Morella faya

Firetree
Myricaceae

Forest Starr, Kim Starr, and Lloyd Loope
United States Geological Survey--Biological Resources Division
Haleakala Field Station, Maui, Hawai'i

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OVERVIEW

Morella faya is a fast growing, quick spreading tree that invades a variety of habitats from disturbed pasture and ranchland to native mesic and wet open forests on the islands of Hawai'i, Maui, Lana'i, O'ahu, and Kaua'i. *M. faya* was originally introduced to Hawai'i in the late 1800's and was used in forestry plantations in the late 1920's. By 1944, *M. faya* was rapidly spreading and was being recognized as a pest plant (Neal 1965). Today, *M. faya* is a declared noxious weed in the state of Hawai'i (HDOA 1992) and it continues to spread and cover large areas. On Maui, *M. faya* covers vast acreage in the 3,000-6,000 ft (914-1,829 m) elevation area on the slopes of Haleakala, but has been found as high as 7,000 ft (2,134 m). Eradication at this time does not seem feasible. This species poses a serious risk to areas in and near the current infestation. In December 2001, a small seedling was found and pulled in Haleakala National Park on Pu'u Nianiau, 7,000 ft (2,134 m) elevation. In addition, Park staff have controlled outlier plants that are approaching the wet forest boundaries. Early detection and containment of *M. faya* in and near natural areas will be key to preventing large infestations and costly removal programs in the future.

TAXONOMY

Family: Myricaceae (Bayberry family) (Wagner et al. 1999).
Latin name: *Morella faya* (Aiton) Wilbur (Wagner et al. 1999, Staples et al. 2002).
Synonyms: *Myrica faya* Aiton (Wagner et al. 1999, Staples et al. 2002).
Common names: Firetree (Neal 1965).
Taxonomic notes: The family Myricaceae is made up of 3 genera and possibly up to 50 species that are widespread in the Old and New World, mostly in temperate and subtropical regions and are represented in Hawai'i by two naturalized species (Wagner et al. 1999, Meidell et al. 1997).
Nomenclature: The genus *Myrica* was recently split into 3 genera after a review by Wilbur (1994) resulting in a name change from *Myrica faya* to *Morella faya* as well as a name change from *Myrica cerifera* to *Morella cerifera* (Wagner et al. 1999, Staples et al. 2002, PLANTS 2003).
Related species in Hawai'i: A second naturalized species in Hawai'i is *Morella cerifera* (wax myrtle). *Morella cerifera* is native to eastern and southern coastal United States and grows in sand dunes, edges of marshes and ponds, and woods (Duncan and Duncan 1987). In Hawai'i, *Morella cerifera* is sparingly cultivated and was recently reported as naturalized on West Maui escaping from Maunalei Arboretum where it was originally planted in 1932 (Meidell et al. 1997). Over 200+ individuals located between Honolua

and Honokahua Valleys at an elevation of 395-490 m (1,296-1,608 ft) have been located and controlled by Pu'u Kukui Watershed staff in attempts to eradicate the species from the area (Meidell et al. 1997). Recently, what appeared to be *M. cerifera* was observed being cultivated as a hedge in Ha'iku, East Maui.

DESCRIPTION

"Evergreen shrubs or small trees up to 8 m tall; branches with reddish peltate hairs. Leaves coriaceous, oblanceolate, 4-11 cm long, 1-2.5 cm wide, glabrous, glandular dots inconspicuous, margins somewhat revolute, remotely serrulate or serrate in upper 1/2, apex rounded to acute. Flowers in usually branched catkins borne among leaves of the current year's growth. Fruit drupaceous, dark red or blackish when mature, slightly fleshy." (Wagner et al. 1999).

BIOLOGY & ECOLOGY

Cultivation: *Morella faya* was introduced to Hawai'i in the late 1800's presumably by Portuguese laborers for ornamental purposes and for making wine out of the fruits (Little and Skolmen 1989). It was then cultivated and planted throughout the Hawaiian Islands for in reforestation efforts in the early 1920's (Skolmen and Little 1989). *Morella faya* is also observed in yards and gardens of Maui as an ornamental tree.

