TAMALPAIS LANDS COLLABORATIVE

# Early Detection of Invasive Plants Protocol

**On the Cover**
Yellow Starthistle (*Centaurea solstitialis*)
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# Early Detection of Invasive Plants Protocol

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# Acknowledgments

This protocol combines the work of several individuals and agencies that have devoted time to their own protocols and the development of this document. This document leans heavily on an early detection protocol from the Inventory and Monitoring Program of the National Park Service: "Early Detection of Invasive Plant Species in the San Francisco Bay Area Network." This document was released in 2009 by Andrea Williams, Susan O'Neil, Elizabeth Speith, and Jane Rodgers. Subsequent revisions to that protocol by Eric Wrubel, Sarah Wakamiya, and Allison Forrestel are also incorporated into the One Tam Early Detection protocol. Sections including SOP 4 on plant collections and vouchering include text directly from that document. Sections 2.1 and 2.2 also strongly reflect NPS protocol. The text is used with permission of the primary author, Andrea Williams. In addition to drawing from the San Francisco Bay Area Network protocol, One Tam adopted several aspects of the early detection protocol in place at Marin County Parks and Open Space District.

A subset of the contributors above comprised a guidance team for this document, known as the Early Detection subgroup of the Tamalpais Lands Collaborative (TLC). Andrea Williams, Eric Wrubel, Pete Frye, and Catey Ritchie provided guidance throughout the development of this workflow.

Field testing of this protocol in 2016 guided the development of this document by exposing areas where we needed to find consensus as a collaborative, and also where the workflows of One Tam staff need deeper documentation than might be required for a single agency. Much of this work was completed by David Greenberger, who also led field testing of Weed Manager appendices and formatted the entire document, increasing its readability and cohesion throughout.

Further contributions were made by the TLC's Conservation Management Team, which approved the species list and other aspects of the protocol. In addition to several of the contributors listed above, this team includes Sharon Farrell, Bree Hardcastle, Mischon Martin, Janet Klein, Catey Ritchie, Bobbi Simpson, and Dave Press.

As of fall 2018, the CMT has merged with the Health Advisory Team, which worked to inform much of One Tam's Peak Health efforts. The new guidance committee is called the Science and Conservation Management Working Group (SCMWG), and an up-to-date roster of group members is on Page 15.

# Tamalpais Lands Collaborative Early Detection of Invasive Species Protocol Narrative Version 1.3 (January 2022)

## 1.0 Introduction

One Tam is a partnership between the four agencies that own land on Mount Tamalpais in Marin County, California. These agencies -- the Marin County Parks and Open Space District (MCP), the Marin Municipal Water District (MMWD), California State Parks (CDPR) and the National Park Service (NPS) -- joined forces with a non-profit partner, the Golden Gate National Parks Conservancy (GGNPC), to protect the open space centered around Mount Tamalpais.

> The mission of the TLC is expressed in the document **One Mountain, One Vision**: "The TLC combines the expertise and resources of the National Park Service, Marin Municipal Water District, Marin County Parks, and the nonprofit Golden Gate National Parks Conservancy to ensure the long-term health of Mt. Tam. The TLC will advance efforts to restore ecosystems, improve trail corridors, enhance visitor experiences, expand education and stewardship programs, and inspire community support through volunteerism and philanthropy."

Among many projects and programs, One Tam put a special emphasis on a mountain-wide early detection of invasive plants program. NPS and MCP have protocols and staff for performing early detection surveys on their lands. To extend these survey efforts across the area of focus, the TLC began hiring Conservation Management staff in late 2015. With input from a Conservation Management Team, One Tam adapted the National Park Service protocol "Early Detection of Invasive Plant Species in the San Francisco Bay Area Network" released in 2009. Changes suit a partnership environment and new database technology. The San Francisco Bay Area Network (SFAN) protocol is available at http://www.sfnps.org/download_product/1260/0. It will be referred to as the SFAN protocol throughout this document.

The One Tam protocol closely follows the SFAN protocol. This adapted protocol, including standard operating procedures in the appendices, does not attempt to recreate the SFAN protocol but

rather emphasizes deviations from the original. For a substantive discussion on the benefits of employing an early detection program, please refer to the original document.

Where the SFAN protocol emphasizes a volunteer-based approach, the One Tam protocol reflects a staff-based, collaborative approach. The deviations presented here often revolve around the complexity of working in a partnership environment. This protocol also includes elements from a Marin County Parks and Open Space District early detection protocol. Treatment during surveys and the strategic repetition of surveys twice in a season are specifically drawn from the MCP approach. Other decisions were made with the Conservation Management Team or iteratively as the One Tam team implemented the pilot protocol in 2016.

Given the complex partnership environment of One Tam, it is expected that elements of this protocol will be flexible in the first three to five years as priorities for surveys are defined and resources for the work grow with the evolution of the collaborative. By documenting these nuances, this document provides guidance to One Tam staff working across agency boundaries on early detection surveys.

## 1.1 Geography

These modifications of the SFAN protocol are relevant to the lands of the TLC as represented in the graphic below (Figure 1). Of the National Park Service (NPS) lands listed in the SFAN protocol, parts of Golden Gate National Recreation Area (GGNRA) and Point Reyes National Seashore (PORE) are included in the One Tam area of focus. In addition to those parks, Mount Tamalpais State Park lies completely within the TLC area of focus and is fully included in the partnership. Other California State Parks lands are in areas of less focus but are not included in the early detection program as of early 2017. The Marin Municipal Water District (MMWD) and Marin County Parks and Open Space District (MCP) are also TLC partner agencies. The NPS, CDPR, MMWD and MCP lands covered by this protocol of these four agencies as of early 2017 are shown in Figure 2. Approximately 36,000 acres of open space are covered by this protocol as of early 2017. As the TLC partnership evolves, One Tam early detection efforts may extend to areas of Less Focus or Future Potential shown in Figure 1.

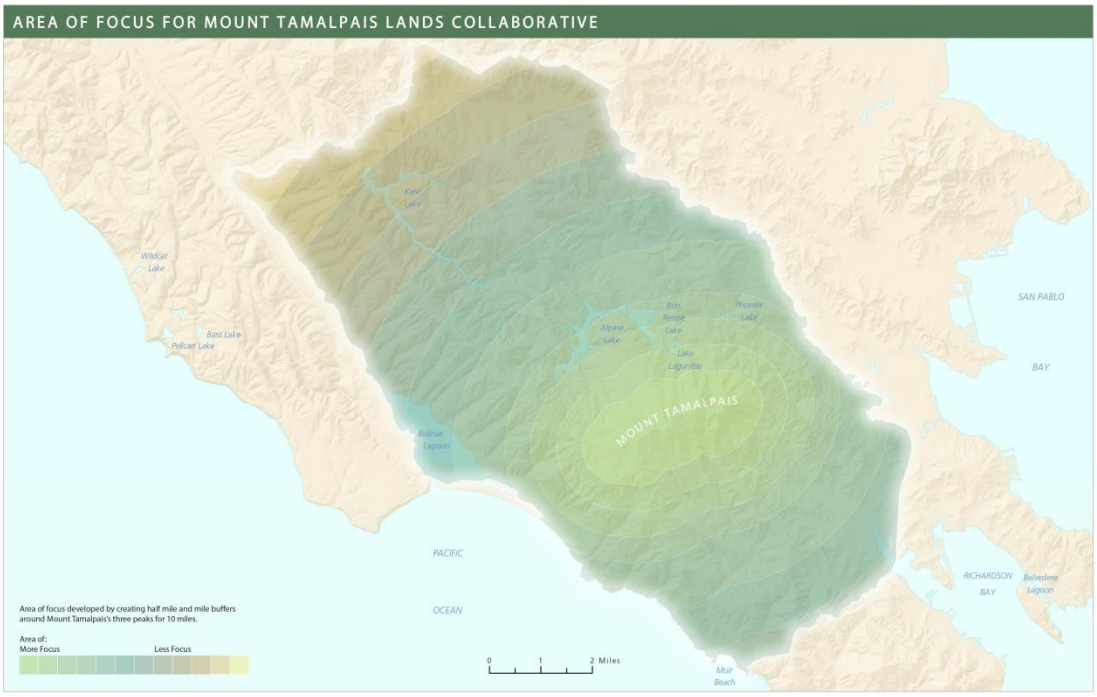



**Figure 1.** The TLC geography can be considered a gradient of more or less focus.


**Figure 2.** Four major agencies own and manage land within the TLC area of focus.

## 1.2 Significance to Management

Each TLC partner spends significant resources on the management of invasive species on their landholdings. Early detection of invasive plant species potentially allows for new patches or populations to be treated at stages that are most cost-effective. This TLC protocol diverges from the SFAN protocol by providing limited direction on treatment during survey work. This integration of rapid response to early detection surveys increases efficiencies. As the Conservation Management Team sought to increase capacity for surveys, there was an intentional choice to also increase treatment capacity. Treatment emphasizes the newest species in the area of focus, leaving new patches of widespread weeds to the resources of existing invasive plant management programs. Feedback loops for sharing information on new invasives are being established iteratively.

## 1.3 Previous Work on Invasive Plants on TLC Lands

### *1.3.1 Marin County Parks and Open Space District*

Marin County Parks staff undertakes a wide range of natural resource management practices, including inventory and monitoring of weeds, wetlands, and special-status species; restoration activities such as invasive species control and road/trail decommissioning; and preventative measures in the form of EDRR.

Several county preserves fall with the One Tam area of focus. Each preserve is subdivided into zones by habitat quality; the One Tam conservation management team runs EDRR surveys on Natural Landscape Zones and Sustainable Natural Systems Zones, dovetailing with MCP staff-run EDRR and treatment efforts in Legacy Zones and Highly Disturbed Management Zones. The two main areas covered by One Tam are the Blithedale Ridge complex of preserves and Cascade Canyon Open Space Preserve. In both areas, ridgetop wide-area fuel breaks are the greatest source of disturbance, leading to dense invasions of French broom, as well as pampas grass, and acacia. MCP is working on strategies to manage these areas for fuel reduction in a more sustainable way.

Volunteerism is also an integral component of MCP's natural resource work, engaging thousands of participants annually. MCP first established a volunteer program in 1979 by creating the Volunteer Mounted Patrol. MCP expanded the volunteer program in 1993, when it hired a half-time volunteer program coordinator. By the mid-1990s, the program grew to include the Environmental Stewardship and Native Plant Nursery programs. Within the past decade, MCP added the Trail Watch and the Conservation Easement Monitoring programs, and the volunteer coordinator has become full time. Natural resource, administrative, and seasonal staff also support volunteer program efforts.

### *1.3.2 Marin Municipal Water District*

Eliminating new colonies of weeds is the most effective action the district can take to preserve biodiversity as well as reduce fuelbreak maintenance costs. The Early Detection Rapid Response (EDRR) program includes conducting regular surveys of those parts of the watershed where weed invasion is most likely, and periodic surveys in remote areas where new weed invasions are likely to be less frequent. The surveys are performed by trained surveyors including district staff and volunteers. EDRR staff, led by new seasonal aides, pull, hoe, or dig out newly discovered invasions. A database of all EDRR populations is maintained and used to facilitate follow-up visits ensuring that the invasion was eliminated. Sites are revisited and retreated annually until five consecutive years with no weed observations are recorded. The district's ongoing control of the invasive species population is accomplished through cutting or pulling invasive weeds.

MMWD's strategy also includes habitat restoration for larger areas where restoration could be effectively implemented and where funding is available. Habitat restoration and rehabilitation differs from weed control by identifying a target plant community or ecosystem function to achieve, rather than simply targeting weed(s) for elimination. Restoration actions include weed control, re-contouring slopes, rerouting trails, removing accumulated thatch, amending soils, and seeding and/or planting native species as needed. The district employs seasonal vegetation staff, uses contract crews for large-scale technical work, and maintains a robust year-round volunteer program.

### *1.3.3 Mount Tamalpais State Park*

The vegetation management goal for Mt. Tamalpais State Park (MTSP) as a whole is to maintain a mosaic of sustainable native plant communities that 1) limit degradation due to exotic plants, 2) support sustainable populations of existing rare, threatened, and endangered species, and 3) present a park landscape of pre-historic vegetation communities to the extent feasible.

A large proportion of natural resources work in MTSP comes as a product of its membership in the Redwood Creek Watershed Collaborative, which covers land from Panoramic Highway down through Muir Woods and out to Muir Beach. This group, which also includes the National Park Service and the Parks Conservancy, enables watershed-scale EDRR, habitat restoration, and maintenance work previously untenable.

In addition to performing widespread EDRR work on State Park lands, One Tam has established a regular volunteer workday program for weed removal and trail work through its Restoration Team.

### *1.3.4 Golden Gate National Recreation Area*

The National Park Service has several programs working exclusively on invasive species removal and restoration of native habitat in GGNRA. The Habitat Restoration Team (HRT) began in 1992, and has grown into a large-scale invasive plant removal program. The team, and its early-detection/follow-up-focused offshoot, the Invasive Plant Patrol, have set routes and priority infestations to treat weekly in summer and monthly in fall/winter. The Park Stewardship Program (PSP), which began in 1993, is a Golden Gate National Parks Conservancy volunteer program focusing on restoration at areas of concern for endangered species within GGNRA. The Parks Conservancy runs several similarly successful volunteer groups such as Trails Forever and the Native Plant Nurseries, and also staffs a restoration technician crew for year-round work in project sites throughout the park. NPS and the Presidio Trust also manage the Presidio Park Stewards, who perform stewardship activities on Presidio lands. Larger projects often require the outsourcing of work to restoration contractors, including Shelterbelt Builders and Great Tree Tenders, among others.

NPS also runs an Inventory and Monitoring program that records data on EDRR species and plant community change. Muir Woods, Muir Beach, and some adjacent land west of Panoramic Highway partially fall under the purview of the Redwood Creek Watershed Collaborative, which combines resources to treat weeds across State and National Park land.

One Tam's area of focus includes a large swath of GGNRA land in Marin. In addition to supporting the above NPS and Conservancy teams, One Tam staff runs a dedicated EDRR program on the federal portion of Mt. Tamalpais land, and holds periodic volunteer workdays at Stinson Beach.

### *1.3.5 Point Reyes National Seashore*

In 1989, Point Reyes National Seashore (PORE) produced an Exotic Plant Management Plan. One aspect of this plan was a ranked list identifying invasive species for early detection. In 1994, PORE established the Habitat Restoration Program (HRP). Modeled after HRT at GOGA, this volunteer group focused on high-priority species removal and limited data collection (location, species, hours worked, quantity accomplished). In 2002, PORE staff developed an SOP outlining data collection and management procedures.

Currently, projects at PORE focus on 20 high-priority species and include a 300-acre coastal dune restoration project, cape ivy control, coastal bluff iceplant removal, and jubata grass control. Jubata grass control along sensitive coastal bluffs demonstrates the high skill, and cost,

often necessary in control efforts. PORE uses a work-performed database similar to GOGA's, with initial point occurrences and UTMs entered and used to track work infestations over time.

Early detection is done on an opportunistic basis by staff and volunteers. Incipient populations of gorse, spartina, yellow starthistle, and giant plumeless thistle are controlled by staff and park partners as time allows.

PORE manages a swath of GOGA land in the northwest corner of the One Tam area of focus, as shown in Figure 2 (Pg. 3).

### 1.4 Collaboration

The goals of the One Tam early detection program are to identify priority invasives at cost-effective stages for treatment, treat high priority patches when possible and to share data across jurisdictions to facilitate prioritization of future work. Invasive plants often spill from one agency's land into the next, making coordinated strategies for management one approach to increasing efficiencies. Sharing techniques and resources can also improve effectiveness of treatments.

In addition to sharing data across jurisdictions within the One Tam area of focus, the TLC recognizes the importance of county-level and regional data sharing. By synthesizing information for land managers, the One Tam early detection team enables a landscape-scale approach to managing invasive plant species on TLC lands. Data sharing is primarily facilitated by the use of the publicly accessible Calflora Database as the central repository for data storage. Calflora's Weed Manager system allows agencies to record tailored data while showing subsets of information to all public users. It is readily accessible online, allowing interested parties to search for species across the state. By making location, patch size, and other data available, Calflora allows for a greater understanding of mapped species distributions than do databases housed on agency servers.

## 2.0 Monitoring Design

This protocol focuses on the early detection of incipient patches of weeds to prevent the establishment of new, entrenched infestations. As well-recognized vector pathways, roads and trails are the primary focus of this protocol. Because riparian corridors are also linear pathways, the protocol is also extended to those habitats.

### 2.1 Monitoring Questions

The primary question this protocol seeks to address is derived from the SFAN protocol:

- Where are new populations of invasive plant species becoming established along roads, trails, and riparian corridors on TLC lands?

## 2.2 Protocol Objectives

As of early 2017, the objectives of this protocol are as follows:

1. Produce a list of target species for survey work.
2. Document survey methodology for One Tam team.

Other monitoring objectives discussed in the SFAN protocol include the prioritization of areas to survey and data analysis. These objectives should be thoughtfully discussed within the SCMWG toward the development of collaborative objectives and methodology. At present, each agency uses different geographical units for prioritizing surveys as shown in Table 1.

**Table 1.** Types of geographical units in use by agencies of the Tamalpais Lands Collaborative.

| Agency | Geographical Unit |
|---|---|
| National Park Service | Subwatersheds |
| Mount Tamalpais State Park | Management Units |
| Marin Municipal Water District | Management Units |
| Marin County Parks | Preserves |

## 2.3 Prioritizing Species

The effort to prioritize species was undertaken by the Conservation Management Team in late 2015. This list is divided into Priority One species, which are truly new to the area of focus or the county. These species are limitedly distributed or unknown. The species on the second part of the list are known as Local Detections. These plants are widespread on TLC lands, and are often the focus of existing invasive plant management programs.

While each TLC partner has interest in species beyond the 65-species EDRR list, a choice was made only to emphasize species that would trigger management. Other early detection protocols also include presence data for all non-native plants. For efficiency, the TLC opted to only look for species that the collaborative would manage, or those that are new and may be suitable candidates for management, if found. This choice allows the One Tam team to collect data on the same suite of species on all four agencies' lands, minimizing errors associated with shifting lists as surveys cross or straddle property boundaries.

While the SFAN protocol provided a detailed ranking assessment to develop its list, the TLC protocol relied on assessments of the Conservation Management Team. As this team includes vegetation ecologists and invasive plant managers familiar with their lands, it was assumed that

the collective body could develop a well prioritized list. Some work on prioritization was referenced, such as the NPS and MCP early detection species lists and the list of the Bay Area Early Detection Network and California Invasive Plant Council rankings and alerts.

The list should be revisited annually for the first five years by the SCMWG. After five years of using the list, the team can decide whether to continue to review annually or move to a biennial review schedule.

## 2.4 Prioritizing Geography

Prioritizing areas to survey in a partnership environment is a complex endeavor. While two agencies (NPS and MCP) have existing early detection programs with their own fully prioritized survey geography, the remaining agencies own more than two-thirds of the area of focus, as shown in Figure 2. Furthermore, the SFAN and MCP early detection protocols prioritize geography with similar metrics but different methods.

The combined EDRR effort of the One Tam collaborative running at normal capacity aims to cover the road and trail network of Mt. Tamalpais every three years (one cycle). This target was set at the completion of the first cycle, which actually took five years (2014-18) as One Tam was being forged and agency strategies were calibrated. The second cycle took the desired three years (2019-21). Beyond that general model, the agencies forward and discuss special requests through the EDRR Subgroup, which are then confirmed by the SCMWG.

For example, since NPS already has its own early detection program, it elected to direct One Tam's added capacity toward surveying riparian corridors instead of roads and trails in 2016-18. And in some cases, an agency may have enough capacity to do all its scheduled EDRR in a given year, such as MCP in 2021, or none of its scheduled EDRR in a given year, such as NPS in 2020/21. One Tam is well-positioned to adapt to these circumstances. As the One Tam team embarks on the third EDRR cycle, shifting levels of capacity and need remain. To clearly prioritize across boundaries, the commitment levels of both the agencies and One Tam must be discussed and communicated thoroughly.

Additionally, some new strategies have emerged since the original writing of the protocol. While roads, trails, and riparian corridors constitute major vectors of plant invasion, disturbance takes many forms, some of which may be missed by the linear survey style outlined in this document. Parking lots, buildings, water tanks, campgrounds, materials depots, dams, and utility lines are all necessary EDRR target sites. As wildfire season has elongated and fire frequency has increased in California, land management agencies have turned a great deal of attention to fuels reduction work and firebreak maintenance. With hand crews and heavy machinery moving through these zones, EDRR is required to make sure weeds do not move in

afterward—One Tam is targeting these areas starting in 2022. EDRR may also be deployed in high-value areas to protect resources. This may include rare plants, locally rare plants, or simply high-value habitats such as wetlands or serpentine grasslands. And in cases where a road is too dangerous to survey on foot, roadside pullouts may be checked as a proxy.

## 3.0 Survey Methods

This protocol is intended for use by professional staff rather than volunteers. The SFAN protocol provides excellent ideas for creating a culture of early detection among volunteers and the interested public. The TLC has a robust community science program, which could incorporate early detection efforts when capacity and priorities allow. Given this protocol's suite of 65 species, many cryptic or highly uncommon, and detailed data collection requirements, this methodology is best suited for conservation professionals. Furthermore, obtaining reliable absence data for the species on the list requires a trained eye and professional commitment to the task of surveying.

One opportunity to deploy this tool more effectively lies in liaising with the mountain biking community for detections of Stinkwort (*Dittrichia graveolens)* in the late summer of 2018. This high priority species is quickly recognizable along trail sides with a late-season green when much vegetation has faded to golden or brown. By focusing on one species for opportunistic sampling, the TLC hopes to engage a user group and get a small amount of highly useful data.

Opportunistic sampling by the public or volunteers can augment these efforts. Currently the TLC uses Calflora's Weed Manager for data storage and reporting. Using the mobile application Observer Pro, opportunistic observations can be made. Using the Weed Alerts system within Calflora, One Tam early detection staff are notified when data for any species on the plant list is uploaded into the database. Use of this system is in the early stages, and has thus far only provided information on common weeds in areas where they are well known and mapped by agency staff.

### 3.1 Same-Year Survey Frequency and Revisit Schedules

At present, all MCP surveys and some road and trail surveys for other agencies will be repeated after three months in the same year. This allows survey teams to find new infestations as seasons shift. Safety hazards and impenetrable vegetation necessitate a slow approach to riparian surveys. These will not be repeated in the same year. One Tam staff may choose not to

repeat some road and trail surveys for NPS, CDPR, and MMWD. Examples of when this may occur include late surveys of grasslands in which repeats would be unlikely to yield new information (dry vegetation).

## 3.2 Gathering Field Data

Directions for field data collection are detailed in SOPs 2 and 3 and Appendix A. Surveyors mostly work in pairs, covering a variable number of miles per day. Experienced surveyors sometimes perform solo surveys. Coverage depends on terrain, weed densities, treatment opportunities and constraints imposed by scheduling and weather. Like the SFAN protocol, a patch is considered an early detection when it is under 100 $m^2$ and more than 20 m from the next patch.

### *3.2.1 Naming Conventions*

While the Calflora Database handles many naming needs internally, there remain a few elements of data storage which require naming shapes, projects, and column sets. When naming these objects within the database, begin column sets and shapes with the prefix "TLC_" to denote their use by One Tam staff.

Weed Manager projects relevant to this protocol are found in each agency's Weed Manager group. They are all named "One Tam EDRR."

### *3.2.2 Negative Data*

As discussed in the SFAN protocol, it is important for land managers to understand where a species does not occur. To get this absence or negative data, surveyors run tracklogs to record where they surveyed. Using the Survey Entry application in Calflora's Weed Manager allows the surveyor to upload a tracklog to buffer or digitize to the site distance, creating a polygon of a surveyed area. This methodology is discussed in Appendix B.

### *3.2.3 Collecting Specimens*

Specimens will only be collected for observations of unknown plants or plants thought to be new to the area of focus. For collection procedures, refer to the original SFAN protocol's SOP 4, "Plant Collection and Vouchering."

# 4.0 Data Management and Reporting

This protocol adopts many of the data management recommendations of the SFAN protocol, adapting those to a collaborative environment in which the primary users of this protocol do

not truly manage the data beyond the quality control stage. Details of using the Calflora database are found in SOP 5.

## 4.1 Database

This early detection program uses the Weed Manager system found within the Calflora Database, which allows the tracking of invasive plant patches or populations and treatments over time. The Calflora Database stores data using an OATS model (Occurrence, Assessment, Treatment, Survey) originally described by the Sonoma Ecology Center. Some data in this model, occurrences, assessments and treatments, can be linked together in history stacks to connect data over time. A discussion of the OATS model as it relates to Calflora is available at: http://www.calflora.org/entry/mgr/datamodel.html.

The Calflora Database is available for viewing at http://www.calflora.org/. Weed Manager is available to groups by subscription. Each TLC agency maintains a subscription to the Weed Manager system (WM). One Tam staff are members of each group. Anyone with an internet connection, including agency staff who are not part of all WM groups in the TLC, can view all population data for an occurrence -- but not treatment information, which is never made public. This is one way that the adoption of WM allows the TLC to overcome maintaining data on five separate computer servers.

In addition to viewing data, tools for searching, reporting on, and downloading data across the groups were developed for One Tam in 2016. These tools are usable by anyone who is a member of multiple groups. In this way, the tools developed by the TLC serve a smaller collaborative in the Redwood Creek watershed, which is entirely contained within the TLC area of primary focus.

In addition to desktop services in Weed Manager, the Calflora Database offers a mobile application, Observer Pro, for field data collection. This software runs on Android operating systems, including phones and tablets. Development for iOS is pending.

## 4.2 Data Management

### *4.2.1 Data Entry, Verification, and Editing*

Uploading data from Observer Pro (OP) via wi-fi to Calflora is recommended at the end of each field day. Staff should review data daily or weekly for quality control purposes. Staff will review their own data to ensure location quality and that all attribute information is fully populated. The One Tam EDRR team functions entirely in the digital realm. This workflow increases field efficiencies, but without paper datasheets to back up data collection, quick upload and quality control measures are essential.

### *4.2.2 Data Archival Procedures*

Data will be archived according to the internal procedures of each agency. It is recommended that data from WM be downloaded and integrated into an agency geodatabase annually or semiannually.

### *4.2.3 Metadata*

Metadata requirements will be defined and managed by each agency as part of data archival procedures.

### *4.2.4 Data Analyses*

Data analysis in the TLC will consist of agencies incorporating One Tam EDRR program data into their own annual analysis projects. In addition to these agency-based analyses, One Tam staff will also provide survey mileage to agency staff, as those data are not currently stored within the Calflora Database. Other data analysis will be undertaken by One Tam staff to inform the Conservation Management Team about the distributions of priority invasive species, as well as metrics on the program's functions such as labor hours and patches detected or treated. Other requests or more formal analysis schedules may emerge as the partnership grows.

## 4.3 Reporting

As noted in the SFAN protocol, "Data acquired from surveys may be time sensitive" (p 31). This protocol attempts to address this truth by incorporating some treatment time into surveys. Other mechanisms for feedback remain informal, with direct notification from One Tam staff to vegetation program leads comprising the primary method of communicating priorities for treatment during the field season. A common understanding of capacity facilitates communication, but much of this feedback loop relies on professional judgment of priorities. As the collaborative grows, a system for feedback loops is warranted.

In addition to reporting to land managers to ensure timely treatment, One Tam staff shall contribute to an annual report showing the "One Tam Lift," or added value brought by collaboration and increased capacity. Metrics suitable for this report include miles surveyed, patches detected, and patches treated.

## 4.4 Time Tracking

The Weed Manager system provides several methods for tracking time (Table 2). One Tam Early Detection will use Calflora to track time to feed treatment reports and other needs.

**Table 2.** Applications for tracking time in Weed Manager and uses by One Tam Early Detection.

| Application | Best Use for Time Keeping |
|---|---|
| Observer Pro Form | Treatments |
| Fieldwork Spreadsheet | Surveys, treatment days |

## 4.5 Revising the Protocol

This document will be updated annually for the first three to five years and then reviewed between survey cycles for necessary changes.

# 5.0 Personnel Requirements and Training

## 5.1 Roles and Responsibilities

Science and Conservation Management Working Group (SCMWG): Land managers and ecologists from each agency, gathered as a team, are responsible for approving survey geography and the species list. They are also responsible for reviewing this protocol and details for treatment work on their respective lands.

Conservation Management Specialist: This program manager has primary responsibility for coordinating protocol development and revision with the SCMWG. S/he is also responsible for overall quality assurance and reporting to the SCMWG when in session, as well as producing data for the TLC annual report. The Conservation Management Specialist requires moderate to high skill with plant identification, supervision, GIS/computers/databases, and writing.

Assistant Conservation Management Specialist: This staff member has day-to-day responsibilities for coordinating surveys, maintaining equipment, field data collection and quality control on his/her own data. S/he also creates maps, assists with reporting, and supervises the Conservation Management Assistant positions. The Asst. Specialist should have moderate to high skill with plant identification.

Conservation Management Assistants (2): Assistants are responsible for field data collection, best management practices for preventing the spread of invasive plants with respect to equipment and vehicles, and quality control on their own data. Assistants should have familiarity with plant identification principles and be trained thoroughly each season on the

species list. They should pair with the Specialist and Assistant Specialist for field surveys to distribute plant identification skills appropriately.

### 5.2 Training

Trainings for new staff will include plant identification for species on the list, including both office and field components prior to official surveys. Exercises in pacing, area estimation, percent cover estimation, and survey techniques will be taught by the Specialist and Technician annually to Seasonal Assistants. This offers an opportunity for long-term staff to refresh their own skills as they teach others. Trainings for Weed Manager and Observer Pro will also take place soon after Assistants are hired each year. Informal trainings in the field will take place as needed.

One benefit of collaboration across agencies is the opportunity for expanded training. Attending the seasonal staff trainings conducted by agencies will allow the Specialist and Technician to affirm that One Tam procedures remain consistent with agency expectations over time. They also offer an opportunity to learn new training techniques. TLC partners are exploring joint trainings, starting with public communication. Because the protocol for One Tam varies slightly from each agency to cover the changes from agency to agency, it is unfeasible to collaborate directly on teaching the protocol or use of Weed Manager and Observer Pro at this time. There remain opportunities to combine efforts on training field exercises and plant identification.

## 6.0 Operational Requirements

### 6.1 Annual Workload and Field Schedule

Early detection of invasive plants can occur year-round, but to maximize efficiencies, most road and trail surveys are conducted from March to September. Riparian surveys take place from July to October, as water levels allow. Reporting and data analysis are typically tasks for fall and early winter, with planning dominating late winter.

**Table 3.** Annual work schedule for the early detection of invasive plant species.

| Activity | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seasonal staff | | | | | | | | | | | | |
| EDRR: Roads/trails | | | | | | | | | | | | |
| EDRR: Riparian | | | | | | | | | | | | |
| Reporting/analysis | | | | | | | | | | | | |
| Planning | | | | | | | | | | | | |

## 6.2 Equipment and Facility Needs

This protocol requires the use of mobile GPS technology with software such as ESRI's FieldMaps app or Calflora's Observer Pro. Adequate licenses for desktop use are also needed to allow staff to perform quality control checks on their data. Each team needs a robust hiking backpack with ample storage for carrying weed propagules on survey treatments. Each team should have at least one hand saw, hori hori, hand pruner, and binocular set. Two radios, one per team, are required for safety. One truck with four-wheel drive and high carriage can be shared by two teams, though efficiency is greater when two vehicles are available. Regular access to wi-fi, charging stations and desktop computers are also required.

# 7.0 Glossary

The following glossary follows the SFAN protocol (p. 42) which itself was partially adapted from Redwood National and State Parks' website, The Nature Conservancy's WIMS handbook, and the Center for Invasive Plant Management. Updates were made to include Weed Manager in the place of outdated Geoweed information.

**Areas**: An *area* is a uniquely named parcel of land that may have either legally defined boundaries or locally derived place names. In this protocol we will use up to three *areas* to locate each *occurrence.* Two are predefined: the sub-watershed (*e.g*. Fort Mason is in GGNRA 26-3) and the site name (*e.g*. Fort Mason, Milagra Ridge, etc.). The third *area*, the *survey area*, will be mapped and documented each day as a way of showing what area was surveyed, thus showing where target species were found and not found.

**Assessments**: Surveys and monitoring of isolated weeds and weed population *occurrences* are defined and recorded in the database as individual *assessments*. An *assessment* therefore is a set of measurements taken over time, recorded for a specified weed *occurrence*. Each *assessment* relates to one specific *occurrence*, while each *occurrence* can accrue a series of *assessments* over time.

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 monitoring the project's effectiveness. The initial *occurrence* and *assessment* data will serve as the baseline for the entire project area, and the project area will be re-assessed annually for the duration of the project. These periodic *assessments* will be used to determine if weed populations are increasing or decreasing in size and distribution and if *treatments* are having the desired effects.

**Invasive:** Tending to spread, intrude, or encroach, usually aggressively and in an ecologically detrimental manner.
Gardeners characterize cultivated plants as "invasive" when they spread aggressively beyond where they were intended to remain, particularly if they outcompete and displace other plants in the garden. Native species can behave invasively, but this term generally connotes non-natives which can spread into undisturbed ecosystems.

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

**Occurrences:** The weed *occurrence* is the basic unit of mapping and assessing a singular weed or weed population/infestation within Weed Manager. 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.

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

**Treatments**: A *treatment* is any weed management activity that occurs at a specific time over a defined geographical area. One *treatment* may affect one or more *occurrences* (of one or several species) over one or more *areas*. The Weed Manager system tracks all types of weed control methods, including manual and mechanical methods, prescribed fire, grazing, biological control, and any chemical treatments. The database also keeps track of how much staff and/or volunteer time has been spent controlling weeds.

**Weed:** A weed is a plant out of place. This term is subjective; a weed is not necessarily an exotic species, although the terms are growing more synonymous. The term "noxious weed" is an official designation for weeds which cause major economic harm. Plants introduced for their ornamental, utilitarian, or food value which "escape" and disrupt natural ecosystems have only

recently been recognized as weeds. More precise, accepted, and general terms for environmentally harmful non-natives are “exotic pest plant” (although “pest” has a legal definition of causing harm, similar to “noxious”) and “invasive plant species.” In Australia, exotic pest plants are termed “environmental weeds.”



## 8.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| 1.0 | November 2017 | Greenberger, D. | Minor edits to layout, maps | New Area of Focus boundary | 1.1 |
| 1.1 | January 2019 | Greenberger, D. | Updates to return interval and prioritization strategies | EDRR Subgroup guidance | 1.2 |
| 1.2 | January 2022 | Kesel, R.; Greenberger, D. | Update survey geography | EDRR Subgroup guidance | 1.3 |

# Standard Operating Procedure (SOP) 1: Protocol Revision Log Version 1.0 (January 2017)

## 1.0 Scope and Application

This SOP is "stolen with pride" from the 2009 SFAN protocol by Andrea Williams, Susan O'Neil, Elizabeth Speith, and Jane Rodgers . It explains how to make changes to the One Tam Early Detection Protocol and accompanying SOPs, and explains procedures for tracking these changes.
One Tam or Conservation Management Team staff who are editing the Protocol Narrative or any SOP must follow this procedure to prevent confusion in data collection and analysis methods.
This SOP also contains a table listing the most current version of the protocol narrative and each of the SOP's. This will provide a single reference for ensuring that the most current documents are being used.

### 1.1 Protocol Revision Procedures

- The One Tam Early Detection Protocol Narrative and accompanying SOPs are a living document, designed to capture current best-laid plans in a readily disseminated and followed format. Changes and revisions will inevitably be made.
- All edits will be reviewed for grammatical and technical accuracy and overall clarity. Minor changes or additions to existing methods will be reviewed by One Tam staff vegetation working group and other appropriate Conservation Management Team members. This protocol should remain close to the SFAN protocol unless major revisions are undertaken with peer review.
- Edits and protocol revisions will be documented in the Revision History Log that accompanies the Protocol Narrative and each SOP. Only changes in the Protocol Narrative or specific SOP that has been edited will be logged. Minor changes, such as an alteration of species lists, will be recorded as decimal increases in version number (*e.g.*, Version 1.1 to 1.2). Major changes, such as an alteration in objectives or update after five-year analysis, will be recorded as integer increases in version number (*e.g.*, Version 1.2 to 2.0).
- Post new versions on the TLC Google Drive and notify all individuals known to have a previous version of the Protocol Narrative or SOP.

**Table 4:** Current SFAN Invasive Species Early Detection Protocol documents.

| Document Name | Current Version | Version Date | Author |
|---|---|---|---|
| TLC Early Detection of Invasive Plants Protocol, Protocol Narrative | 1.1 | January 2017 | Williams, A., Koenen, M., and Kesel, R. |
| SOP 1: Protocol Revision Log | 1.0 | January 2017 | Jordan, J., Williams, A., and Kesel, R. |
| SOP 2: Mapping | 1.0 | January 2017 | Williams, A., Jordan, J., and Kesel, R. |
| SOP 3: Field Data Collection | 1.1 | January 2017 | Williams, A., Jordan, J., and Kesel, R. |
| SOP 4: Plant Collecting and Vouchering | 1.0 | January 2017 | Williams, A. |
| SOP 5: Data Management, Analyses, and Reporting | 1.1 | January 2017 | Williams, A., Phillipi, T., Forrestel, A., Wakamiya, S., and Kesel, R. |

## 2.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| | | | | | |

# Standard Operating Procedure (SOP) 2: Mapping
# Version 1.0 (January 2017)

## 1.0 Introduction

All TLC partners are engaged in invasive plant mapping to some degree. The One Tam EDRR program will augment these efforts using the guidance below to ensure that geospatial data are consistent and interpretable. Guidance here will be limited to how to map in the field with particular emphasis on how to determine what qualifies as a patch. Refer to the SFAN protocol for a fuller description of mapping, including information on projections, datums, and spatial coordinates. Calflora data are recorded and exported in the geocentric NAD83 datum (WGS84).

## 2.0 Mapping Guidance

This section is taken directly from the 2009 SFAN protocol by Andrea Williams, Susan O'Neil, Elizabeth Speith, and Jane Rodgers with minor changes adopted by the TLC Early Detection subgroup of the Conservation Management Team in January 2017.

The question of "what is a patch" has troubled many weed mappers. Since the purpose of early detection mapping is to give rapid responders an idea of where and approximately how much of a priority species has been found, early detection mapping may be more gross or more detailed than desired by others.

### 2.1 General Guidance

- Map safely. Use your finger or a stylus to draw in points and polygons you can't or shouldn't reach.
- Map by species, not area. For each species, create a separate occurrence even if more than one species occurs in the same area.
- Inter-patch distance: Map discrete patches of a single species, unless they are closer than 20 meters apart. Separate data collection must be completed for each discrete patch.
- A patch may be an individual, a single cluster of individuals, or many clusters of individuals.
- When you see a particular species while surveying, walk out about 10 m, or until you can just see the plants clearly (whichever is closer). Walk around the edge of the patch, looking for other individuals or clusters in the same logical, topographical area. If you see more, go out an additional distance from those and continue looking. Do not record an isolated individual or a single cluster until you have determined whether other individuals occur nearby.
- Once you have surveyed the larger area, determine which cover class(es) and which distribution(s) most accurately describe what you see.
- Then fill out the form on Observer Pro, and create the polygon (using GPS when possible)
- In addition to inter-patch distance, use logical boundaries to delineate patches. Survey drainages, hilltops, meadows, or other logical topographical features as a single unit.
- The goal is to map all *occurrences* of each target species, but when determining boundaries between *occurrences* based on cover class, do not map a separate *occurrence* if one of the areas is less than 100 $m^2$ unless the patches are more than 20 meters apart. If only one patch occurs, map it no matter how small (unless dictated otherwise by priority level).

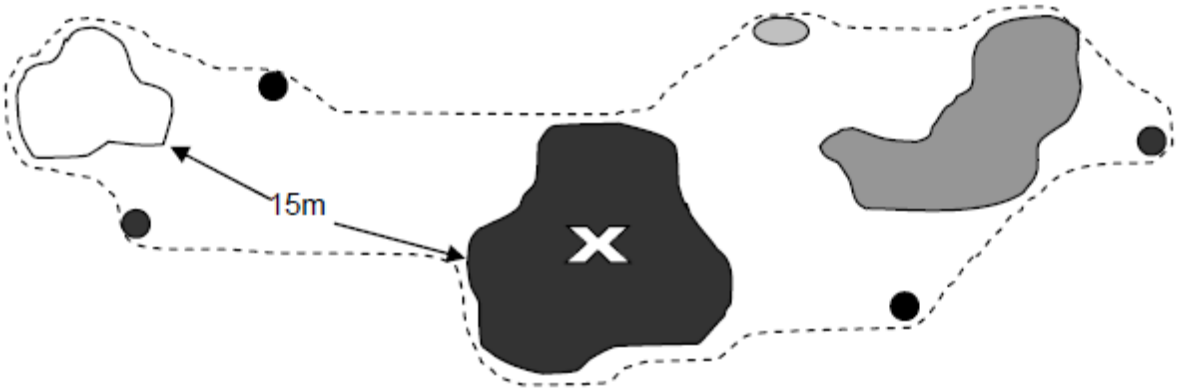



**Figure 3.** A theoretical mapping layout for a single species with multiple clumps of different cover classes, as shown by shading (darker color=higher cover).

The maximum inter-patch distance for the example in Figure 3 is 15 meters, so the entire area is mapped as a single *occurrence* (X) and *assessment* (dashed line) with cover of 5-25%.While this appears to miss a level of detail, one of the reasons the North American Weed Management Association (NAWMA) uses infested acres instead of gross infested acres for reporting is to account for differences in how patches are delineated. If you were to draw each clump as its own assessment and cover class, you should come up with approximately the same number for infested acres (note that midpoints of cover classes are used to calculate infested from gross infested acres) as above:

- Single assessment polygon 50m x 15m x 15% cover **112.5 $m^2$ infested**

- Multiple polygons

| | |
|---|---|
| (5m x 5m x 3% cover) | 0.75 $m^2$ infested |
| + 4(1m x 1m x 97.5% cover) | 3.9 $m^2$ infested |
| + (10m x 10m x 85% cover) | 85.0 $m^2$ infested |
| + (1m x 2m x 15% cover) | 0.3 $m^2$ infested |
| + (10m x 5m x 37.5% cover) | 18.75 $m^2$ infested |
| | **108.7 $m^2$ infested** |

Weed Manager offers nine choices for Percent Cover:

| | |
|---|---|
| Absent | 0 |
| Trace | 0 – 1 |
| Low | 1 – 5 |
| Moderate | 5 – 25 |
| High | 25 – 50 |
| Dense | 50 – 75 |
| Very Dense | 75 – 95 |
| Solid Stand | 95 - 100 |
| Other… | Type a number |

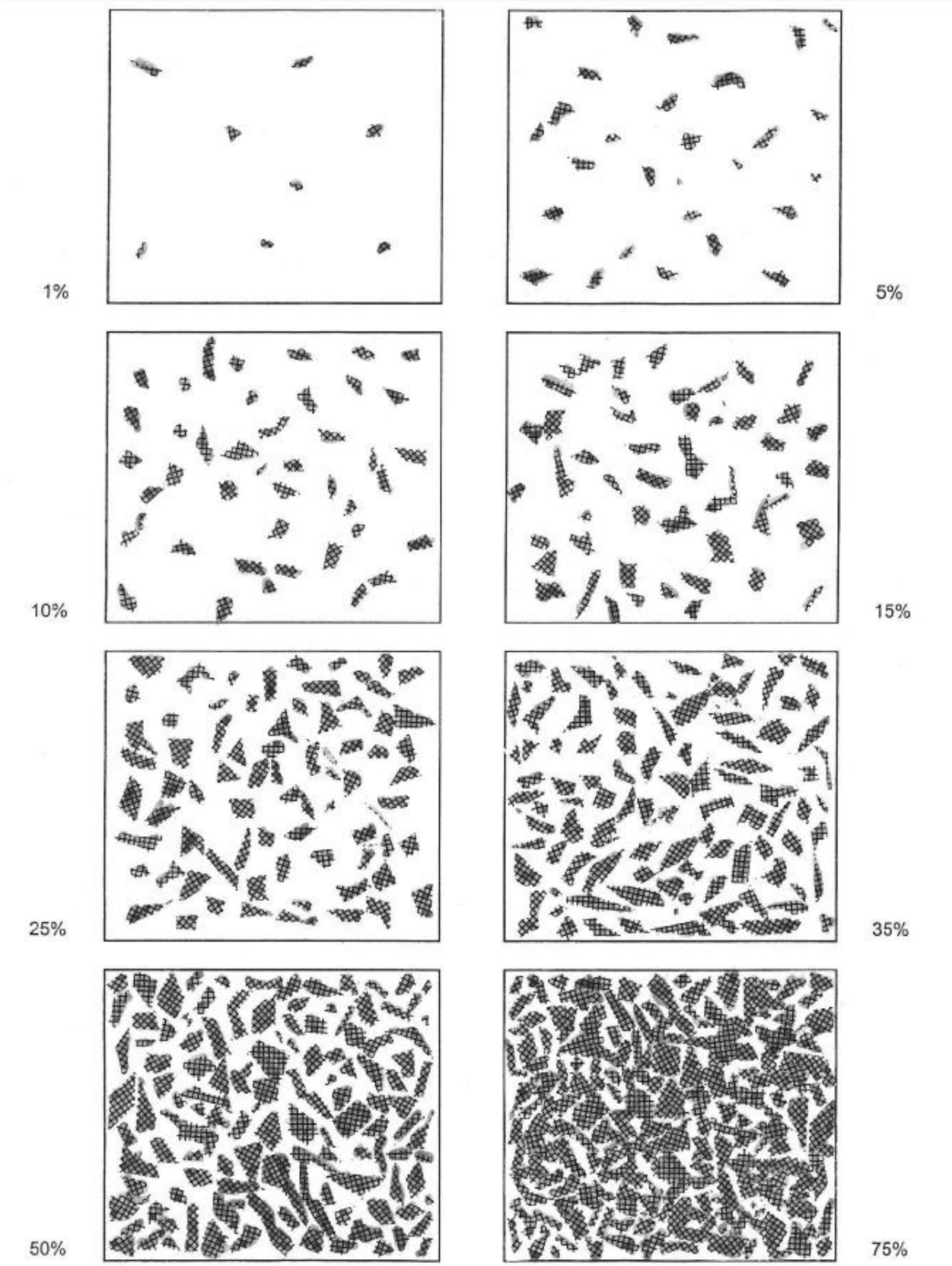



**Figure 4.** California Native Plant Society reference plots for cover class estimation.

## 2.2 Quick Reference Section

**Table 5.** Selections for geometry based on patch size and species priority level.

| Patch Type | Geometry Type |
|---|---|
| Priority 1 species | Polygon |
| Priority 2 species < 100 $m^2$ | Polygon |
| Priority 2 species > 100 $m^2$ | Point in middle of patch |

**Inter-patch distance** = 20 m

# 3.0 Remapping

The most recent Weed Manager data should be taken into the field during surveys as described in SOP 5 Appendix A.

When finding an infestation of invasive plants, check to see if it has already been mapped. If it has, compare the current infestation to the recorded data asking these questions to decide whether to remap it:

Is the location, size, and cover class the same?
    If no, then remap it.
Are you treating the population today?
    If yes, then remap it.

When remapping, follow the steps outlined in the SOP referenced above to create a new assessment of the patch. This will place your new data into a history stack for the occurrence.



# 4.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| | | | | | |

# Standard Operating Procedure (SOP) 3: Field Mapping
# Version 1.0 (January 2017)

## 1.0 Introduction

This SOP is intended for use by professional botanical surveyors engaged in One Tam early detection efforts. In addition to detailing several field practices, such as what to carry in a pack, it also provides detailed information on each field of the three Observer Pro forms in use by the TLC.

## 2.0 Setting Up for Field Success

Ideally, arrange survey pairs such that identification skills are well distributed across teams. Safety considerations, such as familiarity with the area and navigation skills, are also important to consider in assigning teams.

Each surveyor should carry these items:

- Hiking backpack
- GPS-enabled mobile device
- Plastic bags for weed debris
- Gloves
- Water
- Lunch

In addition to the items above, each pair should also have the following:

- Radio
- An assortment of hand tools to include hand saw, hori-hori, and pruners
- Binoculars
- Mt. Tam trail map
- Specimen bags

Each mobile device should be loaded with the following:

- One Tam EDRR Illustrated Plant List
- MMWD Annotated Plant List in 6 pdfs
- Observer Pro app
- Avenza Maps app
- Red Cross First Aid app
- iNaturalist app

## 3.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| | | | | | |

# Standard Operating Procedure (SOP) 4:
# Plant Collection and Vouchering
# Version 1.0 (January 2017)

## 1.0 Introduction

This SOP is "stolen with pride" from the 2009 SFAN protocol by Andrea Williams, Susan O'Neil, Elizabeth Speith, and Jane Rodgers . Having a physical voucher of a plant, especially a potentially new record in the park, remains the preferred method of proving an observation. Staff may field-key or choose to voucher for expert identification, or to record a new species for the park plant list or significant range expansion for an invasive species (*e.g.*, the first record in the county), but should also photograph the plant *in situ* to capture characteristics that may be lost during pressing. Contact park vegetation staff for a list of plants that lack voucher evidence of their presence in the park.

## 2.0 In the Field

### 2.1 Collecting Ethics and Regulations

The following does not apply if you are collecting an invasive species that you have fully identified, in which case you may collect even if there is only one plant.

Only collect if the plant's population will not be seriously affected by the taking: generally, if there are over 20 individuals in the vicinity. If the population is small, but you must collect, take only enough to key without destroying the plant (*e.g.*, a flower and/or stem without roots) and consider photo-vouchering. If plants are, or are suspected to be, rare, consider carefully whether or not to collect. CNPS, State and Federally listed species should not be collected without consultation with the park Supervisory Botanist and the appropriate permits.

### 2.2 Collecting Tips

Plants are best keyed fresh, so field-key when possible. Tiny-flowered plants are especially difficult to key when wilted or pressed. If field-keying is unsuccessful, press some and bag some in a plastic baggie. Blow it up with air and keep it moist (a small piece of wet paper in the bag helps); refrigeration will help keep your specimen fresh. Remember to label both the bagged and the pressed plants! A plastic sandwich container will also work well for delicate structures.

If you decide to collect with the intent of creating a pressed and mounted specimen: Collect a representative example of the species, not the largest or smallest. Try to capture any phenotypic variation.

Collect enough of the plant to make pressing worthwhile. If the plants are tiny, collect enough to fill about half an herbarium sheet. Take enough to make a good voucher, plus a little extra for keying if necessary.

Collect as much of the individual plant as possible, including roots (or a portion if rhizomatous), bulbs, vegetative parts, and flowering/fruiting matter.

Collect as many phenological stages as possible (flowering and fruiting), since many keys use characteristics of fruit and flower. If necessary, snip flowers or fruits off an additional plant to complete the collection.

Press carefully; the standard plant press is the same size as a standard herbarium sheet (11”x17”). How you place the plant in the press will generally be how it will look mounted. If a plant is large, fold it or cut it to fit, keeping branchings and general form intact. Note original dimensions and photograph if possible. Plants may occasionally require more than one sheet for proper representation.

Fill out an observation in Observer Pro with all information.

- Include Slope (in degrees) and Aspect in the notes field. You can also describe the plant in the notes field. Elevation can be calculated in the Weed Manager system.
- Print an herbarium label from the Weed Manager system.

Wash as much dirt as possible from the roots and pat dry before pressing.

If flowers are large enough, cut one or two open and press flat so the interior/cross-section can be seen. Do the same for fruits. Turn over at least one leaf so the underside will be visible in the final mounting.

# 3.0 Post-Collection Processing

## 3.1 Identify the Specimen

Do your best to identify the plant to species level; it may be a good idea to confirm this identification by asking a local expert (Vegetation Management Staff as determined) and comparing to an existing herbarium specimen or online photo (http://calphotos.berkeley.edu/flora/).

## 3.2 Determine Whether You Will Accession the Specimen

If the specimen meets any of the following criteria, you should consider accessioning it into the herbarium collection; if it does not then you may consider adding it to a field collection (an informal notebook or set of specimens that can be used in the field for reference) or you may discard it once you are finished identifying it for whatever purpose you had.

- Is the species under-represented (less than 5 specimens) in the herbarium?
- Does the specimen display a unique feature?
- Is this a unique voucher associated with a study or monitoring project?
- Is the specimen exceptional in some other way?
- Is there complete collection information associated with the specimen? Plants that lack location, habitat, collector and/or identifier information should not be accessioned.

## 3.3 Independent Verification

If plants will be verified, do not accession until they are returned. This makes loan paperwork unnecessary. A receipt for property is sufficient.

Whether or not to verify: If the specimen is to be formally accessioned, independent verification of the specimen's identity should be considered when one or more of the following conditions are met:

- There are no pre-existing specimens of the same species in the collection;
- The collection represents a new species to the park;
- Designated park staff are unable to confirm its identification with certainty;
- The specimen is otherwise unique or problematic.

Where to get them verified: If independent verification is desired for a quantity of specimens, the herbarium manager or curator should arrange for a contract through a recognized herbarium; current options include informal assistance from California Academy of Sciences, the Jepson Herbarium at UC Berkeley, or the herbarium at UC Davis. Small numbers of purported exotic species may be taken to the local County Agriculture Commissioner's Office, where the biologist will assist in identification and/or filling out a Pest Damage Record.

Documenting and packing specimens for shipping: Include proper documentation including a spreadsheet listing the specimens with collection numbers. Place a label with each specimen. You can print a label from Calflora.

Dry and press, but do not mount them. This facilitates identification.

Place them in folded, numbered sheets of newsprint, occasionally layered between cardboard, and tie the entire bundle with string to facilitate removal from the box.

Pack the box tightly to prevent anything from moving around within it.

Send it via a reputable carrier (FedEx, UPS, USPS), insured. If feasible, deliver yourself.

## 3.4 Accessioning the Specimen into the Formal Herbarium Collection

A collection of dried plants to be added to the parks' herbarium needs an accession number as a group plus individual catalog numbers for each specimen. Obtain these from the Museum Curator. Specimens collected as part of a study should be accessioned together, clearly indicating relevant study information. Researchers who have collected specimens under a Scientific Research and Collecting Permit must provide cataloging data in the form specified by the Museum Curator in the permit. Catalogued specimens must be entered into the ANCS+ database.

Contact the Herbarium Manager or Museum Curator for procedures and permit requirements if applicable. Remember that in entering the specimen you should be preserving the process as well as the final identification, so original identifications and identifiers should be recorded even if incorrect. Information needed for ANCS+ includes the data from the sheet above, as well as the date of any subsequent identifications and the name of the person identifying (verifying) the specimen.

## 3.5 Mounting the Specimen

Once specimens are identified and verified, they may be mounted. Mounting can take place before or after accessioning. Not all pressed material must (or should) be mounted: only the most complete plants, plus additional fertile material or leaf variations, should be adhered to a sheet— enough to show the plant's characteristics, but not so much as to crowd the page. Split into "a" and "b" sheets if necessary, and be sure to leave room for label information.



## 4.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| | | | | | |

# Standard Operating Procedure (SOP) 5:
# Data Management, Analyses, and Reporting
# Version 1.0 (January 2017)

## 1.0 Introduction

The Tamalpais Lands Collaborative (TLC) aims to provide and share natural resource data with agency partners to inform planning and land management both in a collaborative setting and within each agency. By sharing data the TLC is better able to develop and measure common goals, evaluate management success and assess future needs. To achieve these goals, a detailed management plan is needed to ensure data quality, interpretability, security, longevity and availability. The invasive species early detection protocol is a status-based, rapid-turnaround program. Each survey has the potential to record information that is vital to both immediate management needs and long-term analysis of invasive species distributions. Additionally, having a variety of different parks and partners sharing data makes a detailed data management plan critical.

## 2.0 Scope and Applicability

The procedures below cover routine data management activities for the One Tam Early Detection Program. This SOP describes how the SFAN invasive species early detection monitoring protocol, adopted by One Tam with modifications, meets data management objectives through data entry specifications, database design, quality assurance and control measures, metadata development, data maintenance, data storage and archiving, and data distribution. Data management procedures are explained for all the components of the protocol, including field data collection, data downloads, data processing and analysis, map requirements, and reporting specifications.

Data analysis and reporting are essential components to any monitoring protocol. This document outlines analysis methods, reporting timelines and materials, as well as the four basic uses of the data: the immediate reporting to management; the periodic analysis of trends in species distribution and abundance; the correlation of invasive species populations with other data (habitat, disturbance, date, etc.); and the periodic analysis of data for protocol improvement.

## 3.0 Description of Data Files and Database

### 3.1 Calflora Weed Manager Database and Observer Pro Application

Weed Manager is a data system created by Calflora for tracking weed infestations and treatments over time. Multiple agencies in the San Francisco Bay Area and throughout California also use Weed Manager, including Golden Gate National Recreation Area, Golden Gate National Parks Conservancy, Marin County Parks, Marin Municipal Water District, and the U.S. Forest Service, promoting data sharing across agencies and political boundaries.

The Weed Manager system is made up of a series of applications including:

- Observer Pro – an Android-based mobile device application used for data collection
- Plant Observation Entry – a web application for entering, editing, and viewing weed data
- Group Observations – a web application for viewing and downloading all records owned by a particular organization
- Project Setup – a web application for managing multiple projects within Weed Manager groups
- Shape Editor – a web application for viewing and editing reference lines or polygons (e.g. roads, trails, subwatersheds) as well as spatial objects (e.g. assessment or treatment polygons).
- Work Session Entry – a web application for tracking crew hours

The Weed Manager system uses a MySQL database to store data and a web API for user interaction in the office. Data is collected in the field using mobile devices with the Observer Pro Android App. Digital data collected in the field is then uploaded to the Weed Manager MySQL database stored in the cloud. Data may be reviewed and downloaded using the Group Observations application (https://www.calflora.org/entry/groupobserv.html) while data edits are conducted using the Plant Observation Entry application (https://www.calflora.org/entry/poe.html).

In the legacy GeoWeed database, which predates Weed Manager, data were organized into *occurrences* of a species, representing the center of an infestation, which were then tied to a series of polygon *assessments* and *treatments* over time. A similar model is employed in Weed Manager, with slight modifications. Historically in GeoWeed, occurrences were always captured as a point feature while assessments were always captured as a polygon feature. Additionally, assessments were always linked to a point occurrence. In Weed Manager, occurrence and assessment data are captured on the same form and the initial detection record may be recorded as a point or polygon feature.

Some of the advantages of Calflora's Weed Manager system are:

- Digital data collection and uploading saves time over manual data entry.
- Data is easily accessible and consumable by multiple partner agencies, researchers, and the public.
- Database structure is shared by multiple partner agencies making future regional analyses more streamlined.

The user manuals for each of the Weed Manager applications may be found at http://www.calflora.org/entry/weed-mgr.html, and specific steps for using Weed Manager applications as it relates to the One Tam Conservation Management Early Detection Program may be found in Appendix B. A data dictionary for Weed Manager fields used by TLC partners may be found in Appendix [C].

## 3.2 Data Workflow

The data workflow for the invasive plants monitoring program of SFAN is outlined below (Figure 5). One Tam is using a similar workflow, though the team has not adopted a validation process as of early 2017. Historical data is uploaded to the tablet, followed by data collection in the field, and then the data gets processed and verified back in the office. At the end of the season, data is used to contribute to the One Tam annual report. Each agency is responsible for including One Tam data in the Weed Manager system with their own data archival procedures. One Tam does not archive any data on Golden Gate National Parks Conservancy servers.

