First on-line draft: March 1, 2012, updated: May 2013, June 2014, March/April 2016

UTAH'S OPUNTIAS

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Note: this is a work-in-process with additions/corrections to follow

Plants of the genus *Opuntia* are characterized by flat stems (or subcylindric to spheric in the case of *O. fragilis*), called pads, joints, or nopales. Similar to *Cylindropuntia* and *Grusonia* (previously included within *Opuntia*, and all part of subfamily Opuntioideae), they are unique in having areoles bearing glochids (short, barbed spines) and early deciduous ephemeral leaves. Unlike *Cylindropuntia* and *Grusonia*, *Opuntia* spines do not separate into a deciduous sheath.

Dry Fruits
Tan at maturity – note: dry fruits that have been parasitized will appear fleshy

Basilaris complex – pink-red filaments, white stigmas, subspheric seeds with smaller raphe, pink inner perianth parts

Current name, with author last names and as commonly abbreviated — see end notes)	Distribution and rank (NS=NatureServe) where appropriate	2n= **	Synonyms/variants/misapplied names/comments
O. basilaris Engelm. & Bigelow var. *basilaris*	In Utah found only in the s southwestern portion of state, prinicpally at low elevations in Wash Co. and disjunct in southeastern Kane Co.; also in AZ, NV, CA and northern Mexico. Var. *basilaris* is primarily a Mojave desert species.	22 (2x)	Taxonomic treatment has remained fairly constant, but has been generally confused with *O. aurea.* May form hybrids with *O. erinacea.* Pads bluish-gray, flattened to somewhat curved or wavy, heart-shaped, clavate-suborbicular to broadly obovate, numerous closely-spaced glochids (10-16 most often diagonally at mid-stem) Taxa in the *O. basilaris* complex appear to survive over a wide range as a hardy diploid; plants in this complex are typically surrounded by polyploids with which they only occasionally hybridize.
O. basilaris Engelm. & Bigelow var. *heilii* Welsh & Neese	Utah endemic restricted to a small area of Emery and Wayne Cos. NS rank: G5T2T3; of	22 (2x)	None. Counts thus far confirmed as 22 by Dean Stock (2013). Included as a synonym in FNA Vol. 4:145. 2003, and Pinkava (2003) under *O. basilaris*

	conservation concern.		var. *longiareolata* but referred to incorrectly as *O. heilii* Welsh & Neese (it was in fact published as a variety of *basilaris* in GBN, 43(4):700. 1983). Occurs near the Dirty Devil/Fremont/Muddy river system, Factory Butte, Hanksville, and Blue Benches. Replaced by *O. nicholii* at higher elevations. Similar distribution to *Sclerocactus wrightiae* in *wrightiae*'s SE range. Light green/green pads lack or mostly lack trichomes. Pads mostly obovate, occasionally spathulate or sub-cordate, yellow glochids, usually 5-6 diagonally at mid-stem (less closely spaced than other varieties). Flowers in hues of pale pink, off-white/pale chartreuse to pink filaments and style; stigma pale cream; pale yellow anthers This entity is very distinct from the one below and should not have been lumped into it; the most aberrant of the basilares.
O. basilaris Engelm. & Bigelow var. *longiareolata* (Clover & Jotter) Benson	Primarily occurs in Coconino Co. AZ (e.g. Lee's Ferry) and downstream in the Grand Canyon; in Utah relict in along the Colorado River drainage in extreme northeastern Garfield and northwestern San Juan Cos. (Cataract Canyon and just above, on the Colorado) NS rank: G5T2Q Of conservation concern particularly in Utah	22 (2x)	See above. We disagree with FNA and any other treatment that includes var. *heilii* within this entity. Sometimes misspelled as "longiaureolata." Specific epithet is not a diagnostic character; some areoles are elongated but not all. Occurs along the Colorado river system. Possibility of extremely relict, sparse occurrence in Glen Canyon before the dam. Darker green pads contain significantly fewer trichomes than var. *basilaris*. Spatulate pads, yellow-brown glochids, typically 8-9 diagonally at mid-stem. Pink/red-pink flowers. Midway in features between var. *basilaris* and var. *heilii*.

