

Metrosideros polymorpha Gaud.

'Ōhi'a lehua

Myrtaceae Myrtle family

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'Ōhi'a lehua (*Metrosideros polymorpha*) is the most abundant and widespread tree in Hawaii. This slow growing native hardwood seeds freely and often starts as an epiphyte in fern forests. It is the first tree to appear on new lava flows where it offers watershed protection. The wood is of fine even texture and takes a good polish. It is used for flooring, fenceposts, and fuel. This tree provides important habitat to native birds, several endangered.

Habitat

Native Range

'Ōhi'a lehua (fig. 1) is a variable and unusual tree found from just above sea level to 2600 m (8,500 ft) as a tree or small shrub on six of the high islands of the State. 'Ōhi'a lehua does not grow in coastal areas with rainfall less than 500 mm (20 in). The species reaches its maximum stand basal area on young volcanic substrates in rain forest habitats on the Island of Hawaii.

Climate

Rainfall and associated cloud cover over the range of 'Ōhi'a lehua vary considerably. Mean annual precipitation varies from 500 mm (20 in) to greater than 11 400 mm (450 in). Mean annual temperatures range from 24° C (75° F) to 10° C (50° F). Seasonal variation in mean monthly temperature probably does not exceed 5° C (9° F). Frost and occasional ephemeral snow occur at higher elevations. Relative humidity commonly averages 70 to 80 percent in windward areas (exposed to northeast trade winds) and 60 to 70 percent in leeward areas.

Soils and Topography

'Ōhi'a lehua grows on many different soils and sites. It is abundant on Histosols and Inceptisols over gently sloping recent to Pleistocene lava flows on the geologically younger volcanoes. It also is known to grow on soil associations within the soil orders Histosols, Mollisols, Spodosols, Oxisols, Ultisols, and Alfisols and on unclassified mountainous land on the

geologically older volcanoes of the Hawaiian archipelago.

The species develops best on relatively level well-drained sites. On exposed ridges, steep slopes, or poorly drained sites, however, 'Ōhi'a lehua does not reach large size and may be reduced to dwarf shrub stature.

Associated Forest Cover

'Ōhi'a lehua grows in association with many other trees in a variety of forest types but not in any classified by the Society of American Foresters. In rain forests, it is often associated with koa (*Acacia koa*), and species of 'olapa (*Cheirodendron*), treefern (*Cibotium*), pilo (*Coprosma*), manono (*Gouldia*), kawa'u (*Ilex*), kōlea (*Myrsine*), 'alani (*Pelea*), guava (*Psidium*), and kōpiko (*Psychotria*) (2,8,13). In drier habitats, 'Ōhi'a lehua is commonly associated with lama (*Diospyros*), 'ākoko (*Dracaena*), wiliwili (*Erythrina*), naio (*Myoporum*), olopua (*Osmanthus*), 'ohe makai (*Reynoldsia*), mamane (*Sophora*), hame (*Antidesma*), and maua (*Xylosma*). In many habitats, 'Ōhi'a lehua is the most common tree.

Life History

Reproduction and Early Growth

Flowering and Fruiting—Flowering generally peaks in spring or summer after vegetative flushing, but some varieties or populations peak in fall or winter. Individual trees or branches may produce flowers at any time during the year. The red, salmon, pink, or yellow perfect flowers are arranged in a dense terminal cymose corymb. The stamens are long and numerous and the flowers are quite showy. Endemic Hawaiian birds (Drepanididae) and insects are the most important pollinators of 'Ōhi'a lehua. The inflorescence normally has 18 to 24 flowers in different developmental stages. Fruit maturation takes 4 to 12 months (15).

Seed Production and Dissemination—Little is known about the age at which the trees begin to bear seeds or the number of seeds produced. Many small lightweight seeds may be produced per capsule, but many of these are infertile (9). Seed germination is best with newly produced seeds and varies from less than 1 to 78 percent (6). In a nonrandom sample of 142 trees more than 90 percent had germination

