Changed *Berberis fremontii* from CRPR 3 to 2B.3, and added *Berberis higginsiae* to CRPR 3.2 in the CNPS Inventory on April 30, 2014

Rare Plant Status Review: *Berberis fremontii* and *B. higginsiae*
Proposed Rank Change of *B. fremontii* from CRPR 3, G5 / S2? to 2B.3 ~~4.3~~, G5 / S2S3
Proposed Re-addition of *B. higginsiae* to CRPR 3.2, G4Q / S2

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Changes made to the original document appear in blue text.

Background - taxonomy

Berberis fremontii is a shrub in the Berberidaceae that is currently included on California Rare Plant Rank (CRPR) 3 of the CNPS Inventory, while its closely-related congener *Berberis higginsiae* is treated as "Considered But Rejected" (CBR) from the Inventory, due to being too common. The closely-related *Berberis haematocarpa* has also been proposed for inclusion in the Inventory, but has not been reviewed until now. *Berberis higginsiae* is known only from the Peninsular Ranges of San Diego County and Baja California. In California, *Berberis fremontii* is known from the eastern and southern Mojave Desert and a few scattered occurrences in the western Mojave, but is also sometimes included within the range of *B. higginsiae*, where the two taxa are thought to overlap morphologically. *Berberis haematocarpa* was treated by Williams (2012) as occurring in the eastern and southern Mojave Desert, but subsequent information suggests that it does not occur in California. All three of these taxa are included in *The Jepson Manual, Second Edition* (Williams 2012) and the *Flora of North America* (Whittemore 1997), but *B. higginsiae* was treated as a synonym of *B. fremontii* in *The Jepson Manual* (Williams 1993).

Berberis higginsiae and *B. fremontii* have a fairly long history of rank changes in the CNPS Inventory. *Berberis higginsiae* was added to the First Edition of the CNPS Inventory (Powell 1974); although a different ranking system was used, it essentially was treated as what is currently CRPR 1B.2. In the Second to Fourth Editions (Smith et al. 1980; Smith and York 1984; Smith and Berg 1988), under the name *Mahonia higginsiae*, its rank was equivalent to our current CRPR 2B, probably due to information showing that the plant was more common than previously thought in Baja California (see Moran 1982). Since Williams (1993) placed *B. higginsiae* in synonymy with *B. fremontii*, the Fifth and Sixth Editions of the CNPS Inventory (Skinner and Pavlik 1994; RPSAC and Tibor 2001) changed the name of the plant from *Mahonia higginsiae* to *Berberis fremontii*. In these editions the name *Berberis fremontii* was applied in a broad sense, to include both *B. higginsiae* and *B. haematocarpa* as synonyms. This was done in contrast to Williams (1993), which recognized *B. haematocarpa* as distinct from *B. fremontii*, but with the caveat that the two species intergrade. Despite this broader taxonomic concept, Skinner and Tibor (unpublished notes1995) noted that "the resulting taxon is nevertheless rare in California". The CNNDB (2013) currently treats *B.*

fremontii in the broad sense, with occurrences from San Diego County that could be attributable to *B. higginsiae*.

Although all three of these taxa are recognized by Whittemore (1997) and Williams (2012), both M. Williams and J. Andre (pers. comms. 2013) now feel that the California plants that have been treated as *B. haematocarpa* should actually be treated as *B. fremontii*. McMinn (1939) similarly only recognized *B. fremontii* for California. Andre (pers. comm. 2013) observed that the California plants of *B. fremontii* have terminal leaflets that are not nearly as elongated as those of typical *B. haematocarpa* from southeastern Arizona to Texas. The leaves of California plants are also not as glaucous as typical *B. haematocarpa* (J. Andre pers. comm. 2013). Therefore, we recognize all of the Mojave Desert plants as *B. fremontii*, and will include *B. haematocarpa* as Considered But Rejected (CBR) from the CNPS Inventory, as it does not occur in California.

The recognition of *Berberis higginsiae* as a species is somewhat questionable, particularly due to variation in leaflet morphology. *Berberis higginsiae* is separated from *B. fremontii* in that it has terminal leaflets with a length that is less than twice the width (versus more than twice the width in *B. fremontii*) and yellow-red berries that are somewhat glaucous (versus heavily glaucous) and not inflated (versus sometimes inflated in *B. fremontii*) (Williams 2012). Here we address each of those morphological characters. While terminal leaflet shape is of taxonomic importance (J. Andre pers. comm. 2013), terminal leaflets on plants just south of the border often have variable terminal leaflets on individual plants, sometimes with a length up to 4.5x the width (Whittemore 1997). According to B. O'Brien (pers. comm. 2013), berry color can be used to easily separate *B. higginsiae* from *B. fremontii*. However, Moran (1982) observed that Baja California plants mostly lack berries, and J. Andre (pers. comm. 2013) suggested that berry color does not work as a taxonomic character, at least in the Mojave Desert. Regarding fruit inflation, Williams (1993, 2012, and pers. comm. 1993) suggested that the inflated fruit of *B. fremontii* is caused by wasp parasitism (due to the presence of exit holes), but its correlation with leaflet morphology suggests that it may be of taxonomic significance, and might not result from wasp parasitism (A. Sanders. pers. comm. 2013, A Whittemore pers. comm. 2007). The difficulty in definitively identifying plants from the Peninsular Ranges is reflected in recent treatments that question whether or not *B. higginsiae* should be recognized and point out a need for further study of the group (Moran 1982, Whittemore 1997, Williams 2012). Williams (pers. comm. 2013) noted that the taxonomy surrounding *B. higginsiae* is "still a bit muddled", and that further study is needed.

