

Ecosystem Restoration Management Plan

MIP Year 14-18, Oct. 2017– Sept. 2022

MUs: Kaena and Kaena East of Alau

Overall MIP Management Goals:

- Form a stable, native-dominated matrix of plant communities which supports stable populations of IP taxa.
- Control fire and weed threats to support stable populations of IP taxa.

Background Information

Location: Westernmost tip of O‘ahu, at Northern base of Waianae Mountains

Land Owner: State of Hawaii

Land Managers: Department of Land and Natural Resources (DLNR) - Natural Area Reserve System (NARS), DLNR – Land Division.

Acreage: 29.9 acres

Elevation Range: Sea level to 894 ft.

Description: Kaena Point includes two IP MUs: Kaena and Kaena East of Alau. Access is via a 4-wheel drive road along the Mokuleia coastline. The Kaena MU is within the Natural Area Reserve (NAR) boundary and is protected from off road vehicles by a large rock barrier. It is actively managed by DLNR, NARS, and OANRP, and contains areas of native dominant dry coastal strand and shrubland. The Kaena East of Alau MU is located on a parcel managed by DLNR Land Division and receives a minimal amount of management by OANRP staff. Vegetation within and surrounding the MU is alien dominant dry coastal shrubland. Fire serves as the greatest threat to these MUs due to heavy public use and high fuel loads in the surrounding area.

Native Vegetation Types

Wai‘anae Vegetation Types	
Dry Costal	<p><u>Canopy includes</u>: <i>Myoporum sandwicense</i>, <i>Psydrax odoratum</i>, <i>Gossypium tomentosum</i></p> <p><u>Understory includes</u>: <i>Eragrostis variabilis</i>, <i>Chenopodium oahuense</i>, <i>Sida fallax</i>, <i>Euphorbia degeneri</i>, <i>Jacquemontia ovalifolia</i>, <i>Melanthera integrifolia</i>, <i>Lipochaeta lobata</i> subsp. <i>lobata</i>, <i>Plumbago zeylanica</i>, <i>Plectranthus parviflorus</i></p>
NOTE: For MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not noted.	

Dry Coastal Vegetation Type at Kaena and Kaena East of Alau



Aerial view of Kaena Point



Kaena MU looking Mauka



Kaena MU looking East



Kaena East of Alau MU, 2009 (prior to clearing *Prosopis pallida*)
Euphorbia celastroides var. *kaenana* population circled in red.

MIP/OIP Rare Resources at Kaena

Organism Type	Species	Pop. Ref. Code	Population Units	Management Designation	Wild/Reintroduction
Plant	<i>Euphorbia celastroides</i> var. <i>kaenana</i>	KAE-A	Kaena East of Alau	MFS	Wild
Plant	<i>Euphorbia celastroides</i> var. <i>kaenana</i>	KAE-B	Kaena	MFS	Wild

MFS= Manage for Stability

Other Rare Taxa at Kaena

Organism Type	Species	Status
Plant	<i>Achyranthes splendens</i> var. <i>rotundata</i>	Endangered
Plant	<i>Scaevola coriacea</i>	Endangered
Plant	<i>Sesbania tomentosa</i>	Endangered

Rare Resources at Kaena and Kaena East of Alau



E. celastroides var. *kaenana*



E. celastroides var. *kaenana* flower and fruit



S. tomentosa flower



A. splendens var. *rotundata*



S. coriacea

Locations of Rare Resources at Kaena and Kaena East of Alau

Map removed to protect rare resources

MU Threats to MIP/OIP MFS Taxa

Threat	Rare Taxa Affected	Management Strategy	Current Status, 2017
Weeds	<i>E. celastroides</i> var. <i>kaenana</i>	Rare taxa sites primarily, across MU secondarily	Regular maintenance performed twice per year.
Fire	<i>E. celastroides</i> var. <i>kaenana</i>	Across MU	Removal of grass and fire prone weeds every 6 months; 50 m fuel break maintained around Kaena East of Alau site
Ungulates	None	No Control	Ungulate sign has never been observed by OANRP staff since management began. There are no fencing plans for either MU.

