OAHU ARMY NATURAL RESOURCES PROGRAM
MONITORING PROGRAM

EFFICACY OF *CENCHRUS SETACEUS* CONTROL WITHIN THE AERIAL SPRAY ZONE AT MAKUA MMR BETWEEN 2012 AND 2016

INTRODUCTION

Following the discovery of an outbreak of *Cenchrus setaceus* (syn. *Pennisetum setaceum*) on steep ridges and cliffs at Makua MMR, the Oahu Army Natural Resources Program (OANRP) began herbicide treatment using aerial ball sprays and ground control on Army land in 2012 (Figure 1). Due to high fire threat associated with this species as well as its ecosystem altering characteristics, it is on the Hawaii Noxious Weed List, considered a high risk weed species (Division of Plant Industry 2003; Hawaii-Pacific Weed Risk Assessment 2009), and a high priority for extirpation by OANRP. Hundreds of plants were identified in 2012, and as plants still remain as of June 2016, control is ongoing. An aerial spray control area was established, with a management strategy to first treat the core infestation with aerial sprays, and secondarily treat all of the defined aerial spray zone. Follow-up treatment in the core, where accessible, was conducted from the ground. An analysis was conducted to examine the efficacy of control efforts within the aerial spray control area using GigaPan® imagery.

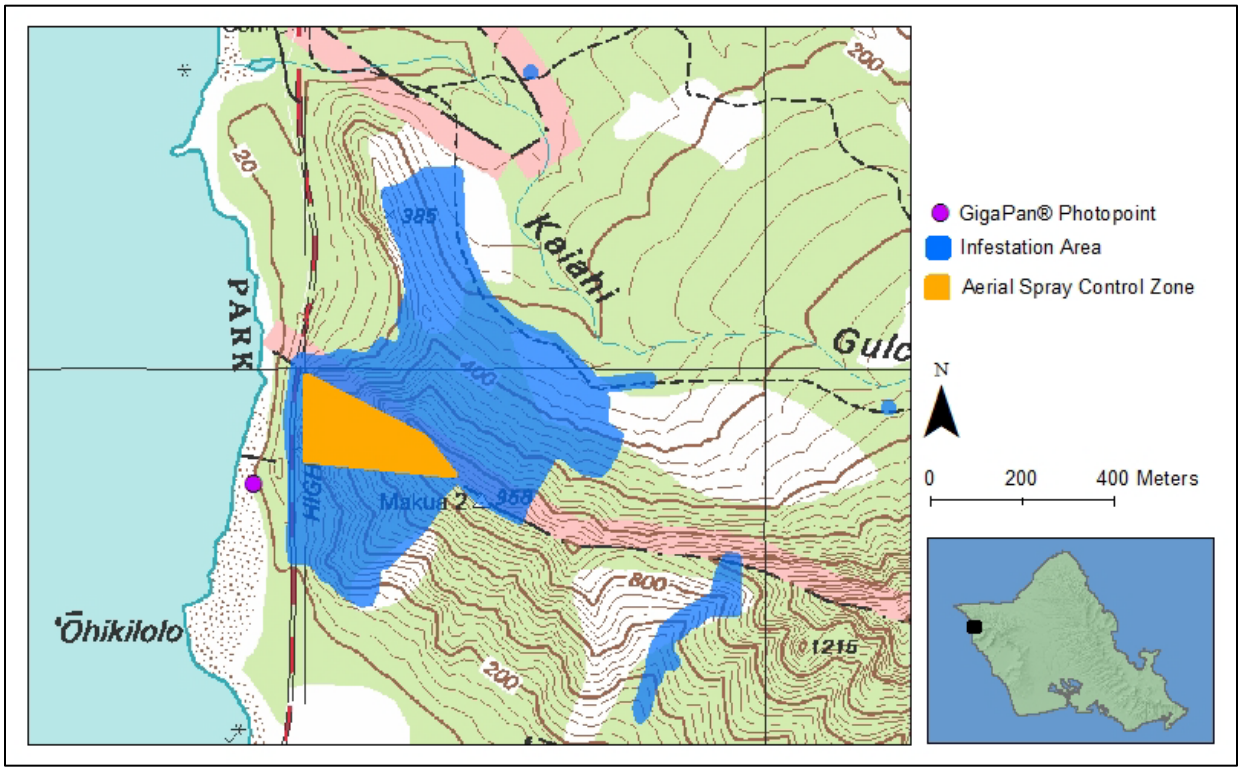

Figure 1. Map showing the location of the aerial spray control zone within the *Cenchrus setaceus* infestation at Makua MMR, and the location of the GigaPan® photopoint used in the analysis.

