



Identification of invasive plant species on  
U.S. Army lands on O'ahu, Option Year 1,  
August 2012 to December 2013

**Hawaii**  
**Biological**  
**Survey**

Final Report

December 2013

**Cover image:**

*Heteranthera reniformis* (Pontederiaceae), kidneyleaf mudplantain, was first discovered by O‘ahu Army Natural Resources Program field crew in a taro (*Colocasia esculenta*) field in Waihe‘e, O‘ahu in July 2013, and represents the first documentation of this highly invasive species in the state of Hawai‘i.

Photograph by J. Beachy

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**Introduction**

On O‘ahu, the U.S. Army Garrison, Hawai‘i (USAG-HI) manages over 47,000 acres of land available for military maneuvers and training at Schofield Barracks Military Reservation, including the South Range Acquisition Range; Schofield Barracks East Range; Kawaihoa Training Area; Kahuku Training Area; Dillingham Military Reservation; Mākuā Military Reservation, and Tripler Army Medical Center. This acreage also includes lands unavailable for training, based largely on topographic and maneuverability constraints, such as restricted areas, impact areas, native habitat and species protection areas, and cultural resource sites (U.S. Army Garrison Hawai‘i 2010).

The goal of the U.S. Army’s ecosystem management program is to conserve, protect, and enhance the natural and cultural resources of Hawai‘i and to comply with all applicable Federal and state laws and regulations, while improving the Army’s ability to conduct and maintain military readiness. To attain this goal the Army is striving to better understand its natural resources to ensure that proper management measures and decisions are made. Introduced plants, especially if aggressively invasive, can interfere with military range function and training operations, and threaten endangered species and native ecosystems by altering habitat and disrupting community structure. Uncontrolled range fires on Army training lands fueled by weedy growth can devastate ecosystems and harm endangered plants and animals, and cause interruptions and delays in training and interfere with troop readiness. As such, rapid identification of newly located and potentially invasive plant species is a critical element for their timely eradication on Army lands and prevention of their spread to neighboring lands. The goal of this project is to accurately identify newly discovered invasive and potentially invasive plant species found on U.S. Army lands using the resources of the Bishop Museum’s *Herbarium Pacificum* (BISH).

**Methods**

During the period of 1 August 2012 to 31 December 2013, 40 plant specimens were collected by O‘ahu Army Natural Resources Program (OANRP) staff from U.S. Army lands and deposited at Bishop Museum for identification or confirmation. Specimens that were new state or island records, important distributional additions, or those extending the known geographic range or morphological variation of a taxon were processed and accessioned into Bishop Museum’s *Herbarium Pacificum*. If

needed, images of the specimens were submitted to taxonomic experts for identification. In general, specimens were discarded by Bishop Museum staff or affiliates if they were sterile and unidentifiable or were identifiable but added no significant new data to the collections. Once positive identification was secured, recommendations could be made for appropriate management actions. Some of the collections, such as the *Heteranthera* (USArmy 320) and *Sagittaria* (USArmy 322) were actually not made on U.S. Army lands, but on private property.

## Results

Of the 40 plant specimens submitted to the Bishop Museum for identification during this time frame, 37 were identified to the species or infraspecific level, while 3 were only identifiable to genus or family level (see Table 1). Of the latter, the unidentified Asteraceae specimen (USArmy 313) could not be matched to any named species in the Bishop Museum herbarium, and we are hopeful that a visiting plant taxonomist will someday recognize it. The two gymnosperm specimens identified only to genus level (USArmy 303 & 327) may require a specialist to correctly name them. Total staff time dedicated to species identification and processing of specimens was 82 person-hours by Clyde Imada; in addition, the O‘ahu Early Detection team (Danielle Frohlich, Alex Lau) spent an estimated 320 person-hours.

Of the collections made during this period, 2 were new state records [NSR], naturalizing species not previously recorded in the Hawaiian Islands: *Heteranthera reniformis* (Pontederiaceae) and *Sagittaria platyphylla* (Alismataceae); 8 were new island records [NIR], species documented as



*Heteranthera reniformis*, new naturalized record for the state, collected from Waihe‘e Valley, O‘ahu. Photo by Jane Beachy, OANRP.



