

A person wearing a black tactical vest and a black ballistic herbicide applicator is shown in a lush green forest. The applicator is a large, black, cylindrical device with a blue handle and a black nozzle. The person is holding the applicator and aiming it towards a tree trunk. The forest is dense with green foliage, including ferns and large-leafed plants. The background is filled with more trees and vegetation, creating a dense canopy.

Reducing the Nascent Patch Network of Miconia (*Miconia calvenscens* DC) with an Accelerated Intervention Strategy Utilizing Herbicide Ballistic Technology (HBT)

For video rendition please visit:

<http://www.youtube.com/watch?v=988i6SQKSzY>

Invasion Biology of *Miconia*

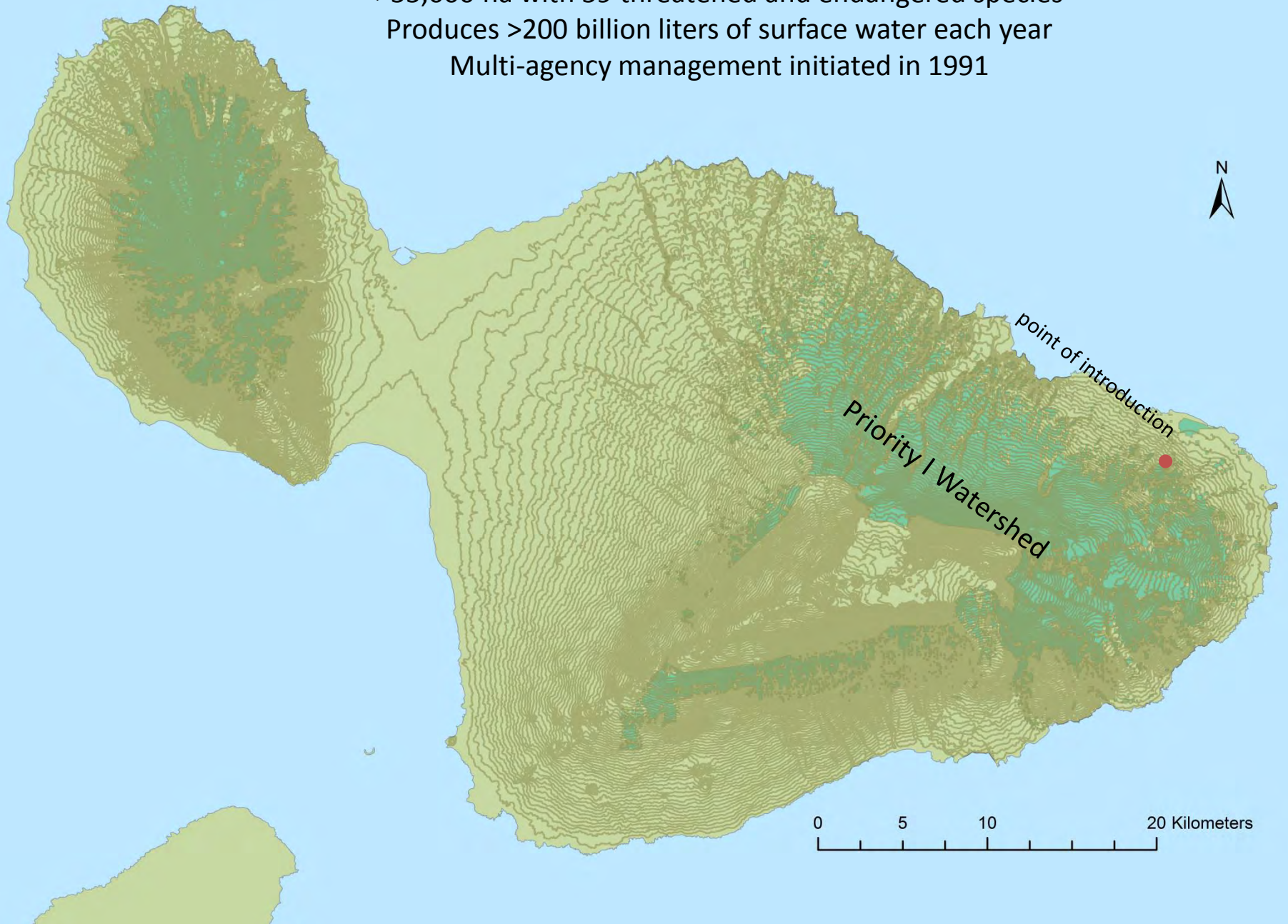
- *Miconia* (*Miconia calvescens* DC)
 - An autogamous (self-fertile) species
 - Millions of seed produced by a single tree
 - Small, edible fruit dispersed by birds
 - Dispersal range >1000 m
 - Seed bank viability >20 years
 - Germination in heavy shade
-
- **A SINGLE MICONIA PLANT CAN IMPACT >1000 HA OF PROTECTED WATERSHED!**



Meyer, J-Y. 1998. Observations on the reproductive biology of *Miconia calvescens* DC (Melastomataceae), an alien invasive tree on the island of Tahiti (South Pacific Ocean). *Biotropica*. 30: 609–624.

Murphy, H.T., B.D. Hardesty, C.S. Fletcher, D.J. Metcalfe, D.A. Westcott, S.J. Brooks. 2008. Predicting dispersal and recruitment of *Miconia calvescens* (Melastomaceae) in Australian tropical rainforests. *Biol. Inv.* 10: 925–936.

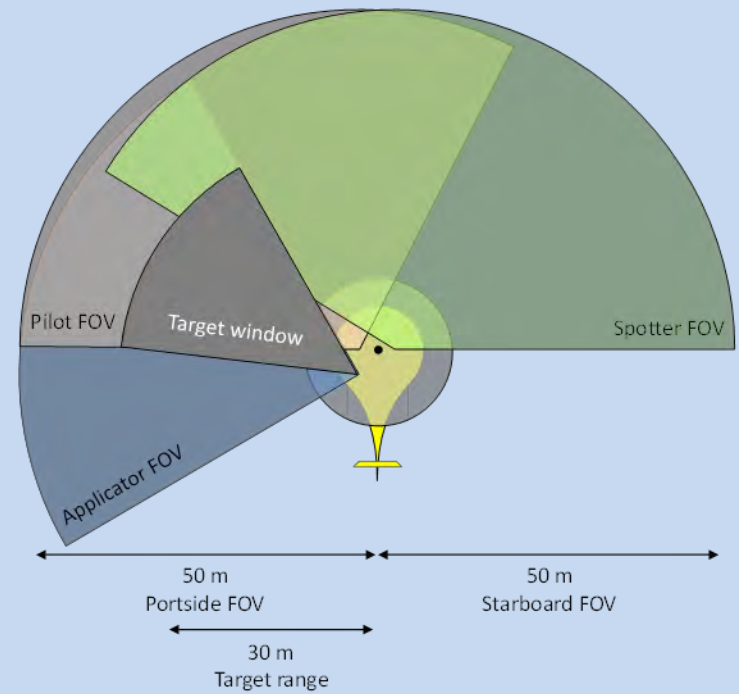
East Maui Watershed
>55,000 ha with 59 threatened and endangered species
Produces >200 billion liters of surface water each year
Multi-agency management initiated in 1991