Invasiveness: *Morella faya* began spreading in the Hawaiian Islands shortly after it was planted in reforestation efforts in the 1920's and was considered a noxious weed by the Hawai'i Department of Agriculture by 1944 (Neal 1965). *M. faya* is naturalized and considered a serious pest , becoming dominant in many areas, occurring in mesic to wet forest, 150-1,310 m (492-4,298 ft), on Kaua'i, O'ahu, Lana'i, Maui, and Hawai'i (Wagner et al. 1999). In addition, it has been recorded as high as 7,000 ft (2,134 m) on Maui. *Morella faya* spreads rapidly and forms a thick monotypic cover that can crowd out desirable vegetation and alter ecosystem dynamics. In addition, the leaf litter of *M. faya* is alleliopathic and is known to prevent germination of native *Metrosideros polymorpha* ('ohia) (Binggeli 1998). *M. faya* produces numerous seeds (ranging from 40,000 to 400,000 fruits/year) (Siebold 2001). The seeds are spread by fruit eating birds and animals such as pigs (Whiteaker and Gardner 1992). *M. faya* is vigorous in a wide variety of habitats. It is a nitrogen fixing tree and readily invades recent nutrient poor volcanic sites much quicker than native plants resulting in a disruption of natural succession (Benton 2002). On Maui, *M. faya* is rapidly invading pasture, light gaps in mesic to wet forests, and degraded shrubland from 3,000-6,000 ft (914-1,829 m) on East Maui from Haleakala Ranch west to Polipoli.

Pollination: *Morella faya* is wind pollinated (Siebold 2001). In Hawai'i, it is visited by the non-native *Apis melifera* (honey bee) (Binggeli 1998).

Propagation: *Morella faya* reproduces from seed. *M. faya* is a dioecious species, however male plants often produce some fruits and female individuals sometimes produce a few male inflorescences (Binggeli 1998). In Hawai'i, fruits ripen mainly between August and November but may be produced throughout the year (Binggeli 1998). Germination occurs at all light levels but is highest under 55% and 63% of shade

(Binggeli 1998). On Maui, *M. faya* is less dense under the shade of Eucalyptus and pine plantations and tends to come up in light gaps, margins, and openings in the forest.

Dispersal: *Morella faya* was first introduced to Hawai'i presumably by Portuguese settlers for ornament, firewood, and making wine out of the fruits. It was then spread throughout the islands in forestry plantings. According to Vitousek and Walker (1989), *Metrosideros* sp. open canopied sites are especially susceptible to invasion by *M. faya* as they are good perch trees for birds which are the primary dispersal agents. Seeds of *M. faya* are primarily spread by *Zosterops japonica* (Japanese white-eye) resulting in population growth by nucleation (Siebold 2001). Other birds associated with the spread of *M. faya* include non-natives such as *Acridotheres tristis* (common mynah) and *Leiothrix lutea* (red-billed leiothrix), and natives such as *Phaeornis obscurus* ('oma'o) (Clarke 1978, Smathers and Gardner 1979, Gardner and Davis 1982, LaRosa et al. 1985). In addition, *Sus scrofa* (feral pigs) have been implicated as dispersal agents for *M. faya* (Clarke 1978).

Pests and diseases: The seeds of *Morella faya* are sometimes eaten by rats (Binggeli 1998). In Hawai'i, *M. faya* was a host for *Sophonia rufostachia* (two-spotted leafhopper). However, populations of the leafhopper have since dropped, and little damage is evident now. Brickell and Zuk (1997) report that species of *Morella* [*Myrica*] are susceptible to leaf spots, stem rots, root rots, dieback, and rust.

DISTRIBUTION

Native range: *Morella faya* is native to the Canary Islands, Madeira, and the Azores (Wagner et al. 1999). The Climate in its native range in the Canary Islands is typically mediterranean with wet winters and dry summers. The average temperatures in the Azores in 21 C (84 F) in the summer and 14.5 C (58 F) in the winter. The climate on Madeira is intermediate. Rainfall in this region increases with altitude, similar to Hawai'i, and varies between 750 and 2,500 mm (30-98 in) and highlands are usually covered in clouds and mist (Binggeli 1998). In the Azores, *M. faya* is the main species in the lowlands to regenerate on old lava flows. Near 600 m (1,968 ft) in the Azores, *M. faya* is a codominant in the canopy and is distributed up to 900 m (2,953 ft) with poor regeneration under canopy (Binggeli 1998). In its native range, *M. faya* is being displaced by *Pittosporum undulatum*, native to eastern Australia (Binggeli 1998).

Global distribution: *Morella faya* is cultivated elsewhere including Australia and New Zealand (PIER 2003). It is apparently naturalized on Chatham Island, New Zealand, but not yet on the mainland (PIER 2003). *M. faya* is cultivated and naturalized in Hawai'i.

