

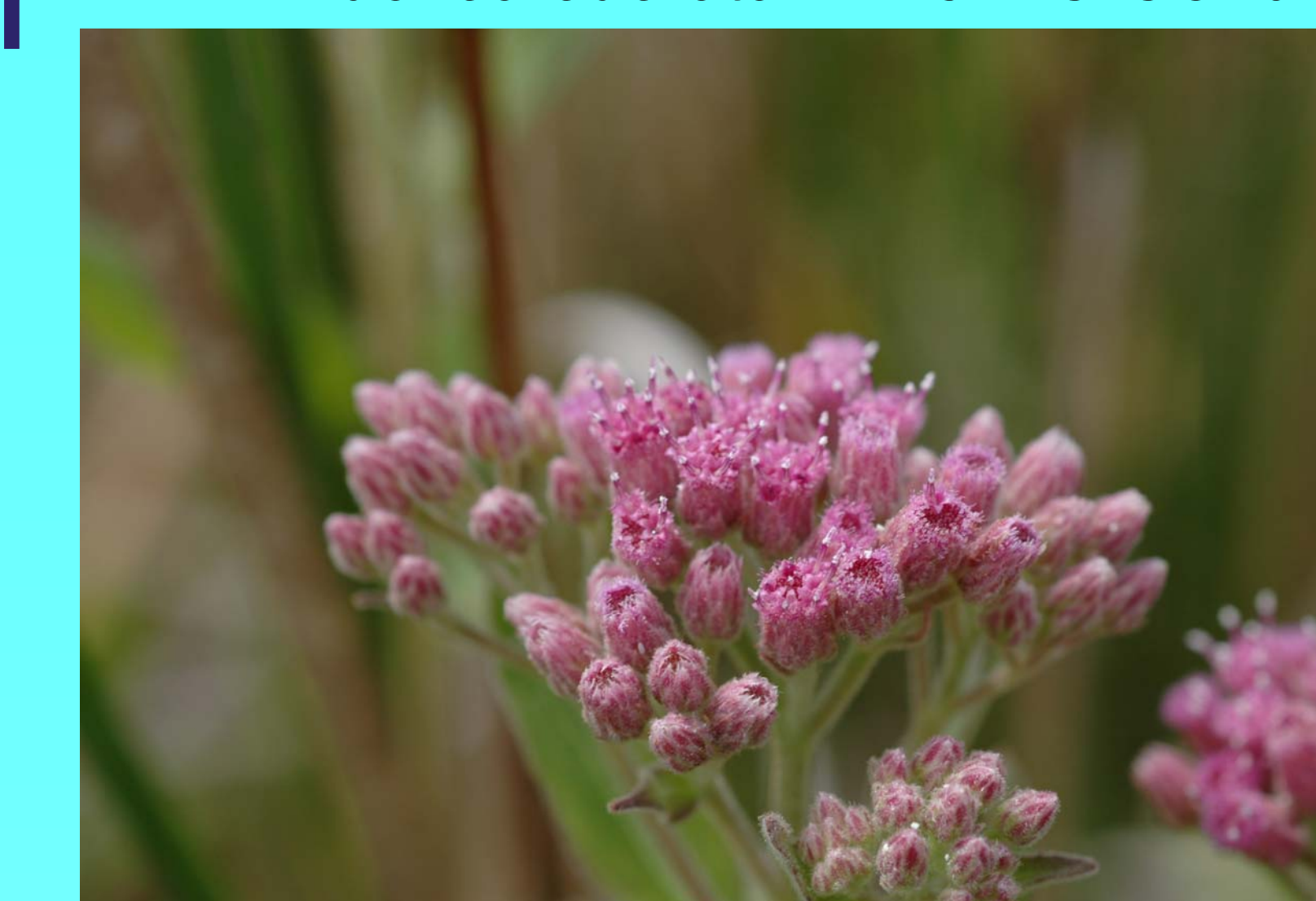


# Effects of Fire Disturbance on Two Brackish Tidal Wetlands in the Upper San Francisco Bay Estuary

M. Vasey<sup>1</sup>, L. Schile<sup>1</sup>, V.T. Parker<sup>1</sup>, J. Callaway<sup>2</sup> and K. Tuxen<sup>3</sup>

<sup>1</sup>San Francisco State University, San Francisco, CA USA, <sup>2</sup>University of San Francisco, San Francisco, CA USA,

