Distribution of Perennial Pepperweed *(Lepidium latifolium)* in Bay-Delta Wetlands

ESA Environmental Science Associates

A CalFed Mapping Project

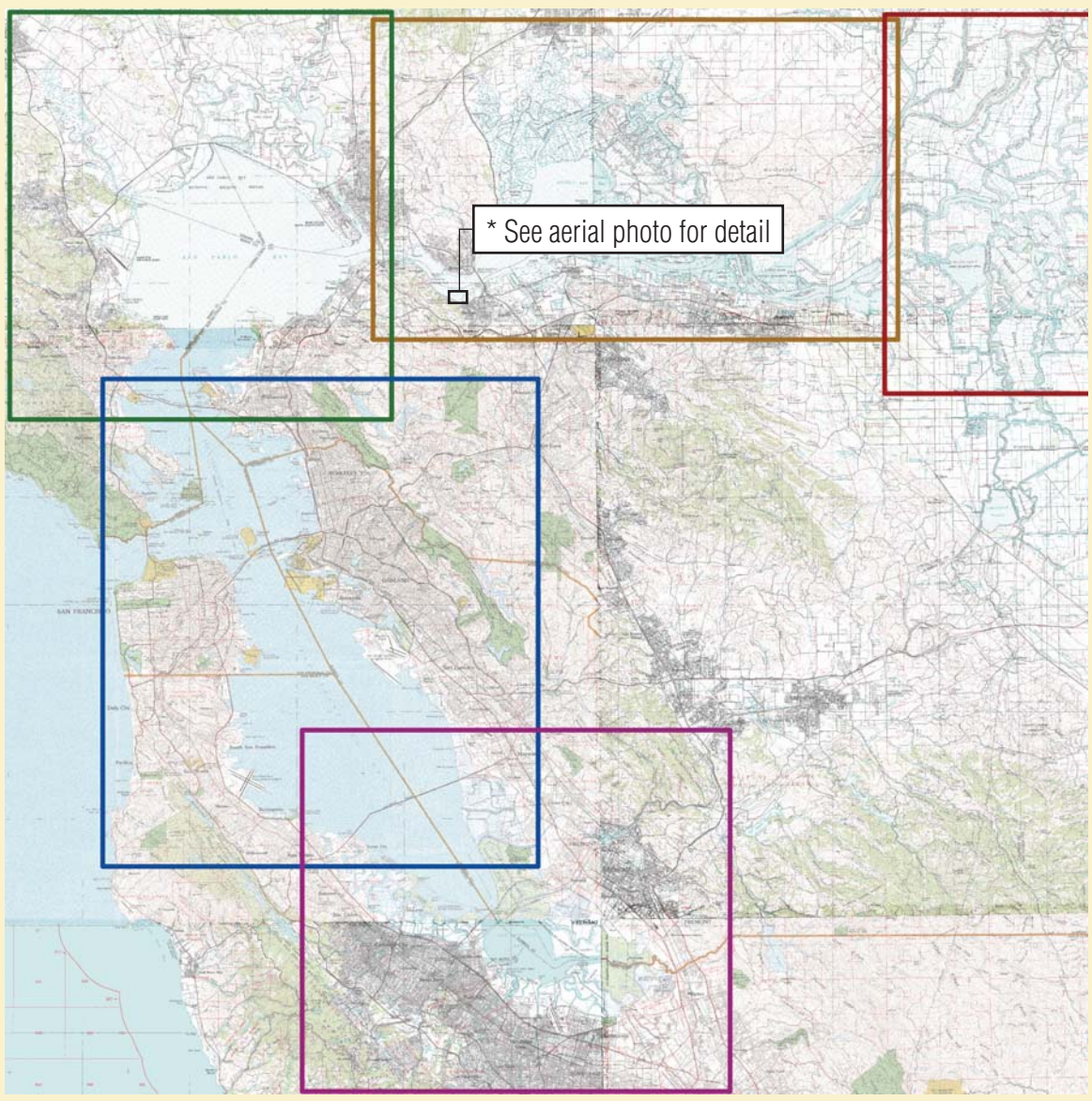
Under the CALFED Ecosystem Restoration Program, Environmental Science Associates (ESA) is undertaking a three-year study of the distribution of perennial pepperweed (Lepidium latifolium), an aggressive invasive plant species in the San Francisco Bay-Delta. The study will include extensive region-wide inventory of the species, and development of GIS mapping and database. New field data and existing publicly-available information will be incorporated to create a spatial model of invaded habitats. The model will be a valuable asset to continuing monitoring of invaded habitats, and will provide a predictive tool to identify habitats at risk of invasion.