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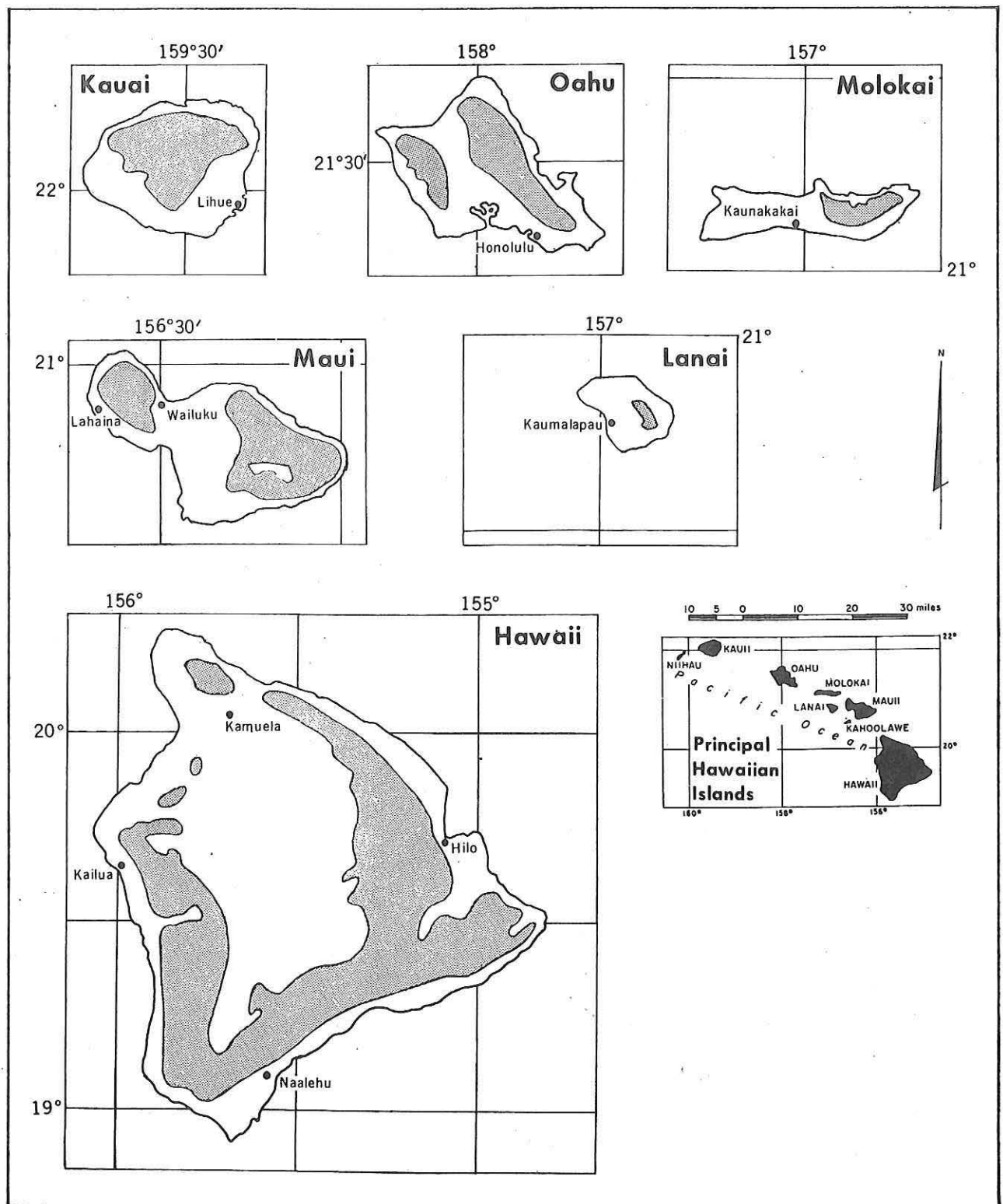


Figure 1—*The range of 'ohi'a lehua.*

rates less than 35 percent. In one study, maximum germination of 'ohi'a lehua seed was obtained at 25° C (77° F) and 4 to 15 percent full sunlight (2). Seeds remain viable for as long as 9 months if stored at room temperature (5).

Seedling Development—Germination is epigeal. Many seeds germinate on downed or upright treeferns and downed moss-covered trees. More than 70 percent of the seedlings in the rain forest habitat grow on these substrates. In one 'ohi'a-treefern community a late summer peak in the appearance of 'ohi'a lehua germinants has been documented (2).

Seedling growth rates are relatively slow. In one study, seedling height growth averaged less than 10 cm (4 in) per year. Survival and growth of seedlings established in shade reached a maximum at less than full sunlight after varying degrees of canopy removal (2).

