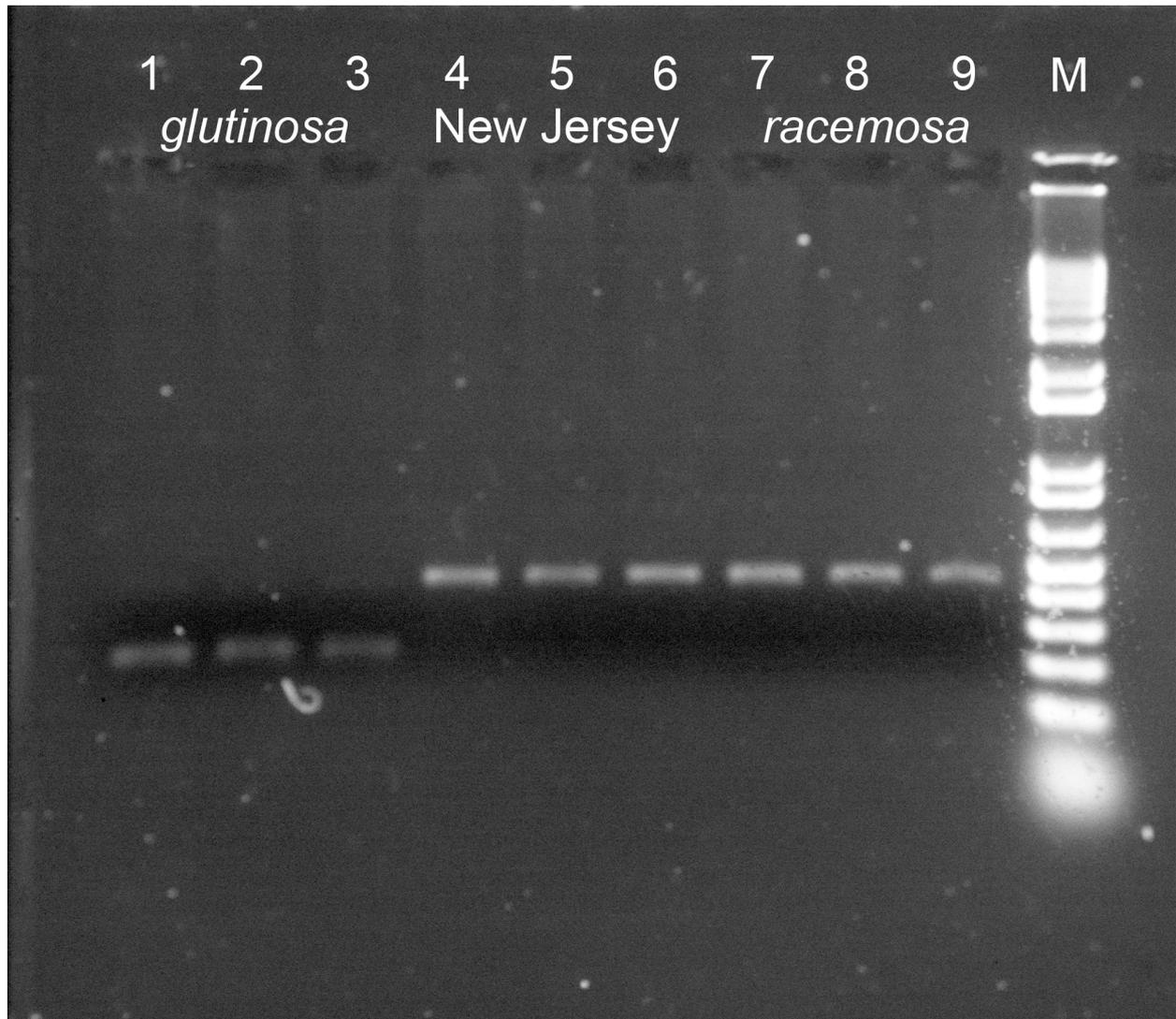


FIGURE 3. RFLP of *trnH-psbA* PCR product using *stul* restriction endonuclease. *Triantha glutinosa* had a single point mutation that differed from both the New Jersey *Triantha* populations and *Triantha racemosa*, the latter of which had identical sequences.

Discussion

Based on these genetic data, New Jersey populations show evidence of being the result of hybrid speciation between *T. glutinosa* and *T. racemosa*. It is theorized that this hybridization event occurred at some point in the past when the species had sympatric distributions. In the nuclear DNA ITS region, New Jersey samples possessed sequences containing nucleotide substitutions diagnostic of both *T. racemosa* (one shared substitution) and *T. glutinosa* (five shared substitutions) (Table 2). It is theorized that homogenization of the ITS region of New Jersey *Triantha* was initiated through concerted evolution, as hybrid progenies have been shown to display allelic sequences similar to those of both parents in bi-parentally inherited regions such as ITS (Fuertes Aguilar *et al.* 1999, Hu *et al.* 2016). For plastid

DNA regions *matK* and *trnH-psbA*, New Jersey samples share unique genetic markers with *T. racemosa*. These data suggest ancestral parentage of both *T. glutinosa* and *T. racemosa* for New Jersey populations, and results are consistent with a hybrid origin. All putative hybrid populations were monomorphic at these variable sites, indicating that hybrids shared cpDNA sequences with only one parental species, thus indicating uniparental inheritance. Although organelle inheritance has not been studied previously in Tofieldiaceae, biparental inheritance of cpDNA is less common in angiosperms. Based on the consistent matching variation in the chloroplast regions between New Jersey plants and *T. racemosa*, it is proposed that *T. racemosa* was the female parent species.

Although New Jersey *Triantha* populations have historically been recognized as *T. racemosa*, the NJ populations have strong similarities to *T. glutinosa* morphologically. The most distinct and consistent traits of New Jersey plants include having larger, chartaceous capsules (Fig. 4A & E), having an elongated seed appendage similar to those of *T. glutinosa* (Fig. 4B & F), and the presence of glutinosa-type glands. These characteristic multicellular glands are dark-colored, nearly sessile, and have a distal pore (Lersten & Curtis 1977). A character that was consistently different between New Jersey specimens and *T. glutinosa* was style length and degree of curvature in the mature fruit, with the styles (sometimes referred to as the capsule beak) of NJ material being more elongate and erect, and those of *T. glutinosa* being distinctly shorter and more recurved (Fig. 4A & E). The ratio between capsule and tepal length has also been regarded as a defining character separating the two species, with the capsule *T. racemosa* equaling or slightly longer than the tepals and the capsule of *T. glutinosa* being approximately twice as long as the tepals. NJ populations fall within the middle, with the tepals approximately 2/3 the length of the capsule (Fig. 4E).

