MONITORING EROSION ON KAHOʻOLAWE

A USGS study in cooperation with the Kahoʻolawe Island Reserve Commission

USGS
science for a changing world

U.S. Department of the Interior
U.S. Geological Survey

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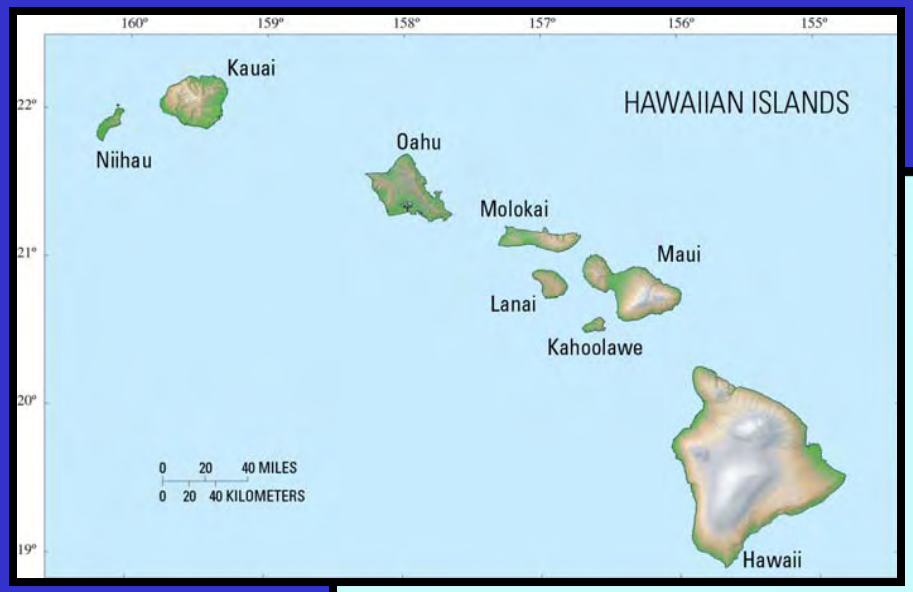

Kaho‘olawe

Area = 45 mi²
Uninhabited
Rainfall ~ 25 in/yr
No perennial streams

Kaulana
Hakioawa
452 m

0 1 mile
0 1 kilometer
Contour interval = 10 m

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History

400 AD – Earliest habitation (archaeological evidence)

Early times – grass and trees grew in thick soil on most of island

Wild goats (~1800 to 1990s)

Sheep and cattle (1858 to 1952)

Target bombing by U.S. military (1941 to 1993)

UXO clearing (1998-2003) 74% of island cleared; 9% to depth of 4 feet

Restoration projects, including revegetation (2001 – present)

(Sources: Kahoʻolawe Island Reserve Commission; Macdonald and others, 1983)

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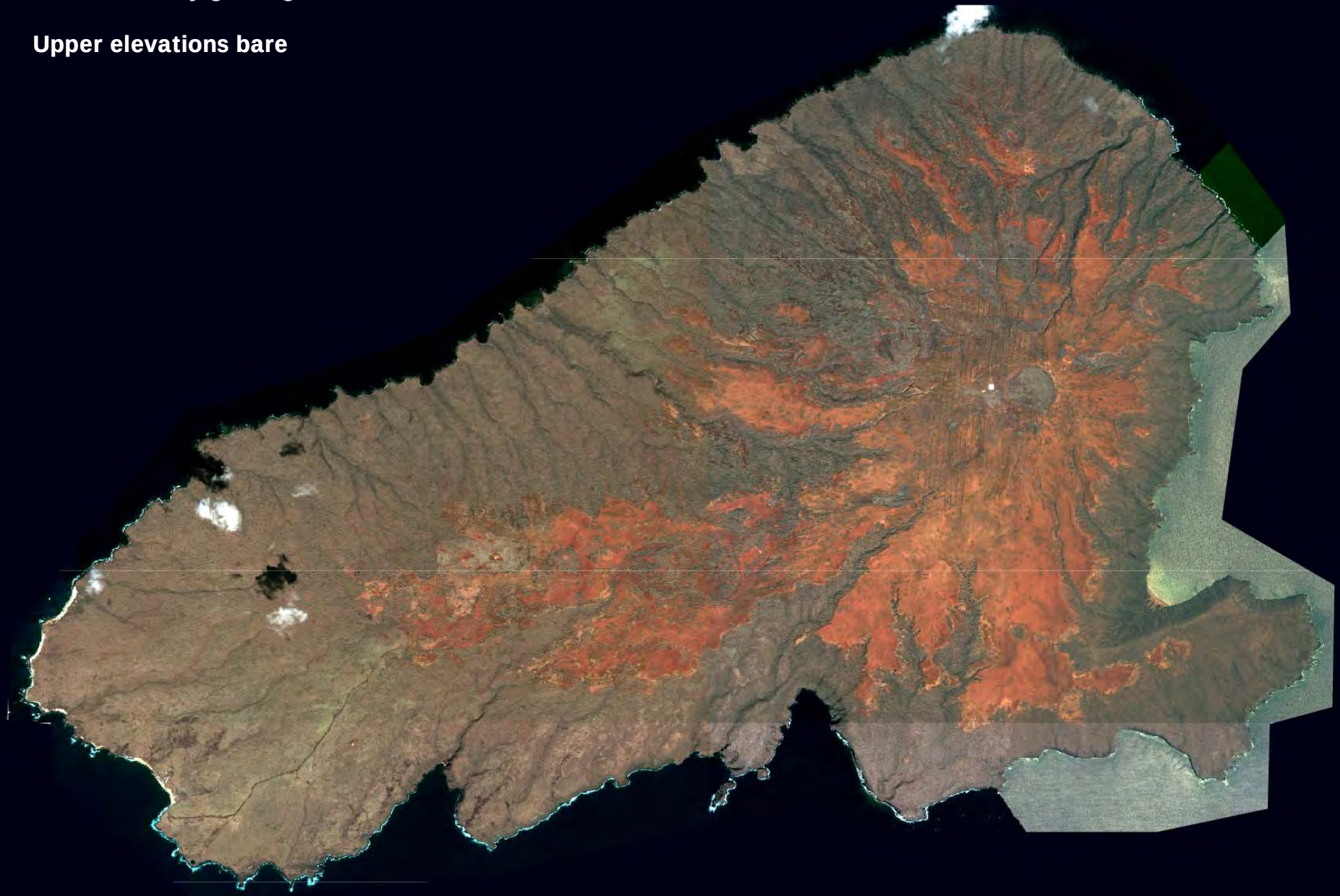
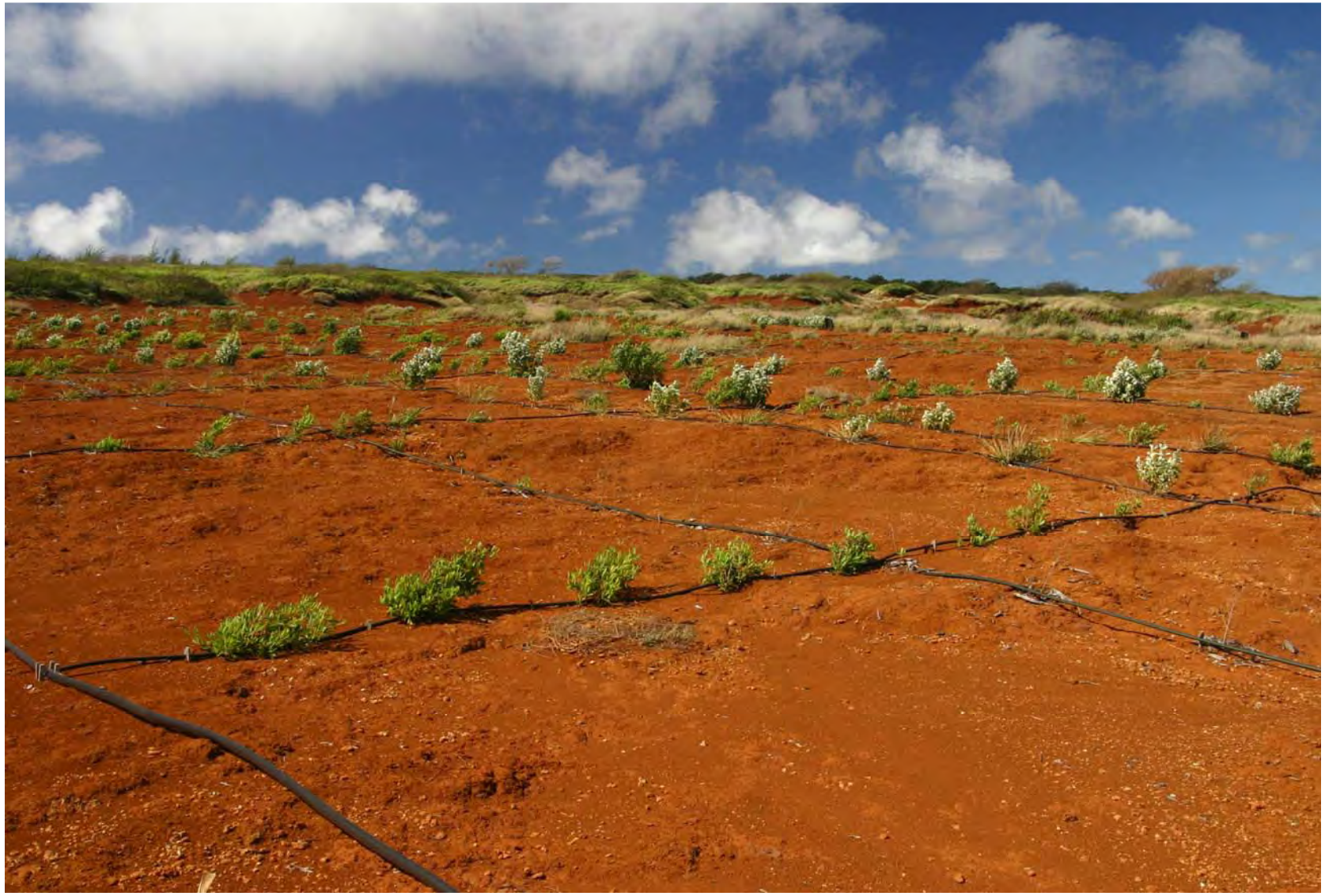
Denudation by grazing