Mission: Conduct interventions on high-value satellite target populations



Photo: C. Duncan

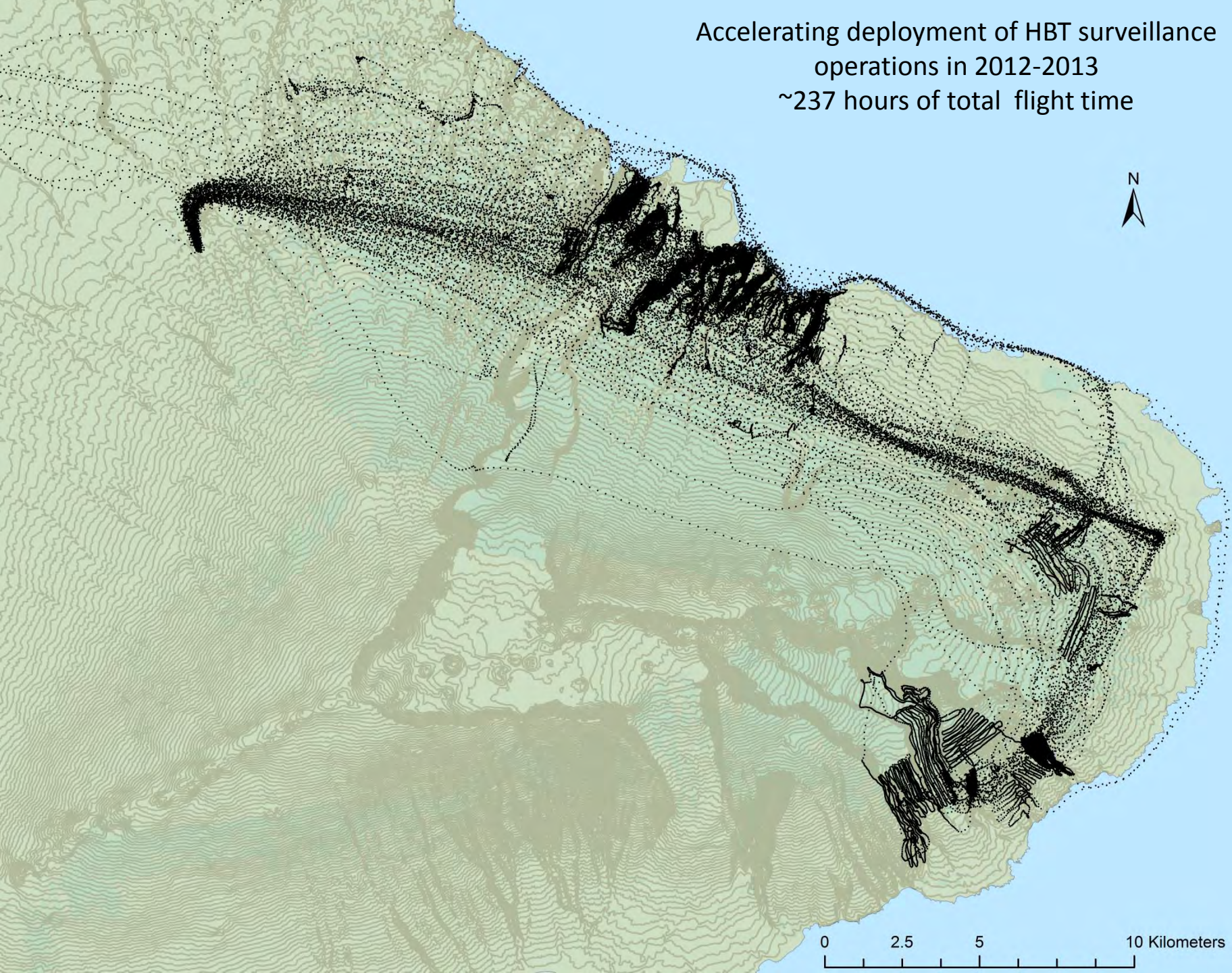


Crew: Portside pilot/applicator + front starboard navigator creating a 220° FOV



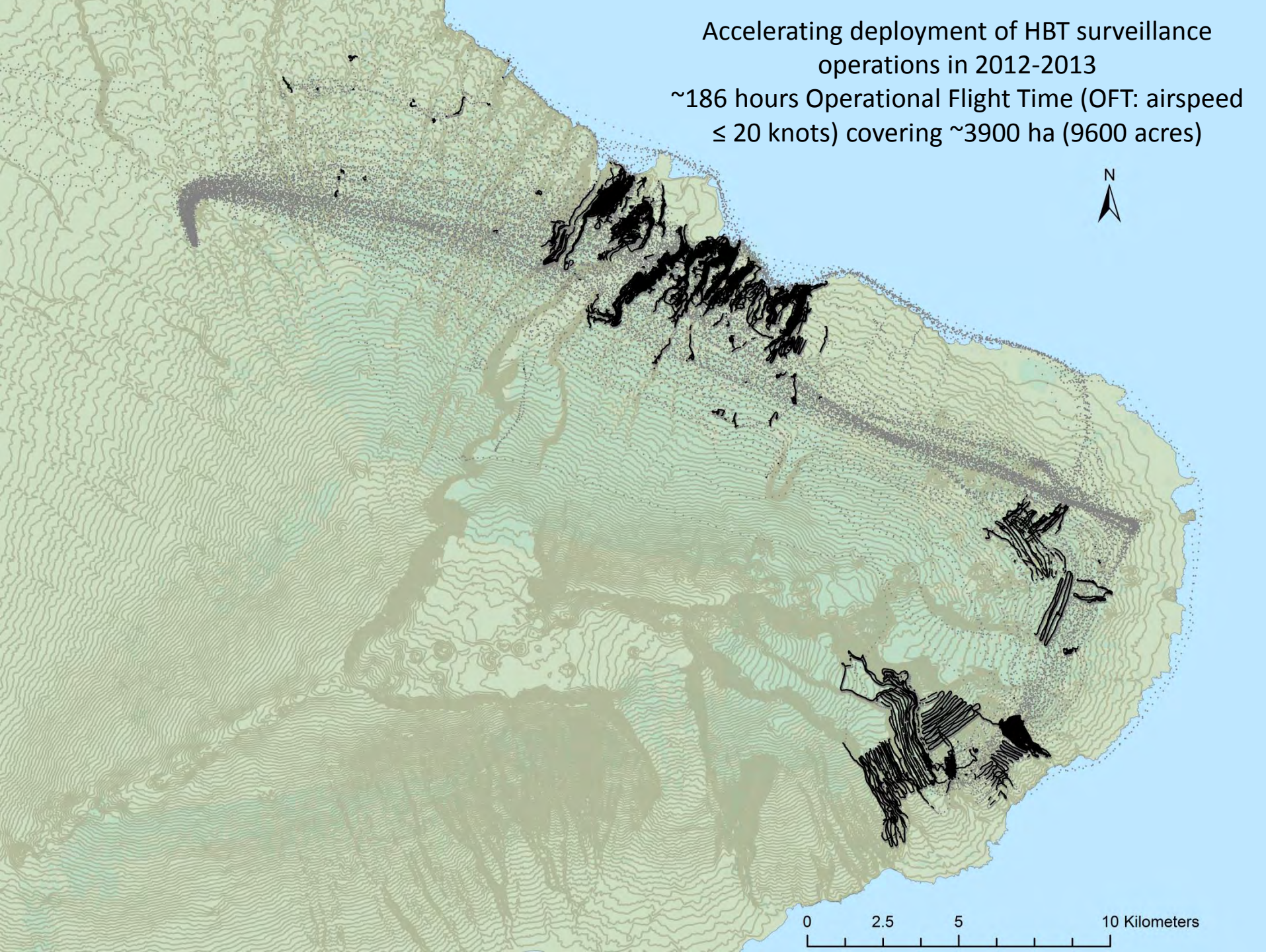
Treatment: 0.68 caliber soft gel projectiles encapsulating 199.4 mg triclopyr (HBT-G4U200)

