A MORPHOLOGICALLY BASED TAXONOMIC REEVALUATION OF THE GENUS *STIPULICIDA* (CARYOPHYLLACEAE), WITH COMMENTS ON RANK

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ABSTRACT

Stipulicida is a narrowly endemic, monotypic genus as currently circumscribed. Previous studies have attempted to diagnose additional taxa within the genus, but only one species comprised of two varieties is currently accepted. These two varieties, *Stipulicida setacea* var. *setacea* and *S. setacea* var. *lacerata*, demonstrate significant phenotypic divergence and idiosyncratic biogeographical patterns. We utilized multivariate analyses and nonparametric analyses of variance to ascertain morphological distinctions between these two taxa and assess biologically appropriate taxonomic rank. Based on our morphometric data and biogeography, we elevate **S. setacea** var. **lacerata** to species and provide a revised key to the species in the genus.

RESUMEN

Stipulicida es un pequeño género endémico, monotípico tal como se circunscribe normalmente. Estudios previos habían intentado diagnosticar taxa adicionales en este género, pero solo se acepta normalmente una especie con dos variedades. Estas dos variedades, *Stipulicida setacea* var. *setacea* y *S. setacea* var. *lacerata*, muestran una divergencia fenotípica y patrones biogeográficos significativos. Utilizamos un análisis multivariante y un análisis no-paramétrico de varianza para establecer diferencias morfológicas entre estos dos taxa y valorar el rango taxonómico apropiado biológicamente. Basados en nuestros datos morfométricos y biogeografía, elevamos **S. setacea** var. **lacerata** a especie y proporcionamos una clave revisada de especies del género.

INTRODUCTION

The monotypic genus *Stipulicida* Michx. (Caryophyllaceae; Paronychioideae; Polycarpeae) is endemic to the southeastern United States and Cuba (Swanson & Rabeler 2005; Weakley 2012; Kartesz 2013). It consists of minimalist plants with slender stems, ephemeral basal rosettes, short awl-shaped opposite leaves with incised stipules, and diffuse, divaricately-branched inflorescences. The flowers are the most conspicuous morphological feature, consisting of 5 dimorphic sepals (often referred to as "inner" and "outer"), 5 white petals, with the terminal clusters subtended by bracts similar to the leaves. The genus was first described by Andre Michaux (1803) from collections made "*in sabulosis aridis Carolinae*" (= sandy, dry soils of the Carolinas) (Fig. 1). *Stipulicida* as a genus has remained unscathed by current phylogenetic and systematic studies of the Caryophyllaceae, perhaps only because of its omission from them. In the most recent molecular phylogenetic studies of the Caryophyllaceae (e.g., Fior et al. 2006; Harbaugh et al. 2010; Greenberg & Donoghue 2011), *Stipulicida* has been one of the few genera omitted. Consequently, exact subfamilial and tribal placement has not been confirmed and current circumscription is based solely on morphology. At the time of its description, the genus was represented by a single species, *Stipulicida setacea* Michx.

Nash (1895) added another putative species from central peninsular Florida, *Stipulicida filiformis* Nash, which allegedly differed from *S. setacea* based on a much more slender habit, fewer, sessile flowers, and shorter bracts. Small (1903, 1913, 1933) maintained this taxon as distinct within his influential manuals and added

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Fig. 1. One of two presumed isotypes of *Stipulicida setacea* (*Michaux s.n.*, P, image #P00156962).

petal shape (constricted at the middle vs. spathulate) as an additional discriminating feature. Judd (1983) sought to address the taxonomic status of *S. filiformis* by conducting extensive fieldwork and observing variation in situ, in addition to morphometric analyses from herbarium specimens. He focused on two quantitative features, stem diameter and number of flowers/inflorescence. Judd (1983) concluded that the plants intergrade broadly with respect to these characters, while also stating that bract size and petal shape failed to provide separation into two taxa, and consequently recognized *S. filiformis* as a mere morphological extreme or ecotype of *S. setacea*, though commenting that its apparent limitation to the Central Florida Ridge was noteworthy due to the number of taxa that are distributed similarly as endemics of xerophytic sands of this region. Ward (2001) felt this pattern (in combination with intergrading morphological distinctions) was sufficient to warrant maintaining it at varietal rank, *Stipulicida setacea* var. *filiformis* (Nash) D.B. Ward, in order to preserve some taxonomic distinction.

James (1957) described the only additional member of this genus to date by recognizing a new variety, *Stipulicida setacea* var. *lacerata* C.W. James, restricted to Florida and the Isle of Pines (now the Isla de la Juventud), Cuba. This variety was considered distinguishable from the typical variant by the presence of lacerate sepals and outer sepals that were mucronate, as well as "essentially allopatric" distributions. James' (1957) rationale for infraspecific rank was explicit:

> "The collection of F.W. Hunnewell (no. 8955, Highlands Co., Fla.), from the eastern limits of the range of var. *lacerata* was the only one seen which consisted of plants of both varieties. The specimen of var. *lacerata* in this collection is somewhat atypical. This, in addition to the fact that there is not a clear-cut discontinuity in the shape of the sepals, indicates that there may be some gene flow between these taxa."

During the course of his study, Judd (1983) also noticed the distinctive nature of lacerate-sepaled plants and felt they were adequately assigned to varietal status due to presence of intermediate plants from Highlands and Volusia Counties.

At present, the general consensus (as shown by recent floras covering all or parts of the distribution of the genus: Wunderlin & Hansen 2011; Swanson & Rabeler 2005; Weakley 2012) has been to follow the taxonomic schema established by Judd (1983) by recognizing a single species within the genus, with two relatively well-marked varieties, *Stipulicida setacea* var. *setacea* (incl. *S. filiformis*) and *S. setacea* var. *lacerata*. The distribution of the genus as a whole is narrow, restricted to the Atlantic and Gulf Coastal Plain (Fig. 2). Of these two varieties, var. *setacea* is the most widespread, extending from southeastern Virginia to Florida and west to eastern Louisiana. The second variety, var. *lacerata*, is much more narrowly distributed in only peninsular Florida, and disjunct in Cuba (Isla de la Juventud) (Wunderlin & Hansen 2005; Weakley 2012).

Previous classification attempts have lacked a comprehensive, systematic approach in documenting key morphological differences between these two entities and have failed to account for what we believe are significant characters, in addition to the seemingly conspicuous sepal morphology. Consequently, we chose to reevaluate the distinctiveness of the two currently recognized varieties using a broader morphometric analysis.

