

Revisiting the Taxonomic and Nomenclatural Problems of the *Quercus sinuata* Walter Complex

Ronald Lance
North American Land Trust
341 Highway 107
Mountain Rest, SC 29664, USA
ronwlance55@gmail.com



The Durand oak, *Quercus durandii/sinuata* (image courtesy of University of West Alabama Herbarium UWAL0001579).

Introduction

The oak species generally known in the United States as “Durand oak” has been subject to multiple and discordant interpretations of its morphological, taxonomical, and nomenclatural significance. Its nomenclature is a particularly contentious issue and deserves a detailed explanation before further analyses of taxonomy are presented. This paper is a summary of the problems associated with recognition of Durand oak and an introduction to a research effort striving for remedial propositions. Throughout this article, the oaks of pertinence are most often referenced using their common colloquial names. The reason for frequent departure from specific epithets is for greater clarity: only one colloquial name is used for the oak of point, rather than one of the multiple epithets which are themselves a focus of nomenclatural dispute. The colloquial names used here are “Durand oak” (*Quercus durandii*, or *Q. sinuata*), “Bigelow oak” (*Q. durandii* var. *breviloba*, or *Q. sinuata* var. *breviloba*) and “bluff oak” (*Q. austrina*).

Three oak taxa are popularly considered representative of or allied to the Durand oak species complex (Photos 1-3). Taxonomic disagreement regarding the parameters of each taxon, whether deserving of specific, varietal, or synonymous status, has been ongoing since the beginning of the 19th century. Across the Southern United States, from Central Texas eastward across the Gulf and Atlantic Coastal Plains to South Carolina, these three oaks have remained more distinctive in appearance than in nomenclatural clarity.

History of *Quercus sinuata* Walter

The first botanical flora prepared for the Southeastern United States, following the new Linnaean nomenclatural system, was written completely in Latin by Thomas Walter, based on specimens originating from the English botanical collector John Fraser and from plants growing near, or on, Walter’s 4,500-acre plantation and home in South Carolina.



Photo 1/ Durand oak (*Quercus durandii/sinuata*) foliage and fruit from a mature tree.

Walter included approximately 1,050 plants in his 1788 *Flora Caroliniana*, including 13 *Quercus* species. Each species was described briefly and received a binomial. It is unclear which plants were known to Walter from the vicinity of his plantation and which may have been supplied to him by John Fraser, who collected specimens during extensive travels from the coastal plain to the southern Appalachians. It is assumed likely that Walter's oaks were growing in an 80.5 km-/50-mile radius (or a 50 square-mile vicinity) of his home and farm tract near the Santee River and Pineville areas of present-day northern Berkeley County, South Carolina. There are no illustrations or type specimens of Walter's oaks



Photo 2/ Bluff oak (*Quercus austrina*) foliage and fruit.

to provide visual reference of the plants he used to draw his descriptions.

The nomenclatural issues relating to Walter's oaks have been discussed in detail by



Photo 3/ Bigelow oak, the western variety (var. *breviloba*) of Durand oak.



Photo 4/ The typical form of Durand oak, with its ca. 12 mm fruit.

Wilbur (2002), as well as briefly by Ward (2007), Palmer (1945) and Sargent (1918). Of the 13 oaks described by Walter, 11 are common, easily recognized species that remain extant in the region of his home and clearly are identifiable by his brief Latin descriptions. The two remaining oaks having questionable nomenclatural application are Walter's *Q. pumila* and *Q. sinuata*. For the former, Wilbur (2002) suggested *Q. elliottii* Wilbur as a new name to replace *Q. pumila*, due to Walter's seemingly inadequate diagnosis of the runner oak, a shrubby species known from Walter's area and for which Walter may have erroneously noted the lower leaf surface as *glauca* (glaucous); actually, this oak displays a

densely grayish-puberulent abaxial surface. The use of both names for runner oak, *Q. pumila* and *Q. elliotii*, are encountered in current application. The remaining name of questionable application is Walter's *Q. sinuata*, of great pertinence to the concept of Durand oak.

