Humboldt Bay Eelgrass Comprehensive Management Plan:

Public Workshop

September 30, 2017

Humboldt Bay Harbor, Recreation and Conservation District

Merkel & Associates, Inc.

HUMBOLDT BAY HARBOR RECREATION & CONSERVATION DISTRICT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Acknowledgements

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Project Partners

California Coastal Conservancy
California Coastal Commission
City of Eureka
City of Arcata
Hog Island Oyster Company
Humboldt Baykeeper
Humboldt Bay Harbor, Recreation, and Conservation District
Humboldt County
NOAA National Marine Fisheries Service
University of California, Sea Grant Extension Program
Wiyot Tribe

Additional Contributors

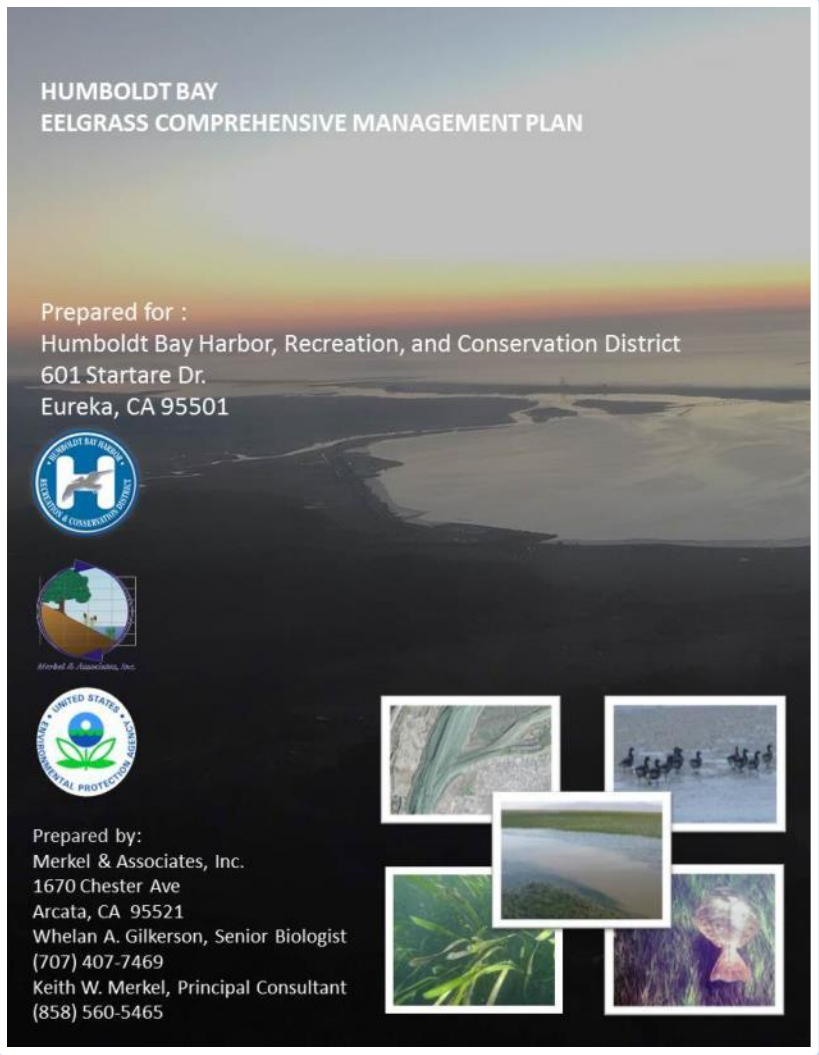
Audubon Society Redwood Region
California Department of Fish & Wildlife
GHD Consulting Services
North Coast Regional Water Quality Control Board
PlanWest Partners
SHN Consulting Engineers & Geologists
Stillwater Sciences
Trinity Associates
U.S. Army Corps of Engineers

Humboldt Bay Eelgrass Comprehensive Management Plan Key Components

- Humboldt Bay Eelgrass Comprehensive Management Plan (Document)
- Humboldt Bay Eelgrass Management webpage & additional resources

Plan Overview

1) **Introduction**
2) Humboldt Bay Eelgrass
3) Comprehensive Management Plan Framework



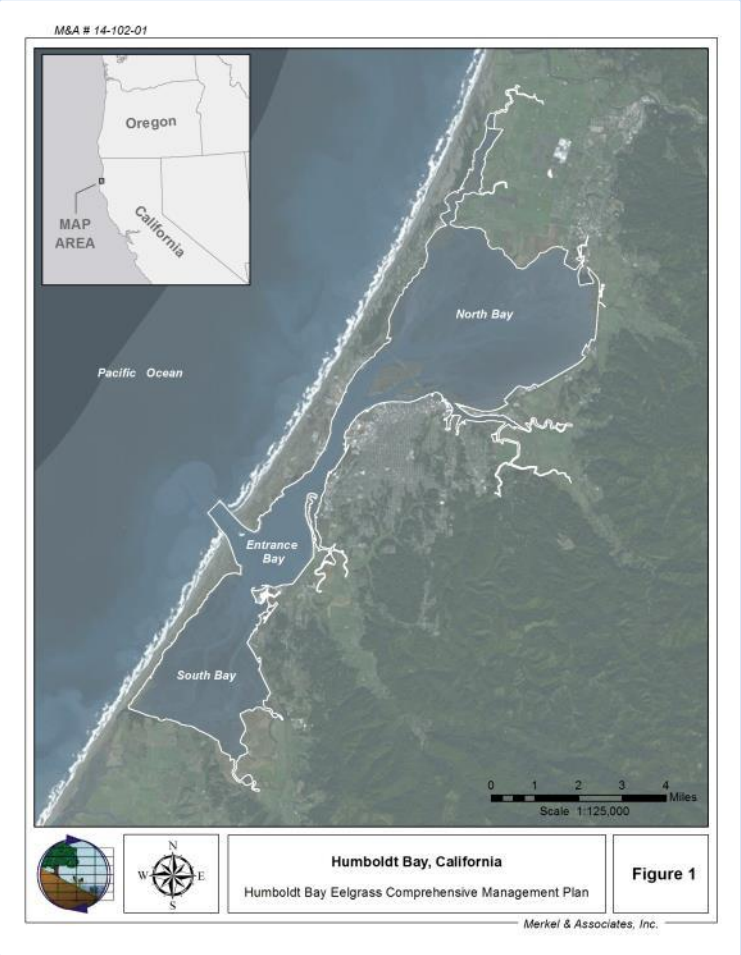
Humboldt Bay Eelgrass Comprehensive Management Plan

1.0 Introduction

1.1 Humboldt Bay

1.2 Birth of the Humboldt Bay Eelgrass Management Plan

1.3 Regulatory Context and the Eelgrass Comprehensive Management Plan



Humboldt Bay Eelgrass Comprehensive Management Plan

Section 1.1 Humboldt Bay

California's 2nd largest Bay

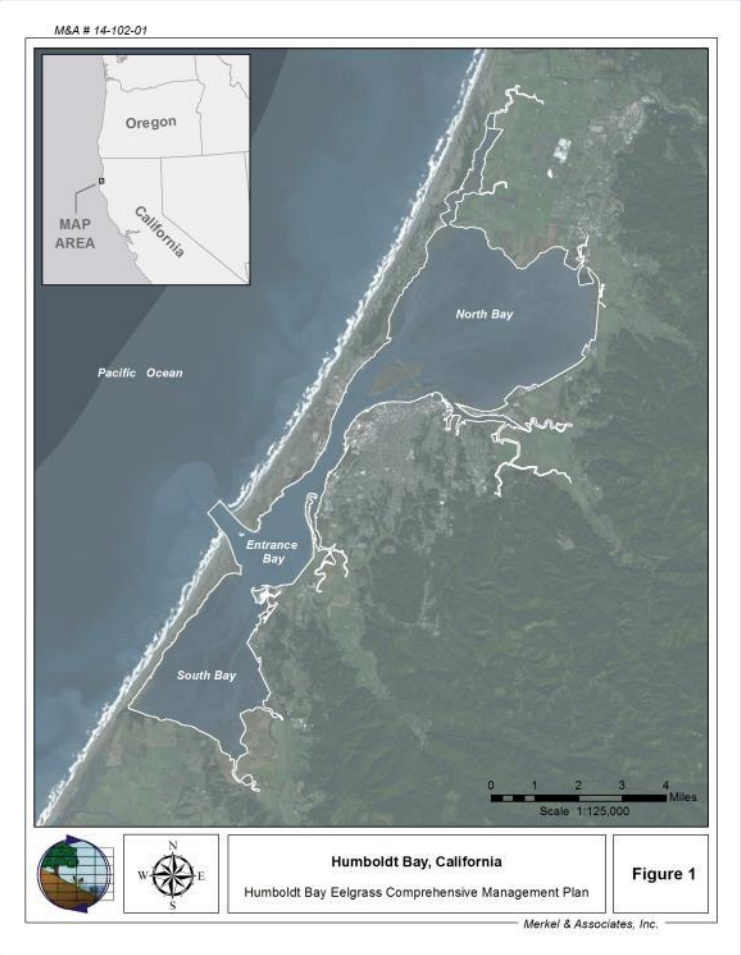
24 mi^2 at high tide and 11 mi^2 at low tide

102 miles of shoreline, 75% composed of artificial structures (Laird 2010)

Provides abundant wildlife habitat and recreational opportunities

Only deep water port between San Francisco and Coos Bay, Oregon

Timber, wood products, commercial fishing and mariculture industries shaped the local economy, development of the port



