Coastal Scrub

Climate Change Vulnerability Assessment for the Santa Cruz Mountains Climate Adaptation Project

This document represents an initial evaluation of mid-century climate change vulnerability for coastal scrub in the Santa Cruz Mountains region based on expert input during an October 2019 vulnerability assessment workshop as well as information in the scientific literature.

Habitat Description

Coastal scrub ecosystems are typically dominated by drought-deciduous or semi-evergreen shrubs with shallow root systems, and are distributed within areas influenced by cooler ocean breezes and coastal fog[1]. Coastal scrub composition and distribution are strongly influenced by salt deposition, water availability, and post-disturbance succession, as well as soils and topography. As a result, species dominance and composition can vary significantly across sites[1–3]. In the Santa Cruz Mountains region, commonly associated species include coyote brush (*Baccharis pilularis*), brambles (*Rubus* spp.), coffeeberry (*Frangula californica*), poison oak (*Toxicodendron diversilobum*), California sagebrush (*Artemisia californica*), yellow bush lupine (*Lupinus arboreus*), seaside woolly-sunflower *(Eriophyllum staechadifolium*), and sticky monkey-flower (*Mimulus aurantiacus*)[1,3,4]. Understory species composition and relative abundance are strongly influenced by canopy gaps that allow greater light penetration, and typically include a mix of annual and perennial grasses and forbs[1,2,4].

Vulnerability Ranking

Moderate Vulnerability

Mod Confidence

Coastal scrub ecosystems are sensitive to climate stressors that impact plant water availability and alter succession regimes for key shrub species, including changes in air temperature, precipitation, soil moisture, coastal fog, and drought. This habitat has a relatively low sensitivity to climate-driven changes in disturbance regimes and non-climate stressors. However, historical agricultural practices and land-use conversion to development has resulted in significant loss, fragmentation, and/or degradation of this habitat over the past century. Many common coastal scrub species are well-adapted to drought and fire, and coastal scrub vegetation can opportunistically expand into adjacent areas that have been disturbed. Management activities that may increase habitat resilience to climate change include invasive species control to promote native communities and maintaining appropriate disturbance regimes through the use of managed grazing and/or prescribed fire. It is also critical to protect existing high-quality scrub areas to limit habitat conversion and preserve potential climate refugia.

As part of this project, Pepperwood Preserve modeled how major vegetation types in five landscape units of the Santa Cruz Mountains region are projected to shift in response to climate change.[1] They found that coastal scrub is likely to decline across all landscape units where it occurs.

Vegetation Type	San Francisco	Santa Cruz Mtns. North	Santa Cruz	Sierra Azul
Coastal scrub	▽	▽	▽	▽

Table 1. Projected trends in vegetation distribution (increase, relatively stable, moderate decline, or dramatic decline) by mid-century within five landscape units of the Santa Cruz Mountains region.

Sensitivity and Exposure

Moderate Impact

Sensitivity is a measure of whether and how a habitat is likely to be affected by a given change in climate and climate-driven factors, changes in disturbance regimes, and non-climate stressors. **Exposure** is a measure of how much change in these factors a resource is likely to experience.

Sensitivity and future exposure to climate and climate-driven factors

Coastal scrub ecosystems are sensitive to climate stressors that impact plant water availability and alter succession regimes for key shrub species.

Climate Stressor	Trend Direction	Projected Future Changes
Air temperature	▲	• 1.5–3.1°C (2.7–5.6°F) increase in annual mean temperature[5,6]
Precipitation	▲ ▼	• Shorter winters and longer, drier summers likely, with higher interannual variability[7,8]
Soil moisture	▼	• Reduced soil moisture likely due to increased evaporative demand[7,9]
Coastal fog	▼	• Possible 12–20% decline in the frequency of days with coastal fog and low clouds[10]
Drought	▲	• Increased frequency of drought years, including periods of prolonged and/or severe drought[7,11]

- **Warmer air temperatures** may allow the expansion of coyote brush into areas currently dominated by coastal prairie grasses[12]. However, increasing air temperatures are also likely to

[1] Information about the methods used to generate these projections can be found on the project page (http://ecoadapt.org/programs/awareness-to-action/santa-cruz-mountains).

enhance moisture stress in coastal scrub communities due to greater evaporative demand, which has the potential to hinder plant growth and productivity[9,13]. Warmer temperatures could also result in a mismatch in the timing of plant flowering and insect pollinator migrations or life cycles, potentially reducing seed set and recruitment[14].

