

**18140**

## **Hawai'i Lowland Mesic Forest**

BpS Model/Description Version: Aug. 2020

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### **Vegetation Type**

Forest and Woodland

### **Map Zones**

79

### **Geographic Range**

This forest ecological system occurs on mesic slopes of Hawai'i, Moloka'i, Maui, Kaua'i and O'ahu.

### **Biophysical Site Description**

This ecological system occurs on mesic slopes of Hawai'i, Moloka'i, Maui, Kaua'i and O'ahu, from 30-1,500m (100-5,250ft) elevation, typically from 250-1,000m. Stands are found in the mesic seasonal zone between the dry leeward and wet windward climates. Sites are too dry to support rain forests, but typically do not experience extended periods of drought like the dry forests (Gagne and Cuddihy 1990). Annual rainfall is 1,200-2,500mm (50-100in) and falls largely from October to March. Substrates are highly variable, but are generally well drained and include steep, rocky talus, shallow to deep soils over weathered rock and gravelly alluvium, rocky shallow organic muck (Gagne and Cuddihy 1990).

### **Vegetation Description**

Vegetation is variable ranging from an open-to-dense, mostly evergreen tree layer 2-20m tall. There is often diverse canopy and subcanopy and tall shrub layers with lianas. As with lowland dry forest, tree diversity is very high. *Metrosideros polymorpha*, *Acacia koa*, *Diospyros sandwicensis*, *Nestegis sandwicensis*, *Pleomele* spp., and *Pritchardia kaalae* dominate or codominate with other trees such as *Antidesma pulvinatum*, *Bobea* spp., *Cryptocarya mannii*, *Nothocestrum* spp., and *Psychotria* spp. Other characteristic species in these diverse mesic forests may include *Alectryon macrococcus*, *Antidesma platyphyllum*, *Charpentiera* spp., *Coprosma* spp., *Gardenia* spp., *Flueggea neowawraeana*, *Hibiscus* spp., *Myrsine* spp., *Pandanus tectorius*, *Rhus sandwicensis*, *Pipturus albidus*, *Pisonia* spp., *Pittosporum* spp., *Santalum* spp., *Syzygium sandwicensis*, *Xylosma hawaiiense*, *Melicope* spp., *Tetraplasandra* spp., *Ochrosia* spp., *Rauvolfia*, *Zanthoxylum hawaiiense*, and drier forest species like *Chamaesyce celastroides*, *Sophora chrysophylla*, and *Myoporum sandwicense*. The understory is variable and may be dominated by sedges and ferns or shrubs. The tree fern *Cibotium* spp. is typically absent. Common shrubs and vines include *Alyxia oliviformis*, *Strongylodon ruber*, *Hedyotis* spp., *Eugenia* spp., *Lobelia* spp., *Cyanea* spp., *Delissea* spp., *Dodonaea viscosa*, *Styphelia tameiameia*, *Vaccinium dentatum*, and vine *Freycinetia arborea*. Common ferns and fern allies

present are *Doodia* spp., *Ctenitis squamigera*, *Pteris* spp., *Asplenium nidus*, *Dicranopteris linearis*, and graminoids *Carex* spp.

### BpS Dominant and Indicator Species

| Symbol | Scientific Name                | Common Name       |
|--------|--------------------------------|-------------------|
| MEPO5  | <i>Metrosideros polymorpha</i> | 'ohi'a lehua      |
| ACKO   | <i>Acacia koa</i>              | Koa               |
| DISA10 | <i>Diospyros sandwicensis</i>  | Lama              |
| NESA2  | <i>Nestegis sandwicensis</i>   | Hawai'i olive     |
| ALMA   | <i>Alectryon macrococcus</i>   | Hawai'i alectryon |
| HIAR   | <i>Hibiscus arnottianus</i>    | White rosemallow  |
| ANPU2  | <i>Antidesma pulvinatum</i>    | Hame              |
| CRMA8  | <i>Cryptocarya mannii</i>      | Holio             |

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

### Disturbance Description

Much like the disturbances in the lowland rainforest see that description. Frequency of human disturbance is less in this than in lowland rainforest. Drivers in the mesic is fires, storms, human ag, landslides (but much of this forest was not in landslide terrain). The material below is form lowland rainforest: The lowland wet forest historically (pre-Polynesian times) more widespread below 1,000m (3,280ft) elevation on the larger islands in windward areas with deep soils before being subjected to cultivation by Hawaiians. Where lands cultivated by Hawaiians were not subsequently used for agriculture, grazing, or urban development, they were invaded by species of Polynesian introduction, particularly kukui (*Aleurites moluccana*) and by later post-European introductions such as strawberry guava (*Psidium cattleianum*). Disturbances in this system include landslides in wet valleys, flood, lava flows, storms, rat predation, and fire.

