A NEW *HEXASTYLIS* (ARISTOLOCHIACEAE) FROM NORTHEAST ALABAMA (U.S.A.) WITH NOTES ON THE SPECIES "GROUPS" WITHIN THE GENUS

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ABSTRACT

A new species of *Hexastylis*—**H. finzelii**—is herein described from northeast Alabama. The historical species groups within *Hexastylis* are re-evaluated.

RESUMEN

Se describe una especie nueva de *Hexastylis*—**H. finzelii**—del nordeste de Alabama. Se reevaluan los grupos de especies históricos de *Hexastylis*.

INTRODUCTION

Hexastylis Raf. (Aristolochiaceae) is a genus of primitive flowering plants comprised of evergreen, terrestrial, acaulescent herbs endemic to the southeastern United States. The recognition of *Hexastylis* at the genus level has been controversial, as numerous authors have opted for its inclusion (along with other Asian allied genera) into a broader circumscribed *Asarum* L. (Kelly 1997, 1998, 2001; Sinn 2015, 2017; Sinn et al. 2015; Takahashi & Setoguchi 2018), while others have maintained *Hexastylis* as distinct from the Asian-North American *Asarum* sensu stricto (Blomquist 1957; Gaddy 1987; Whittemore & Gaddy 1997; Weakley 2015).

Until recently, *Hexastylis* was thought to be comprised of 15 specific and infraspecific taxa. Discoveries in the last five years have led to the description of two new species from the southeastern United States but assigned to the genus *Asarum, A. chueyi* B.T. Sinn (Sinn 2015) and *A. rosei* B.T. Sinn (Sinn 2017). However, both of these taxa align with the description of *Hexastylis* and will soon be transferred to that genus (Weakley pers. comm.). The description of this new species from NE Alabama will bring the total number of *Hexastylis* entities to 18 including the two to be transferred from *Asarum*.

TAXONOMIC TREATMENT

Hexastylis finzelii B.R. Keener, **sp. nov.** (**Fig. 1**). TYPE: UNITED STATES. ALABAMA: Marshall Co.: 6.75 air mi NW of Guntersville, along N side of Tennessee River near the SE corner of Bishop Mountain, W of Hambrick Hollow, 34.42600°N -86.38011°W, 11 Apr 2019, *B.R. Keener 11,076 with Brian Finzel* (HOLOTYPE: UWAL; ISOTYPES: AMAL, APSC, AUA, BRIT, MO, NCU, TROY, UNA, US).

Similar to *H. speciosa* and *H. arifolia*. Differs from *H. speciosa* by the calyx lobes erect (vs. recurved), lower calyx tube below outward flare distinctly shorter than upper tube (vs. lower calyx tube as long as or longer than upper tube), and style appendages maroon (vs. greenish). Differs from *H. arifolia* by calyx shape open cup-shaped (vs. urceolate).

Terrestrial acaulescent herbs from short rhizomes. **Leaves:** petioles to 23 cm long; blades hastate-sagittate with rounded basal lobes to sometimes triangular to less commonly almost cordate; largest leaves 8–12(15) cm long by 8–10(12) cm wide. **Flowers:** peduncle 2–5 cm long; **Calyx** 25–30 mm long, 16–19 mm wide, rounded at base; tube in two parts divided by abrupt out-flaring, with the lower tube campanulate and shorter than upper tube, 4–7 mm long; upper tube more or less cup-shaped or short cylindrical, 10–11 mm long; lobes three, erect, broadly triangular, wider than long, 8–12 mm long, 15–16 mm wide. **Stamens** 12, filament with connective to 3.2 mm long, theca extrorse, 2.5–2.9 mm long, connective only slightly prolonged passed theca.

