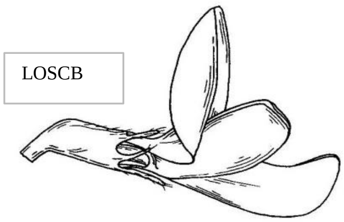
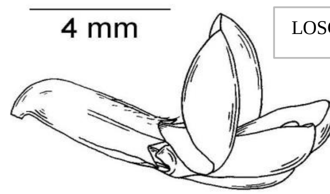
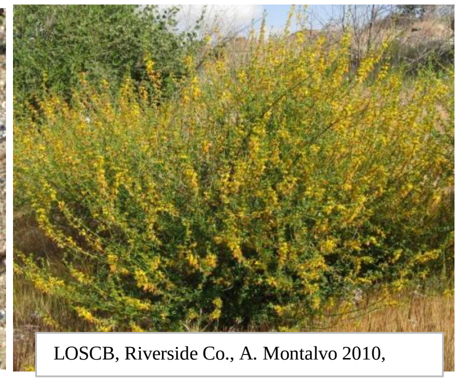
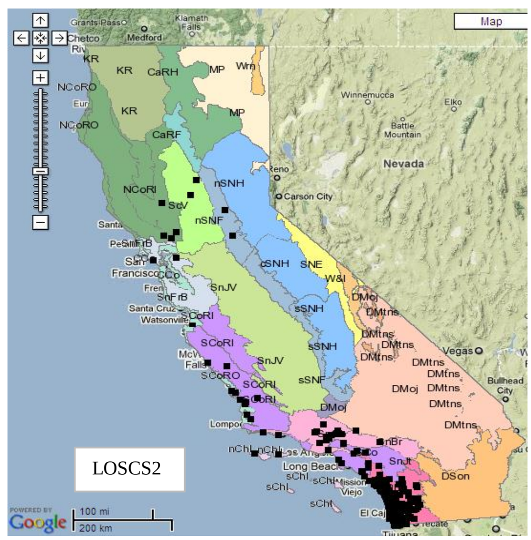
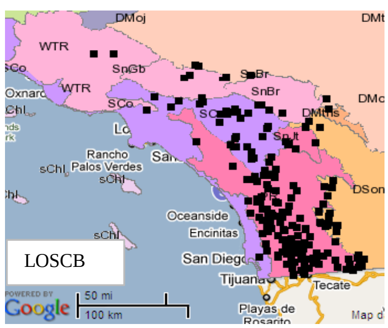
SPECIES	***Lotus scoparius* (Nutt. in Torr. & A. Gray) Ottley** **[= *Acmispon glaber* (Vogel) Brouillet]**
NRCS CODE: LOSC2  LOSCB , Riverside Co., A. Montalvo 2009	Tribe: **Loteae** Subfamily: **Papilionoideae** Family: **Fabaceae** Order: **Fabales** Subclass: **Rosidae** Class: **Magnoliopsida** LOSCB   LOSCS2  LOSCS2, Monterey coast, A. Montalvo 2003  LOSCB, Riverside Co., A. Montalvo 2010,
Subspecific taxa **1. LOSCS2** **2. LOSCB**	1. *Lotus scoparius* var. *scoparius* 2. *Lotus scoparius* (Nutt.) Ottley var. *brevialatus* Ottley
Synonyms (taxa numbered as above)	1. ***Acmispon glaber* (Vogel) Brouillet var. *glaber*** [New name in Jepson Manual 2nd Edition, JepsonOnline 2010] *Hosackia scoparia* Nutt. in T. and G. *H. glaber* Greene *H. crassifolia* Nutt., not Benth *L. glaber* Greene, not Mill. *L. scoparius* (Torr. & A. Gray) Ottley *L. scoparius* (Nutt. in T. & G.) Ottley ssp. *scoparius* (Ottley) Munz *Lotus scoparius* (Nutt.) Ottley var. *perplexans* Hoover p.p. *Syrmatium glabrum* Vogel 2. ***Acmispon glaber* (Vogel) Brouillet var. *brevialatus* (Ottley) Brouillet** [New name in Jepson Manual 2nd Edition] *Hosackia glabra* (Vogel) Torr. var. *brevialata* (Ottley) Abrams *Lotus scoparius* (Torr. & A. Gray) Ottley var. *brevialatus* Ottley *Lotus scoparius* (Nutt. in T. & G.) Ottley ssp. *brevialatus* (Ottley) Munz
Common name (taxa numbered as above)	General for species: California broom, deerweed 1. coastal deerweed, common deerweed 2. desert deerweed, western bird's foot trefoil, short-winged deerweed (Roberts 2008, Painter 2009, USDA PLANTS 2010).
Taxonomic relationships	Over 45 taxa of *Lotus* were recognized in Isely's treatment in Hickman (1993) for California. These taxa had been grouped and regrouped into various species as well as subgenera or genera based on morphology for over a century. Allan & Porter (2000) analyzed DNA (ITS and nuclear ribosomal DNA), geographic, and morphological data for more than 45 taxa of *Lotus* together with additional related taxa of Loteae and found several geographically distinct lineages. *L. argophyllus* (A. Gray) E. Greene var. *fremoniti* (A. Gray) Ottley and *L. nevadensis* (S. Watson) E. Greene were the most closely related taxa to *L. scoparius,* with *L. a.* var. *adsurgens* Dunkle, *L. a.* var. *niveus* (E. Greene) Ottley, *L. dendroideus* (E. Greene) E. Greene, and *L. nuttallianus* E. Greene belonging to the same clade. Further work by Sokoloff (2000) recommended recognition of four genera of North American Loteae, including *Hosackia, Syrmatium, Acmispon* and *Ottleya;* each of which had at some time included *L. scoparius* . Most recently, Brouillet (2008) recognized two major groups *Ottleya* and *Acmispon* for North America and reorganized California taxa of *Lotus* (per Hickman 1993) into two genera, *Acmispon* and *Hosackia.* Brouillet assigned *L. scoparius* to the genus *Acmispon* and formally published recombinations that included the two varieties.

