

A BASELINE ASSESSMENT OF FOREST COMPOSITION, STRUCTURE, AND HEALTH IN THE HAWAII EXPERIMENTAL TROPICAL FORESTS

Robert R. Pattison, Andrew N. Gray, and Lori Tango¹

Abstract—The US Forest Service’s Forest Inventory and Analysis (FIA) Program of the Pacific Northwest (PNW) Research Station has been working in the Hawaiian islands since 2010. During this time they have installed a base grid of field plots across all of the Hawaiian Islands and an intensified sample of two experimental forests, the Laupāhoehoe and Pu‘u Wa‘awa‘a units of the Hawaii Experimental Tropical Forests (HETF). These intensified plots used the standard P3 FIA plot design but included a number of additional measurements that were designed to address forest health issues specific to Hawaiian forests. Preliminary analysis of all of the data provides important insights into the structure and composition of the forests including tree damages, regeneration (seedling recruitment), understory composition, and the presence of invasive species. Results of this initial inventory effort and a preliminary analysis will be presented. Highlights include key differences in the extent of invasive species and ungulate damage across plots in these different forests.

INTRODUCTION

In 2010 the FIA program of the Pacific Northwest Research Station started the first inventory of the state of Hawai‘i. This inventory is set to be completed in the fall of 2015. In addition to the establishment of a 1x grid, the FIA program installed two panels of 2x plots on Hawaii Island and installed an intensified grid on the experimental forest units of Laupāhoehoe and Pu‘u Wa‘awa‘a. The results of these initial insights into the forested conditions on the experimental forests of Hawaii will be discussed.

STUDY AREA

The Laupāhoehoe experimental forest is located on the northern end of the island of Hawaii. The forest is 12,387 acres in size and ranges from 1,700 feet elevation to 6,100 feet. The average annual

precipitation in this forest is 160 inches per year in the lower regions of the forest and 60 to 100 inches at higher elevations. The Pu‘u Wa‘awa‘a experimental forest unit is located on the leeward side of Hawaii island and is 38,885 acres in size. The average annual precipitation is near sea level is 10 inches increasing to 47 inches at higher elevations. This experimental forest unit ranges from sea level feet to 6,100 feet.

METHODS

An intensified sampling of the two experimental forest units was conducted with a total of 69 plots proposed to be visited - 32 plots in the Laupāhoehoe Unit and 37 plots in the Pu‘u Wa‘awa‘a Unit. All installed plots had standard P3 protocols with modifications made to include a macro plot for trees > 24”, a comprehensive tree species list, additional branching, rooting, and crown measurements, and the inclusion of special interest species ranging from invasive plants, pathogens, and feral pig damage.

¹ Research Ecologist (RRP), Pacific Northwest Research Station USDA Forest Service, 161 East 1st Ave, Door 8, Anchorage, AK, 9950; and Research Ecologist (ANG), Pacific Northwest Research Station USDA Forest Service, 3200 SW Jefferson Way, Corvallis, OR, 97331. Hawaii Coordinator (LT) Institute of Pacific Islands Forestry, 60 Nowelo Street, Hilo, HI, 96720. RRP is corresponding author: to contact, call (907) 743-9414 or e-mail at rrpattison@fs.fed.us

RESULTS AND DISCUSSION

Of the 69 planned plots, a combined total of 66 plots were installed. Three plots in the Laupāhoehoe HETF were not measured due to remoteness (*i.e.*, crew was unable to safely access plots). All of the proposed 37 plots at Pu‘u Wa‘awa‘a HETF were installed and measured. Twenty of the 37 plots were considered accessible forest land, and the remaining 17 plots were considered non-forest.

A total of 4,082 and 1,764 live and dead trees and saplings were measured on FIA plots in the Laupāhoehoe and Pu‘u Wa‘awa‘a HETF units, respectively. The native species ‘ōhi‘a (*Metrosideros polymorpha*) was the most abundant species on both of these forest units.