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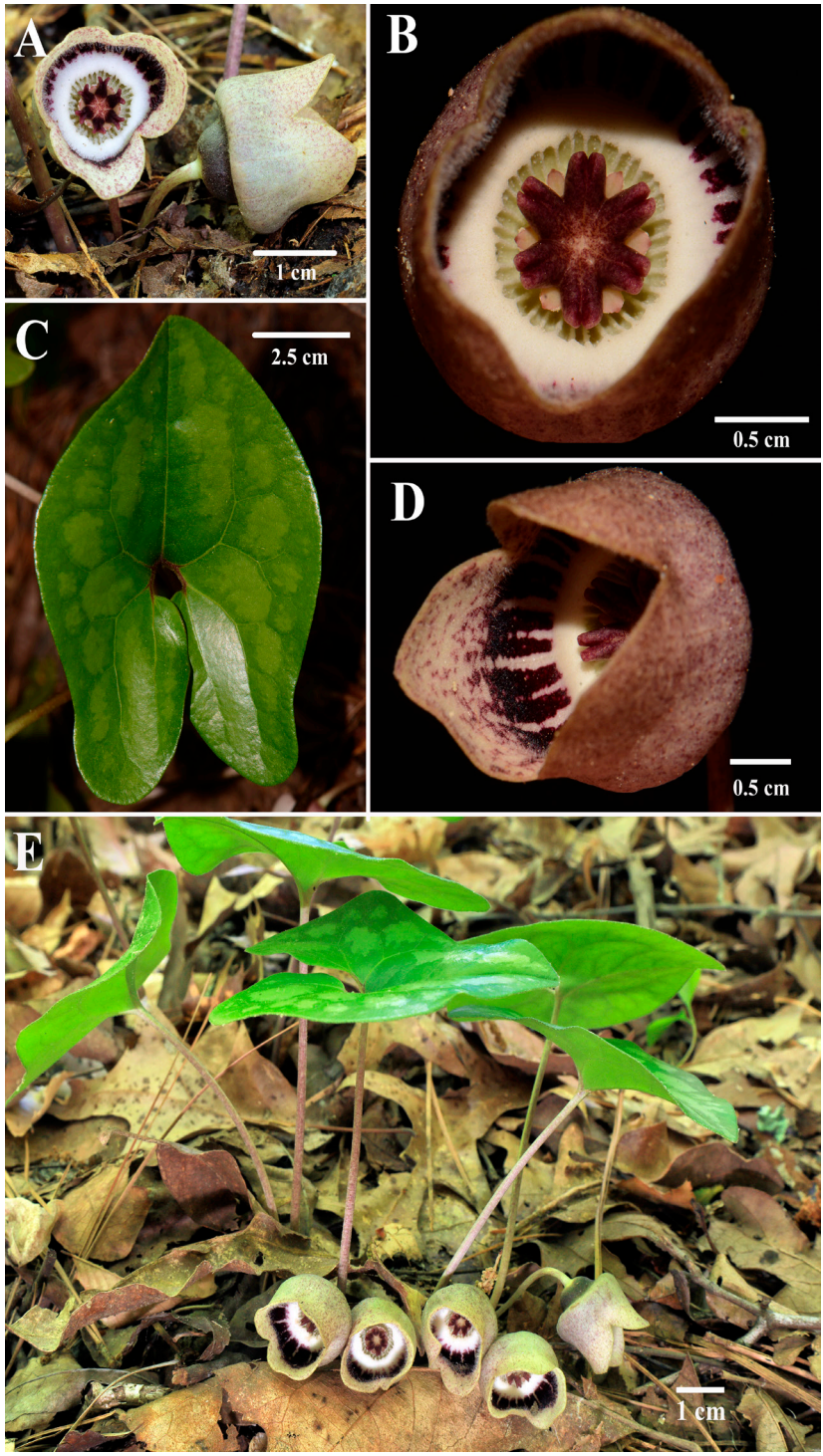

Fig. 1. *Hexastylis finzelii* B.R. Keener. **A.** Flowers front and side. **B.** Flower close-up view, showing maroon style and style appendages. **C.** Leaf. **D.** Flower oblique view. **E.** Habit. (Photos A and E by Alan Cressler; Photos B, C, and D, by Brian Finzel).

Styles maroon, with extensions bifid to stigma, 1.8–2.0 mm long; stigma widely elliptic 1.2 mm long, 0.8 mm wide.