Upper elevations bare



Restoration Efforts



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Motivation for Study

Need to assess effectiveness of restoration efforts in reducing erosion on Kaho‘olawe

Objective

Monitor erosion and sediment transport in Hakioawa and Kaulana watersheds, which are currently undergoing restoration

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Approach

Periodic measurements of soil erosion at selected locations (both in restoration and non-restoration areas)

Monitor streamflow and suspended-sediment discharge at mouths of streams

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Helicopter View of Bare Area

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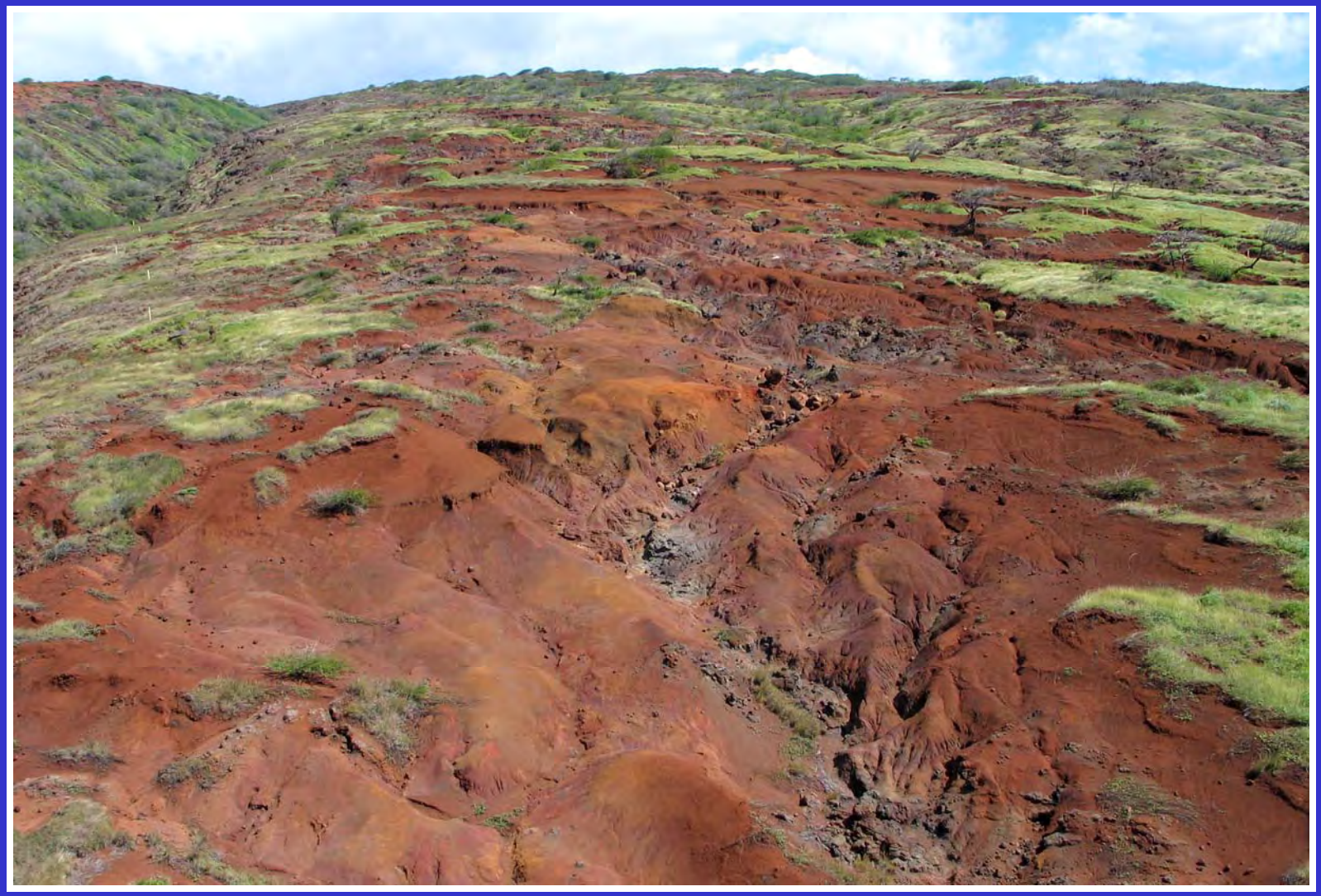
Badlands



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Badlands Erosion in Soft Material

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Pedestal Rocks

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Upper Horizon is Removed in Many Areas

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Erosion Monitoring Method

Install transects (“pins”)