The study will develop a more current and complete understanding of perennial pepperweed distribution, invasion trends, habitats or areas at risk and ecological characteristics. This information will lead to developing better strategies for control, as well as anticipating and responding to invasions of restoration sites. This study will update documentation of current distribution of perennial pepperweed within the Bay-Delta region, and will identify conditions that place existing and restored habitats at greatest risk of invasion through a GIS-based analysis of extensive primary (field) and secondary data sources.

The proposed project will help CALFED meet key milestones for its Multi-Species Conservation Strategy and Ecosystem Restoration Program goals and objectives for At-Risk species and implement non-native species management.

CALFED is a coalition of local, state, and federal agencies and other stakeholders organized to develop a long-term plan to restore the health of the San Francisco Bay/Sacramento-San Joaquin Delta estuary ecosystem, improve water supply and water quality, and improve levee stability.

ESA is a leader in innovative and effective environmental solutions with a 35-year reputation for responsive problem solving on projects ranging from small, focused studies to large, complex analyses. Because we offer technical credibility coupled with a strong understanding of planning and regulatory processes, we can help our clients effectively manage environmental issues to fulfill project goals.



Field Approach to Weed Mapping

Field Data Structure

- Adapted protocol from Team Arundo, California Department of Food and Agriculture, and North American Weed Mapping Association
- Customized a set of parameters for anticipated habitats and site conditions
- Created a data dictionary for Trimble GeoExplorer3 GPS
- Revising the data dictionary as different field conditions are encountered

Data Collection

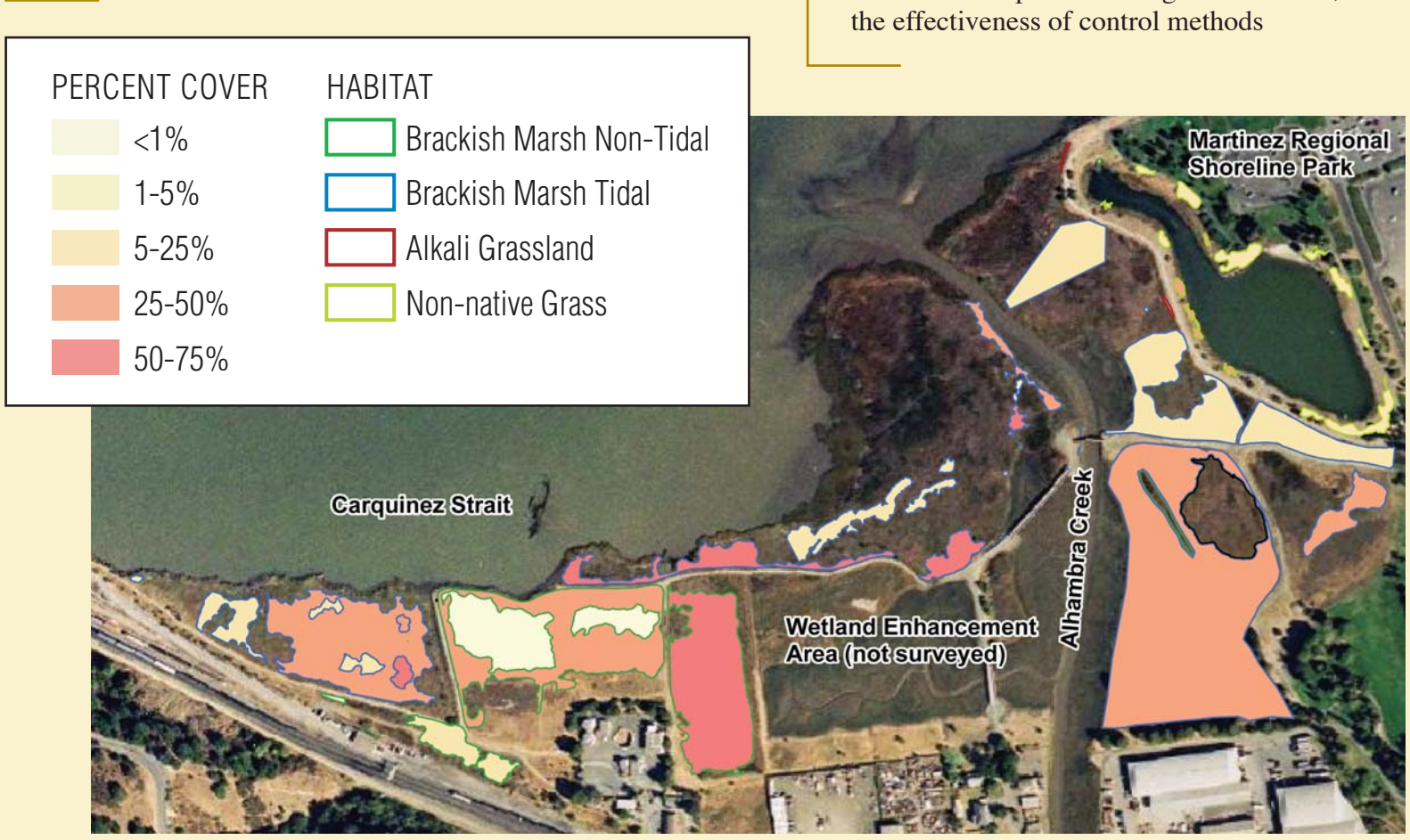
- Location, location, location – the most important item, logged in UTM coordinates (NAD83)
- Percent cover in broad classes
- Phenology – germinating, seedling, flowering, seeding, senescing, dead
- Pattern – patchy, clumped, even, linear
- Patch spread – does the patch appear to be expanding, receding or stable?
- Species associates – unlimited number of species can be entered, but the focus is on the dominants that help define the habitat
- Occupied Habitat Type
- Adjacent Habitat – important to record for later analysis of invasion risk
- Feature type – decisions are made in the field as to how best to represent the population: as a polygon, linear patch, edge of a patch, or offset point (for inaccessible patches). Many variations on these basic types are available

