Results from four years of early detection invasive plant monitoring in Golden Gate National Recreation Area.

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The project described herein is based on the following NPS, Inventory & Monitoring protocol:
Williams, A. E., S. O'Neil, E. Speith, and J. Rodgers. 2009. Early detection of invasive plant species in the San Francisco Bay Area Network: A volunteer-based approach. Natural Resource Report NPS/SFAN/NRR—2009/136. National Park Service, Fort Collins, Colorado.

ABSTRACT

In 2008, the San Francisco Area Network, Inventory and Monitoring Program, began implementing an invasive plant early detection monitoring study in Golden Gate National Recreation Area (GGNRA). Thus far, this work has collected over 3000 occurrences of target invasive species and has removed over 300 populations. Preliminary analyses of the spatial distribution of early detection occurrences reveals higher numbers of invasive plant occurrences and higher invasive species richness associated with urban settings as compared to natural settings. Separate analyses of detection rates for each species reveals that for some, we have likely found most of the extant populations and they do not appear to be colonizing new areas rapidly. However, the rate of detection for other species shows that new occurrences are either steady, fluctuating, or climbing. For species with fluctuating or climbing numbers of new occurrences, it is unknown whether these trends are due to interannual variability, increased colonization rates, difficulty detecting species due to small phenological periods of time when plants are easily noticeable, or due to turnover in field staff with differing plant identification skills. However, based on the large increase in new occurrences during 2011, which coincided with the hiring of a new field technician, it appears that the recent uptick in new invasive plant populations is personnel related. Continuation of these surveys and their linkage into the Bay Area Early Detection Network will improve our understanding of invasive species patterns and will be used to maximize the effectiveness of control efforts within the park and region-wide.

METHODS

Inventory and Monitoring staff ranked both areas and species to prioritize search efforts for the invasive species early detection program (Williams et al. 2009). **The management areas are subwatersheds that are ranked as high, significant, moderate, and low based on invasion risk and harm to significant biological resources. These subwatersheds are surveyed yearly, biennially, every five years, and also every five years, respectively.** The exotic species found in GGNRA were ranked based on a species invasiveness score and the known spatial extent of a species (Williams et al. 2009). This process resulted in List 1, 2, 3, and 4, early detection invasive plant species. Depending on the rank of an invasive species, different levels of information are collected when they are encountered during field surveys:

Our Priorities	Example	Explanation	Data Collected
List 1 (Highest Priority Plants)	 Fertile capeweed	List 1 plants are highly invasive and are typically not widespread. Control or even eradication is often feasible.	*Point occurrences** and *polygon assessments*** are recorded for all patches, regardless of their size.
List 2 (High Priority Plants)	 Cape ivy	List 2 plants are highly invasive and usually more common than List 1 species, but are still feasible to control in many places.	*Point occurrences* are recorded for all patches regardless of their size, and *polygon assessments* are recorded for all patches smaller than 100 square meters.
List 3 (Medium Priority Plants)	 Sweet fennel	List 3 plants are usually widespread and difficult to control at the scale of the park. Uncommon species of concern are also listed here to improve our understanding of their distribution in the park.	*Point occurrences* are recorded for all patches smaller than 100 square meters.
List 4 (Lower Priority Plants)	 Rattlesnake grass	List 4 plants include all other exotic species that are not captured by Lists 1 – 3. Typically, these are ubiquitous invasive plants and are beyond control, or they are waifs.	These plants are not mapped. Skilled observers may record presence/absence.

