

California Least Terns of San Francisco Bay



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California Least Terns

- Breeding ecology and natural history
- Statewide and Bay populations
- Foraging ecology in the Bay Region
- Effects of dredging on foraging birds
- Effects of dredging on prey
- Potential toxicological Impacts of SSC
- Environmental work windows and management of dredging for the benefit of Least Terns

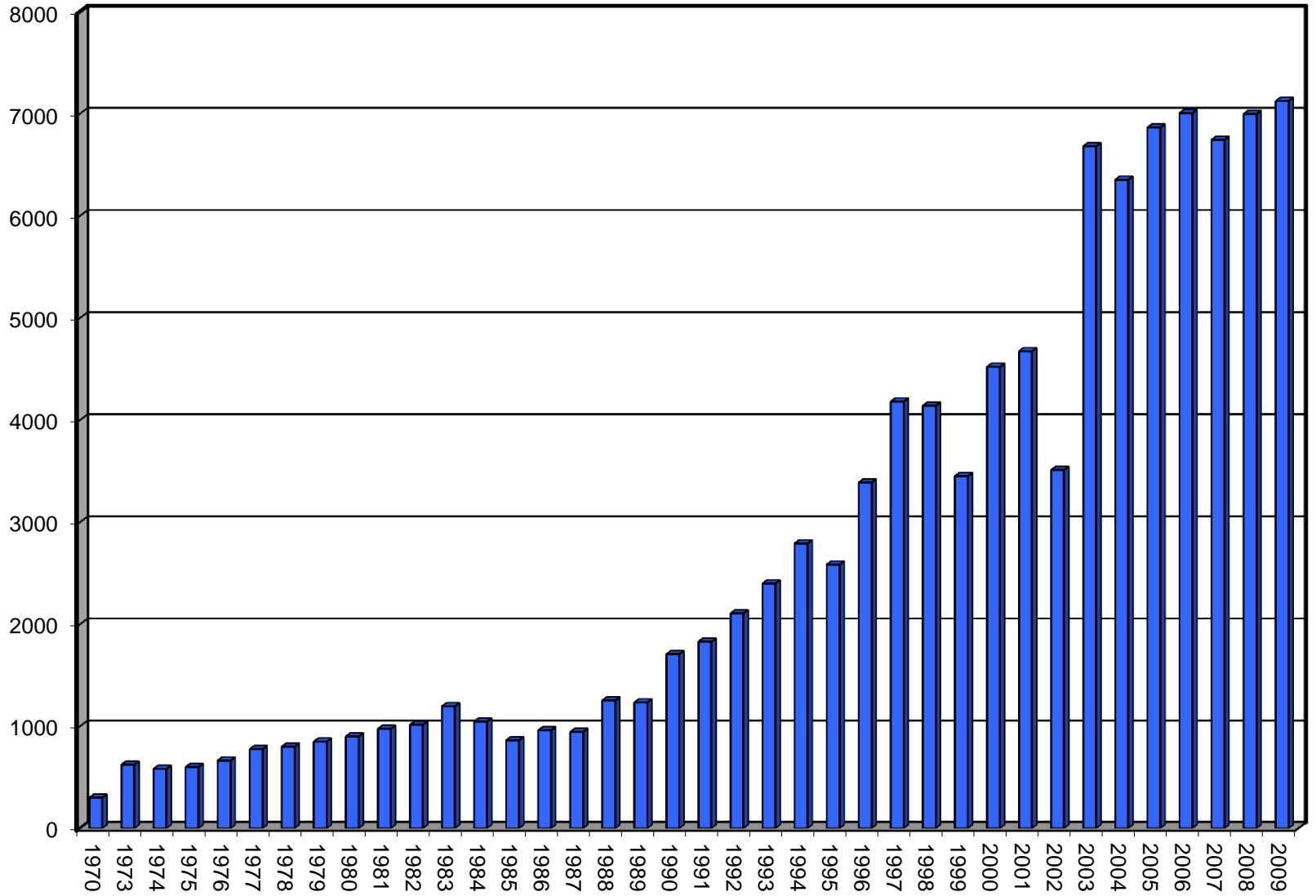






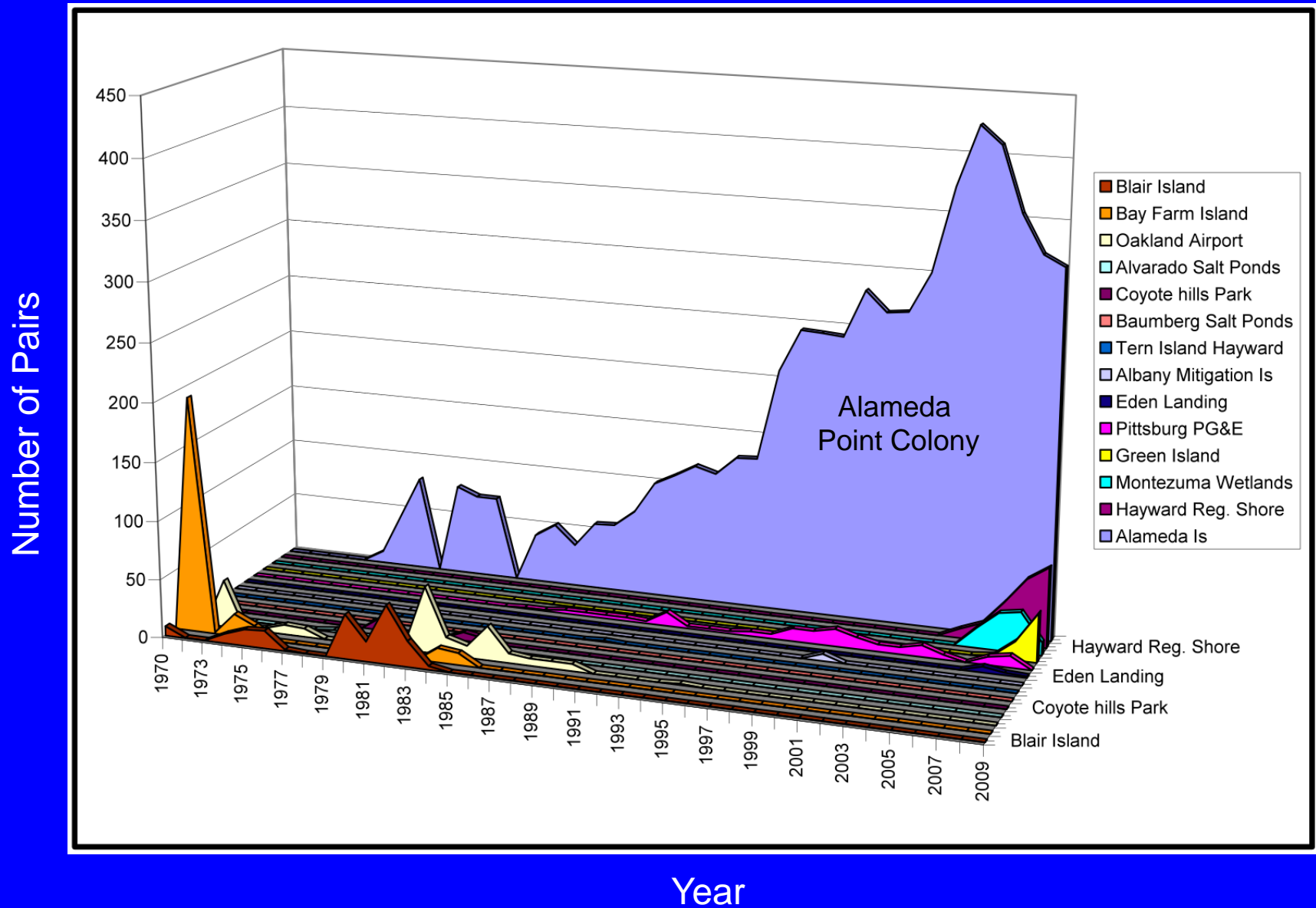
Least Terns Breeding in California 1970 - 2009

