Purdue University Site Update

NSF Center for Advanced Forest Systems
Kohala Coast, Hawai‘i, June 2025

Hardwood Tree Improvement and Regeneration Center (HTIRC)

- Formed in 1998
- US Forest Service NRS – Purdue

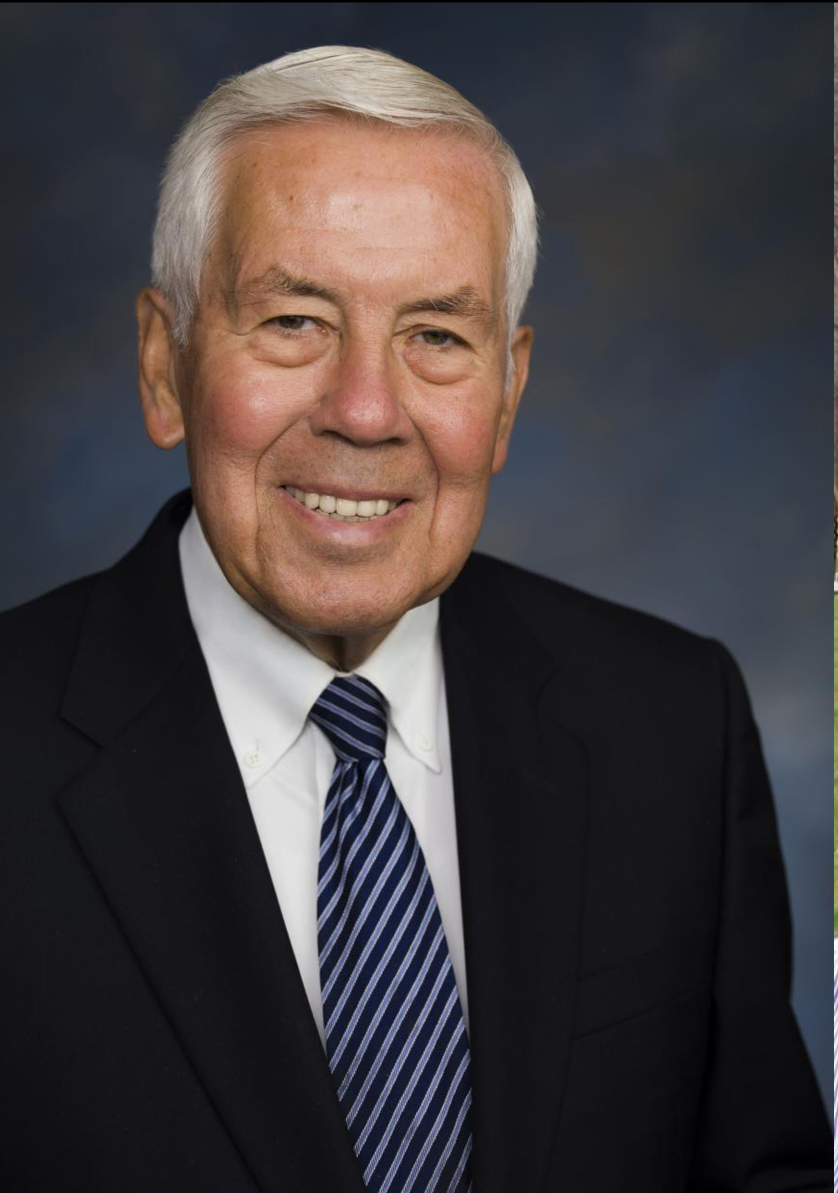
Hardwood Tree Improvement and Regeneration Center (HTIRC)

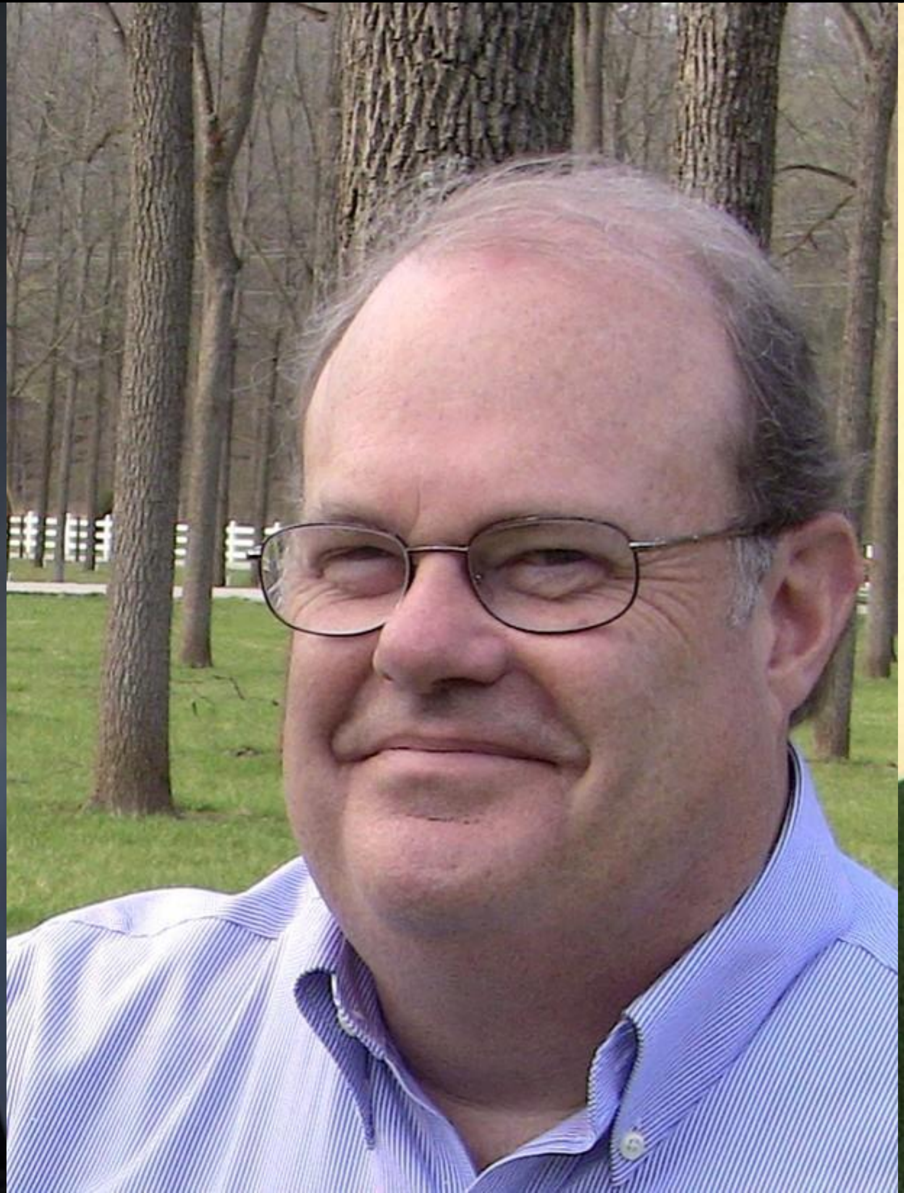
- A collaborative partnership between USDA Forest Service NRS and Purdue University — focused on the advancement of hardwood-focused research, development, and technology transfer in the Central Hardwood Forest Region