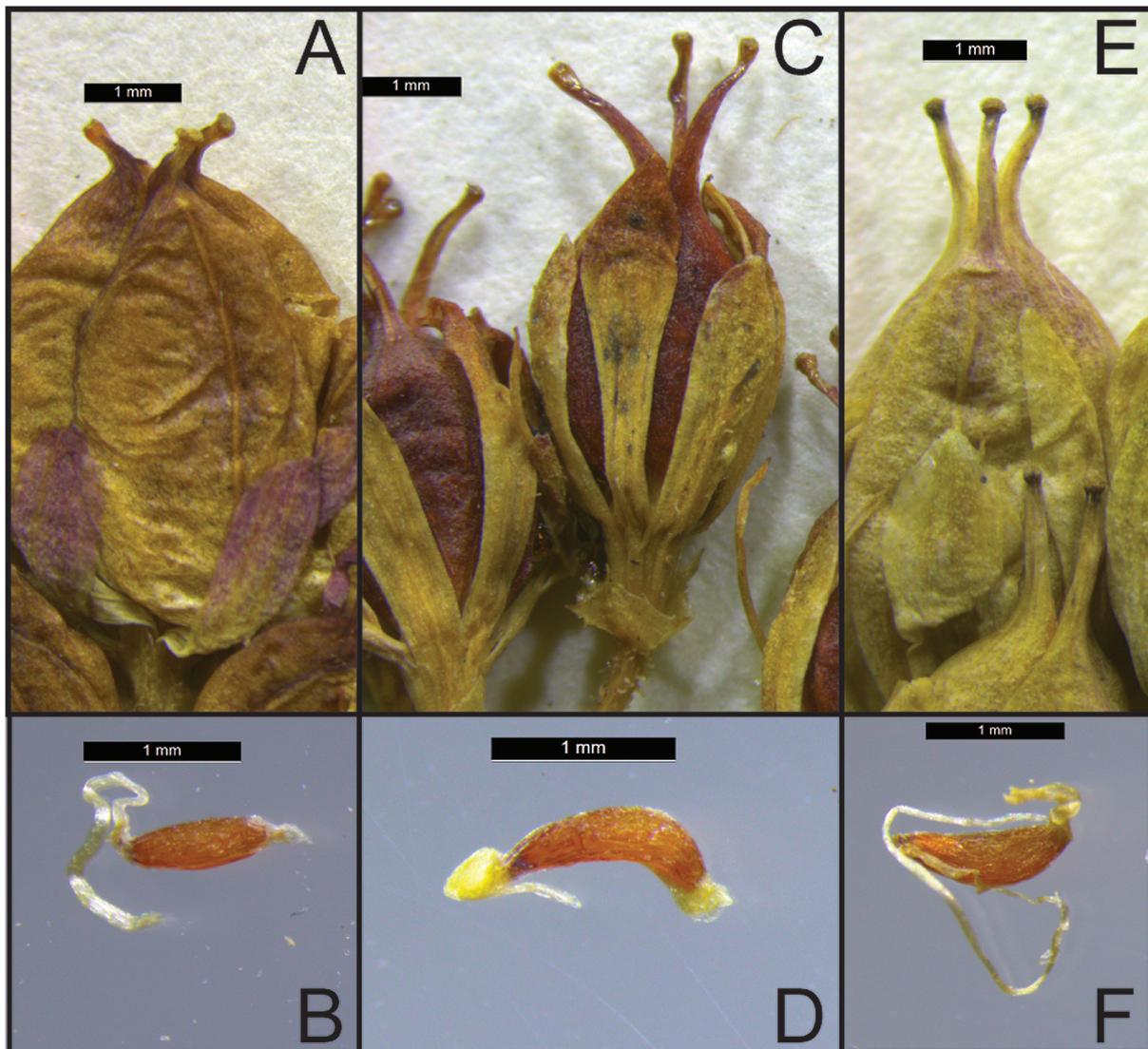


FIGURE 4. Characteristics of (A) *Triantha glutinosa* capsule Fernald, Long and Fogg 1518 PH, (B) *T. glutinosa* seed Walker 1342 PH, (C) *Triantha racemosa* capsule Commons s.n. PH, (D) *T. racemosa* seed Wherry and Pennell 14447 PH, (E) *Triantha novacaesariensis* capsule Fogg 4750 PH, (F) *T. novacaesariensis* seed Long 53816 PH.

Currently, the closest extant populations of both *T. glutinosa* (populations in Saratoga Co., New York, Cheshire Co., New Hampshire, Grayson Co., Virginia) and *T. racemosa* (Prince George Co. and Isle of Wight Co., Virginia) are hundreds of miles from the *Triantha* populations in New Jersey. It is possible that at some point in the past, the two parental species may have had sympatric distribution, possibly in southern periglacial refugia. Some earlier researchers hypothesized that southern New Jersey was a location of a refugium during the Pleistocene epoch, and this theory is still postulated by some authors (Pötzger 1945, 1952, Kim *et al.* 2018). However, the type of environment that existed in this area during the last period of glaciation has also been described as a frozen, arctic landscape where peat accumulation and vascular plant colonization did not begin to occur until the Holocene postglacial warming, and well after the initiation of glacial retreat in areas farther north (Southgate 2000, Stanford 2000).

In a study of sediment cores, it was noted that the sampling site, a savanna along the Oswego River where *Triantha* currently occurs, has been a sphagnum-dominated acidic fen for the last 8000 years, with pollen of the currently co-occurring *Narthecium* identified in sediment cores from approximately 2000–3000 years before present (Southgate 2000). It is likely that *Triantha* populations currently in New Jersey entered the region post-Wisconsin Glaciation from more southerly Appalachian refugia (Buell 1970, Watts 1979, Jackson *et al.* 2000, French *et al.* 2007, French & Demitroff 2012, Demitroff 2016, Wolfe *et al.* 2023).

The historical and current distributions of *Triantha racemosa* and *T. glutinosa* in eastern North America, as well as glaciological evidence, suggest that the New Jersey populations of *Triantha* have been genetically isolated for thousands of years. Due to the unique genetic sequences, unique morphology, and a unique distribution, isolated from all extant *T. glutinosa* and *T. racemosa* populations, New Jersey populations should be recognized as a new independent taxon that is endemic to the state of New Jersey.

Taxonomy

Triantha × *novacaesariensis* Eisenman, *notho* sp. nov.

Triantha novacaesariensis closely resembles *Triantha glutinosa* in that it has chartaceous capsules, squat, dome-shaped multicellular glands and two seed appendages with one being much shorter than the seed and the other being highly contorted and 1–4 times longer than the seed. It differs from *T. glutinosa* by having a taller stature and longer leaves. The styles are consistently longer than those of *T. glutinosa*, and more erect to nearly vertical, with little to no recurvation in fruit prior to dehiscence, while the styles of *T. glutinosa* are shorter, and recurved to nearly a perpendicular position to the axis of capsule. *Triantha novacaesariensis* resembles *Triantha racemosa* in plant height but differs by having a chartaceous capsule that is easily ruptured. It also has a more compact inflorescence with less space between the flower clusters. Unlike *T. racemosa*, its tepals are shorter than the capsule and do not enclose it. The capsules of *T. novacaesariensis* are typically larger, longer, more ellipsoid, and less globose than those of *T. racemosa* with a more gradual taper to the style base. *Triantha novacaesariensis* specimens have capsules that are usually lighter in color, drying tan, and not reddish brown.

Type:—USA, New Jersey: John M. Fogg Jr. 4750 (holotype PH! (PH00587400), isotype PH! (PH00587399).

Herbaceous perennial, rhizomatous; leaves 2-ranked equitant, blades 1–5, 65(–70) cm, linear, glabrous. A smaller single cauline leaf sometimes present, below or above the middle of the flowering scape, 10–60 cm. Flowering scape singular, glandular below inflorescence, glands, primarily conical and occasionally dome-shaped, 1/2–2 times longer than wide, sticky, rarely glandular-pubescent with coarse cylindrical hairs just below the inflorescence. Inflorescences terminal, racemose, dense or open towards base, 30–65 mm, bracteate, bracteolate. Flowers usually in clusters of 3 per node, or less towards top of inflorescence, terminal flowers maturing first; bracts subtending clusters triangular 2.0 × 2.5 mm, bracts subtending individual pedicels 2.0 × 1.5 mm, often acute; bracteoles in epicalyx connate, ranging from shallow to deeply cleft-lobed, typically obtuse, glabrous; pedicels densely covered with cylindrical hairs; tepals 6, persistent, shorter than or equal to the capsule and not enclosing it; stamens 6; styles 3, during fruiting condition elongated with little to no recurvature, less than 45° from vertical. Capsules ovoid, 3.50–7.25 mm, typically longer than tepals and not enclosed by them, chartaceous, easily fractured. Seeds brown with two seed appendages, one being much shorter than the seed and the other being highly contorted and 1–4 times longer than the seed.

Etymology and Vernacular Name—The specific epithet refers to the adjectival form of New Jersey, which is the sole known locality of this taxon. ‘New Jersey false-asphodel’ is proposed as a common name.