State of Hawai'i distribution: *Morella faya* was originally introduced in the late 1800's presumably by Portuguese immigrants who brought the plant for ornament and other uses such as making wine from the fruits (Fosberg 1937, Little and Skolmen 1989). Shortly thereafter, the Hawaiian Sugar Planters' Association obtained seeds from the island of Hawai'i for use in reforestation attempts (Fosberg 1937). In the late 1920's, several hundred *M. faya* trees were planted on the islands of Kaua'i, O'ahu, and Hawai'i (Skolmen 1960). Planting records report 30 trees planted on Kaua'i, 112 trees planted on

O'ahu, and 548 trees planted on Hawai'i (Skolmen 1960). The plantings succeeded too well and by 1944 *M. faya* was declared a noxious weed by the HDOA and efforts began to eradicate the plant (Neal 1965). Despite efforts by the HDOA, State, and National Park Service to control the tree, *M. faya* continues to spread. Today, *M. faya* is now known from Kaua'i, O'ahu, Lana'i, Maui, and Hawai'i (Oppenheimer et al. 1999, Wagner et al. 1999). *M. faya* occurs as low as 1,400 ft (425 m) on lana'i to as high as 7,000 ft (2,134 m) on Maui. In the Hawaiian Islands, *M. faya* invades a wide variety of habitats from mesic to wet forests, urban areas, pastures, and shrubland. Juvik and Juvik (1992) made the following estimates of total infested area: All islands, 85,912 a (34,365 ha); Hawai'i, 72,265 a (28,906 ha); Maui, 4,770 a (1,908 ha); O'ahu, 435 a (174 ha); Kaua'i, 5,925 a (2,370 ha); and Lana'i, 2,518 a (1,020 ha).

Hawai'i: On the island of Hawai'i, *M. faya* is found in the Hamakua district between Laupahoehoe and Honoka'a from 2,000-4,400 ft (610-1,341 m) elevation of mostly ranchland and pastures (Whiteaker and Gardner 1992). A second infestation site occurs in the Volcano area, including a large portion of Hawai'i Volcanoes National Park, at elevations ranging between 1,800-4,000 ft (549-1,219 m), consisting of a wide range of habitats including montane 'ohia rain forest, submontane seasonal forest, montane seasonal forest converted to pasture, and dry scrubland (Whiteaker and Gardner 1992). There are also infestations on Kapapala Ranch in pastures between 3,500 and 3,760 ft (1,067-1,146 m) and on Hualalai in ranchland between 4,850 and 6,040 ft (1,470-1,830 m) elevation (Whiteaker and Gardner 1992).

Maui: See below.

Lana'i: *M. faya* occurs in the mountainous areas of Lana'i Hale from 1,400 ft (425 m) to 3,370 ft (1,020 m) at the summit on narrow ridges, steep slopes, and protected gullies (Whiteaker and Gardner 1992).

O'ahu: *M. faya* occurs in the Wai'anae mountains, O'ahu at 2,000-3,127 ft (610-948 m) elevation in rough mountainous terrain with narrow ridges and steep slopes (Whiteaker and Gardner 1992).

Kaua'i: *M. faya* occurs in a variety of habitats on Kaua'i from montane rain forest to dry open steep slopes in the Koke'e State Park area at 4,200 ft (1,280 m) elevation and on the northwestern slopes of the Island at 1,800 ft (549 m) elevation (Whiteaker and Gardner 1992).

Island of Maui distribution: On Maui, the main *M. faya* infestation occurs on the windward slope of Haleakala from 3,000-7,000 ft (914-2,134 m) elevation from Pu'u Nianiau on the east to Polipoli State Park on the west. In addition, there were a couple plants that were located and controlled above Lahaina on West Maui (H. Oppenheimer pers. comm.). The infestation on East Maui is especially dense in areas nearby forestry plantations and residential sites along Crater Rd. and Kula west to Polipoli. Average annual rainfall in these areas ranges from 30-80 in (76-203 cm) (Juvik and Juvik 1998). Scattered plants can be observed in pastures and degraded shrubland areas just below