METHODS

Efficacy of *C. setaceus* control at Makua MMR was analyzed using gigapixel panoramic imagery (www.gigapan.com) of a portion of the aerial spray zone that included the core infestation and as well as surrounding less densely infested areas. Panoramic imagery was obtained using a GigaPan Epic 100 robotic mount fitted with a Canon PowerShot SX30 IS digital camera, between February 2012 and June 2016. Panoramas were stitched using GigaPan Stitch Version 2.1.0161. With this imagery, individual *C. setaceus* plants were identifiable by enlarging selected areas within the panorama (Figure 2). Seven macroplots within one panoramic view were used to count numbers of plants within the core infestation area over time, as a measure of the reduction of population within the most densely colonized region (Figure 3). Macroplots encompassed the majority of the core infestation area. Numbers of plants were similarly counted in seven additional plots outside of the core infestation, to assess population reduction in the surrounding lower density areas. Macroplots sampled roughly half of the low density area visible within the GigaPan® imagery. Friedman's test was used to analyze change over time within plots. Statistical analyses were performed in IBM SPSS Statistics Version 24.

Figure 2. Enlarged portion of GigaPan® image showing live and dead (successfully treated – plants are straw colored) *Cenchrus setaceus* within the core infestation area. Live plants appear bluish in color, as they were just treated with blue-dyed herbicide.

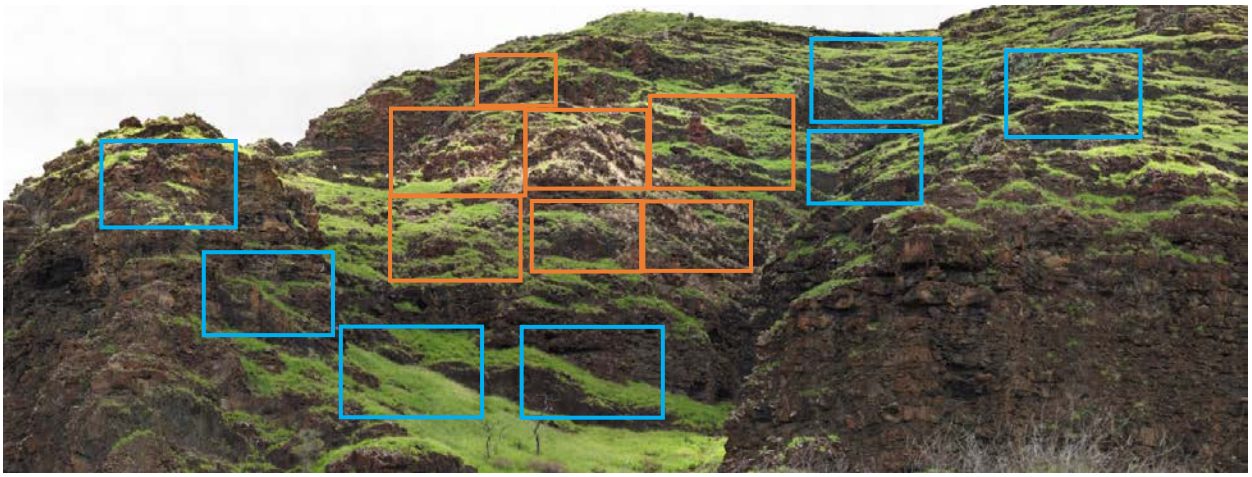

Figure 3. GigaPan® image showing a portion of the *Cenchrus setaceus* aerial control treatment area at Makua MMR, May 2013. Locations of macroplots used to analyze control efficacy are depicted with orange (core infestation area) and blue (low density areas) rectangles. Dead plants (straw-colored) are visible within the core infestation area.