Ecology and distribution—The existing New Jersey populations occur in wet, acidic, nutrient-poor soils of acidic fens or savannas dominated by grass and sedge species and edged by white cedar swamps and pitch pine lowlands (Walz *et al.* 2006). Characterization and knowledge of these Pine Barren savannas have evolved over time. Harshberger (1916) provided an early, detailed description and mapped the extent of savannas. More recent works have further refined the understanding of these systems and have documented the influence of anthropogenic activities on the expansion of these habitats, as well as their subsequent change and reduction of associated flora due to natural succession (McCormick 1979, Breden 1989, Walz *et al.* 2006). The Pine Barren Riverside Savanna complex is found along the floodplain edges of rivers and streams in the New Jersey outer coastal plain. These riverside savannas are ground water seepage saturated peatlands (acidic seepage fens) and are associated with Atlantic white cedar swamps (*Chamaecyparis thyoides* (Linnaeus 1753:1003) Oersted 1865: 21) (Walz 2004).

Six ecological community types of Pine Barren Riverside Savanna in New Jersey have been classified in the U.S.A. National Vegetation Classification system (Walz *et al.* 2006, USNVC 2025). The two associations that are noted as having *Triantha* are CEG006263 (Pine Barrens Streamside Bog Asphodel Wet Meadow) *Chamaecyparis thyoides* / *Nartheceium americanum*—*Sarracenia purpurea*—*Drosera filiformis* / *Sphagnum pulchrum* Fen and CEG006285 (Pine Barrens Streamside Sedge Wet Meadow) *Rhynchospora* (*R. alba*, *R. cephalantha*)—*Muhlenbergia uniflora*—*Lophiola aurea* (NatureServe 2025b, 2025c).

Within New Jersey, *Triantha* × *novacaesariensis* is typically found growing in remote areas of the Pine Barrens with a variety of other rare species, particularly *Nartheceium americanum* Ker Gawler (1812: 1505) (G2, S2, E), which is now solely found in the New Jersey Pine Barrens (Stone 1911, 1912, Schuyler 1990, Kelly 2018, NatureServe 2024). Other commonly associated species include *Calamagrostis pickeringii* Gray (1848: 547) (S2, E), *Calamovilfa brevipilis* (Torrey 1823: 95) Scribner (1890: 216), *Juncus caesariensis* Coville (1894:106) (G2, S2, E), *Lophiola aurea* (Ker Gawler 1813: 1596) Wood (1847: 540), *Muhlenbergia torreyana* (Schultes 1824: 203) Hitchcock (1934: 136) (G3, S3), *Oclemena nemoralis* (Aiton 1789: 198) Greene (1903: 5), *Platanthera integra* Nuttall (1818: 188) Gray ex Beck (1848: 348) (G3, S1, E), *Pogonia ophioglossoides* (Linnaeus 1753: 951) Ker Gawler (1816: 148), *Rhynchospora oligantha* Gray (1835: 212) (G4, S2), *Schizaea pusilla* Pursh (1813: 657) (G3/G4, S3), and *Sphagnum* (Linnaeus 1753: 1106) spp. (Schuyler, 1990).

The New Jersey Natural Heritage Program (NJNHP) has recorded 26 occurrences, of which 5 are historic, 1 is extirpated, and 20 are currently extant. NJNHP currently lists the species as occurring only in Burlington County. Historical records note an occurrence in Lakehurst, Ocean County, but that population is no longer considered extant (Stone 1911, Hough 1983, NatureServe 2024, NJNHP 2024a,b). Surveys conducted between 1985–2022 have documented 20 extant occurrences, all in Burlington County in the Mullica River watershed. Of these, 18 are on protected land (15 state, 3 federal). Of those occurrences, only 5 are in excellent or good condition (NJNHP 2024c).

Even with state protection of vast areas of Pine Barrens in southern New Jersey, Pine Barren Riverside Savanna wetland habitats are globally imperiled and are still at risk (G2, S2). These rare ecological communities have been the subject of studies to determine their historical and current extent, their formation and the effects of anthropogenic activities, and subsequent ecological succession. Early descriptions of these habitats noted wide savannas with terraces that were broader and more contiguous in nature. After studying a variety of savanna sites, it is now understood that size and distribution are the result of earlier periods of bog iron excavation, cranberry cultivation, and “turf cuts” of peat and vegetation layers used in the process of making charcoal (Harshberger 1916, Southgate 2000, Walz 2004, Smith 2014).

Prior to these anthropogenic activities it is likely that naturally formed Pine Barren Riverside Savanna habitats occurred only in relatively narrow bands of wetlands along streams that resulted from the peri-glacial erosional channels and that the remnant effects of anthropogenic activities expanded the savanna habitat. Prior to that the naturally occurring savannas would have likely been smaller, more isolated, individual areas that collectively covered a much-reduced area. Following the decline of industry in the Pine Barrens, succession has been noted as a major factor in the conversion of savanna plant communities from a more herbaceous flora to a woodier assemblage (McCormick 1979, Smith 2012, Kelly 2018). It was found that different types of disturbances influence the rate of succession, with historically undisturbed savannas being less subject to succession (Southgate 2000, Stanford 2000, Walz 2004, Smith 2012).

Phenology—Typically flowers in June through July and fruits late July through October (Johnson & Walz 2013).

Conservation Status—The conservation of *T. × novacaesariensis* populations is aided by the fact that the sites where they’re located are protected as conserved open space. Even with this site-wide protection, habitat disruption may still be caused by various factors. Similar to other co-located species, *T. × novacaesariensis* populations would

likely be impacted by alterations in hydrology and there are a number of potential causes for hydrological change (Schuyler 1990, Obee 1994, Walz *et al.* 2006). Beaver activity is known to occur in the NJ Pine Barrens and beaver dams can alter savanna habitat resulting in a more flooded, aquatic habitat (Hammerson 1994, Walz *et al.* 2006, Johnson & Walz 2013). The construction of cranberry bogs and the expansion of cranberry cultivation in the early 20th century was noted as having negatively impacted the extent of savanna habitat and related plant populations (Stone 1911, Fables 1962). Even now, cranberry farming on adjacent lands could cause detrimental changes to hydrology impacting savanna habitat. Ecological succession and woody plant encroachment into bog and savanna habitat continue to be potential threats (Schuyler 1990, Palmer 2005, Smith 2012, Kelly 2018). Other risks include increased development in surrounding areas which could impact groundwater levels, off road vehicle use in sensitive areas of the Pine Barrens, and trampling from foot traffic during savanna explorations (Walz *et al.* 2006).

Climate change is predicted to influence annual temperature and the amount and frequency of precipitation in New Jersey, in the future. Over the past one hundred years New Jersey's average annual temperature has increased 1.9°C and annual temperatures are expected to increase significantly by 2050 (New Jersey Department of Environmental Protection, 2020). Annual precipitation will also be significantly increased in New Jersey with an expected increase between 4% to 11% by 2050. Other climate change impacts on precipitation include an increase in the intensity and frequency of precipitation events, an increase in the frequency of droughts, and increased flooding. As a result, the hydrology of bogs and savannas in the Pine Barrens may be impacted.