*Sagittaria platyphylla*, new naturalized record for the state, also from Waihe‘e Valley, O‘ahu. Photo by O‘ahu Early Detection.

naturalized on other islands but recorded for the first time on O‘ahu: *Begonia cucullata* (Begoniaceae), *Carmona retusa* (Boraginaceae), *Gladiolus dalenii* (Iridaceae), *Heritiera littoralis* (Sterculiaceae), *Juncus tenuis* (Juncaceae), x*Lindsaeosoria flynnii* (Dennstaedtiaceae) [Note: this plant is a hybrid between a weedy and an indigenous species, so whether it is a new island record for a weed or a native species is open to interpretation], *Urochloa distachya* (Poaceae), and *Veronica arvensis* (Scrophulariaceae); and 5 species were new naturalized records [NNR], previously known only in cultivation in the State but now noted as naturalizing: *Acacia auriculiformis* (Fabaceae), *Mimusops elengi* (Sapotaceae), *Myrciaria floribunda* (Myrtaceae), *Quisqualis indica* (Combretaceae), and *Thysanolaena latifolia* (Poaceae). All of these records are scheduled for publication the 2014 issue of the Bishop Museum Occasional Papers series, *Records of the Hawaii Biological Survey*, by Frohlich and Lau. Publication via this forum allows for widespread dissemination to all those in the state involved in natural resource and weed management, landscaping, and nursery or botanical garden management to become aware of the identifying characters and naturalization potential of plants growing on lands under their care. Copies of past issues can be downloaded at <http://hbs.bishopmuseum.org/hbspubs.html>.

Table 1 presents all of the OANRP plant collections made during this period, listed numerically by collection number. For new records, the comments field indicates the type of record (e.g., NIR, NSR, etc.); for other collections, notes indicate whether the specimen was kept for deposit in the Bishop Museum herbarium, and the reason. For a historical perspective, a complete listing of past collections by OANRP staff representing new naturalized weed records is provided in Appendix 1.

### **Management actions**

The rapid identification of an unknown and potentially invasive plant species that appears to be out of place in the environment is a critical first step for making informed decisions about how to manage the situation. Once a firm identification is provided, usually much can then be learned about the plant’s behavior through online and library research. If it becomes evident that the species has a history of invasiveness elsewhere in the world, but its spread on O‘ahu still appears containable, then multi-agency work crews can be sent out to deter its spread or potentially eradicate populations before they get out of hand.

The discovery of the highly invasive *Chromolaena odorata* on Army land at the Kahuku Training Area in January 2011 (USArmy 199) spurred such an urgent multi-agency effort between OANRP, the O‘ahu Invasive Species Committee, and the Hawai‘i Department of Agriculture (HDOA) to monitor its dispersal and to contain its spread in known populations. The species had already long been on HDOA’s list of noxious weeds designated for eradication or control. The discovery of *Heteranthera reniformis* (USArmy 320) in May 2013 and its recognized detrimental effects in wetland agriculture fields and clogging of waterways prompted the HDOA to release a new pest advisory (<http://hdoa.hawaii.gov/pi/files/2013/01/Heteranthera-reniformis.pdf>) in September 2013.

### **Acknowledgments**

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### **References**

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- U.S. Army Garrison Hawai‘i. 2010. Integrated Natural Resources Management Plan, 2010 - 2014, Island of O‘ahu, Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaiiloa Training Area, Kahuku Training Area, Dillingham Military Reservation, Mākua Military Reservation, and Tripler Army Medical Center. Prepared for the Directorate of Public Works, Environmental Division, Natural Resources Section by the Center for Environmental Management of Military Lands, Colorado State University, Fort Collins, Colorado.

**Table 1:** Collections made by U.S. Army OANRP and identified by O‘ahu Early Detection and Bishop Museum staff from 1 August 2012 to 31 December 2013. Unhighlighted taxa have been positively identified; taxa in yellow were fertile but not identifiable, and their determination is still pending.