Rodents	None	No Control	No rodent damage has been observed on <i>E. celastroides</i> var. <i>kaenana</i> at either MU; no plans for control.
Ants	<i>E. celastroides</i> var. <i>kaenana</i>	No Control	Ants have been surveyed and determined not to pose a significant threat. Risk of incipient ant species being introduced in this hot, dry climate and low elevation is very low.

Management History

- 2001: OANRP staff begins weed control efforts within NAR targeting *Leucana leucocephala*, *Atriplex semibaccata*, and grass species around known *E. celastroides* var. *kaenana*.
- 2004: OANRP staff begins weed control efforts at Kaena East of Alau MU targeting *Leucana leucocephala*, *Atriplex semibaccata*, and grass species around *E. celastroides* var. *kaenana*.
- 2007: Photopoints installed at Kaena MU.
- 2007 August: A wildland fire consumed approximately 74 acres near the Kaena East of Alau MU (approximately 35 m from the Kaena-02 WCA).
- 2007 November: Additional 140 plants found by OANRP about 100 m west of the known NAR population, wrapping around the slope towards Waianae; WCA area expanded.
- 2008: Ongoing restoration work including weed removal and re-vegetation with common native plants is performed by OANRP.
- 2009 July: A wildland fire burned within 95 m of the Kaena East of Alau population. OANRP active in fire response.
- 2009: The genetic storage goals were met for Kaena PU (50 plants represented in seed storage).
- 2009 November: Another group of approximately 30 *E. celastroides* var. *kaenana* found west of the known NAR population.
- 2010 June: Management begins on a new population of *E. celastroides* var. *kaenana* found within the proposed predator proof fence; a second WCA is added.
- 2010 November: Another group of approximately 25 *E. celastroides* var. *kaenana* found west of the known NAR population.
- 2011: State of Hawaii completes predator proof fence around a portion of the NAR (which includes a subset of the *E. celastroides* var. *kaenana* population).
- 2015 September: OANRP conducts a complete census of *E. celastroides* var. *kaenana* and maps the extent of all known populations.
- 2016: OANRP Orange team takes over management from the Blue team.

Weed Control

Weed Control actions are divided into 4 subcategories:

- 1) Vegetation Monitoring
- 2) Surveys
- 3) Incipient Taxa Control (Incipient Control Area - ICAs)
- 4) Ecosystem Management Weed Control (Weed Control Areas - WCAs)

These designations facilitate different aspects of MIP requirements.

Vegetation Monitoring

After a complete census of the *E. celastroides* var. *kaenana* population within the Kaena MU was conducted, it was determined a vegetation monitoring program at Kaena was not necessary in the management of *E. celastroides* var. *kaenana* populations. Vegetation communities will be monitored on a presence/absence basis using annual photopoints and field observations.

Surveys

Potential Vectors: OANRP and NARS staff, public hikers, 4-wheel drive vehicles, and birds.

Management Objective:

- Prevent the establishment of any new invasive alien plant or animal species through regular surveys along roads, trails and other high traffic areas (as applicable).

Strategy and Control Methods:

- Note unusual, significant, or incipient alien taxa during the course of regular field work and complete Target Species form to document sighting.
- Survey main access road every two years.
- Novel alien taxa found will be researched and evaluated for distribution and life history. If taxa found to pose a major threat, control will begin and will be tracked via ICAs.

Discussion:

Surveys are designed to be the first line of defense in locating and identifying potential new weed species. At Kaena, a road survey is conducted on the dirt road starting at the terminus of Farrington Highway and ending at the rock wall barricade. OANRP will consider installing additional surveys in other high traffic areas, however, due to Kaena's small size, incidental observations during regular field management should suffice.