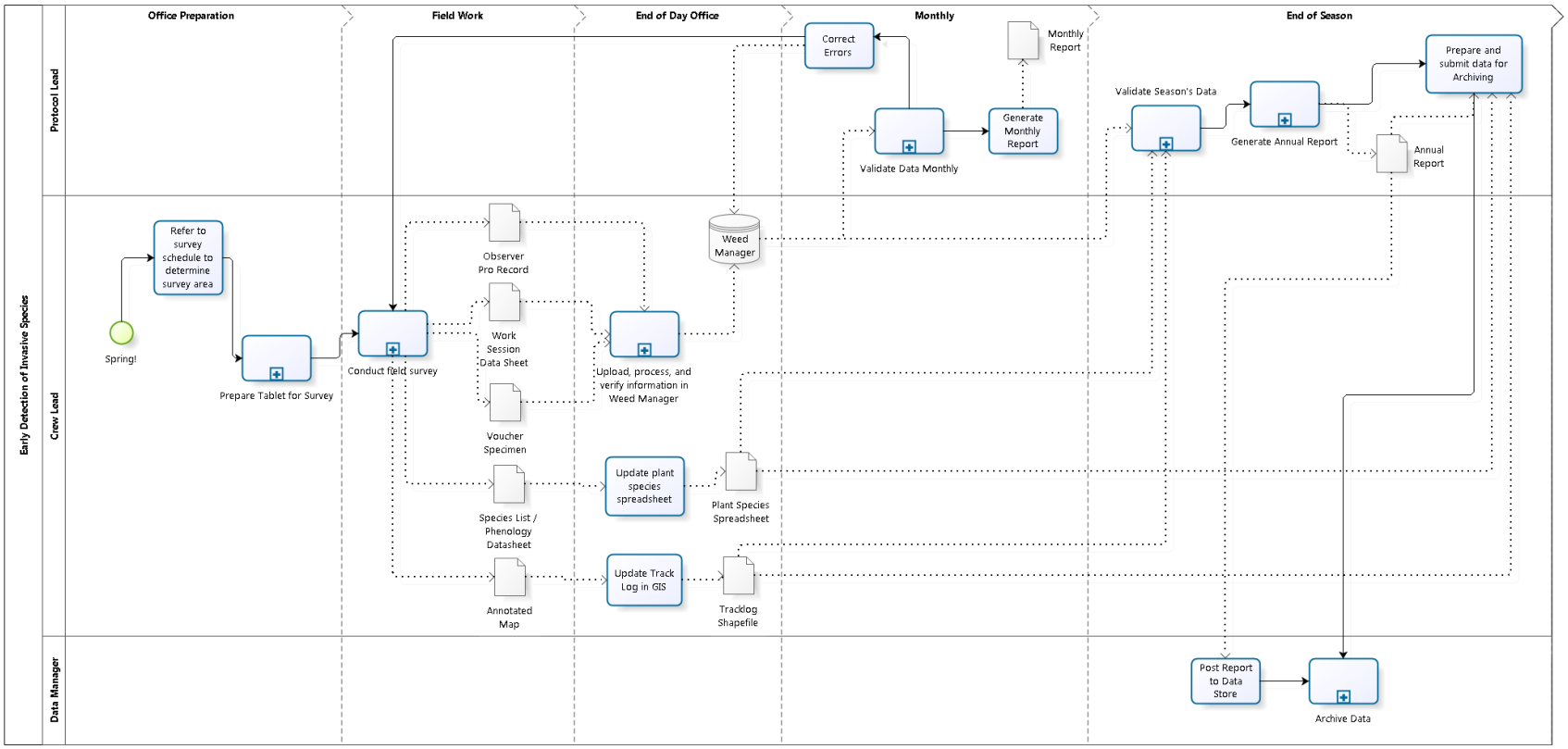



**Figure 5.** Data workflow model for the Invasive Plants Early Detection Monitoring Program of SFAN. One Tam uses a similar workflow which does not include paper datasheets or some validating processes as of early 2017.

### *3.2.1 Mobile Device Preparation and Field Data Collection*

Field data is collected using mobile devices with the Observer Pro application. Prior to conducting a field visit, previously collected data can be loaded into Observer Pro. Data from the area to be surveyed is selected in the Group Observation Application. The selection is then saved in the Project Setup Application, and synced to Observer Pro via wi-fi. Specific steps for using Weed Manager applications and Observer Pro are provided in Appendix B.

In the field, data is collected on the mobile device using Observer Pro. Before leaving a patch, entries made in Observer Pro should be visually scanned to detect missing or erroneous values.

### *3.2.2 Data Processing, Verification, and Review*

At the end of each field day, data entered into Observer Pro must be synced to Weed Manager over a wi-fi connection, or the information will only be stored on the tablet and is susceptible to loss. Work session information should be entered into Weed Manager at the end of each field day using the Work Session Entry application. In reality, work session information is often first recorded in a spreadsheet on the One Tam Google Drive. Work session information from this spreadsheet is later entered into Weed Manager's Work Session Entry application. Any voucher specimens collected in the field should be identified and their records in Weed Manager updated (using Plant Observation Entry).

Daily/weekly checks of data recorded in Observer Pro should be made in Group Observations to ensure all fields are populated. Of particular note are the area fields, which may not be auto-populated in some cases. Using the Group Observation application, the surveyor should also check the location of collected points for accuracy.

After verification, the public access permission for each record should be changed to "published" unless the record contains sensitive information. If the record contains sensitive information, the public access permission level should be set to "private." The default status of newly imported records is "unpublished." Unpublished records are only viewable by members of each Weed Manager group. Once published, the record is public and viewable by all Calflora users.

Data validation is the final step in assuring the accuracy of data and checks for systematic errors, logical errors, and outliers. Questionable data are identified, reviewed, and corrected if necessary. Some validation procedures that check the data as it is entered are built into Observer Pro/Weed Manager and will be modified as needed to improve error-checking abilities. These automatic validations are programming elements that "censor" the data based on known ranges. Examples of built-in validation include plant lists and fields that are restricted based on corresponding field values selected (e.g. the field for type of mechanical treatment can only be entered if "Mechanical" is selected in the Treatment field).

At the end of each calendar year, and on a monthly basis if time allows, agency monitoring staff may run additional validation checks and review mapping data accrued during the year. Additional validation checks are provided by an MS Access database developed by SFAN until such validation checks can be built into Weed Manager. This database allows the user to import Weed Manager data, run validation queries, find erroneous records, and provides links to the record in Weed Manager for correction.

### *3.2.3 Data edits after certification*

Due to the high volume of data changes and/or corrections during data entry, it is not efficient to log all changes until after data are verified, validated, and considered "certified." After certification, all data edits in Weed Manager should be documented in the records "notes" field so that future data users will be aware of changes made after certification. Additionally, the metadata file associated with the file geodatabase should include a narrative explanation that summarizes what changed, when, and why.

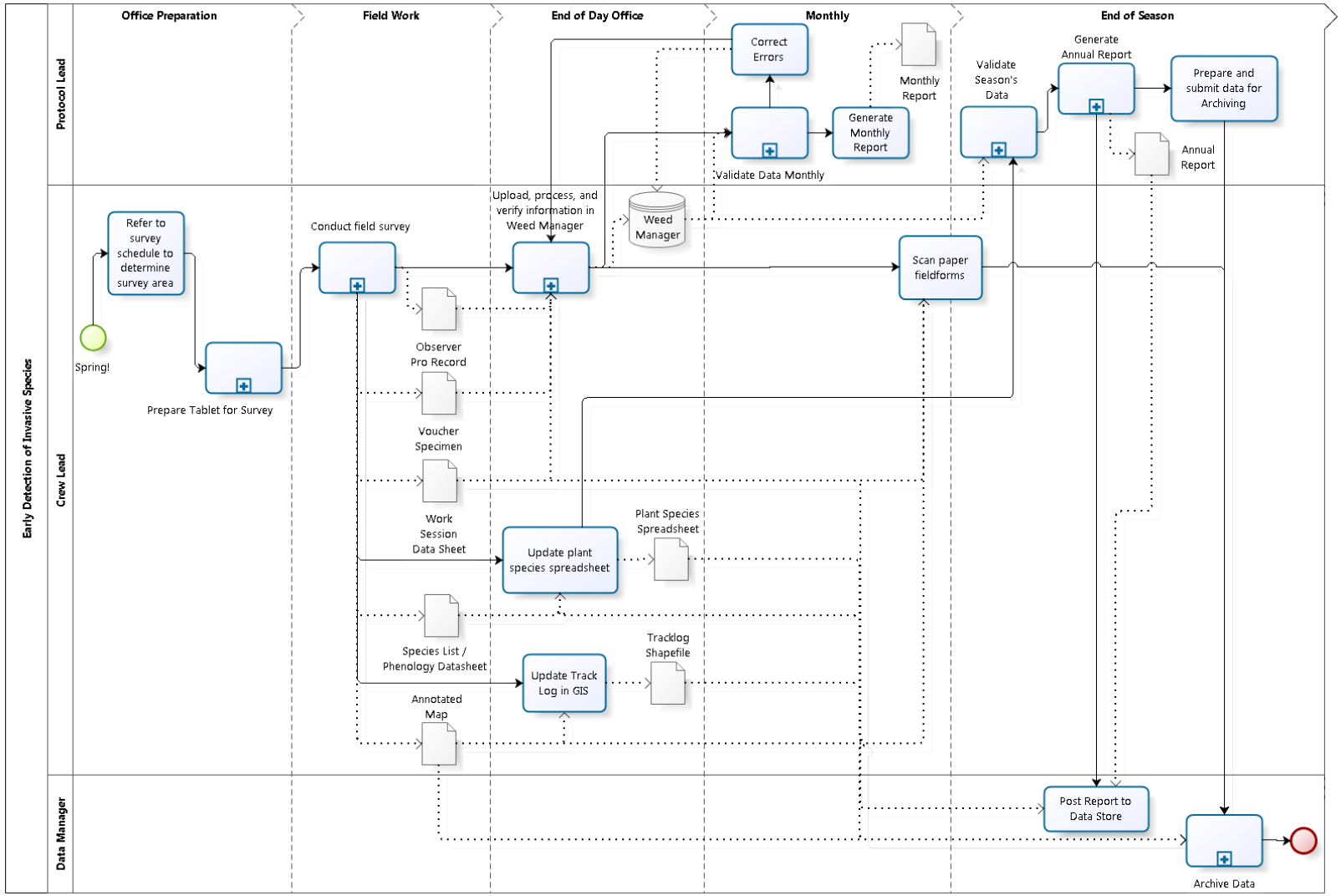



**Figure 6.** Workflow diagram for collecting field data in the SFAN Invasive Plant Early Detection Monitoring Program. One Tam uses a similar workflow that does not include paper datasheets or some validation processes as of early 2017. The reporting and archival procedures are performed by agency staff rather than One Tam staff.

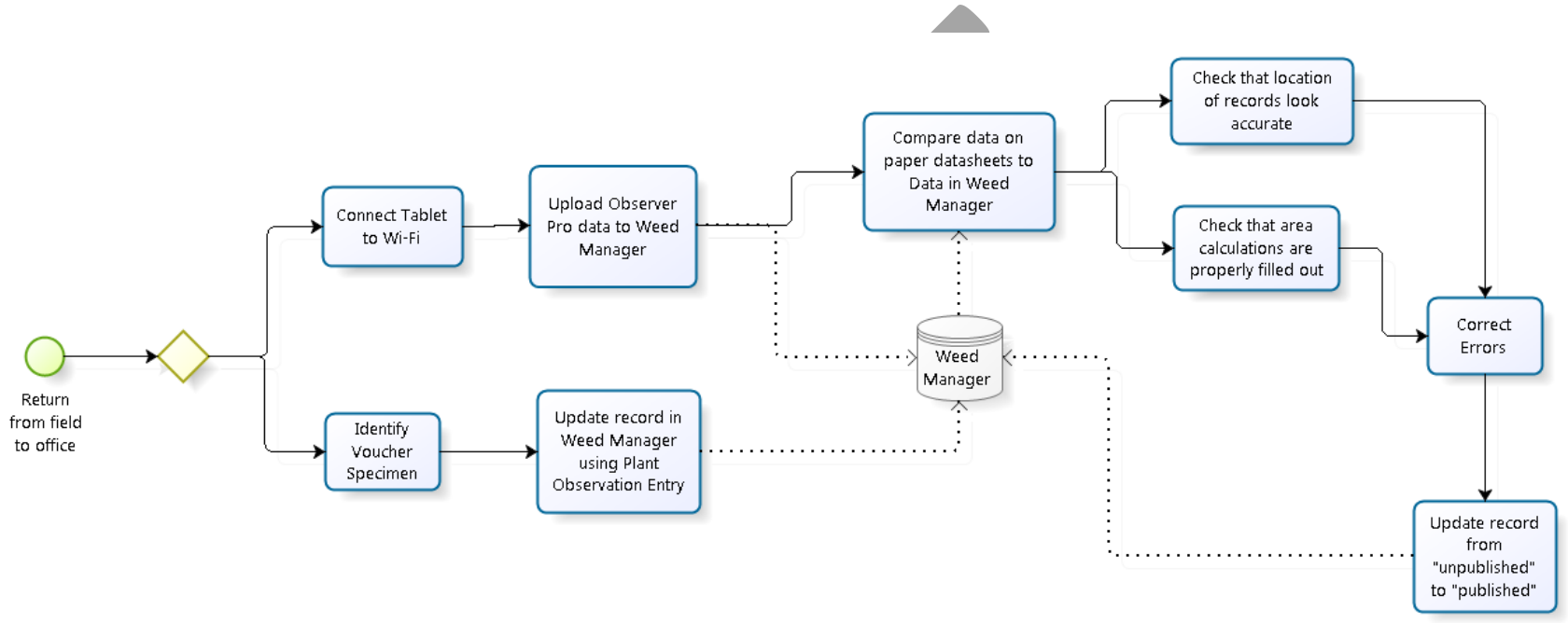



**Figure 7.** Workflow diagram for end-of-day office tasks for the SFAN Invasive Plants Early Detection Monitoring Program. One Tam uses a similar workflow that does not include paper datasheets as of early 2017.

## 4.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| | | | | | |

# SOP 5 Appendix A: Using the Weed Manager Application
# Version 1.2 (January 2022)

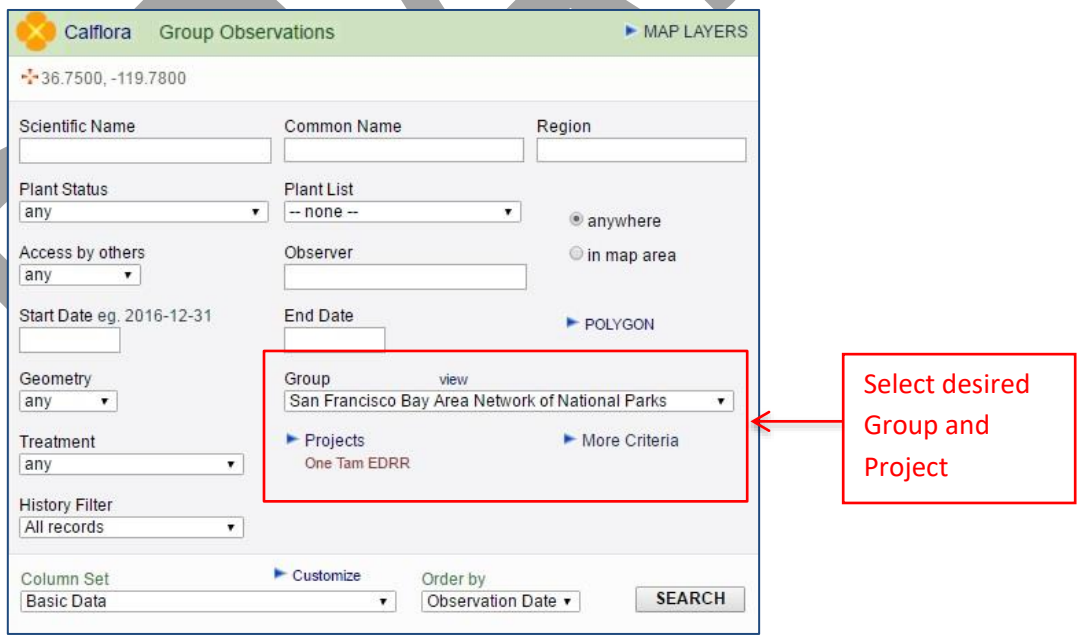
## 1.0 Introduction

One Tam's Conservation Management program uses Calflora's Weed Manager system to collect and manage invasive species data. The instructions provided here are intended to provide general guidance on workflow and use of the Weed Manager application. Additional guidance on each of the applications is provided by Calflora at: http://www.calflora.org/entry/weed-mgr.html.

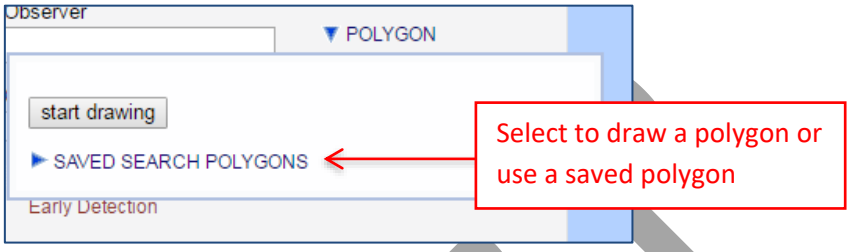
## 2.0 Preparing Mobile Device for Field

Prior to conducting field surveys Data Czars should follow these steps to prepare projects for field staff:

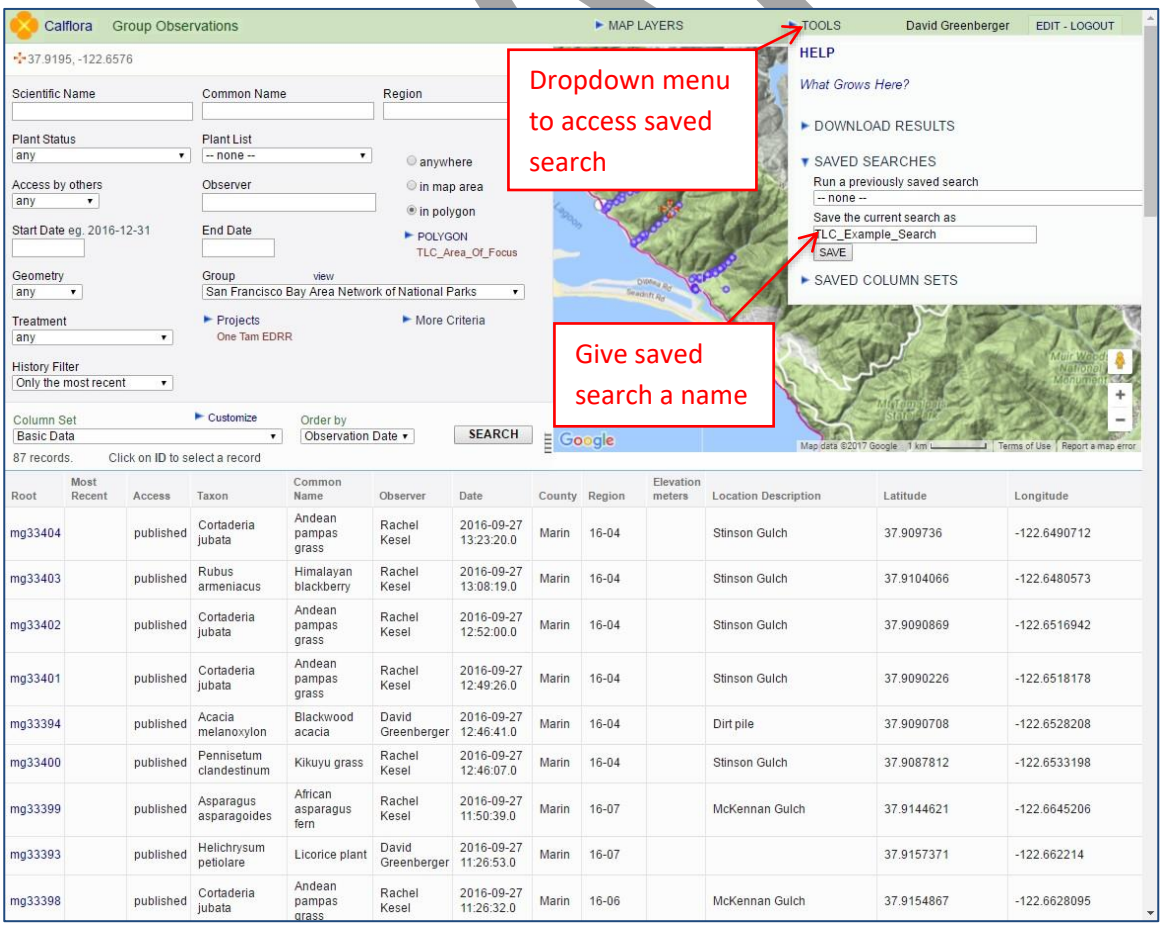
1. Navigate to the Group Observations application (https://www.calflora.org/entry/groupobserv.html).
2. Ensure that the following are set:
    a. Group: Choose from "Marin County Parks data pro," "San Francisco Bay Area Network of National Parks," "Marin Municipal Water District," or "Mount Tamalpais State Park"
    b. Project: "One Tam EDRR"



3. Select the area that will be surveyed using one of the following options:
    a. Option 1: Draw a polygon around the area – Select Polygon, then "Start Drawing."
    b. Option 2: Select a saved search polygon (e.g. Region/Subwatershed/One Tam area of focus) – Select Polygon, then "Saved Search Polygons," then select the desired polygon.
    c. Option 3: Find and zoom to the area of interest in the map window, and select search "in map area"



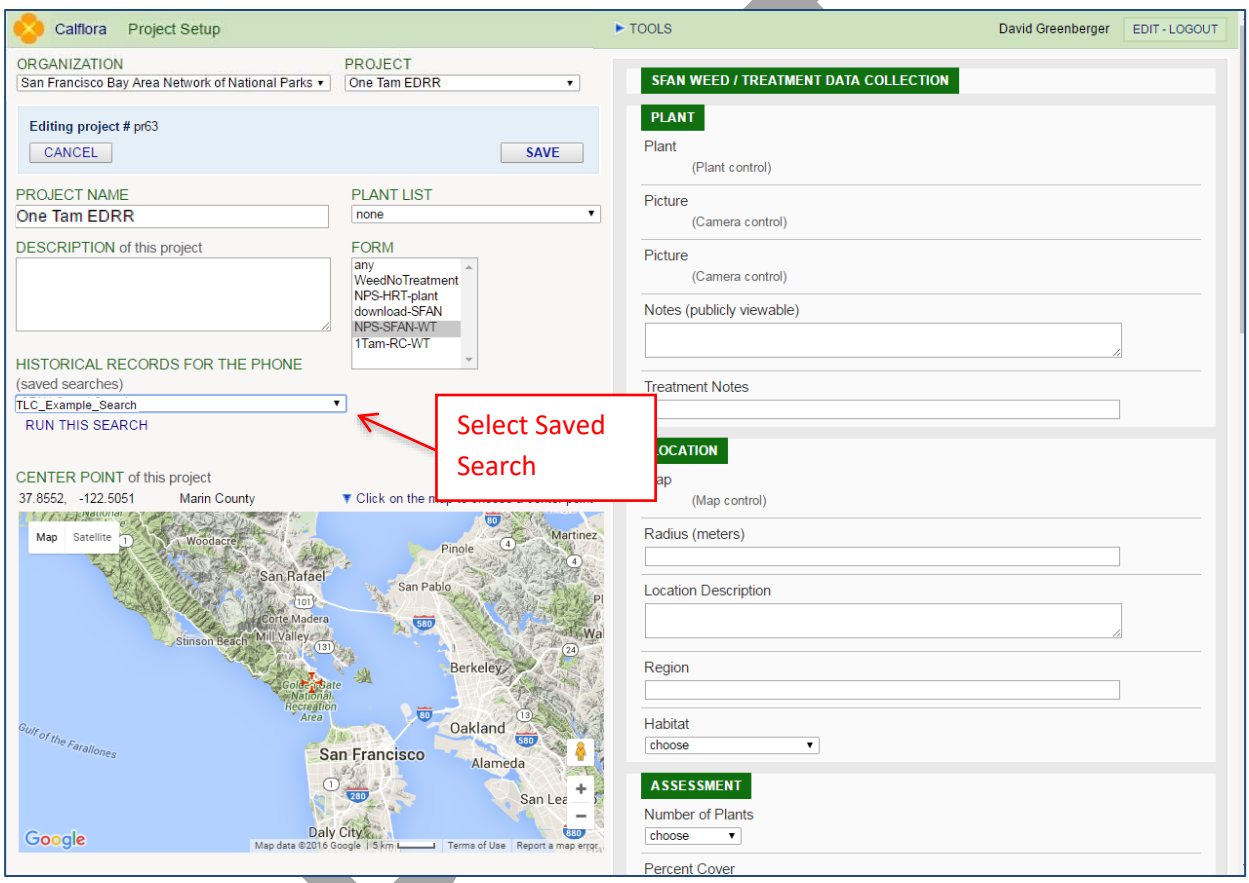

4. Under the History Filter dropdown, select "Only the most recent"
5. Click the Search button
6. Select Tools from the top menu, then select the Saved Search dropdown and enter a name for your new saved search using the standard naming convention (e.g. TLC_Ridgecrest; see Naming Conventions section below), and click Save.




| Root | Most Recent | Access | Taxon | Common Name | Observer | Date | County | Region | Elevation meters | Location Description | Latitude | Longitude |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg33404 | | published | Cortaderia jubata | Andean pampas grass | Rachel Kesel | 2016-09-27 13:23:20.0 | Marin | 16-04 | | Stinson Gulch | 37.909736 | -122.6490712 |
| mg33403 | | published | Rubus armeniacus | Himalayan blackberry | Rachel Kesel | 2016-09-27 13:08:19.0 | Marin | 16-04 | | Stinson Gulch | 37.9104066 | -122.6480573 |
| mg33402 | | published | Cortaderia jubata | Andean pampas grass | Rachel Kesel | 2016-09-27 12:52:00.0 | Marin | 16-04 | | Stinson Gulch | 37.9090869 | -122.6516942 |
| mg33401 | | published | Cortaderia jubata | Andean pampas grass | Rachel Kesel | 2016-09-27 12:49:26.0 | Marin | 16-04 | | Stinson Gulch | 37.9090226 | -122.6518178 |
| mg33394 | | published | Acacia melanoxylon | Blackwood acacia | David Greenberger | 2016-09-27 12:46:41.0 | Marin | 16-04 | | Dirt pile | 37.9090708 | -122.6528208 |
| mg33400 | | published | Pennisetum clandestinum | Kikuyu grass | Rachel Kesel | 2016-09-27 12:46:07.0 | Marin | 16-04 | | Stinson Gulch | 37.9087812 | -122.6533198 |
| mg33399 | | published | Asparagus asparagoides | African asparagus fern | Rachel Kesel | 2016-09-27 11:50:39.0 | Marin | 16-07 | | McKennan Gulch | 37.9144621 | -122.6645206 |
| mg33393 | | published | Helichrysum petiolare | Licorice plant | David Greenberger | 2016-09-27 11:26:53.0 | Marin | 16-07 | | | 37.9157371 | -122.662214 |
| mg33398 | | published | Cortaderia jubata | Andean pampas grass | Rachel Kesel | 2016-09-27 11:26:32.0 | Marin | 16-06 | | McKennan Gulch | 37.9154867 | -122.6628095 |

7. Navigate to the Project Setup application (http://www.calflora.org/entry/projectedit.html)
8. Ensure the Organization and Project are properly set.


9. Under the "Historical Records For The Phone" drop-down menu, select the Saved Search you created in Step 5.




10. Click Save.

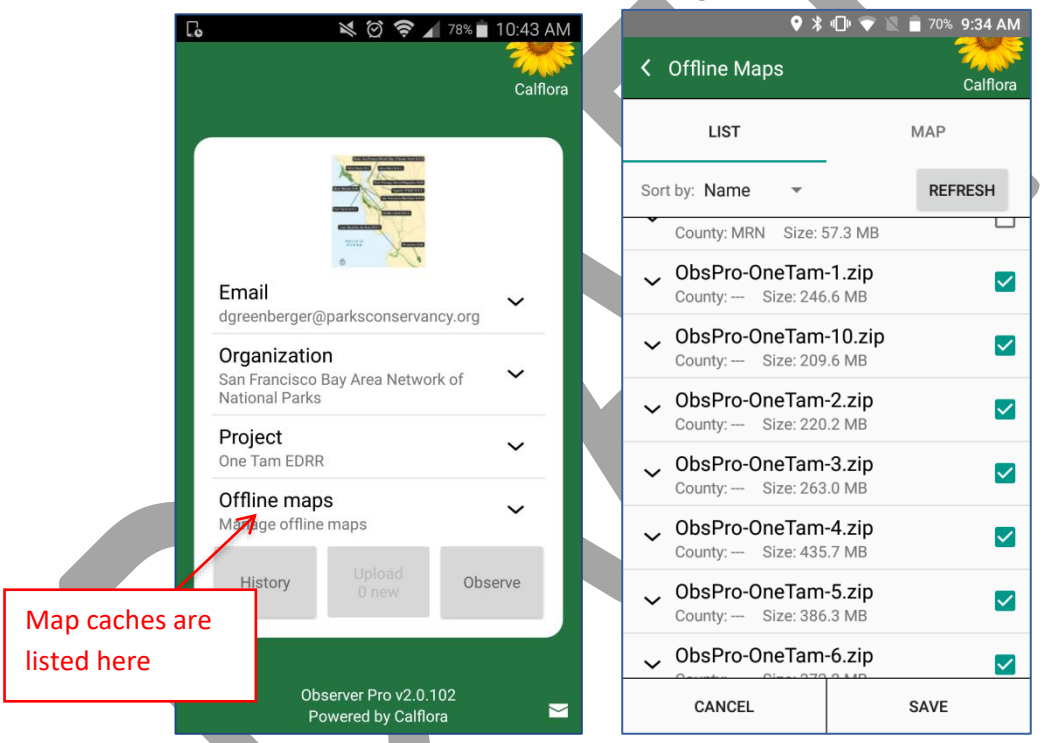
Note: Saved Shapes and Saved Searches created only for updating records on the phone should be added to the Saved Shapes and Searches tab of the Fieldwork spreadsheet on Google Drive. This tab keeps track of items that serve only a temporary purpose and that can be deleted at the end of the season. If a shape serves an additional purpose, such as also being a Survey Entry polygon, do not add it to the spreadsheet.

*All Calflora permission levels can execute the following steps.*

11. Connect the mobile device to Wi-Fi and open Observer Pro.

**Note that imagery and zoom levels can only be set while connected to Wi-Fi.**

12. Make sure that the proper map caches are active. Map caches are zoomable sets of aerial imagery stored locally on each device that can be viewed and referenced in the field when Wi-Fi isn't available. As of 2019, there are 10 map caches covering the entire public land extent of the Area of Focus, plus Samuel P. Taylor State Park.
13. Tap the Offline maps bar to display a list of map caches. The One Tam files are named thusly: ObsPro-OneTam-1.zip, ObsPro-OneTam-2.zip, etc. All 10 should be selected. A map of the cache polygons is shown in Figure 8 on page 71.




14. Any use of the other caches in the offline map list will require a subsequent refresh (by tapping the Email bar) before the changes are active. Since those maps are stored on the internet, this action must be done with Wi-Fi service in order to download the cache files. This can take a long time, and it is not recommended.

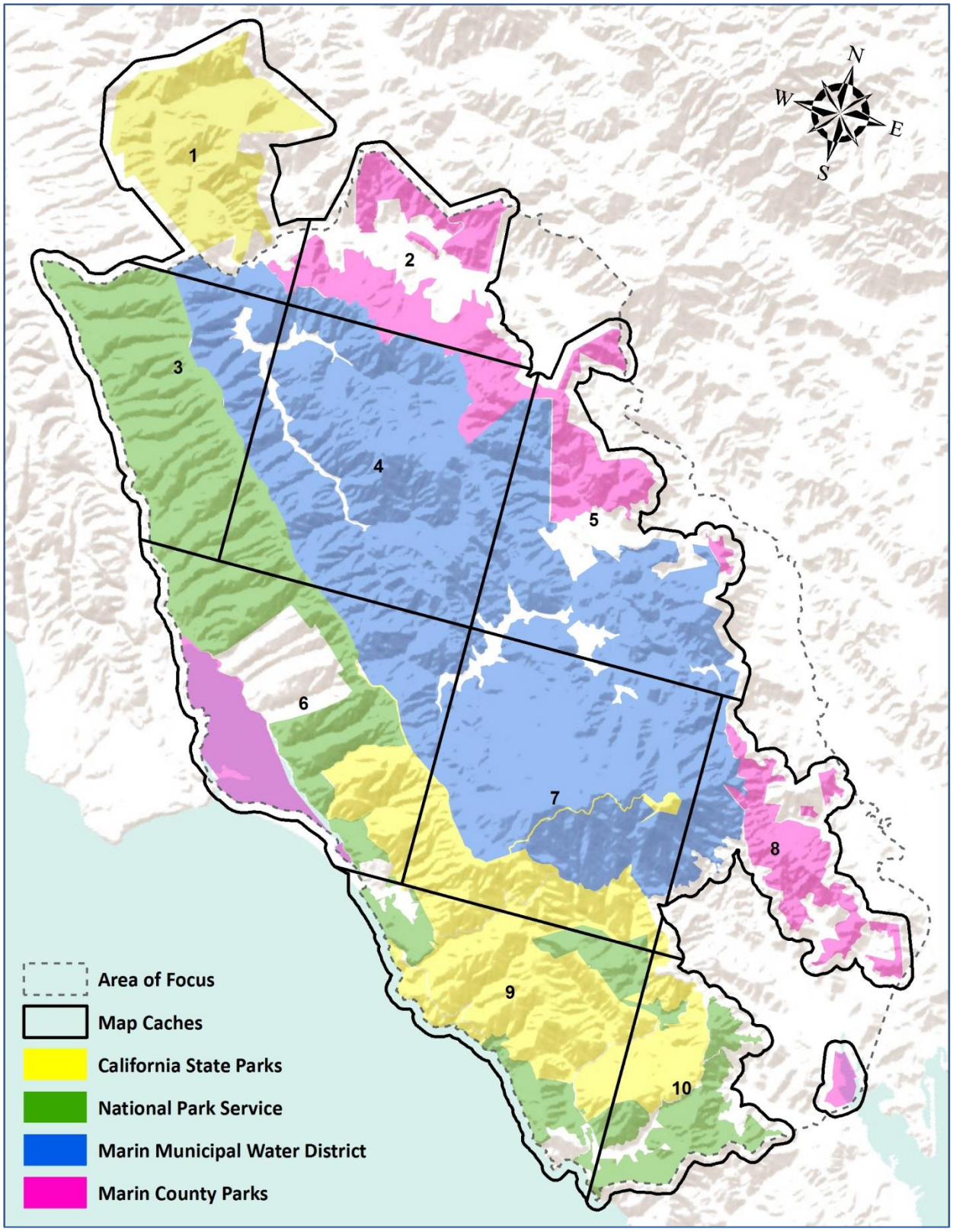
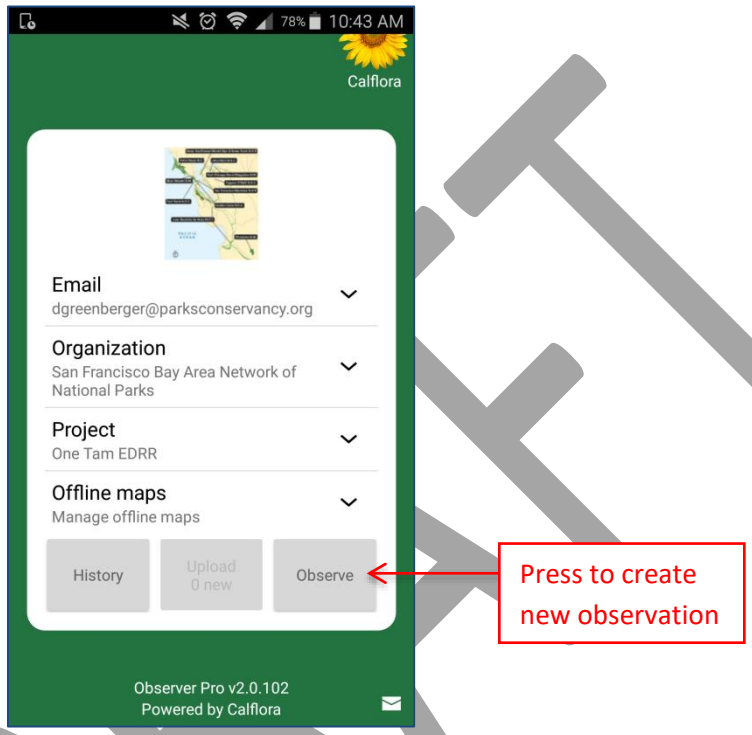



**Figure 8:** Offline map caches in the One Tam Area of Focus.

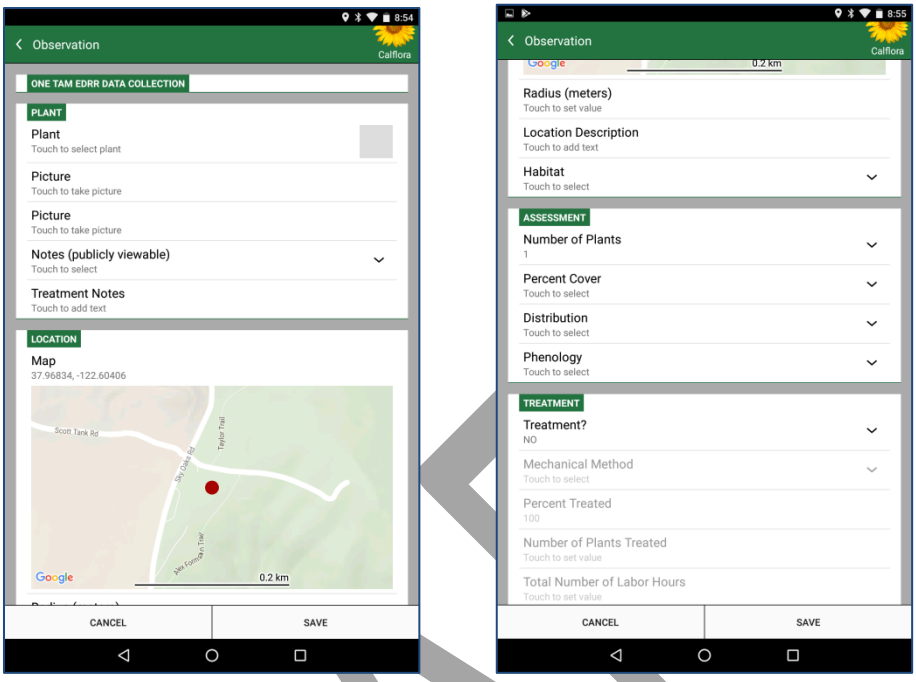
## 3.0 Collecting Data in the Field

1. Upon arriving at a weed patch, determine if the patch was observed in the past. If not previously recorded, create a new observation or "occurrence" (Step 2). If it was previously recorded, add a "NEW ASSESSMENT" (Step 6).
2. To create a new observation, press "Observe" on the Observer Pro home screen.

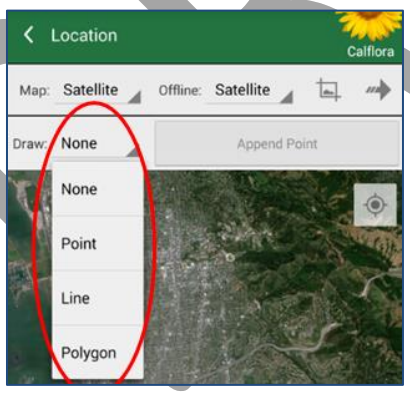



3. Take a photo…
    a. Always for Priority 1 species.
    b. Always for MMWD and MCP.
    c. For NPS and CDPR, a photo is only otherwise require if the plant ID is unknown, of low confidence, new to the park, would aid in relocating the patch, or is otherwise notable.

4. Depending on the priority rank of the species and the size of the patch; fill out relevant information.

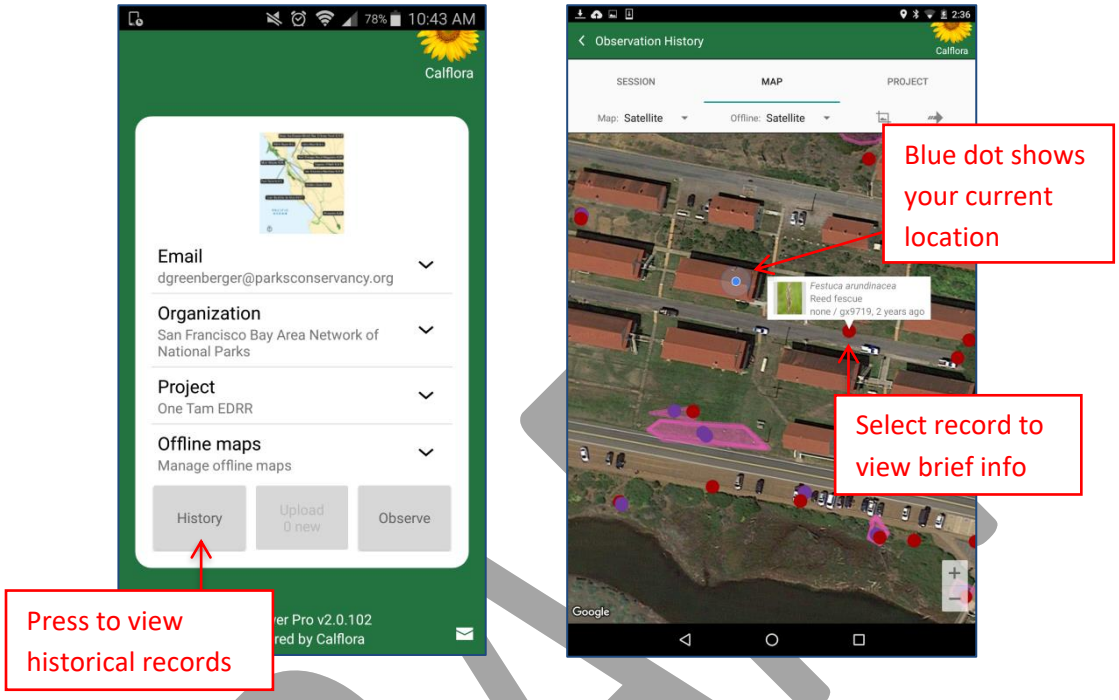



a. To draw a polygon, click on the map in the Location section
b. Press the "Draw" dropdown and select point, polygon or circle to start creating your feature




i. Polygons
   - Click append point to draw a vertex of the polygon at your present location
   - Walk the perimeter of the patch and map by dropping points, OR create polygon vertices by holding a finger on the map where you want the vertex
   - Vertices can be dragged across the map using a long press and dragging your finger or stylus.

5. Press Save
6. To assess a previously observed patch, press the “History” button on the Observer Pro home screen and touch the “MAP” tab.




7. Tap an observation to view more information and ensure it is the observation you wish to add an assessment to.
8. Press the “NEW ASSESSMENT” button
9. Follow steps 3-5 listed above and update relevant information. Save.
10. The location of new records will appear on the History Map as pale red pins. Newly entered records can also be viewed and edited in table form from the “SESSION” tab.

## 4.0 Uploading Data

Data collected in the field using Observer Pro is only stored on the mobile device until data is synced to Weed Manager. Ensure data are uploaded at the end of each field day.

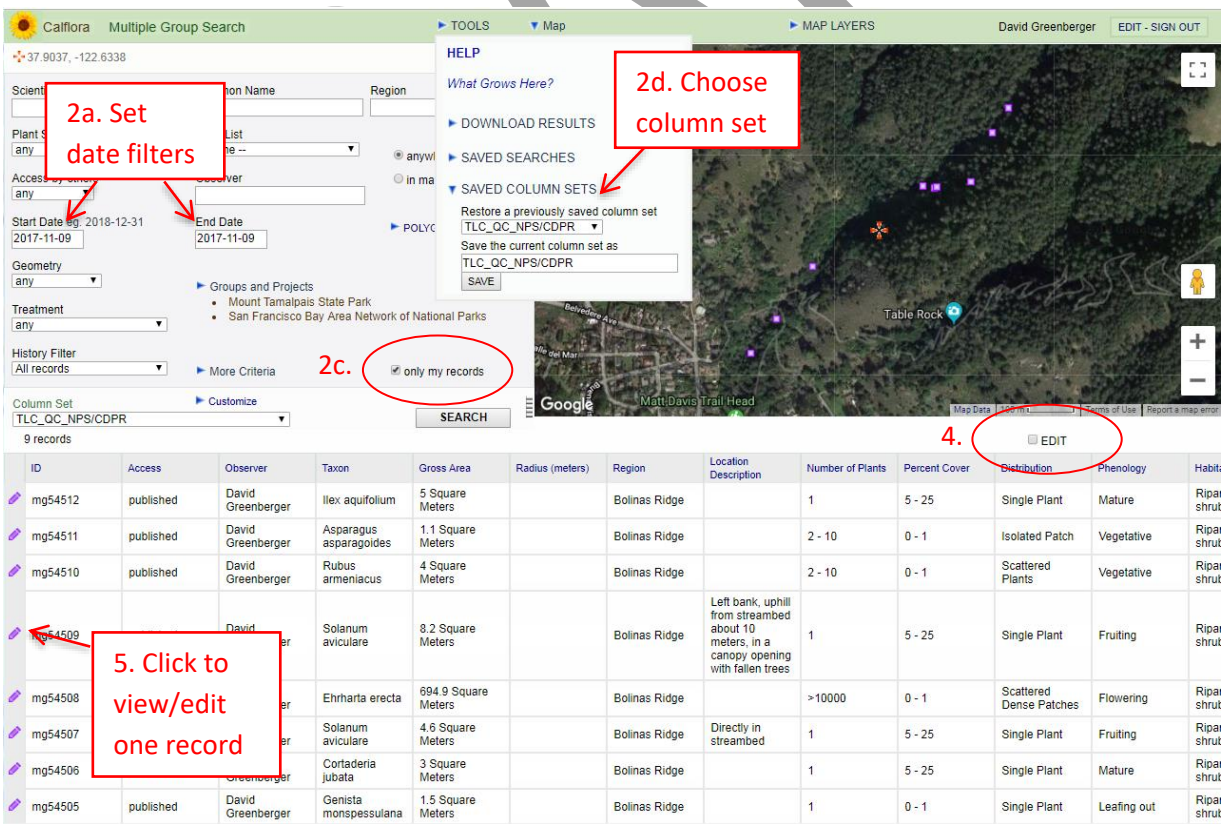
1. Connect mobile device to a Wi-Fi connection.
2. On the Observer Pro home screen, press the “Upload” button.

# 5.0 Editing Data in the Office

After collecting field data, records should be reviewed in Weed Manager to ensure accuracy.

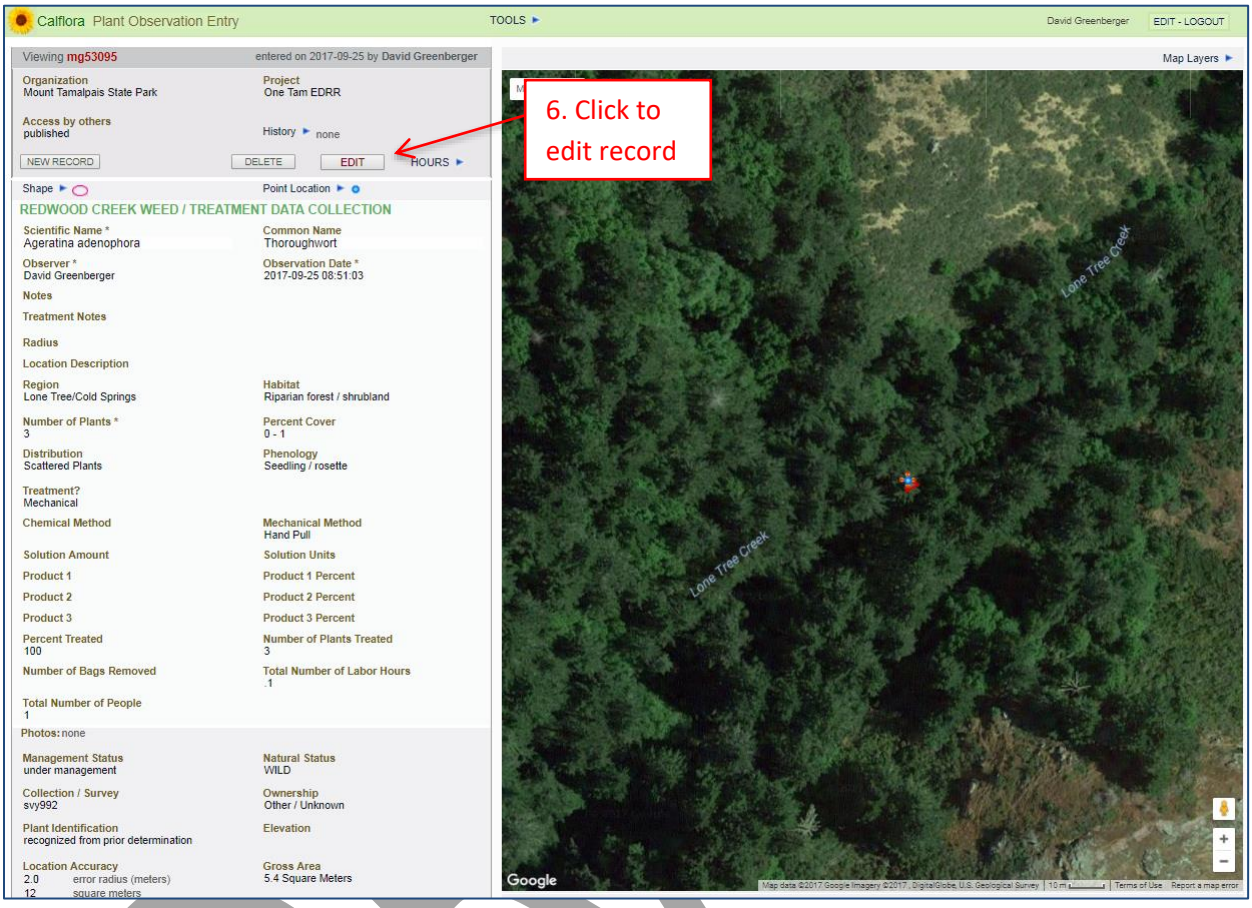
## 5.1 Quality Control (QC)

1. Navigate to the Multiple Group Search tool (https://www.calflora.org/entry/mgo.html).
2. Adjust the various search filters and options.
    a. Ensure the Group is set to the correct agency or agencies, and Project is set to One Tam EDRR. Do one agency at a time, because each agency's form is different (exception: NPS and CDPR have the same form and can be QCed simultaneously).
    b. Restrict the search to a specific date or date range.
    c. Check the "only my records" box.
    d. Using the TOOLS drop-down above the map, select the custom Column Set that matches the Group: TLC_QC_**MMWD**, TLC_QC_**MCP**, or TLC_QC_**NPS/CDPR**. This will ensure that the pertinent fields for each form are displayed.
3. Press Search.
4. Click the checkbox next to EDIT in order to activate real-time table editing. This allows a user to directly click into any field in the search result list and edit the value. After logging a change, a floating box will appear asking whether to save changes. Be sure to save!




| ID | Access | Observer | Taxon | Gross Area | Radius (meters) | Region | Location Description | Number of Plants | Percent Cover | Distribution | Phenology |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mg54512 | published | David Greenberger | Ilex aquifolium | 5 Square Meters | | Bolinas Ridge | | 1 | 5 - 25 | Single Plant | Mature |
| mg54511 | published | David Greenberger | Asparagus asparagoides | 1.1 Square Meters | | Bolinas Ridge | | 2 - 10 | 0 - 1 | Isolated Patch | Vegetative |
| mg54510 | published | David Greenberger | Rubus armeniacus | 4 Square Meters | | Bolinas Ridge | | 2 - 10 | 0 - 1 | Scattered Plants | Vegetative |
| mg54509 | | David | Solanum aviculare | 8.2 Square Meters | | Bolinas Ridge | Left bank, uphill from streambed about 10 meters, in a canopy opening with fallen trees | 1 | 5 - 25 | Single Plant | Fruiting |
| mg54508 | | | Ehrharta erecta | 694.9 Square Meters | | Bolinas Ridge | | >10000 | 0 - 1 | Scattered Dense Patches | Flowering |
| mg54507 | | | Solanum aviculare | 4.6 Square Meters | | Bolinas Ridge | Directly in streambed | 1 | 5 - 25 | Single Plant | Fruiting |
| mg54506 | | | Cortaderia jubata | 3 Square Meters | | Bolinas Ridge | | 1 | 5 - 25 | Single Plant | Mature |
| mg54505 | published | David Greenberger | Genista monspessulana | 1.5 Square Meters | | Bolinas Ridge | | 1 | 0 - 1 | Single Plant | Leafing out |

5. Alternately, one can edit data by clicking into an individual record. This is achieved by clicking the purple marker next to the record ID and then clicking Editor.
6. In Plant Observation Entry, click the "Edit" button to begin editing.




7. Make edits to the record
   a. **Region:** This field, which is not accessible while using Observer Pro, auto-populates with the name of a geographical unit. Each agency has its own geographical units – NPS uses subwatersheds, CDPR and MMWD use their own set of polygons called quads and vegetation management units (VMUs) respectively, and MCP uses preserves. If this field is blank you will need to populate it.

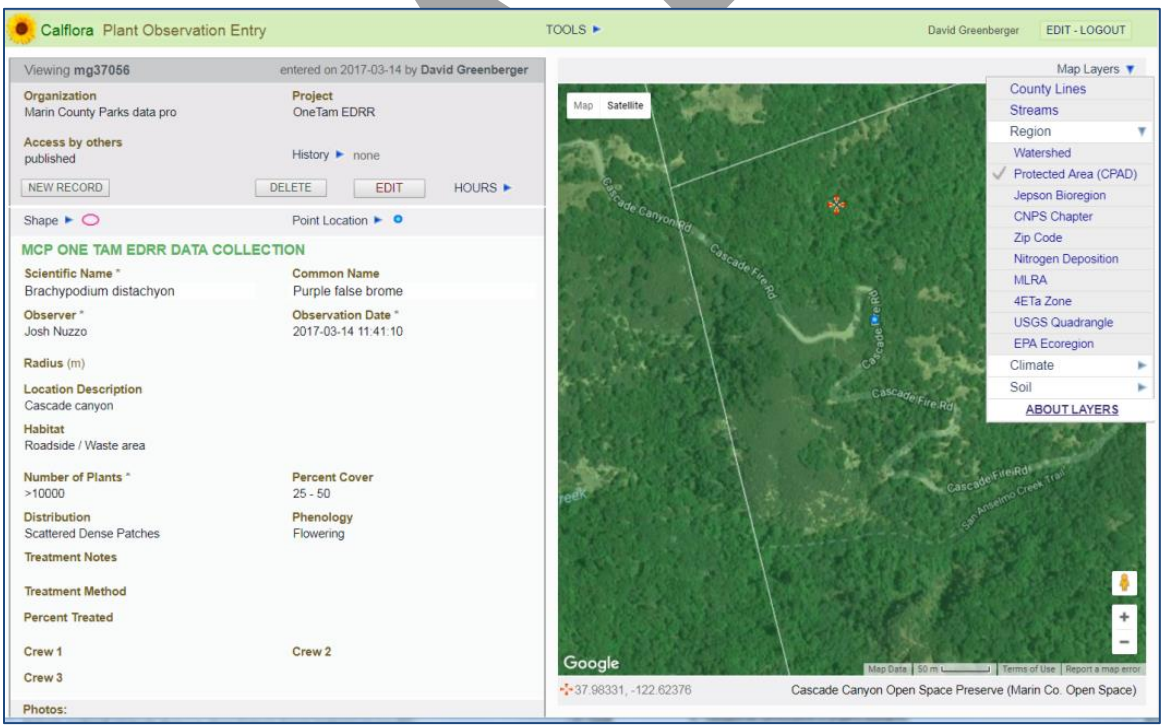
      This can happen if data was taken while in the wrong group, if the GPS fix isn't totally accurate, or if the property boundary layers provided by the agencies to Calflora are not topologically correct. Region maps are available in Figures 9 through 19 below.

8. After correcting any errors, publish the data.
   a. Unpublished (default) – only accessible within group
   b. Published – accessible to the public
   c. Private – published, but only accessible within the group
      i. Use if record contains sensitive information and for all rare plant data
9. Click the "Save" button.

## 5.2 Correcting Jurisdictions

At times data will be accidentally recorded in the wrong Weed Manager Group while in the field. Some surveys cross jurisdictions multiple times. It's a good practice to check the administrative boundaries of a proposed survey before going out into the field. If unable to ascertain in the field whether the jurisdiction has changed, it's easiest to take the day's data under one group and then correct the records in the office using Weed Manager.

1. While editing an individual record, click on the Map Layers drop-down.
2. This menu contains a multitude of overlays for the map, including agency jurisdiction shapes. These can be displayed by clicking on Region then clicking on Protected Area (CPAD).
3. Different agency land parcels are green with thin white borders. In the example below, three parcels are visible, and the occurrence (blue dot) in question is clearly within one of them.
4. Click the mouse anywhere within a parcel (shown here as an orange target cursor) and its name will display below the map. The occurrence here is within Cascade Canyon Open Space Preserve, so the user can be confident that the choice of "Marin County Parks data pro" is correct for the Organization field.




5. It may also be helpful to exercise this step during the creation of a Survey Entry (Section 8). That way, all observations within a survey can be compared with jurisdictional lines at once.

## 5.3 Recording a new occurrence retroactively in POE

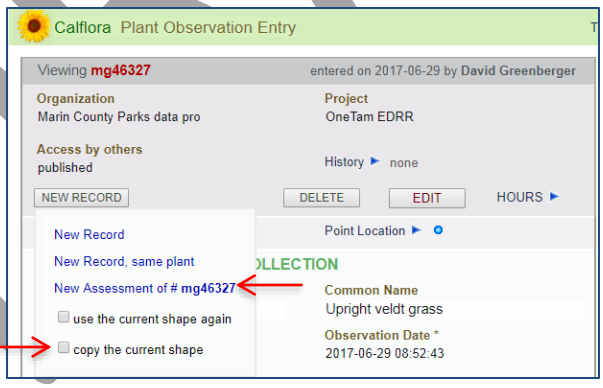
Every effort should be made to collect all necessary data while on site in the field. However, there are occasions where it's impossible to do so (device runs out of batteries) or someone simply doesn't remember. There are ways to enter records retroactively using Plant Observation Entry (POE).

1. From the Calflora home page, navigate to "Add Observations" in the left-hand column. Then click "Plant Observation Entry" under Quick Links.
2. Click "New Record."
3. Select the appropriate Organization and Project – this will automatically load the associated form. Fill out all the salient fields just as you would using Observer Pro, and draw a polygon using Shape -> *start drawing*. Be sure to click *stop drawing* after!
4. Be aware, some fields that auto-populate when using Observer Pro will not auto-populate through POE. Region is one such field.
5. Save.
6. Run any retroactive observations through the QC protocol described above to make sure nothing is missing.

