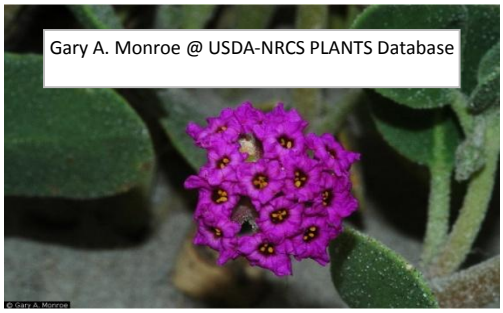
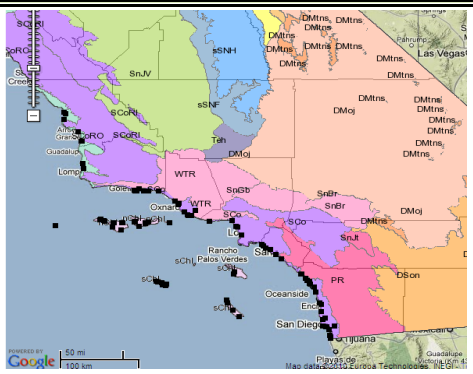
SPECIES	*Abronia maritima* Nutt. ex S. Wats.
NRCS CODE: ABMA2	Family: **Nyctaginaceae**; Order: **Caryophyllales**; Subclass: **Caryophyllidae**; Class: **Magnoliopsida** 
Subspecific taxa	None.
Synonyms	None listed.
Common name	red sand verbena (CalFlora, USDA PLANTS), sticky sand verbena (CalFlora)
Taxonomic relationships	*Abronia latifolia* Eschsch. and *A. umbellata* Lam. are closely related species (Blancas 2001).
Related taxa in region	May co-occur with *A. latifolia* and *A. umbellata* where distributions overlap. All three occur between Point Arguello, Santa Barbara Co., to Morro Bay in San Luis Obispo Co. (Tilllett 1967).
Other	CNPS list 4.2, limited distribution. Endemic to California and Baja California. There has been concern that hybridization with the two more widespread, co-occurring species of *Abronia* together with rapid loss of its coastal dune habitat are making the plants vulnerable to extinction (Blancas 2001). Genetic and morphological studies by Blancas (2001) were consistent with there being a high rate of hybridization with *A. umbellata* within a few small populations.
GENERAL	
Map	Data provided by the participants of the Consortium of California Herbaria represent 114 records with coordinate data out of 324 total records retrieved; data accessed 9/23/10. See Berkeley Mapper: http://ucjeps.berkeley.edu/consortium 
Geographic range	Sparsely located in central and southern California and Baja California (Hickman 1993).
Distribution in California; Ecological section and subsection	South coast and south central coast (Hickman 1993) and Channel Islands. Ecological Sections (http://www.fs.fed.us/r5/projects/ecoregions/ca_sections.htm): Central California Coast (261A), and Southern California Coast (261B).
Life history, life form	Perennial herb, rapidly growing, mat forming pioneer that keeps up with advancing sand dunes.
Distinguishing traits	The deep, wine-red flowers separate ABMA2 from all other N. American *Abronia* (Galloway 1975). Low growing, mat-forming, evergreen, succulent, viscous, herbaceous perennial plant of coastal strand, dune habitats. Its dark, wine-red flowers occur in umbellate inflorescences (Hickman 1993). The dark flower color, smaller flower size, and ovate leaves (longer than wide) help to separate it from co-occurring *Abronia* species: *A. latifolia* is a fleshy perennial with broadly ovate to kidney-shaped leaves (about as long as wide) and golden yellow flowers; *A. umbellata* is an annual plant with ovate to diamond-shaped leaves, and pink flowers with a central eyespot (Tillett 1967, Hickman 1993).
Root system, rhizomes, stolons, etc.	Deep tap root with spreading fine roots (De Jong 1979, Hickman 1993).

Rooting depth	Noted as having "deep rooting tap root". Purer (1936) reported a maximum depth of two feet and lateral root spread of 2- 3 feet; however, De Jong (1979) reported tap roots grow to more than 100 cm before producing fine branch roots.
HABITAT	
Plant Association Groups	Coastal dune mat vegetation alliances including *Abronia latifolia-Ambrosia chamissonis* Herbaceous Alliance (Sawyer et al. 2009).
Habitat affinity and breadth of habitat	Predominately of coastal dune communities (Hickman 1993), but can be found inland where there is loose sand and wind (Purer 1936). Tillett (1967) reported that *A. maritima* occurs in foredunes and is important in fordune formation, *A. umbellata* occurs more in stable dunes, and *A. latifolia* occurs primarily in stable dunes.
Elevation range	Below 100 m (Hickman 1993).
Soil: texture, chemicals, depth	Sandy, unstable wind-blown soils.
Drought tolerance	In one study of dune plants that included *A. maritima* , plants occurred in coastal foredunes where there was moisture available all year long and where salinity levels were only 3% that of seawater (De Jong 1979). The deep tap root may be a mechanism for reaching stable moisture within the sandy dunes.
