Sensitivity

Climate stressors and disturbance regimes
Northern California coastal bluff and scrub habitats are most sensitive to climate stressors and disturbances that lead to bluff erosion and collapse.

- **Sea level rise, increased wave action, and more frequent and intense storms** may increase bluff erosion, including toe erosion, which can cause undercutting or over-steepening of the bluff profile and could contribute to bluff failure (Collins & Sitar 2008; Hanak & Moreno 2012).
- **Changes in precipitation** may alter vegetation assemblages, with drier conditions increasing risk of conversion to grass-dominated communities (Ford and Hayes 2003). Increased precipitation may cause accelerated weathering and erosion of bluffs, which can reduce tensile strength, lead to tensile fracture, and may result in failure of moderately cemented bluffs (Collins & Sitar 2008). Bluff failure may also be caused by precipitation-related surface or groundwater seepage and freeze/thaw effects (Collins & Sitar 2008).
- **Earthquakes and seismic shaking** can damage coastal bluffs. The extent of destruction is dependent on the lithology of the substrate and the presence of joints or faults in the bluff (Griggs 2005).
- **Vegetation distribution** may shift as climatic conditions change. By the end of the century, up to 41% of existing coastal dune and bluff habitat area may remain climatically suitable, but 42-92% of existing habitat area may become climatically exposed (i.e., potentially no longer be suitable for component vegetation). Dune and bluff habitat near Patrick’s Point is projected to become climatically exposed under both warmer/wetter and warmer/drier high emissions scenarios, while habitat between and inland of Capetown and Petrolia is projected to become climatically exposed only under warmer/wetter high emissions scenarios (Thorne et al. 2016).

Non-climate stressors
Coastal bluff and scrub habitats are most sensitive to non-climate stressors that increase competition with non-native species or that lead to erosion and reduction of habitat, which can compound climate-driven habitat losses.

- **Urban and agricultural development** have caused loss, degradation, and fragmentation of coastal bluff and scrub habitat (Ford & Hayes 2007). Additional undesirable effects of urbanization include increased predation by domestic and feral pets and introductions of nuisance plants, which threaten the abundance and diversity native coastal scrub flora and fauna (Ford & Hayes 2007).
- **Coastal armoring** of bluffs can temporarily reduce erosion, although there are ecological consequences for adjacent beaches. Other forms of armoring, including jetties and breakwaters, alter longshore sediment transport patterns; upcoast bluffs experience enhanced protection from direct wave attack as a result of sediment impoundment and widened beaches, while downcoast bluffs experience enhanced wave attack and erosion as fronting beaches are starved of sediment (Griggs & Patsch 2004).
- **Invasive plant species** increase competition with native plant species in coastal scrub and bluff habitats, which can result in reduced species diversity and native plant abundance (Ford & Hayes 2007).
- **Agriculture and livestock grazing** have led to the intentional introduction of non-native species as forage plants, as well as accidental introductions. Both types of introductions jeopardize the abundance and diversity of native species (Norton et al. 2007). Agricultural activities have also altered natural fire regimes via fire suppression (Norton et al. 2007). Overgrazing reduces cover and species richness of native perennial forbs (Hayes & Holl 2002).
- **Nitrogen inputs** from inorganic fertilizer and air pollution results in a reduction of plant diversity, and a decrease in the rate of decomposition of organic matter (Harrison & Viers 2007).
Adaptive Capacity

Geographic extent and fragmentation of habitat
Coastal bluff and scrub habitats extend from the Oregon coast south to California, occur patchily in Humboldt and Mendocino Counties, and reach as far south as San Luis Obispo County (Stromberg et al. 2001). These habitats are largely fragmented by urban development (Stromberg et al. 2001).

Ability to resist/recover from stressors
The ability of coastal bluffs to resist or recover from stressors is unlikely due to the nature of bluff failure. Bluff erosion, loss of beach area, and threats to structures and infrastructure from erosion and coastal flooding due to rising sea level will create a situation from which it is nearly impossible to recover (Hanak & Moreno 2008).

Physical, topographical, and component species diversity
Coastal scrub habitats typically extend no more than 45 km inland, and elevation ranges from sea level to approximately 900 m. Zonation and topography affect the distribution of scrub species on coastal bluffs, and species vary by differential exposure to wind, sea salt, fog, and solar radiation (Baxter & Parker 1999).

Keystone species and species of management/cultural importance
None identified.

Literature Cited