## 5.4 Recording a new assessment retroactively in POE

To enter a new assessment for an existing record using POE, follow these steps.

1. Locate and open the record in question.
2. Click the NEW RECORD button, which will unfold a small menu.




3. Click the checkbox next to "copy the current shape," then click New Assessment of #xxxxxxx" where #xxxxxx is the record number (#mg46327 in the example above). ***DO NOT*** select the checkbox for "use the current shape again." This option makes it so any edits to the polygon cascade to all other records in the history stack. We want each record to have its own independent shape, and the only way to do that is by using "copy the current shape."
4. Fill out the rest of the form as you normally would.
5. Save.

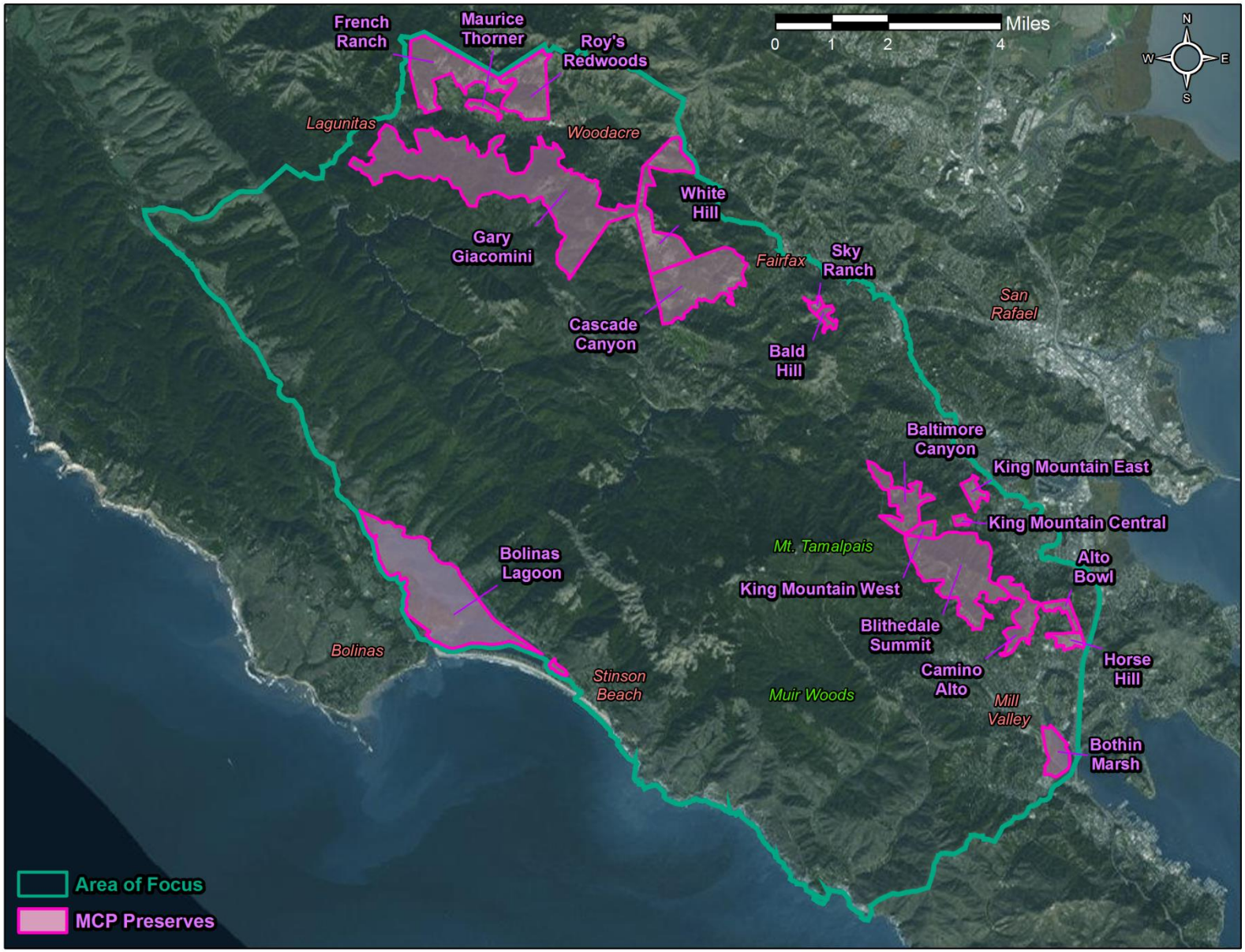



**Figure 9:** Marin County Parks regions map


**Figure 10:** National Park Service regions map


**Figure 11:** California State Parks regions map: Mt. Tamalpais State Park

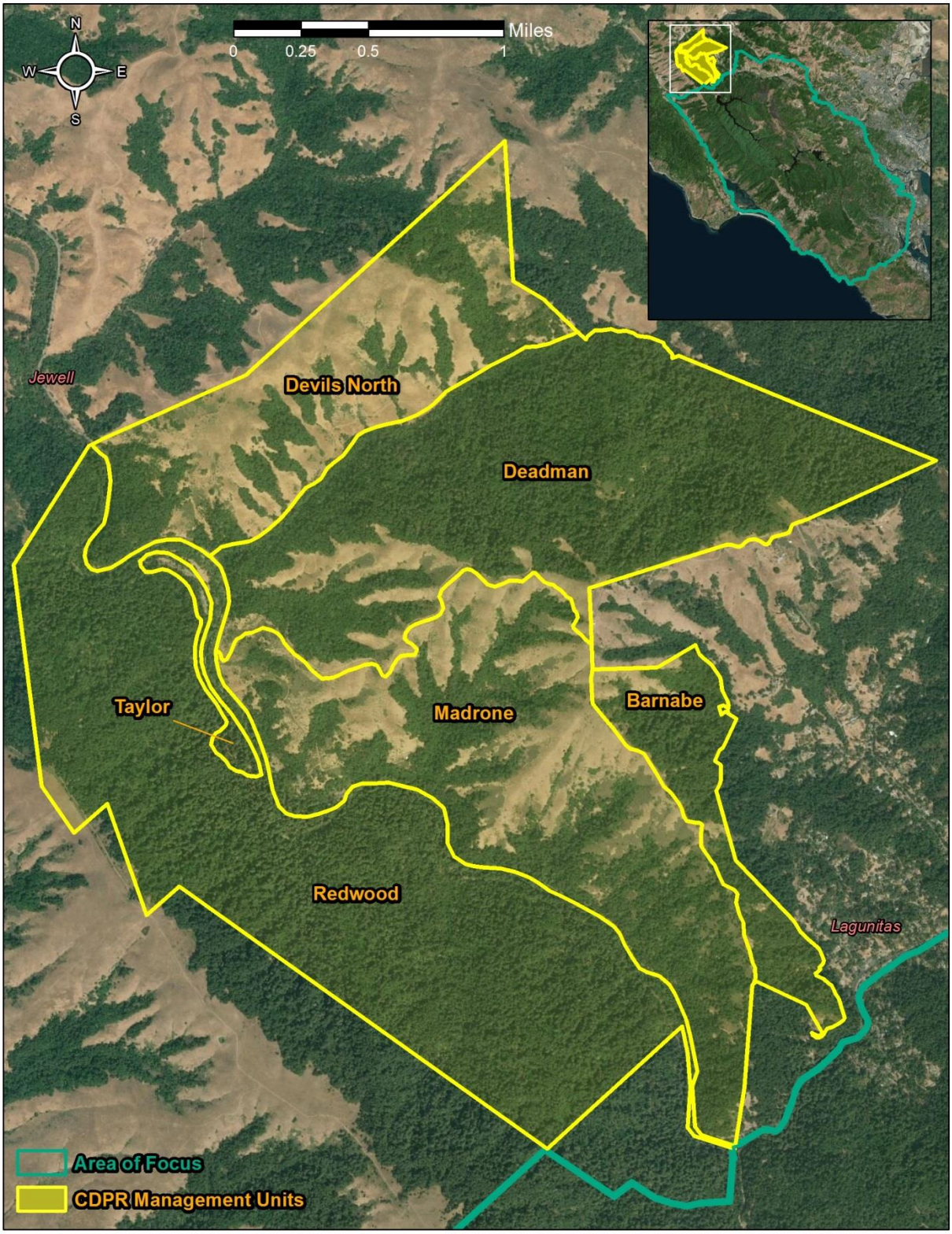



**Figure 12:** California State Parks regions map: Samuel P. Taylor State Park

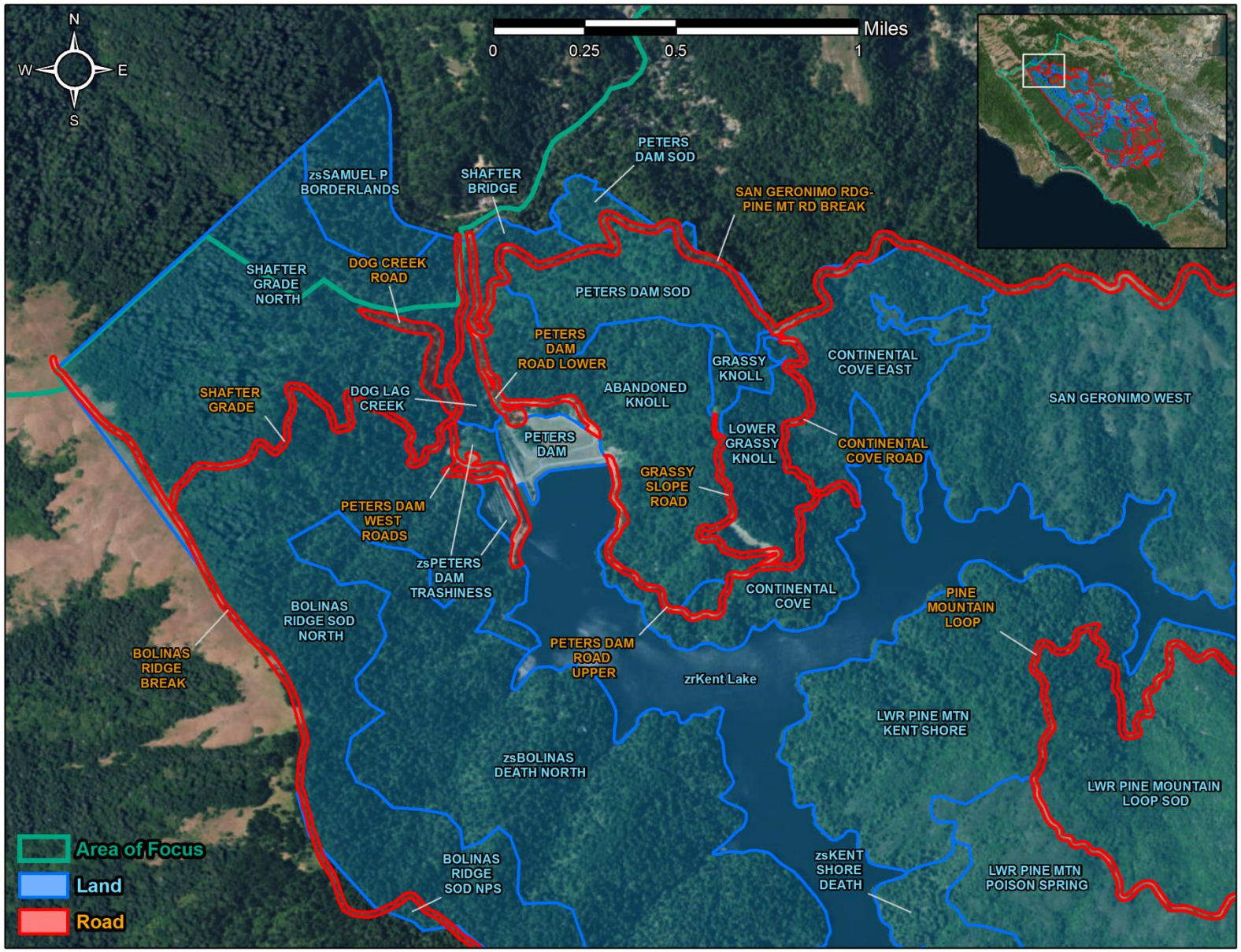



**Figure 13:** Marin Municipal Water District regions map: Northwest

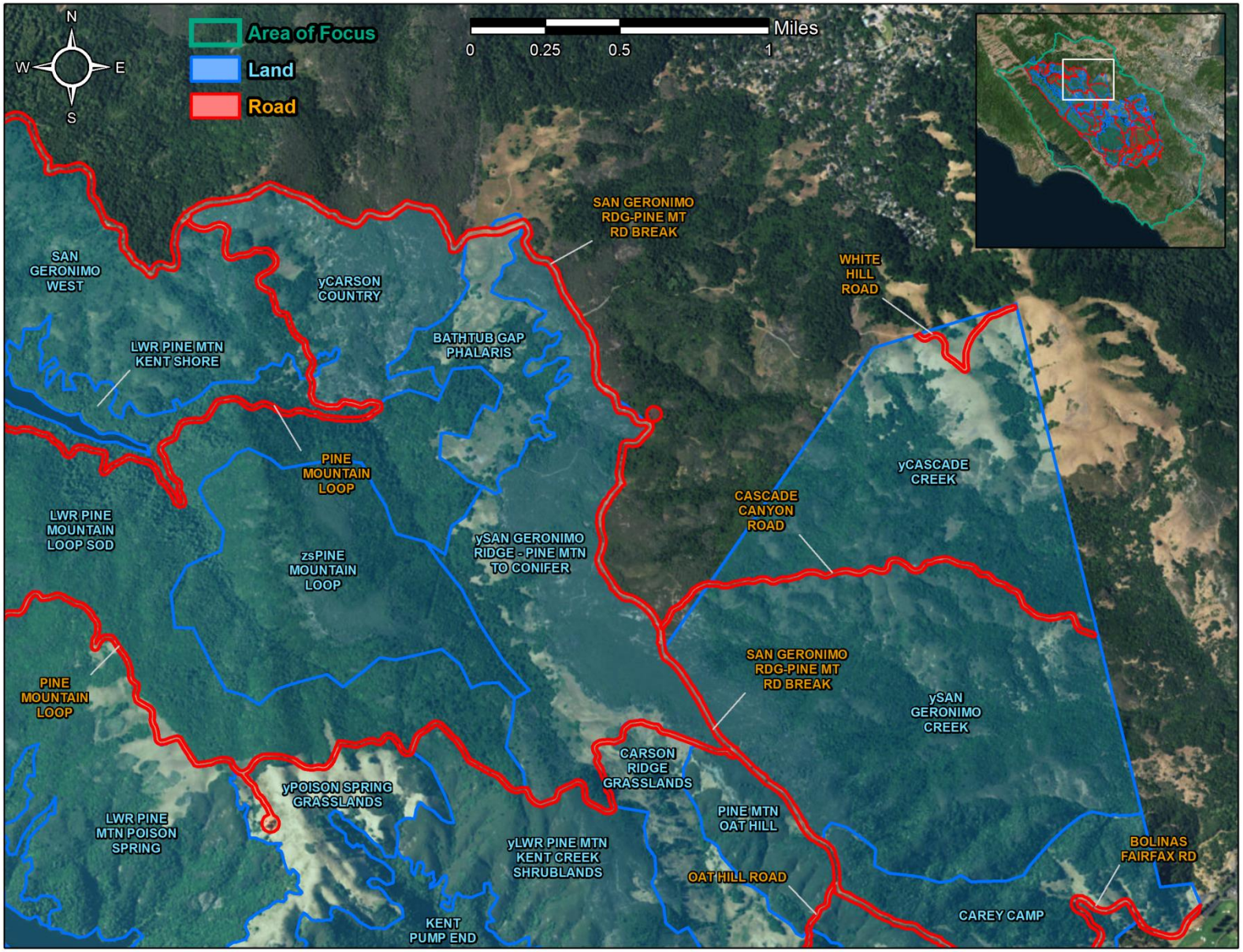



**Figure 14:** Marin Municipal Water District regions map: North

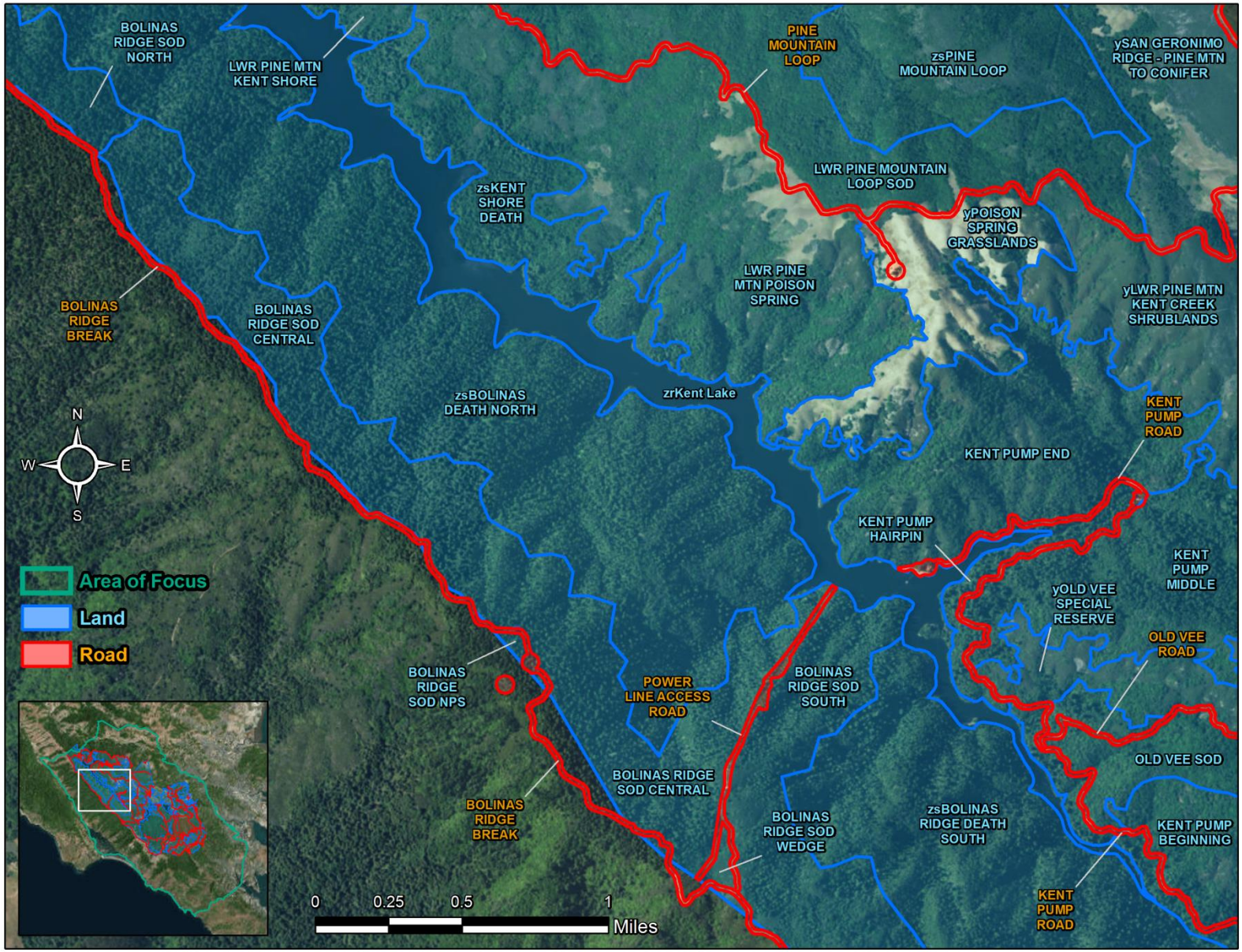



**Figure 15:** Marin Municipal Water District regions map: West


**Figure 16:** Marin Municipal Water District regions map: Central


**Figure 17:** Marin Municipal Water District regions map: East

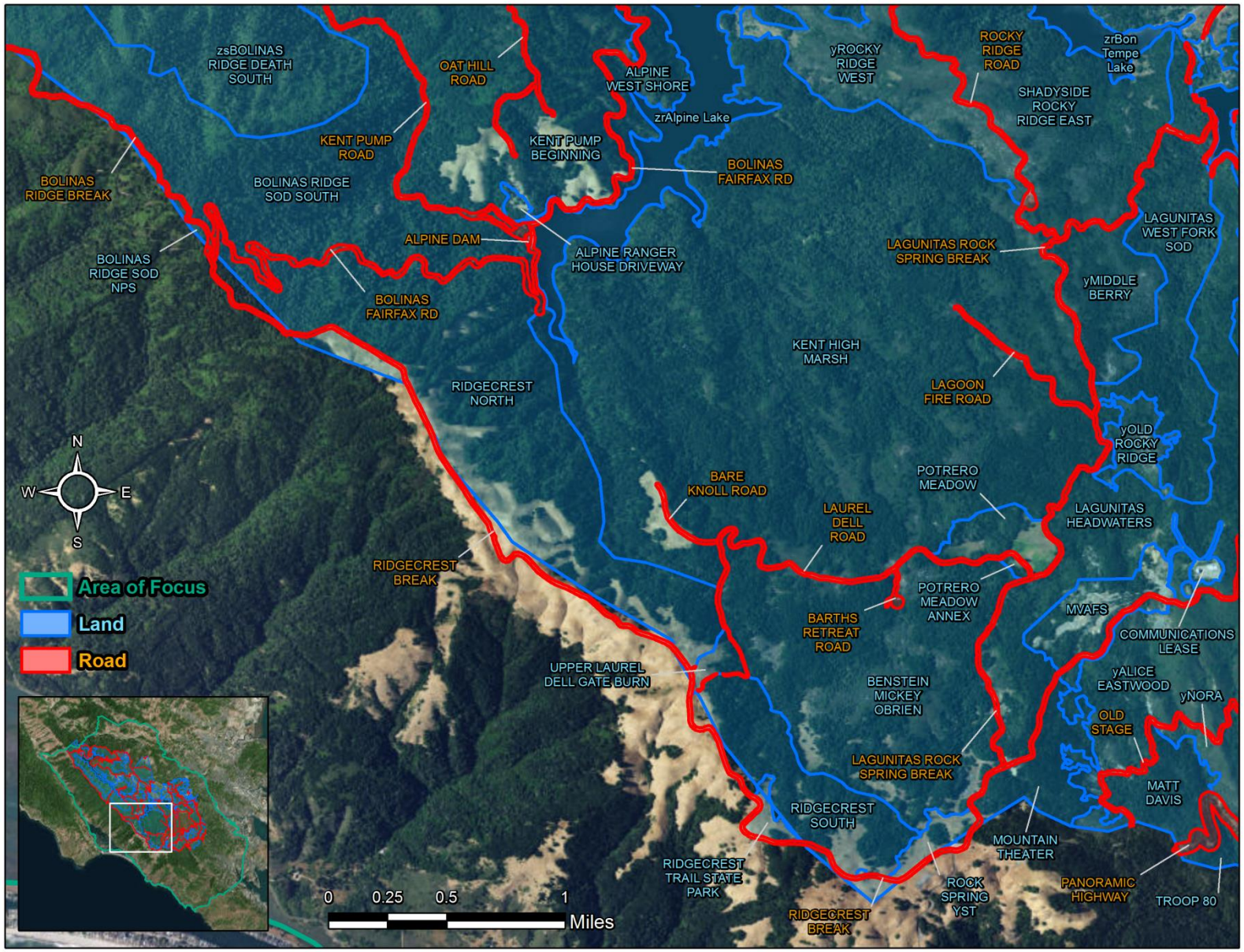



**Figure 18:** Marin Municipal Water District regions map: Southwest

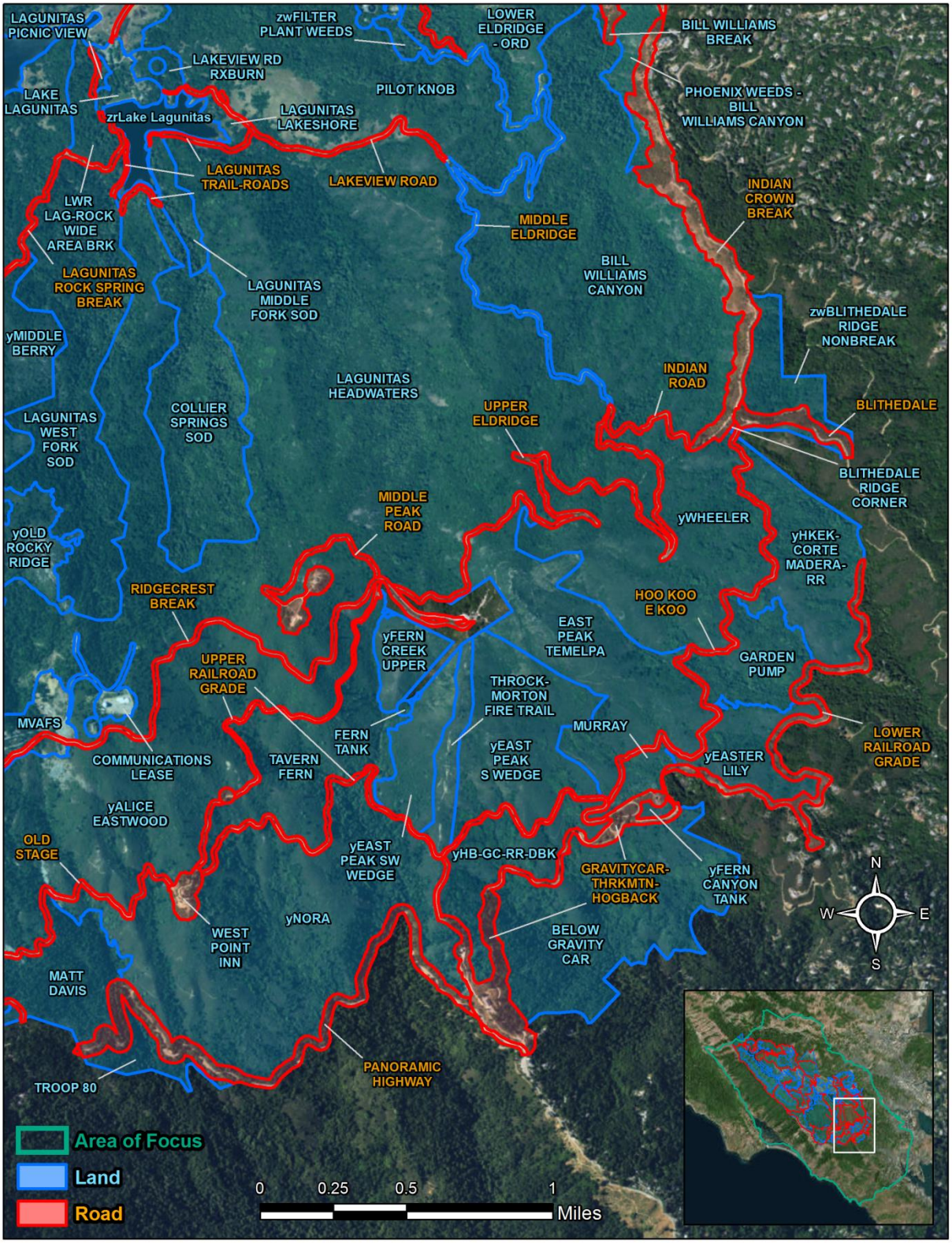



**Figure 19:** Marin Municipal Water District regions map: Southeast

## 6.0 Batch Editing Data

Multiple records may be edited in batch, but only by the owner of the records, Data Czars, or Group Owners. This functionality should be used with caution as it overwrites values in the database and cannot be undone.

For Group Members to batch edit their own data, they must navigate to their records through My Observations. Data Czars and Group Owners can batch edit using Group Observations as well.

1. In My Observations, Navigate to Tools (upper right), then click "Batch Edit."
2. In the Multiple Record Editor tool, enter in values that need to be modified in batch.

Currently, the following fields can be modified in batch by Data Czars:

- Access by other users
- Scientific Name
- Management Status
- Observation Date
- New Owner (user #)
- Source
- Observer
- National Ownership
- Collection/Survey
- Region
- Organization
- Project
- Gross Area
- Infested Area

A subset of these is available to Group Members.

Note that batch editing the New Owner field modifies the User # field in the data output, but leaves the Observer field intact.

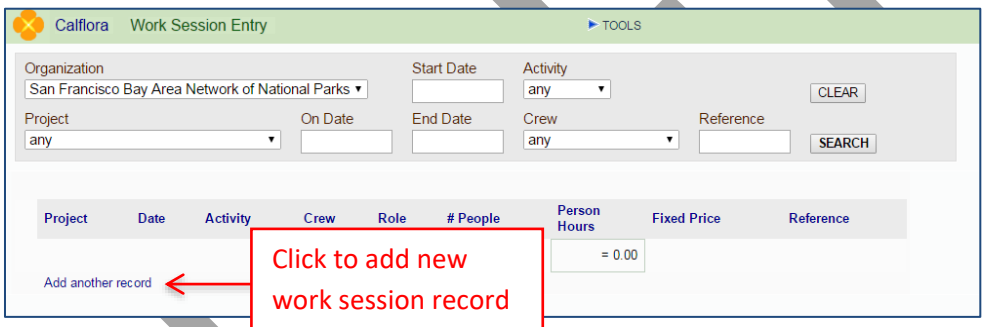
## 7.0 Entering Work Session Data

A work session record should be entered into Weed Manager for each field day. Currently this is only accessible to Data Czars and Group Owners.

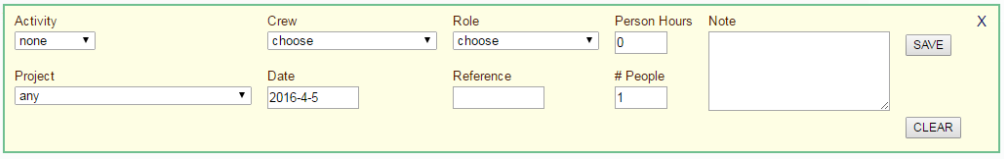
**Table 6.** Guide to options for tracking time in Calflora.

| Application | Best Use for Time Keeping |
|---|---|
| Observer Pro Form | EDRR Surveys |
| Hour and Herbicide Distributor | Big contractor days where you treat many (previously mapped) polygons |
| Plant Observation Entry HOURS drop down | Updating a few records if you forgot to take data in the field |
| Work Session Entry Reference record | Day-long treatments of a few large patches |

1. Navigate to the Work Session application (https://www.calflora.org/entry/sentry2.html)
2. Click "Add another record"




3. Fill in work session entry data
   a. Select Surveying, Treatment, or Other from the Activity dropdown.
   b. For Project, enter "One Tam EDRR"
   c. Crew members from the Crew drop-down and enter their role in the Role drop-down.
   d. Enter survey area and other important information for the survey in the Notes field.




   e. Person-hours should be entered as decimal hours. Use the time tracking table below as a guide for tracking travel time and data management tasks.
      i. Only Person Hours contributes to time data. # of People is not used in any calculations in any interface in the WM/OP system.

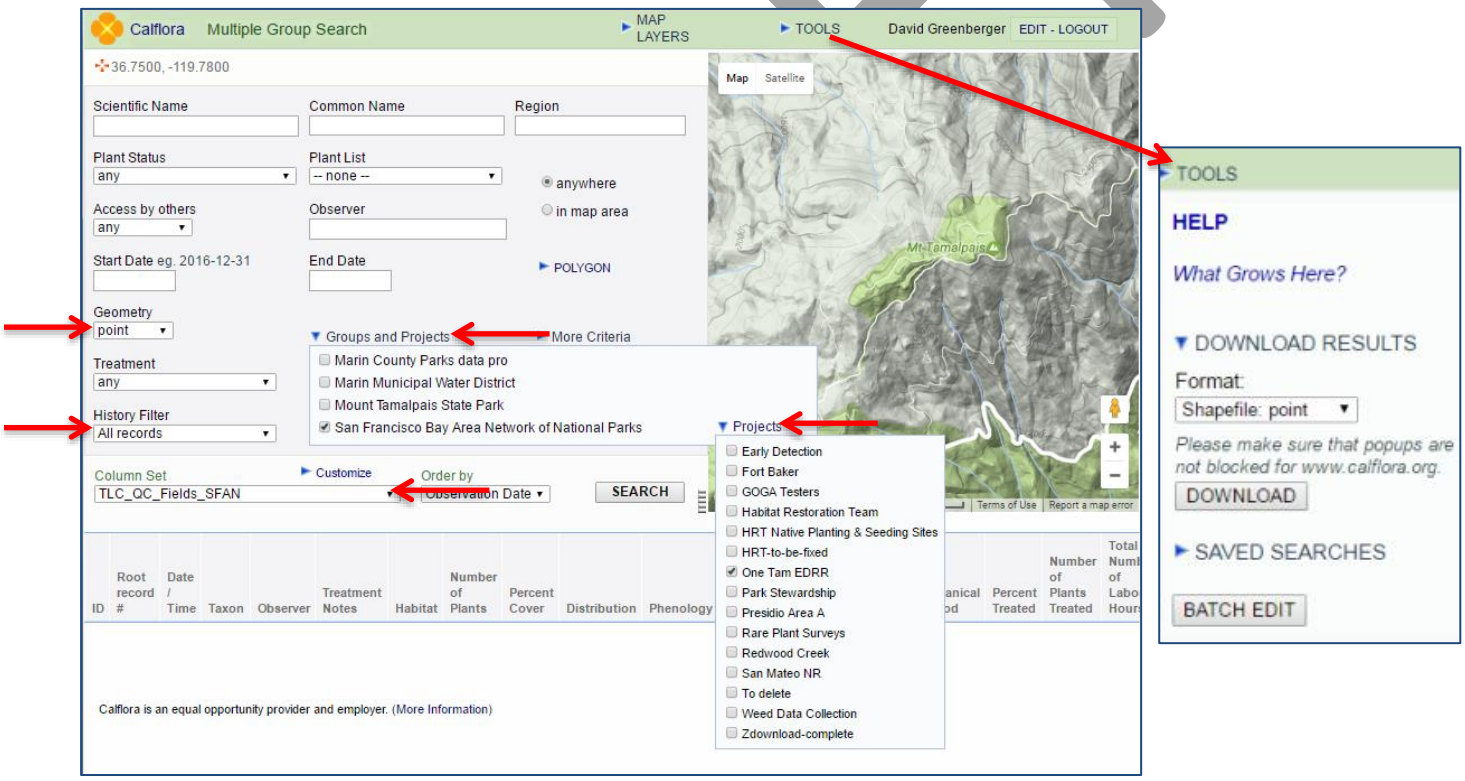
| Task | 1 staff x 2 directions | 2 staff x 2 directions | 4 staff x 2 directions |
|---|---|---|---|
| Drive Time to Baltimore Canyon/Blithedale | .33 | .66 | 1.33 |
| Drive Time to Pantoll area | .66 | 1.33 | 2.66 |
| Drive Time to Ridgecrest | .75 | 3 | 6 |
| Data management/survey | .5 | 1 | 2 |

f. Review treatment records in Group Observations.
   i. Subtract treatment time from total field time.
   ii. Enter difference as “data collection” time

## 8.0 Exporting Data

To review, analyze, and archive data it may be necessary to export data from Weed Manager. Follow the steps below to get data out of Weed Manager.

1. Navigate to Group Observations or Multiple Group Search in Weed Manager (https://www.calflora.org/entry/mgo.html)
2. Ensure desired filters are set properly. To download all One Tam Early Detection data, set **Groups** appropriately. Set **Projects** to “One Tam EDRR” and make sure **History Filter** is set to “All records.” Set **Geometry Type** to “Point” then download using step 3 below. When finished set **Geometry Type** to Polygon and repeat step 3. Use the **Column Set** “TLC_QC_[agency name]” setting (under the **TOOLS** drop-down) to ensure all desired fields are exported and click Search.




3. On the top of the screen, click the **TOOLS** menu, then **Download Results**, then select the desired format for download (point shapefile for point geometry (shown); polygon shapefile for polygon geometry), and click Download. You may also download Excel or CSV formats if you are doing tabular analysis.

# 9.0 Weed Manager List Management

Multiple agencies and programs share the "San Francisco Bay Area Network of Parks" organization with One Tam Early Detection to collect data. To help ensure the system lists (i.e. Members, Projects, Saved Searches, Saved Polygons, and Column Sets) remains manageable and easy to use, despite multiple users and workflows, the following guidelines should be followed.

## 9.1 Members

- **Be mindful of who gets data czar privileges**. Data czars may batch edit records, modify projects, delete projects, etc. Typically only project leads should get data czar privileges, however, on occasion it may be necessary to make a lead field tech a data czar to create saved searches, download historical records to observer pro, etc. At this time, it has been requested that Calflora develop an additional permission level between data czar and data entry to fulfill this need, but may not be developed for some time.
- **Ensure seasonal crew members review data before they leave.** While data czars can batch edit any record within their organization, it is best for the observer to review their own records as they are most familiar with the information they collected.
    - Change the User # field via the Batch Edit tool from seasonal staff to a permanent staff member's User #. This does not change the Observer field but does allow the permanent staff member to edit data going forward.
- **Review members at end of season** or on a regular schedule. Many programs hire seasonal staff or interns. In order to secure data integrity and prevent member lists from becoming unwieldy, it is important for Data Czars to identify inactive members and remove them from the organization.

## 9.2 Naming Conventions

The following naming convention should be used for all saved searches, saved polygons, column sets, and projects:

ProgramCode_BriefDescription

*Program Codes* – 3-4 letter program codes identifying what group the item belongs to (e.g. TLC = Tamalpais Lands Collaborative, HRT = Habitat Restoration Team, FOBA = Fort Baker, etc.). Codes are found in the Weed Manager List google spreadsheet described below.

*Brief Description* – Give a brief description of what the item is. Try to be as concise as possible without losing information.

Examples:

- Saved Search: TLC_Ridgecrest
- Saved Shape: TLC_Area_of_Focus
- Column Set: TLC_QC_MMWD

## 9.3 List Descriptions

Prior to creating a project, saved search, saved polygon, or column set, information about which group the item belongs to, who created it, and a description, should be entered into the Weed Manager Lists google spreadsheet located at:

https://docs.google.com/spreadsheets/d/1RR4UoDFdmRd6Yq9lMTBQbQ1cFGfrj-xJbe2vtSRglq8/edit?usp=sharing

The spreadsheet may also be found via the SFAN Google site:

https://sites.google.com/a/nps.gov/sfan/home/monitoring/invasiveplants



# 13.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | January 2017 | Kesel, R. | Adapted from SFAN protocol | Accommodate collaborative workflows | 1.0 |
| 1.0 | November 2017 | Greenberger, D. | Revised after 2017 field season to add new region maps and Calflora updates. | Incorporation of new Calflora Weed Manager tools. | 1.1 |
| 1.1 | January 2022 | Greenberger, D. | Removed sections on Survey Entry and Hour/Herbicide Distributor tools | Not in use anymore. Archived in prior versions of protocol | 1.2 |

# Appendix 1: One Tam EDRR Plant List
# Version 1.2 (January 2022)

## 1.0 Priority One

| Species | CDFA Rating | Cal-IPC Rating |
|---|---|---|
| *Aegilops triuncialis* | - | High |
| *Ailanthus altissima* | C | Moderate |
| *Albizia lophantha* | - | - |
| *Arctotheca calendula* | A | Moderate |
| *Brachypodium sylvaticum* | - | Moderate |
| *Bromus tectorum* | C | High |
| *Buddleja davidii* | - | Watchlist |
| *Carex pendula* | - | Watchlist |
| *Carthamus lanatus* | B | High |
| *Centaurea calcitrapa* | - | Moderate |
| *Clematis vitalba* | A | Moderate |
| *Cytisus striatus* | B | Moderate |
| *Dittrichia graveolens* | - | Moderate |
| *Dittrichia viscosa* | A | Watchlist |
| *Elymus caput-medusae* | - | High |
| *Fallopia japonica* | A | Moderate |
| *Hypericum grandifolium* | - | Watchlist |
| *Iris pseudacorus* | B | Limited |
| *Maytenus boaria* | - | Watchlist |
| *Sesbania punicea* | - | High |
| *Solanum aviculare* | - | Watchlist |
| *Sorghum halepense* | C | - |
| *Stipa manicata* | - | Limited |
| *Stipa miliacea var. mileacea* | - | Limited |
| *Stipa tenuissima* | - | Watchlist |
| *Ulex europaeus* | - | High |

# 2.0 Priority Two

## 2.1 Third Cycle Target List (2022-24)

| Species | CDFA Rating | Cal-IPC Rating |
|---|---|---|
| *Ageratina adenophora* | - | Moderate |
| *Arctotheca prostrata* | - | Moderate |
| *Calendula arvensis* | - | - |
| *Centaurea solstitialis* | - | High |
| *Cortaderia jubata* | - | High |
| *Cortaderia selloana* | - | High |
| *Delairea odorata* | - | High |
| *Digitalis purpurea* | - | Limited |
| *Ehrharta erecta* | - | Moderate |
| *Euphorbia oblongata* | - | Limited |
| *Festuca arundinacea* | - | Moderate |
| *Foeniculum vulgare* | - | Moderate |
| *Hedera canariensis* | - | High |
| *Hedera helix* | - | High |
| *Helichrysum petiolare* | - | Limited |
| *Hypericum perforatum* | - | Limited |
| *Leucanthemum vulgare* | - | Moderate |
| *Ligustrum lucidum* | - | Limited |
| *Phalaris aquatica* | - | Moderate |
| *Romulea rosea var. australis* | - | Watchlist |
| *Tradescantia fluminensis* | - | - |

## 2.1 Fourth Cycle Target List Additions (2025-27)

| | | |
|---|---|---|
| *Acacia melanoxylon* | - | Limited |
| *Cotoneaster franchetii* | - | Moderate |
| *Cotoneaster lacteus* | - | Moderate |
| *Cotoneaster pannosus* | - | Moderate |
| *Crataegus monogyna* | - | Limited |
| *Cytisus scoparius* | B | High |
| *Dipsacus fullonum* | - | Moderate |
| *Eucalyptus globulus* | - | Limited |
| *Genista monspessulana* | - | High |
| *Ilex aquifolium* | - | Limited |
| *Lathyrus latifolius* | - | - |
| *Pennisetum clandestinum* | - | Limited |
| *Pittosporum crassifolium* | - | - |
| *Pyracantha angustifolia* | - | Limited |
| *Rubus armeniacus* | - | High |
| *Rytidosperma caespitosum* | - | Watchlist |
| *Rytidosperma penicillatum* | - | Limited |
| *Spartium junceum* | - | High |

## 3.0 Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| - | March 2016 | Kesel, R. | One Tam EDRR plant list published | | 1.0 |
| 1.0 | January 2019 | Greenberger, D. | Update P1 list | New species added | 1.1 |
| 1.1 | January 2022 | Greenberger, D. | New species added to P1 list, multiple species delisted from P2 until 2025 | EDRR Subgroup decision | 1.2 |

# Appendix 2: One Tam EDRR Report Priority One Species Accounts Version 1.1 (January 2022)

## Introduction

In 2020, One Tam published a report detailing the distribution and treatment status of target species following the first EDRR cycle. The maps, numbers, and discussions that follow are all based on Priority One species data collected through the 2019 field season. Importantly, the figures for 'Percent Managed' reflect a snapshot in time, and some species have been updated in 2022.

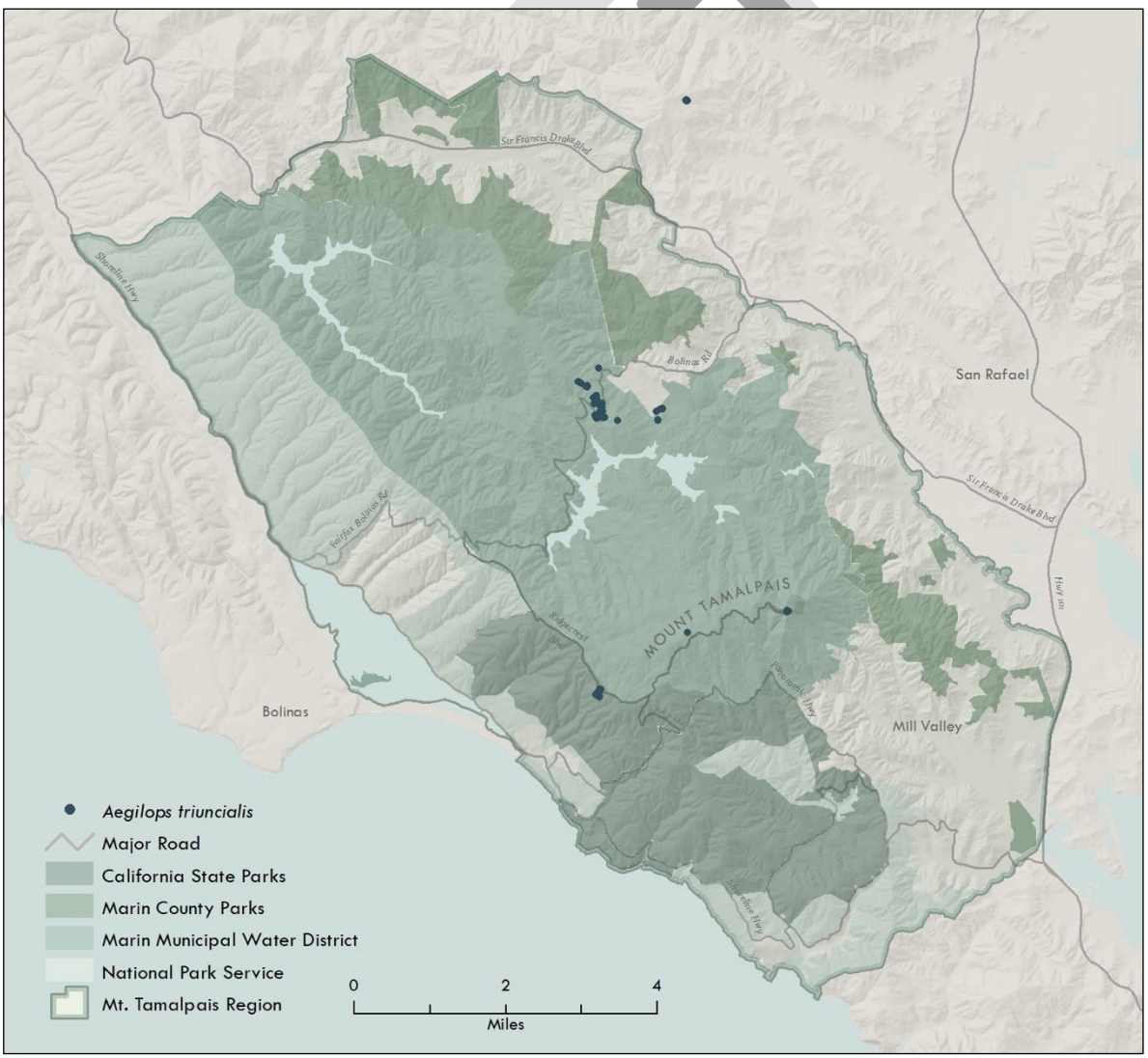
## Table of Contents

# AEGILOPS TRIUNCIALIS

## Family: Poaceae
## Cal-IPC Rating: High

Among the many invasive annual grasses on Mt. Tamalpais, *Aegilops triuncialis* (barbed goatgrass) deserves special consideration for its propensity to invade serpentine soil, including barrens and grasslands that host rare plants. Stiff and rich in silicates, barbed goatgrass also poses challenges to ranchers and private landowners inasmuch as livestock will not eat it, and at times find it injurious.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 41 | 6.25 | 0.14 | 100% |

Barbed goatgrass occurs in several populations from East Peak to Hangglider Point along the mountain's primary ridgeline. The East Peak population has been significantly reduced with treatment. That population is not in prime grassland habitat but is rather in a disturbed area near a parking lot with limited suitable habitat. Additional populations on Carson Ridge and at Bullfrog Quarry (MMWD) are much larger and older. Substantial populations occur north of the Mt. Tamalpais region on public and private land.

All known patches of barbed goatgrass are under management within the Mt. Tamalpais region, however differentiating one annual grass from a sea of other annual grasses is a challenge for treatment crews. Despite significant treatment effort, gross area for this species has remained stable throughout the primary survey period.

# AILANTHUS ALTISSIMA

## Family: Simaroubaceae
## Cal-IPC Rating: Moderate

Intentionally planted around the state as an ornamental, *Ailanthus altissima* (tree-of-heaven) grows quickly, particularly in riparian habitats. This species, which ranges in size from sprawling shrub to stately tree can spread via seed or vegetative growth. A tenacious resprouter when cut, tree-of-heaven is notably challenging to control once established.

### Regional Distribution

Tree-of-heaven is not known to occur on the public lands within the Mt. Tamalpais region.

### Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 0 | 0 | 0 | - |

# ALBIZIA LOPHANTHA

## Family: Fabaceae
## Cal-IPC Rating: Watch

*Albizia lophantha* (stinkbean) can grow in dense stands, especially in moist habitats such as lakeshores or creeksides. With a highly regular growth habit and stiff, hard branches, these patches prove challenging to remove once established. Voluminous production of thick-coated seeds creates a significant seedbank, which necessitates follow-up management once parent trees are removed.

*Paraserianthes lophantha* is a synonym.

### Regional Distribution

Stinkbean is not known to occur on the public lands within the Mt. Tamalpais region.

### Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 0 | 0 | 0 | - |

# ARCTOTHECA CALENDULA

## Family: Asteraceae
## Cal-IPC Rating: Moderate

Like many invasive plants in California, *Arctotheca calendula* (fertile capeweed) is used in horticulture and landscaping. This plant can spread by seed or stolons and can rapidly establish as a mat-forming groundcover.

### Regional Distribution

Fertile capeweed is not known to occur on the public lands within the Mt. Tamalpais region.

### Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 0 | 0 | 0 | - |

Several records in the Calflora Database seemingly indicate the presence of fertile capeweed in Marin County. However, upon inspection, many of these records appear to actually be *A. prostrata* (sterile capeweed). The two taxa were once considered the same species before a taxonomic split was implemented, leaving a residue of confusion in the dataset.

# BRACHYPODIUM SYLVATICUM

## Family: Poaceae
## Cal-IPC Rating: Moderate

In California, *Brachypodium sylvaticum* (slender false brome) is only known in San Mateo and Santa Clara counties, where efforts to eradicate this perennial bunchgrass have faced considerable challenges. One Tam considers slender false brome a watchlist species because suitable habitat exists in the Mt. Tamalpais region.

### Regional Distribution

Slender false brome is not known to occur on the public lands within the Mt. Tamalpais region.

### Occurrence Details

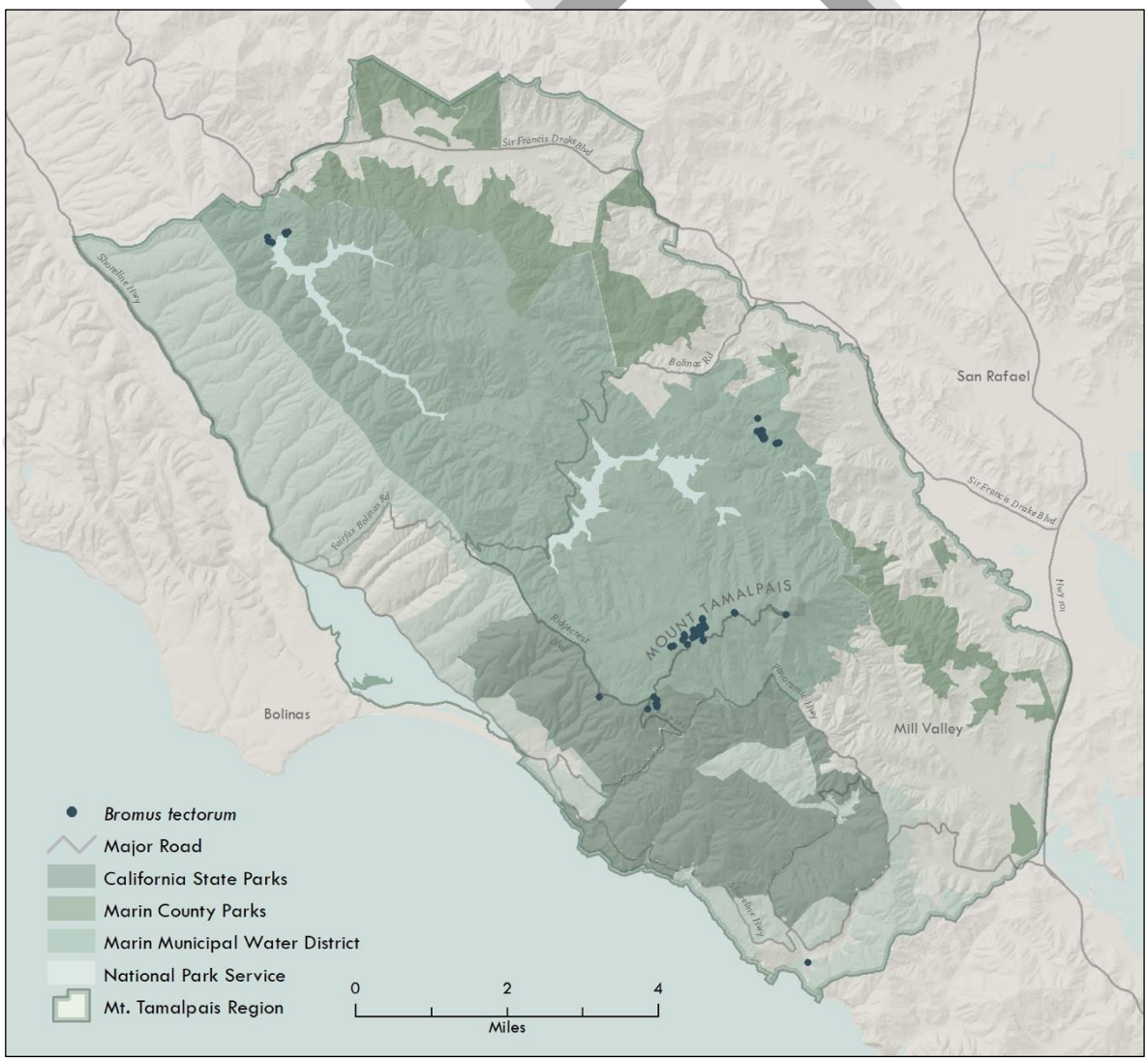
| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 0 | 0 | 0 | - |

# BROMUS TECTORUM

## Family: Poaceae
## Cal IPC Rating: High

Considered a formidable invasive plant throughout much of the American West, *Bromus tectorum* (cheatgrass) has significant impacts on fragile desert communities where it alters the movement and intensity of fire. On Mt. Tamalpais this annual grass grows primarily on gravelly, disturbed soils—including rare serpentine barren habitat. The concern that a fire on the mountain may spread this species to other sensitive habitats also factors into its prioritization. Slight and cryptic, this species evades the eye of many surveyors until they have had a chance to see it *in situ*.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 45 | 13.43 | 0.05 | 99.9% |

Cheatgrass occurs in three clusters in the Mt. Tamalpais region. The Ridgecrest patches occur from a pullout near the top of the mountain to a large stand at West Peak and down to Forbes Bench on State Parks land. A single plant at Hangglider Point (West Ridgecrest Boulevard) was detected and removed in 2017. No further detections of this species have been made at that location since that time. The largest occurrence of cheatgrass occurs at Yolanda Trail on MMWD land. Despite spanning several acres, this population was first detected in 2018. Additional patches occur on the face of Peters Dam, also on MMWD property.

Treatment limitations on MMWD property challenge management of this species. While staff annually attempt a propane flaming strategy at West Peak, weather conditions often confound the effort, relegating options to time-intensive hand removal. Most of this species' gross area occurs on MMWD land.

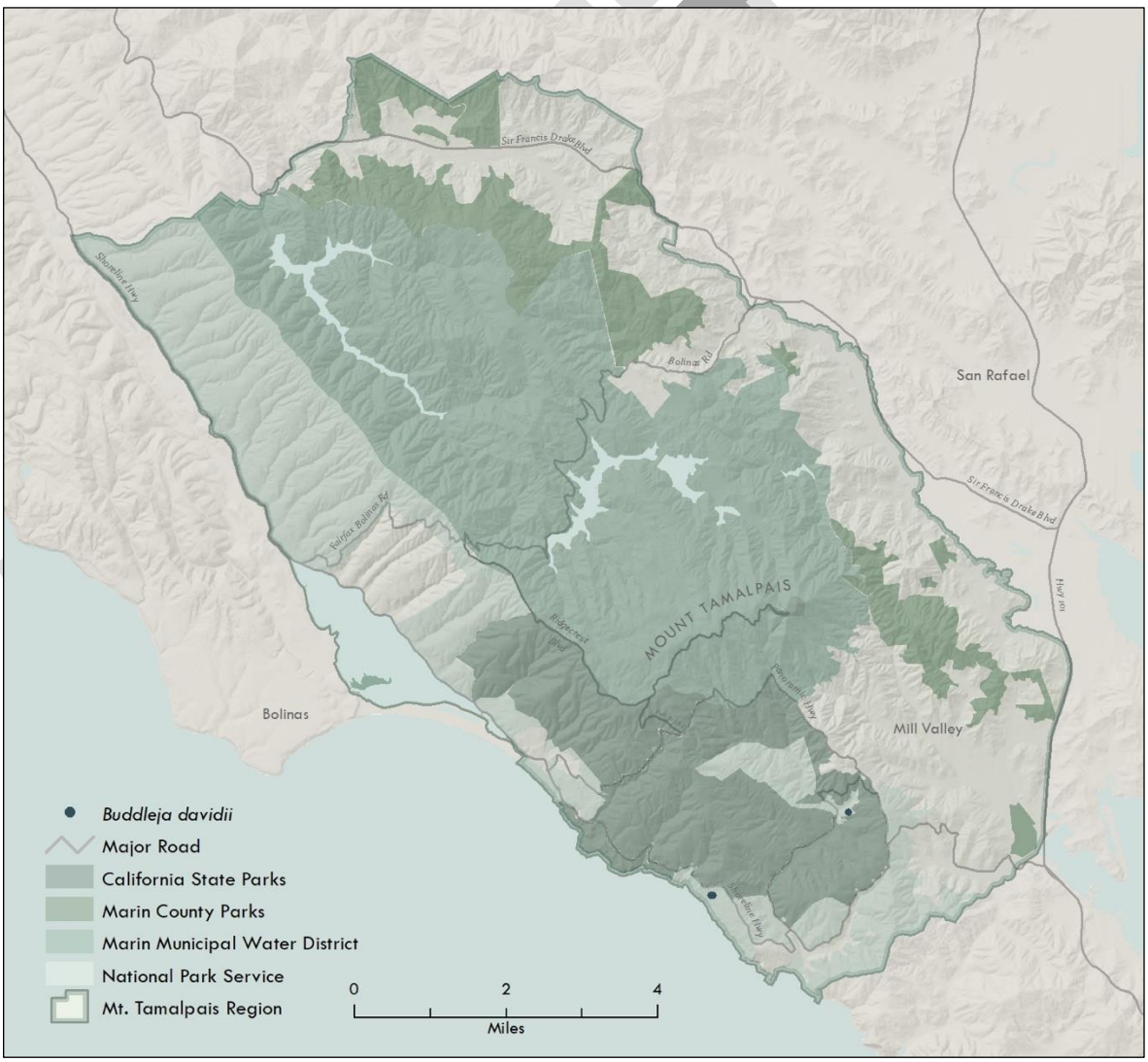
Given that cheatgrass currently exists in many large, well-distributed patches within the area of focus, and that new patches continue to be detected each year, it is likely that eradication is no longer a feasible goal. One Tam will revisit the prioritization and management strategy for this species in fall of 2021 when the EDRR species list comes under review.