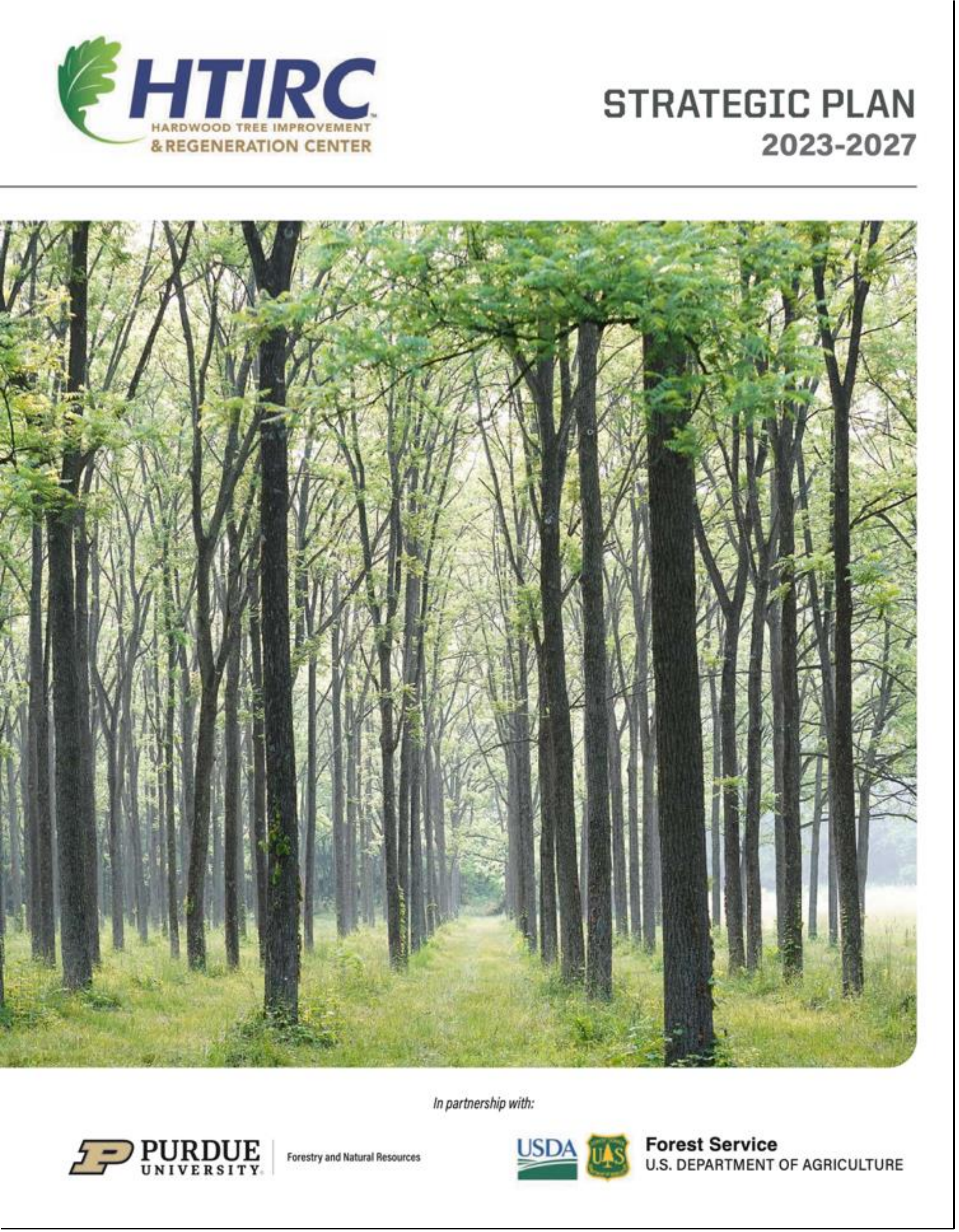
HTIRC™
HARDWOOD TREE IMPROVEMENT
& REGENERATION CENTER



HTIRC Legacy





www.htirc.org

HTIRC and NSF CAFS

- Opportunity to work collaboratively with other CAFS University sites to test theory, concepts, and technology with application to a unique forest type (high-value hardwoods)

HTIRC™

CAFS Center for Advanced Forestry Systems

NSF

CAFS Phase I: Project 10.33

Use of Stable Isotopes to Trace the Fate of Applied Nitrogen in Forest Plantations to Evaluate Fertilizer Efficiency and Ecosystem Impacts

Lead Institutions: University of Washington, Greenwood Resources, Port Blakely Co., Virginia Tech, North Carolina State University, Purdue University

Article

Unde
Plant
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Jay E. Ray

Forest Ecology and Management 376 (2016) 247–255

ELSEVIER

Ammonia volat
efficiency fertil
of the southerr

Jay E. Raymond *, T
Virginia Tech, Department of Fo

Forest Ecology and Management 427 (2018) 317–324

Contents lists available at ScienceDirect

Forest Ecology and Management

ELSEVIER

FOREST ECOLOGY AND MANAGEMENT
SCIENCE TO SUSTAIN THE WORLD'S FORESTS

Enhanced efficiency
Pacific Northwest D

Stephani Michelsen-Corre
University of Washington, School of Environ

forests

MDPI

Article

Nitrogen Recovery from Enhanced Efficiency Fertilizers and Urea in Intensively Managed Black Walnut (*Juglans nigra*) Plantations

Joshua L. Sloan [1,†], Francis K. Salifu [2] and Douglass F. Jacobs [1,*]

Environmental and Experimental Botany 231 (2025) 106094

Contents lists available at ScienceDirect

Environmental and Experimental Botany

journal homepage: www.elsevier.com/locate/envexpbot

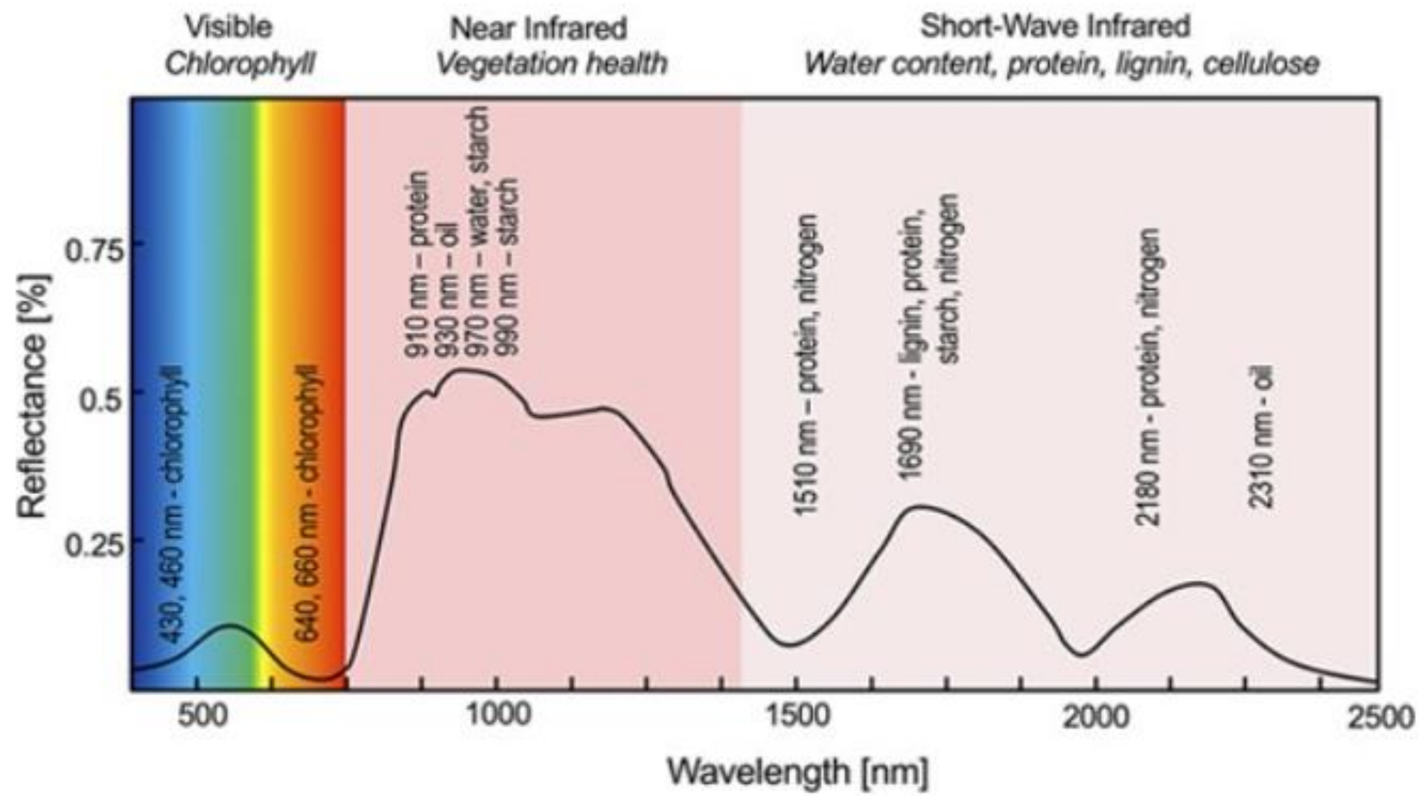
Research paper

Drought memory expression varies across ecologically contrasting forest tree species

Andrei Toca [a,e,1], Carlos A. Gonzalez-Benecke [c,2], Andrew S. Nelson [b,3], Douglass F. Jacobs [a,d,*,4]

[a] Hardwood Tree Improvement and Regeneration Center, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907, USA
[b] Center for Forest Nursery and Seedling Research, College of Natural Resources, University of Idaho, Moscow, ID 83844, USA
[c] Department of Forest Engineering, Resources and Management, College of Forestry, Oregon State University, Corvallis, OR 97331, USA
[d] School for Forest Management, Swedish University of Agricultural Sciences, Skinnskatteberg 739 21, Sweden
[e] John T. Harrington Forestry Research Center, New Mexico State University, Mora, NM, USA

Can spectral phenotyping be used to assess abiotic and biotic stresses in hardwoods?