Additional specimens examined: **U.S.A.** Alabama**: Marshall Co.:** 6.75 air mi NW of Guntersville, along N side of Tennessee River near the SE corner of Bishop Mountain, W of Hambrick Hollow, 34.42600°N -86.38011°W, 6 Apr 2019, *B. Finzel s.n.* (UWAL); near 34.4262410°N -86.38031°W, 10 Apr 2019, *T.W. Barger with B. Finzel #SP4302A* & *#SP4302B* (ALNHS); [exact location withheld for conservation purposes], 16 May 2020, *B.R. Keener et al. 11,803* (UWAL; duplicates to be distributed).

Distribution and habitat.—To date, *Hexastylis finzelii* is known only from two populations, both from Bishop Mountain in Marshall Co., Alabama. The first of these was discovered in 2019 and serves as the type locality cited above. Upon discovery and initial examination, it was comprised of approximately 125–150 individual plants. The second and much larger population comprised of approximately 1000+ individuals was discovered in 2020 and is about 2 km from the type locality. Both populations occur in the Plateau Escarpment of the Southwestern Appalachians ecoregions seemingly at the boundary of the Pennington Formation and Bangor Limestone geologic units with occasional Pottsville Sandstone debris from above (Griffith et al. 2001; Osborne & Ward 2010). The habitat for both populations is slightly mesic with rocky well-drained soil covered by a regenerated forest several decades old. The forest is mostly of hardwoods, oaks, hickories, sweet gum, and tulip poplar while occasionally cedar and pines are also present. The associated plants do not exhibit any substrate chemistry trend toward acidic or alkaline species likely attributable to the geologic mosaic mentioned above.

Etymology and Common Name.—The epithet honors Mr. Brian Finzel (1971–), a native plant enthusiast, nature photographer, high school science teacher, colleague, and friend. His discovery of the first population of the new entity and dedication to systematic plant photography of the southeastern U.S. flora deserve commemoration. I propose a literal translation combined with laymen's traditional vernacular of related species be employed for the common name, "Finzel's Wild Ginger."

Conservation and IUCN Red List Category.—*Hexastylis finzelii* should be considered ENDANGERED based on the criteria set forth by the IUCN Red List Criteria (2012).

KEY TO SPECIES OF THE ARIFOLIA-SPECIOSA GROUP

1. Calyx urceolate **(Fig. 2)**, without an abrupt outward flare dividing the calyx tube into distinct lower and upper portions _____ **H. arifolia**
1. Calyx campanulate-cylindric or cup-shaped with an abrupt outward flare dividing the tube into distinct lower and upper portions.
   2. Calyx lobes recurved; lower calyx tube (below outward flare) as long as or longer than upper calyx tube; style appendages greenish_____ **H. speciosa**
   2. Calyx lobes erect; lower calyx tube distinctly shorter than upper calyx tube; style appendages maroon _____**H. finzelii**

DISCUSSION

Hexastylis finzelii is the second *Hexastylis* endemic to Alabama, a state well documented for high levels of biodiversity. The other endemic, *H. speciosa*, named for its showy flowers, is only known to occur in three counties in central Alabama (Harper 1924; Keener et al. 2020). *Hexastylis speciosa* is currently under review by the U.S. Fish and Wildlife to be listed as a Threatened or Endangered species (USFW, ECOS 2020). Ironically, *H. finzelii* is in much greater need of conservation efforts as the extremely narrow distribution makes it considerably more vulnerable than *H. speciosa*.

SPECIES GROUPS WITHIN *HEXASTYLIS*

In the first modern monograph of the *Hexastylis*, Blomquist (1957) recognized nine species and two additional infraspecific taxa of *H. arifolia* (Michx.) Small. He also erected three different species "groups" ("Arifolia," "Speciosa," and "Virginica") each named after a taxon included within each group. The Arifolia and Speciosa groups were comprised of a single species each, but with two additional infraspecific taxa within the Arifolia group, leaving the remaining seven species in what he defined as the Virginica group. While Blomquist placed *H. arifolia* [with infraspecific taxa] and *H. speciosa* R.M. Harper in different "groups" based primarily on calyx morphology, he recognized the similarities between the two entities as reflected in his key. He separated the

