FRESHWATER MARSHES, WETLANDS, & PONDS

Climate Change Vulnerability and Adaptation Strategies for the Santa Cruz Mountain Region

Habitat Description

Freshwater marshes and wetlands are found on the margins of lakes, creeks, and rivers, while ponds generally occur within natural depressions or isolated channels. Freshwater marshes and ponds may be flooded seasonally or permanently, and plant species composition is dependent on both water depth and hydroperiod (i.e., timing and length of inundation). Artificial ponds in the form of stock ponds, irrigation ponds, and agricultural reservoirs are also common within the study area.

Habitat Vulnerability

High Vulnerability: 🟩 Low 🟩 Moderate [✓ 🟨 High]

High Confidence: ⬜ Low 🟦 Moderate [✓ 🟦 High]

Sensitivity & Exposure

High Impact 🟩 🟩 [✓ 🟨]

Low Confidence [✓ ⬜] 🟦 🟦

Projected Changes	Trend
Precipitation	▲▼
Drought	▲
Streamflow	▲▼
Water temperature	▲
Heat waves	▲
Sea level rise	▲
Storms/flooding	▲

Potential impacts:

- Altered channel structure due to changing patterns of sediment deposition/erosion and vegetation encroachment
- Increased floodplain disconnection, creating isolated pools with high temperatures, low oxygen, and increased risk of harmful algal blooms
- Direct and indirect impacts to aquatic organisms that may result in population declines and range contractions
- Decreased plant growth and increased mortality, resulting in altered composition and structure of riparian vegetation
- Loss of riparian vegetation, altered stream channels, increased risk of landslides/debris flows, higher water temperatures, and reduced water quality following severe disturbances

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

- *Land-use conversion* to development fragments and degrades habitats through draining, vegetation removal, channel incision, and loss of floodplain connectivity
- *Roads, highways, and trails* increase runoff, deliver sediment into waterways, spread invasive species, and often disconnect wetlands from floodplains or rivers/streams
- *Water diversions* decrease surface water supplies, potentially resulting in habitat drying and loss
- *Invasive plants* displace native species, alter nutrient cycles, and reduce water quality
- *Introduced fish, invertebrates, and amphibians* alter the abundance and diversity of native species through competition for resources, increased predation risk, and/or disease spread
- *Pollutants* degrade water quality, with potentially severe impacts on aquatic organisms; excess nutrients also contribute to harmful algae blooms that are exacerbated by warmer temperatures

Freshwater marshes, wetlands, and ponds are sensitive to climate stressors and disturbances that impact water levels, hydroperiods, and water quality, which alter habitat suitability for wildlife and plant species and drive changes in wetland and pond structure and function.

Adaptive Capacity

Moderate Adaptive Capacity

High Confidence

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

▲ Dynamic and productive systems with diverse structural characteristics

▲ Support diverse biological communities, including many rare species

▼ Many freshwater wetlands and ponds eliminated or degraded by human stressors

▼ Reduced resistance to climate change in fragmented/degraded systems

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

▲ Highly valued for water filtration, flood protection, and recreation, among other services

▲ High societal support (e.g., funding, regulations)

▼ Environmental regulations and permitting requirements can make restoration and management efforts more complex

Although freshwater wetland and ponds were historically extensive in the region, human activities have resulted in habitat loss as well as fragmentation and degradation of remaining areas, leaving them more vulnerable to the impacts of climate change.

