Buddleia davidii

Butterfly bush
Buddleiaceae

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OVERVIEW

Buddleia davidii, native to China, is a large shrub with colorful fragrant flowers that is cultivated as an ornamental garden plant in temperate regions of the world, and is often planted to attract wildlife, such as butterflies and hummingbirds, which readily sip nectar from flowers. *B. davidii* is known to spread from gardens and has become invasive in Europe, New Zealand, Australia, and parts of the United States (Binggeli 1998, PLANTS 2002). *B. davidii* spreads in disturbed areas by numerous wind and water dispersed seeds from plants that can reach maturity in less than one year (Binggeli 1998). In invaded areas, such as New Zealand, *B. davidii* quickly colonizes riversides, facilitates succession, and has aggressive growth that out-competes colonization by native vegetation. Studies of *B. davidii* infestations in New Zealand have found that *B. davidii* is relatively short lived with the greatest infestation densities occurring in the first 10 years (Smale 1990). By the time the stand is about 15 years old, densities of infestations lessen. As this happens, native tree species eventually become dominant again. Because of this, along with widespread distribution that gives high re-invasion potential, New Zealanders have taken a strategy of ongoing management focussing control in natural areas where new infestations are found. In cool regions of the United States, including states in the northeast and Pacific northwest, *B. davidii* is increasingly being recognized as a potential pest plant and is currently on several invasive plant watch lists (O'Neill 1998). Though known to spread in several states, the full pest potential of *B. davidii* in natural areas of the United States is not yet known. In Hawai'i, *B. davidii* is commonly cultivated and has occasionally escaped from gardens in cool upland areas of Kaua'i and Maui (Shannon and Wagner 1996, Wagner et al. 1999, Starr et al. in press). The full invasive potential in Hawai'i is also not yet known, though from what has been gathered from known invaded ranges elsewhere, it is presumed that on Maui, this attractive shrub could potentially invade disturbed areas of mid elevation shrubland, roadsides, pastures, gulches, open areas, and perhaps some woodlands. Due to the plant's popularity in landscaping and widespread distribution on Maui, island wide eradication would take large amounts of resources. However, *B. davidii* will only become more widespread and costlier to control in the future. Perhaps the best strategy at this time for *B. davidii* on Maui would be similar to that of New Zealand, where *B. davidii* is discouraged in landscaping and detected and controlled in newly invaded natural areas as early as possible.

TAXONOMY

Family: Buddleiaceae (Butterfly bush family) (Wagner et al. 1999). The genus has also been placed in Scrophulariaceae, Buddlejaceae, and Loganiaceae (GRIN 2002).
Latin name: *Buddleia davidii* Franch. (Wagner et al. 1999).
Synonyms: *Buddleja davidii, Buddleia variabilis* Hemsl., *B. magnifica* Hort., *B. nanoensis* Hort. (Bailey and Bailey 1976, Brickell and Zuk 1997).
Common names: Butterfly bush, Buddleia bush, summer lilac, orange eye butterfly bush (Neal 1965, Brickell and Zuk 1997, Bailey and Bailey 1976).
Taxonomy: *Buddleia* is a genus of about 100 species of evergreen, semi-evergreen, and deciduous shrubs, trees, vines, and herbs from riversides, rocky, and scrub areas of tropical and subtropical Asia, Africa, and North and South America (Brickell and Zuk 1997, Wagner et al. 1999). *Buddleia davidii* is a variable species with many named cultivars, most varying in flower color (Bailey and Bailey 1976, Wagner et al. 1999).
Nomenclature: The genus is named in honor of Reverend Adam Buddle (1660-1715), English botanist and vicar of Farmbridge in Essex (Wagner et al. 1999). The species is named after the French missionary and naturalist Father Armand David, who discovered the species in 1869 (Turner and Wasson 1997).
Related species in Hawai'i: Other *Buddleia* species cultivated in Hawai'i include: *B. asiatica, B. japonica,* and *B. madagascariensis* (Neal 1965). *B. asiatica* is naturalized on O'ahu, Moloka'i, Lana'i, Maui, and Hawai'i (Wagner et al. 1999, Oppenheimer and Bartlett 2000) and is a fairly widespread weed in moist lowland areas. *B. madagascariensis,* with bird dispersed fruit, is naturalized on Kaua'i, O'ahu, Maui, and Hawai'i (Wagner et al. 1999, Lorence and Flynn 1999) and is becoming more recognized as a potentially invasive species in moist temperate climates.

