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REMEMBERING WARREN H. WAGNER, JR. (1911-2000)

Walter L. Meagher

The Orchards, Hopcraft Lane,
Deddington, Oxon. OX15 0TD,
England.

Dr. Wagner was the lab instructor in Botany 101; Dr. Jones was the lecturer. Lab was more interesting, there were microscopes to use, *Chlamydomonas* to see, and gametophytes to confound with sporophytes. Dr. Wagner was a man in motion, with a strong but not a tall build, leaning forward, like a linebacker, and rejoicing in the scrum of knowledge. What thrilled me was that at the end of the term he asked me if I would like to be his lab assistant the next autumn. And get paid!

I discovered I knew the style of Dr. Wagner before I met him, having had Dr. Edgar T. Wherry (1885-1982) as my teacher at the Barnes Foundation Horticultural School, in Merion, PA. I was a freshman in high school when I attended his classes. Wherry made no concession to age; he merely assumed everyone who attended a lecture was eager to hear what he had to say, just as later, under the tutelage of Dr. Wagner, I learned that his commanding enthusiasm for his subject - and life - left no room for indifference among any member of his audience.

That I was invited to be Dr. Wagner's lab assistant seemed to me the height of generosity, but this was his nature, to take students up, to bring them forward, to sit on their doctoral committees, to open doors to their future as professional botanists. He was convinced there could be no higher calling than botany; I believe it is to meet such a man, to fall under his influence, even if for only a time, that the great universities have been established.

It was a highlight of my pre-college botanizing years to go on a field trip, sponsored by the Philadelphia Academy of Science, to the Pine Barrens and cedar swamps of central New Jersey, with Dr. Wherry. There were mosquitoes and wet feet, hardships which seemed to Dr. Wherry, as I would find they seemed, in a different place, to Dr.

Wagner, the occasion of stoicism. Wherry had a mission, as dedicated field botanists do. He was in search of a small nondescript rare fern which he knew to grow in the cedar swamp.

It was not a class, as it would be when Dr. Wagner took his Systematic Botany students to a quaking bog in Michigan; on both occasions, on the bog with Wagner and in the cedar swamp with Wherry, the 'students' were strung out, trying vainly to keep their feet dry. Both men had concluded long ago not to care about wet feet. No more would they care about perilous cliffs, where a rare fern might grow. The message was clear: Dedication must be 100%, and Botany is not for sissies.

HERE IT IS! Dr. Wherry exclaimed: *Schizea pusilla*.

What does one learn from such an experience? I raise the point because Wagner had been Wherry's student at the University of Pennsylvania when Penn was strong in Botany, and when Botany was yet whole and undivided. One understood that *Schizea* had no market value; that it was hardly worth finding unless you were committed to an unfashionable metaphysic; if you were, then you were one of the blessed for whom knowledge is inherently good and wonderful.

Dr. Wagner loved the quaking bog. It was the highlight of the term in Systematic Botany. It was in that class I met Ed Voss, Dr. Wagner's lab assistant who, because he was not yet a Ph.D., was 'Ed'. Since then, of course, he has achieved all the fame of his honorific. The text book was Fernald's edition of Gray's *Manual of Botany*, not a book to read, even though it is as long as War and Peace; not a book with passages to memorize, as in other classes, but a book to use in learning how to key unknowns. Keying is a skill one learns for life, and Gray's *Manual* was the Rosetta Stone of taxonomic botany.

Wagner and Voss were as different as men can be and yet harmonious, like the oboe playing with a cello. The bog was more than a site of rare plants; it was the equivalent of a paleontologist's journey to the Devonian Age. I forget the species, but I remember Dr. Wagner's delight in walking across the quaking surface, the threat and danger it posed, giving an edge to the afternoon, what Bertrand Russell called the

moral equivalent of war. I then remembered Wherry in the cedar swamp! The style of the three botanists is a meme (coined by Richard Dawkins in 1976).

Let us leave Dr. Wagner for a moment and return to Dr. Wherry. He did something else when he bent down, his tall frame curved in mid-body, like a crane. His sight was failing, but not his hearing. He knew by ear what we wouldn't have known by sight. Eyes fully focused on *Schizea*, as if his head were the optics of a microscope lowered over the body of a specimen, he threw up his right arm with a finger pointing skyward, and shouted: Prothonatary Warbler! We were startled into realizing the man was a naturalist. That is a broader and older division of interest in what had become the biological sciences. I saw a similar breadth of interest in Dr. Wagner, who had taught himself the names and behavioral patterns of butterflies, as if it were inappropriate to belong to only one department in the university of natural history.

I left the University of Michigan in 1957, and didn't see Dr. Wagner again until the summer of 1998 in the dining room of the University of Michigan Biological Station (Douglas Lake, near Pellston). In my own mind, I had not deserted Botany, for I had been a college publisher, and originated the botany textbook by Peter Raven. I had gone to UMBS to take the short course in field botany offered by Dr. Voss. He was called Ed, for by that time the use of honorifics had diminished, but the memes had not changed. Suddenly a man hurtled to me across the dining hall, embraced me, smiling broadly, clapped me on the back and said: 'Meagher (he always pronounced my name in the Irish way, 'Mahr'), I always knew you would be a botanist!'

An excellent obit extolling the man's life and contribution to Botany was presented by D. R. Farrer (*Taxon* 49: 585-592).

GEOGRAPHIC VARIATION IN *JUNIPERUS DEPPEANA***Robert P. Adams**

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ABSTRACT

Juniperus deppeana has numerous disjunct populations that include four taxonomic varieties and three forms. Disjunct and continuous populations of *Juniperus deppeana* from the southwest United States, Mexico and Guatemala were analyzed by DNA fingerprinting (RAPD) and the results compared with DNA sequence data from the literature. Some disjunct populations have maintained surprisingly strong genetic affinities despite having seemingly little or no gene flow at present. The expanded distribution of the Pinyon-Juniper woodland into the Chihuahuan desert during the Wisconsin maximal (70,000-13,000 ybp) was examined. The present disjunct *J. deppeana* populations may have been contiguous during the Pleistocene and as recent as the Wisconsin until the Holocene (13,000 ybp). Ancient gene flow seems to have contributed to the strong genetic affinities found among present day disjunct populations. Most varieties of *J. deppeana* have large, woody cones eaten mostly by mammals and are thus not amenable to long distance dispersal. However, *J. deppeana* var. *gamboana* of the highlands of Chiapas, MX and Guatemala, is unusual in having single-seeded, relative small (5-8 mm), soft, fleshy

female cones that are consumed by birds. Long distance bird dispersal seems to have been important in the establishment of *J. d.* var. *gamboana* across the isthmus of Tehuantepec from *J. deppeana*'s center of diversity in north-central Mexico, to the highlands of Chiapas and Guatemala.

KEY WORDS: *Juniperus deppeana* varieties, Cupressaceae, DNA, RAPDs, systematics, geographic variation, speciation.

Juniperus deppeana Steudel has trunk bark that exfoliates in quadrangular plates and thus, the common name 'alligator' juniper. *Juniperus deppeana* is part of the serrate leaf margined *Juniperus* species of the western hemisphere (Adams, 2004). The serrate leaf junipers are characterized by having microscopic (visible at 40 X) serrations (teeth) on the scale and whip leaves and are generally xerophytic, occurring in the great North American deserts and arid mountains adjacent to the deserts. These junipers range from northern Guatemala, into Mexico, thence northward into the southwestern United States, as far north as Oregon (*J. occidentalis* Hook. var. *occidentalis* (Vasek) A.H. & N. H. Holmgr. and eastward on limestone outcrops in Arkansas (*J. ashei* Buch.). Axelrod (1958) proposed that *Juniperus* was a part of the Madro-Tertiary geoflora dating from pre-Eocene (55-33 mya). The Madro-Tertiary geoflora is thought to have arisen from elements of the northern, temperate, deciduous Arcto-Tertiary Geoflora mixing with elements of the southern, Neotropical-Tertiary Geoflora on the dry side of the Sierra Madre Oriental in central and northern Mexico and adjacent United States (Axelrod, 1958). Drying conditions created a different kind of habitat in the Chihuahuan desert and foothills that favored the evolution of sclerophyllous and microphyllous species. This is not to be confused with the geologically recent origin (2-3 mya, Thorne, 1986) of the Mojave and Colorado Deserts that resulted from the rain-shadow caused by the elevation of the southern Sierra Nevada Range. The pre-Eocene (<55 mya) date may be a little early for *Juniperus*, because the oldest known *Juniperus* fossil (*J. pauli* Z. Kvacek) has been radiometrically dated at 35.4 mya (Kvacek, 2002). *Juniperus pauli* is an entire leaf margined juniper discovered in the Czech Republic and appears to be related to the extant *J. excelsa* M-Bieb., a seemingly more recent member of

Juniperus. Kvacek (2002) reviewed and verified several *Juniperus* fossils from North America that included *J. creedensis* Axelrod (~24 mya, Creed geoflora, cf. *J. osteosperma*); *J. desatoyana* Axelrod, (w. Nevada ~22 mya, cf. *J. occidentalis*); *J. nevadensis* Axelrod, (w. North America, Neogene, cf. *J. osteosperma*). It is noteworthy that north-central Mexico has the largest number of *Juniperus* species in the western hemisphere and this is one of three centers of diversity for extant *Juniperus* species (Adams, 2004). The other two centers of diversity are the northern Mediterranean region and western China (Adams, 2004).

The first systematic treatment of the serrate leaf margined junipers was by Martinez (1963) who recognized *J. deppeana* Steudel. var. *deppeana* (checkered bark, (3)4-5(6) seeds/cone, *J. d.* var. *pachyphlaea* (Torrey) Mart. (checkered bark, (1)2-4(5) seeds/cone), *J. d.* var. *robusta* Mart. (checkered bark, (1)2-3(-6) seeds/cone), *J. d.* var. *zacatecensis* Mart. (checkered bark, 1-4(-7) seeds/cone), *J. patoniana* Mart. (laced bark, (1)2-3(-6) seeds/cone, and *J. gamboana* Mart. (checkered bark, 1(2) seeds/cone). Zanoni and Adams (1976), using morphology and essential oils, generally agreed with Martinez's treatment, except *J. patoniana* was reduced to *J. d.* var. *patoniana* (Mart.) Zanoni.

Recently, Adams and Schwarzbach (2006) recognized *J. gamboana* as *J. deppeana* var. *gamboana* (Mart.) R. P. Adams and *J. deppeana* var. *zacatecensis* as *J. deppeana* f. *zacatecensis* (Mart.) R. P. Adams. Figure 1 shows a partial phylogenetic tree (Schwarzbach, et al, 2007) that indicates a well-supported clade (95% bootstrap) composed of *J. d.* var. *gamboana* and *J. deppeana* var. *robusta* (both with quadrangular bark). In addition, all the *J. deppeana* taxa form a very distinct clade (Fig. 1) with 100% support, distinct from the nearest *Juniperus* (*J. saltillensis*). However, Schwarzbach et al. (2008) found that nrDNA and trnC-trnD sequence data did not resolve closely related species and varieties and this is apparent in figure 1, where there is little information concerning infra-specific relationships among the *J. deppeana* varieties.

Juniperus deppeana is one of the most widely distributed *Juniperus* species in Mexico (Fig. 2). The distribution of *J. deppeana* forms a discontinuous ring in the mountains above 2000 m (occasionally down to 1500 m) around the Chihuahuan desert in the

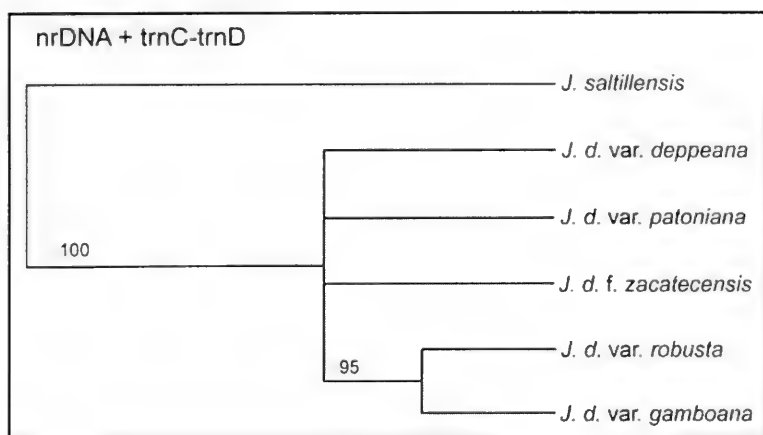


Figure 1. Phylogenetic tree based on nrDNA (ITS) and trnC-trnD sequences (from Schwarzbach, et al., 2007). *Juniperus saltillensis* is an outgroup. Note the bootstrap value of 95% support for the *J. d. var. gamboana*, *J. d. var. robusta* clade.

southwestern US and Mexico (Fig. 2), thence to the very southern-most part of Mexico and northern Guatemala at 1600 - 2200 m.

In this study, a very sensitive DNA technology (RAPDs, Random Amplified Polymorphic DNAs) was utilized to examine small differences between populations. Because there are sometimes problems in the gathering and analyses of RAPDs data in systematics, it seems appropriate to mention that over the past 15 years, we have applied RAPDs to a variety of systematic problems in *Juniperus*, *Brassica*, and *Vetiveria*. The juniper from the southwestern mountains of the Arabian peninsula has been called *J. excelsa* or *J. procera*. RAPDs and sesquiterpenoids analyses revealed that the Abha, Saudi Arabia plants were clearly the same as *J. procera* from Ethiopia (Adams, et al., 1993). In another study (Adams et al., 2003) of five *Juniperus* species comparing classifications based on nrDNA (ITS) sequences, RAPDs, ISSRs, and terpenoids, the highest correlation (0.95) was found between nrDNA sequence and RAPD classifications. This was surprising considering that some systematic information was lost by the lack of resolution of similar molecular weight bands on agarose. Non-homology of co-migrating bands has been shown to be

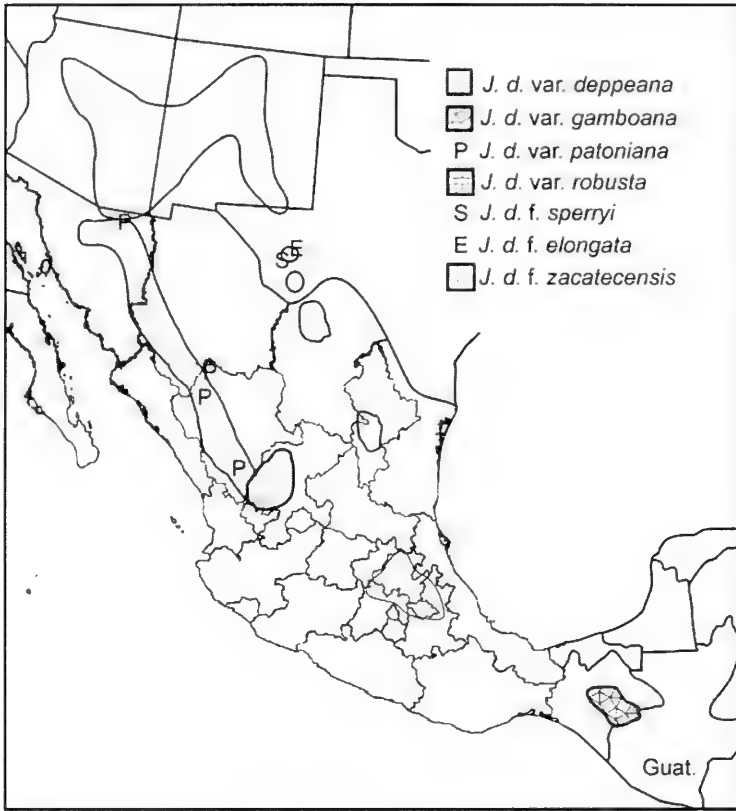


Figure 2. Distribution of *J. deppeana* and its varieties. The population of *J. d. var. patoniana* (P) in n. Sonora, MX has previously been called *J. d. f. sperryi*, but appears more likely to be *J. d. var. patoniana*. Populations sampled are in bold. A, B, C, D, F = *J. d. var. deppeana* from the USA, H, L = *J. d. var. deppeana*, Mexico, P = *J. d. var. patoniana*, R = *J. d. var. robusta*, Z = *J. d. f. zacatecensis*. G = *J. d. var. gamboana*.

9% between two *Helianthus* species (Rieseberg, 1996), ca. 10% in *Glycine* (Williams et al., 1993), and ca. 20% in a *Brassica - Raphanus* comparison (Thormann, et al., 1994). However, Adams and Rieseberg (1998) did a detailed computer simulation study using *Brassica* species

that form the classical U triangle (U, 1935; Demeke, et al., 1992). That study (Adams and Rieseberg, 1998) showed that the use of similarity measures based on character differences coupled with multivariate methods such as principal coordinates analysis (PCO) effectively eliminated the non-homologous band problem even when up to 20% incorrectly scored bands were included in a PCO analysis. However, Adams and Rieseberg (1998) also point out that other numerical methods, as well as phylogenetic tree building programs, may be affected because they generally do not have any provision for accounting for error variance in the data.

So why did RAPDs work in the aforementioned systematic studies? We need to examine the molecular basis for RAPDs. RAPDs are actually inverted DNA repeats (IRs). Inverted repeats (IRs) in ssDNA form hairpin loops that are important for the control of gene transcription and subsequent protein processing (Brown, 2002). In addition, IRs are extremely important in determining the primary structure of RNA. Recently (Noller, 2005) published the structure of 16S rRNA and hairpin loops are the dominant features of 16S rRNA primary structure. Interestingly, most of these hairpins are secured by only 3 to 6 bp with a few 9 - 10 bp clamps. Figure 3 shows, that the

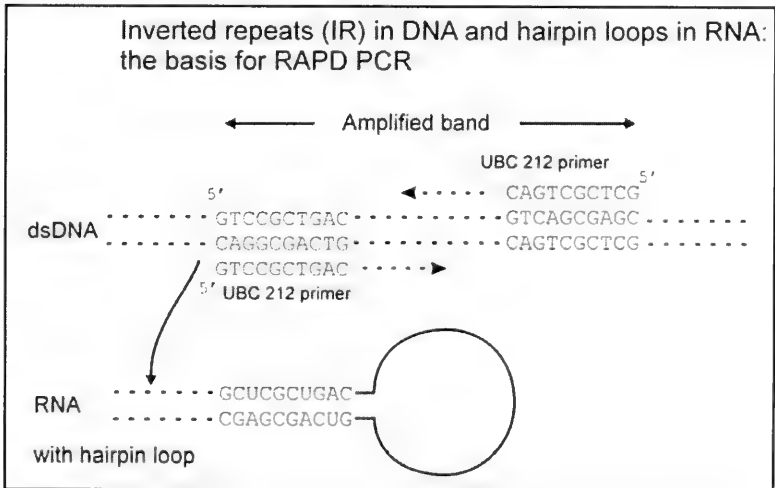


Figure 3. Diagrammatic representation of an inverted repeat PCR and the relationship of the inverted repeat to a RNA hairpin loop.

formation of hairpin loops in RNA. PCR using the single UBC (University of British Columbia) 212 primer results in an amplified band from this section of DNA (Fig. 3). The distance between the inverted repeats determines the size of the amplified band and also the size of the hairpin loop in the RNA (in this example). Of course, an additional priming site(s) may be present much further downstream (or even in an intron or in an inter-genic region) and would result in an additional, larger amplified band(s).

The use of single primers (inverted repeats) was co-discovered by Welsh and McClelland (1990) and Williams, et al. (1990). It is unfortunate that the terms 'random' and 'arbitrary' were used to describe the sequences of these primers, because we have discovered that the sequences are definitely neither 'random' nor 'arbitrary'. Beginning in 1990, we began to screen 10 bp RAPD and 17-21 bp ISSR primers available in kits from the University of British Columbia (UBC). We have evaluated 500 RAPD and 100 ISSR primers for their ability to: 1. amplify DNA (from various sources, both plants and animals); 2. obtain reproducible bands in replicate runs; 3. produce many bands, and 4. produce bands that are polymorphic between closely related species. These screenings discovered about 20 RAPD primers (4%) and 6 ISSR primers (6%) that met those criteria. It is now very apparent that only certain sequences of IRs are common in genomes (about 4% of the primers tested).

The focus of this study was to examine geographic variation among both contiguous and disjunct populations of *J. deppeana* by the use of a sensitive DNA technology (RAPDs) to investigate the effects of genetic isolation in relation to populational differentiation.

MATERIALS AND METHODS

Specimens used in this study: *J. deppeana* var. *deppeana*, Adams 10539-10541, El Chico National Park, Hidalgo, MX (H), Adams 10547-10549, Los Liros (El Tunal), Coahuila, MX (L); Adams 7632-34, Sacramento Mtns., New Mexico, USA (A); Adams 10616-10618, Chisos Mtns., TX, USA (C); Adams 10621-10623, Davis Mtns., TX, USA (D); Adams 10640-10642, Oak Creek Canyon-Flagstaff, AZ (F), USA; Adams 10645-10647, Bisbee, AZ, USA (B); *J. deppeana* var. *patoniana*, Adams 6837-6839, km 152, w. Durango (city), Durango, MX (P); *J. deppeana* var. *robusta*, Adams 6826-6828, Creel,

Chihuahua, MX (R); *J. deppeana* f. *zacatecensis*, Adams 6840-6842, 18 km w. Sombrette, Zacatecas, MX (Z) *J. deppeana* var. *gamboana*, Adams 6863-67, Comitán, Chiapas, MX (G); *J. saltillensis*, Adams 6886-90, 14 km e. San Roberto Junction, Nuevo Leon, MX (S). Voucher specimens are deposited at BAYLU herbarium Baylor University.

One gram (fresh weight) of the foliage was placed in 20 g of activated silica gel and transported to the lab, thence stored at -20°C until the DNA was extracted. DNA was extracted using the Qiagen DNeasy mini kit (Qiagen Inc., Valencia CA). The RAPD analyses follow that of Adams and Demeke (1993). Ten-mer primers were purchased from the University of British Columbia (5'-3'): 134, AAC ACA CGA G; 153, GAG TCA CGA G; 184, CAA ACG GAC C; 212, GCT GCG TGA C; 218, CTC AGC CCA G; 239, CTG AAG CGG A; 249, GCA TCT ACC G; 250, CGA CAG TCC C; 268, AGG CCG CTT A; 338, CTG TGG CGG T; 346, TAG GCG AAC G; 347, TTG CTT GGC G; 431, CTG CGG GTC A; 478, CGA GCT GGT C.