Walter's original and complete diagnosis of an oak he coined *Q. sinuata* was composed of 13 Latin words: "*foliis sinuatis laevibus obtusis supra pallidis, subtus subglaucis, glandibus mediocribus globosis calyce subplano*". The literal translation describes an oak



Photo 5/ The glabrous, lobed leaves and ca. 16 mm fruit of bluff oak.

with "leaves sinuate-margined, obtuse, pale above, subglaucous beneath, acorn mid-sized, globose, cup nearly flat." No specimen of this oak exists in the "Walter Herbarium" of the Natural History Museum of London, where plant specimens labeled by Walter but collected by John Fraser are preserved. Walter's *Q. sinuata* was adopted by Ashe (1916), Trelease (1924), Muller (1944, 1951, 1970) and Dorr and Nixon (1985) as satisfactorily applicable to the species to be later known as Durand oak. Walter's earlier name of *Q. sinuata*, if conspecific, has priority over the later name of *Q. durandii* Buckley, a name having its own measure of ambiguity and no type specimen. Palmer (1945) described the problem associated with Walter's *Q. sinuata* diagnosis and agreed with George Engelmann (1876) that the name was too ambiguous to warrant application to any known oak species at the time, rather being indicative of a possible hybrid of two Red Oaks. The disagreement in application of the names *Q. durandii* and *Q. sinuata* has continued for over 100 years.

Toward the argument against *Q. sinuata* remaining adequate for application to Durand oak (aka *Q. durandii* Buckley) and to a subsequent synonymous name of *Q. austrina* Small, it is relevant to note several key terms in Walter's description. Describing leaves as "pale above" and the acorn "mid-sized" is not descriptive of the eastern forms of what we know as Durand oak; leaves of this oak are typically dark or lustrous green adaxially and the acorns are among the smallest of regional oak species (Photo 4). The terms "subglaucous beneath" and "acorn globose, cup nearly flat" are satisfactorily descriptive of the Durand oak yet are not descriptive of the assumed relative of Durand oak, the bluff oak (*Q. austrina* Small). Currently, there are no known locations or herbarium specimens of Durand oak or bluff oak from the locale of Walter's historic plantation. It cannot be determined if Walter saw specimens of either oak, or if John Fraser encountered any of them. Part of Walter's plantation included bluffs along the Santee River, which conceivably could have provided habitat for the bluff oak, but his *Q. sinuata* description is not accurate for this oak's morphology. It would be expected that Walter would have made a more accurate description of the distinctive leaves and acorns of bluff oak (Photo 5), had that oak been seen by him. It can be considered less likely that typical Durand oak was present in Walter's area since no example of that oak is known from Berkeley County and the closest population that is known is about 130 km/81 air miles west, near the Savannah River. The closest verified

examples of bluff oak to Walter's historic farm are 64 km/40 miles southeast (Charleston Co.) and 132 km/82 miles southwest (Hampton Co.).

Applications of *Q. sinuata* Walter

Ernest J. Palmer (1945) treated *Q. sinuata* as a *nomen dubia*. The possibility of its hybrid origin between *Q. laevis* Walter and *Q. nigra* L. (= *Q. ×walteriana* Ashe), an interpretation suggested by Engelmann (1876) and Sargent (1895), seemed "reasonable" to Palmer, but a hybrid origin involving *Q. cinerea* Michaux (= *Q. incana* Bartram) was also suggested. Palmer maintained that Durand oak, not being known from Walter's region, could scarcely have been known to him and therefore synonymization of *Q. durandii* with *Q. sinuata* was unwarranted. This interpretation had likewise been suggested by Sargent (1918).

Robert L. Wilbur (2002) returned to the problematic issues of Walter's oak names and made a detailed evaluation. He references the synonymy of *Q. durandii* under *Q. sinuata* by "Camus (1939, 2:678), Muller (1951) and Dorr and Nixon (1985)" and that Trelease (1924, p. 101) followed Ashe's earlier opinion in combining *Q. sinuata* and *Q. austrina*." Wilbur further noted that "Muller (1951), ignoring Palmer (1945), took up *Q. sinuata*, including in its synonymy both *Q. austrina* and *Q. durandii*" and that Muller felt that the "inability of contemporary collectors to find the species in Walter's territory...is distinctly inconclusive." Similarly, Dorr and Nixon (1985) accepted submergence of *Q. durandii* and *Q. sinuata*, but Nixon and Muller (1997) separated *Q. austrina* from *Q. sinuata*. Summarily, Wilbur acknowledged "this review of the pertinent literature is not one that gives confidence that enough is known about the identity of the types, the morphological limits of the species involved, or their geographic ranges, etc. to be dogmatic as to the application of the binomials of these taxa."

