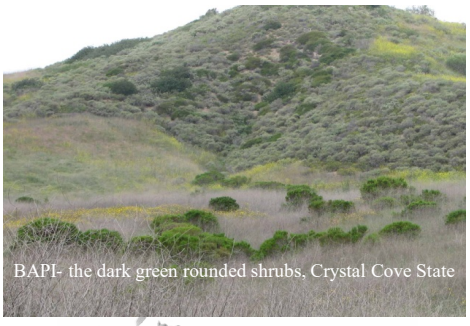
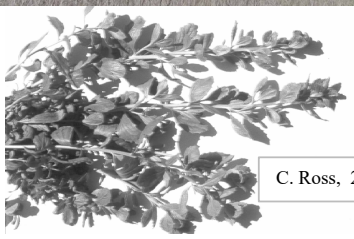
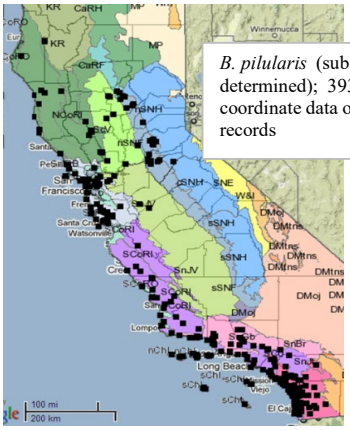
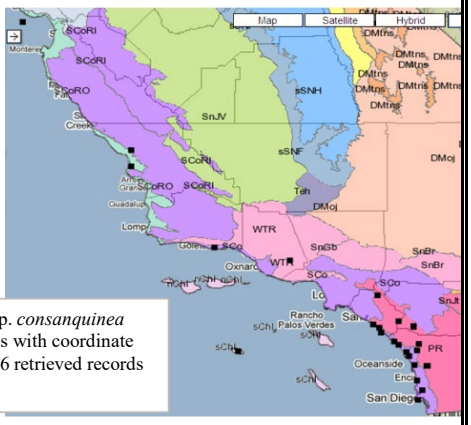
SPECIES	***Baccharis pilularis* DC.**
NRCS CODE: BAPI  immature shrub, Orange Co., CA, A. Montalvo	Tribe: **Astereae** Family: **Asteraceae** Order: **Asterales** Subclass: **Asteridae** Class: **Magnoliopsida**  mature shrub, courtesy Rhizosphere Image Gallery  BAPI- the dark green rounded shrubs, Crystal Cove State  C. Ross, 2004
Subspecific taxa **1. BAPI** **2. BAPIC**	1. *B. pilularis* DC. subsp. *pilularis* 2. *B. pilularis* DC. subsp. *consanguinea* (DC.) C.B. Wolf
Synonyms	2. *Baccharis pilularis* var. *consanguinea* (DC.) Kuntze
Common name	1. dwarf baccharis, bush baccharis (Steinberg 2002, Painter 2016) 2. coyote bush, chaparral broom, coyote brush, chaparral coyote brush (FNA 2010, GRIN).
Taxonomic relationships	The genus *Baccharis* is related to genera in the tribe Astereae of the Asteraceae (e.g., *Aster, Conyza, Erigeron, Gutierrezia, Heterotheca, Isocoma*). Plants in the Astereae share the following traits: phyllaries usually green and imbricate (like shingles on a roof); pappus at top of achenes usually of bristles or awns. The genus *Baccharis* has off-white flowers and a pappus of many fine, unbranched, long (capillary) hairs (Clarke et al. 2007). The unisexual heads and the pappus of many capillary hairs distinguish the genus from other Astereae with whitish flowers.
Related taxa in region (note: nomenclature updated 3/19/2020)	*B. pilularis* is related to three other common species of *Baccharis* shrubs in s CA: *B. salicina* Torr. & A. Gray (Emory's baccharis), *B. salicifolia* (Ruiz & Pavon) Pers. (mule fat), and *B. sarothroides* A. Gray (broom baccharis). Plants are sometimes confused with the more erect, less rounded and more loosely branched *B. salicina,* which occurs mostly inland along streams and drainages and has longer, narrower leaves (generally more than two times long as wide) and longer involucres. *B. pilularis* occurs naturally in areas with maritime influence, inland to Fallbrook in San Diego Co. (Munz 1974, Hickman 1993, Roberts et al. 2004, Roberts 2008).