Polyacantha complex — white to yellow to pink-red filaments, green stigmas, seeds flat with larger raphe, inner perianth yellow to pink (listed alphabetically)

Current name	Distribution	2n=	Synonyms/variants/misapplied names/ comments
O. aurea Baxter	Restricted endemic in western Kane Co, mainly north of Kanab; adjoining AZ); *O. aurea* x *O. polyacantha* hybrids with variable morphology occur in Zion area and northwest to Iron Co./possibly west to Bull Valley Mtns and north end of Beaver Dam Mtns. Also hybrids up Long Valley to Panguitch. NS rank: G3 (S1 in Utah but appears secure)	66 (6x)	*O. basilaris* var. *aurea, O. erinacea* var. *aurea* Historically confused with spineless morphotypes of *O. polyacantha* as well as with *O. basilaris* generally Pads have scattered trichomes. Hybrid forms widespread throughout southern Utah in Washington, Iron and Kane Counties and north into Garfield Co. Has yellow flowers but pink when introgressed with *O. polyacantha* or *O. pinkavae*. East of Kanab (Johnson Canyon) and south of Colorado City, AZ. Hybridizes with *O. pinkavae*. Forms large hybrid swarms in both areas.
Opuntia fragilis (Nutt.) Haw.	A higher elevation species scattered mainly in the central-eastern half of the state in mountain brush communities as well as sandy foothill habitats, known in Utah from Box Elder, Carbon, Davis, Duchesne, Emery, Garfield, Juab, Kane, Morgan, Piute, Salt Lake, San Juan, Sevier, Uintah, Utah, Weber and Wayne Cos. Also in AZ, CA, CO, ID, IL, IA, KS, MI, MN, MT, NV (see Ribbens(2007), NM, ND, OK, OR, SD, TX, WA, WI, WY and Canada	66 (6x)	*O. brachyarthra* Rounded but often at least somewhat flattened when introgressed. Highly variable but normally distinct. Hybridizes with *O. polyacantha* and *O. aurea* where ranges overlap (may have evolved from the same group of diploid ancestors as *O. polyacantha*). In the general vicinity of Hatch, Utah it hybridizes with *O. aurea* hybrids (i.e., with *O. aurea* x *O. polyacantha*) producing some plants with pink flowers. Distribution in Morgan Co. has been confirmed. Small and inconspicuous, it may occur in other counties though not reported.
O. pinkavae Parfitt	Restricted Arizona Strip endemic in southwestern Kane Co. (not in Wash Co.); and northern Mohave and Coconino Cos., AZ NS rank: G3; likely of conservation concern in	88 (8x)	*O. rubrifolia* may be a synonym Hybridizes with *O. aurea*. Somewhat resembles in aspect the fleshy fruited *O. macrorhiza.* Distal spines slender, to stout; often white but can be dark red brown when new; to 6cm in length.

	Utah (conservation status largely unknown, may be secure in Arizona)		Included by Benson in the various morphotypes of *O. erinacea var. utahensis* (which is not however a synonym of this taxon). Parfitt indicates that *O. basilaris* var. *woodburyi* (invalidly published) belongs here but it does not.
Opuntia sp. *nov.* Stock or hybrid form	Under study. Restricted endemic occurring solely in extreme southwestern Utah (Wash. Co.) Of conservation concern; threats include off-road vehicles, overgrazing, habitat loss	88 (8x)	*O. basilaris* var. *woodburyi* (invalidly published), *O. erinacea* var. *woodburyi* A seemingly stable entity of possible hybrid origin between *O. pinkavae* and O. *aurea* and now isolated from its parent species. Distinguished by relative lack of spines, Spines often yellow, especially when new; larger size; and a distinct green color of pads. Glochids often conspicuous.
Opuntia polyacantha complex: *Opuntia polyacantha* Haw. var. *polyacantha*	While plants in northern and northeastern UT were previously placed here, it appears that this var. in fact mostly does not occur in Utah except at distant edges in Rich and Box Elder Cos. Reported from AZ, CO, ID, KS, MT, NE, NV, NM, ND, OK, SD, TX, WY and Canada	44 (4x)	Derived in part from *O. trichophora* Hybrid entries have been assigned names within the polyacantha complex used to reference plants not referred to elsewhere below include: *O. barbata* *O. heacockiae* O. *juniperina, O. polyacantha* var. *juniperina,* *O. erinacea* var. *juniperina*, *O. media* *O. missouriensis* (and in combination with numerous varietal names in addition to those mentioned here – said to occur as low as 4,200 ft in the SL Valley by Watson) *O. polyacantha* var. *salmonea* *O. polyacantha* var. *spirocentra* *O. polyacantha* var. *watsonii* *O. rufispina , O. polyacantha* var. *rufispina* *O. rutila* (said to have occurred from Fillmore to St. George by Watson)

