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Hawai'i Montane-Subalpine Dry Forest and Woodland - Lava

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Modelers		Reviewers	
Jim Jacobi	jim_jacobi@usgs.gov		
Dawn Greenlee	Dawn_Greenlee@fws.gov		
Sam Gon III	sgon@tnc.org		

Vegetation Type

Forest and Woodland

Map Zones

79

Model Splits or Lumps

This BpS is split into multiple models:

This model was split into two types to reflect differences in the model starting points (lava vs ash), trees species (metrosideros on lava vs mamane-naio on ash) and disturbance regimes.

Geographic Range

This forest ecological system is restricted to dryer upper slopes of the higher mountains of Maui (Haleakala) and Hawai'i (Mauna Kea, Mauna Loa, and Hualalai).

Biophysical Site Description

This ecological system occurs on dry slopes of higher mountains of Maui and Hawai'i, from 1,000-2,900m (3,280-9,510ft) elevation. An inversion layer of warmer air forms 50-70% of the time between 1,600-3,000 that dramatically reduces precipitation at higher elevations (Gagne and Cuddihy 1990). This is because the wet trade winds generally do not rise above 1,900m (6,230ft), and are deflected around the mountains leaving upper slopes too dry to support rain forests (Mueller-Dombois and Fosberg 1998). Stands also occur at lower elevations on the leeward sides of islands where there is a strong rain shadow effect. Annual rainfall is generally 300-1,200mm. Many sites are wind exposed. Substrates include cinder, well-drained, sandy loam soils derived from volcanic ash, and weathered 'a'ā or pahoehoe basaltic lava with little soil development.

Vegetation Description

Vegetation is characterized by an open-to-dense tree layer dominated or codominated by *Metrosideros polymorpha*, *Sophora chrysophylla*, *Myoporum sandwicense*, *Acacia koa*, *Chamaesyce celastroides*, or *Chamaesyce olowaluana*. *Acacia koa* forests are tallest (up to 18 m) and *Sophora* – *Myoporum* and *Chamaesyce* forests range from 3-5 m tall. Other trees include *Santalum* spp., *Myrsine lanaiensis*, and *Zanthoxylum hawaiiense*. *Dodonaea viscosa*, *Styphelia tameiameia*, *Chenopodium oahuense*, and *Vaccinium* spp. frequently form a sparse to moderately dense shrub layer up to 3m tall. Other shrubs may include *Bidens menziesii* ssp. *hillebrandii*, *Coprosma ernodoides*, *Dubautia ciliolata*, *Dubautia linearis*, *Silene* spp., *Exocarpos* spp., *Geranium cuneatum*, *Geranium multiflorum*, *Osteomeles anthyllidifolia*, and *Tetramolopium* spp. Native grasses (e.g., *Gahnia* spp.), forbs and ferns (e.g., *Pteridium aquilum*)

are present, but contribute low cover especially at higher elevations. Native grasses include *Eragrostis atropioides*. Fire-adapted exotic grasses such as *Pennisetum setaceum* are invasive and threaten these dry shrublands by increasing fire intensity, frequency, and size (Castillo 1997). The exotic rosette forb *Verbascum thapsus* is a common in many stands.

This is a structurally diverse system that varies depending on pioneer substrates. On basalt lava, ohia is the pioneer species with a mixture of sparse ferns, grasses, and shrubs. Then shrubs such as *Dodonaea viscosa*, *Styphelia tameiameia*, *Chenopodium oahuense*, and *Vaccinium* spp. form a layer with shrubby and tree *Metrosideros polymorpha*. As more ash blows in, other tree species may colonize, such as *Sophora chrysophylla*, *Myoporum sandwicense*, *Acacia koa*, *Chamaesyce celastroides*, or *Dodonaea viscosa*, *Styphelia tameiameia*, *Chenopodium oahuense*, grasses and ferns colonize barren substrates. *Sophora chrysophylla* and *Myoporum sandwicense* become established as the shrub layer closes and stands resemble climax dry shrubland with scattered trees. Grasses may be present with up to 40% cover. *Sophora chrysophylla* and *Myoporum sandwicense* continue to grow and form an open tree canopy with a moderately dense shrub layer and a grass layer (up to 20% cover). Eventually the *Sophora chrysophylla* and *Myoporum sandwicense* tree canopy closes. This late seral tree canopy may become mixed with or in time dominated by *Acacia koa*, *Chamaesyce celastroides*, or *Chamaesyce olowaluana*.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
MEPO5	<i>Metrosideros polymorpha</i>	'ohi'a lehua
SOCH	<i>Sophora chrysophylla</i>	Mamani
MYSA	<i>Myoporum sandwicense</i>	Naio
ACKO	<i>Acacia koa</i>	Koa
CHCE	<i>Chamaesyce celastroides</i>	'ekoko
CHOL3	<i>Chamaesyce olowaluana</i>	Alpine sandmat
DOVI	<i>Dodonaea viscosa</i>	Florida hopbush
STTA	<i>Styphelia tameiameia</i>	Pukiawe

