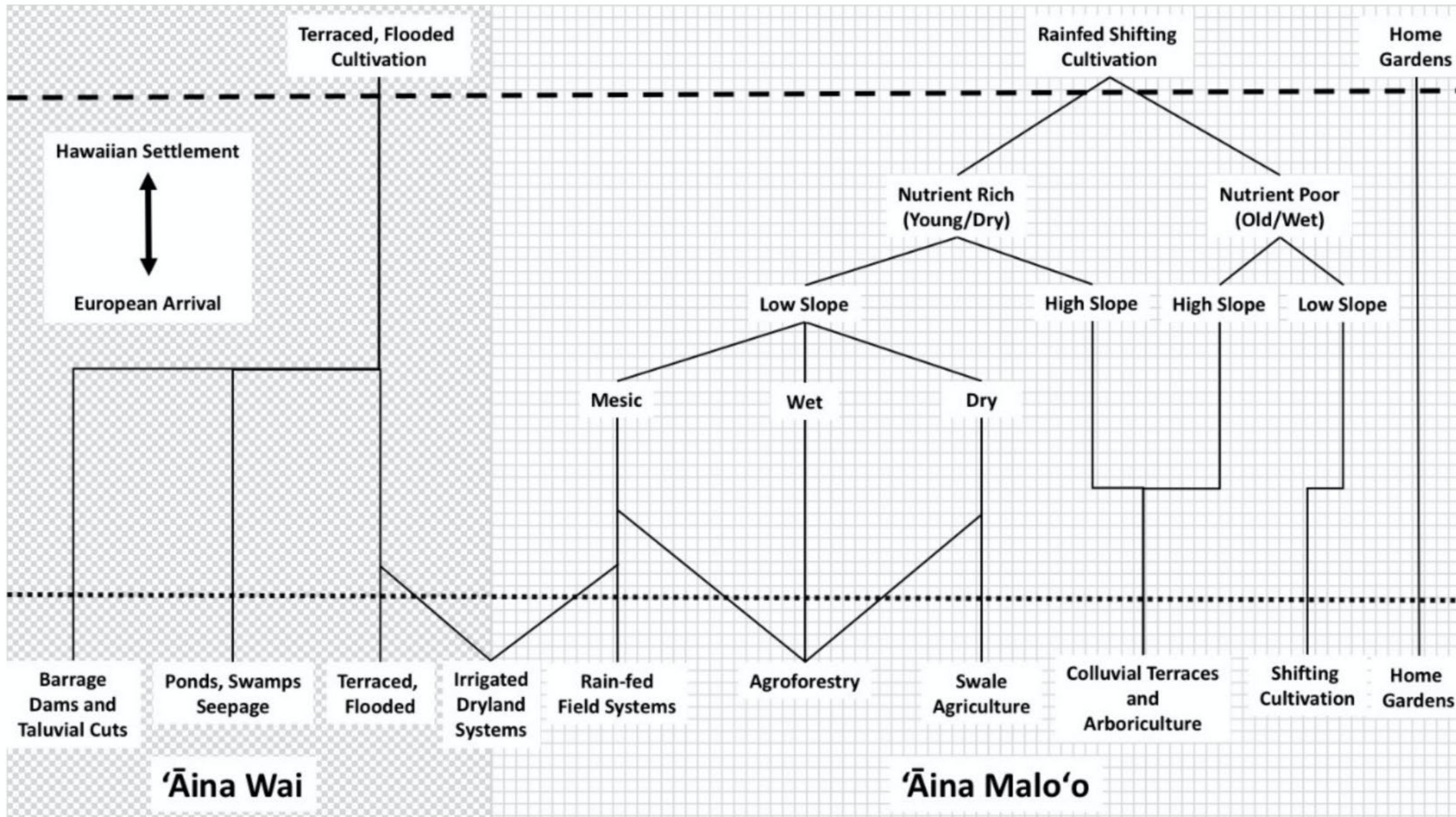


Arboriculture in Hawai'i

Noa Kekuewa Lincoln
University of Hawai'i at Mānoa
nlincoln@hawaii.edu





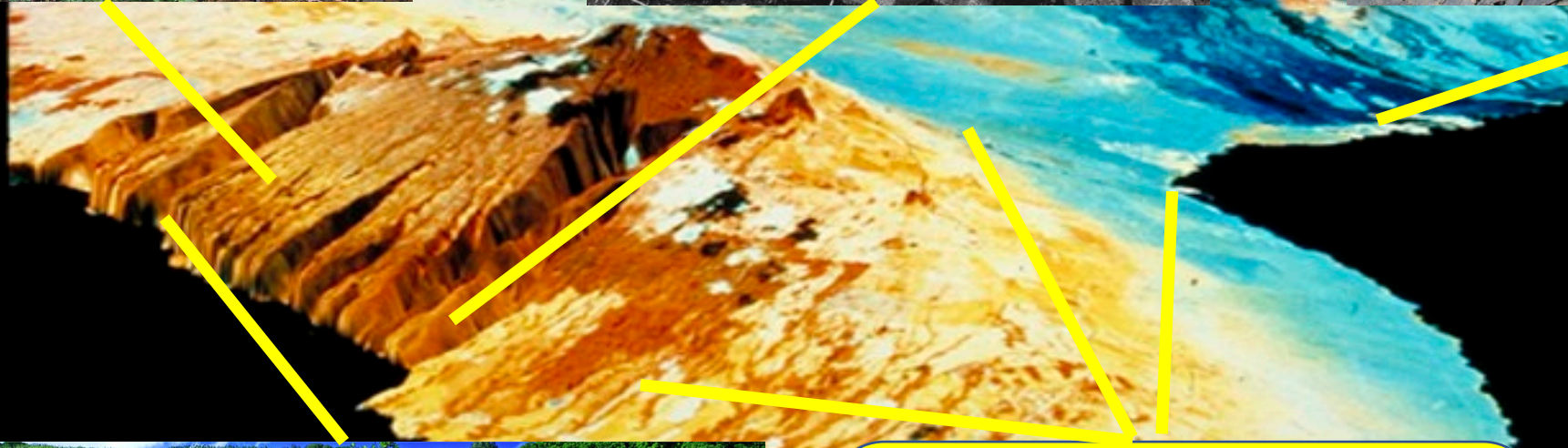
Agroforestry Systems



Colluvial Agriculture



Opportunistic



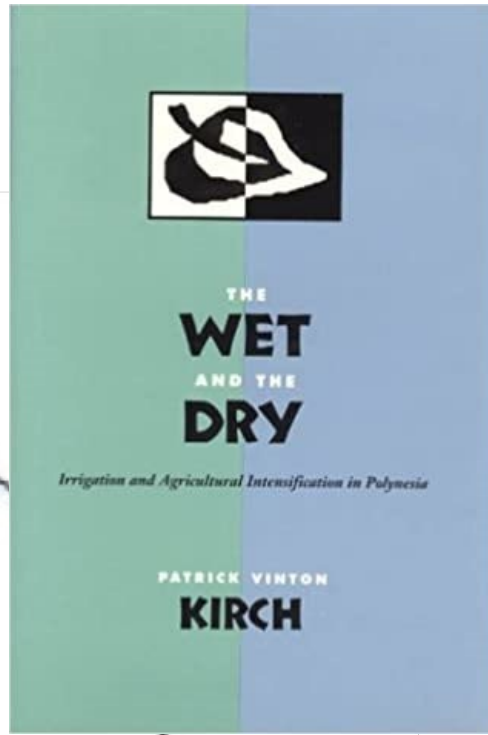
Lo'i Systems

- OTHER AGRICULTURE**
- Shifting/swidden agriculture
 - Intermittent irrigation
 - Hybrid systems
 - Aquaculture