Related taxa in region	*Lotus argophyllus* (=*Acmispon argophyllus* (A. Gray) Brouillet), *L. dendroideus* (= *A. dendroideus* (Greene) Brouillet, *L. nevadensis* (= *A. nevadensis* (S Watson) Brouillet) and their subtaxa.
Taxonomic issues	Of five previously recognized subspecific taxa (Ottley 1923, Munz & Keck 1968), the three from the Channel Islands were reassigned to *L. dendroideus* by Isely (1981). His treatment of the genus recognized the two varieties, *L. s.* var. *scoparius* and *L. s.* var. *brevialatus* adopted in Hickman (1993). These two varieties were considered by Munz (1974) to be different subspecies based on strong differentiation of floral traits and habitat affinity. Genetic, ecological, and hybridization studies by Montalvo & Ellstrand (2000, 2001) also justify subspecific status. There have been numerous revisions of the very large genus *Lotus* over the years. In 2010, the Jepson Flora Project (JepsonOnline 2nd Ed. 2010) accepted the Brouillet (2008) revision of *Lotus* based on genetic and morphological data and reassigned this and related species to *Acmispon*. It will take time for this new name to be picked up by local floras and databases. To facilitate communication, we retain the name *Lotus scoparius* at the top of this profile alongside the name *Acmispon glaber.*
Other	The Latin name "scoparius" refers to the broom-like form which is also evident in the common name "California broom." The other common name, "deerweed," refers to its use as browse by deer. *L. s.* var. *brevialatus* is the form found naturally in hot summer, interior habitats of Riverside, Los Angeles, San Bernardino, and San Diego counties (Steppan 1991, Montalvo & Ellstrand 2000, 2001). Both varieties have been planted widely for roadside revegetation, erosion control, and habitat restoration resulting in their occurrence in areas where they do not exist naturally and where they may be maladapted relative to the home variety. Some disjunct populations of variety *scoparius* have occurred inland for many years along major waterways and may possibly be natural populations.
GENERAL	
Map	Data provided by the participants of the Consortium of California Herbaria represent 312 and 260 records with coordinate data for LOSCS2 (right) and LOSCB (below); accessed 8/2/10; Some specimens may be misidentified. Berkeley Mapper: http://ucjeps.berkeley.edu/consortium  
Geographic range	Western California and northern Baja California. Plants have been introduced into Arizona. 1. Variety *scoparius* is distributed in cismontane California below 1,500 m from Humboldt and Plumas Counties, south into Baja California. 2. Variety *brevialatus* occurs from Los Angeles Co., south into Baja California primarily in the hotter and drier interior regions of Riverside, Los Angeles, western San Bernardino, and eastern San Diego Counties.
Distribution in California; Ecological section and subsection	Jepson general areas of CA: 1. (LOSCS2) Widespread in coastal portions of the North Coast, North Coast Ranges, n Sierra Nevada Foothills, Central Coast, San Francisco Bay Area, South Coast (mostly upper areas and west-facing slopes), Western Transverse Ranges, Peninsular Ranges. 2. (LOSCB) Generally occurs away from immediate coast in the southern California Floristic Province in the South Coast Ranges (east facing slopes), Western Transverse Ranges, San Gabriel and San Bernardino Mtns., San Jacinto and Peninsular Mtns. and the western edge of the Sonoran Desert. Ecological Section/subsection map: http://www.fs.fed.us/r5/projects/ecoregions/ca_sections.htm. Central California Coast (261A), Central California Coast Ranges (M262A), Colorado Desert (322Cb, in desert scrub and chaparral stands), Northern California Coast (263Aj, Al-m), Northern California Coast Ranges (M261B), Northern California Interior Coast Ranges (M261Ca-c), and Sierra Nevada (southern sections of M261Ef-g, Ep, Es), Sierra Nevada Foothills (M261F), Southern California Coast (261B), and Southern California Mountains and Valleys (M262Ba-d, Bf-g, Bi-l, Bn-p) (as listed in Sawyer et al. 2009).
Life history, life form	Perennial subshrub, generally live for about 5 to 10 years (Montalvo 2004 and pers. obs.) but can reach 20 yr (Sawyer et al. 2009). Plants tend to be a component of early stages of vegetation recovery after wildfire.