<sup>3</sup>University of California, Berkeley, CA USA



## Introduction

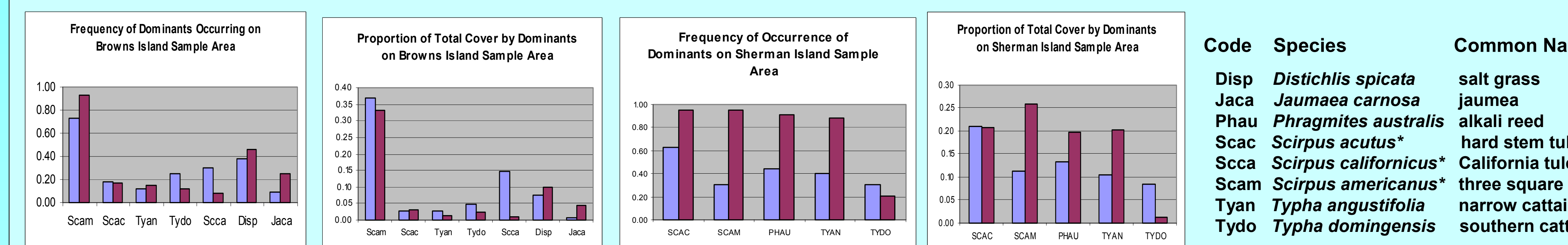
Although fires in wetlands are known to promote species diversity in other areas of the world, effects of fire on tidal wetlands in the San Francisco Bay Estuary are undocumented. Two fires of unknown origin in brackish tidal wetlands in the upper Estuary afforded the opportunity to preliminarily examine some key questions concerning the effects of fire on plant species inhabiting this ecosystem:

- (1) How does fire affect species diversity?
- (2) Does fire enhance the frequency and abundance of certain species?
- (3) Does fire negatively impact the recovery of dominant wetland species?
- (4) How does fire affect non-native invasive species?

## Methods

Random spatial coordinates were assigned to different marsh assemblages and located in the field using hand-held GPS units. Three-meter diameter circular plots were then identified and centered on the GPS coordinates. All species in the plot were recorded and one of seven cover classes assigned to each (>95%, 6 75-95%, 5 50-75%, 4 25-50%, 3 5-25%, 2 1-5%, 1 <1%). Sampling took place from November 2003 to June 2005. A total of 162 plots were recorded in the burned area on Browns Island while 196 plots were recorded in the unburned portion of the island. On Sherman Island, samples include 61 plots that occurred on the burn site and 93 plots that represent unburned vegetation that is comparable to the assemblages inhabiting the burned area. Cover classes were converted to averages and multiplied by 100 to represent relative abundance values (e.g. .86 = 86). Matrices of species by samples were then analyzed for shared versus unique species, average species per sample, average abundance per sample, Margalef's Index per sample, Shannon Index, and Simpson Index for burned and unburned areas. Sample sizes were equalized by randomly deleting unburned sample plots.

## Results: (3) Dominants are not negatively impacted



\* Now placed in the genus *Schoenoplectus*

It appears that the dominant, rhizomatous species that make up the largest proportion of cover on both islands survive fires and recover well. In the high marsh, it may be that salt grass and jaumea actually benefit by the removal of thatch and dense cover of species like three square. All of these dominants resprout each year from rhizomes which are kept wet by tidal flows.

