NEW COMBINATIONS IN *CORYPHANTHA* AND *ESCOBARIA* (CACTACEAE)

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ABSTRACT

Most cactus taxonomists accept *Coryphantha organensis* as a synonym of *Coryphantha orcuttii*. Therefore, at infraspecific rank, *Coryphantha orcuttii* needs to be considered a variety (not a subspecies) of *C. sneedii* because *C. orcuttii* is partially sympatric with the type subspecies/variety of *C. sneedii* at Anthony's Nose, Doña Ana County, New Mexico. This requires a new combination for *Coryphantha orcuttii* and *Escobaria orcuttii* at the rank of variety, depending on whether you consider *Escobaria* to be a separate genus versus subgenus/section of *Coryphantha*. The two new combinations are: **Coryphantha sneedii** var. **orcuttii** comb. et stat. nov. and **Escobaria sneedii** var. **orcuttii** comb. et stat. nov.

RESUMEN

La mayoría de los taxónomos de cactus aceptan *Coryphantha organensis* como sinónimo de *Coryphantha orcuttii*. Sin embargo, a nivel infraspecífico, *Coryphantha orcuttii* necesita ser considerado una variedad (no una subespecie) de *C. sneedii* porque *C. orcuttii* es parcialmente simpátrico con la subespecie/variedad tipo de *C. sneedii* en Anthony's Nose, Doña Ana County, Nuevo México. Esto requiere una nueva combinación para *Coryphantha orcuttii* y *Escobaria orcuttii* en el rango de variedad, dependiendo si se considera o no que *Escobaria* sea un género separado del subgénero/sección *Coryphantha*. Las dos nuevas combinaciones son: **Coryphantha sneedii** var. **orcuttii** comb. et stat. nov. y **Escobaria sneedii** var. **orcuttii** comb. et stat. nov.

INTRODUCTION

While drafting a manuscript on cacti that survive unprotected outdoors in Canada (Gorelick et al. 2015), I wanted to use a combination for a plant taxon in the *Coryphantha sneedii* complex that has not been published. A few of the varieties/subspecies of *C. sneedii* (Britton & Rose) A. Berger, including *C. orcuttii* (Rose ex Orcutt) Zimmerman and the type variety/subspecies of *C. sneedii* Britton & Rose, are the only cacti that I have successfully grown unprotected in both Tempe, Arizona, USA where summer temperatures occasionally hit +50°C, and Ottawa, Ontario, Canada where winter temperatures often hit -30°C, and that is without wind chill.

The type subspecies/variety of *Coryphantha sneedii* appears to be ancestral (Baker 2004) to all other subspecies, varieties, and forms, which are spread out radially in all directions (Zimmerman 1985): '*leei*' and '*guadalupensis*' to the east; '*villardii*' to the northeast; '*sandbergii*' to the north; '*orcuttii*' to the west; two of Allan Zimmerman's unnamed varieties to the south; and '*albicolumnaria*' to the southeast. But, when first described, it was not obvious whether these infraspecific taxa in the *C. sneedii* complex were partially sympatric or allopatric with one another hence it was not obvious whether these were subspecies or varieties (or merely just forms).

Subspecies versus variety

Usage of 'subspecies' and 'variety' has at times been confused and has had a changing history in the more than two centuries since both terms have been in existence (Clausen 1941; Stuessy 2009). Meanings of these two infraspecific categories gradually stabilized by the mid 1900s (Clausen 1941), but there still is some contention about their usage even to this day (Stuessy 2009). I therefore begin by describing Clausen's (1941) definitions given in a paper titled *On the use of the terms 'subspecies' and 'variety'*, followed by Hamilton and Reichard's (1992) paper titled *Current practice in the use of subspecies, variety, and forma in the classification of wild plants*,

followed by Turner and Nesom's (2000) paper whose title begins *Use of variety and subspecies*, and finally Stuessy's (2009) definitions of subspecies and variety from his widely used text titled *Plant taxonomy*.

