
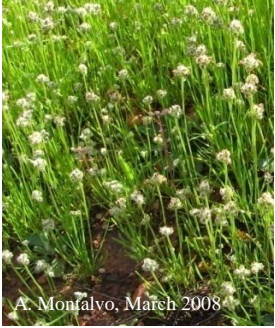

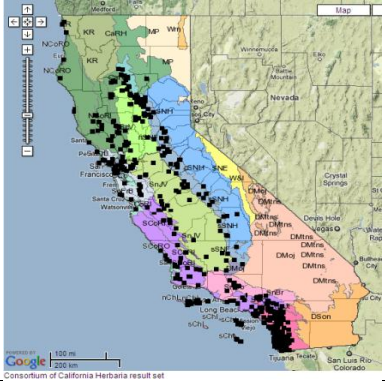


SPECIES	<i>Plantago erecta</i> E. Morris	
NRCS CODE: PLER3	Family: Plantaginaceae Order: Plantaginales Subclass: Asteridae Class: Magnoliopsida	  
Subspecific taxa	Currently, there are no subspecific taxa recognized (JepsonOnline, 2nd Edition).	
Synonyms	<i>P. erecta</i> ssp. <i>rigidior</i> Pilg., <i>P. hookeriana</i> Fisch. & C.A Mey. var. <i>californica</i> (Greene) Poe, <i>P. patagonica</i> Jacq. var. <i>californica</i> Greene, (Calflora 2010, USDA PLANTS 2010); <i>P. bigelovii</i> ssp. <i>c.</i> (Greene) Bassett, misapplied (Hickman 1993); <i>P. tetrantha</i> Morris (Munz & Keck 1968).	
Common name	California plantain, foothill plantain, dotseed plantain (Calflora 2010, USDA PLANTS 2010)	
Taxonomic relationships	There are 16 species of <i>Plantago</i> in California, seven of which have been introduced and naturalized (Hickman 1993).	
Related taxa in region	<i>P. ovata</i> Forsskal is often planted in areas where <i>P. erecta</i> is native. <i>P. ovata</i> generally occurs further inland in drier habitats including the deserts of southern CA. Unlike <i>P. erecta</i> , it has 2n=8 chromosomes, broader leaves, dense silky hairs, and its seeds differ in shape and surface features (Stebbins & Day 1967). The native annual <i>P. elongata</i> Pursh overlaps in general areas, but unlike <i>P. erecta</i> , it is a species of beaches, vernal pools, alkaline and saline places, with 2n=12, 36 chromosomes (Hickman 1993). <i>P. patagonica</i> Jacq. occurs throughout much of North America and overlaps in some habitats within California, such as alluvial scrub and chaparral. It has many more flowers in each inflorescence and each flower has long linear bracts.	
Other	<i>P. erecta</i> occupies a large variety of habitats and is variable in stature over its range. Studies are needed to examine whether there are genetically important ecotypes and if there are geographic, spatial patterns in adaptation to contrasting conditions and to butterflies that use the plant as a larval host.	
GENERAL		
Map	Data provided by the participants of the Consortium of California Herbaria represent 645 records with coordinate data out of 1177 total records; data accessed 1/14/10. See Berkeley Mapper: http://ucjeps.berkeley.edu/cgi-bin/get_consort.pl?taxon_name=Plantago%20erecta	
Geographic range	Widespread and common in CA, OR, Baja CA (Hickman 1993).	
Distribution in California; Ecological Section and Subsection	Jepson general areas of CA: Widespread in the Southwestern, Central Western, North Coast, and Sierra Nevada Foothills of the California Floristic Province, and along the edges of the Great Valley. Generally absent from deserts, high mountains, Modoc Plateau, and Great Basin. Ecological Sections/Subsections (http://www.fs.fed.us/r5/projects/ecoregions/ca_sections.htm): M262B (except g, h, i, l), 261B, M62A, 263A, M261B, 261F, 262A.	
Life history, life form	Annual herb; rapid development from seed to maturity	