Precipitation	
Flooding or high water tolerance	
Wetland indicator status for California	
Shade tolerance	
Salt tolerance	This C3 plant was shown to be less tolerant of saline conditions than two other coastal plants examined from sand dunes (De Jong 1978). In an experiment, mesophyll conductance was found to be highest in the absence of salt, and then it decreased as exposure to salinity increased, but relative growth rate was highest at a low salinity level compared to 0 and higher levels.
GROWTH AND REPRODUCTION	
Seedling emergence relevant to general ecology	Plants produce flowers and seeds throughout the year with most flower and seed production in late spring and summer. In southern California, seedling establishment was low and seemed to require some late spring and early summer rain for seedlings to survive the summer (De Jong 1979). Seed burial in the dune habitat appears to be important to seedling emergence and establishment. (see Seed Germination below)
Growth pattern (phenology)	
Vegetative propagation	
Regeneration after fire or other disturbance	Plants colonize open sand dunes and do not occur in fire-prone habitats.
Pollination	Some of the pollinators are strong fliers (e.g., bumblebees) and capable of dispersing pollen among plants relatively long distances. Expect a range of very localized to distant pollen dispersal. Flowers are visited in the daytime, in the order of highest frequency by: bumblebees, bee-flies, skippers (Hesperoidae), various small bees (Halictidae and Megachilidae), and beetles (Melyridae) (Tillett 1967). Sphinx moths are known to visit other *Abronia* species (e.g., Moldenke 1976).
Seed dispersal	The approximately 1 cm long winged fruits are primarily wind-dispersed, but water may assist in moving seeds. Darling et al. (2008) measured movement of similar winged fruits of *A. umbellata* in a wind tunnel and the ability of seeds to float in relation to "wingedness" of fruits. The wings assist in tumbling across sandy substrates. Larger wings are associated with increasing ability for seed dispersal and increasing ability to self-pollinate near margins of the species distribution.
Breeding system, mating system	Plants are self-sterile (no seeds or fruits produced from self-pollination) (Tillett 1967).

Hybridization potential	ABMA hybridizes with *A. latifolia* and *A. umbellata* (Tillett 1967, Pimentel 1981, Blancas 2001). Crosses between all three species can produce seeds with high germination (Tillett 1967); however, hybrid progeny in the first generation (F1) had low pollen fertility (Tillett 1967), and pollen fertility in areas of introgression was low. Pollen viability was high in areas where species did not co-occur. Blancas (2001) studied 40 populations of *Abronia*, including single and mixed species, for morphology and isozyme variation. She confirmed that 14 of the populations included hybrids, including several what were thought to be single species populations. Isozyme data revealed 13.5% of 551 individuals were hybrids, nearly twice as many as suggested by morphological data.
Inbreeding and outbreeding effects	
BIOLOGICAL INTERACTIONS	
Competitiveness	
Herbivory, seed predation, disease	
Palatability, attractiveness to animals, response to grazing	
Mycorrhizal?	
ECOLOGICAL GENETICS	
Ploidy	2n = about 46 (Tillett 1967) for *A. maritima, A. latifolia* , and *A. umbellata,* but others have estimated more.
Plasticity	
Geographic variation (morphological and physiological traits)	Fruits have 5, thick wings that vary geographically (Tillett 1967). Blancas (2001) examined leaf traits and stem width within 25 wild populations of *A. maritima* . The data were used to identify hybrids and were not analyzed in a way that could show geographic patterns. Darling et al. (2008) found that flowers of the closely related *A. umbellata* become less self-incompatible, smaller, and less "herkogamous" (physical separation between stigma and anthers) toward the edges of the species' range. In addition, the length of the wings on fruits increased in size and dispersal ability toward the edges of the range.
Genetic variation and population structure	Blancas (2001) examined allozyme variation within 25 populations of *A. maritima*. About half of the populations included co-occurring plants of *A. umbellata* and/or *A. latifolia.* The study also included allopatric populations of *A. umbellata* and *A. latifolia* . Populations ranged from Marin Co., CA., into Baja California, and two of the Channel Is. Twenty-four allozyme loci were scored, four of which were useful for assignment of hybrids individuals. Allozyme variation reported: 58% of the loci were polymorphic; there was an average of 2.4 alleles/locus; and 3.32 alleles/polymorphic locus. Neither allele frequencies nor an analysis of population structure were provided.
Phenotypic or genotypic variation in interactions with other organisms	
Local adaptation	
Translocation risks	Blancas (2001) showed significant levels of hybridization between this sensitive species and other more common species of *Abronia* . To protect the genetic integrity of populations of this sensitive species, planting projects should avoid using seeds from source populations where hybridization with other *Abronia* species is known to occur or likely due to the presence of other species of *Abronia* . In addition, local adaptation to different rainfall and temperature regimes has not been studied, but many species show ample differences across elevation and latitude. Using seed sources from within ecological sections and subsections would reduce the potential risk of maladapted genes.
SEEDS	**For seed images: Rancho Santa Ana Botanic Garden Seed Program: http://www.hazmac.biz/041115/041115AbroniaMaritima.html**
General	Flowers produce single-seeded achenes that are surrounded by the base of the parianth which enlarges and forms wings. The specialized fruit is called an anthocarp.