Background specific to *B. fremontii*

For the remainder of this review document, we refer to *B. fremontii* in a narrower sense: it includes the California plants previously treated as *B. haematocarpa* from the Mojave Desert, but does not include plants from the Peninsular Ranges that are assigned to *B. higginsiae*. Future study could show that *B. higginsiae* from the Peninsular Ranges should actually be synonymous with *B. fremontii*, or that both taxa occur in the

Peninsular Ranges. For simplicity, however, we refer all of the Peninsular Range plants to *B. higginsiae* and all of the Mojave Desert plants to *B. fremontii*.

Berberis fremontii occurs in Joshua tree woodland and pinyon/juniper woodland, in rocky, sometimes granitic soils. It occurs in California from about 1145 to 1720 meters in elevation. Although collections have been made between January and October, many specimens may have been collected when not in flower, so we accept Williams' (2012) flowering period of March to May. Fruit is a more valuable trait for identification, and the phenology of flowering time is not very important to field biologists.

Despite a fairly large number of collections in the Consortium of California Herbaria (CCH 2013), *Berberis fremontii* is known from about 19 occurrences in the state. We included all of the specimens treated as *B. fremontii* or *B. haematocarpa* from the Mojave Desert. Fourteen of the occurrences of *B. fremontii* are in the Mojave National Preserve, while three are on BLM lands, and two have an unknown landowner. Ten of the 19 occurrences have been seen recently (occurrences not seen in the past 20 years are considered historical by the CNDDB). However, the historical status of its occurrences may not be significant; there has been little or no land use change in its area of occupancy, so the probability of the plants still being present is considered to be high. Many of the occurrences consist of small populations, but label data for two occurrences note the plant as being locally common. Although *B. fremontii* is known from a fairly small number of locations in California, it may be under-collected, given the remoteness of the areas where it occurs and the need for more botanical collecting in those areas. Williams (pers. comm. 2013) commented that the plant is scattered but fairly common in eastern Mojave Desert ranges and foothills.

Outside of California, *B. fremontii* is common; it is found in Arizona, Colorado, Nevada, New Mexico, Utah, and Mexico (Sonora) (SEINet 2013; NatureServe 2013; Holmgren and Holmgren 2012). *Berberis fremontii* is not ranked as rare in any other state (NatureServe 2013).

Threats to *B. fremontii* should be considered minimal, as most occurrences are in the Mojave National Preserve (J. Andre pers. comm. 2013).

Based on the available information, CNPS and CNDDB recommend changing *B. fremontii* from CRPR 3 to CRPR 2B.3 ~~4.3~~ in the CNPS Inventory. Although ~~the number of occurrences suggests a greater degree of rarity,~~ the lack of threats and remoteness of occurrences suggest that CRPR 4 may be ~~is more~~ appropriate at this time, its limited number of occurrences, limited range within one of the best collected and explored parts of the eastern Mojave Desert in California, suggest CRPR 2B is more appropriate at this time. Here, we propose that none of the plants from the Peninsular Ranges be included within *B. fremontii*, and that they instead be treated as *B. higginsiae*. If future taxonomic work shows that *B. fremontii* does occur in the Peninsular Ranges, CNPS and CNDDB will re-evaluate its status at that time~~, although it could be appropriate to retain it on CRPR 4~~.

Background specific to *B. higginsiae*

Berberis higginsiae is only known from chaparral and Sonoran Desert scrub. It is endemic to southern San Diego County and northern Baja California (Williams 2012) and occurs from about 325 to 1065 meters in elevation within California (CCH 2013; CNDDB 2013). Although it has been collected between January and August, it may have been collected when not in flower, as flowers are not a useful taxonomic character. Therefore, we accept the flowering time of March to April that was provided by Williams (2012).

There are only about seven known occurrences of *B. higginsiae* in California, all of which are known from the Jacumba-Boulevard area of San Diego County. Most of these are currently included as *B. fremontii* in the CNDDB (EO #s 1, 2, 3, 4, 12, and 17). Review of the literature found an additional population in a highway median (Reiser 1994). The inhospitable habitat where it grows may be responsible for its under-collection in California. Williams (pers. comm. 2011 and 2013) noted that *B. higginsiae* is very common along the U.S.-Mexico border and to the south, where it grows in very dense chaparral. Most of the occurrences have an unknown or private landowner, while one occurrence is in Anza-Borrego Desert State Park (ABDSP), and another one is partially in a California Department of Fish and Wildlife (CDFW) Reserve.

