

1999

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Recommended Citation

Columbus, J. Travis (1999) "An expanded circumscription of *Bouteloua* (Gramineae: Choridoideae): new combinations and names," *Aliso: A Journal of Systematic and Evolutionary Botany*: Vol. 18: Iss. 1, Article 16.
Available at: <http://scholarship.claremont.edu/aliso/vol18/iss1/16>

AN EXPANDED CIRCUMSCRIPTION OF *BOUTELOUA* (GRAMINEAE: CHLORIDOIDEAE):
NEW COMBINATIONS AND NAMES

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ABSTRACT

Cladistic analysis of nuclear ribosomal and chloroplast DNA sequences has revealed that the New World grass genus *Bouteloua* (Chloridoideae) is not monophyletic. Indeed, some species of *Bouteloua* are more closely related to species in other genera than to congeners. The problem was dealt with by expanding the circumscription of *Bouteloua* to include species formerly positioned in the satellite genera *Buchloë* (1 species), *Buchlomimus* (1), *Cathestecum* (4), *Cyclostachya* (1), *Griffithsochloa* (1), *Opizia* (2), *Pentarrhaphis* (3), *Pringleochloa* (1), and *Soderstromia* (1). Thirteen new combinations and names were necessary. As here circumscribed, *Bouteloua* is monophyletic and comprises 57 species.

Key words: *Bouteloua*, Chloridoideae, classification, generic circumscription, Gramineae, new combinations, new names, nomenclature, sexual dimorphism, taxonomy.

Until recently, little was known about the phylogeny of the New World grass genus *Bouteloua* Lag. and relatives (Chloridoideae). The first significant contribution came only last year with publication of a cladistic parsimony analysis of nuclear ribosomal internal transcribed spacer (ITS) region DNA sequences (Columbus et al. 1998). Prior to this study, insights into possible relationships were largely confined to remarks concerning a few taxa. Although *Bouteloua* and both subgenera proved not to be monophyletic, Columbus et al. (1998) proposed no new circumscriptions in lieu of additional phylogenetic estimates, particularly from the nonrecombining chloroplast genome. The *trnL-trnF* region of chloroplast DNA has since been sequenced and analyzed (Columbus et al., in press, in prep.). Although differences exist between the ITS and *trnL-F* strict consensus trees, there is much agreement, and nearly all of the discordance involves poorly supported nodes. Figure 1 is the strict consensus of six most parsimonious trees resulting from an analysis of the two data sets combined (Columbus et al., in press). Bullets denote clades having the same composition of taxa in all minimum-length trees from the ITS, *trnL-F*, and combined analyses. Most of these clades are supported by high bootstrap percentages and decay indices. When the data are subjected to other kinds of analyses such as neighbor joining and UPGMA, these same groupings of taxa result (Fig. 2). Hence, because ITS and *trnL-F* are located in distinct genomes, characterized by different modes of inheritance, their phylogenetic concordance provides solid ground upon which to base taxonomic decisions.

In contrast to *Bouteloua* (42 spp.), species in the satellite genera *Buchloë* Engelm. (1 sp.), *Buchlomimus* Reeder, C. Reeder, & Rzed. (1 sp.), *Cathestecum* J. Presl (4 spp.), *Cyclostachya* Reeder & C. Reeder (1 sp.), *Griffithsochloa* G. J. Pierce (1 sp.), *Opizia* J. Presl (2 spp.), *Pringleochloa* Scribn. (1 sp.), and *Soderstromia* C. V. Morton (1 sp.) possess dimorphic spikelets, some or all of which are unisexual. Historically, taxonomists have segregated sexually dimorphic grasses from their hermaphroditic relatives, placing them in different genera. The following excerpt from Reeder and Reeder (1963), justifying their description of a new genus, *Cyclostachya*, to accommodate a dioecious and dimorphic species, illustrates well this traditional practice:

With the discovery that [*Bouteloua stolonifera* Scribn.] is dioecious, a re-evaluation of its generic position seems pertinent. Dioeciousness *per se* would not appear to be sufficient grounds to exclude a species from an otherwise hermaphroditic genus. Both *Poa* and *Eragrostis*, for example, contain dioecious members, even though in the majority of the included species the florets are bisexual. In these cases, however, ♂ and ♀ spikelets are essentially alike morphologically, any differences being largely those of size, and the fact that organs of only one sex are developed.