Distinguishing traits	Small rosette-forming plants, with 3-13 cm long and very narrow, grass-like leaves with sparse, appressed silky hairs; the rosettes bear from one to many 3-30 cm long, scapose inflorescences (on narrow stalks without leaves) with a short, rounded to short cylindrical cluster of sessile flowers that covers less than a fifth of the stalk. Flowers have four thin, whitish-translucent, dry petal lobes on an inferior ovary. The small capsules open at the top to release the seeds (often two seeds). In cultivated fields, plants tend to grow larger than at natural sites and can reach a foot in height.
Root system, rhizomes, stolons, etc.	slender, branched taproot (A. Montalvo, pers. obs.).
Rooting depth	shallow
HABITAT	
Plant association groups	Coastal sage scrub, chaparral, open grassland and forblands (Hickman 1993, Mattoni et al. 1997).
Habitat affinity and breadth of habitat	Grassy slopes, flats, open woodland (Hickman 1993). In Riverside Co., often on shallow soils in open areas in shrublands, forblands, and grasslands where competition from annual grasses is reduced (Mattoni et al. 1997, A. Montalvo, pers. obs.). In a survey of Otay Mountain in San Diego Co., Mattoni et al. (1997) noted that plants were found most often where the soil had a well-developed crust of lichens, blue green algae, mosses and other cryptogams (known as cryptobiotic crusts), which can promote nutrient availability and suitability for mycorrhizal associations (Osborne & Redak 2000).
Elevation range	Below 700 m (Hickman 1993).
Soil: texture, chemicals, depth	Plants occur on a variety of soil types and textures over the species' range. Espeland & Rice (2007) observed plants in low fertility to deep, fertile soils. Hickman (1993) reports plants on sandy, clayey, and serpentine soils. In southern CA, plants also occur on gravely, sandy, to clayey loam soils derived from granite, gabbro, and latite-porphry (A. Montalvo, pers. obs. and herbarium records); plants are often on thin soil where there is little competition from non-native invasive grasses.
Drought tolerance	This annual species is regarded a "drought avoider". It emerges early in the winter rainy season, develops quickly, and typically releases seeds and senesces prior to hot, dry summers (Batten et al. 2006).
Precipitation	Plants grow in areas that average from 10 to over 25 inches of annual rainfall.
Flooding or high water tolerance	Not known to withstand flooding.
Wetland indicator status for California	None.
Shade tolerance	Full sun, but may tolerate partial shade; the related <i>P. ovata</i> withstands full sun to partial shade (Newton & Claassen 2003).
GROWTH AND REPRODUCTION	
Seedling emergence relevant to general ecology	Seedlings of <i>P. erecta</i> emerge early in the winter rainy season, as do the larvae of the checkerspot butterflies that utilize the plants as larval hosts (Dobkin et al. 1987). Although populations occur on serpentine soil, emergence from both serpentine and non-serpentine origin seed was lower on serpentine soil (Espeland & Rice 2007). Emergence rates in a field study in central CA ranged from 28% to 75% (Espeland & Rice 2007).
Growth pattern (phenology)	<i>Plantago erecta</i> is a short-lived annual with a lifespan that coincides with the rainy season (Gulmon et al. 1983). The phenology of these plants can be dependent on microclimatic and macroclimatic patterns. Seeds germinate following the first fall or winter rains, and plants often flower by early March; maximum leaf size occurs in April at Jasper Ridge, CA (Chiariello 1989). Hobbs & Mooney (1985) reported seed release in early summer, followed by another peak of seed release in August, for plants also growing at Jasper Ridge, CA; Hobbs (1985) observed mature seeds at Jasper Ridge in May. Phenology of plants may be earlier in southern CA: in western Riverside Co, mature leaves can be found in March and mature seeds in mid to late April (A. Montalvo, pers. obs.).
Vegetative propagation	None.

