Tidal Marshes

Climate Change Vulnerability and Adaptation Strategies for the Golden Gate Biosphere Region

Ecosystem Description

Tidal marshes are formed at the interface of saltwater and brackish water ecosystems and are heavily influenced by tidal fluctuations. They are often associated with lagoons, creeks, and streams, and are characterized by flat, low-lying terrain. Vegetation structure within tidal marshes exhibits a zonal pattern determined by exposure to varying water levels and fluctuations in salinity. Dominant plant species include California cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia pacifica*). Tidal marshes play a crucial role in supporting many species, including migratory and resident birds, fish, invertebrates, and small mammals such as the salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*). They also aid in mitigating coastal flooding and and help improve water quality.

Ecosystem Vulnerability - *High*

Sensitivity & Exposure - *High*

Projected Changes	Trend
Sea level rise	▲ Increase
Precipitation	▲▼ Varies
Drought	▲ Increase
Water temperature	▲ Increase
Stream flows	▲▼ Varies
Storms	▲ Increase

Potential Impacts:

- Increased soil salinity levels, affecting nutrient cycling and driving composition shifts towards more salt-tolerant species
- Altered species composition resulting from changes in water availability and increased water temperatures
- Shifts in sediment loads and water quality resulting from altered stream flow
- Erosion along marsh edges and disruptions to plant feedback loops critical for maintaining marsh elevation and mitigating subsidence

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

- *Residential and commercial development* limit inland migration of tidal marshes as sea levels rise, and introduce pollutants into the ecosystem
- *Dams and water diversions* limit delivery of sediment to tidal marshes which may lead to subsidence and conversion of marsh into open water
- *Invasive species* displace native species, driving changes in plant community composition
- *Livestock grazing* alters vegetation height, increases soil compaction, and can cause trampling, which, in turn, affects marsh surface elevation and soil carbon content
- *Roads, highways, and trails* fragment tidal marshes, altering hydrology and creating barriers to wildlife movement

Tidal marshes are sensitive to climate stressors that alter flooding regimes, increase erosion, and cause fragmentation, which affects their hydrology, species composition, and ecological functioning

Ecosystem Vulnerability - *High*

Adaptive Capacity - *Low*

Intrinsic factors (i.e., inherent characteristics) that enhance or undermine adaptive capacity:

Enhance:

- Act as transitional zones that can provide refuge for wildlife during high tide events
- High structural diversity, promoting ecosystem health and stability

Undermine:

- Highly degraded and fragmented as a result of human disturbances and land-use conversion
- Limited plant diversity

Extrinsic factors (i.e., management potential) that enhance or undermine adaptive capacity:

Enhance:

- Valued by the public for recreation and coastline protection
- High societal support evident by regulatory backing for wetland conservation

Undermine:

- Active management limited by insufficient funding and staff capacity

A significant proportion of tidal marshes have been lost or degraded due to development and hydrological changes. However, they are structurally diverse systems that provide food resources and shelter for numerous species.

John Weiss, Flickr (CC BY-NC-ND 2.0)

Jerry Kirkhart, Flickr (CC BY 2.0)

Further information and citations can be found in the source reports of the Golden Gate Biosphere Region Climate Adaptation Project, available online at http://ecoadapt.org/goto/GGBRClimateProject.

EcoAdapt™ Meeting the challenges of climate change

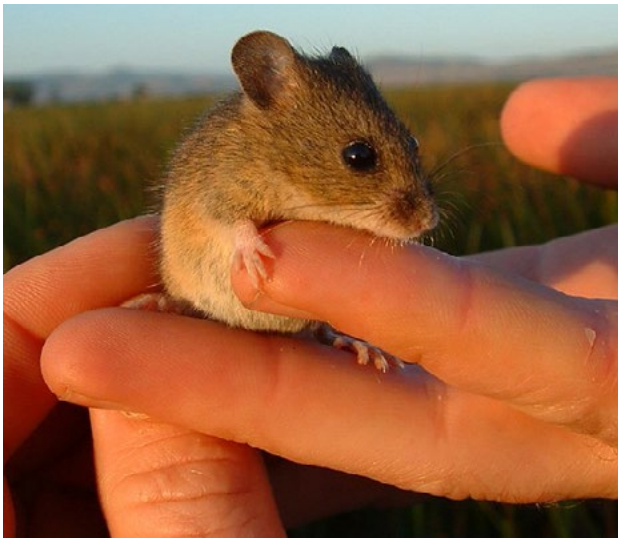
Adaptation Strategies & Actions

Adaptation strategies can reduce climate change vulnerability of a given ecosystem or species by addressing any or all of the three components of vulnerability (i.e., by reducing sensitivity, reducing exposure, and/or increasing adaptive capacity). The table below presents examples of adaptation strategies and actions, which fall within five categories, or approaches: Resistance/Resilience **(R)**, Acceptance **(A)**, Direct/Response **(D)**, Knowledge **(K)**, and Collaboration **(C)**. *Please note that the strategies and actions provided here should not be considered a checklist or plan, but rather as a set of examples for land managers to consider for further study when developing site- or species-specific actions.*

Adaptation Strategies	Adaptation Actions
Promote marsh expansion	• Identify opportunities for marsh expansion **(K)** • Secure uplands for expansion through land acquisition strategies, prioritizing protection in areas most vulnerable to sea level rise **(R)**
Support marsh migration	• Identify areas suitable for marsh migration and predict future marsh conditions **(K)** • Identify and/or develop land acquisition and easement opportunities to support marsh migration, prioritizing protection in areas most vulnerable to sea level rise **(R)**
Restore degraded tidal marshes	• Restore sites with existing tidal marshes that are degraded by fragmentation, elevation, or pollution **(R)** • Restore or create tidal channels that have filled, including in low-salinity areas **(R)** • Collect and grow key plant species for restoration and expansion work, with an emphasis on edge areas/transition zones to maximize genotypes of species and individuals adapted to flux **(R)**

Adaptation strategies and actions generated through breakout group exercises during the adaptation workshop in December 2023.

Lisa Cox/USFWS, Flickr (CC BY 2.0)



USGS, Flickr (Public domain)

Further information and citations can be found in the source reports of the Golden Gate Biosphere Region Climate Adaptation Project, available online at http://ecoadapt.org/goto/GGBRClimateProject.

EcoAdapt™ Meeting the challenges of climate change