METHODS

We examined selected specimens from across the entire distribution of the species (Fig. 2). Physical material was examined from GH, NCU, and USF. The southernmost locality (Isla de la Juventud, Cuba) was examined digitally (*Britton 14200,* NY, image #NY01511627). We also studied the original type description and illustration of *Stipulicida setacea* from Michaux (1803), as well as the putative isotypes from the Michaux Herbarium at the Muséum National d'Histoire Naturelle (*Michaux s.n.,* P, image #P00156961 and #P00156962). In addition, we examined digital images of types of the other named taxa, including *S. filiformis* (*Nash 14*, GH, image #GH00038011, MICH, image #MICH1111011, MIN, image #MIN1002897, NY, image #NY00353092, P, image #P04925565 and #P04925568, US, image #US00103374 and #US00931431) and *Stipulicida setacea* var. *lacerata* (*Tracy 6828*, GH, image #GH00038012, MSC, image #MSC0092943, NY, image #NY00353093, US, image #US00103375). We selected 41 representative specimens of *Stipulicida setacea* (without discrimination between var. *setacea* and var. *filiformis*) and 26 specimens of var. *lacerata* for morphometric analysis to assess

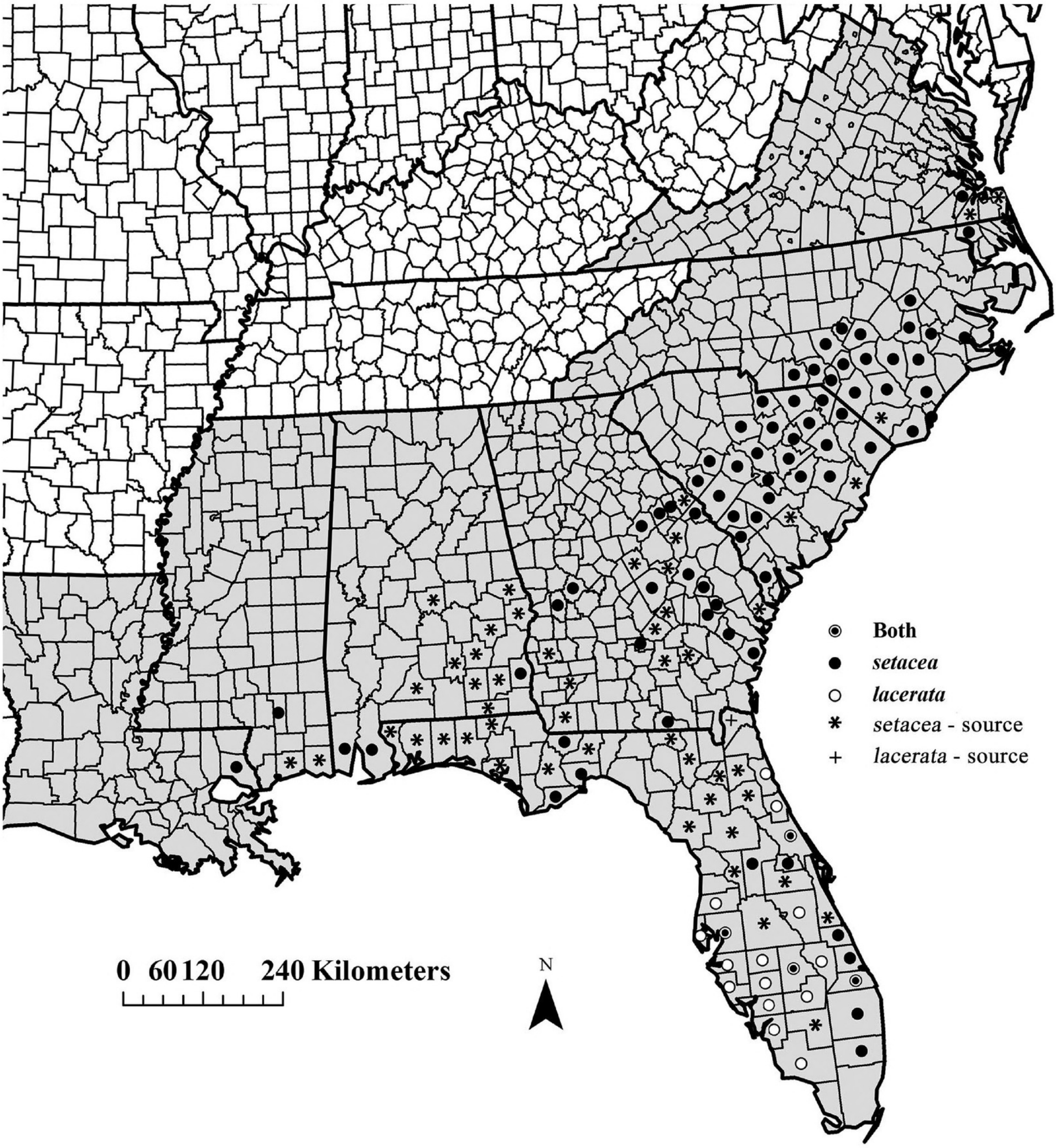

Fig. 2. Distribution of *Stipulicida setacea* specimens examined for this study. Records that have not been physically examined but are from reliable sources (Wunderlin & Hansen 2008; Kartesz 2013) are included. State-level occurrence is indicated by shading.

previously described features (see Nash 1895; James 1957; Judd 1983) and to seek additional diagnostic features. Specimens measured are denoted within the Appendix (below).

We examined nine continuous characters (Table 1). All characters were selected at random, with the exception of the length of the longest mucro (LOM), which necessitated a comprehensive scan of each specimen. In addition, we made general observations regarding the degree of laceration and fimbriate nature of specimens, as well as overall gestalt. All measurements were made with a TDI International, Inc. Micro Ruler.

To determine specimen groups and elucidate the most diagnostic variables, we used principal components analysis (PCA). To avoid weighting characters, we examined pairwise correlation coefficients (CC) that

Table 1. Morphological characters measured from herbarium specimens with abbreviations in parentheses. Those characters used in multivariate analyses are denoted by an asterisk.

1	Length of outer sepal (LOS)
2	Length of inner sepal (LIS)*
3	Width of outer sepal (WOS)*
4	Width of inner sepal (WIS)
5	Stem width below terminal flower cluster (SWF)*
6	Stem width below lowest branching node (SWN)*
7	Length of longest mucro of the outer sepal (LOM)*
8	Difference between inner and outer sepal length (DSL)
9	Difference between inner and outer sepal width (DSW)

may indicate genetically linked characters and excluded those that exceed a standard threshold of > 0.7. The only exception to this concerned the characters LOM and WOS, which exhibited a strong correlation, but we believe that this correlation may be artificial, as it is very unlikely that these two traits would be due to allometric scaling. Thus, we have decided to retain them both within our analyses. For PCA, we conducted analyses on a correlation matrix, which consisted of data that is standardized so that each variable had a mean of 0 and standard deviation of 1. We used only the following five continuous characters in this analysis: LIS, LOM, SWF, SWN, and WOS.