New Jersey populations of *Triantha* were included in a vulnerability assessment to the risk of climate change using NatureServe's Climate Change Vulnerability Index (CCVI) (Ring *et al.* 2013). This assessment ranks vulnerability based on projected exposure to climate change and a species sensitivity to climate change. While the CCVI Vulnerability Index Score for NJ populations of *Triantha* were ranked PS (Not Vulnerable / Presumed Stable), this ranking was given a confidence level of Low. Analysis of individual, intrinsic risk factors and modeled risk factors predicted increased risk in a number of categories. The study had the categories ranked as either GI (Greatly Increased), Inc (Increased), SI (Significantly Increased) (note that this rank was labeled Somewhat Increased by Young *et al.* 2011) SD (Somewhat Decreased) Dec (Decreased), and N (Neutral), N/A (Not Applicable), and U (Unassessed). A rank of Significantly Increased Risk was determined for the category Dispersal and Movement (pertains to the ability to move and relocate under the influence of climate-driven changes). A rank of Significantly Increased Risk was determined for the category Physiological Hydrological Niche (reflects a species' reliance on specific rainfall patterns or wetland habitats). A rank of Greatly Increased Risk was determined for the category Historical Hydrological Niche (this factor shows how much precipitation variation a species has experienced in the past 50 years, based on mean annual rainfall. In this case, the variation has been very small (less than 4 inches/100 mm). The category of Modeled Change, which is a model of future (2050) Change in Range or Population Size, showed Increased Risk and predicted a decrease in distribution range relative to current range within the assessment area. In the assessment of Exposure and Geography Risk Factors, a rank of Significantly Increased Risk was determined for the Natural Barriers category. While the CCVI study provided a much needed assessment of risk associated with climate change, Ring *et al.* (2013) noted at the time of the publication that “*the lack of much variability in both projected climate changes and in historical temperature variability must limit the role of this set of variables in the overall assessment, and highlights the need for finer scale climate predictions and categorizations done specific to New Jersey.*”

Taxonomic considerations—The basionymic type publications for *Triantha glutinosa* [*Nartheceum glutinosum* Michaux], and *Triantha racemosa* [*Melanthium racemosum* Walter], as well as the following heterotypic synonyms for these taxa were consulted to determine type localities (POWO 2026). None of the type descriptions reference specimens or localities in New Jersey. The publication information is followed by excerpts from the original text with the locality information and English translations.

Nartheceum glutinosum Michaux (1803: 210)

“a Quebec ad usque lacus Mistassins.” [from Quebec to Lake Mistassins]

Melanthium aspericaule Poir. in Lamarck (1814: 628)

“Cette plante croît à la Caroline ; elle m'a été communiquée par M. Bosc [This plant grows in Carolina; it was given to me by Mr. Bosc.]”

Nartheceum scabrum Rafinesque (1814: 45) “En Virginie” [In Virginia]

Nartheceum falcatum Wahlenberg (1805: 126) “Peruviae in Andium montibus, et? In Canada” [In the Andes mountains of Peru, and? In Canada]

Melanthium racemosum Walter (1788: 125). No specific location is provided for this species, but the geographic scope of the publication was restricted to “Carolina”, which did not include New Jersey. In the preface, Walter notes that observations had come from the area surrounding the Santee River in Berkeley County, South Carolina (Ward 2007a). Specimens described by Walter that are attributed to the explorations of John Fraser were also collected from the Carolina region (Ward, 2007b).

Nartheceum pubens Michaux (1803: 209) “Hab in Carolia inferiore, circa Charlostown” [Grows in Lower Carolina, near Charleston]

Tofieldia pubescens Persoon (1805: 399) “Hab. In Carol. Interiore.” [Grows in inner Carolina]

Key to *Triantha* taxa occurring in eastern North America

1. Capsules ovoid, 3–4(–5) mm tall, hard, dark colored when dry; seed appendages 1 or 2 with appendage at one end approximately 1/2 as long as the seed, appendage at opposite end less than 1/2 the length of the seed; tepals nearly as long as capsule *Triantha racemosa*
- Capsules subglobose to wide-ovoid, (3–)4–7 mm tall, chartaceous and easily ruptured, light in color when dry; seed appendages 2, located at both ends of seed, one appendage contorted, 1–4 times longer than seed, other appendage less than 1/2 the length of the seed 2
2. Plant height to 50 cm; tepals up to half as long as capsules, styles 1.0–1.3(–1.5)mm long, and recurved in fruit *Triantha glutinosa*
- Plant height to 65 cm; tepals nearly as long as capsules; styles 1.5–2.0 mm long and nearly erect in fruit *Triantha* × *novacaesariensis*

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APPENDIX 1

Voucher specimens (GenBank accession numbers are in square brackets in the following order: *trnH-psbA*, *matK*, ITS)

***Triantha novacaesariensis* Eisenman**

Eisenman BB1 20 Jun 2012 USA, New Jersey (PH) [PV917228, PV917253, PV911658]; *Eisenman BB2* 20 Jun 2012 USA, New Jersey (PH) [PV917229, PV917254, PV911659]; *Eisenman BB3* 20 Jun 2012 USA, New Jersey (PH) [PV917230, PV917255, PV911660]; *Eisenman T1* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T2* 22 Sept 2012 *BB3* USA, New Jersey (PH) [PV917231, PV917256, PV911675]; *Eisenman T3* 22 Sept 2012 *BB3* USA, New Jersey (PH) [PV917232, PV917257, PV911676]; *Eisenman T4* 22 Sept 2012 USA, New Jersey (PH) [PV911677]; *Eisenman T5* 22 Sept 2012 USA, New Jersey (PH) [PV917233, PV917258, PV911678]; *Eisenman T6* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T7* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T8* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T9* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T10* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T11* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T12* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T13* 22 Sept 2012 USA, New Jersey (PH); *Eisenman T14* 22 Sept 2012 USA, New Jersey (PH); *Eisenman WG01* 15 Jul 2013 USA, New Jersey (PH) [PV917234, PV917259, PV911679]; *Eisenman WG02* 15 Jul 2013 USA, New Jersey (PH) [PV917260, PV911680]; *Eisenman WG03* 15 Jul 2013 USA, New Jersey (PH) [PV917235, PV917261, PV911681]; *Eisenman WG04* 15 Jul 2013 USA, New Jersey (PH) [PV917236, PV917262, PV911682]; *Eisenman WG05* 15 Jul 2013 USA, New Jersey (PH) [PV917237, PV917263, PV911672]

***Triantha racemosa* (Walt.) Small**

Eisenman 1-1A 26 Jun 2012 USA, Alabama (PH) [PV917199, PV917238, PV911642]; *Eisenman 1-2A* 26 Jun 2012 USA, Alabama (PH) [PV917200, PV917239, PV911643]; *Eisenman 2-3A* 27 Jun 2012 USA, Alabama (PH) [PV917201, PV917240, PV911649]; *Eisenman 2-4A* 27 Jun 2012 USA, Alabama (PH) [PV917202, PV917241]; *Eisenman 2-5A* 27 Jun 2012 USA, Alabama (PH); *Eisenman 2-6A* 27 Jun 2012 USA, Alabama (PH); *Eisenman 2-7A* 27 Jun 2012 USA, Alabama (PH); *Eisenman 2-8A* 27 Jun 2012 USA, Alabama (PH); *Eisenman 2-9A* 27 Jun 2012 USA, Alabama (PH); *Eisenman 3-10A* 27 Jun 2012 USA, Alabama (PH) [PV917203, PV917242, PV911644]; *Eisenman 3-11A* 27 Jun 2012 USA, Alabama (PH) [PV917204, PV917243, PV911645]; *Eisenman 3-12A* 27 Jun 2012, USA, Alabama (PH) [PV917205, PV917244, PV911646]; *Eisenman 3-13A* 27 Jun 2012, USA, Alabama (PH) [PV917206, PV917245, PV911647]; *Eisenman 3-14A* 27 Jun 2012, USA, Alabama (PH) [PV917207, PV917246, PV911648]; *Eisenman 3-15A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-16A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-17A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-18A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-19A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-20A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-21A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-22A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-23A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-24A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-25A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 3-26A* 27 Jun 2012, USA, Alabama (PH); *Eisenman 4-27F* 28 Jun 2012, USA, Florida (PH) [PV917208, PV917247, PV911651]; *Eisenman 4-28F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-29F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-30F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-31F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-32F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-33F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-34F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-35F* 28 Jun 2012, USA, Florida (PH); *Eisenman 4-36F* 28 Jun 2012; *Eisenman 5-37F* 28 Jun 2012, USA, Florida (PH); *Eisenman 5-38F* 28 Jun 2012, USA, Florida (PH); *Eisenman 5-39F* 28 Jun 2012, USA, Florida (PH); *Eisenman 5-40F* 28 Jun 2012, USA, Florida (PH); *Eisenman 5-41F* 28 Jun 2012, USA, Florida (PH); *Eisenman 5-42F* 28 Jun 2012, USA, Florida (PH); *Eisenman 5-43F* 28 Jun 2012; *Eisenman 6-44G* 29 Jun 2012, USA, Georgia (PH) [PV917209, PV917248, PV911652]; *Eisenman 6-45G* 29 Jun 2012, USA, Georgia (PH) [PV917210, PV911653]; *Eisenman 6-46G* 29 Jun 2012 [PV917211, PV917249, PV911654]; *Eisenman 7-47G* 29 Jun 2012, USA, Georgia (PH) [PV917212, PV917250, PV911656]; *Eisenman 7-48G* 29 Jun 2012, USA, Georgia (PH) [PV917213, PV917251, PV911655]; *Eisenman 7-49G* 29 Jun 2012, USA, Georgia (PH) [PV917214, PV917252, PV911657]; *Eisenman 7-50G* 29 Jun 2012, USA, Georgia (PH); *Eisenman 7-51G* 29 Jun 2012, USA, Georgia (PH); *Eisenman 7-52G* 29 Jun 2012, USA, Georgia (PH)