Berberis higginsiae faces a number of threats throughout the California portion of its range. Some of the locations of *B. higginsiae* are proposed for wind energy development; while the initial construction could threaten some populations, the potential for increased fire frequency from the wind turbines could pose a long-term threat to the plant (D. Bell pers. comm. 2013). The occurrences in ABDSP and on the CDFW Reserve should be considered well-protected, but L. Hendrickson (pers. comm. 2013) was unable to relocate the population at ABDSP (CNDDB EO#2) in 1998 surveys.

Berberis higginsiae is more common where it occurs in Baja California. Although we do not have thorough data on its distribution and abundance in Baja California, Moran (1982), B. O'Brien (pers. comm. 2013) and M. Williams (pers. comm. 2013) all noted that it is common there. The San Diego Natural History Museum had 24 collections of *B. higginsiae* and/or *B. fremontii* from Baja California as of 1994 (Reiser 1994). According to B. O'Brien (pers. comm. 2013), *B. higginsiae* is distributed as far south as the sky islands of the Sierra de San Borja, in southern Baja California, but not extending into Baja California Sur.

The available information suggests that, if recognized taxonomically, *B. higginsiae* would qualify as a CRPR 2B taxon. Although it has been recognized in recent publications, such as Whittemore (1997) and Williams (2012), additional study is needed to determine if this species merits taxonomic recognition, in particular because it overlaps with *B. fremontii* in berry and terminal leaflet morphology. Based on the available information, CNPS and CNDDB recommend adding *B. higginsiae* to CRPR 3.2. If more information about this plant becomes available in the future, CNPS and CNDDB will re-evaluate it at that time.

Recommended Actions
CNPS: Re-rank *Berberis fremontii* from CRPR 3 to 2B.3 ~~4.3~~; Add *Berberis higginsiae* to CRPR 3.2; Add *Berberis haematocarpa* to CBR
CNDDB: Re-rank *Berberis fremontii* from G5 / S2? to G5 / S2S3; Add *Berberis higginsiae* to G4Q / S2

Current CNPS Inventory Record
Berberis fremontii Torr.
Fremont barberry
Berberidaceae
CRPR 3
Arizona, Baja California, Colorado, New Mexico, Nevada, Sonora, Utah
San Bernardino, San Diego
Jacumba (007B) 32116F2, Live Oak Springs (008A)* 32116F3, Barrett Lake (009B) 32116F6, Yucca Valley North (103B) 34116B4, Big Bear City (131D)* 34116C7, Bighorn Basin (176C) 34115G6, Pinto Valley (200A) 35115B3, Mid Hills (200B) 35115B4, Cima (201A) 35115B5, Castle Peaks (224C) 35115C2, Ivanpah (225D) 35115C3.
Chaparral, Joshua tree woodland, pinyon and juniper woodland / rocky; elevation 840 to 1850 meters.
Perennial shrub. Blooms April to June.
Taxonomy extremely complex; intergrades with *B. haematocarpa* and overlaps morphologically with *B. higginsiae*. Definitive study needed. See *Report on the U.S. and Mexican Boundary Survey*, p. 30 (1859) by W. Emory for original description, and *Phytologia* 52:221-226 (1982) for relationship between *Berberis* and *Mahonia*.
Available online at http://www.rareplants.cnps.org/detail/1588.html.

Revised CNPS Inventory Record
Berberis fremontii Torr.
Fremont barberry
Berberidaceae
CRPR 2B.3 4~~.3~~
Arizona, Baja California, Colorado, New Mexico, Nevada, Sonora, Utah
San Bernardino
Rancho Mirage (065B) 3311664, East of Siberia (152A) 3411567, Yucca Valley North (103B) 3411624, Big Bear City (131D) 3411637, Pinto Valley (200A) 3511523, Mid Hills (200B) 3511524, Cima (201A) 3511525, Castle Peaks (224C) 3511532, Ivanpah (225D) 3511533, Mesquite Mountains (249B) 3511566
Joshua tree woodland, pinyon and juniper woodland / rocky, sometimes granitic; elevation 1145 to 1720 meters.
Perennial shrub. Blooms March to May.
Includes California plants previously treated as *B. haematocarpa*. Overlaps morphologically with *B. higginsiae* in the Peninsular Ranges. Definitive study needed. See *Report on the U.S. and Mexican Boundary Survey*, p. 30 (1859) by W. Emory for original description, and *Phytologia* 52:221-226 (1982) for relationship between *Berberis* and *Mahonia*.

New CNPS Inventory Record
Berberis higginsiae Munz
Higgins' barberry
CRPR 3.2
Baja California
San Diego
Jacumba (007B) 3211662, Live Oak Spring (008A) 3211663
Chaparral, Sonoran desert scrub / rocky, sometimes granitic; elevation 800 ~~325~~ – 1065 meters.
Perennial shrub. Blooms March to April.
Move to CRPR 2B? Taxonomy extremely complex; overlaps with *B. fremontii* in leaflet and fruit morphology. Definitive study needed. Potentially threatened by wind energy development. Not in *TJM* (1993). See *Aliso* 4(1):91-92 (1958) for original description.

New CNPS Inventory Record
Berberis haematocarpa
Considered But Rejected: does not occur in California.

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