### Abstract

Impacts of fire on plant species diversity in two brackish tidal wetlands along the upper San Francisco Bay Estuary

As tidal wetlands have disappeared in the San Francisco Bay Estuary, concern about the loss of species diversity in this region has increased. While large-scale wetland restoration focuses on the long-term recovery of these species, the dynamics that stimulate and maintain species diversity in the Estuary are poorly understood. These tidal wetlands are dominated by long-lived species in genera such as *Scirpus*, *Typha*, *Spartina*, and *Salicornia*. Restoration activities generally promote these dominants rather than less common, more specialized plants that are also part of tidal wetland assemblages. Two wetland sites, Brown's Island, a remnant historic wetland, and Lower Sherman Island, a naturally restored wetland, are located at the junction of the western Delta and eastern Suisun Bay in a species-rich, brackish salinity zone. In fall 2003, we used 162 burned and 196 unburned randomly-located 3-m diameter vegetation relevés to sample a large spring 2002 burn from Browns Island. In spring 2004, another fire burned a large area of Sherman Island. Similar random, plot-based surveys were conducted in burned and unburned areas, both before and after the burn. Based on these data, burned areas host significantly higher species diversity and enhance the frequency and abundance of one group of annual and short-lived perennial species. These species appear to opportunistically exploit the post-fire conditions of reduced thatch and increased nutrients. Dominant species in these areas survived, however, and are already returning to their former status. These findings suggest that fire could be used as a management tool to promote species diversity in restored and historic brackish tidal wetlands in the upper San Francisco Estuary.



