



# Pepperweed's Ecosystem Impacts in Suisun Marsh: Methods for Control

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## SUMMARY

Perennial pepperweed (*Lepidium latifolium*) is an aggressive, non-native herbaceous weed displacing native vegetation in marshes, floodplains, prairies and rangeland throughout California. You can even find it growing along roadsides and highways. But does the plant's ubiquity really mean it is an ecological problem warranting costly eradication efforts?

The project's goal was to address this question by quantifying some of the specific ways in which the weed affects plant, insect and invertebrate life, and by extension local food webs, at Rush Ranch Open Space Preserve in Suisun Marsh, part of the San Francisco Bay National Estuarine Research Reserve.

This initial work validates concerns that this exotic from southern Europe and western Asia does indeed have ramifications for high-elevation marshlands in California and has led to a new partnership to examine methods for its safe eradication. The project's final outcome will be a set of recommendations on where to prioritize control efforts in Suisun Marsh, one of the largest remaining coastal wetlands in California, and if applicable, how to go about getting rid of pepperweed in areas that may be home to endangered species.

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A sticky trap in a pepperweed patch collects insects.

## PROJECT

The Delta Science Fellow compared plant, insect and other invertebrate life at invaded and noninvaded sites at low, mid and high elevations of Rush Ranch, and is currently collaborating with the Solano Land Trust (the landowner) and the

U.S. Department of Agriculture on a series of adaptive management experiments. The efficacies and nontarget impacts of three common broad-spectrum herbicides are being evaluated. The three herbicides are imazapyr (also known as Stalker® or Chopper®), 2,4-dichlorophenoxyacetic acid (i.e., 2,4-D—the most commonly used herbicide in the world), and glyphosate (the generic term for an aquatic formulation of Roundup®). In addition, the scientist is analyzing stable isotope data collected from insects to study the weed's effect on food webs.

## ECOLOGICAL IMPACTS

The ecological impacts of pepperweed appear most pronounced at high elevations in the marsh. They include increased soil humidity and soil temperatures, and changes in the relative abundances of native plants, insect and burrowing invertebrates. It is hypothesized that the varying effects of pepperweed with elevation are partly due to the constant inundation and soil saturation by the tides at lower elevations.

In terms of plant communities, pepperweed-infested sites are associated with a reduction in native pickleweed (*Sarcocornia pacifica*), normally a dominant plant in high marshlands, and an increase in alkali heath (*Frankenia salina*), a native species not normally dominant in high marshes. Similarly noticeable changes were not observed at lower elevations, where saltgrass hummocks and tall reeds dominate.

Insect and invertebrate communities were also affected at high elevations, where there are fewer canopy-dwelling insects—especially leafhoppers (species to be determined) and more ground-dwellers, such as the carrion beetle (*Silpha nigra*). In the upper two centimeters of sediment, greater numbers of orabatid mites and fewer amphipods (mainly *Transorchestia traskiana*) were observed.

Changes in numbers of small insects and/or invertebrates can affect the many larger animals (such as the Suisun sparrow) that feed on these organisms. Different invertebrate communities can thus translate into diminished or enhanced foraging opportunities for species higher in food chain.

## HERBICIDE EXPERIMENTS

Because pepperweed is a perennial with underground rhizomes, it is difficult to selectively kill with broad-spectrum herbicides. One of the major lessons to emerge from this project is the degree to which the efficacy and safety of herbicides vary depending on the specific habitat in which they are ap-



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*A spring bloom of pepperweed (in white) at Rush Ranch illustrates the invasion's scale.*

plied. For example, 2,4-D was ineffective at controlling pepperweed in seasonal marshland and also had minimal consequences for surrounding vegetation. In this same habitat, imazapyr was highly effective at killing pepperweed (cover was reduced more than 90 percent), but also killed nontarget native species, so its use was halted.

Scientists are now conducting new trials in high-, mid- and low-elevation tidal marshes using imazapyr, 2,4-D, glyphosate, an imazapyr-glyphosate mix and, in some cases, are weed-whacking infestation sites prior to treatment. (Care is taken to avoid disturbing bird nests.) While the results are preliminary, imazapyr alone appears to suppress above-ground pepperweed biomass with minimal ecological impacts to surrounding vegetation at low marsh elevations. Scientists plan to monitor the test sites for another year to make sure the perennial weed does not return, and to test sediments for evidence of chemical persistence and/or spreading. They may also look at nonchemical eradication strategies for upper marshlands where herbicide control has not been successful and where pepperweed is most problematic from an ecological standpoint.

## APPLICATIONS

The 55,000-acre Suisun Marsh in the San Francisco Estuary is one of the largest remaining coastal wetlands in California and a vital rest stop for migratory birds and home to many other birds, mammals, fishes, reptiles and amphibians. Findings from this project have been shared with managers,

scientists and stakeholders at two specially convened symposiums on pepperweed, sponsored by the California Coastal Conservancy, Solano Land Trust, and San Francisco Bay National Estuarine Research Reserve.

The scientist is summarizing the ideas from the meetings and will compile the results of the herbicide experiments into an easy-to-read chart for restoration planners and managers on how to best control pepperweed without harming other sensitive wildlife, including endangered species such as the Suisun sparrow, salt marsh harvest mouse, Suisun thistle and salt marsh bird's beak, among others.

## COLLABORATORS

U.S.D.A., California Coastal Conservancy, Solano Land Trust

## PRESENTATIONS

Whitcraft, C., D. Talley, B. Wallace, B. Grewell and M. Psaros. Control and Management of Perennial Pepperweed Invasion: An Obtainable Goal? State of the Estuary 2009.

Whitcraft, C., D. Talley and B. Wallace. Impacts of Perennial Pepperweed Invasion in Wetlands along an Inundation Gradient. Benthic Ecology Meeting 2009.

## MENTORS

Research: Professor Drew Talley, University of San Diego

Community: Conservation Project Manager Ben Wallace, Solano Land Trust



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This publication is sponsored by a grant from the Delta Science Program, part of the Delta Stewardship Council. The views expressed herein are those of the authors and do not necessarily reflect the views of the Delta Stewardship Council or any of its sub-programs. This document is available in PDF on the California Sea Grant website: [www.csgc.ucsd.edu](http://www.csgc.ucsd.edu).

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