*Point occurrences are individual points recorded to represent an entire patch of invasive plants
**Polygon assessments describe the size, shape and coverage of a patch

RESULTS/DISCUSSION

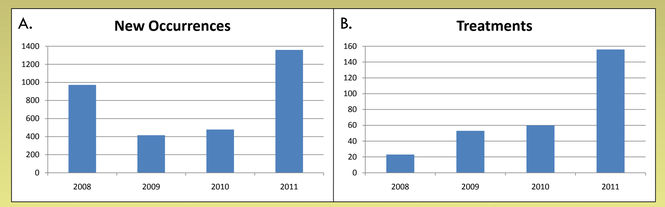


Figure 1. Number of new invasive plant occurrences by year (A) and number of treatments (removal) by year. (B)

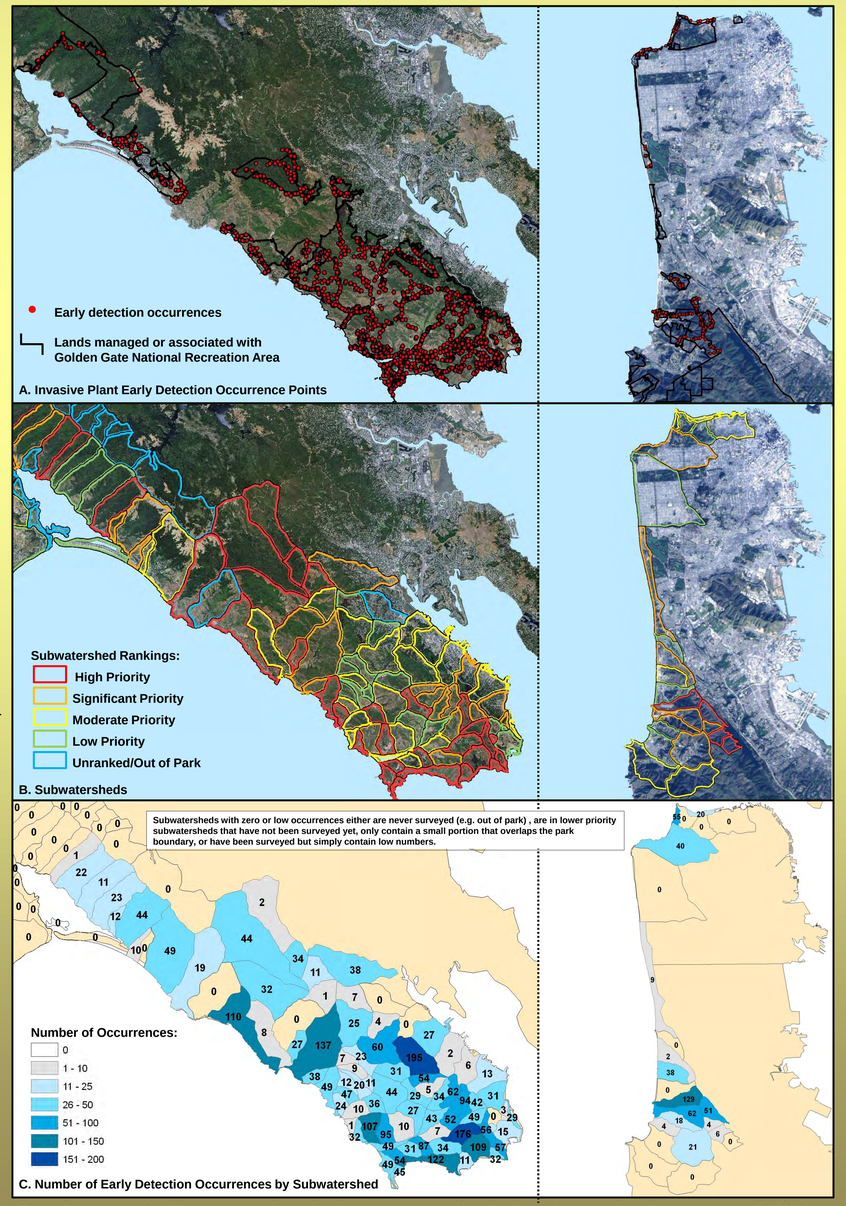
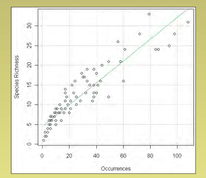


Figure 2. Maps of all Inventory and Monitoring occurrences of early detection invasive plant species in GGNRA (A), maps of subwatersheds and their rankings (B), and maps of number of occurrences by subwatershed (C).