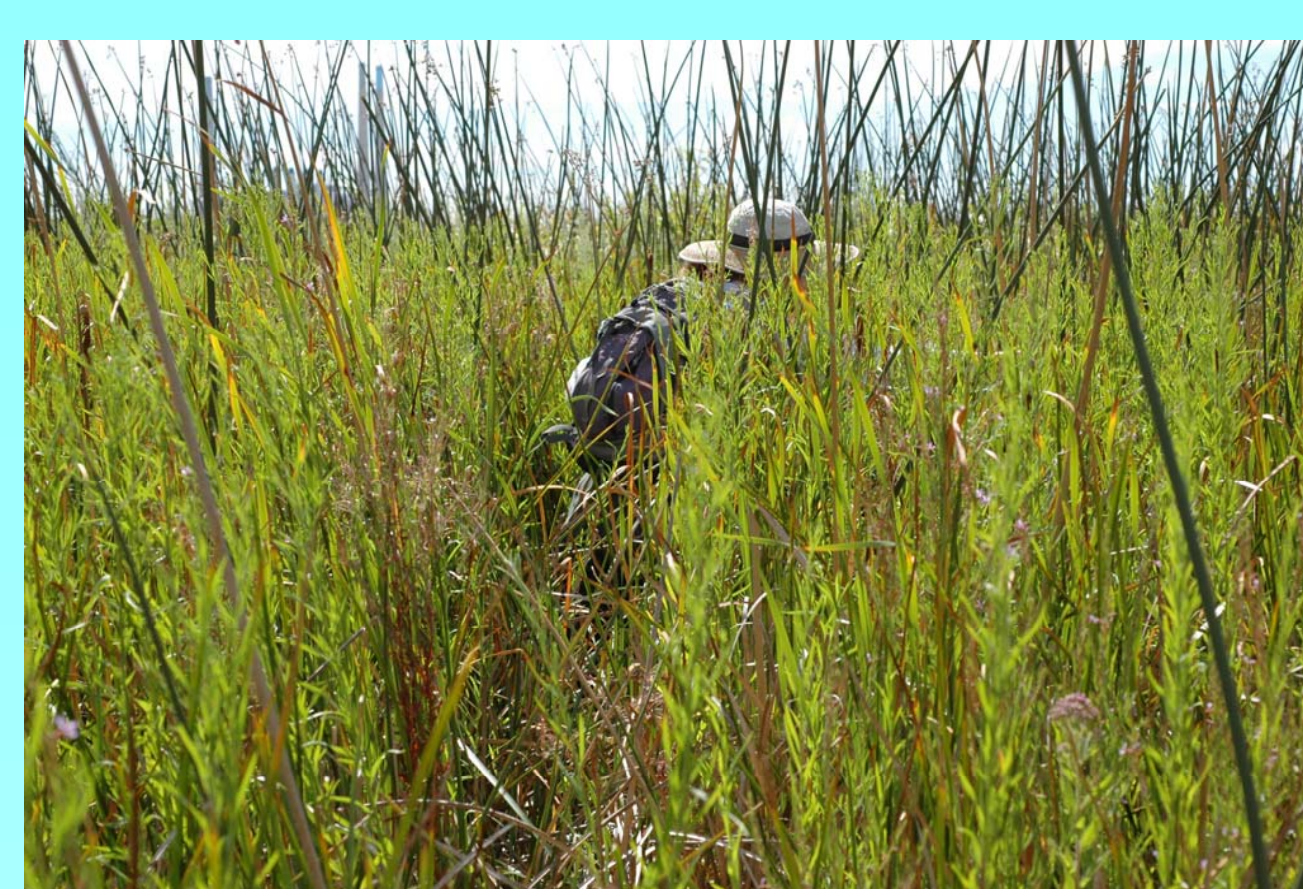
Eastern San Francisco Bay Estuary



1.5 meter high thatch in unburned tule canopy

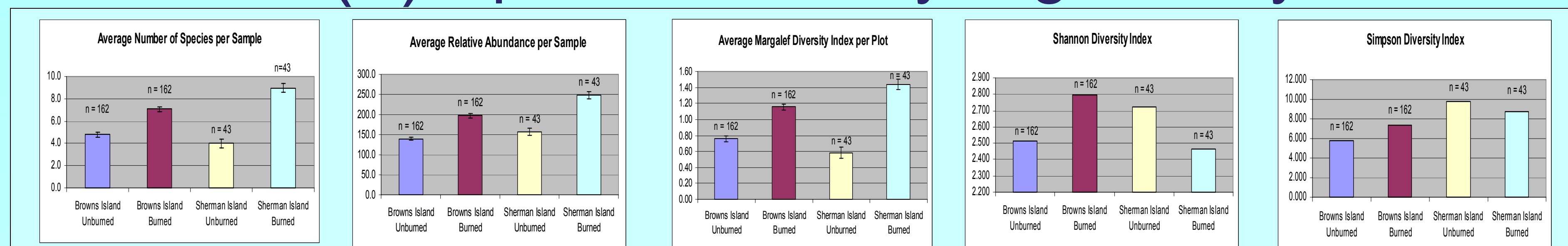


Recent burn opening in tule canopy on Sherman Island



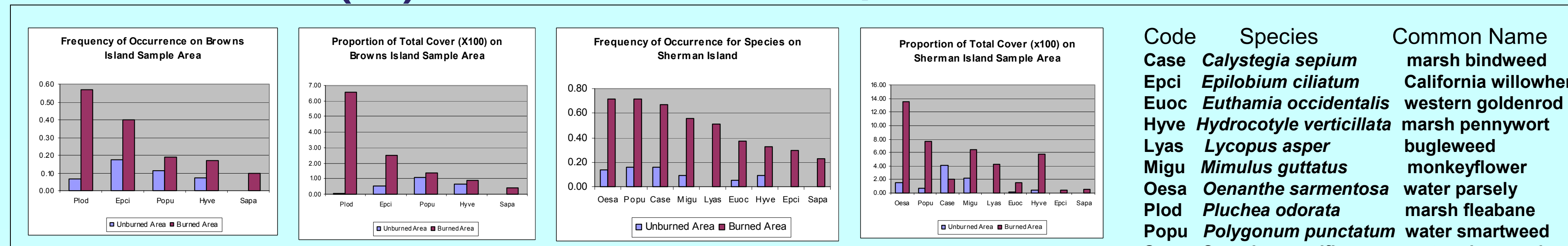
Short-lived species in burned tule canopy one year later