Subspecies are comprised of individuals with a consistent suite of morphological traits that differ from other individuals of the species due to geographic, ecological, or physiological isolation (Clausen 1941). Geographic and ecological isolation are easier for taxonomists to discern than physiological isolation, so I ignore physiology herein. Both varieties and subspecies have consistent morphological features. If that morphology is due to geographic or ecological variation, then Clausen (1941) called that taxon a subspecies, otherwise he called it a variety.

Hamilton and Reichard (1992: 491) "recogniz[ed] subspecies for groups primarily with greater geographic/ecologic distinctness than varieties..." Thus, like Clausen (1941), they required some modicum of geographic or ecological isolation. Hamilton and Reichard (1992) also noted that European plant taxonomists tend to use 'subspecies' more often, while North American plant taxonomist tend to use 'variety' more often.

Turner and Nesom (2000: 258) stated that, "use of the subspecies rank may point to larger patterns of variation and/or coherence within the species. This use of infraspecific categories finds support in the ICBN, which implies that the term subspecies is used for clustering varieties."

Stuessy (2009) did not so much define subspecies and variety, but provided a list of characters that are useful in distinguishing the two. These characters are in the following categories: morphology, geographic overlap, genetic divergence, likelihood of naturally hybridizing, and fertility of hybrids. For the *Coryphantha sneedii* complex, we really only know about geographic overlap and morphology, so can ignore the other characteristics, meaning that difference between subspecies and variety still depend on both morphology and geographical isolation, as was true three-quarters of a century ago (Clausen 1941). For Stuessy (2009), subspecies have a larger number of traits with morphological differences than do varieties. For Stuessy (2009), subspecies are largely allopatric or peripatric, while varieties can have somewhat overlapping distributions.

Some authors (e.g., Corogin & Judd 2014, in this journal) even seem to require that subspecies be allopatric. By contrast, "In American taxonomy, possibly the most widely accepted concept regarding varieties is that … varieties are expected to overlap in distribution …" (A. Michael Powell, pers. comm., 27 Dec 2014). Several authors outside of North America also require varieties, but not subspecies, to have overlapping distributions, e.g., "It is generally held that the rank of subspecies should be used for populations of a species that have several morphological differences and are geographically and/or ecologically separated, whereas varieties, also with some morphological differences, overlap in their distribution" (Newton & Thiede 2015: 30). Therefore in attempting to decide whether members of the *Coryphantha sneedii* complex are subspecies or varieties, we need to focus on number of morphological differences and especially on geographic isolation.

Coryphantha versus *Escobaria*

Should *Coryphantha sneedii* be placed into the segregate genus *Escobaria* Britton & Rose? From a purely formal view, this does not matter here because *Coryphantha sneedii* and *Escobaria sneedii* (Britton & Rose) A. Berger have both been validly published. I leave both options open, even though I consider *Escobaria* to be a subgenus [*Coryphantha* (Engelm.) Lem. subgenus *Escobaria* (Britton & Rose) A. Berger]. Other authors consider *Escobaria* to be a section of *Coryphantha* [*Coryphantha* section *Escobaria* (Britton & Rose) H.E. Moore] This portion of the paper should thus be considered dicta, i.e., this debate does not affect the conclusions of the rest of this paper because I will make combinations in both genera. Debates over whether *Escobaria* is a genus or a subgenus or a section of *Coryphantha* will probably continue for many years.