			O. schweriniana, O. polyacantha var. *schweriniana* *O. splendens* *O. rhodantha, O. erinacea* var. *rhodantha, O. xanthostemma, O. erinacea var. xanthostemma*. Per Parfitt (1997), the type of *O. erinacea* var. *utahensis* is a few-spined individual within the range of this taxon. Northern Utah plants in the past referred to as *O. rhodanth*a and *O. erinacea* var. *utahensis* probably belong here. Garrett and others misapplied morphotypes of this var. to: *O. utahensis* Purpus (a form with unknown relationships), *O. hystricina*, and *O. angustata*. The names *O. rhodantha, O. erinacea* var. *utahensis* (and *O. erinacea* without a varietal name) have been misapplied and often misdescribed when referencing this taxon in northern UT. An earlier name *Opuntia sphaerocarpa* var. *utahensis* corresponds to the valid but no longer recognized name of *O. erinacea* var. *utahensis* (Engelm) Benson (these are not the same as *O. utahensis* Purpus, but all are moot)
*O. polyacantha** x *O. macrorhiza* x *O. fragilis* *and potentially others	Plants in northern Utah, particularly in the Wasatch are introgressed and may be partially or completely spineless.	44 (4x)	See some of the names listed in var. *polyacantha*. Reduced spine to spineless plants of hybrid origin have frequently been described as new entities and/or misidentified.
O. erinacea Engelm. & Bigelow syn. *O. polyacantha* Haw. var. *erinacea* (Engelm. & Bigelow) Parfitt	Southwestern Utah (e.g., Virgin Mtns) to Zion in Virgin River Valley, becoming part of the hybrid mix in the western half of the state; also in AZ, CA and NV	44 (4x)	*O. ursina, O. erinacea* var. *ursina,, O. hystricina* var. *ursina* See also some of the names listed in var. *polyacantha*. Contributes to the hybrid mix in the Great Basin continuing well to the north but mostly

			south of the Great Salt Lake and Utah Lake but absent from eastern Utah.
Misapplied in Utah: *O. polyacantha* Haw. var. *hystricina* (Engelm. & Bigelow) Parfitt	Absent from Utah contrary to what was previously thought. Also in: AZ, CA, CO, NV and NM	44 (4x)	The 66 chromosome plants which occupy a large habitat along the Colorado Plateau with likely incursions into the Uinta Basin is *O. nicholii*. *O. hystricina, O. erinacea var. hystricina*
O. nicholii Benson syn. *O. polyacantha* Haw. var. *nicholii* (Benson) Parfitt	Formerly thought to be restricted to Glen Canyon drainage in Garfield (?), Kane, San Juan Cos., but now known to occupy a larger area in southeastern Utah's canyon country; barely in northern Coconino Co., AZ NS Utah rank: S1S2 But not now likely to be of conservation concern	66 (6x)	Most of what was thought to be *O. hystricina* in southeastern Utah is this entity. This form should be recognized at the species level. It is a distinct form derived from ancient ancestors in common with *O. polyacantha*. It has no relationship to *O. phaeacantha* as often described in the literature. It does hybridize however with *O. phaeacantha* particularly in southeastern Utah forming reduced spine hybrids. *O. nicholii, O. hystricina* var. *nicholii* Occurs east of *O. aurea* and *O. pinkavae* but hybridizes with *O. pinkavae* <u>*in House Rock Valley, AZ.*</u>
O. trichophora (Engelm. & J.M. Bigelow) Britton & Rose syn: *O. polyacantha* Haw. var. *trichopora*	In Utah, occurs only in Grand and San Juan Cos. Curving/curly/flexible hair-like appressed spines and small stem segments Reported also from AZ, CO, NM and TX.	22 (2x)	Treated by Parfitt (1991, see p. 87) and previously by us as a morphotype within the *O. polyacantha* complex but which has been found to be diploid, and appears to in fact be an ancestral plant whose genes have been passed along in tetraploid plants and hence the reason for Parfitt's observation that it is found in the range of the species. More properly recognized at the species level.

