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Hawai'i Montane Rainforest

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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	<i>Metrosideros polymorpha</i>	'ohi'a lehua
CIBOT	<i>Cibotium</i>	Manfern
ACKO	<i>Acacia koa</i>	Koa
ILAN	<i>Ilex anomala</i>	Hawai'i holly
CHEIR	<i>Cheirodendron</i>	Cheirodendron
ASME4	<i>Astelia menziesiana</i>	Pua'akuhinia
CAAL12	<i>Carex alligata</i>	Hawai'i sedge
RUHA	<i>Rubus hawaiensis</i>	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

Additional modelers include: Wayne Ching (wayne.f.ching@hawaii.gov); Andrew Beavers (Andrew.Beavers@ColoState.EDU); Richard Nezelek (rnezelek@pdc.org); Glenn Shishido (Glenn.N.Shishido@hawaii.gov); Ron Cannarella (Ronald.J.Cannarella@hawaii.gov); Dawn Greenlee (Dawn_Greenlee@fws.gov); and Keith Schulz (keith_schulz@naturereserve.org)

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	<i>Metrosideros polymorpha</i>	'ohi'a lehua	Upper
DILI	<i>Dicranopteris linearis</i>	Old world forkedfern	Lower
VARE	<i>Vaccinium reticulatum</i>	Ohelo 'ai	Lower
POPE5	<i>Polypodium pellucidum</i>	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

Class D	66	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
ACKO	<i>Acacia koa</i>	Koa	Upper
RUHA	<i>Rubus hawaiiensis</i>	Hawai'i blackberry	Lower
CIBOT	<i>Cibotium</i>	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*, *Broussaia*, *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
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
MEPO5	<i>Metrosideros polymorpha</i>	'ohi'a lehua	Upper
CHTR2	<i>Cheirodendron trigynum</i>	olapalapa	Upper
PSHA3	<i>Psychotria hawaiiensis</i>	kopiko 'ula	Lower
CIBOT	<i>Cibotium</i>	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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