Data Management and GIS Mapping

- Using ArcGIS 9, shape files are created from data logged in the field
- Data are manipulated on the desktop to close polygons, convert polylines to polygons, and clean up attribute tables
- Map features can be displayed according to selected attributes, as in the inset map showing a portion of the Martinez Regional Shoreline, which displays the cover class as a color overlay and the habitat type as a colored boundary
- Additional displays of patches are possible using the other data attributes, such as associated plant species, general soil type, and disturbance history
- Initial projections on aerial photographs from various sources and flight dates, depending on specific site conditions. The source of base maps or aerials for final product is yet to be determined

Final Product

- All primary and secondary mapping data will be incorporated into a GIS using ArcGIS to create a spatial model of the distribution of pepperweed
- The model would analyze population locations on the basis of the site descriptors
- The GIS would be selectively accessible while under development to encourage participation in the process of documentation
- Sites documented by others would be accepted for inclusion in the GIS if the data are reliably documented according to the mapping standards of this project
- The GIS will be a valuable management tool to identify areas most susceptible to invasion, especially those that also harbor important biological resources, or to track the effectiveness of control methods



Perennial Pepperweed in Profile

Lepidium latifolium L. Brassicaceae (mustard family)

Common names: perennial pepperweed, giant pepperweed or pepper cress, broadleaved peppergrass, Virginia pepperweed, tall whitetop and others

Appearance and Life Cycle

- Tall branching stems that up to two meters high
- Rhizomatous root system, forming dense, often monotypic stands, in some locations eliminating native habitats
- Large inflorescence, small white flowers and abundant seeds
- Germination and early vegetative growth begin in Spring
- Flowering peaks in May to June, senescing in late Summer to early Fall
- Under locally favorable conditions, the growing season can be extended well beyond these typical periods

Perennial pepperweed in flower

Efforts to Control Perennial Pepperweed

- Herbicides- some effectiveness, undergoing further studies
- Biological control methods- none known for mustard family
- Mechanical removal- can increase plant abundance

Distribution

- Native of Eurasia, now found in Australia, Mexico, and many parts of the United States
- Occurs widely throughout the San Francisco Bay-Delta
- Highest density in South Bay, Suisun Marsh, Delta islands

Dense pepperweed lining a tidal channel

Threats to Endangered Species and Habitats

Actual and potential adverse effects include:

- Ability to colonize barren areas, mineral soil and recently disturbance, including areas undergoing restoration
- Ability to displace native wetland plants (i.e. *Salicornia, Scirpus, Atriplex, Frankenia, Grindelia, Distichlis*, etc.) and alter community composition and structure
- Diminished habitat for threat ened and endangered species, such as salt marsh harvest mouse, California clapper rail and black rail
- Reduced waterfowl habitat quality
- Possible allelopathic effects on germination and establishment of native species
- Ability to tolerate moderate inundation and salinity regimes, though typically occurs at higher elevation range

Invaded Habitats

- Tidal and non-tidal (diked) salt marsh and brackish marsh, freshwater marsh
- Riparian areas
- Beaches
- Vernal pools and other seasonal wetlands
- Agricultural fields and irrigation channels
- Roadsides

How Can You Help Us Map Perennial Pepperweed?

- Have you seen a population that has recently become estab- lished? Let us know where it is and who we need to contact for property access.
- Do you work for a public agency with digital maps or GIS layers that include pepperweed as an attribute or part of a vegetation classification? Is the data available to the public?
- Do you have hand drawn maps that show locations of pepper- weed? Please consider sharing them with us.
- Can you arrange access to areas where we can collect data, such as preserves, duck clubs, or private property?

Please take a handout or a business card and contact me if you have data or information that can help us update and improve our maps. We will keep all contacts apprised of the progress of this study, and will make interim and final maps and analysis available for viewing.

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