***Triantha glutinosa* (Michx.) Baker**

Eisenman BSI-13 20 Jul 2013 USA, New York (PH) [PV917215, PV917264, PV911661]; *Eisenman BSI-14* 20 Jul 2013 USA, New York (PH); *Eisenman BSI-16* 20 Jul 2013 USA, New York (PH); *Eisenman BSI-17* 20 Jul 2013 USA, New York (PH); *Eisenman BSI-18* 20 Jul 2013 USA, New York (PH); *Eisenman BSI-19* 20 Jul 2013 USA, New York

(PH); *Eisenman BS1-20* 20 Jul 2013 USA, New York (PH); *Eisenman BS2-06* 20 Jul 2013 USA, New York (PH); *Eisenman BS2-07* 20 Jul 2013 USA, New York (PH); *Eisenman BS2-08* 20 Jul 2013 USA, New York (PH) [PV917216, PV917265, PV911662]; *Eisenman BS2-09* 20 Jul 2013 USA, New York (PH) [PV917217, PV911663]; *Eisenman BS2-11* 20 Jul 2013 USA, New York (PH); *Eisenman BS2-12* 20 Jul 2013 USA, New York (PH); *Eisenman BS3-1* 20 Jul 2013 USA, New York (PH); *Eisenman BS3-2* 20 Jul 2013 USA, New York (PH); *Eisenman BS3-3* 20 Jul 2013 USA, New York (PH); *Eisenman BS3-4* 20 Jul 2013 USA, New York (PH); *Eisenman BS3-5* 20 Jul 2013 USA, New York (PH); *Eisenman NR01* 24 Jul 2013 Canada, New Brunswick (PH) [PV917266, PV911673]; *Eisenman NR02* 24 Jul 2013 Canada, New Brunswick (PH) [PV917218, PV917267, PV911674]; *Eisenman NR03* 24 Jul 2013 Canada, New Brunswick (PH) [PV917219, PV917268, PV911664]; *Eisenman NR04* 24 Jul 2013 Canada, New Brunswick (PH) [PV917220, PV917269, PV911665]; *Eisenman NR05* 24 Jul 2013 Canada, New Brunswick (PH); *Eisenman NR06* 24 Jul 2013 Canada, New Brunswick (PH); *Eisenman NR07* 24 Jul 2013 Canada, New Brunswick (PH); *Eisenman SWMR01* 25 Jul 2013 Canada, New Brunswick (PH) [PV917225, PV917274]; *Eisenman SWMR02* 25 Jul 2013 Canada, New Brunswick (PH) [PV917226, PV917275, PV911667]; *Eisenman SWMR03* 25 Jul 2013 Canada, New Brunswick (PH); *Eisenman SWMR04* 25 Jul 2013 Canada, New Brunswick (PH); *Eisenman SWMR05* 25 Jul 2013 Canada, New Brunswick (PH) [PV917227, PV917276, PV911671]; *Eisenman SWMR06* 25 Jul 2013 Canada, New Brunswick (PH); *Eisenman SWMR07* 25 Jul 2013 Canada, New Brunswick (PH); *Eisenman SWMR08* 25 Jul 2013 Canada, New Brunswick (PH); *Eisenman SWMR09* 25 Jul 2013 Canada, New Brunswick (PH); *Eisenman SJR01* 27 Jul 2013 USA, Maine (PH) [PV917221, PV917270, PV911666]; *Eisenman SJR02* 27 Jul 2013 USA, Maine (PH) [PV917222, PV917271, PV911668]; *Eisenman SJR03* 27 Jul 2013 USA, Maine (PH) [PV917223, PV917272, PV911669]; *Eisenman SJR04* 27 Jul 2013 USA, Maine (PH) [PV917224, PV917273, PV911670]

Other Specimens Examined

Triantha novacaesariensis Eisenman

Stone s.n. 4 Jul 1904 USA New Jersey (PH); *Schuyler 8004*, 8 Sept. 1995 USA New Jersey (PH); *Stone s.n.*, 4 Jul 1904 USA New Jersey (PH); *Stasz s.n.* 5 Jul 1985 USA, New Jersey (PH); *Long 37806* 13 Jul 1932 USA New Jersey (PH); *Van Pelt s.n.* 29 Jun 1906 USA New Jersey (PH); *Stasz & Gordon s.n.*, 1 Jul 1985 USA New Jersey (PH); *Wilkins 3307* 1 Jul 1934 USA New Jersey (PH); *Van Pelt 8304* 18 August 1906 USA New Jersey (PH); *Bartram s.n.*, 20 August 1907 USA New Jersey (PH); *Williamson s.n.*, 20 August 1907 USA New Jersey (PH); *Stone s.n.*, 9 Jul 1909 USA New Jersey (PH); *Canby s.n.* Aug 1867 USA New Jersey (PH); *Taylor* 8, Jul 1914. USA New Jersey (PH); *Fogg 4659* 4 August 1932 USA New Jersey (PH); *Harshberger s.n.*, 13 November 1912 USA New Jersey (PH); *Fogg 4750* 12 August 1932 USA New Jersey (PH); *Saunders & Clute s.n.* 3-9 Jul 1899 USA New Jersey (PH); *Stone 14522* 29 Jul 1913. USA New Jersey (PH); *Harshberger s.n.* 29 Jul 1913 USA New Jersey (PH); *Long 53826* 11 August 1939 USA New Jersey (PH); *Stone* 3 Jul 1904 USA New Jersey (PH); *Koster c10-12-4*, 23 Jul 1939 USA New Jersey (PH); *Long 50865* 28 Jul 1937 USA New Jersey (PH); *Hynes* 25 Jun 1939 USA New Jersey (PH); *Bechtel 18256*. 30 Jun 1953 USA New Jersey (NYBG) *Van Pelt s.n.* 29 Jun 1906 USA New Jersey (NYBG); *Van Pelt s.n.* 18 Aug 1906 USA New Jersey (NYBG); *Stone s.n.* s.d. USA New Jersey (NYBG); *Mackenzie 6079*. 1 Aug 1914 USA New Jersey (NYBG); *Clute s.n.* 3 Jul 1899 USA New Jersey (NYBG); *Wilson s.n.* 29 Jul 1913 USA New Jersey (NYBG); *Pennell 1602*. 8 Jul 1914 USA New Jersey (NYBG); *Johnson & Robbins s.n.* 14 Jul 1934 USA New Jersey (NYBG); *Stone s.n.* 29 Jul 1913 USA New Jersey (NYBG); *Torrey s.n.* s.d. USA New Jersey (NYBG filed under *T. glutinosa*); *Witte s.n.* 25 Aug 1932 USA New Jersey (CHRB); *Witte s.n.*, 15 Jul 1933 USA New Jersey (CHRB); *Van Pelt s.n.*, 9 Jul 1909 USA New Jersey (CHRB); *Stone 14522* 29 Jul 1913 USA New Jersey (CHRB); *Loughridge & Chrysler s.n.* 25 Jul 1931 USA New Jersey (CHRB); *Mackenzie 6079* 1 Aug. 1914 USA New Jersey (CHRB); *Snyder 73-2RU*, 18 Jul 1978. USA New Jersey (CHRB); *Chute & Small s.n.* 2 Jul 1938 USA New Jersey (CHRB); *Carpenter 12*, 10 Jul 1958. USA New Jersey (CHRB); *Beals an&d Chrysler s.n.*, 12 Jul 1930 USA New Jersey (CHRB); *Beals & Chrysler s.n.*[1], 13 Jul 1930. USA New Jersey (CHRB); *Beals & Chrysler s.n.*[2], 13 Jul 1930. USA New Jersey (CHRB); *Stone 7427*, 31 Aug 1906 USA New Jersey (CHRB); *Barringer 13363* 14 Sep 2004 USA New Jersey (BKL);