# BUDDLEJA DAVIDII

## Family: Scrophulariaceae
## Cal-IPC Rating: Watch

A popular ornamental with an appealing common name, *Buddleja davidii* (butterfly bush) can spread from gardens into wildlands. This leggy shrub can sprout from vegetative material or germinate from seed. Areas adjacent to landscaped gardens and riparian areas are the habitats most at risk from this species on Mt. Tamalpais.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 1 | < 0.01 | < 0.01 | 100% |

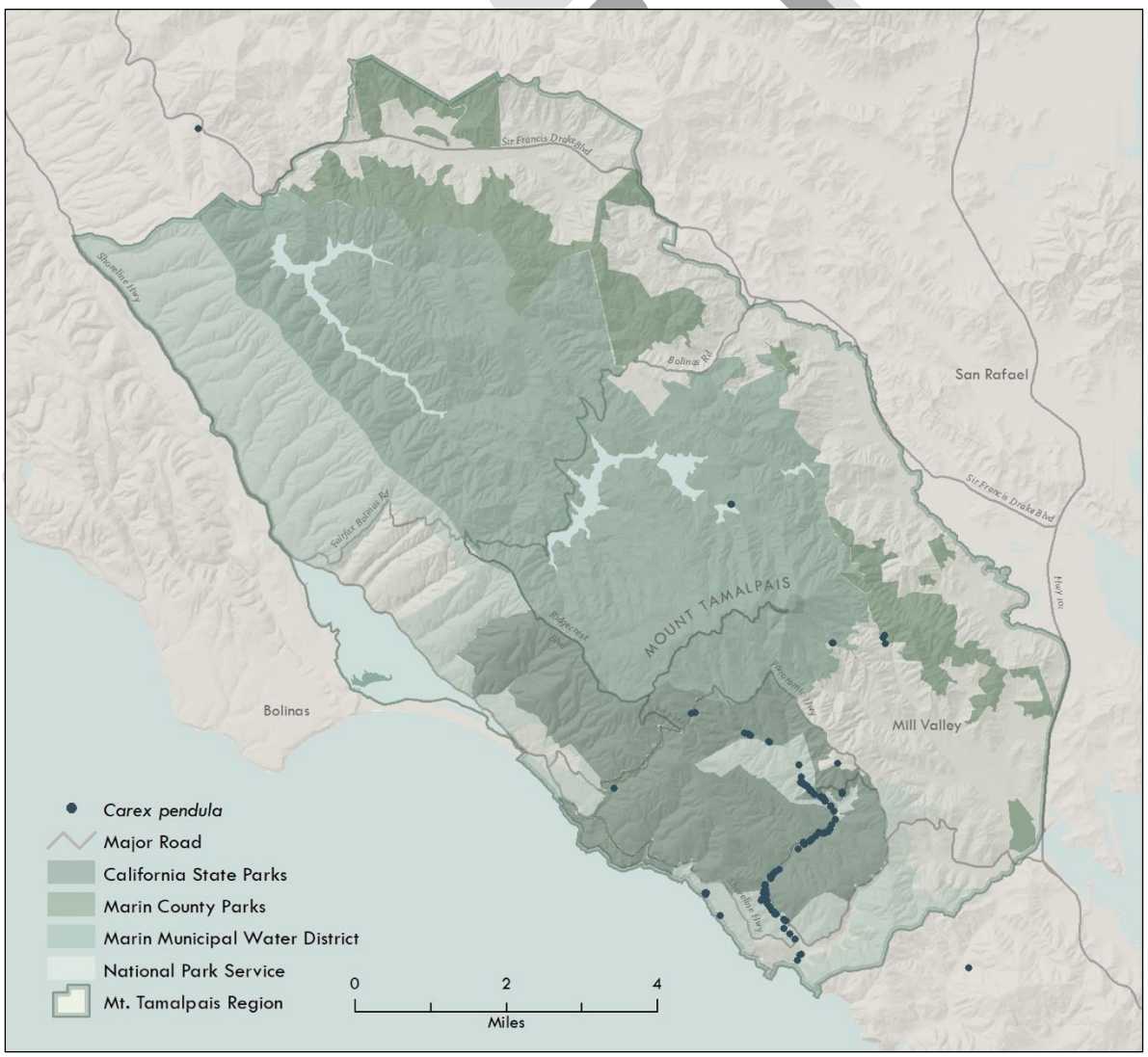
This species has only been detected once on public land in the Mt. Tamalpais region. That occurrence, by the Muir Beach parking lot, was removed several years ago and has not been seen there since. Additional patches have been mapped on private residential land, but those are excluded from this analysis and the acreage totals above since they are not subject to management by One Tam agencies.

# CAREX PENDULA

## Family: Cyperaceae
## Cal-IPC Rating: Watch

*Carex pendula* (hanging sedge) is an impressively large perennial that forms dense tussocked stands in wet habitats. It spreads primarily via prodigious production of seeds, which in riparian settings are swept downstream to find purchase on banks and sandbars. Hanging sedge is also known to grow in high-value regions, including salmonid-bearing streams, California red-legged frog habitat, and deep redwood forest.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 106 | 1.42 | 0.06 | 47.3% |

Hanging sedge occurs along several reaches of Redwood Creek as well as in coastal seeps and forests. The species is also known from Lagunitas Creek north of the Mt. Tamalpais region on land managed by One Tam partners. One of the largest patches in the region spans the borderline between MCP and the township of Mill Valley. Uphill patches on the MCP side are under management, but the bulk remains untreated on Mill Valley land.

## 2022 Update

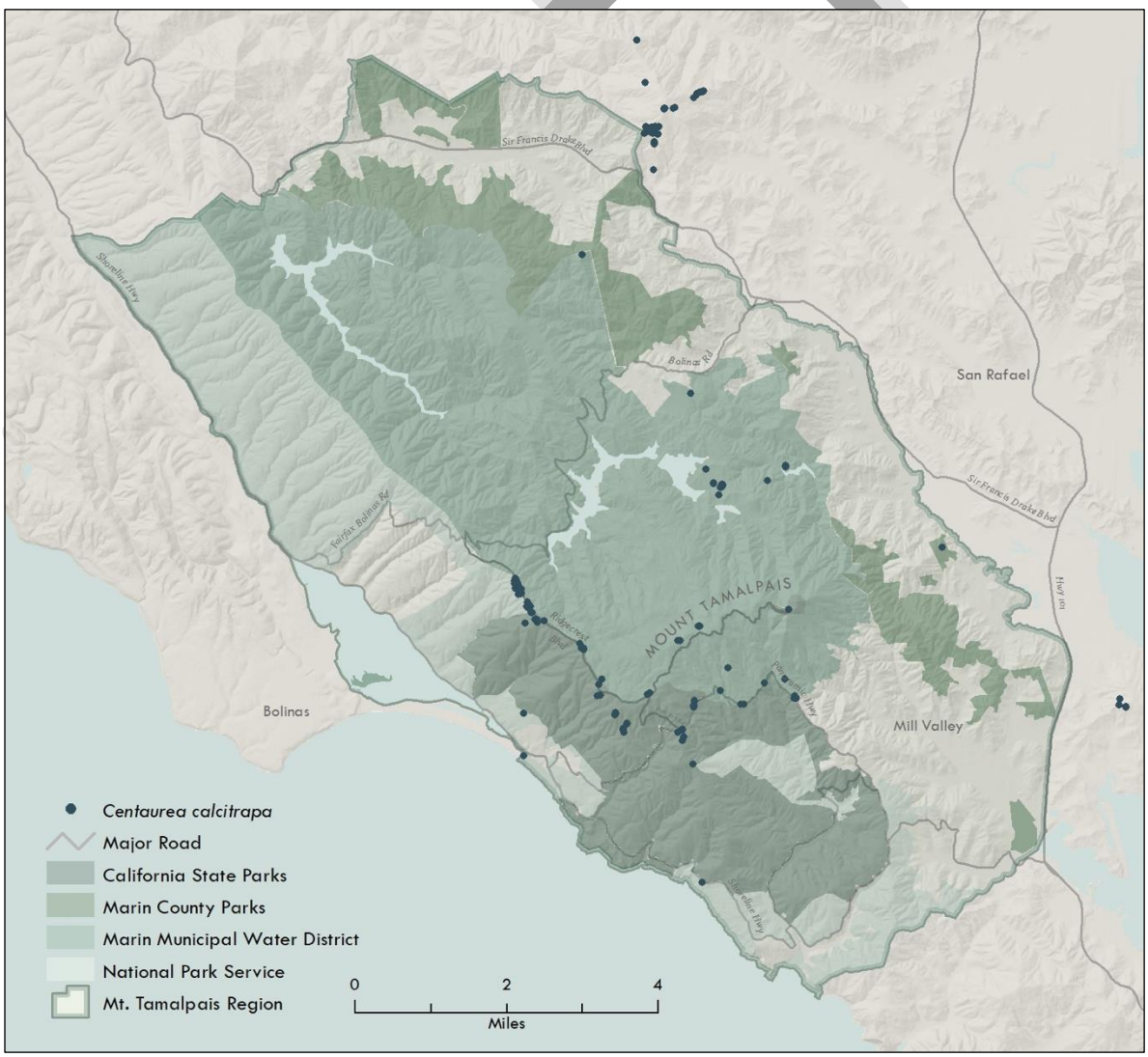
NPS staff have a well-prioritized multi-year management plan that ensures that the species will be 100% managed in that watershed over a longer term.

# CENTAUREA CALCITRAPA

## Family: Asteraceae
## Cal-IPC Rating: Moderate

*Centaurea calcitrapa* (purple starthistle) occurs in sunny areas of high disturbance, including roadsides, parking lots, campgrounds, and overgrazed pastures. This species, whose duration ranges from annual to biennial to weakly perennial, favors compacted soils. In a genus of plants known to be invasive in California, purple starthistle outperforms related species found in the Mt. Tamalpais region in having the stiffest spines. Left unmanaged, this trail-follower can significantly impact visitor experience in summer and fall months.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 95 | 2.60 | 0.03 | 100% |

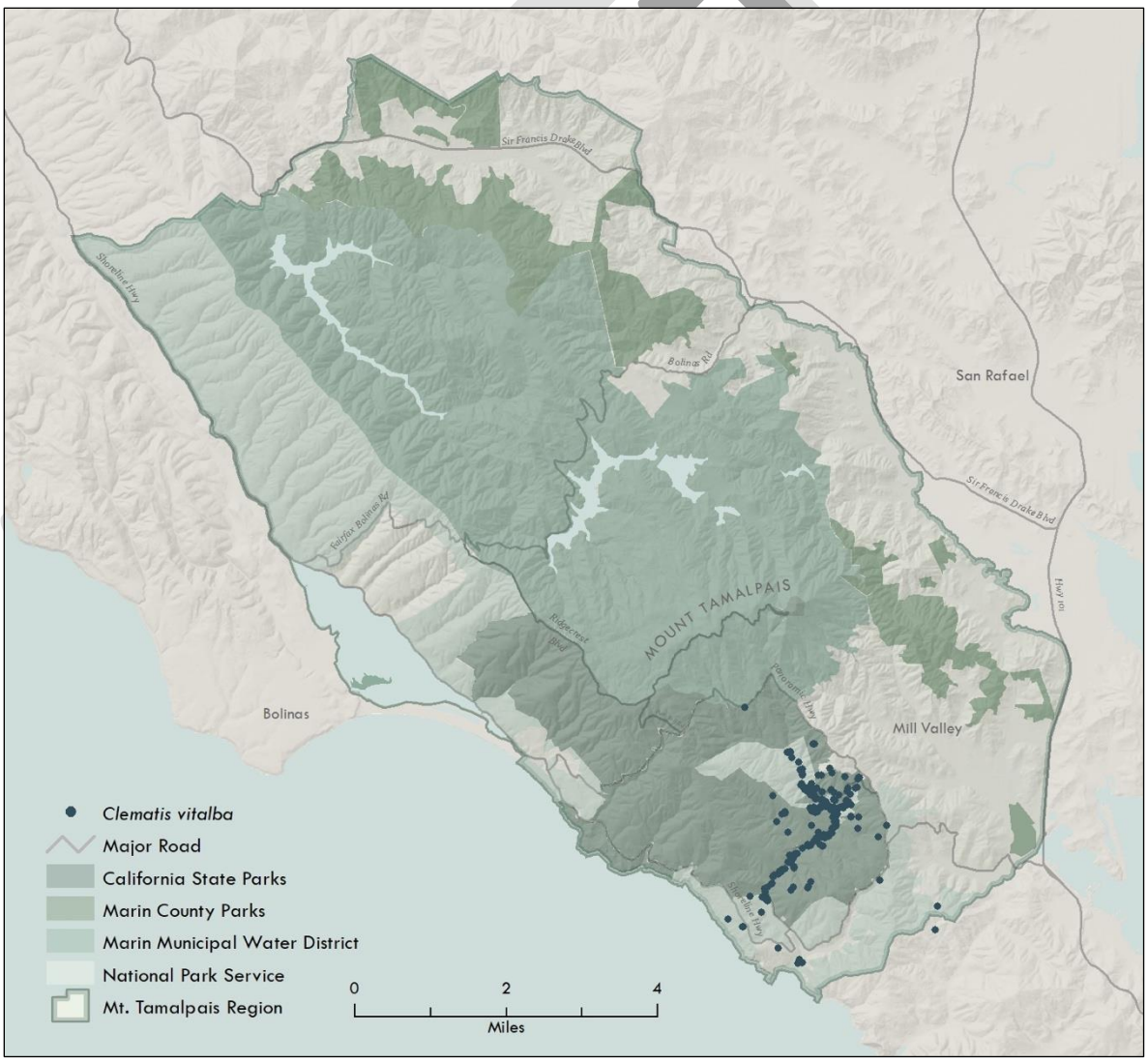
Purple starthistle occurs in three main areas inside the Mt. Tamalpais region: the West Ridgecrest grasslands, Panoramic Highway, and MMWD's lakes region. All patches are under management. Old records in Calflora show plants on the east side of the area of focus which appear to have been managed or initially misidentified, as they no longer occur. Significant populations exist just north of the region in pastures with cattle and horses.

# CLEMATIS VITALBA

## Family: Ranunculaceae
## Cal-IPC Rating: Moderate

A woody riparian vine with native relatives in the same genus, *Clematis vitalba* (old man's beard), was misidentified for several years within the Mt. Tamalpais region. Old man's beard is stout enough to climb up and over the canopies of full-grown trees, where it spreads its feathery seeds on the wind. Hanging shoots that contact the soil can reroot, and plant fragments that wash downstream may also become established.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 225 | 13.27 | 4.8 | 25% |

Old man's beard occurs in the Redwood Creek Watershed in the southwestern quadrant of the region. It also occurs over Coyote Ridge into the Tennessee Valley Watershed. One Tam staff recorded occurrences north of the region as well, on NPS lands along Lagunitas Creek.

## 2022 Update

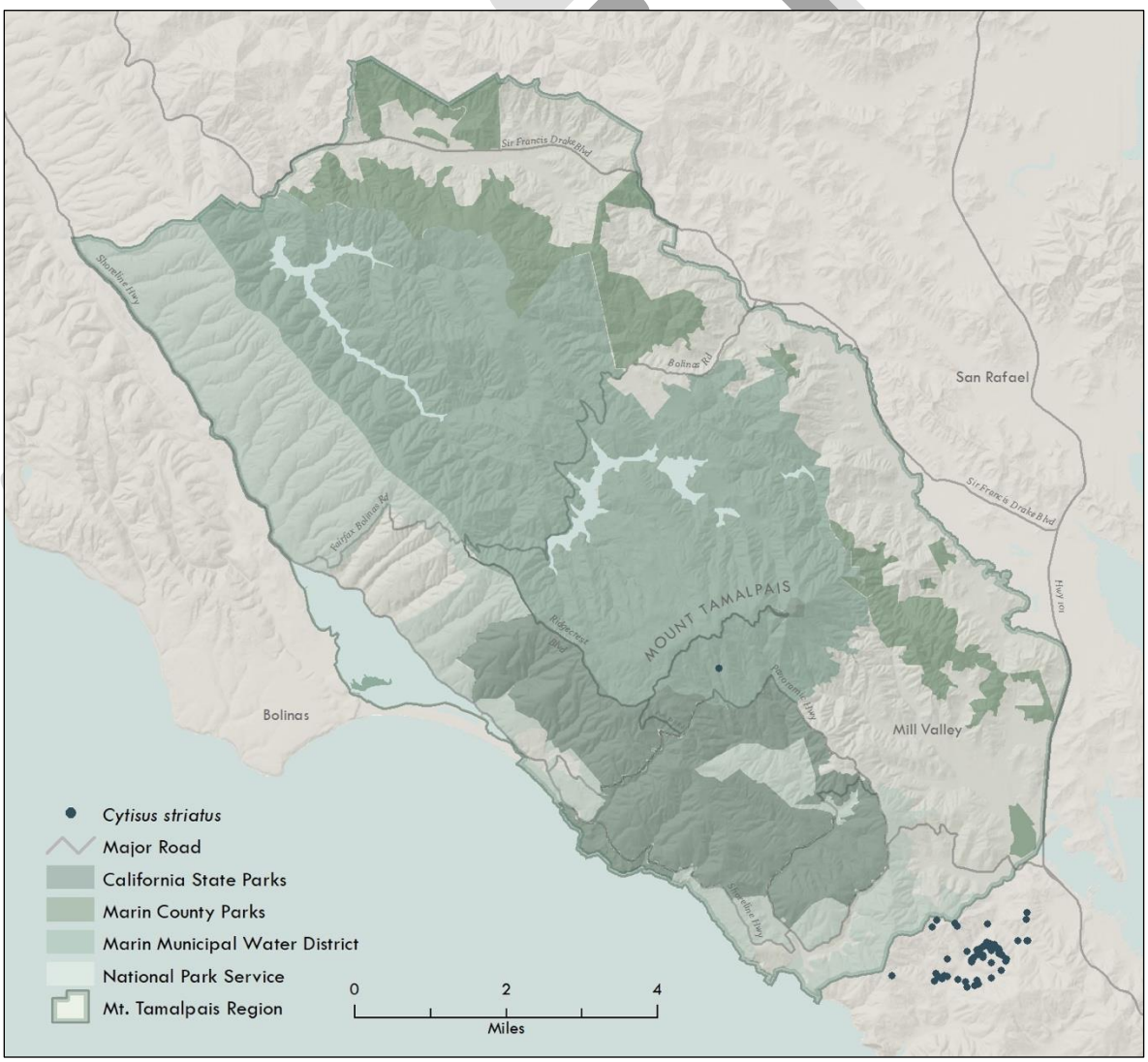
NPS staff have a well-prioritized multi-year management plan that ensures that the species will be 100% managed in that watershed over a longer term.

# CYTISUS STRIATUS

## Family: Fabaceae
## Cal-IPC Rating: Moderate

Bright, conspicuous flowers make *Cytisus striatus* (Portuguese broom) a striking ornamental shrub. Surveyors have spotted specimens in gardens bordering public lands during late spring and summer when mature plants become a blaze of yellow. Like other brooms, Portuguese broom functions as a nitrogen fixer and has long-lived seeds. The Calflora dataset includes some misidentified patches of *Cytisus scoparius*, which have been ferreted out of this account.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 1 | < 0.01 | < 0.01 | 100% |

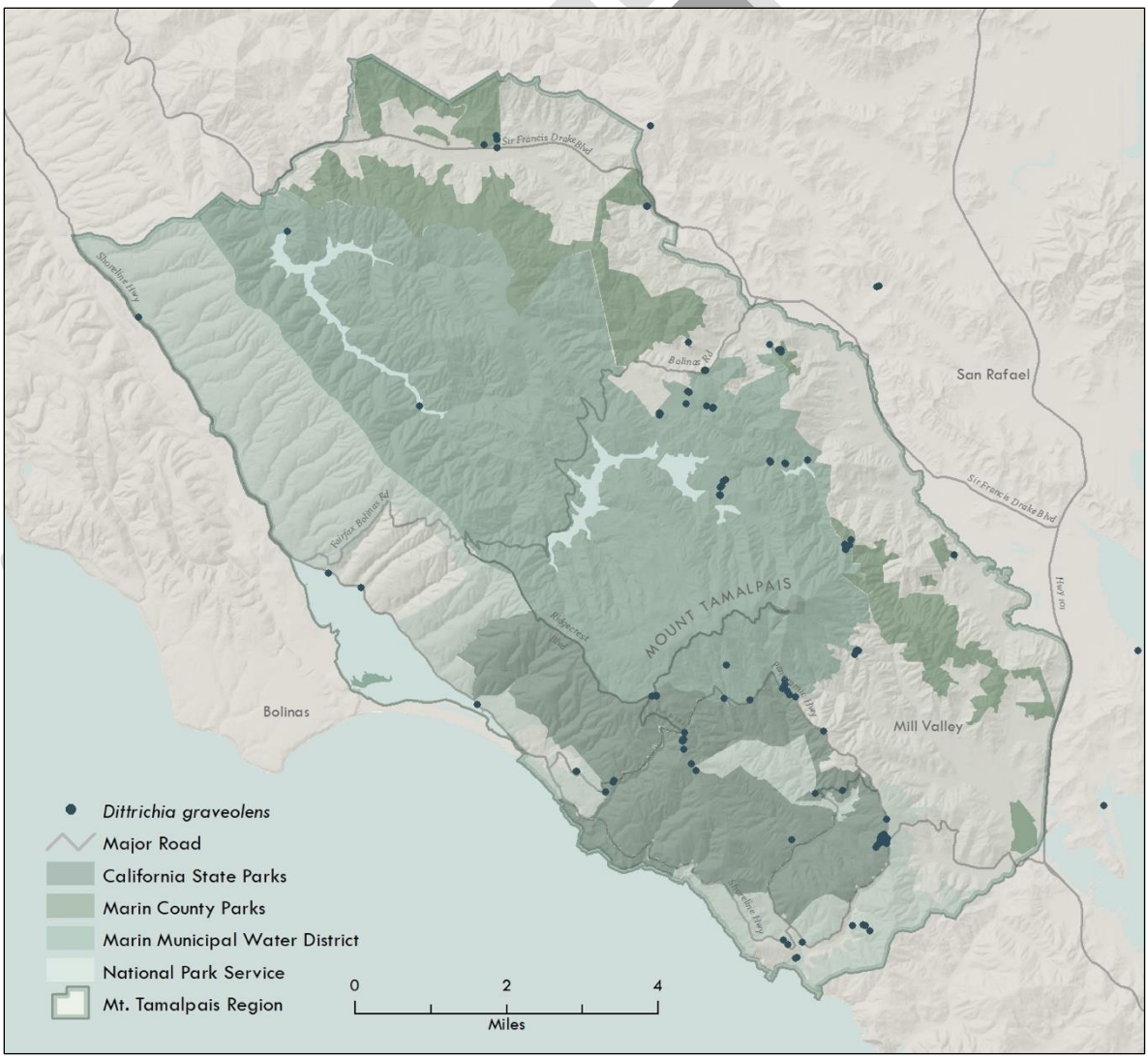
Although Portuguese broom is known within the Mt. Tamalpais region, only one of a handful of patches occurs on public land. A small patch on MMWD land was properly identified and removed in 2014. At least one plant occurs on private land near Muir Beach. This species is more widespread in the Marin Headlands to the south.

# DITTRICHIA GRAVEOLENS

## Family: Asteraceae
## Cal-IPC Rating: Moderate

*Dittrichia graveolens* (stinkwort) lives up to its pejorative common name with a pungent camphor odor. Some people develop contact dermatitis from handling the resinous plants, and the scent lingers where it touches. A devotee of the disturbed trailside habitat niche, this species can impact visitor experiences.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 100 | 8.64 | 0.04 | 77.8% |

Stinkwort has expanded significantly in the Bay Area in the past 10 years. The sticky, feathery seeds both move on vehicles and blow around in their wakes, leading to trenchant establishment along the Highway 101 corridor in Marin. As vehicles traverse the public lands of Mt. Tamalpais, more and more roadside populations have become established there, too.

As a noted disturbance-follower, this species also occurs in landslide soil piles, rock and material depots, parking lots, and infrastructure areas like water tanks. The majority of this species is under management with exceptions on MCP lands with heavily impacted roadways on or near Sir Francis Drake Boulevard.

## 2022 Update

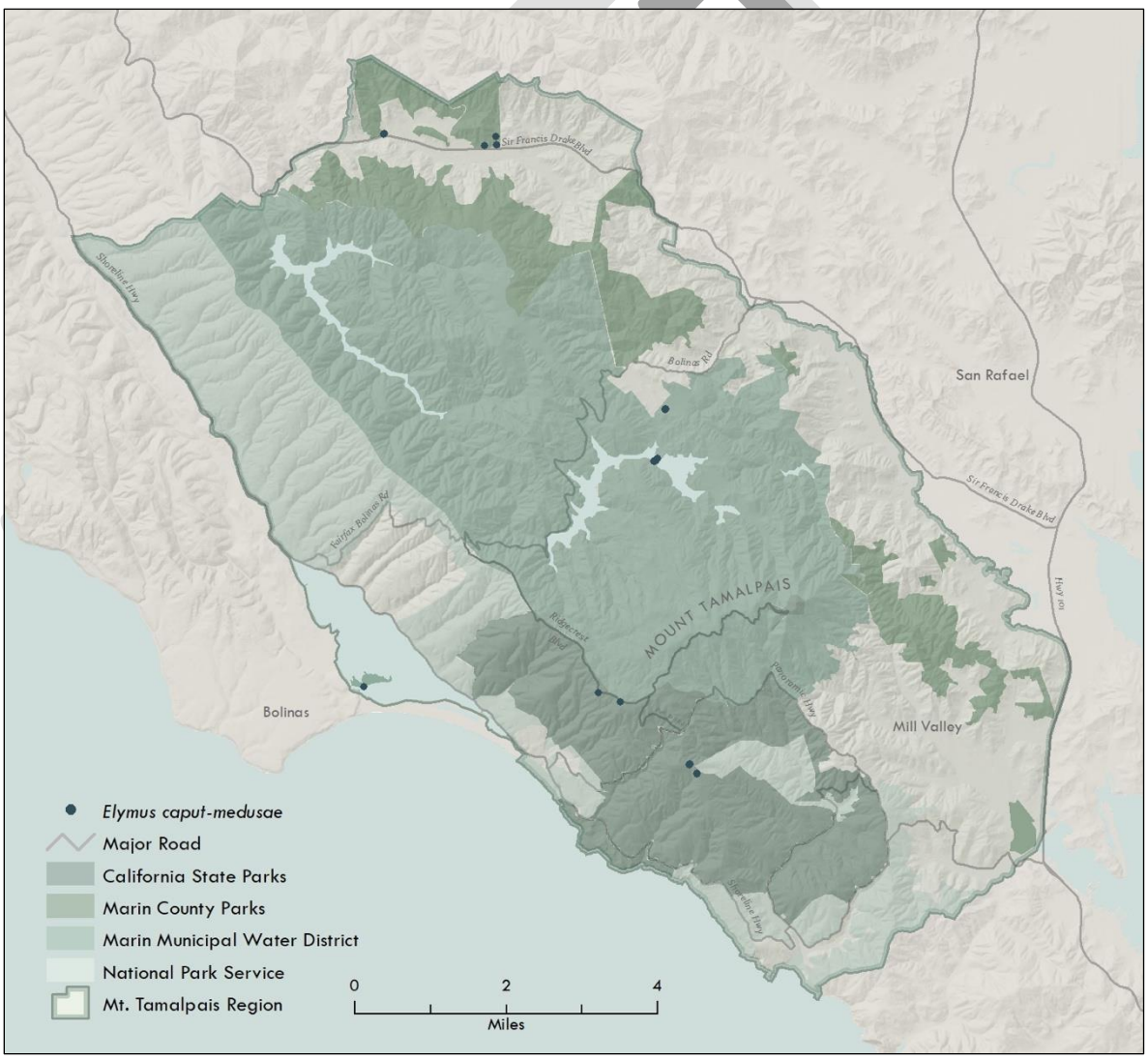
The Sir Francis Drake Blvd. population covers 1.73 acres of land along the road shoulder within the county right-of-way. This location is currently untreatable as a public right of way. If excluded from the percent managed calculation, the species is 99% managed.

# ELYMUS CAPUT-MEDUSAE

## Family: Poaceae
## Cal-IPC Rating: High

*Elymus caput-medusae* (medusahead) has a strong association with livestock and pastures in parts of the Bay Area. Another Mediterranean annual grass, medusahead stands out among its Priority One analogues in its ability to create thick, persistent thatch. The species' impacts on forage lands led to the development of a *Medusahead Management Guide for the Western States* (Kyser et al. 2014).

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 22 | 2.8 | 1.95 | 13.3% |

In the Mt. Tamalpais region, the species has a significant population cluster along Sir Francis Drake Boulevard, part of which sits on private land or rights of way. Smaller patches occur at Sky Oaks Meadow and Bon Tempe Dam on MMWD land. Four small patches occur on State Parks land near disturbed roadside grasslands. One patch occurs next to a construction stockpile of imported rock.

*Taeniatherum caput-medusae* is a synonym. Nomenclature changes should be considered when compiling data from Calflora—some records remain logged under this old name.

## 2022 Update

The Sir Francis Drake Blvd. location is currently untreatable as a public right of way.The percent managed figure jumps from 13.3% to 99% if that population is left out of the calculation.



Kyser, G. B., J. M. DiTomaso, K. W. Davies, J. S. Davy, and B. S. Smith. 2014. Medusahead Management Guide for the Western States. University of California, Weed Research and Information Center, Davis. Available at: wric.ucdavis.edu (accessed 19 February 2020).

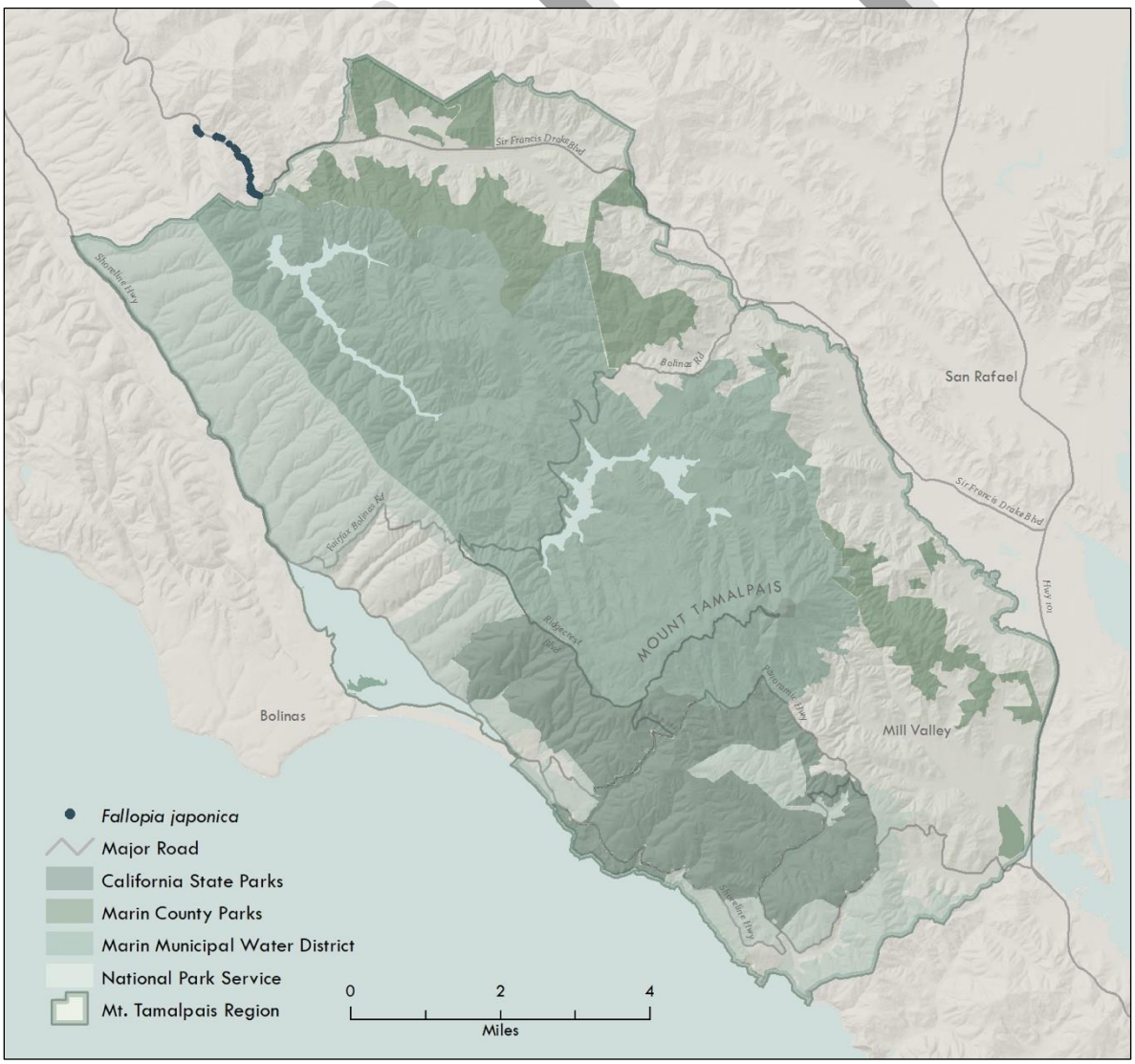
# FALLOPIA JAPONICA

## Family: Polygonaceae
## Cal-IPC Rating: Moderate

*Fallopia japonica* (Japanese knotweed) stands out as a priority invasive species worldwide for its impacts to both wildlands and infrastructure, dually able to form monocultures in riparian environments and compromise building foundations in urban and residential areas.

A vigorous perennial herb, Japanese knotweed spreads not through seeds but through physical breakage and dispersal. Its creekside affinity provides ideal conditions for downstream movement of scoured rhizomes or stem node material. Japanese knotweed and related species appear to have escaped from horticulture.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 0 | 0 | 0 | - |

In the Mt. Tamalpais region, Japanese knotweed only occurs on private land—however, public land occurrences appear immediately north in Samuel P. Taylor State Park and the Golden Gate National Recreation Area. All Marin populations occur within the Lagunitas Creek watershed. Populations on public land are under management. The collaborative group known as the Marin Knotweed Action Team, led by University of California Cooperative Extension and Marin County Agricultural Department, works to address populations on private land. As of 2019, over 60 private properties are also under management.

The rhizomatous nature of Japanese knotweed limits management approaches to either chemical treatment or full removal of all plant and soil material in an infested area. It is reputed that many or most populations of Japanese knotweed are sexually sterile—to that end, One Tam staff collected seeds from mature plants in 2019 for analysis. Viability tests indicated that 0% of the seeds were viable.

*Reynoutria japonica* is a synonym.

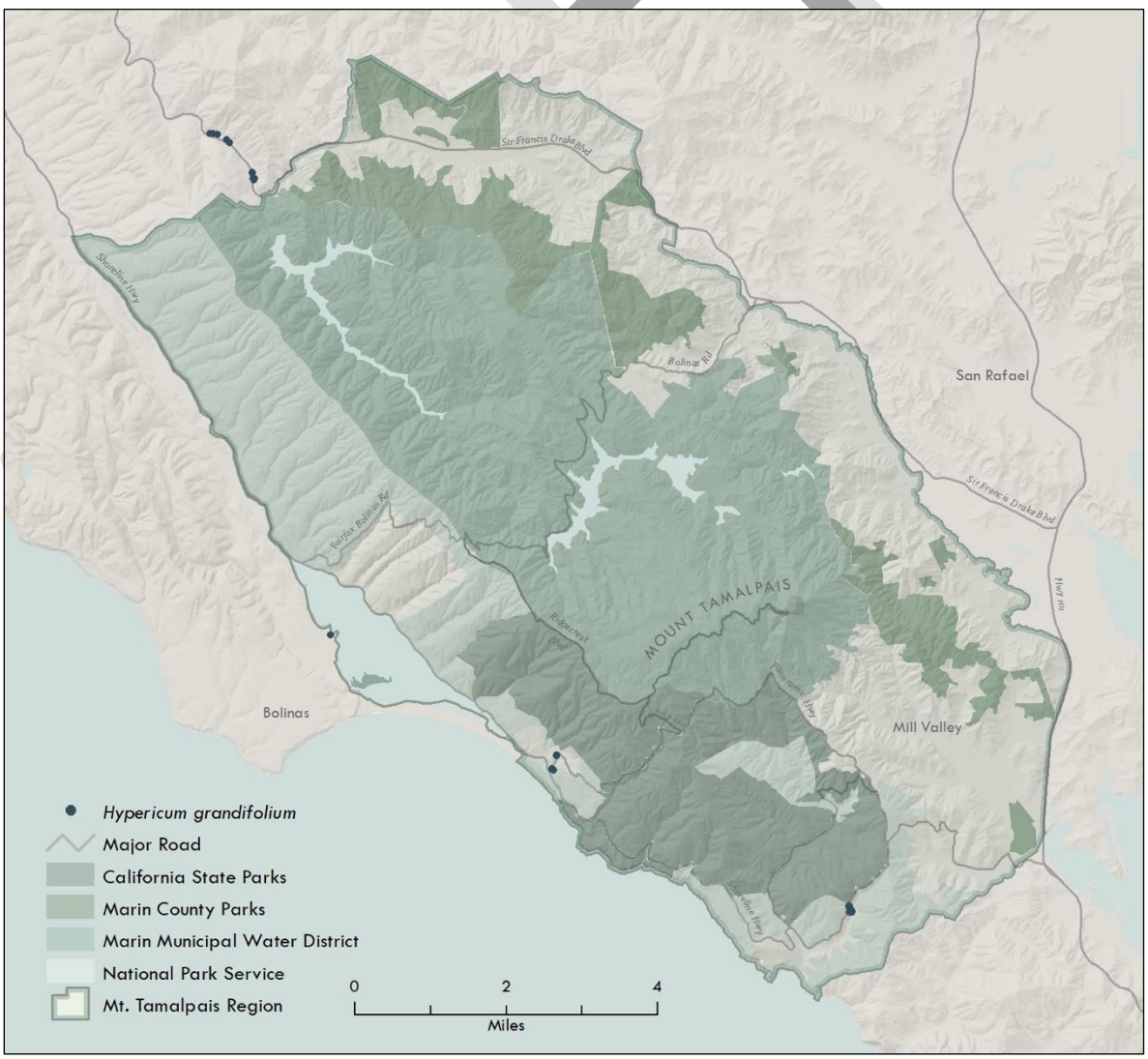
# HYPERICUM GRANDIFOLIUM

## Family: Hypericaceae
## Cal-IPC Rating: Watch

*Hypericum grandifolium* (malfurada), a showy yellow-flowered shrub, frequents moist areas including creeks, wetlands, and foggy coastal scrub. This plant spreads by seeds and rhizomes. Manual removal is complicated by highly fractious root material that may resprout if not completely removed.

Marin County is the primary population center mapped in California to date, while limited records also exist in Calflora for San Mateo and Sonoma counties.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 9 | 0.92 | 0.07 | 96.6% |

Malfurada's distribution concentrates along the coast on National Park Service land. Several patches also occur along Lagunitas Creek north of the Mt. Tamalpais region. Malfurada appears to have been planted on Audubon Canyon Ranch land in the past, where it has spread from a garden into an alder grove. This patch is under manual management.

*Hypericum grandifolium* does not appear in the Jepson eFlora (2020), perhaps due to lingering conflation with the similar species *Hypericum canariense*.



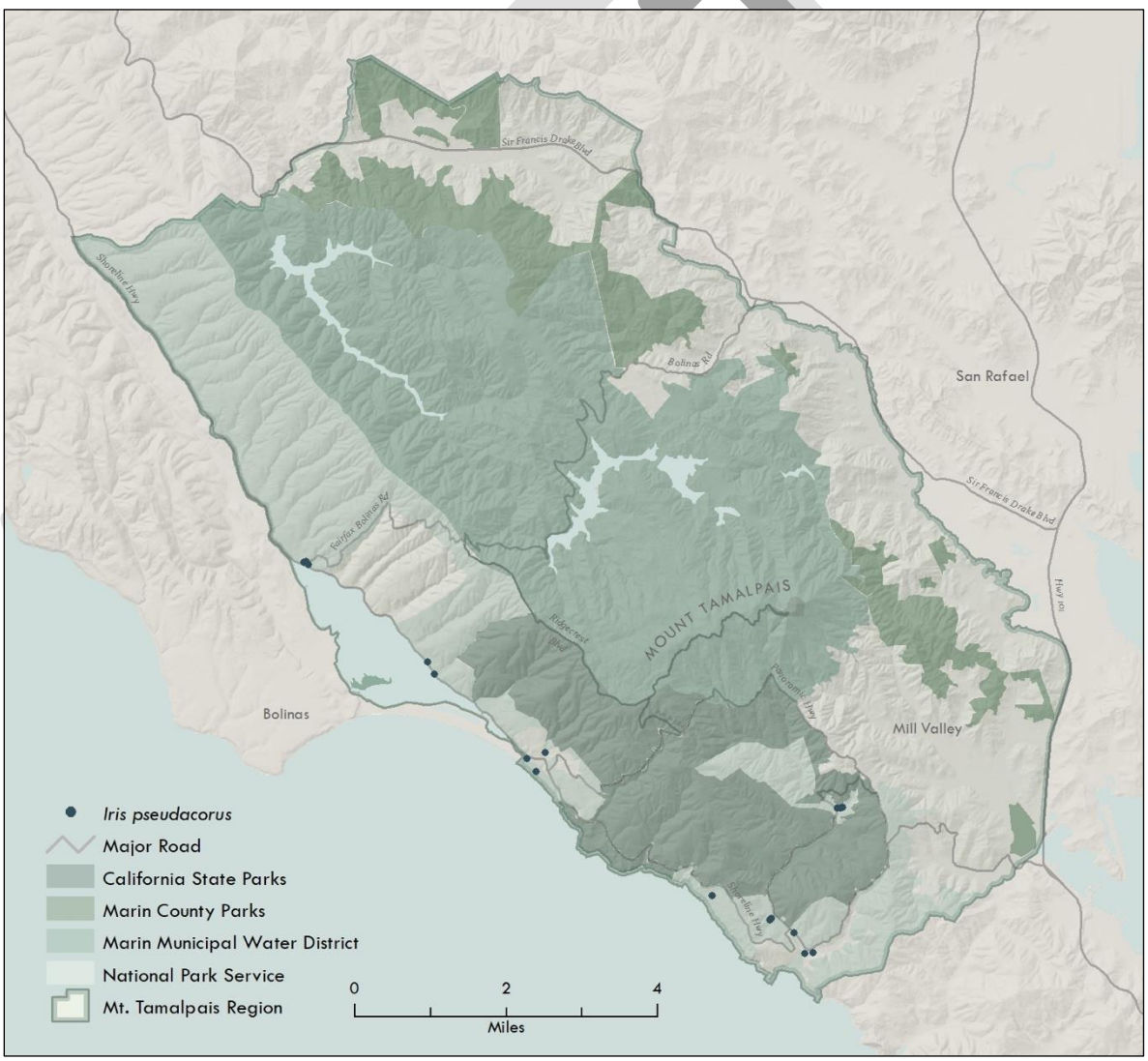
Jepson Flora Project (eds.) 2020. Jepson eFlora. University of California, Berkeley, CA. Available at https://ucjeps.berkeley.edu/eflora/ (accessed on 13 May 2020).

# IRIS PSEUDACORUS

## Family: Iridaceae
## Cal-IPC Rating: Limited

Popular in garden ponds, *Iris pseudacorus* (yellow flag iris) makes a striking impression with tall green leaves and bright yellow flowers. This sizable perennial appears in and around water sources as it prefers to have its roots in moist soils, complicating treatment options. Dense rhizome biomass sunken into saturated mud proves a major challenge for removal efforts.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 17 | 0.61 | 0.09 | 0.1% |

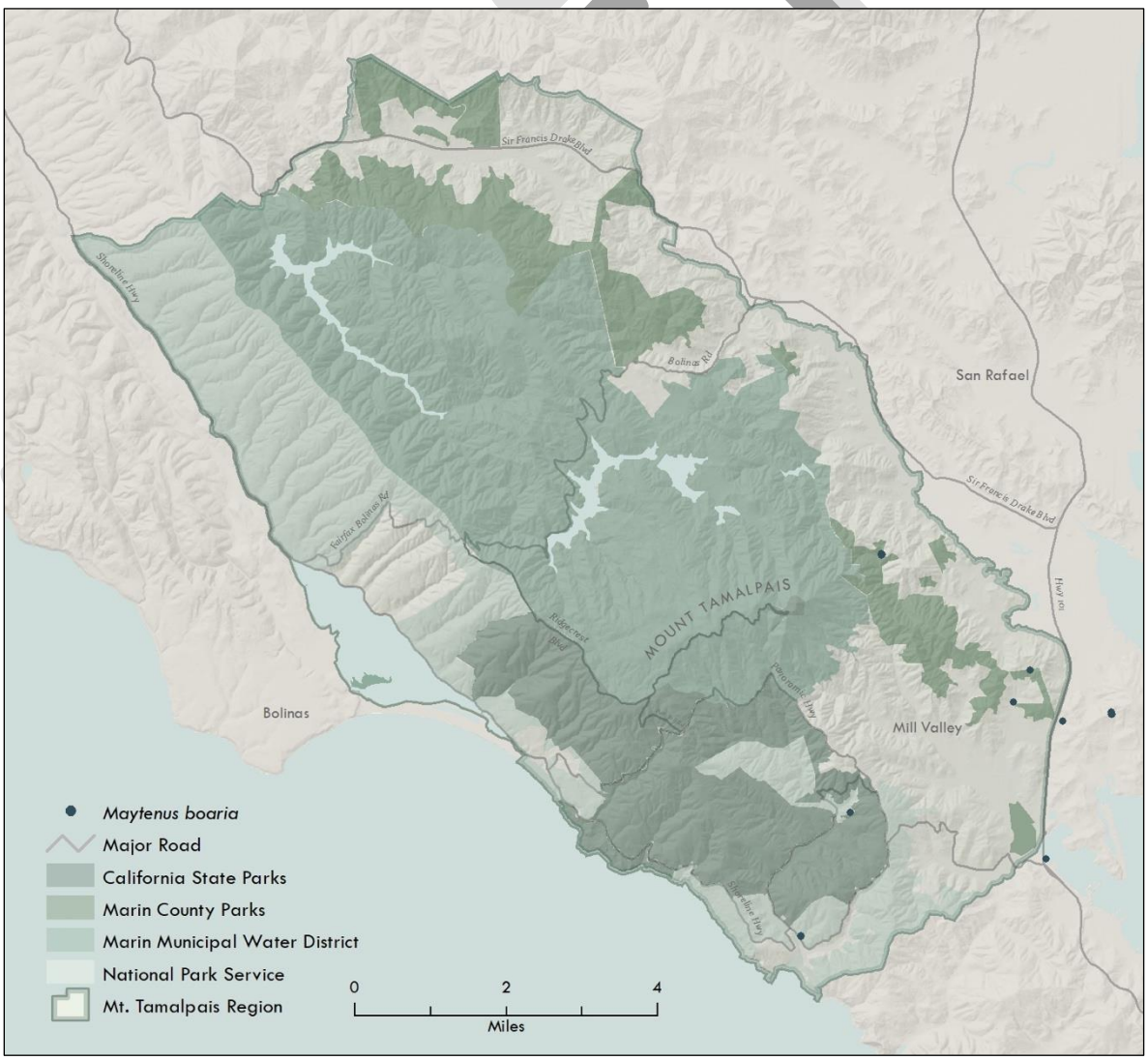
Yellow flag iris has been mapped primarily on NPS lands along the coast, as well as in one location in the southeast corner of Muir Woods National Monument. Less than 1% of mapped occurrences are under management. The species also occurs along Lagunitas Creek north of the Mt. Tamalpais region on NPS land. Additional populations occur on Point Reyes National Seashore lands and the Marin Headlands.

# MAYTENUS BOARIA

## Family: Celastraceae
## Cal-IPC Rating: Watch

With lovely raining branches and tiny green flowers, *Maytenus boaria* (mayten) occurs in Marin as an ornamental tree in landscaping. It has fallen out of favor as a street tree because its roots sucker prolifically, busting forth from sidewalk cracks with new shoots. This same characteristic makes it a management challenge in wildlands where the species favors moist soils but also makes its way into drier habitats when left unmanaged. It also spreads via seeds in California.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 5 | 5.57 | 0.79 | 0.3% |

Mayten occurs in the south and eastern quadrants of the Mt. Tamalpais region, often near neighborhoods. A 5-acre patch on MCP land remains untreated.

## 2022 Update

Since the writing of this report, MCP has adopted a multi-year treatment strategy for the 5.17 acre Baltimore Canyon population. Additionally, a 0.21 acre patch near the Mill Valley bike path falls outside any open space boundary. Removing those two patches from the 'unmanaged' list brings mayten up to 99% managed within the region.

# SESBANIA PUNICEA

## Family: Fabaceae
## Cal-IPC Rating: High

*Sebania punicea* (rattlebox) impacts riparian areas, where the shrub may grow in thick stands. Roadside ditches are another favored habitat. This pea family species fixes nitrogen and contains chemicals toxic to people and wildlife. Despite these characteristics, it is an ornamental favored for its showy red flowers.

### Regional Distribution

Rattlebox is not known to occur on the public lands within the Mt. Tamalpais region.

### Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 0 | 0 | 0 | - |

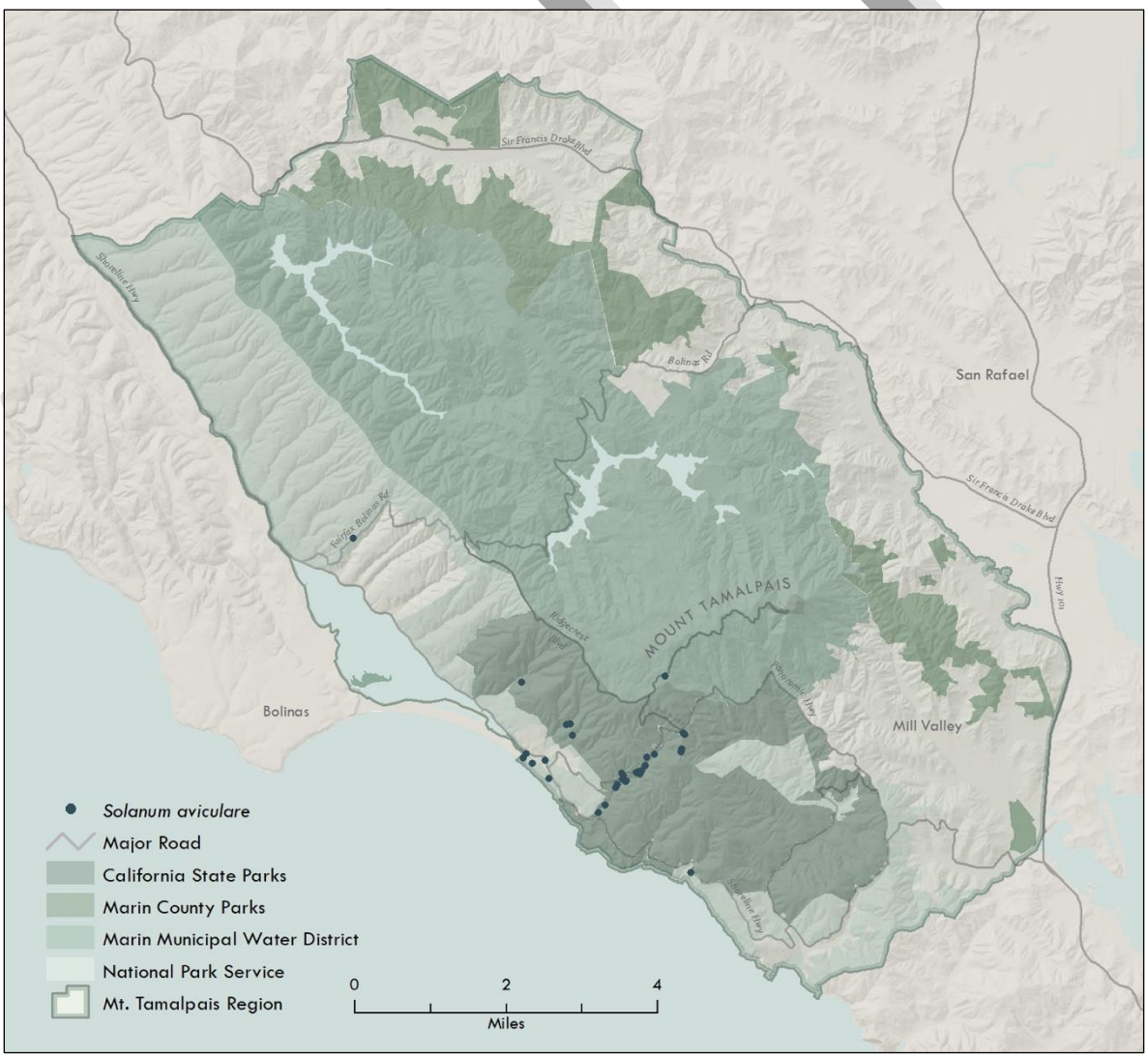
A report of a planted individual in a private garden near MMWD's Bill Williams Canyon has not yet been substantiated. The species has been mapped in Novato to the north—once at Rush Creek on MCP land and once in a residential area where it is presumed to be a garden plant.

# SOLANUM AVICULARE

## Family: Solanaceae
## Cal-IPC Rating: Watch

*Solanum aviculare* (New Zealand nightshade) occurs in riparian areas in the Mt. Tamalpais region. These leggy shrubs are difficult to spot in the deep shade and verdancy of creekside canyons like Steep Ravine's Webb Creek. Surveyors have successfully detected New Zealand nightshade by scanning suitable habitat through binoculars for the bright purple flowers, which have a wide bloom window. In areas where this species is suspected, out-and-back surveys are recommended to give surveyors the opportunity to see vegetation from multiple angles. Ornamental plantings in Marin neighborhoods are the likely origin of this species locally.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 34 | 0.59 | 0.01 | 95.4% |

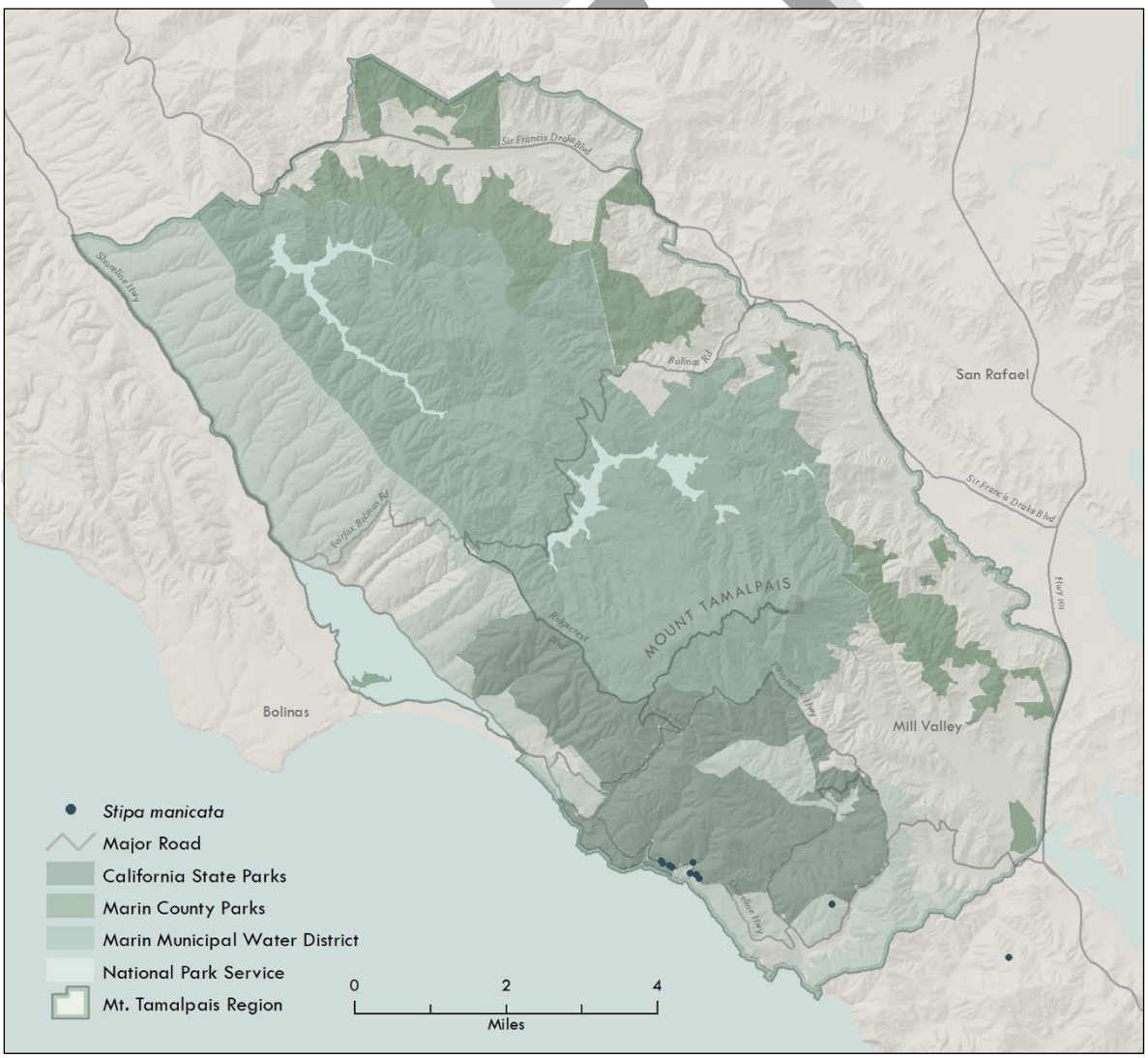
In the Mt. Tamalpais region, New Zealand nightshade tends to occur near residential communities like Stinson Beach and Muir Beach, showing a preference for coastal locations. It also occurs outside the region on the Point Reyes peninsula.

# STIPA MANICATA

## Family: Poaceae
## Cal-IPC Rating: Limited

*Stipa manicata* (Andean tussockgrass) looks very similar to its close relative *Stipa pulchra*, California's ubiquitous State Grass. Field identification of this perennial bunchgrass, which involves analyzing subtle details of the seeds, poses a challenge to comprehensive mapping. Most mapped occurrences are from areas where it was known to be accidentally planted—in one instance, Caltrans used Andean tussockgrass in a slope repair along Highway 1 thinking it was *Stipa pulchra*.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 8 | 5 | 0.01 | 0% |

Andean tussockgrass occurs in the southwest quadrant of the Mt. Tamalpais region primarily along Highway 1 near the population planted by Caltrans. Treatment of that patch is complicated by the need for roadside erosion control on the steep slopes of the site. Trailing roadside patches are similarly in the Caltrans right of way with traffic hazards limiting options for treatment. A large occurrence also exists in the Marin Headlands near Fort Cronkhite, where it has become established following another accidental outplanting.