PCR stock solutions (Taq, primer, buffer) were made in bulk so that all the PCR reaction tubes for a primer were prepared using the same bulk stock. This is a critical factor for minimizing variation in band intensities from sample to sample (see Adams et al. 1998, for protocols to minimize PCR band variation). PCR was performed in a volume of 15 μl containing 50 mM KCl, 10 mM Tris-HCl (pH 9), 2.0 mM MgCl_2 , and 0.1% Triton X-100, 0.2 mM of each dNTPs, 0.36 μM primers, 0.3 ng genomic DNA, 15 ng BSA and 0.6 unit of Taq DNA polymerase (Promega). A control PCR tube containing all components, but no genomic DNA, was run with each primer to check for contamination. DNA amplification was performed in an MJ Programmable Thermal Cycler (MJ Research, Inc.). Samples were run in duplicate to insure reproducibility (Adams and Rieseberg 1998). A temperature profile was obtained for each well of the thermocycler to be sure that no variation occurred in the heating/ cooling block. The thermal cycle used was: 94°C (1.5 min) for initial strand separation, then 40 cycles of 40°C (2 min), 72°C (2 min), 91°C (1 min). Two additional steps were used: 40°C (2 min) and 72°C (5 min) for final extension. The temperature inside a PCR tube containing 15 μl buffer was monitored with a temperature probe, quantitated and printed for each step for each of the 40 cycles for every PCR run (Adams and

Rieseberg 1998) to insure that each cycle met temperature specifications and that each PCR run was exactly the same. Amplification products were analyzed by electrophoresis on 1.5% agarose gels, 75V, 55 min, and detected by staining with ethidium bromide. The gels were photographed over UV light with Polaroid film 667 and scanned to digital images. The digital images were size normalized in reference to pGem® DNA size markers before band scoring. Bands were scored as present (1) and absent (0). Bands that were inconsistent in replicate analyses were not scored.

Associational measures were computed using absolute character state differences (Manhattan metric), divided by the maximum observed value for that character over all taxa (= Gower metric, Gower, 1971; Adams, 1975). Principal coordinate analysis was performed by factoring the associational matrix using the formulation of Gower (1966) and Veldman (1967). It should be noted that problems of homology of RAPD DNA bands on agarose gels can be significant (Rieseberg, 1996), but these errors can be accounted for by using multivariate statistical methods (PCO) (see Adams and Rieseberg, 1998). A minimum spanning diagram was constructed by selecting the nearest neighbor for each taxon from the pair-wise similarity matrix, then connecting those nearest neighbors as nodes in a network that was superimposed on a geographic map (Adams, et al. 2003).

RESULTS AND DISCUSSION

Principal Coordinates analysis (PCO) of the similarity matrix of all samples yielded five eigenroots that accounted for 27.7, 14.4, 8.2, 6.7 and 6.0% of the total variance. The eigenroots appeared to asymptote after five roots and accounted for 63% of the variance. Ordination of the first three roots (Fig. 4) shows that the major trend (28%) to be the separation of *J. saltillensis* from *J. deppeana*. *Juniperus saltillensis* was included in the analysis because, although DNA sequence data indicates it to be one of the most closely related species to *J. deppeana* (Fig. 3), it is quite distinct and provides a relative comparison of speciation in this section. Just as seen in the nrDNA and trnC-trnD sequence data (Fig. 3), *J. d. var. gamboana* appears about as differentiated from other *J. deppeana* varieties as *J. deppeana var. robusta* is from other varieties (Fig. 4). This affirms the recognition of *J. d. var. gamboana* (Adams and Schwarzbach 2006) as

a part of the *J. deppeana* complex. It should be noted that *Juniperus d. var. gamboana* has checkered bark (exfoliation in squares or rectangles) as is characteristic of most *J. deppeana* varieties.

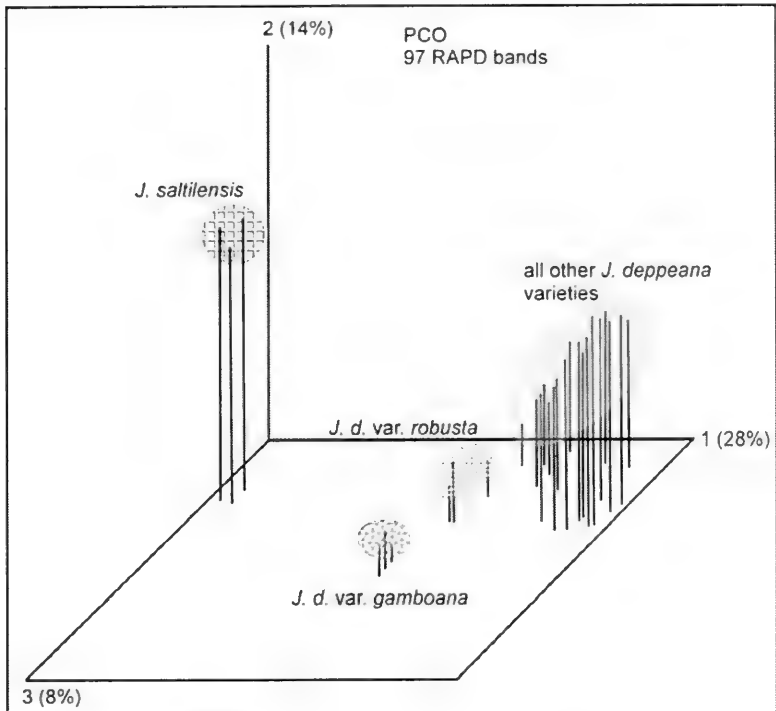


Figure 4. Principal Coordinate Ordination (PCO) for *J. saltillensis* and *J. deppeana* varieties.

Juniperus saltillensis was removed from the data set and a new PCO was performed to allow one to further examine the variation within *J. deppeana*. This PCO yielded five eigenroots that accounted for 58.35% of the variance (23.9, 11.04, 9.29, 8.13, 5.98%) before reaching an asymptote. PCO ordination (Fig. 5) shows that the major eigenroot (24%) tended to separate *J. d. var. gamboana* and *J. d. var. robusta* from the northern-most populations (C, D, A, B, F). In figure 5,

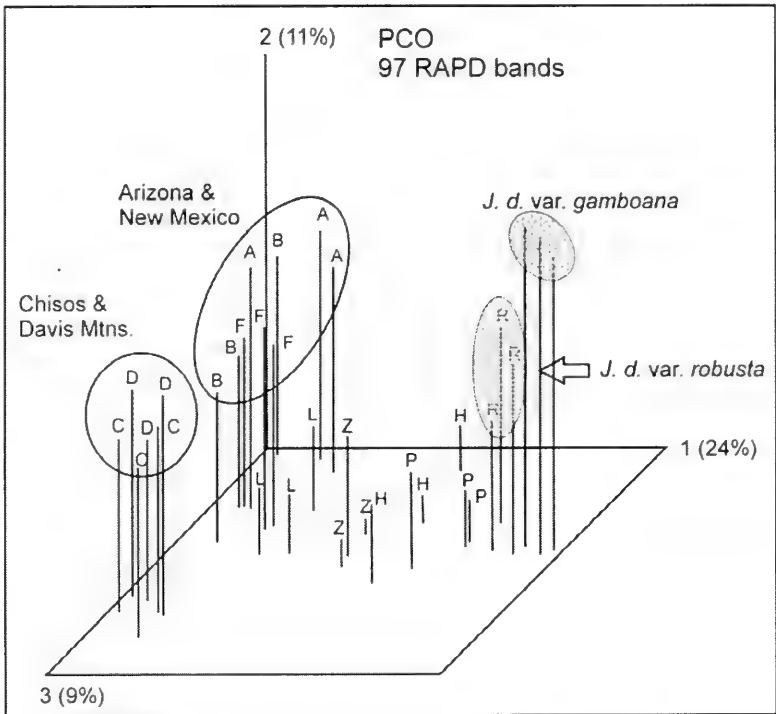


Figure 5. PCO of *J. deppeana* varieties. The first principal coordinate separates *J. d. var. gamboana* and *J. d. var. robusta* from the other *J. deppeana* varieties. Notice some separation between the Arizona - New Mexico and Chisos - Davis Mtns. populations.

one can see that *J. d. var. deppeana* (H, L), *J. d. f. zacatecensis* (Z) and *J. d. var. patoniana* (P) appear to be intermediate on these three axes. However, it should be noted that *J. deppeana* var. *patoniana* was well resolved on the fourth axis (8.13%) (data not shown). There appears to be some division between the Chisos - Davis Mtns. (C, D) populations and the Arizona - New Mexico (B, F, A) populations on the third axis (Fig. 5).

To visualize geographic variation, the order of populational clustering is shown on a contour map (Fig. 6). The most similar populations are the Chisos and Davis Mtns. (C, D, 0.932, Fig. 6). These

populations were probably contiguous during the Wisconsin if the vegetation descended 800 m (Wells, 1966). It appears that the Chisos and Davis Mtns. (and Sierra del Burro Mtns., in Mexico, just south of

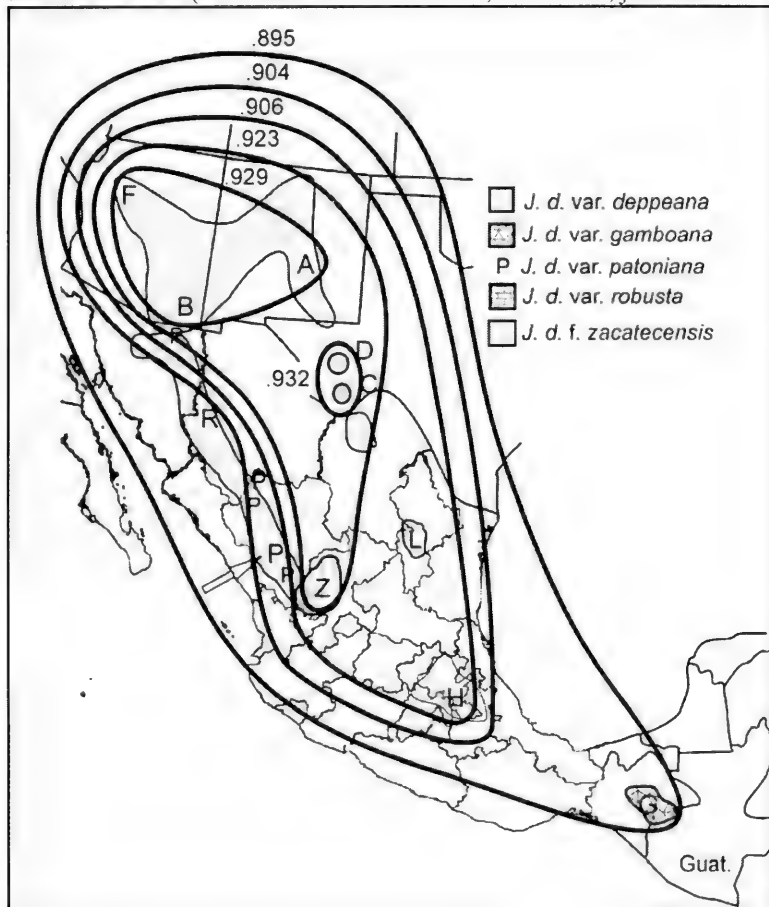


Figure. 6. Contoured groupings based on 97 RAPD bands. The open arrow indicates the location of *J. d. var. patoniana* (P) sampled. See text for discussion.

the Chisos) have only been 'island' populations for the past 10,000 y (Wells, 1966). A similar pattern is seen for the Arizona (B, F) and New Mexico (A) populations (0.929 cluster, Fig. 6). It is noteworthy that population A (Sacramento Mtns., NM) has greater affinities to Arizona (B, F) than to the Chisos - Davis Mtns. (C, D, Fig. 6). Both the Arizona - New Mexico (A, B, F) and the Chisos - Davis Mtns. (C, D) populations were displaced downward and southward during the Pleistocene (Wells, 1966). The uniformity of the Arizona - New Mexico populations suggests that the refugia for these *J. deppeana* populations may have been in the low mountains in the vicinity of Benson, Arizona (B), with recolonization proceeding towards northern Arizona (F) and central New Mexico (A).

Both the Chisos - Davis Mtns. *J. d.* var. *deppeana* (C, D) and the population of *J. d.* f. *zacatecensis* (Z) join the Arizona - New Mexico *J. d.* var. *deppeana* group at about the same level. Thus, although *J. d.* f. *zacatecensis* has distinctively large cones covered with copious amounts of glaucous wax (bloom), this taxon does seem to fit well within *J. d.* var. *deppeana*. The final two Mexican populations of *J. d.* var. *deppeana* are added (H, L, 0.906) giving *J. d.* var. *deppeana* a range from Flagstaff (F) to southern Mexico (Hidalgo, H, Fig. 6). The geographical clustering is completed by the addition of *J. d.* var. *patoniana* (P), *J. d.* var. *robusta* (R) from the Sierra Madre Occidental, and finally, *J. d.* var. *gamboana* (G) from Chiapas and Guatemala (Fig. 6).

To gain additional insight into the geographic dimension of the differentiation among these taxa, the populations were linked by a minimum spanning diagram (Fig. 7). Notice again that the populations in Arizona (B, F) and New Mexico (A) are closely linked (Fig. 7). However, *J. d.* var. *deppeana*, Flagstaff, AZ is a little more closely linked to *J. d.* f. *zacatecensis* (F-Z, 0.923) than to the Chisos Mtns. *J. d.* var. *deppeana* (F-C, 0.921, Fig. 7). The Los Liros population (L) links to Bisbee, AZ (B-L, 0.912, Fig. 7), rather than to the nearer Chisos - Davis Mtns. group (nearest L-C link was 0.894). The Hidalgo (H) population of *J. d.* var. *deppeana* in the Sierra Madre Oriental links to *J. d.* f. *zacatecensis* at a lower level (H-Z, 0.906). Martinez (1963) considered the Hidalgo population as typical for *J. d.* var. *deppeana* and recognized *J. deppeana* var. *pachyphlaea* (Torrey) Mart. in northern Mexico and southwestern United States. From figure 5, it is apparent that individuals from Hidalgo (H) do not form a uniform,

cohesive group but seem genetically diverse. At present, it seems prudent to treat both the northern populations in the USA and the eastern Mexico populations as *J. deppeana* var. *deppeana*. Morphologically, it is very difficult to separate the northern populations from the Hidalgo population. Sequencing additional genes and/or introns may help resolve these relationships.

The *J. d.* var. *gamboana* population (G) has the lowest linkage (G-R, 0.895 to *J. d.* var. *robusta*), followed by the linkage of *J. d.* var.

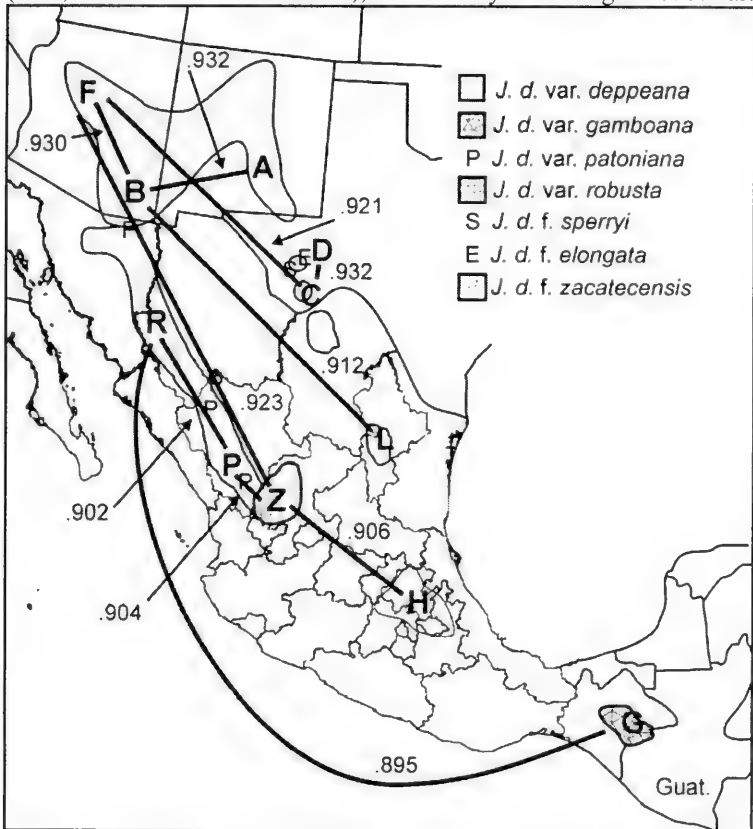


Figure 7. Minimum spanning diagram showing linkage between populations and taxa. Notice that *J. d. f. zacatecensis* is linked to *J. d.* var. *deppeana*, Flagstaff(F). See text for discussion.

patoniana to *J. d. f. zacatecensis* (P-Z, 0.904) and then *J. d. var. robusta* to *J. d. var. patoniana* (R-P, 0.902) (Fig. 7).

CONCLUSION

It is surprising to find high genetic similarities between disjunct populations (Fig. 7). For example, *Juniperus d. var. deppeana* (F, Flagstaff, Arizona) was a little more similar to *J. d. f. zacatecensis* (Z, Fig. 7) than to the Chisos - Davis Mtns. (C, D) *J. deppeana* populations. In addition, plants from the Sacramento Mtns. (A, Fig. 7) were more similar to Benson, AZ (B, Fig. 7), than to the Davis Mtns. (D, Fig. 7) population. The Los Liros population of *J. d. var. deppeana* was more similar to the Benson, Arizona population (B, Fig. 7) than to the nearer Hidalgo population (H, Fig. 7).

Although most *Juniperus* species' seeds are disseminated by birds (see discussion in Adams, 2004), some species are dispersed by small mammals (raccoons, opossums, squirrels). The female cones of most of the *J. deppeana* varieties are probably too large and woody to be a food choice of migratory birds. It would seem that cone dispersal for *J. deppeana* is chiefly by mammals, gravity and water. These kinds of dispersal makes the high genetic similarities between disjunct populations seem even more unusual. The disjunct population of *J. d. var. gamboana* in the mountains of Chiapas and Guatemala (1670-2200 m) would not likely to have ever been contiguous across the isthmus of Tehuantepec (Fig. 7) to the Sierra Madre del Sur and thence into central Mexico. It seems more reasonable that the establishment of *J. d. var. gamboana* in Chiapas, MX and Guatemala was by long distance dispersal by birds because it has one-seeded, relative small (5-8 mm), soft, fleshy female cones that birds consume.

The reason for the high genetic similarities between disjunct populations in central and northern Mexico and the southwest United States may be due to ancient climate and past distributions of *J. deppeana*. Wells (1966), using data from rat middens from the Big Bend of Trans-Pecos Texas region (C in Fig. 2), concluded that during the Wisconsin (70,000 - 13,000 ybp) life zones descended about 800 m leading to the formation of a pinyon-juniper woodland in the present Chihuahuan desert between the Big Bend of Trans-Pecos Texas and the city of Del Rio. Assuming that the effects of glaciation were mediated southward into Mexico so that life zones descended only a few hundred

meters in Hidalgo (E, Fig. 2), it appears that most of the now disjunct populations of *J. deppeana* may have been connected in a nearly continuous population of distribution around the Chihuahuan desert (Fig. 8). It is likely that desert peaks within the ring also supported stands of *J. deppeana*. These Wisconsin populations would have

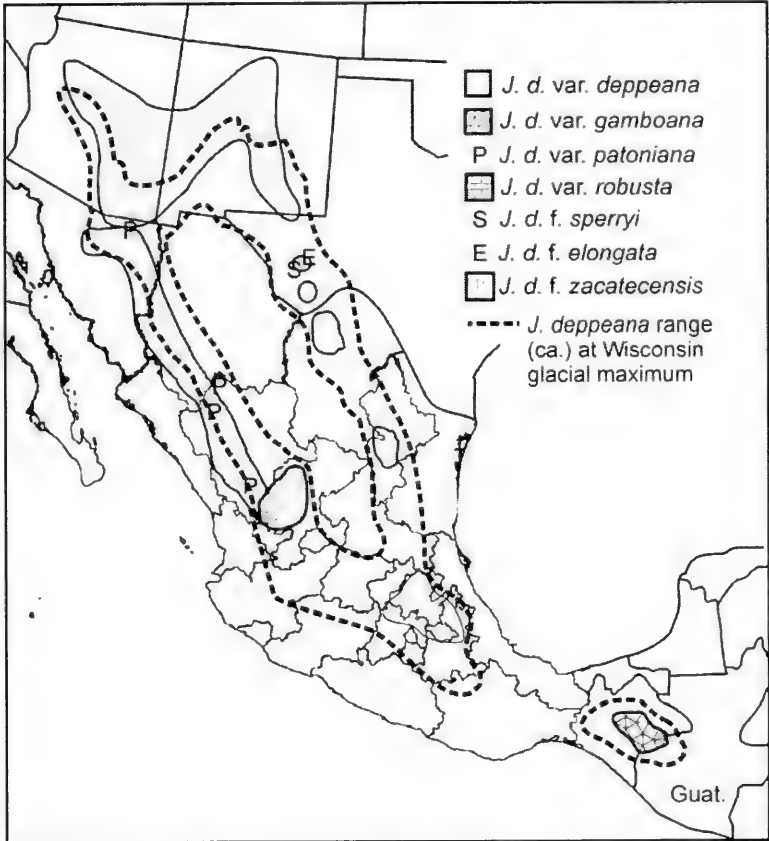


Figure 8. Possible range of *J. deppeana* during the Wisconsin glacial maximum (based on Wells, 1966). The present day disjunct populations were likely continuous in the foothills around the Chihuahuan desert during the Wisconsin.

become spatially separated as dryer, warmer climate developed during the Holocene (past 13,000 y). Of course, the Wisconsin was only the most recent of several pluvial events during the Pleistocene, spanning 1.8 my (Flint, 1971). It is likely that during any one (or several) of these pluvial events, *Juniperus deppeana* occupied lower elevation and more southward habitats, leading to more contiguous populations in Mexico and the southwest United States. If divergent populations (or varieties) became sympatric during the Wisconsin, this would have facilitated infra-specific crossing. This may account for the large genetic variation within some populations. In addition, the millennia of continuous populations could explain the lack of differentiation between the recently (Holocene) geographically isolated populations.