NAR=New Adventive Record  
 NIR=New Island Record  
 NNR=New Naturalized Record  
 NSR=New State Record

US Army #	Date	Family	Taxon	Comments
290	9/12/2012	Fabaceae	<i>Platymiscium stipulare</i>	Discarded; already documented
291		Nephrolepidaceae	<i>Nephrolepis</i> cf. <i>biserrata</i>	Discarded; already documented
292	9/18/2012	Fabaceae	<i>Peltophorum pterocarpum</i>	Discarded; already documented
293	9/18/2012	Iridaceae	<i>Gladiolus dalenii</i>	NIR
294	9/27/2012	Viscaceae	<i>Korthalsella latissima</i>	Discarded; specimen damaged in processing
295	10/4/2012	Orchidaceae	<i>Habenaria rodeiensis</i>	range extension in Koolaus
296	10/5/2012	Sterculiaceae	<i>Heritiera littoralis</i>	NIR
297	10/15/2012	Scrophulariaceae	<i>Lophospermum erubescens</i>	range extension; new O‘ahu locality
298	11/6/2012	Poaceae	<i>Stenotaphrum secundatum</i>	not kept: widespread species
299	11/26/2012	Poaceae	<i>Urochloa plantaginea</i>	kept: further documents naturalized status
300	11/28/2012	Viscaceae	<i>Korthalsella latissima</i>	kept; new locality in Waianaes
301	12/10/2012	Orchidaceae	<i>Epidendrum nocturnum</i>	range extension to Ko‘olau; kept; more plants found than previous single collection at Pu‘u Kaua in Waianaes
302	1/16/2013	Dennstaedtiaceae	x <i>Lindsaeosoria flynnii</i>	NIR; Request more material if LZ is revisited to see variation; this material seems more like <i>Sphenomeris</i> parent, while type material looks more like <i>Lindsaea</i> parent
303	3/6/2013	Cupressaceae	<i>Juniperus</i> sp.	N_R?; This matches best with an unidentified specimen collected in Waimanalo by George Staples



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304	3/6/2013	Poaceae	<i>Paspalum paniculatum</i>	range extension; kept
305	3/6/2013	Poaceae	<i>Digitaria violascens</i>	not kept: widespread species
306	3/12/2013	Cyperaceae	<i>Cyperus sanguinolentus</i>	not kept: already recently collected in the area
307	3/12/2013	Scrophulariaceae	<i>Veronica arvensis</i>	NIR; Voucher was identified, then misplaced; collect more material if possible
308	3/13/2013	Begoniaceae	<i>Begonia cucullata</i>	NIR
309	3/13/2013	Celastraceae	<i>Elaeodendron cf. orientale</i>	not kept; sterile
310	4/10/2013	Juncaceae	<i>Juncus tenuis</i>	NIR
311	4/25/2013	Basellaceae	<i>Anredera cordifolia</i>	not kept; already documented
312	5/30/2013	Asteraceae	<i>Chromolaena odorata</i>	range extension; new locality on O'ahu
313	5/25/2013	Asteraceae		We have been unable to match this plant to anything in the BISH collection; still working on it
314	5/30/2013	Asteraceae	<i>Pseudognaphalium sandwicense</i> var. <i>sandwicense</i>	kept; unusual location
315	5/30/2013	Poaceae	<i>Lolium multiflorum</i>	not kept: already recently collected in the area
316	5/30/2013	Poaceae	<i>Urochloa distachya</i>	NIR
317	5/30/2013	Poaceae	<i>Digitaria violascens</i>	not kept: already recently collected in the area
318				We have no record of this collection #
319	5/30/2013	Combretaceae	<i>Quisqualis indica</i>	NNR
320	5/30/2013	Pontederiaceae	<i>Heteranthera reniformis</i>	NSR
321	5/30/2013	Boraginaceae	<i>Carmona retusa</i>	NIR; material was inadvertently discarded but later recollected (#326)
322	5/30/2013	Alismataceae	<i>Sagittaria platyphylla</i>	NSR
323	8/24/2013	Chrysobalanaceae	<i>Chrysobalanus icaco</i>	kept; already reported as naturalized on O'ahu
324	8/24/2013	Myrtaceae	<i>Leptospermum laevigatum</i>	kept; already reported as naturalized on O'ahu
325	8/24/2013	Poaceae	<i>Thysanolaena latifolia</i>	NNR
326	10/6/2013	Boraginaceae	<i>Carmona retusa</i>	NIR
327	10/4/2013	Cupressaceae	cf. <i>Juniperus</i> sp.	female cones needed for more definitive ID
328	11/12/2013	Myrtaceae	<i>Myrciaria floribunda</i>	NNR
329	11/19/2013	Fabaceae	<i>Acacia auriculiformis</i>	NNR
330	8/24/2013	Sapotaceae	<i>Mimusops elengi</i>	NNR