## Results: (1) Species diversity is generally increased



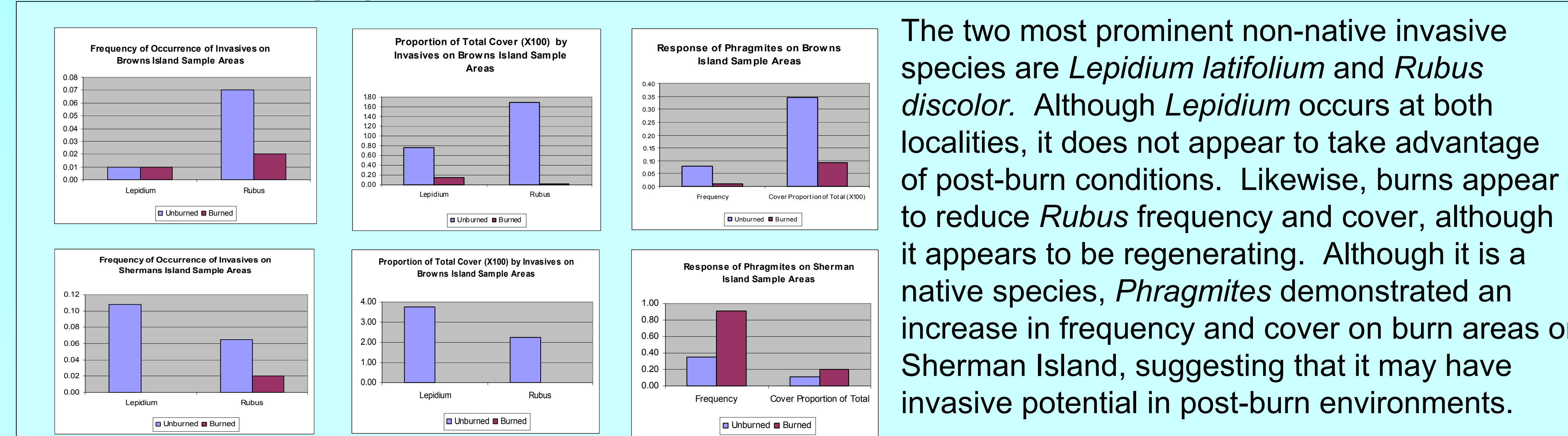
Burn sites on Browns Island and Sherman Island demonstrated significantly higher average species per sample, relative abundance per sample, and diversity per sample (Margalef Index). Nonetheless, perhaps because of the larger and more heterogeneous area sampled in the unburned habitat on Sherman's Island, higher species richness pushed the Shannon Index above the burned area at that locality. The Simpson Index is also slightly higher. Both Shannon and Simpson Indices were greater in the burn area on Browns Island. The inconsistency at Sherman Island needs further analysis; however, over all, richness and evenness increase in burn areas.

## Results: (2) One suite of species is enhanced



A suite of short-lived species appears to dramatically increase in frequency and relative cover after a burn. Some species are important understory elements that take advantage of the opened canopy to spread vegetatively. Others, like *Pluchea*, *Epilobium*, and *Euthamia*, most likely exploit gaps created by the burn for germination events.

## Results: (4) Invasives apparently are not favored by fire



The two most prominent non-native invasive species are *Lepidium latifolium* and *Rubus discolor*. Although *Lepidium* occurs at both localities, it does not appear to take advantage of post-burn conditions. Likewise, burns appear to reduce *Rubus* frequency and cover, although it appears to be regenerating. Although it is a native species, *Phragmites* demonstrated an increase in frequency and cover on burn areas on Sherman Island, suggesting that it may have invasive potential in post-burn environments.