Triantha racemosa (Walt.) Small

Harper 1145 USA, Alabama (PH); *Mohr 1878* USA, Alabama (PH); *Commons s.n.* 15 August 1895 USA Delaware (PH); *Canby s.n.* 13 Jul 1878 USA Delaware (PH); *Otis s.n.* 16 August 1923 USA Delaware (PH); *Chapman s.n.* s.d. USA Georgia (PH); *Torrey s.n.* s.d. USA Florida (PH); *Curtiss 2907* Oct USA Georgia (PH); *Eggleston 5103* USA Georgia (PH); *Backman s.n.* s.d. USA Georgia (PH); *Beyrich s.n.* s.d. USA Georgia (PH); *Lang s.n.* 18 August 1909

USA Georgia (PH); *Baldwin s.n.* s.d. USA Georgia (PH); *Green s.n.* s.d. USA Georgia (PH); *Chapman s.n.* s.d. USA Florida (PH); *Boykin s.n.* s.d. USA Georgia (PH); *Cronquist 5567*, 27 Jul 1948 USA Georgia (PH); *Martindale s.n.* Aug 2 1905 USA Maryland (PH); *Macfarlane & Goertz s.n.* 13 Jun 1905 USA Mississippi (PH, CHRB); *Pursh s.n.* 1806 (PH); *Blomquist s.n.* 11 Jul 1934 USA North Carolina (PH); *Schweinitz s.n.* s.d. Raleigh USA North Carolina (PH); *Williamson s.n.* Aug 1892 USA North Carolina (PH); *Bartram s.n.* 6 October 1908 USA North Carolina (PH); *Fisher s.n.*, s.d. USA North Carolina (PH); *Leeds 1271* 16 Jul 1929 USA North Carolina (PH); *Fernald & Long 6150* 18 Jul 1936 USA Virginia (PH); *Fernald, Long & Smart 5713* 26 Jun 1936 USA Virginia (PH); *Fernald & Long 10577* 27 Jul 1939 USA Virginia (PH); *Fernald & Long 12294* 11 Jul 1940 USA Virginia (PH); *Fernald & Long 8664* 13 Jul 1938 USA Virginia (PH). *Kral 35538* 14 Jul 1969 USA Alabama (NYBG); *Earle s.n.* 3 Jul 1897 USA Alabama (NYBG); *Blanton 59* 18 Jul 1933 USA Alabama (NYBG); *Pennell 4436* 30 Aug 1912 USA Alabama (NYBG); *Haynes 8135* 5 Aug 1980 USA Alabama (NYBG); USA Florida (NYBG); *Nelson 2657* 27 Jul 1983 USA Florida (NYBG); *Chapman s.n.* s.d. USA Florida (NYBG); *Correll 52167* 28 Jun 1981 USA Florida (NYBG); *Ford 3683* 29 Jul 1954 USA Florida (NYBG); *Orzell 14639* 14 Aug 1990 USA Florida (NYBG); *Beckner 1485* 30 Jun 1966 USA Florida (NYBG); *Small 11406* 11 Jul 1924 USA Florida (NYBG); *Cronquist 5567* 27 Jul 1948 USA Georgia (NYBG); *Welch 1424* 11 Aug 1934 USA Georgia (NYBG); *Walker 772* 11 Jun 1994 USA Georgia (NYBG); *Duncan 7668* 13 Jul 1947 USA Georgia (NYBG); *Harper 1035* 9 Jul 1901 USA Georgia (NYBG); *Eggleston 5103* 17 Sep 1909 USA Georgia (PH, NYBG); *Small s.n.* 16 Jun 1895 USA Georgia (NYBG); *Demarée 28223* 18 Aug 1949 USA Mississippi (NYBG); *Tracy 3498* 6 Jul 1897 USA Mississippi (NYBG); *Kral 7153* 5 Jul 1958 USA Mississippi (NYBG); *Skehan 19* Jun 1892 USA Mississippi (NYBG); *Tracy 1347* 15 Jul 1894 USA Mississippi (NYBG); *Underwood. s.n.* Jun 1896 USA Mississippi (NYBG); *Ray Jr. 5054* 21 Jul 1955 USA Mississippi (NYBG); *Ray Jr. 6128* 23 Sep 1955 USA Mississippi (NYBG); *Webster 3418* 16 Jul 1950 USA Mississippi (NYBG); *Pollard 1073* 27 Jul 1896 USA Mississippi (NYBG); *Jones, Jr. 13661* 27 Jun 1967 USA Mississippi (NYBG); *Leidolf 1619* 13 Jul 1995 USA Mississippi (NYBG); *H.E. Ahles 33357* 3 Aug 1957 USA North Carolina (NYBG); *Radford 44973* 14 Aug 1966 USA North Carolina (NYBG); *Barksdale s.n.* 13 Jul 1937 USA North Carolina (NYBG); *Alexander s.n.* 30 Jun 1939 USA North Carolina (NYBG); *Alexander s.n.* 28 Jun 1939 USA North Carolina (NYBG); *Pennell 4905* 15 Oct 1912 USA North Carolina (NYBG); *Curtis s.n.* 1904 USA North Carolina (NYBG); *Bozeman 45248* 17 Sep 1966 USA North Carolina (NYBG); *Fox 3721* 30 Jun 1950 USA North Carolina (NYBG); *Beadle s.n.* Aug 1919 USA North Carolina (NYBG); *Stevenson 3338* 23 Jul 1966 USA North Carolina (NYBG); *Williamson s.n.* s.d. USA North Carolina (NYBG); *Godfrey 99* 23 Jun 1939 USA South Carolina (NYBG); *Godfrey 866* 24 Sep 1939 USA South Carolina (NYBG); *Rhoades s.n.* Aug 1935 USA South Carolina (NYBG); *Hill 23888* 18 Jul 1992 USA South Carolina (NYBG); *Martin 1107* 4 Aug 1939 USA South Carolina (NYBG); *Wilbur 2856* 31 Aug 1950 USA South Carolina (NYBG); *Godfrey 522* 17 Jul 1939 USA South Carolina (NYBG); *House 2689* 27 Jul 1906 USA South Carolina (NYBG); *Naczi 17571* 14 Aug 2019 USA Tennessee (NYBG); USA Texas (NYBG); *E. J. Palmer 12845* 22 Sep 1917 USA Texas (NYBG); *Webster 3207* 4 Jul 1950 USA Texas (NYBG); *Cory 50052* 4 Oct 1945 USA Texas (NYBG); *Fernald & Long 6151* 26 Jul 1936 USA Virginia (PH, NYBG, BKL), *Boufford 10233* 24 Jun 1973 USA Mississippi (GH); *Kral 91457* 28 Jun 2001 USA Georgia; *Greller & Piwowarski 760820-11* 20 Aug 1976 USA North Carolina (BKL); *Manning 280* 9 Jun 1904 USA North Carolina (BKL); *Svenson 7259* 2 Sep 1935 USA Georgia (BKL); *Harper s.n.* 1897 USA Georgia (BKL); *Curtiss 5908* 26 Jun 1897 USA Florida (BKL); *Hall s.n.* 27 Jul 1886 USA USA North Carolina (BKL); *Canby s.n.* 3 Jul 1878 USA South Carolina (BKL)

