



# COASTAL HABITATS

Climate Change Vulnerability and Adaptation Strategies for Northwestern California

## Coastal Habitat Descriptions

This summary includes information about coastal habitats considered within the project area of the Northern California Climate Adaptation Project, which includes the Klamath, Six Rivers, Mendocino, and Shasta-Trinity National Forests as well as public lands managed by the Bureau of Land Management, including Arcata, Redding, and portions of the Ukiah field offices.

The following coastal habitat types are considered in this summary:

### Coastal Dune Systems

Coastal dune systems in northwestern California are distributed in a narrow, discontinuous band that varies in width along the coastline. Dunes range from mobile foredunes to semi- or fully-stabilized dunes dominated by dune grasses and, on the oldest dunes, small patches of forest characterized by beach pine (*Pinus contorta contorta*; also called shore pine). Dune morphology and ecology are strongly impacted by wind and inland sand movement from the beach, as well as land-use change and management activities that impact sand movement and vegetation development. Vegetation communities are characterized by species tolerant of low nutrient availability, high water drainage, salt spray, and wind desiccation.

### Coastal Bluffs & Scrub

Coastal bluff and northern coastal scrub communities occur along the Pacific coast, but can extend up to 20 miles inland. Adjacent to the ocean or bays, nearly-vertical unconsolidated



Photo by John Game via Flickr (CC BY 2.0)

bluffs support sparse plant communities of herbaceous species and low shrubs adapted to an unstable substrate, salt-laden air, and salt-accumulating soils. Marine terraces are generally occupied by denser coastal scrub vegetation, which is dominated by drought-deciduous or semi-evergreen shrubs with shallow root systems such as coyote brush (*Baccharis pilularis*), salmonberry (*Rubus spectabilis*), and thimbleberry (*R. parviflorus*). Community composition is strongly influenced by microclimate, soil, topography, disturbance history, and historical/contemporary land use.

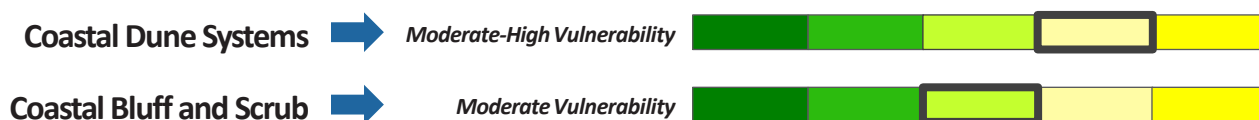
**Most coastal habitats in northwestern California have already experienced significant degradation due to non-climate stressors (e.g., invasive species, development, livestock grazing) that fragment and/or eliminate habitats, damage vegetation, impact sand movement, and negatively affect wildlife movement and habitat quality.**

# Key Climate Vulnerabilities

## Coastal Habitats

Coastal habitats in northwestern California are sensitive to changes in factors that impact plant water availability, which alter survival/recruitment and succession regimes. Coastal erosion may eliminate dune and bluff habitats, and the loss of historical fire regimes have increased tree encroachment into coastal scrub vegetation. Generally, coastal habitats are distributed in a relatively narrow, discontinuous zone along the coast where development pressure is high. The presence of infrastructure fragments remaining habitats, limiting plant dispersal and inland dune migration. High physical and structural variability in coastal habitats supports diverse plant and wildlife communities, though invasive plants have significantly reduced the extent and diversity of native-dominated vegetation. Many component species in coastal habitats are able to colonize newly disturbed areas, but habitat degradation and altered natural geomorphic processes reduce the ability of these habitats to recover from extreme disturbances and climate stressors.