ACKNOWLEDGEMENTS

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**A NEW SPECIES OF *ALLOISPERMUM* (ASTERACEAE,
HELIANTHEAE) FROM GUERRERO, MEXICO**

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ABSTRACT

A new species, *Alloispermum guerreroanum* B.L. Turner, is described from the Chilpancingo area of western Guerrero. It is related to the *A. palmeri*-*A. scabrum* complex, possessing similar foliage, involucre, and ray florets of the former but the vestiture and calvous achenes of the latter.

KEY WORDS: *Alloispermum*, Asteraceae, Mexico, Guerrero

Routine identification of Mexican Asteraceae has revealed the following novelty:

ALLOISPERMUM GUERREROANUM B.L. Turner, sp. nov.

Caleae thysanolepi B.L. Rob. & Greenm. (= *Alloispermum scabrum* var. *thysanolepis* (B.L. Rob. & Greenm.) Fernandez, in prep.) similis sed differt foliis petiolatis (vs sessilis vel subsessilis), bracteis involucri dense pubescentibus trichomatibus glandulosis, et flosculis radii carentibus.

Perennial herbs 30-60 cm high. **Shoots** 1-6, these arising from a woody corm ca 2 cm across. **Stems** pilose with spreading hairs ca 1 mm long. **Leaves** opposite, ovate-lanceolate, 4-6 pairs per stem; petioles 5-10 mm long, tapering into the blades; mid-stem blades 6-7 cm long, 2.0-2.5 cm wide, sparsely pubescent above and below, mainly along the veins, their margins weakly and remotely serrate. **Peduncles** 10-20 cm long, densely glandular-pilose, their ultimate branches bearing 1-3 heads. **Heads** ca 6 mm high, 3 mm wide; involucre bracts in 3-4 series, densely glandular-pubescent, especially at their apices.

Receptacles broadly conical, ca 1.5 mm wide, 1.0 mm high; pales lanceolate, 4-6 mm long. **Ray florets** 5, pistillate and fertile; ligules white, 3-lobed, ca 6 mm long, 4 mm wide; tubes ca 2.5 mm long, pubescent. **Disc florets** 12-20; corollas yellow, 5-lobed, 3-4 mm long, the lobes ca 0.5 mm long. **Achenes** carbonized, glabrous, ca 2 mm long, weakly 5-ribbed; pappus of both ray and disc florets absent.

TYPE: **MEXICO. GUERRERO:** "Km 72 de la carretera Chilpancingo-Chilapa-Tlapa...Creciendo en bosque de pino y encino, normalmente a la sombra de encinos o entre rocas. Occasional." 1900 m, 18 Sep 1993, *J.L. Panero 3321* (with *I. Calzada*). (holotype: TEX; isotype: MEXU).

ADDITIONAL SPECIMEN EXAMINED: **MEXICO. GUERRERO:** 13.4 km E of Chilapa along route 93, 1740 m, "oak-pine forest," 8 Nov 1999, *Yahara et al. 1945* (TEX).

In my treatment of *Alloispermum* for Mexico (in prep., cf. Turner 1997), *A. guerreroanum* will key to *A. palmeri* (A. Gray) Fernandez & Urbatsch ex B.L. Turner, a more northern species having larger, eglandular heads and pappose disc florets. As noted in the above diagnosis, *A. guerreroanum* appears closer to *A. scabrum*, differing from that taxon in a number of characters, including those of foliage and involucre.

Alloispermum scabrum and *A. guerreroanum* appear to occur in the same general area (*A. s. var. thysanolepis*, from 40 km W of Chilpancingo at 2500 m, *Feddema 2826*, TEX). However, the eradiate *A. scabrum* (with two varieties) is widespread throughout most of Mexico, while the rayed *A. guerreroanum*, with its densely glandular involucre, appears to be a localized endemic.

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**GEOGRAPHIC VARIATION IN *JUNIPERUS SABINA* L.,
J. SABINA VAR. *ARENARIA* (E. H. WILSON) FARJON,
J. SABINA VAR. *DAVURICA* (PALL.) FARJON AND
J. SABINA VAR. *MONGOLENSIS* R. P. ADAMS**

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ABSTRACT

Populations of *J. sabina* L., *Juniperus sabina* var. *arenaria* (E. H. Wilson) Farjon, *J. sabina* var. *davurica* (Pall.) Farjon, *J. sabina* var. *mongolensis* R. P. Adams, along with plants of *J. chinensis* L., *J. erectopatens* (Cheng & L. K. Fu) R. P. Adams and *J. procumbens* (Siebold) ex Endl. were examined by use of RAPD markers in concert with terpenoid and sequence data from the literature. *Juniperus chinensis* and *J. procumbens* were confirmed to be very distinct from *J. sabina*. In general RAPD data agreed with essential oils and sequence data from the literature and affirmed the more distant relationship of *J. chinensis* to the *J. sabina* varieties. *Juniperus sabina* var. *arenaria*, the sand-loving juniper, was very similar to *J. sabina* var. *davurica* from Mongolia. However, *J. sabina* var. *mongolensis*, on sand dunes in

Mongolia, was quite distinct in both its sequence data and RAPD markers. Farjon's move (2001) of *J. sabina* var. *arenaria* from *J. chinensis* to *J. sabina* is supported by essential oils, RAPD markers and sequence data. The major geographic pattern in *J. sabina* var. *sabina* was a west to east trend from the Sierra Nevada, Spain to the Pyrenees, Switzerland, and Tian Shan, Xinjiang. Pleistocene refugia and recolonization are discussed in relationship to the present pattern of genetic differentiation found in *J. sabina*.

KEY WORDS: *Juniperus sabina*, *J. s.* var. *arenaria*, *J. s.* var. *davurica*, geographic variation, RAPDs, nrDNA, trn C- trn D, terpenoids.

The genus *Juniperus* consists of approximately sixty-seven species (Adams, 2004), all of which grow in the northern hemisphere, although, *J. procera* Hochst. ex Endl. also grows southward along the rift mountains in East Africa into the southern hemisphere (Adams, 2004). The recent monograph of the genus (Adams, 2004) divides *Juniperus* into three sections: *Caryocedrus* (one species, *J. drupacea* Labill.); *Juniperus* (= *Oxycedrus*) with 11 species and *Sabina* (the remaining 55 species).

Section *Sabina* can be further divided into junipers with serrate and those with entire (smooth) leaf margins. The serrate leaf margined junipers are confined to the western hemisphere except for *J. phoenicea*, which may have a greater affinity to the smooth leaf margined junipers (Schwarzbach et al., 2008).

The *Juniperus* of section *Sabina*, of the eastern hemisphere can be further divided into two groups based on the number of seeds per female cone (often called berry) and female cone shape. The single seed/cone (single-seeded) *Juniperus* of the eastern hemisphere have cones that are ovoid with a noticeable pointed tip, whereas the multi-seeded *Juniperus* are generally globose and often have an irregular surface. *Juniperus sabina* L. is a smooth leaf margined, multi-seeded juniper of the eastern hemisphere. It is very widely distributed from Spain through Europe to Kazakhstan, western China, Mongolia and Siberia (Fig. 1). *Juniperus sabina* has a range that is discontinuous between Europe and central Asia. The species is generally a small shrub less than 1 m tall and ranges up to 1-2 m wide. But in the Sierra

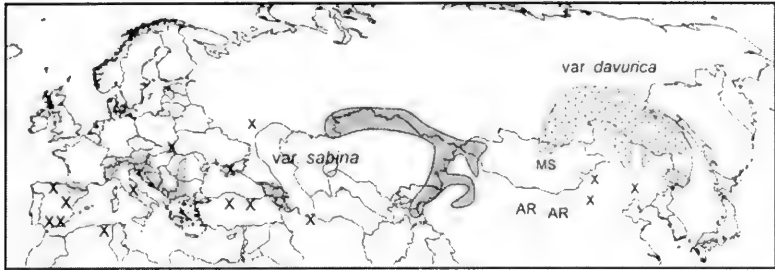


Fig. 1. Distribution of *J. sabina* and its varieties. AR = *J. s. var. arenaria*, MS = *J. s. var. mongolensis*. X = outlying populations of putative *J. sabina*.

Nevada of Spain, it forms a horizontal shrub and in Mongolia it occurs as a prostrate plant on sand dunes.

Wilson (1928) described a prostrate shrub found growing on sand dunes at Lake Qinghai, China as a new variety of *J. chinensis* (*J. chinensis* var. *arenaria* E. H. Wilson). Recently, Farjon (2001) moved the taxon to *J. sabina*, as *J. sabina* var. *arenaria* (E. H. Wilson) Farjon. In addition, Farjon (2001) moved *J. davurica* to *J. sabina* as a new variety, *J. sabina* var. *davurica* (Pall.) Farjon. Table 1 shows the classical and current classifications of the species that have been allied with *J. sabina*. It is apparent from table 1 that the taxonomy of these

Table 1. Comparison of the treatments of *J. sabina* allied taxa.

Classical	Farjon (2005)	Adams (2004)	This study results
<i>J. sabina</i>	<i>J. sabina</i>	<i>J. sabina</i>	<i>J. sabina</i>
<i>J. chinensis</i> var. <i>arenaria</i>	<i>J. sabina</i> var. <i>arenaria</i>	<i>J. sabina</i> var. <i>arenaria</i>	<i>J. sabina</i> var. <i>arenaria</i>
<i>J. sabina</i> var. <i>erectopatens</i>	<i>J. chinensis</i> var. <i>chinensis</i>	<i>J. erectopatens</i>	<i>J. erectopatens</i>
<i>J. davurica</i>	<i>J. sabina</i> var. <i>davurica</i>	<i>J. davurica</i>	<i>J. sabina</i> var. <i>davurica</i>

taxa is not well understood and additional characters are needed to resolve this problem.

DNA sequencing of nrDNA and trnC-trnD (Schwarzbach et al., 2008) based on new collections of *J. sabina* var. *arenaria* from Lake Qinghai and a river bank in Gansu, as well as additional samples from Mongolia, has led to a different picture of the relationships in the *chinensis-erectopatens-davurica-sabina* complex (Fig. 2). Notice that *J. erectopatens* was 100% supported as a distinct clade, as previously shown in both essential oils and RAPD data (Adams, 1999). There was no support for treating *J. erectopatens* as a synonym of *J. chinensis* (Farjon, 2005). *Juniperus erectopatens* is a cryptic species in its morphology, but it is quite distinct as an evolutionary unit in its terpenes, RAPD markers and DNA sequence data. *Juniperus chinensis* (and *J. procumbens*) were also well supported (100%) as being distinct

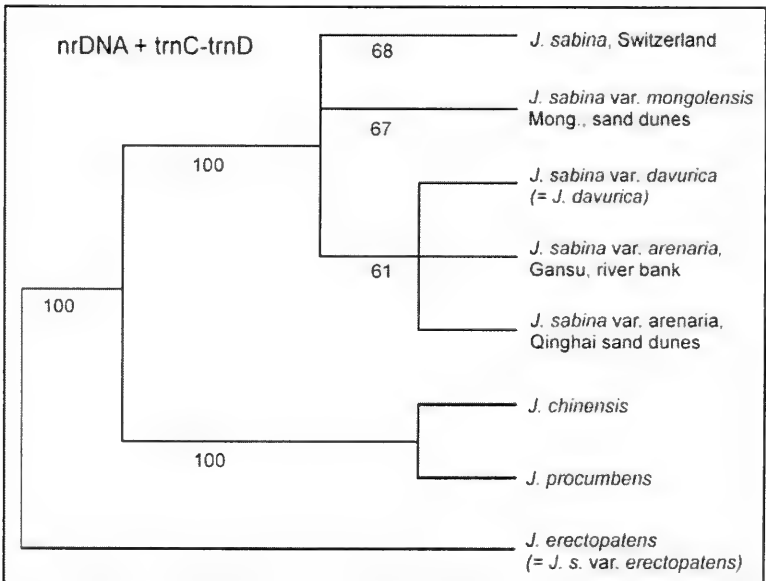


Fig. 2. Phylogenetic tree (from Schwarzbach et al. 2008). Numbers are bootstrap values. See text for discussion.

from *J. sabina* and *J. davurica* (Fig. 2), again as has been shown by their essential oils and RAPD data (Adams, 1999). Among the *J. sabina*, *J. s. var. arenaria* and *J. s. var. davurica* samples, there (Fig. 2) was some support (61-68%) for infraspecific taxa. The *J. sabina* plants from Mongolian sand dunes are distinctly separated (Fig. 2) and have recently been recognized as a new variety, *J. sabina var. mongolensis* R. P. Adams (2006).

Principal coordinate analyses (PCO) of the leaf essential oils (Adams et al., 2006) of these taxa confirmed (Fig. 3) that *J. chinensis* was distinct from the *J. sabina - davurica* complex. Adams et al.

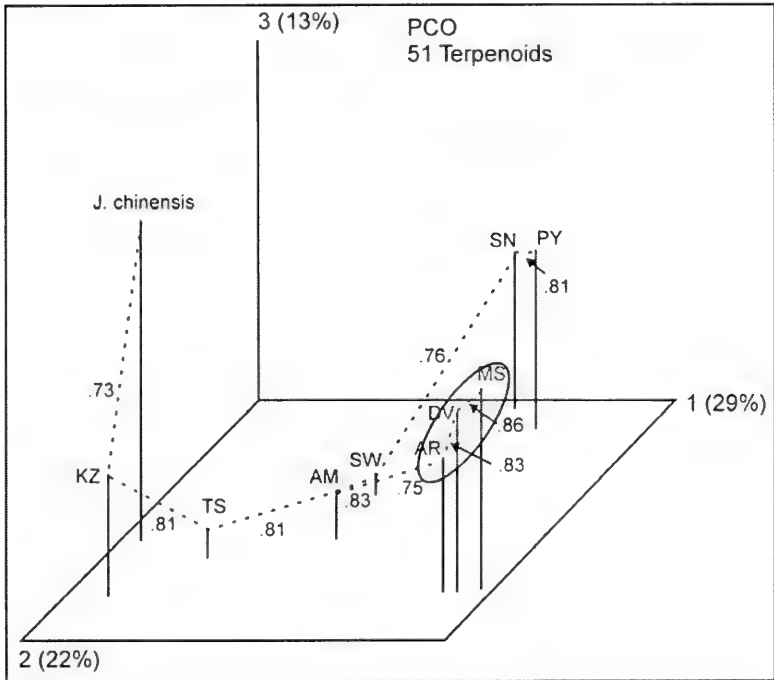


Fig. 3. Principal Coordinate Ordination (PCO) (from Adams et al., 2007) based on 51 terpenoids. Notice the distinct ordination of *J. chinensis* and the prostrate junipers of n China and Mongolia (AR = *J. s. var. arenaria*; DV = *J. s. var. davurica*; MS = *J. s. var. mongolensis*).

(2006) also found that *J. sabina* var. *davurica* (DV, Fig. 3) had a terpenoid composition very similar to that of *J. sabina* var. *arenaria* (AR, Qinghai sand dunes) and *J. sabina* var. *mongolensis* plants growing on Mongolian sand dunes southwest of Ulan Batar (MS). The Iberian *J. sabina* (SN, PY) plants' terpenoids were quite different from nearby Switzerland (SW) and central Asia (AM, TS, KZ).

The purpose of the present study is to examine geographic variation among populations of *J. sabina* from Spain to Mongolia by analyzing and integrating RAPD marker information with terpenoid (Adams et al., 2006) and nrDNA and trnC-trnD sequence data (Schwarzbach et al. 2008).

MATERIAL AND METHODS

Plant Material

Specimens used in this study (species, popn. id., location, collection numbers): *J. chinensis*, CH, Lanzhou, Gansu, China, Adams 6765-67; *J. sabina* var. *davurica*, DV, 15 km se Ulan Bator, Mongolia, Adams 7252, 7253, 7601; *J. procumbens*, Japan, Adams 8683, 8684, 9150; *J. sabina*, Sierra Nevada, Spain, Adams 7197, 7199, 7200; Pyrenees Mtns., Spain/ France border, Adams 7573-77; Switzerland, Adams 7611, 7612, 7614, 7615; Tian Shan Mtns., Xinjiang, China, Adams 7836-38; *J. sabina* var. *arenaria*, sand dunes, Lake Qinghai, Qinghai, China, Adams 10347-52; river bank, Gansu, J-Q. Liu and Adams 10354-56; *J. sabina* var. *mongolensis*, sand dunes, 80 km sw Ulan Bator, Mongolia, Adams 7254-56; Voucher specimens for all collections are deposited at Baylor University Herbarium (BAYLU).

Molecular

One gram (fresh weight) of foliage was placed in 20 g of activated silica gel and transported to the lab, thence stored at -20° C until the DNA was extracted. DNA was extracted using the Qiagen DNeasy mini kit (Qiagen Inc., Valencia CA). The RAPD analyses follow that of Adams and Demeke (1993). Ten-mer primers were purchased from the University of British Columbia (5'-3'): 134, AAC ACA CGA G; 153, GAG TCA CGA G; 184, CAA ACG GCA C; 212, GCT GCG TGA C; 218, CTC AGC CCA G; 239, CTG AAG CGG A; 249, GCA TCT ACC G; 250, CGA CAG TCC C; 268, AGG CCG CTT

A; 327, ATA CGG CGT C; 338 CTC TGG CGG T; 346, TAG GCG AAC G; 347, TTG CTT GGC G; 413, GAG GCG GCG A; 478, CGA GCT GGT C.

PCR stock solutions (Taq, primer, buffer) were made in bulk so that all the PCR reaction tubes for a primer were prepared using the same bulk stock. This is a critical factor for minimizing variation in band intensities from sample to sample (see Adams et al. 1998, for protocols to minimize PCR band variation). PCR was performed in a volume of 15 μ l containing 50 mM KCl, 10 mM Tris-HCl (pH 9), 2.0 mM MgCl₂, and 0.1% Triton X-100, 0.2 mM of each dNTPs, 0.36 μ M primers, 0.3 ng genomic DNA, 15 ng BSA and 0.6 unit of Taq DNA polymerase (Promega). A control PCR tube containing all components, but no genomic DNA, was run with each primer to check for contamination. DNA amplification was performed in an MJ Programmable Thermal Cycler (MJ Research, Inc.). Samples were run in duplicate to insure reproducibility (Adams et al., 1998). A temperature profile was obtained for each well of the thermocycler to be sure that no variation occurred on the heating/ cooling block. The thermal cycle used was: 94°C (1.5 min) for initial strand separation, then 40 cycles of 40°C (2 min), 72°C (2 min), 91°C (1 min). Two additional steps were used: 40°C (2 min) and 72°C (5 min) for final extension. The temperature inside a PCR tube containing 15 μ l buffer was monitored with a temperature probe, quantitated and printed for each step for each of the 40 cycles for every PCR run (Adams et al. 1998) to insure that each cycle met temperature specifications and that each PCR run was exactly the same. Amplification products were analyzed by electrophoresis on 1.5 % agarose gels, 75V, 55 min, and detected by staining with ethidium bromide. The gels were photographed over UV light with Polaroid film 667 and scanned to digital images. The digital images were size normalized in reference to pGem® DNA size markers before band scoring. Bands were scored as present (1) and absent (0). Bands that were inconsistent in replicate analyses were not scored.

Associational measures were computed using absolute character state differences (Manhattan metric), divided by the maximum observed value for that character over all taxa (= Gower metric, Gower, 1971; Adams, 1975). Principal coordinate analysis was performed by factoring the associational matrix based on the formulation of Gower

(1966) and Veldman (1967). It should be noted that problems of homology of RAPD DNA bands on agarose gels can be significant (Rieseberg, 1996), but these errors can be accounted for using multivariate statistical methods (PCO) (Adams and Rieseberg, 1998).

RESULTS AND DISCUSSION

Factoring the association matrix resulted in four eigenroots accounting for 23.9%, 14.8%, 9.0% and 7.0% before the eigenvalues began to asymptote into non-significant values (Cattell, 1966; Rummel, 1970). *Juniperus erectopatens* was not included in this study because both terpenoid (Adams 1999) and sequence data (Fig. 2, Schwarzbach et al. 2008) have previously shown that it is a very distinct species. The first three principal coordinates show three major groupings (Fig. 4). Notice that *J. procumbens* is well resolved.

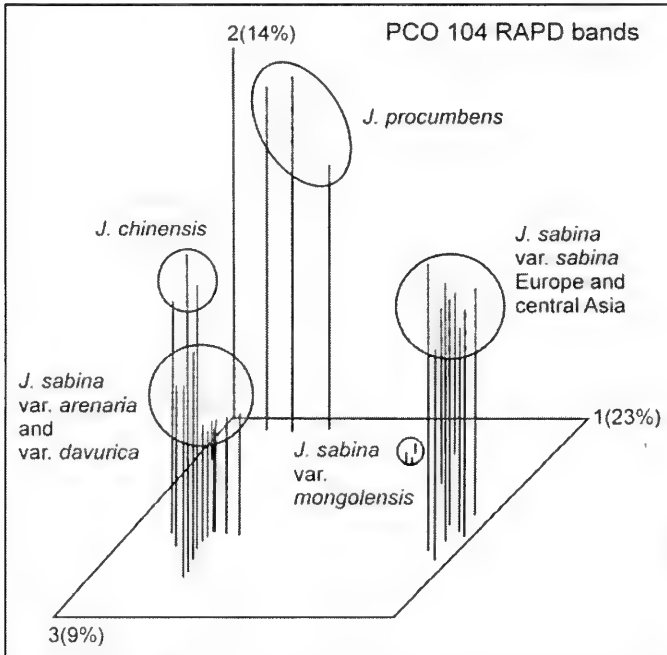


Fig. 4. PCO based on 104 RAPD bands showing the distinct nature of *J. procumbens*. See text for discussion.

Juniperus chinensis appears near *J. sabina* var. *davurica* and *J. sabina* var. *arenaria*, but after removing *J. procumbens* from the data matrix, a subsequent PCO analysis shows that *J. chinensis* is clearly resolved (Fig. 5).