Incipient Taxa Control (ICAs)

No incipient species have been identified by OANRP in the MU, and therefore there are currently no ICAs. OANRP will continue to monitor and consider control on possible incipients when appropriate. Priority will be given to surveying for *Chromolaena odorata* and *Cenchrus setaceus*, as invasion from these high-risk incipients is higher due to high public use and 4-wheel drive vehicles along the access road.

While there are no 'incipient' targets within this MU, *Atriplex semibaccata*, *Achyranthes aspera* var. *aspera*, *Cenchrus echinatus*, and *Verbesina encelioides* are targeted within the WCAs. OANRP will continue to control *Acacia farnesiana* and *Leucaena leucocephala* in order to remove all matures within WCAs. Return visits will be scheduled in order to prevent immature individuals from reaching maturity.

Incipient and Weed Control Areas

Map removed to protect rare resources

Ecosystem Management Weed Control (WCAs)

All weed control geared towards general habitat improvement is tracked in geographic units called Weed Control areas, or WCAs. The goals, strategies, and techniques used vary between WCAs, depending on terrain, quality of native habitat, and presence or absence of rare taxa.

MIP Goals:

- Within 2m of rare taxa: 0% alien vegetation cover except where causes harm.
- Within 50m of rare taxa: 25% or less alien vegetation cover
- Throughout the remainder of the MU: 50% or less alien vegetation cover

Management Objective:

- Reduce alien cover and increase native cover in both understory and canopy across the MU, working towards a goal of 50% or more native vegetation cover.

Discussion: OANRP weed control at Kaena is focused on reducing alien vegetation encroachment on populations of *E. celastroides* var. *kaenana* and providing expanded habitat for population recruitment. Ongoing efforts have been effective at removing woody weeds. Grass species require more difficult and consistent management, and should be targeted across the MU to reduce the threat of fire. Weeding efforts will be modified if *E. celastroides* var. *kaenana* population monitoring indicates weed control efforts are not contributing to stable population growth.

The table below summarizes invasive weeds found at Kaena and Kaena East of Alau, excluding ICA species. While the list is by no means exhaustive, it includes the species targeted/prioritized for control. The distribution of each taxon is estimated as: Widespread (moderate to high densities of individuals, common across MU), Scattered (low densities across all or much of the MU), or Restricted (low or high densities, all in one discrete location).

Summary of Target Taxa

Taxa	Distribution	Notes
<i>Acacia farnesiana</i>	Widespread	The majority of weed efforts have focused on this taxa within the WCAs. Always targeted for removal during weed sweeps.
<i>Agave sisalana</i>	Restricted	A population is located along the mauka side of the access road prior to Kaena East of Alau, previously known from Kaena MU. Zero tolerance within WCAs.
<i>Achyranthes aspera</i> var. <i>aspera</i>	Widespread	Common throughout MUs. NARS targets around Laysan albatross areas. OANRP controls within WCAs. Can form dense mats. Seeds spiky, easily dispersed via birds (attach to feathers) and staff (attach to clothes)
<i>Cenchrus echinatus</i>	Widespread	Common along access road. OANRP will always target for control within WCAs. Easily dispersed seeds (hitchhike via spikes), so priority to keep out of bird zones).
<i>Chloris barbata</i>	Widespread	Grass is widespread throughout Kaena WCAs. Control has been performed in past via grass specific herbicide and outplanting of the native grass Kawelu. NARS will continue to monitor the extent and perform control as necessary. It is seasonal, flushes during wet weather, then quickly dries out and dies, making it difficult to remove from <i>E. celastroides</i> var. <i>kaenana</i> areas. Not a major fire risk, but should be controlled directly around rare taxa to promote recruitment.
<i>Digitaria insularis</i>	Widespread	Most common grass in MU, especially around Kaena East of Alau, therefore posing greatest localized fire threat. Control performed by OANRP within WCAs.
<i>Leucaena leucocephala</i>	Widespread	The majority of OANRP weed efforts were used to control within WCAs. Always targeted for removal during weed sweeps. Mostly only immatures and seedlings left; these can be controlled by handpull or by clip and drip with G4 40%. Note that G4 20% not very effective on LeuLeu.
<i>Passiflora edulis</i>	Scattered	Common along access road. Will monitor within WCAs and perform control as necessary.
<i>Urochloa maxima</i>	Scattered	Mostly found around the perimeter of MUs. OANRP will target for removal within WCAs. Priority for removal due to fire threat.
<i>Verbesina encelioides</i>	Restricted	Targeted for removal within WCAs during weed sweeps. Usually easy to handpull. Short life cycle, and new plants grow and mature quickly. Colonizes disturbed areas. Focus should be on keeping out of WCAs.