Regeneration after fire or other disturbance	Germination of seeds is reduced on gopher mounds (Hobbs & Mooney 1985). Plants can be common in postfire areas and clearings created by other forms of disturbance (Mattoni et al. 1997).
Pollination	Unlike many <i>Plantago</i> , this species is not wind pollinated (Primack 1978). Pollen dispersal is likely to be over very short distances by small insects. Another related species, <i>P. ovata</i> , is pollinated by species of <i>Apis</i> , including <i>A. mellifera</i> , and flies (Sharma et al. 1993).
Primary seed dispersal	Seed dispersal is reported to be ballistic over short distances (Espeland & Rice 2007). Hobbs & Mooney (1985) reported that seed release is "hydraulic," because when the fruits were wetted seeds dispersed short distances and did not merely fall to the ground. Harvester ants such as <i>Veromessor andrei</i> Mayr harvest seeds of <i>P. erecta</i> (Hobbs 1985). Most are destroyed through ant foraging, but some seeds are dispersed and lost.
Breeding system, mating system	Self-compatible, hermaphroditic (perfect) flowers, but outcrossing does occur (Espeland & Rice 2007). Stebbins & Day (1967) mention that the species has a tendency to self-pollinate but provide no data. Primack (1978) reported flowers to be cleistogamous (selfing, closed flowers) with only about 30 pollen grains per anther. Studies are needed to see if there is variation in breeding system.
Hybridization potential	Stebbins & Day (1967) stated that <i>P. erecta</i> is not likely to hybridize with <i>P. ovata</i> , in part due to differences in base chromosome number and to <i>P. erecta</i> often self-pollinating.
Inbreeding and outbreeding effects	No data found. Seed and pollen dispersal appear to be very limited which, in concert with self-pollination, may lead to both adaptive and neutral differences in populations over a relatively small spatial scale. If plants tend to self-pollinate, they may be able to purge deleterious alleles and have a low tendency toward inbreeding depression. However, if there is much local adaptation, such as that between serpentine and non-serpentine populations (Espeland & Rice 2007), translocation of populations to different habitats and regions would be more likely to experience a breakup of local adaptation upon outcrossing than species that have fluid dispersal abilities.
BIOLOGICAL INTERACTIONS	
Competitiveness	Plants of <i>P. erecta</i> are effective competitors for nutrients in the upper soil layer and may reduce growth of <i>Hemizonia</i> (Gulmon et al. 1983). However, the invasive grass, <i>Bromus mollis</i> , outcompetes <i>P. erecta</i> in serpentine grasslands (Koide et al. 1987). Correlation studies suggest that the altered bacterial community of soil in ecosystems invaded by barb goatgrass and yellow star thistle may be one way that these invasive species inhibit the establishment of <i>P. erecta</i> and other species (Batten et al. 2006). However, growth of <i>P. erecta</i> was unaffected by soil altered by goatgrass compared to controls in a pot study (Batten et al. 2008). Plants were also adversely affected by ant mounds (Brown & Human 1997).
Herbivory, seed predation, disease	Seeds are taken by ants (Hobbs 1985). Checkerspot butterfly larvae, <i>Euphydryas editha bayensis</i> , feed on the leaves (Chiariello 1989) as do the larvae of Quino checkerspot butterfly, <i>Euphydryas editha quino</i> Behr. (Mattoni et al. 1997, Pratt & Emmel 2009).
Palatability, attractiveness to animals, response to grazing	Mattoni et al. (1997) report that plants tend to occur more in areas that lack cattle grazing and invasive <i>Erodium</i> species, which are readily grazed. The plants are short lived and small, so not likely to be important forage.
Mycorrhizal? Nitrogen fixing nodules?	<i>P. erecta</i> was reported to obtain 25% mycorrhizal colonization in disturbed serpentine areas versus 50% in undisturbed areas (Koide & Mooney 1987). In a revegetation study on a serpentine outcrop, addition of phosphate fertilizer did not interfere with mycorrhizae and resulted in increased shoot growth (Koide & Mooney 1987). <i>P. lanceolata</i> is also arbuscular mycorrhizal (Cornelissen et al. 2001).
ECOLOGICAL GENETICS	
Ploidy	2n=20 (Munz 1974, Hickman 1993). Munz and Keck (1968) report <i>P. erecta</i> 2n=20, and <i>P. erecta</i> ssp. <i>rigidor</i> with 2n=42 (attribute counts to "Moore 1962" which may be incorrect). More information is needed to document variation in ploidy within this species.
Plasticity	Plant size is affected by planting density and type of soil substrate (Espeland & Rice 2007).
Geographic variation (morphological and physiological traits)	
Genetic variation and population structure	