In the case under discussion, the staminate and pistillate plants differ to such a degree that they have been considered to represent different species. This would suggest that this grass has undergone a long evolutionary history from the time unisexuality first appeared. To retain it within a genus in which no dicliny has been reported thus far would seem to be at variance with accepted practice.

Later, Reeder and Reeder (1966) reported “dioecy (or gynodioecy)” in some populations of *Bouteloua*

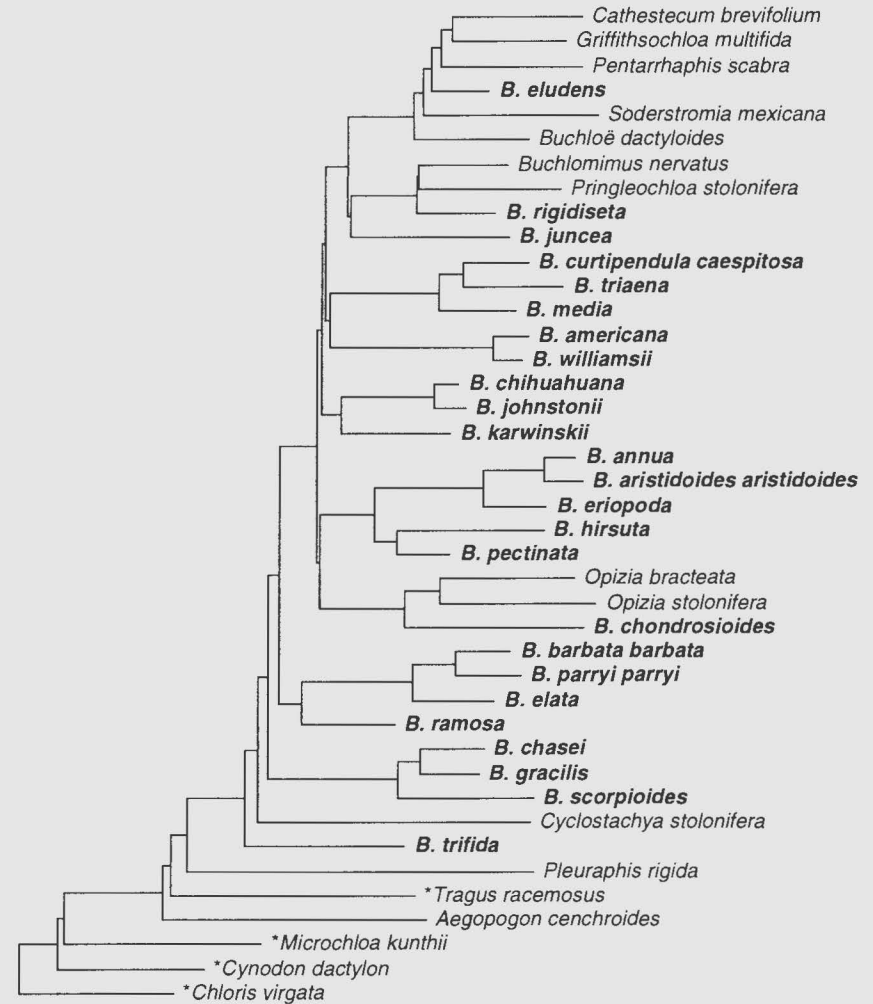
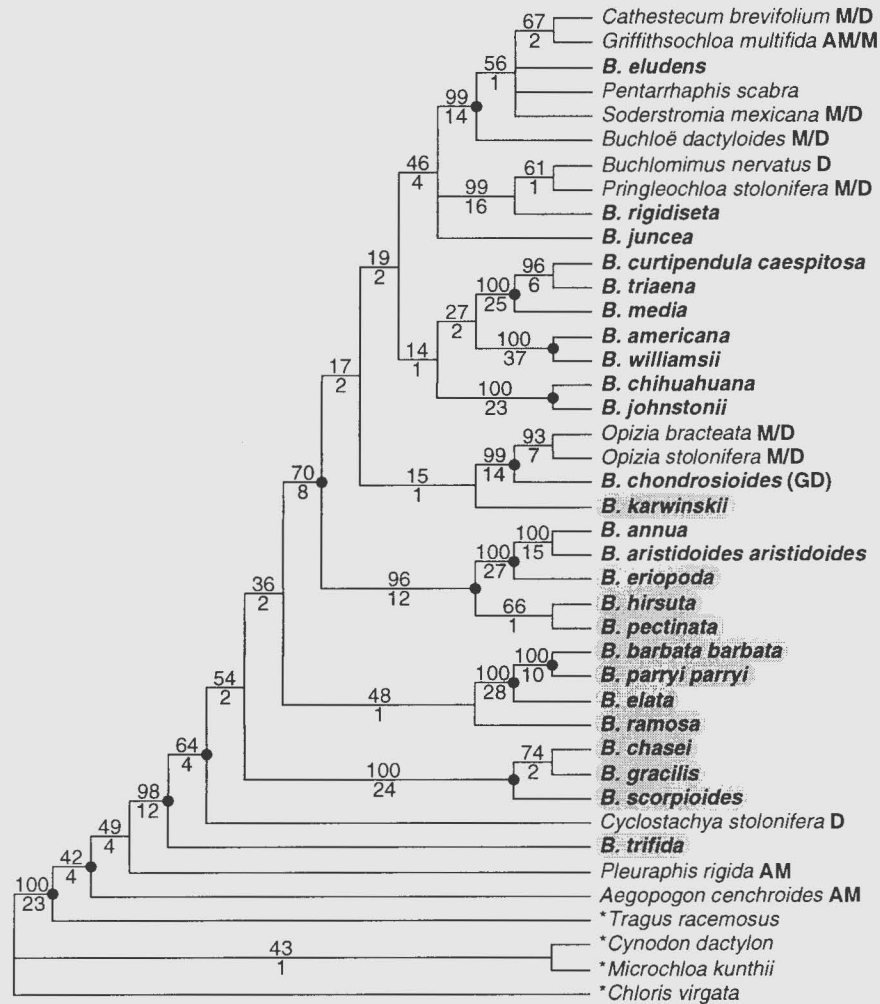