## Vulnerability Rankings for Coastal Habitats



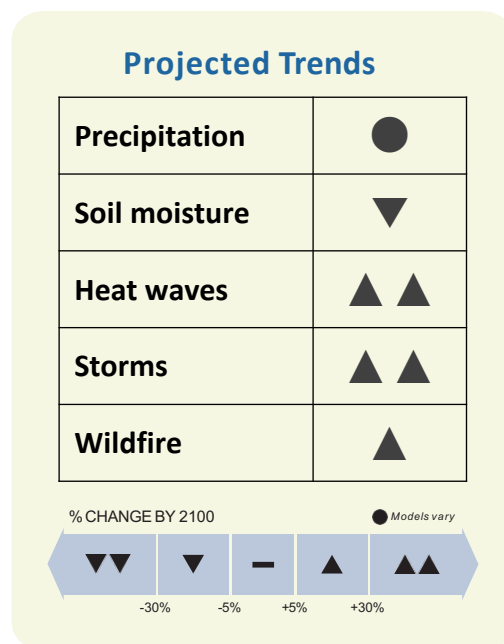
## Sensitivity & Exposure

Potential impacts of projected climate changes on coastal habitats in northwestern California include:

- Altered amount and timing of water availability for coastal vegetation, affecting plant growth/recruitment and successional dynamics
- Likely expansion of invasive plants in response to wetter winter and drier summer conditions, increasing dune stabilization and possible type conversion of coastal scrub to non-native grasslands
- Increased plant mortality due to severe drought and storms/wind events
- Increased coastal erosion and inundation of low-elevation dunes due to sea level rise and storm surge

**Non-climate stressors** may interact with climate stressors and disturbance regimes:

- *Invasive species* alter habitat structure and function by outcompeting native plants and, in dunes, reducing foredune mobility as sand is anchored by deeper root systems
- *Residential/commercial development* and *roads* eliminate, fragment, and/or degrade coastal habitats, reducing habitat extent and limiting dune migration in response to sea level rise
- *Livestock grazing* can negatively impact perennial grasses and has been associated with increased spread and establishment of invasive plants
- *Fire exclusion* has impacted coastal habitat extent and quality due to encroachment of conifers and hardwoods into coastal scrub habitats, potentially resulting in type conversion of coastal scrub to woodlands



## Adaptive Capacity

Intrinsic (i.e., inherent characteristics) and extrinsic (i.e., management potential) factors that enhance or undermine the ability of coastal habitats to cope with climate impacts include:

### Intrinsic factors:

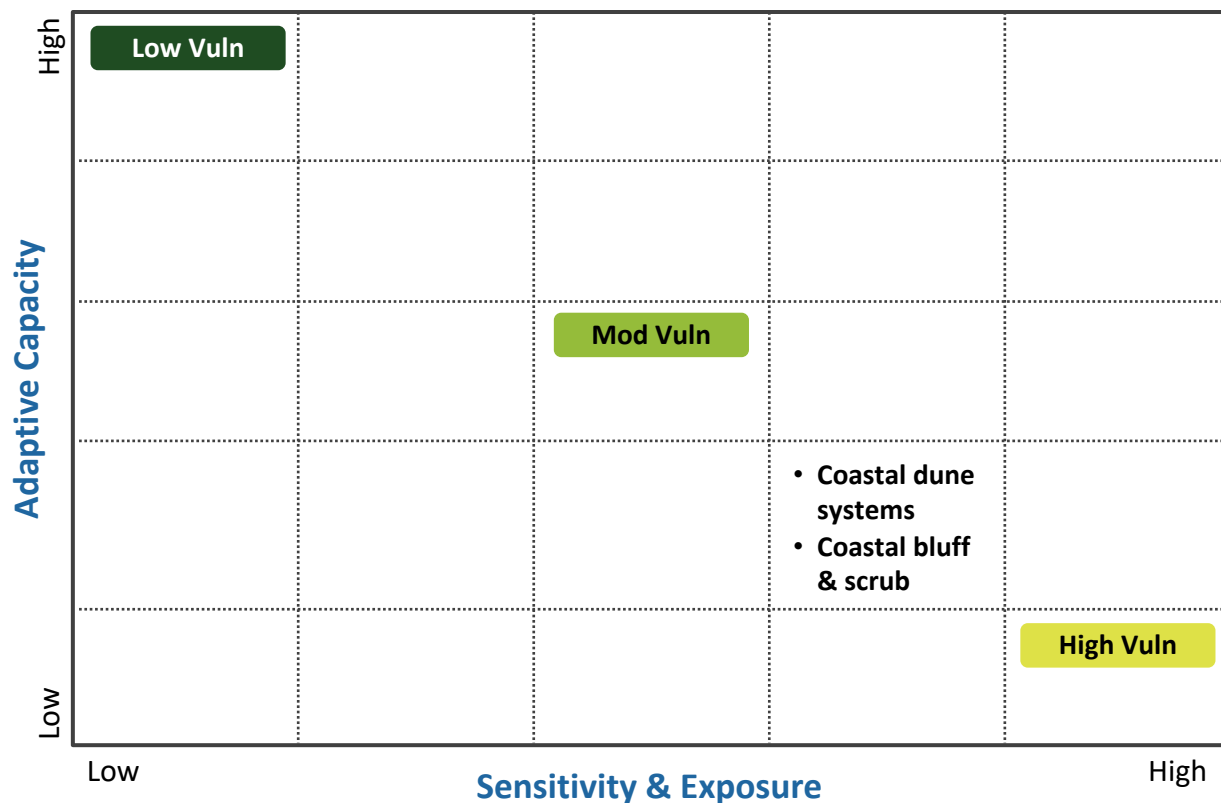
- ▲ High physical/topographical and species diversity
- ▲ Dynamic habitats adapted to harsh conditions and natural disturbances (e.g., drought, fire)
- ▲ Rapid shrub recovery allows opportunistic expansion of coastal scrub into adjacent undisturbed communities
- ▼ Significant habitat loss, fragmentation, and degradation due to fire exclusion and heavy development pressure in coastal areas
- ▼ Reduced plant species diversity in some areas due to loss of historical disturbance regimes
- ▼ Reduced resistance to sea level rise where geomorphic processes are altered

### Extrinsic factors:

- ▲ High public/tribal value and increasing societal interest in coastal resilience planning and action
- ▲ Rapid response to land use and management changes increases restoration potential
- ▼ Lack of public support for prescribed burning due to perceived risk
- ▼ Few funding sources for ongoing invasive species management

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Understanding which components are driving overall vulnerability for a given habitat gives managers a better understanding of the actions that may be most effective at reducing climate change vulnerability.



**Figure 1.** Sensitivity and exposure (impact) and adaptive capacity rankings plotted for northwestern California coastal habitats. Habitats and species with high vulnerability to climate change (high impact/low adaptive capacity) are located in the lower right, while those with low vulnerability (low impact/high adaptive capacity) are in the upper left.

## Climate Change Adaptation Strategies and Actions: Coastal Habitats

**Climate change adaptation** refers to adjustments in natural or human systems in response to changing climate conditions.

Adaptation strategies attempt to reduce climate change vulnerability by **reducing climate impacts (sensitivity and exposure)** and/or **increasing resilience (adaptive capacity)**.

### Adaptation Approaches

Climate change adaptation strategies are organized into three general management approaches: resistance/resilience, acceptance, and direct/response. Two additional approaches – knowledge and collaboration – describe adaptation strategies that support management efforts and may be precursors to implementing a strategy that falls under another approach (e.g., direct/response).



Photo © Laura Hilberg



#### Resistance / Resilience

Focused on managing for persistence of existing ecosystems

*Near- to mid-term planning horizon; management-intensive approach*



#### Acceptance

Focused on accommodating change in response to novel conditions

*Long-term planning horizon; no management action beyond observation*



#### Direct/ Response

Focused on actively facilitating change/transformation in response to novel conditions

*Long-term planning horizon; may be management-intensive*



#### Knowledge

Focused on gathering information about climate impacts and/or the effectiveness of management actions through research and monitoring



#### Collaboration

Focused on coordinating efforts and/or building support and capacity across agencies, organizations, and stakeholder groups

### Aim to identify and/or implement a balanced portfolio of adaptation approaches

Over time, the balance may need to shift towards approaches that allow or facilitate change and transformation.