PURDUE

Butternut canker disease resistance

pure butternut

Japanese walnut

Offspring:
%50:50 JC: JA

Backcross:
>%75 JC or JA

Photos: Aziz Ebrahimi

Genotyping: pure and hybrid butternut

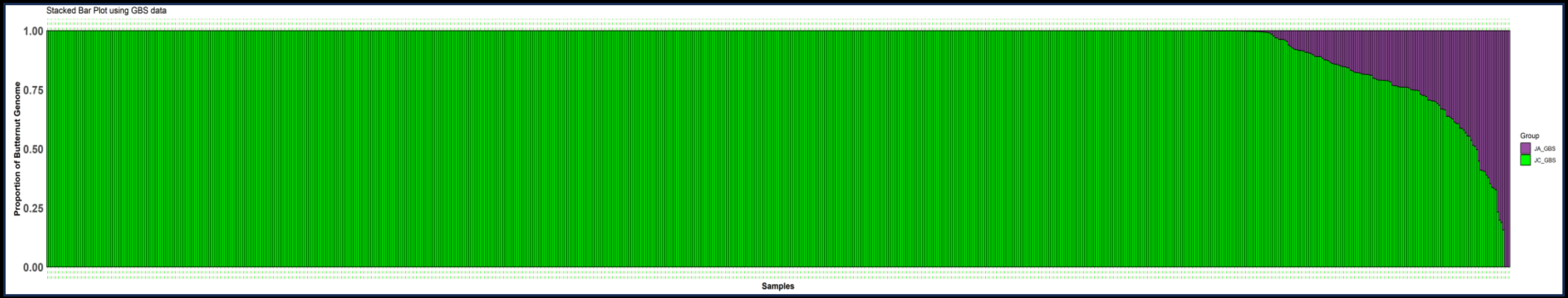


Figure credit: Aziz Ebrahimi

Phenotyping: 5-point rating system for BCD

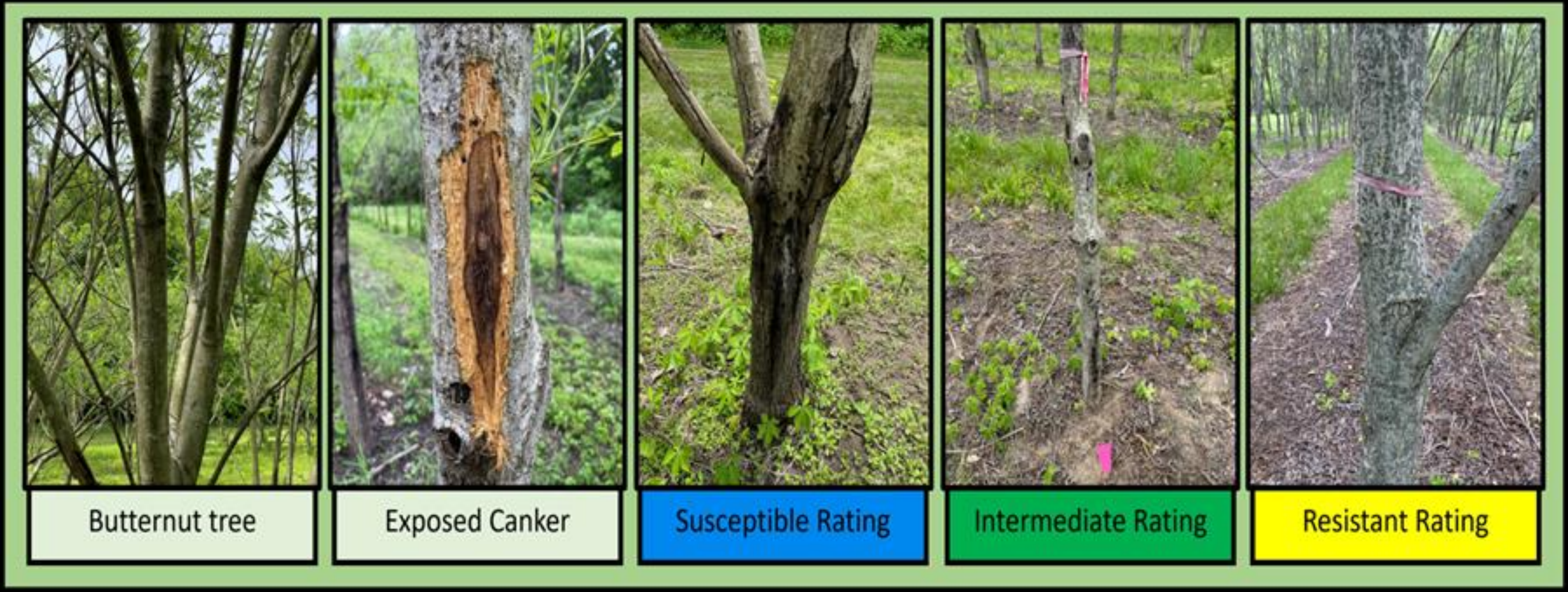
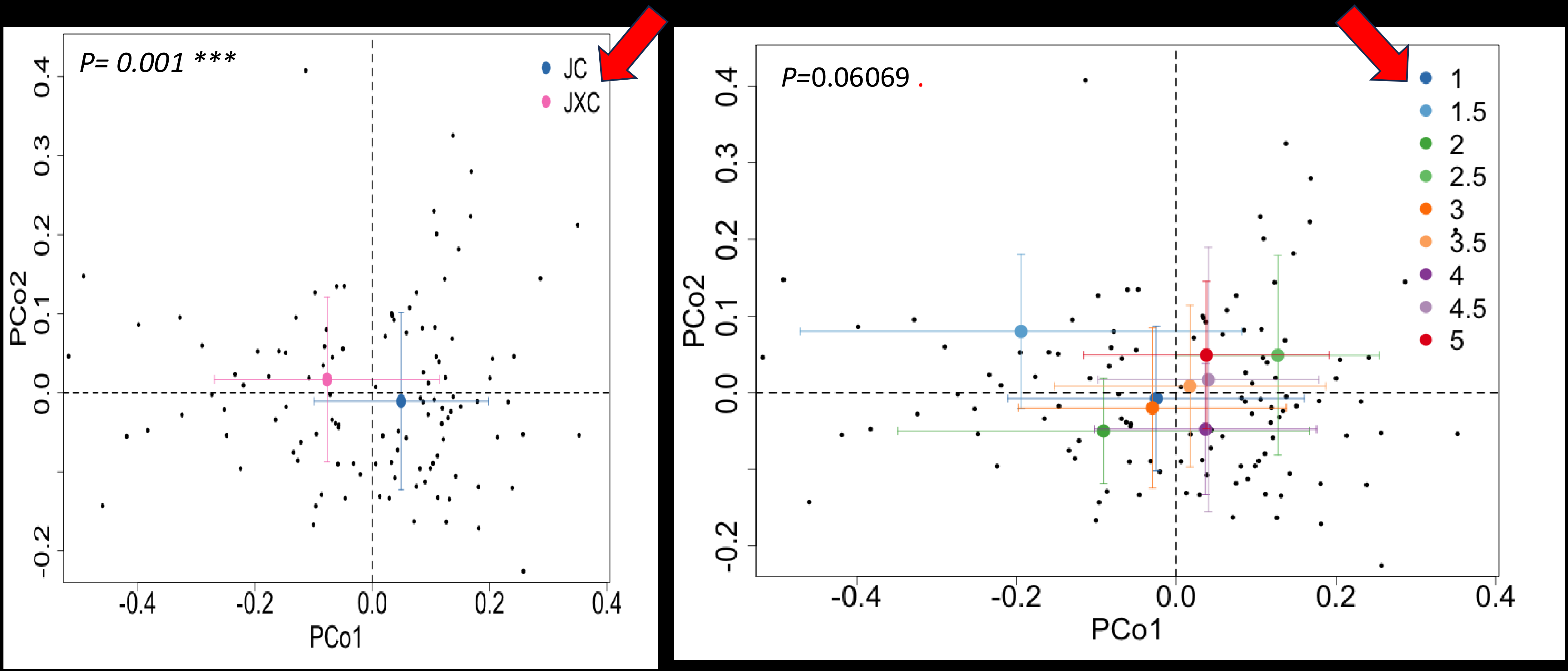


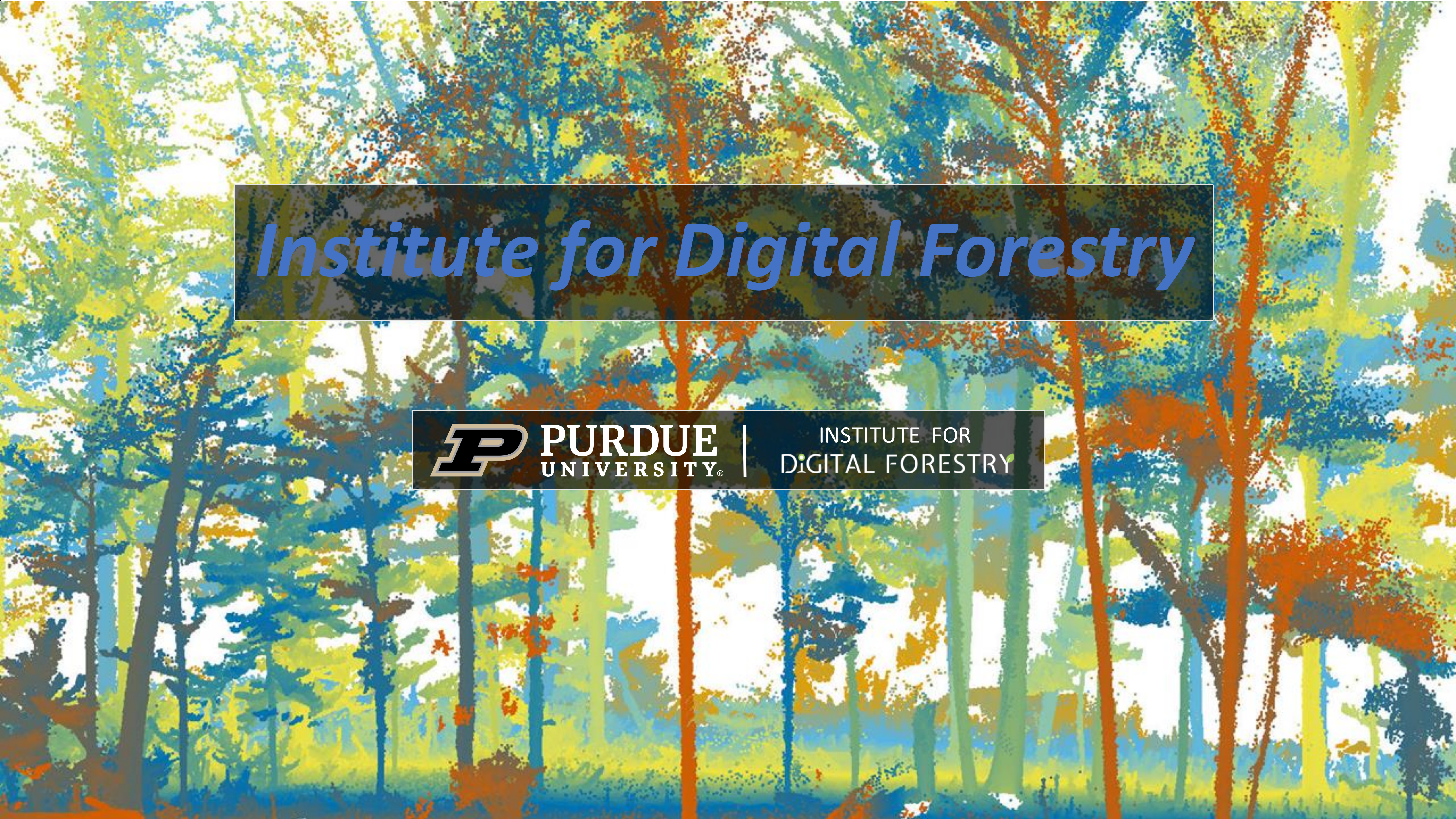
Figure credit: Jonathan Shimizu and Michael Holt