Measure ~ every 6 months for 3 years

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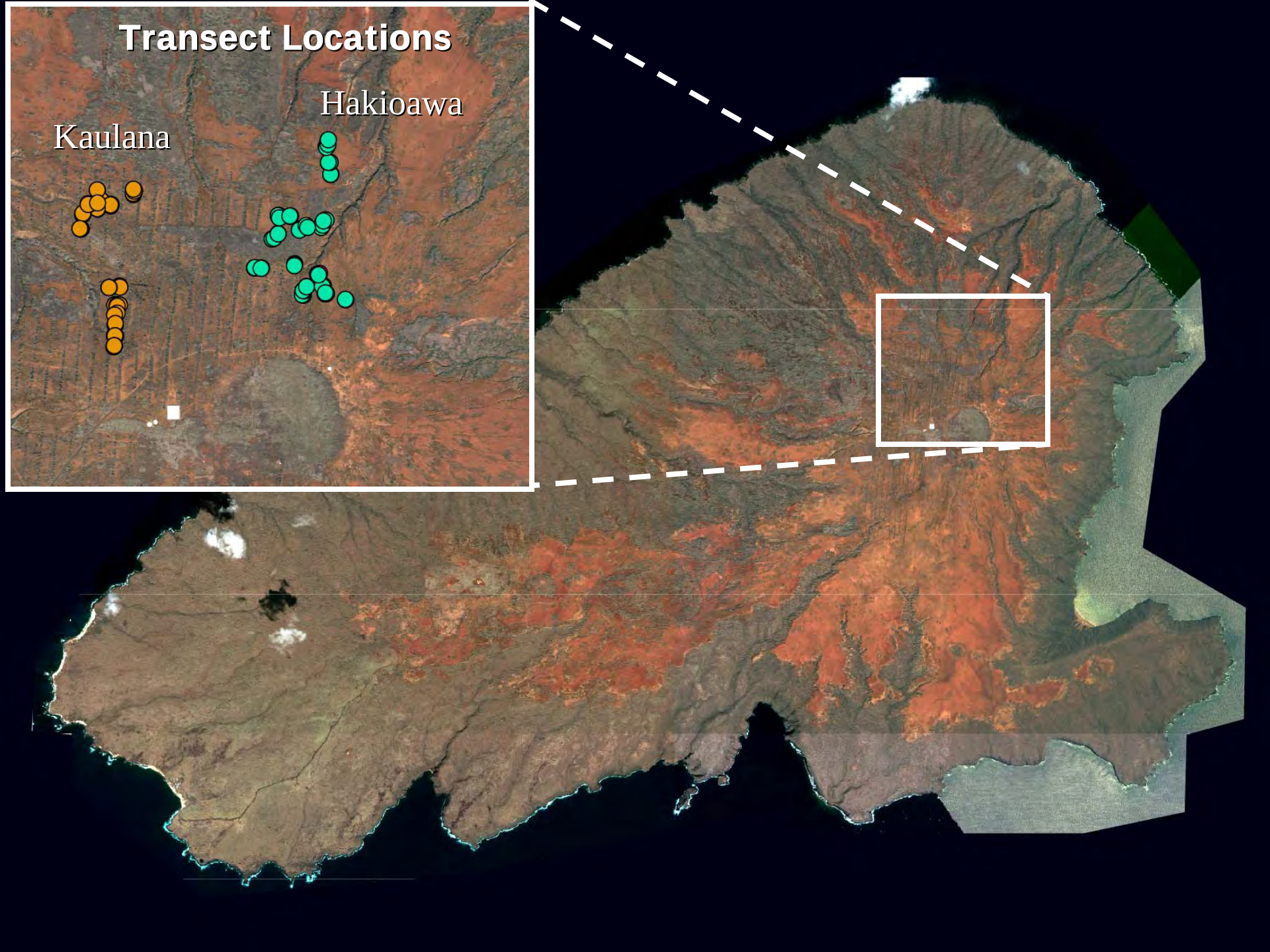
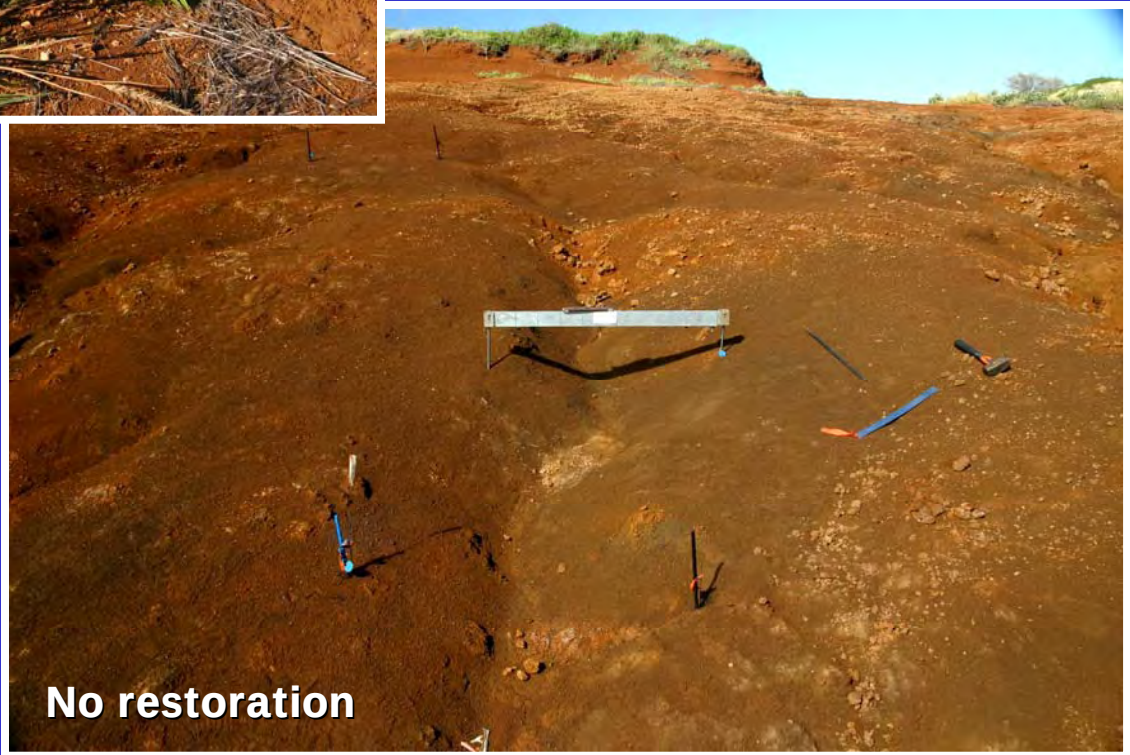

Transect Locations
Hakioawa
Kaulana



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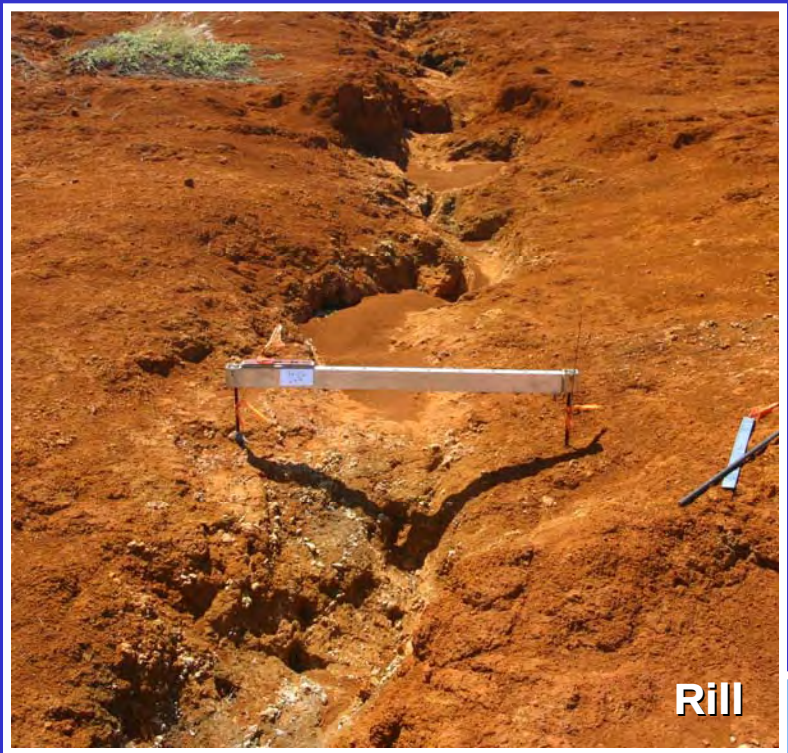