Number of Pairs

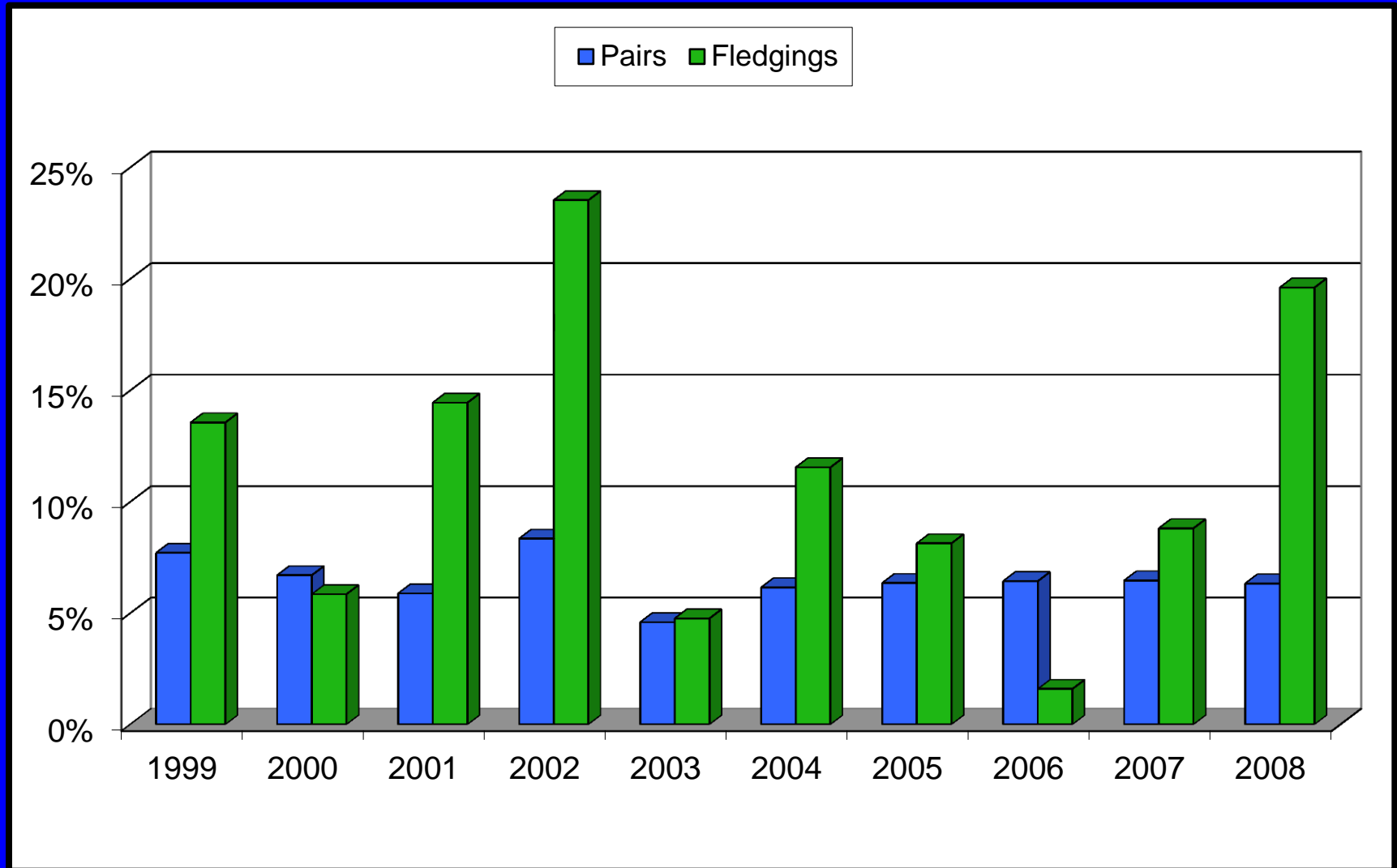


Year

Abundance of Least Tern Pairs at San Francisco Bay Breeding Colonies 1970-2009

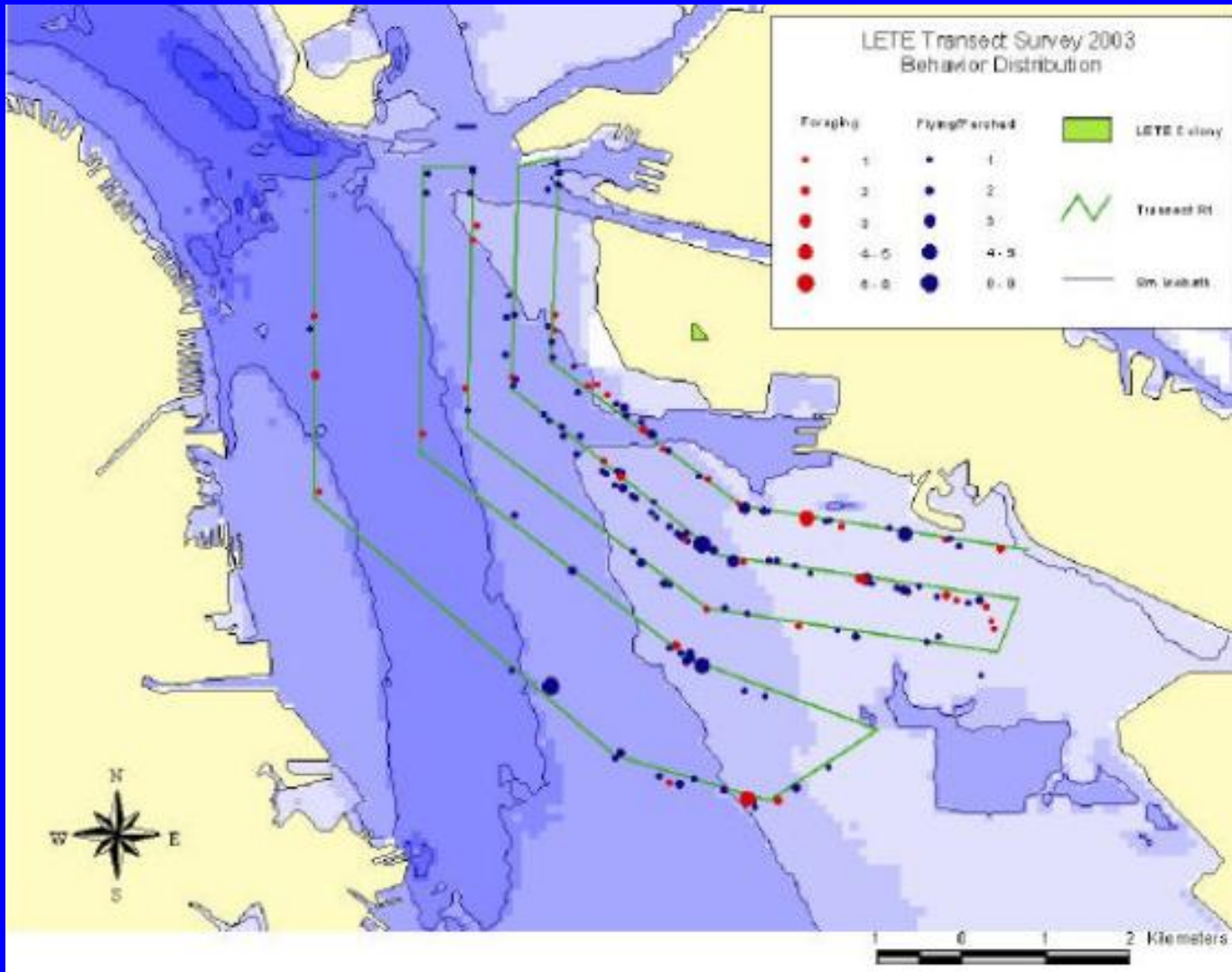