(Engelm. & Bigelow) Coulter			*O. trichophora ,O. polyacantha* var. *trichophora, Opuntia missouriensis* var. *trichophora*

Fleshy fruits
At maturity orange to red or very dark red throughout. Listed alphabetically.

White to yellow filaments, yellow to green stigmas, seeds flat with larger raphe, inner perianth yellow (sometimes with red base) to orange-red

Current name	Distribution and rank	2n=	Older names/comments
O. chlorotica Engelm. & Bigelow	Limited distribution in Utah in Wash. Co. (a state rare species); also in AZ, CA, NV, NM and Mexico NS Utah rank: S1; of conservation concern in Utah	22 (2x)	*O. palmeri* may be a synonym Known to hybridize with *O. phaeacantha* elsewhere Typically in south/southwestern facing sandstone rock crevices To be sought in southwestern Kane Co. (plants occur within two miles of the Utah border southwest of the Coral Pink Sand Dunes, in Mohave Co., AZ
O. macrorhiza Engelm. var. *nov.* Frates, Woodruff & Harrison	Primarily in Salt Lake and Davis Cos. but also in Weber and the eastern edge of Box Elder, and to be expected in Cache Co. Distant and ongoing hybridization is evident with *O. polyacantha* var. *hystricina* with more significant ongoing contact in northern Davis County, and with intermittent zones of ongoing contact northward. So far only known from along the western flank (i.e. the Wasatch Front) of the Wasatch Mtns. Occurs	44 (4x)	At species level, some prior references used in Utah have included: *O. compressa* var. *macrorhiza; O. mesacantha* var. *macrorhiza.* *O. compressa* without the inclusion of a varietal name was formerly used to refer to this entity in Utah Not synonymous with *O. utahensis* Purpus (the type of which is uncertain and the specimen is not a match) A canyon rims/higher elevation species. Poorly understood, greatly confused with *O. phaeacantha, O. aurea* and varieties of *O. polyacantha* with which it also hybridizes. Diploid counts 2n=22 first reported by

	slightly to the interior of the central to northern Wasatch range where where Lake Bonneville was able to penetrate. Very limited occurences of the species occurs in Kane and San Juan Cos. (although in San Juan Co. plants are hybrids with *O. trichophora*) are likely best classified as *O. macrorhiza* var. *macrorhiza*. Increasingly rare, of conservation concern. U.S. distribution of *Opuntia macrorhiza* as a whole is somewhat uncertain due to many misidentifications, FNA reports as : AZ, AK, CO, KS, MO,NM, OK, TX and Mexico as reported by FNA, however, this misses reports in IL, LA,OH, NE, SD, and WI (some of which may be confused with other species/morphotypes) USDA indicates also ID and MT however we have reviewed the lone ID specimen and consider it at best a hybrid; MT is unconfirmed		Majure (2012) from Texas. Baker (2009) reports 2n=55 for a, *O. macrorhiza* x *O. phaeacantha* from Arizona Hybridizes with *O. polyacantha* and others. See also Lucas (2012) where diploids in eastern Texas and southeastern New Mexico are discussed. Suspected to hybridize with *O. pinkavae* or involved in its lineage or both. Plants in Weber Co. and Box Elder are somewhat more introgressed. Reports of the species from southwestern Utah including Zion National park largely in error, or involve possible hybrid plants including small pockets in esatern Washington and southwestern Kane) Cos., frequently misidentified, and has been misreported as being abundant; overall status uncertain with hybrid forms; not in La Sals and not verified elsewhere except for the Glendale Bench in Kane Co. area and near the eastern border of Zion National Park plus one small unusual occurrence under investigation in the Natural Bridges Monument area where there is introgression with *O. trichophora*. East/West Kaibab Plateau plants in adjoining AZ below 7000' are somewhat O. phaeacantha influenced but appear to be strongly related.
O. engelmanii Salm-Dyck ex Engelm. var. *engelmanii*	Mainly Wash Co., also San Juan. Also in: AZ, CA, NV, NM, TX and Mexico	66 (6x)	Large upright plants with concolor yellow flowers, white spines. This form is widely introgressed with *O. phaeacantha* in southern Utah's Virgin River valley and may only be in

