



Invasive Plant Species Early Detection in the San Francisco Bay Area Network

2012 Annual Report

Natural Resource Technical Report NPS/SFAN/NRTR —2013/797



ON THE COVER

Early detection intern Lindsay Ringer teaches volunteers to identify invasive purple foxglove (*Digitalis purpurea*) during a Weed Watchers volunteer training.

Photograph by: Kevin Sherrill/NPS.

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September, 2013

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Wrubel, E. C. and R. J. Steers. 2013. Invasive plant species early detection in the San Francisco Bay Area Network: 2012 annual report. Natural Resource Technical Report NPS/SFAN/NRTR—2013/797. National Park Service, Fort Collins, Colorado.

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Executive Summary

This report summarizes the results of the 2012 invasive plant early detection protocol surveys for the San Francisco Bay Area Inventory and Monitoring Program (SFAN). Invasive plants (see Glossary) represent a high priority vital sign for SFAN because of the negative effects they have on park resources, including altering ecosystem processes (fire regime, hydrology, soil biogeochemical cycling, etc.), reducing habitat quality, blocking views, and increasing trail maintenance needs.

The 2012 early detection surveys were conducted in Golden Gate National Recreation Area (GOGA), John Muir National Historic Site (JOMU), Pinnacles National Monument (PINN), and Point Reyes National Seashore (PORE). Objectives and methods for the 2012 field season were based on a peer-reviewed early detection protocol published in the NPS Natural Resource Report series (Williams et al. 2009). Including field seasons when pilot data was collected, 2012 was the fourth field season of data collection in PINN and JOMU, the fifth in PORE, and the sixth in GOGA. 2012 was also the fifth year of full protocol-level surveys in GOGA, marking the completion of the first five-year survey cycle where all roads and trails have been surveyed at least once.

Volunteers played an important role in the implementation of the 2012 field surveys. At GOGA, 14 volunteers assisted staff to conduct surveys and enter data, contributing 570 hours. At PORE, seven volunteers contributed 100 hours. At PINN, five volunteers contributed 134 hours performing surveys. At JOMU, two volunteers contributed 14 hours performing surveys.

One hundred and nine miles of trails and roadsides were surveyed within GOGA and 1,519 individual occurrences of target weed species were recorded. One-hundred and fourteen miles of trails and roadsides were surveyed at PORE and 348 occurrences of target weeds were recorded. Twenty-four miles of trails, roadsides, fence lines, and drainages were surveyed at PINN and 158 occurrences of target weeds were recorded. Seven miles of trails were surveyed at JOMU, and 21 priority weed occurrences were recorded.

In GOGA, nine non-native species that are new to the park were recorded and collected during the 2012 early detection surveys. Also, one new non-native species was reported to I&M staff through the Bay Area Early Detection Network (BAEDN). Eleven non-native species new to PINN were recorded and collected during the 2012 surveys. One new non-native species was recorded during the PORE surveys, and an additional new non-native species was recorded during a post-season survey. Four of the newly recorded species at GOGA were added to the 2013 GOGA priority list for early detection, and four of the newly recorded species at PINN were added to the 2013 PINN priority list. All new species will be added to the lists of vascular plants for each park in which they were found (IRMA 2012a, b, c).

Maps were created of all areas surveyed in GOGA, JOMU, PINN, and PORE as well as for priority plant populations. Web pages were used to educate the public about the project and provide support to existing volunteers. Features on the web pages included survey maps, species lists, data sheets, and survey calendars. Collaborative efforts with staff at GOGA, JOMU, PINN, PORE, and Golden Gate National Parks Conservancy continued to facilitate communication of findings and to broaden the early detection network.

Acknowledgments

In addition to the primary authors, many contributors provided critical assistance. We thank A. Williams for producing the first early detection annual report, which was used as a template to create this report. We also thank D. George, D. Adams, S. Mohren, M. Koenen, J. Rogers, N. Howe, J. Cartan, K. Hacker, and N. Tallent for providing valuable comments on this manuscript or previous years' reports; M. Alvarez and the Habitat Restoration Team for contributing new records to the GeoWeed database; E. Hamingson and the Habitat Restoration Program for providing important insights into invasive plant issues at PORE; B. Johnson for providing important insights into invasive plant issues at PINN; F. Villalba for providing important insights into invasive plant issues at JOMU; the Golden Gate National Parks Conservancy and the Point Reyes National Seashore Association for support and partnership; the Point Reyes early detection seasonal biologist, C. Davis, and the invaluable contributions of early detection interns, L. Ringer and K. Sherrill, and all the Weed Watcher volunteers.

Introduction

Background

Invasive plant species negatively affect park resources and visitor enjoyment in several ways, including altering landscapes and fire regimes, reducing native plant and animal habitat, blocking views, and increasing trail maintenance needs. Invasive species are second only to habitat loss as threats to global biodiversity (Scott and Wilcove 1998). Given the extraordinary biodiversity of the San Francisco Bay Area and urban development pressures, the San Francisco Bay Area Network (SFAN) parks serve as crucial habitat for native species. Over 100 rare plant species can be found in SFAN parks. Invasive plants threaten many of these rare species. For example, in Golden Gate National Recreation Area (GOGA), 25 species of exotic or non-native plants have been noted as directly threatening rare plant populations (NPS 2004). Trails, roads, and waterways are the main routes of infestation of new exotic species. Monitoring these routes is the most effective way to prevent the spread of existing species and the infestation of new species (McNeely et al. 2001).

During vital sign prioritization by the SFAN Inventory and Monitoring Program, invasive plant species early detection ranked as the second most important vital sign for the network (Adams et al. 2006). The early detection monitoring protocol was developed by the SFAN to locate new, isolated infestations of invasive plants before they become entrenched in the network parks (Williams et al. 2009). For this vital sign, SFAN staff ranked both species and areas (i.e. subwatersheds) in each park to prioritize search efforts. Every year, exotic species lists for each park are re-prioritized, if necessary, based on previous survey data and updated management concerns. Appendices A through D contain the 2012 priority exotic species lists for each park unit.

Objectives

Objectives for the 2012 field season were based on the early detection protocol (Williams et al. 2009) and current management priorities:

- 1) Within GOGA and PORE, survey all roads and trails in high-priority subwatersheds, and also in one-fifth of all other subwatersheds, noting presence and absence of priority exotic species. Use visual assessment and GPS technology to accurately map populations of the top-priority exotic plant species based on ranked species lists.
- 2) Survey all roads and trails in new GOGA lands at Rancho Corral de Tierra.
- 3) Train volunteers to conduct early detection surveys for top-priority SFAN exotic plants.
- 4) Train GOGA and PORE staff plus park-partners to identify top-priority SFAN exotic plants for opportunistic early detection of new populations during regular work activities.
- 5) Revise priority species lists based on information acquired during the previous season.
- 6) Survey select roads, trails, fencelines, and stream corridors for priority species at PINN.
- 7) Survey all trails in the Mt Wanda section of JOMU.

Methods

All methodology follows the SFAN early detection monitoring of invasive plant species protocol (Williams et al. 2009). The following section briefly describes sampling methods, scheduling, data management, and data collection detailed in the protocol.

Prioritization

Full prioritization methods can be found in the protocol and subsequent annual reports, but are summarized briefly here. The lists of target species for GOGA, PINN, and PORE were prioritized based on current knowledge and rankings. This included summing recognized invasiveness and stratifying by feasibility of control based on categories of actual or estimated infested acreage in a park. The target species list for JOMU was recently finalized in 2011 and implemented in 2012. It was based on data collected from 2009 through 2011, records in CalFlora (2012), and procedures described in the protocol (Williams et al. 2009), where applicable.

The list of priority areas where monitoring would take place was generated once for GOGA and PORE in the year prior to full-protocol implementation (2008 and 2009, respectively). This was done by ranking subwatersheds using their number and degree of current infestations, risk of further infestations, and priority of natural resources present. For example, subwatersheds that scored highest were ones that exhibited low infestation levels, had a high risk of further infestation based on presence of infrastructure or invadable vegetation types, and included populations of rare plants or animals.

Search Areas

GOGA manages all or part of 29 watersheds and 110 subwatersheds. Thirty-three of these subwatersheds were deemed at high risk of invasion and harm to significant biological resources. Roads and trails within the high-priority subwatersheds were the first places to be searched. For the purposes of this report, data collected in Fort Point and Muir Woods National Monument are included with GOGA.

PORE manages all or part of 7 watersheds and 124 subwatersheds. Twenty-five of these subwatersheds were deemed at high risk of invasion and harm to significant biological resources. These values include subwatersheds on adjacent GOGA lands that are managed by PORE (e.g. Bolinas Ridge). For the purposes of this report, data collected in those GOGA subwatersheds that are managed by PORE are included with PORE and not GOGA.

PINN is divided into 18 management units that roughly correspond to subwatersheds. None of these units have been prioritized based on their risk of invasion and/or harm to significant biological resources. Instead, surveys are performed on roads, trails, pig fence, and riparian corridors that are of concern to the Pinnacles resource management division. Surveys occur for one week each year during peak flowering season (April through May) and follow field methods in Williams et al. (2009). PINN is relatively isolated and does not have an active volunteer Weed Watcher program.

JOMU contains a small amount of natural vegetation centered on Mount Wanda. This area is not subdivided into smaller subwatersheds/management units. However, the entire Mount Wanda

open space can be surveyed each year. Surveys do not occur in the orchard and landscaped areas maintained at the historic Muir residence across the freeway (State Hwy. 4) to the north. No active Weed Watcher volunteer program is in effect at JOMU primarily because of limited I&M resources.

Field Methods

Searches were conducted by teams of one to four individuals along trails and roads within the parks. The official search area used for recording both positive (plant occurrence) and negative data (areas where target plants were not found) was restricted to 5 m on either side of the route.

Along the survey route observers recorded location and associated biological information (phenology, habitat, distribution) of priority target plant populations that were encountered. The level of detail for data collection was dictated by the ranking of the plant on the priority list, and the extent of the infestation (Figure 1).