Accelerating deployment of HBT surveillance
operations in 2012-2013
~237 hours of total flight time

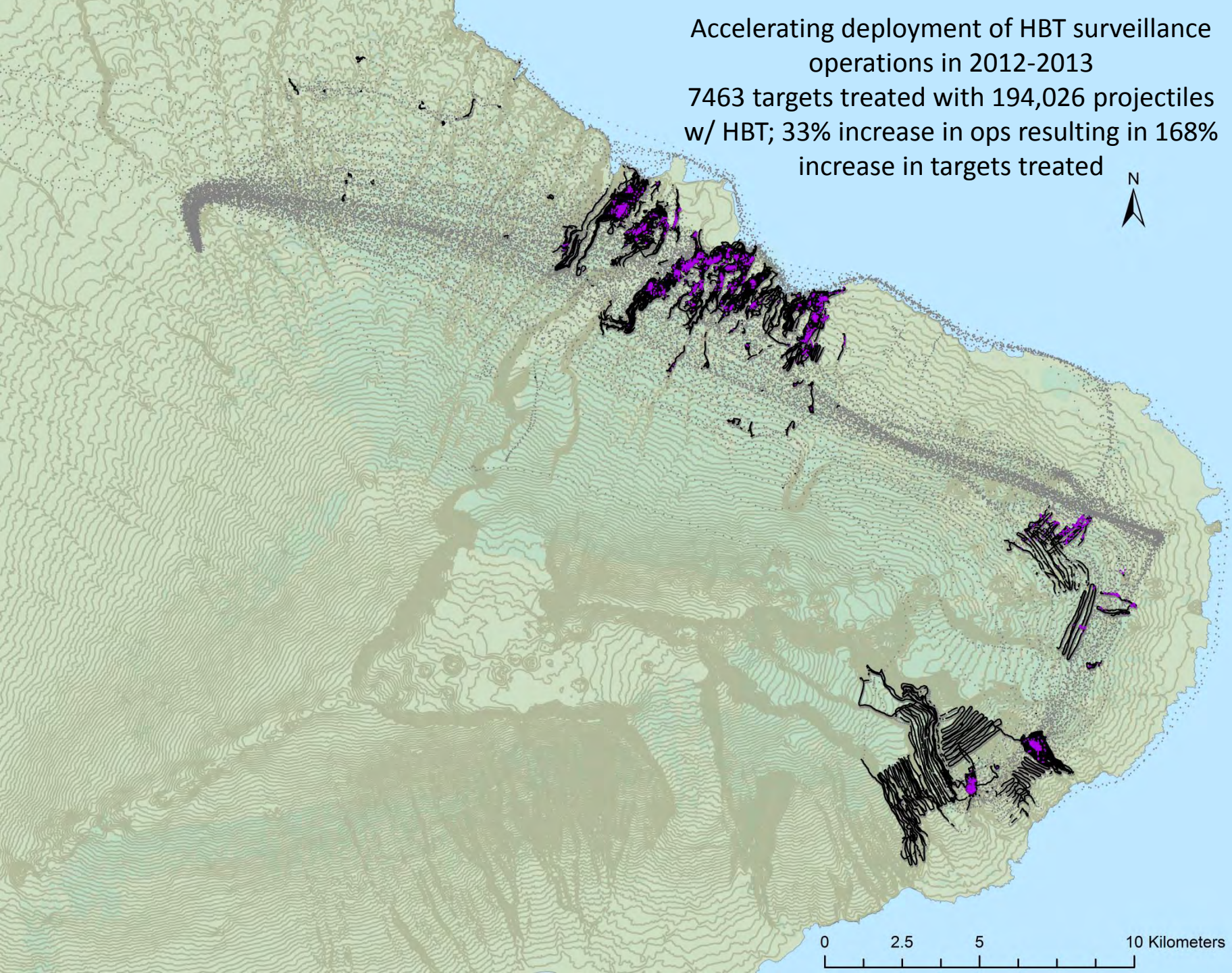


0 2.5 5 10 Kilometers

Accelerating deployment of HBT surveillance
operations in 2012-2013
~186 hours Operational Flight Time (OFT: airspeed
≤ 20 knots) covering ~3900 ha (9600 acres)



Accelerating deployment of HBT surveillance
operations in 2012-2013
7463 targets treated with 194,026 projectiles
w/ HBT; 33% increase in ops resulting in 168%
increase in targets treated