Humboldt Bay Eelgrass Comprehensive Management Plan

Section 1.2 Birth of the Humboldt Bay Eelgrass Management Plan

- Eelgrass Management Workshop (Oct 2014)
- EPA Regional Wetlands Program Development Grant (Sept 2015)
- Goals:

  A) Develop a multi-agency management plan with consistent goals and strategies for restoration/conservation of eelgrass habitat

  B) Improve efficiency of regulatory process for projects in Humboldt Bay

  C) Establish long-term conservation strategy that allows for SLR adaptation, dredging, and economic development in Humboldt Bay

Humboldt Bay Eelgrass Comprehensive Management Plan

Section 1.3 Regulatory Context and the Eelgrass Comprehensive Management Plan

- California Eelgrass Mitigation Policy & Implementing Guidelines (NMFS 2014)
- Poor history of eelgrass mitigation success (25%) in Humboldt Bay led to high prescriptive mitigation ratio (4.82:1)
- Eelgrass near carrying capacity, makes mitigation more difficult, costly
- Comprehensive Management Plans (CMP) under the CEMP

Plan Overview

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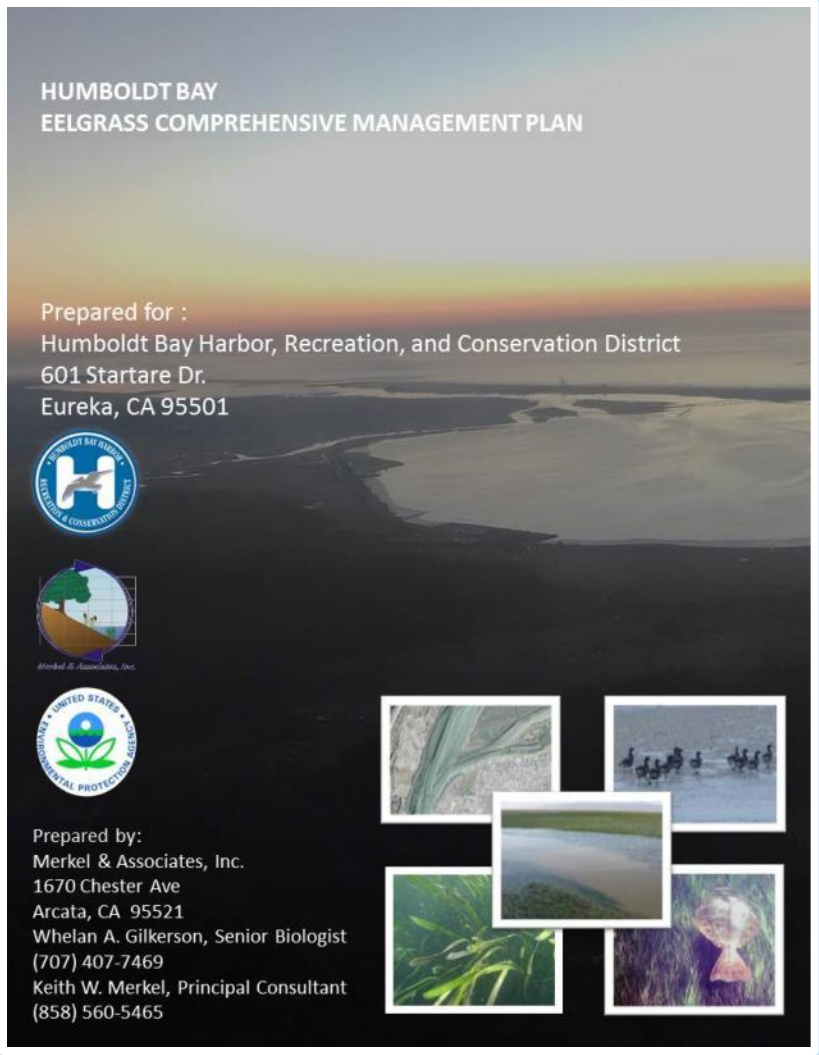
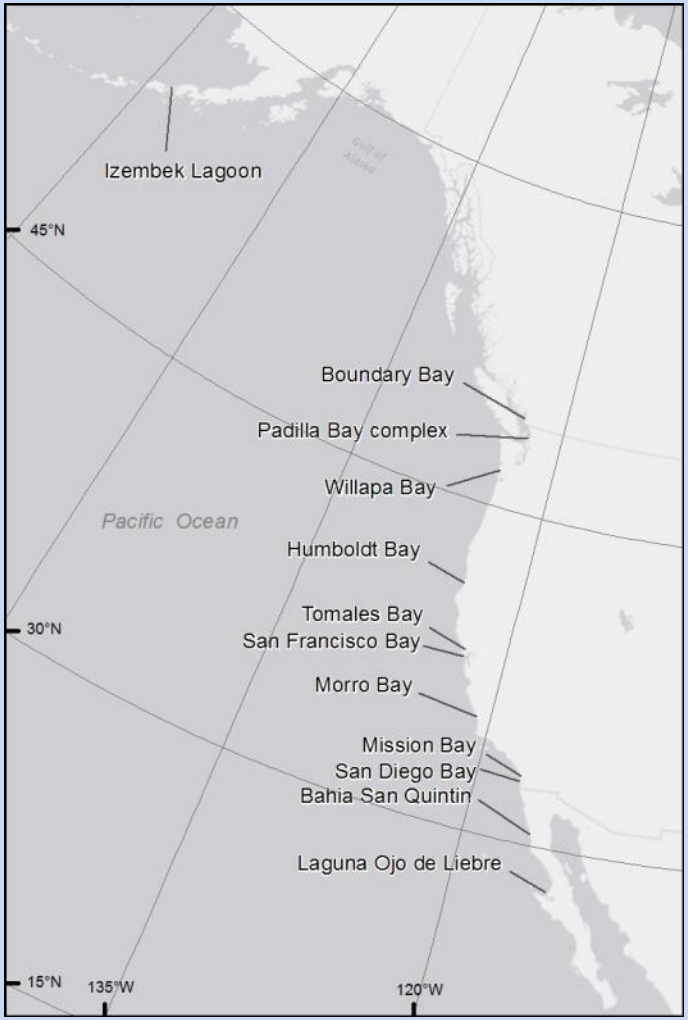


Humboldt Bay Eelgrass Comprehensive Management Plan

2.0 Humboldt Bay Eelgrass

2.1 Eelgrass distribution and abundance

- **Broad geographic context**
- California eelgrass
- Humboldt Bay eelgrass
- Historic review



Humboldt Bay Eelgrass Comprehensive Management Plan

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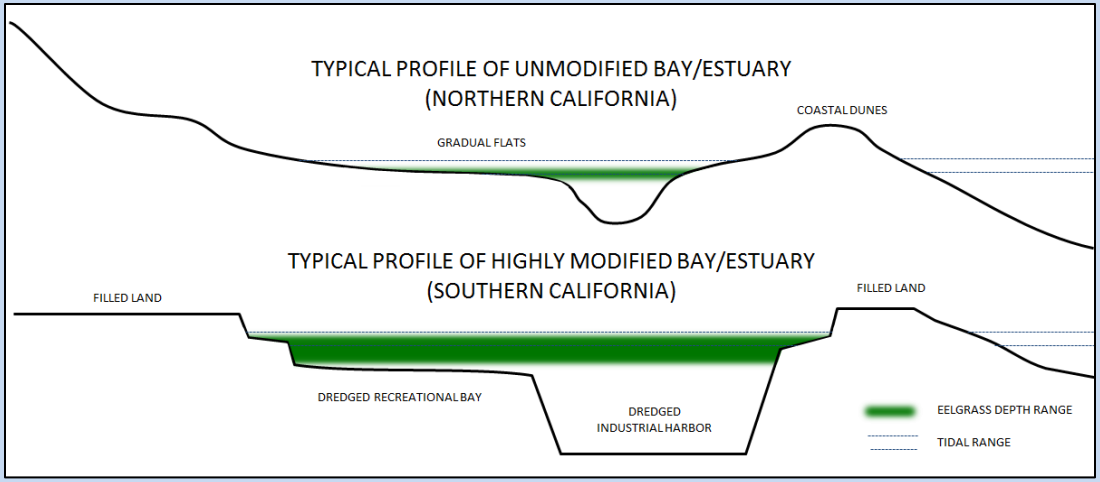
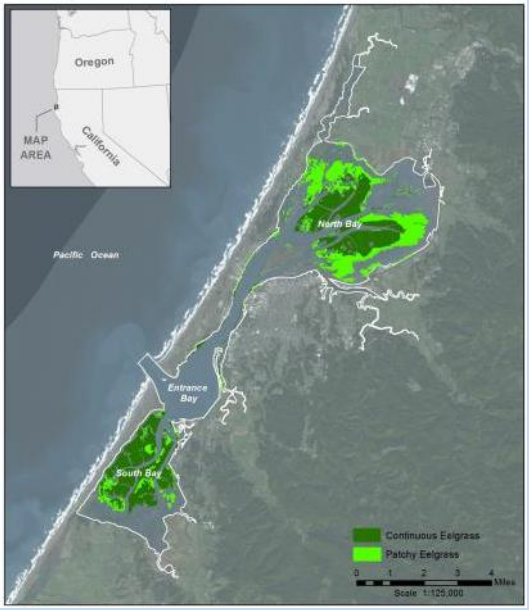


System	Acreage	% Total
Humboldt Bay	~4,700	31%
San Francisco Bay	~3,000	20%
San Diego Bay	~2,100	14%
Tomales Bay	~1,300	9%
Mission Bay	~1,100	7%
All Other Systems	~3,000	19%
Total	**~14,900**	**100%**