- **Changes in patterns of precipitation (e.g., amount and timing)** and **soil moisture** are likely to alter habitat distribution; specifically, drier conditions may increase the risk of conversion to dominance by grasses, while wetter conditions may allow coastal scrub expansion into adjacent communities[1,15]. In general, low levels of precipitation early in the growing season (i.e., late winter/early spring) can negatively affect the growth and recruitment of coyote brush, particularly on drier sites and/or in the presence of exotic annual grasses that compete for growing season soil moisture[1,15,16]. By contrast, increased early-season precipitation and soil moisture would likely benefit coastal scrub species[1,15], allowing coyote brush expansion into adjacent coastal prairie[12,15–17]. However, above-average precipitation also enhances the growth and abundance of exotic annuals[18], and on mesic sites can lead to the encroachment of hardwoods such as California bay (*Umbellularia californica*) in the absence of disturbance[19,20].
- **Decreases in the frequency of days with coastal fog and low clouds** are likely to enhance seasonal drought stress for coastal scrub species that utilize fog water inputs, and may increase evaporative water loss due to greater sun exposure[21–24]. Changes in fog patterns may also alter wildfire regimes, as the presence of fog limits fuel moisture loss[21].
- **Increases in the severity and length of future droughts** may reduce the extent, productivity, species richness, and total herbaceous cover of coastal scrub vegetation[12,25,26]. Recruitment in shrubs that reproduce by seed is reduced during periods of drought, especially where seed density of exotic annual grasses is high[16,27]. However, plant species that reproduce primarily by seed may also recover more rapidly from severe drought compared to those that resprout from roots[13,28]. Similarly, non-native annual species decline more rapidly during periods of severe drought, but they also appear to recover more rapidly, suggesting that they may benefit from projected increases in interannual precipitation variability[29].

Sensitivity and future exposure to climate-driven changes in disturbance regimes


Coastal scrub habitats have low sensitivity to climate-driven changes in disturbance regimes[24], largely because disturbances that are projected to increase (e.g., fire) generally have net positive impacts on habitat extent by allowing expansion of coyote brush and other coastal scrub species into neighboring grasslands[1–4]. However, more frequent and/or severe storms may increase gullying and upland bluff erosion[24].

Sensitivity and current exposure to non-climate stressors


Non-climate stressors have a relatively low impact on climate change sensitivity of coastal scrub within the study region[24].

Adaptive Capacity

Moderate Adaptive Capacity

Adaptive capacity is the ability of a habitat to accommodate or cope with climate change impacts with minimal disruption.

Habitat extent, integrity, continuity, and barriers to dispersal

Although coastal scrub is distributed across much of the Santa Cruz Mountains region, historical agricultural practices and land-use conversion to development have eliminated, fragmented, and/or degraded much of this habitat type[1]. Degraded sites are generally dominated by coyote brush[4], with reduced community and plant diversity due to fragmentation and the loss of variable microsites[24,30]. While the overall extent of structurally diverse, species-rich coastal scrub continues to decline due to the ongoing expansion of developed areas[1], lack of grazing and less frequent fire has allowed degraded coyote brush communities to expand into the wildland–urban interface[1].

Fragmentation as a result of land-use conversion and the presence of roads and highways can act as barriers to plant dispersal and gene flow as well as to wildlife movement[1,31], potentially undermining the ability of component species to adapt to climate change[31].

Habitat diversity

Structural and species diversity in coastal scrub habitats varies widely depending on disturbance and land use history, topographic relief, distance inland, water availability, and other factors[1–4]. Although shrubs are the dominant functional group, herbaceous understory species are the most species-rich group[1,4]. As shrubs and trees grow, coastal scrub habitat becomes more structurally diverse[15,20,32,33], providing cover for small mammals that reduce the herbaceous understory[34]. Coastal scrub also provides important habitat for diverse pollinator, bird, and reptile communities, as well as a large number of rare and endemic plant and wildlife species[1,3,30,35].

Resistance and recovery

Coastal scrub vegetation is well-adapted to seasonal drought, featuring a variety of adaptations (e.g., long taproots, drought-deciduousness, sclerophyllous leaves) that allow them to persist during dry periods[1,20,36,37]. For instance, coyote brush benefits from fog water harvested by neighboring grass species, which wets shallow soil layers in the vicinity of coyote brush seedlings[21,22]. This gives coastal scrub species an advantage over non-native annual grasses, which are less resistant to drought due to their shallower root systems[26,29,38–40]. However, exotic species may recover more rapidly from drought, potentially resulting in greater invasive abundance compared to pre-drought conditions[29]. Many common shrubs in this environment are well-adapted to fire and recovery is generally rapid, primarily due to the ability of shrubs to resprout or regenerate from the soil seed bank[1,20,41,42]. Coastal scrub vegetation can also opportunistically expand into surrounding areas that have been disturbed[1,20].

Management potential

The general public values coastal scrub habitats for aesthetics and recreation, though there is often limited understanding of the value of this habitat type in supporting biodiversity (including pollinators) and protecting adjacent habitats and communities from erosion[1]. However, there is growing recognition that mature, structurally diverse occurrences of coastal scrub are rare and worth

preserving[1,3], and public education to further enhance understanding of this habitat's value could increase support for management efforts.

Management actions in coastal scrub habitats are generally focused on invasive species control, as well as maintaining appropriate disturbance regimes through managed grazing and prescribed fire[1,3]. These practices promote structurally-diverse plant communities and support plants and wildlife that may be rare and/or particularly sensitive to climate change[3]. For projects involving revegetation of degraded habitat sites, managers may consider the use of plant taxa and seeds from nearby sites with similar topographic exposure[3]. Finally, existing high-quality coastal scrub could be protected to limit habitat conversion and accommodate potential climate refugia[3,31,43].

Recommended Citation

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Further information on the Santa Cruz Mountains Climate Adaptation Project is available on the project page (http://ecoadapt.org/programs/awareness-to-action/santa-cruz-mountains).

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