Species names are from the NRCS PLANTS database. Check species codes at <http://plants.usda.gov>.

Disturbance Description

Lava flow is the primary disturbance event for this system. Some disturbances originating from fire events can occur in these dry forests. Storms can create wind throw but not as major as at lower elevations.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	3274	13		
Moderate (Mixed)	470	87		
Low (Surface)				
All Fires	411	100		

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

None

Adjacency or Identification Concerns

Symbol	Scientific Name	Common Name	Canopy Position
MEPO5	<i>Metrosideros polymorpha</i>	'ohi'a lehua	Upper
ASAD	<i>Asplenium adiantum-nigrum</i>	Black spleenwort	Lower
POPE5	<i>Polypodium pellucidum</i>	Dotted polypody	Lower
VARE	<i>Vaccinium reticulatum</i>	Ohelo 'ai	Lower

Description

This is a lava flow initiated seral state.

Maximum Tree Size Class

None

Class B	11	Mid Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
MEPO5	<i>Metrosideros polymorpha</i>	'ohi'a lehua	Upper
STTA	<i>Styphelia tameiameia</i>	Pukiawe	Upper
DENU6	<i>Deschampsia nubigena</i>	Alpine hairgrass	Lower
GAGA3	<i>Gahnia gahniiformis</i>	Gaudichaud's sawsedge	Lower

Description

Shrubs, ferns and grasses (grasses can be 20-40%).

Maximum Tree Size Class

None

Class C	50	Mid Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
MEPO5	<i>Metrosideros polymorpha</i>	'ohi'a lehua	Upper
VARE	<i>Vaccinium reticulatum</i>	Ohelo 'ai	Middle
GECU	<i>Geranium cuneatum</i>	Hinahina	Low-Mid
DOVI	<i>Dodonaea viscosa</i>	Florida hopbush	Middle

Description

Metrosideros taller, tree-like, grasses. Shrubs are more important and ferns remain.

Maximum Tree Size Class

None

Class D	30	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
MEPO5	<i>Metrosideros polymorpha</i>	'ohi'a lehua	Upper
PICO4	<i>Pittosporum confertiflorum</i>	Ho'awa	Middle
EXGA	<i>Exocarpos gaudichaudii</i>	Hulumoa	Middle
STTA	<i>Styphelia tameiameiae</i>	Pukiawe	Middle

Description

Closed canopy trees, taller, more diverse, still have shrub/fern understory.

Maximum Tree Size Class

None

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:CLS	100
Mid1:CLS	101	Mid1:OPN	150
Mid1:OPN	151	Late1:CLS	300
Late1:CLS	301	Late1:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start Age After Disturbance?	Years Since Last Disturbance
Optional 1	Early1:ALL	Early1:ALL	0.001	1000	No	0
Optional 1	Mid1:OPN	Early1:ALL	0.001	1000	Yes	0
Mixed Fire	Mid1:OPN	Mid1:CLS	0.002	500	Yes	0
Wind or Weather or Stress	Mid1:OPN	Mid1:OPN	0.005	200	No	0
Optional 1	Mid1:CLS	Early1:ALL	0.001	1000	Yes	0
Mixed Fire	Mid1:CLS	Mid1:CLS	0.005	200	No	0
Replacement Fire	Late1:CLS	Mid1:CLS	0.001	1000	Yes	0
Optional 1	Late1:CLS	Early1:ALL	0.001	1000	Yes	0
Mixed Fire	Late1:CLS	Mid1:OPN	0.002	500	Yes	0
Wind or Weather or Stress	Late1:CLS	Mid1:OPN	0.005	200	Yes	0

Optional Disturbances

Optional 1: Lava Flows

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