WCAs: Kaena-01

Veg Type: Dry Coastal

MIP Goal: 25% or less alien cover (rare taxa in WCA).

Targets: All woody species, particularly *A. farnesiana* and *L. leucocephala*, as well as herbaceous weeds *A. aspera* var *aspera*, *V. encelioides*, and *A. semibacatta*. Grasses such as *C. barbata*, *D. insularis* and *U. maxima* are also targeted as needed.

Notes: Weed control began at the Kaena MU in coordination with NARS in 2001. The focus of control efforts has been around the Kaena Point *E. celastroides* var. *kaenana* population in the eastern portion of the NAR. WCA control efforts were expanded in 2007, and again in 2009, 2010 and 2016 upon discovery of new groups of plants. The WCA boundary was expanded to encompass these additional areas. Control of *A. farnesiana* and *L. leucocephala* within this WCA has succeeded in drastically diminishing their overall extent. Visitation frequency has been dramatically reduced. Few woody weeds are now found throughout the WCA, most of which are small immatures. We will continue to control these woody species directly around *E. celastroides* var. *kaenana* individuals, and to connect the populations.

Although common along the access road, there is zero tolerance for *C. echinatus* and *A. aspera* var. *aspera* within the WCAs. *Digitaria insularis* and *U. maxima* are targeted along the upper portion of WCA to aid fire suppression. OANRP is currently evaluating control of *C. barbata* found throughout WCA. Previous control efforts have proven to be relatively effective; it does not appear to be spreading beyond its initially observed extent. OANRP will continue to monitor and control *C. barbata* as necessary.

OANRP also target *A. semibacatta*, a creeping shrub that densely occupies *E. celastroides* var. *kaenana* habitat. *A. semibacatta* is easily removed by handpulling during weed sweeps. OANRP will continue to monitor *A. semibacatta* and investigate further control methods if necessary.

Common native plant reintroductions of *Myoporum sandwicense* and *Eragrostis variabilis* were conducted in 2008 to aid in weedy grass control, habitat restoration, and fire prevention. OANRP staff hopes to continue working with DOFAW staff to grow more common native plants and reintroduce them in order to aid in restoration and fire suppression efforts, but there are no current plans.

WCA: Kaena-02

Veg Type: Dry Coastal

MIP Goal: 25% or less alien cover (rare taxa in WCA).

Targets: All woody species, particularly *A. farnesiana* and *L. leucocephala*, as well as herbaceous weeds *A. aspera* var *aspera*, *V. encelioides*, and *A. semibacatta*. Grasses such as *D. insularis* and *U. maxima* are also targeted as needed.

Notes: OANRP control efforts in Kaena-02 began in 2010. This WCA is enclosed by the predator proof fence at Kaena point. Weed control is conducted around a patch of *E. celastroides* var. *kaenana* that is fragmented from the larger patch below a road. The substrate here is rockier; hence, there is less grass and vegetation, both native and non-native, and less control is necessary. The weed control goals and targets in this WCA are largely the same as those in Kaena-01. Annual sweeps for target weeds across the entire WCA will be conducted.

WCA: KaenaEastOfAlau-01

Veg Type: Rock/talus slope

MIP Goal: 25% or less alien cover (rare taxa in WCA).