Humboldt Bay Eelgrass Comprehensive Management Plan



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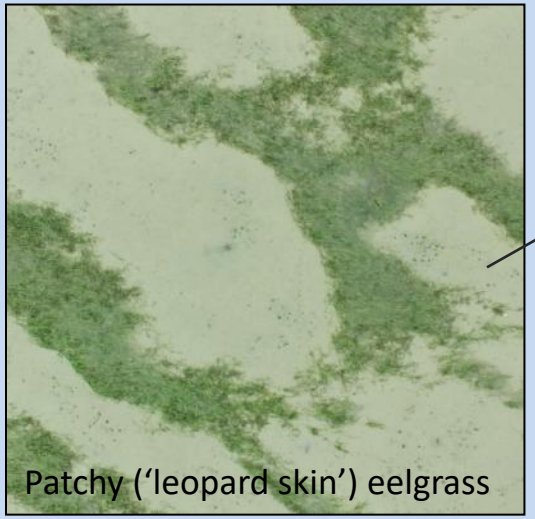
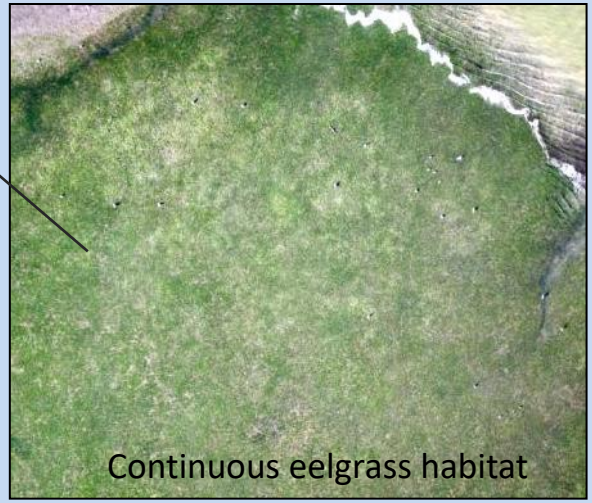


Patchy ('leopard skin') eelgrass

3,644 acres continuous eelgrass habitat
2,043 acres patchy habitat (Schlosser & Eicher 2012) patchy, ~50% cover



Continuous eelgrass habitat

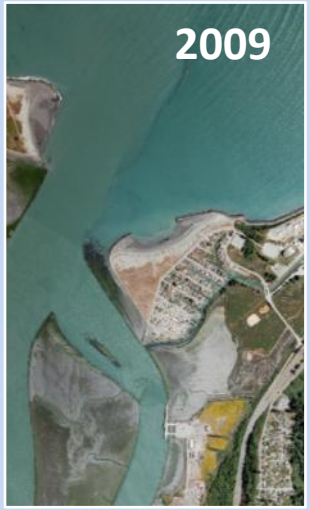
Humboldt Bay Eelgrass Comprehensive Management Plan

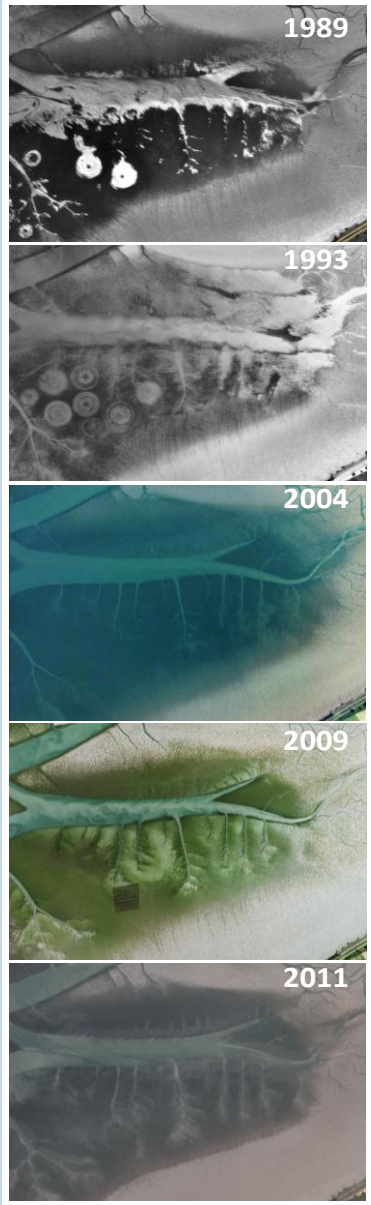
2.1 Eelgrass distribution and abundance

- Broad geographic context
- California eelgrass
- Humboldt Bay eelgrass
- **Historic review**

*Humboldt Bay topographic/bathymetric surveying history (1854- present)
Baywide eelgrass mapping history (1959-2009)

Losses, gains, and resiliency





Humboldt Bay Eelgrass Comprehensive Management Plan

2.2 Eelgrass Ecosystem Functions

Overview

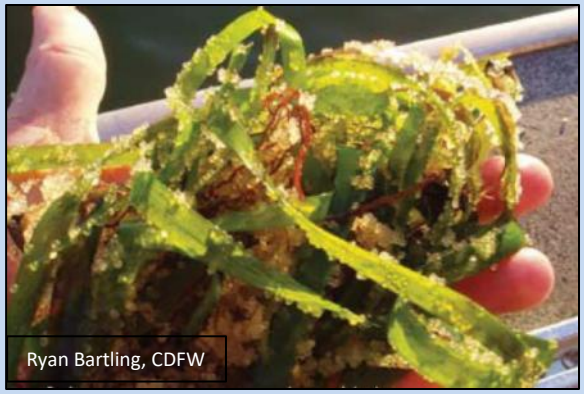
- Seagrass systems among most productive on earth
- Eelgrass most abundant and productive seagrass in Northern Hemisphere
  - "Habitat architect, foundation species, ecosystem engineer" (physical, chemical, biological services)
  - PP
  - Sediment deposition & stabilization
  - Wave and current dampening
  - Improves water quality & clarity
  - Carbon sequestration
  - Nutrient cycling
  - pH buffering/OA
  - Structure & nursery habitat
  - Food for grazers, detrital food web
  - Environmental sentinel
  - Others?

Humboldt Bay Eelgrass Comprehensive Management Plan

2.2 Eelgrass Ecosystem Functions

Humboldt Bay Functions

- Physical & chemical (bay morphology & dynamic adjustment w SLC, nutrient cycling & pH buffering)
- Fisheries support (groundfish, dungeness crab, oyster mariculture, herring, salmonids?)
- Brant and other migratory waterfowl



Humboldt Bay Eelgrass Comprehensive Management Plan

2.3 Threats to Eelgrass in Humboldt Bay

- Natural and anthropogenic factors
- Some factors span multiple categories
- Awareness of indicators provides context, supports understanding of system state

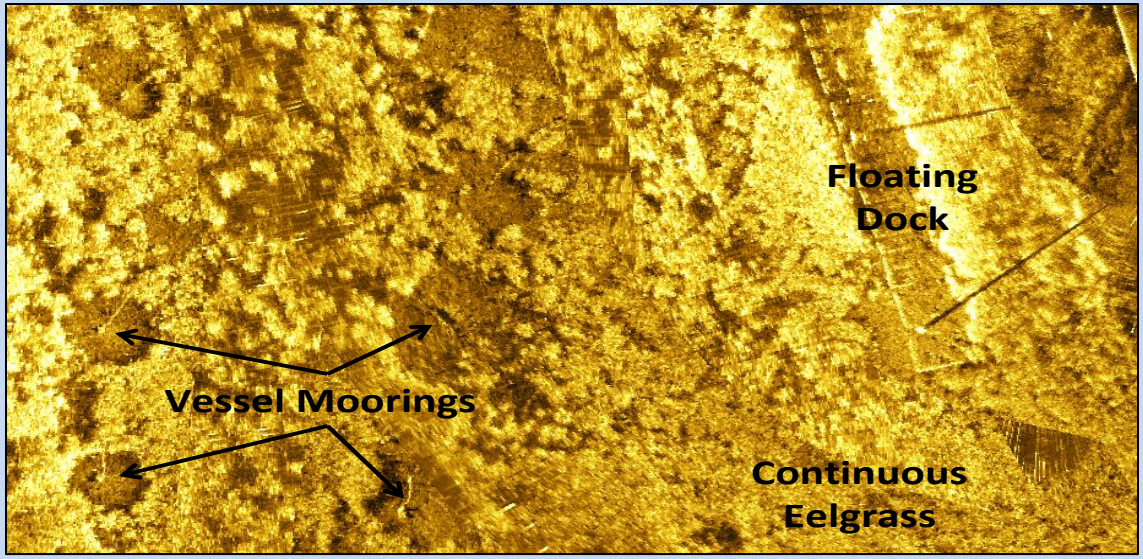
STRESSORS	*GENERAL INDICATORS*
Physical Stressors	
o **Wave and current energy**	short and narrow leaved growth form; exposed turions at patch margins; coarse sand with ripples outside of bed; limited to no detritus accumulation
o **Sediment burial, instability**	leaf sheath buried below sediment surface; upwardly migrating turions where burial is occurring; free rhizomes and water roots in erosive areas
o **Dredging**	steep active slumping of adjacent side slopes; frequently, sliding eelgrass on slopes adjacent to cuts; uneven bottom due to recent cuts by dredging
o **Wake scour and prop scars**	undercut rhizomes at patch margins; loose or free eelgrass plants with water roots; linear cuts in bed with loose sediment in trough
o **Shading and circulation patterns**	loss of eelgrass under structures and adjacent thinning of turion densities increased sediment loading compared to nearby beds
o **Animal grazing and bioturbation**	apparent random pattern of rhizome exposure; forage pits in beds (rays); clipped leaves, rasping or chewed tissues, waste and prints (waterfowl), invert. herbivores
Chemical Stressors	
o **Sediment toxicity**	Variable to unknown
o **Water contamination**	Variable to unknown
o **Oiling and other chemical fouling**	oils on leaves and soil; bleaching of leaves
Biological Stressors	
o **Metabolic Stressors**	
• Photosynthetic limitation and light competition	
➢ Turbidity	low transparency in water; Sedimentation on plants; declining leaf density and chlorotic tissues
➢ Phytoplankton bloom	red tides or green water
➢ Macroalgal blooms	accumulation of sheet and tube alga (typically *Ulva*, *Enteromorpha*, *Porphyra*, and *Gracilaria* species); thinning of eelgrass beds in matted algae
➢ Epiphytic loading	heavy growth of epiphytes on leaves; high silt loading on plants
➢ Ambient water transparency	Gradual reduction in eelgrass cover over bottom; reduction in shoot density within patches at depth
• Heat and desiccation	bleaching of leaves at upper shore; loss of turgor in leaves mottled light and dark splotches on leaves
• Osmotic regulation and other salinity stresses	loss of turgor in leaves; decline of bed in regions of prolonged elevated or depressed salinities
o **Disease and infection**	pronounced decline of eelgrass in dense beds areas; black mottling and rot on leaves
o **Invasive species**	presence of invasive species in areas of eelgrass, displacement patterns along margins or within beds