Any attempt to segregate *Escobaria* from *Coryphantha* will probably result in paraphyly. Thus the *Flora of North American* (Parfitt & Gibson 2003; Zimmerman & Parfitt 2003) subsumes *Escobaria* under the earlier valid genus epithet *Coryphantha*, as did Benson (1982), Powell and Weedin (2004), and most other North American authors. Paraphyly provides a reason to dismiss *Escobaria*, even though there are morphological differences, albeit not consistent morphological differences, between taxa considered to be *Escobaria* versus *Coryphantha*. Subgenus *Escobaria* has pitted seeds, whereas subgenus *Coryphantha* does not (Anderson 2001; Zimmerman & Parfitt 2003; Dicht & Lüthy 2005; Hunt et al. 2006), except for *C. gracilis* L. Bremer & A.B. Lau

(Taylor 1986; Dicht & Lüthy 2005). Most taxa in subgenus *Coryphantha* contain extra-floral nectary glands, whereas all taxa in subgenus *Escobaria* lack these glands (Zimmerman & Parfitt 2003; Dicht & Lüthy 2005). Subgenus *Escobaria* generally has smaller flowers, fruits, and seeds than subgenus *Coryphantha* (Castetter et al. 1975). For these reasons, most European authors consider *Escobaria* to be a valid genus (Dicht & Lüthy 2005), even if many North Americans do not (Zimmerman & Parfitt 2003).

But, with the logic of trying to avoid paraphyly, there may also be reason to dismiss *Coryphantha* as a genus and subsume it under *Mammillaria*. A phylogenetic analysis based solely on chloroplast markers showed *Coryphantha, Escobaria, Pelecyphora* Ehrenb., *Ortegocactus* Alexander, and *Neolloydia conoidea* Britton & Rose to all be embedded within *Mammillaria* Haw. (Butterworth & Wallace 2004), i.e., making both *Escobaria* and *Coryphantha* paraphyletic. However, it is not obvious how much weight to place on that 2004 molecular study because chloroplast inheritance is not always maternal in the Cactaceae (Corriveau & Coleman 1988; Gorelick 2014) and there is probably some alloploidy in this clade, e.g., the tetraploid *Coryphantha missouriensis* (Scheer) Britton & Rose (Weedin & Powell 1980), indicating the need for reticulate phylogenies. I therefore lean towards retaining use of *Coryphantha* as a genus, subsuming all *Escobaria* therein, but could be persuaded otherwise after more systematic analyses are performed based on both genotype and phenotype, especially if nuclear markers are used in constructing molecular phylogenies.

Coryphantha orcuttii, C. organensis, C. sneedii

In New Mexico, *Coryphantha orcuttii* ranges from the Peloncillo Mountains to the Florida Mountains (Ferguson 1998a). This taxon is also found in neighboring Arizona, Chihuahua, and Sonora. This range extends to the Organ Mountains if *C. organensis* Zimmerman is considered a synonym of *C. orcuttii* (see below). *C. orcuttii* and *C. sneedii* var. *albicolumnaria* (Hester) A.D. Zimmerman are by far the most widespread taxa in the *Coryphantha sneedii* complex.

The type subspecies/variety of *Coryphantha sneedii* is endemic to the Franklin Mountains in El Paso County, Texas, the southern end of the Organ Mountains in Doña Ana County, New Mexico, and some of the mountains between the two, e.g., Bishop's Cap and Anthony's Nose.

