18100

Hawai'i Montane Rainforest

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

79

Geographic Range

This system is found from 1,200-2,200m (4,000-7,000ft) elevation on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. Hawai'i Montane Rainforest encompasses a mosaic of rainforest and shrublands between 1,200 and 2,200m (4,000-7,000ft) elevation on all the high islands.

Biophysical Site Description

Montane rainforest occurs as a large-patch mosaic on windward areas that receive evenly distributed orographically derived rainfall exceeding 2,500mm (99in) annually. The climate is warm, with frequent afternoon fog often generating fog drip. Soils generally have a gley horizon 10-70 cm (4-28in) deep, underlain by lateritic weathered basalt and overlain with organic hummus ranging from 10-30cm (4-12in) deep.

Vegetation Description

Across the range of the ecological system, vegetation varies in height, structural complexity and species richness. Forests can be dominated by *Metrosideros polymorpha*, tree fern (*Cibotium* spp.) in some areas, or by a tall, well-stratified canopy of koa (*Acacia koa*) in other areas. At higher elevations on Maui and Hawai'i, *Metrosideros* forms a 5- to 8-m canopy that is relatively simple floristically. Canopy height becomes as low as 2m in poorly drained areas and along bog margins. At the lower elevational limit, montane rainforests merge with Hawai'i Lowland Rainforest (CES412.226). At the upper elevational limit on Hawai'i and Maui, they quickly grade into *Acacia* / *Sophora* forest and other mesic communities. Montane rainforests frequently support a large mass of epiphytic mosses, ferns, and other plants. Common codominant and associated species include *Cheirodendron* spp., *Astelia menziesiana*, *Carex alligata*, *Clermontia* spp., *Cyrtandra* spp., *Dicranopteris* spp., *Psychotria* spp., *Pteridium aquilinum*, *Rubus* spp., *Urera glabra*, and *Vaccinium calycinum*. Olapa (*Cheirodendron* spp.) is often co-dominant in low statured, wind stunted forests of peaks and ridges, areas almost continually brushed by clouds (Cuddihy et al. 1990). Plants that act as epiphytes include *Astelia menziesiana*, *Carex alligata*, *Elaphoglossum* spp., *Metrosideros polymorpha*, *Peperonima* spp., *Vaccinium calycinum*, and others.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| MEPO5 | *Metrosideros polymorpha* | 'ohi'a lehua |
| CIBOT | *Cibotium* | Manfern |
| ACKO | *Acacia koa* | Koa |
| ILAN | *Ilex anomala* | Hawai'i holly |
| CHEIR | *Cheirodendron* | Cheirodendron |
| ASME4 | *Astelia menziesiana* | Pua'akuhinia |
| CAAL12 | *Carex alligata* | Hawai'i sedge |
| RUHA | *Rubus hawaiensis* | Hawai'i blackberry |

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

Disturbance Description

The major disturbance factors in this system were from climatic factors, particularly hurricanes and drought, or periodic and widespread dieback of the Metrosideros tree canopy that has been documented for the islands of Hawai'i and Maui. On the island of Hawai'i, lava flows periodically ran through forests on the flanks of Mauna Loa and Hualalai volcanoes.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 17921 | 48 |  |  |
| Moderate (Mixed) | 16502 | 52 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 8591 | 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

Adjacency or Identification Concerns

This system is similar to the Hawai'i Lowland Rainforest (CES412.226) and

Hawai'i Uluhe Fern Woodland (CES412.219)

At the lower elevational limit, montane rainforests merge with Hawai'i Uluhe Fern Woodland (CES412.219) and Hawai'i Lowland Rainforest (CES412.226). At the upper elevational limit on Hawai'i and Maui, they quickly grade into *Acacia* / *Sophora* forest and other mesic communities.

Montane rainforests differ from cloud forests by the lack of ground-level clouds

nearly every day; cloud forests support more epiphytes than montane rainforests.

Issues or Problems

The boundary between the lowland and montane wet forests in Hawai'i is not generally agreed upon by all botanists and ecologists, and it may be variable on different Islands. A clear picture of pre-human vegetation is complicated by the extreme disturbance the lowlands have suffered.