The most recent attempt to resolve the issue of Walter's *Q. sinuata* was undertaken by Daniel B. Ward (2007), who searched the area of Walter's historic home and farm in 1990 to locate an extant oak corresponding to the original description. Several examples of a hybrid Red Oak, proposed as *Q. falcata* Michx. × *Q. phellos* L. (= *Q. ×ludoviciana* Sargent), were documented from the vicinity, from slopes along the Santee River. A *Q. sinuata* neotype was designated by Ward from these hybrid plants. These type specimens display leaves with sinuate margins and pale abaxial surfaces, and some (isoneotype USCH0000048, FLAS218677) have relatively flat acorn cup samples, corresponding to Walter's *Q. sinuata* description; however, the leaf tips are not obtuse and upper surfaces do not appear pale (Fig. 1). Robert Wilbur, DUKE, annotated in November 2008, on at least two of the types that he "does not find this specimen to be a good match for Walter's protologue of *Quercus sinuata*." Because no mention of characters such as bark or apicular awns were made by Walter, it is impossible to assume with any certainty if Walter's *Q. sinuata* was a member of the White Oak or Red Oak group. Nearly flat acorn cups are more characteristic of Durand oak than any other eastern White Oak, but several Red Oak species in Walter's area may have similar shape (*Q. nigra*, *Q. phellos*, *Q. hemisphaerica*, *Q. laurifolia*) and hybrid combinations of these and other Red Oaks could produce the same. The neotypification of *Q. sinuata* by Ward has apparently not received widespread application, and the name of *Q. sinuata* continues to be applied to the Durand and bluff oaks in publications and herbaria. The obscurity of Walter's *Q. sinuata*, caused by a combination of abbreviated traits that defy complete application to



ISO-NEOTYPE

Quercus sinuata Walter, Fl. Carol. 235. 1788.

Daniel B. Ward

31 July 2006

Herbarium of the University of Florida
Plants of South Carolina

Quercus sinuata Walter

Quercus falcata x *Quercus phellos*
Mid-sized tree; bark hard, dark gray (like *Q. laurifolia*); leaves dark green, glossy above, pale green below; cups (found on ground) flat. Few; wooded mid-slope of bluff on south bank of Santee River ("Wilson's Landing"), 3/4 mi. w. of Thomas Walter's grave, 1/2 mi. e. of Lake Marion dam, n.w. corner of

BERKELEY County.

coll. Daniel B. Ward 10586 24 July 1990
with Sylvia J. Ward

det. D. B. W.

confirmed as to parentage: David M. Hunt,
29 Oct 1990

Figure 1/ Daniel Ward's neotype of *Q. sinuata* (image courtesy of University of Florida Herbarium specimen FLAS218677, Florida Museum of Natural History; SERNEC portal Dec. 2021).

any known oak species, remains. In this author’s opinion, sufficient cause exists for the renewed designation of *Q. sinuata* as a *nomen dubium*.

History and dispositions of *Quercus durandii* Buckley

Samuel B. Buckley described over 200 plant species, the majority from Texas, during 1859-1861. Employed as a teacher in Wilcox County, Alabama in 1839 (Mohr 1901), Buckley began botanical contributions in earnest after he journeyed to Texas in 1859. During that same year, he described an oak in Wilcox County as *Q. durandii* Buckley, in honor of Ellias M. Durand (1794-1873), then curator at the Herbarium of the Philadelphia Academy of Natural Sciences. Buckley’s descriptions were brief and specimens useful as types were not particularly orderly. Consequently, there is no extant specimen of *Q. durandii* collected in Alabama by his hand.

Dorr and Nixon (1985) discussed at length the taxonomic and nomenclatural issues of Samuel Buckley’s oak descriptions and collections. The protologue of Buckley (1860) stated that *Q. durandii* was from “Wilcox County, Alabama, Upper Louisiana, and Middle and Southern Texas.” Later, Buckley (1881) stated he first found the species in 1859 when he walked from Camden to Allenton, in Wilcox County, Alabama. No original material of *Q. durandii* being found by Dorr and Nixon, they reportedly designated a

neotype of *Q. durandii* Buckley as “US, Alabama, Dallas Co, 12 mi W of Selma. 1 Jul 1941, C.H. Muller 36898 NA; isoneotype: UCSB-M!” This neotype has not been located, to date. Although these authors acknowledged “there continues to exist controversy over the application of the name *Q. sinuata*,” they continued placement of *Q. durandii* in synonymy under *Q. sinuata*, based on “evaluation of its original description.”

The Bigelow oak joins in

Buckley’s *Q. durandii* and two other oaks described by him from Texas, *Q. annulata* (Buckley, 1860) and *Q. san-sabeana* (Buckley 1873) were delegated by Sargent (1895, 1905) to synonymy under the name of *Q. breviloba* (Torrey) Sargent, a name later re-delegated as a variety of Durand oak by Muller (1944) and Palmer (1945). This Texas oak, the Bigelow oak, is thus usually designated today as *Q. durandii* var.