Spectral data has potential to distinguish among different paternal groups and BCD ratings



Principal Coordinate Analysis using Euclidian distance of spectral data (350 – 2500 nm) measured in July

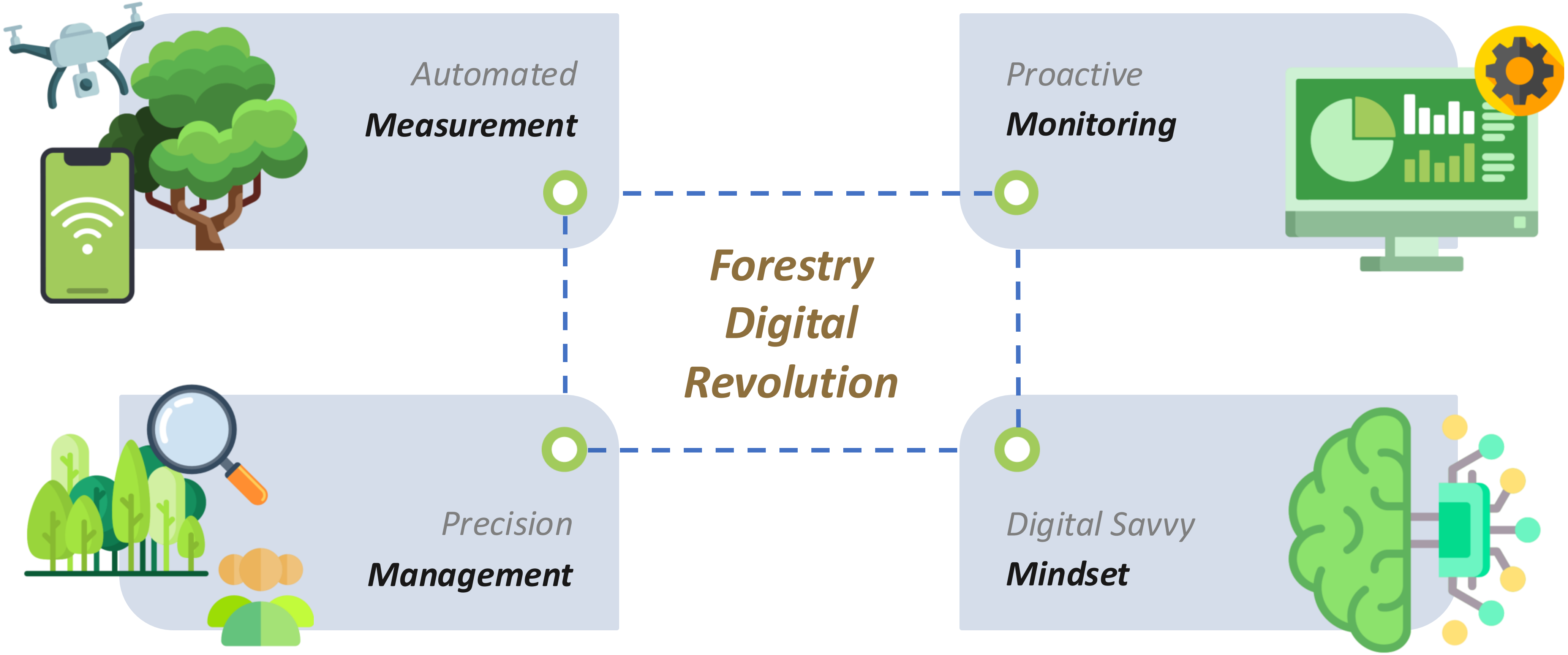
Institute for Digital Forestry



PURDUE UNIVERSITY | INSTITUTE FOR DIGITAL FORESTRY

MOONSHOT GOAL

Measuring every tree on the planet



Purdue University — Institute for Digital Forestry

Digital Forestry — Measuring Every Tree on the Planet

People

College · Department · Name

36 PIs, **11** staff, **7** postdoc, **>50** grads, **>20** undergrads, **3** research assistant professors

Agriculture

- **FNR**
  - *Director* Fei, Songlin
  - Gazo, Rado
  - Jacobs, Douglass
  - Jenkins, Mike
  - Saunders, Michael
  - Shao, Guofan
  - Wang, Jianmin
  - Zhao, Ma
- **AGEC**
  - Mallory, Mindy
- **FNR/ENTM**
  - Couture, John
  - Ginzel, Matt
- **FNR/EEE**
  - Hardiman, Brady
- **FNR/BPP**
  - Furze, Morgan
- **ABE**
  - Jin, Jian

USFS

- **NRS**
  - Conrad, Anna

Engineering

- **CE**
  - *Co-Director* Habib, Ayman
  - Crawford, Melba
  - Jung, Jinha
- **ME**
  - Zhang, Song
- **IE**
  - She, Yu
- **AAE**
  - Garrison, James
- **ECE**
  - Zoltowski, Carla

Science

- **CS**
  - Aliaga, Daniel
  - Benes, Bedrich
  - Bera, Aniket
  - Yeh, Raymond
- **STAT**
  - Ward, Mark
  - Zhang, Tonglin

Liberal Arts

- **AD**
  - Qian, Zhenyu Cheryl

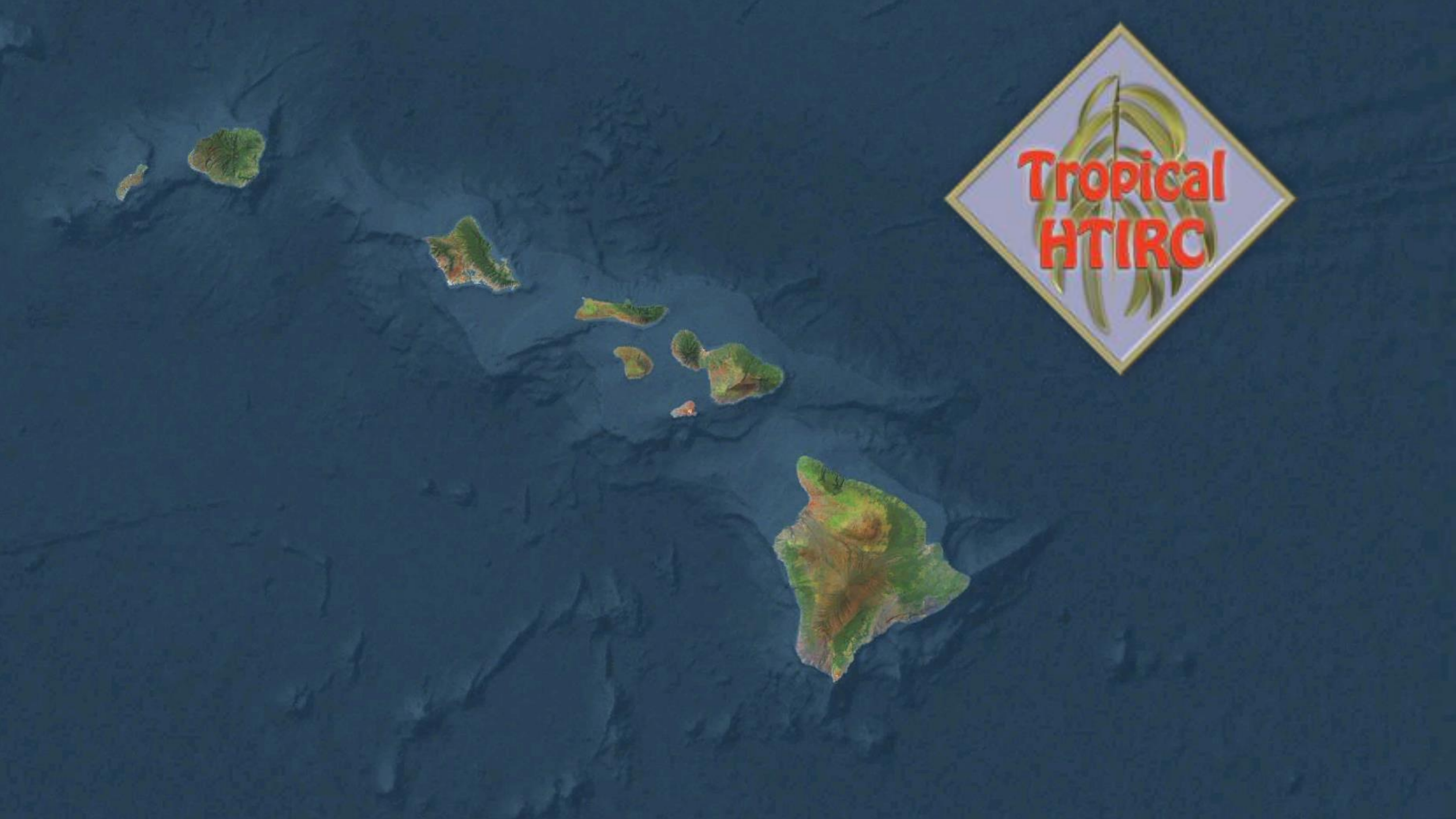
Polytech

- **ODI**
  - Brunswicker, Sabine
- **CGT**
  - Chen, Yingjie Victor
- **CIT**
  - Yang, Baijian Justin
- **ATT**
  - Hupy, Joseph

Libraries

- **LIBR**
  - Kong, Ningning Nicole
  - Shao, Gang


Institute for
Digital Forestry
at Purdue University


Tropical
HTIRC

Brief History of Hawai‘i Forests

- Beginning in ~1200 AD and accelerating with Western contact: native ecosystems replaced by agriculture, ranching, urbanization
- More than half of native ecosystems converted to non-native vegetation
- Large-scale restoration began in 1970s and 80’s >> upland grasses to native *Acacia koa*

Tropical HTIRC History

- Hawaii Tropical Forest Recovery Act – 1992
- Tropical HTIRC – formed in 2010

RICHARD G. LUGAR
INDIANA

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WASHINGTON, DC 20510
202-224-4814

http://lugar.senate.gov

COMMITTEES:
FOREIGN RELATIONS, RANKING MEMBER
AGRICULTURE, NUTRITION, AND FORESTRY

United States Senate

WASHINGTON, DC 20510–1401

June 23, 2010

The Honorable Daniel K. Inouye
United States Senator
722 Hart Senate Office Building

Dear Senator Inouye:

I was pleased to learn of your interest in the Hardwood Tree Improvement and Regeneration Center (HTIRC), located in West Lafayette, Indiana, and their recent work involving Hawaiian Acacia Koa trees.