Humboldt Bay Eelgrass Comprehensive Management Plan

2.3 Threats to Eelgrass in Humboldt Bay

Anthropogenic Threats

- **Dredging**
- **Filling**
- **Bay coverage**
- **Moorings**
- Mariculture
- Vessel grounding
- wake damage
- prop scarring



Humboldt Bay Eelgrass Comprehensive Management Plan

2.3 Threats to Eelgrass in Humboldt Bay

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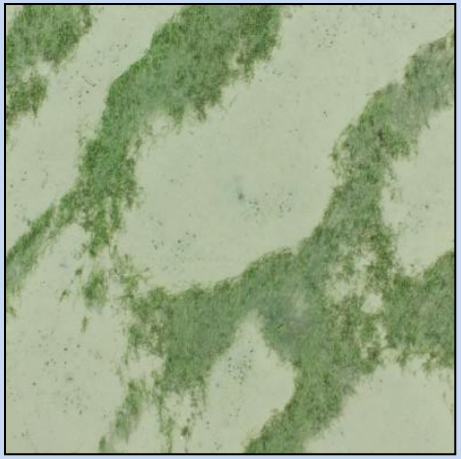

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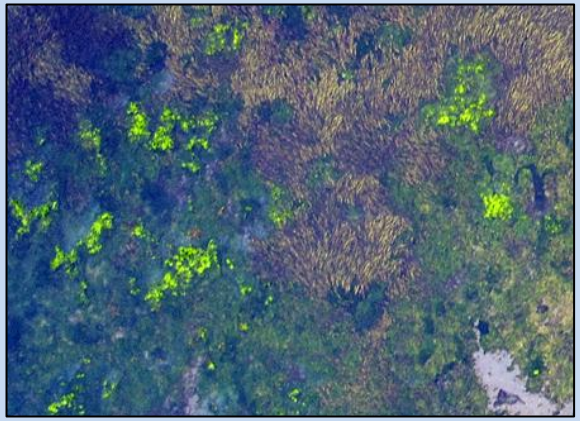
2.3 Threats to Eelgrass in Humboldt Bay

- Invasive species
- Eutrophication
- Bioturbation & herbivory


Matthieu Leray, Smithsonian Institution




U.S. Fish & Wildlife Service


Len Blumin, Audubon Society

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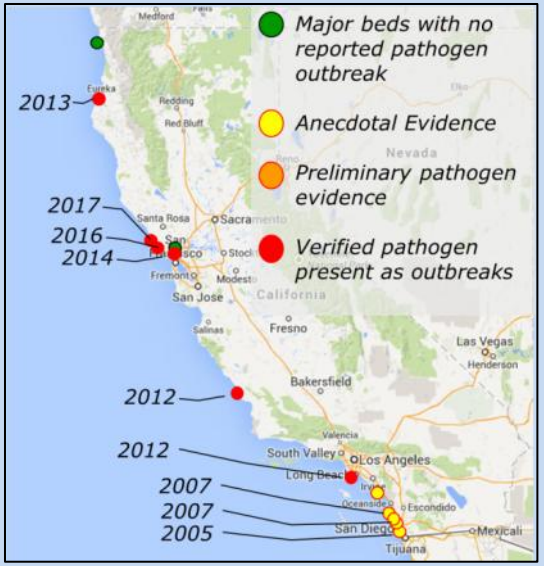
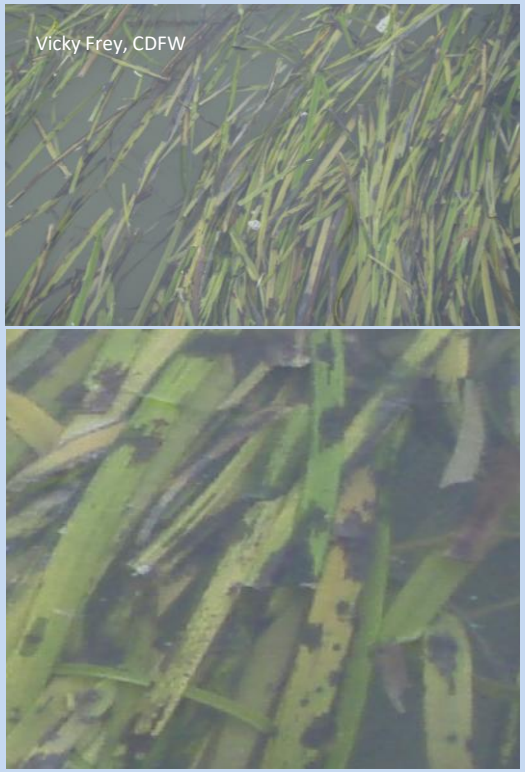


- Wasting Disease (Perhaps the greatest threat to Humboldt Bay)



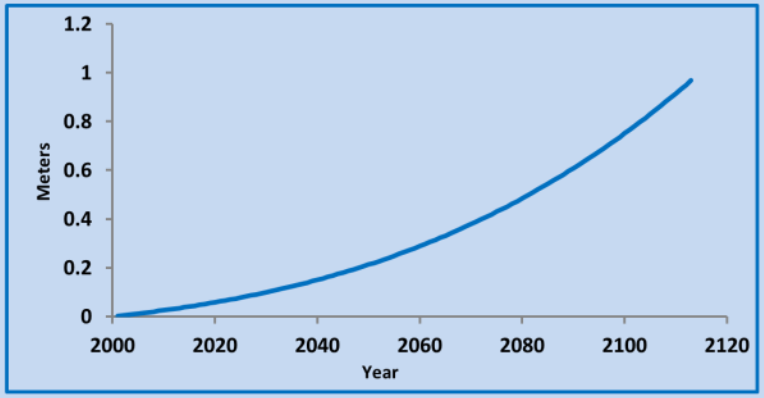
Humboldt Bay 2013

Morro Bay 2009 vs 2010

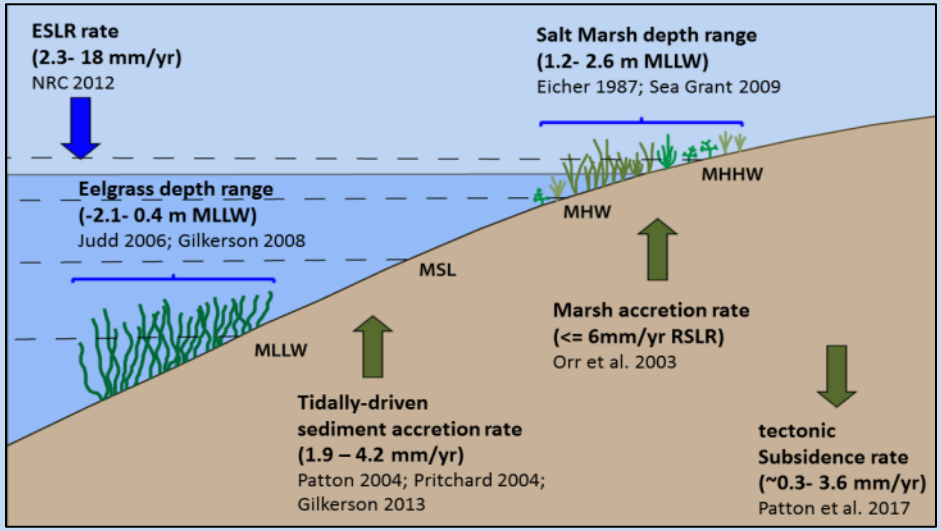
Humboldt Bay Eelgrass Comprehensive Management Plan

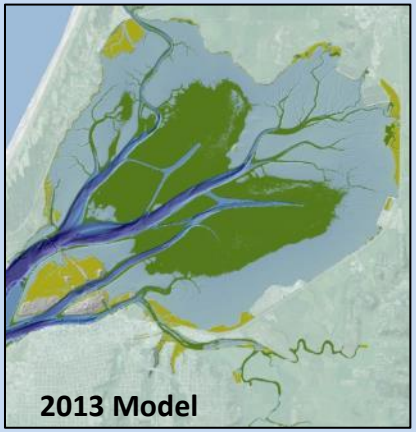
Eelgrass and Sea Level Rise in Humboldt Bay