Given the huge amount of morphological variation and geographic range in the *Coryphantha sneedii* complex (Zimmerman 1985), it makes sense to follow the modern consensus amongst cactus taxonomists that *C. orcuttii* should be considered an infraspecific form of *C. sneedii* (Zimmerman & Parfitt 2003; Baker 2004; Powell & Weedin 2004; Hunt et al. 2006). Thus, *Coryphantha orcuttii* is usually considered to be a synonym of *Escobaria sneedii* Britton & Rose subsp. *orcuttii* (Boed.) Lüthy, but here I argue that a subspecies designation is inappropriate for this taxon. *Coryphantha orcuttii* seems to be morphologically indistinguishable from *Coryphantha organensis* (synonym: *Escobaria organensis* (Zimmerman) Castetter, P. Pierce, & K.H. Schwer.) (Ferguson 1998 a,b). The only morphological trait that supposedly consistently distinguishes *Coryphantha organensis* from the rest of the *C. sneedii* complex is a slight yellowish cast to spine color in *C. organensis* (Zimmerman 1972a; Taylor 1986; Ferguson 1998b). Color is typically a variable trait, often encoded by an allelic shift at a single genetic locus, thus at most warranting designation as a form, not a variety, let alone a subspecies (Stuessy 2009). Therefore many authors consider *C. organensis* to be a synonym of *C. orcuttii*, itself possibly subsumed under *C. sneedii* (e.g., Lüthy 1999; Hunt et al. 2006; U.S. Geological Survey's 'Integrated Taxonomic Information System' (ITIS; http://www.itis.gov/)). If *C. organensis* is a synonym of *C. orcuttii*, then the subspecies designation of *C. orcuttii* as *Escobaria sneedii* subsp. *orcuttii* and the hitherto unpublished combination *Coryphantha sneedii* subsp. *orcuttii* cannot be valid because *C. organensis* and *C. sneedii* subsp. *sneedii* have overlapping distributions at Anthony's Nose (Ferguson 1998 b,c; Gorelick 2006), which straddles the Texas-New Mexico border, and probably also have overlapping distributions at North Anthony's Nose ('nose' is an idiosyncratic local term for these mountains). Anthony's Nose and North Anthony's Nose are separated by Anthony Gap, through which runs New Mexico State Highway 404, at the northern end of the Franklin Mountains (Doña Ana County, New Mexico and El Paso County, Texas), south of Fillmore Pass and the Organ Mountains. Clausen (1941), Hamilton and Reichard (1992), Stuessy (2009), and Corogin and Judd (2014) all require allopatry or peripatry between two or more subspecies of a given species. Turner and Nesom (2000) do not require allopa-

try or peripatry between subspecies, but insist that a subspecies be an aggregate of two or more varieties. However, that is not the case here because *C. organensis* is a synonym of *C. orcuttii* and there are no other obvious varieties in the *Coryphantha sneedii* complex west of the franklin and organ Mountains. The only possible exceptions are *Escobaria orcuttii* var. *macraxina* Castetter, P. Pierce & K.H. Schwer. from the Big Hatchet Mountains and *Escobaria orcuttii* var. *koenigii* Castetter, P. Pierce & K.H. Schwer. from the Florida Mountains (Castetter et al. 1975; Taylor 1986), but nobody nowadays, including me, accepts these as valid varieties or even consistent forms or morphs. Therefore a subspecies designation is inappropriate for *Coryphantha orcuttii* seemingly regardless of usage of the designation 'subspecies'.

Instead of a subspecies designation, should *Coryphantha orcuttii* be considered a variety of *C. sneedii*? *Coryphantha orcuttii* is consistently morphologically different from *C. sneedii* subsp. *sneedii*, despite these two taxa being partially sympatric at Anthony's Nose. *Coryphantha sneedii* has many more shoots, sometimes hundreds more, than *C. orcuttii*, which is often solitary (Ferguson 1998a,c; Anderson 2001; Hunt et al. 2006). *Coryphantha sneedii* has smaller shoots (2.5–10 × 1.0–2.5 cm) than *C. orcuttii* (15 × 6–9 cm) (ibid). *Coryphantha sneedii* has shorter central spines (4.5–10 mm) than *C. orcuttii* (9–22 mm) (ibid). Seemingly the only viable alternative is therefore to consider *Coryphantha organensis* to be a synonym of *C. orcuttii* and then to classify *C. orcuttii* as a variety of either *Coryphantha sneedii* or *Escobaria sneedii* (not a variety of *Coryphantha strobiliformis* (Poselg.) Moran, where the name *orcuttii* currently exists at the rank of variety). This requires one of the following two new combinations, the choice of which depends on whether or not you consider *Escobaria* to be a separate genus of subgenus/section of *Coryphantha*:

Coryphantha sneedii var. **orcuttii** (Boed.) Gorelick, comb. et stat. nov. Basionym: *Escobaria orcuttii* Bödecker, Ein Mammillarien Vergleichs-Schlüssel 17. 1933. Type: U.S.A. New Mexico. Hidalgo Co.: Peloncillo Mountains, near Granite Pass, Mar 1926, *J.N. Rose s.n.* (lectotype, designated by Benson 1969: 26: DS).