***Triantha glutinosa* (Michx.) Baker**

Michaux s.n. s.d. (P) (Type[photo!], microfiche image designated as Lectotype (Uttal 1984), P00730498!, P00730497!); *Fernald & Long 1519* 27 Aug 1929 Canada, Newfoundland (PH); *Fernald, Long & Dunbar 26511* 30 Jul 1924 Canada, Newfoundland (PH); *Fernald, Long, Wiegand, Long, Gilbert, Jr., & Hotchkiss 27818* 31 Jul 1924 Canada, Newfoundland (PH); *Heyl 163* 19 Aug 1939 Canada, Newfoundland (PH); *Robinson & Schrenk 39* Canada, Newfoundland (PH); *Fernald, Gilbert & Hotchkiss 27820* 13 Aug 1925 Canada, Newfoundland (PH); *Fernald, Pease & Long 27817* 23 Jul 1925 Canada, Newfoundland (PH); *Fernald & Long 27819* 7 Aug 1925 Canada, Newfoundland (PH); *Fernald, Long, & Fogg, Jr. 1518* 10 Aug 1929 Canada, Newfoundland (PH); *Fernald, Long, & Fogg, Jr. 181* 1 Sept 1926 Canada, Newfoundland (PH); *Fernald, Long, and Fogg, Jr. 1817* 22 Jul 1929 Canada, Newfoundland (PH); *Fernald, Long & Dunbar 26510* 28 Jul 1924 Canada, Newfoundland (PH); *Eames & Godfrey 5889* 31 Jul 1908 Canada, Newfoundland (PH); *Fernald & Weigand 5174* 23 Aug 1911 Canada, Newfoundland (PH); *Hay s.n.* Jul 1882 Canada, New Brunswick (PH); *Chrysler s.n.*, 8 Sept. 1935 Canada, New Brunswick (CHRB); *Williamson s.n.* 23 Jul 1910 Canada, Quebec (PH); *Cinq-Mars, Thibault & Asselin L-133* 10 Aug 1972 Canada, Quebec (PH); *Fernald, Bartram, Long & St. John 7189* 17 Jul 1912 Canada, Quebec (PH); *Rousseau & Bonin 32193* 24-25 Jul 1929 Canada, Quebec (PH); *Victorin &*

Germain 20265 20 Jul 1925 Canada, Quebec (PH); *Bartram & Long 642* 23 Jul 1910 Canada, Quebec (PH); *Bartram & Long 704* 23 Jul 1910 Canada, Quebec (PH); *Chrysler s.n.*, 14 Aug. 1935 Canada, Quebec (CHRB); *Williamson 2176* 8 Aug 1912 Canada, Ontario (PH); *McNab s.n.* Aug 1834 Canada, Ontario (PH); *Krotov 7270* 29 Jun 1933 Canada, Ontario (CHRB); *Chrysler s.n.*, 20 Jun 1934 Canada, Ontario (CHRB); *Whitehorn 492* 3 Jul 1971 Canada, Alberta (PH); *Schaffer s.n.* Jul 1899 Jul 1899 Canada, Alberta (PH); *Schaffer s.n.* 19 Jul 1893 Canada, North West Territories (PH); *Shaw s.n.* 2 Jul 1904 Canada, British Columbia (PH); *Kellogg 400.* 2 Sep 1905 USA Alaska (PH); *Meehan s.n.* 25 February 1905 USA Alaska (PH); *Williamson s.n.* 16 August 1900 USA Maine (PH); *Pringle s.n.* 22 August 1878 USA Maine (PH); *Robbins s.n.* s.d. USA Maine (PH); *Churchill s.n.* 9 August 1901 USA Maine (PH); *Walker 2161* 21 Aug 1940 USA Maine (PH); *Fernald 107* 11 Aug 1893 USA Maine (PH); *Chrysler 2230* 21 Aug 1937 USA Maine (PH) (CHRB); *Williams s.n.* 24 Jul 1900 USA Maine (PH); *Eggleston 2808* 25 Jun 1902 and 27 Jul 1902 USA New Hampshire (PH); *Knowlton s.n.* 10 Jul 1917 USA Vermont (PH); *Eggleston 2681* 27 Jun and 28 Sept 1893 USA Vermont (PH); *Knowlton s.n.* 10 Jul 1917 USA Vermont (PH); *Kittredge s.n.* 12 August 1918; *Clinton s.n.* 2 Aug 1905 USA New York (PH); *Clinton s.n.* s.d. USA New York (PH); *Wiegand 9609* 18 Aug 1918; USA Ohio (PH) *Van Cleve s.n.* s.d. USA Ohio (PH); *Williams. s.n.* s.d. USA Ohio (PH); *Fassett 5645* 16 Aug 1927 USA Indiana (PH); *Chase s.n.* 19 Jul 1897 and 1 Sept 1897 USA Indiana (PH); *Umbach s.n.* 14 Jul 1896 USA Indiana (PH); *Deam 39489* 7 Aug 1923 USA Indiana (PH); *Loughridge 4019* 25 Jun 1944 USA Michigan (CHRB); *Bassett s.n.* Jul 1881 USA Michigan (PH); *Williamson 2273* 15-16 Aug 1912 USA Michigan (PH); *Porter s.n.* 5 August 1865 USA Michigan (PH); *Hermann 6961* 14 Aug 1935 USA Michigan (PH); *Benner 6599* 18 Jul 1935 USA Michigan (PH); *Wadmond s.n.* 13 Jul 1934 USA Wisconsin (PH) ; *Hale s.n.* s.d. USA Wisconsin (PH); *Roberts s.n.* 1 Jul 1884 USA Minnesota (PH); *Hitchcock & Muhlick 12797* 27 Jul 1945 USA Montana (PH); *Hitchcock & Muhlick 12792* 23 Jul 1945 USA Montana (PH); *Umbach s.n.* 22 August 1901 27 Jul 1945 USA Montana (PH); *Berkheimer 11720* USA Wyoming (PH); *Marshall 1272* 7 Jul 1950 USA Idaho (PH); *Barkley 1731* 18 Sept 1918 USA Montana (NYBG); *Gorman 78* 6 Jun 1895 USA Alaska (NYBG); *Atha 10700* 18 Jun 2011 USA New York (NYBG); *Greene 1* 11 Sept 2013 USA New York (NYBG); *Smithman LS-0434* 6 Aug 1979 USA Idaho (NYBG); *Smithman LS-0738* 27 Aug 1981 USA Idaho (NYBG); *Smithman LS-0447* 10 Aug 1979 USA Idaho (NYBG); *Fernald 107* 11 Aug 1893 USA Maine (NYBG); *Wiegand 626* 12 Aug 1909 USA Maine (NYBG); *Lichvar 3097* 8 Jul 1980 USA Wyoming (NYBG); *Wiegand 625* 9 Aug 1909 USA Maine (NYBG); *Delamare 299* 4 Aug 1882 Saint-Pierre et Miquelon Miquelon-Langlade (NYBG); *John 2209* 21 Jul 1917 USA Maine (NYBG); *Ertter 9433* 31 Jul 1990 USA Idaho (NYBG); *Lorain 1975* 28 Jul 1989 USA Idaho (NYBG); *MacDougal 287* 4 Aug 1900 USA Idaho (NYBG); *Scott 2712* 5 Aug 2006 USA Wyoming (NYBG); *McKee 588* 31 Jul 1926 USA Michigan (NYBG); *Thompson 15094* 1 Aug 1940 USA Washington (NYBG); *Thompson 9569* 23 Jul 1933 USA Washington (NYBG); *Thompson 10759* 23 Jun 1934 USA Washington (NYBG); *Thompson 9706* 7 Aug 1933 USA Washington (NYBG); *Anderson 589* 31 Jul 1956 USA Wyoming (NYBG); *Wellner 1967* 4 Aug 1979 USA Idaho (NYBG); *Hitchcock 15101* 27 Jul 1946 USA Montana (NYBG); *Hitchcock 15316* 10 Aug 1946 USA Montana (NYBG); *Hitchcock 12672* 23 Jul 1945 USA Montana (NYBG); *Hitchcock 17170* 16 Aug 1947 USA Montana (NYBG); *Hitchcock 17104* 5 Aug 1947 USA Montana (NYBG); *Hitchcock 17043* 29 Jul 1947 USA Montana (NYBG); *Ertter 7744* 20 Jul 1988 USA Idaho (NYBG); *Wellner 1646* 5 Aug 1978 USA Idaho (NYBG); *Hitchcock 5751* 8 Aug 1939 USA Idaho (NYBG); *Hitchcock 10143* 19 Jul 1944 USA Idaho (NYBG); *Hitchcock 12797* 27 Jul 1945 USA Montana (NYBG); *Hitchcock 13149* 1 Aug 1945 USA Montana (NYBG); *Payson 2185* 3 Aug 1920 USA Wyoming (NYBG); *Anderson 589* 31 Jul 1956 USA Wyoming (NYBG); *Ertter 8732* 25 Jul 1989 USA Idaho (NYBG); *McNeal 3336* 22 Jul 1988 USA Idaho (NYBG); *Nelson 6382* 9 Aug 1899 USA Wyoming (NYBG); *Wellner 1440* 18 Jul 1978 USA Idaho (NYBG); *Atwood 14202* 2 Aug 1990 USA Idaho (NYBG); *Atwood 14039* 31 Jul 1991 USA Idaho (NYBG); *Yuncker 10794* 31 Aug 1941 USA Indiana (NYBG); *Yuncker 16291* 31 Aug 1955 USA Indiana (NYBG); *Halse 9520* 7 Jul 2015 USA Idaho (NYBG); *Herzog 2015-109* 20 Jun 2015 USA Idaho (NYBG); *Arsène 150* 13 Aug 1900 Saint-Pierre et Miquelon Miquelon-Langlade (NYBG); *Smithman 3:240:78* 28 Jul 1978 USA Idaho (NYBG); *Naczi 15992* 1 Aug 2015 Canada, Alberta (NYBG); *Watson 3057* 6 Aug 1926 Canada, Ontario (NYBG); *Canby 328* 3 Aug 1883 USA Montana (NYBG); *Herbarium 3599a* 30 Jul 1898 USA North Carolina (NYBG); *Allen s.n.* 17 Aug 1881 Canada, Quebec (NYBG); *Macoun s.n.* 21 Aug 1883 Canada, Alberta (NYBG); *Taylor 30830* 21 Jul 1981 Canada, British Columbia (NYBG); *Marie-Victorin 33881* 24 Aug 1930 Canada, Quebec (NYBG); *Sandberg 629* 1 Aug 1893 USA Washington (NYBG); *Halse 3704* 1 Aug 1988 USA Oregon (NYBG); *Eggleston s.n.* 1 Jul 1893 USA New Hampshire (NYBG); *Gleason 9903* 2 Aug 1940 USA Michigan (NYBG); *Smith 4636* 2 Jul 1981 USA Minnesota (NYBG); *Muenschner 7720* 4 Aug 1937 USA Washington (NYBG); *Britton s.n.* 4 Jul 1910 USA Vermont (NYBG); *Wheeler s.n.* 4 Jul 1915 USA Vermont (NYBG); *Johnson 587* 4 Jul 1941 USA Minnesota (NYBG); *Porter s.n.* 5 Aug 1865 USA Michigan (NYBG); *Ferguson s.n.* 5 Jul 1909 USA Alaska (NYBG); *Britton s.n.* 6 Jul 1910 USA Vermont (NYBG); *Umbach 6541* 7 Aug 1913 USA Illinois (NYBG); *Kruckeberg 2596* 7 Aug 1950 USA Washington (NYBG); *Werner*