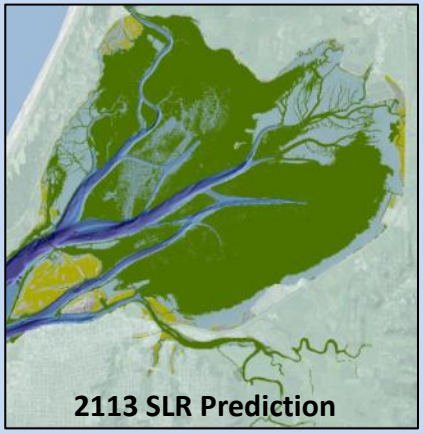
- Most rapid rate of SLR on U.S. west coast in SHB (Patton et al. 2017)
- Likely to promote overall increase in eelgrass in Humboldt Bay
- Some gains in eelgrass may lead to losses in mudflat and saltmarsh habitat



Current ESLR rate ~2.3 mm/yr Pacific Ocean (Burgette and Weldon, 2009)
NRC projection = 9.9 cm by 2030, 21.4 cm by 2050, and 75.1 cm by 2100







Humboldt Bay Eelgrass Comprehensive Management Plan

Eelgrass and Ocean Acidification

- Likely increase in eelgrass photosynthesis & growth rates
- Research needed and currently underway to understand buffering potential
- Buffering may have a mitigating/positive effect for shell forming invertebrates & mariculture industry (calcite and aragonite solubility)

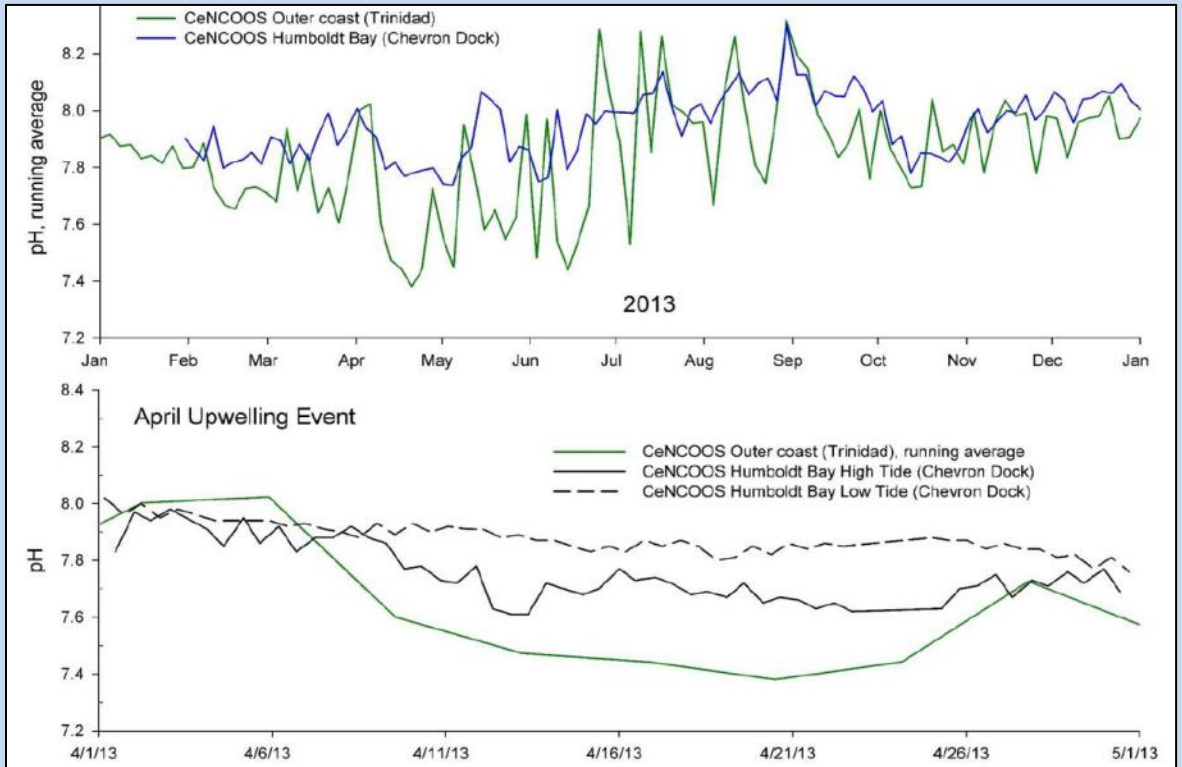


Figure by Shaughnessy (2013), illustrating potential buffering effect of eelgrass in North Humboldt Bay.

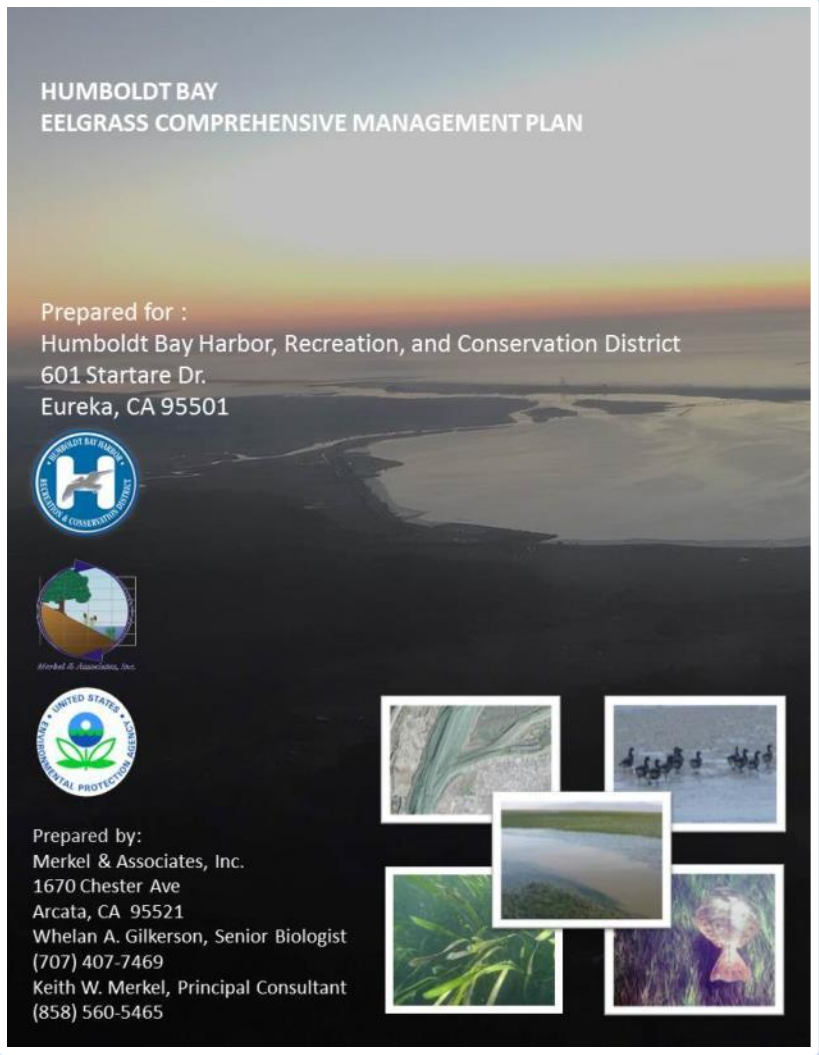
Humboldt Bay Eelgrass Comprehensive Management Plan

Other Climate Concerns

- Decrease in summer fog extent (30%; Johnstone & Dawson 2010)
- Multi-year Pacific marine 'heatwave' (Di Lorenso and Mantua 2016)
- Both factors increase thermal stress, intertidal areas most affected
- May also exacerbate/trigger wasting disease outbreaks
- Both factors likely resulted in substantial decline in HB intertidal eelgrass 2013-2016

Plan Overview

1) Introduction
2) Humboldt Bay Eelgrass
3) **Comprehensive Management Plan Framework**



Humboldt Bay Eelgrass Comprehensive Management Plan

3.0 Comprehensive Management Plan Framework

3.1 Eelgrass Policy Standards

- CEMP Overview and CMP context
  - Authored by NOAA/NMFS in 2014
  - Broadly adopted by other state and federal agencies
  - Establishes standards and expectations of performance
  - Goal: no net loss of eelgrass function
  - Supportive of system specific plans (CMPs) where CEMP guidance does not address local needs

Humboldt Bay travel lift nearly non-operational due to accumulation of sediment in the ways. Dredging will impact eelgrass and require mitigation. Under the CEMP the dredging would require one time eelgrass mitigation provided the impact and mitigation are tracked.

Humboldt Bay Eelgrass Comprehensive Management Plan

Regulatory Programs, Agency Roles and Permitting

- ***Army Corps of Engineers – Clean Water Act and Rivers & Harbors Act***

  Clean Water Act 1972 (Section 404) Regulates discharge of dredged or fill material into Waters of the U.S. (including wetlands)

  Rivers & Harbors Act 1899 (Section 10) Regulates development or maintenance activities below OHW level of Navigable Waters

- **Individual permits**- Project may have potential significant impacts
- **Programmatic permits** (NWP or RGP)-Activities do not individually or collectively have more than minimal impact on the aquatic environment

* *San Francisco District administers USACE permits in Humboldt Bay*

Humboldt Bay Eelgrass Comprehensive Management Plan

Regulatory Programs, Agency Roles and Permitting

- ***California Coastal Commission – California Coastal Act (1976)***
  - **Coastal Commission established as a quasi-judicial body , tasked with broad regulatory oversight and permit authority relating to:**

  land-use regulations, public access, recreation, marine and terrestrial habitat protection, water quality, energy development and resource extraction, visual resources, agricultural lands, transportation, public works and port activities occurring in the Coastal Zone.

