Tracking Coastal Habitat Change Over Time: *Considerations for Routine Mapping*

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OCEAN PROTECTION COUNCIL

SFEI San Francisco Estuary Institute


Monitoring basemap
Trend assessment
Planning studies
Model inputs
Prioritization

Importance of Accurate and Current Maps

Identify priority areas in need of management actions

Restoration or rehabilitation following impacts

Vulnerability to risk of future loss or degradation

Track progress toward achieving stated management goals

Understand where actions are working and where adaptive management is needed

Provide up to date base maps to inform monitoring programs

Challenges

- Rapid change in the coastal zone
- Stochastic events
- Data availability
- Spatial and temporal resolution
- Method selection
- Cost

Objectives

- Evaluate approaches for mapping habitat extent and tracking acreages statewide on a regular basis

- Provide considerations for each approach
  - pros and cons, level of effort, cost, etc.

- Summarize findings to inform agency decisions regarding future mapping efforts

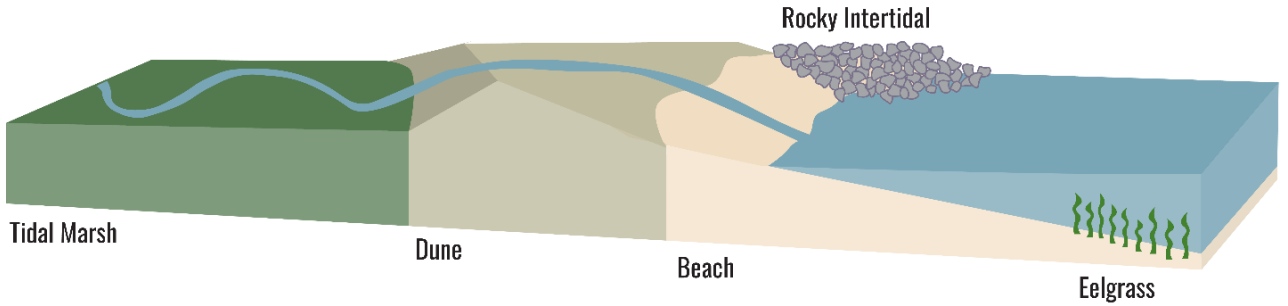
Priority Habitats

Beaches & Dunes

Rocky Intertidal

Eelgrass

Coastal Wetlands

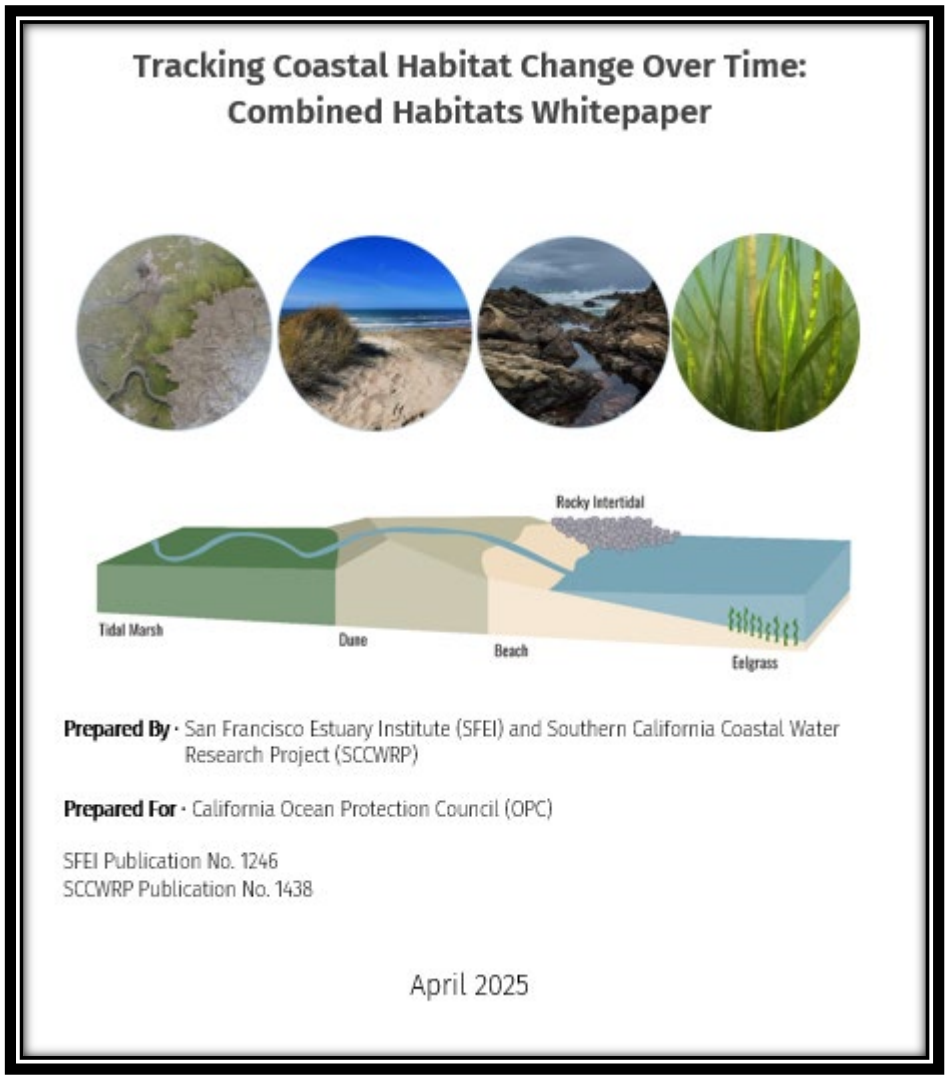


Process

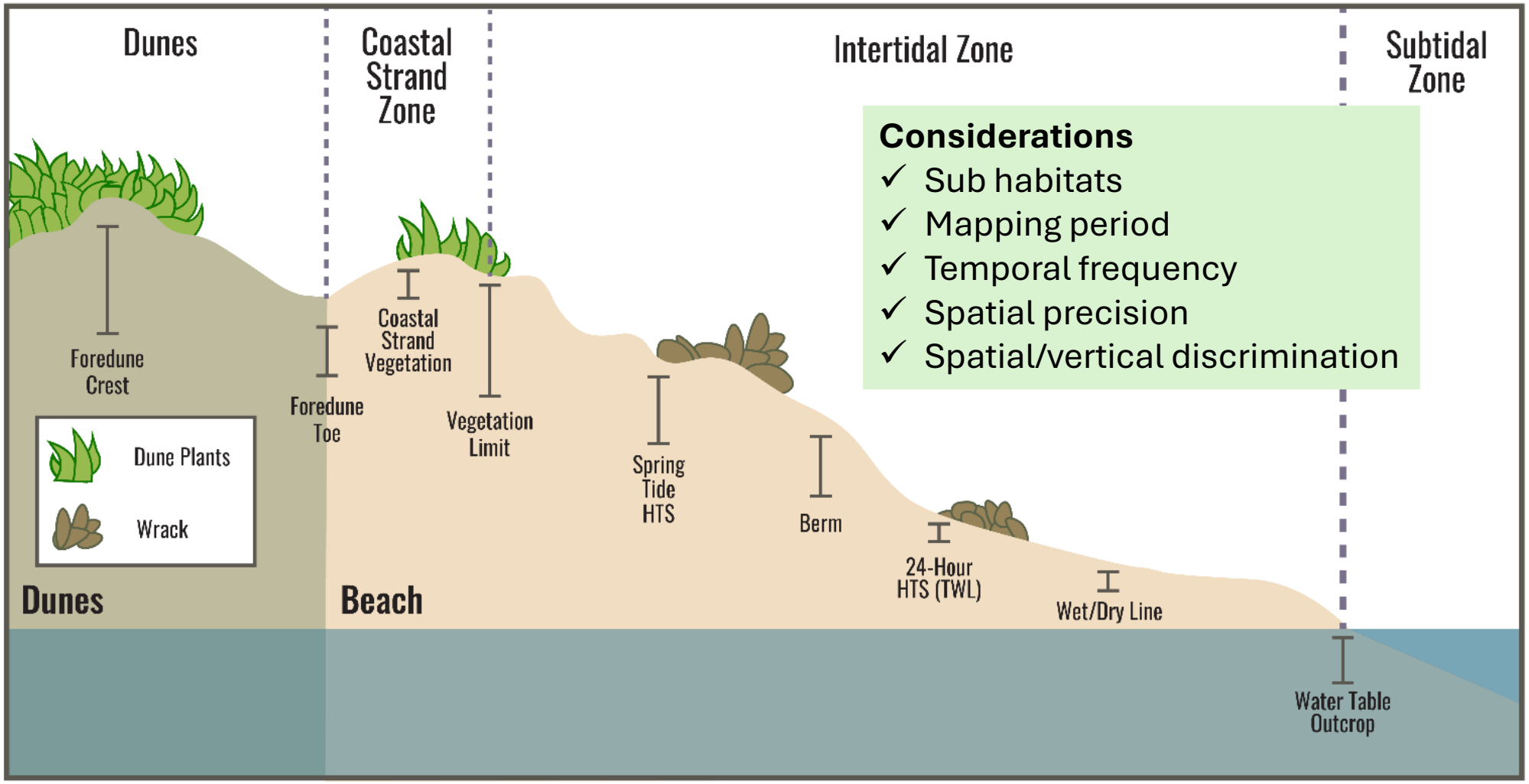
- Convene expert workgroups
  - Distinct workgroup for each habitat + overall discussions
- Explore data sources and mapping approaches
- Review other programs
- Workgroups develop consensus considerations
  - Overall and by habitat