Number of Breeding Pairs and Fledglings at the Alameda Point Colony Relative to Statewide Populations 1999-2008 *



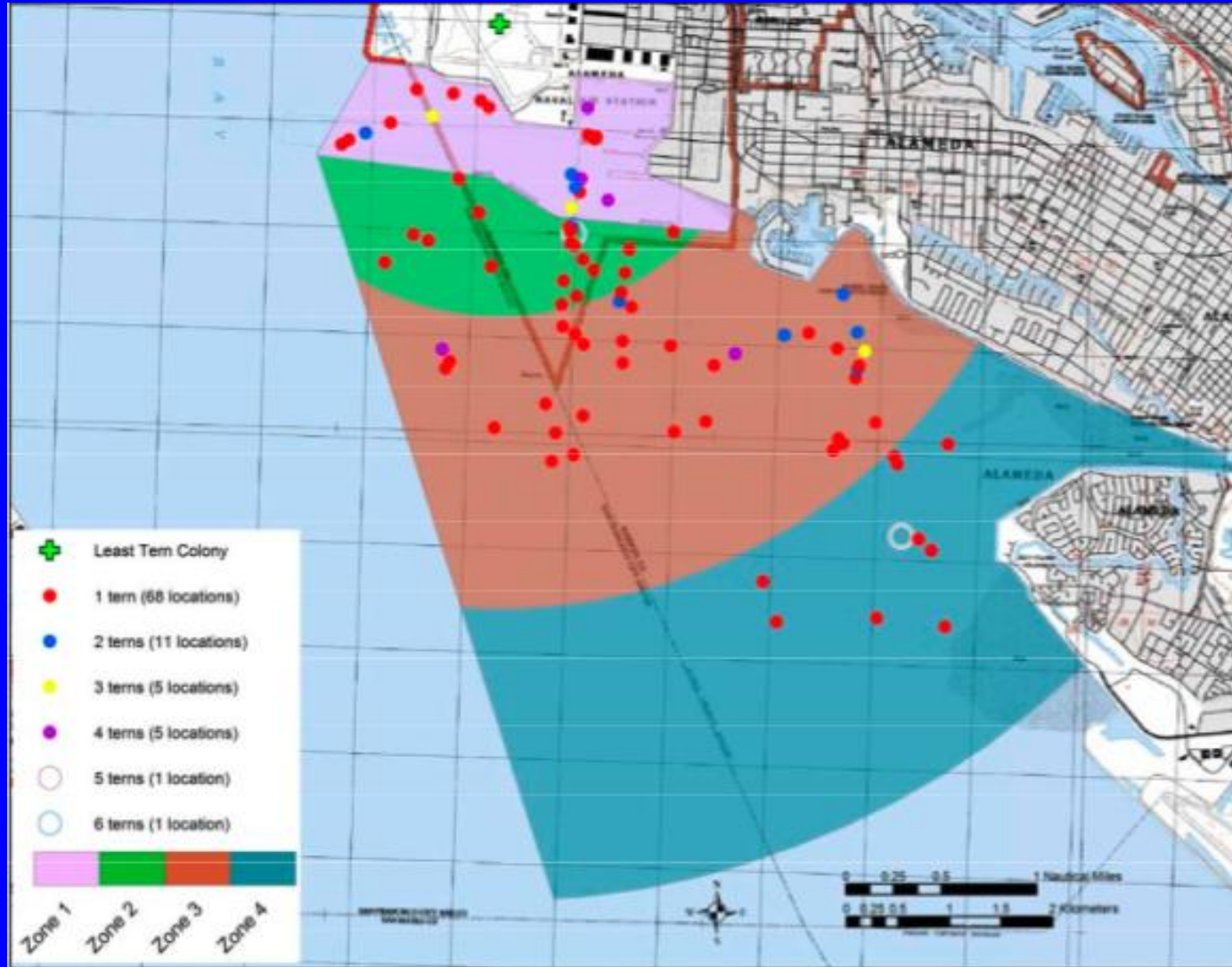
* - expressed as percentages of the total numbers of breeding pairs and fledglings statewide