Distinguishing traits	Generally erect, suffrutescent shrub, 0.4 to 1.5 m tall, with many flexible green branches arising from a woody base. Branches are mostly glabrous except toward tips. Prostrate ecotypes of *L. s.* var. *scoparius* occur occasionally along coast bluffs and sand dunes, especially near Monterey. The flimsy, alternate leaves are pinnately compound with three (occasionally four to five) oblong to oblanceolate leaflets (broader at to above the middle), usually 4 to 10 mm long with short, sparse, appressed hairs, and are subtended by small, gland-like stipules. The sessile, usually two to seven flowered, umbellate inflorescences are in the axils of leaves. The yellow pea-like flowers are 7 to 10 (occasionally to 15) mm long, have short pedicels, and sometimes bear a red splotch of varying intensity on the back of the banner. Flower traits separate the varieties. In *L. s.* var. *scoparius*, the keel of the corolla is about as long as the wings and the calyx has broad triangular teeth; in *L.* var. *brevialatus* the keel is longer than the shortened wings and the calyx has narrow teeth. The small indehiscent pods bear one to two (rarely three) seeds that vary from brown to greenish brown with or without dark brown mottling. (modified from Montalvo 2004).
Root system, rhizomes, stolons, etc.	Branched taproot system becomes somewhat fibrous (Hellmers et al 1955).
Rooting depth	Excavated roots penetrated soil up to 3.7 feet (Hellmers et al. 1955).
HABITAT	
Plant association groups	Present as a canopy dominant to scattered in many lowland shrub communities such as coastal sage scrub, chaparral, desert scrub, alluvial scrub, and coastal sand dunes. Often dominant or co-codominant with *Eriogonum fasciculatum, Salvia mellifera, S. apiana, Corethrogyne filaginifolia, Artemisia californica, Adenostoma fasciculatum* and other shrubs (Saywer et al. 2009).
Habitat affinity and breadth of habitat (taxa numbered as above)	In southern California, plants tend to grow much more on gentle slopes (< than 5º) than on steeper slopes (Kirkpatrick & Hutchinson 1980). 1. Primarily in shrublands and associated open areas, and primarily in the coastal regions of California and also inland habitats north of Los Angeles. 2. Primarily in the hotter and drier interior regions of southern California.
Elevation range	Several meters above sea level (var. *scoparius*) to about 1,500 m (Montalvo 2004).
Soil: texture, chemicals, depth	Prefers well-drained soils but can occur on a wide range of soil textures. Most common on unconsolidated soils and "other" soils than on granite (Kirkpatrick & Hutchinson 1980). Found on soils derived from a variety of parent materials including granite, serpentinite, gabbro, andesite, sandstone, and shale (Montalvo, pers. obs.).
Drought tolerance	Drought tolerant. Plants can become dormant and drop leaves during prolonged summer drought (Nilsen & Muller 1980, Montalvo & Ellstrand 2000). They are facultatively drought-deciduous, a trait commonly associated with shallow-rooted shrubs of coastal sage scrub vegetation in California. Seasonality of leaf production, nutrient accumulation, and leaf drop in response to summer drought has been studied extensively in *L. s.* var. *scoparius* (Nilsen & Muller 1980, 1981a, 1981b, 1982, Nilsen & Schlesinger 1981, Nilsen 1982).
Precipitation	Plants typically occur in Mediterranean climate regions of California that are usually dry in summer, wet in the cool winter, becoming dry mid to late spring, depending on location. Total annual precipitation ranges from about 10 to 25 in with variety *scoparius* on the higher end and variety *brevialatus* on the lower end of the range. Some north coastal forms of variety *scoparius* (such as the prostrate forms on sand dunes) may receive higher annual precipitation.
Flooding or high water tolerance	Upland species of well-drained soils. May occur in well-drained sandy to gravely soil of infrequently flooded alluvial fans and alluvial terraces along major stream channels (Kirkpatrick & Hutchinson 1980, Montalvo, pers. obs.).
Wetland indicator status for California	None.
Shade tolerance	Shade intolerant. Requires full sun or nearly full sun.
GROWTH AND REPRODUCTION	
Seedling emergence relevant to general ecology	Seeds of *L. scoparius* germinate in mid to late winter during the rainy season in gaps, along roadsides, or following a fire (DeSimone & Zedler 1999, Montalvo 2004).
Growth pattern (phenology)	Plants establish quickly from seed with normal rainfall and typically reach flowering size the second year. Most seedling and vegetative growth occurs from mid January to late May (study in Santa Barbara Co., Nilsen & Schlesinger 1981; A. Montalvo, pers. obs. Riverside Co. and San Diego Co.). Flowering occurs sequentially over a long season, primarily from March to June but may start as early as January in warm, wet winters, and last much longer in more moist, coastal areas and in years with long-lasting soil moisture. Seeds mature within six weeks of pollination and tend to hold on the stems until the end of flowering (A. Montalvo, pers. obs.). Plants drop leaves during the summer drought and if drought begins early, so does leaf drop. Seed production is highly variable and can be very low in years that have an early onset of drought (DeSimone & Zedler 2001).

Vegetative propagation	None.
Regeneration after fire/other disturbance	Obligate seeder and colonizer. The hard seed coat is scarified by fire and most seedlings are recruited the first rainy season following fire (Keeley et al. 2006). Seedlings also emerge in open, disturbed areas of coastal sage scrub, chaparral, desert scrub, washes, coastal strand, or along roadsides (Montalvo 2004). Plants are generally killed by fire (Keeley & Keeley 1984). They have a thin epidermis, do not resprout, and have a broom-like canopy that is susceptible to burning (Sawyer et al. 2009). About 2 to 3 years after fire in sage scrub vegetation, and following a burst of herbaceous species, California broom can become the dominant canopy species, eventually becoming replaced by long-lived shrub species. Its abundance gradually decreases in 5 to 10 years after fire (Montalvo 2004).
Pollination	Flowers are visited and pollinated primarily by native bees in the genera *Bombus, Hoplitus, Anthophora, Habropoda, Osmia, Agapostemon,* and *Anthidium,* but flowers are also visited by butterflies and the non-native honeybee, *Apis mellifera* (Jones & Cruzan 1999, Montalvo, pers. obs.).
Seed dispersal	Primarily gravity. The indehiscent pods tend to drop to the ground and may be passively dispersed short distances (Montlavo 2004). DeSimone & Zedler (2001) found that for *L. s.* var. *scoparius* in the foothills of Orange Co., seeds dispersed a meter or less from parent shrubs.
Breeding system, mating system	Flowers are self-compatible and insect-pollinated (Moldenke 1976, Hickman 1993, Jones & Cruzan 1982, 1999, Montalvo & Ellstrand 2001). Inbreeding coefficients based on allozymes of 12 southern California populations were low for all populations, a pattern consistent with substantial cross pollination, severe loss of inbred progeny, or both (mean inbreeding coefficient = 0.09) (Montalvo, Clegg, & Ellstrand, unpublished manuscript cited in Montalvo 2004).
Hybridization potential	Among varieties: In experimental arrays of potted plants, bees moved freely between flowers of the two varieties (P. Aigner & A. Montalvo, pers. obs.). Experimental cross pollinations by hand between *L. s.* var. *scoparius* and var. *brevialatus* produced hybrids with flowers of intermediate form but with wings as long as the keel (Montalvo & Ellstrand 2001, Montalvo 2004). The two varieties hybridize where they come into contact naturally and hybrids have been observed in narrow hybrid zones (Isely 1981, Steppan 1991, Montalvo & Ellstrand 2001). Many areas of overlap may be due to natural secondary contact, but some are clearly due to seeding projects along roads and utility corridors. Among species: Putative hybrids have been reported between California broom and *L. junceus* (Benth.) Greene and *L. benthamii* Green in central and northern California, as well as between other members of the species complex (Isely 1981), but these have not been confirmed with genetic studies. Liston and others (1990), however, did genetic studies on San Clemente Is. and documented hybridization between the rare *L. dendroideus* (Greene) Greene var. *traskiae* (Nodden) Isely, formally *L. scoparius* ssp. *traskiae* (Noddin) Raven, and the more widespread *L. argophyllus* (A. Gray) E. Greene var. *ornithopus* (E. Greene) Ottley. They concluded that genetic assimilation of the rare species by the widespread species is possible.
Inbreeding and outbreeding effects	Montalvo and Ellstrand (2001) directly tested the potential for "outbreeding depression," a loss of fitness upon crossing genetically differentiated populations, by crossing individuals from six populations of the two varieties in every combination and testing the progeny in two common gardens at wild sites. Seeds per flower and seedling emergence decreased significantly with an increase in genetic distance of the crossed parental populations. Among variety crosses were only 70 percent as fit as within variety crosses by the time seedlings emerged, and further fitness differences accumulated after seedlings were outplanted into field plots. In these common gardens, success of progeny decreased with increasing differences between parental environments and the transplant location.