Taxonomic issues	USDA PLANTS (2010) includes the two subspecies as synonyms of a larger taxon. However, FNA (2010) and the 2nd edition of the Jepson Manual (JepsonOnline 2nd Ed. 2010) recognize *B. pilularis* subsp. *pilularis* and *B. p.* subsp. *consanguinea*. In FNA, the former subspecies is confined to exposed sandy coastal bluffs and dunes along the central California coast and is prostrate, flexible, and mat-forming; the latter subspecies is the more widespread and weedy subspecies that occurs along the coast as well as inland. *B. p.* subsp. *consanguinea* is also often recognized by botanists in southern California, including authors of the checklists for Riverside and Orange Counties (Roberts et al. 2004, Roberts 2008). The checklist for San Diego Co. does not recognize subtaxa (Rebman & Simpson 2006), but it does list *B. p.* subsp. *consanguinea* as a synonym for plants in that area. There are apparently adaptive differences between populations of the formerly recognized subspecies that are worthy of consideration in revegetation and restoration work.
Other	This species can be an aggressive colonizer. Care needs to be taken not to overplant this taxon and to check revegetation sites and plant lists carefully to ensure project plans have specified the correct species of *Baccharis*.
Note added 3/19/2020:	Note: For an update on the cultivation and use of this taxon, please see the USDA Natural Resources Conservation Service Plant Guide published in 2016, six years after this profile was completed (https://plants.usda.gov/plantguide/pdf/pg_bapi.pdf).

GENERAL	
Map Data provided by the participants of the Consortium of California Herbaria represent records with coordinate data; data accessed 9/14/10. See Berkeley Mapper: http://ucjeps.berkeley.edu/cgi-bin/get_consort.pl?taxon_name=Baccharis%20pilularis	 *B. pilularis* (subsp. not determined); 393 records with coordinate data of 797 retrieved records  *B. p.* subsp. *consanquinea* 28 records with coordinate data of 136 retrieved records
Geographic range	Common and widespread along the coast, the Channel Islands, and in coastal foothills of OR south through CA and into northern Mexico (Ross 2004). Also reported from NM (USDA PLANTS).
Distribution in California; Ecological section and subsection	Jepson Regions: NW CA, Sierra Nevada Foothills, w Central Western CA, South Coast, Channel Islands, Western Transverse Ranges, Peninsular Ranges (Hickman 1993). The Sierra Nevada Foothill populations are disjunct from coastal populations. Ecological Sections/Subsections for s CA: Southern CA Coast 261B; western portions of Southern CA Mountains and Valleys M262Bf, Bj-k, Bn-o with some maritime influence. In western Riverside Co., *B. pilularis* is uncommon and occurs naturally where there is some maritime influence and where it has escaped from plantings (Roberts et al. 2004).
Life history, life form	Perennial, fairly long lived, evergreen shrub. Sawyer et al. (2009) list these shrubs as reproductive from about the third year to more than 50 yr.
Distinguishing traits	Much branched, often very dense, rounded, dioecious shrub with dark green, simple, alternate, obovate, sessile leaves that lack hairs and have a rounded tip that narrows to a wedge-shaped base. Leaves are thick, have resin glands, three main veins from the base, sparse coarse teeth, vary in size within a plant, and are usually 1 to 1.5 times as long as wide. The tips of young, leafy branches are somewhat sticky and produce inflorescences toward the end of summer into the fall. Plants produce many, small, single-sex heads with many small creamy to white disk flowers on separate plants. The tiny achenes have a ring of long, unbranched pappus bristles. 1. *B. p.* subsp. *pilularis* is a prostrate, mat forming shrub that occurs along sandy beaches and coastal bluffs, with smaller leaves (5-15 mm long) than subsp. *consanquinea* (JepsonOnline 2nd Ed. 2010). 2. *B. p.* subsp. *consanquinea* is generally erect and only occasionally prostrate and with leaves generally 15 to 40 mm long (JepsonOnline 2nd Ed. 2010).