Figure 2/ Type specimen of Bigelow oak, Crockett Co., Texas (image courtesy of Gray Herbarium of Harvard University).



Photo 6/ Bigelow oak, typical growth habit on calcareous soil in Central Texas.

breviloba (Torr.) Palmer or *Q. sinuata* var. *breviloba* (Torr.) Muller: it is clearly a western form of Durand oak, or at least allied closely to it. Also known as “Texas white oak,” the type locality was “mountain gorges near Howard Springs, western Texas” (Mohr 1901), this being in Crockett County and collected by J.M. Bigelow in 1859 (Fig. 2); another early delineation of this oak was *Q. obtusifolia* var. *breviloba* by Torrey (1859).

The typically shrubby habit of Bigelow oak (Photo 6) is likely due to stresses imposed by environmental factors over time, as this oak is usually seen in thin, rocky, calcareous soils of Central Texas and southern Oklahoma, sites prone to windy and droughty conditions. Bigelow oak is mostly allopatric from typical Durand oak in its range (Fig. 3). East of this range, errors in herbarium annotations of juvenile Durand oak material, where leaf shapes may mimic Bigelow oak, have caused confusion and inaccurate range extensions. The confusion was no doubt enhanced after Sargent’s use of *Q. breviloba* as a name inclusive of the others. Some overlap of Durand oak and Bigelow oak in Eastern Texas, such as along streams and in deeper soils, undoubtedly invite intermediates to establish themselves. The range of typical Durand oak extends from Eastern Texas to South Carolina (Fig. 4), and it is a tree most frequently seen in basic or calcareous soils of bottomlands and

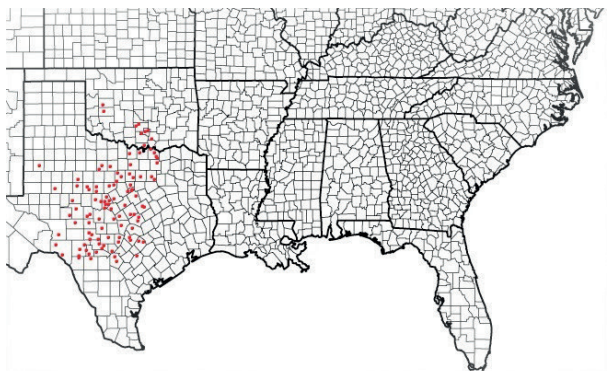


Figure 3/ The natural range of Bigelow oak based on herbarium specimens. Red dots: distinct specimens.

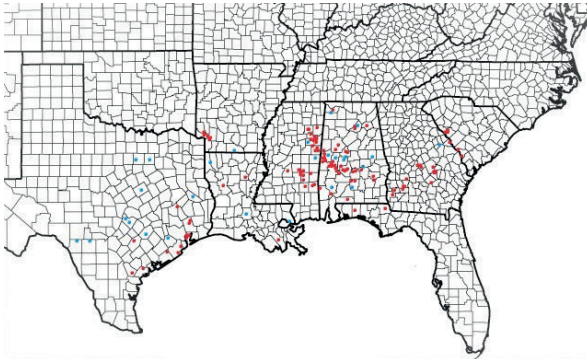


Figure 4/ The natural range of typical Durand oak based on herbarium specimens. Red dots: distinct specimens; blue dots: indistinct/doubtful specimens.

his publication *Plant Life of Alabama* (1901). The synonymy was a timely taxonomic adherence to Sargent’s 1895 designation of *Q. breviloba* as a species that incorporated Buckley’s names. Mohr’s collections of Durand oak made in the late 1800’s were labeled by him as *Q. breviloba*, this being significant as one such collection would be chosen later by J.K. Small as the type for *Q. austrina*. The use of the name *Q. breviloba* as inclusive of *Q. durandii* continued for some time among various collectors, authors, and herbarium annotators until the name *Q. sinuata* received wider application after 1945.

streamsides, moist terraces within swamps, mesic hardwood slopes and ravines, prairies, and limestone outcroppings. It is not common across its discontinuous, spotty range, but sizable local populations sometimes occur.