## 2022 Update

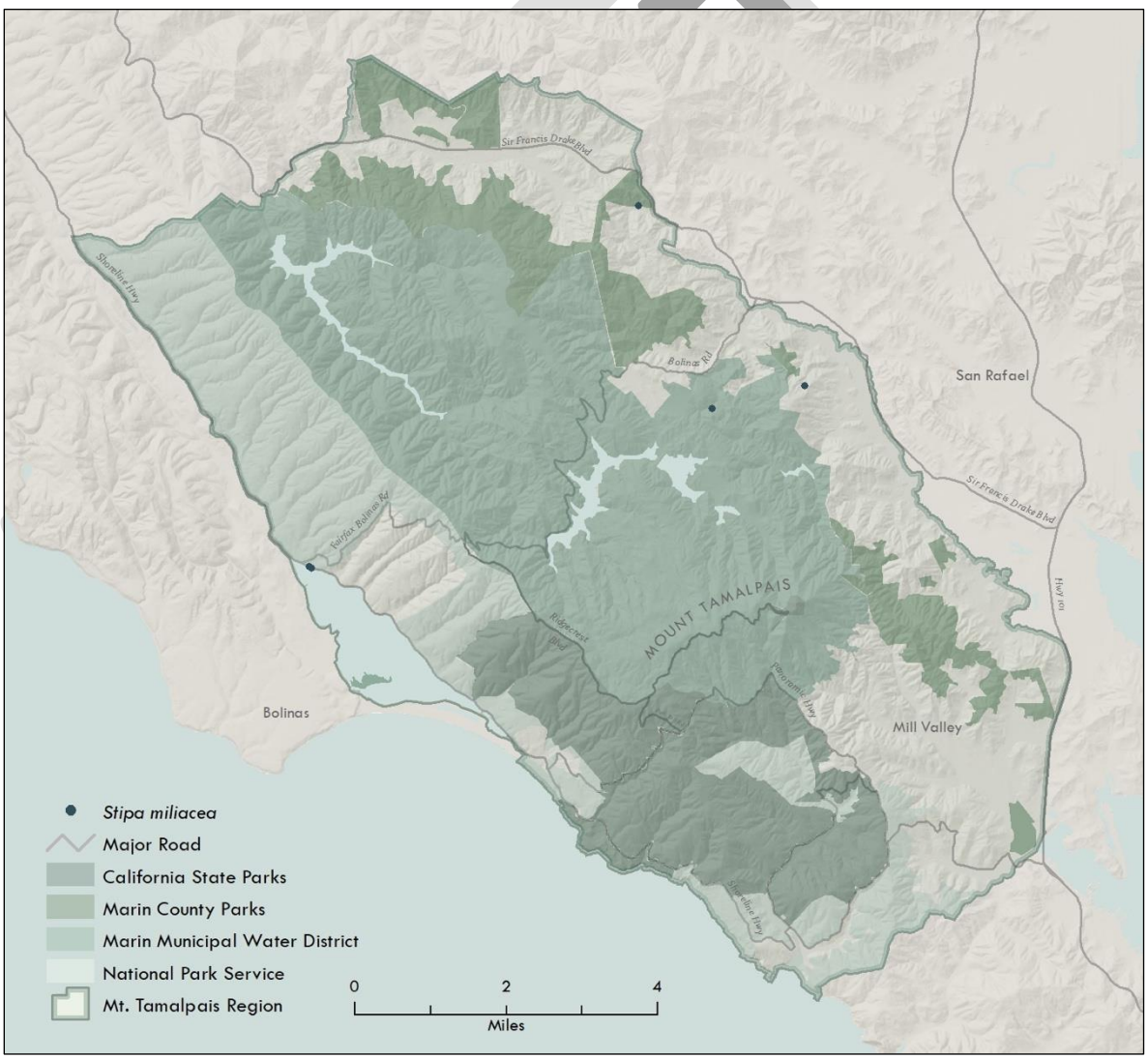
The Highway 1 patches, which comprise the only Mt. Tamalpais population of this species, remain untreatable due to their location in a Caltrans right of way.

# STIPA MILIACEA

## Family: Poaceae
## Cal-IPC Rating: Limited

*Stipa miliacea* (smilograss) lines several roadways in Marin, including stretches of Sir Francis Drake Boulevard in San Rafael and the San Geronimo Valley. Tiny seeds disperse on the wind and hitch rides around the county on vehicles, clothing, and wildlife. On Mt. Tamalpais this straggly perennial is often associated with construction sites, for example slide repair zones on Concrete Pipe Fire Road.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 12 | 0.06 | < 0.01 | 54.2% |

Smilograss occurs in the interior lands of MMWD as well as some coastal locations along Highway 1 south of Bolinas-Fairfax Road. Similar roadside patches occur along Sir Francis Drake Boulevard near MCP preserves. While the roadside patches are largely untreated, interior patches on MMWD land are under management.

Smilograss appears in the dataset as both *S. miliacea* and *S. miliacea* var. *miliacea*. In California, both of these names represent the same entity. The other described variety, *S. miliacea* var. *thomasii*, has never been recorded in the wild in North America.

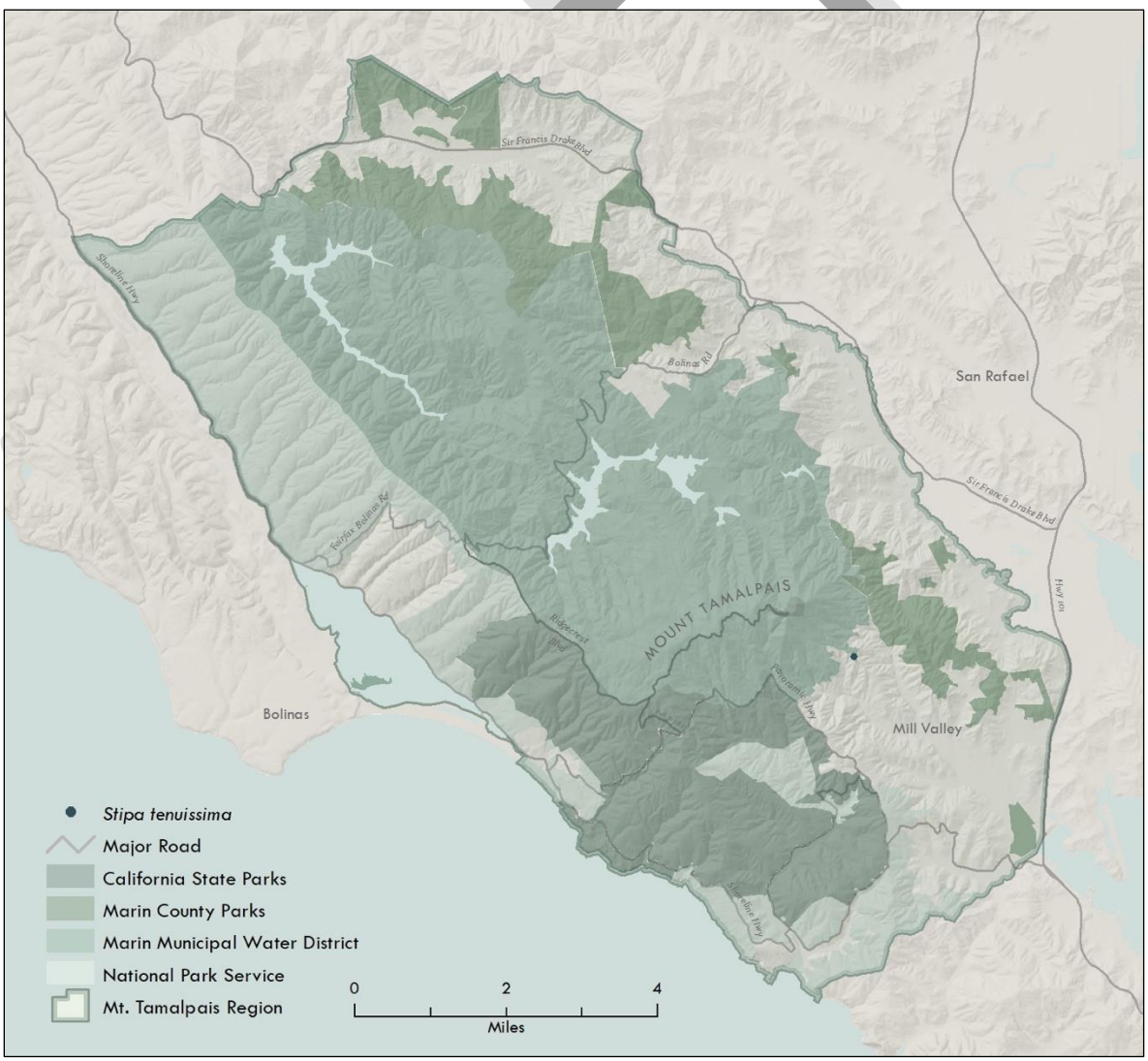
*Achnatherum miliaceum, Piptatherum miliaceum,* and *Oryzopsis miliacea* are synonyms.

# STIPA TENUISSIMA

## Family: Poaceae
## Cal-IPC Rating: Watch

Dense yet delicate, *Stipa tenuissima* (Mexican feathergrass) has exploded in popularity as an ornamental throughout the Bay Area over the past ten years. Prized for its drought-tolerant nature and attractive tufts, extensive plantings were installed throughout the last decade. Tiny seeds with clinging awns ride wind currents, often germinating in sidewalk cracks adjacent to landscaping. Bird nests made entirely of Mexican feathergrass seeds and awns have been observed, indicating that wildlife move propagules as well.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 1 | < 0.01 | < 0.01 | 100% |

To date, one lone Mexican feathergrass patch has been detected, on MMWD land near water tanks where it appears to have come in on service vehicles. That patch was removed and is now under surveillance. Roadside patches along Panoramic Highway and Highway 1 outside the Mt. Tamalpais region have also been documented. Several mapped patches occur on private lands. Vigilance along trails and disturbed areas near neighboring communities is recommended.

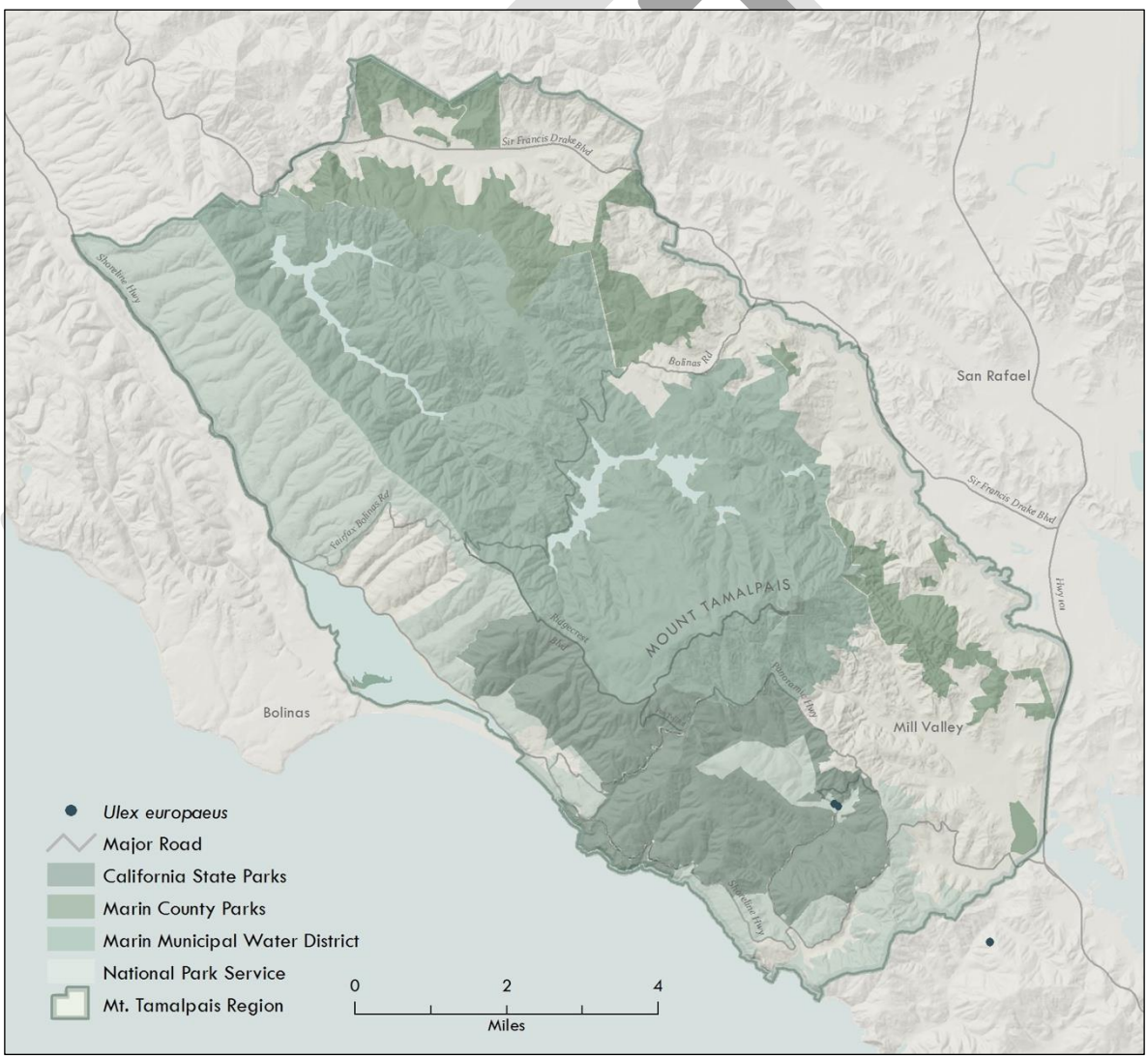
*Nassella tenuissima* is a synonym.

# ULEX EUROPAEUS

## Family: Fabaceae
## Cal-IPC Rating: High

Among the invasive pea-family shrubs in the Bay Area, *Ulex europaeus* (gorse) stands out as a high priority for rapid response in part because of its growth habit. With stiff spines and a propensity for developing dense thickets, gorse presents significant treatment challenges once established. This species can impact visitor experiences when occurring near infrastructure or trails.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Net Acres | Percent Managed |
|---|---|---|---|
| 2 | 0.15 | 0 | 100% |

Two patches of gorse have been mapped in the Mt. Tamalpais region, both in the southeast corner of Muir Woods. These patches were treated many years ago and have not been found since, thus the population is believed to have been eradicated. Populations also occur outside the area along Tomales Bay, in Point Reyes National Seashore, and in the Marin Headlands. It is also mapped in the eastern area of the town of San Rafael.

## Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | June 2020 | Kesel, R.; Greenberger, D. | EDRR Report published | | 1.0 |
| 1.1 | January 2022 | Greenberger, D. | Species profiles edited | Add caveats to explain undertreated species | 1.1 |

# Appendix 3. WHIPPET Analysis of Priority Two Species
# Version 1 (June 2020)

## INTRODUCTION

Vegetation managers across the Mt. Tamalpais region (Figure 1) manage dozens of invasive plant species each year under varying prioritization schemes. The One Tam collaborative has a ranking system for weeds in which agencies agree to treat all Priority One species (Appendix B) populations every year. On the other hand, an additional 39 species occur on the mountain in much wider, denser distributions, making it impossible to treat every patch every year with current and foreseeable funding resources.

THE **MT. TAMALPAIS REGION** DESCRIBES APPROXIMATELY 40,000 ACRES OF OPEN SPACE MANAGED BY THE PARTNERS OF THE ONE TAM COLLABORATIVE

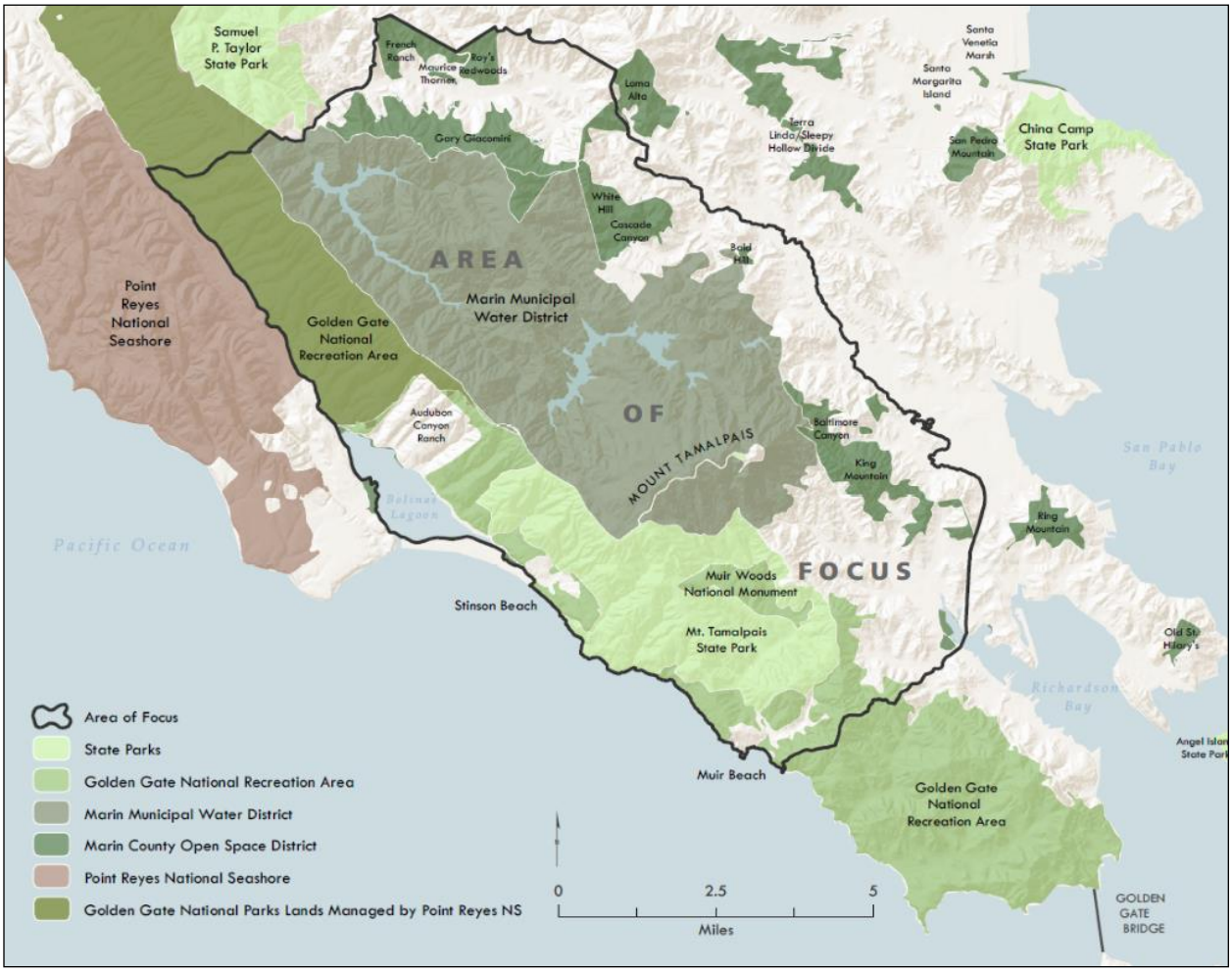



**Figure 1.** Four public agencies and a non-profit steward the lands of Mt. Tamalpais in Marin County, California. Together they form the One Tam collaborative. The Area of Focus in this map is also referred to as the Mt. Tamalpais region.

## WHIPPET TOOL

The Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET) provides land managers with a systematic approach to selecting weed targets for eradication (Skurka Darin et al. 2011). The tool evaluates a suite of criteria related to species traits, geographic location, and cost. WHIPPET analyzes geospatial data with weed and vector locations in conjunction with tabular data about species traits and costs using various scoring criteria (Figure 2).

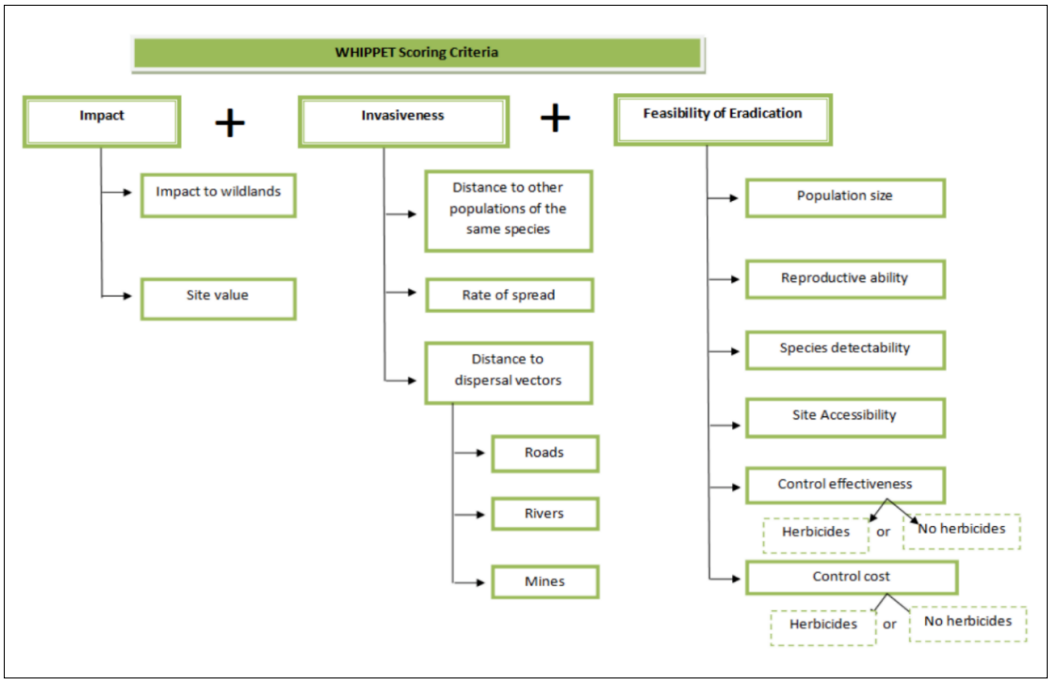



**Figure 2.** WHIPPET scoring criteria shown as a flow chart. (Skurka Darin 2011; Cal-IPC 2014)

Designed for use on California Department of Food and Agriculture's (CDFA) list of A-rated weeds (highest rating), WHIPPET offers a robust method of prioritizing infrequent weeds. Gina Darin worked with CDFA, the University of California, Davis, and the California Invasive Plant Council (Cal-IPC) to develop WHIPPET.

Five years into the One Tam partnership, most agency vegetation managers operate with an understanding of weed distributions on lands under their purview. Time constraints often preclude deeper analysis. With a survey of the road and trail network completed, One Tam took the opportunity to look at widespread weeds more holistically. WHIPPET offers a systematic framework for analyzing One Tam data.

In order to strategically assess invasive plant management strategies on the mountain, One Tam staff applied the WHIPPET tool to 32 widely distributed weed species across the Mount Tamalpais region. This analysis supports, but does not replace, vegetation management plans in place at any One Tam partner agencies. This supplemental approach to prioritization provides a regional perspective on weed distributions and management actions currently in progress.

Although WHIPPET provides some framing to a fundamental question—what species

should be managed and where?—it does not deliver a perfect list of weed patches to treat. The tool was originally designed for use on infrequently distributed species populations, and it seeks to rank the feasibility of eradication rather than mere control. One Tam used the tool for frequently distributed species where control is often the best-case outcome. While the tool design did not perfectly meet the needs of the One Tam prioritization, this heuristic approach delivered a useful framework for developing a regional strategy for widespread weed targets when paired with staff analysis.

## METHODS

Weed species occurrence data used for the WHIPPET analysis came from the Calflora Database, where One Tam agencies host the majority of their invasive plant data. The parameters used to export a working dataset included the following:

- Species is on the One Tam Priority Two species list (Table 1)
- Species is evaluated in the Cal-IPC Inventory
- Observation date is from 2009 through 2019
- Occurrences are within the Mt. Tamalpais region plus a one-mile buffer
- Data is included in a project within agency Calflora groups
- Search filtered by 'most recent' to produce one record per history stack

| Priority Two Species | |
|---|---|
| *Acacia melanoxylon* | *Genista monspessulana* |
| *Ageratina adenophora* | *Hedera canariensis* |
| *Arctotheca prostrata* | *Hedera helix* |
| *Calendula arvensis** | *Helichrysum petiolare* |
| *Centaurea solstitialis* | *Hypericum perforatum* |
| *Cortaderia jubata* | *Ilex aquifolium* |
| *Cortaderia selloana* | *Lathyrus latifolius** |
| *Cotoneaster franchetii* | *Leucanthemum vulgare* |
| *Cotoneaster lacteus* | *Ligustrum lucidum** |
| *Cotoneaster pannosus* | *Pennisetum clandestinum* |
| *Crataegus monogyna* | *Phalaris aquatica* |
| *Cytisus scoparius* | *Pittosporum crassifolium** |
| *Delairea odorata* | *Pyracantha angustifolia* |
| *Digitalis purpurea* | *Romulea rosea* var. *australis** |
| *Dipsacus fullonum* | *Rubus armeniacus* |
| *Ehrharta erecta* | *Rytidosperma caespitosum*** |
| *Eucalyptus globulus* | *Rytidosperma penicillatum* |
| *Euphorbia oblongata* | *Spartium junceum* |
| *Festuca arundinacea* | *Tradescantia fluminensis** |
| *Foeniculum vulgare* | |

**Table 1.** Priority Two species on the One Tam EDRR list.
*Species not covered by this prioritization because they do not appear in the Cal-IPC inventory.
**Species absent from the survey area and therefore not incorporated.

Several of the WHIPPET equation variables are drawn directly or indirectly from this dataset: population size, distance from nearest conspecific population, and difficulty of site access. Other variables are derived from assorted data sources (Table 2).

| Data | Use | Source |
|---|---|---|
| **Road and trail GIS layer** | Applied to vector spread model | Agency data |
| **Stream GIS layer** | Applied to vector spread model | Agency data |
| **Site value layer** | Ranks importance of occurrence based on overall value of geographic area in which it occurs | Agency data |
| **Species traits tabular data** | Ranks species traits such as rate of spread and treatment cost | WHIPPET |

**Table 2.** Data inputs for WHIPPET model.

Data downloaded from Calflora starts as a suite of three shapefiles for each species: points, lines, and polygons. The download contained over 15,000 records, each conceptually representing a mapped patch of weeds. Using ArcGIS, these patches were all converted to polygons and buffered by 30 meters, or roughly 100 feet. This distance was chosen as it had been successfully employed for the same purpose by the Bay Area Early Detection Network. The results were dissolved where overlap occurred to create a standardized representation of each plant's population distribution (Figure 3).

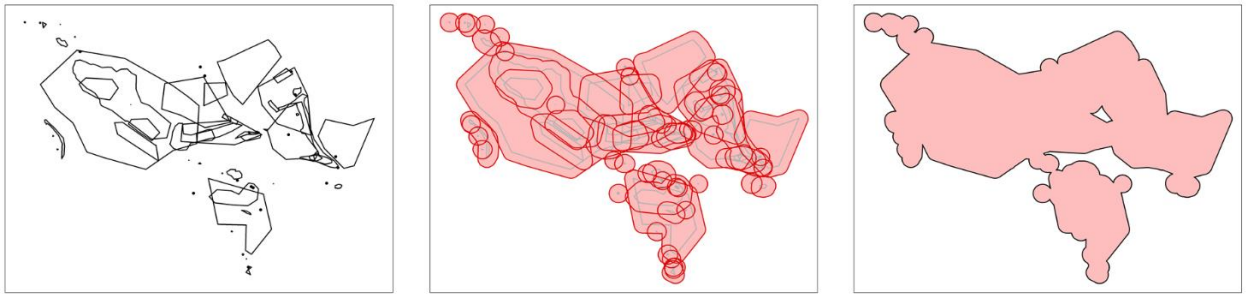
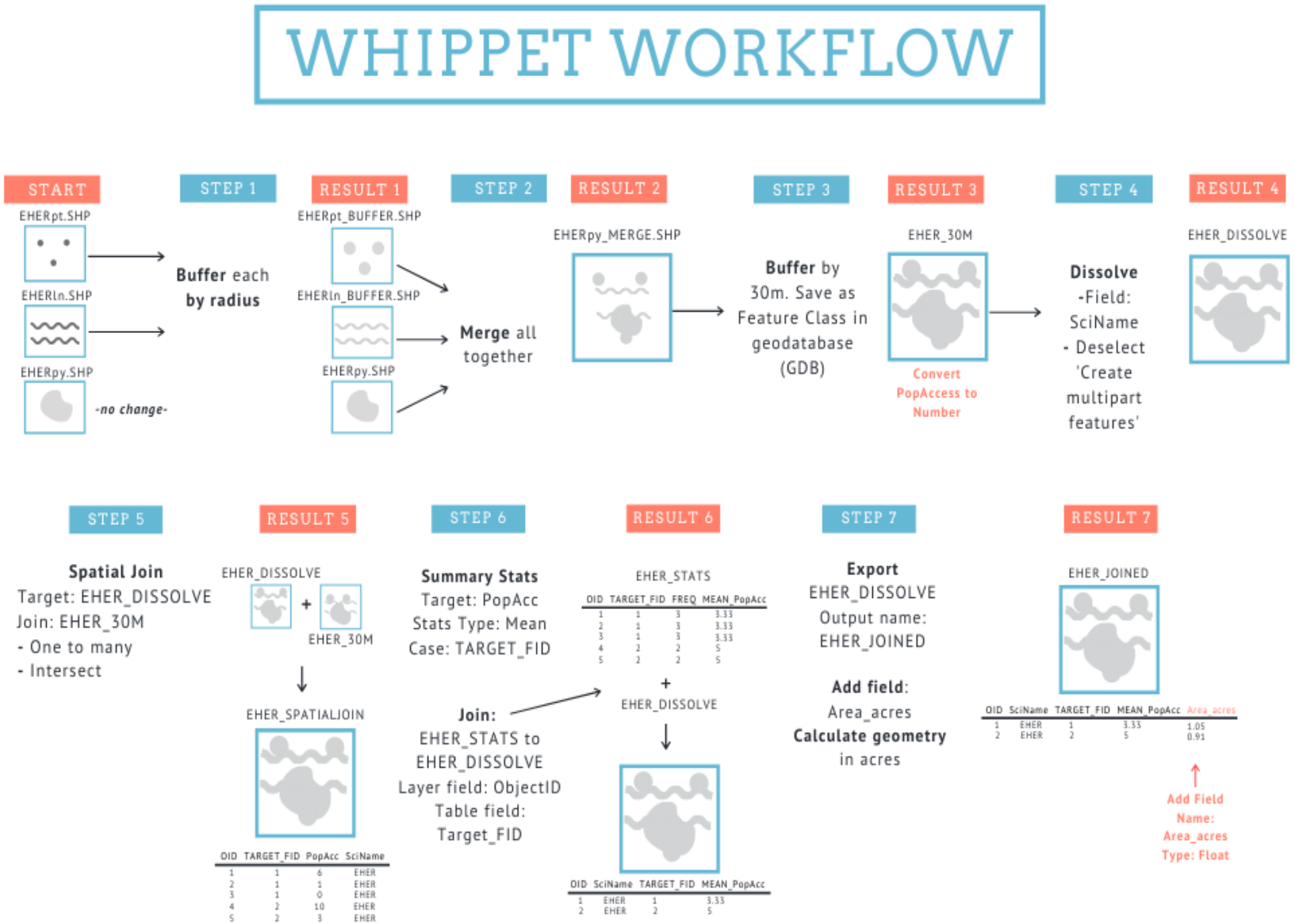


**Figure 3.** Converting occurrence data into populations. Panel 1 shows a localized cluster of 67 individually mapped records of *Ageratina adenophora* downloaded directly from Calflora. The overlapping, redundant nature of these features is incompatible with the concept of population prioritization. To solve this issue, the features were buffered by 30 meters (panel 2) and then dissolved into one single polygon representing a population of the weed (panel 3) that could be properly assessed.

This geospatial simplification brought the dataset down to under 6,000 records. These population polygons were used to calculate area, and the centroids of these polygons were used to calculate distances to nearest neighbor and to spread vectors. The tabular data was then run through the WHIPPET calculator in Microsoft Excel, resulting in a priority score for each population. An in-depth workflow for the steps leading up to the WHIPPET calculations is provided in Figure 4.


WHIPPET WORKFLOW
START
EHERpt.SHP
EHERln.SHP
EHERpy.SHP
-no change-
STEP 1
Buffer each by radius
RESULT 1
EHERpt_BUFFER.SHP
EHERln_BUFFER.SHP
EHERpy.SHP
STEP 2
Merge all together
RESULT 2
EHERpy_MERGE.SHP
STEP 3
Buffer by 30m. Save as Feature Class in geodatabase (GDB)
RESULT 3
EHER_30M
Convert PopAccess to Number
STEP 4
Dissolve
-Field: SciName
- Deselect 'Create multipart features'
RESULT 4
EHER_DISSOLVE
STEP 5
Spatial Join
Target: EHER_DISSOLVE
Join: EHER_30M
- One to many
- Intersect
RESULT 5
EHER_DISSOLVE
EHER_30M
EHER_SPATIALJOIN
OID TARGET_FID PopAcc SciName
1 1 6 EHER
2 1 1 EHER
3 1 0 EHER
4 2 10 EHER
5 2 3 EHER
STEP 6
Summary Stats
Target: PopAcc
Stats Type: Mean
Case: TARGET_FID
Join:
EHER_STATS to EHER_DISSOLVE
Layer field: ObjectID
Table field: Target_FID
RESULT 6
EHER_STATS
OID TARGET_FID FREQ MEAN_PopAcc
1 1 3 3.33
2 1 3 3.33
3 1 3 3.33
4 2 2 5
5 2 2 5
EHER_DISSOLVE
OID SciName TARGET_FID MEAN_PopAcc
1 EHER 1 3.33
2 EHER 2 5
STEP 7
Export
EHER_DISSOLVE
Output name:
EHER_JOINED
Add field:
Area_acres
Calculate geometry
in acres
RESULT 7
EHER_JOINED
OID SciName TARGET_FID MEAN_PopAcc Area_acres
1 EHER 1 3.33 1.05
2 EHER 2 5 0.91
Add Field Name: Area_acres Type: Float

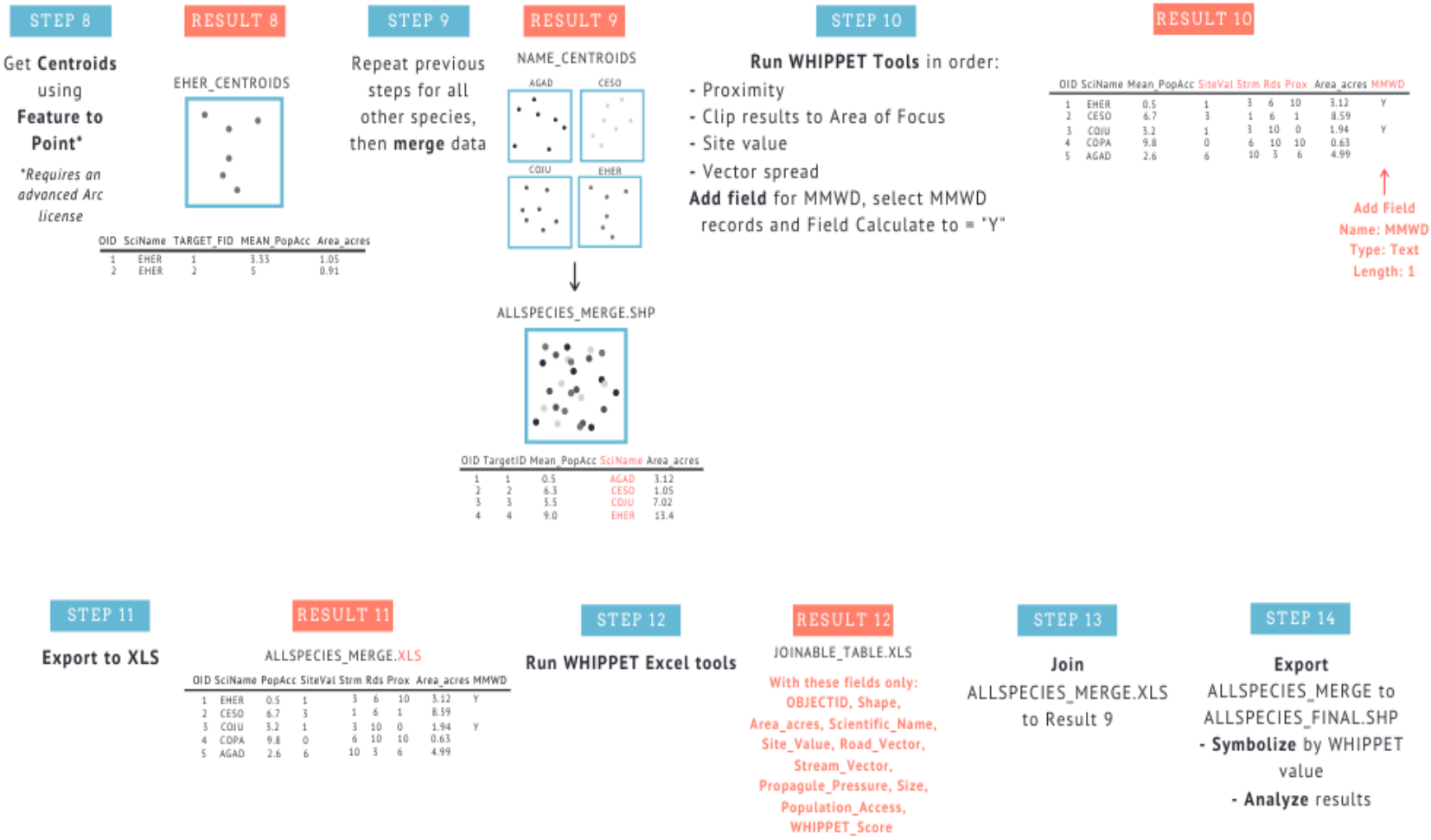



**Figure 4.** GIS workflow for dissolving discretely mapped patches into polygons for use in the WHIPPET tool. This workflow allows the user to retain valuable attribute data stored in the Calflora system.

## LIMITATIONS AND SOURCES OF ERROR

While WHIPPET incorporates a host of important criteria, it does not include every factor a land manager may consider important. Criteria excluded from the WHIPPET model include topography, population management status, and the presence of high-value resources, except as is captured by site values. Site values were developed by each agency, not as a collaborative. Furthermore, the tool does not account for the cost savings of initiating work within active restoration sites, or any other site-specific priorities.

- Calflora export
    - Some point and line records have blank gross area.
        - Resolution: Populate radius to equal one meter and recalculate area.
    - History stacking, a Calflora technique, is lacking across the dataset.
        - Resolution: Records that belong in a history stack are assimilated into a single population through the buffer + dissolve process.
    - A small subset of records represents absence data.
        - Resolution: Staff analysis of WHIPPET results should reveal any of these records, which can be eliminated from the prioritization.
- GIS Exercises/choices
    - Buffer distance of 30 meters chosen out of heuristic simplicity and in consultation with local ecologists.
    - Patches within a single population often have different site access values.
        - Resolution: Calculate the mean in these cases.
- WHIPPET
    - Preset calculators use inappropriate distances for The Mt. Tamalpais region.
        - Resolution: Alter code blocks to use smaller, more appropriate distances.
    - Tool uses centroid points to rank distance from conspecific neighbor and spread vectors. Population edges may in fact be far closer together than centroids.
    - Topography is not factored into the calculation.
    - Management status is not factored into the calculation.
- Data In
    - Site value scores are determined subjectively and vary dramatically across agencies in size and precision.
    - No single road and trail dataset for the area is both comprehensive and entirely accurate.

## RESULTS

Theoretically, the WHIPPET equation can produce scores between 0 and 10. High scores connote high priority and high feasibility of patch eradication, while low scores connote the opposite. In total, 5,373 total invasive species populations were assessed through the tool.

A population of *Foeniculum vulgare* claimed the highest score of the entire dataset at 8.28. A *Euphorbia oblongata* population took the lowest score at 2.97. Between those two bounds, the scores showed an approximately normal distribution (Figure 5).

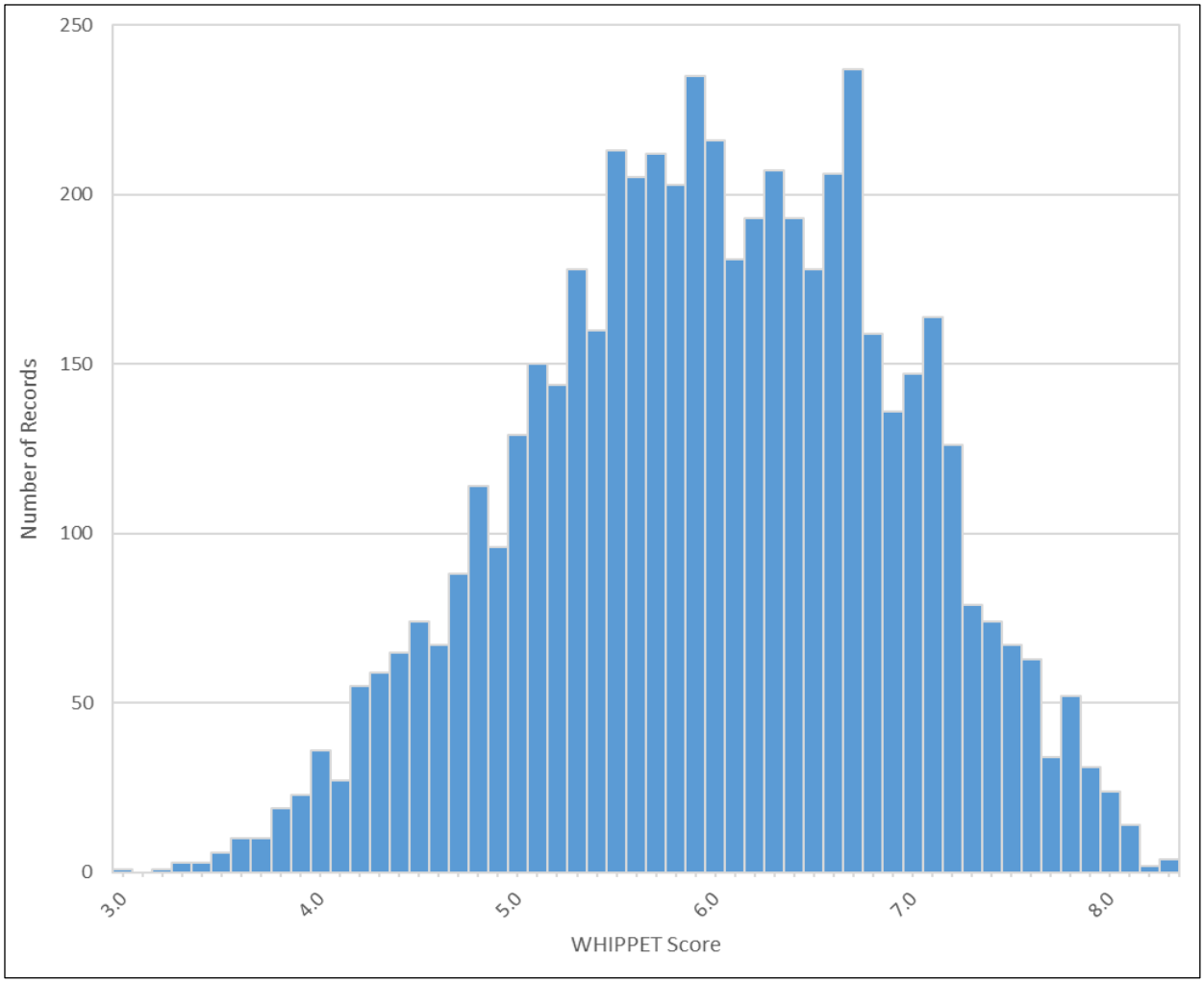



**Figure 5.** WHIPPET Score distribution histogram. n = 5,373

Several species clearly rose to the top of the rankings. *Cortaderia jubata*, for example, occupied 45 of the top 100 scores, *Hedera helix* and *Hedera canariensis* taken together accounted for 24, and *Rubus armeniacus* another 15. These four plus *Cortaderia selloana* made up the top 5 species in average score (Table 3). Notable among species at the bottom of average scoring is *Helichrysum petiolare*, the regional significance of which is perhaps understated by the tool.

| Species | Min | Max | Mean |
|---|---|---|---|
| *Cortaderia jubata* | 4.74 | 8.25 | 6.84 |
| *Cortaderia selloana* | 6.06 | 7.47 | 6.78 |
| *Hedera canariensis* | 5.17 | 7.97 | 6.63 |
| *Hedera helix* | 4.79 | 8.20 | 6.57 |
| *Rubus armeniacus* | 4.86 | 8.06 | 6.54 |
| *Genista monspessulana* | 4.27 | 7.80 | 6.45 |
| *Foeniculum vulgare* | 4.97 | 8.28 | 6.44 |
| *Delairea odorata* | 4.97 | 7.94 | 6.39 |
| *Ilex aquifolium* | 5.28 | 7.77 | 6.37 |
| *Arctotheca prostrata* | 5.17 | 7.24 | 6.29 |
| *Cytisus scoparius* | 4.22 | 8.05 | 6.23 |
| *Cotoneaster pannosus* | 4.53 | 7.67 | 6.04 |
| *Cotoneaster franchetii* | 4.34 | 7.41 | 6.03 |
| *Cotoneaster lacteus* | 5.17 | 7.48 | 6.02 |
| *Leucanthemum vulgare* | 4.77 | 6.94 | 5.86 |
| *Spartium junceum* | 4.74 | 7.46 | 5.86 |
| *Dipsacus fullonum* | 4.49 | 6.94 | 5.76 |
| *Ageratina adenophora* | 4.53 | 7.12 | 5.74 |
| *Pyracantha angustifolia* | 4.44 | 7.35 | 5.55 |
| *Hypericum perforatum* | 5.01 | 6.22 | 5.52 |
| *Eucalyptus globulus* | 3.72 | 7.18 | 5.51 |
| *Phalaris aquatica* | 3.86 | 7.04 | 5.45 |
| *Centaurea solstitialis* | 3.29 | 6.96 | 5.39 |
| *Pennisetum clandestinum* | 4.17 | 6.40 | 5.35 |
| *Ehrharta erecta* | 3.29 | 6.79 | 5.26 |
| *Crataegus monogyna* | 3.84 | 6.80 | 5.18 |
| *Acacia melanoxylon* | 3.55 | 6.66 | 4.97 |
| *Festuca arundinacea* | 3.32 | 6.32 | 4.88 |
| *Rytidosperma penicillatum* | 3.20 | 6.08 | 4.80 |
| *Digitalis purpurea* | 3.43 | 6.08 | 4.77 |
| *Helichrysum petiolare* | 3.34 | 6.07 | 4.66 |
| *Euphorbia oblongata* | 2.97 | 6.11 | 4.50 |

**Table 3.** WHIPPET statistics for all species evaluated in the assessment, sorted by mean score.

WHIPPET scores for populations on MMWD land are consistently lower than on any other agency's land, due to the WHIPPET evaluation of treatment effectiveness and cost when chemical methods are not an option. This has a damping effect on a given species' minimum and mean scores that must be considered when interpreting the analysis on a regional level.

# RECOMMENDATIONS BY SPECIES



After running the WHIPPET tools, staff analyzed the results toward a deeper prioritization and synthesis. Because WHIPPET evaluates populations by species, this analysis takes a similar approach. Congeneric species, including those in *Cortaderia*, *Cotoneaster*, and *Hedera*, were assessed together in their respective groups. Due to similarities in invasiveness and treatment strategy, the three brooms are also grouped into a single profile despite hailing from different genera.

While One Tam has found a workable goal for managing Priority One early detection species widespread weeds require deeper consideration. These recommendations and

the map products offer a starting point for collaborative discussion of a regional strategy for widespread weed management. These products provide a regional-scale perspective on species distributions and treatment to date. Despite strong collaboration on weed management, most One Tam partner staff do not work across jurisdictions enough to carry an understanding of weed distributions beyond their agency borders. The EDRR survey of the road and trail network provided an opportunity to synthesize this information toward a regional strategy.

## HOW TO USE THIS ANALYSIS

Each species account includes a repeating framework with the following components.

- Species description
- Regional distribution
- Map
- WHIPPET score
- Recommended treatment strategy
- Future management recommendations

To learn more about a species, follow the hyperlink to the Cal-IPC profile page. Each of those webpages contains a link to the Weed Control in Natural Areas in the Western United States (DiTomaso et al. 2013) for treatment options. This document covers those topics lightly in favor of focusing on a regional control strategy. Staff considered treatment options limitedly during the prioritization.

Some terminology in this report requires definition for clarity. Like applying a heuristic model to invasive plant data, the use of terms including region, patch and population comes with tradeoffs. For the purposes of this analysis, region refers to the One Tam area of focus. Patch refers to the data derived from dissolving overlapping records exported from Calflora. The term population refers to the buffered and dissolved data, as described in the Methods section. Eradication refers to the reduction of a population of invasive plants to zero plants for at least five years.

With this framework in place, staff analyzed species populations using the WHIPPET scores and management status. The team also used their knowledge of sites including topography and the presence of sensitive species or habitats. An understanding of staffing resources and agency priorities also informed the prioritization. Treatment limitations range from prohibitions on chemical treatments on MMWD land to access limitations on roadsides. These considerations also factored into the overall treatment strategies presented here.

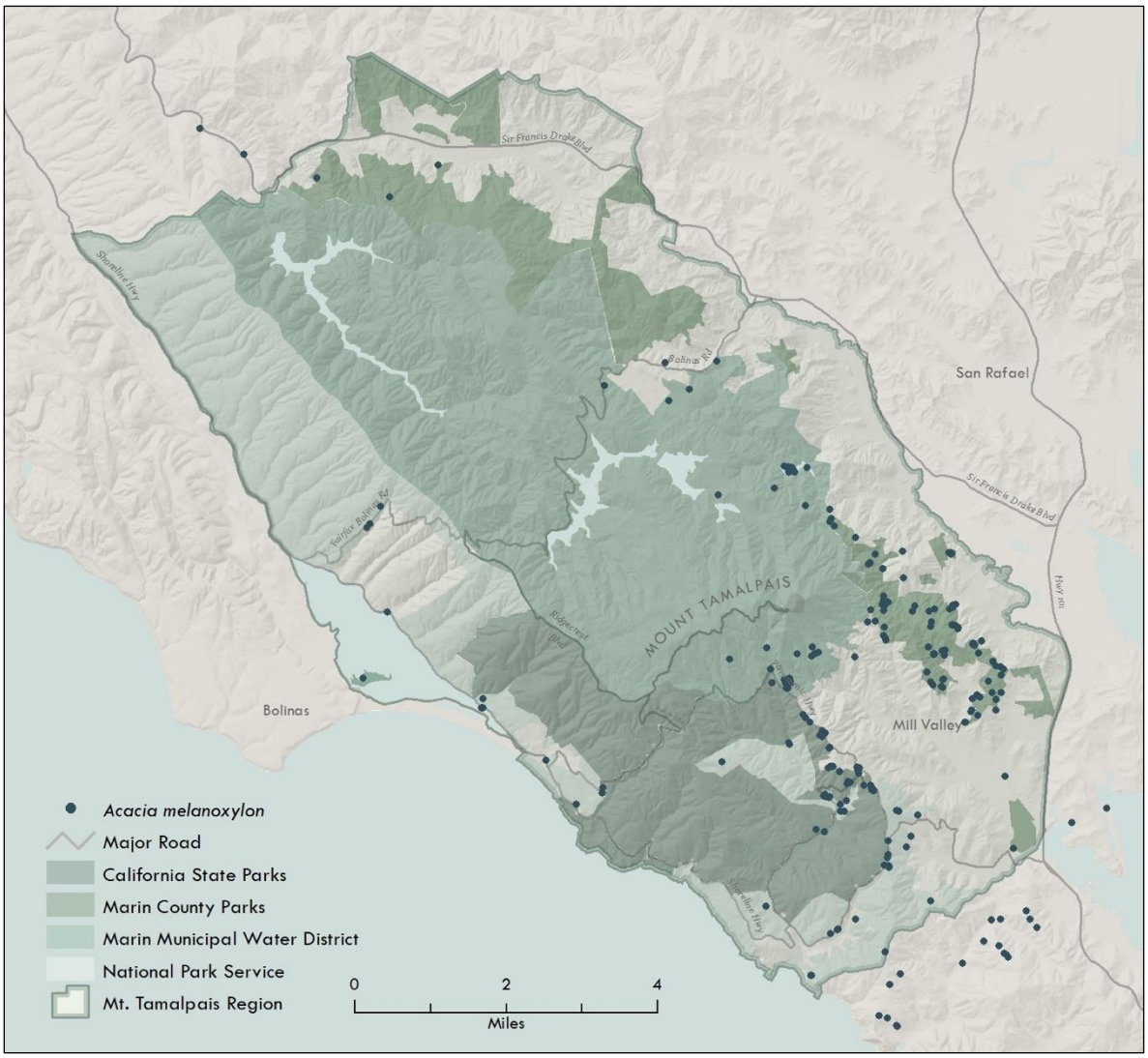
Maps are included to provide an overview of the regional distribution of each species or genus grouping when species are lumped. For those who want to zoom in to the patch level data, a map package will follow this report. One Tam staff will present the results and demonstrate how to navigate the geodatabase and map products. Similarly, all source data for this report are permanently available in the Calflora Database.

# ACACIA MELANOXYLON

## Family: Fabaceae
## Cal-IPC Rating: Limited

A popular and swift-growing tree, *Acacia melanoxylon* (blackwood acacia) is a common ornamental on private lands. Planted stands of blackwood acacia may encroach into wildlands. With heavy seeds and clonal growth, spread tends to occur incrementally from established plantings. This species can have long-lasting soil impacts through allelopathy and nitrogen fixation.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 165 | 129 | 28.24 |

This species occurs from Coyote Ridge in the south to Gary Giacomini Preserve in the north. It has populations as far west as Kent Island and as far east as King Mountain. Despite this distribution in all quadrants of the region on each agency's land, the species clusters south of the peaks and skews more inland than coastal.

Treatment history of this species includes work on all agency lands. State Parks has undertaken extensive treatment east of Muir Woods. NPS has treated areas near Diaz and Coyote Ridges as well as on lands near the Muir Beach and Stinson Beach communities. MMWD has treated patches south of the peaks, often in the course of fuel reduction work. MCP has treated patches at Gary Giacomini and Kings Mountain. This leaves extensive populations at the Blithedale Summit/Baltimore Canyon complex as well as on MMWD lands and near Homestead Valley on NPS land.

## WHIPPET Scores

### 3.55 – 6.70

Concentrations of high scores occur north of Audubon Canyon ranch on NPS land (treated) as well as in the northwest corner of Muir Woods (untreated). Populations at the north end of Green Gulch (treated) and at the north end of Gary Giacomini (unknown treatment history) also rank highly. Other high scores include scattered areas in the Blithedale Summit area (untreated). Outliers on MMWD do not rank highly, likely because treatment costs for eradication are very high for this species without chemical treatment options.

## Recommended Treatment Strategy

Treat in high-value areas.

Justification: The incremental spread of this species allows for a measured approach. Treatment options on MMWD land are highly limited. This approach aligns with current management status, which can protect valuable resources.

## Future Management Recommendations

### MCP

- Continue treatment in Gary Giacomini.

### MMWD

- Treat as indicated by site-specific priorities.

### NPS

- Continue treatment on Green Gulch and Bolinas-Fairfax Road populations.
- Initiate treatment on Muir Woods population.

### State Parks

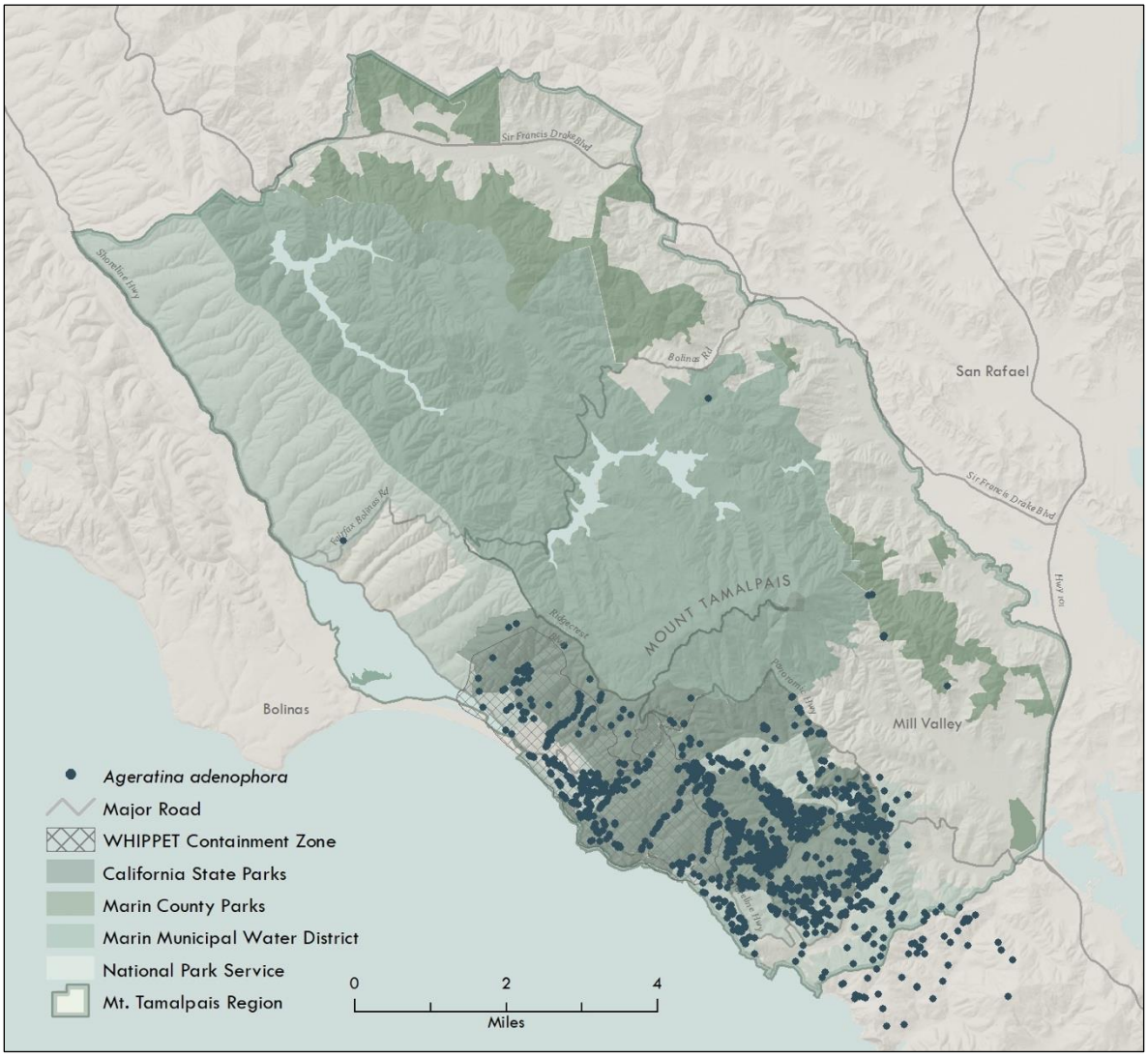
- Continue treatment east of Muir Woods.