			relatively pure form within Zion Canyon. Appears to be maintaining its form within large population of *O. phaeacantha* by apomictic reproduction. *O. discata, O. phaeacantha* var. *discata, O. megacarpa. O. procumbens, O. angustata* A lower elevation species. Hybridizes with *O. phaeacantha*; often confused with that taxon. See discussion elsewhere re: *O. woodsii* The name *O. tenuispina* was used by Angus Woodbury in 1933 to refer to Zion NP occurrences of *O. engelmanii*. *O. tenuispina* is a synonym of *O. pottsii* (*O. macrorhiza* var. *pottsii*) which does not occur in Utah.
O. phaeacantha Engelm. var. *phaeacantha*	Beaver, Millard (Wah Wah Mtns), eastern/northeastern Sevier (Upper Ivie Creek; Link Canyon), Garfield, Grand, Iron, Kane, San Juan, Washington, and (eastern to central-western) Wayne Cos. Also in: AZ, CA, CO, KS, NV, NM, OK, SD (?), TX and Mexico Primarily found in Utah in Washington, Kane, San Juan and Grand Cos. with scattered occurrences in other counties in the southern half of the state.	66 (6x)	*O. phaeacantha* var. *major, O. gilvescens, O. phaeacantha var. laevis, O. laevis* (the spineless "laveis" form is known from the Beaver Dam wash area in Wash. Co.) *O. woodsii* Backeb**.** (or *O.* x *woodsii)* is also a name synonymized by some sources to this taxon but more properly refers to hybrids with *O. engelmanii* from Zion Park and into the Virgin River Valley. *O. phaeacantha* has a more northerly distribution in Utah that has been previously documented and may be a Holocene relict, and more responsible for creating reduced spine hybrids that has previously been realized. Welsh 23187A places it in northeastern Sevier near its border with Emery and Sanpete Cos line, and it is known from the Fremont Junction area where various hybrids are also found (with both *O. fragilis* and *O.* cf. *nicholii*). In Colorado, its most northerly known distribution is about seven miles north of Boulder in Boulder County, Colorado (roughly the same latitude as northern Utah Co./Tooele Co. in Utah).

O. phaeacantha Engelm. var. *castorea* Welsh & Atwood	Utah endemic in the Beaver Dam Wash/ Mtns, Wash Co. Extent of rarity unknown; included in UNPS 2009 watch list; conservation concern unknown	66? (6x)	Named in 2003. Not accepted as a valid segregate by some authorities. These large flowered/fruited forms are largely restricted to the wash area where non-native *O. santa-rita* were planted by local ranchers. It is not known if hybridization has occurred. This form deserves further study.

Introduced and possibly escaped: cacti are commonly used in horticulture throughout the state. These are usually confined to private or public gardens. Washington Co.'s favorable climate allows for the possibility of some imported plants persisting and creating biologic confusion.