Charles Mohr, an eminent botanist who collected extensively in Alabama from 1880-1899, acknowledged Buckley’s *Q. durandii* but placed it in synonymy with *Q. breviloba* (Torr.) Sargent in

***Deciphering the situation of Quercus austrina* Small**

John K. Small (1861-1938) was a botanical explorer of the Southeastern United States and authored over 2,000 taxa. He first entered the state of Florida in 1901 (NYBG 2006), and his doctoral dissertation *Manual of the Southeastern Flora* was published in 1903. In that publication, *Q. austrina* was introduced as a distinct species and its separation from *Q. durandii* was described. The separation of these oaks was upheld in Small’s second edition of the *Flora* in 1913. Among the significant differences Small attributed to *Q. austrina* to distinguish it from *Q. durandii*, two pertinent statements are “leaf blades 5-15 cm long, with 3-5 blunt lobes, ascending, white-tomentose beneath but soon glabrous...” and acorn cup “...hemispheric, 12-16 mm wide; nut ovoid, 15-20 mm long.” Small’s leaf description is interesting since leaves described as white-tomentose abaxially is not consistent with the concept of bluff oak later adopted, while all other characters, including acorn features, are in line with the concept. In Small’s dichotomous key to oak species, defining traits of *Q. austrina* are “Leaf-blades glabrous, at least when fully grown, green beneath; acorn-cup hemispheric, sometimes slightly constricted at the base.” In contrast, *Q. durandii* had “Leaf-blades persistently pubescent and white beneath; acorn-cup very shallow, saucer-shaped or almost disk-like.” Only the “white-tomentose” aspect that Small attributed to young leaves of *Q. austrina* is of questionable accuracy. In application to field and herbarium specimens over many years and across the range of the two oaks of issue, the scarcity of indumentum on young leaves of *Q. austrina* has been a noticeable and significant trait, and in no instance, aside from suspect hybrid examples, has this author encountered a dense, whitish layer of hairs on bluff oak (*Q. austrina*) leaves. When the foliage characters expressed in Small’s description are compared to the type material, some clarity, as well as more disparity, is noticeable.

The holotype of *Q. austrina* (NY00248614) from the J.K. Small herbarium, purchased

in 1900 by the New York Botanical Garden, has Small's hand-written "type" annotation above the collection label (Fig. 5). The sample is by Charles Mohr, from Gallion, Hale County, Alabama, and from an unspecified date (but presumed late 1800s). Also scribed on the sample are the words "*Q. sinuata* Walt cited by Trelease." This specimen is historically and taxonomically significant because it is composed of three segments, each possibly from different trees or seasonal periods of the same tree, but all representative of the Durand oak. None of the three segments represent satisfactorily what has become generally recognized as the bluff oak. The segment taped to the right side of the sheet clearly shows a flowering sprig with fragments of early foliage whitened abaxially by dense hairs, a trademark feature of Durand oak foliage on mature branches. The sterile cluster of foliage on the upper left side of the sheet is from a late summer or autumn sample, with mature leaves having no clearly visible indumentum and with a size and shape of foliage a bit closer to what is generally considered today as bluff oak; however, the leaves lack the type of lobed margin normally present in bluff oak and the blunt buds of the twigs more suggest it belongs to Durand oak. Likewise, the lower, sterile sample attached to this sheet shows very typical Durand oak through its small leaf size, grayish twigs, and dark, broadly obtuse buds. No fruiting material is evident on the sample. This type material being selected by Small to delineate his concept of *Q. austrina* presents evidence for his statement about abaxial surfaces being white-tomentose in *Q. austrina*, but the sample is not separable from Durand oak by any of the characters he described.

Due to the lack of distinction between Small's type of *Q. austrina* and typical Durand oak, the separation of these names as two different taxa is not defensible using the existing type. Synonymy of *Q. austrina* Small into either of the earlier names of *Q. sinuata* Walter or *Q. durandii* Buckley is, and has been, a correct determination if authenticity of the type specimen is utilized. It is unclear why the distinctive segments of Durand oak on the Mohr sample, which the collector originally labeled as *Q. breviloba*, were given the new name of *Q. austrina* by Small. That Small likely encountered bluff oak during his Florida excursions and was able to describe it accurately in all ways as *Q. austrina*, excepting the young white-tomentose abaxial leaf surfaces (which may have been due to Small's type sample fragment), it is unfortunate that a more tenable



Figure 5/ Holotype of *Quercus austrina* Small (image courtesy of the C.V. Starr Virtual Herbarium, New York Botanical Garden).