I have enclosed a copy of a letter that I received from Jay T. Akridge, Dean of the School of Agriculture at Purdue University that highlights the university's support of and interest in elevation of the HTIRC as a national center within the Forest Service budgeted programs.

Sincerely,

Richard G. Lugar
United States Senator

Tropical Hardwood Tree Improvement & Regeneration Center

A collaborative research and extension center for tropical tree breeding and silviculture

Cooperators

NM State University

Purdue University

University of Hawai'i

Forest Service U.S. Department of Agriculture

Hawaiian Home Lands Trust

USDA Natural Resources Conservation Service

HARC

Forestry and Wildlife Hawaii

Forest Solutions Inc.

Hāloa ʻĀina Royal Hawaiian Sandalwood

University of Alberta

Hawai'i Forest Industry Association Since 1989

The Nature Conservancy

Parker Ranch® est. 1847

College of Tropical Ag and Human Resources University of Hawai'i at M

Paniolo Tonewoods Hawaii

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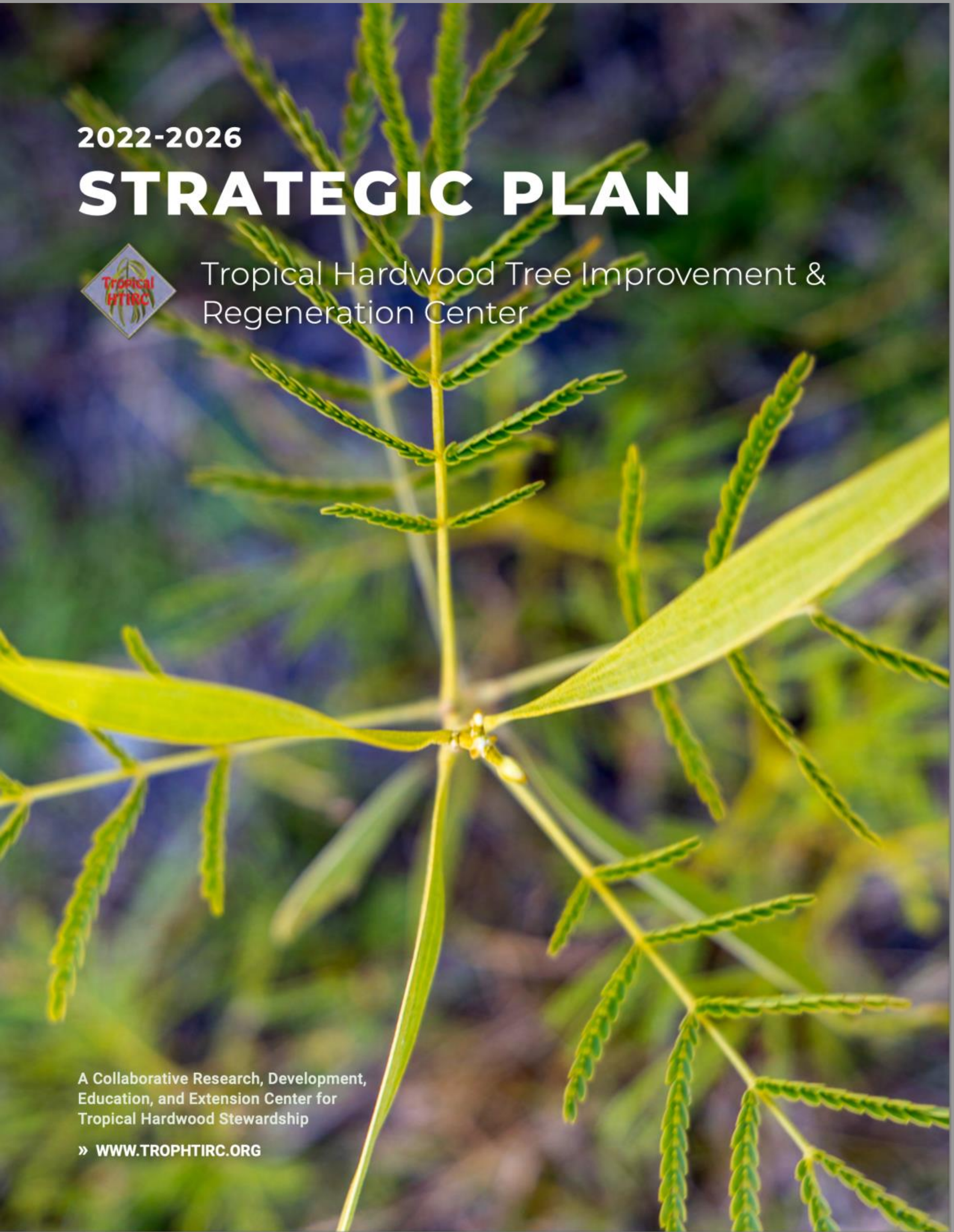
Kealakekua Mountain Reserve | cō·impact

Akaka Foundation for Tropical Forests

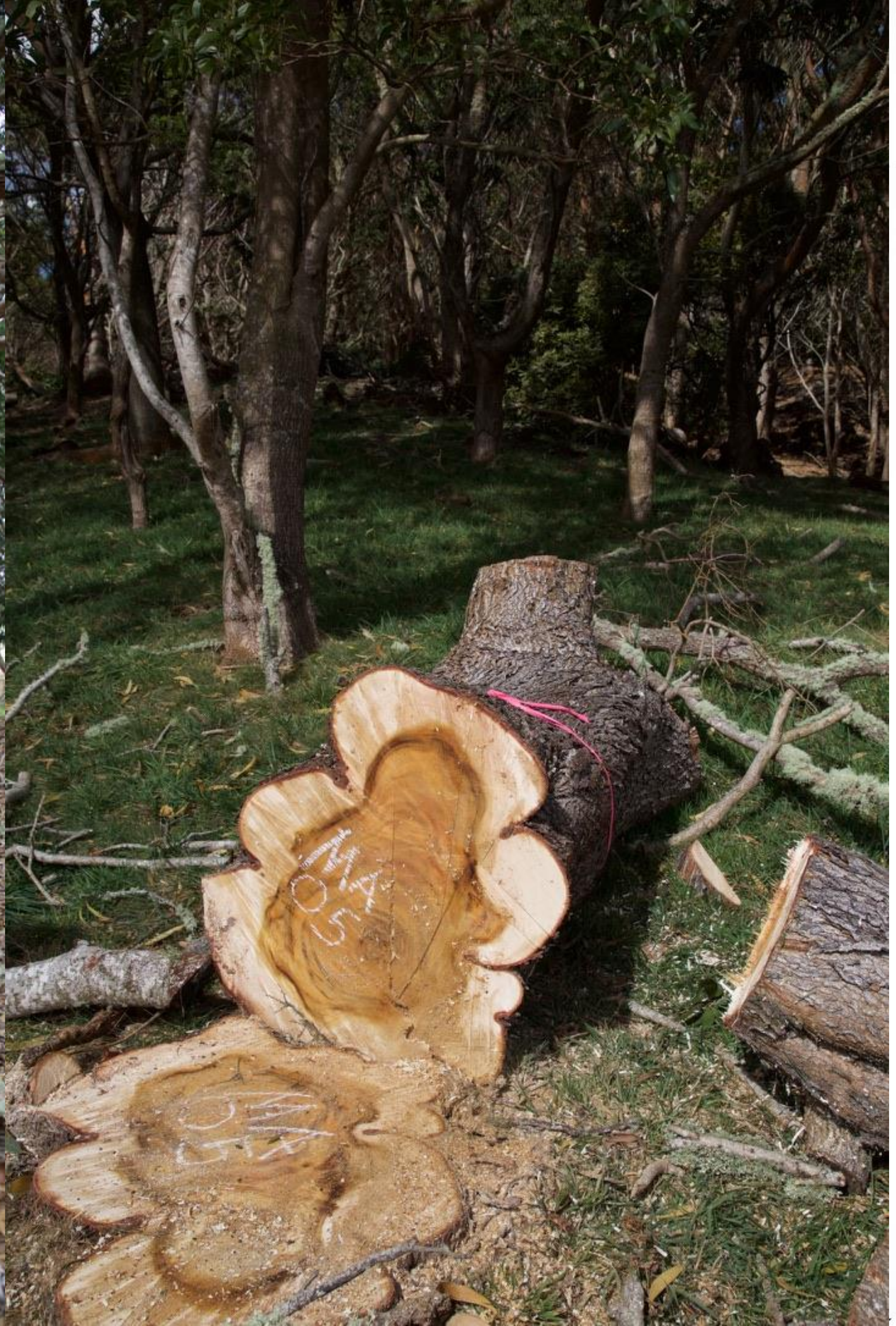

2022-2026
STRATEGIC PLAN
Tropical HTIRC
Tropical Hardwood Tree Improvement & Regeneration Center
A Collaborative Research, Development, Education, and Extension Center for Tropical Hardwood Stewardship
» WWW.TROPHTIRC.ORG