Fig. 1. Strict consensus of six most parsimonious trees resulting from a PAUP* version 4.0 beta 1 (Swofford 1998) analysis of combined ITS and *trnL-F* sequences of representatives of *Bouteloua* and related and outgroup genera (Columbus et al., in press). Asterisks denote outgroup taxa. In bold are members of *Bouteloua*. Shaded are members of *Bouteloua* subgenus *Chondrosium* (Desv.) Gould. Numbers above and below branches are bootstrap percentages and decay indices, respectively. Bullets denote clades having the same composition of taxa in all minimum-length trees from separate and combined analyses of ITS and *trnL-F*. AM = andromonoecious, D = dioecious, (GD) = facultatively gynodioecious, M = monoecious. Tree length = 2001, consistency index = 0.51, retention index = 0.59.

Fig. 2. Neighbor-joining tree computed by PAUP* version 4.0 beta 1 using uncorrected ("p") distances and combined ITS and *trnL-F* sequences of representatives of *Bouteloua* and related and outgroup genera. Asterisks denote outgroup taxa. In bold are members of *Bouteloua*.

chondrosioides (Kunth) Benth. ex S. Watson, but refrained from erecting a new genus because the requisite dimorphic features were not evidenced. (Reeder [1969] subsequently indicated that the populations are likely gynodioecious, a conclusion confirmed by H. E. Conner [pers. comm. in Columbus et al., in press].)

Given the greater insight into the phylogeny of *Bouteloua* and related genera afforded by these molecular data, a reconsideration of generic circumscriptions is in order. A major problem with the present classification is that some species of *Bouteloua*, namely *B. chondrosioides*, *B. eludens* Griffiths, and *B. rigidiseta* (Steud.) Hitchc., are more closely related to species in other genera than to congeneric species (Fig. 1). All taxonomic solutions, therefore, necessarily involve changes in the circumscription of *Bouteloua*. In order to maintain all of the satellite genera, *Bouteloua* would have to be diminished in size, beginning with the removal of *B. chondrosioides* (to *Opizia* or a new genus), *B. eludens* (to a new genus), and *B. rigidiseta* (to a new genus). Removal of these species, however, would not render *Bouteloua* monophyletic. To achieve a system of monophyletic genera, further fragmentation of *Bouteloua* would be necessary. Because the relationships among a number of the terminal taxa and clades remains uncertain, as is evident from those nodes in the ITS + *trnL-F* strict consensus tree having low bootstrap percentages and decay indices (Fig. 1), the establishment of unequivocally monophyletic genera would result in more than double the number of genera currently recognized. Such a classification would have limited practical utility, as morphologically similar pairs of species such as *B. chondrosioides*-*B. eludens* and *B. chasei* Swallen-*B. karwinskii* (E. Fourn.) Griffiths would be positioned in different genera.