Alameda Point Least Tern Foraging Locations 2003



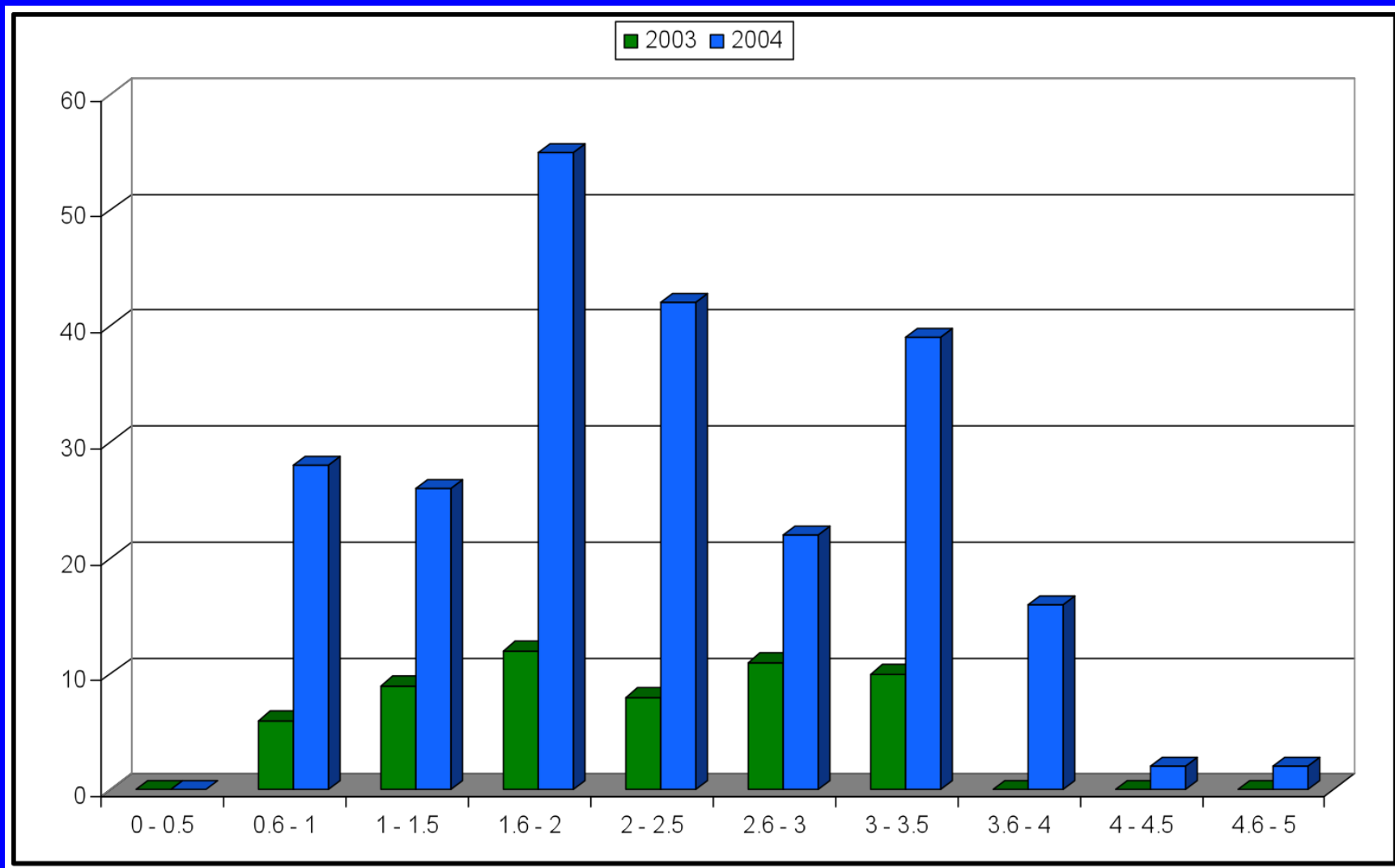
(Elliot et al. 2004)