2023 ANNUAL REPORT
Tropical HTIRC
Tropical Hardwood Tree Improvement & Regeneration Center
www.trophtirc.org


Koa – *Acacia koa* A. Gray



Stock #1699 Stabilized
Curly Hawaiian Koa
www.BurlSource.us

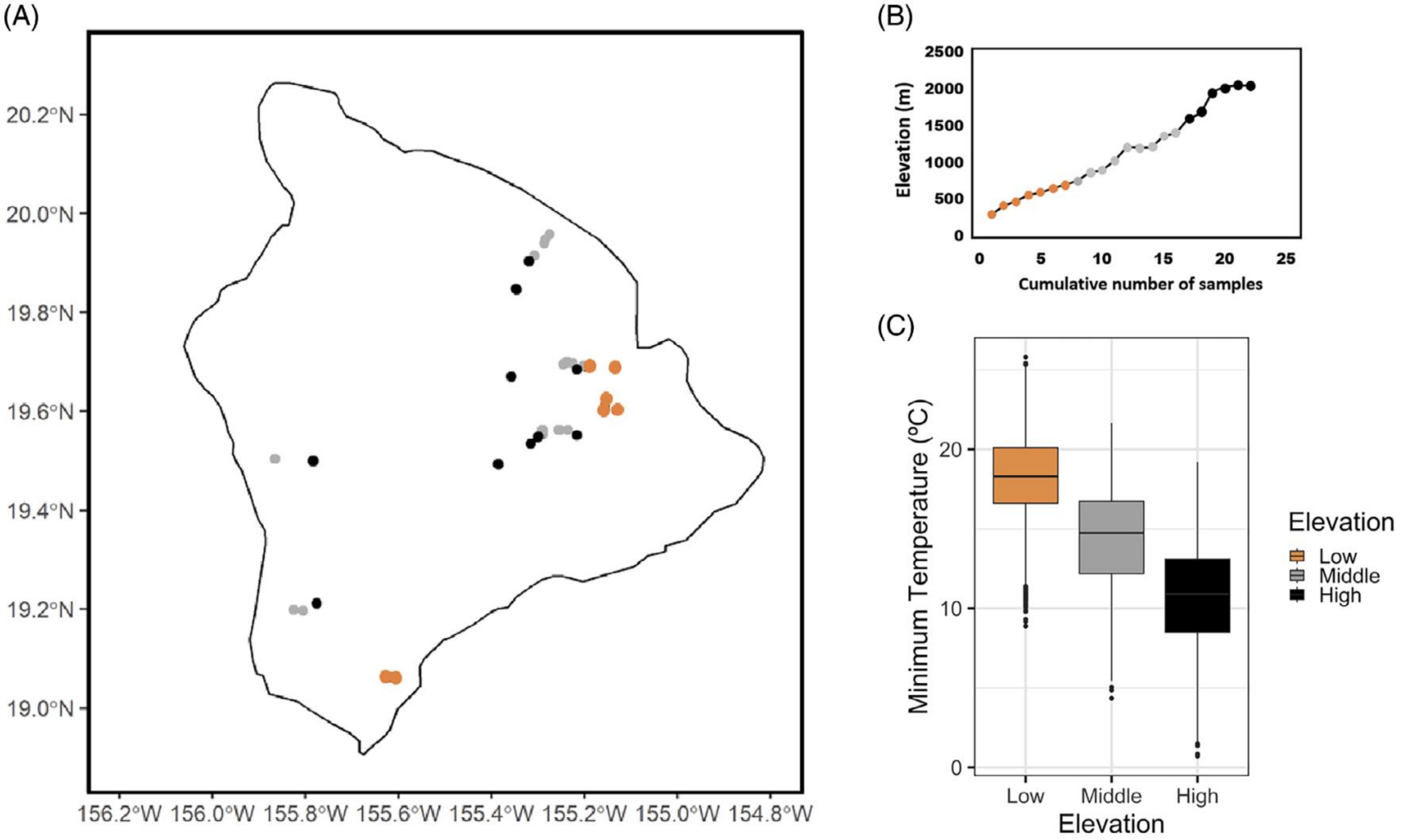


Hakalau NWR, Photo: Andrew Kikuta

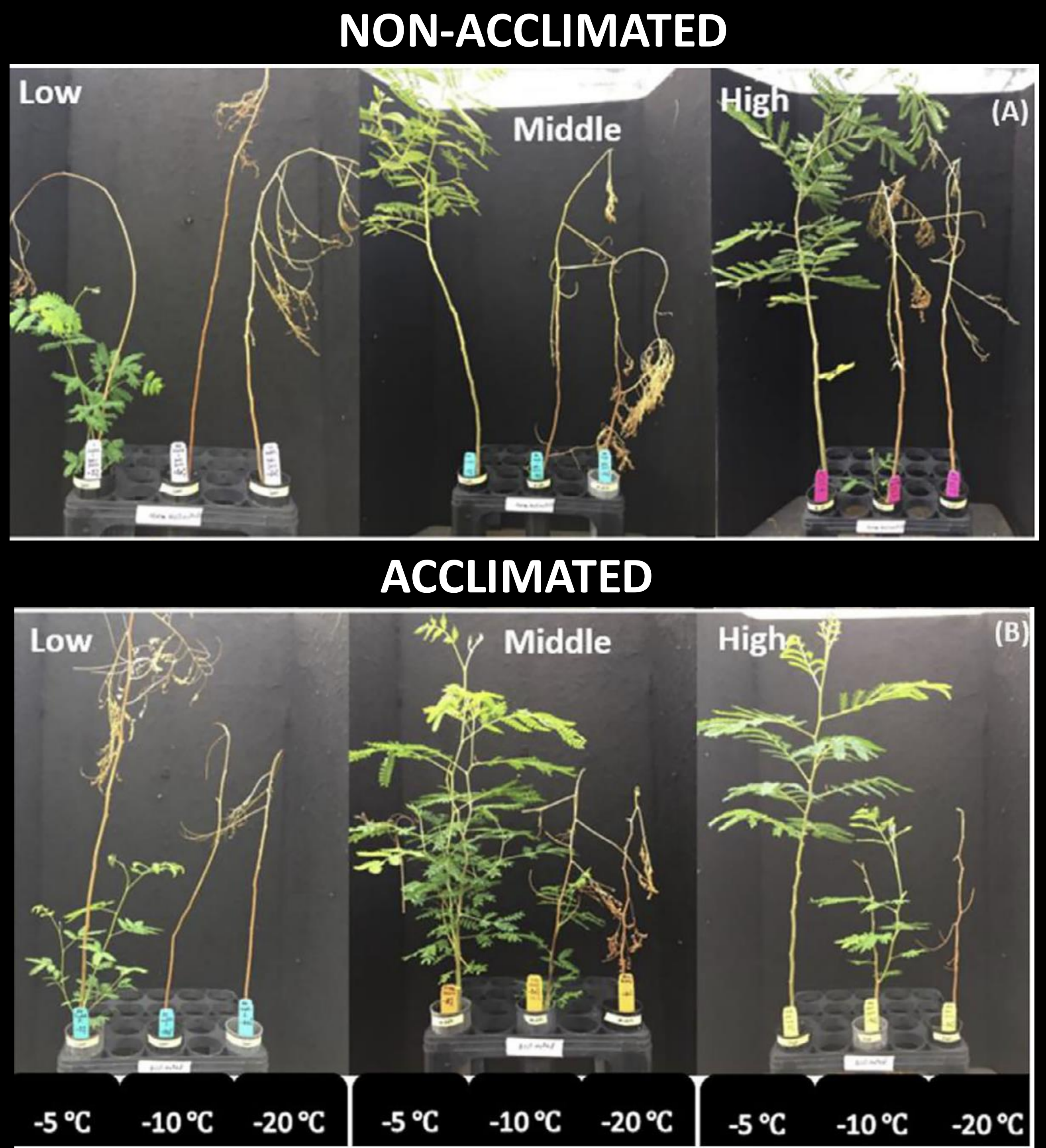
ʻakiapōlāʻau,
Photo: Jack Jeffrey

Adaptative variation in cold tolerance?


Photo: JB Friday


(A)
20.2°N
20.0°N
19.8°N
19.6°N
19.4°N
19.2°N
19.0°N
156.2°W 156.0°W 155.8°W 155.6°W 155.4°W 155.2°W 155.0°W 154.8°W
(B)
Elevation (m)
2500
2000
1500
1000
500
0
0 5 10 15 20 25
Cumulative number of samples
(C)
Minimum Temperature (°C)
20
10
0
Low Middle High
Elevation
Elevation
Low
Middle
High

Ayala et al. 2022, *Forests*
Ebrahimi et al. 2023, *Physiologia Plantarum*



Can koa be grafted?

Table 1--Grafting trials of Acacia koa

Reference number	Grafts	Type of graft[1/]	Sc
1	36	Side veneer	Shoot (juv.
2	30	Side veneer	Root s (juv.
3	29	t-bud	Root s (juv.
4	12	Side veneer	Stem s (juv.
5	6	t-buds	Root s (juv.
6	6	Side veneer	Root s (juv.
7	7	Top cleft	Root s (juv.
8	15	Patch buds	Root s (juv.
9	15	Side veneer	Root s (juv.
10	6	Side veneer	Seedli (10 m
11	10	Top cleft	Seedli (juv.
12	4	Approach	Root s propa
13	8	Side tongue	Seedli (juv.
14	10	Whip	Seedli (matu
15	8	Side veneer	Root s (juv.) 10 mo.