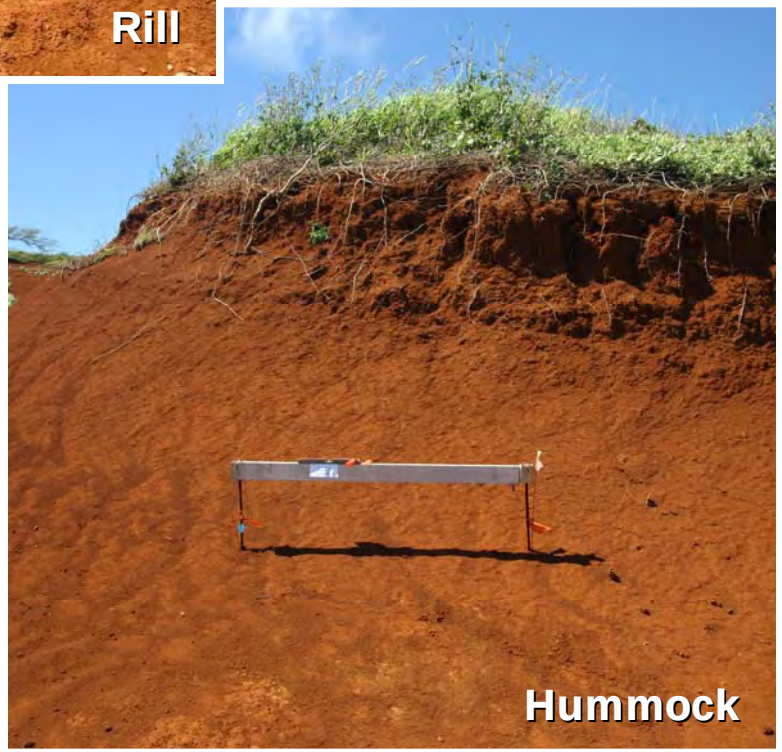

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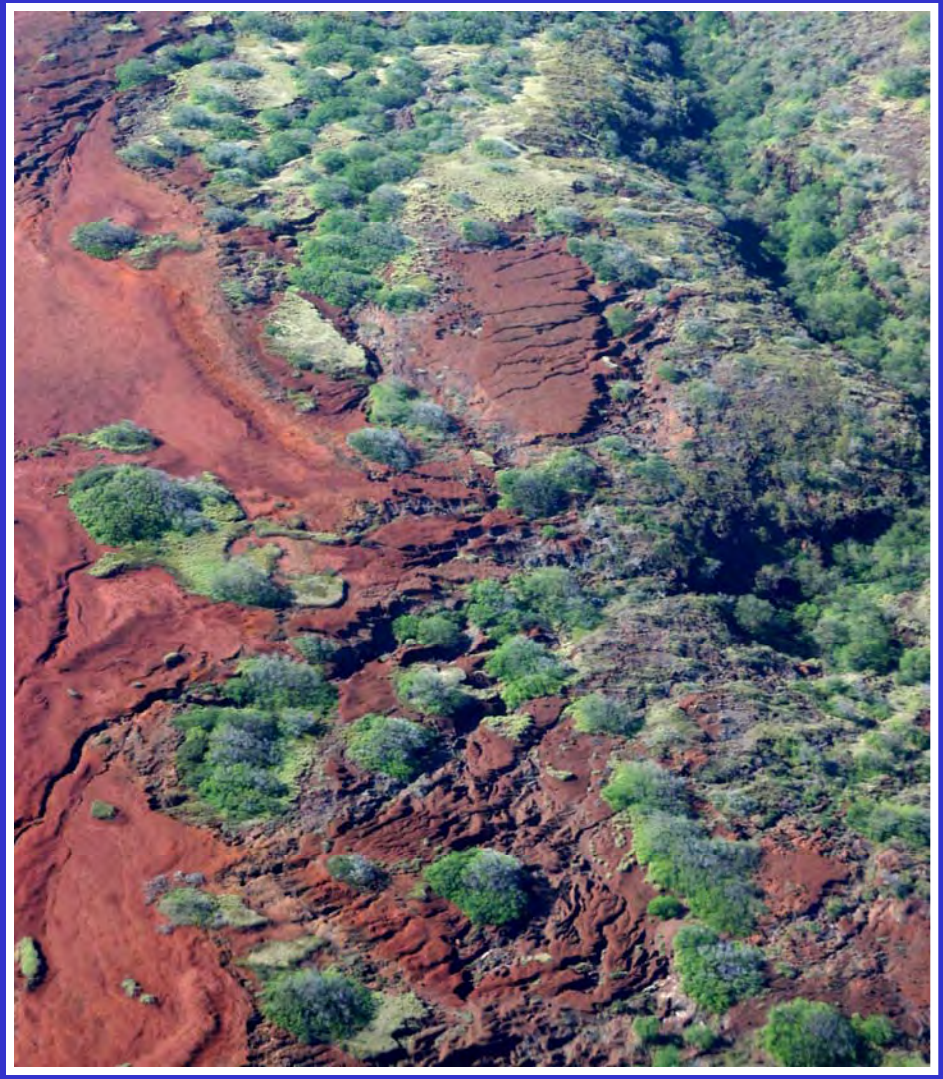
PRELIMINARY RESULTS