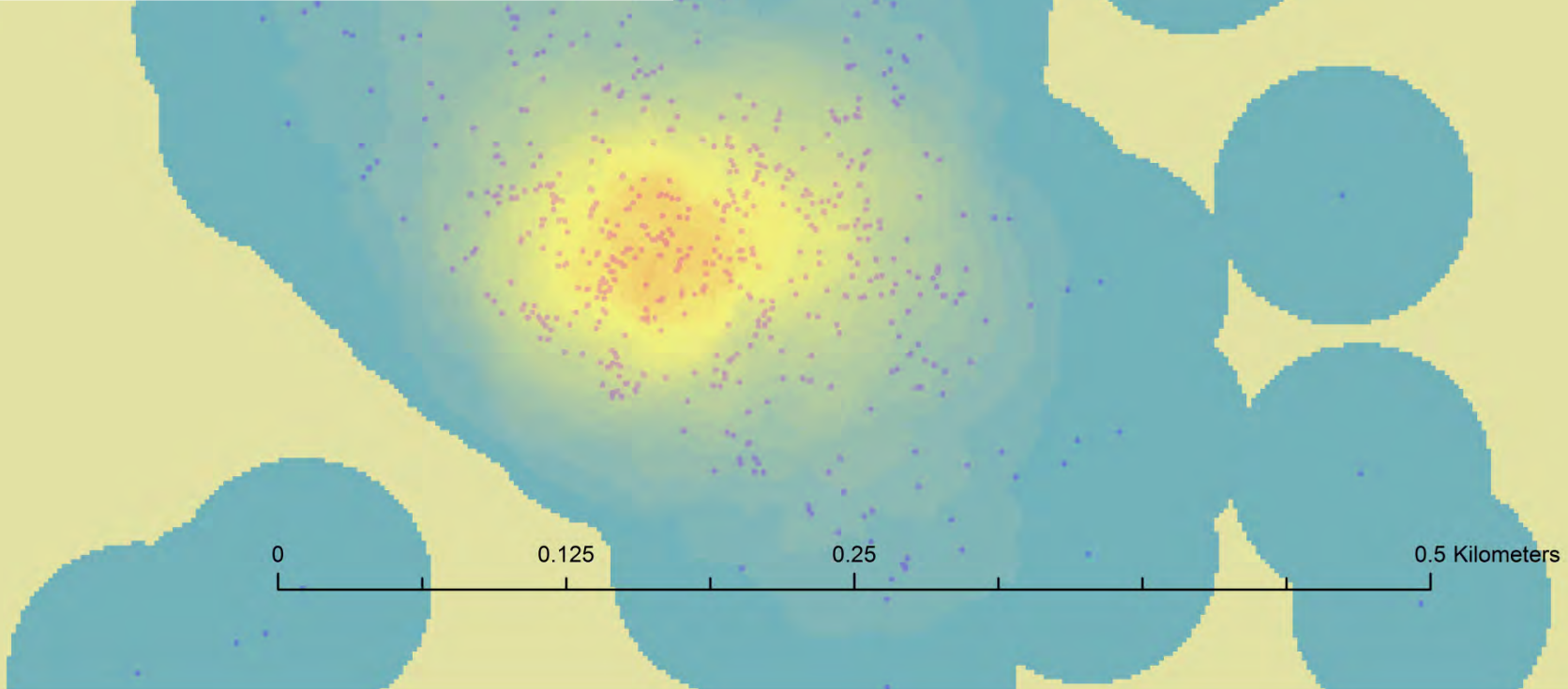
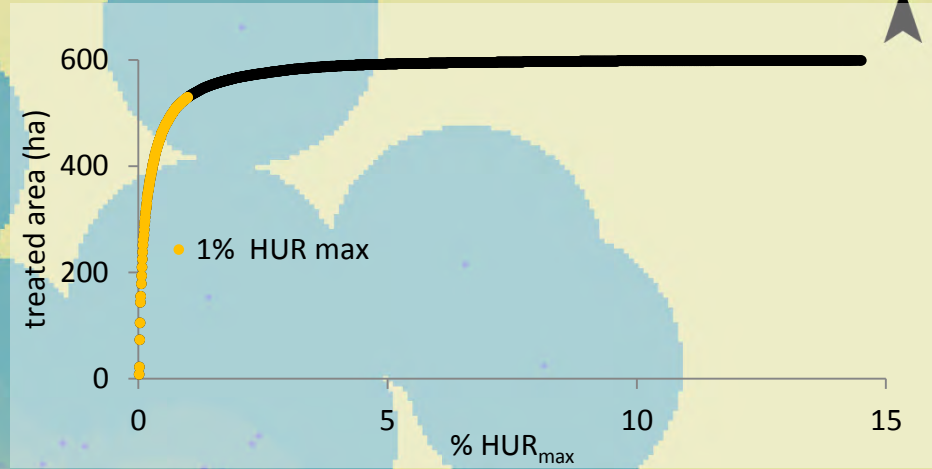
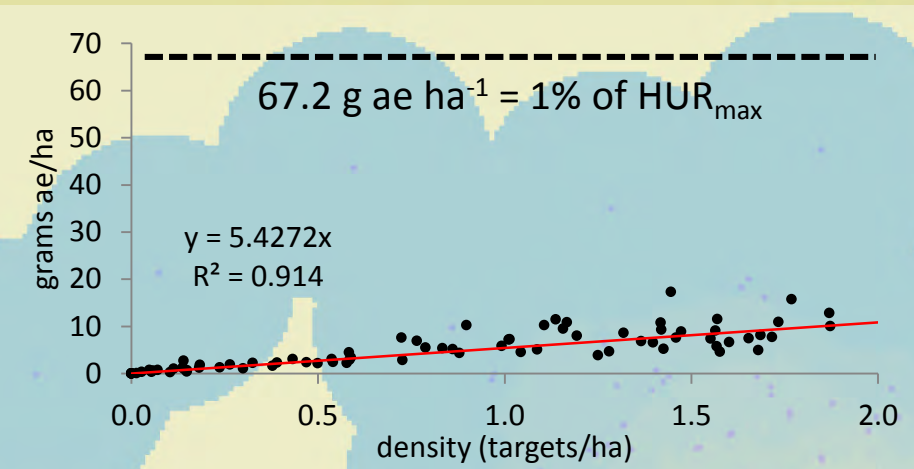