### Fire Frequency

| Severity         | Avg FI | Percent of All Fires | Min FI | Max FI |
|------------------|--------|----------------------|--------|--------|
| Replacement      |        |                      |        |        |
| Moderate (Mixed) | 506    | 100                  |        |        |
| Low (Surface)    |        |                      |        |        |
| All Fires        | 506    | 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

Adjacent to lowland rainforest, *metrosideros* is dominant component in each; tree diversity across full-range of this distribution is different, e.g. dispersal of species has not reached some of the smaller/outer islands.

### Issues or Problems

Exotic trees *Morella faya*, *Psidium* spp., and *Schinus terebinthifolius* are often present in disturbed stands. Fire adapted exotic grasses such as *Oplismenus hirtellus* and *Pennisetum setaceum* are invasive and threaten these forests by increasing fire intensity, frequency, and size.

### 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     | A     | A     | A     | A      |
| Shrub                | 1.0-3.0    | B                | B     | B     | B     | B       | B     | B     | B     | B     | B      |
| Shrub                | >3.0       | B                | B     | B     | B     | B       | B     | B     | B     | B     | B      |
| Tree                 | 0-5        | B                | B     | B     | B     | C       | C     | C     | C     | C     | C      |
| Tree                 | 5-10       | D                | D     | D     | D     | E       | E     | E     | E     | E     | E      |
| Tree                 | 10-25      | D                | D     | D     | D     | E       | E     | E     | E     | E     | E      |
| Tree                 | 25-50      | D                | D     | D     | D     | E       | E     | E     | E     | E     | E      |
| Tree                 | >50        | D                | D     | D     | D     | E       | E     | E     | E     | E     | E      |

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

|                |          |                                             |
|----------------|----------|---------------------------------------------|
| <b>Class A</b> | <b>2</b> | <b>Early Development 1 - All Structures</b> |
|----------------|----------|---------------------------------------------|

### Indicator Species

| Symbol | Scientific Name         | Common Name          | Canopy Position |
|--------|-------------------------|----------------------|-----------------|
| DILI   | Dicranopteris linearis  | Old world forkedfern | Upper           |
| MEPO5  | Metrosideros polymorpha | 'ohi'a lehua         | Upper           |
| MIST4  | Microlepidia strigosa   | Palapalai            | Lower           |
| ACKO   | Acacia koa              | Koa                  | Upper           |

Description

Disturbances in this class include lava flows.

## Maximum Tree Size Class

None

|                |           |                                 |
|----------------|-----------|---------------------------------|
| <b>Class B</b> | <b>15</b> | <b>Mid Development 1 - Open</b> |
|----------------|-----------|---------------------------------|

### Indicator Species

| Symbol | Scientific Name                | Common Name          | Canopy Position |
|--------|--------------------------------|----------------------|-----------------|
| DILI   | <i>Dicranopteris linearis</i>  | Old world forkedfern | Upper           |
| SAFR4  | <i>Santalum freycinetianum</i> | Forest sandalwood    | Upper           |
| NESA2  | <i>Nestegis sandwicensis</i>   | Hawai'i olive        | Upper           |
| GABE   | <i>Gahnia beecheyi</i>         | Forest sawsedge      | Lower           |

Description

Generally, <10% of grasses, mostly shrubs. From lowland rainforest: Open woodland of *Metrosideros* over a mixed groundcover of ferns and shrubs.

## Maximum Tree Size Class

None

|                |           |                                   |
|----------------|-----------|-----------------------------------|
| <b>Class C</b> | <b>12</b> | <b>Mid Development 1 - Closed</b> |
|----------------|-----------|-----------------------------------|

### Indicator Species

| Symbol | Scientific Name               | Common Name          | Canopy Position |
|--------|-------------------------------|----------------------|-----------------|
| DISA10 | <i>Diospyros sandwicensis</i> | Lama                 | Upper           |
| PSHA3  | <i>Psychotria hawaiiensis</i> | Kopiko 'ula          | Upper           |
| BOTI   | <i>Bobea timonioides</i>      | 'ahakea              | Upper           |
| DOKU   | <i>Doodia kunthiana</i>       | Kunth's hacksaw fern | Lower           |

Description

Mid-development of closed canopy forest.