We performed a Bartlett test for homogeneity of group variances on each variable. Variables that demonstrated variances that were significantly heterogeneous were log-transformed before further analysis. We tested each variable for deviations from normality using the Goodness-of-Fit test. Nearly all variables deviated significantly from a normal distribution. We chose to maintain a conservative approach using the nonparametric Kruskal-Wallis test and employed the Steel-Dwass method (i.e., a nonparametric version of the Tukey Honestly Significantly Different test) to further detect the amount of differences between groups. Principal components and nonparametric analyses were conducted using JMP® version 11 software (SAS Institute, Cary, NC) on an Apple ® MacBook Pro™ computer.

RESULTS

Principal components analysis yielded strong resolution with *Stipulicida setacea* var. *lacerata* and var. *setacea* clearly separating within the ordination space (Fig. 3). Principal component 1 was responsible for 57.3% of the observed variation and principal component 2 was responsible for 16.7%, for a total of 74.0% of the variance explained. An examination of specimens likely to be assigned to *Stipulicida setacea* var. *filiformis* based on their "wiry" habit and geographic distribution revealed that they were embedded within the var. *setacea* data cluster (data not shown). Likewise, the Kruskal-Wallis test supported two distinct groups. Both taxa differed from each other with respect to means of nearly all measured characters except LOS and LSW (Table 2).

DISCUSSION

The genus *Stipulicida* has recently been treated as monospecific and is currently represented by one species, *Stipulicida setacea*, and two varieties (Swanson & Rabeler 2005; Weakley 2012): *S. setacea* var. *setacea* and *S. setacea* var. *lacerata*. The paucity of distinctive morphological characters found within the genus have perhaps led to a general acceptance of this current taxonomic treatment and a lack of interest in further study. This research sought to reevaluate the distinctiveness of these two entities through a more rigorous morphometric approach that implemented multivariate analyses, in an attempt to address appropriate taxonomic ranks. We selected several characters that had previously been emphasized by other authors, but also generated new characters (e.g., outer and inner sepal length differences) that have aided in the further discrimination these taxa. Despite considerable overlap, many diagnostic trends are apparent. Though both taxa have dimorphic sepals, those of var. *lacerata* are distinctly lacerate/fimbriate and usually unequal in length (**Fig. 4**A–B). Conversely, the sepals of var. *setacea* are mostly entire margined and often even in length (Fig. 4C–D). *Stipulicida setacea* var. *lacerata* exhibits longer and wider inner sepals on average, and outer sepals that are generally wider and with a more pronounced mucronate apex (which is usually obsolete in var. *setacea*). Variety *lacerata* also appears generally stouter than var. *setacea* in all aspects as evidenced by significantly greater average stem widths (Table 2).

A combination or suite of characters rather clearly defines these two taxa within ordination space (Fig. 3).

Table 2. Means ± 1 SD and ranges for morphological characters measured. Character abbreviations correspond to those in Table 1. All measurements are in millimeters. N equals the sample size. Within a row, means with different superscripts differ significantly (Kruskal-Wallis, $P < 0.05$).

Character	S. setacea (N=41)	S. lacerata (N=26)
1. LOS	1.4 ± 0.2^a (0.9 - 1.8)	1.5 ± 0.29^a (1.0 - 2.0)
2. LIS	1.5 ± 0.21^a (1.0 - 1.9)	1.8 ± 0.32^b (1.1 - 2.2)
3. WOS	0.4 ± 0.1^a (0.2 - 0.7)	0.8 ± 0.1^b (0.6 - 1.1)
4. WIS	0.6 ± 0.1^a (0.4 - 0.9)	1.0 ± 0.2^b (0.7 - 1.4)
5. SWF	0.3 ± 0.1^a (0.2 - 0.6)	0.4 ± 0.1^b (0.3 - 0.5)
6. SWN	0.5 ± 0.1^a (0.3 - 0.9)	0.8 ± 0.1^b (0.5 - 1.1)
7. LOM	0.0 ± 0.04^a (0.0- 0.1)	0.3 ± 0.1^b (0.2 - 0.5)
8. DSL	0.1 ± 0.1^a (-0.2 - 0.5)	0.3 ± 0.2^b (0.1 - 0.7)
9. DSW	0.2 ± 0.1^a (0.1 - 0.5)	0.2 ± 0.1^a (0.0 - 0.4)

As a secondary measure, we selected specimens that were either originally determined as *Stipulicida setacea* var. *filiformis* (or *S. filiformis*) or were within the originally described distribution and ecological preference of this taxon. We mapped these specimens within our PCA and found them to be centrally nested within *S. setacea* var. *setacea* (data not shown), which further supports Judd's (1983) conclusion that *S. filiformis* is not distinct from var. *setacea*. These data, in conjunction with known biogeographic patterns, suggests that *Stipulicida setacea* var. *lacerata* and *S. setacea* var. *setacea* are sufficiently distinct to be recognized as discrete entities. However, previous authors (James 1957; Judd 1983) have indicated that a handful of specimens in areas of sympatry are intermediate. The one specimen (Highlands County, FL, *Hunnewell 8955,* GH) cited by James (1957) as a mixed collection was included in our analyses, focusing on the portion he described as "atypical" *Stipulicida lacerata* and it was nested within the var. *setacea* data cluster. Though we did not examine two of the additional specimens mentioned as intermediate by Judd (1983), we did examine one from Volusia County, FL (*D.S. & H.B. Correll 51934,* USF). This specimen appeared to be a mixed collection with one branch that was unassociated with a parent plant, but mounted on top of another such that it was not easily detectable as separate. We measured both this stem, which based on our PCA was nested within var. *lacerata*, and another full plant on the sheet separately, which was nested within var. *setacea*. Since we have not examined other putative intermediates reported, we cannot attest to their identity.

We also recognize that some within taxon variation is apparent and could lead to perceived intermediacy. For instance, some trends were observed that may not be readily apparent, e.g., northernmost populations of var. *setacea* exhibit acute to slight retuse outer sepal apices, with progressively more retuse to strongly obcordate apices as one progresses further south. This pattern is also seen with northern populations possessing inner and outer calyces that are narrow and subequal in length, while those of southern populations are wider and often unequal, as well as shorter in comparison. Even the amount of lacerations/fimbriae of var. *lacerata* can vary somewhat and an examination of an entire specimen is necessary to evaluate the plasticity in this qualitative character state. James (1957) also remarked that the specimens from Cuba do not have as strongly lacerate sepals as those from Florida, though we found this to be within the range of variation of this taxon.