BIOLOGICAL INTERACTIONS

Competitiveness	Mature plants do not compete well with later seral shrubs of sage scrub vegetation. In mature vegetation, seedling emergence is associated with gaps in the vegetation (DeSimone & Zedler 2001). Seedlings do appear to compete well in the matrix of new shrubland vegetation that emerges following fire or mechanical clearing. However, seeds do not appear to accumulate in the seedbank or compete well in areas that have become dominated by non-native grasses and forbs (DeSimone & Zedler 2001). In western Riverside Co., an average of 41.9 seedlings/meter emerged from soils collected from shrub-dominated plots whereas only 6.3 emerged from soils of grass-dominated plots (Cox & Allen 2008).
Herbivory, seed predation, disease	Plants develop flower galls. Larvae of 27 species of butterflies in the Lycaenidae were successfully reared on the leaves and flowers of *L. scoparius* collected in Riverside, California (Pratt & Ballmer 1991). Genera included *Lycaena, Atlides, Callophrys, Chlorostrymon, Erora, Ministrymon,* and *Satyrium* . Larval Nepticulidae butterflies in the species *Microcalyptris lotella,* mine the stems (Wagner 1987). Seed predation after seed dispersal in shrubland can be high (70%) but it is much lower in grassland and the shrub/grassland ecotone (DeSimone & Zedler 2001).
Palatability, attractiveness to animals; response to grazing	The plants provide valuable forage for deer, especially in drought years or after fire when growth of herbaceous vegetation is sparse (Conrad 1987, Dale 2000). Plants tend to branch after light grazing (Montalvo, pers. obs.).
Mycorrhizal? Nitrogen fixing nodules?	Roots form symbiotic associations with nitrogen fixing bacteria within root nodules and with arbuscular mycorrhizal fungi (Montalvo 2004, A. Montalvo, pers. obs.).

ECOLOGICAL GENETICS	
Ploidy	Both varieties have 2n = 14 chromosomes (Munz & Keck 1968, Grant 1995).
Plasticity	Most plasticity is in vegetative traits rather than in traits of the flowers (A. Montalvo, pers. obs.).
Geographic variation (morphological and physiological traits)	There is genetically based geographic variation in floral form. The morphological differences between varieties were retained in common garden studies for two generations (Montalvo & Ellstrand 2001). In San Diego Co., Steppan (1991) detected distinct discontinuities in floral morphology between varieties and moderate correlations among environmental variables and floral traits of wild populations. Montalvo and Weaver (unpublished data) measured floral traits of plants from 12 populations raised in a common environment and compared each pair of populations for genetic, floral, geographic, and environmental differences. The degree of difference in floral morphology correlated with environmental distance. Genetic distance correlated with floral distance, but genetic distance did not correlate with geographic distance. These results are consistent with floral form having a genetic basis and with environmental factors playing a role in influencing genetic divergence in floral form.
Genetic variation and population structure	There are significant genetic differences among populations of the two varieties of California broom (Montalvo & Ellstrand 2000, 2001). An analysis of genetic marker data (13 allozyme loci) from three populations of var. *brevialatus* and nine populations of var. *scoparius* from southern California showed significant population substructure due primarily to differences among populations of the two varieties. In an analysis of all populations, 18 percent of the variation was due to differences among populations, while analysis of just var. *brevialatus* or var. *scoparius* populations showed only 1 and 8 percent of the variation due to differences among populations. Thus, populations within a variety are substantially more genetically similar to each other than to populations of the other variety.
Phenotypic or genotypic variation in interactions with other organisms	In a study of plants from 12 populations, P. Aigner and A. Montalvo (unpublished) found large differences in nectar production among the two varieties which appears to correlate with use of the flowers by different groups of bees. Nectar foraging bees tend to prefer variety *scoparius*, which produces significantly more nectar, and pollen foraging bees tend to prefer variety *brevialatus*.
Local adaptation	Common garden experiments testing plants originating from seed collected from 12 southern California source populations (both varieties represented) demonstrated a significant home site advantage (Montalvo & Ellstrand 2000, 2001). On average, plants survived and produced more flowers in the common garden most similar to the site where seeds were first collected. Environmental similarity (based on a variety of climate, soil, and coastal influence variables) of source sites relative to planting sites was much more important than the geographic distance between source and planting sites in predicting performance in the common gardens.
Translocation risks	Montalvo & Ellstrand (2001) found significant "outbreeding depression," a loss of fitness upon crossing genetically differentiated populations in experiments with *Lotus scoparius*. They crossed individuals from six populations of the two varieties in every combination and tested the progeny in two common gardens at wild sites. Progeny from crosses among varieties suffered significantly lower seedling emergence, survival, growth, and flower production. The substantial genetic differentiation of populations from different environments, evidence for local adaptation (see above), and the demonstrated lower success of hybrids created from parents of contrasting environments or varieties show that there is substantial risk to establishing populations from seed sources collected from divergent environments or sites that naturally support the contrasting variety (Montalvo 2004). The size of the risk increases with the scale of the genetic and habitat differences among populations.
SEEDS	For additional images: http://www.hazmac.biz/050411/050411LotusScopariusScoparius.html http://www.ars-grin.gov/cgi-bin/npgs/html/dispimage.pl?162165 LOSCS2 seeds removed from pods © 2009 California State University, Stanislaus 
General	Seeds of var. *scoparius* are narrow bean-shaped, curved, and 1.2 - 2 mm (sometimes 3 mm) long. Seeds of var. *brevialatus* are generally narrower (ca. 3 to 4 x longer than wide). Standard purity and germination ranges from about 95% and 80%, respectively (S&S Seeds, pers. com.) to 90% and 60% (Stover Seed Company, pers. com.).
Seed longevity	Long lived in soil seed bank and in cool, dry storage. Went & Munz (1949) included *L. s.* var. *brevialatus* seeds from Riverside Co. east of Temecula in their seed longevity study started in 1947. Seeds were dried to low moisture content and stored in vacuum vials. Seed tests (likely untreated seeds) yielded 7%, 20% , 0%, and 10% germination in 1947, 1948, 1967, and 1997, respectively (Went & Munz 1949, Michael Wall, Rancho Santa Ana Botanic Garden, pers. com.).