Targets: All weeds, focusing on *A. farnesiana* and *L. leucocephala* and grasses.

Notes: OANRP control efforts began in 2004 at the Kaena East of Alau MU. Minimal weed control effort is needed because *E. celastroides* var. *kaenana* plants are found on rock talus with few weeds directly surrounding them. A small weed-free buffer is maintained around this talus slope to reduce any impacts to the *E. celastroides* var. *kaenana*, and to encourage recruitment. OANRP has reduced fire fuel loads east of the patch by clearing a large stand of Kiawe (*Prosopis pallida*). Removal of *A. farnesiana* and *L. leucocephala*, and regular controls of non-native grasses around the WCA to create a wide fire buffer zone (approximately 50 m) will also aid in fire suppression.

Fire Control

Historic Fires near Kaena East of Alau MU

Map removed to protect rare resources

Threat Level: High

Seasonality/Potential Ignition Sources: Due to high fuel loads, low precipitation levels, and high arson activity, fire poses a constant threat to both MUs. Dry summers can further exacerbate the situation. Rarely does a year go by without a wildfire starting somewhere within Kaena State Park or the surrounding DLNR Land Division lands.

Management Objective:

- To prevent fire from burning any portion of the MU at any time.

Strategy and Control Methods:

- Maintain a 50 m fuel break in order to reduce fuel loads surrounding the *E. celastroides* var. *kaenana* at the Kaena East of Alau MU.
- Reduce fuel loads within both MUs

- If a fire occurs, conduct a post-fire survey, including mapping the perimeter of the fire and document damage via photos. If possible, rehabilitate burned areas within the fuel break with native species in collaboration with State Parks and/or NARS staff.

Discussion: OANRP efforts have focused on preventative fire measures, notably weed control within the MUs. Removal of the most fire prone weeds (*A. farnesiana*, *L. leucocephala* and *U. maxima*) remains a high priority within the MUs. The Kaena East of Alau MU has a higher fire threat than the Kaena MU, due to higher fuel loads. OANRP will continue to maintain a 50 m fuel break in order to reduce fuel loads surrounding the *E. celastroides* var. *kaenana* PU. See the Weed Control section for further details. While there are no definite plans, OANRP staff will discuss possible common reintroductions in the future to serve as a green fuel break around the Kaena East of Alau site.

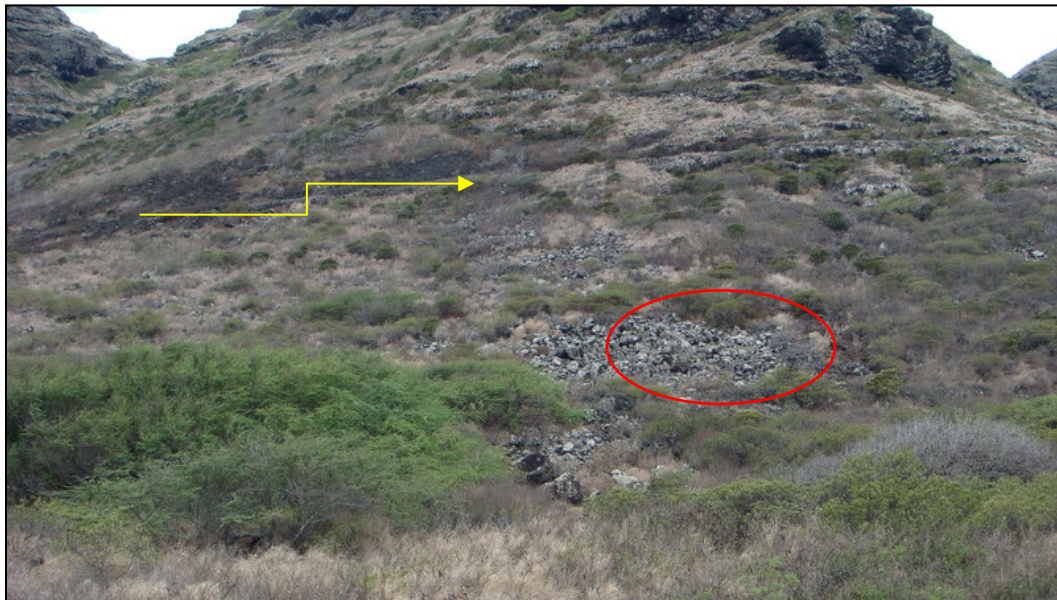
OANRP will focus on maintaining good communication with the Wildland Fire Working Group to facilitate positive on-the-ground fire response in the event of another fire.