Root system, rhizomes, stolons, etc.	Taproot and with well developed lateral roots (Steinberg 2002). For images of roots inside soil, see: http://ic.ucsc.edu/~wxcheng/wewu/baccharispilularis.htm.
Rooting depth	Taproot to 3.2 m (Steinberg 2002). In a study in 1-m deep sandy soil in coastal CA, Holl (2002) found that after about 5.5 years of growth, roots penetrated to the maximum depth and also laterally from 0.2 to 4.5 m.
Other	The distribution and range of this species in southern California may be increasing inland due to its use in revegetation projects outside its native range (A. Montalvo, pers. obs.). For example, plants can now be found along roadsides far inland in San Diego Co near Alpine and Cuyamaca, possibly due to planting after fire and construction disturbance. In Riversde Co., consultants have mistakenly placed this species on restoration plant palettes in areas where *B. salicina* is common.
HABITAT	
Plant association groups	Plants occur as a dominant or co-dominant in a number of shrubland alliances in California and make up the *Baccharis pilularis* shrubland alliance when they are > 50% of the shrubland's absolute cover (Sawyer et al. 2009). The shrubs tend to be in the more early seral stages of forest vegetation development in the north than in the south. In northern CA and OR, plants can be a dominant in various scrub plant communities on coastal bluffs, in coastal prairies, and oak woodlands, but less frequent on coastal dunes. In southern CA, plants tend to be less dominant members of coastal sage scrub and grassland communities but can dominate patches of vegetation in particular microsites (Steinberg 2002). In southern CA shrublands, plants may sometimes be co-dominant with *Artemisia californica, Salvia mellifera* , or *Lotus scoparius* var. *scoparius.*
Habitat affinity and breadth of habitat	Primarily on coastal bluffs, dunes, oak woodlands (Hickman 1993). In southern California, it occurs mostly along the coast and western slopes of coastal and transverse ranges. Stands can become dense along swales, valleys, and canyons within coastal sage scrub and grassland communities.

Elevation range	Below 1500 m (Hickman 1993).
Soil: texture, chemicals, depth	Medium and coarse soils (Steinberg 2002). Sometimes on serpentine soils (Hickman 1993).
Drought tolerance	Seedlings are sensitive to drought (Zavaleta 2006). Inland erect forms may be more drought tolerant than coastal prostrate forms. Coastal forms tend to require supplemental irrigation when planted away from the coast (Perry 1992, Pittenger et al. 2001).
Precipitation	Varies with location. Occurs primarily in areas with more than 15 inches/year.
Flooding or high water tolerance	
Wetland indicator status for California	None.
Shade tolerance	Occurs in open grassland and shrubland. Plants occur in earlier seral stages and die out as forest canopies close in and shade out plants (Sawyer et al. 2009).

GROWTH AND REPRODUCTION

Seedling emergence relevant to general ecology	Seedlings emerge early in the rainy season soon after dispersal and are very susceptible to herbivory and drought. Seedlings emerged in December and January after planting seeds into field plots in early December in the central coast foothills (Zavaleta 2006). Early season mortality was primarily from herbivory, while late season mortality was primarily from drought stress.
Growth pattern (phenology)	Seed dispersal Oct-Jan, germination in early winter, growth during spring (Steinberg 2002), and seedlings emerge early in the rainy season. Seedling root growth tends to occur later in the spring and can be highly dependent on late season rains to grow long enough to survive the summer drought (Williams & Hobbs 1989). Once plants are established, most leaf growth occurs Feb-June (Hobbs & Mooney 1985); plants flower during the late summer from July-Oct. Fruits mature Sept-Dec, later inland than in coastal populations (Steinberg 2002).
Vegetative propagation	From cuttings. Native Plant Network has an on-line protocol (Young 2001 in NPNPP): http://www.nativeplantnetwork.org/network/view.asp?protocol_id=706. Cuttings were made from actively growing shoots in the spring (Miller & Weiss 1999). In a revegetation review by Hektner et al. (1981) unrooted stem cuttings were used at Redwood National Park in northern CA, and 47% survived after 1 year.