Our Priorities	Example	Explanation	Data collected
List 1 (Highest Priority Plants)	 Capeweed	List 1 plants are highly invasive and are typically not widespread. Control or even eradication is often feasible.	<i>Point occurrences</i> and <i>polygon assessments</i> are recorded for all patches, regardless of their size.
List 2 (High Priority Plants)	 Cape Ivy	List 2 plants are highly invasive and usually more common than List 1 species. Small, outlier patches may be targeted for eradication or control.	<i>Point occurrences</i> are recorded for all patches regardless of their size, and <i>polygon assessments</i> are recorded for all patches smaller than 100 m ² .
List 3 (Medium Priority Plants)	 Sweet fennel	List 3 plants are usually widespread and difficult to control at the scale of the park. Uncommon species of concern are also listed here to improve our understanding of their distribution in the park.	<i>Point occurrences</i> are recorded for all patches smaller than 100 m ² .
List 4 (Lower Priority Plants)	 Rattlesnake grass	List 4 plants include all other exotic species that are not captured by Lists 1 – 3. Typically, these are very widespread invasive plants and are beyond control, or they are waifs.	These plants are not mapped. Observers record presence/absence.

Figure 1. Tiered levels of data collection.

For the initial survey of a route, *point occurrences* and *polygon assessments* were mapped for list 1 species; *point occurrences* and *polygon assessments* (if patch size is less than 100 m²) for list 2 species; presence/absence, or *point occurrences* (if patch size is less than 100 m²) for list 3 species; and presence/absence recorded for list 4 species, along with the *survey area*.

All of the reported field data to date have been collected during surveys for the full list of species by advanced observers. No data from unsupervised volunteers are in the GeoWeed database or are utilized for data analyses or incorporated into summaries reported herein. A detailed description of field methodology can be found in the early detection of invasive plants protocol: SOP 2- Mapping; SOP 3- Field Data Collection (Williams et al. 2009).

Species List Revisions

The 2012 priority lists for each park were revised in response to concerns of resource management staff based on results of the 2011 surveys. Changes to the species lists made for the 2012 field season are explained in the 2011 annual report (Wrubel and Steers 2012). Each park unit's species lists for the 2012 field season are also included in Appendices A through D.

Results

The 2012 survey results are presented below. All data on species occurrences are based on the species lists for each park for the 2012 field season (Appendices A-D). Species nomenclature follows The Jepson Manual, First Edition (Hickman 1993). For species that are not described in the Jepson Manual, First Edition, nomenclature follows the Jepson Online Interchange (Jepson Flora Project 2012). Links or directions to the survey maps are found in Appendix E.

GOGA

Search Effort

One hundred and nine miles of trails and roadsides were surveyed within GOGA during the 2012 field season. Seventy-seven priority subwatersheds were surveyed. In total, 16 people spent 780 hours to complete these surveys; 570 of these hours were contributed by 14 volunteers. Three of the volunteers were I&M interns, two who worked for the Weed Watchers program at both GOGA and PORE for a six month duration and one who worked for the SFAN I&M Plant Community Change Protocol. Two additional volunteer interns were sponsored by the Golden Gate National Parks Conservancy through their Advanced Youth Internship Program.

Species Found

In 2012, 1,519 individual occurrences of target weed species were recorded in GOGA during early detection surveys and entered into the GOGA GeoWeed database, representing List 1, 2, and 3 species (Table 1). Three hundred and fifteen of these occurrences were List 1 species, 757 were List 2 species, and 447 were List 3 species. The 1,519 individual occurrences of target weed species that were recorded during the GOGA surveys were represented by 77 plant species.

Nine new non-native species were found during the 2012 early detection surveys that were not previously documented on the GOGA working list of vascular plants (IRMA 2012a), and one additional new non-native species was reported to I&M staff through the Bay Area Early Detection Network (BAEDN). Four of these species have been added to the GOGA 2013 priority species list (see discussion). All ten new species will be added to the GOGA working list of vascular plants (IRMA 2012a).

Table 1. GOGA 2012 survey results. New occurrences and number of subwatersheds with target species present.

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Ailanthus altissima</i>	tree-of-heaven	0	0
1	<i>Albizia lophantha</i>	silk tree	15	3
1	<i>Ammophila arenaria</i>	European beachgrass	0	0
1	<i>Ammophila breviligulata</i>	American beachgrass	0	0
1	<i>Anthoxanthum odoratum</i>	sweet vernalgrass	0	0
1	<i>Aptenia cordifolia</i>	heartleaf iceplant	6	2
1	<i>Arctotheca calendula</i>	fertile capeweed	2	1
1	<i>Arctotheca prostrata</i>	creeping capeweed	17	9
1	<i>Arundo donax</i>	giant reed	0	0
1	<i>Berberis darwinii</i>	Darwin's berberis	1	1
1	<i>Carduus acanthoides</i>	plumeless thistle	0	0

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Carex pendula</i>	hanging sedge	0	0
1	<i>Carpobrotus chilensis</i>	sea fig	3	2
1	<i>Carthamus lanatus</i>	woolly distaff thistle	0	0
1	<i>Centaurea calcitrapa</i>	purple starthistle	3	3
1	<i>Centaurea solstitialis</i>	yellow starthistle	0	0
1	<i>Cirsium arvense</i>	Canada thistle	0	0
1	<i>Conicosia pugioniformis</i>	narrow-leaved iceplant	8	2
1	<i>Cortaderia selloana</i>	pampas grass	2	2
1	<i>Crataegus monogyna</i>	singleseed hawthorn	10	8
1	<i>Cynara cardunculus</i>	cardoon	0	0
1	<i>Cytisus scoparius</i>	Scotch broom	12	7
1	<i>Cytisus striatus</i>	Portuguese broom	3	2
1	<i>Digitalis purpurea</i>	purple foxglove	3	3
1	<i>Dittrichia graveolens</i>	stinkweed	0	0
1	<i>Drosanthemum floribundum</i>	showy dewflower	0	0
1	<i>Echium plantagineum</i>	salvation jane	0	0
1	<i>Ehrharta calycina</i>	perennial veldt grass	0	0
1	<i>Eichhornia crassipes</i>	water hyacinth	0	0
1	<i>Euphorbia oblongata</i>	oblong spurge	6	2
1	<i>Hedera canariensis</i>	Algerian ivy	0	0
1	<i>Helichrysum petiolare</i>	licorice plant	12	8
1	<i>Hypericum grandifolium</i>	no common name	0	0
1	<i>Hypericum perforatum</i>	Klamathweed	6	3
1	<i>Ilex aquifolium</i>	English holly	14	9
1	<i>Lepidium latifolium</i>	perennial pepperweed	1	1
1	<i>Limonium ramosissimum</i>	Algerian sea lavender	0	0
1	<i>Ludwigia hexapetala</i>	six-petal water primrose	1	1
1	<i>Ludwigia peploides</i> ssp. <i>montevidensis</i>	floating water primrose	0	0
1	<i>Maytenus boaria</i>	Chilean mayten	1	1
1	<i>Mesembryanthemum crystallinum</i>	ice plant	0	0
1	<i>Myriophyllum aquaticum</i>	parrot's-feather	1	1
1	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	0	0
1	<i>Nicotiana glauca</i>	tree tobacco	0	0
1	<i>Phalaris arundinacea</i>	reed canary grass	0	0
1	<i>Pittosporum crassifolium</i>	stifleaf cheesewood	12	7
1	<i>Pyracantha angustifolia</i>	narrowleaf firethorn	19	10
1	<i>Rhamnus alaternus</i>	Italian buckthorn	2	1
1	<i>Robinia pseudoacacia</i>	black locust	1	1
1	<i>Romulea rosea</i> var. <i>australis</i>	rosy sandcrocus	3	3
1	<i>Rytidosperma caespitosum</i>	common wallaby grass	27	4
1	<i>Rytidosperma penicillatum</i>	hairy wallaby grass	44	18
1	<i>Scabiosa atropurpurea</i>	mourningbride	20	12
1	<i>Spartina alterniflora</i>	smooth cordgrass	0	0

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Spartium junceum</i>	Spanish broom	0	0
1	<i>Stipa manicata</i>	Andean tussockgrass	2	2
1	<i>Trifolium angustifolium</i>	narrowleaf crimson clover	35	10
1	<i>Ulex europaeus</i>	gorse	4	3
1	<i>Vinca major</i>	periwinkle	19	15
2	<i>Acacia melanoxylon</i>	blackwood acacia	34	21
2	<i>Ageratina adenophora</i>	thoroughwort	24	13
2	<i>Agrostis avenacea</i>	Pacific bentgrass	0	0
2	<i>Bromus madritensis ssp. rubens</i>	red brome	70	23
2	<i>Bromus tectorum</i>	cheat grass	0	0
2	<i>Buddleja davidii</i>	butterfly bush	3	3
2	<i>Calendula arvensis</i>	field marigold	9	8
2	<i>Centaurea melitensis</i>	totalote	46	24
2	<i>Cestrum parqui</i>	orange jessamine	1	1
2	<i>Cynodon dactylon</i>	Bermudagrass	2	2
2	<i>Dactylis glomerata</i>	orchard grass	97	41
2	<i>Delairea odorata</i>	cape ivy	57	23
2	<i>Dipsacus fullonum</i>	Fuller's teasel	9	8
2	<i>Eucalyptus globulus</i>	bluegum eucalyptus	17	13
2	<i>Festuca arundinacea</i>	tall fescue	83	38
2	<i>Geranium purpureum</i>	herb robert	1	1
2	<i>Hedera helix</i>	English ivy	56	24
2	<i>Hirschfeldia incana</i>	shortpod mustard	72	35
2	<i>Iris pseudacorus</i>	yellow flag iris	1	1
2	<i>Ligustrum lucidum</i>	glossy privet	3	2
2	<i>Leptospermum laevigatum</i>	Australian teatree	15	5
2	<i>Leucanthemum vulgare</i>	oxeye daisy	17	10
2	<i>Mentha pulegium</i>	pennyroyal	19	10
2	<i>Mercurialis annua</i>	annual mercury	1	1
2	<i>Oxalis pes-caprae</i>	Bermuda buttercup	26	14
2	<i>Pennisetum clandestinum</i>	Kikuyu grass	27	14
2	<i>Roldana petasitis</i>	velvet groundsel	2	2
2	<i>Rosa eglanteria</i>	sweetbriar rose	13	3
2	<i>Rubus discolor</i>	Himalayan blackberry	49	22
2	<i>Solanum laciniatum</i>	New Zealand nightshade	3	2
3	<i>Arrhenatherum elatius</i>	tall oatgrass	0	0
3	<i>Brassica rapa</i>	field mustard	2	2
3	<i>Carpobrotus edulis</i>	iceplant	15	9
3	<i>Coprosma repens</i>	creeping mirrorplant	6	2
3	<i>Cortaderia jubata</i>	jubata grass	71	38
3	<i>Cotoneaster franchetii</i>	orange cotoneaster	12	9
3	<i>Cotoneaster lacteus</i>	milkflower cotoneaster	25	17
3	<i>Cotoneaster pannosus</i>	silverleaf cotoneaster	35	25