Phenotypic or genotypic variation in interactions with other organisms	This plant is essential to more than one subspecific taxon of checkerspot butterfly over its natural range of distribution. Studies about local adaptation of butterflies and host plant populations may be important to helping practitioners understand if planting projects inside rare butterfly habitat are suitable for local butterfly populations.
Local adaptation	High potential based on reciprocal transplant studies (Espeland & Rice 2007). Needs further study.
Translocation risks	Yes, plants grown from seeds collected from serpentine vs. non-serpentine soils behave differently when grown in the alternate medium (Espeland & Rice 2007). Plants grew larger in their home soils and were smaller in foreign soil. Plant density only affected growth when plants were grown on the non-local soil type; for example, plants from non-serpentine origin grew larger than plants of serpentine origin only when grown at high densities in serpentine soil.
SEEDS	
General	RSABG for image: http://www.hazmac.biz/031117/031117PlantagoErecta.html Agriculturally produced seeds have an average of 98% purity and 75% germination (Stover Seed Company 2010). Hobbs & Mooney (1985) estimated that 94% of germinated seeds survived to flowering and that seed production was 5,460 seeds/m ² at Jasper Ridge, California. Density of plants at Jasper Ridge was estimated at 2,550/m ² , with 3.7 seeds produced per plant (Hobbs & Mooney 1985).
Seed longevity	
Seed dormancy	No treatment needed for germination. Non-dormant (Gulmon 1992).
Seed maturation	The tiny capsules dehisce when the seeds are mature, often in April and May in Riverside Co. (A. Montalvo, pers. obs.).
Seed collecting	Dehiscent inflorescences can be collected whole into a paper bag or envelope and later processed to separate chaff from seeds.
Seed processing	Seeds are smaller and similar in shape to those of <i>Plantago ovata</i> and can be processed similarly, but they may require smaller mesh size than for <i>P. ovata</i> (e.g. a #18 sieve). Wall & Macdonald (2009) report that ripe seeds of <i>P. ovata</i> can be collected into a paper bag; the seed material can then be sifted through a #16 sieve to separate seeds and chaff. They recommend a blower speed of 1.5 for final separation.
Seed storage	Cool dry storage.
Seed germination	With adequate water, seeds germinated under temperatures ranging from 30° C in late September to 12° C in late December (Gulmon 1992).
Seeds/lb	250,000 (Stover Seed Company 2009).
Planting	Plant densities of 1 plant per cm ² have been observed in natural populations (Espeland & Rice 2007). Sowing density was found to affect seedling emergence in a pot experiment; there was less emergence at high sowing densities (Espeland & Rice 2007). In flats, all seeds germinated when a thin layer of surface litter was sprinkled over seeds, whereas topsoil over seeds to depth of 0.62 cm and 1.24 cm decreased germination to 92% and 62%, respectively (Gulmon 1992). Shallow planting methods are expected to yield superior seedling emergence. The similar <i>P. ovata</i> performs very well when hydroseeded (A. Montalvo, pers. obs.).
Seed increase activities or potential	Seed production fields have been successful in California (S&S Seeds, pers. com.). There is a high potential for success of seed increase from other seed sources.
USES	
Revegetation and erosion control	<i>P. erecta</i> is becoming more widely used in hydroseed and dry broadcast seed mixtures in lowland southern CA, where cool season annuals are desired to provide early cover for erosion control. This early annual compliments later emerging shrubs and perennials, while also providing a food source for the rare Quino checkerspot butterfly. Plants are shorter in stature than the often-used <i>P. ovata</i> (= <i>P. insularis</i>) (e.g., Newton & Claassen 2003), and it is native to coastal sage scrub and chaparral communities. <i>P. ovata</i> has often been used outside of its native range and within the range of <i>P. erecta</i> with the thought that it won't persist, but plants readily reseed and have been observed to persist in some habitats for at least four years after initial planting (A. Montalvo, pers. obs.).
Habitat restoration	Seeds are used in restoration of coastal sage scrub in southern CA (A. Montalvo, pers. obs.).

Horticulture or agriculture	Farming to increase seeds is currently done in California.
Wildlife value	Important larval host plant of the rare and endangered Quino checkerspot butterfly, <i>Euphydryas editha quino</i> (Mattoni et al. 1997, Pratt & Emmel 2009). <i>P. erecta</i> is a main host plant for the larvae of checkerspot butterflies in the broad sense (<i>Euphydryas editha</i>), and the phenology of the butterflies is dependent upon the phenology of the plants (Dobkin et al. 1987).
Plant material releases by NRCS and cooperators	None.
Ethnobotanical	Although <i>P. erecta</i> has been reported to be used by native peoples, Timbrook (2007) notes that introduced species of <i>Plantago</i> were utilized by the Chumash and others and that medicinal use of <i>Plantago</i> species was not likely of indigenous origin.
ACKNOWLEDGMENTS	Partial funding for production of this plant profile was provided by the U.S. Department of Agriculture, Forest Service, Pacific Southwest Region Native Plant Materials Program.
CITATION	Montalvo, A. M., L. K. Cooke, and J. L. Beyers. 2010. Plant Profile for <i>Plantago erecta</i> . 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.rcrd.com/index.php?option=com_content&view=article&id=88&Itemid=190 .
LINKS TO REVIEWED DATABASES & PLANT PROFILES (last accessed September 2010)	
Fire Effects Information System (FEIS)	No matches
Jepson Flora, Herbarium (JepsonOnline)	http://ucjeps.berkeley.edu/cgi-bin/get_JM_treatment.pl?Plantago+erecta
USDA PLANTS	http://plants.usda.gov/java/profile?symbol=PLER3
Native Plant Network Propagation Protocol Database (NPNDP)	no matches http://nativeplants.for.uidaho.edu/network/
Native Seed Network (NSN)	No matches, http://www.nativeseednetwork.org/
Germplasm Resources Information Network (GRIN)	http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl
Flora of North America (online version)	No matches
Native American Ethnobotany Database	http://herb.umd.umich.edu/
Calflora	http://www.calflora.org/
Rancho Santa Ana Botanic Garden Seed Program, RSABG seed photos	http://www.hazmac.biz/rsabghome.html

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