**Appendix 1. Published new naturalized records based on OANRP staff collections, through 2013**

The 45 records listed below represent collections of new records of weedy vascular plants collected by OANRP staff and published in the Bishop Museum’s *Records of the Hawaii Biological Survey* since the inception of the series in 1995. Included are 26 new island records, 9 new naturalized records, 8 new state records, and 2 new adventive records. This list does not include additional as-yet unpublished records discussed in this report.

*Legend for record type/citation.* Record type: NAR=New adventive record; NIR=New island record; NNR=New naturalized record; NSR=New state record. This is followed by author/year citation (from the alphabetical listing below) and the page number on which the record was described. These papers, all published in the *Bishop Museum Occasional Papers* series, are available as pdfs at <http://hbs.bishopmuseum.org/hbspubs.html>, in the *Records of the Hawaii Biological Survey* section.

Frohlich, D. and A. Lau. 2007. New plant records from O’ahu for 2006. *Bishop Museum Occasional Papers* 96: 8–13.  
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 Frohlich, D. and A. Lau. 2010. New plant records from O’ahu for 2008. *Bishop Museum Occasional Papers* 107: 3–18.  
 Frohlich, D. and A. Lau. 2012. New plant records for the Hawaiian Islands 2010–2011. *Bishop Museum Occasional Papers* 113: 27–54.  
 Herbst, D. R., G. W. Staples and C. T. Imada. 2004. New Hawaiian plant records for 2002–2003. *Bishop Museum Occasional Papers* 78: 3–12.  
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 Snow, N. 2008. Notes on grasses (Poaceae) in Hawai’i. *Bishop Museum Occasional Papers* 100: 38–43.  
 Snow, N. and G. Davidse. 2011. Notes on grasses (Poaceae) in Hawai’i: 3. *Bishop Museum Occasional Papers* 110: 17–22.  
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Family	Scientific name	Record type; citation
<b>DICOTS</b>		
Aquifoliaceae	<i>Ilex cassine</i>	NNR; Imada et al. 2000:9
Asteraceae	<i>Chromolaena odorata</i>	NSR; Frohlich & Lau 2012:30
Asteraceae	<i>Senecio madagascariensis</i>	NIR; Herbst et al. 2004:4
Bignoniaceae	<i>Pyrostegia venusta</i>	NNR; Frohlich & Lau 2012:31
Brassicaceae	<i>Lepidium africanum</i>	NIR; Frohlich & Lau 2010:6
Caryophyllaceae	<i>Petrorhagia velutina</i>	NIR; Frohlich & Lau 2012:32
Celastraceae	<i>Catha edulis</i>	NNR; Frohlich & Lau 2012:32
Crassulaceae	<i>Crassula multicava</i>	NIR; Lau & Frohlich 2012:13
Crassulaceae	<i>Kalanchoe crenata</i>	NSR; Herbst et al. 2004:6
Fabaceae	<i>Acacia mangium</i>	NNR; Frohlich & Lau 2008:6
Fabaceae	<i>Albizia adianthifolia</i>	NSR; Lau & Frohlich 2013:7
Fabaceae	<i>Albizia saponaria</i>	NIR; Lau & Frohlich 2012:15
Fabaceae	<i>Crotalaria lanceolata</i>	NIR; Imada 2007:37
Moraceae	<i>Ficus pumila</i>	NAR; Frohlich & Lau 2012:50
Oleaceae	<i>Olea europaea</i> subsp. <i>cuspidata</i>	NIR; Frohlich & Lau 2010:12
Onagraceae	<i>Oenothera kunthiana</i>	NIR; Frohlich & Lau 2010:13
Scrophulariaceae	<i>Veronica serpyllifolia</i>	NIR; Lau & Frohlich 2012:22