Seed dormancy	The hard seeds require heat or mechanical scarification to break dormancy. Of several treatments including control, soil heated to 100 °C for 1 hr, ash /chemical fertilizer, and heat plus fertilizer, Christensen and Muller (1975) found that heat treatment yielded the highest germination. In addition, Keeley (1987) found that heating seeds in their pods to 120 °C for 5 minutes increased germination over that of unheated controls. Pods or cleaned seeds can be covered with boiling water and left to soak to break dormancy (Atwater 1980, Young & Young 1986, Emery 1988, Montalvo & Ellstrand 2000, 2001). For seed testing, a hot water soak before germinating at 20°C improved germination from 30% to 64% with 32% hard seed remaining (Atwater 1980) .
Seed maturation	The indehiscent pods ripen in about 4 to 6 weeks (Montalvo 2004). Pods are brown and dry when seeds are mature. Bright green seeds are not ripe. Seeds turn a more olive-green to brown when mature.
Seed collecting and harvesting	In southern California the small pods can be collected from May to July depending on location (Montalvo 2004). Plants can flower and set seed later in the summer along the central and northern coasts of California where peak blooming can be as late as mid July (A. Montalvo, pers. obs.). When ripe, seeds are stripped from stems into barrels or onto tarps.
Seed processing	Care needs to be taken to avoid breaking seeds during thrashing to remove them from stems and pods. For most planting purposes, the pod can be left on the seed. To clean, sift through a sieve to remove chaff. To remove seeds from pods for detailed seed banking, Wall & Macdonald (2009) recommend rubbing floral material with wooden block over medium screen or #16 sieve, then shaking released seeds through sieve, and resieve several times through #12 sieve. Seeds can then be removed from chaff with a seed blower with speed set to 1.75. Resieve several times through #12 and #16 sieves.
Seed storage	Store seeds dry. They store best under cool storage conditions.
Seed germination	Seedlings tend to emerge 7 to 14 days after sowing and watering in the cool rainy season (Montalvo, pers. obs.). In seed tests, Mirov & Kraebel (1939) recorded 6 days from sowing to start of germination.
Seeds/lb	LOSCS2: 314 seeds/gram ~ 143,000 seeds/lb (Golden Gate National Park nursery) LOSCB: 170,000 seeds/lb (S&S Seeds, http://www.ssseeds.com/database/db_testvv.php3?uid=305) LOSCB: 220,000 seeds/lb (Stover Seeds, http://www.stoverseed.com/websearch/itemsheet.cfm?ic=LOSCO)
Planting	Whole pods can be dry or wet broadcast in the fall for revegetation and restoration. Seedling plugs can also be used for small projects and are best planted out early in the rainy season. In one study, seeds sown were sown February 8-9 in plug flats and seedling plugs were planted in the field March 20 (Montalvo & Ellstrand 2000). In a more successful round, seeds were surface sown in plugs flats on December 18-19 and the seedlings outplanted February 14-15. Greenhouse temperatures were ambient during seedling emergence but kept within 4.4 and 32.2ºC (Montalvo & Ellstrand 2001). For container plant production, plant seeds on surface of soil in plug flats (nursery protocol by Young, Betty, 2001, USDI NPS - Golden Gate National Parks, San Francisco, California. In: NPN. URL: http://www.nativeplantnetwork.org (accessed 26 August 2010). Seeds sown in August germinate in about 10 days and can be transplanted into lager containers after about 10 to 14 days.
Seed increase activities or potential	Plants can be grown to increase seeds, but this is probably unnecessary. Seeds can be wild-collected from large stands of plants for several years after wildfire. The Irvine Ranch Conservancy initiated a 1-acre seed increase field in fall 2009 in Orange Co. (J. Burger, pers. com.). The plants suffered damage from herbivory shortly after transplanting, but many damaged plants recovered by the end of the growing season. Many plants flowered by the end of the first growing season but not enough for seed harvest.
USES	
Revegetation and erosion control	California broom is an important, fast growing, early successional species used extensively in roadside revegetation, erosion control, post-fire mitigation, and habitat restoration in California, especially in coastal sage scrub (Montalvo 2004). Newton and Claassen (2003) recommend use of this plant that has nitrogen fixing nodules for disturbed lands within the central western California and southwestern California regions.
Habitat restoration	Plants and seeds area frequently used in restoration of coastal sage scrub and other shrubland habitats. To avoid outbreeding depression and maladaptation, careful attention should be given to matching the variety native to the site and to the environment of source populations relative to planting location, especially when choosing source populations for restoration, mitigation, and roadside landscaping through wildland areas (Montalvo 2004).
Horticulture or agriculture	Horticulture: Plants are occasionally used in naturalistic, dry garden landscapes. The long branches yield long, arching sprays of small yellow flowers in the spring (Montalvo, pers. obs.). The flowers provide a great food source for native bees in a bee-friendly garden. Recommended for low water gardens (O'Brien et al. 2006, Perry 2010). Added water in spring during drought extends leaf retention and flowering. Plants are not adapted to summer water. Dormant plants can be trimmed back in late summer and fall. Agriculture: Padgett et al. (2000) examined the effect of four types of supplemental irrigation on establishment of plants from seeds planted outside in Riverside (variety not indicated) including no supplemental water, spring water (March 1-July 1), summer water (July 1- Oct. 1), and continuous water (Dec. 1995-Oct 1996). Seedling emergence was not improved by irrigation and by the end of the second year, seedling survival was highest in the unirrigated control plots. Addition of summer water after seedling establishment significantly reduced survival of seedlings.