Haleakala National Park. In the Polipoli area, where *M. faya* was likely planted in forestry efforts, the infestation is especially dense in some nearby areas where it is becoming a co-dominant with other weedy plants including *Pinus radiata* (Monterey pine), *Acacia mearnsii* (black wattle), and *Passiflora mollissima* (banana poka) in degraded shrubland, mesic forest, pastures, and abandoned pastures. Numerous fruit eating birds in the area as well as feral pigs are likely dispersing seeds of *M. faya*. Under dense plantations of *Pinus* spp. and *Eucalyptus* spp., *M. faya* is not as aggressive and only occupies areas where there are light gaps and openings in the forest. The furthest east that *M. faya* has been found is Pu'u Nianiau, Haleakala National Park (HNP), elevation 7,000 ft (2,134 m) where 1 small plant found and pulled in December, 2001 by Betsy Gagne and Forest Starr. The National Park Service's -Exotic Plant Management Team has done control on plants at the leading edge of the invasion in Haleakala Ranch land located directly adjacent to and below HNP. Currently, locating and controlling *M. faya* in the open ranchland is relatively easy. Park staff is concerned that once *M. faya* reaches the wet forest, it will be extremely difficult to locate and control. *M. faya* seems to not have reached its full potential distribution on Maui and continued early detection in natural areas along with control of outliers will be key to preventing future infestations and costly control.

CONTROL METHODS

Physical control: Small seedlings and saplings of *M. faya* can be hand pulled or dug up.

Chemical control: Foliar applications of herbicide will work to control *M. faya* and is best done in easily accessible areas where native plants are not nearby, such as in pastures and ranchland. Gardner and Kageler (1982) tested several different methods for application in sensitive areas and found that the method that worked best was to inject undiluted Roundup (5-10 ml) per tree. This method allows for quick absorption and least amount of non-target effects. Other methods that likely control *M. faya* include basal bark and cut stump applications of Garlon 4 and Garlon 3A.

Biological control: The agent *Botrytis cinerea* is a locally established pathogen (fungus) in Hawai'i that has been found to diminish *M. faya* populations. The fungus causes fruit rot and is known to diminish seed viability from 66% to 16.8% in Hawai'i Volcanoes National Park (Siebold 2001). The infected fruit also is less attractive to birds which lessens their dispersal rate (Siebold 2001). The fungus *B. cinerea* is spread by several fruit eating insects including *Amorbia emigratella* and *Cryptoblabes gnidiella* which act as vectors for the fungus (Siebold 2001). Two spotted leaf hopper (*Sophonia rufostachia*) has also been documented on *M. faya* in Hawai'i resulting in yellowing of leaves and affecting the health of plants.

Cultural control: *M. faya* seems to be somewhat shade tolerant and has difficulty invading closed intact forests. Limiting disturbances, damage caused by feral animals, and fragmentation of forests may help prevent infestations of *M. faya* (Whiteaker and Gardner 1992).

Noxious weed acts: *Morella faya* is listed as a Hawai'i State noxious weed (HDOA 1992).

MANAGEMENT RECOMMENDATIONS

Morella faya was introduced to Hawai'i in the late 1800's and was widely planted throughout the state in the 1920's. By 1944, the tree was considered a pest species and is now on the Hawai'i State noxious weed list. Despite control programs, *M. faya* continues to spread today and covers vast acreage on most of the main Hawaiian Islands. On Maui, *M. faya* is established in the Kula and Polipoli areas where it is rapidly spreading in pastures, residential areas, along roads, shrublands, and mesic forests. *M. faya* may have some trouble invading dense intact native forests, but will opportunistically colonize disturbances, light gaps, and openings in the forest. Early detection and control of outliers in and nearby natural areas will need to continue in order to fend off the invasion of *M. faya*.

REFERENCES

Benton, N. 2002. Firetree (*Myrica faya*). Plant Conservation Alliance, Alien Plant Working Group and The Nature Conservancy, Arlington, VA. Available: http://www.nps.gov/plants/alien/fact/myfa1.htm (Accessed: February 26, 2003).

Binggeli, P. 1998. *An Overview of Invasive Woody Plants in the Tropics*. School of Agricultural and Forest Sciences Publication Number 13, Unversity of Wales, Bangor, UK.

Brickell, C. and J.D. Zuk. 1997. *The American Horticultural Society A-Z Encyclopedia of Garden Plants.* DK Publishing, Inc., NY.

Clarke, G. 1978. The distribution of *Myrica faya* and other selected problem exotics within Hawaii Volcanoes National Park. Pres. 2nd Conf. Nat. Sci., Hawaii Volcanoes Natl. Park, June 1-3, 1978. Abstract, *Proc. 2nd Conf. Nat. Sci., Hawaii Volcanoes Natl. Park*, 51. Univ. Hawaii Coop. Natl. Park Resour. Stud. Unit, Honolulu, HI

Duncan, W.H. and M.B. Duncan. 1987. *The Smithsonian Guide to Seaside Plants of the Gulf and Atlantic Coasts.* Smithsonian Institution Press, Washington, DC.