How does this analysis translate to taxonomic decision-making? We find that (despite variation within each) two morphologically distinctive entities ("*lacerata*" and "*setacea s.s.*") are consistently separable and identifiable using a suite of morphological characters. The several morphological characters are correlated with one another, and do not randomly assort. An ordination confirms the more subjective assessment that two morphologically distinct entities can be recognized. No true intermediates have been seen; and a few "putative intermediates" cited by previous workers prove not to be, based on careful analysis. Neither are there situations in which the correlation of the seemingly independent characters breaks down. When mapped, these two morphologically distinct entities have distinctive and different distributions, with a substantial area of overlap in peninsular and northeastern Florida. In areas of distributional overlap, intermediates are not seen, although at least one studied collection is mixed. Each of the distribution patterns shown by the two enti-

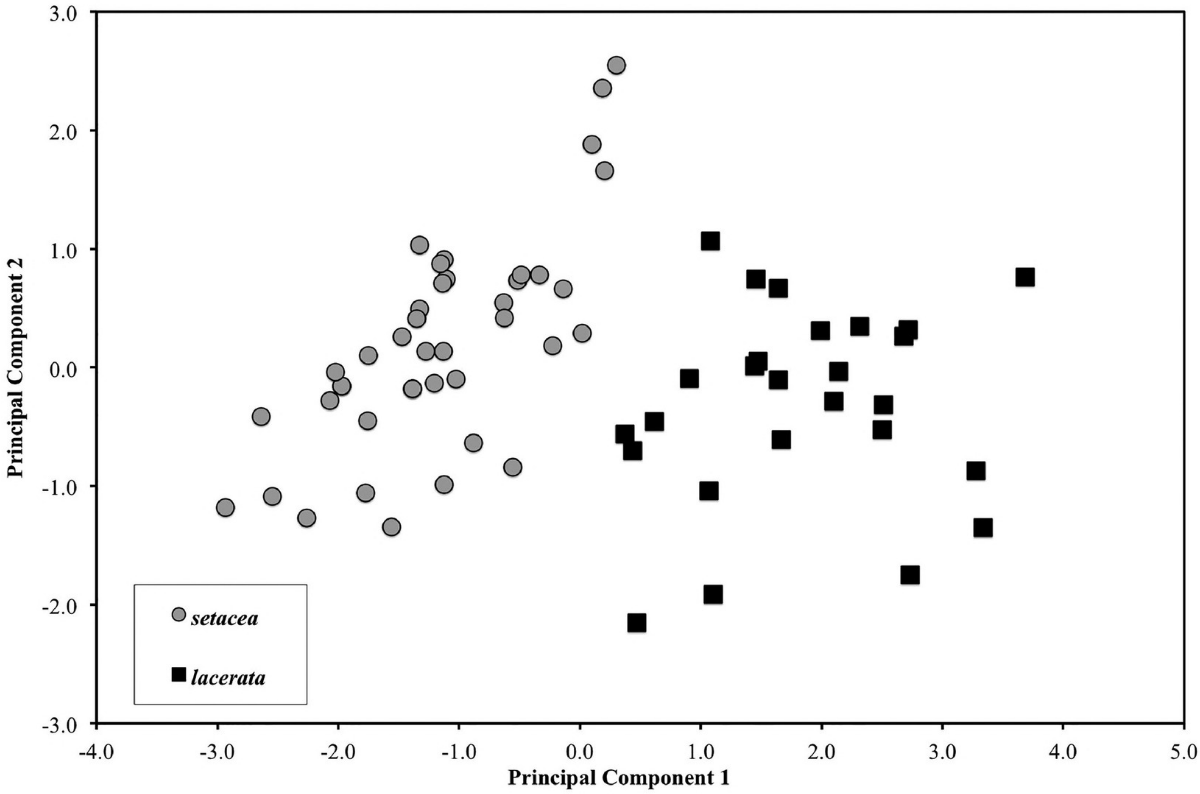

Fig. 3. Principal components analysis (PCA) of seven morphological characters (LOC, SWN, SWF, OSL, ISL, OSW, ISW) measured from *Stipulicida lacerata* and *S. setacea.*

ties is a distribution pattern represented by a large number of other angiosperm (and even animal) species: the "se. Virginia to s. Florida, west to e. Louisiana" distribution of "*setacea s.s.*" and the "Florida peninsula" distribution (with optional disjunction into the West Indies) of "*lacerata*"—both commonly repeated distributions across many organism groups and therefore likely to show "biogeographic signal" (see Sorrie & Weakley 2001, 2006).

If two taxonomic entities are warranted, what should their taxonomic rank be? Based on the analysis presented above, we believe that these two entities represent independent evolutionary entities (by biological, evolutionary, and/or phylogenetic criteria) at this time—species per most modern species concepts. A frequently used, though usually not explicitly stated, assumption suggests that the magnitude of morphological difference is well-correlated with taxonomic rank—a paradigm that might be characterized as "if you can tell two entities apart with readily observable, macroscopic characters, they are species, but if the characters require magnification or are 'fussy', they are infrataxa (subspecies or varieties)". Ward (2012), in a paper proposing the reduction of dozens of Southeastern United States species of vascular plants species to varietal status, makes some of these points more explicitly, decrying the proliferation of "microspecies". The following statement regarding *Conradina etonia* may be regarded as an example: "Details of indumentum, of leaf venation, of size and pilosity, and of stamen pubescence, while wholly persuasive of the taxon's genetic separateness, do not rise to the level of difference to be found among related species" (Ward 2012). But modern biological and phylogenetic species concepts are not based on the magnitude of morphological variation but on the degree to which two entities are demonstrably separate biological/evolutionary entities—not determinable by the size of their characters but by inductive reasoning (as in the previous paragraph). The consistency and evolutionary meaningfulness of the characters is what tells the tale, not their size; small plants with small characters are not less significant evolutionary entities.

Gill (2014) has also recently, and significantly, raised the issue of "burden of proof" in modern taxonomic decision-making. When previous taxonomic studies have proposed a range of conclusions (splitting to lumping), what is the null hypothesis and on whom does the burden of proof lie; to disprove previous lumping, or to disprove previous splitting? Gill (2014) argues that in bird studies, allopatric "populations" have almost always been shown, after detailed genetic study to warrant taxonomic recognition at species rank, and that the burden of proof should now be (based on this preponderant pattern) on those who favor "lumping". Additionally, this assumption is more conservationally helpful and parsimonious, in providing a more accurate hypothesis of significant evolutionary entities requiring conservation attention. In much less well-studied groups (such as vascular plants of the southeastern United States), patterns of previous studies are less clear, but generally also show that recent rigorous and/or molecular-based studies show a greater general reliability of older morphological studies (reflected in the treatments of Small, 1903, 1913, and 1913) than the casual lumping seen in many late 20th century and early 21st century floras (e.g., Radford et al. 1968; Wunderlin & Hansen 2011). As demonstrated by Weakley (2005), eastern North American floras from the 1960s to 1990s instituted a trend of lumping, often without additional studies of the plants themselves either in the field or in herbaria. This has led to a current misimpression that many "splits" (recognized, for instance by J.K. Small in the Southeast and Fernald in the Northeast) have been disproven, when most have received little or no additional study since the first half of the 20th century.