Seed longevity	Seeds of ABMA2 used by Drennan (2008) in seed germination trials had been in storage for 6 years. Tetrazolium tests showed 96% viability and seed germination treatments produced about 90% germination.
Seed dormancy	Drennan (2008) verified seed dormancy in *A. umbellata, A maritima, A vilosa,* and *A. fragrans*. Ethylene sometimes substitutes for cold stratification so Drennan (2008) examined germination of achenes with the outer shell of the anthocarp removed under a control treatment with distilled water vs. treatment with ethephon (an ethylene compound) with a 12 hr light/12hr dark cycle and alternating temperatures of 27/20 ^{o}C. For ABMA2, controls germinated to about 80% after 3 weeks; achenes treated with ethephon germinated to 90% in 2 to 5 days. The lower concentrations of 10 to 100 µ mol l^{-1} produced normal growth of plants. Achenes of the other three species of *Abronia* also germinated to high percentages within 3 to 5 days after treatment with ethephon at 100 µ mol l^{-1}. The author recommends treating seeds during production of plants for restoration to avoid selecting for populations with low seed dormancy. Seeds from populations of the closely related *A. umbellata* ssp. *breviflora* vary from high to low dormancy depending on source population and year of seed collection (Kaye 1999).
Seed maturation	
Seed collecting and harvesting	
Seed processing	Wall and MacDonald (2009) recommend rubbing the fruits over a medium screen and then using an Oregon Seed Blower unit at speed 2.0 to remove chaff from sieved seeds.
Seed storage	
Seed germination	Baskin & Baskin (1998) tabulate ABMA2 as emerging from seeds buried in sand to a depth of 8 cm (study in Baja California). Kaye (1999) reported on a series of seed germination experiments for the related rare species, *Abronia umbellata* ssp. *breviflora* of the coastal Pacific NW dune habitats. In the lab, alternating temperatures and photoperiods of 20^{o}C, 16 h dark/30^{o}C, 8 h fluorescent light combined with removal of seeds from the achene husk resulted in the highest germination rates. Removal of the achene wall increased germination from less than 2% to 52-74%. Seed dormancy varied among populations and cold stratification for 2 weeks at 4^{o}C significantly increased germination of the most dormant populations, and did not decrease germination in less dormant populations. Longer periods of stratification did not improve germination. Seed burial experiments initiated in the field in the fall showed that seeds planted at a depth of 3 cm emerged in the spring at much higher rates than those planted at 10 cm or at the surface of the sand.
Seeds/lb	15,000 seeds/lb (S&S Seeds 2010, database: http://www.ssseeds.com/database/index.html).
Planting	
Seed increase activities or potential	Use of this species for revegetations and restoration is best limited to coastal dune areas. The need for seeds is likely limited and may be best served through a combination of special collections and propagation of container stock. Source-identified seeds would be valuable. It is unlikely that there would be enough demand for this species to invest in development of methods for agricultural production of seeds. Care would need to be made so that seeds are not overcollected. If propagation is needed for reintroduction or augmentation of populations, special attention should be made to collect from many individuals without overcollecting from any one population.
USES	
Revegetation and erosion control	Can be useful in initial stages of dune stabilization, then declines as other species fill in (Tillett 1967).
Habitat restoration	Container plants used in restoration of coastal dunes (Drennan 2008).
Horticulture or agriculture	Recommended for gardens (Hickman 1993): sandy, dry, sunny sites: Sunset zones: 17, 24. However, plants produced for horticulture or from non-local sources should not be planted near wild populations of this sensitive species.
Wildlife value	
Plant material releases by NRCS and cooperators	None.
Ethnobotanical	
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CITATION	Montalvo, A. M., and J. L. Beyers. 2010. Plant Profile for *Abronia maritima.* 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: http://www.rcrcd.com/index.php?option=com_content&view=article&id=88&Itemid=190.
LINKS TO REVIEWED DATABASES & PLANT PROFILES (last accessed September 2010)	
Fire Effects and Information System (FEIS)	No matches: http://www.fs.fed.us/database/feis/
Jepson Flora, Herbarium (JepsonOnline)	http://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?ABMA2
Jepson Flora, Herbarium, Second Edition Review	http://ucjeps.berkeley.edu/tjm2/review/treatments/nyctaginaceae.html#11554
USDA PLANTS	http://plants.usda.gov/java/profile?symbol=ABMA2
Native Plant Notebook (NPN)	No matches: http://www.fs.fed.us/r6/uma/native/
Native Plant Network Propagation Protocol Database (NPNPP)	No matches: http://nativeplants.for.uidaho.edu/network/
Native Seed Network	No matches: http://www.nativeseednetwork.org/
GRIN (provides links to many resources)	http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?316868
Flora of North America (FNA) (online version)	http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242415087
Ethnobotanical	Moerman's Native American Ethnobotany Database
Calflora	http://www.calflora.org/
Rancho Santa Ana Botanic Garden Seed Program, seed photos	http://www.hazmac.biz/rsabghome.html
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