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
3	<i>Ehrharta erecta</i>	panic veldt grass	49	28
3	<i>Erigeron karvinskianus</i>	Latin American fleabane	6	4
3	<i>Foeniculum vulgare</i>	sweet fennel	36	28
3	<i>Genista monspessulana</i>	French broom	54	34
3	<i>Gunnera tinctoria</i>	Chilean gunnera	0	0
3	<i>Lathyrus latifolius</i>	everlasting pea	59	27
3	<i>Ligustrum ovalifolium</i>	California privet	1	1
3	<i>Linaria vulgaris</i>	butter and eggs	0	0
3	<i>Lonicera japonica</i>	Japanese honeysuckle	0	0
3	<i>Phalaris aquatica</i>	harding grass	50	31
3	<i>Pinus radiata</i>	Monterey pine	25	17
3	<i>Schinus molle</i>	pepper tree	1	1
3	<i>Tamarix chinensis</i>	saltcedar	0	0
3	<i>Xanthium spinosum</i>	spiny cocklebur	0	0
3	<i>Xanthium strumarium</i>	rough cocklebur	0	0

PORE

Search Effort

One-hundred and fourteen miles of trails and roadsides were surveyed during the 2012 field season at PORE, including GOGA property managed by PORE. A total of 40 subwatersheds were surveyed (32 subwatersheds belonging to PORE and 8 that belong to GOGA but are managed by PORE). In total, 10 people spent 230 hours to complete these surveys, 100 of those hours were contributed by 7 volunteers, 2 of whom were interns who worked part time for the Weed Watchers program at both GOGA and PORE for 6 months, and 2 who were sponsored by the Golden Gate National Parks Conservancy through their Advanced Youth Internship Program.

Species Found

In 2012, 348 individual occurrences of target weed species (List 1, 2 or 3) were recorded in PORE during early detection surveys and entered into the PORE GeoWeed database (Table 2). Ninety-three of these occurrences were List 1 species, 139 were List 2 species, and 116 were List 3 species. Forty-one plant species contributed to the 348 occurrences that were recorded during the 2012 PORE surveys.

One new non-native species was found during the 2012 early detection surveys that was not previously documented on the PORE working list of vascular plants (IRMA 2012b). One additional new non-native species was recorded by I&M staff during a post-season, focused survey for weeds. One of these species has been added to the PORE 2013 priority species list (see discussion). Both new species will be added to the PORE working list of vascular plants (IRMA 2012b).

Table 2. PORE 2012 survey results. New occurrences and number of subwatersheds with target species present.

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Acroptilon repens</i>	Russian knapweed	0	0
1	<i>Aegilops triuncialis</i>	barbed goatgrass	0	0
1	<i>Ageratina adenophora</i>	thoroughwort	0	0
1	<i>Albizia lophantha</i>	silk tree	0	0
1	<i>Alisma lanceolatum</i>	lanceleaf water plantain	0	0
1	<i>Anthoxanthum odoratum</i>	sweet vernalgrass	0	0
1	<i>Arundo donax</i>	giant reed	0	0
1	<i>Brachypodium distachyon</i>	purple false brome	1	1
1	<i>Carduus acanthoides</i>	plumeless thistle	0	0
1	<i>Carex pendula</i>	hanging sedge	0	0
1	<i>Carthamus lanatus</i>	woolly distaff thistle	0	0
1	<i>Centaurea calcitrapa</i>	purple starthistle	0	0
1	<i>Centaurea iberica</i>	Iberian star thistle	0	0
1	<i>Centaurea melitensis</i>	totalote	4	2
1	<i>Centaurea solstitialis</i>	yellow starthistle	0	0
1	<i>Conicosia pugioniformis</i>	narrow-leaved iceplant	0	0
1	<i>Cotoneaster franchetii</i>	orange cotoneaster	1	1
1	<i>Cotoneaster pannosus</i>	silverleaf cotoneaster	10	6
1	<i>Dittrichia graveolens</i>	stinkweed	0	0
1	<i>Egeria densa</i>	Brazilian waterweed	0	0
1	<i>Ehrharta calycina</i>	perennial veldt grass	0	0
1	<i>Euphorbia oblongata</i>	oblong spurge	0	0
1	<i>Helichrysum petiolare</i>	licorice plant	0	0
1	<i>Hypericum grandifolium</i>	no common name	0	0
1	<i>Hypericum perforatum</i>	Klamathweed	1	1
1	<i>Iris pseudacorus</i>	yellow flag iris	0	0
1	<i>Lepidium latifolium</i>	perennial pepperweed	0	0
1	<i>Limonium ramosissimum</i>	Algerian sea lavender	0	0
1	<i>Ludwigia hexapetala</i>	six-petal water-primrose	0	0
1	<i>Ludwigia peploides ssp. montevedensis</i>	floating water primrose	0	0
1	<i>Marrubium vulgare</i>	horehound	0	0
1	<i>Myriophyllum aquaticum</i>	parrot's-feather	0	0
1	<i>Phalaris arundinacea</i>	reed canary grass	0	0
1	<i>Robinia pseudoacacia</i>	black locust	0	0
1	<i>Romulea rosea var. australis</i>	rosy sandcrocus	0	0

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Rytidosperma penicillatum</i>	hairy wallaby grass	66	19
1	<i>Salsola soda</i>	oppositeleaf Russian thistle	0	0
1	<i>Senecio jacobaea</i>	tansy ragwort	0	0
1	<i>Spartina alterniflora</i>	Smooth cordgrass	0	0
1	<i>Trifolium angustifolium</i>	narrowleaf clover	10	6
1	<i>Ulex europaeus</i>	gorse	0	0
2	<i>Acacia melanoxydon</i>	blackwood acacia	1	1
2	<i>Arctotheca calendula</i>	fertile capeweed	0	0
2	<i>Arctotheca prostrata</i>	creeping capeweed	2	2
2	<i>Berberis darwinii</i>	Darwin's berberis	0	0
2	<i>Cakile edentula</i>	European searocket	0	0
2	<i>Cytisus scoparius</i>	Scotch broom	6	5
2	<i>Datura stramonium</i>	jimsonweed	0	0
2	<i>Delairea odorata</i>	cape ivy	2	2
2	<i>Echium candicans</i>	pride of Madeira	0	0
2	<i>Genista monspessulana</i>	French broom	12	5
2	<i>Glyceria declinata</i>	waxy mannagrass	0	0
2	<i>Hedera helix</i>	English ivy	16	8
2	<i>Ilex aquifolium</i>	English holly	2	2
2	<i>Lathyrus latifolius</i>	everlasting pea	17	6
2	<i>Leucanthemum vulgare</i>	oxeye daisy	25	11
2	<i>Linaria vulgaris</i>	butter and eggs	0	0
2	<i>Maytenus boaria</i>	Chilean mayten	0	0
2	<i>Oxalis pes-caprae</i>	Bermuda buttercup	0	0
2	<i>Paspalum dilatatum</i>	dallis grass	5	5
2	<i>Pennisetum clandestinum</i>	Kikuyu grass	2	1
2	<i>Pittosporum undulatum</i>	Victorian box	1	1
2	<i>Rubus armeniacus</i>	Himalayan blackberry	36	8
2	<i>Tetragonia tetragonioides</i>	New Zealand spinach	4	3
2	<i>Vinca major</i>	periwinkle	8	7
2	<i>Xanthium spinosum</i>	spiny cocklebur	0	0
3	<i>Acacia longifolia</i>	Sydney golden wattle	0	0
3	<i>Acacia verticillata</i>	prickly Moses	0	0
3	<i>Allium triquetrum</i>	Three corner leek	1	1
3	<i>Ammophila arenaria</i>	European beachgrass	0	0
3	<i>Carpobrotus chilensis</i>	sea fig	1	1
3	<i>Carpobrotus edulis</i>	iceplant	0	0
3	<i>Cestrum parqui</i>	chilean jessamine	0	0

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
3	<i>Conium maculatum</i>	poison hemlock	12	7
3	<i>Cortaderia jubata</i>	jubata grass	2	2
3	<i>Cortaderia selloana</i>	Uruguayan pampas grass	0	0
3	<i>Cotoneaster lacteus</i>	milkflower cotoneaster	0	0
3	<i>Crataegus monogyna</i>	singleseed hawthorn	2	1
3	<i>Cupressus macrocarpa</i>	Monterey cypress	1	1
3	<i>Cynodon dactylon</i>	Bermuda grass	1	1
3	<i>Digitalis purpurea</i>	purple foxglove	14	8
3	<i>Dipsacus fullonum</i>	Fuller's teasel	0	0
3	<i>Dipsacus sativus</i>	Indian teasel	1	1
3	<i>Drosanthemum floribundum</i>	showy dewflower	0	0
3	<i>Echium plantagineum</i>	salvation jane	0	0
3	<i>Ehrharta erecta</i>	panic veldt grass	23	11
3	<i>Eucalyptus globulus</i>	bluegum eucalyptus	1	1
3	<i>Euphorbia lathyris</i>	gopher plant	6	4
3	<i>Festuca arundinacea</i>	tall fescue	14	8
3	<i>Foeniculum vulgare</i>	sweet fennel	5	4
3	<i>Hypericum calycinum</i>	Aaron's beard	3	2
3	<i>Lythrum hyssopifolia</i>	hyssop loosestrife	0	0
3	<i>Mentha pulegium</i>	pennyroyal	11	8
3	<i>Myoporum laetum</i>	myoporum	0	0
3	<i>Phalaris aquatica</i>	Harding grass	14	8
3	<i>Pinus radiata</i>	Monterey pine	2	1
3	<i>Populus alba</i>	white poplar	0	0
3	<i>Pyracantha angustifolia</i>	narrowleaf firethorn	0	0
3	<i>Rosa eglanteria</i>	sweetbriar rose	0	0
3	<i>Scabiosa atropurpurea</i>	mourningbride	0	0
3	<i>Sorghum halepense</i>	Johnson grass	0	0
3	<i>Sparaxis tricolor</i>	Harlequin flower	0	0
3	<i>Tanacetum parthenium</i>	feverfew	0	0
3	<i>Verbascum blattaria</i>	moth mullein	0	0
3	<i>Watsonia meriana</i>	bulbil bugle-lily	0	0
3	<i>Zantedeschia aethiopica</i>	calla lily	2	2

PINN

Search Effort

Twenty-four miles of trails, fencelines, and drainages were surveyed during the 2012 field season at PINN. In total, eight people spent 226 hours conducting surveys; 134 of these hours were contributed by five volunteers. Three of the volunteers were I&M interns, 2 who worked for the Weed Watchers program and 1 who worked for the SFAN I&M Plant Community Change Protocol.

