# USDA ORCS **United States Department of Agriculture** Natural Resources Conservation Service

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# **Physiographic features of Kaho'olawe**

- Smallest of the 8 major Hawaiian islands
- OApprox: 11,500 ha (~28,500 acres) Elevation range: 0-460 m (0-1500 ft) above sea level
- Mean annual rainfall: less than 625 mm (20 in)
- **OLocated in the "rain shadow" of** Haleakala Volcano on Maui
- **ORainfall is dominated by isolated**, intense "Kona" storm events



# **Management History**

- Settled and inhabited by the Native Hawaiian people as early as 400 AD **OResident population believed to be small given lack of water resources OISLAND had major cultural significance, especially for voyaging** Cattle and goats introduced in late 1700's
- **OResulted in severe overgrazing and erosion (wind and water)**
- US Navy gunnery, firing and bombing range (1941-1994)
- **OExtensive impact on the island including large amounts of unexploded ordnance Returned to State of Hawaii control in 1994.** 
  - **OManaged by the Kaho'olawe Island Reserve Commission (KIRC)**
- parts of the island so access to much of the island remains limited **ORevegetation and restoration efforts are ongoing**



Soil Scientists Ralph Tucker and Mike Kolman in front of the **Ordnance display** 



A'ali'i (Dodonea viscosa) established behind pili grass bales



Aeolian sediment accumulated behind pili grass (Heteropogon contortus) bales



'Aki'aki (Sporobolus virginicus established on the plateau

# Kaho'olawe, Hawaii: Soil Survey in a Highly Anthropogenic Landscape

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# **Soil Survey Challenges / Difficulties**

### SAFETY

>Only a small percentage of the island has been cleared of subsurface unexploded ordnance (green areas on map) >A larger percentage has been cleared on the surface, but

no excavation can be done (yellow areas)

**OIN these areas, all field visits must be accompanied by** an ordnance safety expert

> A significant percentage of the island remains un-cleared and inaccessible (pink areas)

Map prepared by the Kaho'olawe Island Reserve **Commission: Status is as of 2008** 

## **Rugged Terrain**

> Approximately 25% of the island has slopes in excess of 35%

>An additional ~20% of the survey area is very rocky **Few roads and trails exist; none are improved** > Access from the coast to the plateau is difficult



Lithic Torriorthents in foreground on cliffs and gullies Typic Haplotorrox, wind polished, in background on



**Exposed soil profiles – central plateau** 

### **Limited Data**

Twenty-one (21) site descriptions (232's) **Fifteen (15) soil profiles sampled • Total of thirty-five (35) horizons Only three (3) pedons have data collected and** analyzed below 60 cm (40 in)

**Soil Survey History** 

>Initial field survey conducted by NRCS-Hawaii staff from 1992 – 1994 under contract with the US Navy

Followed standard soil survey protocols as much as was practical given limited access and safety issues

Profiles were described (primarily gullies and road cuts) and limited samples collected Soil chemical analysis (primarily for fertilityrelated properties) was conducted at the University of Hawaii on 35 samples >Map units originally delineated on natural color aerial photography and compiled on black

and white copies for publication Report was prepared and published in 1995 (Nakamura and Smith)



Soil Survey of Island of Kahoolawe Hawaii In cooperation with United States Nevy Pacific Division Nevel Facilities Engineering Command



# **Key Decisions before database development**

Recompile lines on orthoimagery (Digital Globe – natural color and CIR) informed by IFSAR-derived elevation data, original mapping and field notes **OVery few major line placement changes were required** 



**Original delineations** 

**Recompiled delineations** 

>Use higher order taxonomic classification (Great Group level) **OAvailable data was insufficient to support classification to the series level** >Assume aridic soil moisture regime based on annual precipitation and estimated evapotranspiration

>Assume isohyperthermic soil temperature regime based on temperature data for the same elevation range from other islands

**Estimate slope ranges for map units based on a digital elevation model (DEM)** derived from IFSAR elevation data

>Use phase modifiers to provide additional descriptive information for map units with otherwise identical classifications

> Populate sub-surface data in NASIS based on limited pedon analysis and expert knowledge of "comparable" soils on nearby islands (Moloka'i and Lana'i)

**OTypic Torrifluvents: Mala Series – Typic Torrifluvent (Moloka'i) OTypic Haplotorrox: Uwala Series – Typic Haplotorrox (Lana'i) OTypic Haplotorrerts: Lualualei Series – Typic Gypsotorrerts (Moloka'i) OTypic Haplocambids: Waikapu Series – Torroxic Haplustolls (Moloka'i) OBeaches: Jaucas Series – Typic Ustipsamments (all islands) OSaprolite: C-horizon from Uwala series (see above)** 