Report Contents

- Definitions
- Boundary demarcation
- Key mapping considerations
- Data types/sources
- Mapping approaches and tradeoffs
  - Data suitability for each mapping approach
- Considerations for implementation
- Topics for future investigation



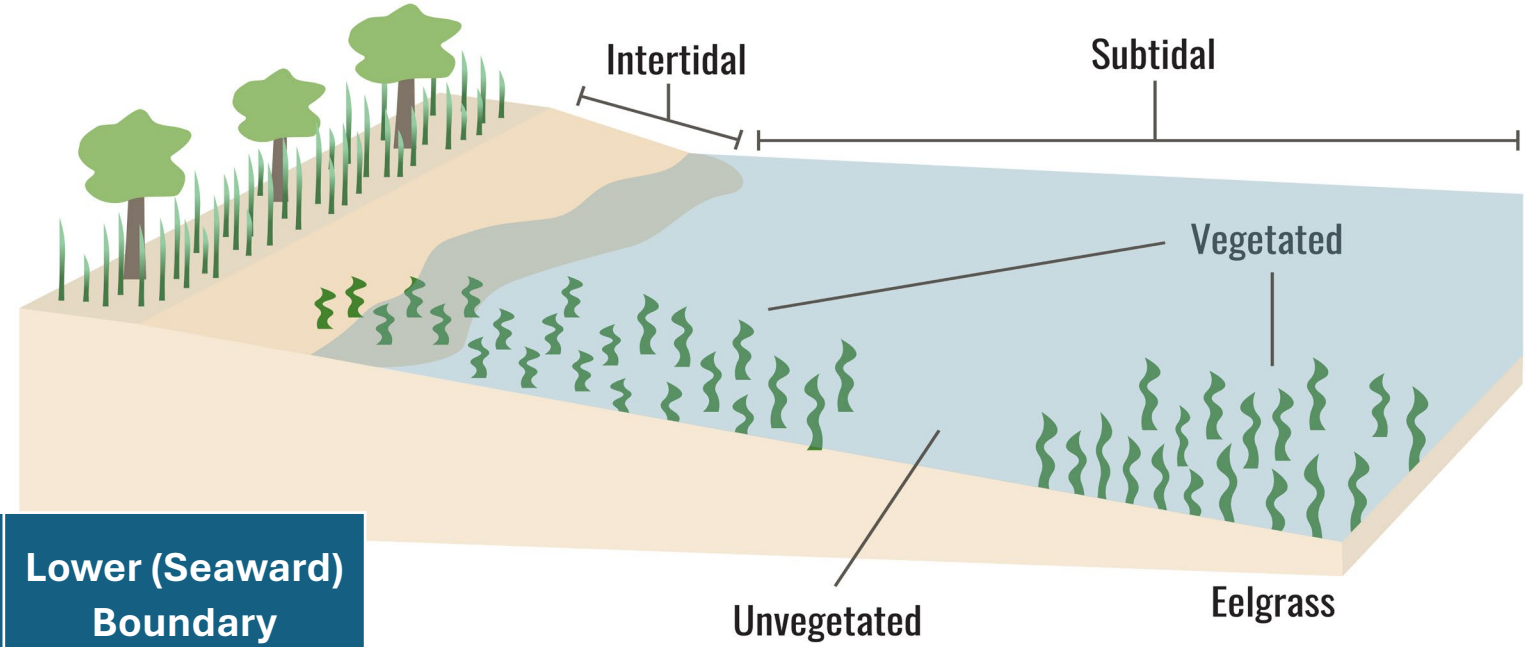
Boundary Demarcation: Dunes



Toe: Inflection + Vegetation

Start: MLLW = MHW + slope

Boundary Demarcation: Eelgrass



Region	Upper (Landward) Boundary	Lower (Seaward) Boundary
Coastal Channel Islands	+1m MLLW	-30m MLLW
Coastal Mainland	+1m MLLW	-20m MLLW
Embayments between Tijuana River Estuary and Point Conception	+1m MLLW	-10m MLLW
Embayments between Point Conception and Point Ano Nuevo	+1m MLLW	-6m MLLW
San Francisco Bay	+1m MLLW	-3m MLLW
Embayments (excluding SF Bay) between Point Ano Nuevo and the CA-OR border	+1m MLLW	-5m MLLW

Data Types Evaluated

- Spectral imagery (satellite, plane, UAS)
- Terrain and topography data (LiDAR, 3DEP)
- Locally collected georeferenced data (e.g., RTK GPS)
- Models (e.g., tide models)

Availability Considerations

Availability Metrics for COASTAL WETLANDS, ROCKY INTERTIDAL, AND BEACHES AND DUNES

	Satellite				Plane			UAS	
Availability Metrics	**LandSat**	**Sentinel 2**	**PlanetScope**	**WorldView - Maxar (fed access) - only coastal wetlands**	**Oblique imagery - only rocky intertidal**	**NAIP**	**Lidar**	**imagery**	**Lidar**
Publically available	yes	yes	commercial	commercial	yes	yes	custom	custom	custom
Cost	low	low	moderate	moderate	low	low	high	moderate	moderate
Ease of data processing	moderate	moderate	moderate	moderate	moderate	moderate	high	high	high
Logistics of implementing	low	low	moderate	moderate	low	low	high	high	high
Availability of historical informaiton	1972	2015	RGB: 2014 Mutispectral: 2016-2018	2014	1989	2003	depends	limited/no	limited/no

	Low utility
	Medium utility
	High utility

Mapping Approaches

Satellite-based mapping