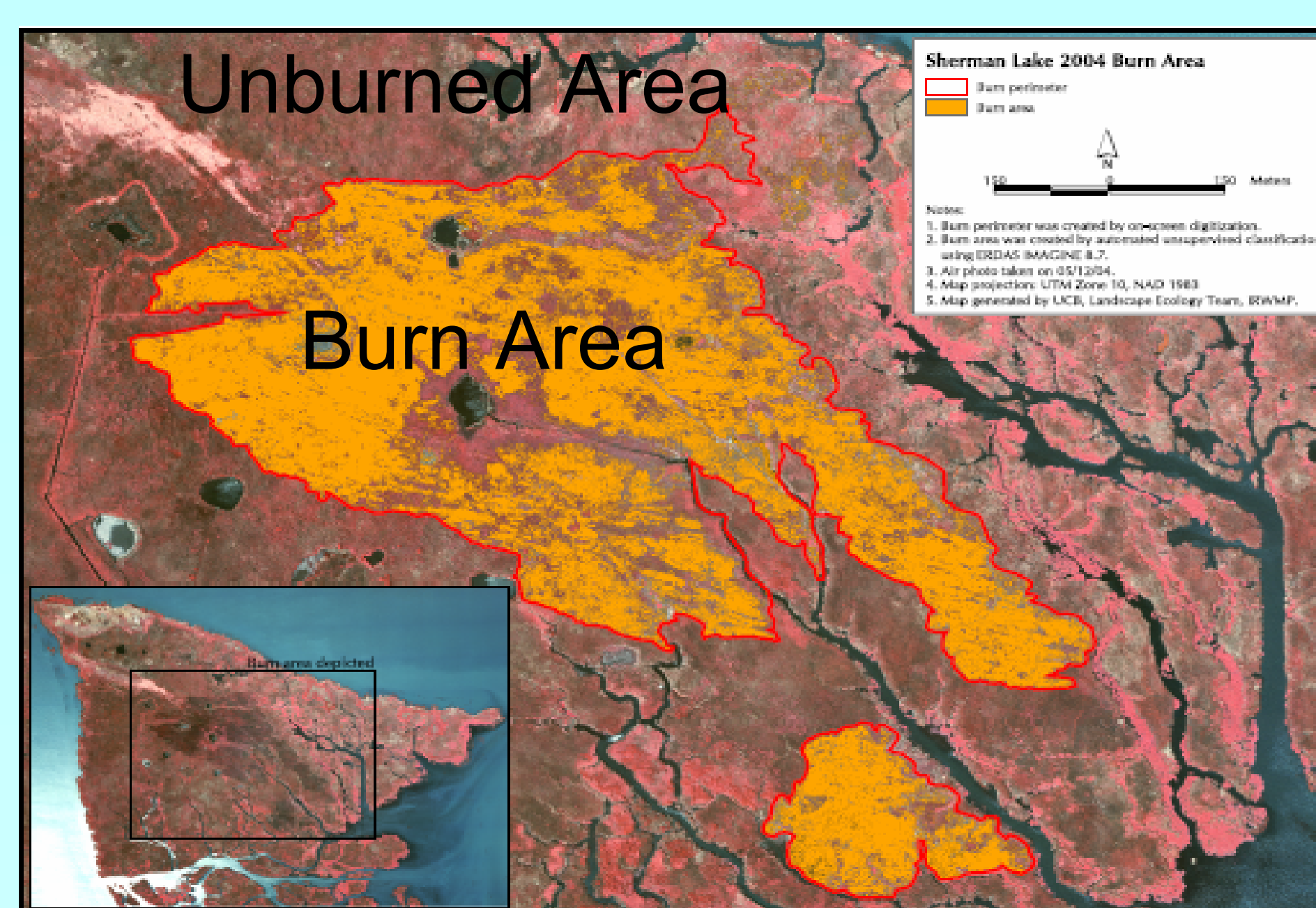
## Conclusion

Fires in brackish tidal wetlands of the San Francisco Bay Estuary apparently remove thatch and open habitats for less-common short-lived plant species that experience population flushes during these events. Dominant species appear not to experience mortality and recover in a relatively short time. Invasive species do not appear to be particularly favored, at least in the habitats investigated. Overall biological diversity appears to be enhanced by the effects of fire based on this preliminary study. These findings suggest that further experimental research might be warranted to investigate the potential beneficial impacts of managed burns as a means of stimulating species diversity in mature brackish tidal wetlands.

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Browns Island (Burned Spring 2002)



Sherman Island (Burned Spring 2004)