Coryphantha strobiliformis (Poselg.) Moran var. *orcuttii* (Rose ex Orcutt) L.D. Benson, Cacti Ariz. ed. 3, 26. 1969.
Coryphantha orcuttii (Rose ex Orcutt) Zimmerman, Cact. Succ. J. (US) 44:156. 1972.
Coryphantha organensis Zimmerman, Cact. Succ. J. (US) 44:114. 1972.
Escobaria organensis (Zimmerman) Castetter, P. Pierce & K.H. Schwer., Cact. Succ. J. (US) 47:60. 1975.
Escobaria sneedii Britton & Rose subsp. *orcuttii* (Boed.) Lüthy, Kakt. and. Sukk. 50:278. 1999.
Escobaria sneedii Britton & Rose subsp. *organensis* (Zimmerman) Lüthy, Kakt. and. Sukk. 50:278. 1999.

Escobaria sneedii var. **orcuttii** (Boed.) Gorelick, comb. et stat. nov. Basionym: *Escobaria orcuttii* Bödecker, Ein Mammillarien Vergleichs-Schlüssel 17. 1933. Type: U.S.A. New Mexico. Hidalgo Co.: Peloncillo Mountains, near Granite Pass, Mar 1926, *J.N. Rose s.n.* (lectotype, designated by Benson 1969: 26: DS).

Coryphantha strobiliformis (Poselg.) Moran var. *orcuttii* (Rose ex Orcutt) L.D. Benson, Cacti Ariz. ed. 3, 26. 1969.
Coryphantha orcuttii (Rose ex Orcutt) Zimmerman, Cact. Succ. J. (US) 44:156. 1972.
Coryphantha organensis Zimmerman, Cact. Succ. J. (US) 44:114. 1972.
Escobaria organensis (Zimmerman) Castetter, P. Pierce & K.H. Schwer., Cact. Succ. J. (US) 47:60. 1975.
Escobaria sneedii Britton & Rose subsp. *orcuttii* (Boed.) Lüthy, Kakt. and. Sukk. 50:278. 1999.
Escobaria sneedii Britton & Rose subsp. *organensis* (Zimmerman) Lüthy, Kakt. and. Sukk. 50:278. 1999.

According to Zimmerman (1972b), Joseph N. Rose in 1926 named this taxon '*Neolloydia orcuttii*' (*nomen nudum*) for a specimen collected by Charles Russell Orcutt from Granite Pass, near the New Mexico-Arizona border, in the Peloncillo Mountains, and Rose did not designate a type. Granite Pass in the Peloncillo Mountains of New Mexico is almost certainly now known as "Granite Gap." I have been unable to trace when this wording change occurred other that it was on or before the mid 1950s (Gillerman 1957). The global unique identifier for the lectotype is "CAS:DS:307410." The California Academy of Sciences website (http://collections.calacademy.org/bot/) gives a collection date of 28 March 1926 for this specimen. According to Roy Mottram (pers. comm., 14 Feb 2014), Rose also provisionally published the combination '*Escobaria orcutti*' for this plant taxon in Cactography 4(1):5, 1926. Spelling of *orcutti* with a single '*i*' also appears in the documentation for *Coryphantha strobiliformis* in Benson (1982: 963), probably as a typographical error.