Forests at the Laupāhoehoe HETF tended to be dominated by moderate-sized trees with approximately 54% of all trees ranging in DBH from 5.0 to 9.9 inches. The average sapling height was 23 ft, the average tree heights from subplot trees was 34 feet. The tallest tree on an FIA plot in this Unit was a 131 ft tall ‘ōhi‘a (*M. polymorpha*) with a DBH of 72.3 inches. Forest stands at the Pu‘u Wa‘awa‘a HETF were dominated by moderate-sized trees with approximately 63% of all trees measured on plots falling into the 5.0 to 9.9 inches in diameter size class. There were no trees with diameters larger than 40.0 inches in the Pu‘u Wa‘awa‘a Unit. For the Pu‘u Wa‘awa‘a Unit the average sapling and tree heights were 15 ft, and 35 ft respectively. The tallest tree on an FIA plot in this unit was a 95 ft tall ‘ōhi‘a (*M. polymorpha*) with a DBH of 21.1 inches.

Most live trees in the Laupāhoehoe HETF supported light to heavy epiphyte loading, while only a few species of live trees in the Pu‘u Wa‘awa‘a HETF supported epiphytes. Light epiphyte loading included trees that had epiphytes present but occupied less than 50 percent of branches or bole and heavy epiphyte loading included trees that had greater than 50 percent of the branches or bole loaded with epiphytes.

Approximately nine percent of trees measured in the Laupāhoehoe HETF had some form of visible damage. The primary damage types observed here were broken branches, dead tops, and open wounds. At the Pu‘u Wa‘awa‘a HETF approximately 18 percent of trees measured had some form of visible damage. The primary damage types reported here were broken or dead branches, dead tops, and vines in the crown.

In the Laupāhoehoe HETF, 19 different seedling species were tallied on plots. The invasive strawberry guava (*Psidium cattleianum*) was by far the most abundant seedling tallied in the Laupāhoehoe HETF with four low elevation (2100 to 2800 ft) FIA plots in the Natural Area Reserve containing at least 50 seedlings on each plot. In the Pu‘u Wa‘awa‘a HETF, six different seedling species were tallied on plots. The native ‘ōhi‘a (*M. polymorpha*) and māmane (*Sophora chrysophylla*) were the most abundant seedlings in the Pu‘u Wa‘awa‘a HETF.

Common understory seedling and sapling sized tree species by estimated cover were the native tree fern hāpu‘u pulu (*Cibotium glaucum*), ‘ōhi‘a (*M. polymorpha*), ‘ōlapa (*C. trigynum*), kolokolo mokihana (*Melicope clusiifolia*), and the non-native shamel ash (*Fraxinus uhdei*). There were 19 different fern, forb, graminoid, shrub, and vine species in the understory on plots in the Laupāhoehoe HETF. In the Pu‘u Wa‘awa‘a HETF, six species of seedling and sapling sized trees (excluding invasive species) were tallied. The common understory seedling and sapling sized tree species by estimated cover area in the Pu‘u Wa‘awa‘a HETF were all native: ‘ōhi‘a (*M. polymorpha*), māmane (*S. chrysophylla*), and koa (*Acacia koa*), naio (*Myoporum sandwicense*), and lama (*Diospyros sandwicensis*). Twenty one fern, forb, graminoid, and shrub species were found in the Pu‘u Wa‘awa‘a HETF. Common non-tree understory species included non-native grasses: meadow rice grass (*E. stipoides*), kikuyu grass (*Pennisetum clandestinum*), and velvet grass (*Holcus lanatus*).

A list of priority invasive species for Hawai'i was generated through consultations with local experts. The percent cover of these species on each subplot was tallied separately. There were eight priority invasive species tallied on the Laupāhoehoe HETF. Strawberry guava (*P. cattleianum*), Koster's curse (*Clidemia hirta*), and kahili ginger (*Hedychium gardnerianum*) were among the most common species. There were five priority invasive species tallied on Pu'u Wa'awa'a HETF. Fountain grass (*Pennisetum setaceum*), lantana (*Lantana camara*), and banana poka (*Passiflora mollissima*) were the most common invasive species on the Pu'u Wa'awa'a HETF.

Noticeable pig damage to the ground (wallows) and/or ground vegetation (rubbing) on plot was estimated as a percent of each subplot. Pig damage was observed on 29 plots in the Laupāhoehoe HETF with an average area of impact of 8%. Pig damage was observed on 19 plots in the Pu'u Wa'awa'a HETF; with an average area of impact of only 1-2%.