Species Found

In 2012, 158 occurrences of target weed species were recorded in PINN during early detection surveys and entered into the PINN GeoWeed database. Thirty-five of these occurrences were List 1 species, 24 were List 2 species, and 99 were List 3 species (Table 3). The 158 individual occurrences of target weed species that were recorded during the PINN surveys were represented by 24 plant species.

Eleven new non-native species were found during the 2012 early detection surveys that were not previously documented on the PINN working list of vascular plants (IRMA 2012c). Four of these species have been added to the PINN 2013 priority species list (see discussion). All eleven new species will be added to the PINN working list of vascular plants (IRMA 2012c).

Table 3. PINN 2012 survey results. New occurrences and number of subwatersheds with target species present.

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Acroptilon repens</i>	Russian knapweed	0	0
1	<i>Ailanthus altissima</i>	tree-of-heaven	0	0
1	<i>Arundo donax</i>	giant reed	0	0
1	<i>Chenopodium ambrosioides</i>	Mexican tea	0	0
1	<i>Cnicus benedictus</i>	blessed thistle	2	1
1	<i>Dittrichia graveolens</i>	stinkweed	0	0
1	<i>Iris pseudacorus</i>	yellow flag iris	0	0
1	<i>Lepidium latifolium</i>	perennial pepperweed	0	0
1	<i>Lolium multiflorum</i>	Italian ryegrass	14	4
1	<i>Lolium perenne</i>	perennial ryegrass	2	2
1	<i>Lolium temulentum</i>	darnel	3	2
1	<i>Malva parviflora</i>	cheeseweed	3	1
1	<i>Melilotus alba</i>	white sweetclover	0	0
1	<i>Nicotiana glauca</i>	tree tobacco	0	0
1	<i>Picris echioides</i>	bristly oxtongue	0	0
1	<i>Piptatherum miliaceum</i>	smilo grass	2	1
1	<i>Poa bulbosa</i>	bulbous bluegrass	4	2
1	<i>Rubus armeniacus</i>	Himalayan blackberry	1	1
1	<i>Salsola tragus</i>	oppositeleaf Russian thistle	0	0
1	<i>Taeniatherum caput-medusae</i>	Medusahead	0	0

2012 list	Scientific name	Common name	Number of new occurrences	Number of subwatersheds
1	<i>Tamarix ramosissima</i>	saltcedar	0	0
1	<i>Tragopogon dubius</i>	yellow salsify	4	3
1	<i>Tribulus terrestris</i>	puncturevine	0	0
1	<i>Trifolium hirtum</i>	rose clover	0	0
1	<i>Verbascum blattaria</i>	moth mullein	0	0
1	<i>Verbascum thapsus</i>	woolly mullein	0	0
1	<i>Xanthium spinosum</i>	spiny cocklebur	0	0
2	<i>Carduus pycnocephalus</i>	Italian thistle	10	3
2	<i>Carduus tenuiflorus</i>	slender-flowered thistle	0	0
2	<i>Conium maculatum</i>	poison hemlock	2	1
2	<i>Cotula coronopifolia</i>	brassbuttons	0	0
2	<i>Crypsis schoenoides</i>	swamp prickly grass	0	0
2	<i>Cynodon dactylon</i>	Bermudagrass	0	0
2	<i>Cyperus difformis</i>	variable flatsedge	0	0
2	<i>Marrubium vulgare</i>	horehound	12	3
2	<i>Veronica persica</i>	birdseye speedwell	0	0
2	<i>Vinca major</i>	periwinkle	0	0
3	<i>Amaranthus albus</i>	tumbleweed	0	0
3	<i>Brassica nigra</i>	black mustard	0	0
3	<i>Brassica rapa</i>	field mustard	1	1
3	<i>Centaurea melitensis</i>	toocalote	22	7
3	<i>Centaurea solstitialis</i>	yellow starthistle	16	2
3	<i>Cirsium vulgare</i>	bull thistle	6	2
3	<i>Hirschfeldia incana</i>	shortpod mustard	11	4
3	<i>Lactuca serriola</i>	prickly lettuce	23	6
3	<i>Mentha spicata</i> var. <i>spicata</i>	spearmint	2	2
3	<i>Mentha X piperita</i>	peppermint	0	0
3	<i>Plantago lanceolata</i>	English plantain	3	2
3	<i>Polygonum arenastrum</i>	oval-leaf knotweed	1	1
3	<i>Raphanus sativus</i>	wild radish	0	0
3	<i>Rumex acetosella</i>	sheep sorrel	1	1
3	<i>Rumex crispus</i>	curly dock	10	4
3	<i>Silybum marianum</i>	blessed milkthistle	3	2

JOMU

Search Effort

Seven miles of trails in the Mount Wanda section of JOMU were surveyed during the 2012 field season. In total, 3 people spent 27 hours conducting surveys, 14 of which were volunteer hours. The 2 volunteers were interns for the JOMU Natural Resources Division.

Species Found

In 2012, 21 individual occurrences of target weed species were recorded in JOMU during early detection surveys and entered into the JOMU GeoWeed database. Five of these occurrences were List 1 species, 9 of these were List 2 species, and 7 were List 3 species. The 21 individual occurrences of target weeds that were recorded during the PINN surveys were represented by 15 plant species (Table 4).

Table 4. JOMU Mount Wanda 2012 survey results. New occurrences of target species.

2012 list	Scientific name	Common name	Number of new occurrences
1	<i>Acroptilon repens</i>	Russian knapweed	0
1	<i>Aegilops triuncialis</i>	barbed goatgrass	0
1	<i>Arundo donax</i>	giant reed	0
1	<i>Calendula arvensis</i>	field marigold	0
1	<i>Cardaria draba</i>	Whitetop	0
1	<i>Carthamus baeticus</i>	Smooth distaff thistle	0
1	<i>Centaurea calcitrapa</i>	Purple star thistle	0
1	<i>Centaurea melitensis</i>	Napa star thistle	0
1	<i>Cynara cardunculus</i>	cardoon	0
1	<i>Cytisus striatus</i>	striated broom	0
1	<i>Dittrichia graveolens</i>	stinkwort	3
1	<i>Ehrharta erecta</i>	panic veldt grass	0
1	<i>Eucalyptus globulus</i>	Bluegum eucalyptus	1
1	<i>Euphorbia oblongata</i>	oblong spurge	1
1	<i>Ficus carica</i>	common fig	0
1	<i>Genista monspessulana</i>	French broom	0
1	<i>Geranium robertianum</i>	Robert geranium	0
1	<i>Lepidium latifolium</i>	broadleaved pepperweed	0
1	<i>Lythrum salicaria</i>	purple loosestrife	0
1	<i>Nicotiana glauca</i>	tree tobacco	0
1	<i>Oxalis pes-caprae</i>	sourgrass	0
1	<i>Schinus molle</i>	Peruvian peppertree	0
1	<i>Sesbania punicea</i>	rattlebox	0
1	<i>Tamarix parviflora</i>	Fourstamen tamarisk	0
2	<i>Bellardia trixago</i>	Mediterranean lineseed	0
2	<i>Brachypodium distachyon</i>	False brome	0
2	<i>Centaurea solstitialis</i>	yellow star thistle	1
2	<i>Cestrum parqui</i>	Chilean jessamine	0

2012 list	Scientific name	Common name	Number of new occurrences
2	<i>Cirsium vulgare</i>	bull thistle	1
2	<i>Conium maculatum</i>	poison hemlock	0
2	<i>Cotoneaster lacteus</i>	milkflower cotoneaster	0
2	<i>Cotoneaster pannosus</i>	silverleaf cotoneaster	1
2	<i>Cynodon dactylon</i>	Bermudagrass	0
2	<i>Dactylis glomerata</i>	orchard grass	1
2	<i>Foeniculum vulgare</i>	sweet fennel	1
2	<i>Hirschfeldia incana</i>	shortpod mustard	1
2	<i>Olea europaea</i>	olive	2
2	<i>Phalaris aquatica</i>	bulbous canarygrass	1
2	<i>Piptatherum miliaceum</i>	smilo grass	0
2	<i>Rubus discolor</i>	Himalayan blackberry	0
2	<i>Tribulus terrestris</i>	puncturevine	0
3	<i>Ailanthus altissima</i>	tree-of-heaven	2
3	<i>Brassica nigra</i>	black mustard	0
3	<i>Carduus pycnocephalus</i>	Italian thistle	0
3	<i>Convolvulus arvensis</i>	field bindweed	0
3	<i>Lathyrus latifolius</i>	everlasting pea	0
3	<i>Ligustrum lucidum</i>	glossy privet	0
3	<i>Ligustrum ovalifolium</i>	California privet	0
3	<i>Marrubium vulgare</i>	horehound	0
3	<i>Picris echioides</i>	Bristly oxtongue	3
3	<i>Prunus cerasifera</i>	cherry plum	1
3	<i>Robinia pseudoacacia</i>	black locust	0
3	<i>Silybum marianum</i>	blessed milkthistle	1
3	<i>Vinca major</i>	periwinkle	0

Discussion

Species Occurrences

The occurrence data revealed that collectively, invasive species are widespread throughout the park units of the SFAN, with PINN having noticeably lower numbers of priority exotic plant occurrences than the other park units in relation to survey area. Because the monitoring program is still in initial stages of implementation, it is difficult to draw conclusions about how environmental factors correlate with exotic species occurrences or to examine trends in species detection at this time.

It should be noted that the numbers of occurrences found for each species may not be a true indication of their abundance. For example, a species that is already locally abundant along a survey route can be underestimated through relying on occurrence data alone since only one occurrence point will be used to represent the population. Additionally, detectability can vary during the field season for many species. For example, oxeye daisy (*Leucanthemum vulgare*) is not obvious from any distance except during its flowering period, whereas Monterey pine (*Pinus radiata*) is obvious year round. Assessments were also recorded in addition to occurrences for all List 1 species and also for all List 2 species that have a patch size < 100 m² (Figure 1). These assessments include the spatial coverage of the listed exotic plant. Assessments can be used to detect change in a species' areal extent over time; however, assessment data are not presented in this report.

