***Lupinus arboreus* Sims** yellow bush lupine
FABACEAE

Synonyms: None

General Description.—Yellow bush lupine is a small erect shrub, less than 20 dm tall, with cauline leaves on 2- to 3- cm petioles, and composed of five to 12 leaflets, on 8 to 12 mm stipules. Leaf colors range from green and smooth to silver and hairy. In northern California it grades into and coexists with *L. rivularis* Doug. ex Lindl., distinguished by blue flowers (Sholars 1993).

Range.—Yellow bush lupine is native on coastal bluffs and dunes, or less than 5 km inland (Davidson and Barbour 1977), in central California from Ventura to Sonoma Counties, and is widely naturalized on the northern California coast (Sholars 1993) and as far north as Vancouver, Canada (Hitchcock and Cronquist 1973). There has been considerable debate over the native range, although it probably encompasses only the southern part of the current range.

Ecology.—Yellow bush lupine is an aggressive colonizer of dunes, where it outcompetes native dune mat species. It encourages other non native invaders by fixing nitrogen (Pickart and others 1998) and creating shade. Outside its former range, it also hybridizes with native lupines, especially *L. rivularis* (National Park Service 2001). The California Native Plant Society places it on the "A" List of invasive weeds in Humboldt County; however, it is apparently only a serious invader of dune communities (Anderson et al. 1999). Most lupines are poisonous to large herbivores, but I found no data on this species. Yellow bush lupine is a strong nitrogen fixer, and is used in New Zealand as a planted precursor to tree planting in unstable, nitrogen-deficient dune environments, where it has been estimated to contribute 220 kg of nitrogen/ha in 4 ½ years of growth (Gadgil 1971). In California coastal prairies it is a facilitator of exotic weed and annual grass invasions, which establish after the dense canopies of the short-lived lupines are opened by fire or insects (Maron and Connors 1996). A variety of insects prey upon it, sometimes killing extensive stands. Among the predators are the subterranean ghost moth *Hephialus californicus* and the tussock moth *Orgyia vetusta*. The nitrogen rich litter that results from such mortality makes establishment of native vegetation uncertain and a long-term process (Maron and Jefferies 1999).

Reproduction.—Inflorescences are 10 to 30 cm, with flowers sometimes arranged in whorls. Flowers are 14 to 18 mm with upper lip 5 to 9 mm and lower lips 5 to 7 mm. Petals are yellow, or north of central California lilac to purple. Pods are hairy, brown or black, 4 to 7 cm long. Eight to 12 seeds per pod are black, tan, or striped, and are 4 to 5 mm long (Sholars 1993). Flowers are both self-compatible and outcrossing and have generated considerable interest from genetic investigators. Self-pollination requires facilitation, usually from insects, but is responsible for only about 25 percent of seed production (Kittelson and Maron 2000).

Fire Effects.—Although fire may cause widespread mortality in dense lupine stands, and may be followed by invasion of annual weeds and grasses (author's observation), the long-lived lupine seed banks may result in reestablishment of lupine (Maron and Connors 1996). The annual weeds and grasses that follow the nitrogen enrichment by lupine potentially alter fire regimes, increasing frequency and intensity of

burns.

Growth and Management.—Yellow bush lupine is fast growing and short lived (maximum 7 years) (Davidson and Barbour 1977). Stands may grow rapidly and die off in as little as 3 years (Strong et al. 1995). Restoration of lupine-invaded sites should include litter and duff removal in addition to direct removal of lupine, because it enriches soil to the detriment of native competitors (Pickart and others 1998). In New Zealand, where it is used as a soil developer, it is controlled prior to tree planting by crushing and herbicides (Gadgil 1971). Coastal dune restoration in northern California has focused heavily on removal of yellow bush lupine. Manual removal is accomplished by pulling up small plants and chopping larger ones, which rarely crown sprout. Heavy equipment has also been used successfully, but all mechanical methods are labor intensive and expensive (Pickart and Sawyer 1998). Although others have noted a long-lived seed bank (see Maron and Connors 1996 and above), Pickart and Sawyer (1998) found no recruitment by 3 years after removal of established stands.

Benefits.—Yellow bush lupine has been widely cultivated as a sand stabilizer and ornamental in coastal California. It is a strikingly beautiful plant, both in and out of bloom, although its short life and messy litter probably limit its value as an ornamental. Elsewhere it has been used to prepare coastal and dune soils for planting of commercially useful trees (Gadgil 1971). It provides habitat for birds, reptiles, and rodents.

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