GROWTH FORM DICHOTOMY IN SUBSPECIES OF *ARCTOSTAPHYLOS PENINSULARIS* FROM BAJA CALIFORNIA

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ABSTRACT

Arctostaphylos peninsularis subsp. *peninsularis* is a crown sprouting species with massive burls that dominates much of the Sierra San Pedro Martir of northern Baja California. In the adjacent Sierra Juarez, ***A. peninsularis*** subsp. ***juarezensis*** is a non-burl-forming arborescent obligate seeder. Hypotheses are proposed to account for this marked difference in fire response.

RESUMEN

Arctostaphylos peninsularis subesp. *peninsularis* es una especie poseedora de tubeŕculo lignoso que rebrota despues de incendios y se encuentra por todo la Sierra San Pedro Martir de Baja California norte. Encuentran en las montanas adyacientes, la Sierra Juarez, ***A. peninsularis*** subesp. ***juarezensis.*** Es esta una especie arborescente la cual no posee un tuberculo lignoso ni puede rebrotar despues de los incendios. Hipotesis son proponer para explicar esta differencia en respuesta regeneracion del fuego.

Arctostaphylos peninsularis Wells has been described as a crown-sprouting species "tending to develop massive burls" or "in some individuals the burl apparently absent" (Wells 1972). Field studies reveal that this description does not adequately describe the pattern of variation present throughout the range of this species in Baja California. Extensive collections from much of the range of *A. peninsularis* indicates a remarkable geographical pattern in the presence or absence of the basal burl and it is proposed that these taxa are best treated as burl-forming and non-burl-forming subspecies.

Throughout the western face of the Sierra San Pedro Martir, between 1200 m and 2400 m, *A. peninsularis* is a burl-forming, multi-stemmed, postfire resprouting shrub. Thousands of individuals have been examined and all plants in the San Pedro Martir are burl-forming resprouting shrubs (Keeley unpublished data). In marked contrast, throughout the adjacent Sierra Juarez to the north, *A. peninsularis,* is a non-burl-forming, typically arborescent, postfire obligate-seeder; extensive collections from the central to northern portion of the Sierra Juarez plateau have revealed no exceptions to this rule.

This growth form difference is the only characteristic that consistently separates these taxa; herbarium specimens from the Sierra

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San Pedro Martir and the Sierra Juarez are indistinguishable. In light of the importance of the burl to *Arctostaphylos* taxonomy and the well-defined geographical distribution of sprouters and seeders, these differences are best treated as subspecies.

ARCTOSTAPHYLOS PENINSULARIS P. V. Wells subsp. PENINSULARIS, Madroño 21:268. 1972.—TYPE: MEXICO, Baja California, gravelly hillside 1 mile east of Corral de Sam, elevation 2200 m, Sierra San Pedro Martir, near 31°03′N, 115°33′W, *Reid Moran 15531* (SD).

Burl-forming shrub that resprouts vigorously after fire, often forming large clones on the western face of the Sierra San Pedro Martir, from 1200 m to 2400 m, interspersed with other chaparral shrubs at the lower elevations, but often dominating entire slopes at the higher elevations.

Arctostaphylos peninsularis subsp. **juarezensis** J. E. Keeley, subsp. nov.—TYPE: MEXICO, State of Baja California, Cerro Hanson, 1625 m, Sierra Juarez, 32°04′N, 115°55′W, 14 May 1989, *J. E. Keeley 11145* (holotype, LOC).

Frutices arborescentes, 2–4 m alti, caudex basi etumescens, trunco manifeste; cortex laevis ruber.

Non-burl-forming shrub, either single-stemmed to 4 m or lower and multi-stemmed and mounded due to rooting of branches. Obligate-seeder, not resprouting after fire. In other respects as in the nominal subspecies. Restricted to boulder-strewn rocky outcrops scattered throughout the Sierra Juarez plateau.

PARATYPES: MEXICO, State of Baja California, growing amongst boulders of Cerro El Toro, 20 km N of Cerro Hanson, 1540 m, Sierra Juarez, 32°13′N, 115°59′W, 26 July 1992, *J. E. Keeley, A. Massihi, R. Goar 18174* (LOC); boulder-strewn outcrop, 10 km S of Cerro Hanson, 1640 m, Sierra Juarez, 31°59′N, 115°51′W, 25 July 1992, *J. E. Keeley, A. Massihi, R. Goar 18054* (LOC).

The striking difference in postfire response of these two taxa in adjacent mountain ranges requires closer analysis. The Sierra San Pedro Martir is a rugged range of steep slopes, much of the crestline extending to 2900 m. Here, *Arctostaphylos peninsularis* subsp. *peninsularis* dominates in a belt between 1500 and 2200 m, in places creating pure stands of resprouting manzanita.

The Sierra Juarez is a plateau of about 1500 m with widely disjunct peaks of 1600–1700 m. ***Arctostaphylos peninsularis*** subsp. ***juarezensis*** is restricted to the disjunct boulder-strewn peaks, often separated by 10 km or more. On the flats of the plateau, between the peaks, *A. peninsularis* is absent and is replaced by *A. pungens* H.B.K. On some outcrops, *A. peninsularis* coexists with two other congeneric species, *A. pringlei* Parry (subsp. *pringlei*) and *A.* cf. *parryana* Lem-

mon. It is curious that all four of the manzanita species in the Sierra Juarez share, not only the same initial letter in the epithet, but the feature of being non-burl-forming obligate-seeders; crown-sprouting manzanitas are apparently absent from the main portion of this mountain range.

We hypothesize that the obligate-seeding mode has been selected in the Sierra Juarez due to a lower probability of burning than is the case in the Sierra San Pedro Martir. It is to be expected that the much lower elevation of the Sierra Juarez leads to a lower fire frequency due to a lesser incidence of lightning ignitions (Keeley 1982). Regardless of the frequency of ignitions, *A. peninsularis* in the Sierra Juarez are unlikely to burn very frequently because of their restriction to boulder-strewn peaks, where more than 30% of the ground cover is rock. Thus, ***A. peninsularis*** subsp. ***juarezensis*** remains undisturbed by fire for much longer periods than is likely the case for *A. peninsularis* subsp. *peninsularis* in the Sierra San Pedro Martir.

Field observations confirm these ideas as most ***A. peninsularis*** subsp. ***juarezensis*** are quite massive, often with trunks in excess of 50 cm diameter and probably greatly exceeding 50 yr of age. This is noteworthy in light of the fact that Baja California has no active program of fire suppression (Minnich 1983), and thus these manzanitas are not currently experiencing an unnaturally low frequency of fires; indeed, because fire prevention is not practiced, the frequency of fires may be even higher than prior to human occupation of the region. In contrast, observations in the Sierra San Pedro Martir reveal that most populations of *A. peninsularis* subsp. *peninsularis,* particularly at the higher elevations, have experienced fire within the last decade or two. Nowhere were massive, ancient individuals observed as seen in the Sierra Juarez.

These observations support the hypothesis (Keeley and Zedler 1978) that, in these relatively slow growing woody plants, the obligate-seeding mode is well adapted to withstand long fire-free periods and poorly adapted to very high fire frequencies.

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