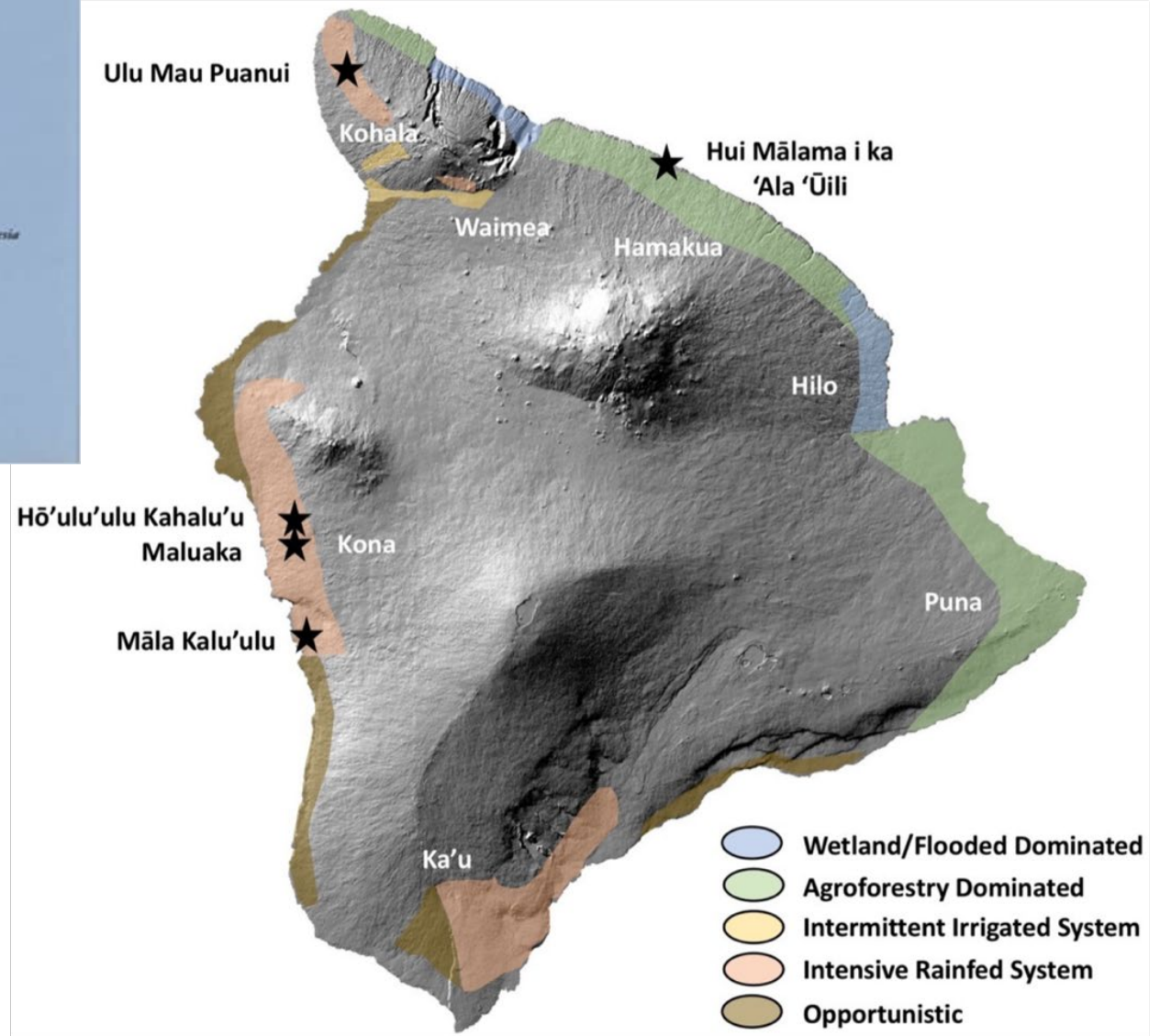


Intensive Rainfed

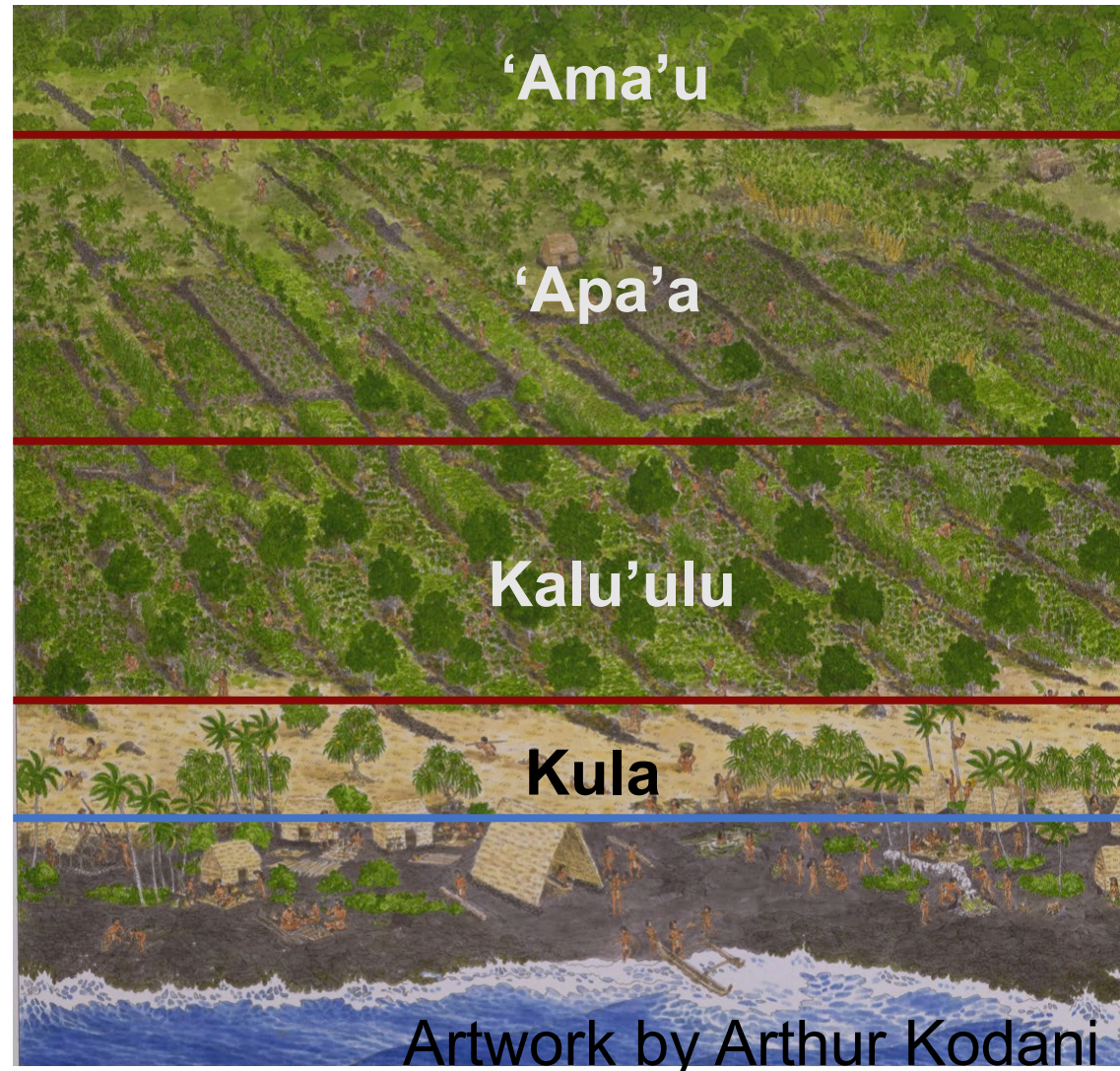
Ladefoged et al. 2009



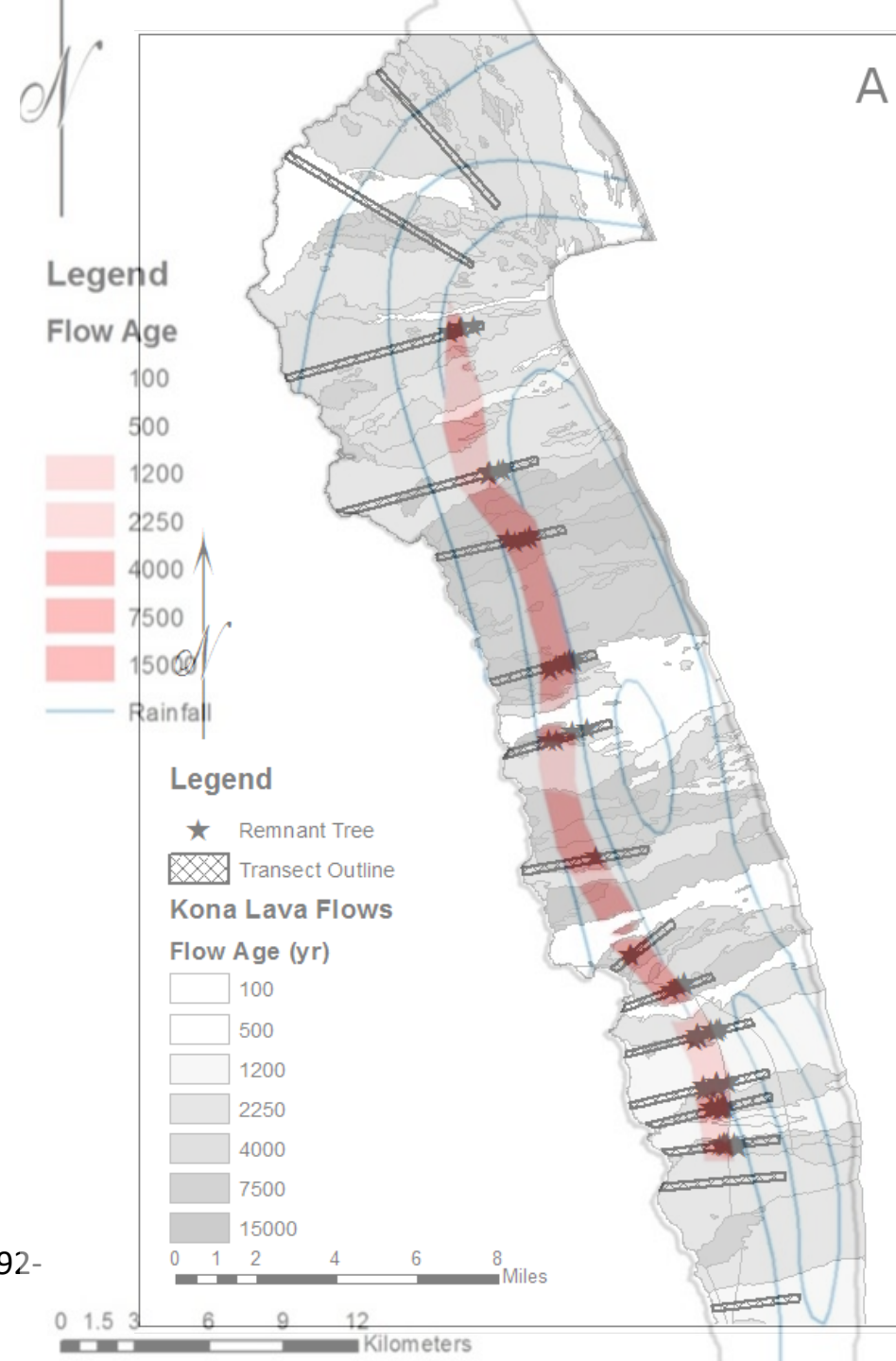
Lincoln et al. 2018



Example: Kona and the Kalu'ulu

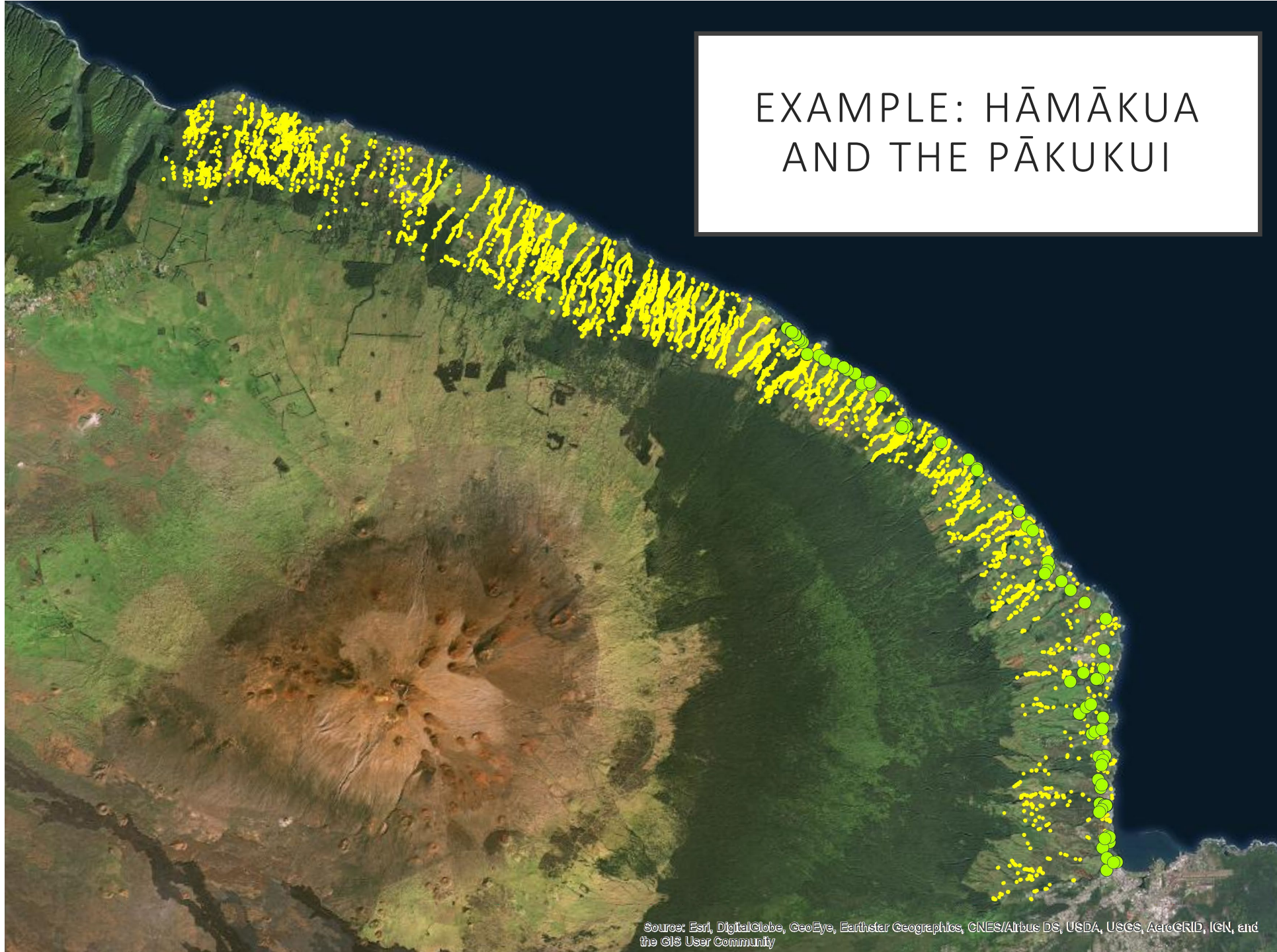