Species List Revisions

After each field season, the species lists for each park unit are updated for the following field season. The majority of list revisions were made immediately following the 2007 and 2008 seasons (Williams and Speith 2008, Williams and Jordan 2010). Minor list revisions were made in subsequent years (Williams et al. 2011, Steers et al. 2011, Wrubel and Steers 2012).

Based on results from the 2012 field season, four species were added to the GOGA 2013 priority list (Table 5). These species were not known to occur on GOGA lands until they were discovered during the 2012 early detection surveys. All four are reported to be invasive elsewhere. One species was moved from List 2 to List 4 because it was more abundant than previously known.

Table 5. Revisions to the GOGA priority species list for 2013.

Scientific name	Common name	2012 List	2013 List	Justification
<i>Geranium robertianum</i>	Robert's geranium	n/a	2	Newly recorded in GOGA during 2012 surveys. On Cal-IPC Watchlist (Cal-IPC 2012).
<i>Glyceria declinata</i>	waxy mannagrass	n/a	2	Newly reported and confirmed in GOGA in 2012. Cal-IPC rating: moderate (Cal-IPC 2006).
<i>Hirschfeldia incana</i>	shortpod mustard	2	4	Too abundant; beyond early detection.
<i>Parietaria judaica</i>	spreading pellitory	n/a	3	Newly recorded in GOGA during 2012 surveys. On Cal-IPC Watchlist (Cal-IPC 2012). Cal-IPC Red Alert 2010. Invasive in some East SF Bay Area urban creeks.
<i>Salsola soda</i>	oppositeleaf Russian thistle	n/a	2	Newly recorded in GOGA during 2012 surveys. On Cal-IPC Watchlist (Cal-IPC 2012). Cal-IPC Red Alert 2009. Invasive in Suisun Marsh, Contra Costa Co., CA.

For PORE, based on the results of an off-season focused survey, one species was added to the PORE priority list for the 2013 field season (Table 6). This species was placed on List 2 because it is not widespread at PORE and has moderate potential to become invasive.

Table 6. Revisions to the PORE priority species list for 2013.

Scientific name	Common name	2012 List	2013 List	Justification
<i>Rhamnus alaternus</i>	Italian buckthorn	n/a	2	Newly recorded at PORE in 2013. On Cal-IPC Watchlist (Cal-IPC 2012).

Based on the results of the 2012 field season, four species were added to the PINN priority list for the 2013 field season (Table 7). One species was placed on List 1, because of its known invasiveness in habitats similar to those found at PINN. Three species were placed on List 2 because they do not appear to be widespread at PINN, and have moderate potential to become invasive at PINN.

Table 7. Revisions to the PINN priority species list for 2013.

Scientific name	Common name	2012 List	2013 List	Justification
<i>Bromus tectorum</i>	cheatgrass	n/a	1	Newly recorded at PINN during 2012 surveys. Cal-IPC rating: high (Cal-IPC 2006).
<i>Dactylis glomerata</i>	orchard grass	n/a	2	Newly recorded at PINN during 2012 surveys. Cal-IPC rating: limited (Cal-IPC 2006).
<i>Phalaris aquatica</i>	harding grass	n/a	2	Confirmed present at PINN during 2012 surveys. Cal-IPC rating: moderate (Cal-IPC 2006).
<i>Schismus arabicus</i>	Arabian schismus	n/a	2	Newly recorded at PINN during 2012 surveys. Cal-IPC rating: limited (Cal-IPC 2006).

At JOMU, no species were removed from the list, and no plants were shifted from one priority list to another for the 2013 field season.

Outreach

Education and outreach play an important role in the engagement of a network of early detectors. Several “Weed ID” classes were held for volunteers and interns at GOGA and PORE. Whenever possible, volunteers were trained on an individual basis to conduct early detection surveys and map incipient populations of target invasive plants. I&M also staffed a table at the Point Reyes 2012 Trails Challenge kickoff event, to promote the “What’s Invasive” smart phone application described below.

The monthly newsletter “Early Detection News” continued to be well received by network parks staff and other organizations involved in vegetation management throughout the Bay Area region. The newsletter is sent via email in HTML format, so recipients can view it directly in their email client. The newsletter contains tables of monthly survey results, and news of noteworthy early detections, with links to information about featured invasive species. The monthly report also includes links to Google Earth™ KMZ files showing early detection survey routes and mapped occurrences.

In 2011 our program adopted the “What’s Invasive” data collection and reporting tool for GOGA. What’s Invasive is a free web-based application for use on Android or iPhone-based devices. It displays local lists of top invasive plants with images and short descriptions. Users can browse these lists of species and send geo-tagged observations, photos, and notes via their personal electronic devices to the What’s Invasive website. On the What’s Invasive website, users can view data and statistics for the park. This tool was a welcomed advancement in the capture and storage of volunteer or citizen science data over our older methods of using paper maps. Lastly, these data are not included in the GeoWeed database or annual reports, but are followed up during early detection surveys by SFAN staff.

Web pages were maintained to provide support to Weed Watcher participants (http://science.nature.nps.gov/im/units/sfan/vital_signs/Invasives/weed_watchers.cfm). Online versions of the “Plant-out-of-Place” cards, a narrative explaining the necessity for invasive plant early detection, and information about how to take part in our volunteer program are featured on the web pages, as well as maps and the Early Detection News monthly reports.

To communicate findings to a wider audience, I&M staff presented a talk entitled “New environmental weeds in the Golden Gate and Point Reyes National Parks” at the San Francisco Bay Area Network Science Symposium at Fort Mason, San Francisco in May of 2012.

Collaboration

Early detection surveys have the greatest utility to park management when coupled with rapid response to invasions. Invasive plant management teams exist in each of the SFAN parks. Collaboration and communication with these management teams is aided by both the implementation of the SFAN early detection program and the quality of its reporting products.

PORE has a well-established weed management program with an affiliated volunteer program, the Habitat Restoration Program (HRP). Ellen Hamingson, the NPS lead for the HRP program, worked closely with the Weed Watcher program in 2012 to implement rapid response treatment for many of the infestations that were mapped by the Weed Watchers. She also provided on-site supervision to the seasonal early detection technician at PORE, which readily facilitated daily communication between the two programs. Monthly results are reported to all PORE vegetation staff via the Early Detection News.

The SFAN I&M Program continued its partnership in 2012 with the California Exotic Plant Management Team (EPMT) to hire two early detection and rapid response interns that worked at PORE and GOGA. The EPMT provides grants for weed management projects at national parks across California. The interns conducted early detection surveys three days a week, and worked for HRT on the other two days for rapid response removal work. The interns improved communication between the programs at GOGA and made sure priority species mapped during early detection surveys were being removed.

In 2012 I&M hosted two high-school interns through the GGNPC Advanced Youth Internship program. This program funds summertime internships for exceptional student-volunteers. The interns assisted with early detection surveys and data entry.

With the help of the resource and maintenance staff at PINN, high-priority areas were surveyed for weeds and the results were reported to Park Botanist, Brent Johnson. At JOMU, surveys were conducted with the assistance of park interns and the results were reported to the Natural Resources Specialist, Fernando Villalba.

As network parks share borders with many other land management agencies, an integrated approach is key to stopping the spread of new invaders. In addition to working with the network of parks, I&M staff are active participants in the Bay Area Early Detection Network (BAEDN), the Marin-Sonoma Weed Management Area (MSWMA) and Cal-IPC. In 2012, I&M staff demonstrated methods and consulted with California State Parks staff to support the development of a State Parks early detection protocol.

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Glossary

Assessments: An assessment for each occurrence can be recorded as a point, a line, or a polygon. Assessments will be used to depict the size, scale, and coverage of an occurrence and therefore will be used as a basis for evaluating change with or without management actions.

Exotic: Occurring in a given place as a result of direct or indirect, deliberate or accidental actions by humans. Synonyms: alien, introduced, non-native, and non-indigenous.

GeoWeed: The Microsoft Access-based database developed by the Sonoma Ecology Center from the Weed Information Management System. GeoWeed is a relational database that offers digital data collection of management and spatial weed data through ESRI ArcPad applets. The San Francisco Bay Area Network uses GeoWeed for its Early Detection data. Additional information available in SFAN's protocol and at <http://geoweed.org>.

Invasive species: Official term for an exotic species whose introduction can cause economic or environmental harm or harm to human health. This definition originated in Presidential Executive Order 13112 issued February 3, 1999.

Management units: Areas to be monitored for new species/infestations. A management unit may be the entire park, critical habitat within a park, or areas of concern given their proximity to known entry points. Some parks define areas by watershed, others use site names—both are considered a management unit.

Occurrences: The weed occurrence is the basic unit of mapping and assessing a singular weed or weed population/infestation within WIMS and GeoWeed. Each occurrence defines the presence of a single species and is recorded at a specific location. The occurrence location is recorded as a point in space, although each occurrence may actually be a population of plants covering an extensive area.

Region: A region is a uniquely named parcel of land that may have either legally defined boundaries or locally derived place names. In the protocol we may use up to three regions to locate each occurrence; one is mandatory: the sub-watershed.

SOP: Standard Operating Procedures. These are the detailed steps explaining how to carry out the monitoring protocol.

Subwatershed: A management subunit of a watershed, based largely on drainages, and used to track weed work in GOGA.

Treatments: A treatment is any weed management activity that occurs at a specific time over a defined geographical area. The GeoWeed databases track all types of weed control methods and how much staff and/or volunteer time has been spent controlling weeds.

Weed: A weed is a plant out of place. The term “noxious weed” is an official designation for weeds which cause economic harm.

Appendix A: 2012 list of priority invasive species at GOGA.