Wildlife value	The flowers and seeds are an important food resource for a variety of insects and seed foraging rodents and birds (Duncan 1968). Plants supply food for rodents (Meserve 1976), scarab beetles (Evans 1985), and the larvae of many species of butterflies (Howe 1975, Pratt & Ballmer 1991). The plants provide valuable forage for deer, especially in drought years when growth of herbaceous vegetation is sparse (Dale 2000). Conrad (1987) states that the plants provide staple to low value browse for deer and livestock.
Plant material releases by NRCS and cooperators	None.
Ethnobotanical	Moerman's Native American Ethnobotany Database (http://herb.umd.umich.edu/) lists several uses by native peoples including: decoction of foliage for coughs (Costanoan); food for livestock (Diegueno); fiber for building materials (Costanoan); for house construction (Costanoan and Cahuilla); and roots for soap (Diegueno).
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., and J. L. Beyers. 2010. Plant Profile for *Lotus scoparius.* 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 Information System (FEIS)	*Lotus scoparius* not available. http://www.fs.fed.us/database/feis/
Jepson Flora, Herbarium (JepsonOnline)	http://ucjeps.berkeley.edu/cgi-bin/get_JM_treatment.pl?3691,3958,4013
Jepson Flora, Herbarium, Second Edition Review (Jepson Online 2nd Ed.)	http://ucjeps.berkeley.edu/tjm2/review/treatments/fabaceae_all.html#91709
USDA PLANTS	http://plants.usda.gov/
Native Plant Network Propagation Protocol Database (NPNPP)	http://www.nativeplantnetwork.org/
GRIN (provides links to many resources)	http://www.ars-grin.gov/cgi-bin/npgs/html/taxgenform.pl
Wildland Shrubs	http://www.fs.fed.us/global/iitf/pdf/shrubs/Lotus%20scoparius.pdf
Flora of North America (FNA) (online version)	Fabaceae not available
Native American Ethnobotany Database	http://herb.umd.umich.edu/
Calflora	http://www.calflora.org/
Rancho Santa Ana Botanic Garden Seed Program, seed images	http://www.hazmac.biz/rsabghome.html
USE OF IMAGE WITH COPYRIGHT	

Bibliography for *Lotus scoparius* (= *Acmispon glaber*)

Allan, G. J., and J. M. Porter. 2000. Tribal delimitation and phylogenetic relationships of Loteae and Coronilleae (Faboideae: Fabaceae) with special reference to *Lotus*: Evidence from nuclear ribosomal ITS sequences. American Journal of Botany **87**:1871-1881.

Atwater, B. R. 1980. Germination, dormancy and morphology of the seeds of herbaceous ornamental plants. Seed Science and Technology **8**:523-573.

Bowler, P. A., A. Wolf, H. V. Pham, M. A. Archer, A. S. Bak, M. Bedaux, A. Chhun, J. S. Crain, S. Feeney, A. Gloskowski, P. Golcher, C. J. Hodson, M. L. James, R. C. Johnson, M. S. Milane, V. H. Nguyen, R. S. Salazar, and C. R. Simonds. 1994. Transplanting coastal sage scrub seedlings from natural stands (California). Restoration and Management Notes **12**:87-88.

Brouillet, L. 2008. The taxonomy of North American loti (Fabaceae: Loteae): New names in *Acmispon* and *Hosackia*. Journal of the Botanical Research Institute of Texas **2**:387-394.

Christensen, N. L., and C. H. Muller. 1975. Relative importance of factors controlling germination and seedling survival in *Adenostoma* chaparral. The American Midland Naturalist **93**:71-78.

Comstock, J., and J. R. Ehleringer. 1986. Photoperiod and photosynthetic capacity in *Lotus scoparius*. Plant, Cell and Environment **9**:609-612.

Conrad, C. E. 1987. Common Shrubs of Chaparral and Associated Ecosystems of Southern California. General Technical Report PSW-99, U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA, 86 p.

Cox, R. D., and E. B. Allen. 2008. Composition of soil seed banks in southern California coastal sage scrub and adjacent exotic grassland. Plant Ecology **198**:37-46.

Dale, N. 2000. Flowering Plants: The Santa Monica Mountains, Coastal and Chaparral Regions of Southern California, 2nd edition. California Native Plant Society, Sacramento, CA.

De Ruff, R. 1990. The plants of upper Newport Bay, 1982-1989. Pages 10-19 *in* P. J. Bryant and J. Remington, editors. Endangered Wildlife and Habitats in Southern California. The Natural History Foundation of Orange County, Newport Beach, CA.

DeSimone, S. A., and P. H. Zedler. 1999. Shrub seedling recruitment in unburned Californian coastal sage scrub and adjacent grassland. Ecology **80**:2018-2032.

DeSimone, S. A., and P. H. Zedler. 2001. Do shrub colonizers of southern Californian grassland fit generalities for other woody colonizers? Ecological Applications **11**:1101-1111.