FIELD-MEASUREMENT DATES

1. January 2007
2. September 2007
3. March 2008

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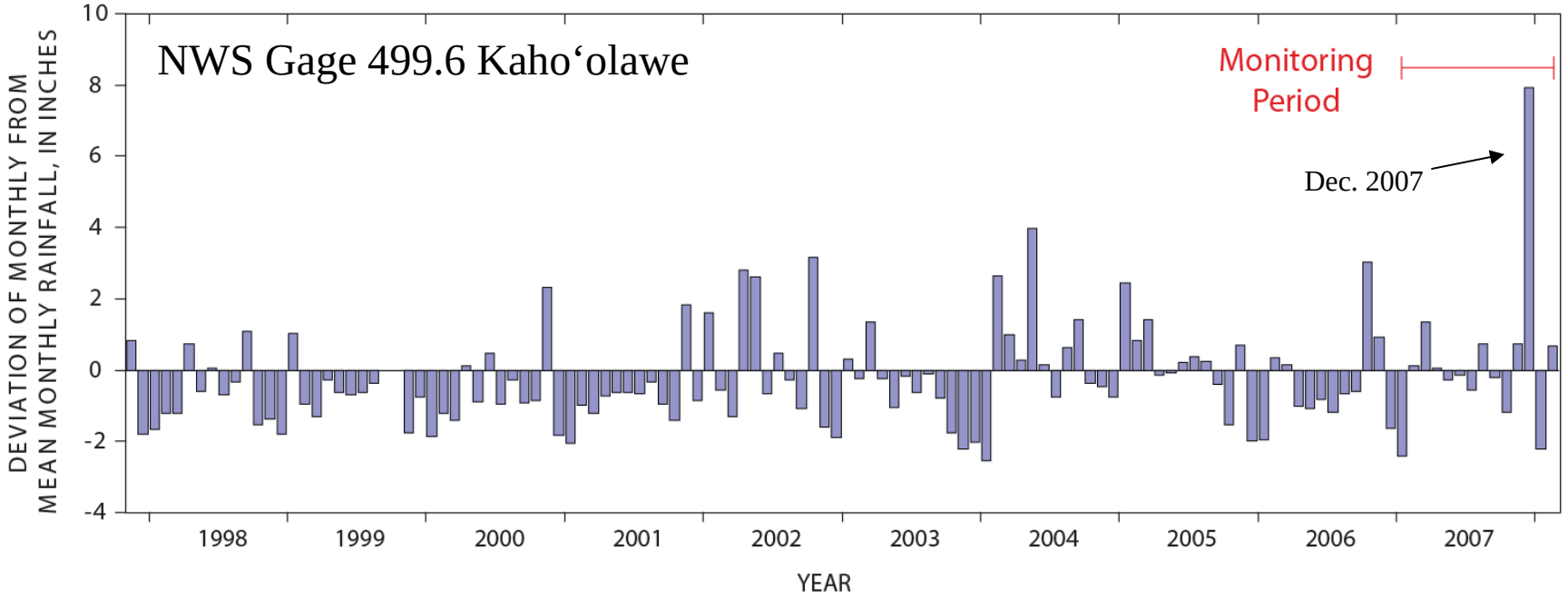
Rainfall During Erosion Monitoring



Data from National Climatic Data Center and National Weather Service (Data after November 2007 is preliminary and subject to change)

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Change Between January 2007 and March 2008

(negative = erosion)

Average Change (mm/yr)			
Feature	Restoration started	No Restoration	All
Rill	7	-2	0
Interfluve	0	-1	-1
Hummock	NA	-6	-6
All	2	-2	-1

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Statistical Significance?

Erosion rate of restoration sites was statistically less than that of non-restoration sites (one-tailed test, 95% confidence interval)

Erosion rate of rills was not significantly different from that of interfluves (two-tailed test, 95% confidence interval)

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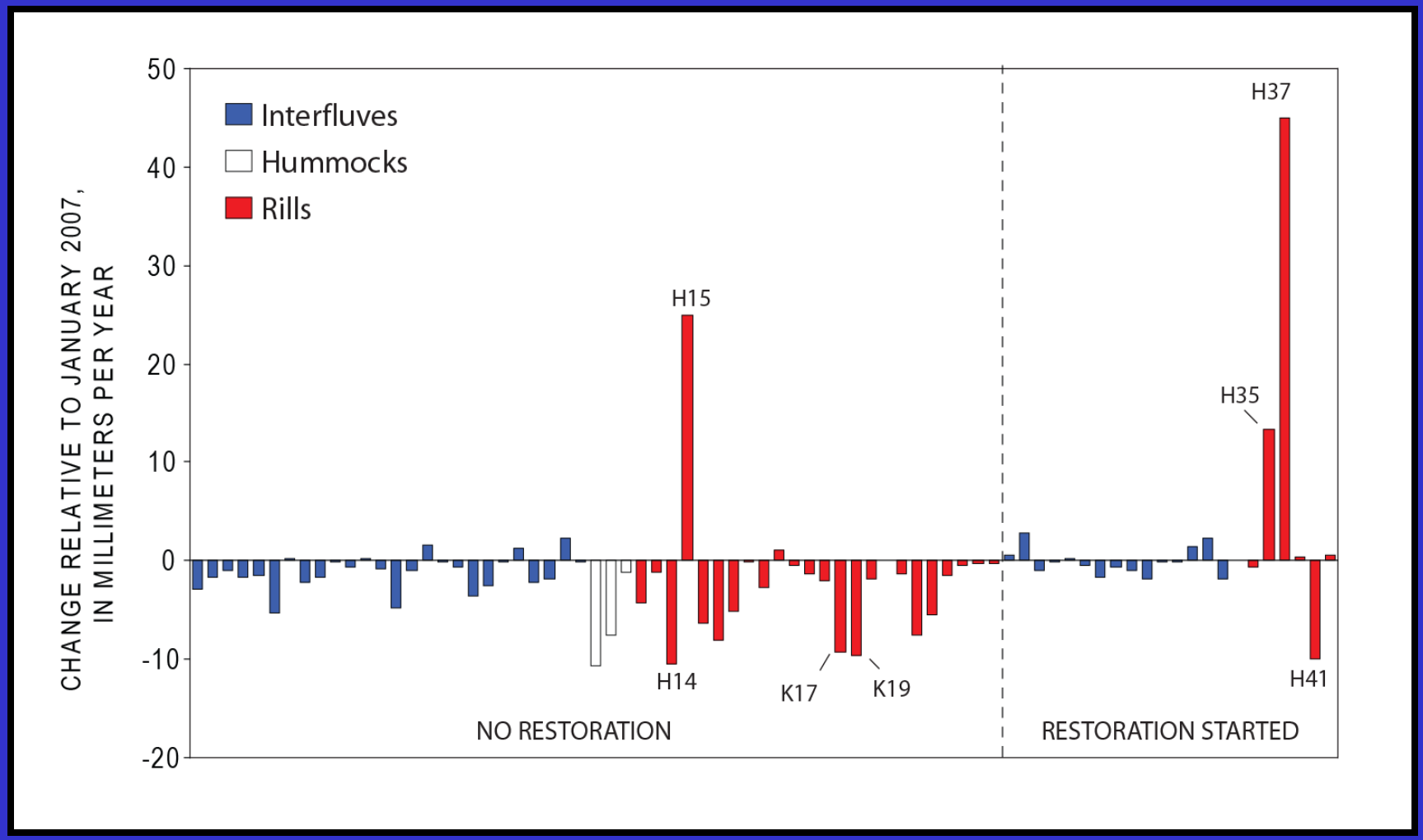
Even So, Rills Show Extremes of Erosion / Deposition