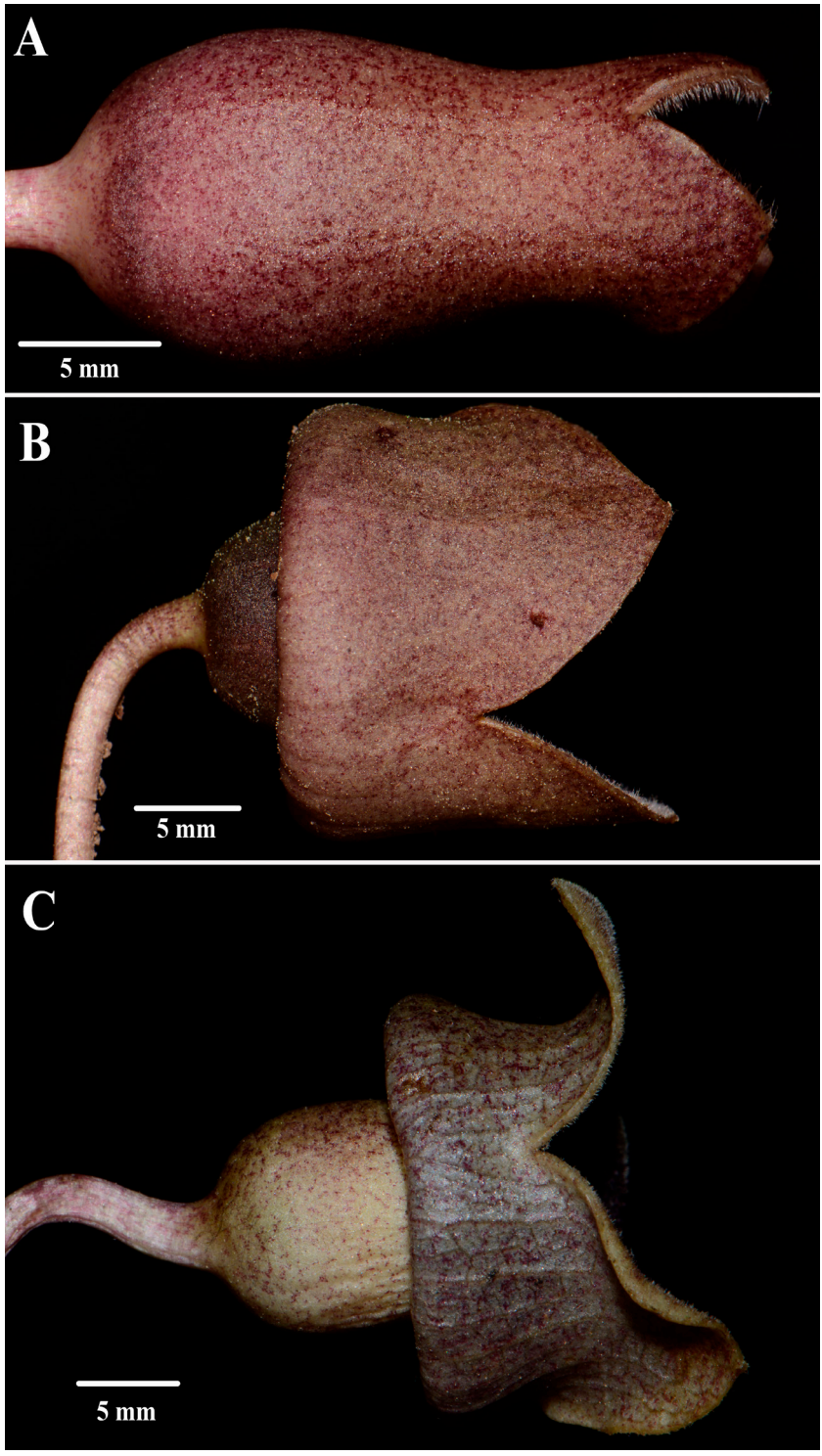

Fig. 2. Comparison of calyx from side view. **A.** *Hexstylis arifolia*. **B.** *H. finzelii*. **C.** *H. speciosa*. (Photos by Brian Finzel).