- Suitable for tracking statewide acreage change over time
- Limited spatial and temporal resolution

Plane-based mapping

- Supports more detailed mapping of sub habitats
- Can more readily capture seasonal changes and stochastic events
- Higher cost means less frequent mapping interval

Field-based remote sensing and surveys

- Suitable for mapping intertidal and subtidal habitat extent
- Most appropriate for mapping eelgrass but could be applicable to other coastal habitats

Key Findings

- Boundary Attributes
  - Vegetation boundaries are best characterized by spectral imagery
  - Elevation based features are best categorized by Lidar data
  - Multiple image types will typically need to be used to optimize mapping efforts.

- Mapping Approaches
  - Plane-based mapping is more appropriate for the scale coastal habitats
  - Satellite-based approaches are useful for general low-resolution characterizations of large habitat patch area quantification, except for eelgrass
  - For eelgrass, site-based (UAS) remote sensing combined with field surveys is likely necessary to capture the patchy distribution in both intertidal and subtidal habitats

- Data Availability
  - Moderate resolution satellite data (i.e., Sentinel-2) cannot reliably capture habitat features smaller than $5m^2$ or narrower than ~5-10m, but is publicly available
  - Higher resolution satellite imagery (i.e., PlanetScope) could discriminate smaller scale (1-2m) habitat features/boundaries and has higher temporal resolution, but is a commercial data product

Considerations for Future Implementation

- Use the report findings to solicit support for statewide tracking of trends and progress toward meeting multiple agency goals for coastal habitats
  - Explore joint funding opportunities
- Develop capacity for data management and dissemination
- Develop data visualization and interpretation tools
- Provide mechanisms to accommodate emerging technologies

Questions