0 2.5 5 10 Kilometers

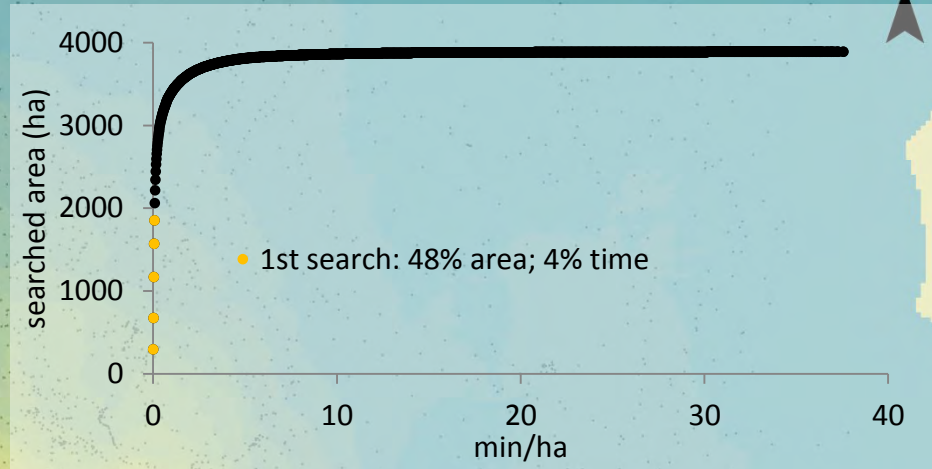
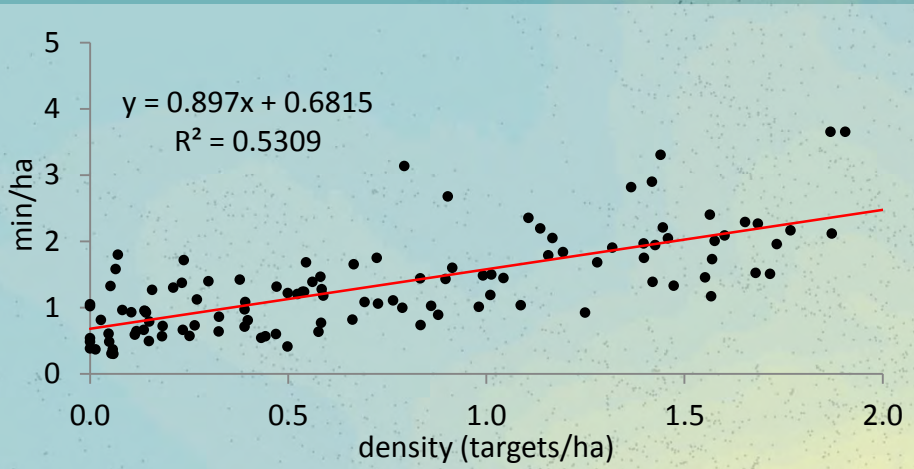
A surgical herbicide delivery technique = small footprint on the landscape

Mean herbicide dose is 5.42 grams ae = 28 projectiles target⁻¹

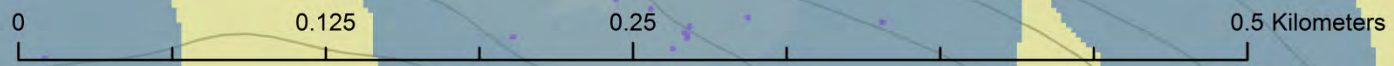
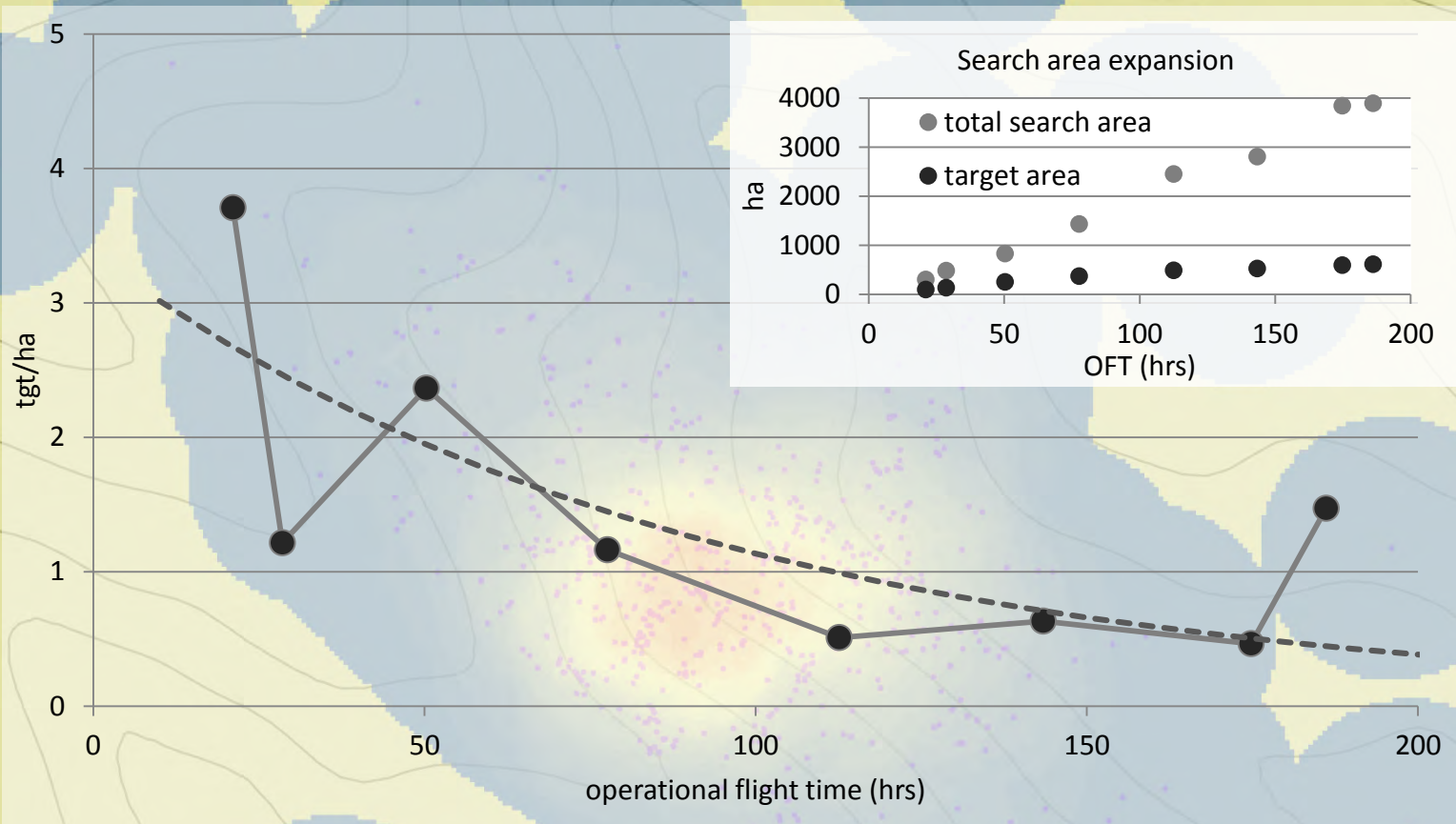
89% of total net treated area (~530 ha) = <1% of max herbicide use rate (HUR_{max}; 6.72 kg ae/ha)