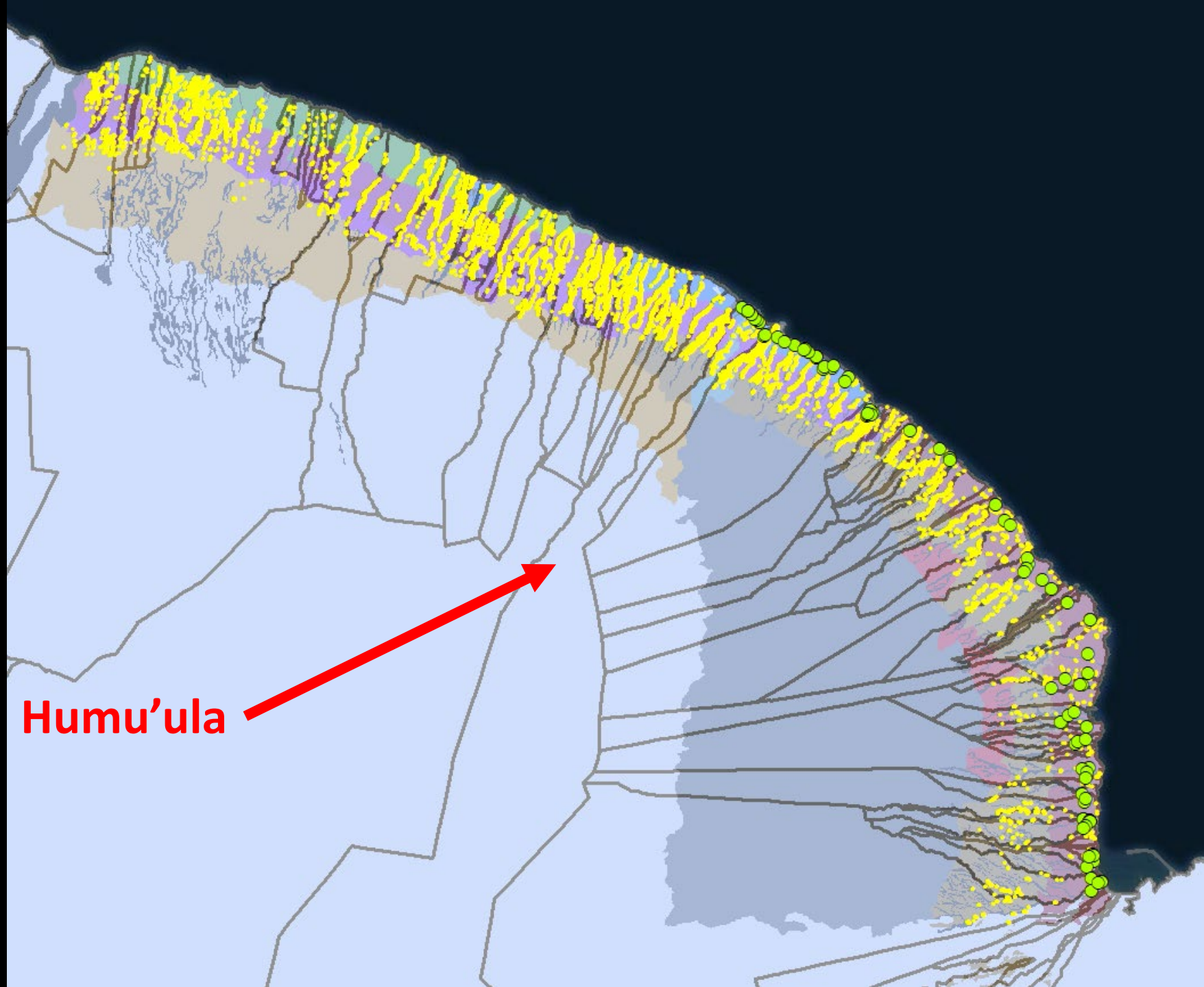




Lincoln, N. & Ladefoged, T. N. (2014) Agroecology of pre-contact Hawaiian dryland farming: the spatial extent, yield and social impact of Hawaiian breadfruit groves in Kona, Hawai'i. *Journal of Archaeological Science* 49, 192-202.