# AGERATINA ADENOPHORA

## Family: Asteraceae
## Cal-IPC Rating: Moderate

*Ageratina adenophora* (thoroughwort) is a perennial subshrub native to Mexico. Its introduction to California via the horticultural trade nearly 100 years ago has led to multiple escapes and establishments along the southern half of the state's coast. Marin County is the northernmost reported station for this species, lending a special import to the broader conservation implications of regional management. Thoroughwort is a moisture-loving plant, and as such it shows high fidelity to coastal fog zones and riparian systems. Apomictic reproduction and wind-dispersed seeds readily spread this species on Mt. Tamalpais' coast-facing slopes and in disturbed lowlands.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 1,174 | 479 | 184.37 |

Thoroughwort is largely confined to the southern end of the Mt. Tamalpais region, where foggy coastal scrub provides its favored habitat. Almost all populations lie in the Redwood Creek Watershed or the slopes below the Ridgecrest grasslands. Outliers beyond these confines are of highest management importance.

The northernmost occurrence in California was detected in 2008 on NPS land just north of the Mt. Tamalpais region—this patch was treated and has since been confirmed eradicated (zero plants found in 2018). MMWD's only known occurrence, a single plant in the Fairfax Hills area, was removed in 2016 and is under annual surveillance. The westernmost known population, another single plant along Bolinas-Fairfax Road on NPS land, was detected and removed in 2018. Four MCP populations have been mapped in the Blithedale/Baltimore Canyon region and are largely under management.

Significant infestations have been mapped in several Bolinas Ridge gulches, but not every gulch has been surveyed. It's possible that this species is more widespread than currently mapped on Bolinas Ridge.

## WHIPPET Scores

4.53 – 7.12

Thoroughwort scores fall in the lower, middle, and upper tiers of all rankings. Clusters of high scores are mainly found in and around Muir Woods. The 10 highest scores are all under management already by agency or One Tam staff.

## Recommended Treatment Strategy

Continue treatment and annual monitoring of northern outliers. Initiate treatment of populations in Ridgecrest grasslands. Institute containment downslope of these grasslands from the forest boundary all the way to the coast. Continue Redwood Creek management according to collaborative goals, with an emphasis on keeping the species out of Muir Woods.

Justification: Outliers beyond the major infestation are good targets for eradication. The proposed containment zone circumscribes dozens of large unmanaged populations, along with some areas of focused management—reintroduction potential is inescapable at the current level of treatment effort.

## Future Management Recommendations

### MCP

- Verify status of Blithedale Summit/Baltimore Canyon complex populations. If extant plants are found, initiate or continue treatment.

### MMWD

- Continue annual surveillance of lone population on Concrete Pipe Road until eradication status is achieved.

## NPS

- Continue annual surveillance of Bolinas-Fairfax Road population until eradication status is achieved.
- Defer action north and east of Stinson Beach.
- Treat populations within containment zone according to agency directives.
- Continue follow-up in Muir Woods.
- Survey Bolinas Ridge drainages to determine true extent.

## State Parks

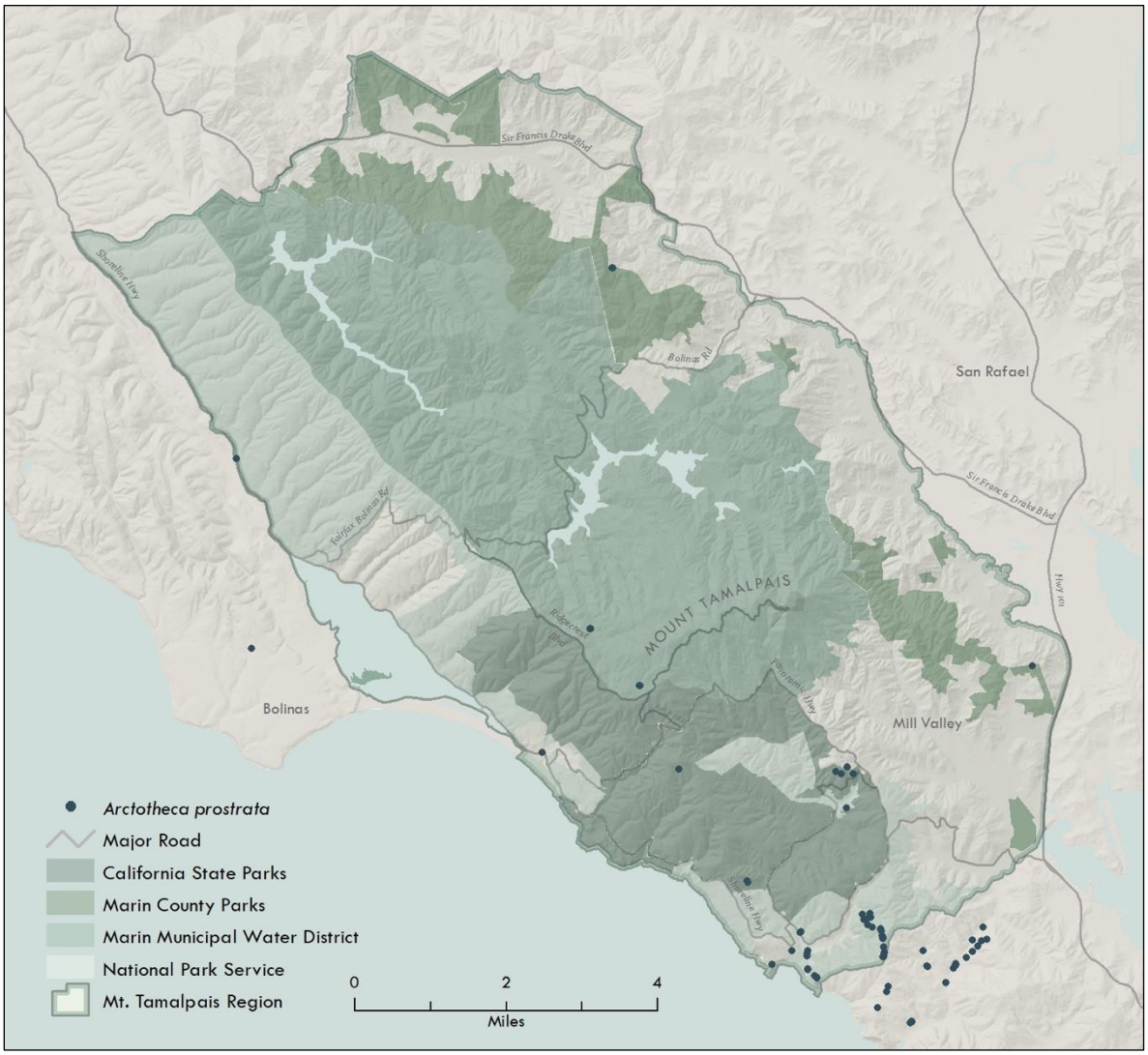
- Initiate treatment on all unmanaged populations in and around Ridgecrest grasslands.
- Continue follow-up and monitoring on all previous managed populations in and around Ridgecrest grasslands.
- Establish containment line approximately at grassland-forest interface below Ridgecrest.

# ARCTOTHECA PROSTRATA

## Family: Asteraceae
## Cal-IPC Rating: Moderate

*Arctotheca prostrata* (prostrate capeweed) is a creeping herb native to South Africa. This species is widely used in landscaping as a low-maintenance groundcover due to its rosette-forming habit with fast-spreading stolons. Escapes occur exclusively via fragmentation and vegetative spread—prostrate capeweed flowers are infertile. As such, most detections occur near buildings and residential areas where it had been planted, and along heavily trafficked trails.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 45 | 27 | 0.97 |

This species is widespread in the Marin Headlands, and its northward thrust extends into the Mt. Tamalpais region most densely around Coyote Ridge and Muir Beach. Other blips appear around the mountain's periphery, but very few occurrences are known from undisturbed interior habitat.

## WHIPPET Scores

### 5.17 – 7.24

Several uppermost scores, including the highest overall mark, belong to populations either on private property. The highest-scoring population in a wildland setting is in a weedy spring along Dipsea Trail above Lone Tree Creek.

## Recommended Treatment Strategy

Treat in high-value areas only.

Justification: Prostrate capeweed has significant impacts to wildlands but has trouble reaching them in the first place. Low-quality habitats such as heavily compacted trailsides, historic homesteads, and neighborhood lawns host the bulk of this plant's distribution in the region.

## Future Management Recommendations

### MCP

- None

### MMWD

- Continue follow-up treatment on Rock Spring population.

### NPS

- Continue early detection in the Muir Beach area to prevent encroachment into California red-legged frog habitat.

### State Parks

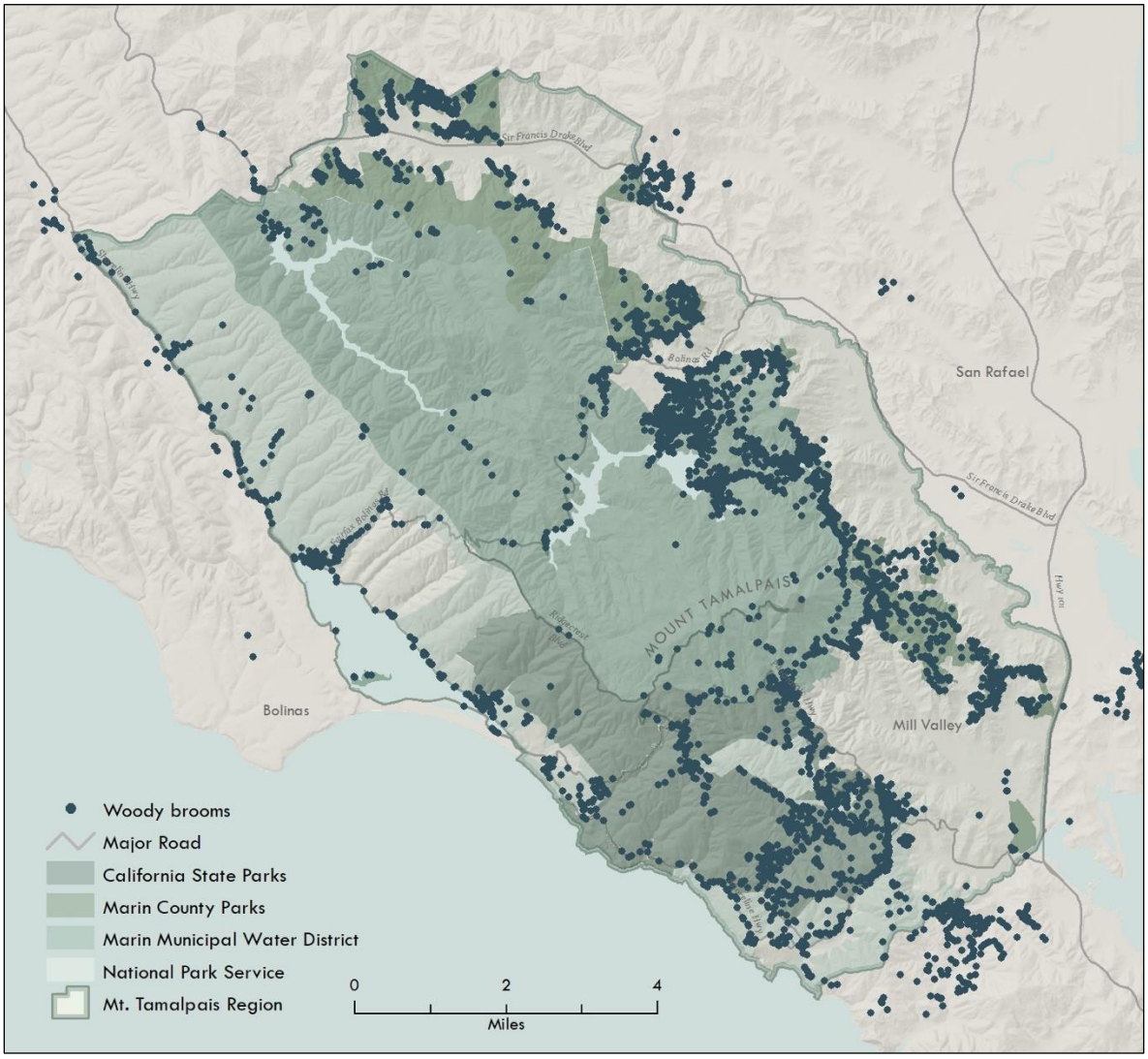
- Assess feasibility of management at Dipsea Trail population—several other high-scoring weed patches occur at that locality that may merit treatment, including *Foeniculum vulgare, Hedera spp.,* and *Cotoneaster pannosus*. Consider entire suite together.

# BROOMS

## Family: Fabaceae
## Cal-IPC Rating: High

Four broom species occur in the Mt. Tamalpais region. The EDRR collaborative classifies one of them, *Cytisus striatus* (Portuguese broom), as a Priority One species. Priority Two broom species include *Cytisus scoparius* (Scotch broom), *Genista monspessulana* (French broom), and *Spartium junceum* (Spanish broom). For the purposes of the WHIPPET prioritization, these three species are lumped for analysis. The brooms readily invade grassland, woodland, disturbed areas, and coastal scrub, creating dense infestations and deep, long-lived seedbanks. Like many species in *Fabaceae*, these shrubs fix atmospheric nitrogen, enriching soil to the disadvantage of many native species (Haubensak et al. 2004). These legacy effects persist after broom removal.

### Regional Distribution



## Occurrence Details

| | Patches | Populations | Gross Acres |
|---|---|---|---|
| *Cytisus scoparius* | 475 | 200 | 191.26 |
| *Genista monspessulana* | 1,262 | 477 | 3,710.16 |
| *Spartium junceum* | 63 | 37 | 51.72 |

Well-known in Marin, French broom has an oppressive reach in the Mt. Tamalpais region. While the eastern and southern portions of the region have the most extensive populations, this species occurs throughout the area, often in large, contiguous populations. Scotch and Spanish brooms cover far fewer acres, concentrating inland, often mixing with French broom.

These species are well-mapped by surveyors and treatment staff. Special efforts to map broom include a five-year cycle at MMWD to map all broom on the watershed.

Treatment of broom species is highly prioritized by agency staff. Rigorous plans exist for MMWD and MCP lands. Many of the broom populations on NPS land are under routine management, as evidenced by the data from Calflora. All agencies have some areas under management and some in a deferred action or containment status, often along inaccessible roadsides.

## WHIPPET Scores

*Cytisus scoparius* 4.23 – 8.05
*Genista monspessulana* 4.27 – 7.80
*Spartium junceum* 4.74 - 7.46

Somewhat surprisingly, all three brooms have populations in the high and middle tiers. High scores do not cluster tightly as they only occur on populations under 5 square meters and out of range of other broom populations. All scores over 7.5 are under management, unless they are on Panoramic Highway or Highway 1 roadsides. This indicates that land managers have rigorously prioritized their broom management. One area that emerges as having interrupted management and a higher priority is the band from approximately Bootjack to Pantoll Campground, mostly above Panoramic Highway and up toward the hairpin on Pan Toll Road.

## Recommended Treatment Strategy

Proceed with existing agency prioritization plans. Consider undertaking deeper analysis of populations along property boundaries, including the area along Panoramic Highway from Bootjack to Pantoll.

## Future Treatment Recommendations

### All Agencies

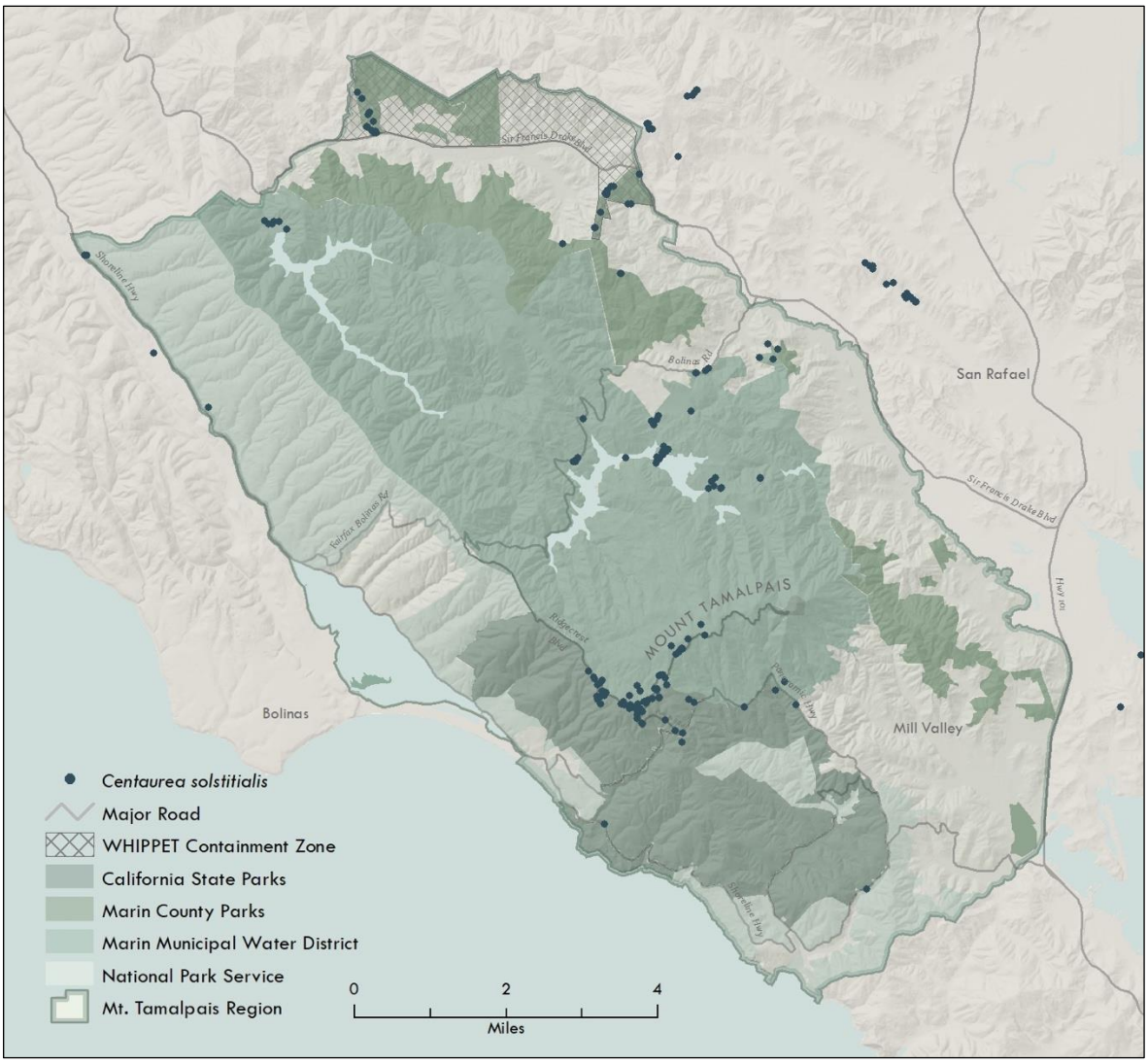
- Continue treatments on EDRR surveys

# CENTAUREA SOLSTITIALIS

## Family: Asteraceae
## Cal-IPC Rating: High

*Centaurea solstitialis* (yellow starthistle), a spiny annual forb from the Mediterranean, is considered one of the costliest invasive plants in California. It spreads readily in grasslands, disturbed areas, and along roads and trails through scrub and woodland habitats. This propensity for spreading along roadways challenges rapid response efforts as populations on winding roads are difficult to manage safely.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 145 | 59 | 190 |

Yellow starthistle ranges through all quadrants of the region with a strong concentration near the top of the mountain at West Peak and the sweeping grasslands of West Ridgecrest Boulevard. Smaller populations are found in grasslands and roadsides on the south side of the mountain as well as the Alpine and Bon Tempe lakes areas of MMWD. Further populations are found on White Hill, Peters Dam, and on French Ranch Preserve.

Most populations of yellow starthistle are under management with some exceptions on Marin County Parks land near Sir Francis Drake Boulevard. Considerable unmanaged populations occur on private land as well.

## WHIPPET Scores

3.29 – 6.96

Yellow starthistle scores fall into the middle and lower tiers.

## Recommended Treatment Strategy

Contain yellow starthistle north of Sir Francis Drake as far east as Woodacre. There, use the large open grassland of White Hill as a line, managing all populations to the south.

Justification: This approach largely aligns with current management practice. The containment zone leaves several small patches along White Hill Fire Road unmanaged. These patches are adjacent to larger, uncontrolled patches on private land which are likely to remain unmanaged. Without coordination with those private properties, drawing the line at Sir Francis Drake would likely prove aspirational.

## Future Management Recommendations

### MCP

- Continue management of new patches in White Hill Preserve.
- Initiate treatment on Bald Hill Preserve to tie in with MMWD efforts to the west.

### MMWD

- Continue follow-up treatments on all patches.

### NPS

- Continue follow-up treatments on all outlier patches.

### State Parks

- Initiate treatment on roadside population on lower Pantoll Road.
- Continue follow-up treatments on all other populations.

### Critical Collaboration Zones

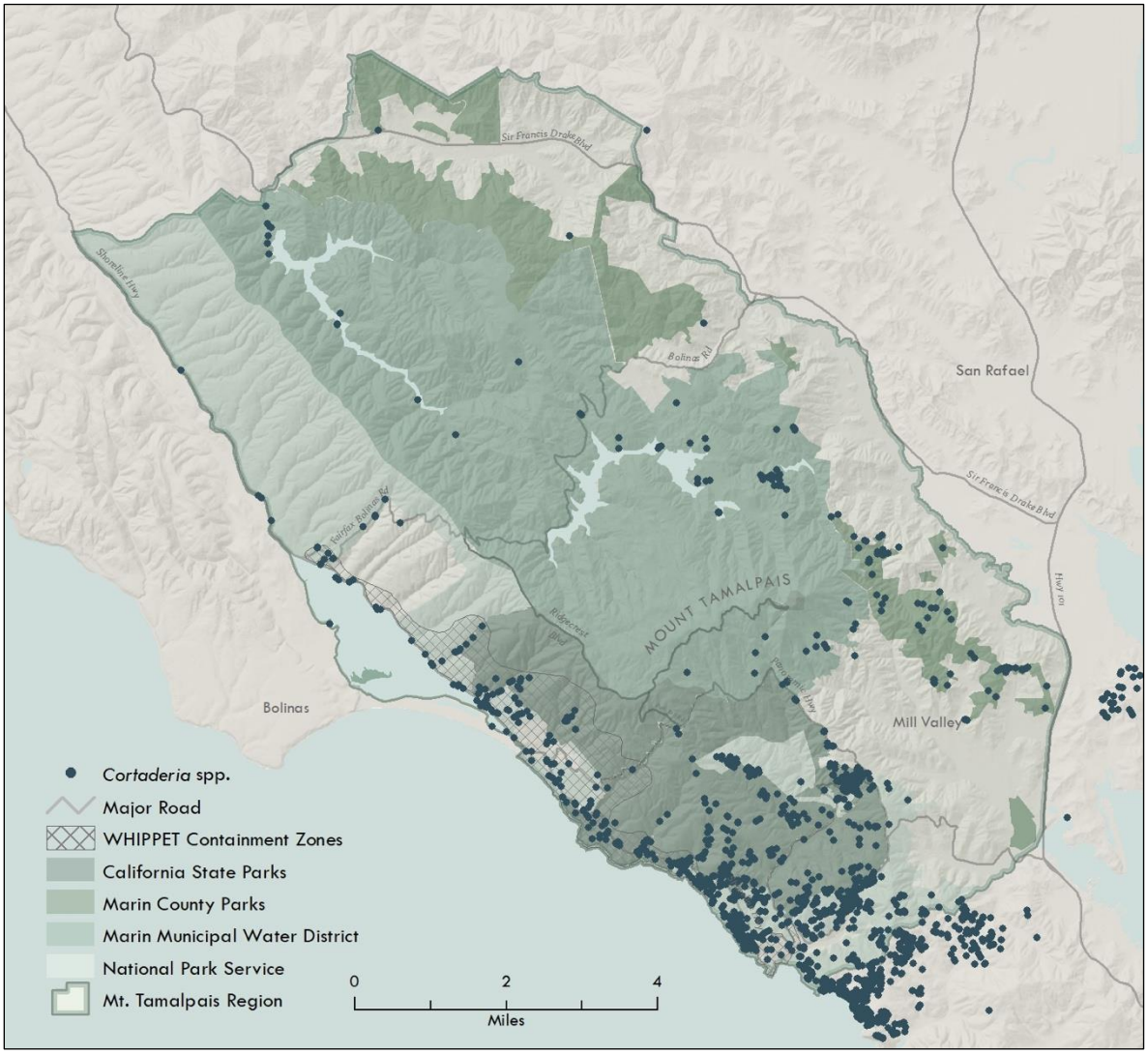
- Continue One Tam coordination of treatments of West Ridgecrest Boulevard to ensure all populations on all agency lands are treated annually.
- Consider collaborative approach to Bald Hill initial treatment.

# CORTADERIA SPP.

## Family: Poaceae
## Cal-IPC Rating: High

*Cortaderia jubata* (jubata grass) and *Cortaderia selloana* (pampas grass) are large perennial bunchgrasses from South America. Despite significant differences in morphology and reproductive biology, the two taxa are similar-looking, frequently confused, and managed in the same way—therefore they are treated together in one profile herein.

### Regional Distribution



## Occurrence Details

| | Patches | Populations | Gross Acres |
|---|---|---|---|
| *Cortaderia jubata* | 988 | 445 | 128.04 |
| *Cortaderia selloana* | 18 | 15 | 0.65 |

These plants flourish along the coastline and move inland wherever conditions are mild and moist. Mt. Tamalpais is no exception—jubata grass is a fixture of coastal bluffs and grasslands in the southwest quadrant of the region, but also ventures toward the interior to sporadically inhabit lakeshores, drainages, springs, and foggy exposures. These plants readily escape from horticultural installations and are seen densely represented within the wildland-urban interface east of the mountain's peak and around coastal hamlets like Stinson Beach. High potential for reintroduction from private lands and other untreated populations should be considered in all management planning for jubata and pampas grass.

## WHIPPET Scores

*Cortaderia jubata* 4.74 – 8.25

*Cortaderia selloana* 6.06 – 7.47

Jubata and pampas grass populations make up a huge proportion of the overall top scores irrespective of species. These high scores cluster in geographic areas that have been assigned high site values—Muir Woods, Lone Tree/Cold Stream, and Dias Ridge especially. High-scoring populations in Baltimore Canyon and Blithedale Summit require management status verification.

## Recommended Treatment Strategy

Continue follow-up treatments where populations are at maintenance level. Initiate new treatment only in highest-value habitats. Where possible, prioritize tops of watersheds over bottoms.

Justification: Many populations of jubata and pampas grass, unfortunately, exist in a variety of untreatable conditions. Some have found purchase on near-vertical coastal cliffs, and others are peppered throughout the landscaping of private residences. These plants will likely always exist as source material for reintroduction, and as such, the best-case outcome for adjacent patches is at the level of maintenance rather than eradication.

Jubata and pampas grass have a long history of devoted management in the region and many populations are already at maintenance level. The Redwood Creek Watershed and areas south of it have been extensively managed and we recommend that these efforts continue. For sporadic interior patches, rapid response is recommended, especially in instances where sensitive habitat or rare plant impacts are present such as serpentine chaparral and grasslands.

## Future Management Recommendations

### MCP

- Verify management status of high-scoring populations in the Blithedale Summit/Baltimore Canyon complex before moving forward with prioritization.
- Follow up on managed population in high-value habitat at French Ranch.
- Defer action in Alto Bowl and Camino Alto.
- Continue to treat new or small patches during EDRR surveys.

### MMWD

- Continue follow-up on maintenance-level populations at Filter Plant and Peters Dam.
- Continue follow-up on populations in high-value habitats at Azalea Hill, Old Stage Fire Road, and Kent Lake shoreline.
- Initiate treatment on Matt Davis Trail population – contractors likely necessary.
- Follow up on managed one-off populations such as those around Hoo-Koo-E-Koo and Double Bowknot opportunistically during adjacent fieldwork or during EDRR surveys.
- Continue to treat new or small patches during EDRR surveys.

### NPS

- Follow up on managed population in high-value habitat toward upper end of Bolinas-Fairfax Rd.
- Continue maintenance-level management in Redwood Creek Watershed.
- Verify management status of populations near Stinson Beach before attempting prioritization. In the meantime, institute containment around coastal corridor from Bolinas Lagoon to Slide Ranch.

### State Parks

- Initiate treatment at two small populations in high-value serpentine habitat just west of Pantoll Campground.
- Continue maintenance-level management in Redwood Creek Watershed.
- Institute containment to keep plants out of Ridgecrest grassland complex.
- Assess feasibility of treating populations in high-value habitats in Lone Tree Creek and Cold Stream Creek.
- Continue to treat new or small patches during EDRR surveys.

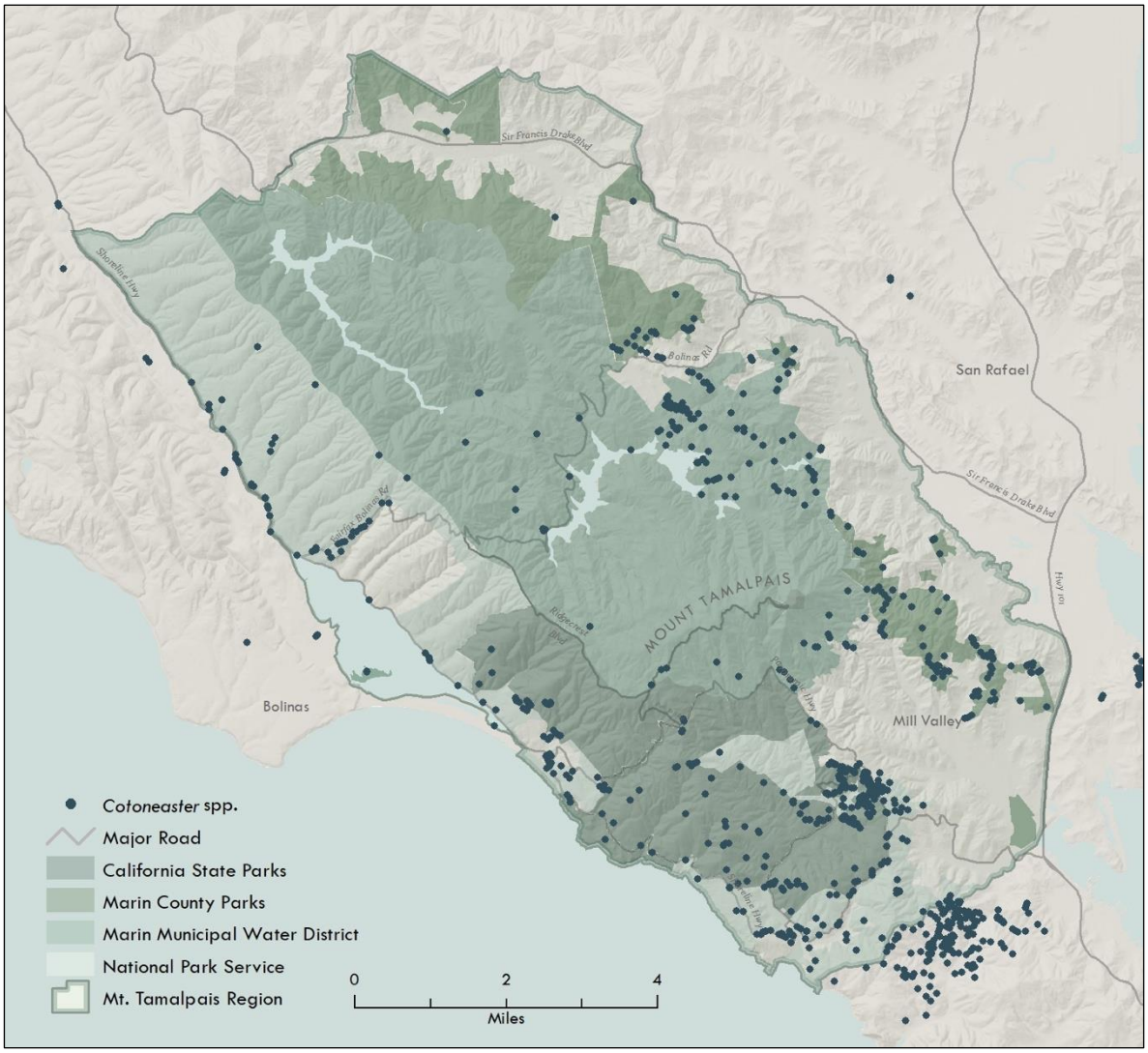
# COTONEASTER SPP.

## Family: Rosaceae
## Cal-IPC Rating: Moderate

Three species of *Cotoneaster* are mapped during EDRR surveys: *C. pannosus* (silverleaf cotoneaster), *C. franchetii* (orange cotoneaster), and *C. lacteus* (milkflower cotoneaster). While their distributions vary, these shrubs follow an identical pathway to wildland invasion: source populations abound in landscaping, birds disperse the fruits, and new infestations take hold in woodlands, shrublands, and grasslands. As such, this group of closely related plants are treated in one profile here.

Other similar EDRR species include *Pyracantha angustifolia*, *Crataegus monogyna*, and the unrelated *Ilex aquifolium*. Management strategy is the same for all of these plants, and they should be considered together with cotoneasters when planning treatment.

### Regional Distribution



## Occurrence Details

| | Patches | Populations | Gross Acres |
|---|---|---|---|
| *Cotoneaster franchetii* | 120 | 74 | 49.32 |
| *Cotoneaster lacteus* | 50 | 46 | 0.12 |
| *Cotoneaster pannosus* | 524 | 307 | 11.85 |

Cotoneasters are represented throughout all quadrants of the Mt. Tamalpais region. Major concentrations exist along the eastern periphery where propagules flow in from nearby residential zones; such is also the case near Muir Beach and Stinson Beach. Outliers can be found anywhere frugivorous birds venture, although there is a significantly lower density of mapped occurrences in the northern half of the region. It is presumed that these species are under-mapped, since most mapping efforts only follow roads and trails—birds do not.

The treatment history shows that cotoneaster has not been highly prioritized. Only about a third of the records in the dataset across the three species are listed as "managed."

## WHIPPET Scores

*Cotoneaster franchetii* 4.34 – 7.41

*Cotoneaster lacteus* 5.17 – 7.48

*Cotoneaster pannosus* 4.53 – 7.67

Scores fall across the lower, middle, and upper tiers of overall rankings. Clusters of high scores can be seen the coastal shrublands and grasslands of Mount Tamalpais State Park, the woodlands of Blithedale Summit and Baltimore Canyon, and the high-value sections of Bolinas Ridge's west-facing flank.

## Recommended Treatment Strategy

Treat in high-value areas, particularly coastal scrub and coastal grasslands.

Justification: Cotoneaster's significant impacts occur in coastal habitats, where plants can form impenetrable, wind-hardened thickets that are inhospitable to the wildlife and native plants that need intact, open land to thrive. Outlier seedlings should be pulled as found. The endless propagule pressure from neighborhoods makes management along the margins of public lands unlikely to succeed.

## Future Management Recommendations

### MCP

- Defer action.

### MMWD

- Continue annual follow-up in Lagunitas Meadows to protect *Calochortus uniflorus*, *Perideridia gairdneri* ssp. *gairdneri*, *Castilleja ambigua* ssp. *ambigua*, and other rare wet meadow species.
- Manage incipient patches and outliers as detected.

### NPS

- Defer action.

### State Parks

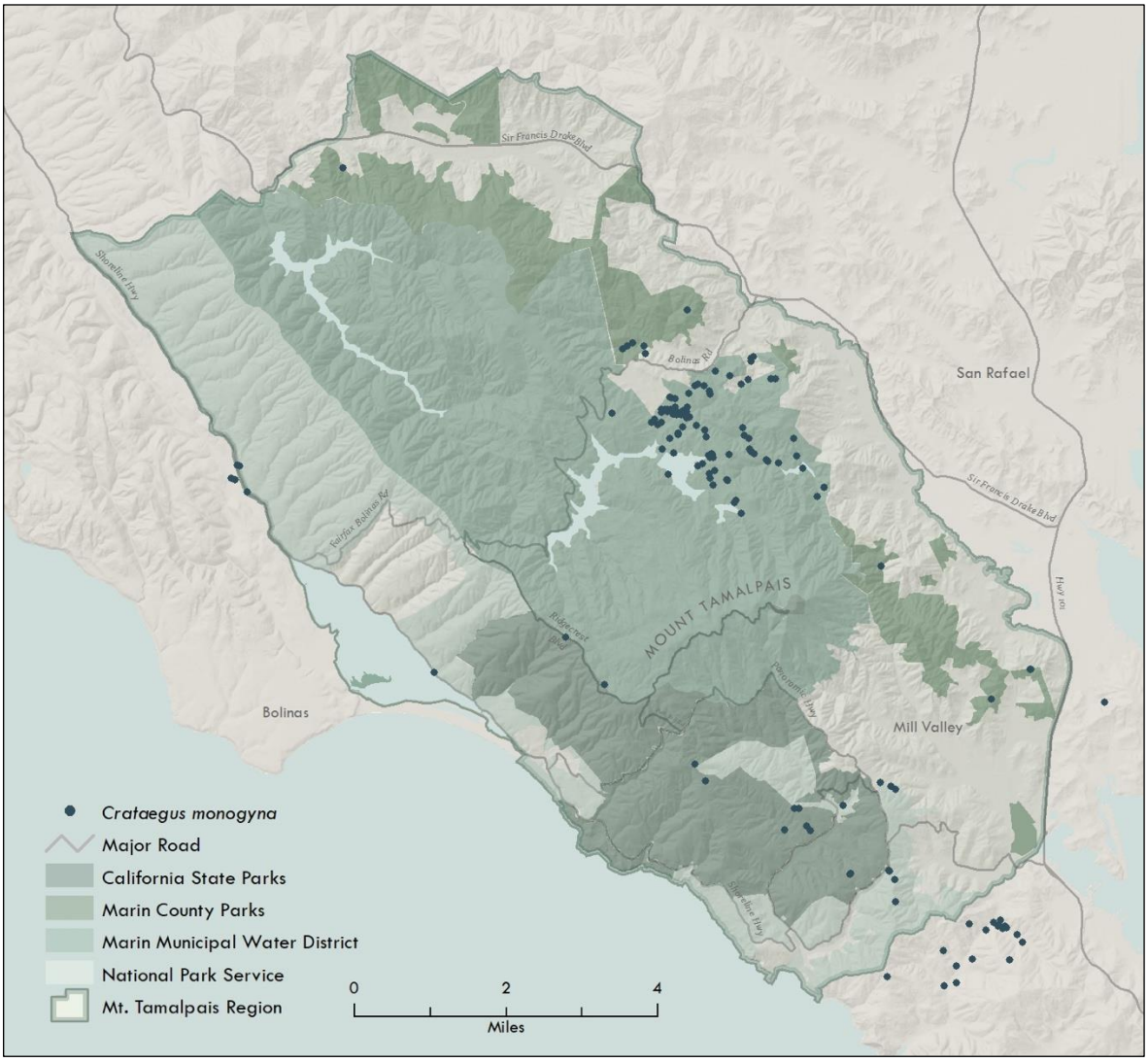
- Defer action along Panoramic corridor east of Muir Woods.
- Initiate treatment in Lone Tree and Cold Stream grasslands alongside broom and *Helichrysum petiolare* sweeps.

# CRATAEGUS MONOGYNA

## Family: Rosaceae
## Cal-IPC Rating: Limited

*Crataegus monogyna* (English hawthorn) is a shrub or tree native to Eurasia and established throughout the Bay Area via the horticultural trade. Its red berries are browsed and dispersed by birds, who sometimes prefer it to the native *Crataegus douglasii*.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 126 | 85 | 19.71 |

English hawthorn is mainly concentrated in the Sky Oaks region of the MMWD watershed. It is sporadic elsewhere in the Mt. Tamalpais region and nearly absent in the northwest half.

## WHIPPET Scores

3.84 – 6.80

English hawthorn scores place it in the lower to middle tiers of the overall score distribution. Treatment history varies widely.

## Recommended Treatment Strategy

Treat only in high-value areas, particularly wet meadows. Treatment is recommended outside this context where similarly behaving species are slated for management—English hawthorn, *Pyracantha angustifolia*, *Cotoneaster* spp., and *Ilex aquifolium* should all be considered together. Treat new and small populations when encountered.

## Future Management Recommendations

### MCP

- Defer action

### MMWD

- Continue annual follow-up in Lagunitas Meadows to protect *Calochortus uniflorus*, *Perideridia gairdneri* ssp. *gairdneri*, *Castilleja ambigua* ssp. *ambigua*, and other rare wet meadow species.

### NPS

- Defer action

### State Parks

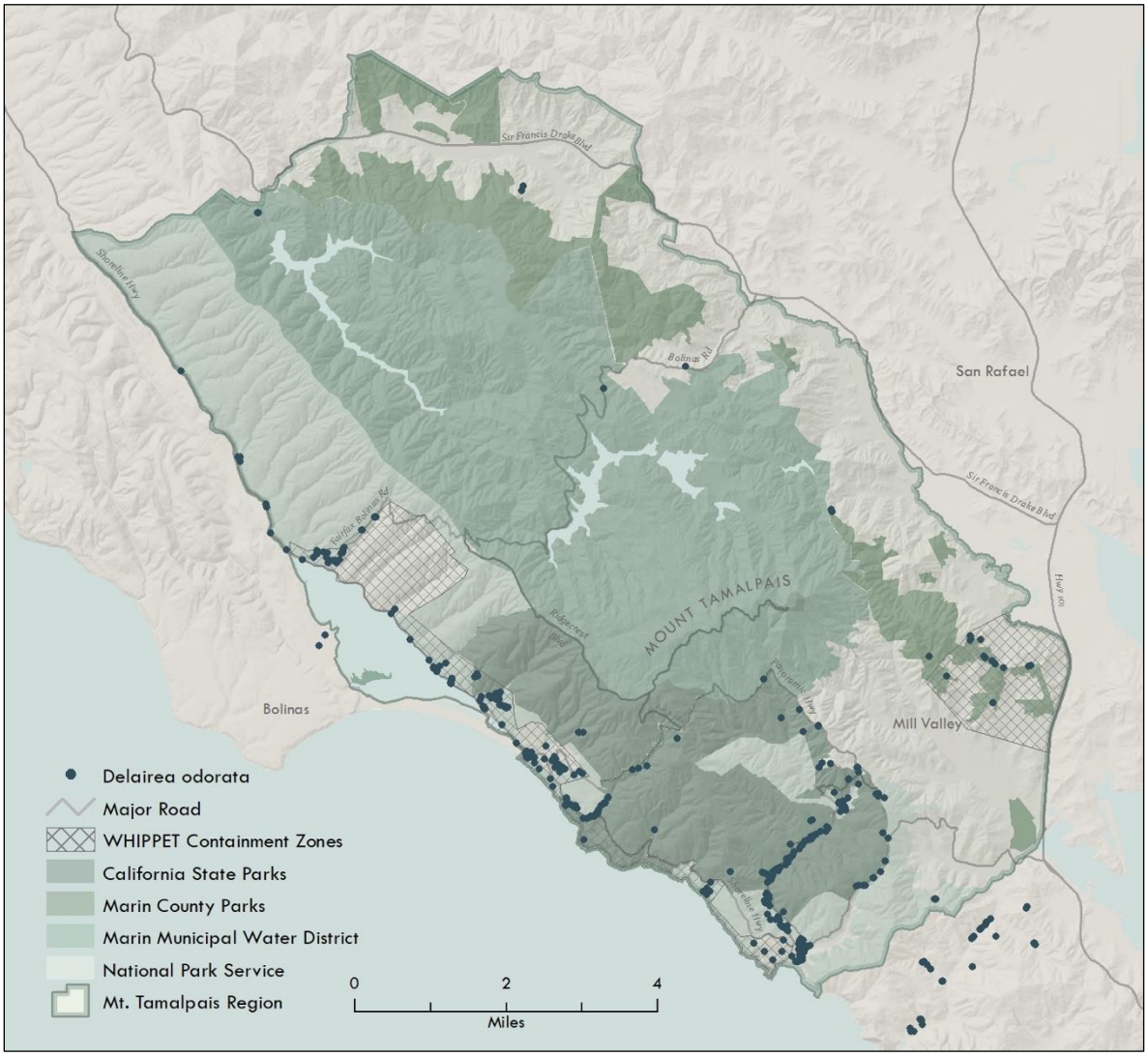
- Defer action

# DELAIREA ODORATA

## Family: Asteraceae
## Cal-IPC Rating: High

A fragile yet aggressive climbing forb, *Delairea odorata* (Cape ivy), spreads readily by vegetative fragments. In California, very few plants produce viable seed (DiTomaso et al. 2013). A vigorous competitor in riparian and coastal habitats, this species also establishes in drier interior lands, though more slowly. Beyond smothering native vegetation, Cape ivy contains toxic alkaloids capable of leaching if leaves steep in standing water. Vulnerable habitats include seeps and creeks that may support California red-legged frogs. Recent field trials with a gall fly suggest a successful biocontrol may be available in the years to come.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 344 | 123 | 55.55 |

Managed and unmanaged populations of Cape ivy abound along the foggy coast and lower Redwood Creek. Webb Creek in Steep Ravine canyon also has several populations with varying management histories. Disparate patches persevere inland, largely in forests at the wildland urban interface or lining moist drainages.

Several patches trace the lower end of drainages off the west side of Bolinas Ridge. Nearby Audubon Canyon Ranch (ACR) has many uncontrolled patches of Cape ivy between NPS-managed areas. While ACR has undertaken initial containment lines on some patches, that organization's manual-only treatment strategy for Cape ivy indicates the species will persist on its inholding for the foreseeable future.

NPS staff have, at times, managed the Bolinas-Fairfax Road cluster, which falls west of the ridgetop. They also manage several patches in the Stinson Beach area. Redwood Creek staff manage high-priority populations in Muir Woods, though one large Camino del Canyon patch appears unmanaged in the Calflora data. That team also manages several populations along Redwood Creek, though much of that larger population remains untreated. Treatment history on Slide Ranch and Muir Beach areas require verification.

State Parks deploys contractors to manage some lower Webb Creek patches. This area may benefit from off-trail mapping and monitoring of treatment efficacy to ensure all patches in the population are under management. MMWD staff manage the Peters Dam area while a population near the Meadow Club remains untreated. MCP staff manage one population at Blithedale Summit (Elinor Fire Road) while nearby Baltimore Canyon populations remain unmanaged.

Cape ivy exists on private property north of Gary Giacomini near Carson Road and Conifer Way and along Pine Mountain Tunnel Road. The distribution of Cape ivy on private land is likely much higher than mapping indicates.

## WHIPPET Scores

4.97 – 7.94

Cape ivy scores place it in the middle and highest tiers of the overall ranking. Clusters of high scores are found along Bolinas-Fairfax Road, the top of Webb Creek, lower Lone Tree Creek, Slide Ranch, Muir Beach community, lower Muir Woods, Fern Creek trail, and an unnamed creek north of Cronin Gulch east of Hwy 1.

Two outlier patches on MMWD land (Bolinas-Fairfax Road near the Meadow Club and Peters Dam) are not highly ranked, likely because of treatment costs on that agency's land.

## Regional Treatment Strategy

Implement progressive containment from upper elevations toward the coast to the west and Mill Valley to the east. Treat outlier MMWD patches. Monitor patches mapped off agency property for spread onto managed lands.

Justification: Cape ivy exists in all quadrants of the Mt. Tamalpais region with significant concentrations in the coastal zone. This approach largely aligns with current management practices.

## Future Management Recommendations

### MCP

- Establish and annually maintain a containment line around population at Crown Road.
- Continue annual treatment of Elinor Fire Road population.

### MMWD

- Establish and annually maintain a containment line around population near Bolinas-Fairfax Road near the Meadow Club.
- Continue annual treatment of Peters Dam population.

### NPS

- Continue treatment along upper Bolinas-Fairfax Road, in Muir Woods and Green Gulch.
- Establish and annually maintain a containment line above patches north of Cronin Gulch.
- Assess treatment approach to Stinson Beach and lower Bolinas-Fairfax Road populations.

### State Parks

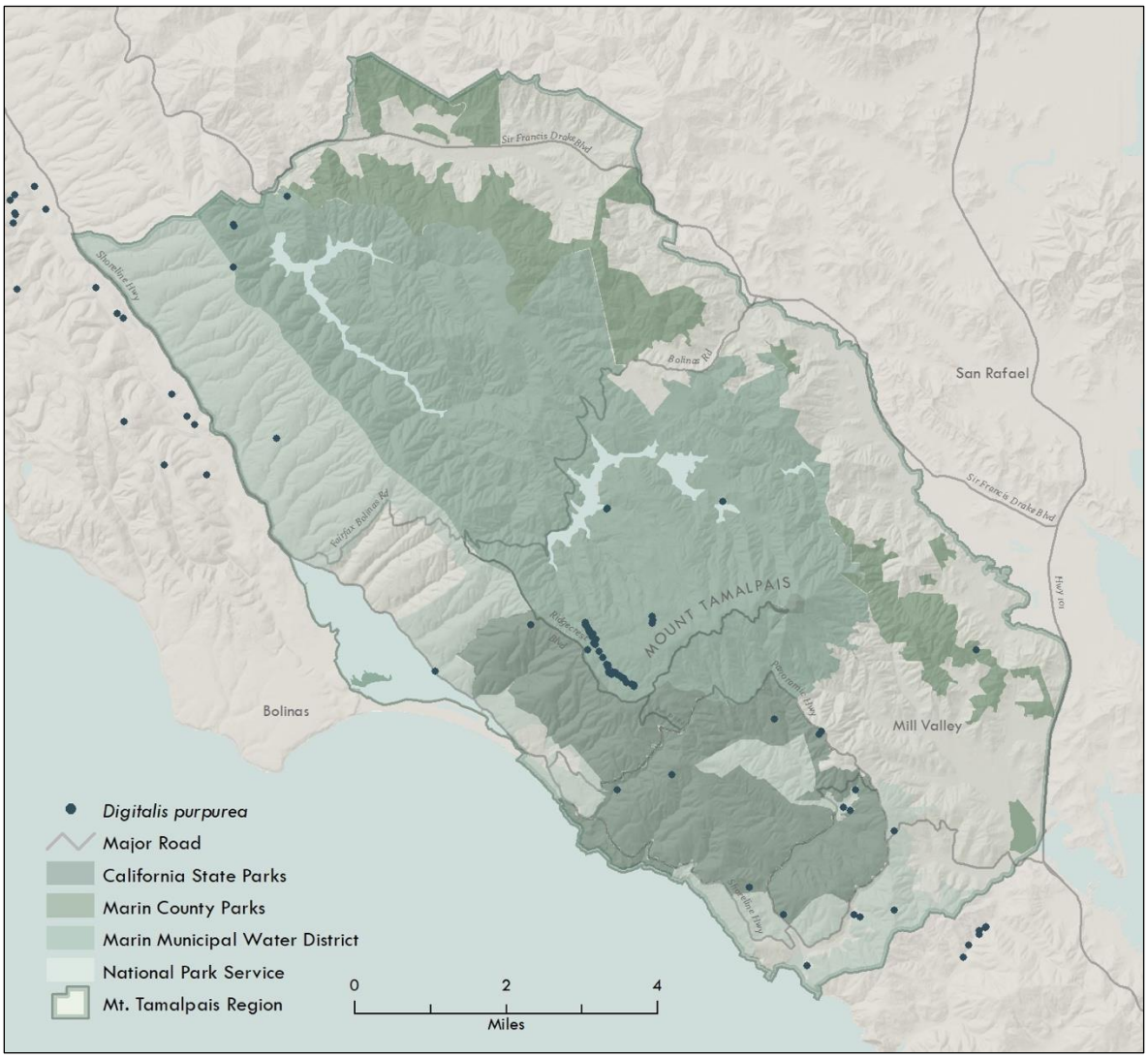
- Initiate treatment at upper Fern Creek Trail.
- Continue annual treatment of Lone Tree population.
    - Resurvey drainage in 2020 or 2021 to confirm that no spread has occurred upstream.
- Assess treatment approach to Webb Creek population, including upstream outliers along creek and Panoramic Highway.

# DIGITALIS PURPUREA

## Family: Plantaginaceae
## Cal-IPC Rating: Limited

*Digitalis purpurea* (foxglove) is a showy, columnar plant, popular in gardens. It's chiefly a horticultural escape specializing in moist habitats such as riparian corridors and drainages. Its thousands of tiny seeds readily spread via watercourses and on muddy boots.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 344 | 123 | 55.55 |

Foxglove has only one prominent infestation within the region—Cataract Creek between Rock Spring and Laurel Dell. Small one-offs are scattered around the well-trafficked and peripheral portions of the Mt. Tamalpais region.

Detection of this plant is exceedingly easy during its peak bloom time in early summer but can be quite difficult otherwise. Springtime surveys may overlook the subtle rosettes and it is likely that the species is under-mapped as a result.

## WHIPPET Scores

### 3.43 – 6.08

These scores fall in the middle and lower tiers of the overall ranking. The highest scores are found in areas with high site value, including McCurdy Trail, Dipsea Trail, and Cataract Creek.

The Cataract population undergoes annual treatment by MMWD staff and contractors. The incipient occurrence at Dipsea Trail was also removed. The McCurdy population is the only high score that has no recorded management history.

## Recommended Treatment Strategy

Continue treatment in high-value habitat. Manage early detections opportunistically.

Justification: Most populations of this plant are of minimal gross area, meaning they are early detections – managing these opportunistically during surveys and other fieldwork requires minimal effort. Larger infestations in high-quality habitat can be slated for treatment during summertime, a somewhat less busy part of the year for many land managers compared to spring.

## Future Management Recommendations

### MCP

- Treat new or small patches opportunistically.

### MMWD

- Continue annual follow-up treatment at Cataract Creek population.
- Continue annual follow-up treatment at Kent Trail population.
- Treat new or small patches opportunistically.

### NPS

- Treat new or small patches opportunistically.

### State Parks

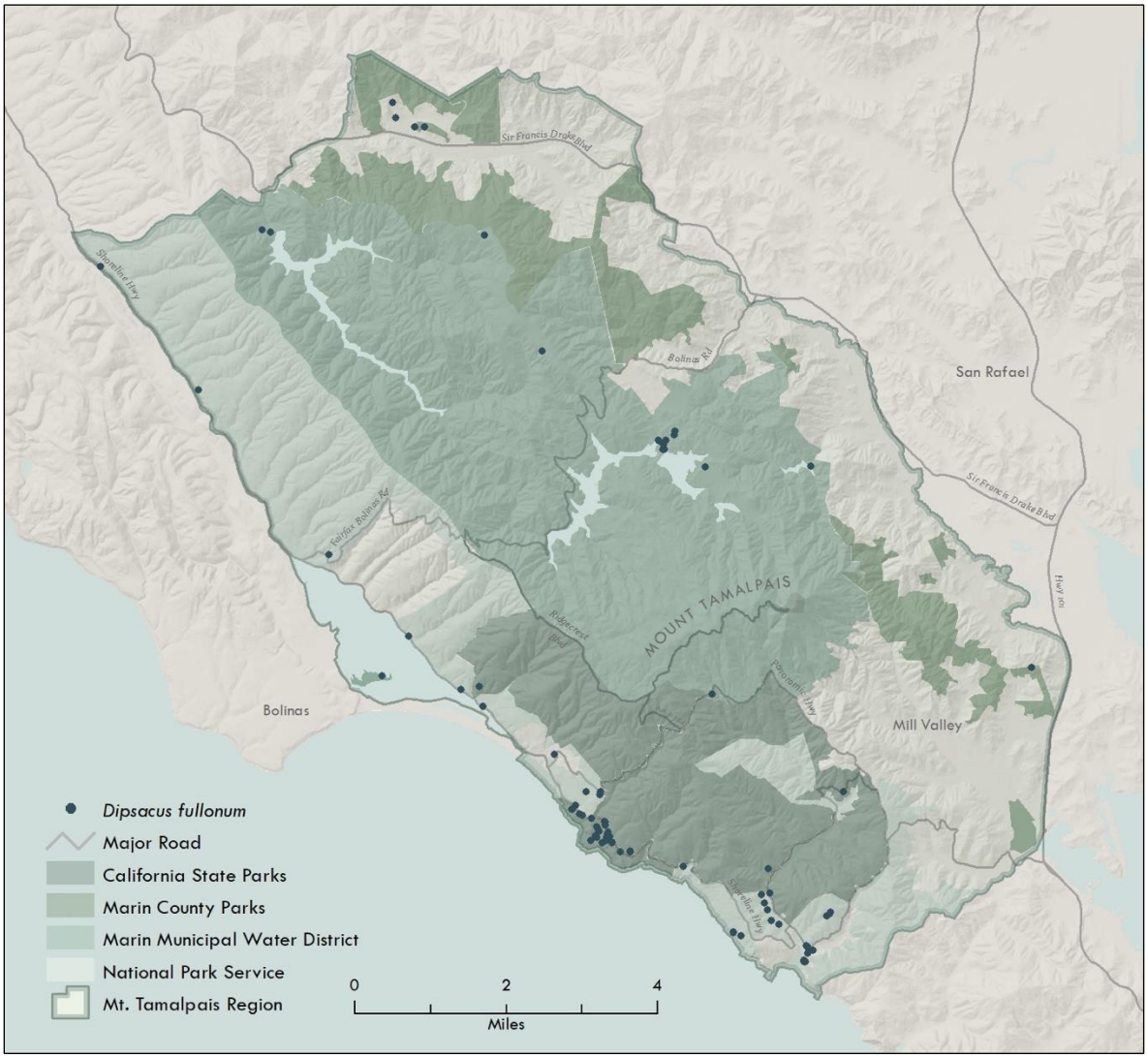
- Treat new or small patches opportunistically.

# DIPSACUS FULLONUM

## Family: Dipsacaceae
## Cal-IPC Rating: Moderate

*Dipsacus fullonum* (wild teasel) spreads successfully along roadsides, particularly in drainages. It also invades wetland areas, which are the primary resource focus in the following recommendations. Wild teasel often co-occurs with other wetland-loving weeds including *Phalaris aquatica* and *Festuca arundinacea*.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 83 | 60 | 26.54 |

Wild teasel is found sporadically throughout the Mt Tam region, with heavy concentrations along the coast and southern edges of the region. This species is likely under-mapped as it rarely makes it into vegetation management plans.

## WHIPPET Scores

### 4.49 – 6.94

Wild teasel scores fall in the middle tier of the rankings.

## Recommended Treatment Strategy

Treat in high-value areas, particularly wet meadows.

Justification: This species has a wide distribution throughout the region. It occurs on all agency lands, inland and coastal. Drawing a containment line is not straightforward given the distribution. Roadside areas are unlikely to be treated or maintained, thus providing significant opportunity for re-introduction.

## Future Management Recommendations

### MCP

- Continue annual treatment on Kent Island – This locality has the highest WHIPPET score (6.94) of any teasel population.

### MMWD

- Initiate treatment at Alex Foreman parking lot to prevent spread to Lagunitas Meadows.
- Initiate treatment at Pine Mountain Fire Road to protect *Toxicoscordion fontanum* population.
    - Treat *Phalaris aquatica* at same location.
- Follow up on Bathtub Gap treatment as part of ongoing *Phalaris aquatica* management.

### NPS

- Treat as indicated by site-specific priorities.