For *Stipulicida*, previous taxonomic studies have concluded that there are one, two, or three entities, and at various ranks. We concede that we have not presented the ultimate and final analysis, based on an ideal and complete (as of methodologies available in 2014) synthesis of molecular data, morphological character analysis, and population biology studies. Such a study would require substantial effort, and with thousands of such taxonomic problems remaining in the southeastern United States flora and few investigators and even less funding, it is not our highest priority. We offer this analysis and set of taxonomic conclusions (resulting in the recognition of two taxa, not one or three) as a current, yet disprovable hypothesis of the taxonomy of *Stipulicida*.

We conclude that the best evidence available supports the recognition of two specifically distinct entities within *Stipulicida*, and therefore here elevate var. *lacerata* to the rank of species and provide a revised identification key to members of the genus.

Stipulicida lacerata (C.W. James) D.B. Poind., K.E. Bennett, & Weakley, comb. et stat. nov. *Stipulicida setacea* var. *lacerata* C.W. James; Rhodora 59:98. 1957. Type: UNITED STATES. Florida. Pinellas Co.: Dunedin, 14 Apr 1900, *Tracy 6828* (holotype: GH!, image; isotypes: MSC!, image, NY!, image, US!, image).

KEY TO SPECIES OF *STIPULICIDA*

1. Sepal margins lacerate-fimbriate; outer sepals often much shorter than inner sepals (usually by 0.1–0.5 mm); tips of the outer sepals with longest mucro (0.1–)0.2–0.4(–0.5) mm; [of FL and Cuba (Isla de la Juventud)] ____ **S. lacerata**
1. Sepal margins entire or frayed (not lacerate-fimbriate); outer sepals subequal to slightly shorter or longer than inner sepals (usually by 0.0–0.2 mm); tips of the outer sepals acute to obtuse or retuse-obcordate; with longest mucro or apicule 0.0–0.1 mm; [of se. VA south to s. FL, west to e. LA] ____ **S. setacea**

Additional studies of the interesting, and seemingly isolated, genus *Stipulicida* are warranted. Population genetic and molecular studies could elucidate additional patterns of variation, and more definitively clarify the status of the alleged "*filiformis*" entity and the widely disjunct population of *S. lacerata* in the Isla de la Juventud (Cuba), as well as providing additional confirmation of our proposed species-level distinction of *S. setacea* and *S. lacerata*. Additionally, the failure to include *Stipulicida* in recent molecular studies of the family leaves its phylogenetic affinities and exact taxonomic placement within the Caryophyllaceae uncertain and conjectural.

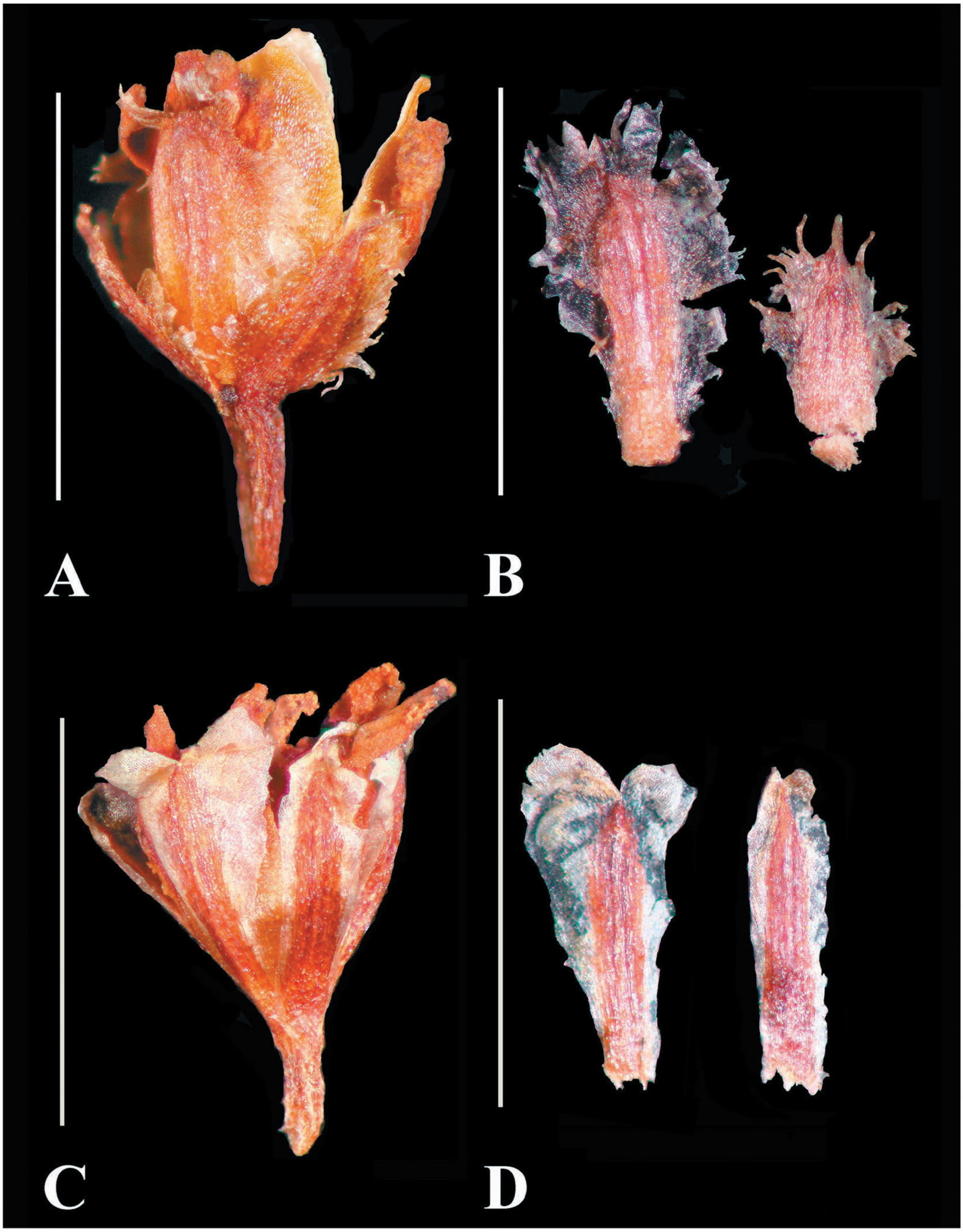

Fig. 4. Mature capsules, calyces and calyx lobes (inner lobes = left, outer lobes = right) of **A–B**) *Stipulicida lacerata* (Sarasota County, Florida, *Perkins s.n.*, NCU) and **C–D**) *S. setacea* (Bamberg County, South Carolina, *Ahles 25982*, NCU). Scale bar = 2 mm.