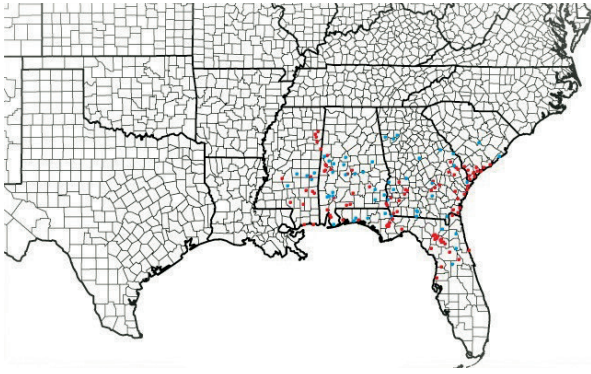


Figure 6/ The natural range of bluff oak based on herbarium specimens. Red dots: distinct specimens; blue dots: indistinct/doubtful specimens.

type was not selected by Small. Despite the discrepancy of the type material, the name *Q. austrina* was subsequently taken up by other authors and workers as applying to the more distinctly lobed, glabrate-leaved oaks with turbinate acorn cups and acutely pointed buds that are morphologically separable from Durand oak. Conversely, because of the ambiguity of morphology expressed in the type, *Q. austrina* was placed in synonymy with the Durand oak by others.

The delegation of Small’s *Q. austrina* to the concept of Durand oak introduced another dimension of confusion to the names *Q. durandii* and *Q. sinuata*. Palmer (1945) noted that, “in no character except possibly leaf shape could Walter’s 1788 description be reconciled with the concept of *Q. austrina* Small.” Palmer also pointed out that Ashe (1918, p. 11) reconsidered his 1916 opinion that *Q. sinuata* was an earlier name for *Q. austrina* after Ashe became more familiar with the taxa. Intending a taxonomic resolution, Palmer in the same publication proposed *Q. austrina* as a variety of *Q. durandii*, presenting accurate illustrations and descriptions of the bluff oak (as *Q. austrina*). This trend, to recognize *Q. austrina* as a distinct entity (following Small), was also applied by Charles Sargent (1918). Sargent made no mention of the names *Q. sinuata*, *Q. durandii*, and *Q. austrina* in the first edition of his *Manual of the Trees of North America* (Sargent, 1905), instead describing generally the concept of Durand oak under the species *Q. breviloba* Sargent; in his second edition (Sargent 1922), *Q. breviloba* was abandoned in favor of separating these affiliated oaks into *Q. annulata* Buckley, *Q. durandii* Buckley and *Q. austrina* Small. Aside from the nomenclatural issues, the illustrations and descriptions of these three oaks in Sargent’s second edition represent the first time that accurate representation of the Durand oak, Bigelow oak and bluff oaks, as they are recognized today, appeared in print. Illustration of *Q. austrina* leaves in *Flora of North America* (Nixon and Muller 1997) do not display the characteristic lobing that is typical of bluff oak, since the type material, composed of Durand oak, was used in reference.

The concept that *Q. austrina* constituted a differing entity from typical Durand oak seems to have its illustrated beginnings with Sargent and Palmer, in that the deeper acorn cups and the more consistent lobing pattern and glabrescent nature of the leaves distinguished the entity *Q. austrina*. These characters were used in Palmer’s key to his *Q. durandii* varieties in 1945. Corresponding oaks collected across the Southeastern US were subsequently identified by various collectors as *Q. austrina*, and the concept of “bluff oak” being a unique species or variety gained ground. Examples of conceptual bluff oak are particularly distinctive in Florida and coastal fringes of the range from Alabama to South Carolina. They are an anomaly to the Durand oak complex and have only the epithet *austrina* available for scientific notoriety, a name insufficient by its synonymy. Remedial elucidation and taxonomic recognition of these oaks in another way is warranted.



Photo 7/ Bluff oak (in foreground) on a terrace above a river swamp.

The bluff oak of today

The Southern oak that has come to be known as “bluff oak” over the last century is a tree of sporadic distribution across most states of the Southeastern US coastal plain (Fig. 6). The colloquial name originates from a most conspicuous trend of this oak to grow on banks and bluffs of rivers. It is also an occasional member of maritime forests, mesic hardwood forests, rich slopes and ravines, and in the vicinity of springs and hardwood hammocks, particularly in Florida (Photos 7-10). It is also known as “bastard oak” in some areas, presumably because it suggests a hybrid White Oak in appearance. The entirety of its range and habitats are in the coastal plain, within 28.5° to 34° latitude and -79.7° to -90.5° longitude. The western portion of its range is shared with the typical form of the more commonly abundant Durand oak, and the two oaks are frequently found near, or in, the same riverine habitats. This shared cohabitation occurs mostly in Mississippi and Alabama, and to what degree intergradation may be mixing any genetic integrity the bluff oak possesses is unknown. Examples of doubtful and possibly



Photo 8/ Bluff oak on sandy upland near the Altamaha River, Georgia.