Across GGNRA, species richness of invasive plants was positively correlated with the number of invasive plant occurrences per subwatershed ($R^2 = 0.8523$, $P < 0.0001$).

Figure 3. Species richness of early detection invasive plants per subwatershed regressed against the number of early detection occurrences by subwatershed.

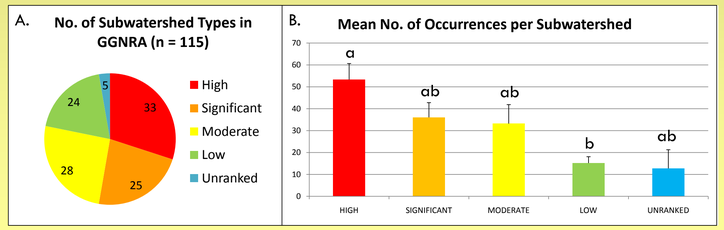


Figure 4. Number of subwatershed in each category (A) and the mean number of occurrences by category (B). Letters above bars indicate significant differences based on a post-hoc Tukey test.

Because there is unequal sampling effort among the different ranked subwatersheds, with high priority subwatersheds being surveyed more frequently than significant ones, etc…, the difference between the mean number of occurrences among subwatershed types ($F = 3.7756$, $P = 0.00685$) was lower than expected based on a post-hoc Tukey test (Figure 4.B).

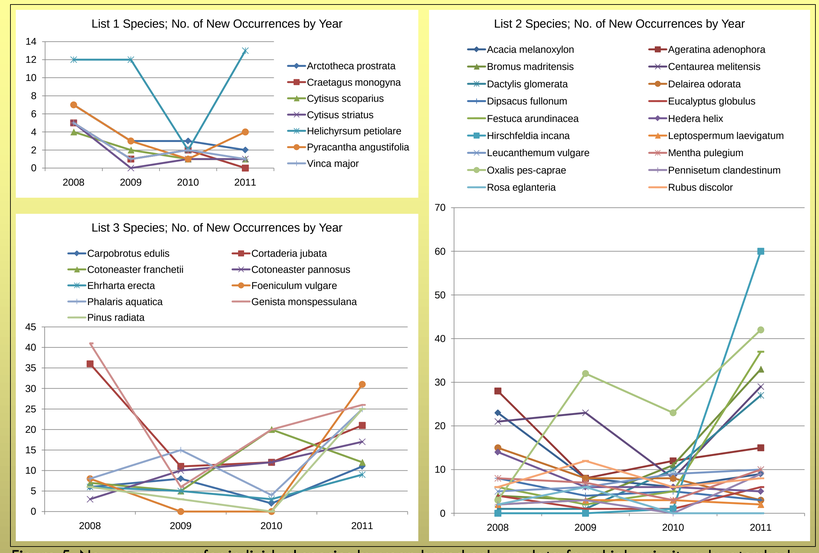


Figure 5. New occurrences for individual species by year, based only on data from high priority subwatersheds.

Turnover in personnel has led to differences in the number and types of species recorded among years, making species-specific trends difficult to draw conclusions from (Figure 5). Regardless of different skill-levels of weed mappers, some species show a decreasing trend in number of annual occurrences over time, likely indicating that most extant populations are mapped and they are not proliferating. Other species show fluctuations, which may indicate that they are either difficult to identify, are only noticeable during certain phenological stages that may have coincided with some but not every survey date thus far, or they exhibit dynamic meta-populations.

A full sampling cycle, where all subwatersheds are surveyed, will occur by the end of the 2012 field season. When the sampling cycle is complete, further analyses will be performed to better understand spatial patterns and trends of early detection invasive plant species in GGNRA.