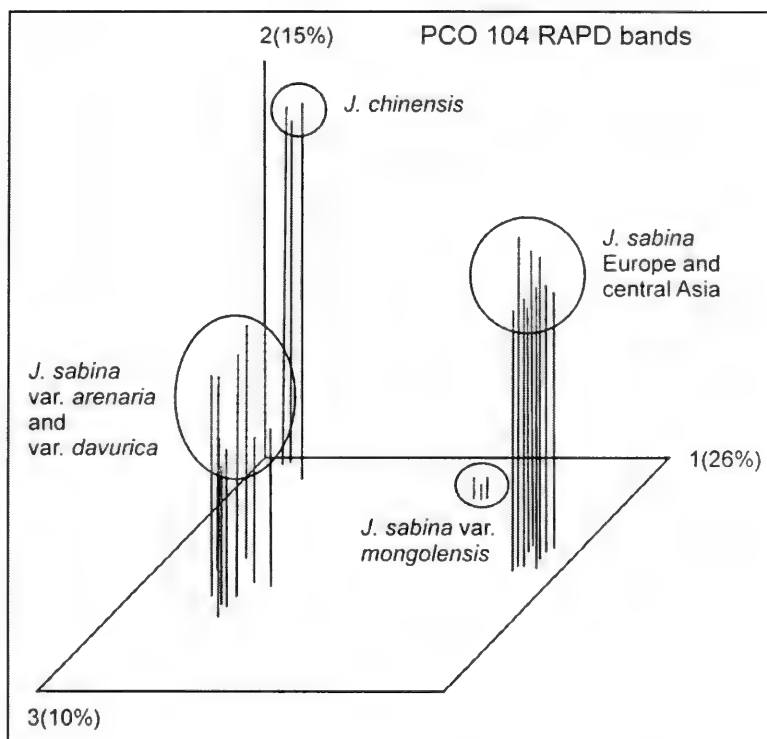


Fig. 5. PCO depicting four major groups, with *J. chinensis* well separated from *J. sabina*.

Because the sequence data clearly showed that *J. chinensis* and *J. procumbens* are not part of the *J. sabina* - *arenaria* - *davurica* - *mongolensis* complex, these two taxa were removed from the data set and a new PCO was performed. Factoring resulted in eigenroots accounting for 27.4%, 15.5%, 7.4% and 6.4%. The eigenroots began to asymptote after the fourth eigenroot. Ordination reveals four groups (Fig. 6) composed of *J. sabina* (Europe and Tian Shan, Xinjiang, China); *J. sabina* var. *mongolensis* and *J. sabina* var. *arenaria* - var. *davurica*. A close relationship between *J. sabina* var. *arenaria* and *J. sabina* var. *davurica* has also been shown in their DNA sequence data

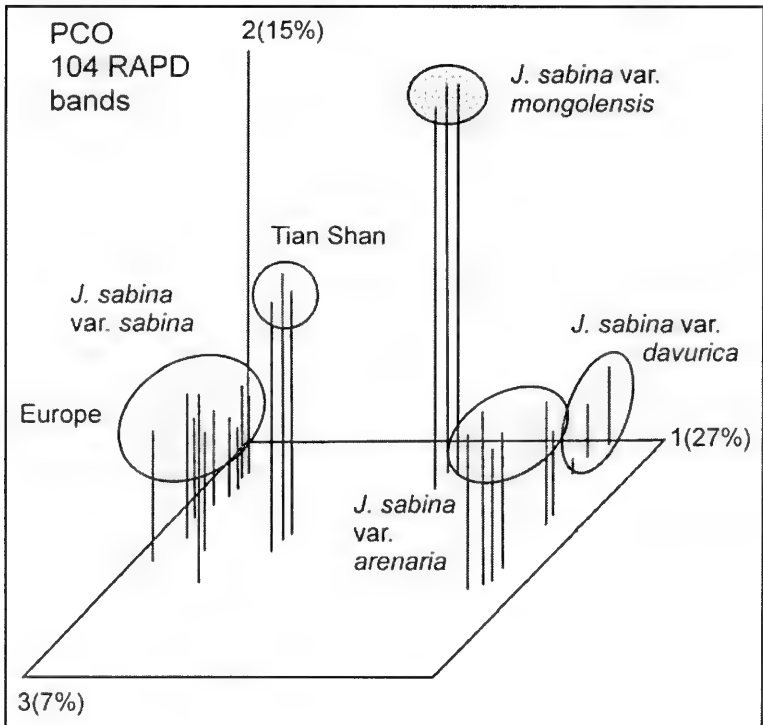


Fig. 6. PCO of *J. sabina* and its varieties. There are three major groups: European - central Asia (*J. s.* var. *sabina*); *J. s.* var. *mongolensis*; and *J. s.* var. *arenaria* - var. *davurica*.

(Fig. 2) and terpenoids (Fig. 3). However, the DNA sequence data (Fig. 2) clearly separates *J. sabina* var. *mongolensis*, but the terpenoids of *J. s.* var. *arenaria*, *J. s.* var. *davurica* and *J. s.* var. *mongolensis* are very similar (Fig. 3). The RAPDs data is more congruent with the DNA sequence data than with the terpenoid data. This same kind of association was reported by Adams et al. (2003) who examined five species of *Juniperus* (in section *Juniperus*), and found a 0.95 correlation between DNA sequence and RAPD data but only a 0.30 correlation between DNA sequence and terpenoid data sets. They concluded that the terpenoid data was more useful at and below the species level.

To examine variation in *J. sabina* from Spain to central Asia, *J. sabina* var. *arenaria* and *J. s.* var. *davurica* were removed from the data set and a new PCO was performed. Factoring this matrix resulted in three eigenroots (33.8%, 12.7%, 9.8%). PCO ordination (Fig. 7)

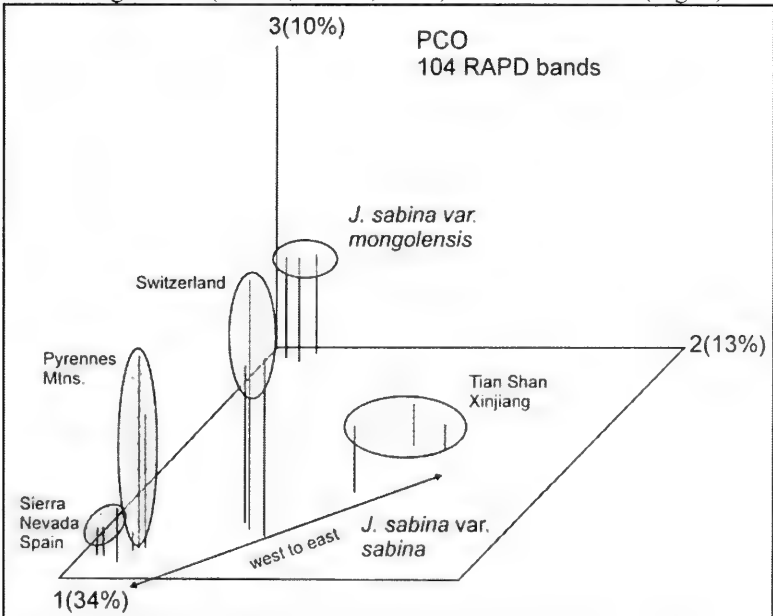


Fig. 7. PCO showing west to east clinal variation within *J. s.* var. *sabina*.

shows a west to east trend from Spain to Tian Shan, Xinjiang.

Many of the populations of *J. sabina* examined in this study were glaciated areas during the last ice age (14,000 - 70,000 ybp, Flint, 1971). The plants now growing in the Iberian peninsula likely survived at lower elevations or perhaps by retreating into the Atlas mountains of northern Africa. The Switzerland population was likely recolonized from seed from populations in Italy. The central Asian populations may have been recolonized from southern refugia or forced to lower elevation (warmer) habitats. Yet, in spite of the large geographic displacements of populations during recent glacial events and the distances separating European and central Asia populations (Fig. 1), there persists strong genetic affinities between these populations.

CONCLUSIONS

An important aspect of this study is discovery of the distinct nature of the *J. sabina* var. *mongolensis* plants that grow on the sand dunes sw of Ulan Batar in both their sequence data (Fig. 2) and RAPD data (Fig. 5, 6). These data support the recent recognition (Adams, 2006) of this morphologically cryptic variety. Comparing *J. sabina* var. *mongolensis* versus *J. sabina* var. *arenaria*, the seeds are 2-4 per cone vs. (1) 2 (3-4), and are flattened globose with an obtuse tip vs. an elongated ellipsoid with an acute tip that resemble a duck bill, and with ultimate branchlets that grow from the top (upper) side of long lateral branches vs. radially distributed branching. In both taxa, the female cones are borne on long, curved peduncles.

More detailed population level studies are clearly needed in order to reconstruct postglacial migration routes and to better explain present distribution patterns.

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**KEYS TO THE FLORA OF FLORIDA - 16
XYRIS (XYRIDACEAE)**

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ABSTRACT

Xyris (Xyridaceae) is represented in Florida by 19 species, two of which (*X. isoetifolia*, *X. longisepala*) are endemic to the state. Seven of the species are considered rare within Florida. Three species (*X. chapmanii*, *X. isoetifolia*, *X. longisepala*) are rated as endangered, and one (*X. scabrifolia*) as threatened. *Xyris difformis* is believed to consist of 3 varieties, and *Xyris elliottii* of 2 varieties. The nomenclatural basis for *Xyris caroliniana* is discussed. An amplified key is given to the Florida taxa.

KEY WORDS: *Xyris*, Xyridaceae, Florida flora.

Few genera in the southeastern United States are as readily identified as *Xyris*, the Yellow-eyed-grasses. Their narrow wholly-basal leaves, the solitary, compact, ellipsoid heads atop a slender scape, and the 3-petaled yellow (or white) flowers, mark this genus as no other.

Yet identification to species is vastly more difficult. The very uniformity of form that so well distinguishes this genus simultaneously blends the text-book description of one species or variety into that of another. Identification is further impeded by the few morphological characters possessed by these plants and the necessity for systematists to invoke critical but often subtle distinctions for separation of the taxa.

Two authors have been outstanding for their skill in recognizing the sometimes obscure features that define *Xyris* species. Alvan Wentworth Chapman, physician and astute botanist of Apalachicola, Franklin County, in the sequential editions of his Flora of

the Southern United States (1860, 1889, 1897), identified 7 new species of *Xyris* in panhandle Florida. Robert Kral, beginning with the summer of 1958 devoted to collection of Florida plants (sponsored by George Cooley), has gained a mastery of the genus that has enabled him to prepare and publish a series of detailed treatments (Rhodora 62:295-319. 1960; Sida 2:177-260. 1966; Novon 9:205-219. 1999; Flora N. Amer. 22:154-167. 2000), including a further 5 new taxa.

Though the genus *Xyris* contains 200-400 species worldwide (D. J. Mabberley. 1997), no foreign species appears to have become established in Florida; all Florida species of *Xyris* are native. *Xyris jupicai* is the most abundant, aggressive member of the genus in the state, characteristics that suggest it may have been recently introduced. But Chapman knew it (as *X. elata*) in 1860, and A. Michaux used "*jupicai*" on a label, about 1790.

Nomenclature for most Florida species of *Xyris* is straightforward, with the type known (and in nearly all cases examined by Kral). Only one name has generated uncertainty and dispute.

In the late 18th century the South Carolina rice planter and amateur botanist Thomas Walter published his landmark Flora Caroliniana (1788). Though 10 species of *Xyris* are now known in coastal South Carolina (Radford et al., Manual of the Vascular Flora of the Carolinas. 1968), Walter recognized only one, his *Xyris caroliniana*. Walter kept no type, nor is there a specimen of the genus in the herbarium in London (BM) of Carolina plants prepared by his friend John Fraser. H. L. Blomquist (J. Elisha Mitchell Sci. Soc. 71:35-46. 1955) considered *X. caroliniana* to be ambiguous, and for many years the name was largely disregarded.

In search for a specimen that could be interpreted as the type of Walter's *Xyris caroliniana*, Kral (Sida 2:236-237. 1966) located a Fraser specimen in the Lamarck herbarium, Paris (P) that he identified as *X. flexuosa*. This inconspicuous dry-soil species surely isn't what Walter (1788) knew in the rice fields of his Santee River plantation, nor do its linear twisted leaves correspond to Walter's "fol. *gladiatis*." In a recent search (D.B.W., July 1990), *X. flexuosa* could not be found anywhere in the vicinity of Walter's homesite. Moreover, though

Fraser visited Walter at his Santee plantation and provided him with materials for some of the plants described in his Flora, the great bulk of Fraser's collections was made quite independently of Walter (Ward, Taxon 26:227-234. 1977; Sida, in press), and there is no sufficient reason for connecting the specimen of Fraser with the description by Walter. Kral's selection is thus effectively a neotype, from another location and by a different collector.

But the inadequacy of Fraser's specimen as a type for *Xyris caroliniana* does not readily lead to an incontrovertible alternative. *Xyris flexuosa* Muhl. (1813) is unidentifiable and nude. *Xyris flexuosa* Muhl. ex Ell. (1816) is well described but is superfluous since *X. caroliniana* is cited in synonymy. *Xyris flexuosa* Muhl. ex Cham. (1860) similarly fails, with *X. bulbosa* Kunth (= *X. torta* J. E. Sm.) in synonymy. Since these names, from their accompanying descriptions, refer to the dry-soil species, it is disappointing that they are unavailable. For the present, unsatisfying as it may be, there seems no alternative clearly better than the neotypification proposed by Kral.

The following "amplified key"¹ is largely based on the documentation and conclusions in the publications of Robert Kral, and the verbal and written supplements he has generously given me over the years. The structure and phraseology, however, are often of my own design, permitting the reader access to an independent view and a somewhat different terminology that may assist in the identification of this unique group of Florida plants.

XYRIS L. Yellow-eyed-grasses

1. Sheath of the scape, with its leaflike terminal extension, equalling or exceeding the longest leaves; plants diminutive (leaves usually <5 cm. long, rarely to 10 cm.); scapes filiform.

2. Base of leaf abruptly lustrous chestnut-brown; sheath of the scape about equalling the longer foliage leaves; yellow-flowered. Perennial herb. Moist acid sands and sandy peats of seepage bogs and ditches. Western panhandle (e. to Liberty County); rare. Summer-fall. *Xyris drummondii* Malme

2. Base of leaf not differently colored; sheath clearly exceeding the longer foliage leaves.

3. Bracts of the spike with the outer border maroon and the edge lacerate; leaves ascending, usually narrowly linear, the apical portion usually green; plants usually in clumps with many scapes; yellow-flowered. Perennial herb. Moist acid sands of pond margins, low pinelands, clearings, and disturbed areas. South peninsula (Collier County), north to mid-panhandle (Gulf, Liberty counties); common, at times so abundant as to form a thin turf. Winter-spring. *Xyris brevifolia* Michx.

3. Bracts of the spike with outer border not differently colored, the edge entire or minutely erose; leaves flabellately spreading, often maroon; plants usually with solitary or few scapes; yellow-flowered. Perennial herb. Moist acid sands of pond margins and clearings in pine flatwoods. Nearly throughout; infrequent (rare in south peninsula and western panhandle). Spring. *Xyris flabelliformis* Chapm.

1. Sheath of the scape surpassed by the longest leaves; plants delicate to robust but of appreciable size (the leaves >8 cm. in length, often very much so); scapes stout or slender, but not filiform (except *X. isoetifolia*, with linear-filiform scapes and leaves as short as 4 cm.).

4. Keel of the lateral sepals prominently fimbriate, the longer strands of tissue threadlike and definitely exceeding the width of the keel (although perhaps not the width of the entire sepal); tips of lateral sepals exerted beyond the subtending bract; spikes usually >1.0 cm. long.

5. Bases of leaves hard, lustrous chestnut-brown; ridges on scape inconspicuous, smooth to the touch; spikes narrowly ellipsoidal or lance-ovoid, somewhat lustrous; plant wiry, to 1 m. tall, with narrow, spirally twisted leaves and a bulbous base deeply buried in the substrate; yellow- or white-flowered (almost exclusively white in s. pen.), usually opening in the afternoon. Perennial herb. Moist to dry acid sands of pond embankments, pine flatwoods, and savannas. Nearly throughout (excl. Keys); common. Summer-fall.

[*Xyris flexuosa* Muhl.; *Xyris pallescens* (Mohr) Small, the white-flowered form; *Xyris torta*, misapplied] Twisted yellow-eyed-grass
Xyris caroliniana Walt.

5. Bases of leaves soft, straw-colored to pale green or pinkish; ridges on scape prominent, harsh to the touch; spikes ovoid or broadly ellipsoidal, dull brown; plant robust, to 1.5 m. tall; yellow-flowered, opening in the morning. Perennial herb. Ditches, wet pinelands, shallow ponds, usually with the base of the plant submersed. North Florida, south to mid-peninsula (Lake Okeechobee); infrequent. Summer-fall. *Xyris fimbriata* Ell.

4. Keel of the lateral sepals variously ciliate to lacerate or entire, the longer strands of tissue either shorter than the width of the keel or, if longer, ragged and not forming fimbriate threads; tips of the lateral sepals exserted or not.

6. Tips of at least some of the lateral sepals slightly to conspicuously exserted beyond the subtending bract.

7. Leaves 5-15 mm. broad; plant robust, the scapes to 1.5 m. tall; seeds >0.7 mm. long; yellow-flowered. Perennial herb. Shallow standing water of cypress ponds, lake shores, wet prairies, and ditches, with the base of plant submersed. Nearly throughout (excl. Keys); infrequent. All year. If lateral sepals are not observed as exserted, this may be mistaken for *X. jupicai* from which it is separated by its larger size and usually pinkish basal coloration. *Xyris smalliana* Nash

7. Leaves 1-2 mm. broad; plant slender, almost delicate, yet tall, the scapes to 0.8 m. in height; seeds <0.3 mm. long; yellow-flowered. Short-lived perennial herb, or annual. Exposed sandy shores of fluctuating karst-pond lakes. West and central panhandle (e. to Leon County); rare. Summer. Endemic. ENDANGERED (State listing). *Xyris longisepala* R. Kral

6. Tips of lateral sepals not exserted beyond the subtending bract (only appearing exserted if detached, as in old or dried spikes).

8. Leaves narrowly linear to filiform (<2 mm. wide); base of leaves hard, dark brown, often lustrous; spikes <1 cm. long (occasionally somewhat more in *X. elliotii*); plants growing in large tufts with many scapes.

9. Keel of lateral sepals with irregular, jagged or torn edge; leaves narrowly linear to filiform, 10-30 cm. long; spikes with numerous, tightly imbricated bracts; staminodia bearded or not; seeds various.

10. Staminodia bearded (and visible as a tangle of yellow threads in the open flower); seeds 0.5-0.6 mm. long; yellow-flowered. Perennial herb. Sandy soils of roadside ditches, pond margins. Spring-summer. *Xyris elliotii* Chapm.

a. Leaves narrowly linear (1-2 mm. wide), pale to near-white on edges. Throughout; common to abundant.

var. *elliotii*

a. Leaves filiform (<1 mm. wide), lacking or with inconspicuously paler edges. Throughout; frequent to common (less frequent overall than var. *elliotii*, but locally predominant in central peninsula and western panhandle).
var. *stenotera* Malme

10. Staminodia beardless (without tangle of yellow threads in the open flower); seeds 0.8-1 mm. long; leaves filiform (<0.5 mm. wide); yellow-flowered. Perennial herb. Moist sands of pine flatwoods and roadside ditches. Panhandle and north Florida (s. to Levy, Marion counties); infrequent. Spring. *Xyris baldwiniana* Schult. in Roem. & Schult.

9. Keel of lateral sepals with regularly spaced, short, cilia-like teeth; leaves filiform (<0.5 mm. wide), relatively short (4-15 cm. long); spikes with few, loosely imbricated bracts; staminodia bearded (with a tangle of yellow threads in the open flower); seeds <0.5 mm. long; yellow-flowered. Perennial herb. Moist sands or sandy peats of savanna bogs, flatwood pond margins, lake shores. Central panhandle (Bay,

Gulf, Washington counties); very local and rare. Spring-summer. Endemic. ENDANGERED (State listing).

Xyris isoetifolia R. Kral

8. Leaves linear but not narrowly so (>2 mm. wide); base of leaves soft (fibrous in *X. ambigua*), pink, pinkish-purple, straw-colored, greenish, or brown to blackish (but not lustrous); spikes >1 cm. long (frequently less in *X. jupicai* and *X. difformis*); plants with solitary or few scapes (or in large clumps in *X. stricta* and *X. serotina*).

11. Keel of lateral sepals with regularly spaced, short, cilia-like teeth; old leaf bases persisting as blackened or brown shreds; plants robust, at times forming large clumps.

12. Edge of leaves strongly papillate, the individual protrusions usually several times as long as wide; leaves usually spreading, less than one-half the height of the scape, drying to uniform brown or tan, the inner leaf bases without dark veins; petals 8-10 mm. long, yellow, the flowers opening in the early morning; seeds translucent. Perennial herb. Moist sandy or peaty soils of pine flatwoods, savannas, roadside ditches. Panhandle and peninsula (s. to Collier, Palm Beach counties); frequent to common. Summer-fall. *Xyris ambigua* Beyr. ex Kunth

12. Edge of leaves mildly papillate or merely roughened, the protrusions low and rounded; leaves usually erect and more than one-half the height of the scape, drying to dark pinkish-brown, the inner leaf bases with dark veins against a pale surface; petals 4-5 mm. long, yellow, the flowers opening in late morning; seeds opaque, yellow. Perennial herb. Summer-fall. *Xyris stricta* Chapm.

a. Leaves 3-8 mm. broad, clearly papillate. Very wet sandy or peaty soils of cypress-gum swamps and low flatwoods, the plant base often submersed. Central panhandle, disjunct to upper east coast (Flagler, Volusia counties); infrequent. var. *stricta*

a. Leaves 2.5-3 mm. broad, smooth to slightly papillate. Moist sandy peats or clays, never immersed. West panhandle (e. to Liberty County); rare. [*Xyris louisianica* Bridges & Orzell] var. *obscura* R. Kral

11. Keel of lateral sepals with irregular, jagged or torn edge; old leaf bases soft and not persisting; plants robust to small and slender.

13. Leaves and scapes markedly spirally twisted above, pink or purplish (infrequently ivory) toward base.

14. Plants slender (leaves 2-4 mm. wide); lowest portion of leaf not conspicuously thickened; base of plant deeply buried but not bulbous; leaves smooth, the outermost not appreciably shorter than others; flowers opening in the late morning; petals ca. 3 mm. long, yellow. Perennial herb. Deep muck of acid bogs. Western panhandle (Munson, Santa Rosa County); very rare. ENDANGERED (State listing).

Xyris chapmanii Bridges & Orzell

14. Plants robust (leaves 5-10 mm. wide); lowest 1-2 cm. of each leaf thickened and fleshy, forming a bulb-like enlargement at base of plant (more conspicuous when fresh); usually a few outermost leaves very short (1 to 2 times as long as wide), spoon-like around the swollen base; flowers opening in the afternoon; petals ca. 5 mm. long.