Regeneration after fire or other disturbance	Plants colonize bare areas from seed after fire and can also invade grassland areas during long fire-free intervals (Sawyer et al. 2009). Larger plants sometimes resprout from the base after fire (McBride & Heady 1968) but may be killed by moderate to severe fire; young plants are killed by fire (Ross 2004). Plants resprout after cutting, and success is age and size-dependent (Hobbs & Mooney 1985). Resprouting in 3-4 year old shrubs was highest, low in 1-year old shrubs, and zero in shrubs more than 8 years old. Success was thought to be related to root system development and availability of resprout buds (Hobbs & Mooney 1985). Plants used for groundcover recover from mowing (Ross 2004).
Pollen dispersal	The small fragrant flowers of both sexes bloom in mass and are heavily visited by insects in a way that suggests cross pollination. Steinberg (2002) cites Steffan as observing 55 insect species visiting flowers of both sexes, most commonly Argentine ants (*Linepithema humile*), parasitic hymenoptera (*Agathis gibbosa, Synopeas* spp., and *Dolichogenidea* spp.), and honey bees (*Apis mellifera*).
Primary seed dispersal	Wind (Steinberg 2002). The achenes have a long pappus that aids in wind dispersal. Mammals may sometimes further disperse seeds after initial wind dispersal (Steinberg 2002).
Breeding system, mating system	Dioecious (Steinberg 2002). Obligate outcrosser.
Hybridization potential	There is a high liklihood that bees would transfer pollen among flowers of different species or populations if they are in flower at the same time at the same location. Bogler (in FNA 2010) reports there is hybridization and introgression among other species of *Baccharis* .
Inbreeding and outbreeding effects	No information.

BIOLOGICAL INTERACTIONS

Competitiveness	Plants can invade grasslands but success may be only in wet years (DeSimone & Zedler 2001). Seedlings need late season rains to grow deep enough to compete with grasses for late season soil moisture (Williams & Hobbs 1989). Reported to invade overgrazed and eroded rangelands (Bogler in FNA 2010).
Herbivory, seed predation, disease	Gall-forming midge, *Rhopalomyia californica* Felt (Ehler 1979; Miller &Weiss, 1999). In a reciprocal transplant experiment, Miller and Weiss (1999) found no difference in the infection of the gall-making midge in plants propagated from north coastal and southern inland populations of *B.pilularis.* A fungal parasite, *Diaporthopsis,* was found to cause die back and witches-broom in *B. pilularis* (Bonar 1966). Seedling herbivory by slugs in the central CA foothills can be extremely high (Zavaleta 2006).

Palatability, attractiveness to animals, response to grazing	Low (Steinberg 2002, USDA PLANTS 2010). Sampson and Jesperson (1963) noted that *B. p.* var. *consanquinea* has low palatability but provides useful browse for goats and, to a lesser degree, for deer, cattle and sheep.
Mycorrhizal?	
Other biological interactions	*B. pilularis* mature plants served as nurse plants for the establishment of *Quercus agrifolia* and may be important to development of later seral stages from early non-native grassland stages (Zavaleta & Kettley 2006). Along the central coast, seedlings can invade grasslands and in northern CA can invade coastal dunes that have been stabilized by invasive grass and lupine (Sawyer et al. 2009).
ECOLOGICAL GENETICS	
Ploidy	2n=18 (Hickman 1993). Populations have the basic, gametic chromosome number of x=9 (Raven et al. 1960), a number shared by other species of *Baccharis* and related genera (Anderson et al. 1974).
Plasticity	There may be a combination of genetic and environmental effects on stature in this species. Low growing forms have been selected in horticulture. However, in a greenhouse study of *B. pilularis* from central California (noted as var. *tipica*), prostate versus erect stature depended on night and day temperatures (Hellmers & Ashby 1958). Plants grown from seeds collected from prostrate plants from the cool coast tended to become upright when grown under conditions of cool nights and hot days. However, seeds may have included variation for the traits that control stature. In another study, plants propagated from seeds and cuttings from 0.7 km inland, north coastal Bodega Bay (prostrate form), and from 7 km inland, south coastal Irvine (taller, erect form), retained their growth forms when reciprocally transplanted into a common greenhouse and into common gardens at both sites of origin, but traits such as leaf size were plastic and varied with environment (Miller & Weis 1999). The retention of growth form in a replicated experiment indicates that there are genetic differences among the populations for growth form.