Priority	Scientific Name	Common Name	Family	Code
1	<i>Ailanthus altissima</i>	tree-of-heaven	Simaroubaceae	AIALXX
1	<i>Albizia lophantha</i>	silk tree	Fabaceae	ALLOXX
1	<i>Ammophila arenaria</i>	European beachgrass	Poaceae	AMAR4X
1	<i>Ammophila breviligulata</i>	American beachgrass	Poaceae	AMBRXX
1	<i>Anthoxanthum odorata</i>	sweet vernal grass	Poaceae	ANODXX
1	<i>Aptenia cordifolia</i>	heartleaf iceplant	Aizoaceae	APCOXX
1	<i>Arctotheca calendula</i>	fertile capeweed	Asteraceae	ARCA45
1	<i>Arctotheca prostrata</i>	creeping capeweed	Asteraceae	ARPR??
1	<i>Arundo donax</i>	giant reed	Poaceae	ARDO4X
1	<i>Berberis darwinii</i>	Darwin's berberis	Berberidaceae	BEDAXX
1	<i>Carduus acanthoides</i>	plumeless thistle	Asteraceae	CAACXX
1	<i>Carex pendula</i>	hanging sedge	Cyperaceae	CAPE45
1	<i>Carpobrotus chilensis</i>	sea fig	Aizoaceae	CACH38
1	<i>Carthamus lanatus</i>	woolly distaff thistle	Asteraceae	CALA20
1	<i>Centaurea calcitrapa</i>	purple starthistle	Asteraceae	CECA2X
1	<i>Centaurea solstitialis</i>	yellow starthistle	Asteraceae	CESO3X
1	<i>Cirsium arvense</i>	Canada thistle	Asteraceae	CIAR4X
1	<i>Conicosia pugioniformis</i>	narrow-leaved iceplant	Aizoaceae	COPU18
1	<i>Cortaderia selloana</i>	pampas grass	Poaceae	COSE4X
1	<i>Crataegus monogyna</i>	singleseed hawthorn	Rosaceae	CRMOXX
1	<i>Cynara cardunculus</i>	cardoon	Asteraceae	CYCAXX
1	<i>Cytisus scoparius</i>	Scotch broom	Fabaceae	CYSC4X
1	<i>Cytisus striatus</i>	Portuguese broom	Fabaceae	CYST7X
1	<i>Digitalis purpurea</i>	purple foxglove	Scrophulariaceae	DIPUXX
1	<i>Dittrichia graveolens</i>	stinkweed	Asteraceae	DIGR4X
1	<i>Drosanthemum floribundum</i>	showy dewflower	Aizoaceae	DRFL2X
1	<i>Echium plantagineum</i>	salvation jane	Boraginaceae	ECPLXX
1	<i>Ehrharta calycina</i>	perennial veldt grass	Poaceae	EHCAXX
1	<i>Eichhornia crassipes</i>	water hyacinth	Pontederiaceae	EICRXX
1	<i>Euphorbia oblongata</i>	oblong spurge	Euphorbiaceae	EUOB4X
1	<i>Hedera canariensis</i>	Algerian ivy	Araliaceae	HECAXX
1	<i>Helichrysum petiolare</i>	licorice plant	Asteraceae	HEPE8X
1	<i>Hypericum grandifolium</i>	no common name	Clusiaceae	HYGR6
1	<i>Hypericum perforatum</i>	Klamathweed	Clusiaceae	HYPEXX
1	<i>Ilex aquifolium</i>	English holly	Aquifoliaceae	ILAQ80
1	<i>Lepidium latifolium</i>	perennial pepperweed	Brassicaceae	LELA2X
1	<i>Limonium ramosissimum</i>	Algerian sea lavender	Plumbaginaceae	LIRA2
1	<i>Ludwigia hexapetala</i>	six-petal water primrose	Onagraceae	LUGRH
1	<i>Ludwigia peploides</i> ssp. <i>montevidensis</i>	floating water primrose	Onagraceae	LUPEM

Priority	Scientific Name	Common Name	Family	Code
1	<i>Maytenus boaria</i>	Chilean mayten	Celastraceae	MABO8X
1	<i>Mesembryanthemum crystallinum</i>	ice plant	Aizoaceae	MECR3X
1	<i>Myriophyllum aquaticum</i>	parrot's-feather	Haloragaceae	MYAQ2X
1	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	Haloragaceae	MYS2X
1	<i>Nicotiana glauca</i>	tree tobacco	Solanaceae	NIGLXX
1	<i>Phalaris arundinacea</i>	reed canary grass	Poaceae	PHAR3X
1	<i>Pittosporum crassifolium</i>	stiffleaf cheesewood	Pittosporaceae	PICRXX
1	<i>Pyracantha angustifolia</i>	narrowleaf firethorn	Rosaceae	PYANXX
1	<i>Rhamnus alaternus</i>	Italian buckthorn	Rhamnaceae	RHAL12
1	<i>Robinia pseudoacacia</i>	black locust	Fabaceae	ROPSXX
1	<i>Romulea rosea</i> var. <i>australis</i>	rosy sandcrocus	Iridaceae	ROROAX
1	<i>Rytidosperma caespitosum</i>	common wallaby grass	Poaceae	RYCAXX
1	<i>Rytidosperma penicillatum</i>	hairy wallaby grass	Poaceae	RYPEXX
1	<i>Scabiosa atropurpurea</i>	mourningbride	Dipsacaceae	SCATXX
1	<i>Spartina alterniflora</i>	smooth cordgrass	Poaceae	SPALXX
1	<i>Spartium junceum</i>	Spanish broom	Fabaceae	SPJU2X
1	<i>Stipa manicata</i>	Andean tussockgrass	Poaceae	NAMA7X
1	<i>Trifolium angustifolium</i>	narrowleaf clover	Fabaceae	TRAN6X
1	<i>Ulex europaeus</i>	gorse	Fabaceae	ULEUXX
1	<i>Vinca major</i>	periwinkle	Apocynaceae	VIMAXX
2	<i>Acacia melanoxylon</i>	blackwood acacia	Fabaceae	ACMEXX
2	<i>Ageratina adenophora</i>	thoroughwort	Asteraceae	AGAD2X
2	<i>Agrostis avenacea</i>	Pacific bentgrass	Poaceae	AGAV
2	<i>Bromus madritensis</i> ssp. <i>rubens</i>	red brome	Poaceae	BRMARX
2	<i>Bromus tectorum</i>	cheat grass	Poaceae	BRTEXX
2	<i>Buddleja davidii</i>	butterfly bush	Scrophulariaceae	BUDA2
2	<i>Calendula arvensis</i>	field marigold	Asteraceae	CAARXX
2	<i>Centaurea melitensis</i>	tochalote	Asteraceae	CEME2X
2	<i>Cestrum parqui</i>	orange jessamine	Solanaceae	CEPA9X
2	<i>Cynodon dactylon</i>	Bermudagrass	Poaceae	CYDAXX
2	<i>Dactylis glomerata</i>	orchard grass	Poaceae	DAGLXX
2	<i>Delairea odorata</i>	cape ivy	Asteraceae	DEODXX
2	<i>Dipsacus fullonum</i>	Fuller's teasel	Dipsacaceae	DIFU2X
2	<i>Eucalyptus globulus</i>	bluegum eucalyptus	Myrtaceae	EUGLXX
2	<i>Festuca arundinacea</i>	tall fescue	Poaceae	FEAR3X
2	<i>Geranium purpureum</i>	herb robert	Geraniaceae	GEROP
2	<i>Hedera helix</i>	English ivy	Araliaceae	HEHEXX
2	<i>Hirschfeldia incana</i>	shortpod mustard	Brassicaceae	HIIN3X
2	<i>Iris pseudacorus</i>	yellow flag iris	Iridaceae	IRPS
2	<i>Ligustrum lucidum</i>	glossy privet	Oleaceae	LILU2

Priority	Scientific Name	Common Name	Family	Code
2	<i>Leptospermum laevigatum</i>	Australian teatree	Myrtaceae	LELA29
2	<i>Leucanthemum vulgare</i>	oxeye daisy	Asteraceae	LEVUXX
2	<i>Mentha pulegium</i>	pennyroyal	Lamiaceae	MEPUXX
2	<i>Mercurialis annua</i>	annual mercury	Rubiaceae	MEAN
2	<i>Oxalis pes-caprae</i>	Bermuda buttercup	Oxalidaceae	OXPEXX
2	<i>Pennisetum clandestinum</i>	Kikuyu grass	Poaceae	PECL2X
2	<i>Roldana Petasitis</i>	velvet groundsel	Asteraceae	ROPE6
2	<i>Rosa eglanteria</i>	sweetbriar rose	Rosaceae	ROEGXX
2	<i>Rubus discolor</i>	Himalayan blackberry	Rosaceae	RUDI2X
2	<i>Solanum laciniatum</i>	New Zealand nightshade	Solanaceae	SOAVXX
3	<i>Arrhenatherum elatius</i>	tall oatgrass	Poaceae	AREL3X
3	<i>Brassica rapa</i>	field mustard	Brassicaceae	BRRAXX
3	<i>Carpobrotus edulis</i>	iceplant	Aizoaceae	CAED3X
3	<i>Coprosma repens</i>	creeping mirrorplant	Rubiaceae	CORE4X
3	<i>Cortaderia jubata</i>	jubata grass	Poaceae	COJU2X
3	<i>Cotoneaster franchetii</i>	orange cotoneaster	Rosaceae	COFR3X
3	<i>Cotoneaster lacteus</i>	milkflower cotoneaster	Rosaceae	COLA18
3	<i>Cotoneaster pannosus</i>	silverleaf cotoneaster	Rosaceae	COPA14
3	<i>Ehrharta erecta</i>	panic veldt grass	Poaceae	HERXX
3	<i>Erigeron karvinskianus</i>	Latin American fleabane	Asteraceae	ERKA2X
3	<i>Foeniculum vulgare</i>	sweet fennel	Apiaceae	FOVUXX
3	<i>Genista monspessulana</i>	French broom	Fabaceae	GEMO2X
3	<i>Gunnera tinctoria</i>	Chilean gunnera	Gunneraceae	GUTIXX
3	<i>Lathyrus latifolius</i>	everlasting pea	Fabaceae	LALA4X
3	<i>Ligustrum ovalifolium</i>	California privet	Oleaceae	LIOVXX
3	<i>Linaria vulgaris</i>	butter and eggs	Scrophulariaceae	LIVU2X
3	<i>Lonicera japonica</i>	Japanese honeysuckle	Caprifoliaceae	LOJAXX
3	<i>Phalaris aquatica</i>	Harding grass	Poaceae	PHAQXX
3	<i>Pinus radiata</i>	Monterey pine	Pinaceae	PIRA2X
3	<i>Schinus molle</i>	pepper tree	Anacardiaceae	SCMOXX
3	<i>Tamarix chinensis</i>	saltcedar	Tamaricaceae	TACH2X
3	<i>Xanthium spinosum</i>	spiny cocklebur	Asteraceae	XASP2X
3	<i>Xanthium strumarium</i>	rough cocklebur	Asteraceae	XASTXX

Appendix B: 2012 List of priority invasive species at PORE.