15. Leaf and scape surfaces smooth; plants tall (the scape to 1 m.); flowers usually white, sometimes yellow, the petals obovate; seeds <0.6 mm. long. Perennial herb. Wet acid sands, pine flatwoods, grassy savannas, pond margins, ditch banks, quickly occupying cleared and disturbed soils. Panhandle, south to mid-peninsula (Lee, Martin counties); common. Summer-fall. *Xyris platylepis* Chapm.

15. Leaf and scape surfaces prominently papillose or tuberculate-scabrid, the foliage appearing glazed or glassy; plants medium (the scape seldom above 0.5 m.); flowers yellow, the petals suborbicular; seeds 0.6-1 mm. long. Perennial herb. Moist to wet sandy peats of acid bogs or seepage slopes. West and central panhandle (Escambia, Washington, Calhoun, Bay counties); rare. Summer-fall. Endemic. Threatened (State listing). *Xyris scabrifolia* Harper

13. Leaves and scapes not markedly spirally twisted, tan or pinkish toward base.

16. Scape flattened and 2-edged, in cross section narrowly elliptic, the edges smooth; spike usually >2 cm. long; plants robust (leaves 10-25 mm. wide); base of plant pink to purplish; yellow-flowered. Perennial herb. Emergent from shallow water at edge of streams or flatwood ponds, usually on clayey soils. Western panhandle (e. to Jefferson County), disjunct to northeast Florida (St. Marys River, Nassau County); rare. Summer-fall. [*Xyris iridifolia* Chapm.]

Xyris laxifolia Mart. var. *iridifolia* (Chapm.) R. Kral

16. Scape terete, with 2-several ridges sharply distinct from the scape-body, the edges papillate-scabrid or smooth; spikes usually <1.5 cm. long; plants medium to small (leaves <15 mm. wide).

17. Plant base pink to purplish (sometimes faded in dried material; not to be confused with pigment-congested cells of upper leaves and scape), if pigment absent, ridges on scape broad (each of larger ridges half or more the width of the scape-body); yellow-flowered. Perennial herb. Seepage bogs, acid pond margins, wet ditchbanks, and along streams in bottomland woods. Summer-fall. *Xyris difformis* Chapm.

a. Surface of leaves smooth; scape ridges usually 2, infrequently 3, the edges papillate-scabrid to nearly smooth. Western panhandle (e. to Jefferson County); infrequent. var. *difformis*

a. Surface of leaves, particularly the outermost, papillose or tuberculate-scabrid; scape ridges usually >3, the edges papillate-scabrid.

b. Plants usually over 20 cm. tall, the leaves 10-30 cm. long; seeds opaque, farinose. Peninsula (s. to Lake Okeechobee); frequent. var. *floridana* R. Kral

b. Plants usually under 20 cm. tall, the leaves less than 10 cm. long; seeds translucent, non-farinose. North and mid-Florida (Duval, Charlotte, Dade counties); rare. [*Xyris neglecta* Small]
var. *curtissii* (Malme) R. Kral

17. Plant bases green to straw-colored or blackish, without pink coloration; ridges of the scape narrow (much less than half the width of the scape-body).

18. Scape with 2 ridges (shortly below the spike), the edges smooth or very nearly so; plants pale green or straw-colored toward the base; yellow-flowered. Annual or short-lived perennial herb. Wet sand of ditches, clearings, prairies, pond margins, and lakeshores, often in disturbed areas. Throughout; common, sometimes locally abundant. Summer-fall-winter. [*Xyris communis* Kunth; *Xyris elata* Chapm.]
Xyris jupicai L. Rich.

18. Scape with 2 primary and 2-several secondary ridges, the edges clearly scabrous; plants dark brown or blackish toward the base; yellow-flowered. Perennial herb, usually in large clumps with many scapes. Wet sandy peat at edge of cypress ponds or flatwoods depressions. Western panhandle (e. to

Apalachicola drainage), disjunct in eastern peninsula (Volusia, Indian River counties); rare. Summer-fall.

Xyris serotina Chapm.

¹The "amplified key" format employed here is designed to present in compact form the basic morphological framework of a conventional dichotomous key, as well as data on habitat, range, and frequency. This paper is a continuation of a series begun in the 1970's (*Phytologia* 35: 404-413. 1977). Keys are being prepared for all genera of the Florida vascular flora, but the present "amplified" series is restricted to genera where a new combination is required or a special situation merits extended discussion.

TWO HISTORICAL PLANT COLLECTION LOCALITIES IN ARIZONA: NOTES CONCERNING MISTAKEN GEOGRAPHY

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ABSTRACT

Two historic plant collection localities – Camp or Fort Lowell, and Silver Lake – near Tucson, Pima County, southern Arizona, have been confused with more recent, geographically distant locations in Arizona having the same or similar names. This confusion has found its way to the literature and persists with sheets in herbaria, even making its way into specimen databases. These instances are briefly reviewed, and collectors known to be associated with each of these locations are noted. Clarification is offered to enable accurate attribution of specimens from these localities, by these collectors, as duplicates are potentially widely distributed among herbaria.

KEY WORDS: Fort Lowell, Rillito Valley, Silver Lake, Santa Cruz Valley, Tucson, Arizona, David Griffiths.

I. THE MEANINGS OF ‘LOWELL’ ON PLANT SPECIMEN LABELS FROM ARIZONA

On nineteenth century plant specimen labels from Arizona, the locality ‘Lowell’ refers to Camp or Fort Lowell, Pima County. From 1866 to 1873, the military camp was located in what is today downtown Tucson, Pima County, southern Arizona, about one mile east of the Santa Cruz River (Weaver 1947). The Army post was relocated about nine miles northeast to the Rillito Valley in Mar 1873, was renamed a Fort in 1879 (Alexander 1998), and was abandoned in Jan 1891 (Weaver 1947). Only the ruins of the latter site are still associated with the historic name, and are shown on modern maps as a Pima County historical park. A portion of the site of the original camp downtown is preserved by the City of Tucson as Armory Park.

Several instances appear in the taxonomic literature of the twentieth century where specimens labeled 'Lowell', 'Camp Lowell', or 'Fort Lowell' have been cited with Cochise County, Arizona (Table 1). In herbaria and related databases, there remain cases where 'Cochise Co.' was penciled on a sheet and/or entered in a database for specimens labeled with 'Lowell' in any of these forms. The misattribution is not altogether unfounded – at the turn of the twentieth century, a community named Lowell was established near the mines of the Warren District, southeast of Bisbee, in Cochise County, southeastern Arizona (Barnes 1935; Varney 1994). The town appeared on period maps and, in light of the military places near Tucson having been long-abandoned by the time of these taxonomic works, may simply have been the most conspicuous bearer of the name 'Lowell' remaining in the region. The consequences of this confusion for documenting or interpreting species' geography are apparent enough: in addition to being separated by about 80 mi (130 km) and more than 2600 ft (790 m) elevation, the Tucson localities are located squarely in the Sonoran Desert, while the town of Lowell sits at the transition between semi-desert grassland and the greater Chihuahuan Desert (Figure 1). The geographic locations for these place names are summarized in the Appendix.

A combination of specimens, literature, and archives documents the whereabouts of several collectors, including those cited in Table 1, in Pima County near Tucson (and not near Bisbee) at the times of their 'Lowell' collections (Mauz 2006). These collectors (with collection years) include: J.T. Rothrock (1874), J.G. Lemmon (1880), C.G. Pringle (1881-84), W.F. Parish (1884), J.W. Toumey (1891-98), F.X. Holzner (1893), W.W. Price (1894), and M. Zuck (1896). After the turn of the century, botanists who made collections at Fort Lowell included D. Griffiths (1900), J.J. Thornber (1901-16), Mrs. [H.A.] Thornber (1903), and F. Shreve (1908).

Although these collectors were referring to the ultimate location of Camp or Fort Lowell on their labels, a note of caution is warranted against interpreting this location too literally in the Rillito Valley: it does not always mean *at* Fort Lowell. The ~1,850-hectare military

Table 1. Examples of collections from Camp Lowell, Fort Lowell, or 'Lowell' in Pima Co., mistakenly cited for Cochise Co., Arizona, in the literature.

Taxon cited	Collector number, date	Reference
<i>Lupinus brevicaulis</i> S. Watson	J.G. Lemmon, 1880	Smith 1919:399
<i>Rhamnus crocea</i> Nutt.	W.F. Parish 37	Wolf 1938:44
subsp. <i>ilicifolia</i> (Kellogg) C.B. Wolf		
<i>Psilostrophe cooperi</i> (A. Gray) Greene	W.F. Parish 111	Heiser 1944:287
<i>Lycium californicum</i> Nutt.	W.F. Parish 179	Hitchcock 1932:328
<i>Verbena gooddingii</i> Briq.	W.F. Parish 197	Moldenke 1963:145
<i>Eriophyllum lanosum</i> A. Gray	C.G. Pringle, 13 Apr 1881	Constance 1937:117-118
<i>Chilopsis linearis</i> (Cav.) Sweet var. <i>arcuata</i> Fosberg	C.G. Pringle, 13 May & 27 Jul 1881; Thornber 51	Fosberg 1936:366
<i>Verbena plicata</i> Greene	C.G. Pringle, 8 Jun 1882	Moldenke 1964:18

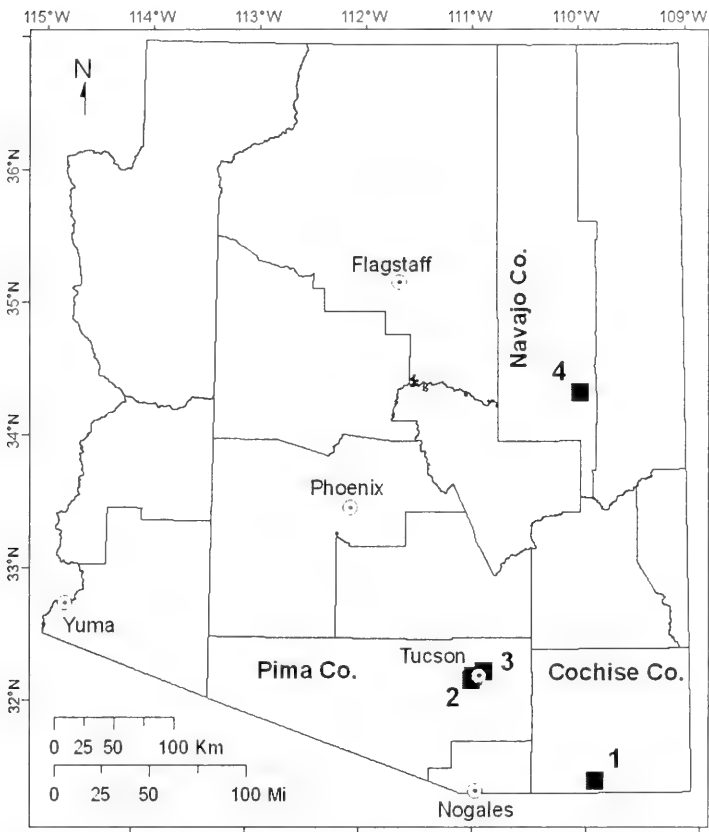


Fig. 1. Map of Arizona showing counties and locations discussed in the text. Cochise Co.: 1—Lowell; Pima Co.: 2—Silver Lake and Camp Lowell (1866-1873), 3—Camp/Fort Lowell (1873-1891); Navajo Co.: 4—Silver Lake (White Mountain Lake). Map projection: Universal Transverse Mercator (UTM, zone 12); datum: NAD83.

Reservation surrounding the Fort grounds was extensive: in addition to encompassing about 20 mi (32 km) of lower tributaries to Rillito Creek, the property spanned desert uplands at the foot of the Santa Catalina Mountains (Figure 2). Fort Lowell was a stepping-off point for

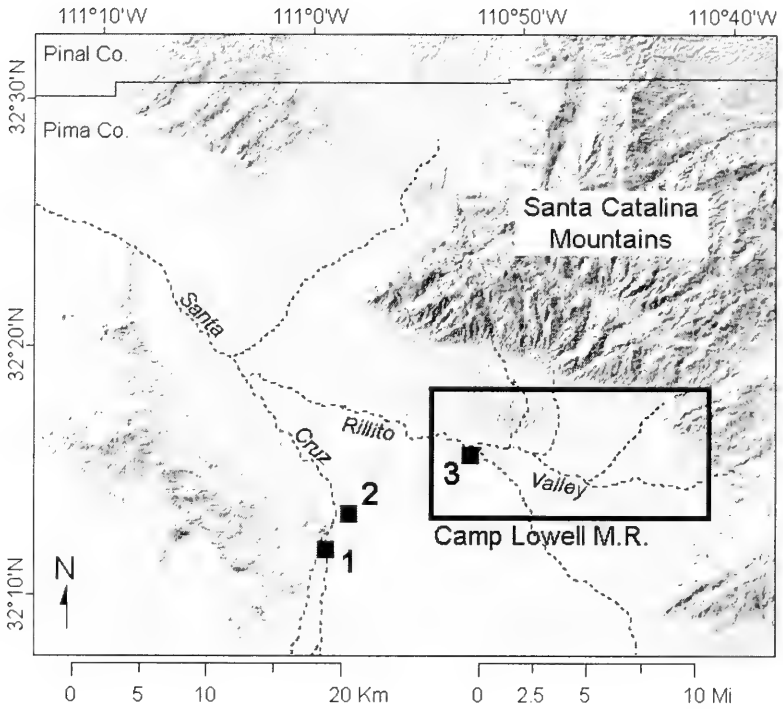


Fig. 2. Shaded relief map of the Tucson Basin, Pima Co., southern Arizona, showing historic locations discussed in the text. Santa Cruz Valley: 1—Silver Lake, 2—Camp Lowell (1866-1873); Rillito Valley: 3—Camp/Fort Lowell (1873-1891), and the extent of the historic military reservation (M.R.) at the foot of the 9157 ft (2791 m) Santa Catalina Mts. Map projection: Universal Transverse Mercator (UTM, zone 12); datum: NAD83.

exploration in the neighboring mountains, and in these cases, the Fort may have served merely as a reference point for those collection sites. On some labels, but not others, additional descriptive terms may appear that place the collection location well above the valley bottom. For example, W.F. Parish's labels of 1884 might include 'High Mts',

'Foothills', or 'High plains' with the locality, 'Lowell'. These presumably refer to the adjacent uplands and the Santa Catalina Mountains north of the Rillito Valley. Several collections by J.T. Rothrock in 1874 were labeled 'Camp Lowell, alt. 4500 ft' – an elevation more than 2000 ft (610 m) above the Fort grounds on the valley floor and beyond even the highest elevations within the military reservation. Thus, while specimens from this vicinity were sometimes labeled as specifically as 'Rillito bottoms, Fort Lowell', implying proximity to the actual Fort location, the name of the Fort, alone, on a label could potentially indicate very different collection environments (Table 2). The difference of a few or several aerial miles (likewise, kilometers) between the valley and the piedmont or mountains poses little consequence at a regional scale, for example in describing the geographic range of a species, but certainly could have implications for documenting the vertical or ecophysiological range of that same taxon.

II. 'SILVER LAKE' – A COLLECTION LOCALITY OF THE 'GILDED AGE'

Silver Lake was a man-made reservoir on the Santa Cruz River just south of Tucson, Pima County, southern Arizona (Figure 2), originally held behind an earthen dam built in 1857 to provide power for a grain mill (Kitt 1962). In addition to becoming a popular recreation area for the town, wetland and riparian vegetation grew there and along the adjacent river. Botanists known to have collected at Silver Lake in the Santa Cruz Valley near Tucson include (with collection years): J.W. Toumey (1891-92), L.H. Dewey (1891), D. Griffiths (1900-01), [W.P.?] Blake (1903), and J.J. Thornber (1904) (Mauz 2006). The dam was damaged or washed out repeatedly in the 1880s and 1890s (e.g., *Arizona Daily Citizen*, 17 Aug 1891: 4). Although the place name was still in use around the turn of the century (e.g., *Arizona Daily Star*, 10 Aug 1898: 4; 24 Jun 1905: 2) and a small water feature was indicated near the historical locality on the USGS 30' Tucson topographic map of 1905, both name and feature were absent even from maps of the valley (e.g., Dobbins 1912; Henley 1932) well before mid-century.

Griffiths cited collections at Silver Lake on five dates in 1900-1901 (Table 3) in his field notebook for those years (Griffiths 1901). The notebook, housed at the University of Arizona (UA) Herbarium (ARIZ),

Table 2. Examples of collections from Camp or Fort Lowell, Pima Co., Arizona, with descriptors indicating a range of locations and environments associated with this placename.

Taxon	Location	Collector (Accession)
<i>Oenothera arizonica</i> (Munz) W.L. Wagner	Lowell	W.F. Parish 64 & 65 (GH!)
<i>Psilostrophe cooperi</i> (A. Gray) Greene	High plains, Lowell	W.F. Parish 111 (UC!,US!) ^a
<i>Harpagonella palmeri</i> A. Gray var. <i>arizonica</i> I.M. Johnst.	Plains, Lowell	W.F. Parish 162 (holotype:GH!)
<i>Verbena gooddingii</i> Briq.	High mts, Lowell	W.F. Parish 197 (GH!)
<i>Gutierrezia serotina</i> Greene	Mesas near Camp Lowell	Pringle 13 Apr 1881 (PH!,VT!)
<i>Machaeranthera asteroides</i> (Torr.) Greene var. <i>asteroides</i>	Valley near Camp Lowell	Pringle 12 May 1883 (PH!)
<i>Solidago velutina</i> DC. subsp. <i>sparsiflora</i> (A. Gray) Semple	Camp Lowell, 4500 ft	Rothrock 706 (holotype:GH!) ^b

^a A duplicate number at MO (!) does not include 'high plains' on the label.

^b Isotypes, viewed as images, at NY (sciweb.nybg.org/science2/VirtualHerbarium.asp) and US (ravenel.si.edu/botany/types) do not indicate the elevation on the label.

had been in the care of ARIZ curator-emeritus Charles T. Mason since at least 1956, when an inquiry was made about it by Lyman D. Benson, then at Pomona College, who thought that it might be useful in the curation of Griffiths' cactus specimens (letter with notebook); it has only recently resurfaced. Several of Griffiths' correspondingly numbered specimens, made when he was a member of the UA faculty and Agricultural Experiment Station (Taylor 1935), are housed at ARIZ. On the majority of them, the label contains only the plant name and Griffiths' name and collection number, but not a locality or date.

Under the heading "Trip to Silver Lake," Griffiths recorded a series of numbers (2691-2707) in his notebook. The entry was not dated, but occurred between entries for 22 Apr and 30 Apr 1901. Two specimens with corresponding numbers [2694 – *Polypogon monspeliensis* (L.) Desf.; 2704 – *Phalaris caroliniana* Walter] found at the Smithsonian Institution (US) are labeled 'Silver Lake' and dated 29 Apr 1901, so that date has been adopted for this series. At least three sheets of this series at ARIZ, numbered but without location or date, were stamped 'Navajo County' at some point during the latter part of the twentieth century. A plausible scenario underlying this attribution would be that a past collections manager knew of Griffiths' notebook, correlated the collection number on the specimen with the notebook entry, and looked up 'Silver Lake' – finding the feature of that name in Navajo County, northern Arizona (Figure 1).

Although the particular reference consulted is not known, other reference materials constrain the age of the named feature in Navajo County. The U.S. Geological Survey Geographic Names Information System (GNIS) indicates that 'Silver Lake' is one of four 'historic variants' (i.e. synonyms) – also including Baggs Reservoir, Daggs Reservoir, and Silver Creek Reservoir – for what is now White Mountain Lake on Silver Creek (a tributary of the Little Colorado River), Navajo County (see Appendix). The impoundment dates to between 1940, when it *did not* appear on the map of the adjacent Sitgreaves National Forest, and 1951, when it *was* shown, and labeled 'Daggs Reservoir' on Sheet 7 of the Arizona State Highway Department Navajo County General Highway Map. In 1964, the community of White Mountain Lake was developed and promoters advertised a 250-acre lake on Silver Creek (*Arizona Daily Star*, 30 Apr

Table 3. Griffiths' (1901) field notebook entries for collection dates bracketing and including work at 'Silver Lake' (*italicized*) in Arizona. Collection numbers are included for Silver Lake citations only.

Year	Mo	Day	Locality	Coll. Nos.
1900	Nov	14	Tucson	
		15	<i>Silver Lake</i>	2110
		17	Castle Rock ^a	
		18	Tucson	

1901	Feb	5	Tucson	
		6	<i>"at Silver Lake, Tucson"</i>	2256
		9	range plots	
		10	Santa Cruz [River] bottoms	
		12	range plots	
		...		
		19	<i>Silver Lake; UA</i> ^b <i>Campus</i>	2279
20	Rillito; UA Campus			

	Apr	22	Tucson	
		...		
		29 ^c	<i>"Trip to Silver Lake"</i>	2691-2707
		30	Santa Cruz [River] bottoms	
	May	1	UA Campus	
		3	range plots	
		5	range plots	
		...		
		9	<i>"Silver Lake, Arizona"</i>	2719-2723
		10	UA Campus	

^a The entry for 26 Nov places this locality in the Santa Catalina Mountains northeast of Tucson. ^b University of Arizona. ^c This date derives from two corresponding numbered specimens at US (see text), but does not accompany the locality heading in the notebook. An ellipsis (...) indicates a gap in time of more than three days between contiguous entries in the notebook. Dashes (- - -) represent spans of time omitted in this excerpt.

1964: C15) that was essentially an expansion of the preexisting reservoir. While Daggs Reservoir was the name used on the Sitgreaves National Forest maps of 1960 and 1964, the Forest maps dating from at least 1972 labeled the water feature itself as 'White Mountain Lake'.