August 2007 fire; Kaena east of Alau population to the west (left) of the photo



August 2007 fire, Red circle indicates Kaena East of Alau *E. celastroides* var. *kaenana* PU



July 2009 fire, Kaena East of Alau *E. celastroides* var. *kaenana* PU circled in red, yellow arrow indicates furthest extent of burned area.

Action Table

The table below is a comprehensive list of threat control actions planned for the MU for the next five years. Weed control actions are grouped into the following categories: General Survey, ICA code, or WCA code. Cells filled with hatch marks denote the quarters in which an action is scheduled. IP years run from October of one year through September of the next. Therefore, Quarter 4 (October-December) is listed first for each report year, followed by Quarter 1 (January-March), Quarter 2 (April-June), and Q3 (July-September). Species names are written as six-digit abbreviations, such as ‘CenSet’ instead of *Cenchrus setaceus*, for brevity.

Action Type	Actions	MIP Year 14 Oct 2017- Sept 2018				MIP Year 15 Oct 2018- Sept 2019				MIP Year 16 Oct 2019- Sept 2020				MIP Year 17 Oct 2020- Sept 2021				MIP Year 18 Oct 2021- Sept 2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
General Survey	Survey along Kaena dirt road from gate at the end of the paved road to the NAR barrier. Every other year.																				
Kaena-01	Control weeds across entire WCA every 6 months/year. Focus on <i>L. leucocephala</i> , <i>A.farnesiana</i> , <i>A. semibacatta</i> , <i>A. aspera</i> var. <i>aspera</i> , <i>C. echinatus</i> , and <i>V. encelioides</i> . Work to remove all mature <i>L. leucocephala</i> from area, expand to boundaries of WCA, and connect various <i>E. celastroides</i> var. <i>kaenana</i> patches.																				
	Control grass across WCA as needed, every 6 months/year. Focus on upper portion of patch (<i>D. insularis</i> and <i>U. maxima</i>). On lower portion of patch, consider strategies for <i>Chloris</i> sp. Zero tolerance for <i>C. echinatus</i> within WCA.																				
	Take Photopoints annually at Kaena-01.																				
Kaena-02	Control weeds across entire WCA annually. Focus on <i>L. leucocephala</i> , <i>A.farnesiana</i> , <i>A. semibacatta</i> , <i>A. aspera</i> var. <i>aspera</i> , VerEnc. Work to remove all mature <i>L. leucocephala</i> from area, expand boundaries of WCA.																				
KaenaEastofAlau-01	Control weeds across WCA annually (minimum). Target <i>A.farnesiana</i> and <i>L. leucocephala</i> but include other weeds as well. Expand boundaries of weeded area to improve habitat. Area severely fire threatened.																				
	Control weedy grasses in area. Fire threat is high.																				

Action Type	Actions	MIP Year 14 Oct 2017- Sept 2018				MIP Year 15 Oct 2018- Sept 2019				MIP Year 16 Oct 2019- Sept 2020				MIP Year 17 Oct 2020- Sept 2021				MIP Year 18 Oct 2021- Sept 2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Use chainsaws and possibly chipper to remove a large <i>P. pallida</i> on the East side of the WCA, and a 50m swath of <i>A.farnesiana</i> and <i>L. leucocephala</i> surrounding the WCA in order to create a fire buffer zone.																				