******California's lead land-use authority within the Coastal Zone, responsible for issuing* ***Coastal Development Permits (CDPs)*** *in Humboldt Bay*

Humboldt Bay Eelgrass Comprehensive Management Plan

Regulatory Programs, Agency Roles and Permitting

- ***Regional Water Quality Control Board – Clean Water Act and Porter-Cologne Act***

  State Water Resources Control Board (SWRCB) established by the California State Legislature in 1967.

  – Dual Authority over water quality protection and water allocation (Beneficial Uses)

  – 9 Regional boards operate under SWRCB

  Regulate discharge of fill and dredged material (401 Water Quality Certification and Wetlands Program) established under joint authority of Federal CWA Section 401 and State Porter-Cologne Water Quality Control Act of 1969 (California Water Code, Section 7)

**The NCRWQCB is responsible for water quality regulations and issuance of 401 water quality certifications in Humboldt Bay.*

Humboldt Bay Eelgrass Comprehensive Management Plan

Regulatory Programs, Agency Roles and Permitting

- ***California Department of Fish and Wildlife***
  - CDFW is the trustee agency for fish and wildlife resources in the State of California under CEQA
  - Has jurisdiction over fish and wildlife resources, including native plant communities and habitat required to support sustainable populations
  - Responsible for issuing Scientific Collecting Permits (Required for harvest of donor eelgrass material)
  - A Letter of Authorization (LOA) is also required from CDFW to support and justify the location and source of eelgrass donor material to be used for transplanting activities.

Humboldt Bay Eelgrass Comprehensive Management Plan

Regulatory Programs, Agency Roles and Permitting

- **NOAA Fisheries (*National Marine Fisheries Service*)**

Magnuson-Stevens Fishery Conservation and Management Act (1996)

- Designation of eelgrass as Essential Fish Habitat (EFH) and a Habitat of Particular Concern

Endangered Species Act (ESA) Section 7 Consultations

- federal agencies are required to consult with NMFS (NOAA Fisheries) regarding measures that can be taken to avoid or minimize adverse effects to eelgrass resulting from project activities
- Ensure federal actions do not threaten the survival of particular species or result in degradation of critical habitat
- As authoring agency of the CEMP-NOAA Fisheries promulgates eelgrass mitigation policy with the goal of providing a consistent approach to achieving 'no net loss' of eelgrass habitat function throughout California.

Humboldt Bay Eelgrass Comprehensive Management Plan

Regulatory Programs, Agency Roles and Permitting

- ***Cultural Resources Consultations***
  - Consultation under CEQA required in advance of submitting either a Mitigated Negative Declaration or Environmental Impact Report, or releasing these documents for public review
  - Tribal entities shall be given written notice (Project description, location, notification of the Tribe's 30-day response period for consultations)
  - Tribes may request confidentiality (Cultural Resources at risk, not required to be disclosed in public CEQA documents)
  - Efforts must be made to identify mutually acceptable actions to minimize or mitigate significant impacts to cultural resources
  - Failure to achieve consensus between a lead agency and a Tribe may still ultimately satisfy the requirement for consultation
  - NHPA Section 106 Consultation

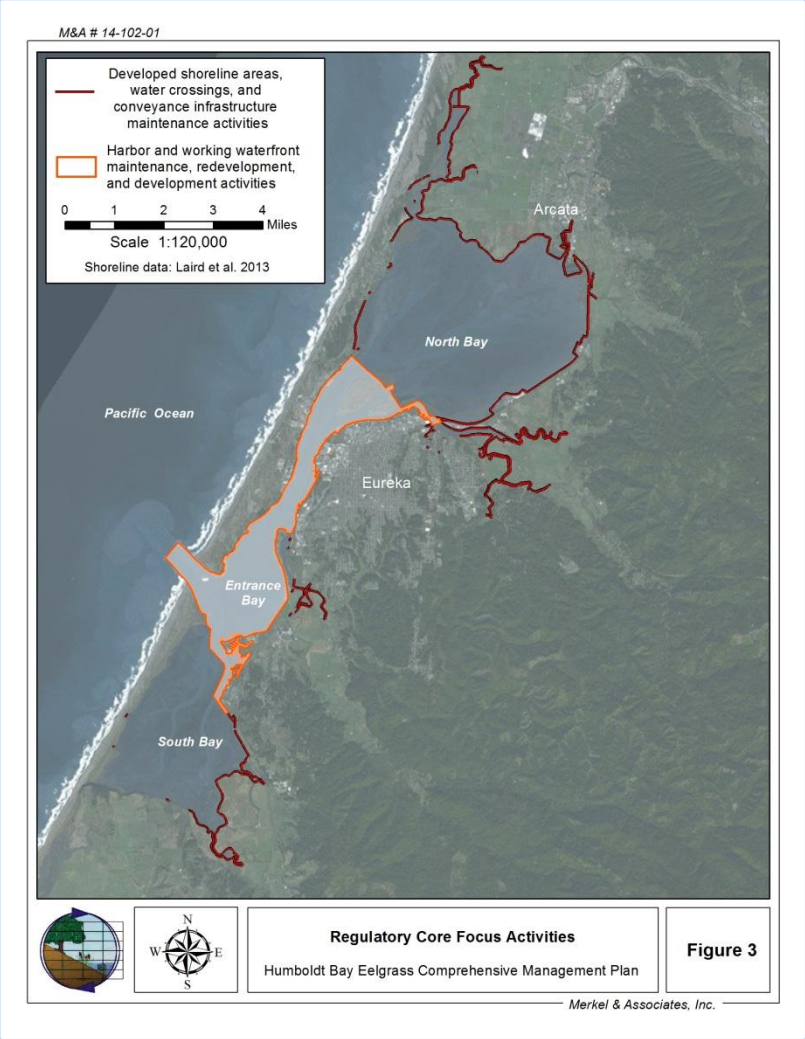
**In Humboldt Bay, the Wiyot Tribe is involved in cultural resources consultations and are additionally playing an active role as a partnering organization in development of the HBECMP. The Blue Lake Rancheria and Bear River Tribe may also be involved in consultations.*

Humboldt Bay Eelgrass Comprehensive Management Plan

3.2 Humboldt Bay Eelgrass Management

Humboldt Bay Eelgrass Comprehensive Management Plan Goals

- Disseminate Eelgrass information to project applicants by means of the Humboldt Bay Eelgrass Management Plan Website
- Support inventory, evaluation and prioritization of eelgrass mitigation/restoration opportunities in Humboldt Bay
- Facilitate efficiency and consistency in the application of eelgrass regulatory policy in Humboldt Bay
- Identify and pursue programmatic regulatory/permitting mechanism(s) capable of supporting a suite of similar activities focused on harbor maintenance and shoreline development needs of Humboldt Bay
- Promote system-level long-term monitoring of Humboldt Bay's eelgrass population to understand interannual variability of the resource, overall system health, and the effects of climate change on the Humboldt Bay Ecosystem.

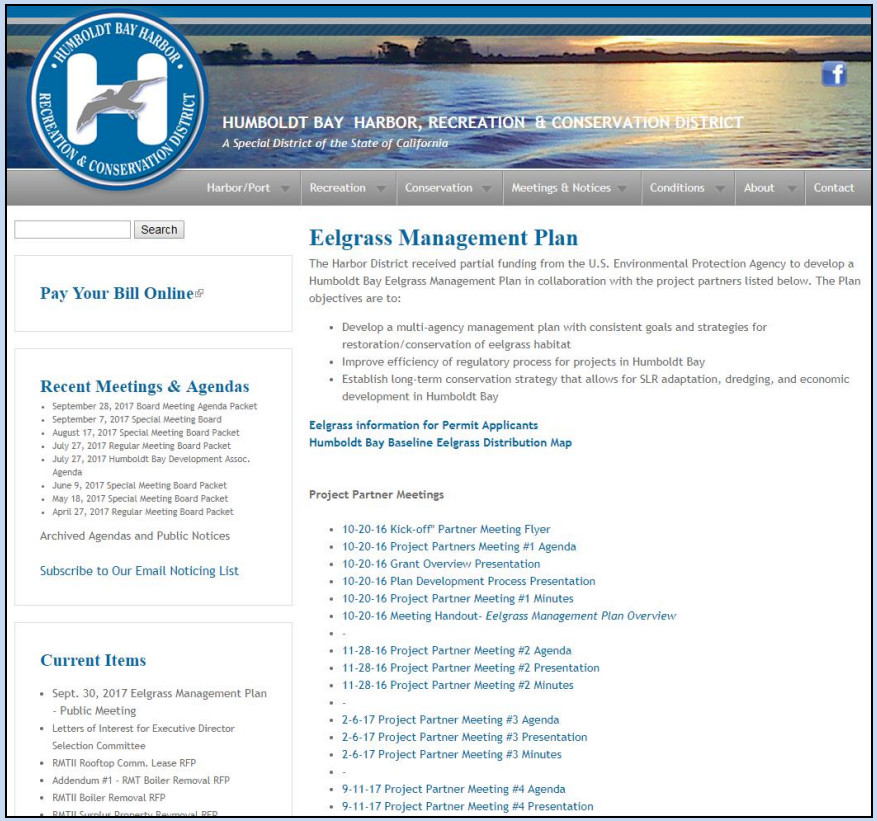


Humboldt Bay Eelgrass Comprehensive Management Plan

3.3 Humboldt Bay Eelgrass Impact Project Evaluation Framework

- Pre-Project eelgrass checklist (Plan & website)
- Recommended eelgrass surveying methods/standards (Plan)
- Surveying guidance-Area of Potential Effect (APE) (Plan & website)
- Online eelgrass distribution map (website)