### State Parks

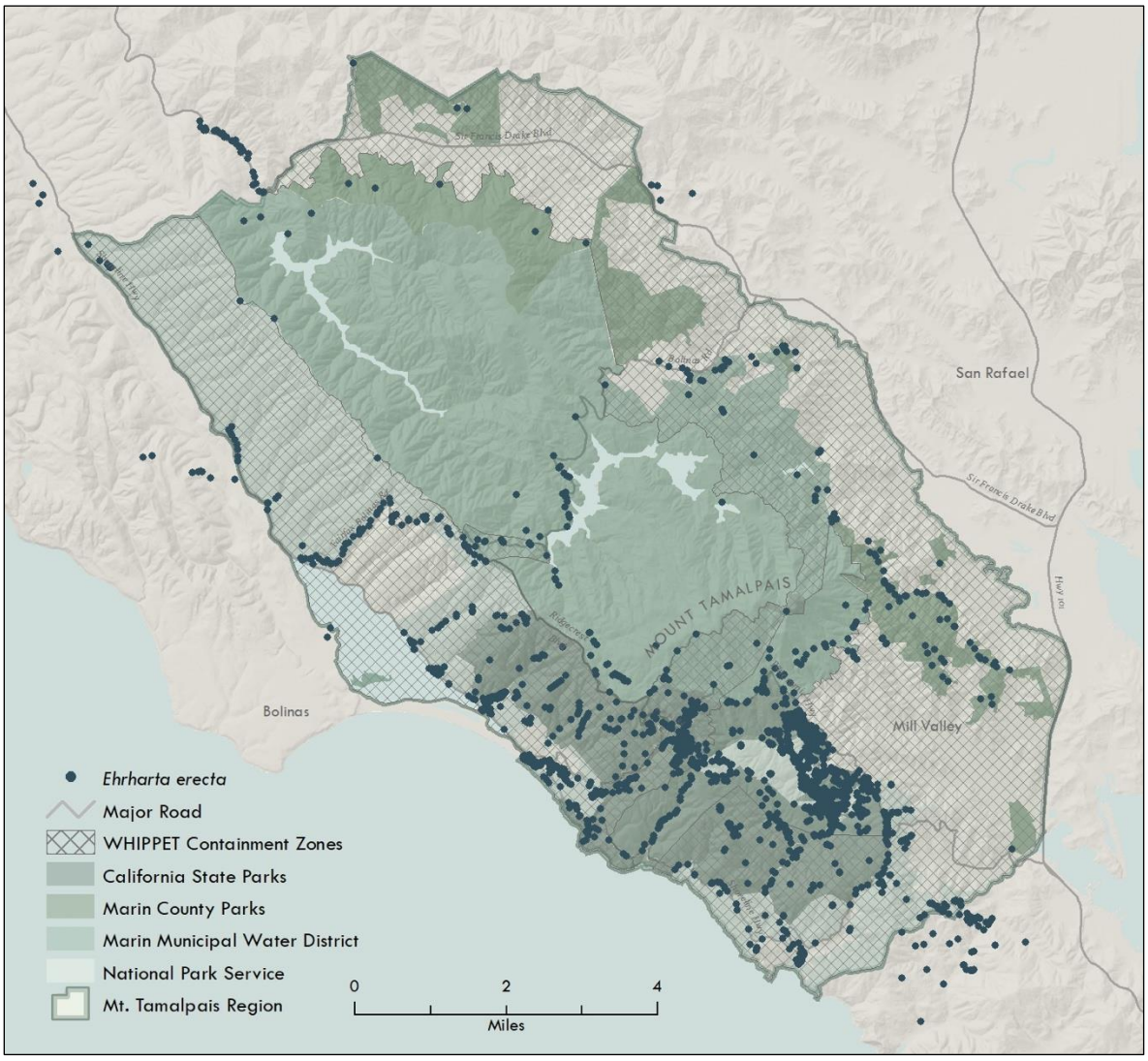
- Treat as indicated by site-specific priorities.

# EHRHARTA ERECTA

## Family: Poaceae
## Cal-IPC Rating: Moderate

*Ehrharta erecta* (panic veldtgrass) populations have exploded in the Bay Area in the past 30 years. First grown as a subject of genetic research by academic institutions in Berkeley and Davis, this perennial grass grows vigorously in riparian areas and most other habitats with even small amounts of summer fog drip. Panic veldtgrass has the uncommon ability to spread in old growth redwood forests, including in Muir Woods. Despite the dark understory conditions, panic veldtgrass spreads easily. Tiny, highly mobile seeds catch a ride on wind, water, wildlife, hikers, and vehicles. Protracted urban populations of panic veldtgrass indicate a future of continual introductions from visitors and workers.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 1,402 | 462 | 510.81 |

Although this species shows strong preference for infrastructure areas, riparian systems, and forests in the southwest quadrant of the region, populations exist throughout the region on public and private lands. With smaller populations on ridgetops, including East Peak, panic veldtgrass is poised to move into the interior lands of MMWD, which to date remain the least impacted. Extensive populations along winding, steep roadways (Bolinas-Fairfax Road, Highway 1, and Panoramic Highway) further complicate holistic treatment of panic veldtgrass.

While many populations appear as managed in the dataset, the dates of populations along several drainages and Bolinas-Fairfax road vary in terms of recency. Additionally, this species is likely under-mapped both in cross country contexts, particularly in drainages, and on private lands. Substantial, uncontrolled populations are known to exist on Audubon Canyon Ranch lands, for example. Urban areas adjacent to MCP and MMWD lands also have abundant populations. Areas include Deer Park and Marin Stables, entrances to Blithedale Summit and Baltimore Canyon, as well as the private property above Sky Oaks Road.

## WHIPPET Scores

### 3.30 – 6.80

Panic veldtgrass scores place it in the middle and lower tiers of the overall ranking. High scores are distributed largely on State Parks and NPS sites around Muir Woods and Pantoll Campground out Coastal Fire Road and down into the Lone Tree basin. These high scores do not fully align with existing management goals.

Large, contiguous swaths of panic veldtgrass in Muir Woods rank in the lowest tier because of their total gross area, however, these populations are under routine maintenance after years of treatment. One small population on MMWD ranks at the high end of the scale for this species, but all other MMWD infestations rank in the low tier, likely because of treatment costs on those lands. Some patches on eastern MCP lands rank high for this species, but because these areas abut private urban lands, unmapped populations likely border these occurrences.

Several attributes of this species – its impact to old growth redwood understory habitat, broad ecological tolerance, high seed mobility, and urban abundance - challenge the WHIPPET model.

## Recommended Treatment Strategy

The complicated nature of this species requires a combined approach of treatment in high-value areas, particularly old growth redwood stands, and containment. High-value

areas include Muir Woods National Monument and surrounding State Parks lands, as well as the Lone Tree basin.

Site-specific restoration plans should inform the extent and duration of panic veldt grass treatment. For example, agencies may manage panic veldtgrass while restoration plantings become established, but walk away when those plants become established, particularly if plantings are of trees or larger stature shrubs.

Containment of panic veldtgrass at the ridgetops should be attempted to preserve the lesser affected lands of MMWD and Gary Giacomini Preserve. Management of ridgetop populations on East Ridgecrest Boulevard, West Ridgecrest Boulevard, and Bolinas Ridge Road can enact an upper watershed containment line. It is possible that the line on West Ridgecrest Boulevard may be best placed at Cataract Creek. Cross-country surveys of this area are needed.

Eastern containment should emphasize areas north of Bolinas-Fairfax Road, which itself has many unmanaged populations. Trails leading north from this road remain largely unaffected. Northern containment at the boundary of Gary Giacomini can be attempted. If this proves unsustainable, moving the line in to San Geronimo Ridge Fire Road may be more realistic. This containment strategy should be reviewed annually.

Justification: Panic veldtgrass compromises valuable redwood habitat in Muir Woods National Monument. Well-vetted control strategies in the Redwood Creek watershed can successfully protect understory characteristics, though widespread populations may require frequent maintenance. Roadside areas are unlikely to be treated or maintained, thus providing significant opportunity for re-introduction.

The interior lands of MMWD and MCP's Gary Giacomini Preserve have less panic veldtgrass than surrounding areas. Vigilance and rapid response may keep the species in check on these lands. Treatment limitations on MMWD land may hinder successful control of this prolific seeding species.

### Future Management Recommendations

#### MCP

- Continue maintenance treatments in Gary Giacomini Preserve.

#### MMWD

- Continue maintenance treatments on West Ridgecrest Boulevard, Laurel Dell Fire Road, and Cataract Trail.
- Continue maintenance treatments on East Ridgecrest Boulevard, including at Mountain Theater and Rock Spring parking areas.
- Continue maintenance treatments in Peters Dam area.
- Continue maintenance treatments on Bolinas Ridge Road.
- Continue maintenance treatments on Kent Pump Road.

- Continue maintenance treatments at Sky Oaks Road and Concrete Pipe Fire Road.
- Continue maintenance at Canyon Trail and Moore Trail.
- Annually survey Kent Pump Road and Old Sled Road for new populations. Treat any new populations.

### NPS

- Continue maintenance treatments in Muir Woods.
- Continue to treat in other high-value areas as restoration goals require.

### State Parks

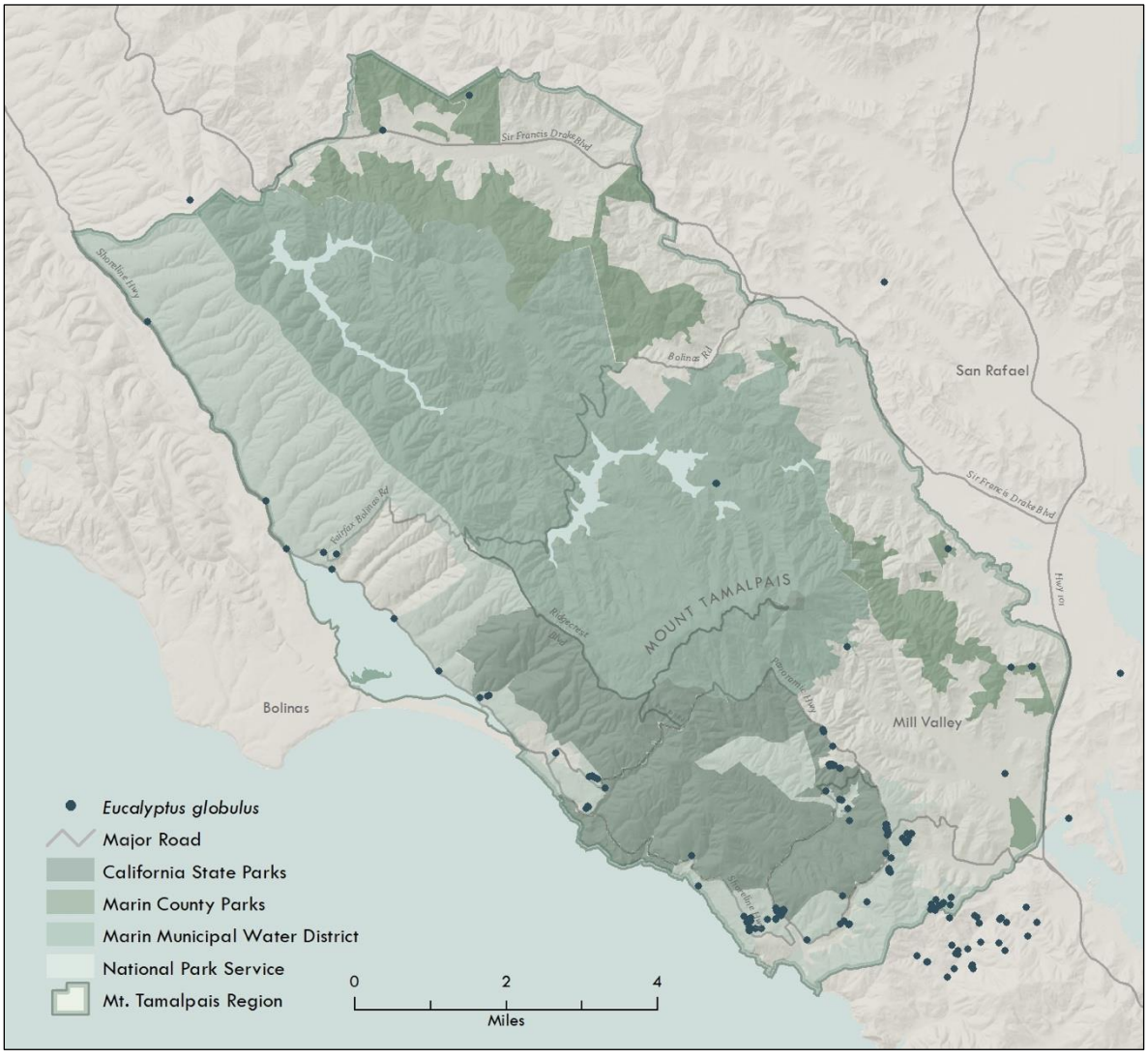
- Continue maintenance treatments surrounding Muir Woods, including the Pantoll area.
- Continue annual treatment of East Peak population.
- Continue to treat in other high-value areas as restoration goals require.
- Evaluate feasibility of extending control into Lone Tree basin.

# EUCALYPTUS GLOBULUS

## Family: Myrtaceae
## Cal-IPC Rating: Limited

*Eucalyptus globulus* (blue gum eucalyptus) represents one of the most contentious species on the list in terms of public opinion. Nostalgic odes to the tree's stateliness often clash with management concerns around flammability and invasiveness. This robust species, planted extensively in groves for windbreaks and timber in the last 100-plus years, persists near homesteads and along roadsides, and spreads in a limited fashion. Blue gum eucalyptus readily over-shades grassland and scrubland habitats. It reproduces most successfully near riparian areas, where it can draw significantly on water resources with a deep root system.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 96 | 48 | 111.96 |

Most of the blue gum eucalyptus present on Mt. Tam occurs south of the peaks on NPS and private property, though all agencies have at least one population. Highway 1 and Muir Woods Road have the most substantial populations, with outliers on MCP preserves in the east and north. MMWD has one population near the sludge pond east of Bon Tempe reservoir.

Treatment tends to focus on saplings. Leaving mature trees in place requires staff to control saplings indefinitely. Dispersal distance for this species is limited, thus large trees are an easy beacon for locating areas to manage saplings. Seedlings rarely appear more than 200 meters from a mature tree.

## WHIPPET Scores

### 3.72 – 7.18

These scores fall in the middle and lower tiers of the overall ranking. Clusters of high scores occur near Miwok Trail and along roads in the southeast part of the region.

WHIPPET scores for this species have little bearing on treatment likelihood. Public interest in these trees, as well as cultural designations for some agencies make treatment of mature stands highly unlikely.

## Recommended Treatment Strategy

Treat all saplings growing outside of mature stands at least every five years.

Justification: Public interest and cost of removal complicate the treatment of mature stands. Treating saplings from the edges of stands will mitigate impacts by limiting spread.

## Future Treatment Recommendations

### All Agencies

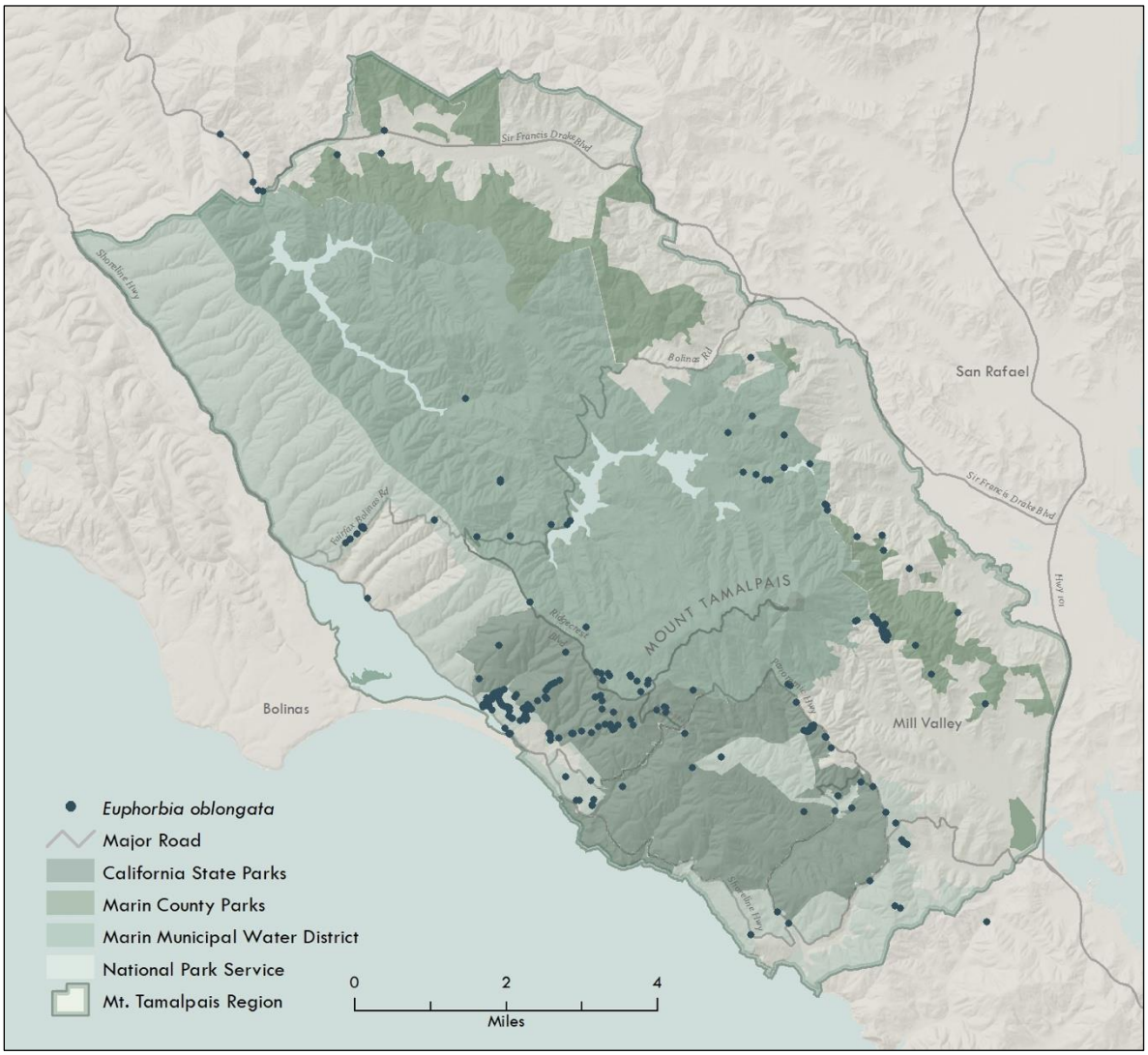
- Treat all saplings growing outside of mature stands at least every five years.

# EUPHORBIA OBLONGATA

## Family: Euphorbiaceae
## Cal-IPC Rating: Limited

*Euphorbia oblongata* (oblong spurge) is a perennial herb native to Eurasia. This species has moderate fidelity to disturbance corridors but thrives in moist natural areas as well—on Mt. Tamalpais it shows up primarily in riparian woodland, wet meadows, and foggy coastal slopes. Its preference for moist soil can make small patches easy to tackle by hand, but workers must be careful to avoid skin or eye contact with the plant's toxic white sap.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 196 | 117 | 31.71 |

Populations exist in all quadrants of the region but are most prevalent in the south and east. The most significant concentration is centered north of Stinson Beach on NPS land, stretching up into the State Park. Scattered patches radiate upslope to the ridgeline and over into the wet meadow complex at Rock Spring.

## WHIPPET Scores

### 2.97 – 6.11

WHIPPET Scores place it in the lower and middle tiers of all scores. The innate characteristics of this species keep it from ranking very high, especially on MMWD land where treatment cost is higher and effectiveness is lower.

## Recommended Treatment Strategy

Treat in high-value areas. Continue existing treatment efforts according to agency priorities. Defer action southwest of Ridgecrest Boulevard.

Justification: Oblong spurge rarely invades high-quality habitat but makes an exception to the rule in the wet meadows north and west of the Rock Spring parking lot. These meadows host rare wetland obligates such as *Astragalus breweri* and *Hosackia gracilis,* as well as several locally rare taxa. Some patches are directly adjacent and pose an explicit threat. Less mesic grasslands appear less hospitable to oblong spurge, which makes the coast-facing bulk of the Ridgecrest grasslands suitable as a natural containment line. The infestation epicenter at Stinson Beach has a long and intentional management history, yet there is a large unmanaged bloc uphill around the water tank road that threatens to perpetually support reinvasion.

## Future Management Recommendations

### MCP

- Initiate treatment on French Ranch population. It is the highest scoring species occurrence and it is located reasonably close to high-value grasslands.
- Verify management status of H-Line/Old Railroad Grade populations—no 2019 data available.

### MMWD

- Continue follow-up on Rock Spring and Cataract Creek populations.
- Continue follow-up on Kent Pump Road population.
- Treat new or small patches opportunistically.

### NPS

- Treat according to site-specific priorities.

### State Parks

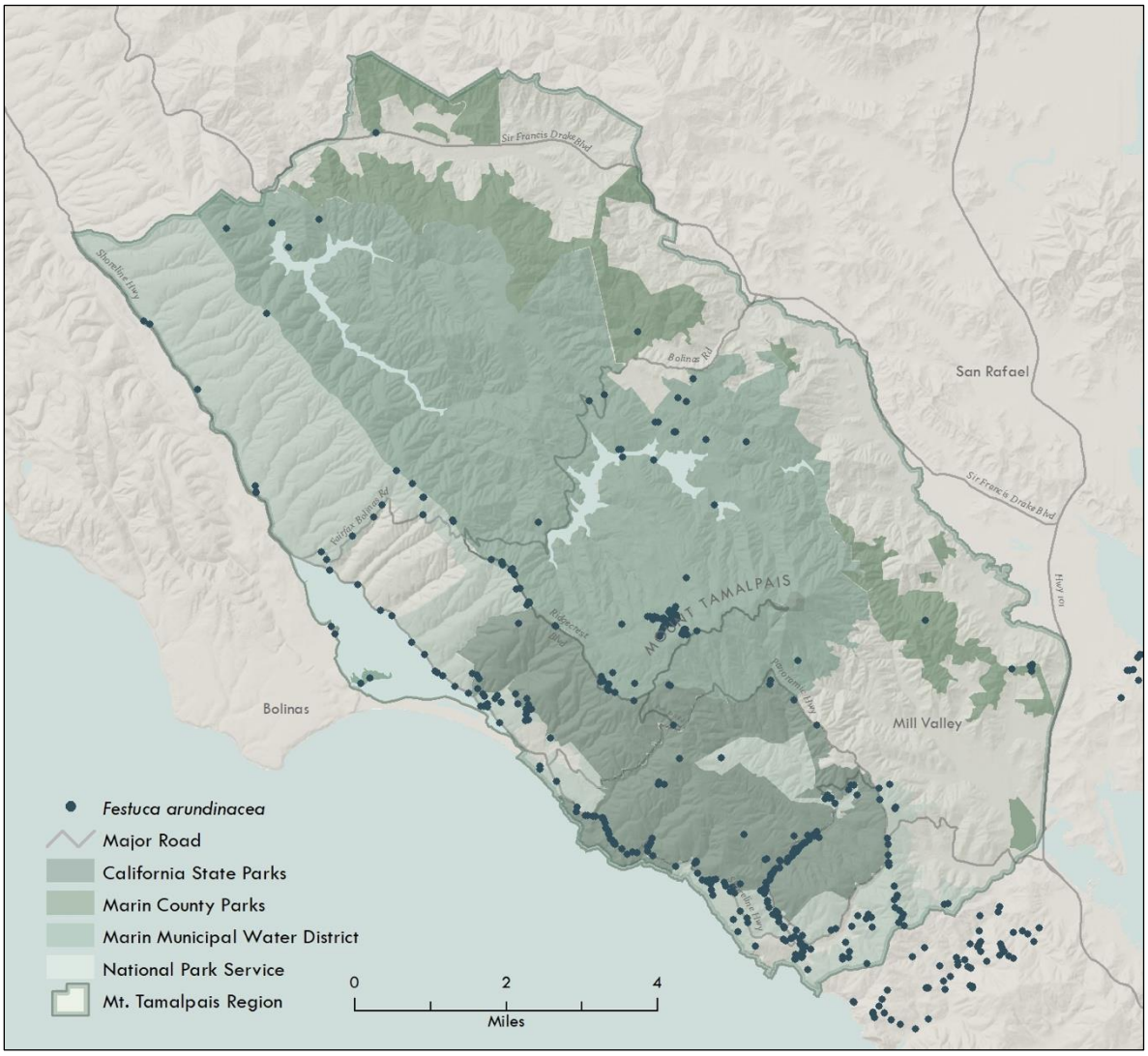
- Continue follow-up treatments in Ridgecrest grasslands to establish containment.

# FESTUCA ARUNDINACEA

## Family: Poaceae
## Cal-IPC Rating: Moderate

*Festuca arundinacea* (tall fescue), a sometimes-rhizomatous perennial grass, has a wide distribution on Mount Tamalpais. It traces roadsides, including Highway 1 and Muir Woods Road, in addition to invading grassland, wet meadow, and some coastal scrub communities. Favored for its winter luster in turf and agriculture, this species has a long history of intentional introduction throughout much of California and the United States.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 399 | 211 | 45.04 |

While tall fescue has some populations in the northern part of the region near Peters Dam, most of the distribution occurs south of the MMWD reservoirs. The largest population occupies Potrero Meadow and surrounding environments north of West Peak where it impacts important wet meadow habitat. In addition to the previously mentioned roadside populations, tall fescue also has impacts to grasslands along West Ridgecrest Boulevard.

This species is likely well mapped on public lands but may be under-mapped on unsurveyed roadsides in the county, as well as on private land or recreation areas. Treatment history has emphasized small patches in areas including West Ridgecrest Boulevard, Coyote Ridge, and north of Stinson Beach community.

## WHIPPET Scores

3.32 – 6.32

All scores for this species fall in the middle and lower tiers. High scores for this species appear in areas largely inappropriate for management focus. Those areas include a northwest, forested section of Muir Woods, two areas along Highway 1, and one area adjacent to Sir Francis Drake Boulevard. All high-ranking patches remain untreated at this time. Some other highly ranked middle-tier populations include grasslands at Rock Spring and near Pantoll station.

## Recommended Treatment Strategy

Treat in high-value areas, particularly wet meadows, seeps or springs, and grasslands. Treat in conjunction with *Phalaris aquatica* when feasible.

Justification: This species has a strong distribution in the county. Roadside areas are unlikely to be treated or maintained, thus providing significant opportunity for re-introduction. Populations with rhizomes present significant treatment challenges, both in terms of workers' ability to comprehensively identify the species as well as the efficacy of manual and chemical methods.

## Future Management Recommendations

### MCP

- Continue treatments of new and small populations found on EDRR surveys.

### MMWD

- Continue and expand annual treatment of West Ridgecrest Boulevard populations. Work between road and Cataract trail toward eradication.
- Continue to evaluate feasibility of removing Potrero Meadow population with associated trail realignments.

### NPS

- Continue treatment along Miwok Trail on Coyote Ridge. Pair with treatment of *Phalaris aquatica*.
- Initiate treatment of populations on West Ridgecrest Boulevard to match effort of MMWD.
- Evaluate success of Muir Beach treatments to determine whether to continue.

### State Parks

- Initiate treatment of populations on West Ridgecrest Boulevard to match effort of MMWD and align with existing *Phalaris aquatica* treatments.

### Critical Collaboration Zones

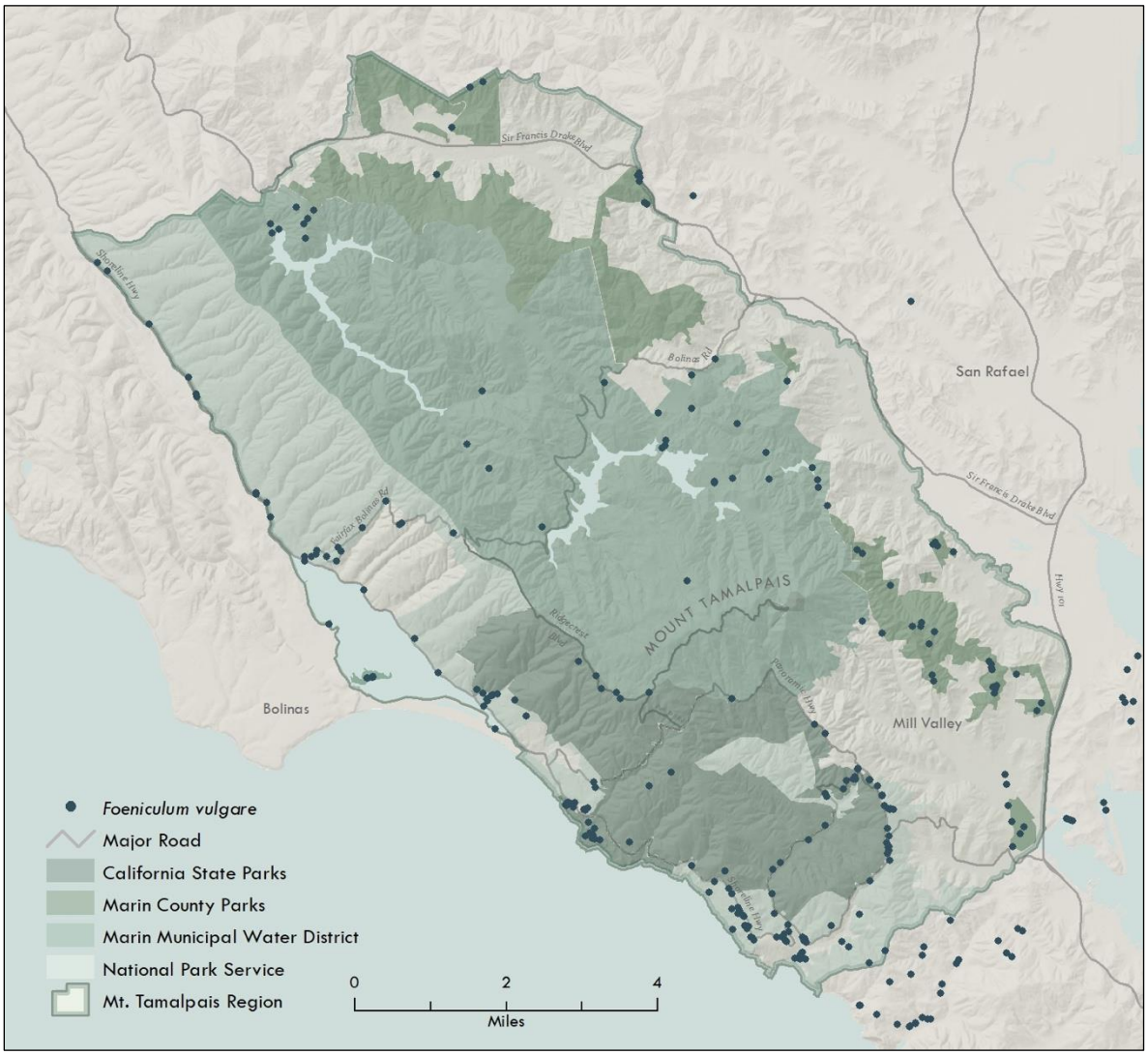
- West Ridgecrest Boulevard populations offer an opportunity for collaboration to reach successful eradication. This area sees much collaboration led by One Tam staff in Restoration, Conservation Management, and Youth Engagement around *Centaurea solstitialis* and *Phalaris aquatica*. Tall fescue is a challenge for most volunteers but may prove suitable for returning volunteers. Conservation Management staff could lead well-trained contractors on *F. arundinacea* control projects.

# FOENICULUM VULGARE

## Family: Apiaceae
## Cal-IPC Rating: Moderate

*Foeniculum vulgare* (fennel) is a perennial herb or subshrub with impacts to grasslands and coastal scrub communities in the region. While it shows some preference for coastal habitats in Marin, extensive populations also arise inland, including throughout large sections of Highway 101. Large populations in grasslands may alter the structural complexity of those systems, while in scrubland it often occurs at lower densities. Fennel establishes easily in disturbed areas, particularly roadsides. Entrenched populations require chemical treatment or labor-intensive, high-disturbance manual removal of sizable taproots.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 217 | 161 | 94.01 |

Fennel appears extensively in the southwestern quadrant of the region, particularly along the Highway 1 corridor. The Blithedale Summit/Baltimore Canyon complex on the southeastern side of the mountain also has substantial populations. Scattered populations persist throughout suitable habitat on the mountain, including areas of West Ridgecrest Boulevard, Bolinas Ridge, one forested area of Gary Giacomini, and the interior of the MMWD watershed in low levels. This species is likely under-mapped in the county. Significant populations exist on private lands and rights of way.

Treatment history varies among agencies. One Tam and MCP surveyors routinely remove small plants found on EDRR surveys. Priority grassland and scrubland habitats of NPS, including near Homestead Valley and the Muir Beach community have had treatments. Similarly, areas of Bothin Marsh, Kent Island, and the Blithedale Summit/Baltimore Canyon complex have had treatments. Some areas on State Parks and MMWD have had treatments. All agencies have extensive unmanaged fennel acreage.

## WHIPPET Scores

4.97 – 8.28

High scores for fennel appear around Rock Spring on MMWD land and in the Blithedale Summit/Baltimore Canyon complex as well as Bothin Marsh. Additional high scores appear along lower Coastal Fire Road on State Parks land and down into NPS land, as well as some areas of Muir Woods Road. Many outliers on MMWD land do not rank highly, likely as a result of treatment costs on those lands.

## Recommended Treatment Strategy

Treat in high-value areas, particularly in grasslands. Treatment limitations on MMWD land indicate a need to treat early and thoroughly.

Justification: While fennel is widespread throughout Marin and has a high fidelity to disturbance, the species can have significant impacts on grasslands and coast scrub habitats. Roadside areas are unlikely to be treated or maintained, thus providing significant opportunity for re-introduction. This approach aligns with current management status, which sufficiently protects vulnerable grassland and coastal scrub resources.

## Future Treatment Recommendations

### MCP

- Continue annual treatment of populations at Kent Island, Bothin Marsh, and the Blithedale Summit/Baltimore Canyon complex.
- Continue treatments of new and small populations found on EDRR surveys.
- Rapidly respond to new detections in priority grasslands, particularly Gary Giacomini.

### MMWD

- Continue treatments of new and small populations found on EDRR surveys.
- Rapidly respond to new detections in priority grasslands.

### NPS

- Continue annual treatment on populations in Homestead Valley and Owl Trail.
- Continue annual treatment of population south of Muir Beach, which is currently under management.

### State Parks

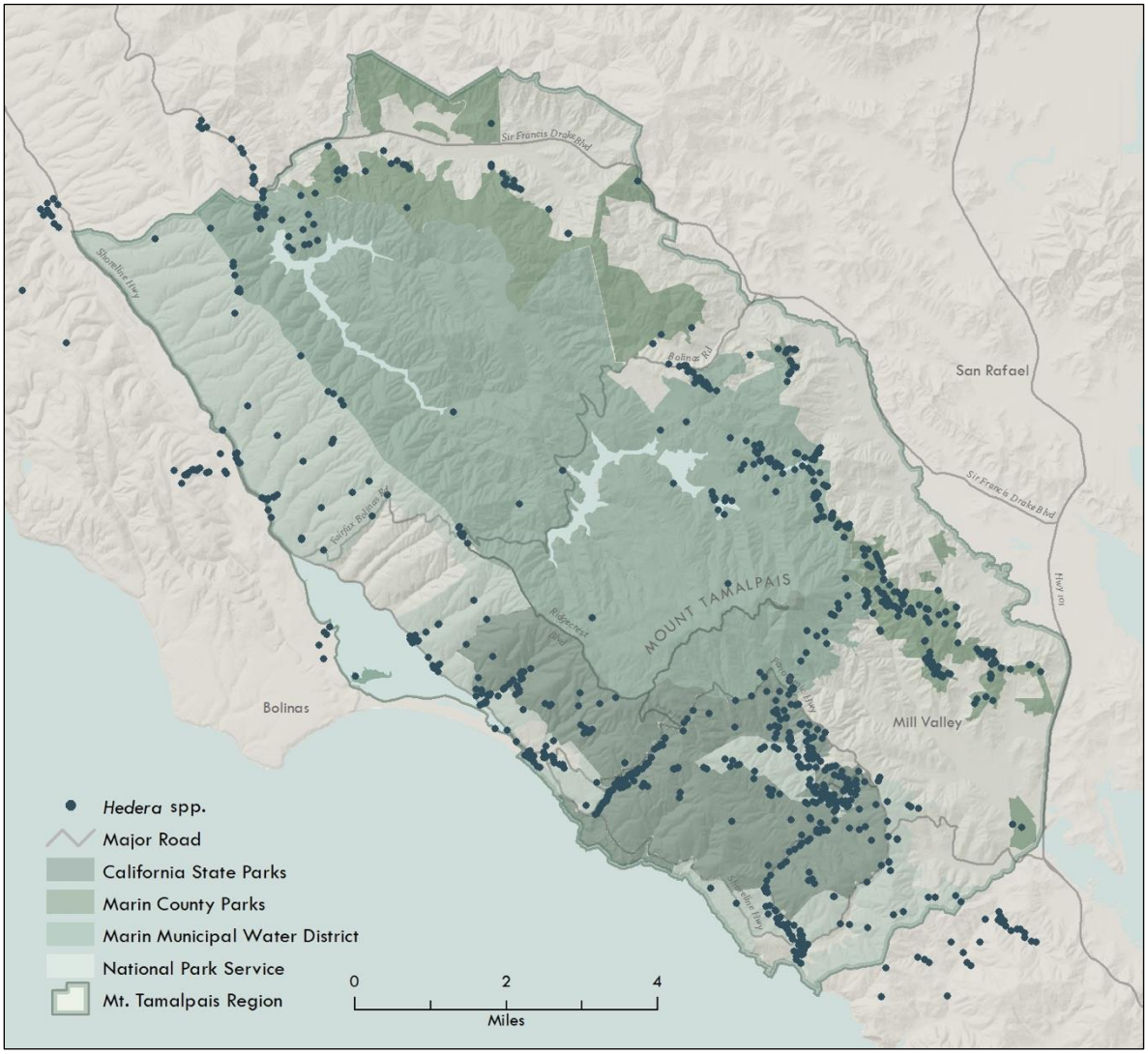
- Continue treatments of new and small populations found on EDRR surveys.

# HEDERA SPP.

## Family: Araliaceae
## Cal-IPC Rating: Limited

*Hedera canariensis* (Algerian ivy) and *Hedera helix* (English ivy), well-known ornamental vines, occur throughout the Mount Tamalpais region in forests and woodlands. Riparian systems often suffer the most from these species. These species will form dense, strangling mats that climb trees and hang down like curtains. Dense understory mats smother all vegetation, greatly reducing biodiversity as well as altering ecosystem structure. These ivies only fruit when allowed to grow vertically. A waxy cuticle complicates chemical treatment, amplifying the need promptly address small patches. These species do not strictly follow roads and trails, thus the corridor approach to early detection surveys may not fully capture their full extent.

### Regional Distribution



## Occurrence Details

| | Patches | Populations | Gross Acres |
|---|---|---|---|
| *Hedera canariensis* | 219 | 157 | 6.95 |
| *Hedera helix* | 643 | 422 | 31.27 |

Algerian and English ivies have small populations throughout the Mt. Tamalpais region. Distributed from neighborhood plantings into wildlands by frugivorous birds, these species have higher densities and larger populations adjacent to communities. Riparian surveys down Bolinas Ridge picked up repeated off trail occurrences. Similar surveys of the eastern side of the ridge may document some currently unmapped populations. Staff have observed significant populations in human communities around the region, which also remain unmapped.

Treatment history of these species appears to vary along size parameters: Surveyors often pluck seedlings as they encounter them while larger populations linger unmanaged in many areas. Notable treatment areas include Muir Woods where most populations appear under management with a few exceptions. NPS work in the Stinson Beach area has emphasized these species at times.

## WHIPPET Scores

*Hedera canariensis* 5.17 – 7.97

*Hedera helix* 4.79 – 8.20

Algerian ivy and English ivy have scores in the high and middle tiers among all species. These species have more high scores than most other species, barring *Cortaderia jubata*. Much of this can be attributed to small population sizes in high-value areas like Muir Woods and Steep Ravine. Many of the patches elevated by the WHIPPET model are at the minimum mapping unit of 1 square meter The WHIPPET model looks at these two species separately, thus a patch of Algerian ivy next to a patch of English ivy may rank higher than it should when aggregating to genus level. Species are lumped in this analysis because impact and treatment are the same across the two species.

Populations on MMWD land consistently rank lower because of treatment costs on those lands. Notable exceptions include outliers on Kent Pump Road, Shadyside Trail, Matt Davis Trail, and Hoo-Koo-E-Koo near Baltimore Canyon. Other areas with high scores include small patches in drainages of Bolinas Ridge, State Parks in the Alice Eastwood area, and much of the Blithedale Summit/Baltimore Canyon complex. The latter area deserves deeper consideration as untreated populations in neighboring communities may prevent eradication.

## Recommended Treatment Strategy

Progressive containment to margins of publicly owned open space: Treat all interior patches and consider Bolinas Ridge Fire Road a containment line.

Justification: Algerian and English ivy have low population sizes in the interior lands of the One Tam collaborative. Management strategies on larger patches appear to work. Management of larger infestations, such as the areas in and around the north and east of Muir Woods, aligns with current agency approaches. Pushing back toward source populations at community boundaries is the most feasible approach. Without routine management of MMWD lands, future control becomes infeasible given the limited toolkit.

## Future Management Recommendations

### MCP

- Continue removal of small patches detected on EDRR surveys.

### MMWD

- Initiate treatment on Lake Lagunitas populations.
- Initiate treatment on north Kent Lake populations.
- Initiate treatment on Concrete Pipe Road.
- Initiate treatment on Fish Grade.
- Continue treatment of all trailside patches detected on EDRR surveys.

### NPS

- Continue and expand management in Muir Woods.
- Continue management in Muir Beach, Coyote Ridge, Stinson Beach areas.
- Initiate management of small patches on EDRR surveys, if feasible.

### State Parks

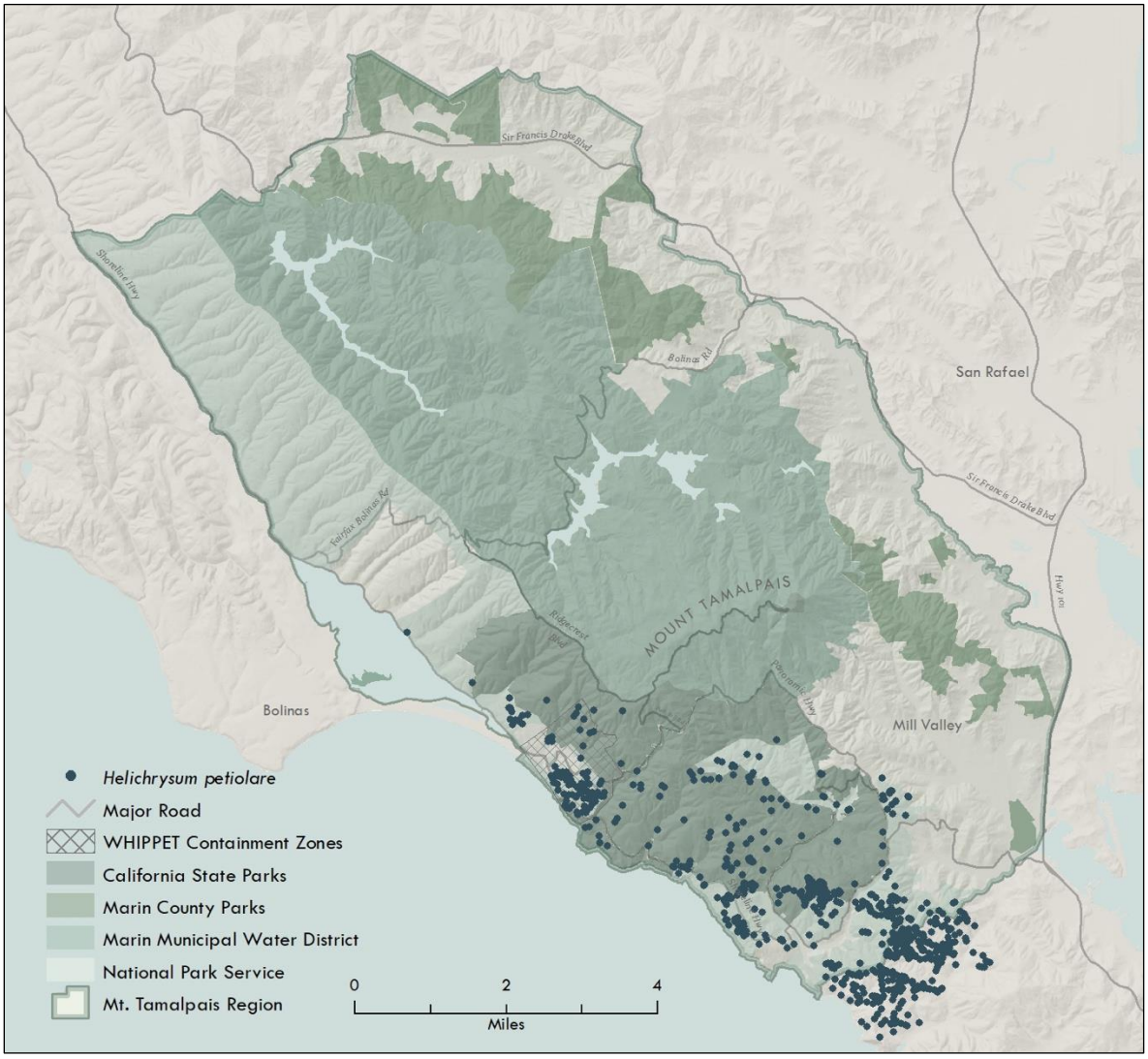
- Continue and expand management in the Redwood Creek Watershed.
- Initiate management in upper Steep Ravine canyon.
- Continue removal of small patches detected on EDRR surveys.

# HELICHRYSUM PETIOLARE

## Family: Asteraceae
## Cal-IPC Rating: Limited

*Helichrysum petiolare* (licorice plant), a soft, climbing ornamental, has an unprecedented and disturbing distribution on Mount Tamalpais. The populations in Marin County represent the largest mapped infestations in California. This shrub grows readily in coastal scrub where it can create dense mats of smothering vegetation. It also invades forest understory habitat where it rises into trees. The wind dispersed seeds of licorice plant do not appear to require disturbance to germinate and establish. The nature of the habitats it invades makes detection in off-trail areas a challenge.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 399 | 198 | 360.86 |

Licorice plant is largely concentrated on coastal slopes. This species has not crossed the ridgeline to the interior lands of MMWD or MCP. Considerable populations also occur south of the Mt. Tamalpais region in the Marin Headlands. Golden Gate National Recreation Area staff treat these populations.

Licorice plant is the focus of concerted treatment effort on both NPS and CDPR lands. Extensive populations on steep, inaccessible slopes and private land above Stinson Beach remain untreated, casting seeds into the wind for wide-ranging dispersal each year. Treatments have gained and lost ground over many years of treatment.

## WHIPPET Scores

### 3.34 – 6.07

Raw scores place licorice plant in the low and middle tiers of the rankings.

## Recommended Treatment Strategy

Establish a progressive containment line around the two large Stinson patches as the northern and eastern boundaries. Use the forested areas as the boundary to the northeast. Remove any populations that jump the line toward ridgetops.

Justification: Extensive populations of largely contiguous licorice plant remains untreated or partially treated. The difficult terrain and lack of long-term funding has forced managers to take a measured approach to this species to date.

## Future Management Recommendations

### MCP

- Continue to monitor for and address new patches.

### MMWD

- Continue EDRR efforts to monitor for and address new patches.

### NPS

- Verify that all known patches are under management.
- Continue treatment of southern patches, particularly in Muir Woods and surrounding forests.
- Continue to monitor for and address new patches outside of containment zone.

### State Parks

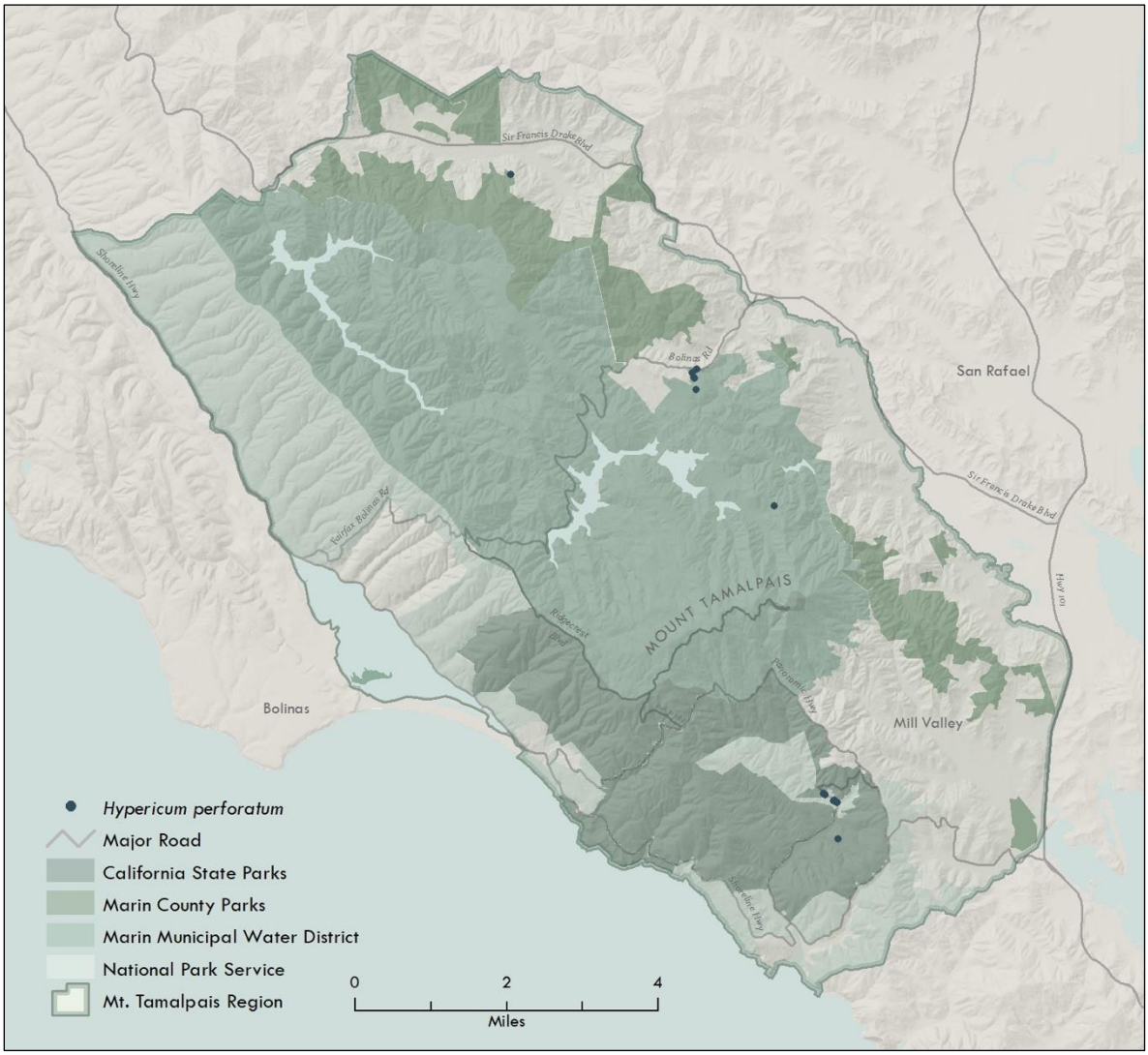
- Verify that all patches designated as managed are in annual treatment plans.
- Assess the feasibility of long-term management of the largest patch east of Stinson Beach.
- Continue contractor effort on outliers.
- Continue to monitor for and address new patches outside of proposed containment zone.

# HYPERICUM PERFORATUM

## Family: Hypericaceae
## Cal-IPC Rating: Limited

*Hypericum perforatum* (Klamathweed), a perennial herb popular for its medicinal qualities, has spread throughout much of California. Klamathweed appears in disturbance zones including roadsides, and in grasslands, forests, and woodlands. Because of its toxicity to some livestock, agricultural departments have targeted it for control. Biocontrol agents, including the Klamathweed beetle (*Chrysolina hyperici, C. quadrigemina*) and St. Johnswort root borer (*Agrilus hyperici*) have proven highly successful in lower elevation habitats (DiTomaso *et al.* 2013).

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 16 | 9 | 0.87 |

Klamathweed ranges from the Redwood Creek Watershed in the south to Gary Giacomini Preserve in the north. Unlike many species monitored by the One Tam collaborative, this species prefers drier inland habitats. Surveyors have documented 17 populations. The largest cluster appears near the Sky Oaks area of MMWD, with Redwood Creek populations following close behind in size. While the MCP population in Gary Giacomini and the largest patch on MMWD have no treatment history, agencies have performed at least one treatment on all other populations.

## WHIPPET Scores

### 5.01 – 6.22

These scores fall throughout the tiers of WHIPPET scores. The highest-ranking scores are in Gary Giacomini and State Parks land between Muir Woods Road and Dias Ridge Fire Road. These are small, outlier populations, while the additional populations in Muir Woods and MMWD lands have more patches covering larger areas.

## Recommended Treatment Strategy

Treat in high-value areas, including new restoration plantings. Defer action in all other areas until population reaches level for biocontrol re-introduction.

Justification: Klamathweed has limited impacts on wildlands. Impacted agency lands do not host livestock. Biocontrol treatment for this species has proven efficacy but requires population sizes sufficient to host the insects.

## Future Management Recommendations

### MCP

- Defer action until populations reach size adequate to support biocontrol hosts.

### MMWD

- Defer action until populations reach size adequate to support biocontrol hosts.

### NPS

- Continue annual treatments in Muir Woods.

### State Parks

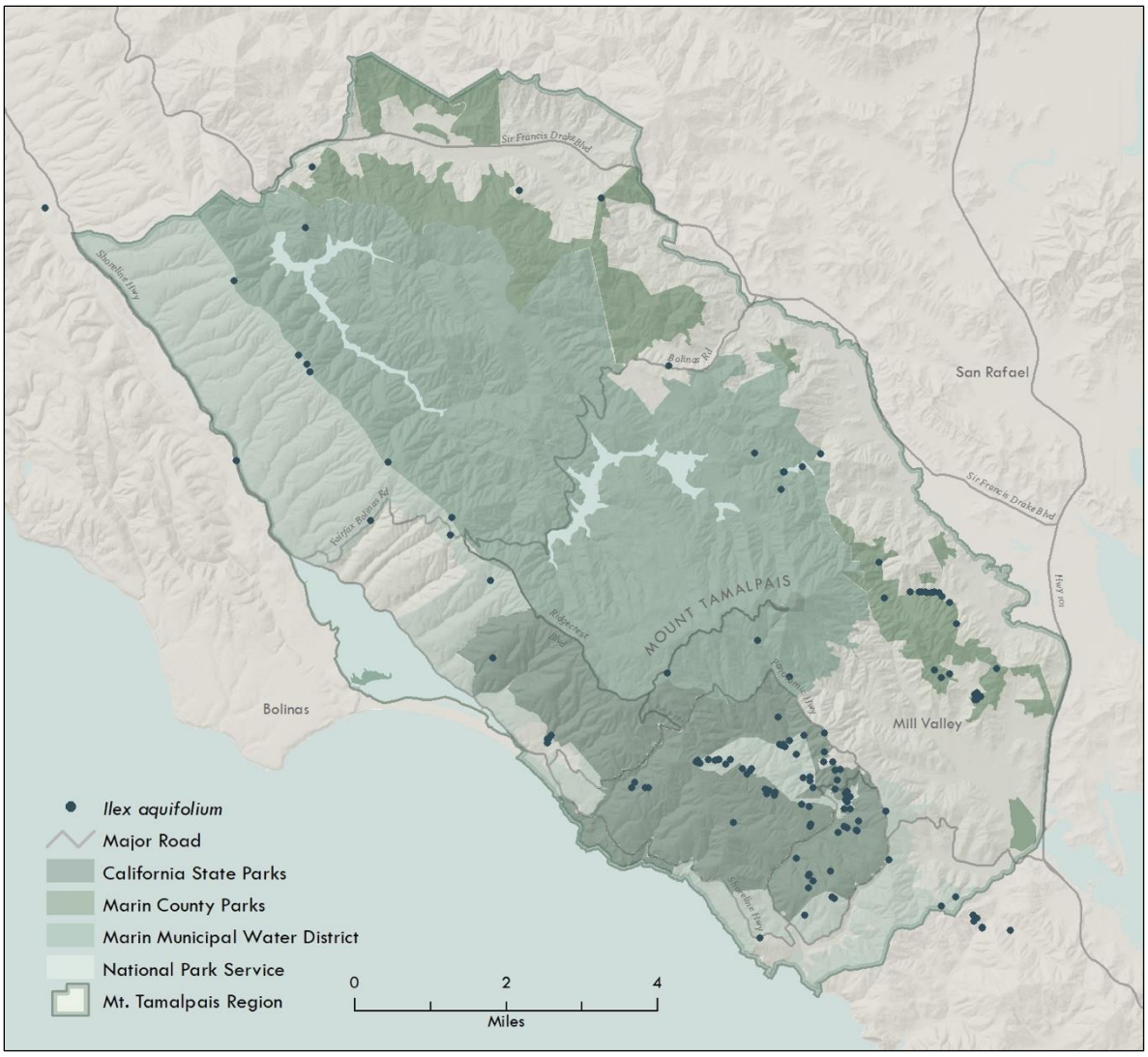
- Continue annual treatment on Dias Ridge.

# ILEX AQUIFOLIUM

## Family: Aquifoliaceae
## Cal-IPC Rating: Limited

*Ilex aquifolium* (English holly) is a Mediterranean perennial shrub that can reach small tree sizes. It is popular as a landscaping plant due to its dramatic foliage and clusters of red berries, which are dispersed into wildlands by birds and other animals. This species prefers moist, mild forests and woodlands, where it can thrive even in heavy shade.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 135 | 102 | 2.13 |

Like most bird-dispersed species in this report, English holly is densest in areas close to residential housing and old homesteads. The most prominent concentration in the region is in the Redwood Creek watershed, but English hawthorn can be found in forests throughout all quadrants. It is prudent to consider other bird-dispersed invasive shrubs when planning English hawthorn management. Populations often overlap with taxa that occupy a similar niche, such as Cotoneaster spp.

## WHIPPET Scores

### 5.28 – 7.77

English holly's scores sit in the middle and upper tiers of all rankings. A cluster of high scores is situated at the eastern corner of Muir Woods along the Deer Park corridor.

## Recommended Treatment Strategy

Initiate treatment in high-value forests – namely Muir Woods. Manage outliers when encountered during EDRR surveys.

## Future Management Recommendations

### MCP

- Treat new and small populations during EDRR surveys.

### MMWD

- Treat new and small populations or resprouting individuals during EDRR surveys.

### NPS

- Initiate treatment of populations in Muir Woods National Monument footprint.
- Treat new and small populations as detected, with an emphasis on Bolinas Ridge.