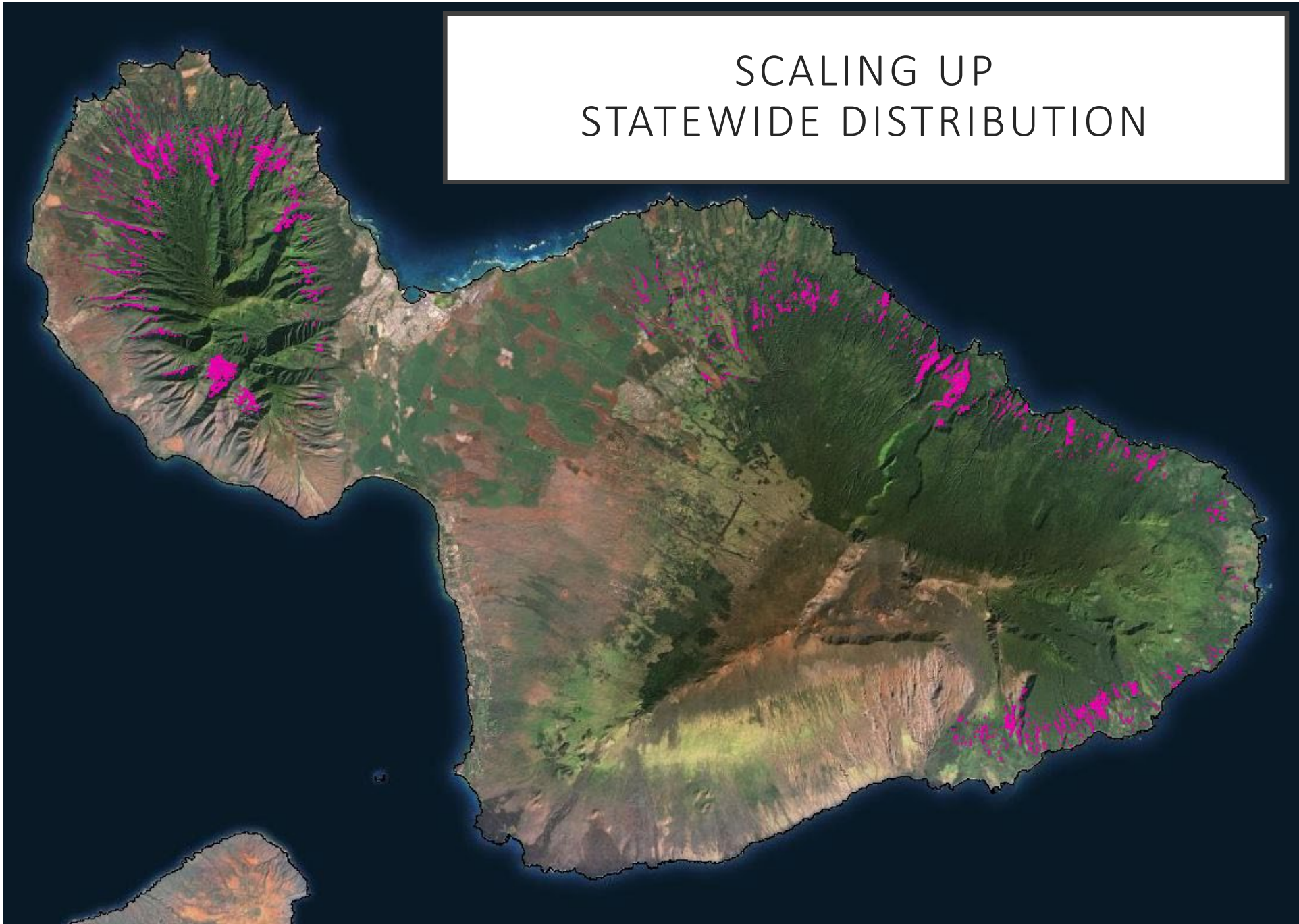
EXAMPLE: HĀMĀKUA
AND THE PĀKUKUI





Humu'ula

SCALING UP
STATEWIDE DISTRIBUTION



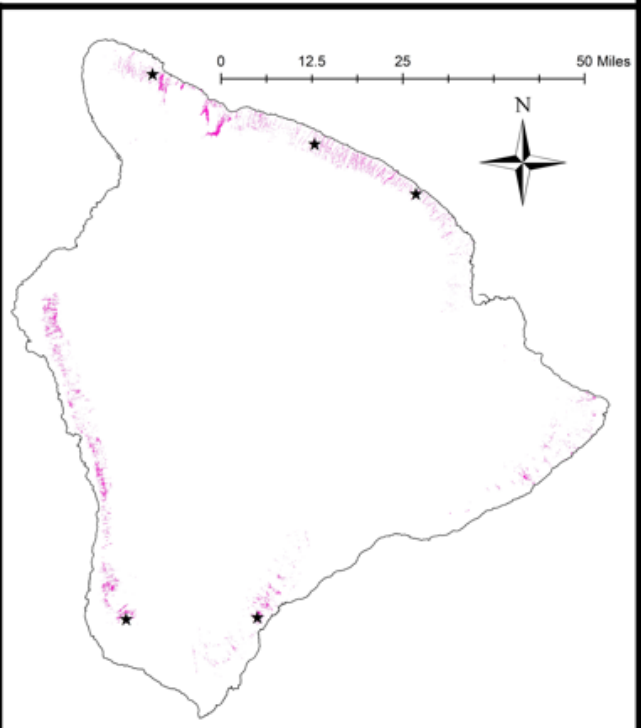
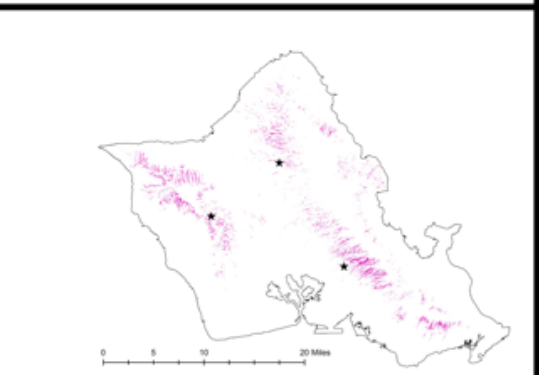
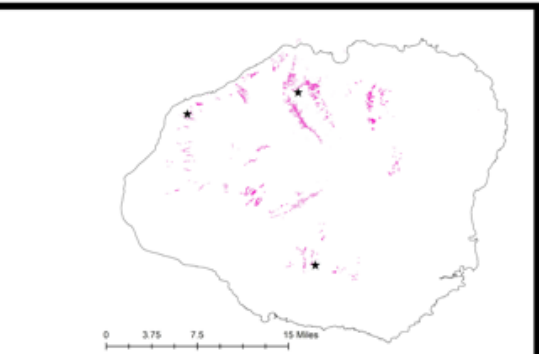
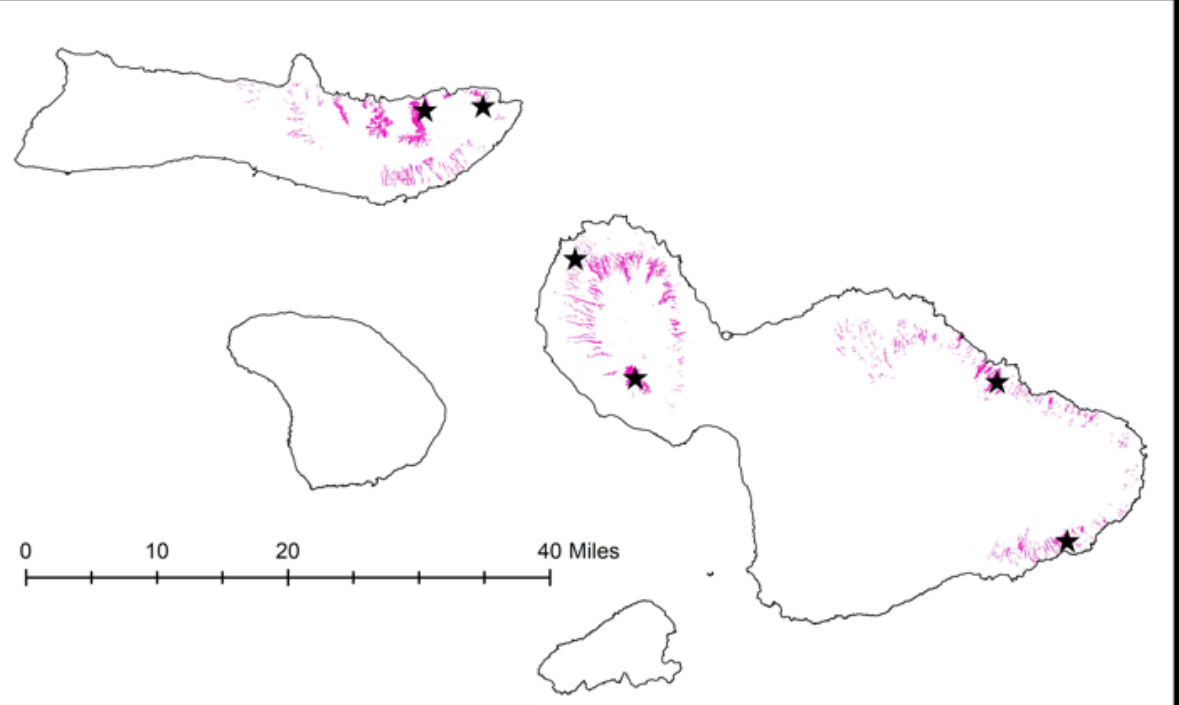
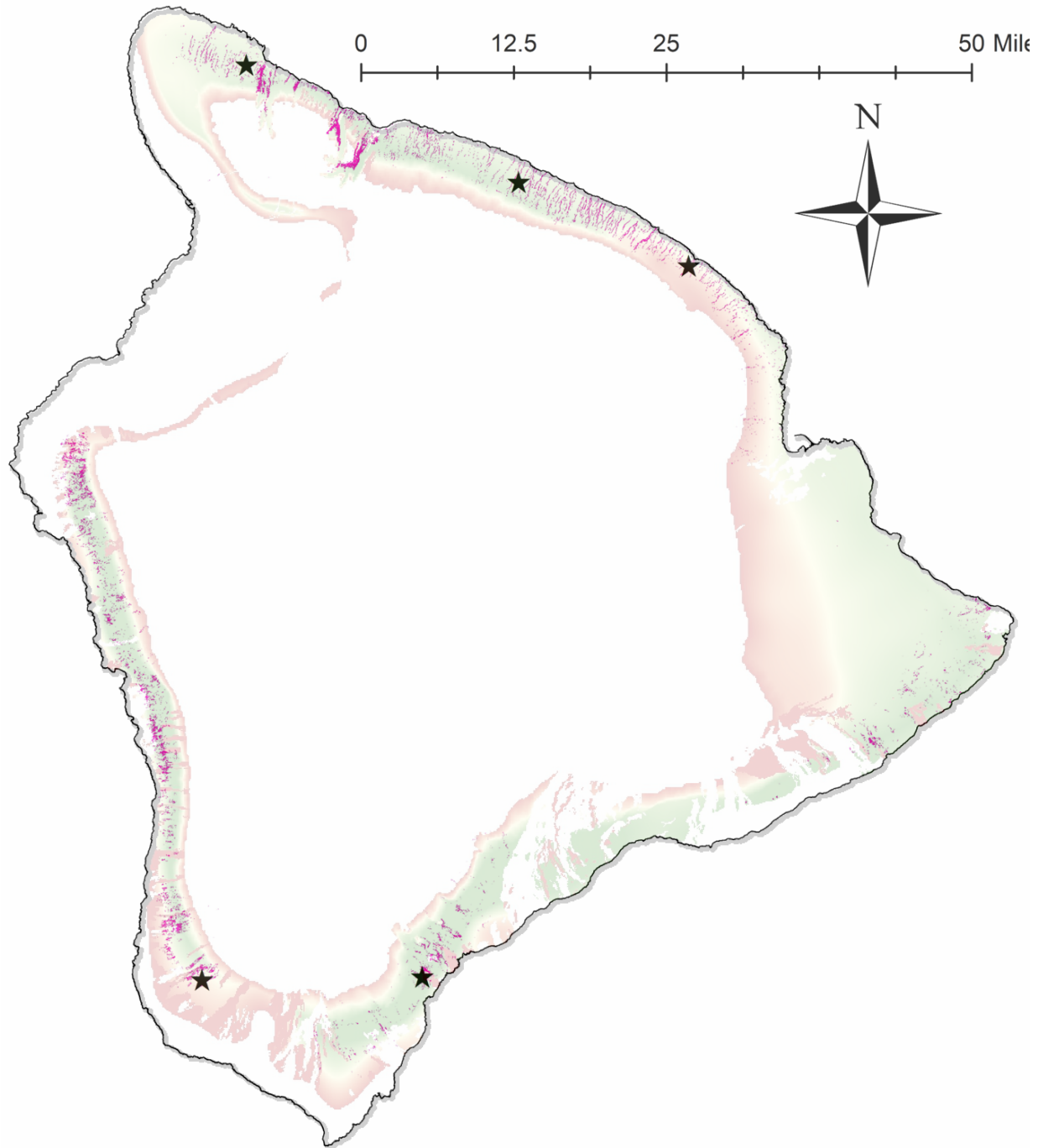


Table 1. Total basal area and the percent land cover of remotely mapped kukui on the five largest Hawaiian Islands

District	Island	Kukui Basal Area (m2)	% Total Area
All	All	41,695,766	0.26
All	Hawaii	14,432,995	0.14
	Kauai	4,974,563	0.35
	Maui	8,785,213	0.47
	Molokai	4,215,122	0.62
	Oahu	9,287,873	0.61
Hamakua	Hawaii	4,387,764	0.26
Hilo	Hawaii	924,774	0.05
Kau	Hawaii	2,185,752	0.08
Kohala	Hawaii	1,387,305	0.13
Kona	Hawaii	4,432,081	0.22
Puna	Hawaii	1,115,318	0.09
Halelea	Kauai	2,662,421	1.11
Kona	Kauai	1,689,006	0.24
Koolau	Kauai	288	0.00
Napali	Kauai	467,456	1.16
Puna	Kauai	155,391	0.04
Hamakualoa	Maui	794,161	0.55
Hamakuapoko	Maui	147,709	0.20
Hana	Maui	392,915	0.35
Honuaula	Maui	0	-----
Kaanapali	Maui	2,116,686	1.39
Kahikinui	Maui	0	-----
Kaupo	Maui	747,169	0.58
Kipahulu	Maui	601,875	1.17
Koolau	Maui	2,009,987	1.10
Kula	Maui	0	-----
Lahaina	Maui	1,406,328	0.93
Peali Komohana	Maui	568,383	0.26
Kona	Molokai	1,010,983	0.18
Koolau	Molokai	3,204,139	2.60
Ewa	Oahu	2,990,154	0.69
Kona	Oahu	1,701,451	0.97
Koolauloa	Oahu	715,295	0.36
Koolaupoko	Oahu	365,611	0.18
Waialua	Oahu	2,015,314	0.68
Waianae	Oahu	1,500,049	0.68



How well does kukui represent our ancestral forest footprint?