By the time Griffiths' Silver Lake specimens were stamped 'Navajo Co.' in the herbarium, the historic reservoir of the same name near Tucson had long since disappeared. There is no cause to doubt, and good reason to believe, that Griffiths' collection locality was near Tucson. In one notebook entry (6 Feb 1901), Griffiths gave the locality, "at Silver Lake, Tucson," and on 19 Feb 1901, he cited collections from both Silver Lake and the University of Arizona campus, just a few miles away. For each of the five collection dates referencing Silver Lake (Table 3), the collection localities cited in Griffiths' notebook on the days prior and subsequent to collections there indicate proximity to Tucson, and not a location in northern Arizona. As in the case described above for the confusion of Lowell, Arizona, with Camp or Fort Lowell near Tucson, the two 'Silver Lake' locations – one in the Sonoran Desert, one at the southern edge of the Colorado Plateau – are biogeographically very different, separated by more than two degrees of latitude and about 3600 ft (1100 m) elevation. Griffiths' specimens are the only ones so far encountered that have been misattributed to the northern location. Although the collection numbers are few, his duplicates may be widespread; these 'Silver Lake' collections, as well as those of the other collectors listed above, should be affiliated with Pima County, Arizona, in herbaria, related databases, and citations of *exsiccatae*.

ACKNOWLEDGEMENTS

I thank the University of Arizona Herbarium (ARIZ) for permitting use of Griffiths' field notebook, and the Arizona Historical Society and University of Arizona Libraries for *retaining*, and permitting access to, historic maps. The curators of ARIZ, GH, MO, PH, UC, US, and VT permitted collections research that included the specimens cited here. Figures for this note were prepared, with permission, at the Arizona Remote Sensing Center, University of Arizona. The comments by two reviewers of this manuscript are appreciated.

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Appendix. Locations of Arizona place names discussed in the text.

Place Name	Latitude ^a	Longitude ^a	Elevation	PLSS		County	Reference
				Divisions ^b	Sec.		
Camp Lowell (1866-1873)	32.22 N	110.97 W	2380 ft (725 m)	T14S, R13E	Sec.13	Pima	USGS Tucson 7.5' quadrangle
Camp/Fort Lowell (1873-1891)	32.26 N	110.87 W	2440 ft (743 m)	T13S, R14E	Secs.35-36	Pima	GNIS 42713 ^c
Lowell	31.43 N	109.89 W	5075 ft (1547 m)	T23S, R24E	Sec.15	Cochise	GNIS 7442 ^c
Silver Lake	32.20 N	110.99 W	2375 ft (724 m)	T13S, R13E	Sec.23	Pima	USGS Tucson 7.5' quadrangle
Silver Lake (White Mtn Lake)	34.37 N	109.99 W	5961 ft (1817 m)	T11N, R22E	Secs.10,15	Navajo	GNIS 36091 ^c

^a Lat & Long coordinates rounded to two decimal places; North American Datum (NAD) 1983.

^b Public Land Survey System; Gila & Salt River Base Line & Meridian.

^c United States Geological Survey (USGS) Geographic Names Information System (GNIS; geonames.usgs.gov/pls/gnispublic).

**ELEVATION OF TWO VARIETAL TAXA OF *PERYMENIUM*
(ASTERACEAE, HELIANTHEAE) TO SPECIFIC RANK**

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ABSTRACT

Perymenium hintoniorum var. *gypsophilum* B.L. Turner and *P. buphthalmoides* var. *sonoranum* B. L. Turner are elevated to specific rank, necessitating the following new combinations: **P. gypsophilum** (B.L. Turner) B.L. Turner, **stat. nov.**, and **P. sonoranum** (B.L. Turner) B.L. Turner, **stat. nov.** Both taxa are native to Mexico, the latter to the states of Chihuahua and Sonora, the former to Nuevo Leon.

KEY WORDS: *Perymenium*, Asteraceae, Mexico, Sonora, Nuevo Leon

Additional collections of the genus *Perymenium* over the past ten years or so have suggested that the following varietal taxa are worthy of specific rank:

Perymenium gypsophilum (B.L. Turner) B.L. Turner, **stat. nov.**
Based upon *Perymenium hintoniorum* var. *gypsophilum* B.L. Turner, Phytologia 79: 343. 1995.

The distinctions between var. *gypsophilum* and the typical var. *hintoniorum* called to the fore by Turner (1995) continue to hold and, combined with its edaphic endemism, I have little hesitation in elevating this to specific status.

Perymenium sonoranum (B.L. Turner) B.L. Turner, **stat. nov.**
Based upon *Perymenium buphthalmoides* var. *sonoranum* B.L. Turner, Phytologia 64: 266. 1988.

At the time of its description (Turner 1988), only two sheets of this taxon were known, the type (from Sonora) and a Pennington collection from Chihuahua. Subsequently, one additional collection from Chihuahua has come to the fore (*Knoblock 5219*, MSC) and an additional 12 collections from Sonora (*Burquez 96-826, 96-923; Neff 8-17-19-11, 8-18-91-5; Reina 97-626, 97-1367, 2001-808; Traba s.n.* (19 Aug 1997); and *VanDevender 95-866A, 96-198, 97-704, 98-884*. Except for the Knoblock collection, all of the above vouchers are on file at LL, TEX.

Turner (1988) compared var. *sonoranum* with the typical var. *buphthalmoides*. However, he noted that the variety was "A very distinct taxon, perhaps deserving of specific rank." This has proved to be the case, the syndrome of characters concerned being quite uniform among the specimens cited, and all are restricted to the same general region of the Sonoran Desert, well removed from the range of var. *buphthalmoides*. I have no hesitation in hoisting the taxon to specific level.

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**TWO NEW SPECIES OF *AGERATINA* (ASTERACEAE:
EUPATORIEAE) FROM MEXICO**

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ABSTRACT

Two new species of *Ageratina* (subgenus *Neogreenella*) are described from Mexico: *A. humochica* B.L. Turner and *A. serboana* B.L. Turner, both from the state of Oaxaca. Their relationships to previously described taxa are discussed and photographs of their holotypes are provided.

KEY WORDS: *Ageratina*, Asteraceae, Mexico, Oaxaca

Routine identification of Mexican Asteraceae has revealed the following novelties:

AGERATINA HUMOCHICA B.L. Turner, **sp. nov.** Fig. 1

Ageratina pendula Panero & Villasenor similis sed differt habitu robuste subfruticoso (vs herba perennis), foliis plerumque alternis (vs. oppositis), et capitulis multo majoribus.

Robust herbs or subshrubs to 1 m (?) high. **Stems** densely glandular-pubescent. **Leaves** markedly alternate; petioles 1.5-2.5 cm long; blades cordate, rugose, glandular-pubescent above and below, their margins crenulate throughout. **Capitulescence** a terminal somewhat pendulous panicle 6-10 cm high and about as wide; ultimate peduncles 1-2 cm long. **Heads** 12-15 mm high; involucre composed of ca 30 linear-lanceolate, somewhat gradate, bracts 6-12 mm long. **Receptacles** plane, glabrous, 3-4 mm across. **Florets** numerous; corollas glabrous, ca. 8 mm long, the tubes 2-3 mm long. **Achenes** 3-4 mm long, sparsely pubescent with ascending short hairs; pappus of ca 30 readily deciduous tawny-white bristles ca 6 mm long.

TYPE: **MEXICO. OAXACA:** Distrito Ixtlan, 43 km N of Ixtlan de Juarez, "Steep slope along crest with *Quercus* and *Symplocus* northwest slope of Cerro Humo Chico" 2870 m, 6 Nov 1983, *Breedlove & Almeda 60017* (holotype: TEX).

In my treatment of *Ageratina* for the Comps of Mexico (Turner 1997) *A. humochica*, because of its alternate upper stem leaves, will key to or near *A. thyrsiflora*, which it resembles not at all. It appears closest to the recently described *A. pendula* as noted in the above diagnosis, which is also an Oaxacan species (from Distrito Juxtlahuaca). The latter taxon was not accounted for in my Mexican account.

The novelty is named for Cerro Chico Humo, where first collected.

AGERATINA SERBOANA B.L. Turner, *sp. nov.* Fig. 2

Ageratina josepaneroi B.L. Turner similis sed differt capitulescentiis omnino glandulosi-pubescentibus (vs. puberulis) et pedunculis ultimis 3-6 cm longis (vs 0.5-1.0 cm).

Perennial herbs 60-70 cm high, the shoots presumably arising from slender ligneous rhizomes. **Stems** purplish, the lower portions with a vestiture of crinkly spreading hairs to 1 mm long, these underlain by a dense array of much shorter glandular hairs, the latter becoming the sole pubescence along the upper branches. **Leaves** opposite throughout, the internodes mostly 5-10 cm long; petioles 2-3 cm long; blades deltoid to semicordate, marginally crenate, pubescent above and below, more so beneath, the lower surface moderately glandular-punctate. **Captulescence** a very loose terminal panicle ca 28 cm long, 12 cm across, the ultimate peduncles 3-6 cm long, densely glandular-pubescent. Involucre of ca 10 linear-lanceolate subequal bracts 6-8 mm long. **Receptacle** plane, ca 2 mm across, glabrous. **Florets** 25-30; corollas white, ca 6 mm long, the tube ca 2 mm long, the lobes ca 1 mm long. **Achenes** ca 5 mm long, pubescent with ascending short hairs; pappus of ca 30 slender bristles 5-6 mm long arranged in a single series.

TYPE: **MEXICO. OAXACA:** Mpio. Santago Textitlan, Cerro el Briche, pine oak forests, 1884 m, 21 Jul 2006, *Rosario Trujillo Vasquez 138* (holotype TEX).

Ageratina serboana belongs to the subgenus *Neogreenella* and will key to or near *A. cardiophylla* in my treatment of *Ageratina* for the Comps of Mexico (Turner 1997). Unfortunately, *A. josepaneroi*, with which the present species is compared in the above diagnosis, was described (Turner 1996) after my Comp treatment went to press.

The species name, "serboana," reflects the acronym of Sociedad para el Estudio de los Recursos Bioticos de Oaxaca, which funded collection of the type concerned.

ACKNOWLEDGEMENTS

I am grateful to my longtime colleague, Guy Nesom, for providing the Latin diagnoses and for his review of the manuscript. Emily Lott suggested the species name and also reviewed the paper.

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Fig. 1. *Ageratina humochica* (Holotype).



Fig. 2. *Ageratina serboana* (Holotype).

**CALOREZIA, A NEW GENUS OF TRIBE NASSAUVIEAE
(ASTERACEAE, MUTISIOIDEAE)**

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ABSTRACT

Results from molecular phylogenetic studies of tribe Nassauvieae based on chloroplast DNA coding regions show that the genus *Perezia* is not monophyletic. Based on these studies, *Perezia nutans* is herein recognized as the type of the new genus *Calorezia*. *Calorezia* is described and its phylogenetic relationships discussed. *Perezia prenanthoides*, a taxon morphologically similar to *P. nutans*, is also transferred to *Calorezia*.

KEY WORDS: Asteraceae, Mutisioideae, Nassauvieae, *Calorezia*, *Calopappus*, *Perezia*

Tribe Nassauvieae contains approximately 24 genera and 370 species of annual or perennial herbs and shrubs. With the exception of the genus *Acourtia* and some species of *Trixis*, the species of Nassauvieae are endemic to South America. *Trixis* and *Acourtia* are the largest genera of the tribe. The tribe, for the most part, can be separated from other composites by its capitula with bilabiate corollas and styles with truncate to rounded penicillate style branches, as well as by pollen morphology (Crisci, 1974).

Molecular phylogenetic studies of tribe Mutisieae s. l. by Kim et al. (2002) based on chloroplast *ndhF* showed that *Perezia* is sister to *Nassauvia* and *Triptilion*. Further studies, aimed at elucidating the relationships of tribe Nassauvieae (Panero et al., in prep.) and sampling multiple coding loci and additional taxa, reveal that *Perezia* is not monophyletic as *Perezia nutans* is sister to *Calopappus*, *Nassauvia* and *Triptilion* and not to other species of *Perezia* including its type *P. magellanica* (L.f.) Less. To maintain a taxonomy that only recognizes

monophyletic groups, I propose the removal of *P. nutans* from *Perezia* as the type of the new genus *Calorezia*. *Perezia prenanthoides*, a taxon morphologically similar to *P. nutans* (Vuilleumier, 1970) is herein transferred to *Calorezia* as well.

Calorezia Panero gen. nov. TYPE: *Calorezia nutans* (Less.) Panero

Genus tribi Nassauvieae Pereziae similis sed differt cypselis trichomatibus binatis gradatim protractis, foliis amplis runcinatis, et capitulis aliquando nutantibus.

Perennial herbs. Leaves mostly basal on short internodes forming a rosette, blades oval in outline, deeply runcinate. Capitula epaleate, turbinate. Corollas bilabiate (3+2), pink-purple, essentially glabrous. Anthers blue, shallowly calcarate, tailed, appendages strongly sclerified approximately $\frac{1}{2}$ the size of the thecae. Styles white, nectary disc-shaped, style glabrous, style branches rounded to truncate with continuous stigmatic surfaces, minutely pappillose on abaxial surface. Cypselae tubular to turbinate, shallowly ridged, sparsely to moderately pubescent, twin trichomes short, narrowly deltoid, tapered, both cells of equivalent length, glandular trichomes composed of two rows of cells of equivalent width and length, apical pair of cells conspicuously enlarged. Pappus of multiple, persistent, flattened bristles in 2 rows.

The name *Calorezia* is derived from a combination of the names *Calopappus* and *Perezia*. The name also alludes to the beauty of these plants.

Calorezia nutans (Less.) Panero, comb. nov. *Perezia nutans* Less. Synop. Comp. 409. 1832.

Calorezia prenanthoides (Less.) Panero comb. nov. *Perezia prenanthoides* Less. Synop. Comp. 409. 1832

Key to the genera of the *Perezia* clade.

For a key to all genera of tribe Nassauvieae see Vuilleumier (1970) or Crisci (1974). A recent key for all genera of Mutisieae s.l. can be found in Hind (2007).

1. Capitula with 5 or fewer florets.....(2)
 1. Capitula with more than 5 florets.....(4)
2. Cypselae with a pappus of 3, rarely 4 scales.....*Triptilion*
 2. Cypselae with a pappus of more than 4 bristles or scales....(3)
3. Corollas white, sometimes suffused with pink.....*Nassauvia*
 3. Corollas yellow turning purple with age.....*Calopappus*
4. Apices of twin trichomes of cypselae, fused, tapered; glandular trichomes with two distinctive rows of cells of equivalent width and length and forming a straight line between adjacent cells as seen through light microscopy; capitula sometimes nodding; florets pink-mauve or purple; phyllaries narrowly lanceolate and usually without hyaline edges.....*Calorezia*
4. Apices of twin trichomes (when present) of cypselae shallowly to broadly divergent; glandular trichomes composed of one or two rows of cells, if of two rows of cells, the cells staggered and forming a sinuous line among the adjacent cells as seen through light microscopy, the terminal cell composed of one swollen cell; capitula never nodding; florets blue, white or yellow, rarely pink or purple, phyllaries mostly ovate, rarely narrowly lanceolate, with hyaline edges.....*Perezia*

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RECENSION OF *KYRSTENIOPSIS* (ASTERACEAE:
EUPATORIEAE) AND DESCRIPTION OF A NEW SPECIES
FROM OAXACA, MEXICO

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ABSTRACT

A recension of the Mexican species of *Kyrsteniopsis* is rendered. Nine species are recognized, including the newly described *K. chiapasana* B.L. Turner, **sp. nov.** A key to the species is provided, along with maps showing their distributions.

KEY WORDS: Asteraceae, Eupatorieae, *Kyrsteniopsis*, *Pseudokyrsteniopsis*, Mexico. Oaxaca

King and Robinson (1971) established the genus *Kyrsteniopsis* as monotypic, typified by *Eupatorium nelsonii* B.L. Rob. The genus was largely erected on a syndrome of characters: partly deciduous involucre bracts; large ungrooved anther appendages; style branches not enlarged apically; and thickened ribs of the achenes, among other characters. King and Robinson (1972, 1987) subsequently expanded the genus to four species with the addition of three additional taxa: *K. congesta* King & H. Rob., *K. cymulifera* (B.L. Rob.) King & H. Rob., and *K. dibollii* King & H. Rob.

The present author (Turner 1998) further expanded the genus to include five additional taxa: *K. eriocarpa* (B.L. Rob.) B.L. Turner, *K. heathiae* (B.L. Turner) B.L. Turner, *K. iltisii* (King & H. Rob.) B.L. Turner, *K. perpetiolata* (King & H. Rob.) B.L. Turner, and *K. spinaciifolia* (DC.) B.L. Turner. Description of the present species, *K. chiapasana*, brings to nine the number currently recognized for the genus.

Turner (1997) provided a key to the complex (including *Pseudokyrsteniopsis*) in his treatment of the group for his Comps of Mexico, and this has been modified below to accommodate the species described herein.

Artificial key to species of the genus *Kyrsteniopsis*

[Modified from Turner, 1997, Comps of Mexico, Phytologia Memoirs 11: 111-112.]

- 1. Petioles glabrate to variously pubescent, but not glandular-pubescent(3)
- 1. Petioles densely and uniformly glandular-pubescent.....(2)
- 2. Base of petiole enlarged, markedly perpetiolate; Guatemala**K. perpetiolata**
- 2. Base of petiole scarcely enlarged, if at all; Chiapas, Mexico**K. chiapasana**
- 3. Heads with 9-20 florets(6)
- 3. Heads with 4-6 florets(4)
- 4. Petioles 4-8 mm long; Oaxaca**K. eriocarpa**
- 4. Petioles 10-40 mm long; Chiapas(5)
- 5. Involucres 10-12 mm high; achenes densely pubescent throughout**K. iltisii**
- 5. Involucres 5-6 mm high; achenes sparsely pubescent, mainly along ribs.....**K. heathiae**
- 6. Leaves trullate-hastate, glabrous, except for the major veins beneath.....**K. spinaciifolia**
- 6. Leaves otherwise, clearly pubescent or glandular-punctate beneath(7)
- 7. Achenes without atomiferous glands; pappus of 25-30 bristles.....**K. nelsonii**
- 7. Achenes with atomiferous glands; pappus of 35-50 bristles.....(8)

8. Heads few, borne on ultimate peduncles 6-20 mm long
**K. cymulifera**
8. Heads numerous, borne on ultimate peduncles 3-6 mm long
**K. dibollii**

KYRSTENIOPSIS CHIAPASANA B.L. Turner, *sp. nov.* Fig. 1

Kyrsteniopsis perpetiolatae (King & H. Rob.) B.L. Turner similis sed differt petiolis longioribus (5-7 cm vs. 2-3 cm) non perpetiolatis ad basim, flosculis per capitulum numerosioribus (25-30 vs. 12-20), et pedunculis ultimis longioribus (capitulis in pedunculis 3-10 mm longis vs. sessilis vel paene sessilis).

Resembling *Kyrsteniopsis perpetiolata* (King & H. Rob.) B.L. Turner but the petioles longer (5-7 cm long vs 2-3 cm), not noticeably perpetiolate at the base, florets more numerous per head (25-30 vs 12-20), and ultimate peduncles longer (heads on peduncles 3-10 mm long vs sessile or nearly so).

Sprawling "over shrub," 1-2(?) m high. **Stems** terete, densely glandular-pubescent, the vestiture 0.2-0.3 mm high. **Leaves** opposite, 7-14 cm long, 5-12 cm wide; petioles 3-5 cm long, weakly perpetiolate at the base, if at all; blades cordate to hastate-deltoid, 3-nervate from the very base, the margins irregularly dentate. **Capitulescence** with 7-11 heads at apex of leafy stems or lateral branches. **Heads** ca 8 mm high, the bracts linear-lanceolate, arranged in 3-4 imbricate series, pubescent externally with multiseptate hairs. **Receptacles** plane, ca 1 mm across, epaleate. **Florets** reportedly "white," "greenish," or greenish-yellow," ca 20 per head; corollas slender, ca 4 mm long, the 5 lobes ca 0.15 mm long. **Anther appendages** ovate, ca 0.5 mm long, 0.25 mm wide. **Stylar shaft** not enlarged at base, the style branches becoming somewhat enlarged apically. **Achenes** carbonized, 5-ribbed, sparsely pubescent; pappus of 20-30 slender bristles ca 4 mm long, arranged in a single series.

TYPE: **MEXICO. CHIAPAS:** Mpio. Tuxtla Gutierrez, "S of Tuxtla Gutierrez on Hwy 195 (to Villaflora), on limestone escarpment; alt. 830 m. Scattered on steep brushy slope" 1 Nov 1980, *Paul A. Fryxell & Emily Lott 3253* (holotype: TEX).

ADDITIONAL SPECIMENS EXAMINED: **MEXICO. CHIAPAS:** Mpio. Trinitaria, "along small dirt road to Boqueron & Ejido Mujica west of Mexican Highway 190 at point 18 km southwest of La Trinitaria." Tropical Deciduous Forest, 900 m, 5 Dec 1976, *Breedlove 42148* (LL); Mpio. Socoltenango, Seasonal Evergreen Forest along stream and large waterfall, 30 km ESE of Pugiltic on road to Comitán, 760 m, 8 Jan 1982 *Breedlove & Almeda 56869* (TEX).

The present novelty is clearly closely related to *K. perpetiolata* and was treated as belonging to that taxon in my treatment of the *Kyrsteniopsis* complex for the Comps of Mexico (Turner 1997). It differs from that species in several characters, as noted in the above diagnosis, most notably in lacking clearly perpetiolate leaves. According to Williams (1976), *K. perpetiolata* is known only from dry mountain slopes in Guatemala near Rio Blanco, El Quiche.

The species is named for the state of Chiapas, Mexico, where seemingly confined.

KYRSTENIOPSIS CYMULIFERA (B.L. Rob.) King & H. Rob.,
Phytologia 24: 58. 1972.

Brickellia cymulifera B.L. Rob.

Eupatorium cymuliferum (B.L. Rob.) B.L. Turner

This is a relatively distinct taxon, known to me only by collections from the Mexican states of San Luis Potosi, Guanajuato, and Queretaro (Fig 2).

KYRSTENIOPSIS DIBOLLII King & H. Rob., *Phytologia* 24: 58.
1972.

Eupatorium dibollii (King & H. Rob.) B.L. Turner

This species is known to me only by collections from southeastern Puebla and closely adjacent states (Fig. 2).

KYRSTENIOPSIS ERIOCARPA (B.L. Rob. & Greenm.) B.L.
Turner, *Phytologia* 82: 387. 1998.

Critonia eriocarpa (B.L. Rob. & Greenm.) King & H. Rob.

Eupatorium eriocarpum B.L. Rob. & Greenm.

This relatively rare taxon is known by only a few collections from Oaxaca (Fig. 2). My treatment of the species within the *Kyrsteniopsis* complex follows the suggestion of Alan Whittemore (pers. comm).

KYRSTENIOPSIS HEATHIAE (B.L. Turner) B.L. Turner,
Phytologia 82: 387. 1998.