Arifolia and Speciosa groups from the Virginica group based on leaf variegation with lighter green between the primary veins and style extensions bifid to the stigmas. These characters create a decisive dichotomy with the Virginica group taxa, which have lighter variegations along the primary veins of the leaves and style extensions only notched at the apex.

Thirty years later, Gaddy (1987) published a revised treatment of *Hexastylis* including the two new taxa that were described since Blomquist's monograph (1957), both members of the Virginica group. Gaddy maintained the Blomquist species groups while dividing the Virginica group into three subgroups. A broader cladistic analysis by Kelly (1997) included allied genera but had limited *Hexastylis* sampling and thus did not address species groups within *Hexastylis*. However, a year later using morphology and the molecular ITS marker, Kelly (1998) demonstrated Blomquist's Arifolia and Speciosa groups to be monophyletic together and basal to a limited sampling but monophyletic Virginica group which was in turn basal to the Asian genus *Heterotropa* C. Morren & Decn.

Sinn et al. (2015), using data from the ITS nuclear regions and seven plastid markers, addressed the broader question of generic delineation among *Asarum* and related genera including *Hexastylis*. In their study, several more *Hexastylis* (treated as a section) taxa (15) were utilized in sampling than the earlier Kelly (1998) study. Sinn et al. found similar results to Kelly in that Blomquist's Arifolia and Speciosa groups were monophyletic together and sister to a monophyletic Virginica group that demonstrated three subgroups. One surprising result from the Sinn et al. study was the inclusion of *H. lewisii* (Fernald) H.L. Blomq. & Oosting within the *arifolia-speciosa* clade. It was unexpected because *H. lewisii* produces lighter green variegations on the primary leaf veins and merely notched style appendages, hallmarks of Blomquist's Virginica group. Using the ITS and matK molecular markers, Takahashi and Setoguchi (2018) reinforced the monophyly of the *arifolia-speciosa* clade as distinct from other *Hexastylis* "Virginca group" taxa, but they did not include *H. lewisii*. However, in recent unpublished data using ITS with indels coded, *H. lewisii* was found to be in the expected location, within the Virginica group while also maintaining a monophyletic *arifolia-speciosa* clade (A. Floden pers. comm.).

According to the "group" structure established by Blomquist (1957), *Hexastylis finzelii* is only the second member of the Speciosa group. This placement is due to the wide calyx opening and outward flare of the calyx tube along with lighter green variegations between the primary veins of the leaves and bifid style appendages. This is notable as all new *Hexastylis* taxa described since Blomquist's monograph can be attributed to his Virginica group. However, it may be that Blomquist's Speciosa and Arifolia group distinctions are no longer warranted based on the molecular data alluded to earlier. The discovery of *H. finzelii* will facilitate the legitimacy of these groups through future molecular testing with the addition of a new close relative. At this time, the vegetative morphology does not support the group distinctions as the leaves of *H. finzelii*, *H. arifolia*, and *H. speciosa* are essentially indistinguishable from each other though occasionally *H. speciosa* may sometimes seem wider in a few individual leaves. Despite the dramatically different calyx morphology, both *H. finzelii* and *H. arifolia* have maroon styles and style appendages compared with light green in *H. speciosa*. Also, given the disjunction of approximately 170 km between *H. finzelii* and *H. speciosa* coupled with the short-range dispersal mechanisms of *Hexastylis*, it could be that *H. finzelii* will be found more closely related to the wide-ranging and sympatric *H. arifolia* than the expected narrow endemic *H. speciosa*. Going forward, it may be more appropriate to simply recognize two primary groups of taxa in the genus *Hexastylis*: Arifolia-Speciosa Group [*H. arifolia* (and varieties), *H. speciosa*, and *H. finzelii*] and Virginica Group [all remaining taxa]. Alternatively, based on the molecular data cited above, it may be warranted to transfer the Virginica group taxa to a newly erected genus to achieve a monophyletic classification for each of the two groups. In either scenario, more molecular data is required.

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