- No shift in local elevational limits
- Substantial, consistent decline in remote habitats
- Patterns in distribution correlated to other social and agroecological indicators
- Several large areas of suitable habitat unoccupied

Flat spur covered with a dense scrub of Sumach

PUUAKULA:

PUBLIC LANDS MAP NO 8

Precipitous Ridge covered with a dense Ohia Scrub and thick undergrowth of Ferns.

Amphitheatre of extremely precipitous Spurs covered with a heavy forest and undergrowth.

Dense Scrub of Bananas with thick undergrowth of Ferns

Remains of Old Taro Patches

MAP - of -

WAIMANU VALLEY HAMAKUA HAWAII

Surveyed for the Commissioners of Public Lands.

— by —
Chas. VEDove. Surveyor.

Scale 200 Ft = 1 Inch.

HONOLULU. Feb. 1896.

Reg. No. 10

Level ground covered with heavy Kuku

KAPUWAIHALULU.

Forest and dense undergrowth of ferns.

ILILOA

Spur covered with dense Scrub and heavy undergrowth of ferns.

Extremely Precipitous Spier covered with dense Ohia Scrub

LAUOMENS FALLS

WAIHILAU

LOT 1.

Flat land covered with a dense 8 Acres

NAPILI.

undergrowth of Ferns and Light Kuku

LOT 2. 80 Acres

Forest. Remains of Ancient Taro Patches

LOT 3

LOT 10

LOT 9

partially open grown with

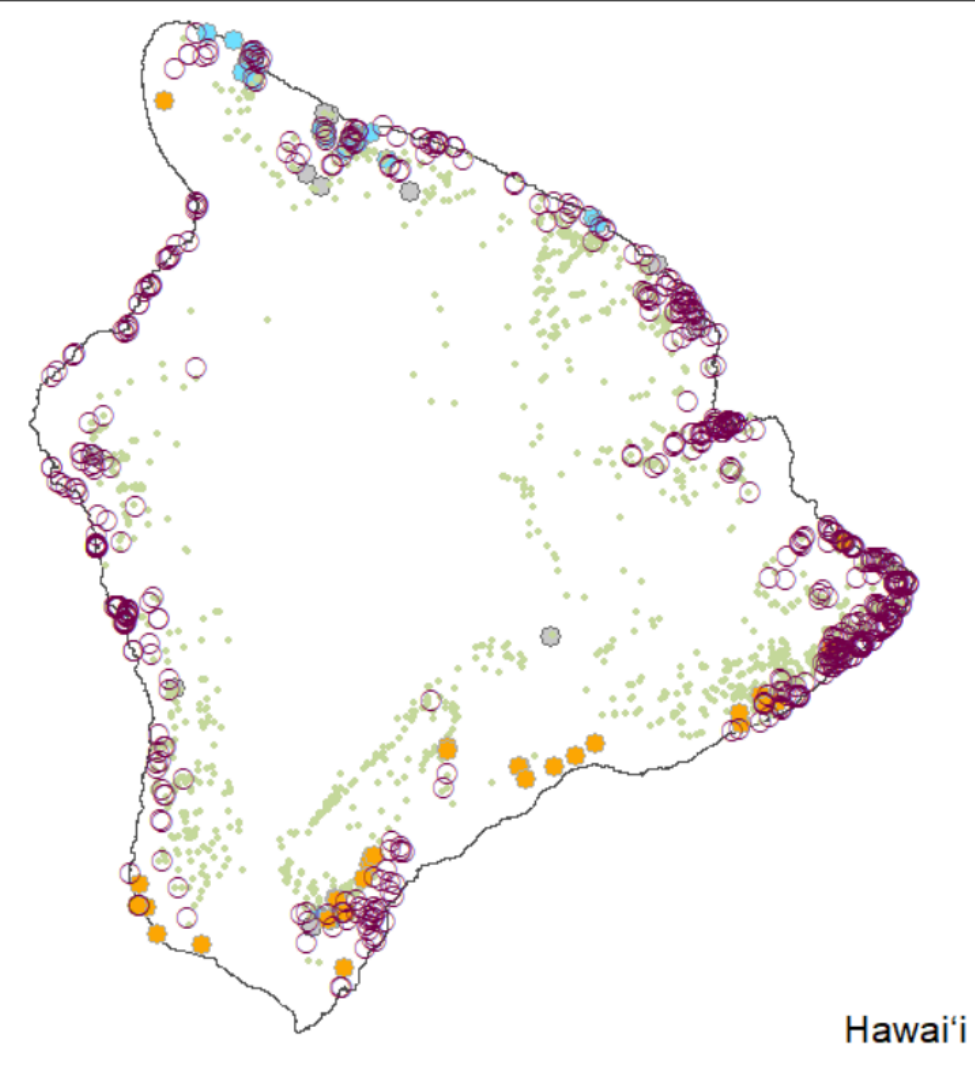
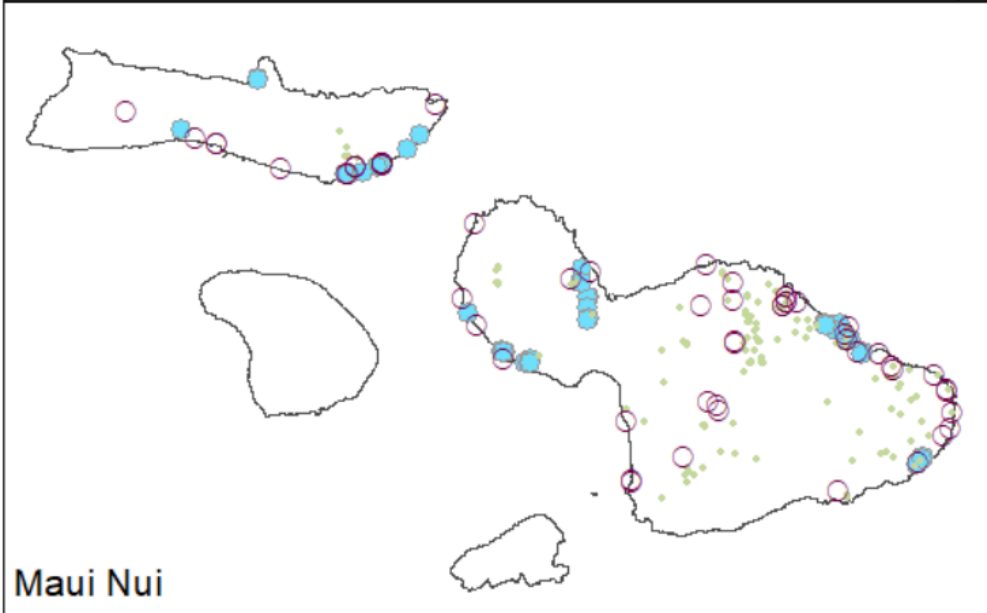
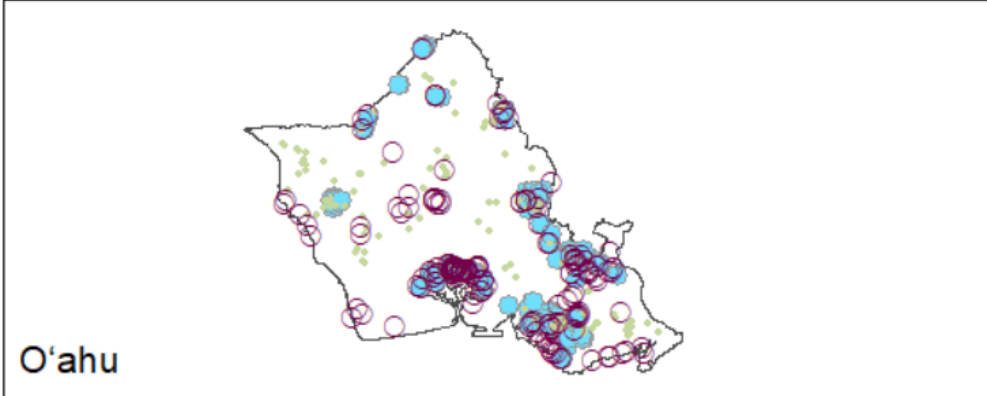
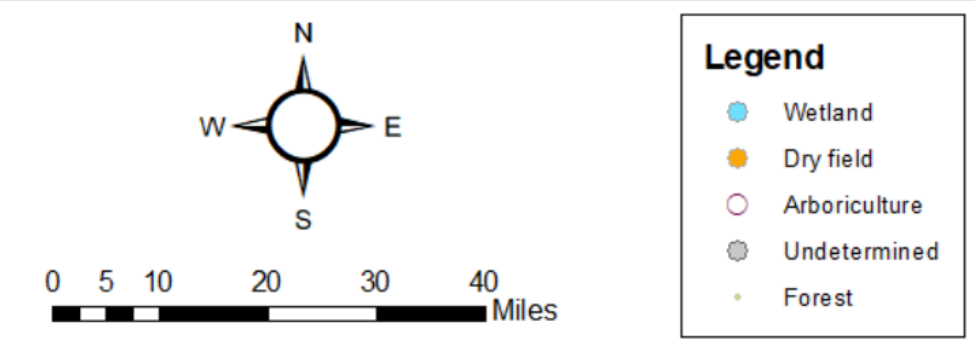
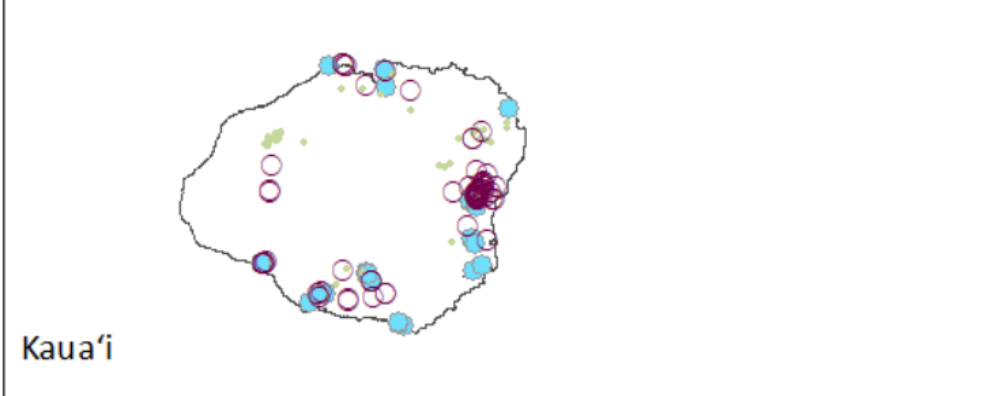
80a.