Geographic variation (morphological and physiological traits)	The species is variable in plant stature and there there appears to be continuous variation between the erect, more widespread form (subsp. *consanguinea*) and the prostrate form (ssp. *pilularis*) (Munz & Keck 1968, Steinberg 2002). Plants away from the immediate coast and of inland locations have an erect, taller form than plants of windswept dunes and headlands along the immediate coast (Munz & Keck 1968, Miller & Weis 1999). Prostrate forms are found along the coast and have been the genetic source of ground covers used in horticulture. Horticultural selections retain distinct differences in leaf size and plant stature.
Genetic variation and population structure	Due to the outcrossing mating system and wind dispersal of seeds, it is expected that populations would harbor high levels of genetic variation and that structure would be low on a local level.
Variation in interactions with other organisms	
Local adaptation	Studies suggest that coastal populations are adapted to different conditions than more interior populations. Differences among selected cultivars in their heat and drought tolerance have been noted by horticulturalists (e.g., Perry 1992). In reciprocal common garden studies, Miller & Weis (1999) found that stature of *B.pilularis* is dependent on their native home environment and that the different forms are adapted to different conditions. It appears that coastal, exposed and windy conditions select for a prostate growth form, and inland hot and dry summers and colder winters select for a tall and rounded form.
Translocation risks	There is potential for maladaptation and hybridization if seed sources or plants are moved from coastal or high rainfal areas to dry inland sites, or when moving erect forms to habitats that support low growing prostrate forms. Collection and deployment of seeds within Ecological Sections would help reduce risks.
SEEDS	Seed image courtesy of Steve Hurst @ USDA-NRCS PLANTS Database 
General	Female plants are prolific seeders. Standard seed purity and germination reported at 50% (see protocal by Young 2001 at link under NPNPP).
Seed longevity	Seeds of the genus *Baccharis* are not long-lived and are considered "transient" (Sawyer et al. 2009). Some species showed distinct drops in germination after 2 years of storage (Karrfalt & Olsen 2008).
Seed dormancy	Non-dormant.
Seed maturation	The single seeded achenes tend to begin dispersal in November (Ross 2004) and continue through the fall. Mature seeds are dark brown. Light brown seeds are immature (see protocal by Young 2001at link under NPNPP).

Seed collecting	Seeds in Marin Co. are collected August 1-December 1 (Young 2001 NPNPP). Seeds can be collected by hand into open breathable bags (woven, paper). Open tubs or tarps can be placed under branches that are shaken or brushed to release seeds (e.g., Karrfalt & Olsen 2008).
Seed processing	The dried heads and achenes can be rubbed between the hands or over a screen to remove pappus and phyllaries (Young 2001 NPNPP, Karrfalt & Olsen 2008). Dried heads and entire inflorescences can be threshed from the stems and pappus using a brush machine (Karrfalt & Olson 2008).
Seed storage	Cleaned, dry seeds of *Baccharis* species can be stored at 1.7 to 4.5 ^{o} C in airtight containers (Karrfalt & Olsen 2008).
Seed germination	Seeds germinate without treatment (Hellmers & Ashby 1958, Karrfalt & Olsen 2008). De Hart (1994) reports no treatment required when sow in winter. Germination may occur to higher percentages under cool conditions (Karrfalt & Olsen 2008).
Seeds/lb	8,200,000 (NSN 2010); 9,000,000 (S&S Seeds 2009); a low, questionable number published for these very light achenes is 180,000/kg (Karrfalt & Olsen 2008).
Planting	Generally, seed of species of *Baccharis* are sown in the fall to early spring (Everett 1957). In a controlled experiment in coastal central CA, Zavaleta (2006) planted seeds directly into experimental field plots and exposed plots to CO_2 and water addition treatments. Both treatments increased or accelerated germination. Herbivory and drought severely reduced seedling survival; survivorship was <0.1% across treatments. In a temperature controlled greenhouse, seeds can be surface sown in mid-August to produce plants for outplanting the next winter (see Young 2001 at NPNPP link below).