Alameda Point Least Tern Foraging Locations 2004



(Steinbeck et al. 2004)

Distances Least Terns were Observed from the Alameda Colony 2003-2004



miles

(adapted from Elliot et al. 2004 and Steinbeck et al. 2004)

Eelgrass Beds Near Alameda Point



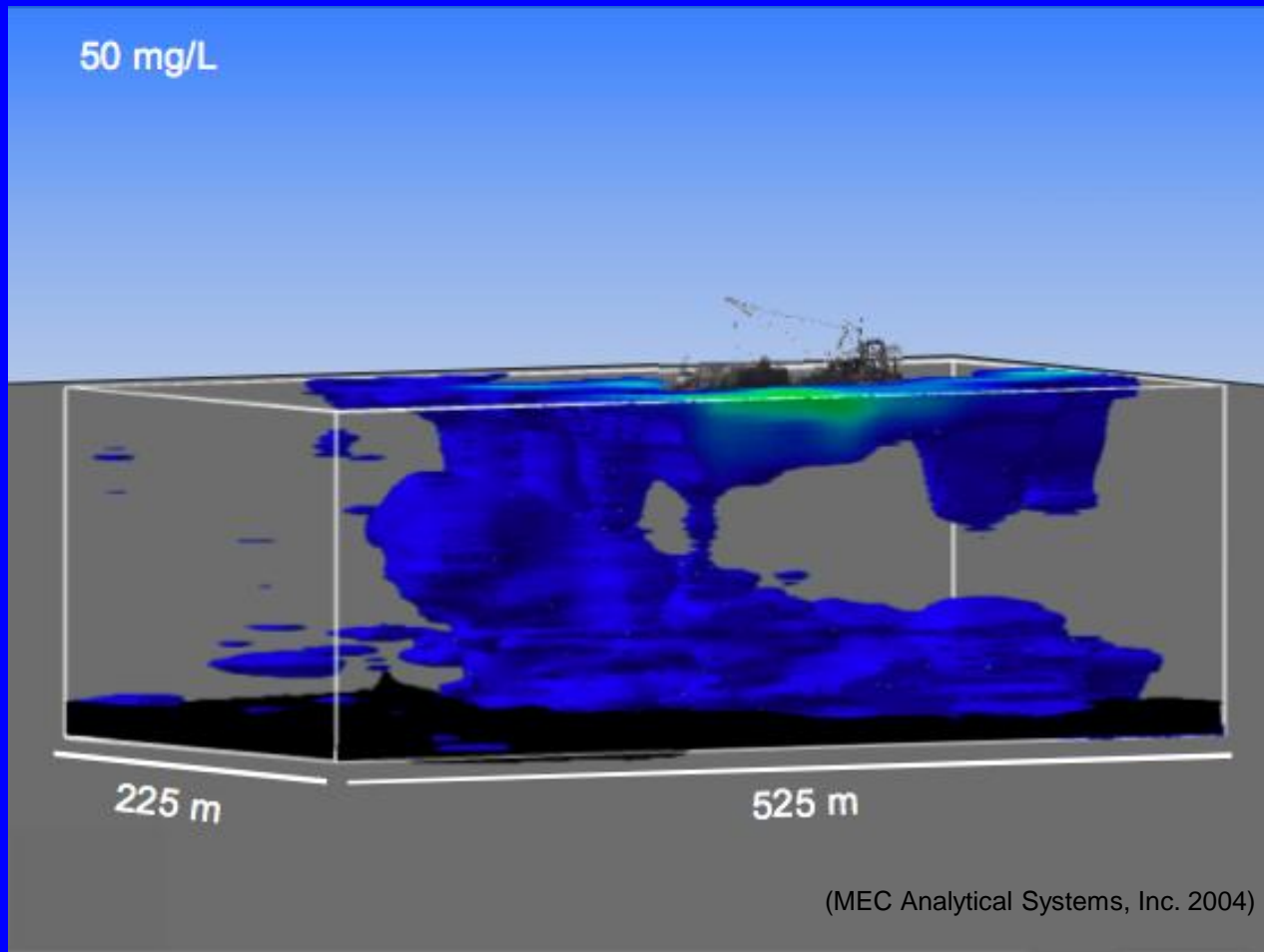
(Merkel 2004)