120 Acres.

Ferns. Kuaunua standing.

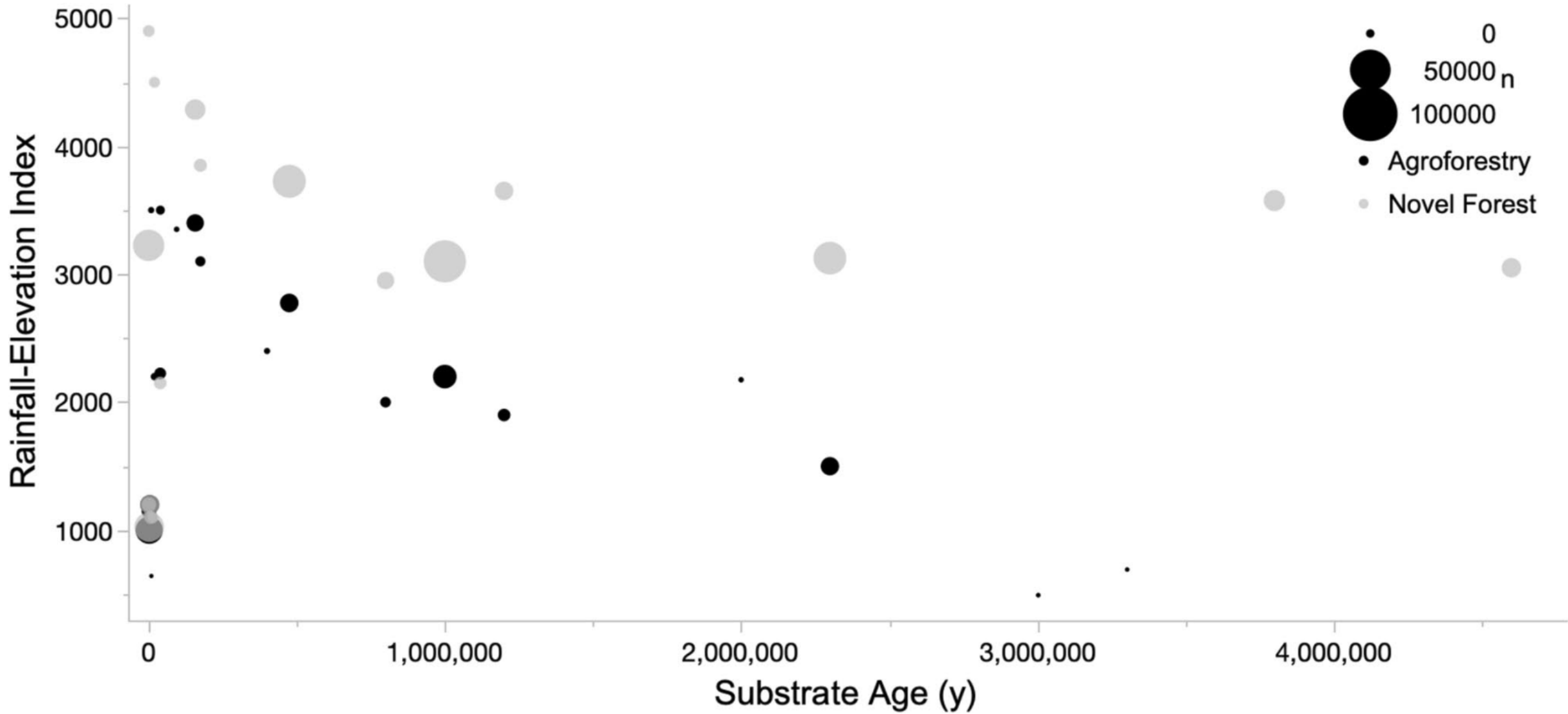
Remains of old Taro patches

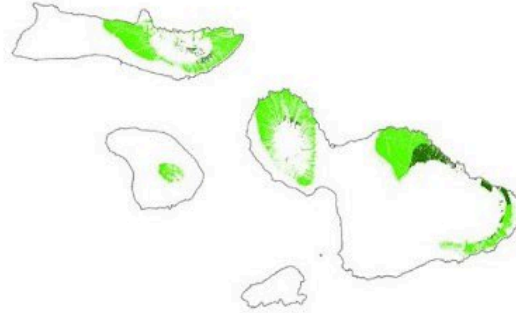




Methods

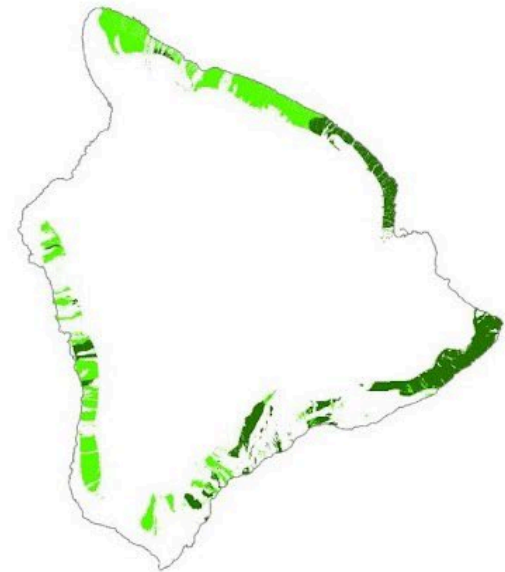
- Used distribution of Kukui and Breadfruit to define two arboricultural types – food forest and more intensive agroforestry
- Define fertility-based limitations by substrate age class, then fit biexponential equation to data to define ecosystem evolution and avoid overfitting of data
- Add additional environmental limitations of rainfall, slope, temperature, etc.
- Prioritize more favorable forms of agriculture (wetland, intensive, colluvial)