DESCRIPTION

Deciduous or semi-evergreen shrubs. Stems up to 3-5 m. Leaves opposite, lance shaped, deep green above, lower surface white-tomentose, margins finely toothed, up to 9-25 cm long. Flowers densely clustered in cones born at the tips of canes. Corolla tube 9-12 mm long, lilac with orange eye, fragrant, in erect or nodding spikes to 25 cm long. Some of the different flower colors obtainable include pink, purple, mauve, red, blue, orange, yellow, and white. There are numerous cultivars named, such as 'Black Knight', with dark purple/blue flowers and 'Pink Delight' with bright pink flowers. Fruit is a two valved capsule that splits downwards to release about 50 seeds. Capsules about 8 mm long. Seeds are very small and elongated at either end into a pointed wing. (Neal 1965, Williams 1979, Brenzel 1995, Wagner et al. 1999).

BIOLOGY & ECOLOGY

Cultivation: *B. davidii* is a popular ornamental plant often grown in gardens to form a hedge, specimen plant, or in borders. This shrubby plant has numerous attractive and fragrant flowers clustered in conicle panicles born at the tips of arching branches and is often grown to attract wildlife such as butterflies and hummingbirds which sip nectar from flowers. *B. davidii* is attractive in shrub or perennial borders and is suitable for containers (Fell 1993). *B. davidii* prefers full sun and good drainage, but thrives in any soil type (Turner and Wasson 1997). In cold climates the soft wood freezes to the ground, but roots remain hardy (Fell 1993). In Hawai'i, *B. davidii* is widely cultivated.

On Maui, it is widely cultivated and especially popular in cooler climates and mid elevations, such as Kula.

Invasiveness: *B. davidii* has become a pest in several places where it is cultivated, such as Great Britain, New Zealand, Australia, and the United States (Binggeli 1998, PLANTS 2002). Plants produce numerous wind born seeds that readily germinate in disturbed areas nearby plantings. Plants are aggressive and infestations quickly form dense, shrubby, monotypic thickets that can out-compete and inhibit reproduction of other vegetation. According to the Pacific North West Natives and the Native Plant Society of Oregon's internet list (PNW and NPSO list) species of *Buddleia* (*B. alternifolia, B. davidii*) are forming riparian monocultures along Salmon Creek and in Lake Oswego area where it displaces native willows which are essential for native butterflies. *B. davidii* facilitates succession, attracts wildlife such as insects which attract birds, and facilitates invasion by other species (Binggeli 1998). *B. davidii* can tolerate a wide range of climatic conditions, including oceanic, continental, and Mediterranean, though it does not favor wet conditions, and prefers dry open disturbed sites such as roadsides, streams, new developments, abandoned areas, wastelands, pastures, open woodlands, and scree slopes (Binggeli 1998).

Pollination: Potential pollinators of *B. davidii* include butterflies, bees, hummingbirds, and other insects, that often visit the flowers to feed on the honey scented nectar (Dole 1997, Turner and Wasson 1997, Binggeli 1998). In New Zealand, almost all native butterfly species have been observed sipping nectar from *B. davidii* (Binggeli 1998).

Propagation: *B. davidii* is propagated from cuttings or by seed (Brickell and Zuk 1997). "*B. davidii* starts flowering and fruiting after 1 year, although some panicles may be present within the first year. It has a large seed output at approximately 3 million seeds per 'average' plant (Binggeli, 1998). As stated above, some varieties and hybrids have a lower rate of viable seeds.

Dispersal: "The small and light seeds (50-100 per fruit and 315,000 seeds/kg) can be carried great distances by the wind and occasionally by cars. They have deep dormancy and may remain in the soil for many years" (Binggeli, 1998).