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Sterculiaceae	<i>Melochia umbellata</i>	NIR; Frohlich & Lau 2007:11
Verbenaceae	<i>Verbena bonariensis</i>	NIR; Frohlich & Lau 2008:9
<b>MONOCOTS</b>		
Cyperaceae	<i>Cyperus sanguinolentus</i>	NIR; Frohlich & Lau 2008:5
Iridaceae	<i>Dietes iridioides</i>	NNR; Frohlich & Lau 2012:39
Iridaceae	<i>Sisyrinchium exile</i>	NIR; Lau & Frohlich 2013:8
Liliaceae	<i>Dianella caerulea</i> var. <i>assera</i>	NNR; Lau & Frohlich 2012:18
Orchidaceae	<i>Dendrobium</i> 'Jaquelyn Thomas'	NAR; Lau & Frohlich 2013:15
Orchidaceae	<i>Dendrobium mirbelianum</i>	NSR; Frohlich & Lau 2012:41
Orchidaceae	<i>Epidendrum nocturnum</i>	NSR; Frohlich & Lau 2012:42
Orchidaceae	<i>Habenaria rodeiensis</i>	NIR; Lau & Frohlich 2012:19
Poaceae	<i>Agrostis hyemalis</i>	NSR; Snow & Lau 2010:46
Poaceae	<i>Andropogon glomeratus</i> var. <i>pumilus</i>	NIR; Herbst et al. 2004:10 (as <i>Schizachyrium condensatum</i> ), Snow & Lau 2010:48
Poaceae	<i>Anthoxanthum odoratum</i>	NIR; Snow & Davidse 2011:17
Poaceae	<i>Bothriochloa bladhii</i>	NIR; Snow 2008:38, Frohlich & Lau 2010:14
Poaceae	<i>Entolasia marginata</i>	NIR; Frohlich & Lau 2012:44
Poaceae	<i>Eragrostis elongata</i>	NIR; Herbst et al. 2004:9
Poaceae	<i>Paspalum virgatum</i>	NSR; Snow & Lau 2010:54
Poaceae	<i>Schedonorus arundinaceus</i>	NIR; Herbst et al. 2004:10
Poaceae	<i>Schizachyrium condensatum</i>	NIR; Lau & Frohlich 2013:10
Poaceae	<i>Setaria sphacelata</i>	NIR; Herbst et al. 2004:10
Poaceae	<i>Urochloa decumbens</i>	NIR; Lau & Frohlich 2013:10
<b>GYMNOSPERMS</b>		
Cupressaceae	<i>Callitris columellaris</i>	NIR; Frohlich & Lau 2012:34
Cupressaceae	<i>Callitris endlicheri</i>	NNR; Lau & Frohlich 2012:14
Cupressaceae	<i>Cupressus lusitanica</i>	NNR; Frohlich & Lau 2012:34
Cupressaceae	<i>Juniperus bermudiana</i>	NIR; Lau & Frohlich 2013:6
Podocarpaceae	<i>Podocarpus macrophyllus</i>	NNR; Lau & Frohlich 2012:20
<b>PTERIDOPHYTES</b>		
Blechnaceae	<i>Blechnum orientale</i>	NSR; Lau & Frohlich 2012:10
Pteridaceae	<i>Adiantum</i> 'Edwinii'	NIR; Lau & Frohlich 2012:21