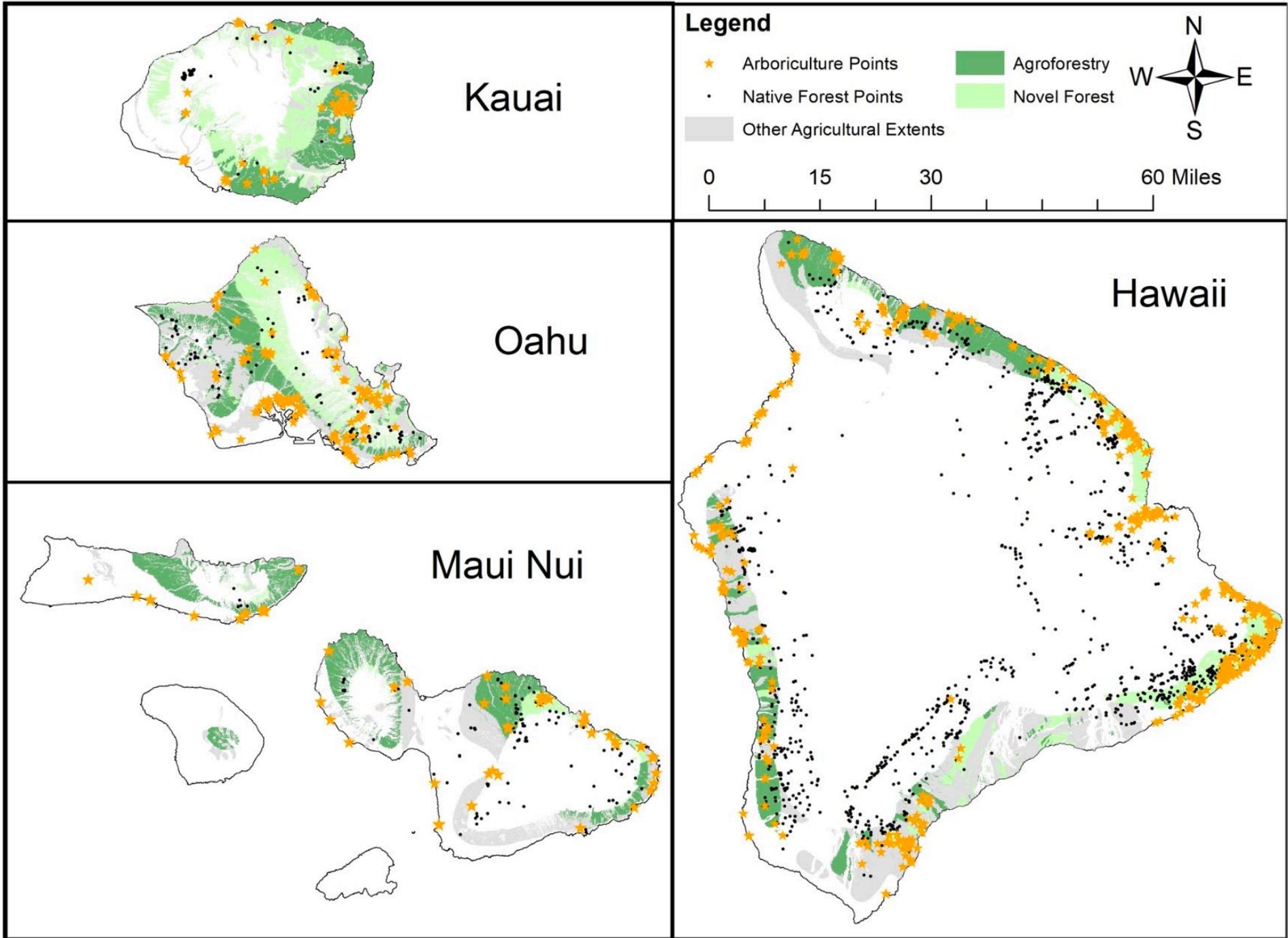




Legend

-  Agroforestry
-  Novel Forest

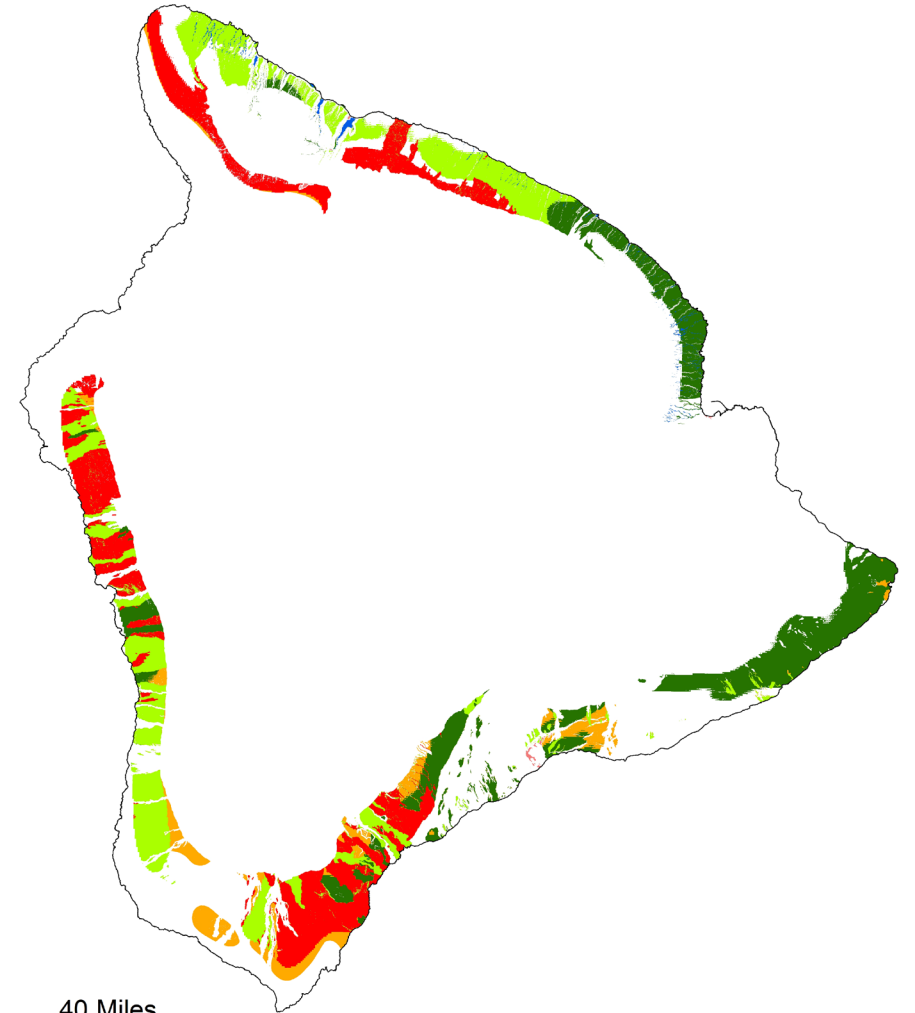
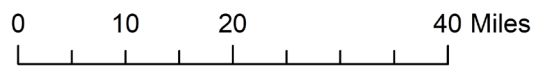




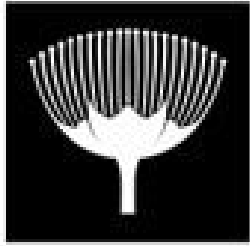


Agricultural Form

- Colluvial Agriculture
- Flooded Pondfield
- Intensive Rainfed
- Marginal Rainfed
- Novel Food Forest
- Other Agroforestry



- Estimates of Hawaiian agricultural footprint is ~25%
- Arboriculture ~50% of the total agriculture in ancient Hawai'i

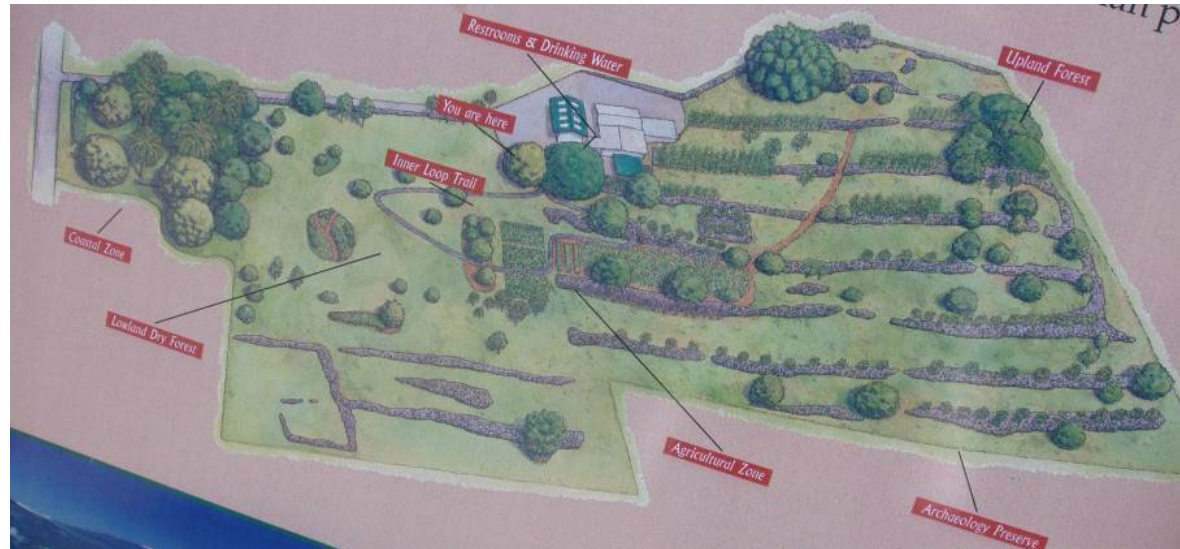


BISHOP MUSEUM
AMY B.H. GREENWELL
ETHNOBOTANICAL GARDEN





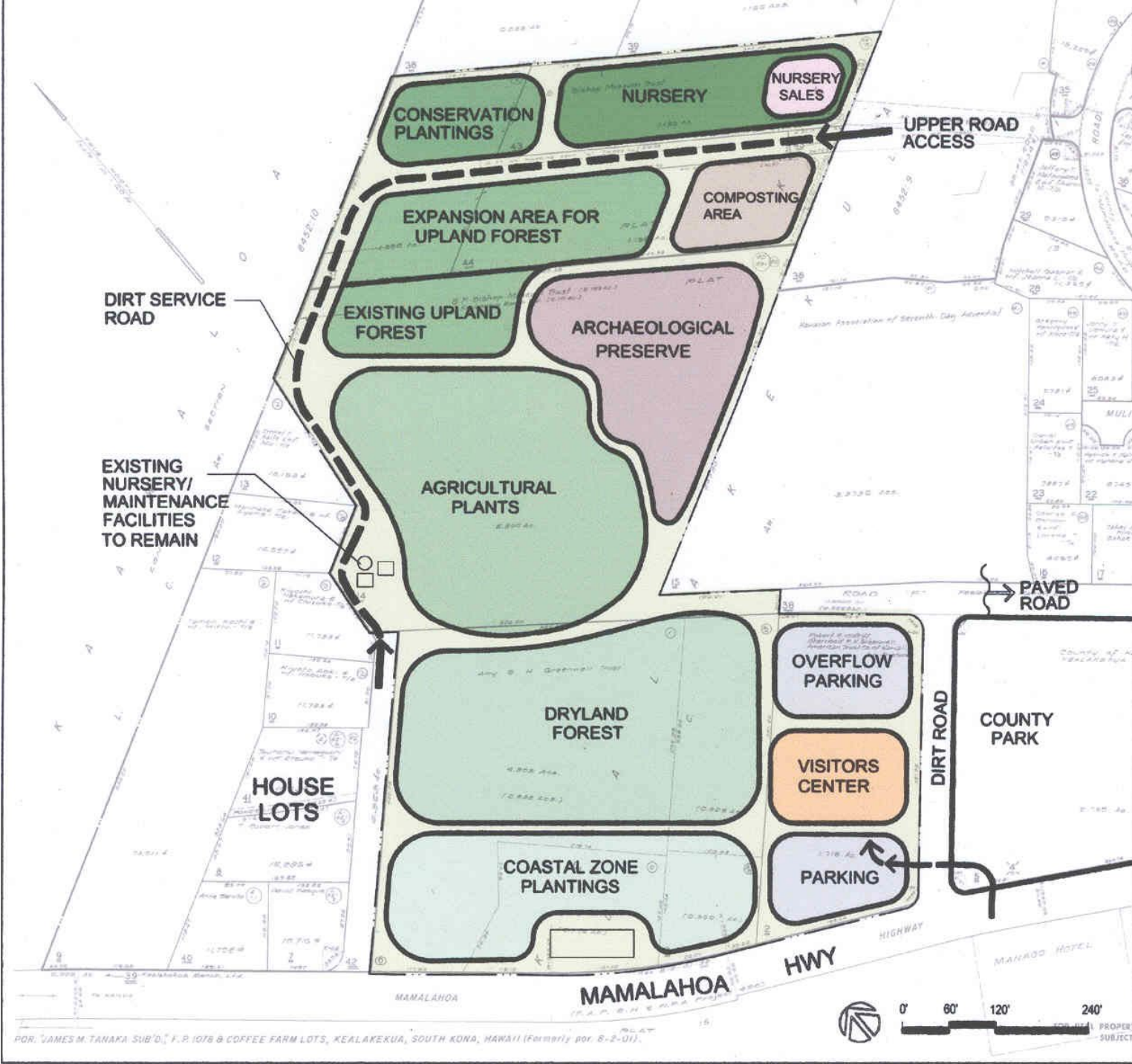
We are a garden of native Hawaiian plants and Polynesian introduced crops, telling the story of traditional Hawaiian culture and the plants that sustained it.