An alternate solution, and the one I advocate, is to expand the circumscription of *Bouteloua* to include the aforementioned genera and *Pentarrhaphis* Kunth (3 spp.). Dating from 1805, *Bouteloua* has priority over the other generic names (see Clayton and Renvoize 1986). Monophyly of *Bouteloua* in this expanded sense has strong support (bootstrap 98%, decay index 12; Fig. 1) and, by accenting the morphological similarities among the species, the new generic circumscription has a practical advantage over the current classification: species can be more readily and accurately determined to genus, especially in the field, by persons not expert in the group. The following new combinations and names are thereby necessary:

***Bouteloua bracteata* (McVaugh) J. T. Columbus, comb. nov.**

Basionym: *Opizia bracteata* McVaugh. Fl. Novo-Galiciana, vol. 14, pp. 269–271. 1983.

***Bouteloua dactyloides* (Nutt.) J. T. Columbus, comb. nov.**

Basionym: *Sesleria dactyloides* Nutt. Gen. N. Amer. pl., vol. 1, p. 65. 1818.

***Bouteloua dimorpha* J. T. Columbus, nom. nov.**

Replaced name: *Opizia stolonifera* J. Presl. Reliq. Haenk., vol. 1, pp. 293–294, pl. 41, figs. 1–11. 1830.

Notes.—A new specific epithet is necessary due to (1) the existence of the validly published *Bouteloua stolonifera* Scribn. and (2) the absence of taxonomic synonyms. The epithet refers to the sexually dimorphic inflorescences and spikelets.

***Bouteloua diversispicula* J. T. Columbus, nom. nov.**

Replaced name: *Cathestecum brevifolium* Swallen. J. Wash. Acad. Sci. 27: 500–501. 1937.

Notes.—A new specific epithet is necessary due to (1) the existence of the validly published *Bouteloua brevifolia* Buckley and (2) the absence of taxonomic synonyms (Pierce 1979). The epithet refers to the polymorphic spikelets, which vary according to position and sex.

***Bouteloua erecta* (Vasey & Hack.) J. T. Columbus, comb. nov.**

Basionym: *Cathestecum erectum* Vasey & Hack. Bull. Torrey Bot. Club 11: 37–38, pl. 45. 1884.

***Bouteloua griffithsii* J. T. Columbus, nom. nov.**

Replaced name: *Cathestecum prostratum* J. Presl. Reliq. Haenk., vol. 1, p. 295, pl. 42. 1830.

Notes.—A new specific epithet is designated on account of (1) the validly published *Bouteloua prostrata* Lag. and (2) the validly published *B. annua* Swallen, which precludes the transfer to *Bouteloua* of *Cathestecum annuum* Swallen, the sole taxonomic synonym of *C. prostratum* (Pierce 1979). The epithet commemorates David Griffiths, who in 1912 authored a revision of *Bouteloua* and relatives.

***Bouteloua mexicana* (Scribn.) J. T. Columbus, comb. nov.**

Basionym: *Fourniera mexicana* Scribn. U. S. D. A. Div. Agrostol. Bull. 4: 8–9. 1897.

***Bouteloua multifida* (Griffiths) J. T. Columbus, comb. nov.**

Basionym: *Cathestecum multifidum* Griffiths. Contr. U. S. Natl. Herb. 14: 360–361. 1912.

***Bouteloua polymorpha* (E. Fourn.) J. T. Columbus, comb. nov.**

Table 1. Corresponding species names under the former (e.g., Pierce 1979; McVaugh 1983; Clayton and Renvoize 1986) and new treatments.