APPENDIX

List of representative specimens. Those utilized for morphometric analysis are denoted by an asterisk.

Stipulicida lacerata **(C.W. James) D.B. Poind., K.E. Bennett, & Weakley—U.S.A. FLORIDA. Charlotte Co.:** NE of Pirate Harbor, 10 May 1990, *Orzell 13438* (USF); Prairie/Shell Creek, 11 May 2009, *Franck 1250* (USF*). **Collier Co.:** Immokalee city limits, 7 Apr 1968, *Lakela 31361* (USF*); vicinity of Lake Trafford, 31 Jul 1968, *Lakela 31560* (USF*). **De Soto Co.:** W side of Peace River, 31 Jul 2008, *Franck 771* (USF*). **Flagler Co.:** NE of US 1, 1 May 2006, *Slaughter 14843* (USF*). **Glades Co.:** Fisheating Creek Wildlife Management Area, 30 May 2010, *Franck 2184* (USF*). **Hardee Co.:** AMAX property, 26 Mar 1979, *Arcuri 856* (USF); Goose Pond Rd., 9 Apr 1981, *Robinson 129* (USF*). **Highlands Co.:** S of Old Venus, 1 May 1958, *Cooley 6137* (USF*); Archibold Biological Station, 24 Dec 1960, *Craighead s.n.* (USF). **Hillsborough Co.:** Tarpon Springs, 23 Mar 1923, *Churchill s.n.* (GH*); Little Manatee River, 21 Feb 1974, *Shuey s.n.* (USF); Little Manatee River State Park, 11 Apr 1999, *Myers 342* (USF*). **Lee Co.:** Myers, 1900, *Hitchcock 5* (GH*); Fort Meyers, May 1928, *Small s.n.* (NCU*); Koreshan State Park, US 41, 20 Apr 1964, *Lakela 26983* (USF); Bonita Springs, 13 Feb 1965, *Foster s.n.* (USF); Koreshan State Park, 1 mi S of Estero, 1 Mar 1969, *McCart 10,630* (NCU*). **Manatee Co.:** Wingate Creek State Park, 14 Mar 1991, *Weber WC0046* (USF); Lake Manatee State Recreation Area, 14 Apr 1992, *Weber LM0039* (USF*). **Martin Co.:** Jonathan Dickinson State Park, 9 Feb 1969, *McCart 10,522* (NCU*); Hobe Mountain, Sep 1987, *Woodbury 87* (USF*). **Okeechobee Co.:** Kissimmee Prairie, 27 Apr 1923, *Small 10898* (GH*). **Osceola Co.:** Kempfer Ranch, 9 Mar 1976, *Huck 1728* (NCU*). **Pasco Co.:** SE of Lacoochee, 29 Jun 1992, *Orzell 19761* (USF); Starkey Wilderness Park, 20 Mar 2004, *Ferguson 659* (USF). **Pinellas Co.:** NE of Clearwater, 3 Apr 1970, *Lelong 5344* (NCU*); Highway 19, 3 Apr 1970, *Rogers 2877-B* (NCU*); Dunedin Hammock, 1 May 1977, *Genelle 2728* (USF*); Magnolia Creek, 24 Mar 1988, *Fleming 3981* (USF*). **Sarasota Co.:** Sarasota, 3 Jan 1943, *Perkins s.n.* (NCU*); Oscar Scherer State Park, 27 Aug 1994, *Cole OSO257* (USF); Deep Prairie Creek Preserve, 23 Aug 2007, *Franck 332* (USF). **St. Johns Co.:** Hastings, 11 Jun 1975, *Godfrey 74329* (NCU*). **Volusia Co.:** Route 415, 26 May 1981, *Correll 51934-B* (USF*); Tomoka State Park, 15 Mar 2006, *Kunzer 1454* (USF*).