Vegetative Reproduction—'Ohi'a lehua often reproduces vegetatively from stem sprouts on fallen trees. The stem sprouts can produce adventitious roots and eventually become independent. Stem sprouts on a standing weakened or dying tree may outlive the parent tree and grow to maturity. Planting stock can be produced from at least 60 percent of new-growth cuttings within about 6 months compared with up to a year to produce seedlings (4).

Sapling and Pole Stages to Maturity

Growth and Yield—'Ohi'a lehua is a relatively slow-growing tree. In one study (unpublished), saplings and mature trees in stands rated as commercial 'ohi'a lehua forest had a mean annual d.b.h. increment of 0.25 cm (0.10 in).

On good sites, 'ohi'a lehua commonly grows to 20 m (65 ft) and 45 cm (18 in) in diameter (fig. 2). Trees 30 m (100 ft) tall exceeding 120 cm (48 in) in diameter have been found.

'Ohi'a lehua grows in both pure and mixed stands. Stand basal area can exceed 40 m²/ha (175 ft²/acre) in pure stands on good sites. Pure stands probably are the result of disturbance.

Rooting Habit—No quantitative studies are available concerning the rooting habit of 'ohi'a lehua. Most roots apparently are near the surface. On deep soil and broken lava some deep woody roots may be formed.

Reaction to Competition—Shade tolerance of 'ohi'a lehua ranges from intolerant to intermediate, depending on varietal differences (3,13).



Figure 2—A mature stand of 'ohi'a lehua on the island of Hawaii.

A pioneer species on young volcanic substrates (17), 'ohi'a lehua retains dominance on some relatively old soils. *Acacia koa* is its primary competitor for canopy dominance in wet forests. *Cibotium* spp. (treeferns) may displace 'ohi'a lehua on those sites with optimal conditions for treefern growth (2,13).

Damaging Agents—Many insects attack 'ohi'a lehua trees. Among these, the endemic cerambycid borer *Plagithmysus bilineatus* has the greatest potential impact. It may become epidemic and fatal to weakened trees and is associated with extensive canopy dieback. Environmental stresses are significant in reducing 'ohi'a lehua vigor and predisposing the trees to attack by *P. bilineatus* (14). Other potentially damaging borers are *Ceresium unicolor*, *Xyleborus saxesensi*, and *X. similimus*. Defoliators and sapsucking insects also cause minor injury to 'ohi'a lehua.

The root rots, *Phytophthora cinnamomi* (14) and *Pythium vexans*, and the shoestring root rot, *Armillaria mellea*, can be locally damaging and also are associated with canopy dieback. Damping off caused by *Rhizoctonia* spp. also has been reported (6).

Decline of 'ohi'a lehua canopy has been the subject of considerable research since 1975 showing that the phenomenon is most likely characteristic of the species. The loss of ability to withstand environmental stresses, diseases, or insect attacks is apparently synchronous among trees within populations. Entire stands of approximately equal age trees may die back to a few remnants (1,10,11).

Special Uses

'Ohi'a lehua provides valuable watershed protection in Hawaii. It is also an important source of nectar and insect prey of most native birds. Among these birds are some endangered species, the ākepa (*Loxops coccinea*), the crested honeycreeper (*Palmeria dolei*), and several species of *Hemignathus*.

Genetics

Taxonomists recognize 11 varieties of *Metrosideros polymorpha* (16,17,18). Only *M. polymorpha* var. *prostrata* does not attain tree stature. Intrapopulation variability of many morphological characters is large and some vegetative characteristics vary clinally with altitude (6,7).

The distinction between races (ecotypes) and varieties in 'ohi'a lehua is not clear. Altitudinal (7), edaphic, and successional (13) ecotypes have been proposed in this variable species. Some ecotypes or varieties appear to be pioneer plants in primary succession. On Mauna Loa, an active volcano, the species is found up to 2,500 m elevation, but on nearby Mauna Kea, a volcano extinct since the Pleistocene, the upper limit is about 1,650 m. On older high islands, the species seems to be limited to continuously moist rain forest environments (12). Morphology of the varieties also differs; those with pubescent leaves are apparently pioneering forms of the species and glabrous leaf varieties are found in later successional stages (19).

Intraspecific hybridization has been demonstrated in 'ohi'a lehua but there is some evidence of partial incompatibility (6).

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