Priority	Scientific Name	Common Name	Family	Code
1	<i>Acroptilon repens</i>	Russian knapweed	Asteraceae	ACRE3X
1	<i>Aegilops triuncialis</i>	barbed goatgrass	Poaceae	AETRXX
1	<i>Ageratina adenophora</i>	thoroughwort	Asteraceae	AGAD2X
1	<i>Albizia lophantha</i>	silk tree	Fabaceae	ALLOXX
1	<i>Alisma lanceolatum</i>	lanceleaf water plantain	Alismataceae	ALLA2X
1	<i>Anthoxanthum odoratum</i>	sweet vernalgrass	Poaceae	ANODXX
1	<i>Arundo donax</i>	giant reed	Poaceae	ARDO4X
1	<i>Brachypodium distachyon</i>	purple false brome	Poaceae	BRDI2X
1	<i>Carduus acanthoides</i>	plumeless thistle	Asteraceae	CAACXX
1	<i>Carex pendula</i>	hanging sedge	Cyperaceae	CAPE45
1	<i>Carthamus lanatus</i>	woolly distaff thistle	Asteraceae	CALA20
1	<i>Centaurea calcitrapa</i>	purple starthistle	Asteraceae	CECA2X
1	<i>Centaurea iberica</i>	Iberian starthistle	Asteraceae	CEIBXX
1	<i>Centaurea melitensis</i>	tocalote	Asteraceae	CEME2X
1	<i>Centaurea solstitialis</i>	yellow starthistle	Asteraceae	CESO3X
1	<i>Conicosia pugioniformis</i>	narrow-leaved iceplant	Aizoaceae	COPU18
1	<i>Cotoneaster franchetii</i>	orange cotoneaster	Roseaceae	COFR3X
1	<i>Cotoneaster pannosus</i>	silverleaf cotoneaster	Roseaceae	COPA14
1	<i>Dittrichia graveolens</i>	stinkweed	Asteraceae	DIGR4X
1	<i>Egeria densa</i>	Brazilian waterweed	Hydrocharitaceae	EGDEXX
1	<i>Ehrharta calycina</i>	perennial veldt grass	Poaceae	EHCAXX
1	<i>Euphorbia oblongata</i>	oblong spurge	Euphorbiaceae	EUOB4X
1	<i>Helichrysum petiolare</i>	licorice plant	Asteraceae	HEPE8X
1	<i>Hypericum grandifolium</i>	no common name	Clusiaceae	HYGR6
1	<i>Hypericum perforatum</i>	Klamathweed	Hypericaceae	HYPEXX
1	<i>Iris pseudacorus</i>	yellow flag iris	Iridaceae	IRPSXX
1	<i>Lepidium latifolium</i>	perennial pepperweed	Brassicaceae	LELA2X
1	<i>Limonium ramosissimum</i>	Algerian sea lavender	Plumbaginaceae	LIRA2
1	<i>Ludwigia hexapetala</i>	six-petal water primrose	Onagraceae	LUHE5X
1	<i>Ludwigia peploides</i> ssp. <i>montevedensis</i>	floating water primrose	Onagraceae	LUPEM
1	<i>Marrubium vulgare</i>	horehound	Lamiaceae	MAVUXX
1	<i>Myriophyllum aquaticum</i>	parrot's-feather	Haloragaceae	MYAQ2X
1	<i>Phalaris arundinacea</i>	reed canary grass	Poaceae	PHAR3X
1	<i>Robinia pseudoacacia</i>	black locust	Fabaceae	ROPSXX
1	<i>Romulea rosea</i> var. <i>australis</i>	rosy sandcrocus	Iridaceae	ROROAX
1	<i>Rytidosperma penicillatum</i>	hairy wallaby grass	Poaceae	RYPE
1	<i>Salsola soda</i>	oppositeleaf Russian thistle	Chenopodiaceae	SASO3X
1	<i>Senecio jacobaea</i>	tansy ragwort	Asteraceae	SEJAXX
1	<i>Spartina alterniflora</i>	Smooth cordgrass	Poaceae	SPALXX

Priority	Scientific Name	Common Name	Family	Code
1	<i>Trifolium angustifolium</i>	narrowleaf clover	Fabaceae	TRAN6
1	<i>Ulex europaeus</i>	gorse	Fabaceae	ULEUXX
2	<i>Acacia melanoxylon</i>	blackwood acacia	Fabaceae	ACMEXX
2	<i>Arctotheca calendula</i>	fertile capeweed	Asteraceae	ARCA45
2	<i>Arctotheca prostrata</i>	creeping capeweed	Asteraceae	ARCA??
2	<i>Berberis darwinii</i>	Darwin's berberis	Berberidaceae	BEDAXX
2	<i>Cakile edentula</i>	European searocket	Brassicaceae	CAEDXX
2	<i>Cystisus scoparius</i>	Scotch broom	Fabaceae	CYSC4X
2	<i>Datura stramonium</i>	jimsonweed	Solanaceae	DASTXX
2	<i>Delairea odorata</i>	cape ivy	Asteraceae	DEODXX
2	<i>Echium candicans</i>	pride of Madeira	Boraginaceae	ECCA5X
2	<i>Genista monspessulana</i>	French broom	Fabaceae	GEMO2X
2	<i>Glyceria declinata</i>	waxy mannagrass	Poaceae	GLDE
2	<i>Hedera helix</i>	English ivy	Araliaceae	HEHEXX
2	<i>Ilex aquifolium</i>	English holly	Aquifoliaceae	ILAQ80
2	<i>Lathyrus latifolius</i>	everlasting pea	Fabaceae	LALA4X
2	<i>Leucanthemum vulgare</i>	oxeye daisy	Asteraceae	LEVUXX
2	<i>Linaria vulgaris</i>	butter and eggs	Scrophulariaceae	LIVU2X
	<i>Maytenus boaria</i>	Chilean mayten	Celastraceae	MABO8
2	<i>Oxalis pes-caprae</i>	Bermuda buttercup	Oxalidaceae	OXPEXX
2	<i>Paspalum dilatatum</i>	dallis grass	Poaceae	PADI3X
2	<i>Pennisetum clandestinum</i>	Kikuyu grass	Poaceae	PECL2X
2	<i>Pittosporum undulatum</i>	Victorian box	Pittosporaceae	PIUN2X
2	<i>Rubus armeniacus</i>	Himalayan blackberry	Rosaceae	RUDI2X
2	<i>Tetragonia tetragonoides</i>	New Zealand spinach	Aizoaceae	TETE3X
2	<i>Vinca major</i>	periwinkle	Apocynaceae	VIMAXX
2	<i>Xanthium spinosum</i>	spiny cocklebur	Asteraceae	XASP2X
3	<i>Acacia longifolia</i>	Sydney golden wattle	Fabaceae	ACLOXX
3	<i>Acacia verticillata</i>	prickly Moses	Fabaceae	ACVE2X
3	<i>Allium triquetrum</i>	threecorner leek	Liliaceae	ALTR4X
3	<i>Ammophila arenaria</i>	European beachgrass	Poaceae	AMAR4X
3	<i>Carpobrotus chilensis</i>	sea fig	Aizoaceae	CACH38
3	<i>Carpobrotus edulis</i>	iceplant	Aizoaceae	CAED3X
3	<i>Cestrum parqui</i>	chilean jessamine	Solanaceae	CEPA
3	<i>Conium maculatum</i>	poison hemlock	Apiaceae	COMA2X
3	<i>Cortaderia jubata</i>	jubata grass	Poaceae	COJU2X
3	<i>Cortaderia selloana</i>	Uruguayan pampas grass	Poaceae	COSE4X
3	<i>Cotoneaster lacteus</i>	milkflower cotoneaster	Rosaceae	COLA18
3	<i>Crataegus monogyna</i>	singleseed hawthorn	Rosaceae	CRMOXX
3	<i>Cupressus macrocarpa</i>	Monterey cypress	Cupressaceae	CUMA2X
3	<i>Cynodon dactylon</i>	Bermudagrass	Poaceae	CYDAXX
3	<i>Digitalis purpurea</i>	purple foxglove	Scrophulariaceae	DIPUXX

Priority	Scientific Name	Common Name	Family	Code
3	<i>Dipsacus fullonum</i>	Fuller's teasel	Dipsacaceae	DIFU2X
3	<i>Dipsacus sativus</i>	indian teasel	Dipsacaceae	DISA9X
3	<i>Drosanthemum floribundum</i>	showy dewflower	Aizoaceae	DRFL2X
3	<i>Echium plantagineum</i>	salvation jane	Boraginaceae	ECPLXX
3	<i>Ehrharta erecta</i>	panic veldt grass	Poaceae	EHXX
3	<i>Eucalyptus globulus</i>	bluegum eucalyptus	Myrtaceae	EUGLXX
3	<i>Euphorbia lathyris</i>	gopher plant	Euphorbiaceae	EULA4X
3	<i>Festuca arundinacea</i>	tall fescue	Poaceae	FEAR3X
3	<i>Foeniculum vulgare</i>	sweet fennel	Apiaceae	FOVUX
3	<i>Hypericum calycinum</i>	Aaron's beard	Clusiaceae	HYCA10
3	<i>Lythrum hyssopifolia</i>	hyssop loosestrife	Lythraceae	LYHY2X
3	<i>Mentha pulegium</i>	pennyroyal	Lamiaceae	MEPUXX
3	<i>Myoporum laetum</i>	myoporum	Myoporaceae	MYLA5X
3	<i>Phalaris aquatica</i>	Harding grass	Poaceae	PHAQXX
3	<i>Pinus radiata</i>	Monterey pine	Pinaceae	PIRA2X
3	<i>Populus alba</i>	white poplar	Salicaceae	POAL7X
3	<i>Pyracantha angustifolia</i>	narrowleaf firethorn	Rosaceae	PYANXX
3	<i>Rosa eglanteria</i>	sweetbriar rose	Rosaceae	ROEGXX
3	<i>Scabiosa atropurpurea</i>	mourningbride	Dipsacaceae	SCATXX
3	<i>Sorghum halepense</i>	Johnson grass	Poaceae	SOHAXX
3	<i>Sparaxis tricolor</i>	harlequin flower	Iridaceae	SPTRXX
3	<i>Tanacetum parthenium</i>	feverfew	Asteraceae	TAPA6X
3	<i>Verbascum blattaria</i>	moth mullein	Scrophulariaceae	VEBLXX
3	<i>Watsonia meriana</i>	bulbil bugle-lily	Iridaceae	WAMEXX
3	<i>Zantedeschia aethiopica</i>	calla lily	Araceae	ZAAEXX

Appendix C: 2012 List of priority invasive species at PINN.