Former treatment	New treatment
<i>Buchloë dactyloides</i> (Nutt.) Engelm.	<i>Bouteloua dactyloides</i> (Nutt.) J. T. Columbus
<i>Buchlomimus nervatus</i> (Swallen) Reeder, C. Reeder, & Rzed.	<i>Bouteloua nervata</i> Swallen
<i>Cathestecum brevifolium</i> Swallen	<i>Bouteloua diversispicula</i> J. T. Columbus
<i>Cathestecum erectum</i> Vasey & Hack.	<i>Bouteloua erecta</i> (Vasey & Hack.) J. T. Columbus
<i>Cathestecum prostratum</i> J. Presl	<i>Bouteloua griffithsii</i> J. T. Columbus
<i>Cathestecum varium</i> Swallen	<i>Bouteloua varia</i> (Swallen) J. T. Columbus
<i>Cyclostachya stolonifera</i> (Scribn.) Reeder & C. Reeder	<i>Bouteloua stolonifera</i> Scribn.
<i>Griffithsochloa multifida</i> (Griffiths) G. J. Pierce	<i>Bouteloua multifida</i> (Griffiths) J. T. Columbus
<i>Opizia bracteata</i> McVaugh	<i>Bouteloua bracteata</i> (McVaugh) J. T. Columbus
<i>Opizia stolonifera</i> J. Presl	<i>Bouteloua dimorpha</i> J. T. Columbus
<i>Pentarrhaphis annua</i> Swallen	<i>Bouteloua swallenii</i> J. T. Columbus
<i>Pentarrhaphis polymorpha</i> (E. Fourn.) Griffiths	<i>Bouteloua polymorpha</i> (E. Fourn.) J. T. Columbus
<i>Pentarrhaphis scabra</i> Kunth	<i>Bouteloua scabra</i> (Kunth) J. T. Columbus
<i>Pringleochloa stolonifera</i> (E. Fourn.) Scribn.	<i>Bouteloua reederorum</i> J. T. Columbus
<i>Soderstromia mexicana</i> (Scribn.) C. V. Morton	<i>Bouteloua mexicana</i> (Scribn.) J. T. Columbus

Basionym: *Atheropogon polymorphus* E. Fourn. Mexic. pl., vol. 2, p. 141. 1886.

***Bouteloua reederorum* J. T. Columbus, nom. nov.**

Replaced name: *Atheropogon stolonifer* E. Fourn. Mexic. pl., vol. 2, pp. 140–141. 1886.

Notes.—A new specific epithet is necessary on account of (1) the validly published *Bouteloua stolonifera* Scribn., (2) the validly published *B. pringlei* Scribn., which rules out the transfer to *Bouteloua* of *Opizia pringlei* Hack., a nomenclatural synonym of *Atheropogon stolonifer*, and (3) the absence of taxonomic synonyms. The epithet honors John R. Reeder and Charlotte O. Goodding Reeder, who have contributed much to our understanding of *Bouteloua*, including the discovery of dioecism in two species.

***Bouteloua scabra* (Kunth) J. T. Columbus, comb. nov.**

Basionym: *Pentarrhaphis scabra* Kunth. Nov. gen. sp., vol. 1, p. 178, pl. 60. 1816.

***Bouteloua swallenii* J. T. Columbus, nom. nov.**

Replaced name: *Pentarrhaphis annua* Swallen. *Ceiba* 4: 286–287. 1955.

Notes.—A new specific epithet is designated on account of (1) the validly published *Bouteloua annua* Swallen and (2) the absence of taxonomic synonyms. The epithet honors Jason R. Swallen, who described a number of species belonging to *Bouteloua*.

***Bouteloua varia* (Swallen) J. T. Columbus, comb. nov.**

Basionym: *Cathestecum varium* Swallen. *J. Wash. Acad. Sci.* 27: 498–499. 1937.

The change in generic circumscription affects the

names of 15 species. Listed in Table 1 are the binomials as employed under the former treatment and the corresponding names under the new treatment. Adding these species to the 39 recognized in Gould's (1980) treatment and three later additions (Reeder and Reeder 1981; Beetle 1986; Columbus 1996), *Bouteloua* now comprises 57 species.