Duncan, D. A. 1968. Food of California quail on burned and unburned central California foothill rangeland. California Fish and Game **54**:123-127.

Emery, D. E. 1988. Seed Propagation of Native California Plants. Santa Barbara Botanical Garden, Santa Barbara, California.

Evans, A. V. 1985. New host plant association for adult Scarabs (Coleoptera: Scarabaeidae: Melolonthinae) from Arizona and California. The Coleopterists Bulletin **39**:86-88.

Genin, D., and A. Badan-Dangon. 1991. Goat herbivory and plant phenology in a mediterranean shrubland of northern Baja California. Journal of Arid Environments **21**:113-121.

Genin, D., and A. P. Pijoan. 1993. Seasonality of goat diet and plant acceptabilities in the coastal scrub of Baja California, Mexico. Small Ruminant Research **10**:1-11.

Grant, W. F. 1995. A chromosome atlas and interspecific-intergenic index for *Lotus* and *Tetragonolobus* (Fabaceae). Canadian Journal of Botany **73**:1787-1809.

Haidinger, T. L., and J. E. Keeley. 1993. Role of high fire frequency in destruction of mixed chaparral. Madroño **40**:141-147.

Harrison, A. T., E. Small, and H. A. Mooney. 1971. Drought relationships and distribution of two Mediterranean-climate California plant communities. Ecology **52**:869-875.

Hellmers, H., J. S. Horton, G. Juhren, and J. O'Keefe. 1955. Root systems of some chaparral plants in southern California. Ecology **36**:667-678.

Hickman, J. C. 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, CA.

Hillyard, D. 1990. Coastal sage scrub restoration in Orange County: Two approaches. Pages 20-25 *in* P. J. Bryant and J. Remington, editors. Endangered Wildlife and Habitats in Southern California. The Natural History Foundation of Orange County, Newport Beach, California.

Howe, W. H. 1975. The Butterflies of North America. Doubleday and Company, Inc., Garden City, New York.

Isely, D. 1978. New varieties and combinations in *Lotus*, *Baptisia*, *Thermopsis*, and *Sophora* (Leguminosae). Brittonia **30**:466-472.

Isely, D. 1981. Leguminosae of the United States III subfamily Papilionoidae: Tribes Sophoreae, Podalyrieae, Loteae. Memoirs of the New York Botanical Garden **25**:1-264.

JepsonOnline. 2010. The Jepson Manual Higher Plants of California; Online Version with 2nd edition notes. http://ucjeps.berkeley.edu/jepman.html.

JepsonOnline 2nd Ed. 2010. L. Brouillet. 2011, in press. *Acmispon*. *In* B. G. Baldwin et al., editors. The Jepson Manual: Vascular Plants of California, 2nd Edition. University of California Press., Berkeley, CA. Online: http://ucjeps.berkeley.edu/jepman.html. Accessed: September 30, 2010.

Jones, C. E., and M. Cruzan. 1982. Floral color changes in deerweed (*Lotus scoparius*): Possible function. Crossosoma **8**:1-6.

Jones, C. E., and M. B. Cruzan. 1988. Adaptive significance of time dependent, pollination related flora changes in California xerophytes. Pages 124-139 *in* R. G. Zahary, editor. Desert Ecology 1986: A Research Symposium. Southern California Academy of Science and Southern California Desert Studies Consortium, Special Publication, Los Angeles, CA.

Jones, C. E., and M. B. Cruzan. 1999. Floral morphological changes and reproductive success in deer weed (*Lotus scoparius*, Fabaceae). American Journal of Botany **86**:273-277.

Keator, G. 1994. Complete Garden Guide to the Native Shrubs of California. Chronicle Books, San Francisco, CA.

Keeley, J. E. 1987. Role of fire in seed germination of woody taxa in California chaparral. Ecology **68**:434-443.

Keeley, J. E., C. J. Fotheringham, and M. Baer-Keeley. 2006. Demographic patterns of postfire regeneration in Mediterranean-climate shrublands of California. Ecological Monographs **76**:235-255.

Keeley, J. E., and S. C. Keeley. 1984. Postfire recovery of California coastal sage scrub. The American Midland Naturalist **111**:105-117.

Keeley, J. E., B. A. Morton, A. Pedrosa, and P. Trotter. 1985. Role of allelopathy, heat and charred wood in the germination of chaparral herbs and suffrutescents. Journal of Ecology **73**:445-458.

Kirkpatrick, J. B., and C. F. Hutchinson. 1980. The environmental relationships of California coastal sage scrub and some of its component communities and species. Journal of Biogeography **7**:23-28.

Lexer, C., R. A. Randell, and L. H. Rieseberg. 2003. Experimental hybridization as a tool for studying selection in the wild. Ecology **84**:1688-1699.

Liston, A., L. H. Rieseberg, and O. Mistretta. 1990. Ribosomal DNA evidence for hybridization between island endemic species of *Lotus*. Biochemical Systematics and Ecology **18**:239-244.

Meserve, P. L. 1976. Habitat and resources utilization by rodents of a California coastal sage scrub community. The Journal of Animal Ecology **45**:647-666.

Mirov, N. T., and C. J. Kraebel. 1939. Collecting and handling seeds of wild plants. Civilian Conservation Corps, Forestry Publication 5; 42 p.

Moldenke, A. R. 1976. California pollination ecology and vegetation types. Phytologia **34**:305-361.

Montalvo, A. M. 2004. *Lotus scoparius* (Nutt.) Ottley. Pages 445-448 *in* J. K. Francis, editor. Wildland Shrubs of the United States and its Territories: Thamnic Descriptions. Volume 1. General Technical Report IITF-GTR-26, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry and Rocky Mountain Research Station, Fort Collins, CO.

Montalvo, A. M., and N. C. Ellstrand. 2000. Transplantation of the subshrub *Lotus scoparius*: Test of the home site advantage hypothesis. Conservation Biology **14**:1034-1045.

Montalvo, A. M., and N. C. Ellstrand. 2001. Nonlocal transplantation and outbreeding depression in the subshrub *Lotus scoparius* (Fabaceae). American Journal of Botany **88**:258-269.