Photo 9/ Bluff oak near a natural spring.

introgressive individuals encourage opinions for taxonomic combination of these two oaks, yet detailed, investigative insights conveying clarity of phylogenetic origin and genetic relatedness of bluff oak to Durand oak across the range have not been performed.

Additional examples of suspected introgression of bluff oak with other White Oaks are occasionally seen throughout the range. Near floodplains, some of these dubious specimens are often identified tentatively as bluff oak but suggest by leaf and acorn morphology an affinity to *Q. lyrata* Walter and *Q. similis* Ashe, two species sometimes peripheral in lower and wetter habitats. Similarly, influence of *Q. alba* L. and *Q. margarettae* Ashe ex Small from adjacent upland sites can be seen. In nearly all cases

where intermediate trees were investigated by the author, and where fertile material was available, inspection of acorn cupules and twigs was highly useful in separation of these intermediates. However, estimates of mixed parentage visible through cupule morphology is most significant in F1 generation hybrids but less distinct in subsequent generational hybrids, or in cases where acorn differences between parent species is not great. Since hybrid oaks are regularly found among natural, mixed populations of all compatible oak species, it should be expected that genetic mixing is widespread and intermediate individuals are best not assigned specific identity without supporting fertile material. Suspect hybridity within bluff oak populations includes influence from *Q. alba*, *Q. durandii*, *Q. lyrata*, *Q. margarettae*, *Q. similis*, and *Q. stellata*.

Aside from doubts of intermediacy in a small proportion of cases, the distinction of bluff oak in the region of Mississippi and Alabama is usually clear enough to illustrate a morphological difference. Farther east in Georgia, Florida and South Carolina, the uncommon bluff oak rarely shares company with Durand oak, the latter being equally uncommon and sporadic in distribution in these states. Durand oak in this eastern range tends to occupy bottomlands, streamsides, and in basic to calcareous soils of clay and loam nature, mostly in areas devoid of bluff oak specimens. The bluff oak is more characteristic of sandy soils having a proportion of organic matter. In calcareous shell middens of the coastal zone, bluff oak is an occasional resident, but this oak is not restricted to calcareous soils throughout its range as is sometimes attributed, the Durand oak being more characteristic of such conditions.

It is evident that some sterile samples attributed to either Durand or bluff oak in parts of the range are transposed in identification, particularly when foliage shapes are inconclusive or mature twig and fruit characters are not present. Leaf characters on juvenile



Photo 10/ Bluff oak in maritime forest.

plants and on lower, juvenile branches of taller plants may be insufficient for separation of Durand and bluff oak, as both are of similar appearance and appear green and glabrous abaxially. Differences in the types of leaf hairs, as discussed by Hardin (1976) and Thomson and Mohlenbrock (1979), reveal indumentum differences between Durand and bluff oak that apply to the leaves of mature trees. Under magnification, sparse, appressed,



Photo 11/ A Florida genotype of bluff oak with leaves 9-19 cm long.

yellowish glandular hairs occur in spring on the leaf adaxial surface of bluff oak, like those seen in *Q. alba*. Non-glandular abaxial hairs are infrequent on leaf midribs and mostly involve solitary hairs and some fasciculate types. In Durand oak, only non-glandular hairs were noted by Thomson and Mohlenbrock (1979); the larger, fasciculate types found on the midvein and smaller, whitened, stellate types found on the leaf abaxial surface.

The bluff oak often appears as a lone tree or in small groups of individuals in most of its locations. Higher numbers of trees, where dozens of plants may be found in one vicinity, are known from few places. Riverine populations along the Alabama River near Selma, Alabama, the Flint River near Albany, Georgia, and the Altamaha River near Hazelhurst, Georgia, have appreciable examples; the linear extent of such populations is not well documented because of access difficulties to the steep riverbanks. Other significant locales where bluff oak is reasonably abundant are hills and ravines in one area of Kolomoki Mounds State Park in Georgia, along rivers and springs in southern Columbia County, Florida and near Gainesville, in Alachua County, Florida. The latter areas in Florida appear to be one of the most



Photo 12a/ Comparison of acorn and twig of Durand oak (L) and bluff oak (R).



Photo 12b/ The closely adherent cupule rim of bluff oak acorn (L) as compared to Durand oak acorns (R), which often show a gap around the nut.

significant, broad areas of bluff oak occurrence and numerous examples of the tree are evident. Several Florida examples of bluff oak are also significant in having the largest average leaf size (Photo 11) and grow well beyond the range of Durand oak.