I propose no subgeneric or sectional names at this time, pending additional sampling of taxa and greater knowledge of relationships (discussed above). The key remaining species of *Bouteloua* to be sequenced for ITS or *trnL-F* is *Bouteloua megapotamica* (Spreng.) Kuntze. Genera believed to be related to *Bouteloua* (e.g., Lamson-Scribner 1890; Clayton and Richardson 1973; Clayton and Renvoize 1986) and hence in need of sampling include *Melanocenchris* Nees (2 spp.), *Neobouteloua* Gould (2 spp.), and *Schaffnerella* Nash (1 sp.). *Neobouteloua lophostachya* (Griseb.) Gould was first described as a species of *Bouteloua* and treated as such in Griffiths' (1912) revision of the genus.

ACKNOWLEDGMENTS

I thank Mark Porter, Eric Roalson, and Victor Steinmann for helpful discussions and manuscript reviews.

LITERATURE CITED

- BEETLE, A. A. 1986. Noteworthy grasses from Mexico XII. *Phytologia* 59: 287–289.
- CLAYTON, W. D., AND S. A. RENVOIZE. 1986. Genera graminum: grasses of the world. *Kew Bull., Addit. Ser.* 13: 1–389.
- , AND F. R. RICHARDSON. 1973. The tribe Zoysieae Miq. Studies in the Gramineae: XXXII. *Kew Bull.* 28: 37–48.
- COLUMBUS, J. T. 1996. *Bouteloua chihuahuana* (Gramineae), a new nomenclatural combination. *Aliso* 14: 227.
- , M. S. KINNEY, R. PANT, AND M. E. SIQUEIROS D. 1998. Cladistic parsimony analysis of internal transcribed spacer region (nrDNA) sequences of *Bouteloua* and relatives (Gramineae: Chloridoideae). *Aliso* 17: 99–130.

- , ——, M. E. SIQUEIROS D., AND J. M. PORTER. In press. Phylogenetics of *Bouteloua* and relatives (Gramineae: Chloridoideae): cladistic parsimony analysis of internal transcribed spacer (nrDNA) and *trnL-F* (cpDNA) sequences. In S. W. L. Jacobs and J. Everett [eds.], Proceedings of the *Second International Conference on the Comparative Biology of the Monocotyledons and the Third International Symposium on Grass Systematics and Evolution*. Vol. 2. Grass systematics and evolution. CSIRO Publishing, Victoria, Australia.
- GOULD, F. W. 1979 [1980]. The genus *Bouteloua* (Poaceae). *Ann. Missouri Bot. Gard.* **66**: 348–416.
- GRIFFITHS, D. 1912. The grama grasses: *Bouteloua* and related genera. *Contr. U. S. Natl. Herb.* **14**: 343–428.
- LAMSON-SCRIBNER, F. 1890. New or little known grasses—II. *Bull. Torrey Bot. Club* **17**: 225–234.
- MCVAUGH, R. 1983. Flora Novo-Galiciana: a descriptive account of the vascular plants of western Mexico. Vol. 14. Gramineae. Univ. of Michigan Press, Ann Arbor.
- PIERCE, G. J. 1979. A biosystematic study of *Cathestecum* and *Griffithsochloa* (Gramineae). Ph. D. diss., University of Wyoming.
- REEDER, J. R. 1969. Las Gramíneas dioicas de México. *Bol. Soc. Bot. México* **30**: 121–126.
- , AND C. G. REEDER. 1963. Notes on Mexican grasses II. *Cyclostachya*, a new dioecious genus. *Bull. Torrey Bot. Club* **90**: 193–201.
- , AND ———. 1966. Notes on Mexican grasses IV. Dioecy in *Bouteloua chondrosioides*. *Brittonia* **18**: 188–191.
- , AND ———. 1980 [1981]. Systematics of *Bouteloua brevisetata* and *B. ramosa* (Gramineae). *Syst. Bot.* **5**: 312–321.
- SWOFFORD, D. L. 1998. PAUP*. Phylogenetic analysis using parsimony (*and other methods). Vers. 4.0 beta 1. Sinauer Associates, Sunderland, Massachusetts. Computer software.
- Errata to Columbus et al. 1998, *Aliso* **17**: 99–130.
- P. 106, Fig. 4, *Aegopogon* and *Pleuraphis*: AM, not A/M
- P. 111, col. 1, line 24: decay index of 1, not 1.0
- P. 112, col. 2, line 2: Pentarrhaphis, not Pentar raphis
- P. 121, Appendix 1: scale (·) and indel (+) markers should be shifted one nucleotide to the left
- P. 122, Appendix 1: scale 560 marker (·) should be moved one nucleotide to the right