Google Earth

400 ft

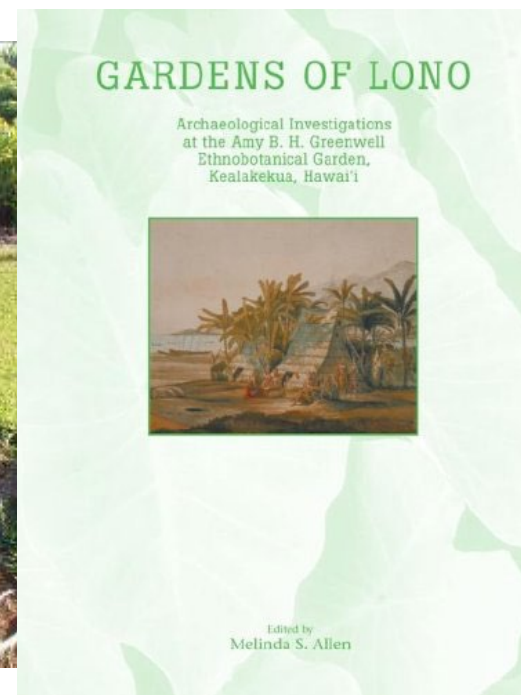
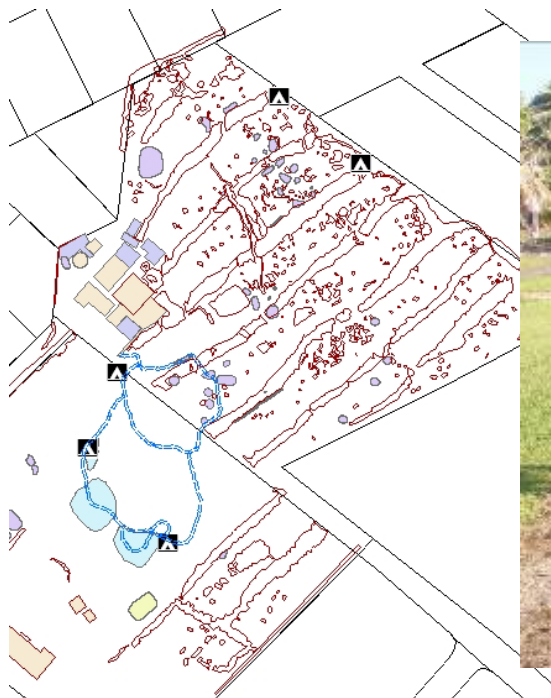


POR. "JAMES M. TANAKA SUB'D," F.P. 1078 & COFFEE FARM LOTS, KEALAKEKUA, SOUTH KONA, HAWAII (Formerly por. 8-2-01).

Exceptional Value for Cultural and Archaeological Resources

The only publically accessible, interpreted archeological site of the “most monumental work of ancient Hawai‘i,” the Kona Field System





Pa'ikapahu Heiau





HEIAU OF THE ISLAND
OF HAWAII

A Historic Survey of Native Hawaiian

Temple Sites

JOHN F. G. STORES

EDITED AND INTRODUCED BY TOM DYER

Restored Landscape and Resources for Cultural Practices

- Freely provide access to resources such as kī, hala, maile, wauke and more for hula, lapa‘au, kapa, dyes, and other practices
- Grows source material of kalo, ‘uala, kō, and other traditional crops for farming and food
- Creates unique and authentic venue for cultural activities such as imu, hula, weaving, and more

Agricultural Lands that are
Unique and Productive

Rich, young soils on 4ky flow



50+ Hawaiian Kalo Varieties



40 Native Cane Cultivars



20+ 'Uala Cultivars



13 'Awa, 15 Mai'a, etc.



Lands Providing Habitat for Threatened or Endangered Species



Rare Plant Refuge

- The Garden is a refuge for rare plants, providing source documented accessions, genetic safety nets, and propagation material.
- We are a participating institution with the Center for Plant Conservation, and are the primary caretaker for nine species of endangered Hawaiian species.
- We also house conservation collections of many other native plants with partners such as USFWS, State of Hawai'i, and other botanical gardens and arboreta.



Kokia cookei

Open Space Resources that are of
Exceptional Aesthetic Value



- Located in the heart of Captain Cook town, the garden is surrounded by increasingly subdivided residential areas
- Major stopping point for tourists and locals alike
- Limited public space in the mauka areas
- Provides open space venues for community events and individual recreation
- Adjacent to Hawai'i County Park
- Home of the South Kona Green Market, exactly because there is no other adequate open space available



Lands with Education,
Engagement, and Awareness
Value

Education and Outreach

- 2,600 School Visitors
- 2,600 Outreach Served
- 2 After School Clubs
- 12,000 Self guided visitors
- 1,000 Workshop Participants
- Events
 - Grow Hawaii Festival
 - Seed Exchange
 - Arbor Day Tree Giveaway



Education and Outreach

- Arbor Day: The Garden celebrates Arbor Day annually by giving away free native plants, some of which are rare and unusual.
- Workshops:
 - Traditional arts and practices:
Conducted by local kupuna and other cultural plant experts
 - Horticultural classes and workshops:
Conducted by our own knowledgeable staff and other professionals
- *Hua o ke Ao* after school program
- Grow Hawaiian Horti/Cultural Festival
- Seed Exchange
- Garden Tours



Partnerships

■ Restoration Partnerships

- Kamehameha Schools
 - Ke`ei, Kahalu`u, Makalawena
- West Hawaii Veterans' Cemetary
- Kuki`o
- QLCC
- Kohala Center/UCSB
- Ka`upulehu/Ka Ahahui o Nahelehele
- Koloa Habitat – USFW/Ducks
Unlimited/Landowners
- NPS Honaunau and Kaloko/Honokohau

■ Education Partnerships

- Kohala Center
- DOE and Private schools
- TREE Hawaii
- YCC
- Alu Like
- QLCC
- NPS
- Kamehameha Schools
- HSDFWS
- UH Hilo/Mānoa
- Many Others

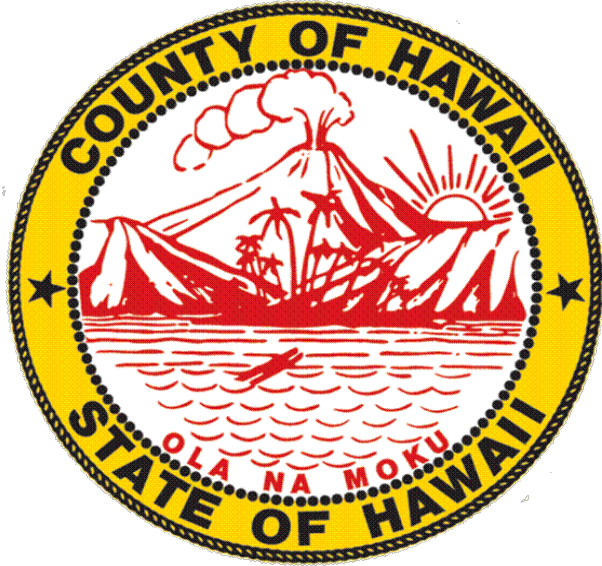
Cultural, Archeological, and
Natural Resources that are in
Danger

West Hawaii Today

February 1, 2016

‘It’s going to be a great loss’: Visitors say goodbye to Greenwell Garden





PONC Fund -- aka Open Space or 2% Fund

Public Access, Open Space and
Natural Resources
Preservation Commission

- Hawaii County has placed **the Garden** as it's **#1 Priority for funding**, up to \$400,000, for a Conservation Easement.
- PONC favors using their funds as a match.
- These PONC funds will help us raise the match for Legacy Lands funds, should we be awarded.

AMY B.H. GREENWELL ETHNOBOTANICAL GARDEN COMMUNITY FOREST



"This purchase represents a remarkable group effort. When the garden closed, our Friends organization sprang into existence, determined to open the Garden's gates once more."

MAILE MELROSE, PRESIDENT OF FRIENDS OF AMY B. H. GREENWELL ETHNOBOTANICAL GARDEN



COMMUNITY FOREST



PROGRAM

This program provides financial assistance to local governments and qualified non-profit organizations to acquire private lands threatened by conversion to non-forest uses.

- Lands must be at least five acres in size and 75 percent forested.
- Public access is required.
- Full fee title acquisition is required. Conservation easements are not eligible.
- The program pays up to 50% of the project costs with a 50% non-federal match.
- Lands are managed with a community forest plan to provide economic benefits, clean water, wildlife habitat, educational opportunities, and public access for recreation.

Community forests are protected forest lands that contribute to healthy, flourishing communities. These lands are guided by local say to achieve local priorities. These unique assets are land-based economic development tools that deliver positive outcomes to the residents, visitors, and businesses located in their service areas.

Roots and Shoots – ‘Ulu for the Future

The Friends’ new ‘ulu (breadfruit) project responds to the challenge of the pandemic and relies on Hawaiian tradition to promote food security, families across our island, beauty, and a greener Hawai‘i.

‘Ulu shoots are now rising in the Garden as a result of tree-trimming and the Kona rainy season. These shoots are from trees descended from the original ‘ulu brought to Hawai‘i on canoes centuries ago. Beginning in mid-August, several hundred will be air-layered and potted for distribution.

All project activities are in partnership with technical expertise from Lili‘uokalani Trust, Kipuka Kona & Hilo; staff assistance from Peter Van Dyke, Garden Manager and others from B.P. Bishop Museum; and the essential contributions of Friends volunteers. We will look to supporting groups Hawai‘i ‘Ulu Cooperative and Ho‘oulu ka ‘Ulu for networking and information assistance.

The majority of saplings will be distributed by the Trust to families on Big Island. Potted ‘ulu will also be available at the Garden and also for a special ‘ulu event at the Museum in Honolulu in Spring 2021.

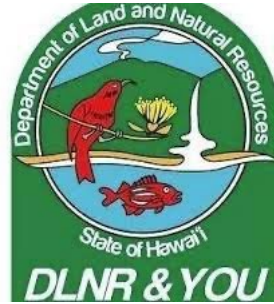


‘Ulu shoots galore rise in the Garden. (Photo by Maile)

Urban and Community Forestry

Friends of Amy B H Greenwell Ethnobotanical Garden	Resilient Forests - Strong Communities: Anchoring a Public Forestry Campaign in Hawaii's Only Federally-designated Community Forest: This project will increase equitable access to tree canopy; elevate workforce development and culturally-embedded educational programming; expand local participation in the development and execution of five-year Community Forest Plan; and improve resilience to climate change through the propagation, distribution, and out-planting of endemic, indigenous, and Polynesian-introduced plants.	<ul style="list-style-type: none">• Tree Planting & Maintenance• Restoration & Resilience• Workforce Development• Planning & Community Engagement	\$2,000,000
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Mahalo



ATHERTON FAMILY
FOUNDATION



KAULUNANI
urban & community
FORESTRY
PROGRAM.



HAWAI'I COMMUNITY
FOUNDATION



CERES
TRUST



COOKE FOUNDATION, LIMITED