Depth Range	Project Scale	Recommended Survey Method
Intertidal (-1 to +4 ft):	0-1,000 m^2 (0-10,764 ft^2)	Total station/sub-meter GPS/ low-altitude UAV
	0-3,000 m^2 (0-32,292 ft^2)	Total station/sub-meter GPS/low-altitude UAV
	3,000 m^2 -100 ha (0.74-250 ac)	Low-altitude UAV
	50 ha+ (125 ac+)	Low-altitude UAV/Manned aircraft
Subtidal (-10 to -1 ft):	0-1,000 m^2 (0-10,764 ft^2)	Total station/sub-meter GPS w/ diver transects/single-beam or SS sonar
	1,000-2,000 m^2 (10,764-21,528 ft^2)	Sub-meter GPS/single-beam or SS sonar
	2,000 m^2 + (21,528 ft^2)	SS sonar

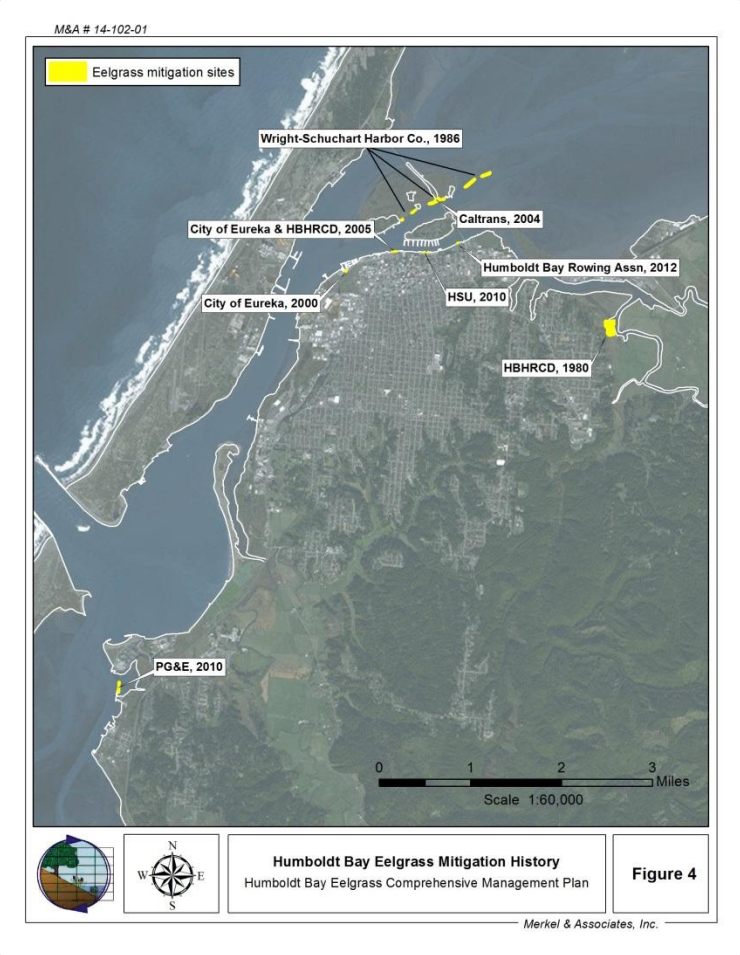


Humboldt Bay Eelgrass Comprehensive Management Plan

3.4 Eelgrass Mitigation/Restoration Opportunities in Humboldt Bay

History of Eelgrass Mitigation

- 8 projects identified as completed (mitigation and monitoring)
- Methods included bare-root transplanting, plug transplanting, debris removal, and out-of-kind wetland enhancement
- Failures driven by poor site selection, lack of site development, potentially unsuitable anchoring material for transplant units, and lack of follow through on permit conditions
- Successes achieved by appropriate site selection and site development in conjunction with active bare-root and plug-based transplanting; passive debris removal and successful out-of-kind mitigation under earlier regulatory framework



Humboldt Bay Eelgrass Comprehensive Management Plan

History of Eelgrass Mitigation (cont.)

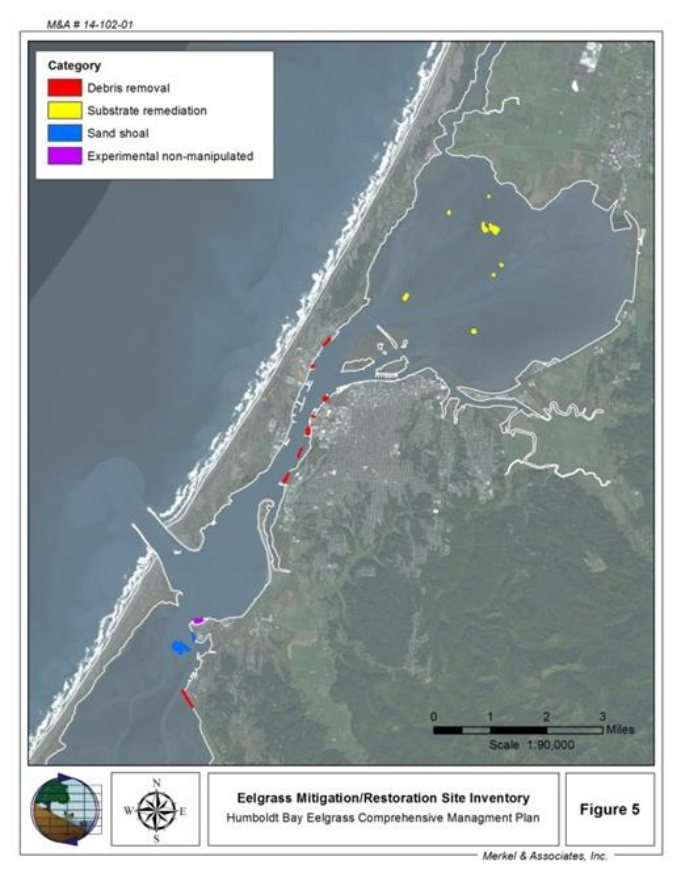
- Important to understand causes of past failures-lessons learned
- HBECMP focused on informing future project implementation, consistent project/permit evaluation framework moving forward
- Adoption of HBECMP under the CEMP intended to improve the outcome of future mitigation (better guidance and support of regional/combined mitigation)
- Goal- greater assurance of success and accountability with respect to no-net-loss policy

Substrate remediation to remove non-functional revetment and restoration planting of eelgrass into areas where debris and rubble had been removed. This 2012 project is the first in Humboldt Bay subject to full standards of the SCEMP as a precursor to adoption of the CEMP. In 2017, the project met established 5-year success milestones.

Humboldt Bay Eelgrass Comprehensive Management Plan

3.4 Eelgrass Mitigation/Restoration Opportunities in Humboldt Bay

- Removal of derelict infrastructure
- Substrate remediation
- Synergistic restoration of former tidelands
- Site development and mitigation transplanting
- Experimental/unmanipulated site transplanting



Humboldt Bay Eelgrass Comprehensive Management Plan

3.4 Eelgrass Mitigation/Restoration Opportunities in Humboldt Bay

- **Removal of derelict infrastructure**
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Humboldt Bay Eelgrass Comprehensive Management Plan

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Humboldt Bay Eelgrass Comprehensive Management Plan

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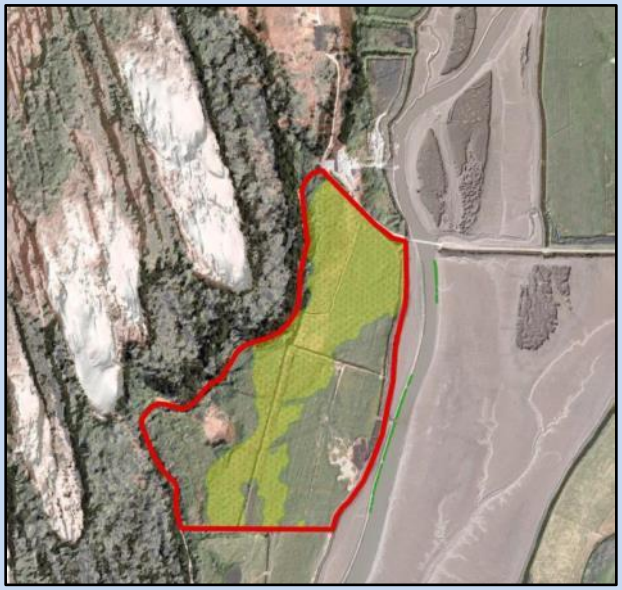
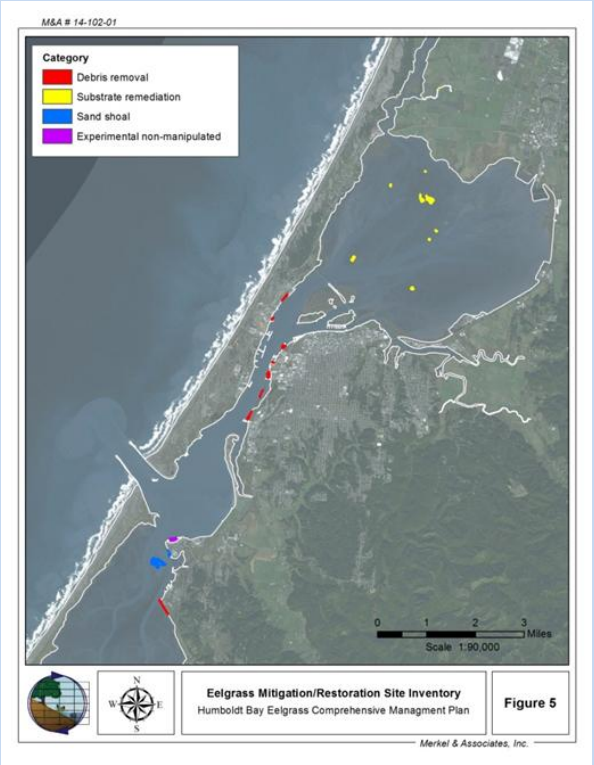