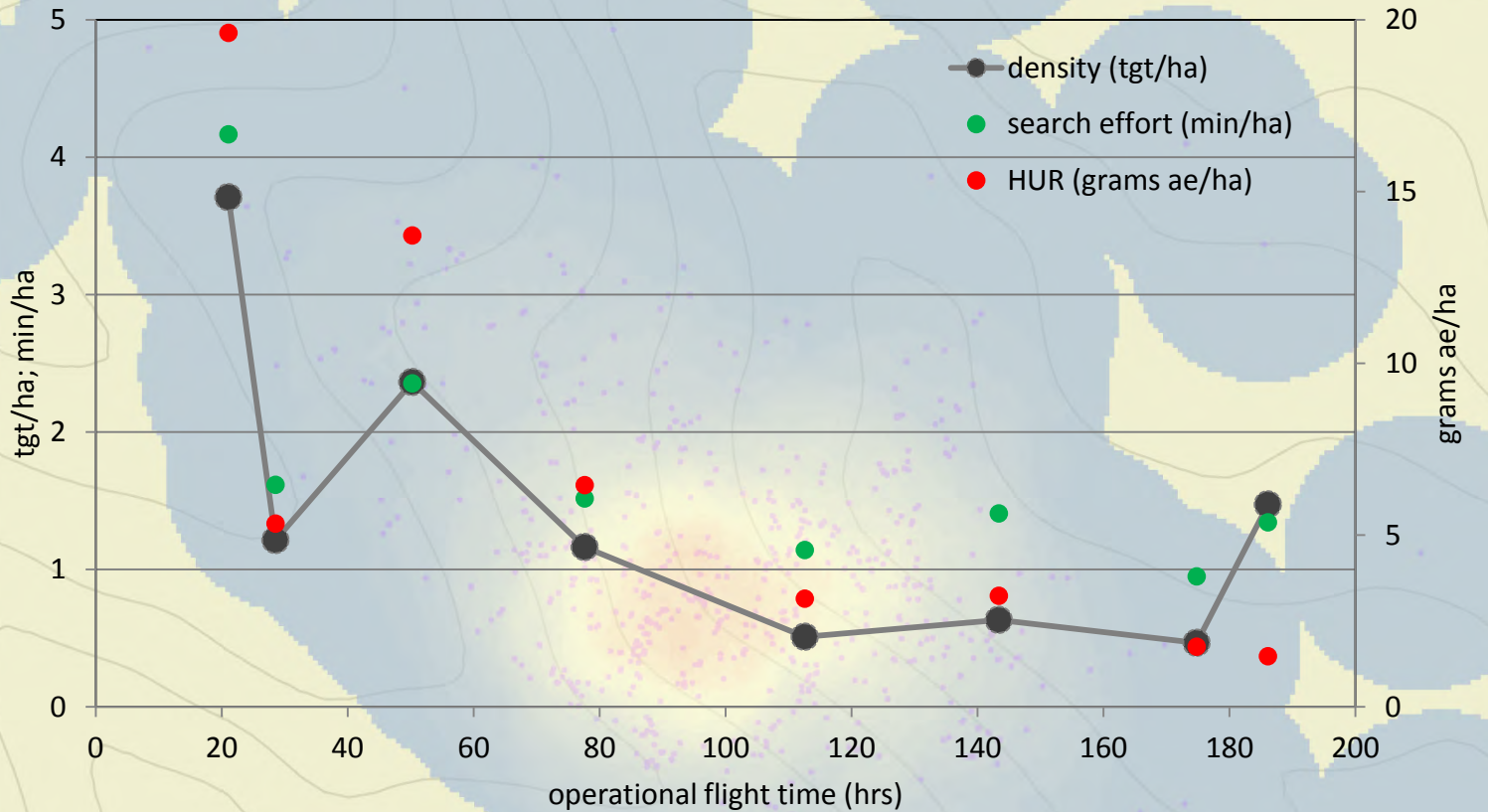
Search efficiency of an HBT surveillance operation
y-intercept = 40.9 sec ha⁻¹; slope = 53.8 sec target⁻¹
48% of total net area (~1850 ha) searched with only 4% OFT



Target density reduction fits exponential decay function
1% decay rate with 60% target density reduction; reduction half-life = 64 hrs OFT
Delimiting process expanding search area beyond known target locations



Operational performance improves with accelerated schedule
Herbicide use rate (grams acid equivalent) reduced 92.5%
Search efficiency improved by 68%

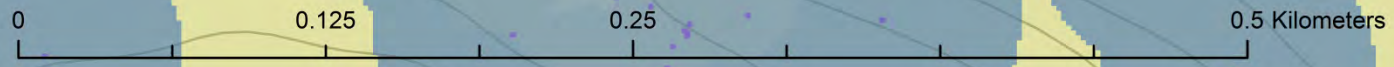
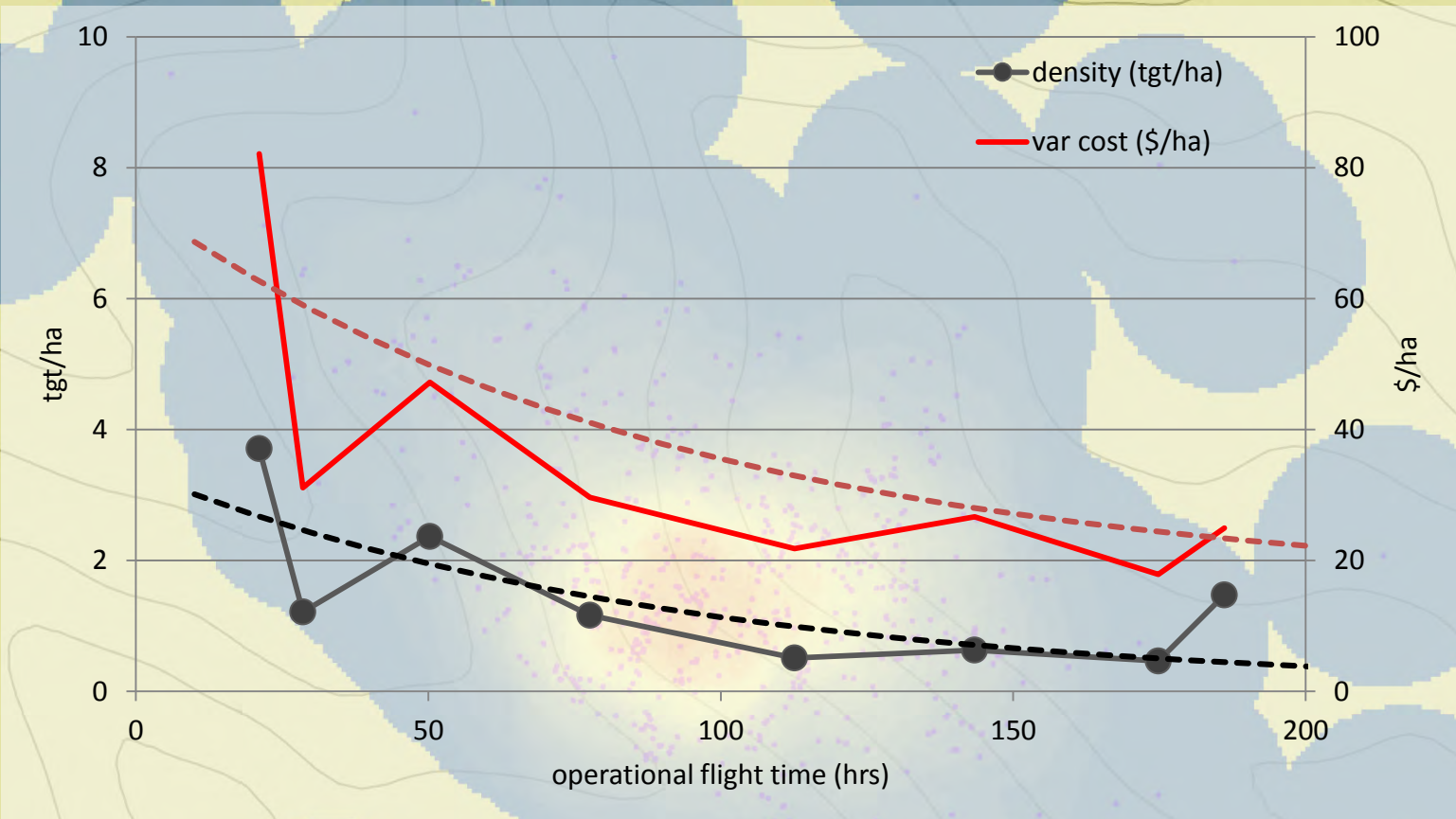