## Adaptation Strategies for Coastal Habitats

The table below summarizes management goals and associated adaptation strategies that have been identified for northwestern California coastal habitats and associated species.

### GOAL 1. REDUCE THE IMPACT OF NON-CLIMATE STRESSORS

1.1 Prevent the introduction and establishment of invasive species and remove existing populations

1.2 Limit anthropogenic disturbances on sensitive and/or high-quality sites

### GOAL 2. SUSTAIN FUNDAMENTAL ECOLOGICAL FUNCTIONS AND PROCESSES

2.1 Restore the role of fire as an ecological process on the landscape

### GOAL 3. ENHANCE HABITAT QUALITY AND AVAILABILITY FOR ANADROMOUS FISH

3.1 Restore tidal marshes and estuaries to enhance habitat for anadromous fish

### GOAL 4. ALLOW OR FACILITATE SPECIES AND HABITAT ADJUSTMENTS TO BETTER ALIGN WITH CHANGING CLIMATE CONDITIONS

4.1 Favor or restore native species and genotypes that are expected to be adapted to future conditions

4.2 Plan for and allow coastal retreat

### GOAL 5. INTEGRATE AND ALIGN MANAGEMENT ACROSS AGENCIES AND ORGANIZATIONS

5.1 Incorporate tribal priorities and traditional knowledge into coastal management activities



Photo by Bob Wick/BLM (Public Domain)

## Reducing Vulnerabilities Through Adaptation Actions

The table below presents examples of adaptation actions associated with each management goal and strategy. Adaptation actions fall within the five adaptation approaches: Resistance/Resilience **(R)**, Acceptance **(A)**, Direct/Response **(D)**, Knowledge **(K)**, and Collaboration **(C)**. Adaptation strategies can reduce climate change vulnerability of a given habitat or species by addressing any or all of the components of vulnerability: reducing sensitivity, reducing exposure, and/or increasing adaptive capacity. Strategies are linked to whether they reduce climate impacts (sensitivity & exposure) or increase resilience (adaptive capacity).



**Reduce climate impacts**  
(sensitivity & exposure)



**Increase resilience**  
(adaptive capacity)

**Reduce  
Climate Change  
Vulnerability**

### GOAL 1. REDUCE THE IMPACT OF NON-CLIMATE STRESSORS

#### 1.1 Prevent the introduction and establishment of invasive species and remove existing populations

*Example adaptation actions:*

- Remove invasive plants from intact remnant dune habitats to allow for the recovery of native vegetation and natural dune processes **(R)**
- Set up an early detection-rapid response program to prevent the establishment of invasive species on remnant native-dominated dune systems **(R)**
- Increase public awareness of invasive species removal efforts in dune habitats and their role in reducing climate vulnerability **(R/C)**

*Vulnerabilities addressed:*

Invasive plants

Air temperature (*expanding range of invasive plants*)

Precipitation and drought (*competition for soil moisture*)

Sea level rise (*dune overstabilization that limits sand movement necessary for inland habitat migration*)

Management potential (*public understanding that influences societal support for management*)

#### 1.2 Limit anthropogenic disturbances on sensitive and/or high-quality sites

*Example adaptation actions:*

- Protect sensitive dune habitats still dominated by native vegetation from human disturbance (e.g., recreation) **(R)**

*Vulnerabilities addressed:*

Recreation (*disturbance that promotes the spread/establishment of invasive plants*)

Invasive plants (*displacement of native vegetation and overstabilization of mobile dunes*)