Potential Ecological Impacts of Dredging



- Impacts to habitats – eelgrass beds, benthic
- Turbidity impacts on fish
- Turbidity may impact Least foraging success
- Contaminants

Dredging Turbidity Plume



- Dredging plume – ~ 30 acres
- SSC – majority < 100 mg/L
- SSC – highest 389 mg/L

Impacts of Dredging on Least Tern Foraging

- Increased turbidity limited Common Tern feeding efficiency (Becker et al. 1985) but they show a preference for turbid water (Safina & Burger 1988).
- Little Tern food intake rates were higher in clearer water (Benninkmeijer et al 2002); yet they forage in turbid and clear water equally (Cyrus 1991).
- Least Terns found foraging in turbid water with greater frequency than expected (Haney and Stone 1988).
- Forster's Terns show preference for turbid water on Monterey Bay (Henkel 2006).
- Turbid water may attract juvenile fish (Blaber & Blaber 1980), particularly in an estuarine environment; and turbidity may benefit plunge divers as fish tend to aggregate at the surface in turbid water (Mous 2000, Johnston & Wildish 1982).

Impacts of Dredging on Least Tern Prey

- Backgrounds levels of SSC at Sacramento River outfall up to 420 mg/L (McKee et al. 2002).
- Kiorboe et al. (1981) found no effect on Pacific herring when exposed to SSC of up to 500 mg/L.
- Boehlert & Morgan (1985) found increased feeding rate of Pacific herring in water with SSC of 500-1000 mg/L, and yet found a decreased foraging ability at higher concentrations.
- Johnston & Wildish (1982) found that feeding success of young larvae more affected by increased SSC than for older larvae

Potential Toxicological Impacts of SSC on Least Terns

- The Oram & Melwani (2006) model suggests DDT concentrations in biota exposed to dredging plume may increase by up to 200%.
- They predicted DDT concentrations in fish would be elevated from 10-15 ng/g to 50 ng/g, exceeding threshold for protection of predatory birds (National Academy of Sciences 1973). The model also predicted that just beyond the dredge site the concentration of DDT in fish was expected to be 2 orders of magnitude lower than at the dredge site.
- Fairey et al. (1997) found mercury, PCBs, organochlorines in Bay fish; Ohlendorf et al. (1985) found highest concentration of DDT breakdown products in topsmelt and Davis et al. (2002) found high contaminant levels in jacksmelt; both important prey species for Least Terns.
- Least Tern eggs from Alameda Point contain mercury, selenium, organochlorines (including DDE), although the source is not well constrained (Hothem and Zador 1995).