Munz, P. A. 1974. A Flora of Southern California. University of California Press, Berkeley, CA.

Munz, P. A., and D. D. Keck. 1968. A California Flora with Supplement. University of California Press, Berkeley, CA.

Newton, G. A., and V. Claassen. 2003. Rehabilitation of Disturbed Lands in California: A Manual for Decision-Making. California Department of Conservation, California Geological Survey.

Nilsen, E. T. 1980. Phenology of *Lotus scoparius* (Nutt. in T.& G.) Ottley: Climate control and adaptive significance. Dissertation. University of California, Santa Barbara.

Nilsen, E. T. 1982. Productivity and nutrient cycling in the early postburn chaparral species *Lotus scoparius*. Pages 291-296 *in* C. E. Conrad and W. C. Oechel, editors. Proceedings of the Symposium on Dynamics and Management of Mediterranean-type Ecosystems. General Technical Report PSW-58, U.S. Department of Agriculture Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.

Nilsen, E. T., and W. H. Muller. 1980. An evaluation of summer deciduousness in *Lotus scoparius* Nutt. (T.& G.). The American Midland Naturalist **103**:88-95.

Nilsen, E. T., and W. H. Muller. 1981a. Phenology of the drought-deciduous shrub *Lotus scoparius*: Climatic controls and adaptive significance. Ecological Monographs **51**:323-341.

Nilsen, E. T., and W. H. Muller. 1981b. The influence of low plant water potential on the growth and nitrogen metabolism of the native California fire response shrub *Lotus scoparius*. American Journal of Botany **68**:402-407.

Nilsen, E. T., and W. H. Muller. 1982. The influence of photoperiod on drought induction of dormancy in *Lotus scoparius*. Oecologia **53**:79-83.

Nilsen, E. T., and W. H. Schlesinger. 1981. Phenology, productivity, and nutrient accumulation in the post-fire chaparral shrub *Lotus scoparius*. Oecologia **50**:217-224.

O'Brien, B., B. Landis, and E. Mackey. 2006. Care & Maintenance of Southern California Native Plant Gardens. Rancho Santa Ana Botanic Garden, Claremont, CA.

Ottley, A. M. 1923. A revision of the Californian species of *Lotus*. University of California Publications in Botany **10**:189-305.

Padgett, P. E., S. N. Kee, and E. B. Allen. 2000. The Effects of irrigation of revegetation of semi-arid coastal sage scrub in Southern California. Environmental Management **26**:427-435.

Painter, E. 2009. Common (vernacular) names applied to California vascular plants. University of California Herbarium. Available online: http://herbaria4.herb.berkeley.edu/cgi-bin/get_painter_common.pl?3640.

Perry, R., Jr. 2010. Landscape Plants for California Gardens: An Illustrated Reference of Plants for California Landscapes, 1st edition. Land Design Publishing, Claremont, CA.

Pratt, G. F., and G. R. Ballmer. 1991. Acceptance of *Lotus scoparius* (Fabaceae) by larvae of Lycaenidae. Journal of the Lepidopterists' Society **45**:188-196.

Preston, K. P. 1988. Effects of sulphur dioxide pollution on a Californian coastal sage scrub community. Environmental Pollution **51**:179-195.

Riordan, E. C., and P. W. Rundel. 2009. Modelling the distribution of a threatened habitat: The California sage scrub. Journal of Biogeography **36**:2176-2188.

Roberts, F. M., Jr. 2008. The Vascular Plants of Orange County, California: An Annotated Checklist. F. M.

Roberts Publications, San Luis Rey, CA.

Roberts, F. M., Jr., S. D. White, A. C. Sanders, D. E. Bramlet, and S. Boyd. 2004. The Vascular Plants of Western Riverside County, California: An Annotated Checklist. F. M. Roberts Publications, San Luis Rey, CA.

Rundel, P. W., and D. J. Parsons. 1984. Post-fire uptake of nutrients by diverse ephemeral herbs in chamise chaparral. Oecologia **61**:285-288.

S&S Seeds. 2009. S & S Seeds Inc. Plant database: http://www.ssseeds.com/database/index.html. Accessed November 23, 2009.

Sawyer, J. O., T. Keeler-Wolf, and J. M. Evens. 2009. A Manual of California Vegetation, 2nd edition. California Native Plant Society Press, Sacramento, CA.

Sokoloff, D. 2000. New combinations in *Acmispon* (Leguminosae, Loteae). Annales Botanici Fennici **37**:125-132.

Steppan, S. J. 1991. Geographic distribution of flower morphological traits in subspecies of *Lotus scoparius*. Journal of Biogeography **18**:321-331.

USDA PLANTS. 2010. The PLANTS Database (http://plants.usda.gov). National Data Center, Baton Rouge, LA 70874-4490 USA.

Vreeland, J. K., and W. D. Tietje. 2004. Vegetative structure of woodland-grassland edges in coastal central California. The Southwestern Naturalist **49**:305-310.

Wagner, D. L. 1987. A new *Microcalyptris* species from California (Lepidoptera: Nepticulidae). Pan-Pacific Entomologist **63**:278-283.

Wall, M., and J. Macdonald. 2009. Processing Seeds of California Native Plants for Conservation, Storage, and Restoration. Rancho Santa Ana Botanic Garden Seed Program, Claremont, CA; available online: http://www.hazmac.biz/seedhome.html.

Went, F. W., and P. A. Munz. 1949. A long term test of seed longevity. El Aliso **2**:63-75.

White, S. D., and W. D. Padley. 1997. Coastal sage scrub series of western Riverside County, California. Madroño **44**:95-105.

Young, J. A., and C. G. Young. 1986. Collecting, Processing, and Germinating Seeds of Wildland Plants. Timber Press, Portland, OR.

Zammit, C. A., and P. H. Zedler. 1988. Germination response to extreme acidity: Impact of simulated acid deposition from a single shuttle launch. Environmental and Experimental Botany **28**:73-81.