Key Climate Vulnerabilities: ***California Red-Legged Frog & San Francisco Garter Snake***

High Vulnerability

Moderate Confidence

California red-legged frogs and San Francisco garter snakes utilize both aquatic (e.g., ponds, wetlands, perennial streams) and upland habitats, so they are highly dependent on habitat connectivity and availability of suitable conditions across different habitats. Generally, these two species are sensitive to climate stressors and disturbances that impact water availability (e.g., precipitation changes, altered stream flows, increased drought) and, in turn, the extent and availability of aquatic habitats. Climate stressors impact red-legged frogs and garter snakes by increasing physiological stress and mortality rates, reducing reproductive success, and altering habitat availability and quality. Other possible impacts may include:

- Increased predation of frogs due to lower pond water levels and shorter hydroperiods
- Reduced water quality as a result of warmer temperatures and post-fire runoff and sedimentation
- Decreased frog recruitment following more frequent and/or more severe floods that wash away or strand and desiccate eggs and tadpoles
- Higher rates of direct mortality due to disease and wildfire
- Interactions between climate stressors and non-climate stressors (e.g., land-use conversion to development and agriculture, invasive species, exposure to pesticides, roads, dams and water diversions, illegal collection) that cause direct mortality, reduce food resource availability, and/or impact habitat availability, quality, and connectivity.

Factors that enhance or undermine adaptive capacity:

▲ Red-legged frogs possess behavioral adaptations to the presence of bullfrogs

▲ Protected by federal- and state-listings

▲ High public support for management

▼ Significant population declines in both species

▼ Reduced genetic diversity and enhanced risk of extirpation for populations isolated by habitat fragmentation

Adaptation Strategies for Freshwater Marshes, Wetlands, & Ponds

Management practices for freshwater marshes, wetlands, and ponds that reduce vulnerability to climate change are likely to focus on maintaining or restoring natural hydrologic regimes, retaining water within the system, managing vegetation (e.g., through planting, mowing, disking, or grazing), reducing nutrient inputs, and protecting floodplains. Climate-informed management of these habitats also helps maintain high biodiversity across the landscape and provides the public with important water resources and recreational benefits.

Management strategies for California red-legged frogs and San Francisco garter snakes may include protection of remnant natural habitat and important movement corridors, creation of artificial habitat (e.g., stock ponds with suitable conditions), and management of invasive species.

ADAPTATION APPROACH	ADAPTATION STRATEGIES
Resistance strategies: Maintain current conditions by limiting change *Near-term approach*	• Improve water conservation and efficiency • Increase storage potential for water users so they are less reliant on instream flows during dry years* • Remove non-native fish and bullfrogs that are likely to exacerbate the impacts of climate change on native species (e.g., frogs)
Resilience strategies: Accommodate some change while enabling a return to prior conditions *Near- to mid-term approach*	• Maintain and restore hydrologic connectivity (e.g., replace undersized culverts, remove dams) • Identify opportunities for diversifying water supply* • Encourage the creation of irrigation districts to improve strategic management of where water is coming from*
Response strategies: Intentionally facilitate or direct change to adaptively respond to new conditions *Long-term approach*	• Maintain and protect potential refugia (e.g., historical floodplains along creek edges, wetland areas with groundwater inputs) • Source wetland species for plantings from areas lower in the watershed that are warmer and drier*
Knowledge strategies: Gather information about climate changes, impacts, and/or management effectiveness *Near- to long-term approach*	• Improve understanding of where ponds and wetlands are on the landscape* • Create a ranking of ponds and wetlands (e.g., prioritized based on species of special concern, drought risk, “old growth” ponds)* • Identify which ponds and wetlands are most at risk during periods of drought/low precipitation* • Identify opportunities and/or ideas for how to keep water in the system (e.g., how to improve groundwater recharge)*
Collaboration strategies: Coordinate management efforts and/or capacity across boundaries *Near- to long-term approach*	• Increase education with landowners about likely climate impacts as well as management actions that increase water availability/ reliability* • Expand partnerships focused on reducing invasive species and pathogens* • Collaborate with farmers to reduce agricultural runoff that contains contaminants and and excess nutrients*

** Future management strategies (not currently occurring)*

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Further information and citations can be found in the source reports of the Santa Cruz Mountains Climate Adaptation Project, available online at http://ecoadapt.org/programs/awareness-to-action/santa-cruz-mountains.