Current name	Distribution	**2n=**	Synonyms/variants/misapplied names/ comments
O. santa-rita (Griffiths & Hare) Rose	Introduced in Utah in the Beaver Dam Wash, Wash. Co. Native to southern Arizona and Sonora Mexico	22 (2x)	*Opuntia chlorotica* var. *santa-rita* *Opuntia violacea* var. *santa-rita* Established plants were observed on the Terry's Ranch in the late 1940's to early 50s by A. Dean Stock. A gas station at Beaver Dam, Arizona had a cactus collection; local ranchers acquired plants from the station and planted them in the Beaver Dam Wash. A large plant still exists in front of the main building at BYU's Lytle Ranch Preserve. Not determined if plants have become naturalized in area.

END NOTES:

*As a result of other changes in more modern treatments of the Cactaceae, all species in Utah that fall into the genus *Opuntia* are plants with flat pads since the chollas previously called *Opuntia acanthocarpa, O. echinocarpa* and *O. whipplei* now fall under the genus *Cylindropuntia*, and *O. pulchella* is now placed under *Grusonia.*

**Cacti generally: x=11

Author abbreviations of Utah native species:

Baxter Edgar M. Baxter (1903-1967)
Benson Lyman D. Benson 1909-1993 (often abbreviated as L. Benson or L.D. Benson)
Backeb. Curt Backeberg (1894-1966)
Clover & Jotter Elzada U. Clover (1897-1980), Mary Lois Jotter (Lois Jotter Cutter) (b. 1914)+
Engelm. & Bigelow George Engelmann (see below) and John M. Bigelow (1804-1878)
Engelm. George Engelmann (1809–1884)
Haw. Adrian H. Haworth (1768–1833)
Neese Elizabeth J. Neese (1934-2008)
Nutt. Thomas Nuttall (1786–1859)
Parfitt Bruce D. Parfitt (1953-2009)
Welsh & Atwood Stanley L. Welsh (b. 1928) and N. Duane Atwood (b. 1938)

+Clover and Jotter were the first women to float completely through the Colorado system (1938)

Taxa either indicated elsewhere as occurring in Utah but which do not actually occur here, or which no longer have any direct conceptual relationships with our plants:

*O. martiniana (*syn. *O. littoralis* var. *martiniana)* — not a distinguishable taxon

O. covillei was also used to distinguish certain plants from *O. phaeacantha* (mainly to distinguish Benson's O. *littoralis* var. *martiniana* so in that sense the two are synonymous, but, these names now do not apply to Opuntias in Utah and have no direct connection to any of our plants as currently understood; these names have been since synonymized with taxa that occur elsewhere.

O. humifusa, an eastern U.S. species which does not occur in Utah

O. debreczyi, described in 2005 by an overseas author based on a plant in horticulture since 1973 and purported by some to extend into Utah appears to be an *Opuntia fragilis* hybrid and relates to morphotypes that may not comprise a taxon and cannot in any event be considered as appropriate for use for any *Opuntia* species in Utah and probably also not elsewhere.

Acknowledgements:

We gratefully acknowledge the contributions and suggestions made by *Opuntia* researchers Drs. A. Dean Stock and Lucas Majure (University of Florida and Desert Botanical Gardens). Both Stock and Majure have made numerous chromosome counts of materials from Utah and adjoining states.

Special thanks to various herbarium curators and collection managers at Utah State University, the University of Utah and in particular the late Ann Kelsey of the Garrett Herbarium, and BYU, and many others in different states.

Field and other observations at various times have been contributed by Kipp Lee, Blake Wellard, Walt Fertig and Bill Gray.

Coloradans Scott Smith and the late Dale Denham provided valuable insight and materials with respect to the distribution of certain pricklypear taxa in their state for comparison with Utah materials, particularly with respect to *Opuntia macrorhiza*.

References:

[To be added: all of the early Utah floras and additional publications we have reviewed]
[To be added: Watson reference and then coordinate reference with text above re: 4200 ft valley location]

Baker MA,Rebman JP, Parfitt BD,Pinkava DJ, Zimmerman AD. 2009. Chromosome numbers in some cacti of Western North America-VIII. *Haseltonia* 15:117-134.

Benson L. 1977. The cacti of Arizona. 3rd ed. Tucson, Arizona: University of Arizona Press. 218 pp.