Environmental Work Windows



- Central San Francisco Bay

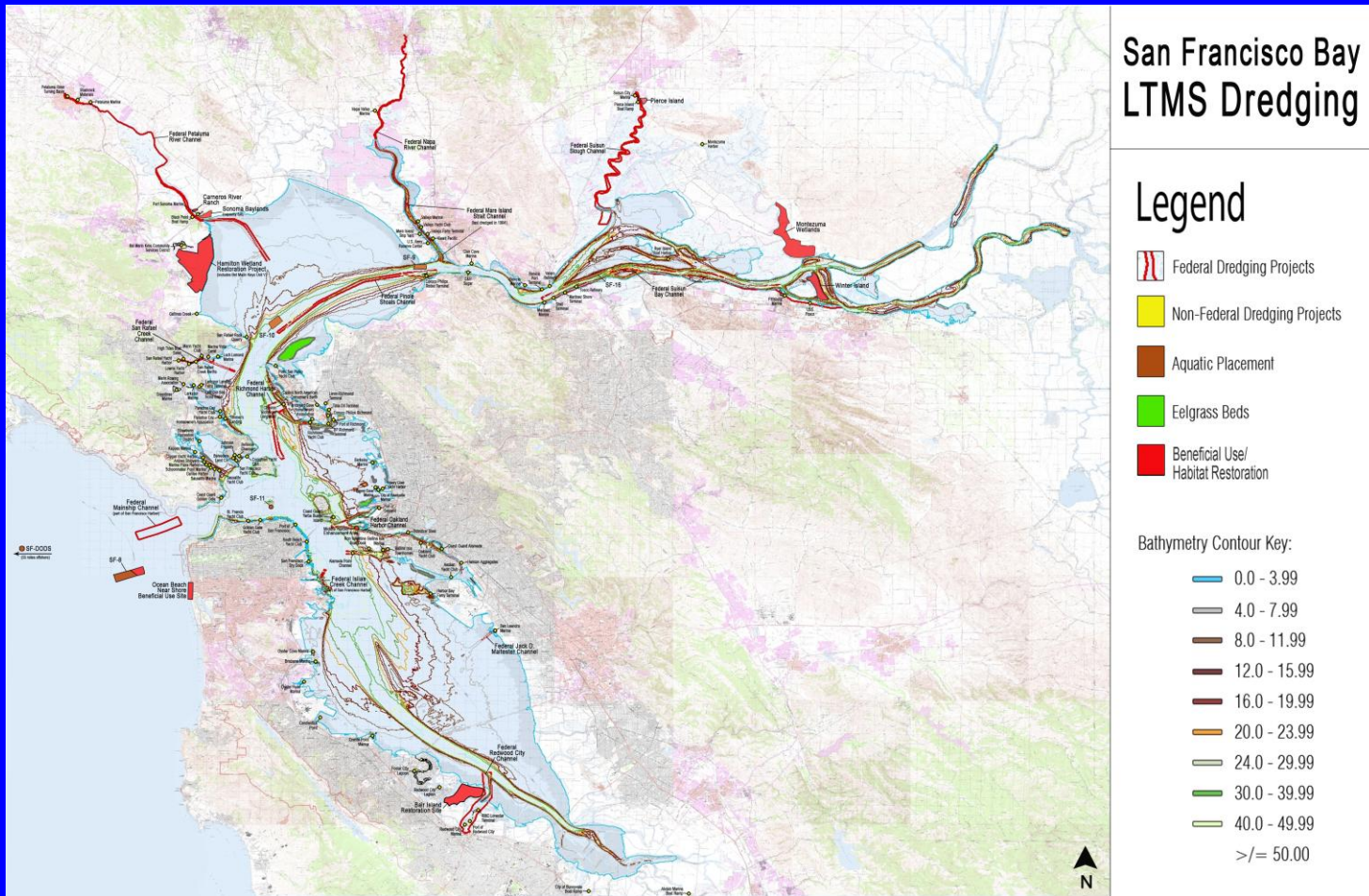
- Waters of Marin

- Richardson Bay

- South Central San Francisco Bay

- South San Francisco Bay

Current Dredging Projects



Least Tern - Environmental Work Window Restrictions

Location	Dredging Restrictions for Least Terns	Potential Impact	Terns Present 1999-2009	Consult. Required
Blair Island	All eelgrass beds and salt ponds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	No	Yes
Bay Farm Island	All eelgrass beds and waters and sloughs within 1 mile of coast - Berkeley Marina south through San Lorenzo Creek	Loss of eelgrass bed foraging habitat	No	Yes
Oakland Airport	All eelgrass beds and waters and sloughs within 1 mile of coast - Berkeley Marina south through San Lorenzo Creek	Loss of eelgrass bed foraging habitat	No	Yes
Alvarado Salt Ponds	All eelgrass beds and salt ponds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	No	Yes
Coyote Hills Park	All eelgrass beds and salt ponds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	No	Yes
Baumberg Salt Ponds	All eelgrass beds and salt ponds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	Post-season	Yes
Tern Island Hayward	All eelgrass beds and salt ponds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	No	Yes
Albany Caltrans Mitigation Island	All eelgrass beds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	Yes	Yes
Eden Landing	All eelgrass beds and salt ponds Jan 1 - Dec 31	Loss of eelgrass bed foraging habitat	Yes	Yes
Hayward Reg. Shoreline	Located south of restricted area between Berkeley Marina and San Lorenzo Creek	Loss of eelgrass bed foraging habitat	Yes	Yes
Alameda Point, Alameda Island	All eelgrass beds and waters and sloughs within 1 mile of coast - Berkeley Marina south through San Lorenzo Creek	Loss of eelgrass bed foraging habitat	Yes	Yes
Pittsburg PG&E	No restrictions specified for Least Terns	None identified	Yes	No
Green Island, Napa River	No restrictions specified for Least Terns	None identified	Yes	No
Montezuma Wetlands	No restrictions specified for Least Terns	None identified	Yes	No