Pests and diseases: *Buddleia* have very few pests but are susceptible to caterpillars, weevils, mullein moth, spider mites, fungal leaf spots and dieback (Brickell & Zuk 1996).

DISTRIBUTION

Native range: *B. davidii* is native to central and south-western China from Tibet to Hubei at elevations up to 2,600 m (8,530 ft) (Turner and Wasson 1997, Binggeli 1998). GRIN (2002) lists the native range as China: Gansu, Guangdong, Guangxi, Guizhou, Hubei, Hunana, Jiangsu, Jiangxi, Shaanxi, Sichuan, Xizang, Yunnan, and Zhejiang. The average temperature in these regions is about 32-50 F (0-10 C) in January and 68-86 F (20-30 C) in July and the average annual rainfall is about 40-80 in (100-200 cm) (Hammond 1986).

Global distribution: *B. davidii* is naturalized in parts of Europe, New Zealand, Australia, and the United States (Binggeli 1998, PLANTS 2002). The Missouri Botanical Garden's (2002) specimen database listed the following collections and location information. USA: Missouri, 160 m (525 ft), 38.36N 90.15W; North Carolina, 320 m (1,050 ft), 35.26N 84.00W; Washington, 100 m (328 ft), 48.28N 121.47 W. Mesoamerica: Panama, 5,600 ft (1,707 m), 8.30N 82.15W. South America: Bolivia, 3,300 m (10,827 ft), 16.31S 68.05W; Ecuador, 240-3,800 m (787-12,467 ft), 00.12S-00.41S 76.26W-78.31W. Asia: Republic of Georgia, 0-10 m (0-33 ft), 41.42.14N 041.43.06E.

In Europe, *B. davidii* was first introduced to Britain from China in the 1890's (Binggeli 1998). It rapidly invaded disturbed sites, including areas that were scarred from bombs in World War II, mining towns, road cuts, and new developments (Dole 1997). *B. davidii* is now widespread in European cities, with the northern limit at Bergen, Norway, and most commonly observed from Glasgow southwards, forming monotypic stands in disturbed sites (Binggeli 1998). *B. davidii* is now listed as one of the top 20 invasive weeds in England (OSU 2002).

In New Zealand, *B.davidii* is widespread in disturbed riparian habitat where it alters the course of natural succession and inhibits reproduction of native seedlings (Binggeli 1998) *B. davidii* also invades forestry plantations, quickly forming monotypic thickets and inhibiting the growth of newly planted seedlings. In National Park areas, *B. davidii* interferes with scenic vistas and makes some areas impassible (Williams 1979). A heavy infestation in New Zealand occurs at Te Urewera National Park. This area is at an elevation of 300-400 m (984-1,312 ft) with a mild, humid climate, annual temperatures of 10-12.5 C (50-54.5 F), and annual rainfall amounts of about 1,500 mm (59 in) (Smale 1990).

In Australia, *B. davidii* is found here and there in open woodlands (Binggeli 1998).

In Canada, *B. davidii* was listed as an additional species of interest/concern and described as widespread in lower Fraser Valley of British Columbia (Haber 1996).

In the United States, *B. davidii* is documented from the following states: California, Connecticut, Georgia, Hawai'i, Kentucky, Maryland, Massachusetts, Michigan, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Puerto Rico, South Carolina, Tennessee, Virginia, Washington, and West Virginia (PLANTS 2002). *B. davidii* colonizes roadsides, streams, and disturbed areas in many of these states. In California, *B. davidii* is known from coastal counties of both northern and southern California at elevations between sea level and 656 ft (200 m) (CalFlora 2002). An infestation in Lake Oswego, Oregon, is displacing native willows which are essential to native butterflies there (O'Neill 1998). In Hawai'i, *B. davidii* is sparingly naturalized in at least Koke'e Park, Kaua'i and in the Kula area of Maui.