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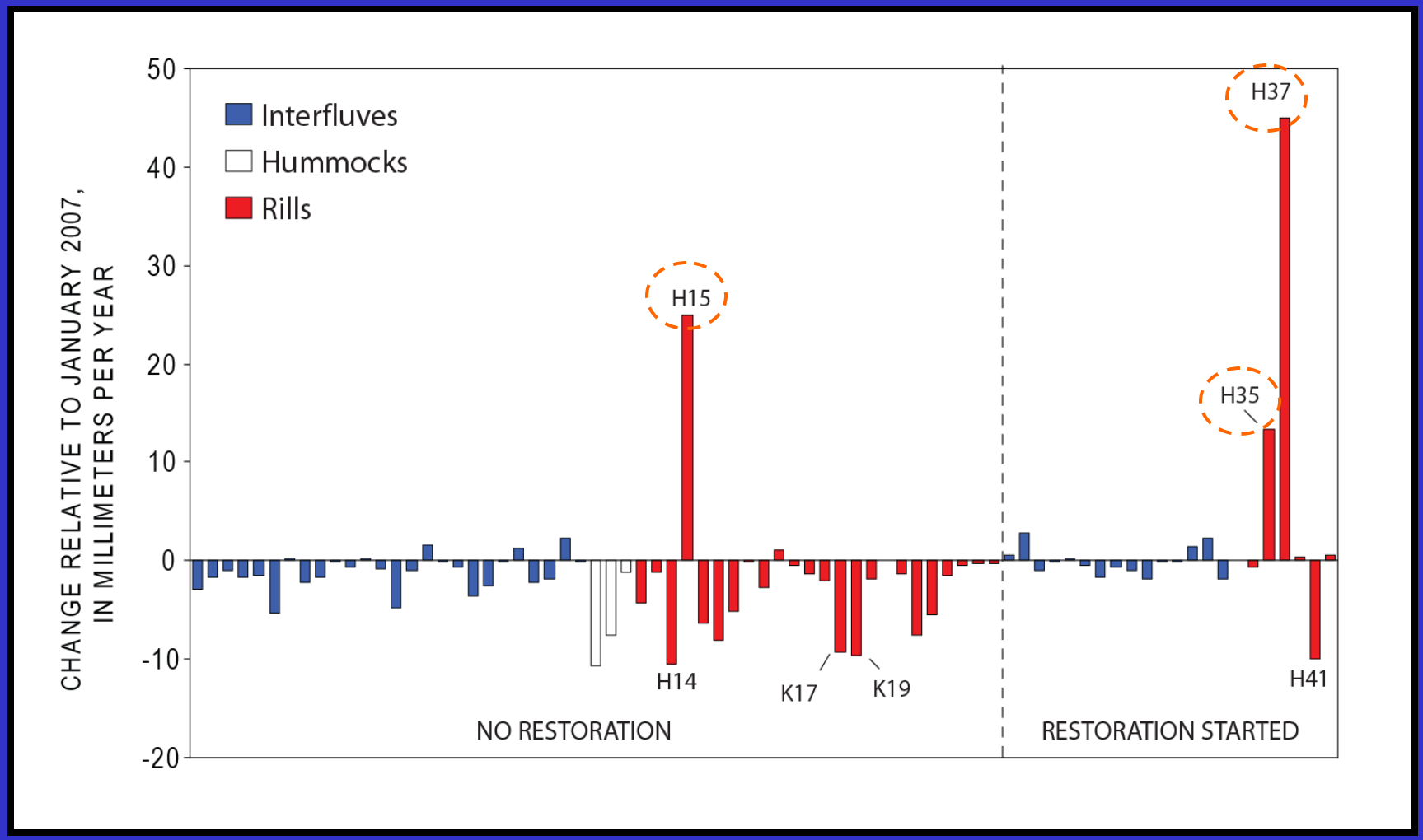
Sites with Greatest Deposition



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H15 – Sediment deposition in rill

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H35 – Deposition in rill caused by straw mulch

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H37 – Deposition in rill caused by plants

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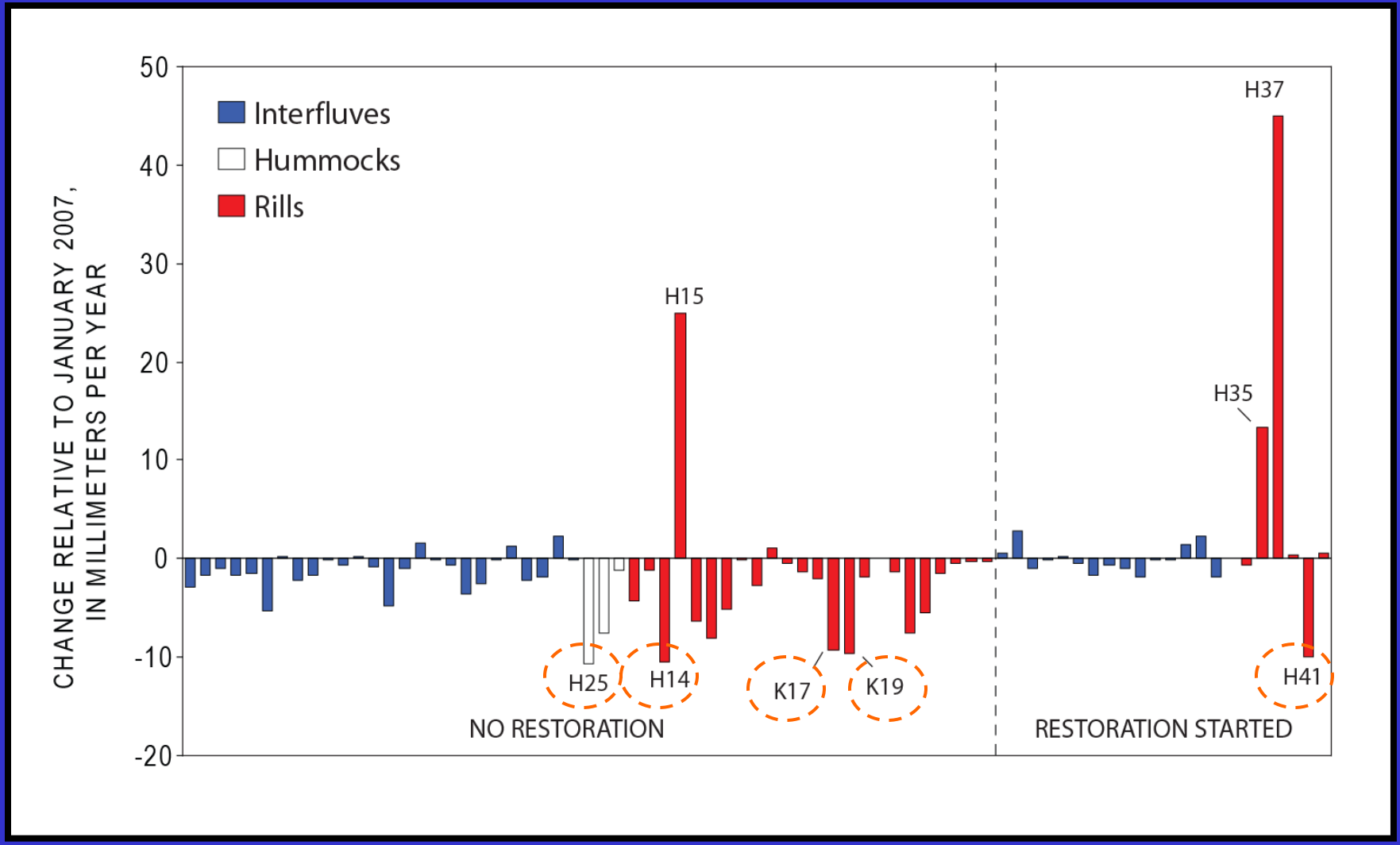
Sites with Greatest Erosion