Breslin P, Romero R, Starr G, Watkins V. 2015. Field guide to cacti and other succulents of Arizona. Tuscon, Arizona: Tucson Cactus and Succulent Society. 302 pp.

Grant, V, Grant KA. 1979. Systematics of the *Opuntia phaeacantha* group in Texas. *Bot. Gaz.* 140(2):199-207.

Holmgren NH, Holmgren PK, Reveal JL and others. 2012. Intermountain flora: Vascular plants of the Intermountain West, U.S.A. Vol. 2A, Subclass Magnoliidae-Caryophyllidae. Bronx, New York: The New York Botanical Garden. 731 pp.

Majure LC, Judd WS, Soltis PS, Soltis DE. 2012. Comparative Cytogenetics. CompCytogen 6(1): 53–77.

Parfitt BD. 1991. Biosystematics of the *Opuntia polyacantha* complex (Cactaceae) complex of western North America. PhD. Thesis. Arizona State University. 115 pp.

Pinkava DJ, Rebman JP, Baker MA. 1998. Chromosome numbers in some cacti of western North America, VII. *Haseltonia* 6:32–41.

Pinkava, DJ. 2003. Opuntia. In: *Flora of North America North of Mexico,* Flora of North America Ed. Comm., eds. 1993+. 16+ vols. New York. Vol. 4, pp. 123-150.

Powell AM, Weedin JF. 2001. Chromosome numbers in Chihuahuan Desert Cactaceae. III. Trans-Pecos Texas. *American Journal of Botany* 88(3):481-485

Ribbens E. 2007. *Opuntia fragilis*: taxonomy, distribution and ecology. *Haseltonia*(14):94-110

Van Buren R, Cooper JG, Shultz LM, Harper KT. 2011. Woody Plants of Utah: A Field Guide with Identification Keys to Native and Naturalized Trees, Shrubs, Cacti, and Vines. Logan: Utah State University Press. 513 pp.

Webb RH, Melis TA, Valdez RA . 2002. Observations of Environmental Change in Grand Canyon, Arizona. USGS Water-Resources Investigation Report 02-4080. 33 pp.

Welsh SL, Neese E. 1983. New variety of *Opuntia basilaris* (Cactaceae) from Utah. Great Basin Naturalist 43(4):700.

Welsh SL. 1984. Utah flora: Cactaceae. Great Basin Naturalist 44(1):52-69.

Welsh SL, Atwood ND, Goodrich S, Higgins LC [eds]. 2008. *A Utah Flora.* 4th ed., rev. 2004-2008 summary monograph. Provo, Utah: Brigham Young University. 1019 pp.

Welsh SL, Atwood ND, Goodrich S, Higgins LC [eds]. 2015. A Utah flora, fifth edition, revised. 2015 summary monograph. Provo, Utah: Brigham Young University. 987 pp.

Woodruff DW. 2012. *Opuntia basilaris* var. *heilii*, a rare Utah endemic. Sego Lily 35(3):10-11.

Woodruff DW. 2012. *Opuntia basiliaris* var. *heilii*. Lecture/presentation at annual Utah Rare Plant Meeting held on March 6, 2012 co-hosted by Red Butte Garden and the Utah Native Plant Society. Salt Lake City, UT: University of Utah.

Wright D. 1973. Cactaceae – Cactus Family. In: Welsh S, Moore G, editors. Utah plants tracheophyta. 3rd ed. Provo, Utah: Brigham Young University Press. p. 63-65.

Revision history: First draft: 11/25/09; updated: 11/27/09; 8/22/10, 11/8/10, 11/13/10,12/3/10, 12/5-6/10,12/30/10,1/27/11,2/22/11, 7/29/11, 11/25/11,2/20/12 and revised/reviewed for the first on-line edition in February 2012; updated 5/30/13, June 2014, March 2016). Citation to this article:

Frates AJ, Woodruff DW, Harrison T. 2016 [cited {access date}]. Utah's Opuntias. [Internet]. Salt Lake City, UT: Utah Native Plant Society. Available from: http://www.unps.org/UtahOpuntias.pdf