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CORRIGENDUM: NEW COMBINATIONS IN *CORYPHANTHA* AND *ESCOBARIA* (CACTACEAE)

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In the previous issue (9, no. 1, 2015) of this journal, I provided two new combinations—*Coryphantha sneedii* var. *orcuttii* and *Escobaria sneedii* var. *orcuttii*—based on the same basionym, *Escobaria orcuttii* Boed. (Gorelick 2015). Shortly thereafter, David Hunt kindly informed me that this contravenes the International Code of Nomenclature (Melbourne Code) Article 36.2 (McNeill et al. 2012) [previously the International of Botanical Nomenclature (Vienna Code) (McNeill et al. 2006) Article 34.2], which states:

> When, on or after 1 January 1953, two or more different names based on the same type are proposed simultaneously for the same taxon by the same author (so-called alternative names), none of them is validly published.

Therefore, I hereby correct this error by only proposing one of those two combinations, namely:

Coryphantha sneedii var. **orcuttii** (Boed.) Gorelick, comb. et stat. nov. BASIONYM: *Escobaria orcuttii* Boed., Ein Mammillarien Vergleichs-Schlüssel 17. 1933. TYPE: U.S.A. NEW MEXICO. Hidalgo Co.: Peloncillo Mountains, near Granite Pass, Mar 1926, *J.N. Rose s.n.* (LECTOTYPE, designated by Benson 1969: 26: DS).

Coryphantha strobiliformis (Poselg.) Moran var. *orcuttii* (Rose ex Orcutt) L.D. Benson, Cacti Ariz. ed. 3, 26. 1969.
Coryphantha orcuttii (Rose ex Orcutt) Zimmerman, Cact. Succ. J. (US) 44:156. 1972.
Coryphantha organensis Zimmerman, Cact. Succ. J. (US) 44:114. 1972.
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Escobaria sneedii Britton & Rose subsp. *orcuttii* (Boed.) Lüthy, Kakt. and. Sukk. 50:278. 1999.
Escobaria sneedii Britton & Rose subsp. *organensis* (Zimmerman) Lüthy, Kakt. and. Sukk. 50:278. 1999.

That previous paper in this journal (Gorelick 2015) was predicated on (1) *Escobaria orcuttii* being a variety, rather than a subspecies, because of sympatry with other taxa and (2) *Escobaria* Britton & Rose being either a subgenus or section of *Coryphantha* (Engelm.) Lem. Many European botanists have abandoned use of the rank variety ('varietas'). The Cactaceae Working Party of the International Organization for Succulent Plant Study (IOS) has also abandoned use of the rank variety, albeit apparently without complete consensus as reflected by the opening quote in that paper (Hunt 1999: 23; quoting Meregalli 1993):

> Probably one category only, below the species, would do for the great majority of infraspecific taxa, although in (possibly very few) cases some striking variants of low systematic value (i.e. not related to geographic/ecological isolation) may warrant recognition.

If *Escobaria orcuttii* is considered a subspecies of *Coryphantha sneedii*, which I do not advocate because of sympatry with the type variety/subspecies of *Coryphantha sneedii* at Anthony's Nose, then someone will have to propose the new combination *Coryphantha sneedii* subsp. *orcuttii*. If *Escobaria orcuttii* is considered a variety of *Escobaria sneedii*, which I do not advocate because of lack of consistent morphological differences between *Coryphantha* and *Escobaria*, then someone will have to propose the new combination *Escobaria sneedii* var. *orcuttii*, which was a nomen nudum in Gorelick (2015). Another plausible combination for this taxon, one for which I do not agree with the subspecies designation nor the choice of genus, would be *Escobaria sneedii* subsp. *orcuttii* (Boed) Lüthy, which has been validly published. A final possibility is that *Coryphantha orcuttii* is merely a form ('forma') of *Coryphantha sneedii*. But I am reluctant to invoke this last option without spending more time in Luna and Hidalgo Counties of New Mexico, especially given the seemingly consistent morpho-

logical differences between *Coryphantha sneedii* and *Coryphantha orcuttii* in terms of number of shoots, size of shoots, and length of central spines (Gorelick 2015 and references therein).

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