### State Parks

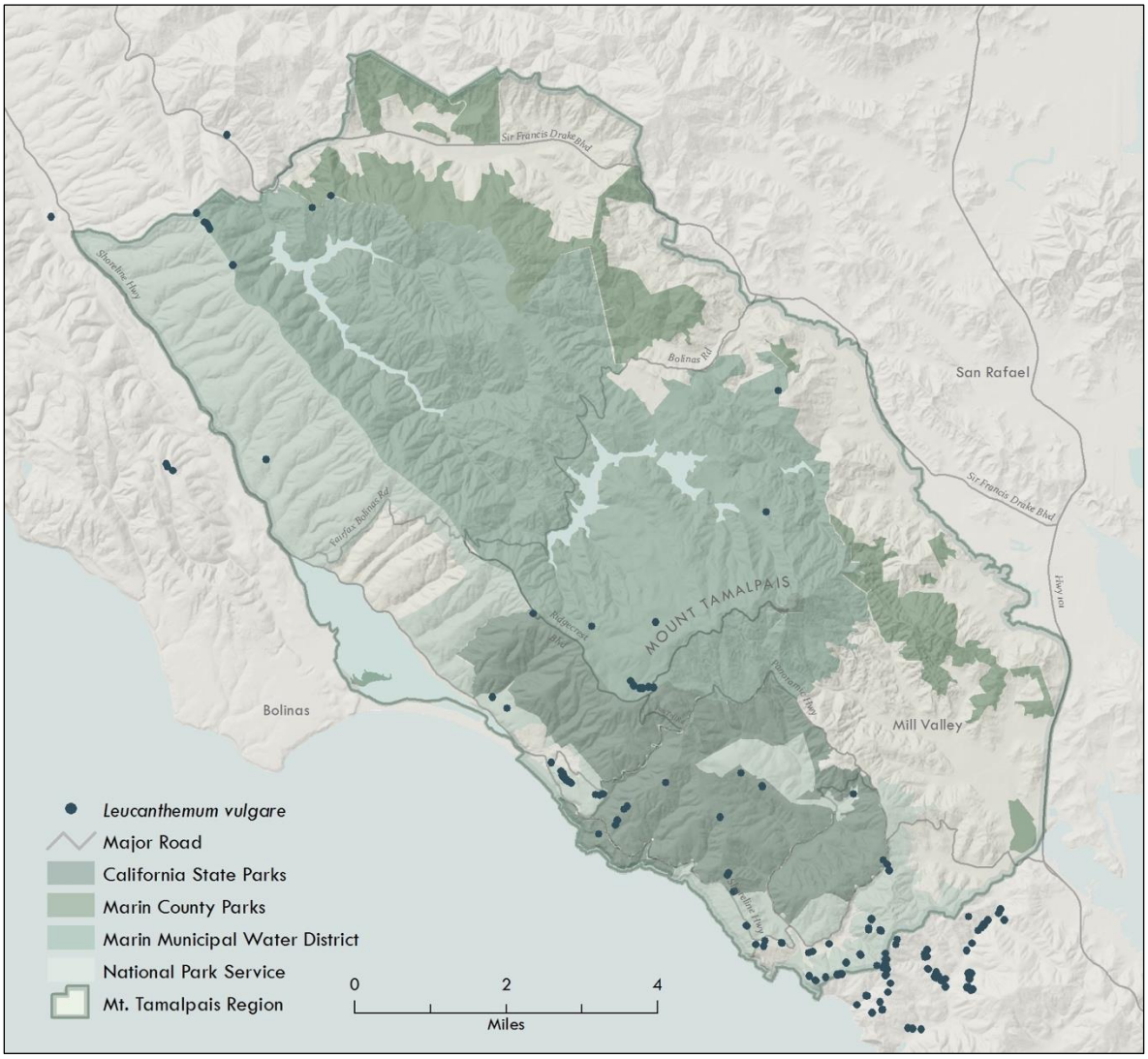
- Treat only around Muir Woods.

# LEUCANTHEMUM VULGARE

## Family: Asteraceae
## Cal-IPC Rating: Moderate

*Leucanthemum vulgare* (oxeye daisy) is a Eurasian perennial herb that spreads both via seed and by fragmentation of fragile rhizomes. It follows disturbance along trails and ditches but demonstrates the ability to move into coastal shrublands and grasslands with fog influence, as well as wet meadows.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 75 | 50 | 9.07 |

Oxeye daisy is extremely prevalent in the southern Marin Headlands, and pokes into the Mt. Tamalpais region mostly along the southwest edge at Coyote Ridge and Coastal View. The northern half of the area much sparser, with one cluster on the formerly grazed northern end of Bolinas Ridge. There's a significant concentration along the seepy watercourse in Rock Spring Meadow.

## WHIPPET Scores

### 4.77 – 6.94

Oxeye daisy scores place it in the middle of the pack among all species. High-scoring populations can be found at the top of Lone Tree Fire Road, in the town of Muir Beach on private property, and at Rock Spring Meadow. An occurrence at McCurdy Trail has the highest ranking but the annotations report no plants were found at last check. Most high-scoring populations are under management.

## Recommended Treatment Strategy

Treat in high-value habitat, particularly wet meadows. Defer action otherwise.

Justification: The prolific seed production, impressive seed viability, and easily fragmenting root system of this species make successful eradication unlikely. The habitats it invades can host rare plants, especially in the unique wet meadow complexes on the lee side of Ridgecrest. Care should be taken to time treatment to minimize soil disturbance wherever hand-pulling is required.

## Future Management Recommendations

### MCP

- No mapped occurrences.

### MMWD

- Continue annual follow-up treatment at Rock Spring Meadow.
- Continue annual follow-up treatment at Laurel Dell Road by Potrero Meadow.

### NPS

- Defer action.

### State Parks

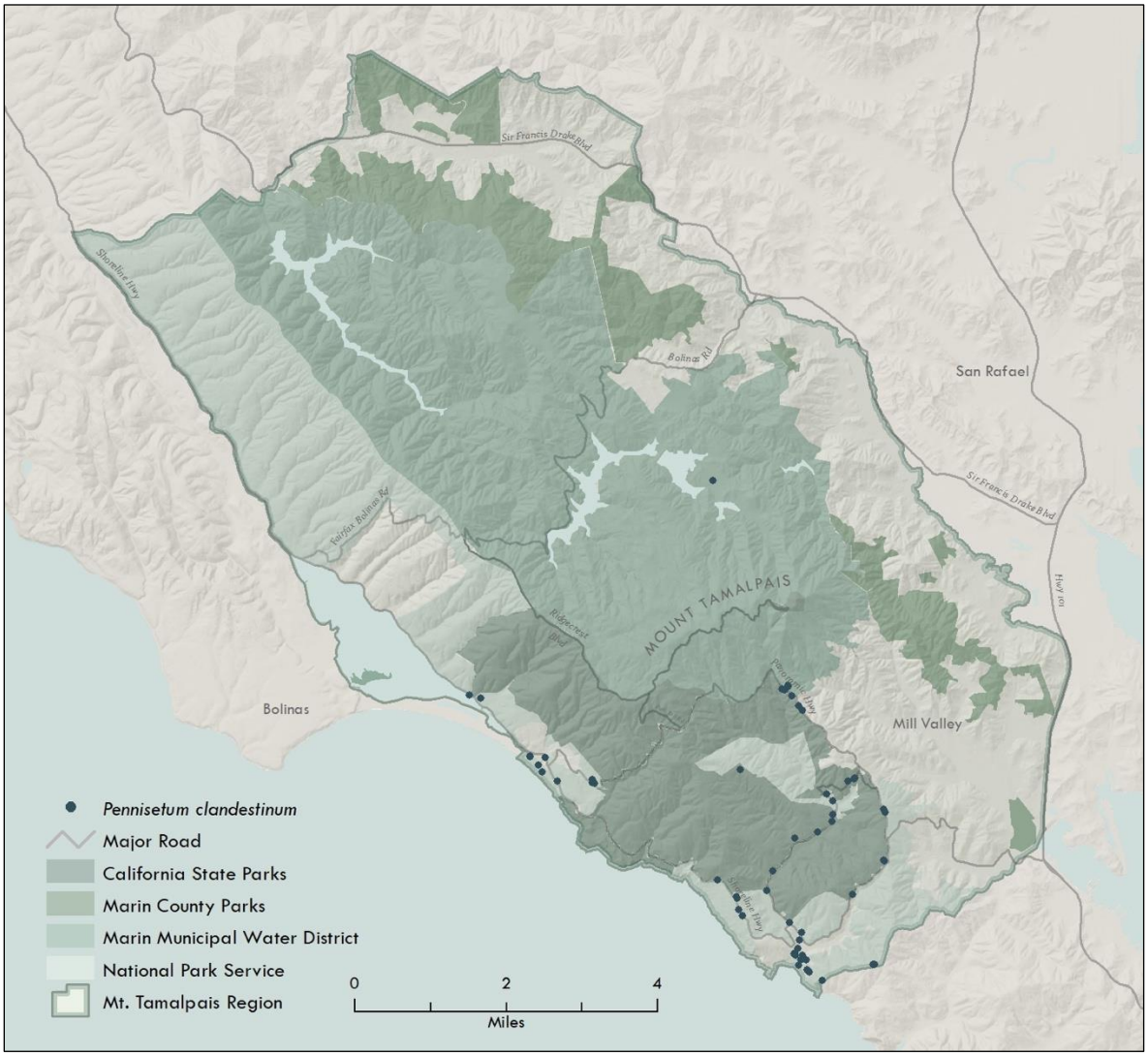
- Defer action.

# PENNISETUM CLANDESTINUM

## Family: Poaceae
## Cal-IPC Rating: Limited

*Pennisetum clandestinum* (kikuyugrass), a mat-forming perennial grass, often occurs in urban and disturbed areas. It frequently spreads vegetatively in a fairly localized fashion, though fertile plants also occur in California. Mechanical vegetation management practices, including roadside mowing, often spread viable rhizomes and stolons. Habitat preferences on Mt. Tam include seeps, roadsides, and debris piles.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 62 | 45 | 1.36 |

Kikuyugrass populations cluster along Highway 1 near Stinson Beach, Panoramic Highway near Throckmorton, and along Muir Woods Road. Additional populations occur at Muir Beach and on Coyote Ridge.

Treatment history varies with most land managers leaving roadside patches alone but initiating treatment when populations spread into desirable habitat. For example, the NPS Habitat Restoration Team treats kikuyugrass on Panoramic Highway where it has invaded herbaceous wetland habitat. The team manages other species in that location, including *Ageratina adenophora*. These site-specific weed management approaches likely drive the decision to treat this species. Kikuyugrass's frequent affiliation with disturbance means that it regularly co-occurs with other weeds in this prioritization.

## WHIPPET Scores

4.17 – 6.40

Kikuyugrass falls into the middle and lower scores among all species. Areas with high scores for eradication appear along Muir Woods Road, Highway 1, and Panoramic Highway. These scores likely reflect the high site values of their respective regions.

## Recommended Treatment Strategy

Treat in high-value areas, particularly wetland habitat.

Justification: The roadside nature and limited spread of this species should influence its ranking for treatment more than the possibility to eradicate particular populations.

## Future Management Recommendations

### All Agencies

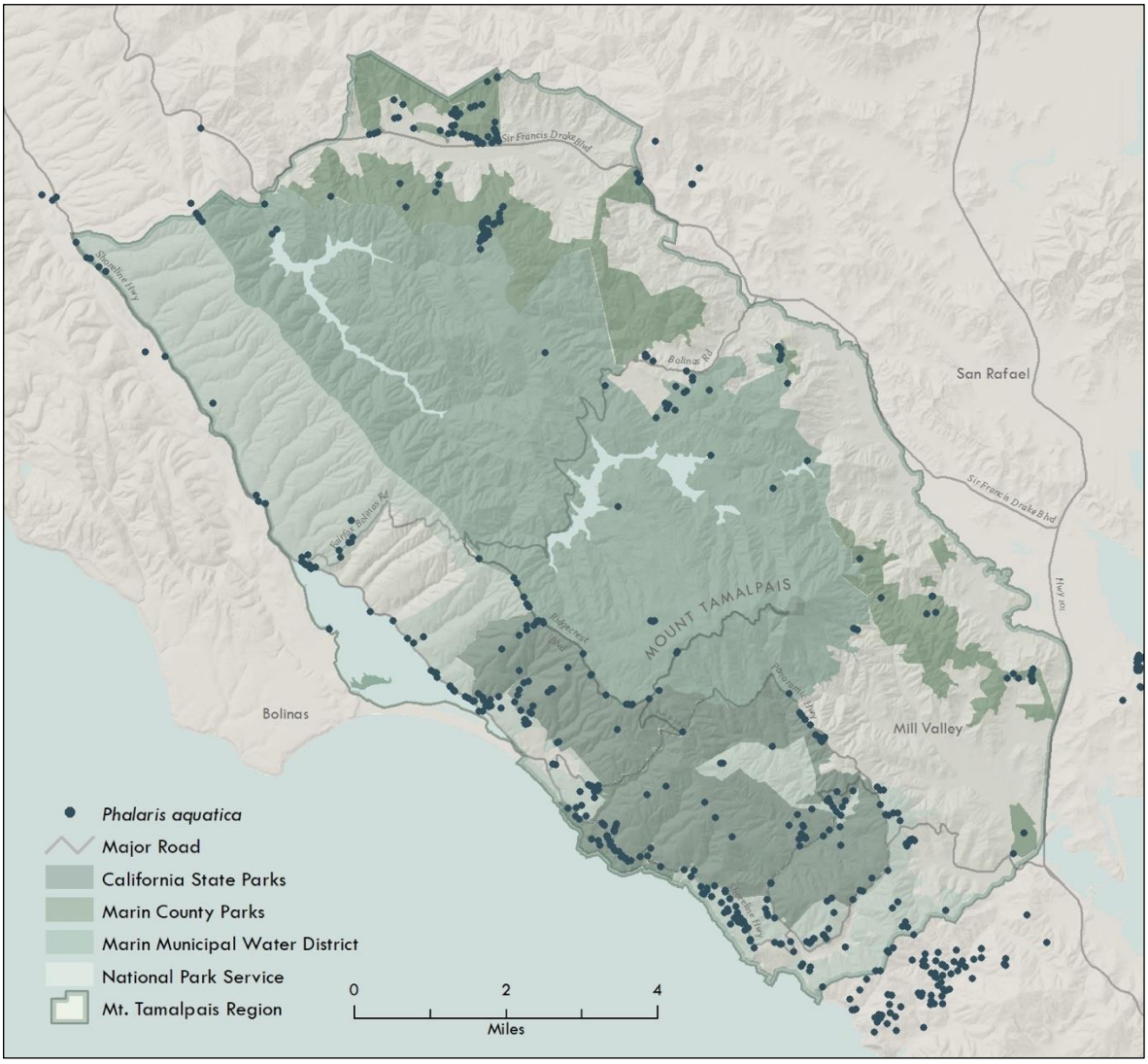
- Treat as indicated by site-specific priorities.

# PHALARIS AQUATICA

## Family: Poaceae
## Cal-IPC Rating: Moderate

*Phalaris aquatica* (Hardinggrass), a robust perennial with lanky culms and a hardy crown, often appears in disturbed areas including roadsides and pastures. It can have significant impacts to grassland species composition in wildlands. Surveyors may occasionally confuse this species with the native *Phalaris californica* in wet areas.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 450 | 259 | 101.63 |

Hardinggrass occurs sporadically on the margins of the region as well as densely on the western and southern sides. It has spotty distribution across the interior MMWD lands with notable outliers near Potrero Meadow, Kent Trail, and Pine Mountain Fire Road south of the intersection with San Geronimo Ridge Road. Like *Festuca arundinacea* and several herbaceous weeds, this species traces major roadsides including Muir Woods Road, Highway 1, and West Ridgecrest Boulevard.

Hardinggrass species is likely well-mapped on public lands, but under-mapped on rights of way and private lands, particularly pastures. Treatment history for this species includes extensive work on Owl Trail, Coyote Ridge, Homestead Valley, and near the bottom of Panoramic Highway. Work on West Ridgecrest Boulevard by One Tam Restoration has emphasized State Parks land while MMWD has performed some limited control on the north side of that road. MMWD has also committed significant effort to the management of the northern population at Bathtub Gap, while MCP has largely abandoned the effort to control the population on their property. One Tam EDRR staff remove individual plants encountered in grassland habitat on surveys.

## WHIPPET Scores

3.86 – 7.04

The highest scoring population appears along Bootjack trail on State Parks land above Muir Woods; Redwood Creek staff managed this 1 square meter population in 2016. Additional high scores appear at the top of Lone Tree Fire Road on State Parks land as well as Pantoll Road at Panoramic Highway. Many other high scores appear along trails or roads in forests where they represent outliers in high site value zones. These high scores do not align well with current management efforts for this species, which typically aim to protect rich grasslands. Large populations like those above Bathtub Gap get low rankings because of their size and site value.

## Recommended Treatment Strategy

Treat in high-value areas, particularly grasslands.

Justification: Hardinggrass has prolific populations throughout the region. The wide distribution and fidelity to roadside habitat requires a measured approach. This approach aligns with current management status, which has the potential to protect vulnerable grasslands from impact, if implemented cohesively across the partnership. While the interior core of MMWD has few populations, most of the core has less suitable habitat than areas already invaded. New populations found through the EDRR program warrant consideration as they arise.

## Future Management Recommendations

### MCP

- Resume control efforts in Gary Giacomini preserve to match nearby effort of MMWD.

### MMWD

- Continue management of outlier populations in the interior core.
- Continue management along West Ridgecrest Boulevard and Bathtub Gap.
- Initiate treatment at Potrero Meadow.

### NPS

- Continue follow-up treatment on Coyote Ridge and Homestead Valley.
- Initiate treatment on West Ridgecrest Boulevard to match effort by MMWD and State Parks.

### State Parks

- Continue and augment management on grasslands of West Ridgecrest Boulevard and Pantoll Road.
- Continue to monitor population on Bootjack Trail north of Muir Woods.
- Initiate treatment on Pantoll Road at Panoramic Highway.

### Critical Collaboration Zones

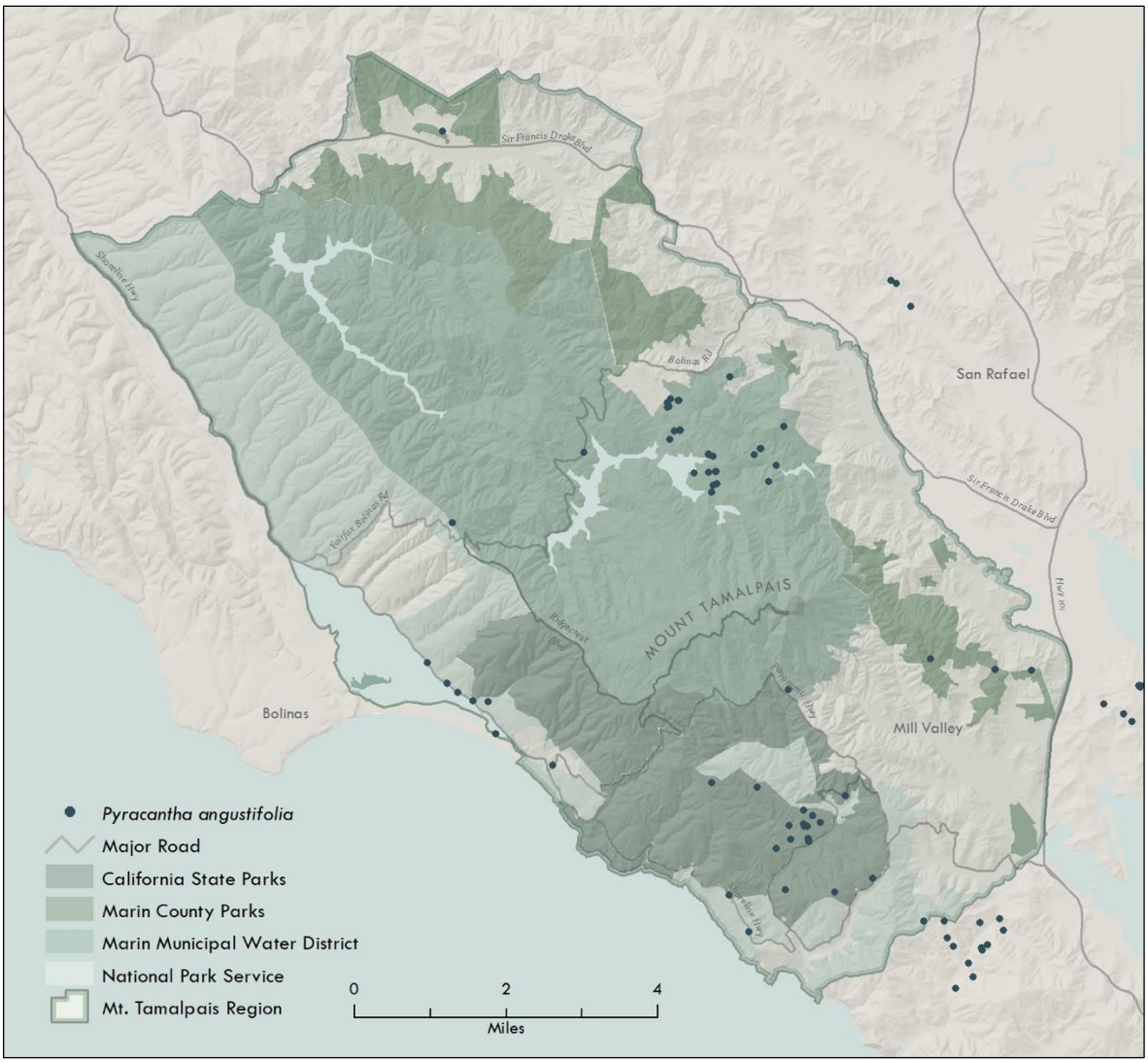
- West Ridgecrest Boulevard populations offer an opportunity for collaboration to reach successful eradication. This area sees much collaboration led by Parks Conservancy staff in Restoration, Conservation Management, and Youth Engagement around *Centaurea solstitialis* and Hardinggrass. The San Geronimo Ridge population near Bathtub Gap's rich grasslands offers another opportunity for collaboration.

# PYRACANTHA ANGUSTIFOLIA

## Family: Rosaceae
## Cal-IPC Rating: Limited

*Pyracantha angustifolia* (narrow-leaved firethorn) is a spiny shrub native to China and commonly used in California as a landscaping feature for its hedge-like density, evergreen foliage, and bright red berries. It belongs to a guild of weedy roses that originate in gardens and are dispersed into wildlands by birds—as such it is often detected alongside its confamiliars.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 61 | 51 | 0.54 |

Narrow-leaved firethorn is found primarily in two population clusters on Mt. Tamalpais: one in the center of the Redwood Creek Watershed, and one in the lakes region of the MMWD Watershed. Records outside of these localities are exceedingly sparse.

## WHIPPET Scores

4.44 – 7.35

These numbers fall across low, middle and high tiers of overall scores. Neither of the major clusters have any high-ranking points within them. The populations in Redwood Creek are largely unmanaged, but several populations on MMWD land are prioritized in meadow habitat.

## Recommended Treatment Strategy

Treat in high-value areas, particularly where rare plants are threatened. Defer action elsewhere, unless as part of localized management of similar shrubs.

Justification: Narrow-leaved firethorn and other rosaceous shrubs can gain footholds in wet meadows, where they alter habitat and outcompete sensitive taxa. Treatment is recommended outside this context where similarly behaving species are slated for management already—*Pyracantha*, *Crataegus monogyna*, *Cotoneaster* spp., and *Ilex aquifolium* should all be considered together.

## Future Management Recommendations

### MCP

- Defer action.

### MMWD

- Continue annual follow-up in Lagunitas Meadows to protect *Calochortus uniflorus*, *Perideridia gairdneri* ssp. *gairdneri*, *Castilleja ambigua* ssp. *ambigua*, and other rare wet meadow species.

### NPS

- Defer action.

### State Parks

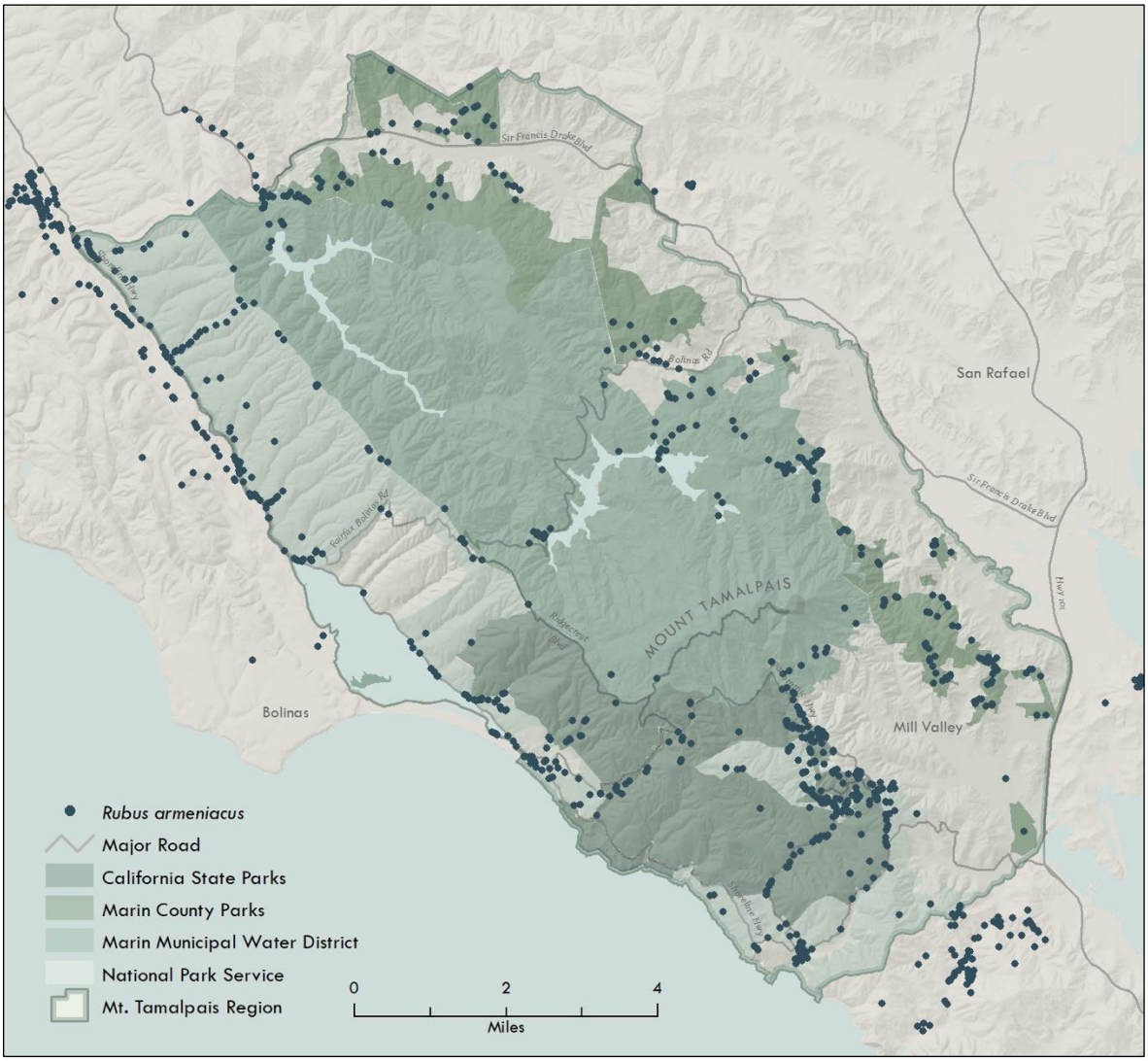
- Defer action.

# RUBUS ARMENIACUS

## Family: Rosaceae
## Cal-IPC Rating: Limited

*Rubus armeniacus* (Himalayan blackberry), a rambling, thorny shrub with tasty berries, invades a variety of coast range habitats including riparian corridors, wetland margins, forests, and coastal scrub. Robust, gnarled root masses complicate manual removal of large patches, though repeated mowing can prevent fruit set, thereby reducing spread. Wildlife disperse the sweet fruits readily. Vegetative propagation occurs when heavy canes arc back to the ground and root from shoot tips.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 61 | 51 | 0.54 |

Himalayan blackberry distribution forms a distinctive ring around the region, likely because of its association with unmanaged private lands. It also has a strong presence along the shores and dam infrastructure areas of MMWD lands. This species is likely under-mapped in off-trail drainages within a quarter-mile or so of large infestations like those mentioned on MMWD land. Agencies have taken a cautious approach to management, leaving most areas untreated. Exceptions include Homestead Valley, 2017 treatments in Muir Woods, and treatments on surveys of patches under 5 square meters.

## WHIPPET Scores

4.86 – 8.06

These scores range through all tiers with the highest scores standing out in areas in and adjacent to Muir Woods. Surprisingly, the western toe of Bolinas Ridge has many high scores. The WHIPPET model does not incorporate any topographical information into its calculations. Northern and eastern preserves also have high scores. Interior lands consistently rank lower, likely because of the treatment costs on MMWD lands.

## Recommended Treatment Strategy

Treat in high-value areas, particularly in wet meadows. Continue treatment of small patches on EDRR surveys.

Justification: Himalayan blackberry has a wide distribution and strong presence. Off-trail drainages adjacent to large patches likely have additional populations, and unmanaged adjacent lands are likely to remain source populations. Where MMWD lands appear to have an intact core toward Kent Lake and Carson Ridge, treatment on surveys will slow establishment in less impacted areas. High-value areas such as wet meadows and restoration sites deserve special consideration with this species.

## Future Management Recommendations

### All Agencies

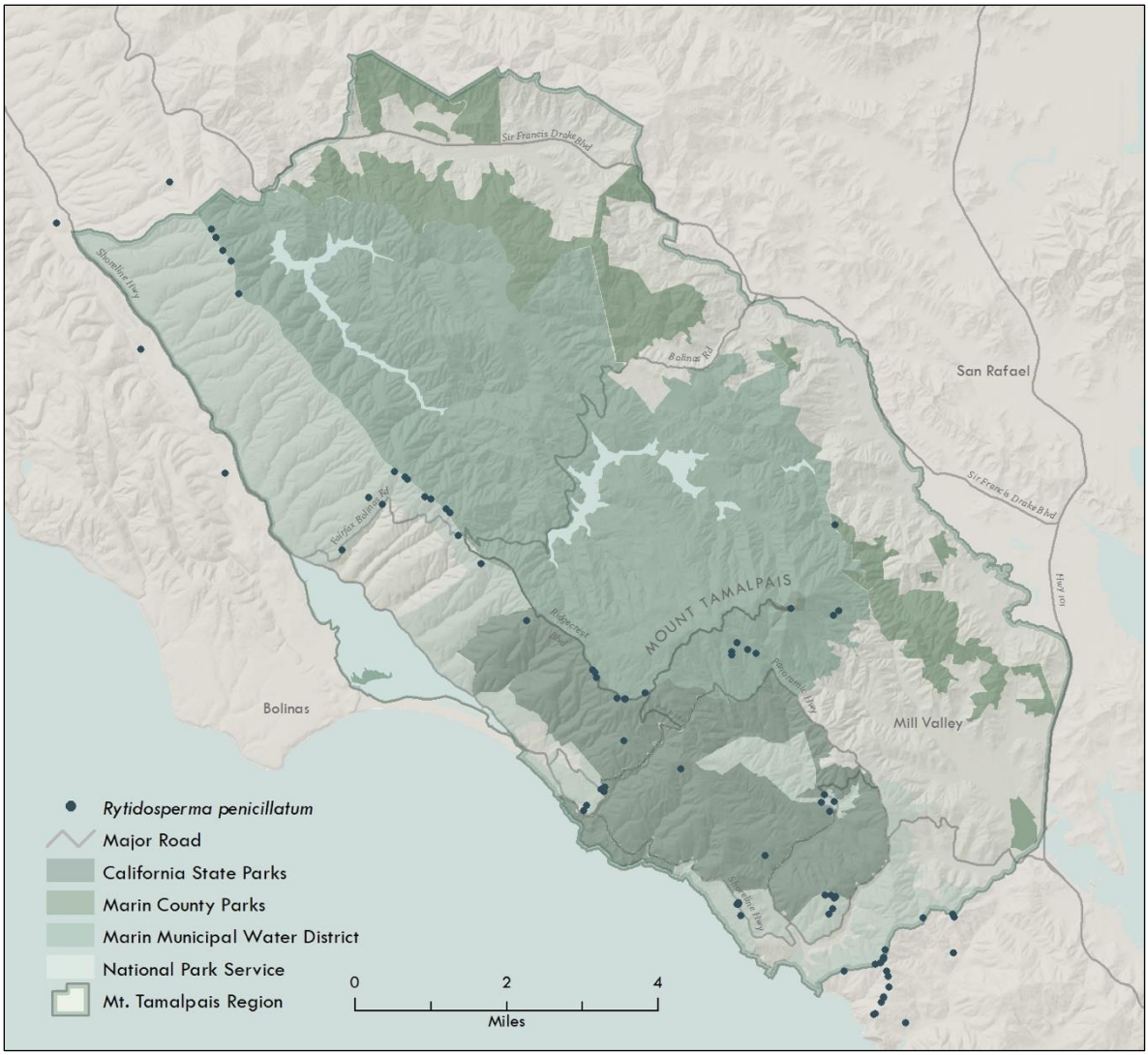
- Continue annual treatment in high-value areas as identified by vegetation management plans.
- Continue treatments on EDRR surveys for new patches in largely unimpacted areas if manageable within 10 minutes.

# RYTIDOSPERMA PENICILLATUM

## Family: Poaceae
## Cal-IPC Rating: Limited

*Rytidosperma penicillatum* (hairy oatgrass) appears along disturbed trailsides in grasslands and shrublands as well as some forests in the Mt. Tam region. This easily overlooked perennial bunchgrass poses a significant detectability challenge for early detection surveyors. In at least one case, surveyors missed seeing hairy oatgrass during the survey of the road and trail network.

### Regional Distribution



## Occurrence Details

| Patches | Populations | Gross Acres |
|---|---|---|
| 63 | 48 | 5.13 |

While likely under-mapped, this species has known populations along Bolinas Ridge, East Ridgecrest Boulevard and in the Redwood Creek watershed. A small population on Kent Pump Road is known but remains unmapped. Treatment history includes sporadic management of the population at East Peak, as well as one-off treatments on EDRR surveys.

## WHIPPET Scores

3.20 – 6.08

Hairy oatgrass scores place it in the middle and lower tiers among all species. A population at Dipsea Trail ranks as the highest for treatment, followed by one population on Bolinas-Fairfax Road. The latter population has several nearby patches in off-trail conditions nearby.

## Recommended Treatment Strategy

Delist and defer action on all populations.

Justification: This species has limited impacts in wildlands and is likely highly under-mapped. It does not appear in many high-value areas at this time. Challenges in identification complicate successful surveys and treatment.

## Future Management Recommendations

None

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## Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | June 2020 | Kesel, R.; Greenberger, D. | EDRR Report published | | 1.0 |

# Appendix 4. Priority Two Accounts for Species Excluded from WHIPPET Analysis Version 1 (June 2020)



Six species on the One Tam Priority Two list were not evaluated for the California Invasive Plant Council inventory at the time of this writing. These species were excluded from WHIPPET analysis because the WHIPPET formula draws from the Cal-IPC inventory for species trait information. Some species in this list are currently under review by Cal-IPC and, pending the outcome, could be evaluated using WHIPPET in the future.

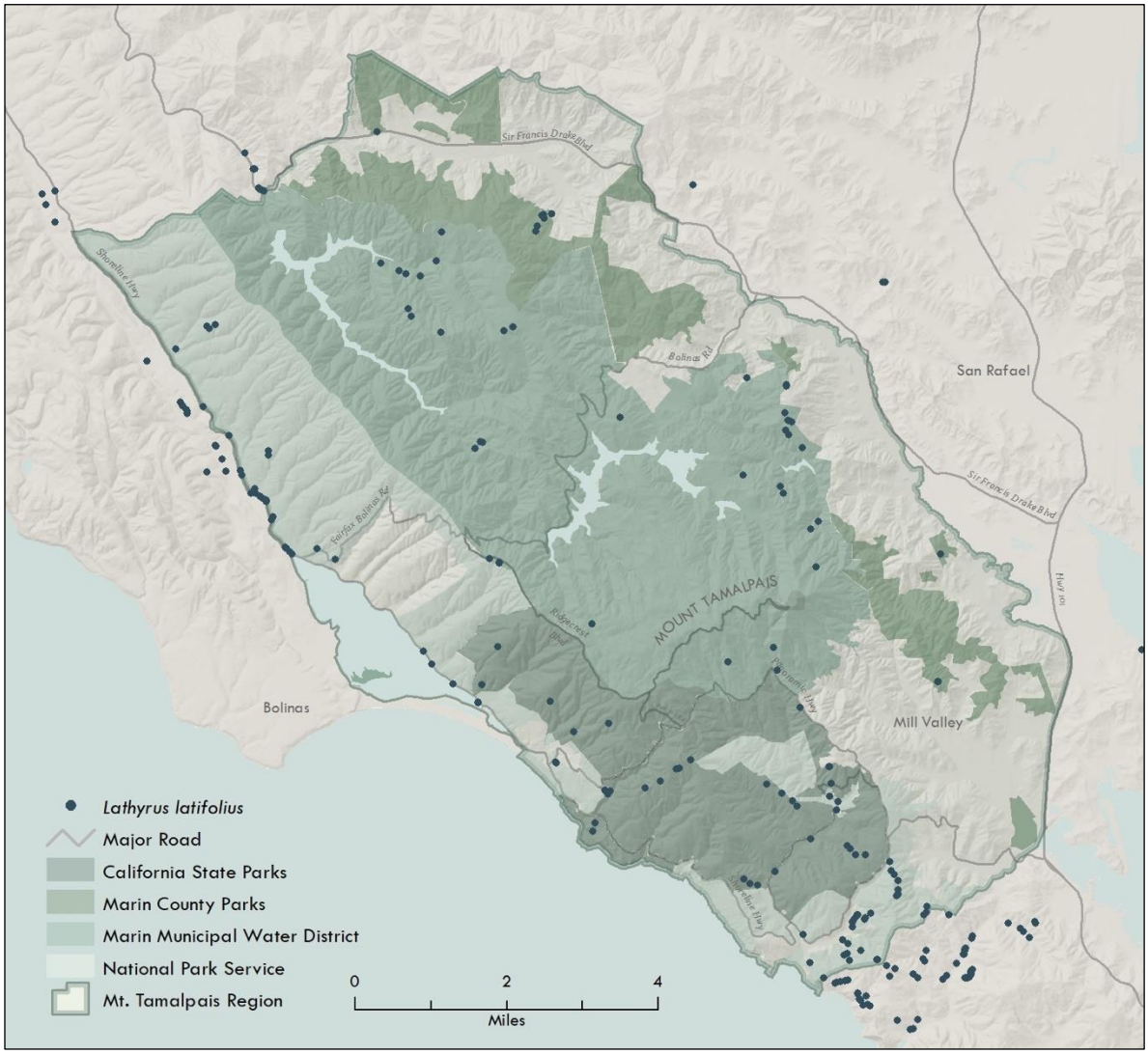
One species on the Priority Two list, *Rytidosperma caespitosum*, was excluded from WHIPPET analysis because no occurrences for this species have been mapped in Marin County to date.

# LATHYRUS LATIFOLIUS

## Family: Fabaceae
## Cal-IPC Rating: Not ranked

*Lathyrus latifolius* (everlasting pea) produces bright, fragrant flowers favored by horticulturalists. With long-lived seeds and deep, extensive rhizome networks, this species spreads readily, climbing over adjacent vegetation and occasionally forming thick monocultures. Herbaceous vines die back entirely each summer. Small shoots often belie the mass of root material below the surface. Digging this species out is unfeasible beyond the first year of growth without heavy equipment. Because this species can move via rhizome fragments, excavated soil should never be moved off site unless it is into a known sacrifice area or to landfill. Chemical treatments are challenged by the low ratio of aboveground plant material to root mass.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Percent Managed |
|---|---|---|
| 142 | 1.06 | 15.6% |

Everlasting pea occurs throughout the Mt. Tamalpais region. Notable populations include the seep at upper Dipsea Trail near Veterans Bench and Worn Spring on MMWD land. Treatment for this species is infrequent. It is recommended that this species be addressed in high-value areas such as wetlands, when feasible. Because MMWD does not use herbicide, treatment options are limited to excavation with heavy equipment once established. The cost-benefit analysis of this approach will likely limit treatment on MMWD land to existing construction projects.

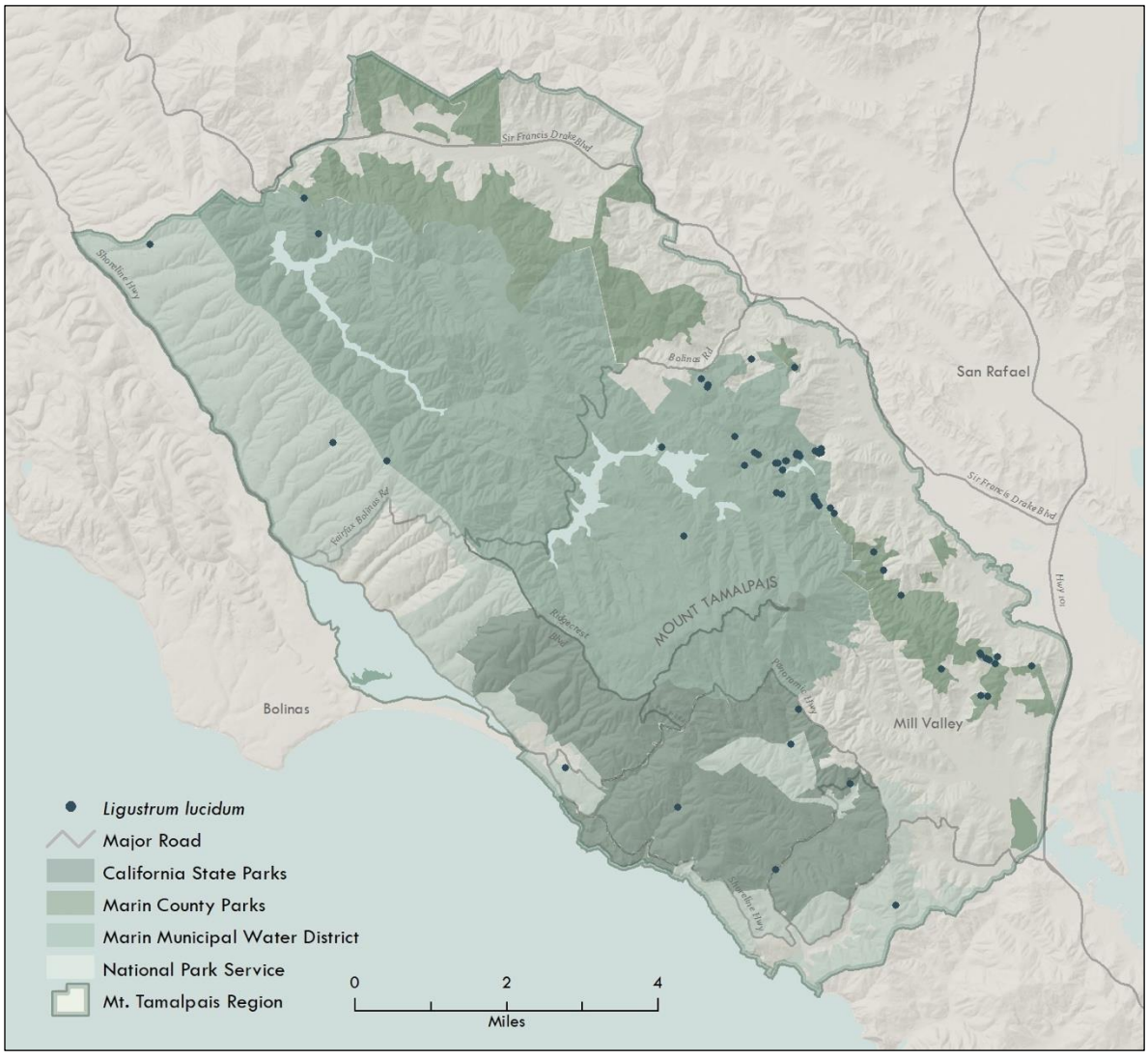
This species occurs throughout Marin and is likely under-mapped on private lands.

# LIGUSTRUM LUCIDUM

## Family: Oleaceae
## Cal-IPC Rating: Limited

*Ligustrum lucidum* (glossy privet) is a favorite among horticulturalists as a garden border tree, a shade establisher, and a profuse bloomer. Such backyard plantings are the main source population for this species in Marin. Birds, readily observed eating the abundant black fruits, disperse seeds across wildlands, though usually in relative proximity to neighborhoods. New plants will then grow readily in understory or open habitats, particularly if near surface water. Fortunately, saplings tend to spend most of their time growing up rather than down—shallow roots enable easy removal of most early detections.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Percent Managed |
|---|---|---|
| 59 | 0.16 | 23.4% |

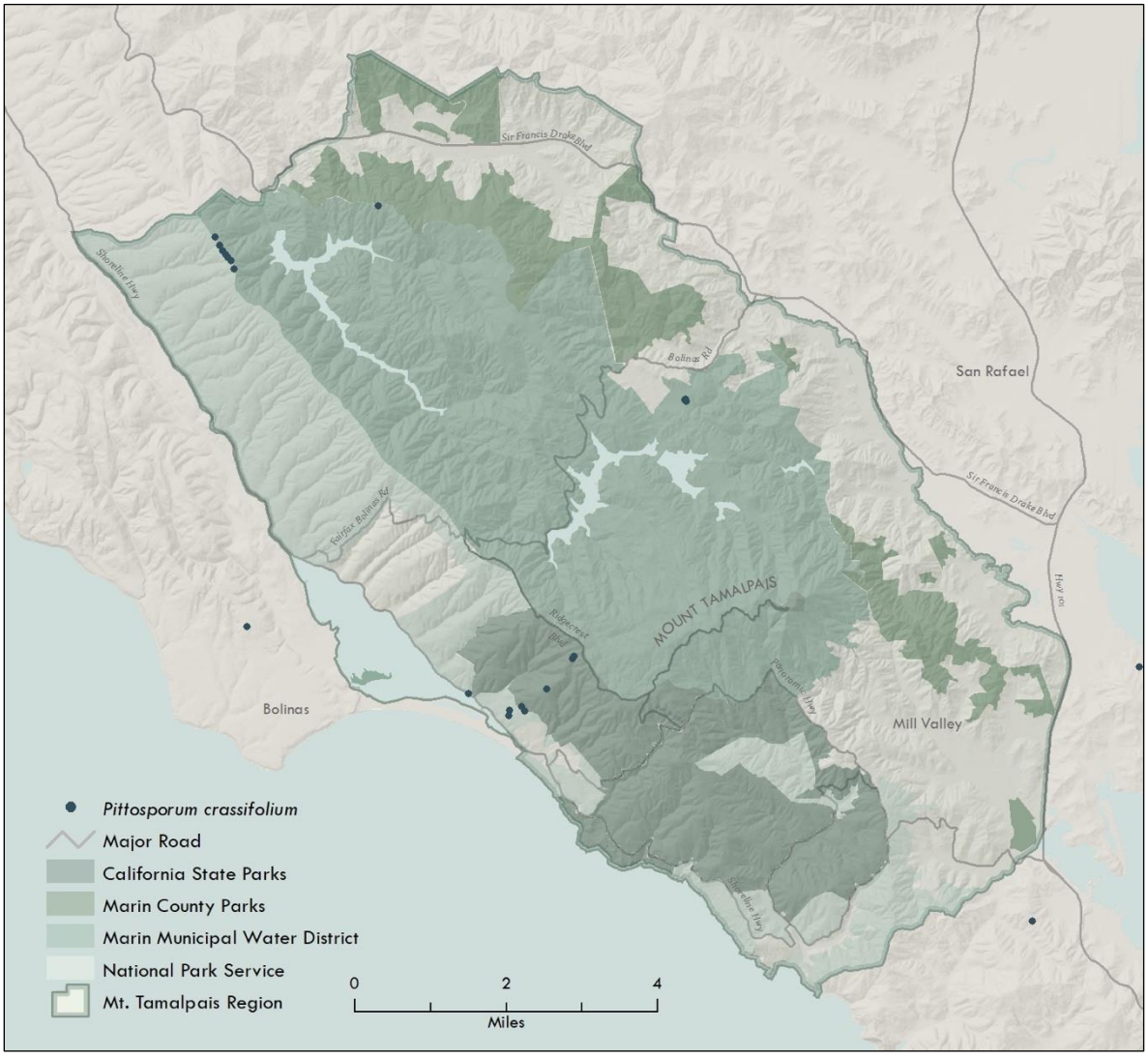
While glossy privet clusters along the eastern edge of the region adjacent to the communities of Corte Madera, Larkspur, and Kentfield, it also occurs near Stinson and Muir Beaches as well as the town of Lagunitas. This species occurs throughout Marin and is likely under-mapped on private lands.

# PITTOSPORUM CRASSIFOLIUM

## Family: Pittosporaceae
## Cal-IPC Rating: Watch

The horticultural popularity of *Pittosporum crassifolium* (thick-leaved box) and others in its genus presents the opportunity for repeated introductions of the species. The conspicuous fleshy fruits of this widely planted tree are eaten and dispersed by wildlife.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Percent Managed |
|---|---|---|
| 3 | < 0.01 | 0% |

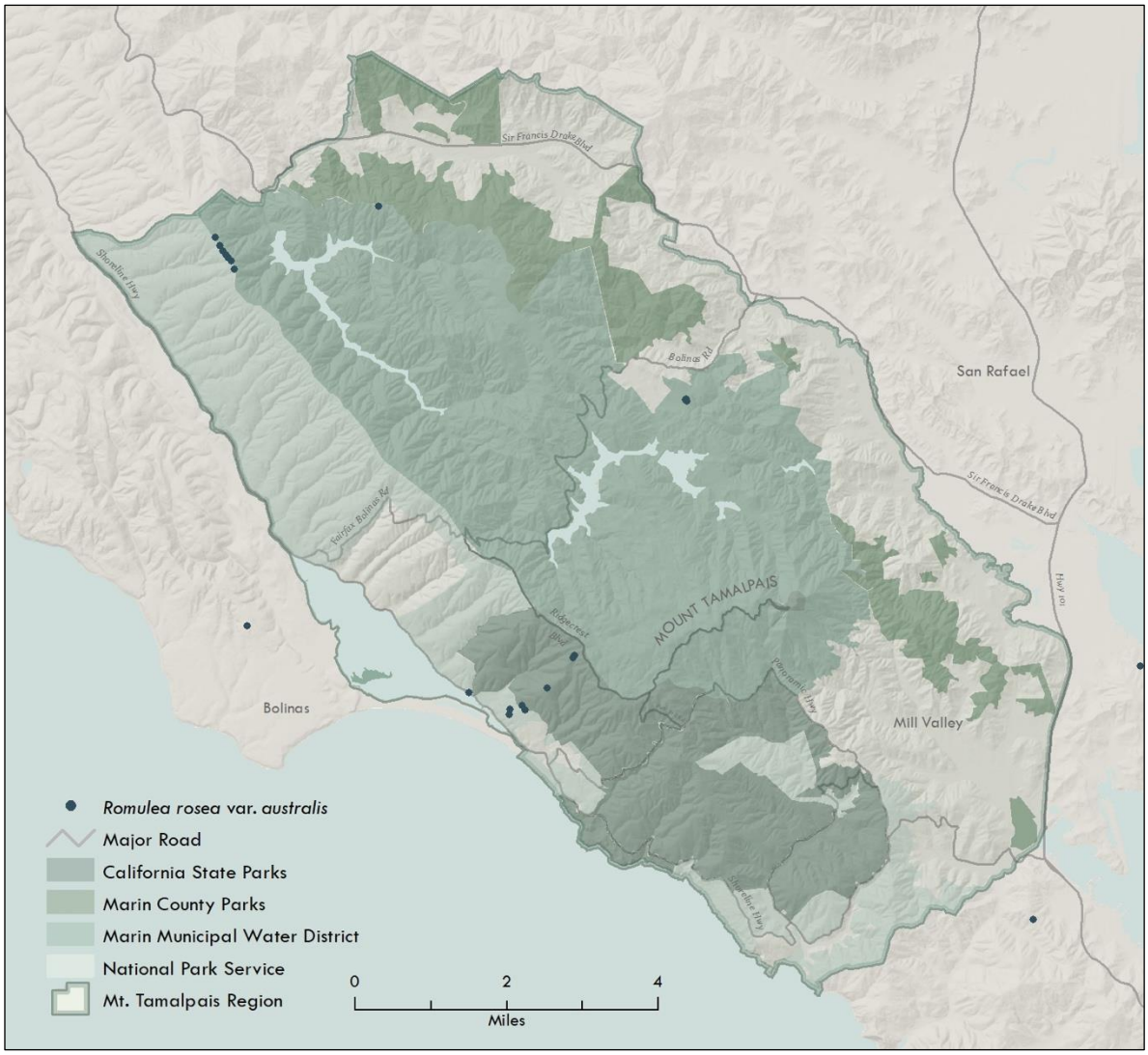
Thick-leaved box occurs very limitedly along the coast near the Muir Beach and Stinson Beach communities. One occurrence near Muir Beach occurs on private land or a Caltrans right of way.

# ROMULEA ROSEA VAR. AUSTRALIS

## Family: Iridaceae
## Cal-IPC Rating: Watch

*Romulea rosea var. australis* (rosy sandcrocus) shows up in disturbed grasslands, pastures, and trail beds. Frequently overlooked, this species is most detectable during its narrow flowering window in March and April. The small pink flowers may not catch the eye of surveyors early in the day when they remain closed at the base of the plant.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Percent Managed |
|---|---|---|
| 23 | 2.37 | 2.9% |

This species occurs in all quadrants of the region with a preference for open, disturbed habitats. Clusters of occurrences include the northern grasslands of Bolinas Ridge and the Willow Camp Fire Road corridor. A population at the Sky Oaks gateway is under management while many other populations are untreated. This species also occurs frequently at Point Reyes National Seashore, where it has been expertly mapped by the NPS Inventorying and Monitoring program. It likely occurs on pasture lands in north and west Marin. It is presumably vastly under-mapped on private land and much public land outside the region.

# RYTIDOSPERMA CAESPITOSUM

Family: Poaceae
Cal-IPC Rating: Watch

*Rytidosperma caespitosum* (tufted wallabygrass) is a perennial grass known to invade some grassland and dune habitats in San Mateo and Santa Cruz counties.

## Regional Distribution

Tufted wallabygrass is not known to occur on the public lands within the Mt. Tamalpais region.

## Occurrence Details

| Patches | Gross Acres | Percent Managed |
|---|---|---|
| 0 | 0 | - |

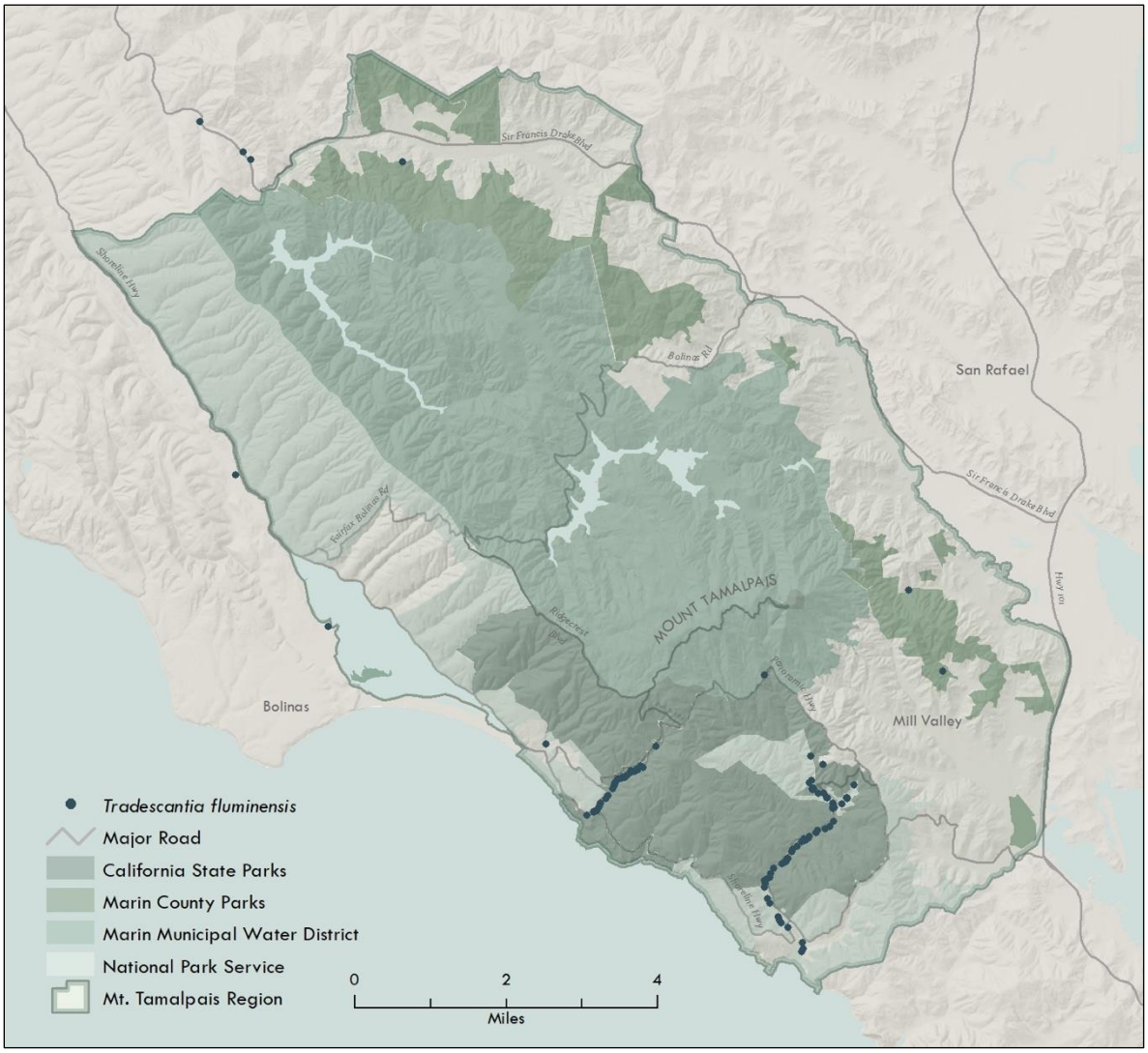
At present, tufted wallabygrass has not been mapped anywhere in Marin County. During the next protocol revision, it is recommended that the species be moved from the Priority Two list to the Priority One list to reflect its watchlist status. Another option would be to remove both *Rytidosperma* spp. from the list given identification challenges.

# TRADESCANTIA FLUMINENSIS

## Family: Commelinaceae
## Cal-IPC Rating: Not ranked

*Tradescantia fluminensis* (small-leaved spiderwort) traces creek banks in several watersheds of Marin County. This plant appears to spread in riparian areas with the scouring of creek banks through the movement of rhizome and stem node material. Dense, mat-forming growth has been observed in riparian understory, including in coast redwood habitat.

### Regional Distribution



## Occurrence Details

| Patches | Gross Acres | Percent Managed |
|---|---|---|
| 99 | 1.09 | 40.2% |

Small-leaved spiderwort's distribution in the Mt. Tamalpais region follows obvious creek corridors including Redwood Creek and Webb Creek. Smaller patches also occur along Panoramic Highway and the eastern MCP preserves. Outside the region, small-leaved spiderwort is mapped at Pine Gulch on NPS land and along Lagunitas Creek in Samuel P. Taylor State Park. While Redwood Creek staff manage some patches, most occurrences remain untreated.

## Revision History Log

| Previous Version # | Date | Author | Changes | Reason | New Version # |
|---|---|---|---|---|---|
| -- | June 2020 | Kesel, R.; Greenberger, D. | EDRR Report published | | 1.0 |