State of Hawai'i distribution: In Hawai'i, *B. davidii* is widely cultivated and sparingly naturalized at least on Kaua'i and Maui (Shannon and Wagner 1996, Wagner et al. 1999,

Starr et al. in press). On Kaua'i, *B. davidii* is sparingly naturalized from plantings in Koke'e State Park, elevation 1,158 m (3,800 ft), in secondary forest and remnant mixed mesophytic forest with *Acacia koa* and *Metrosideros polymorpha* (Shannon and Wagner 1996). The area receives about 60-80 in (152-203 cm) rainfall annually (Juvik and Juvik 1998). *B. davidii* is also reported to be a target for weed control on O'ahu (Monroe Bryce pers. comm.).

Island of Maui distribution: On Maui, *B. davidii* is sparingly cultivated near Iao, West Maui, and widely cultivated in cool, moist to arid, mid elevation residential areas of "Upcountry" East Maui, including Ha'iku, Makawao, Pukalani, Pi'iholo, Olinda, Kula, and Keokea. It is just now beginning to show signs of spread into nearby pastures from plantings in Kula, elevation 3,800 ft (1,158 m) in a residential / pasture setting. The area receives about 40-60 in (102-152 cm) rainfall annually (Juvik and Juvik 1998). The flower color of the naturalizing population is purple with orange, but there are many other flower colors being grown, including red, white, blue, and deep purple. None of the other flower colors have been noted to be naturalized yet. It is possible that other naturalized locations exist and were missed during island wide surveys, but there are currently no large infestations, and it is likely that *B. davidii* is just now beginning to spread.

CONTROL METHODS

Physical control: In New Zealand, plants that are merely cut will resprout (Smale 1990). In addition, plants buried by river sediment or knocked down by wind storms continued to grow by sending up new shoots from the base (Smale 1990). Seedlings may be hand picked, however, because of its preference for highly disturbed sites, hand picking may result in increased disturbance and increased populations of *B. davidii*. Hand picking of seedlings may be successful if followed by quickly establishing a ground cover of a desired species which will inhibit resprouting of *B. davidii* (Binggeli 1998). It may be possible to dig plants up, but again, disturbance encourages seedling growth and should be avoided if possible.

Chemical control: Veitch (1997) recommends cutting the plant down and treating the stump with the following herbicide mix (Escort herbicide 10 grams, Roundup herbicide 1 liter, Pulse surfactant 5 ml, water 2 liters, and a vegetable marker dye). In Hawai'i, it is likely that *B. davidii* could be treated like other woody shrubs with either a cut stump, foliar, or basal bark application of herbicide, such as triclopyr or glyphosate.

Biological control: A program in New Zealand has begun to consider biological controls to prevent further spread of *B. davidii* in forestry plantations. A species of weevil, *Cleopus japonicus* (Coleoptera: Curculionidae), was tested as a potential biological control agent for *B. davidii*. Tests showed that feeding damage caused by the weevil can result in a significant reduction in stem length and biomass and can even cause death in some plants (Brockerhoff et al. 1999). In addition, a stem boring beetle, *Mecyslobus erro*, is also being considered for biological control of *B. davidii* in New Zealand.

Cultural control: The residents of Maui could be discouraged from planting *B. davidii* or other species that have the potential to escape and become pests.

Noxious weed acts: *B. davidii* is not listed as noxious in the United States. However, several postings on the internet report *B. davidii* as invasive, including: Invasive plants of Canada, the Georgia Native Plant Society, the Pacific Northwest Exotic Pest Plant Council, who listed it as "most invasive - regional (highly to moderately invasive but still with a potential to spread); and the Exotic Invasive Vegetation in Rhode Island website (http://www.edc.uri.edu/homeasyst/hlipage/exotics.html) listed *B. davidii* is a new problem for riparian areas of Rhode Island.

MANAGEMENT RECOMMENDATIONS

B. davidii is widely planted on Maui and is beginning to show signs of spread in Kula. With a notoriously invasive history in other cool, mild climates it seems likely that *B. davidii* is well poised to invade similar areas of Maui. In other invaded ranges, *B. davidii* tends to colonize disturbed areas, but has also invaded several natural riparian and wooded areas. In Hawai'i, only time will tell how invasive *B. davidii* will become. Efforts to slow the invasion in these areas include avoiding plantings of this species near natural areas and finding alternatives to use in landscaping. Newly naturalized plants should be monitored and controlled as early as possible to avoid large infestations.

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