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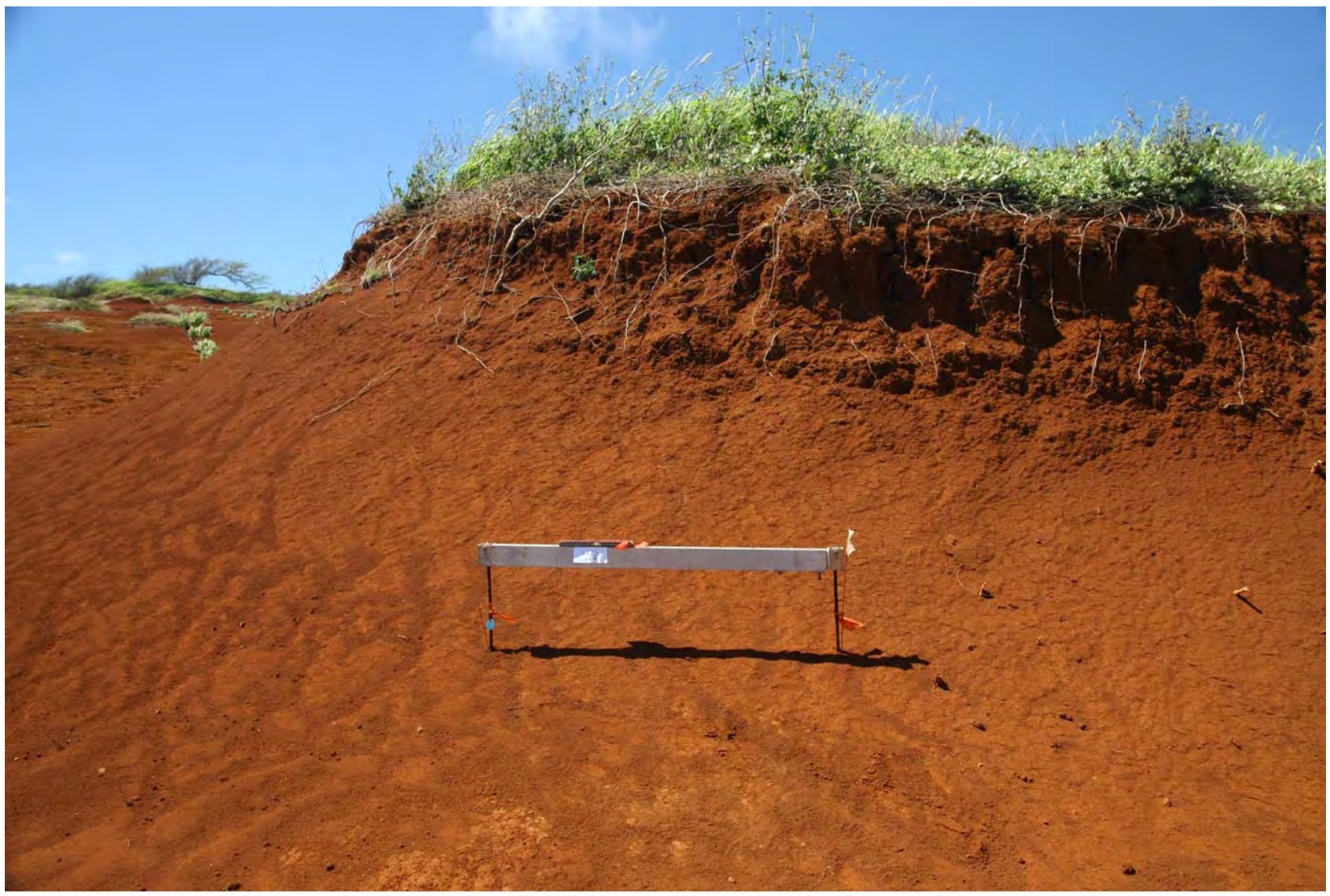
H25 – Erosion of hummock slope



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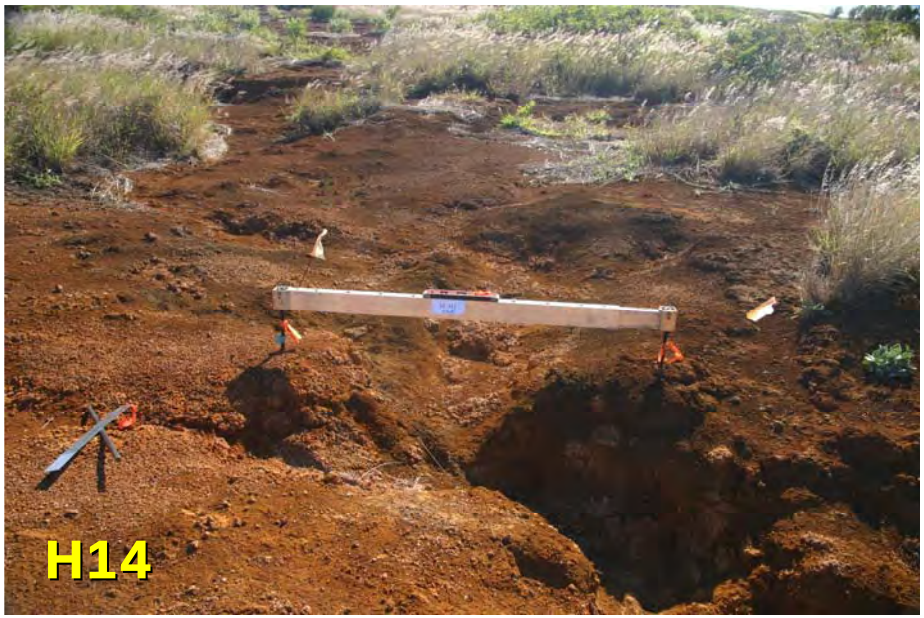
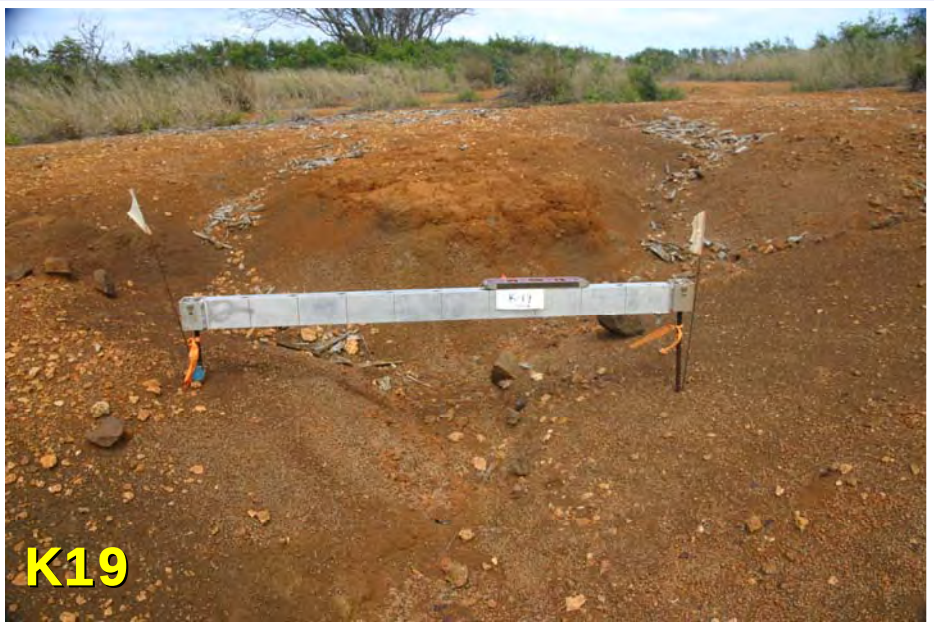
H14, K17, K19 – Rill erosion at non-restoration sites