## GOAL 2. SUSTAIN FUNDAMENTAL ECOLOGICAL FUNCTIONS AND PROCESSES

### 2.1 Restore the role of fire as an ecological process on the landscape

#### *Example adaptation actions:*

- Streamline internal and external permitting process for the use of prescribed fire **(R)**
- Explore the use of programmatic permits to allow easier implementation of projects that incorporate prescribed fire **(R)**
- Increase public education and outreach to raise awareness of the role of fire in coastal ecosystems **(R/C)**

#### *Vulnerabilities addressed:*

Wildfire

Fire exclusion (*buildup of fuels that contribute to climate-driven changes in fire regimes*)

Management potential (*capacity to scale up use of prescribed fire; public/societal support for management*)

## GOAL 3. ENHANCE HABITAT QUALITY AND AVAILABILITY FOR ANADROMOUS FISH

### 3.1 Restore tidal marshes and estuaries to enhance habitat for anadromous fish

#### *Example adaptation actions:*

- Restore tidal prism by excavating tidal channels **(R)**
- Restore overflow channels and off-channel ponds in tidally-influenced habitats **(R)**
- Place large wood in tidally-influenced habitats to enhance instream habitat complexity **(R)**
- Add sediment to existing tidal marsh surface to increase elevation **(D)**

#### *Vulnerabilities addressed:*

Development, agriculture, and other human land uses that result in loss of habitat availability and quality (*exacerbates climate-driven population declines in sensitive species*)

Sea level rise and storm surge/coastal flooding (*loss of floodwater storage in degraded marshes and sediment supplies needed for marsh accretion as sea levels rise*)

Habitat diversity (*instream habitat complexity that provides flood and temperature refugia for anadromous fish*)

## GOAL 4. ALLOW OR FACILITATE SPECIES AND HABITAT ADJUSTMENTS TO BETTER ALIGN WITH CHANGING CLIMATE CONDITIONS

### 4.1 Favor or restore native species and genotypes that are expected to be adapted to future conditions

#### *Example adaptation actions:*

- Modify planting pallet to include species and/or genotypes tolerant of projected future conditions (e.g., drought-tolerant species; genotypes from the southern portion of a species' range) **(D)**

#### *Vulnerabilities addressed:*

Air temperature, precipitation, soil moisture, and drought (*changes in habitat suitability*)

Storms and coastal flooding (*loss of plant cover due to changing climate conditions that reduce sediment trapping/retention*)

## GOAL 4. ALLOW OR FACILITATE SPECIES AND HABITAT ADJUSTMENTS TO BETTER ALIGN WITH CHANGING CLIMATE CONDITIONS (CON'T)

### 4.2 Plan for and allow coastal retreat

#### *Example adaptation actions:*

- Downscale infrastructure as a precursor to retreat **(D)**
- Conduct a feasibility study and pilot land acquisition in priority areas to evaluate a variety of creative alternatives (e.g., rolling easements, flood easements, life estates) **(D/K)**
- Monitor sites where coastal retreat has already begun (e.g., channel breaches) and determine whether to manage sites more actively based on desired conditions **(D/K)**
- Identify and/or develop cooperative management and land acquisition opportunities to proactively address habitat loss due to sea level rise **(D/C)**

#### *Vulnerabilities addressed:*

Sea level rise and storm surge/coastal flooding

Development, roads/highways, agricultural dikes, and other infrastructure (*barriers that limit ability of coastal habitats to migrate inland*)

Habitat continuity

Management potential (*information to support management decisions*)

## GOAL 5. INTEGRATE AND ALIGN MANAGEMENT ACROSS AGENCIES AND ORGANIZATIONS

### 4.1 Incorporate tribal priorities and traditional knowledge into coastal management activities

#### *Example adaptation actions:*

- Increase coordination and consultation between federal/state agencies and tribes to improve management of vulnerable cultural resources in coastal areas **(C)**

#### *Vulnerabilities addressed:*

Cultural value (*loss of vulnerable cultural resources*)

Management potential (*information to support management decisions*)



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All information within this brief is summarized from the source reports of the Northern California Climate Adaptation Project, available at <https://tinyurl.com/NorCalAdaptation>