## Maximum Tree Size Class

None

|                |           |                                  |
|----------------|-----------|----------------------------------|
| <b>Class D</b> | <b>13</b> | <b>Late Development 1 - Open</b> |
|----------------|-----------|----------------------------------|

### *Indicator Species*

| Symbol | Scientific Name        | Common Name          | Canopy Position |
|--------|------------------------|----------------------|-----------------|
| CYAN6  | Cyanea angustifolia    | 'aku                 | Low-Mid         |
| POSA11 | Pouteria sandwicensis  | 'ala'a               | Upper           |
| DILI   | Dicranopteris linearis | Old world forkedfern | Low-Mid         |
| DISA6  | Dianella sandwicensis  | 'uki'uki             | Lower           |

### Description

This successional stage is a result of agriculture, mixed fire, and storms which open the diverse canopy of stage E but is not stand-replacing.

## None

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### Indicator Species

| Symbol | Scientific Name              | Common Name             | Canopy Position |
|--------|------------------------------|-------------------------|-----------------|
| CRMA8  | <i>Cryptocarya mannii</i>    | Holio                   | Upper           |
| ANPU2  | <i>Antidesma pulvinatum</i>  | Hame                    | Upper           |
| NEPO   | <i>Nesoluma polynesianum</i> | Keahi                   | Upper           |
| PLFO2  | <i>Pleomele forbesii</i>     | Waianae range hala pepe | Upper           |

Description

This class is representative of a closed canopy very diverse forest.

Maximum Tree Size Class

None

### Model Parameters

## Deterministic Transitions

| From Class | Begins at (yr) | Succeeds to | After (years) |
|------------|----------------|-------------|---------------|
| Early1:ALL | 0              | Mid1:OPN    | 20            |
| Mid1:OPN   | 21             | Mid1:CLS    | 100           |
| Mid1:CLS   | 101            | Late1:CLS   | 200           |
| Late1:OPN  | 201            | Late1:CLS   | 230           |
| Late1:CLS  | 201            | 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 2                | Mid1:OPN              | Mid1:OPN            | 0.001                   | 1000                  | No                                                  | 0                            |
| Optional 1                | Mid1:OPN              | Early1:ALL          | 0.001                   | 1000                  | Yes                                                 | 0                            |
| Mixed Fire                | Mid1:OPN              | Mid1:OPN            | 0.002                   | 500                   | No                                                  | 0                            |
| Wind or Weather or Stress | Mid1:OPN              | Mid1:OPN            | 0.005                   | 200                   | No                                                  | 0                            |
| Optional 2                | Mid1:CLS              | Mid1:OPN            | 0.001                   | 1000                  | Yes                                                 | 0                            |
| Optional 1                | Mid1:CLS              | Early1:ALL          | 0.001                   | 1000                  | Yes                                                 | 0                            |
| Mixed Fire                | Mid1:CLS              | Mid1:OPN            | 0.002                   | 500                   | Yes                                                 | 0                            |
| Wind or Weather or Stress | Mid1:CLS              | Mid1:OPN            | 0.005                   | 200                   | Yes                                                 | 0                            |
| Optional 2                | Late1:OPN             | Late1:OPN           | 0.001                   | 1000                  | No                                                  | 0                            |
| Optional 1                | Late1:OPN             | Early1:ALL          | 0.001                   | 1000                  | Yes                                                 | 0                            |
| Mixed Fire                | Late1:OPN             | Late1:OPN           | 0.002                   | 500                   | No                                                  | 0                            |

|                           |           |            |       |      |     |   |
|---------------------------|-----------|------------|-------|------|-----|---|
| Wind or Weather or Stress | Late1:OPN | Late1:OPN  | 0.005 | 200  | No  | 0 |
| Optional 2                | Late1:CLS | Late1:OPN  | 0.001 | 1000 | Yes | 0 |
| Optional 1                | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire                | Late1:CLS | Late1:OPN  | 0.002 | 500  | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:OPN  | 0.005 | 200  | Yes | 0 |

### Optional Disturbances

Optional 1: lava flow

Optional 2: agriculture

### References

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 ).

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.