Adenocritonia heathiae (B.L. Turner) H. Rob.

Eupatorium heathiae B.L. Turner

This Chiapasan taxon (Fig. 3) is not accounted for in the exceptional treatment of the tribe Eupatorieae by King and Robinson (1987), not having been described at the time. Robinson (1991) subsequently treated *K. heathiae* as belonging to the subtribe Critonieae as a member of the small genus *Adenocritonia*, retaining *Kyrsteniopsis* in the subtribe Alomiinae. Regardless, as I conceive *Kyrsteniopsis* it is a heterogeneous assemblage of species having characters of both of the aforementioned subtribes and is perhaps a catch-all category for those taxa having a *Koanophyllon*-type habit, *Brickellia*-like corollas, and *Critonia*-like heads and achenes.

KYRSTENIOPSIS ILTISII (King & H. Rob.) B.L. Turner,
Phytologia 82: 387. 1997.

Critonia iltisii King & H. Rob.

My treatment of this taxon within the *Kyrsteniopsis* complex follows the suggestions of Whittemore (pers comm. and annotations), this not mentioned in my formal transfer. So far as known, the species is confined to Guatemala and Chiapas, Mexico (Fig. 3).

KYRSTENIOPSIS NELSONII (B.L. Rob.) King & H. Rob.,
Phytologia 22: 146. 1971

Kyrsteniopsis congesta King & H. Rob.

Eupatorium nelsonii B.L. Rob.

This, the generitype, is the most widespread, commonly encountered, species of *Kyrsteniopsis* in Mexico (Fig.2). It superficially resembles a species of *Brickellia*, but the styler characters and achenes rule out that genus, as well noted by King and Robinson (1987).

KYRSTENIOPSIS SPINACIIFOLIA (DC.) B.L. Turner, *Phytologia* 82: 387. 1997.

Bulbostylis spinaciifolia DC.

Critonia spinaciifolia (DC.) King & H. Rob.

Eupatorium spinaciifolium (DC.) A. Gray

Inclusion of this taxon in the *Kyrsteniopsis* complex follows the suggestions by Whittemore (pers. comm. and annotations), this not acknowledged in my formal transferal. The species is relatively common in northeastern Mexico (Fig. 3).

KYRSTENIOPSIS PERPETIOLATA (King & H. Rob.) B.L. Turner, *Phytologia* 82: 387. 1997.

Eupatorium perpetiolatum (King & H. Rob.) L. Williams

Pseudokyrsteniopsis perpetiolata King & H. Rob.

This Guatemalan species (Fig. 2) is closely related to *K. chiapasana*, as noted in the above account.

ACKNOWLEDGEMENTS

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The University of Texas at Austin, 2005
Kyrsteniopsis chiapasana R.L. Turner 2007

U.S. Department of Agriculture
Agricultural Research Service - Crops Research Division
Herbarium

U.S. Department of Agriculture

Agricultural Research Service - Crops Research Division

Cotton Branch Herbarium

Eupatorium propatiale (K.S.P.) C.D. Coker

[*Pseudokyrsteniopsis*]

MEXICO: CHIAPAS: Tapia, Jacinto Gutierrez: 3 of Jacinto Gutierrez on Hwy 193 (to Villaflores), 1.5 miles S of Jct. with bypass. Dense forest on limestone escarpment; alt. 850 m. Herb to 1.5 m tall with greenish flowers. Scattered on steep brushy slope.



00117150

Collector: Paul A. Fryxell & Emily J. Lott

Date: 1 November 1980

No. 3253

Fig. 1. *Kyrsteniopsis chiapasana* (Holotype).

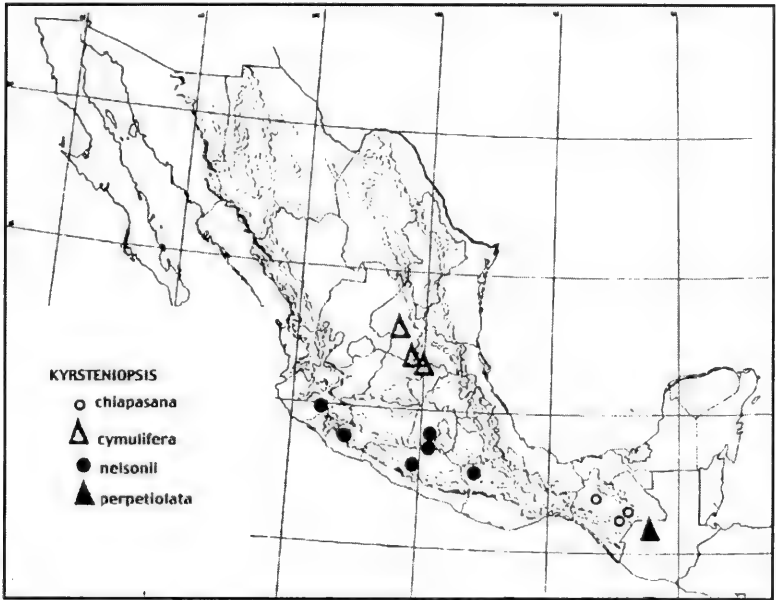


Fig. 2 Distributions of *Kyrsteniopsis chiapasana*, *K. cymulifera*, *K. nelsonii*, and *K. perpetiolata*.

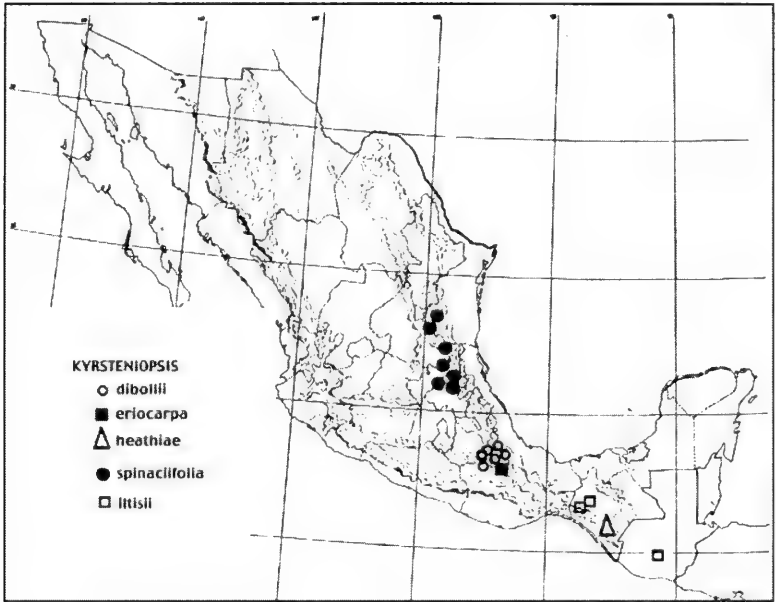


Fig 3. Distributions of *Kyrsteniopsis dibollii*, *K. eriocarpa*, *K. heathiae*, *K. spinaciifolia*, and *K. iltisii*.

**TWO ADDITIONS TO THE FLORA OF OKLAHOMA AND
NOTES ON *XYRIS JUPICAI* (XYRIDACEAE) IN OKLAHOMA**

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ABSTRACT

Eleocharis flavescens and *Rhynchospora scirpoides* are reported as new to Oklahoma. *Xyris jupicai*, which has been mentioned as occurring in Oklahoma, is documented in the state by citation of voucher specimens. The overall distribution of these species in the West Gulf Coastal Plain is discussed.

KEY WORDS: Cyperaceae, Xyridaceae, *Eleocharis*, *Rhynchospora*, *Xyris*, Oklahoma.

Eleocharis flavescens and *Rhynchospora scirpoides* are not cited as occurring in Oklahoma by Taylor and Taylor (1994) and the Oklahoma Vascular Plants Database (Hoagland et al. 2006), nor is either included as part of the Oklahoma flora by the applicable parts of the Flora of North America (Kral 2000a, Smith et al. 2000). Therefore, the records cited below constitute the first report of these species in the

state. *Xyris jupicai* is cited by Kral (2000b) as occurring in Oklahoma, but apparently the species has never been documented in the state by citation of a voucher specimen. It is not included as part of the Oklahoma flora by Taylor and Taylor (1994) or the Oklahoma Vascular Plants Database (Hoagland et al. 2006). The present paper documents the occurrence of this species at five locations in two counties.

Eleocharis flavescens (Poir.) Urban (Cyperaceae).

Voucher specimens: OKLAHOMA. **Choctaw Co.:** Hugo Bog, 4 mi. E of U.S. Hwy 70, 4 mi. N on U.S. Hwy 271 & 2 miles N of Soper, 8 Oct 1988, *Orzell & Bridges 8654* (BRIT, TEX); same location, 15 Aug 2006, *Singhurst & Bridges 14362* (BAYLU).

Eleocharis flavescens was collected at the Hugo Bog (also known as Soper Bog and Railroad Bog) southwest of Antlers in southeast Oklahoma in 1988 by Edwin Bridges and Steve Orzell, but was not reported as new to Oklahoma at that time. In August 2006, Bridges and Singhurst revisited the site and confirmed that this species was still present. This site is about 140 km north of the nearest known occurrence of *E. flavescens* in Franklin County, Texas (Turner et al. 2003).

This site consists of a hillside seepage bog with a blend of West Gulf Coastal Plain flora and Ozark fen flora, possibly the only known example with this floristic mixture in the West Gulf Coastal Plain. During the 2006 inventory of the bog, 120 vascular plant taxa were recorded (Bridges and Singhurst 2006) while 144 taxa have been recorded in a list combined from all visits. The site was dominated by *Andropogon glomeratus* var. *glomeratus*, *A. virginicus* var. *virginicus*, *Carex atlantica* subsp. *atlantica*, *Carex stricta*, *Eleocharis tortilis*, *Schoenoplectus americanus*, *Scleria verticillata*, *Sphagnum* spp., *Rhynchospora capitellata*, *R. gracilentata*, *R. glomerata*, and *Rudbeckia fulgida*. Other herbaceous plants of interest include *Asclepias incarnata*, *Cinna arundinacea*, *Cirsium muticum*, *Coreopsis tripteris*, *Eryngium integrifolium*, *Fuirena squarrosa*, *Impatiens capensis*, *Lysimachia quadriflora*, *Melanthium virginicum*, *Mikania scandens*, *Oxypolis rigidior*, *Parnassia grandifolia*, *Rudbeckia subtomentosa*,

Scleria muehlenbergii, *Selaginella apoda*, *Spartina pectinata*, *Thalictrum dasycarpum*, *Veronicastrum virginicum*, and *Xyris torta*.

Within this seepage bog, *Eleocharis flavescens* is restricted to areas of deep, quaking, saturated muck with little vegetative cover. This is also a preferred microhabitat of this species in deep muck seepage bogs in the Post Oak Savanna region of Texas. *Eleocharis flavescens* infrequently occurs in marshy streamsides, pondshores, lakeshores, and other wet habitats in the Edwards Plateau, Pineywoods, and Coastal Prairie regions of Texas, and is widespread, though infrequent, throughout much of the temperate and tropical regions of the western hemisphere.

Rhynchospora scirpoides (Torr.) Griseb. (Cyperaceae)

Voucher specimens: OKLAHOMA. **Atoka Co.:** Boehler Seeps and Sandhills Preserve, Boehler Lake bog, 14 Aug 2006, *Singhurst & Bridges 14366* (BAYLU); Boehler Seeps and Sandhills Preserve, Hassel Lake Bog, 14 Aug 2006, *Singhurst & Bridges 14367* (BAYLU).

Rhynchospora scirpoides was discovered at two locations at Boehler Seeps and Sandhills Preserve in Atoka County, Oklahoma. The plants were found along lakeshore mud flats at the base of extensive seepage slope bogs at Boehler and Hassel Lakes. The species occurred mostly in small clumps of young seedlings, which suggests greater abundance during periods of low water when more non-vegetated shoreline is exposed. This location is approximately 220 km north of the nearest known location of the species reported by Turner et al. (2003) in Anderson County, Texas. However, there is also a specimen (*Orzell and Bridges 7991*, TEX) from Henderson County, Texas, which is slightly nearer to Oklahoma.

Associated flora include *Boehmeria cylindrica*, *Brasenia schreberi*, *Cyperus erythrorhizos*, *C. strigosus*, *Diodia virginiana*, *Dulichium arundinaceum*, *Eleocharis tortilis*, *Fimbristylis autumnalis*, *Hedyotis uniflora*, *Hydrocotyle ranunculoides*, *Hydrolea ovata*, *Hypericum mutilum*, *Juncus diffusissimus*, *Ludwigia sphaerocarpa*, *Nuphar lutea* subsp. *advena*, *Rhexia virginica*, *Sacciolepis striata*, *Sparganium americanum*, *Triadenum virginicum*, *Utricularia gibba*, *Xyris jupicai*, and *X. difformis*. The habitat and associates of

Rhynchospora scirpoides at these sites are rather similar to those reported in the northern Post Oak Savanna region of Texas (Orzell and Bridges 1989).

Rhynchospora scirpoides is relatively rare and habitat restricted throughout most of its range, primarily on the Atlantic and Gulf Coastal Plains and disjunct to sand deposits near the Great Lakes (Reznicek 1994). It is most commonly associated with Atlantic Coastal Plain pondshores and lakeshores with seasonal water level fluctuation, where it is seen mostly during low water periods. It has been more precisely considered a species of the "Organic Exposed Pond Bottom" vegetation zone on Long Island (Zaremba and Lamont 1993), which is amazingly similar to its Oklahoma habitat. Because of its prolific seed production (and documented seed banking, see Schneider 1994), it can be common in these habitats in certain seasons, as well as in nearby disturbed areas. It is listed as a rare plant in most states where it occurs (Orzell and Bridges 1989, Sorrie 1994).

***Xyris jupicai* L.C. Rich. (Xyridaceae)**

Voucher specimens: OKLAHOMA. **Atoka Co.:** Boehler Seeps and Sandhills Preserve, Boehler Lake bog, 14 Aug 2006, *Singhurst and Bridges 14365* (BAYLU); **Pushmataha Co.:** 4.3 miles E of U. S. Hwy 271 and jct. of Hwy 3 at Antlers, S side of Hwy 3, 14 Aug 2006, *Singhurst & Bridges 14330* (BAYLU); 1.4 miles NW of jct. of Coffee Creek Road (NS412RD) and WD194 RD on Powers Ranch. Bog #1, 14 Aug 2006, *Singhurst & Bridges 14386* (BAYLU); Harrison/Doshier Bog, 5 miles W on Hwy 3 & 7, 1 mile S of Antlers, 13 Aug 2006, *Singhurst & Bridges 14404* (BAYLU); bog 5.5 mi W of Antlers, 1 Sep 1976, *Taylor 23385* (NLU).

In Atoka County, *Xyris jupicai* was found growing with *X. difformis* at Boehler Seeps and Sandhill Preserve in a low hillside seepage bog and wet sandy lakeshore. Other associated species included *Andropogon virginicus* var. *virginicus*, *Bartonia paniculata*, *Boehmeria cylindrica*, *Dichanthelium scoparium*, *Eleocharis tortilis*, *Fuirena squarrosa*, *Hedyotis uniflora*, *Helianthus angustifolius*, *Hypericum mutilum*, *Juncus diffusissimus*, *Linum striatum*, *Lobelia puberula*, *Lycopus rubellus*, *Rhexia virginica*, *Rhynchospora capitellata*, *R. glomerata*, *R. scirpoides*, *Sacciolepis striata*, and *Scleria*

muehlenbergii. In Pushmataha County, *X. jupicai* was located in hillside seepage bogs and along a highway right of way that has intercepted a low hillside seepage bog. At the right-of-way site, *Xyris jupicai* was located in moderately disturbed seepy sand supporting *Andropogon virginicus* var. *virginicus*, *Boehmeria cylindrica*, *Dichantherium scoparium*, *Eleocharis tortilis*, *Fuirena squarrosa*, *Hedyotis uniflora*, *Hypericum mutilum*, *Juncus diffusissimus*, *Lobelia puberula*, *Lycopus rubellus*, *Rhexia virginica*, *R. glomerata*, and *Sacciolepis striata*.

The only mention of *Xyris jupicai* in Oklahoma is by Kral (2000b), who includes Oklahoma in the stated distribution and maps the species as occurring in the eastern part of the state. The species is not included in Waterfall (1966) or in Taylor and Taylor (1994). Furthermore, a search of the Vascular Plants of Oklahoma Database (Hoagland 2006), which includes data of specimens of *Xyris* from OCLA, OKL, and Oklahoma Panhandle State University (herbarium acronym not assigned), was also negative. The *Taylor 23385* specimen had been originally determined as *Xyris torta* Smith, but was annotated by Bridges in 1988 as *X. jupicai*.

Xyris jupicai is often confused with the sympatric *X. difformis* Chapman, which may have been the case in Oklahoma. The two species can be separated by the ridges of the scapes, those of *X. difformis* being scabrous, often wide and prominent, and those of *X. jupicai* being smooth and narrow. Additional characters that can be used to distinguish the two species include the perennial nature, ovoid to subglobose spikes, presence of red pigmentation on leaf sheaths or sheath bases, and more spreading leaves of *X. difformis*. *Xyris jupicai* (in temperate regions of North America) is typically annual (or rarely biennial), has narrowly ovoid to oblong spikes, lacks red pigmentation on leaf sheaths or sheath bases, and has more ascending leaves. Additional comments and keys to these species can be found in Kral (2000b) and Bridges and Orzell (2003).

Kral (2000b) cites *Xyris jupicai* as the most widely distributed of all New World xyrids and, at the same time, the most ecologically tolerant. He mentions that it is a frequent invader of disturbed or fallow open wetlands throughout its range. Some authors have suggested that this species may have been introduced to the United States from tropical America (Kral 1966, Godfrey and Wooten 1979, Wunderlin 1998). However, it is not listed as introduced in Kral (2000b).

The species is of fairly common occurrence in weedy or disturbed habitats (and some more natural habitats) in northeast, southeast, east-central (Post Oak Savanna region), and southern coastal Texas (Turner et al. 2003), Louisiana (Thomas and Allen 1993), and southern Arkansas (Smith 1988). It is also recorded in a few counties in the Ouachita Mountains and Coastal Plain regions of Arkansas (Smith 1988).

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We would like to thank Bruce Hoagland of the Oklahoma Natural Heritage Program for conducting database searches and securing access to Boehler Seeps and Sandhill Preserve. We are also grateful to Jim Erwin and Jay Pruett of the Nature Conservancy of Oklahoma for their assistance at Boehler Seeps and Sandhill Preserve. We are also indebted to Robert Kral for his comments on *Xyris jupicai* and to Steven Powers, who graciously permitted access to his ranch. Bruce Hoagland and Eric Keith are credited with review of the manuscript. Finally, we are grateful to NLU and TEX for use of their herbarium specimens cited here.

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**A NEW SPECIES OF *ERIGERON* (ASTERACEAE: ASTEREAEE)
FROM THE RÍO MAYO REGION OF SONORA, MEXICO**

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ABSTRACT

Erigeron barbarentis Nesom & T.R. Van Devender, sp. nov., is a previously undescribed species from the Río Mayo region of northwestern Mexico. It is similar to *Erigeron karvinskianus* but differs in its annual duration, slender to delicate taproot, glandular stems with spreading hairs, ciliate leaves, subcorymboid capitulescence, smaller heads, and caducous pappus bristles. The new species is known from two localities -- one in southern Sonora, the other in closely adjacent Chihuahua.

KEY WORDS: *Erigeron* sp. nov., *Erigeron karvinskianus*, Sonora, Chihuahua, Mexico

Erigeron barbarentis Nesom & T.R. Van Devender, sp. nov.

Erigeronti karvinskiano DC. similis sed differt duratione annua, radice palari tenui vel delicata, caulibus glandulosis trichomatibus patentibus, foliis ciliatis, capitulescentia subcorymboidea, capitulis minoribus, et setis pappi caducis.

TYPE: México: Sonora. Mpio. Álamos, Barranca Pozo Azul above junction with Arroyo Santa Bárbara, ca 3 km S of Rancho Santa Bárbara (ENE of Álamos), ca. 27° 05'40"N, 108° 43'15"W, oak woodland with tropical elements, 900 m elev., 5 Oct 2006, *T.R. Van Devender 2006-1194* with Reina-G., Dimmit, and Loyola-R. (holotype: TEX; isotype: MEXU).

Plants annual from a slender, often delicate taproot. Stems erect, 25–55 cm high, weakly hirsutulous on proximal 1/3–1/2 and minutely glandular with viscid type B and type C trichomes (Nesom 1976), loosely strigose with upcurved trichomes on distal 1/2 and eglandular. Leaves basal and cauline, basal oblanceolate to spatulate, often deciduous by flowering, cauline narrowly elliptic to elliptic-lanceolate or elliptic-oblanceolate, not clasping, mostly 2–4 cm long, 5–10 mm wide, entire or with 1–2 pairs of coarse teeth, relatively even-sized up to the capitulescence or largest near midstem, hirsutulous-strigose with basally erect but antrorsely upcurved hairs, eglandular, margins antrorsely ciliate. Heads 3–8 in a loosely corymboid arrangement, on peduncles 15–45 mm long; involucre ca. 4 mm wide; phyllaries in 3–4 subequal series, the inner 2.0–2.5 mm long, sparsely hirsutulous-strigose along the midvein, eglandular. Ray florets 32–48 in 1 series, corollas 5–6 mm long, white, laminae 0.2–0.4 mm wide, not coiling. Disc florets: corollas 1.8–2.0 mm long. Achenes oblong, ca. 1 mm long, 2-nerved, sparsely strigose; pappus of 10–15 fragile, basally caducous bristles, outer series not evident.

Additional collection studied. México. Chihuahua. Río Mayo, Guasaremos, tropical Sonoran hillslope, 16 Sep 1935, *H.S. Gentry 1828* (MO).

The localities for the new species are in the broad Río Mayo region of southern Sonora and adjacent Chihuahua as defined by Gentry (1942) and Martin et al. (1998). *Gentry 1828* was collected on a hill slope in the margin between Short-tree Forest and Oak Forest (tropical deciduous forest and oak woodland in Martin et al. 1998) at 915 m elevation at Guasaremos (27°39'30"N 108°42'30"W). This locality is in the Sierra Madre Occidental in the upper Río Mayo drainage in Chihuahua about 85 km by air north-northeast of Alamos, Sonora. The type collection was made in the Rancho Santa Bárbara area, a southwestern extension of the Sierra Madre Occidental about 25 km by air east-northeast of Alamos in southern Sonora. The specific epithet refers to Arroyo Santa Bárbara, recognizing its importance for the flora of tropical Sonora.