[1/] Descriptive terms follow those by Hartmann and Kester (1975).

[2/] Juv. indicates juvenile or true-leaf stage; mature indicates phyllode stage.

RESULTS AND DISCUSSION

Many of the results of the propagation experiments were negative.

Grafting

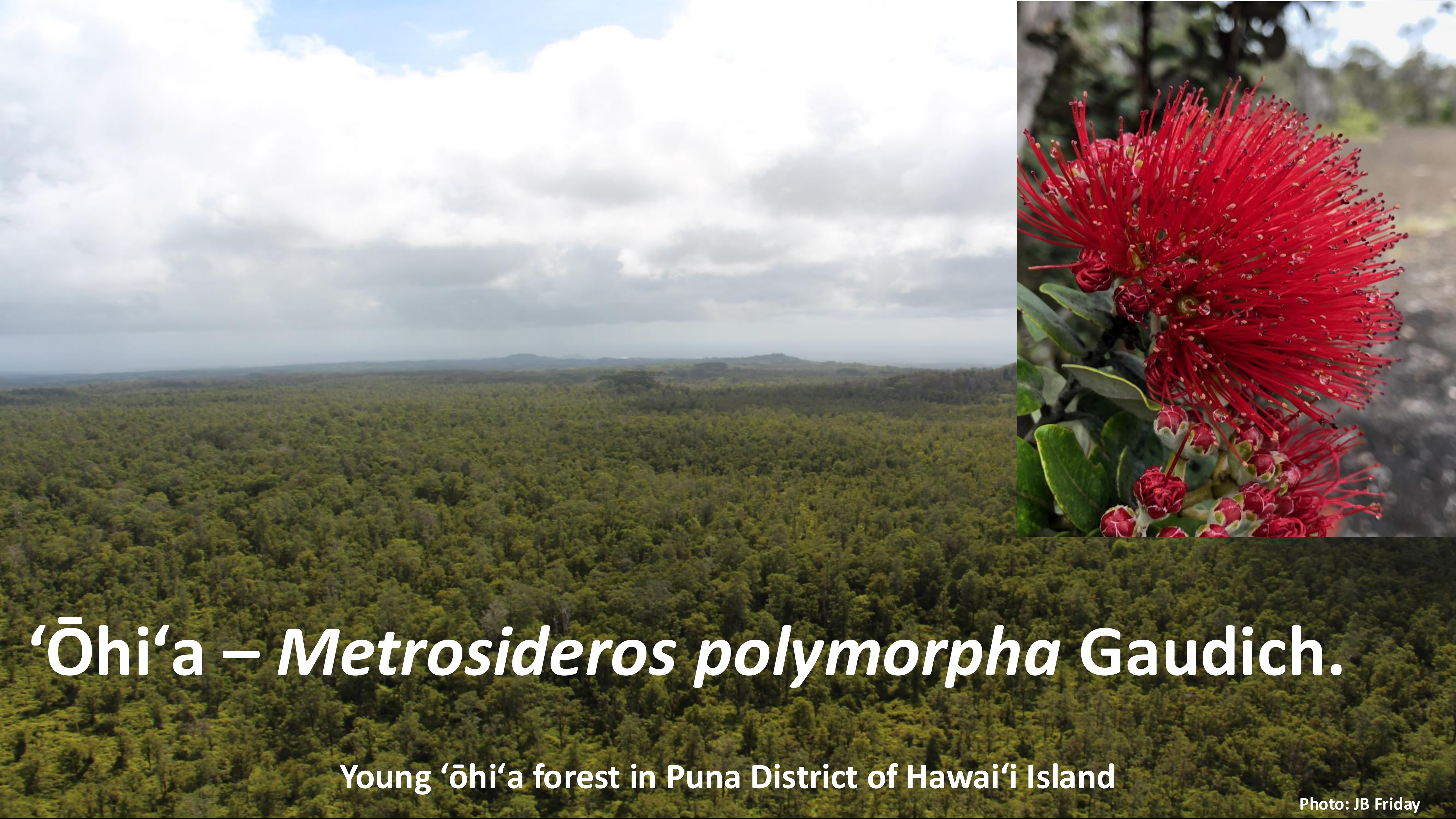
All grafting experiments failed. These experiments included a total of 202 grafts (Table 1). Except for grafts 6, 8, 9, and 11 to 15, all grafts in the table were made by using polyethylene wrappings. The others were made by using raffia and grafting wax.

The basic reason for failure was that koa would not form callus at the grafts. Even when cuttings taken from a root stock were grafted back to the same plant, the grafts failed (Table 1, no. 10). The closest to a successful graft was achieved with an approach graft of a root sucker propagule to a seedling root stock (Table 1, no. 12). This graft held briefly but then broke apart a few days after it was cut free from the potted scion and unwrapped.

Skolmen, 1978


NM
STATE


Photos: JB Friday



‘Ōhi‘a – *Metrosideros polymorpha* Gaudich.