Native Uncharacteristic Conditions

Comments

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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 | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | B | B | B | B | B | B | C | C | C | C |
| Tree | 5-10 | B | B | B | B | B | B | C | C | C | C |
| Tree | 10-25 | E | E | E | E | E | E | D | D | D | D |
| Tree | 25-50 | E | E | E | E | E | E | D | D | D | D |
| Tree | >50 | E | E | E | E | E | E | 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 |
| DILI | Dicranopteris linearis | Old world forkedfern | Lower |
| VARE | Vaccinium reticulatum | Ohelo 'ai | Lower |
| POPE5 | Polypodium pellucidum | Dotted polypody | Lower |

Description

Recent lava flow landscape with 0-10% pioneer vegetation that can include sapling *Metrosideros*, and various ferns, forbs, and shrub species. Variants may include *Dicranopteris*-dominated pioneer vegetation. Of the two major lava flow types, seral development occurs more rapidly on 'a'a (rough, clinkery) than on pahoehoe (smooth). Current restricted to the island of Hawai'i, largely on the eastern flank, associated with lava flows from Mauna Loa and Kilauea, running through lowland wet regions.

*Maximum Tree Size Class*  
None

Class B 6 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| DILI | Dicranopteris linearis | Old world forkedfern | Lower |
| SAPA11 | Sadleria pallida | Ama'u | Lower |
| PIAL2 | Pipturus albidus | Waimea pipturus | Low-Mid |

Description

Open woodland of *Metrosideros* over a mixed groundcover of *Dicranopteris*, other ferns, such as *Sadleria,* and *Cibotium*. Dominant cover is understory ferns and shrubs. Important shrubs are *Pipturus* and *Vaccinium calycinum*. At this stage several common native tree species are also found in this community, including *Coprosma*, *Myrsine*, and *Ilex*.

*Maximum Tree Size Class*  
Medium 9-21"DBH

Class C 13 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| COOC3 | Coprosma ochracea | Maui mirrorplant | Middle |
| BRAR6 | Broussaisia arguta | Kanawao | Lower |
| CIGL | Cibotium glaucum | Hapu'u | Middle |

Description

Closed *Metrosideros* forest with simple understory of trees, treeferns, shrubs, and ferns. Native trees may include *Cheirodendron*, *Coprosma*, *Ilex*, and *Myrsine*. Tree ferns include *Cibotium* and *Sadleria* spp. Shrubs include *Cyrtandra*, *Broussaisia*, *Vaccinium calycinum*, *Rubus hawaiiensis*, and *Coprosma*. Ground ferns include *Diplazium*, *Athyrium*, *Pteris*, *Pneumatopteris sandwicensis*, *Elaphoglossum*, and *Asplenium* spp. Herbs and forbs include *Astelia*, and *Peperomia*.

*Maximum Tree Size Class*  
Large 21-33" DBH

Class D 66 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| ACKO | Acacia koa | Koa | Upper |
| RUHA | Rubus hawaiensis | Hawai'i blackberry | Lower |
| CIBOT | Cibotium | Manfern | Lower |

Description

*Metrosideros* and *Acacia koa* are the tallest forest canopy forming species among many other native Hawaiian tree species found in this mature forest type. Other common trees in this rich climax stage include *Ilex*, *Melicope*, *Myrsine*, and *Coprosma*. The understory is primarily dominated by *Cibotium treeferns*. Shrubs include *Hedyotis*, *Broussaisia*, *Cyrtandra*, *Clermontia*, *Cyanea*, *Coprosma*, and *Vaccinium*. Lianas and vines include *Alyxia* and *Smilax*. Many ferns and herbs in groundcover.

*Maximum Tree Size Class*  
Very Large >33" DBH

Class E 6 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MEPO5 | Metrosideros polymorpha | 'ohi'a lehua | Upper |
| CHTR2 | Cheirodendron trigynum | olapalapa | Upper |
| PSHA3 | Psychotria hawaiiensis | kopiko 'ula | Lower |
| CIBOT | Cibotium | Manfern | Lower |

Description

This is a variant of class D in which canopy has been opened, but constituent species remain largely the same (rich in several layers).

*Maximum Tree Size Class*  
Very Large >33" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 50 |
| Mid1:OPN | 51 | Mid1:CLS | 90 |
| Mid1:CLS | 91 | Late1:CLS | 180 |
| Late1:CLS | 181 | Late1:CLS | 999 |
| Late1:OPN | 181 | Late1:CLS | 205 |

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 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.0005 | 2000 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0005 | 2000 | Yes | 0 |
| Optional 2 | Mid1:OPN | Early1:ALL | 0.0005 | 2000 | Yes | 0 |
| Optional 1 | Mid1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Mid1:OPN | Mid1:OPN | 0.004 | 250 | No | 0 |
| Optional 1 | Mid1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late1:OPN | Mid1:OPN | 0.0005 | 2000 | Yes | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.0005 | 2000 | No | 0 |
| Optional 1 | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late1:OPN | Late1:OPN | 0.005 | 200 | No | 0 |
| Optional 1 | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Competition or Maintenance | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:OPN | 0.004 | 250 | Yes | 0 |

Optional Disturbances

Optional 1: Lava Flows

Optional 2: Landslides

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