Reclaiming former tidelands increases tidal prism and promotes eelgrass expansion, often beyond the project area…

Humboldt Bay Eelgrass Comprehensive Management Plan

3.4 Eelgrass Mitigation/Restoration Opportunities in Humboldt Bay

- Mitigation transplanting and site development (Clam Island)
- Experimental Transplanting (King Salmon)

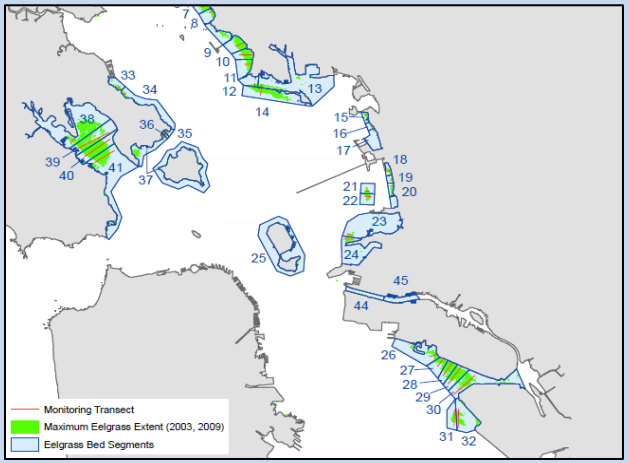


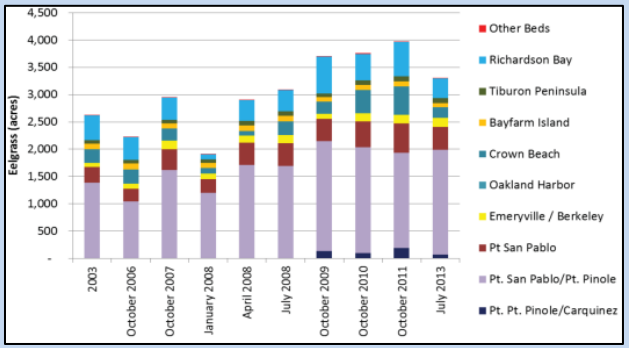
Humboldt Bay Eelgrass Comprehensive Management Plan

3.5 Humboldt Bay Eelgrass Monitoring Program

- Humboldt Bay Cooperative Eelgrass Project (2001-2008)
- SeagrassNet Monitoring Program (2009-present)

- UAV/(ISS?)-based belt transects to capture spatial parameters paired with biometric data collection= cost effective means to re-establish cooperative monitoring program in HB

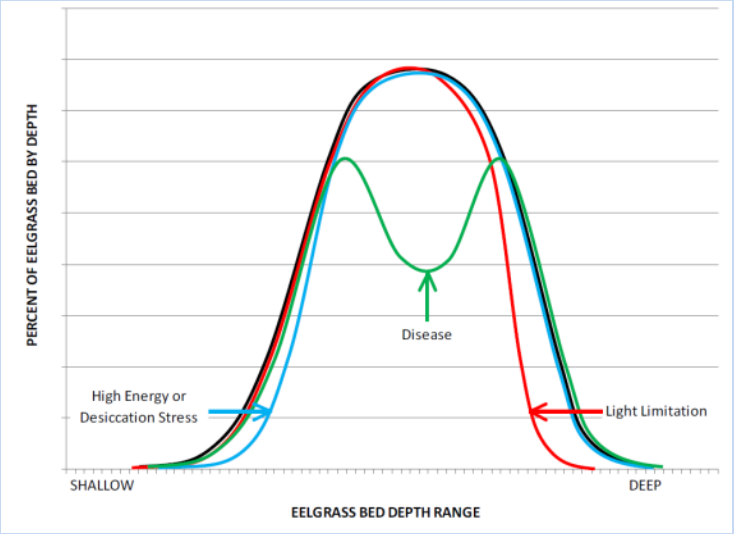


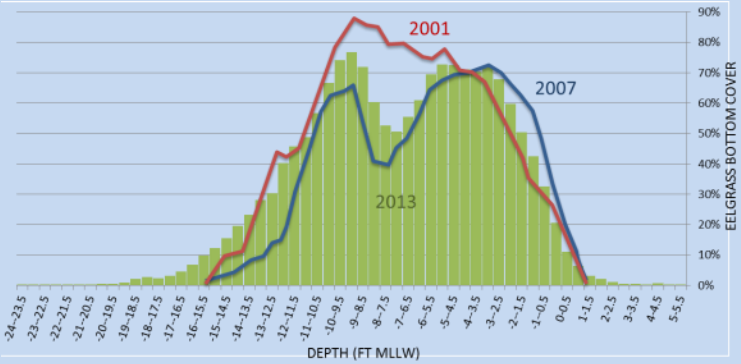


Humboldt Bay Eelgrass Comprehensive Management Plan

3.5 Humboldt Bay Eelgrass Monitoring Program

- Depth distribution monitoring component
- Provides key information on system-level response to environmental change (low-cost, pre-deployed bio-sonde)
- Light environment, temperature, and early indicators of disease





Humboldt Bay Eelgrass Comprehensive Management Plan

Recommendations

- Establish a baywide cooperative monitoring program
- Develop RGP to permit projects identified as 'Core Focus Activities' within the Plan
- Follow up on King Salmon/Clam Island mitigation implementation

Eelgrass habitat in this area of North Bay, experienced dramatic declines in bed continuity and overall abundance between 2009 and 2016. Similar observations have been made in other locations of the bay, however, very little is known about the spatial extent and overall magnitude of the decline, or how this may have affected organisms dependent upon intertidal eelgrass. Image credits: NOAA (left) and Merkel & Associates (right).

Humboldt Bay Eelgrass Comprehensive Management Plan (CMP) Section 3 Updates

Recommendations

- Seek to implement pilot studies to investigate

a) remediation of legacy substrate impacts through dredging/excavation of a shell hash site

b) lower-order channel excavation to alleviate historic/anthropogenic sedimentation as a means of eelgrass restoration

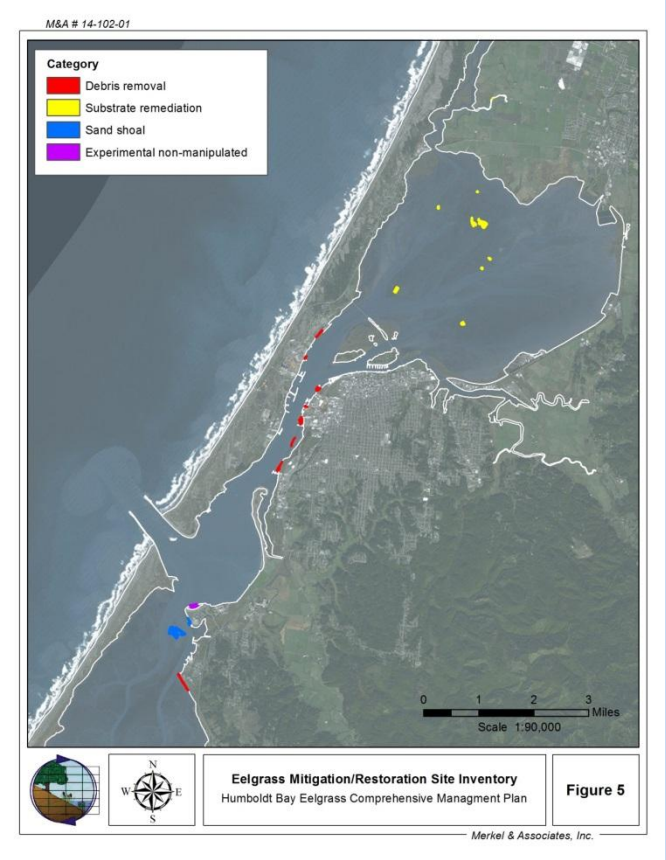
c) Review/reconstruct eelgrass gains following tideland/saltmarsh restoration projects (if possible) or look to integrate a monitoring component into a tideland restoration project to develop a better understanding of tidal prism/eelgrass expansion relations in Humboldt Bay

Humboldt Bay Eelgrass Comprehensive Management Plan (CMP) Section 3 Updates

Conservation Recommendations

- Investigate potential for developing a multivariate, hydrodynamic model of Eelgrass habitat in Humboldt Bay
  - Predictive capacity for eelgrass occurrence given the right combination of physical conditions that can be monitored/modeled <>How can eelgrass serve as a biosonde to further inform water quality monitoring efforts currently underway?

- Develop living shoreline projects (native oyster reef to facilitate patchy eelgrass microhabitat development near the upper limits of distribution)



Questions?