Stipulicida setacea **Michx.—U.S.A. ALABAMA. Baldwin Co.:** Point Clear, 20 Mar 1883, *Mohr s.n.* (NCU); Orange Beach, 4 Jul 2012, *Spaulding 13613* (NCU). **Henry Co.:** NE of Abbeville, 8 May 1989, *Orzell 9538* (NCU). **Mobile Co.:** Little Dauphin Island, 15 Jul 1965, *Bray 442* (NCU); S of Audubon Bird Sanctuary, 15 Aug 1966, *Bray D995* (NCU); Dauphin Island, 15 May 1972, *Lelong 6502* (NCU*).—**FLORIDA. Broward Co.:** Deerfield Beach, 17 Jun 1978, *Correll 49877* (NCU*); **Franklin Co.:** near Appalachicola, s.d., *Curtiss exsiccata no. 336* (NCU*); S of US Route 98, 22 May 1971, *Godfrey 70233* (NCU*). **Gadsden Co.:** near Lake Talquin, 29 Apr 1977, *Anderson 4430* (NCU*). **Highlands Co.:** Sebring, 7 Mar 1924, *Hunnewell 8955* (GH*); S of Childs, 25 Apr 1960, *Ray 9788* (NCU*); S of Sebring, 25 Apr 1960, *Ray 9731* (NCU*). **Hillsborough Co.:** W of Plant City, 8 Mar 1963, *Wall 30* (NCU). **Indian River Co.:** near Sebastian, 3 Apr 1921, *Small 9864* (NCU*). **Lake Co.:** Howey-in-the-Hills, 29 April 1960, *Cooley 7352* (NCU*). **Martin Co.:** Hobe Sound, 22 May 1960, *Atwater M-214* (NCU*). **Palm Beach Co.:** W of Lantana, 5 Aug 1952, *Howard 12959* (NCU*); West Palm Beach, 14 Feb 1969, *Cassen 461* (NCU*). **Seminole Co.:** S of Wagner, 3 May 1960, *Cooley 7612* (NCU*). **St. Lucie Co.:** E of US 1, 28 Jul 1962, *Lakela 25219* (NCU). **Volusia Co.:** Route 415, 26 May 1981, *Correll 51934-A* (USF*). **Wakulla Co.:** Mashes Island, 24 Apr 1955, *Godfrey 53207* (NCU*).—**GEORGIA. Ben Hill Co.:** NNE of Fitzgerald, 4 May 1968, *Faircloth 5189* (NCU*). **Candler Co.:** 32°16'N, 81°57'W, 3 May 1965, *Cook 167* (NCU*); E of the Canoochee River, 13 May 1975, *Walker 134* (NCU). **Echols Co.:** Mayday, 15 May 1969, *Faircloth 5831* (NCU*). **Emanuel Co.:** N of the Ohoopee River, 18 May 1976, *Boufford 18438* (NCU*). **Evans Co.:** NW of Claxton, 9 May 1977, *Oliver 96* (NCU). **Hancock Co.:** NE of Sparta, 3 Jun 1972, *Williams s.n.* (NCU*). **Laurens Co.:** E of Dublin, 26 Jul 1967, *Logue 2113* (NCU). **Long Co.:** near Beard's Bluff, 10 Apr 1963, *Bozeman 2543* (NCU). **Marion Co.:** S of Geneva, 17 May 1974, *Faircloth 7770* (NCU). **McDuffie Co.:** S of Thomson, 29 Jul 1950, *Duncan 11558* (NCU); N of Thomson, 18 May 1952, *Duncan 13568* (NCU). **McIntosh Co.:** NW of Cox, 4 Jun 1962, *Bozeman 710* (NCU). **Richmond Co.:** near August Airport, 17 Jun 1950, *Radford 5358* (NCU*); E of Briar Creek, 16 May 1958, *Duke 614* (NCU). **Tattnall Co.:** NW of Reidsville, 11 Jun 1961, *Ahles 54183* (NCU*). **Taylor Co.:** W of Butler, 16 May 1974, *Faircloth 7559* (NCU). **Warren Co.:** NE of Sparta, 3 Jun 1972, *Williams s.n.* (NCU).—**LOUISIANA. St. Tammany Co.:** E of Slidell, 17 May 1983, *Thomas 83658* (NCU*). —**MISSISSIPPI. Forrest Co.:** Hattiesburg, 29 Jun 1971, *Rogers 6585* (NCU*).—**NORTH CAROLINA. Anson Co.:** SE of Lilesville, 30 Jun 1956, *Radford 13452* (NCU). **Bladen Co.:** Sandy places, 10 Jun 1898, *Ashe s.n.* (NCU); W of White Oak, 22 Jun 1957, *Ahles 29167* (NCU); S of Cumberland County line, 12 May 1971, *Leonard 4784* (NCU). **Brunswick Co.:** Boiling Springs Lakes Preserve, 6 Jun 2006, *Morris 052605-04* (NCU). **Carteret Co.:** E of Bogue, 21 Jun 1947, *Wood 7014* (NCU); N of NC 24, 15 May 1976, *Snyder 814* (NCU); Patsy Pond, 22 May 1976, *Wilson 1782* (NCU). **Craven Co.:** W of Vanceboro, 19 Jul 1958, *Radford 37647* (NCU). **Cumberland Co.:** S of Fayetteville on NC 53, 11 May 1941, *Radford 1063* (NCU); N of Cedar Creek, 2 Aug 1954, *Munson s.n.* (NCU); SE of Spring Lake, 4 May 1957, *Ahles 24290* (NCU); WSW of Cumberland, 27 Jun 1957, *Ahles 29729* (NCU). **Duplin Co.:** NE of Magnolia, 27 Apr 1957, *Ahles 24047* (NCU*); N of Scotts Store, 15 Jun 1957, *Ahles 28407* (NCU*). **Gates Co.:** White Oak Pocosin, 30 May 1958, *Duke 805* (NCU*); near Chowan River, 10 Jun 1989, *Musselman s.n.* (NCU*). **Harnett Co.:** SE of Spout Springs, 7 May 1946, *Downs 13446* (NCU*); N of Lillington, 11 May 1946, *Radford 3047* (NCU*). **Hoke Co.:** SW of Bowmore, 12 May 1957, *Ahles 25089* (NCU); Ashley Heights, 26 Jun 1957, *Ahles 29353* (NCU). **Lee Co.:** N of Moore County line, 24 May 1940, *Radford 137* (NCU); SE of St. Andrews Church, 7 Jun 1958, *Stewart 469* (NCU). **Lenoir Co.:** W of Deep Run, 22 Jun 1957, *Radford 25701* (NCU). **Moore Co.:** Weymouth Woods State Park, 13 Jun 1965, *Ahles 59622* (NCU); Weymouth Woods-Sandhills Nature Preserve, 12 May 1973, *Carter 556* (NCU); N of Southern Pines, 11 Jun 1978, *Reed 106667* (NCU). **New Hanover Co.:** Wilmington, May 1867, *Canby s.n.* (NCU*); NW of Carolina Beach, 12 Jun 1958, *Bell 12691* (NCU); UNC-Wilmington, 2 Jun 1975, *Sieren 1330* (NCU). **Pender Co.:** SE of Montague, 26 Jul 1953, *Radford 7400* (NCU); NE of Hampstead, 13 Jun 1957, *Ahles 28003* (NCU). **Richmond Co.:** S of Moore County Line, 4 Jun 1958, *Duke 976* (NCU). **Robeson Co.:** S of Red Springs, 21 Jun 1957, *Ahles 28922* (NCU). **Sampson Co.:** SE of Highsmith, 5 May 1957, *Ahles 24643* (NCU); W of Clement, 28 Jun 1957, *Ahles 30058* (NCU). **Scotland Co.:** W of Laurinburg, 8 May 1957, *Ahles 24817* (NCU); S of Hoke - Scotland County line, 20 Jun 1957, *Ahles 28580* (NCU); NW of US 15-501, 18 May 1973, *Sharp 1592* (NCU); Green Pond, 2 Nov 1984, *Berg 1198* (NCU); Scotland Road Annual Burn Site, 2 Jun 2007, *McCormick s.n.* (NCU). **Wayne Co.:** W of Seven Springs, 21 Jun 1957, *Radford 25480* (NCU). **Wilson Co.:** NW of Sims, 28 Jul 1958, *Radford 38003* (NCU).—**SOUTH CAROLINA. Darlington Co.:** Cannon's, 8 Jul 1909, *Coker s.n.* (NCU); Hartsville, 15 May 1910, *Coker s.n.* (NCU); W of Black Creek, 12 Jul 1920, *Norton s.n.* (NCU); W of Hartsville, 22 Apr 1921, *Norton s.n.* (NCU); Hartsvlle, 10 May 1932, *Smith s.n.* (NCU); near Black Creek along Highway 34, 23 May 1940, *Smith 1664* (NCU); Kalmia Gardens., 27 Sep 1940, *Smith*