1579 Aug 1893 USA Ohio (NYBG); *Johnson s.n.* 9 Sept 1923 USA New York (NYBG); *Knowlton Plantae Exsiccatae Grayanae* 351 10 Jul 1917 USA Vermont (NYBG); *Fernald* 3229 10 Jul 1934 USA Michigan (NYBG); *Fernald* 107 11 Aug 1893 USA Maine (NYBG); *Cummings s.n.* 11 Jul 1893 USA Maine (NYBG); *Mackenzie* 3438 11 Jul 1908 USA Maine (NYBG); *Mackenzie* 3438 11 Jul 1908 USA Maine (NYBG); *Gleason* 144 11 Jul 1933 USA Michigan (NYBG); *Barneby* 8274 11 Jul 1946 USA New Hampshire (NYBG); *Kittredge s.n.* 12 Aug 1918 USA Vermont (NYBG); *Cummings s.n.* 12 Jul 1893 USA Maine (NYBG); *Hutton* 117 13 Aug 1940 USA West Virginia (NYBG); *Hutton s.n.* 13 Aug 1940 USA West Virginia (NYBG); *Peck* 9141 14 Aug 1919 USA Oregon (NYBG); *Hunnewell* 157001 15 Jul 1938 USA Montana (NYBG); *Jesup s.n.* 16 Jul 1891 USA Vermont (NYBG); *Gillman s.n.* 17 Aug 1873 USA Michigan (NYBG); *Allen* 274 17 Aug 1897 USA Washington (NYBG); *Allen* 274 17 Aug 1897 USA Washington (NYBG); *Matthews s.n.* 18 Sept 1919 USA New York (NYBG); *Deam s.n.* 20 Aug 1916 USA Indiana (NYBG); *Gillman s.n.* 20 Jul 1874 USA Michigan (NYBG); *Hermann* 8169 20 Jul 1936 USA Michigan (NYBG); *Lloyd s.n.* 20 Jun 1894 USA Oregon (NYBG); *Petersen s.n.* 21 Jul 1984 USA Wisconsin (NYBG); *Schuette* 1.10.148 21 Jun 1896 USA Wisconsin (NYBG); *Bartley* 2892 21 Jun 1964 USA West Virginia (NYBG); *Eggleston s.n.* 22 Jul 1891 USA Vermont (NYBG); *Conard* 370 22 Jul 1902 USA Washington (NYBG); *Hunnewell* 2611 22 Jul 1913 USA Montana (NYBG); *Cusick* 25411 23 Jun 1986 USA Ohio (NYBG); *Eggleston* 2808 25 Jun 1902 USA New Hampshire (NYBG); *Degener* 17323 25 Jun 1925 USA Michigan (NYBG); *Ek s.n.* 26 Jul 1941 USA Indiana (NYBG); *Grant* 3160 27 Aug 1929 USA Minnesota (NYBG); *Eggleston* 2101 27 Jul 1900 USA New Hampshire (NYBG); *Bartley* 565 27 Jul 1937 USA Ohio (NYBG); *Hill s.n.* 28 Jul 1875 USA Indiana (NYBG); *Gleason* 9805 28 Jul 1940 USA Michigan (NYBG); *Gleason* 9791 28 Jul 1940 USA Michigan (NYBG); *McNeilus* 99-595 28 Jul 1999 USA Michigan (NYBG); *Gleason* 9844 29 Jul 1940 USA Michigan (NYBG); *Sherman s.n.* 30 Jul 1882 USA Wisconsin (NYBG); *House* 18565 30 Jul 1931 USA New York (NYBG); *Bechtel* 15808 31 Aug 1941 USA Indiana (NYBG); *Ek s.n.* 31 Aug 1942 USA Indiana (NYBG); *Ek s.n.* 31 Aug 1942 USA Indiana (NYBG); *Hunnewell* 9320 31 Jul 1924 USA Michigan (NYBG); *Grassl* 2290 10 Aug 1932 Canada, Ontario (NYBG); *Hosie* 1787 30 Jul 1938 Canada, Ontario (NYBG).