Young ‘ōhi‘a forest in Puna District of Hawai‘i Island

Photo: JB Friday

Lowland wet forest in Puna, Hawai‘i: Before ROD

Photo: JB Friday

Lowland wet forest in Puna, Hawaiʻi: After ROD

Photo: JB Friday

The ‘Ōhi‘a Disease Resistance Program

FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

AKAKA FOUNDATION
FOR TROPICAL FORESTS

USDA
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MANOA
1907

FORESTRY AND WILDLIFE
HAWAII

Tropical
HTIRC

SDAV
UH HILO

PURDUE
UNIVERSITY

HARC

ASU Center for Global Discovery and Conservation Science

KALEHUA
SEED CONSERVATION CONSULTING

Survivor ‘Ōhi‘a Trees

Photo: JB Friday

January 2023 ʻŌhiʻa Clone Trial

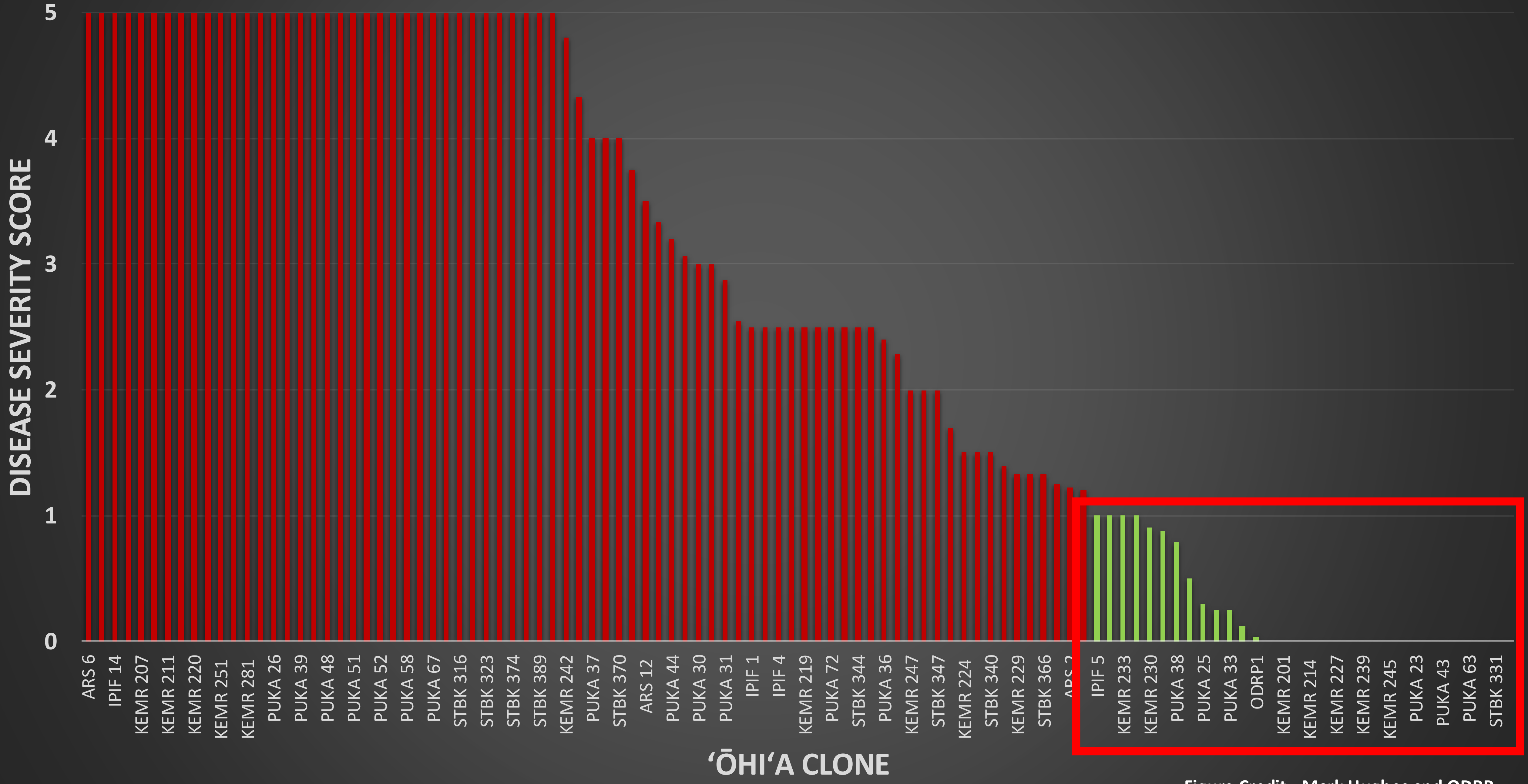
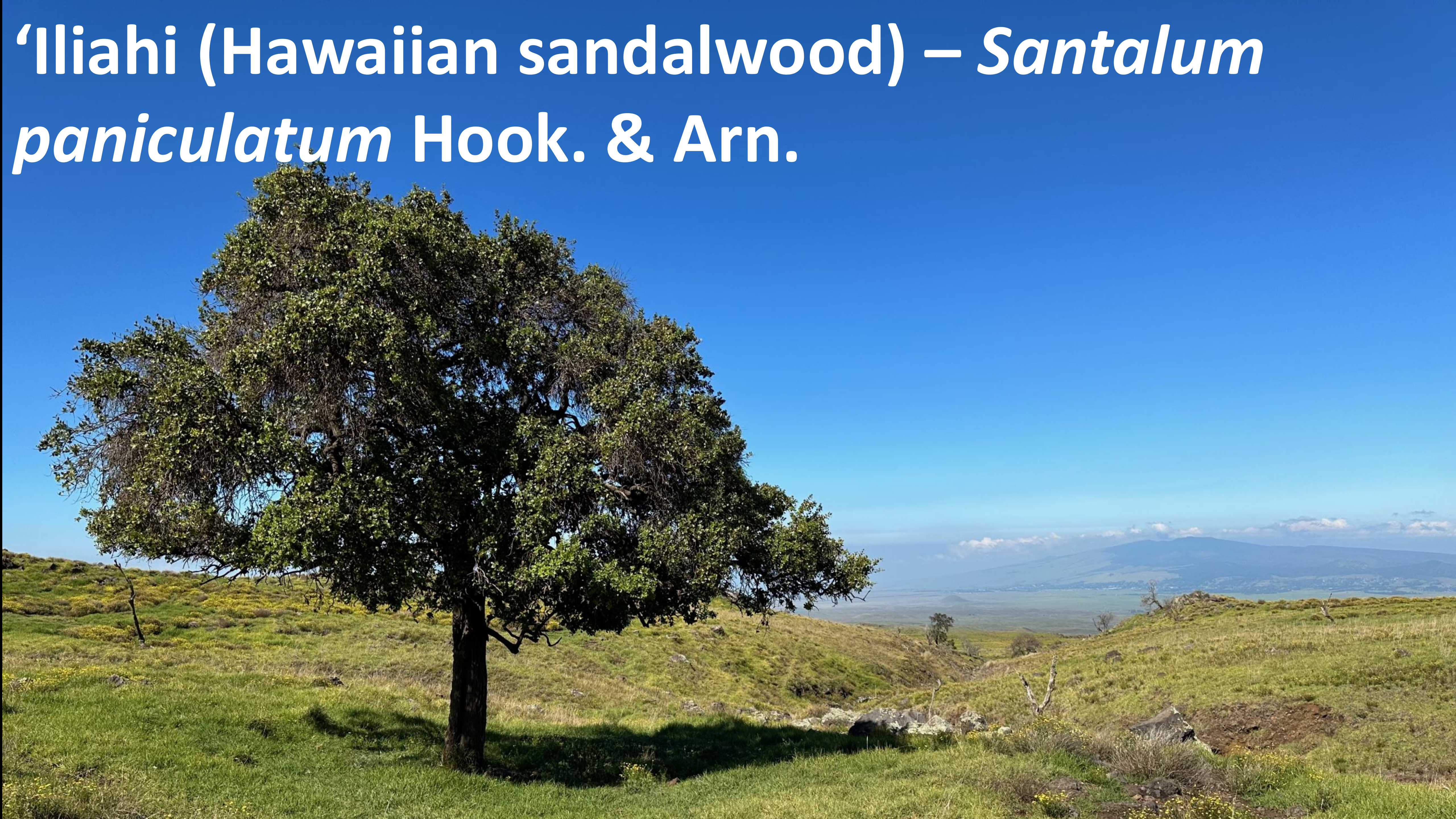


Figure Credit: Mark Hughes and ODRP

‘Iliahi (Hawaiian sandalwood) – *Santalum paniculatum* Hook. & Arn.

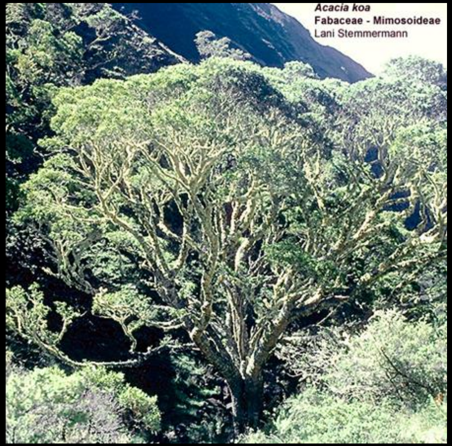


A ship's hull template called *lua na moku ʻiliahi* (sandalwood measuring pit) located adjacent to the Maunahui Forest Reserve on Molokaʻi, Hawaiʻi. It was used to measure an amount of sandalwood that would fit in a ship's hull. When the template was filled, the logs were carried down the mountain to a waiting ship.

Root hemiparasite


Marmot

Potential Hawaiian native hosts



Koa (*Acacia koa*) Legume: Tree

Photo: Tawn Speetjens

‘A‘ali‘i (Dodonaea viscosa) Non-Legume: Tree-shrub

Host suitability

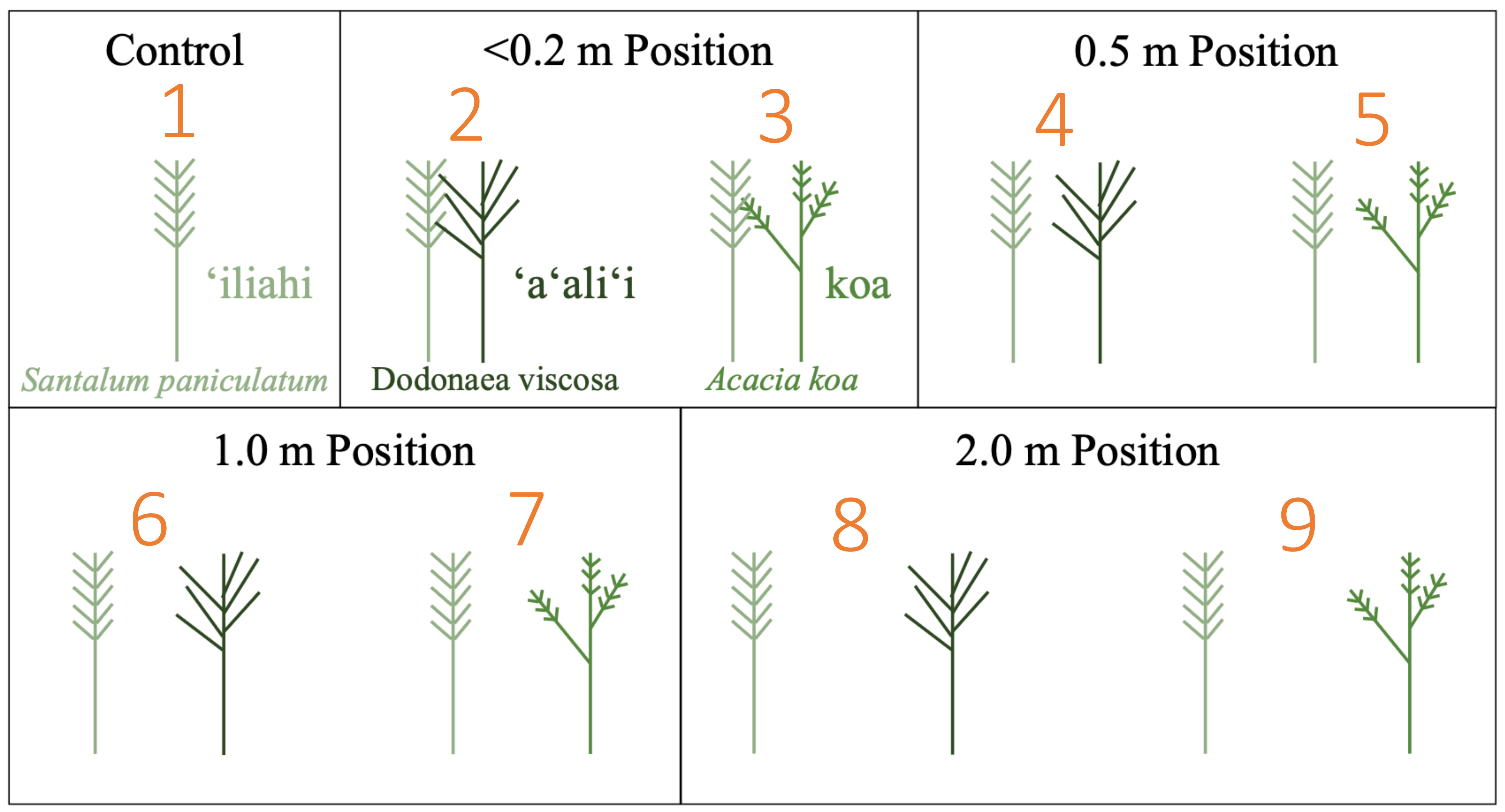


Photo: Kyle Rose

Thyroff et al. 2023, *Forest Ecology and Management*

Photo: Andrew Conti

Photo: Ryen Helzer

Mahalo!

Tropical HTIRC

CAFS Center for Advanced Forestry Systems

NSF

Forest Service U S Department of Agriculture

HTIRC Hardwood Tree Improvement & Regeneration Center

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