Seed increase activities or potential	Plants are fast growing and would be easy to grow in monoculture for seed production. Mortality of seedlings from slugs can be high (Zavaleta & Kettley 2006).
USES	
Revegetation and erosion control	Recommended for stablilization of disturbed lands such as barren roadsides (Newton & Claassen 2003). The deep roots and abundant canopy cover help to stabilize slopes. This species has been used to revegetate roadside areas in eastern San Diego Co. after wildfire and disturbance. It can be very aggressive and invade adjacent habitats, especially near riparian zones.
Habitat restoration	The erect forms of this species are often used for restoration in southern CA (Perry 1992). It should be used sparingly so that it does not dominate sites before other desirable species become established. This species has often been mis-specified on restoration plant palettes for inland regions of Riverside Co. in areas where the similar *B. salicina* is native (A. Montalvo per. obs.). Care needs to be taken to understand the particular site so that *B. pilularis* does not outcompete other important species and become the dominant shrub in areas where dominance is not desired.
Horticulture or agriculture	Selections, such as *Baccharis pilularis* 'Pigeon Piont', *B. c.* 'Twin Peaks', and *B. c.* 'Centennial', have been made from central and northern coastal, prostrate forms for use as evergreen ground covers. Male plants are generally selected for horticulture. Cultivars are generally propagated from cuttings. Some of these cultivars are more tolerant of dry, hot, inland s. CA than others (Perry 1992). Erect forms are also used in horticulture (Perry 1992). Miller & Weis (1999) provide details about propagation from cuttings in a greenhouse. Seeds of the erect forms establish readily, and plants can become invasive in yards (A. Montalvo pers. obs.). In restoration, plants can be grown from seeds in containers and outplanted, or they can be direct seeded. Freshly cut woody stems can also be planted and rooted.
Wildlife value	Useful for bird nesting habitat (Chase 2002). Sampson and Jesperson (1963) rated its browse as fair for sheep and goats, poor to useless for cattle and deer, and useless for horses. They also stated that it encroached on grasslands.
Plant material releases by NRCS and cooperators	None.
Ethnobotanical	Boiled leaves were applied to skin as a remedy for poison oak rash (Timbrook 2007). *Baccharis pilularis* is used medicinally for hay fever, sinusitis, and headaches in Mexico (Freire et al. 2007).
ACKNOWLEDGMENTS	Partial funding for this project was provided by the U.S. Department of Agriculture, Forest Service, Pacific Southwest Region Native Plant Materials Program.
CITATION	Montalvo, A. M., L. K. Goode, and J. L. Beyers. 2010. Plant Profile for *Baccharis pilularis.* Native Plant Recommendations for Southern California Ecoregions. Riverside-Corona Resource Conservation District and U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Riverside, CA. Online: https://www.rcrcd.org/plant-profiles.

LINKS: REVIEWED DATABASES & PLANT PROFILES	
Fire Effects Information System (FEIS)	https://www.fs.fed.us/database/feis/plants/shrub/bacpil/all.html
Jepson Flora, Herbarium (JepsonOnline)	https://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?1603
Jepson Flora, 2nd Edition (JepsonOnline 2nd Ed) now is Jepson eFlora	https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=1603
USDA PLANTS	https://plants.usda.gov/core/profile?symbol=BAPI
USDA PLANTS plant guide	https://plants.usda.gov/plantguide/pdf/pg_bapi.pdf
Native Plant Network Propagation Protocol Database (NPNPP)	https://npn.rngr.net/propagation/protocols
Native Seed Network	https://nativeseednetwork.org/
GRIN	https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=6237
Wildand Shrubs	https://www.fs.usda.gov/treesearch/pubs/27005
Flora of North America (online version) (FNA)	http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250066185
Native American Ethnobotany Database (NAE)	http://naeb.brit.org/uses/search/?string=Baccharis+pilularis
Woody Plant Seed Manual	https://www.fs.usda.gov/nsl/nsl_wpsm.html

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