The bluff oak, as understood today, appears to be consistent in several key character traits that serve to distinguish it from typical Durand oak and its western form, the Bigelow oak. These characters are presented in Table 1 and Photos 12a and b. Field and herbarium research of this oak is continuing, with a goal being discernment if specific validity of the bluff oak is warranted and a resolution of its taxonomy and nomenclature introduced. Genetic analysis of bluff oak across its range would be a valuable contribution to the author's study, but heretofore is not an included aspect of the study.

	Leaves of mature wood	Leaves of juvenile wood	Twigs and buds	Acorns	Bark	Habitat, range
Durand oak	4-10 cm long, 1-4cm wide, margin entire, sinuate or shallowly and asymmetrically lobed, abaxially whitened, appressed-stellate	4-12 cm long, 1-5 cm wide, margin entire, sinuate or asymmetrically lobed, green and glabrate abaxially	Twigs gray or pale brown; buds obtuse or blunt, 2-3 mm long, scales dark brown	Nut ovoid or subglobular, 10-15 mm; cup thin, saucer-shaped or disk-like, 1-5mm deep, covers < 1/3 of nut, often a gap between cupule rim and nut	Grayish, furrowed to scaly on trunk; very scaly or flaky on upper trunk and branches of young trees	Basic or calcareous soils; in coastal plain from east Texas to east S. Carolina; usually in clay or loam soils
Bigelow oak	3-6 cm long, margin sinuate or lobed, less frequently near entire, abaxially pale, appressed-stellate	Margin sinuate or lobed, rarely entire, green or grayish abaxially	Twigs grayish; buds obtuse or domelike, 2-4 mm long, scales dark brown	Nut ovoid, 10-25 mm; cup thick, shallowly bowl-shaped, 3-8 mm deep, covers 1/4 to 1/3 of nut, cup scales thickened at base	Grayish or pale brown, scaly and dehiscent on trunk and branches	Calcareous soils in plains and rocky uplands; central Texas, southern Oklahoma; shrubby habit on thin soils
Bluff oak	6-19 cm long, margin usually with 1-3 short, symmetrical lobes per side, uncommonly sinuate or entire or asymmetrically lobed, abaxially green, glabrous, in spring some fascicled or straight hairs	Margin sinuate or shallowly lobed, uncommonly subentire, abaxially green, glabrous	Twigs reddish-brown, glabrous; buds acutely pointed, 3-5 mm long, scales red-brown or brown, glabrous or puberulent	Nut ovoid, 12-20mm; cup turbinate, 6-10mm deep, covers 1/3 to 1/2 of nut, cupule rim tight against nut, cup scales thin, appressed; peduncle 2-20 mm	Grayish, scaly or with scaly plates or ridges on trunk; scaly or with brittle flakes on upper trunk or branches of vigorous young trees	Mesic, sandy or sandy loam soils, acidic to calcareous, in coastal plain riverine or maritime forests; Mississippi to coastal S. Carolina, central Florida

Table 1/ Comparison of distinguishing traits of Durand oak (*Quercus durandii* or *Q. sinuata*), Bigelow oak (var. *breviloba*) and bluff oak (*Q. austrina*).

Conclusion

Disagreement in application of the epithets *Q. sinuata* Walter and *Q. durandii* Buckley has not been unequivocally resolved. The choice of which name may be most suitable for Durand oak remains a matter of nomenclatural opinion since no type specimens by the original authors of the names are extant and only the abbreviated descriptions can be

used. The designation of *Q. austrina* as a synonym of *Q. sinuata* can be justified using type material but the protologue is in contrast and applies conceptually to the widely recognized bluff oak. Walter's name *Q. sinuata* is not accurate in its entirety for either of the two oaks generally christened with that name, the novelty of its early appearance in publication dictating a greater priority for application than by botanical accuracy. Buckley's *Q. durandii* has more logical botanical merit but neotypification of Durand oak under that name is needed. Assignment of taxonomic significance to the oak generally known as bluff oak is contingent on clearer separation from Durand oak *sensu stricto*, warranting neotypification or a new epithet since the type material of *Q. austrina* Small is conspecific to material of Durand oak. The varietal designation of Bigelow oak (var. *breviloba*) within species parameters of Durand oak appears least contentious among the entire complex of names associated with the latter.

Photographers. Photos 1-12: Ronald Lance. Herbarium images used with permission of the Herbarium noted with the image.

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