RESULTS

Since *Cenchrus setaceus* was first discovered and treatment initiated on Army land in 2012, the number of plants within the core infestation area declined significantly (Friedman's test: $p < 0.001$) by 78% as of June 2016 (Figure 4). While counts of plants in the adjacent low density areas remained low, there was no significant population reduction (Friedman's test: $p = 0.249$) in those areas.

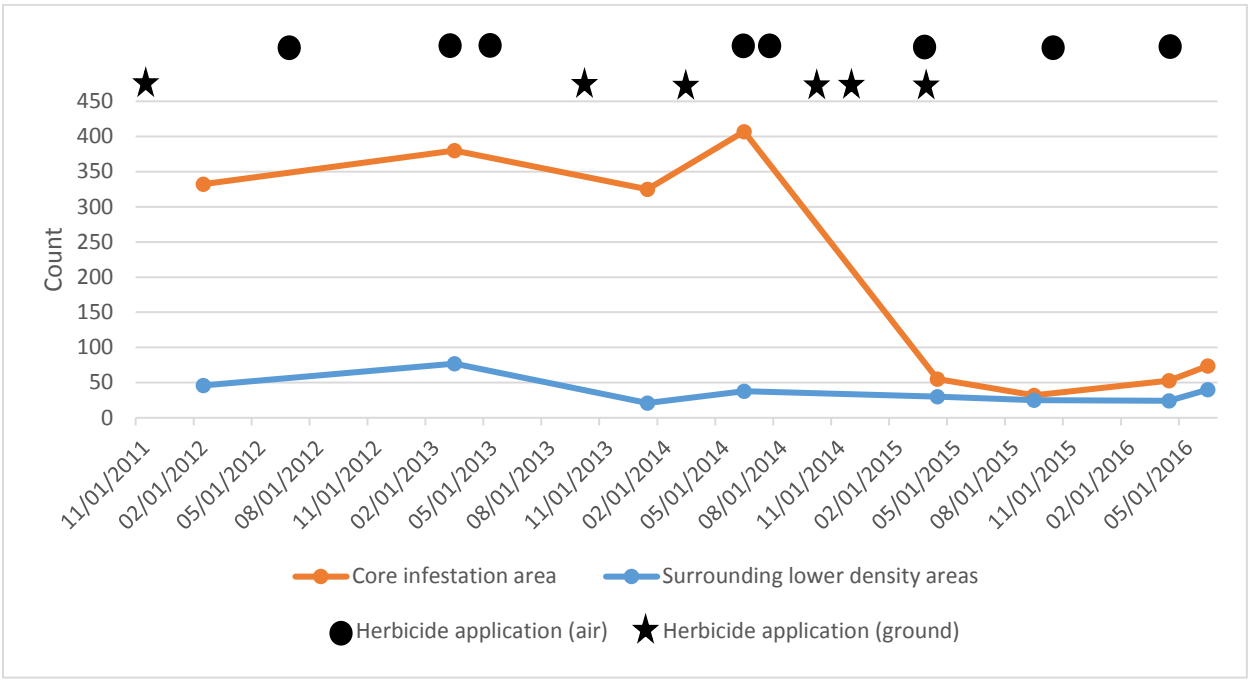

Figure 4. *Cenchrus setaceus* population change over time in macroplots within core infestation (n = 7) and surrounding low density areas (n = 7) at Makua MMR, with herbicide application dates (helicopter and ground sprays) indicated. Counts are combined total numbers of plants visible within all macroplots.

DISCUSSION

The marked reduction in numbers of plants in the core infestation area suggests significant declines within a matter of a few years are achievable for dense populations of *C. setaceus* with hundreds of individuals. The lack of significant reduction of plants in the monitored area adjacent to the core reaffirms the importance of addressing isolated plants and those remaining in low densities. Eradication cannot be achieved without consistent control of the entire infestation. Control of *C. setaceus* within the aerial spray zone at Makua MMR is challenging due to the steep nature of the terrain. Despite these challenges, considerable progress in controlling the core infestation has been accomplished, and efforts may now focus on controlling all plants within the aerial spray zone.

REFERENCES

Division of Plant Industry. 2003. List of plant species designated as noxious weeds (20 October 2003). Hawaii Department of Agriculture.

Hawaii-Pacific Weed Risk Assessment. 2009. *Pennisetum setaceum*. www.hpwra.org [Accessed June 2016]