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# **Final Product**

**SSURGO-certified spatial and tabular geodatabases** >Includes selected relevant interpretations >Available on Web Soil Survey (WSS) and Soil Datamart

# **Soil Survey Legend**

Symbol 1 2	Soil name Typic Torriorthents, Badlands-typic Haplotorrox-rock Outcrop Complex,10 to 30 Percent	Acres	Dorcont
	Typic Terriertheats, Badlands, typic Hapleterrey, resk Outgreap Compley 10, to 30 Percent		rencent
	Typic for for thems, Badiands-typic Haploton 0x-rock Outer op complex, 10 to 50 Percent		
2	Slopes	5,434	19.1
2	Typic Torriorthents, Badlands-typic Torriorthents, Eolian, Complex,5 to 25 Percent Slopes	436	1.5
4	Beaches, 0 To 5 Percent Slopes	69	0.2
5	Typic Haplotorrox, 5 To 15 Percent Slopes	357	1.3
6	Typic Haplotorrox, Wind Polished, 3 To12 Percent Slopes	2,400	8.4
7	Typic Haplotorrox, Wind Polished, 12 To 20 Percent Slopes	973	3.4
	Typic Haplotorrox, Wind Polished-typic Torriorthents, Badlands, Complex, 3 To 12 Percent		
8	Slopes	479	1.7
9	Typic Torriorthents, Eolian, 3 To 15 Percent Slopes	221	0.8
11	Typic Torriorthents, Eolian, 15 To 30 Percent Slopes	52	0.2
12	Typic Haplotorrerts, Extremely Stony, 3 To 15 Percent Slopes	136	0.5
13	Typic Torrifluvents, 0 To 6 Percent Slopes	62	0.2
14	Typic Haplocambids, Moderately Deep, 3 To 12 Percent Slopes	621	2.2
15	Typic Haplocambids, Moderately Deep-rock Outcrop Complex, 5 To 20 Percent Slopes	2,986	10.5
16	Typic Haplotorrox, Windblown, 3 To 12 Percent Slopes	697	2.4
17	Typic Haplotorrox, Windblown, 8 To 20 Percent Slopes	446	1.6
18	Typic Haplotorrox, Black Subsoil, 8 To 20 Percent Slopes, Gullied	224	0.8
19	Typic Haplotorrox, Windblown, 3 To 8 Percent Slopes, Hummocky	336	1.2
20	Rock Outcrop-lithic Torriorthents Complex, 50 To 150 Percent Slopes	1,126	4
21	Rock Outcrop-typic Haplotorrerts Complex, 8 To 20 Percent Slopes	97	0.3
22	Rock Outcrop-typic Haplocambid, Moderately Deep, Complex, 12 To 25 Percent Slopes	259	0.9
23	Lithic Torriorthents-rock Outcrop Complex, 5 To 15 Percent Slopes	4,574	16.1
24	Lithic Torriorthents-rock Outcrop Complex, 15 To 30 Percent Slopes	2,423	8.5
25	Rock Outcrop-lithic Torriorthents Complex, 30 To 50 Percent Slopes	1,778	6.2
26	Rubble Land, 3 To 12 Percent Slopes	146	0.5
27	Typic Torriorthents, Saprolite-Rock Outcrop Complex, 5 To 20 Percent Slopes	707	2.5
28	Typic Haplotorrerts, Excavated-Urban Land Complex, 0 To 8 Percent Slopes	15	< 0.1
29	Typic Haplocambids, deep, 3 To 12 Percent Slopes	1,035	3.6
30	Typic Haplocambids,deep, 8 To 20 Percent Slopes	37	0.1
	Typic Haplocambids, Deep-Typic Haplocambids, Moderately Deep Complex, 3 to 8 Percent		
31	Slopes	234	0.8
32	Typic Haplotorrox, Dark Surface, 3 To 8 Percent Slopes, Severely Eroded	111	0.4
	TOTAL	28,471	100

**Potential utility for KIRC and other future** planners, managers and land users

>Identify priority areas to focus scarce human and funding resources on revegetation and restoration efforts

• Survey identifies areas with the fewest limitations to plant growth

 Survey includes "native species to manage" information Identify priority areas for additional ordinance removal activities – spend the money on areas that have the highest use potential >Identify appropriate areas for infrastructure development

- Hawaiian Cultural Education Center (proposed)
- Additional housing and support facilities for volunteers

• Additional roads and trails to increase access to currently inaccessible areas for cultural and restoration purposes

#### **References:**

Kaho'olawe Island Reserve Commission (KIRC) web site: http://www.kahoolawe.hawaii.gov (last accessed October 26, 2010)

Nakamura S. and C. Smith. 1995. Soil Survey of the Island of Kahoolawe, Hawaii. USDA-NRCS in Cooperation with the US Navy. Honolulu, HI.