Fosberg, F.R. 1937. Immigrant plants in the Hawaiian Islands. I. *Univ. Hawaii Occas. Paper* No. 32, University of Hawai'i, Honolulu, HI.

Gardner, D.E. and C.J. Davis. 1982. The propects for biological control of nonnative plants in Hawaiian national parks. *Tech. Rep*. 45, Univ. Hawaii Coop. Natl. Park Resour. Stud. Unit, Honolulu, HI.

Gardner, D.E. and V.A.D. Kageler. 1982. Herbicidal control of firetree in Hawaii Volcanoes National Park: a new approach. *Natl. Park Serv. Ecol. Serv, Bull*. 7. U.S. Dep. Interior, Washington, DC.

HDOA (Hawai'i Department of Agriculture). 1992. *List of Plant Species Designated as Noxious Weeds for Eradication or Control Purposes* (June 18, 1992). Hawaii Department of Agriculture. Available: http://www.botany.hawaii.edu/cpsu/-strawgua/other/noxious/noxious.html (Accessed: February 26, 2003).

Juvik, S.P and J.O. Juvik. 1998. *Atlas of Hawai'i.* 3rd ed. Department of Geography, University of Hawai'i press, Honolulu, HI.

LaRosa, A.M., C.W. Smith, and D.E. Gardner. 1985. Role of alien and native birds in hte dissemination of firetree (*Myrica faya* Ait. - Myricaceae) and associated plant in Hawaii. *Pac. Sci*. 39: 372-378.

Little, E.L. and R.G. Skolmen. 1989. *Common Forest Trees of Hawai'i*. Agriculture Handbook No. 679. United States Department of Agriculture, Washington, DC.

Meidell, J.S., H.L. Oppenheimer, and R.T. Bartlett. 1997. New plant records from Pu'u Kukui Watershed and adjacent areas, Maui. *Bishop Mus. Occas. Pap.* 49(2): 17-19.

Neal, M.C. 1965. *In Gardens of Hawai'i.* Bernice P. Bishop Museum Special Publication 40, Bishop Museum Press, Honolulu, HI.

Oppenheimer, H.L., J.S. Meidell, and R.T. Bartlett. 1999. New plant records for Maui and Moloka'i. *Bishop Mus. Occas. Pap*. 59(2): 7-11.

PLANTS (National Plants Database). 2003. Online database. United States Department of Agriculture, Natural Resources Conservation Services, National Plant Data Center, Baton Rouge, LA. Available: http://plants.usda.gov (Accessed: February 26, 2003).

Siebold, R. 2001. Controlling Fire Tree (*Myrica faya*) in Hawai'i. Restoration and Reclamation Review Student On-line Journal, Volume 6. Dept. of Horticultural Science, University of Minnesota, St. Paul. Available: http://www.hort.agri.urmn.edu/hort5015/00papers/siebold.htm (Accessed: February 26, 2003.

Skolmen, R.G. 1960. *Plantings on the Forest Reserves of Hawai'i: 1910-1960.* Institute of Pacific Islands Forestry, Pacific Southwest Forest and Range Experiment Station, United States Forest Service, Honolulu, HI.

Smathers, G.A. and D.E. Gardner. 1979. Stand analysis of an invading firetree (*Myrica faya* Aiton) population, Hawai'i. *Pac Sci*. 33(3): 239-255.

Staples, G.W., C.T. Imada, and D.R. Herbst. 2002. New Hawaiian plant records for 2000. *Bishop Mus. Occas. Pap.* 68(1): 3-18.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. *Manual of the Flowering Plants of Hawai'i*. 2 vols. Bishop Museum Special Publication 83, University of Hawai'i and Bishop Museum Press, Honolulu, HI.

Whiteaker, L.D. and D.E. Gardner. 1992. Firetree (*Myrica faya*) Distribution in Hawai'i. In: *Alien Plant Invasions in Native Ecosystems of Hawai'i*, C.P. Stone, C.W. Smith, and J.T. Tunison, eds. University of Hawai'i Press, Honolulu, HI.

Wilbur, R.L. 1994. The Myricaceae of the United States and Canada: genera, subgenera, and seies. *Sida* 16(1): 93-107.