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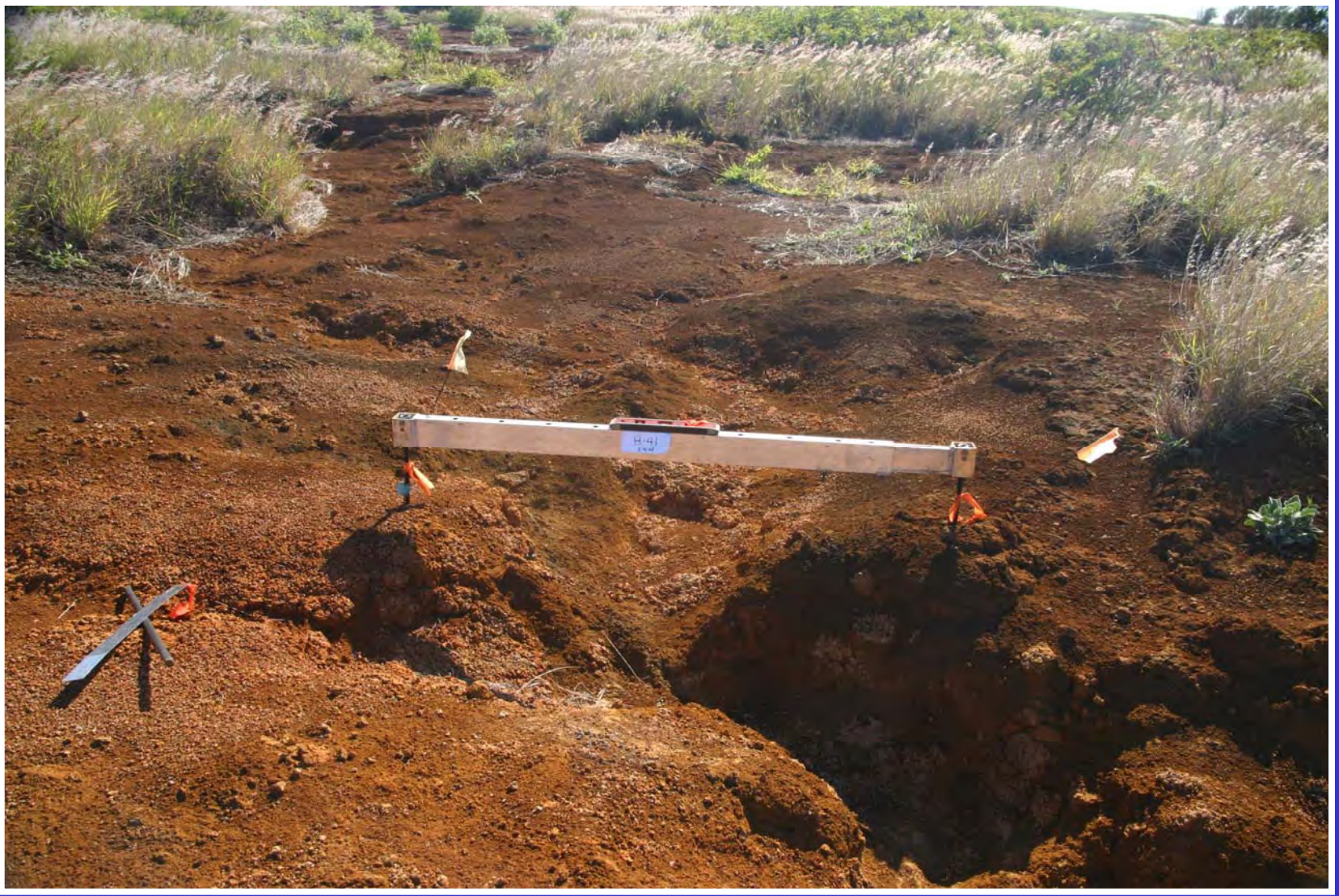
H41 – Rill erosion in restoration site



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Some Variation in Rills and Interfluves not Accounted for in Sampling Design

Are the transects representative of the entire watershed?

Assume that we have enough transects to eliminate bias in computed statistics

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Restoration Effect Likely to Mature over Time

Plants are small at present

Erosion rate likely to change in the future as plants grow

Erosion data collected today can be used basis for comparison in future

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Some Eroded Sediment Discharges to Ocean

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Stream Gage and Automatic Sediment Sampler Monitor Sediment Transport

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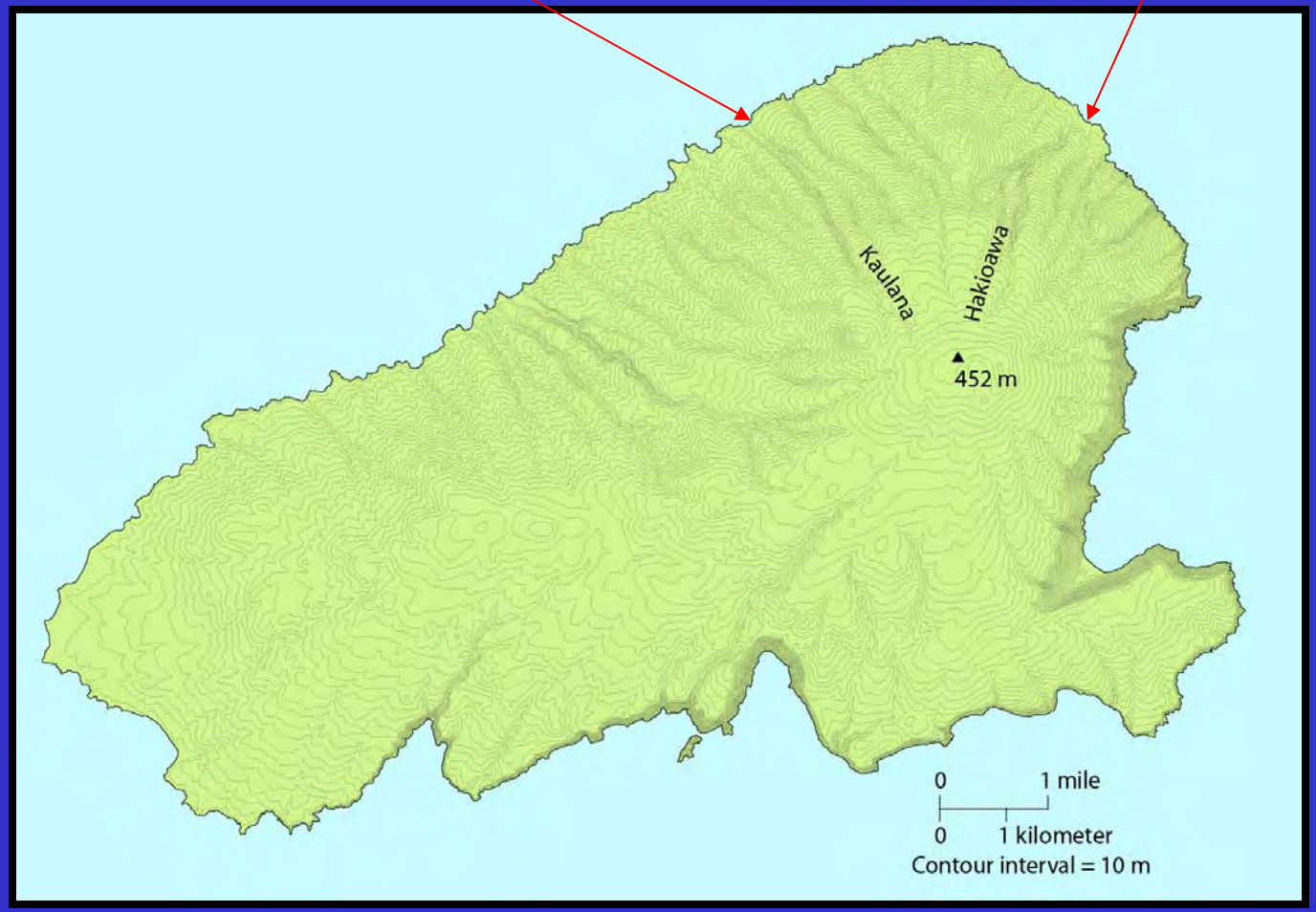
Sediment Discharge in Water Year 2007
(October 2006 through September 2007)

Kaulana:
400 tons

Hakioawa:
Data not yet available



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Preliminary Observations

Rills show extreme variability in deposition and erosion

Erosion rate less extreme in interfluves but mean is not statistically different from rills

Erosion rate high in hummocks

Erosion rate statistically lower in restoration than in non-restoration areas (but there is question of whether transect data are representative of the whole watershed)

Erosion rate is likely to change as plants grow; data collected today can be basis for comparison with a future study

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