0 0.125 0.25 0.5 Kilometers

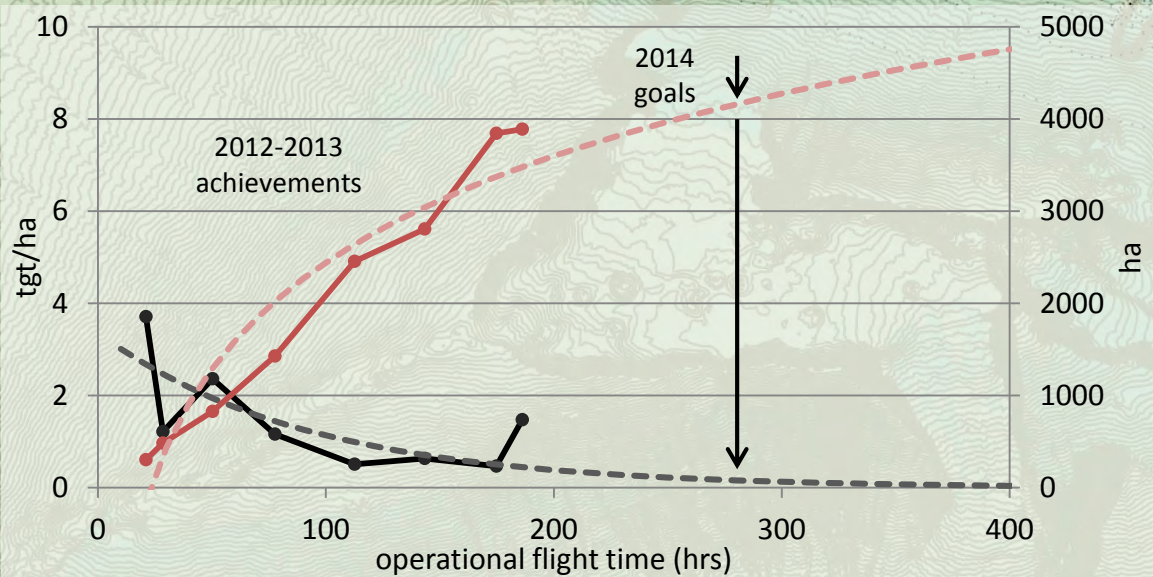
Reducing variable cost of operations

$$\$(ops) = TD * [(SE * OFT (\text{heli} = \$16.68/\text{min}; \text{3-person crew} = \$1.22/\text{min}) + (PTE * (\$0.31/\text{projectile}))]$$

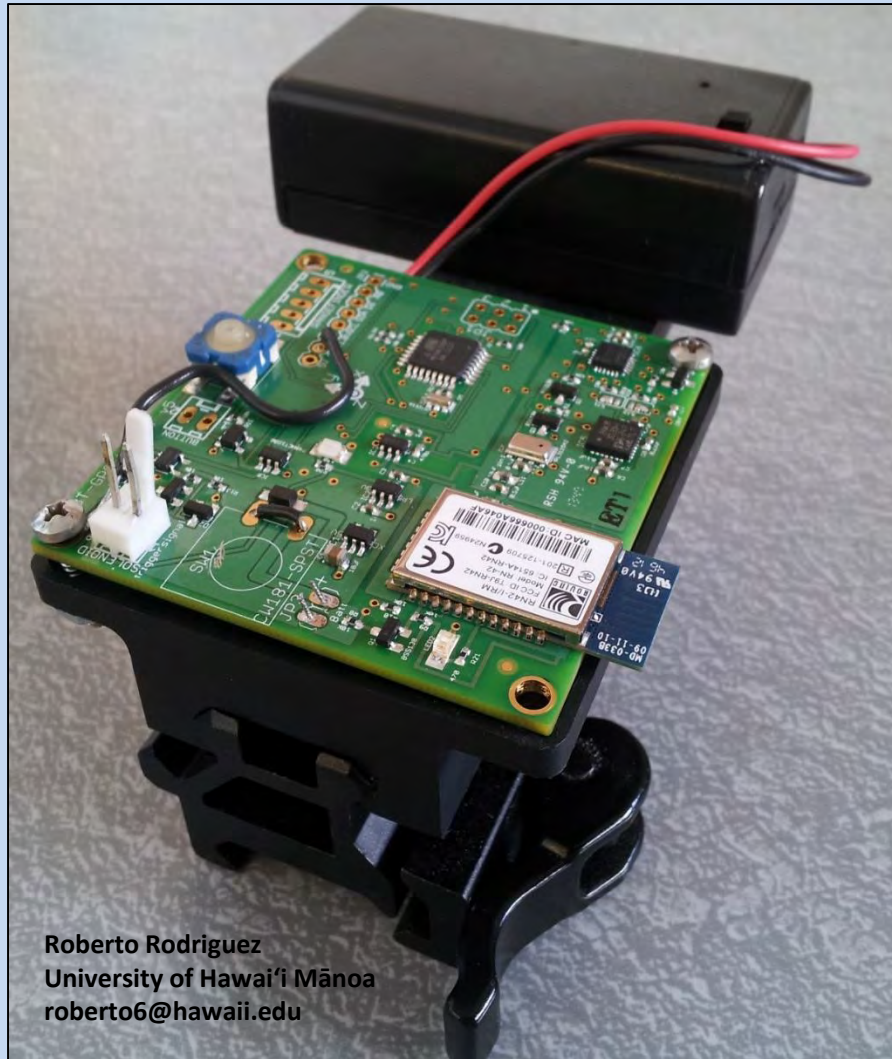
Variable costs of operation reduced 70%; **Protecting watershed at < \$10/acre!!!**