Priority	Scientific Name	Common Name	Family	Code
1	<i>Acroptilon repens</i>	Russian knapweed	Asteraceae	ACRE3
1	<i>Ailanthus altissima</i>	tree-of-heaven	Simaroubaceae	AIALXX
1	<i>Arundo donax</i>	giant reed	Poaceae	ARDO4
1	<i>Chenopodium ambrosioides</i>	Mexican tea	Chenopodiaceae	CHAM
1	<i>Cnicus benedictus</i>	blessed thistle	Asteraceae	CNBE
1	<i>Dittrichia graveolens</i>	stinkweed	Asteraceae	DIGR
1	<i>Iris pseudacorus</i>	yellow flag Iris	Iridaceae	IRPS
1	<i>Lepidium latifolium</i>	perennial pepperweed	Brassicaceae	LELA2
1	<i>Lolium multiflorum</i>	Italian ryegrass	Poaceae	LOMU
1	<i>Lolium perenne</i>	perennial ryegrass	Poaceae	LOPE
1	<i>Lolium temulentum</i>	darnel	Poaceae	LOTE2
1	<i>Malva parviflora</i>	cheeseweed	Malvaceae	MAPA5
1	<i>Melilotus alba</i>	white sweetclover	Fabaceae	MEAL2
1	<i>Nicotiana glauca</i>	tree tobacco	Solanaceae	NIGL
1	<i>Picris echioides</i>	bristly oxtongue	Asteraceae	PIEC
1	<i>Piptatherum miliaceum</i>	smilo grass	Poaceae	PIMI3X
1	<i>Poa bulbosa</i>	bulbous bluegrass	Poaceae	POBU
1	<i>Rubus armeniacus</i>	Himalayan blackberry	Rosaceae	RUDI2
1	<i>Salsola tragus</i>	oppositeleaf Russian thistle	Chenopodiaceae	SATR12
1	<i>Taeniatherum caput-medusae</i>	Medusahead	Poaceae	TACA8
1	<i>Tamarix ramosissima</i>	saltcedar	Tamaricaceae	TARA
1	<i>Tragopogon dubius</i>	yellow salsify	Asteraceae	TRDU
1	<i>Tribulus terrestris</i>	puncturevine	Zygophyllaceae	TRTE
1	<i>Trifolium hirtum</i>	rose clover	Fabaceae	TRHI4
1	<i>Verbascum blattaria</i>	moth mullein	Scrophulariaceae	VEBL
1	<i>Verbascum thapsus</i>	woolly mullein	Scrophulariaceae	VETH
1	<i>Xanthium spinosum</i>	spiny cocklebur	Asteraceae	XASP2
2	<i>Carduus pycnocephalus</i>	Italian thistle	Asteraceae	CAPY2
2	<i>Carduus tenuiflorus</i>	slender-flowered thistle	Asteraceae	CATE2
2	<i>Conium maculatum</i>	poison hemlock	Apiaceae	COMA2
2	<i>Cotula coronopifolia</i>	brassbuttons	Asteraceae	COCO7
2	<i>Crypsis schoenoides</i>	swamp prickly grass	Poaceae	CRSC
2	<i>Cynodon dactylon</i>	Bermudagrass	Poaceae	CYDA
2	<i>Cyperus difformis</i>	variable flatsedge	Cyperaceae	CYDI4
2	<i>Marrubium vulgare</i>	horehound	Lamiaceae	MAVUXX
2	<i>Veronica persica</i>	birdseye speedwell	Scrophulariaceae	VEPE3
2	<i>Vinca major</i>	periwinkle	Apocynaceae	VIMA
3	<i>Amaranthus albus</i>	tumbleweed	Amaranthaceae	AMAL
3	<i>Brassica nigra</i>	black mustard	Brassicaceae	BRNI

Priority	Scientific Name	Common Name	Family	Code
3	<i>Brassica rapa</i>	field mustard	Brassicaceae	BRRA
3	<i>Centaurea melitensis</i>	toçalote	Asteraceae	CEME2
3	<i>Centaurea solstitialis</i>	yellow starthistle	Asteraceae	CESO3
3	<i>Cirsium vulgare</i>	bull thistle	Asteraceae	CIVU
3	<i>Hirschfeldia incana</i>	shortpod mustard	Brassicaceae	HIIN3
3	<i>Lactuca serriola</i>	prickly lettuce	Asteraceae	LASE
3	<i>Mentha spicata</i> var. <i>spicata</i>	spearmint	Lamiaceae	MESP3
3	<i>Mentha Xpiperita</i>	peppermint	Lamiaceae	MEPI
3	<i>Plantago lanceolata</i>	English plantain	Plantaginaceae	PLLA
3	<i>Polygonum arenastrum</i>	oval-leaf knotweed	Polygonaceae	POAR11
3	<i>Raphanus sativus</i>	wild radish	Brassicaceae	RASA2
3	<i>Rumex acetosella</i>	sheep sorrel	Polygonaceae	RUAC3
3	<i>Rumex crispus</i>	curly dock	Polygonaceae	RUCR
3	<i>Silybum marianum</i>	blessed milkthistle	Asteraceae	SIMA3

Appendix D: 2012 List of priority invasive species at JOMU.

Priority	Scientific Name	Common Name	Family	Code
1	<i>Acroptilon repens</i>	Russian knapweed	Asteraceae	ACRE3X
1	<i>Aegilops triuncialis</i>	barbed goatgrass	Poaceae	AETRXX
1	<i>Arundo donax</i>	giant reed	Poaceae	ARDO4X
1	<i>Calendula arvensis</i>	field marigold	Asteraceae	CAARXX
1	<i>Cardaria draba</i>	Whitetop	Brassicaceae	CADRXX
1	<i>Carthamus baeticus</i>	Smooth distaff thistle	Asteraceae	CALAC3
1	<i>Centaurea calcitrapa</i>	Purple star thistle	Asteraceae	CECA2X
1	<i>Centaurea melitensis</i>	Napa star thistle	Asteraceae	CEME2X
1	<i>Cynara cardunculus</i>	cardoon	Asteraceae	CYCAXX
1	<i>Cytisus striatus</i>	striated broom	Fabaceae	CYST7X
1	<i>Dittrichia graveolens</i>	stinkwort	Asteraceae	DIGR3X
1	<i>Ehrharta erecta</i>	panic veldt grass	Poaceae	HERXX
1	<i>Eucalyptus globulus</i>	bluegum eucalyptus	Myrtaceae	EUGLXX
1	<i>Euphorbia oblongata</i>	oblong spurge	Euphorbiaceae	EUOB4X
1	<i>Ficus carica</i>	common fig	Moraceae	FICAXX
1	<i>Genista monspessulana</i>	French broom	Fabaceae	GEMO2X
1	<i>Geranium robertianum</i>	Robert geranium	Geraniaceae	GEROXX
1	<i>Lepidium latifolium</i>	broadleaved pepperweed	Brassicaceae	LELA2X
1	<i>Lythrum salicaria</i>	purple loosestrife	Lythraceae	LYSA2X
1	<i>Nicotiana glauca</i>	tree tobacco	Solanaceae	NIGLXX
1	<i>Oxalis pes-caprae</i>	sourgrass	Oxalidaceae	OXPEXX
1	<i>Schinus molle</i>	Peruvian peppertree	Anacardiaceae	SCMOXX
1	<i>Sesbania punicea</i>	rattlebox	Fabaceae	SEPU7X
1	<i>Tamarix parviflora</i>	Fourstamen tamarisk	Tamaricaceae	TAPA4
2	<i>Bellardia trixago</i>	Mediterranean lineseed	Scrophulariaceae	BETRXX
2	<i>Brachypodium distachyon</i>	False brome	Poaceae	BRDI2X
2	<i>Centaurea solstitialis</i>	yellow star thistle	Asteraceae	CESO3X
2	<i>Cestrum parqui</i>	Chilean jessamine	Solanaceae	CEPA9X
2	<i>Cirsium vulgare</i>	bull thistle	Asteraceae	CIVUXX
2	<i>Conium maculatum</i>	poison hemlock	Apiaceae	COMA2X
2	<i>Cotoneaster lacteus</i>	milkflower cotoneaster	Rosaceae	COLA18
2	<i>Cotoneaster pannosus</i>	silverleaf cotoneaster	Rosaceae	COPA14
2	<i>Cynodon dactylon</i>	Bermudagrass	Poaceae	CYDAXX
2	<i>Dactylis glomerata</i>	orchard grass	Poaceae	DAGLXX
2	<i>Foeniculum vulgare</i>	sweet fennel	Apiaceae	FOVUXX
2	<i>Hirschfeldia incana</i>	shortpod mustard	Brassicaceae	HIIN3X
2	<i>Olea europaea</i>	olive	Oleaceae	OLEUXX
2	<i>Phalaris aquatica</i>	bulbous canarygrass	Poaceae	PHAQXX
2	<i>Piptatherum miliaceum</i>	smilo grass	Poaceae	PIMI3X

Priority	Scientific Name	Common Name	Family	Code
2	<i>Rubus discolor</i>	Himalayan blackberry	Rosaceae	RUDI2X
2	<i>Tribulus terrestris</i>	puncturevine	Zygophyllaceae	TRTEXX
3	<i>Ailanthus altissima</i>	tree-of-heaven	Simaroubaceae	AIALXX
3	<i>Brassica nigra</i>	black mustard	Brassicaceae	BRNIXX
3	<i>Carduus pycnocephalus</i>	Italian thistle	Asteraceae	CAPY2X
3	<i>Convolvulus arvensis</i>	field bindweed	Convolvulaceae	COAR4X
3	<i>Lathyrus latifolius</i>	everlasting pea	Fabaceae	LALA4X
3	<i>Ligustrum lucidum</i>	glossy privet	Oleaceae	LILU2X
3	<i>Ligustrum ovalifolium</i>	California privet	Oleaceae	LIOVXX
3	<i>Marrubium vulgare</i>	horehound	Lamiaceae	MAVUXX
3	<i>Picris echioides</i>	Bristly oxtongue	Asteraceae	PIECXX
3	<i>Prunus cerasifera</i>	cherry plum	Rosaceae	PRCE
3	<i>Robinia pseudoacacia</i>	black locust	Fabaceae	ROPSXX
3	<i>Silybum marianum</i>	blessed milkthistle	Asteraceae	SIMA3X
3	<i>Vinca major</i>	periwinkle	Apocynaceae	VIMAXX

Appendix E. Maps showing 2012 survey results.

Available online at:

http://science.nature.nps.gov/im/units/sfan/vital_signs/Invasives/EDNews.cfm

<http://www.calflora.org/cgi-bin/occform.cgi>

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 963/122360, September 2013

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