18151

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

BpS Model/Description Version: Aug. 2020

Update: 6/6/2018

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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 tameiameiae*, *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, ohi'a is the pioneer species with a mixture of sparse ferns, grasses, and shrubs. Then shrubs such as *Dodonaea viscos*, *Styphelia tameiameiae*, *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 tameiameiae*, *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 | *Metrosideros polymorpha* | 'ohi'a lehua |
| SOCH | *Sophora chrysophylla* | Mamani |
| MYSA | *Myoporum sandwicense* | Naio |
| ACKO | *Acacia koa* | Koa |
| CHCE | *Chamaesyce celastroides* | 'ekoko |
| CHOL3 | *Chamaesyce olowaluana* | Alpine sandmat |
| DOVI | *Dodonaea viscosa* | Florida hopbush |
| STTA | *Styphelia tameiameiae* | 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

Seral state A will be confused with Class A in the ash deposit initiated system (18152) since vegetation structure and composition are very similar.

Issues or Problems

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 common in many stands.

Native Uncharacteristic Conditions

Comments

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | B | B | B | B |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | B | B | B | B |
| Shrub | >3.0 | C | C | C | C | C | C | B | B | B | B |
| Tree | 0-5 | C | C | C | C | C | C | B | B | B | B |
| Tree | 5-10 | C | C | C | C | C | C | D | D | D | D |
| Tree | 10-25 | C | C | C | C | C | C | D | D | D | D |
| Tree | 25-50 | C | C | C | C | C | C | D | D | D | D |
| Tree | >50 | C | C | C | C | C | C | D | D | D | D |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 9 Early Development 1 - All Structures

Indicator Species

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

Description

This is a lava flow initiated seral state.

*Maximum Tree Size Class*  
None

Class B 11 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| STTA | Styphelia tameiameiae | Pukiawe | Upper |
| DENU6 | Deschampsia nubigena | Alpine hairgrass | Lower |
| GAGA3 | Gahnia gahniiformis | 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

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| VARE | Vaccinium reticulatum | Ohelo 'ai | Middle |
| GECU | Geranium cuneatum | Hinahina | Low-Mid |
| DOVI | Dodonaea viscosa | 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

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| PICO4 | Pittosporum confertiflorum | Ho'awa | Middle |
| EXGA | Exocarpos gaudichaudii | Hulumoa | Middle |
| STTA | Styphelia tameiameiae | 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

References

Castillo, J. M. 1997. Control of Pennisetum setaceum (Forssk.) Chiov. in native Hawaiian dry upland ecosystems. Unpublished thesis, Department of Forestry, Colorado State University, Fort Collins. 35 pp.

Gagne, W.C., and L.W. Cuddihy. 1990. Vegetation. Pages 45-114 in: W.L. Wagner, D.R. Herbst, and S.H. Sohmer, editors. Manual of the Flowering Plants of Hawaii. 2 Volumes. University of Hawaii Press, Honolulu.

Mueller-Dombois, D., and F.R. Fosberg. 1998. Vegetation of the tropical Pacific islands. Springer-Verlag, New York. 733 pp.

NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 3, 2008 ).

Price, J.P., S.M. Gon III, J.D. Jacobi, and D. Matsuwaki. 2007. Mapping plant species ranges in the Hawaiian Islands: Developing a methodology and associated GIS layers. Hawai'i Cooperative Studies Unit. Technical Report HCSU-008. Pacific Aquaculture and Coastal Resources Center (PACRC), University of Hawai'i, Hilo. 58 pp., includes 16 figures and 6 tables.

Shaw, R.B., and J.M. Castillo. 1997. Plant communities of Pohakuloa Training Area, Hawaii. Center for Ecological Management of Military Lands. Department of Forest Sciences. Colorado State University. Fort Collins.

Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1999. Manual of the flowering plants of Hawaii. Revised edition. Volumes 1 and 2. University of Hawaii Press and Bishop Museum Press, Honolulu. 1919 pp.

Western Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boulder, CO.