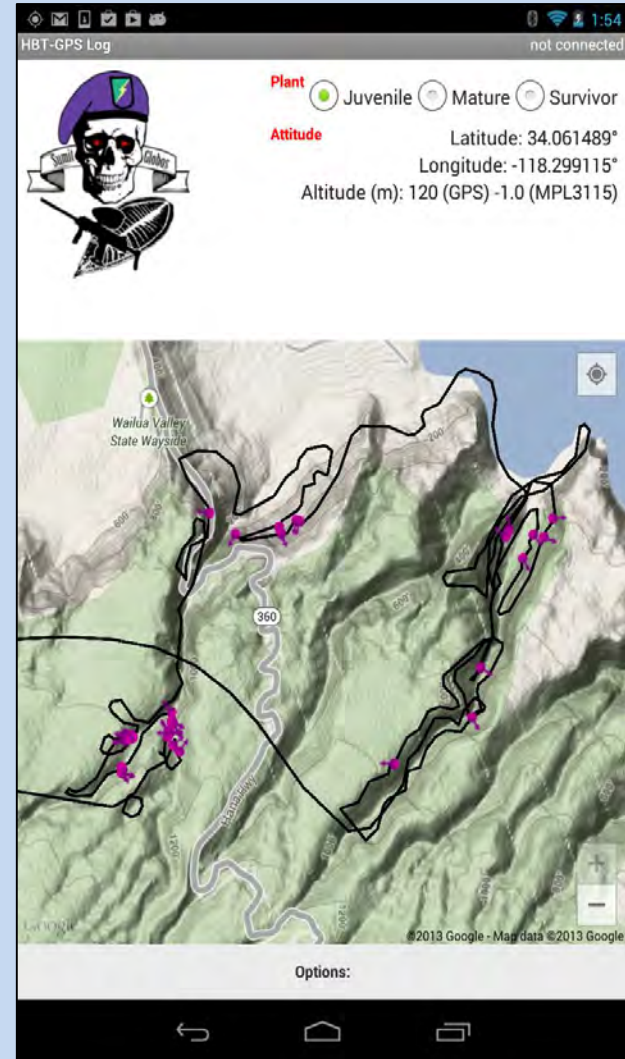
Projecting future goals
2012-2013 achievements: 60% target density reduction;
protected 3900ha
2014 goals: target density reduction >95%;
expand protection >4100 ha



Custom HBT sensor data logger system



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400

Improving spatial resolution (10m pixel res) of herbicide use rate

PRJ	9
ALT	834'
AZM	168°
TILT	-32.7°
DIS	130'

PRJ	8
ALT	844'
AZM	164°
TILT	-45.1°
DIS	130'

PRJ	19
ALT	834'
AZM	123°
TILT	-26.7°
DIS	170'

500

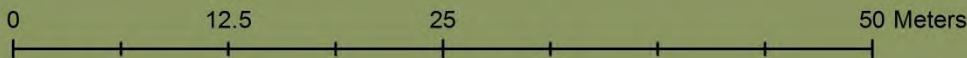
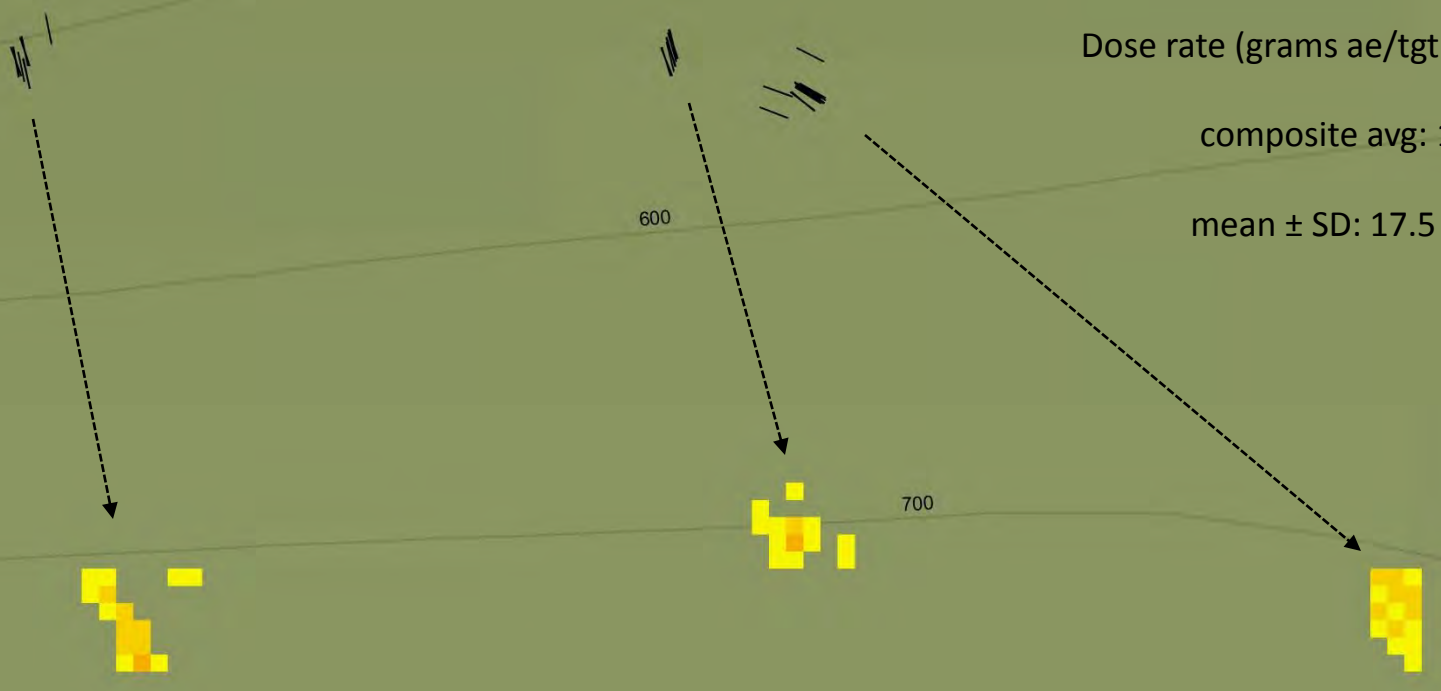
Dose rate (grams ae/tgt) for 142 TGTs

composite avg: 18.6 g

mean ± SD: 17.5 ± 12.6

600

700



Partners and Sponsors

This project is a partnership of the following programs:

The Maui Invasive Species Committee, Pacific Cooperative Studies Unit, UHM

The Exotic Plant Management Team, Haleakala National Park

College of Tropical Agriculture and Human Resources



This project is sponsored in parts by:

The Maui County Department of Water Supply

The Maui County Office of Economic Development

The Hawaii Invasive Species Council

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Sumit Globos





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