The type locality is Barranca Pozo Azul, a deep rocky canyon that joins Arroyo Santa Bárbara from the west just above its junction

with Arroyo Verde. The vegetation is oak woodland dominated by encino cochi (*Quercus tuberculata*) on steep, shady slopes. A population of the palma de la virgen cycad (*Dioon sonora*) is nearby. Ferns (*Anemia affinis*, *Asplenium palmeri*, *Polypodium praeterissimum*, *Woodsia mollis*), spike moss (*Selaginella pallescens*), and other herbs dominate the shady understory. The vegetation of the broader Arroyo Santa Bárbara area is pine-oak forest and oak woodland at 1200 to 1500 m elevation, oak woodland down to 1000 m, and tropical deciduous forest down to 300 m on the Río Cachujaqui, a major tributary of the Río Fuerte in Sinaloa.

The deep, shady Arroyo Verde, which joins Arroyo Santa Bárbara from the east several kilometers below the ranch, supports the only semideciduous forest in Sonora with northern isolated stands of tropical trees (*Aphananthe monoica*, *Bursera simaruba*, *Cinnamomum hartmanii*, *Dendropanax arboreus*, and *Drypetes gentryi*).

Erigeron barbarensis is similar to *E. karvinskianus* in leaf shape, production of small, axillary leaves, and white, non-coiling rays. Both species characteristically occur in subtropical vegetation at relatively low elevations (most species of *Erigeron* occur in temperate, arid, or alpine vegetation). We had tentatively identified the Gentry collection as a morphologically unusual, geographically disjunct collection of *E. karvinskianus*, but with the Sonoran collection, its evolutionary distinction became apparent. The new species differs in a number of features, as outlined below.

1. Plants annual from a slender to delicate taproot; stems weakly hirsutulous and minutely glandular on proximal 1/3–1/2, loosely strigose above with upcurved hairs; glandular stems with spreading hairs; leaves ciliate; heads in a subcorymboid capitulescence; involucre ca. 4 mm wide, the inner phyllaries 2.0–2.5 mm long; ray florets 32–48; pappus of 10–15 fragile, basally caducous bristles, outer series not evident.....**Erigeron barbarensis**

1. Plants perennial from a woody taproot or subrhizomatous caudex; stems closely strigose with straight hairs, eglandular; leaves not distinctly ciliate; heads in a diffuse arrangement; involucre 7–10 mm wide, inner phyllaries 2.5–4.0 mm long; ray florets 45–80; pappus of 15–27 persistent bristles, outer series of setae..**Erigeron karvinskianus**

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A NEW COMBINATION IN *ELYMUS* (POACEAE: TRITICEAE)

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ABSTRACT

The new combination *Elymus ponticus* (Podp.) N. Snow is proposed for a taxon recently treated in the genus *Thinopyrum*.

KEY WORDS: Poaceae, Triticeae, *Elymus*, systematics, nomenclature

During the recent updating (Snow, in prep.) of a checklist of vascular plant taxa for the Southern Rocky Mountain region (Snow and Brasher 2004) it became evident that a combination for the species recently treated as *Thinopyrum ponticum* (Podp.) Barkworth & D. R. Dewey (Barkworth et al. 2007) was not available in the genus *Elymus*.

Generic classifications in the grass Tribe Triticeae are fraught with difficulties (Kellogg 1989). Some have advocated for (Dewey 1982) or against (Seberg and Peterson) genomic analysis to elucidate generic boundaries, whereas others argue taken a more intermediate view (Kellogg 1989). Widespread hybridization in much of the Tribe also complicates taxonomy at the specific level.

For data basing projects and the production of interactive keys in the Southern Rocky Mountain region we (Snow and Brasher 2004) chose to recognize a broadly defined *Elymus* that excludes (from our region) generic segregates such as *Thinopyrum* A. Löve, *Pseudoregneria* A. Löve, *Leymus* Hochst., *Pascopyrum* A. Löve, and *Elytrigia* Desv. Since a combination is not available at the specific level in *Elymus* for the following taxon it is proposed herein.

Elymus ponticus (Podp.) N. Snow, **comb. nov.** Basionym: *Triticum ponticum* Podp., Verh. Zool.-Bot. Ges. Wien 52: 681. 1902.

This taxon is native to western Asia and southern Europe (Barkworth et al. 2007), where it is most common in maritime sands and gravels and riverine gravels. Its range in North America includes scattered but widespread reports in Canada and the eastern USA (particularly near the eastern Great Lakes region), but most reports are scattered across the drier parts of the western half of the USA.

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**A CORRECTED IDENTIFICATION AND A NEW
COMBINATION FOR A RECENT FLORIDA INTRODUCTION:
AGALOMA GRAMINEA (EUPHORBIACEAE)**

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ABSTRACT: *Euphorbia graminea* (Euphorbiaceae) is confirmed as a recent introduction to the Florida flora, and *E. oerstediana* is excluded as a misidentification. Both are considered best assigned to the segregate genus *Agaloma*, within which *A. graminea* is formed as a new combination.

KEY WORDS: *Agaloma*, *Euphorbia*, Euphorbiaceae, Florida flora.

In 1994 Alan Herndon (Sida 16: 208-209) identified a spurge found on greenhouse wastes in Dade County, Florida, as *Euphorbia graminea* Jacquin (Euphorbiaceae), a species common throughout Mexico and central America and the West Indies. Other Florida botanists quickly identified it as *Euphorbia oerstediana* Klotzsch & Garcke, an infrequent species of much the same range.

In the belief the Florida plant was *Euphorbia oerstediana*, and with the conviction the enormous association known as *Euphorbia* (with over 1500 species) was both too unwieldy and morphologically too diverse to be held within a single genus, Ward (Novon 11: 361-362, 2001) formed the new combination *Agaloma oerstediana* (Kl. & Gke.) D. B. Ward, and reported that species as a member of the Florida flora.

The plant has rapidly expanded its Florida range, always found initially in association with greenhouse detritus but also soon appearing in landscape plantings. From its original Dade County location, by 1999 it was found in Palm Beach and Broward counties (D. F. Austin,

pers. comm.) and by 2001 had reached Alachua County (R. Abbott, pers. comm.), thus now is at least sparingly present throughout the Florida peninsula.

All specimens seen from within the state have now been identified as *Euphorbia graminea*. Present identification is based on the key and description by Michael Huft (Flora de Nicaragua, 1: 880-882. 2001) and the extended discussion of its variations within Mexico by Rogers McVaugh (Contr. Univ. Mich. Herb. 19: 220-227. 1993). The glabrous capsules and small (<2 mm.) coarsely alveolate seeds are definitive of *E. graminea* (vs. the pubescent capsules and larger (2.5-3.0 mm.) finely patterned seeds of *E. oerstediana*).

Other authors have placed *Euphorbia graminea* (as well as *E. oerstediana*) in *Euphorbia* subgen. *Agaloma* (G. L. Webster, J. Arnold Arbor. 48: 303-430. 1967). Less often, these species and their allies have been treated as generically distinct, as *Agaloma* Rafinesque. The merit of distinct generic placement has been discussed by Ward (2001), with the suggestion that the unique structure of the cyathial inflorescence has overridden conflicting criteria that would otherwise justify generic ranking.

Thus, to retain the generic placement accorded related Florida species, and to correct the misidentification given the first discoveries, the following new name is formed:

Agaloma graminea (Jacquin) D. B. Ward, comb. nov.
Basionym: *Euphorbia graminea* Jacquin, Sel. Stirp. Amer. 151.
1763 (holotype: *icon*, Obs. Bot. 2: 5, pl. 31. 1767).

This seemingly innovative recognition of *Agaloma* is less iconoclastic when considered alongside other segregates of *Euphorbia*, two of which are commonly recognized as quite sufficiently distinct to carry generic rank. Within Florida, equivalent status is merited by *Chamaesyce* S. F. Gray, *Poinsettia* Graham, and *Tithymalus* Gaertner. By this treatment, *Euphorbia* L., s. str., is mostly restricted to Old World succulents and is wholly excluded from the Florida flora.

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WHAT IN THE WORLD DID THOMAS WALTER MEAN BY
Xxxxx yyyyy?
PART ONE: THE COMPLETE UNKNOWNNS

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ABSTRACT

Flora Caroliniana, published by Thomas Walter in 1788, was the first treatment of American plants to employ the binomial nomenclature and sexual classification system of Linnaeus. Many of its species were new to science, and their names remain important in documentation of the southeastern American flora. But Walter kept no herbarium, and certain of his plants have not been matched with modern names. Assistance of select readers is requested to determine to the extent possible what plants Walter must have had in hand when he named and described 17 of his yet unidentified new species.

"So many of Walter's plants...which were once considered doubtful, have been from time to time discovered, that this at least merits a further enquiry."
(Stephen Elliott, *Sketch* 1:351. 1821)

REQUEST FOR TAXONOMIC ASSISTANCE

In the 1780s Thomas Walter owned and operated a rice plantation on the coastal plain bottomlands of the Santee River, South Carolina. Apparently guided solely by a few books from Linnaeus, he compiled an inventory of the plants he found within a brief distance of his home, either copying from Linnaeus or composing a brief Latin description of his own. A few additional species were brought to him by John Fraser, from the western Carolina mountains and upper Georgia. His manuscript was then carried back to London by Fraser, and published in 1788.

An annotated index of all of Walter's new species is now in preparation, and a majority of his names have now been adequately identified. But many of Walter's species were described too briefly or lacked contrast with other known species, and have thus been misidentified or wholly overlooked. A significant number of Walter's names have remained unidentified -- more than two centuries after their publication. It is now time to enlist the aid of other persons to determine what had been meant by these puzzling Walter names.

The present effort is to be presented in two parts: one, of the names that seem unidentifiable even to genus; and a second, of names that are perhaps now identified to genus but with their species still unknown. For each species, Walter's Latin description is provided. (At times, if a copy of Walter's *Flora* is conveniently available, further suggestions may be found in his generic descriptions.) Where Walter chose to emphasize a term, that word is here given in Roman type. Other species with their modern names, recorded by Walter immediately before and after his unidentified new names, are also noted. (Walter's placement of the unknown species is indicated by a series of question marks.) In many cases it is expected that knowledge of the modern species Walter placed adjacent may aid in determination of the unidentified names. His listing cannot of course be considered to be solely guided by presumed relationships, for his reliance on the Linnaean sexual system of classification, with its employment of simple counts of stamens, carpels, etc., often placed quite disparate species in close proximity. (Walter's placement of *Apluda scirpioides* between the grass *Dactyloctenium aegyptium* and the tree *Celtis laevigata* can be of scant guidance as to the nature of Walter's plant.)

One must assume that each of Walter's names was intended to refer to *something*, thus a knowledge of the Carolina coastal plain flora *should* lead to a certain identification. Yet the following 17 names have thwarted the present writer's best efforts. PLEASE EXAMINE THIS LISTING AND SEE IF ANY DESCRIPTIONS RING BELLS! Revelations, approximations, even best guesses will be warmly welcomed. [E-mail: DBW, c/o kperkins@flmnh.ufl.edu]

LIST OF SPECIES

Walter's name: **Apium bipinnatum** Walter (p. 115)

Walter's description: *foliis caulinis bipinnatis, foliolis inciso-serratis; floribus albis.*

Adjacent listings: *Oxypolis rigidior, Sium suave, Ligusticum canadense, ?????, Angelica venenosa, Cicuta maculata.*

Modern name: Undetermined.

No type of *Apium bipinnatum* Walt. is known. No neotype has been selected. Suggested by I.K. (1893) to be *Selenium canadense* Michx. (= *Conioselenium chinense* (L.) BSP.); but that species is northern, unknown in the Carolinas.

Walter's name: **Apluda Scirpioides** Walter (p. 250)

Walter's description: *foliis longis lanceolatis, culmo ramoso paniculato, flosculis muticis.*

Adjacent listings: *Dactyloctenium aegyptium, ?????, Celtis laevigata.*

Modern name: Undetermined.

Apluda L. is a grass; No type of *Apluda scirpioides* Walt. is known. No neotype has been selected.

Walter's name: **Arctotis caroliniana** Walter (p. 216)

Walter's description: *foliis radicalibus rotundato-ovatis trinerviis dentatis hirsutis, pedunculis radicatis brevibus pilosis unifloris, flore luteo erecto. Calyce corollaque Melampodii, seminibus alienis.*

Adjacent listings: *Helianthus angustifolius, Helianthus atrorubens, ?????, Polymnia uvedalia, Tetragonotheca helianthoides.*

Modern name: Undetermined.

Arctotis L. is a composite. No type of *Arctotis caroliniana* Walt. is known. No neotype has been selected.

Walter's name: **Arethusa foliosa** Walter (p. 223)

Walter's description: *radice bulbosa, caule folioso unifloro, foliis alternis brevibus nervosis, flore terminali lineari albido, capsula oblonga hexangula.*

Adjacent listings: *Cleistes divaricata, Ponthieva racemosa, Hexalectris spicata, ?????, Passiflora lutea, Passiflora incarnata.*

Modern name: Undetermined.

No type of *Arethusa foliosa* Walt. is known. No neotype has been selected.

Walter's name: **Aster ciliatus** Walter (p. 209)

Walter's description: *fol. lanceolatis integris ciliatis, caule tripedali, floribus magnis purpureis subsolitariis, pedunculis foliosis.*

Adjacent listings: *Aster concolor, Aster ?grandiflorus, ?????, Aster walteri, Aster ?laevis.*

Modern name: Undetermined.

No type of *Aster ciliatus* Walt. is known. No neotype has been selected. Not *Aster ciliatus* Muhl. in Willd.

Walter's name: **Calea caroliniana** Walter (p. 200)

Walter's description: *floribus paniculatis, calycibus multifloris, seminibus papposis, foliis alternis lanceolatis subserratis sessilibus.*

Adjacent listings: *Conoclinium coelestinum, Fleischmannia incarnata, ?????, Marshallia graminifolia, Marshallia obovata.*

Modern name: Undetermined.

Calea L. is a composite. No type of *Calea caroliniana* Walt. is known. No neotype has been selected. Listed by I.K. (1893) without comment.

Walter's name: **Celtis #2 (unnamed)** Walter (p. 250)

Walter's description: *foliis (space), fructu caerulea.*

Adjacent listings: *Celtis laevigata, ?????, Acer negundo.*

Modern name: Undetermined.

No type is known. No neotype should be selected. Walter apparently saw no leaves; he noted only "*foliis (space).*" Then fruits "*caeruleo.*" Very probably this was a Fraser discovery, brought to Walter only in fragmentary form. But not a *Celtis*; no species with blue fruits grows in the Carolinas.

Walter's name: **Clypeola caroliniana** Walter (p. 173)

Walter's description: *caulescens, ramosa, foliis caulinis petiolatis, ovato-lanceolatis, duploserratis, subscabris, floralibus lineari-lanceolatis, integris sessilibus; siliculis bilocularibus, seminibus solitariis.*

Adjacent listings: *Penstemon laevigatus*, ?????, *Lepidium virginicum*,
Capsella bursa-pastoris.

Modern name: Undetermined.

Clypeola L. is a crucifer. No type of *Clypeola caroliniana* Walt. is known. No neotype has been selected. I.K. (1893) recorded this as *Lepidium virginicum*, although Walter recognized another plant by that name, immediately following.

Walter's name: **Cucumis #3 (unnamed)** Walter (p. 240)

Walter's description: *foliis hastatis oppositis*.

Adjacent listings: *Melothria pendula*, *Sicyos angulatus*, ?????,
Osmanthus americana.

Modern name: Undetermined.

No type of this unnamed *Cucumis* is known. No neotype should be selected. Walter's "*foliis hastatis oppositis*" fits no Carolina cucurbit.

Walter's name: **Erigeron cymosum ?** Walter (p. 206)

Walter's description: *calycibus sublaevibus, foliis dentato-laciniatis, floribus numerosis luteis*.

Adjacent listings: *Erigeron strigosus*, ?*Euthamia* sp., ?????, *Solidago sempervirens*.

Modern name: Undetermined.

No type of *Erigeron cymosum* Walt. is known. No neotype has been selected. The name is not italicized, and is queried. Even so, it has been credited to Walter, by I.K. (1893).

Walter's name: **Erigeron glandulosum** Walter (p. 205)

Walter's description: *caule foliisque pilosis, foliis ovato-lanceolatis integris, pedunculis ternis, calycis squamis rectis subliberis latioribus glanduloso-pilosis, floribus luteis, calycibus haemisphericis*.

Adjacent listings: *Erigeron strigosus*, ?*Euthamia* sp., ?????, *Solidago sempervirens*.

Modern name: Undetermined.

No type of *Erigeron glandulosum* Walt. is known. No neotype has been selected.

Walter's name: **Erigeron squarrosus** Walter (p. 206)

Walter's description: *calycis squamis tomentosus patentibus, floribus luteis.*

Adjacent listings: *Erigeron strigosus*, *?Euthamia sp.*, *Chrysopsis gossypina*, ?????, *Solidago sempervirens*.

Modern name: Perhaps **Chrysopsis** sp.

No type of *Erigeron squarrosus* Walt. is known. No neotype has been selected. Perhaps a *Chrysopsis*; identified as *C. gossypina* by I.K. (1893), though that species appears to be listed by Walter as *Erigeron pilosum*, immediately preceding.

Walter's name: **Hydrocotyle cordata** Walter (p. 113)

Walter's description: *foliis cordatis integris erectis.*

Adjacent listings: *Hydrocotyle umbellata*, *Hydrocotyle ramunculoides*, *Centella asiatica*, ?????, *Sanicula ?canadensis*, *Oxypolis filiformis*.

Modern name: Undetermined.

No type of *Hydrocotyle cordata* Walt. is known. No neotype has been selected. Certainly Walter's plant was not a *Hydrocotyle*. Elliott (1817: 347) remarked: "I have never seen [it]." I.K. (1893) referred it to *Limnanthemum trachyspermum* Gray, a synonym of *Nymphoides aquatica* (Walt. ex Gmel.) Kuntze. But that species was already described elsewhere by Walter (1788: 109). Perhaps a Fraser discovery, represented by an imperfect specimen that Walter misinterpreted. A Fraser collection (spm. 59-E) of *Nymphoides aquatica* was labeled "*Hydrocotyle*" in Walter's hand.

Walter's name: **Leysera caroliniana** Walter (p. 211)

Walter's description: *foliis radicalibus rotundatis quinquenerviis subserratis hirsutis, caulinis oppositis sessilibus parvis minoribus, caule superne ramoso hirsuto.*

Adjacent listings: *Gaillardia pulchella*, *Helenium flexuosum*, ?????, *Anthemis cotula*, *Anthemis arvensis*.

Modern name: Undetermined.

Leysera L. is a composite. No type of *Leysera caroliniana* Walt. is known. No neotype has been selected.

Walter's name: **Orchis calcarata** Walter (p. 220)

Walter's description: *albo-viridis, bulbis indivisis, nectarii labio septemcalcarato, cornu longissimo.*

Adjacent listings: *Pogonia ophioglossoides, Platanthera lacera, ?????, ?Liparis liliifolia, Calopogon pulchellus, Spiranthes praecox.*

Modern name: Undetermined.

No type of *Orchis calcarata* Walt. is known. No neotype has been selected.

Walter's name: **Panicum anomalum** Walter (p. 72)

Walter's description: *spica composita, spiculis secundis horizontalibus alternis oppositis ternisque; calycibus laevibus confertis in triplici ordine; corollis trivalvibus; culmo decumbente; fol. longis, laevibus.*

Adjacent listings: *Setaria ?geniculata, Setaria ?magna, Echinochloa walteri, ?????, Echinochloa colonum, ?Panicum capillare.*

Modern name: Undetermined.

No type of *Panicum anomalum* Walt. is known. No neotype has been selected. I.K. (1894) suggested Walter's plant to be *Panicum dichotomum* L., a common species in SC. Hitchcock (1905: 35) did not find Walter's name used by earlier authors, even in synonymy, and concluded "it was impossible to identify the species." He later (1951: 982) believed it to be a *Setaria*. The description, however, contains distinctive features ("*spiculis secundis horizontalibus alternis oppositis ternisque;...culmo decumbente*"), and calls for one familiar with the Carolina grasses to identify.

Walter's name: **Senecio ciliatus** Walter (p. 208)

Walter's description: *floribus disco luteo radio albo, caule 6 ad 8-pedali piloso, foliis lanceolato-linearibus ciliatis.*

Adjacent listings: *Conyza ?parva, Erechites hieracifolia, ?????, Aster carolinianus.*

Modern name: Undetermined.

No type of *Senecio ciliatus* Walt. is known. No neotype has been selected. I.K. (1895) suggested Walter's plant was *Erigeron canadensis* L. (= *Conyza canadensis* (L.) Cronq.), although Walter elsewhere (1788: 207) described that species as *Cineraria canadensis*.

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TWO NEW COMBINATIONS IN *IPOMOPSIS CONGESTA*
(POLEMONIACEAE)

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ABSTRACT

Ipomopsis congesta (Hook.) V. Grant var. *montana* (Constance & Rollins) Reveal and *I. congesta* var. *viridis* (Cronquist) Reveal are established to complete the transfer of all varieties from *Gilia* to *Ipomopsis*.

KEY WORDS: *Ipomopsis*, *Gilia*, *Polemoniaceae*

Over the past several years various authors (Dorn 1988; Tiehm 1996; Welsh 2003) have transferred varieties of *Gilia congesta* as circumscribed by Constance and Rollins (1936) and Cronquist (1959) to *Ipomopsis* as defined by Grant (1956) and Day (1980). Two more names are moved to complete the task for the Intermountain West.

Ipomopsis congesta (Hook.) V. Grant var. *montana* (Constance & Rollins) Reveal, **comb. nov.** Based on *Gilia congesta* Hook. var. *montana* Constance & Rollins, Amer. J. Bot. 23: 439. 1936. *Gilia montana* A. Nelson & P. B. Kenn., Proc. Biol. Soc. Wash. 19: 37. 1906, non (Greene) Rattan (1898).

Ipomopsis congesta (Hook.) V. Grant var. *viridis* (Cronquist) Reveal, **comb. nov.** Based on *Gilia congesta* Hook. var. *viridis* Cronquist, Vasc. Pl. Pacific Northw. 4: 107. 1959.

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