1668 (NCU); Witherspoon Island, 3 Jun 1941, *Smith 612* (NCU); E side of Lynches River above Clyde, 18 Jul 1941, *Smith 777* (NCU); Coker College Arboretum, 26 Apr 1944, *Matthews s.n.* (NCU). **Dillon Co.:** NNE of Oak Grove, 18 Apr 1957, *Ahles 23281* (NCU); NW of Dillon, 12 Jun 1957, *Ahles 27802* (NCU); **Edgefield Co.:** S of Trenton, 4 Jul 1957, *Radford 26445* (NCU). **Fairfield Co.:** W of Lugoff, 24 Aug 1961, *Radford 44256* (NCU). **Florence Co.:** NE of Lynches River, 30 Jun 1958, *Bell 13449* (NCU). **Horry Co.:** Myrtle Beach, 23 Jun 1931, *Coker s.n.* (NCU). **Jasper Co.:** Turtle Island, 14 Jun 1997, *McMillan 2492* (NCU). **Kershaw Co.:** N of Bethune, 3 Aug 1958, *Duke 1846* (NCU). **Lancaster Co.:** SW of Heath Springs, 6 Jun 1957, *Ahles 27403* (NCU). **Lee Co.:** NE of Bishopville, 6 Jun 1957, *Radford 24295* (NCU); NE of Lucknow, 26 Jul 1957, *Radford 17340* (NCU). **Lexington Co.:** SE of Lexington, 27 May 1957, *Radford 23315* (NCU). **Marlboro Co.:** Little Pee Dee River, 10 Jun 1956, *Radford 12493* (NCU). **Orangeburg Co.:** W of Orangeburg, 18 May 1957, *Ahles 25242* (NCU). **Richland Co.:** E of Ft. Jackson entrance, 13 May 1958, *Duke 529* (NCU). **Saluda Co.:** S of Ridge Spring, 26 May 1957, *Radford 23128* (NCU). **Sumter Co.:** N of Pinewood, 5 Jun 1957, *Radford 24011* (NCU). **Williamsburg Co.:** N of Mouzon, 12 Jun 1957, *Radford 24825* (NCU).—**VIRGINIA. Isle of Wight Co.:** S of Lees Mill, 29 May 1966, *Svenson 13932* (NCU*).

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REFERENCES

Fior, S., P. Ola Karis, G. Casazza, L. Minuto, & F. Sala. 2006. Molecular phylogeny of the Caryophyllaceae (Caryophyllales) inferred from chloroplast *matK* and nuclear rDNA ITS sequences. Amer. J. Bot. 93:399–411.

Gill, F.B. 2014. Species taxonomy of birds: Which null hypothesis? The Auk 131:150–161.

Greenberg, A.K. & M.J. Donoghue. 2011. Molecular systematics and character evolution in Caryophyllaceae. Taxon 60:1637–1652.

Harbaugh, D.T., M. Nepokroeff, R.K. Rabeler, J. McNeill, E.A. Zimmer, & W.L. Wagner. 2010. A new lineage-based tribal classification of the family Caryophyllaceae. Int. J. Pl. Sci. 171:185–198.

James, C.W. 1957. A new variety of *Stipulicida setacea*. Rhodora 59:98.

Judd, W.S. 1983. The taxonomic status of *Stipulicida filiformis* (Caryophyllaceae). Sida 10:33–36.

Kartesz, J.T. 2013. *Taxonomic Data Center*. (http://www.bonap.net/tdc). The Biota of North America Program (BONAP). Chapel Hill, North Carolina, U.S.A. [maps generated from Kartesz, J.T. 2013. Floristic synthesis of North America, Version 1.0. Biota of North America Program (BONAP). (in press)]

Michaux, A. 1803. Flora Boreali-Americana. Vol. 1. Levrault, Paris, France.

Nash, G.V. 1895. Notes on some Florida plants. Bull. Torrey Bot. Club 22:141

Radford, A.E., H.E. Ahles, & C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill, North Carolina, U.S.A.

Small, J.K. 1903. Flora of the southeastern United States, being descriptions of the seed-plants, ferns and fern-allies growing naturally in North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, and in Oklahoma and Texas east of the one hundredth meridian. Published by the author, New York, New York, U.S.A.

Small, J.K. 1913. Flora of the southeastern United States, being descriptions of the seed-plants, ferns and fern-allies growing naturally in North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, and in Oklahoma and Texas east of the one hundredth meridian, second edition. Published by the author, New York, New York, U.S.A.

Small, J.K. 1933. Manual of the southeastern flora, being descriptions of the seed plants growing naturally in Florida, Alabama, Mississippi, eastern Louisiana, Tennessee, North Carolina, South Carolina, and Georgia. University of North Carolina Press, Chapel Hill, North Carolina, U.S.A.

Sorrie, B.A. & A.S. Weakley. 2001. Coastal Plain vascular plant endemics: Phytogeographic patterns. Castanea 66:50–82.

Sorrie, B.A. & A.S. Weakley. 2006. Conservation of the endangered *Pinus palustris* ecosystem based on Coastal Plain centres of plant endemism. Appl. Veg. Sci. 9:59–66.

Swanson, A. & R.K. Rabeler. 2005. *Stipulicida*. In: Flora of North America Editorial Committee, eds. Flora of North America north of Mexico. Vol. 5. Magnoliophyta: Caryophyllidae, part 2. Oxford University Press, New York, U.S.A. Pp. 27–28.

Ward, D.B. 2001. New combinations in the Florida flora. Novon 11:360–365.

Ward, D.B. 2012. New combinations in the Florida flora III. Phytologia 94:459–485.

Weakley, A.S. 2005. Change over time in our understanding of the flora of the southeastern United States: Implications for plant systematics, bioinformatics, and conservation. Ph.D. dissertation, Duke University, Nicholas School of the Environment and Earth Sciences, Durham, North Carolina, U.S.A.

Weakley, A.S. 2012. Flora of the southern and mid-Atlantic states, working draft of 30 November 2012. University of North Carolina Herbarium, Chapel Hill, North Carolina, U.S.A.

Wunderlin, R.P. & B.F. Hansen. 2008. Atlas of Florida vascular plants. www.plantatlas.usf.edu [S.M. Landry and K.N. Campbell (application development), Florida Center for Community Design and Research.] Institute for Systematic Botany, University of South Florida, Tampa, Florida, U.S.A. Accessed 28 Feb 2014.

Wunderlin, R.P. & B.F. Hansen. 2011. Guide to the vascular plants of Florida, third edition. University Press of Florida, Gainesville, Florida, U.S.A.