River and Stream Habitats
Climate Change Vulnerability, Adaptation Strategies, and Management Implications in Southern California National Forests

Habitat Description

Rivers and streams are powerful drivers of landscape patterns and ecological communities, and provide California's most valuable forest resource: water. Rivers and streams in southern California are primarily fed by precipitation, surface runoff, and groundwater discharge; historically, peak flows and flooding occur in winter and spring, and low- or no-flow conditions often occur in the summer and fall. This assessment includes both perennial and ephemeral systems, as well as associated riparian vegetation.

Habitat Vulnerability

Sensitivity & Exposure

Rivers and streams are sensitive to climate drivers that alter hydrology, water temperature, and water quality. Patterns of high and low streamflows, flooding, and drying are primarily responsible for the dynamic nature of lotic systems. Rivers and streams in southern California already reflect highly variable flow regimes; however, extreme flooding and/or drought events may magnify many processes in the system (e.g., channel incision). Extensive habitat alteration due to non-climate stressors such as dams and water diversions is likely to exacerbate the impacts of climate change.

Moderate Vulnerability

Low ⟶ High
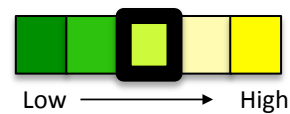
Drivers of Rivers and Streams

- <u>Climate sensitivities</u>: Precipitation, drought, low stream flows
- <u>Disturbance regimes</u>: Wildfire, flooding
- <u>Non-climate sensitivities</u>: Dams and water diversions, invasive species

Projected Climate and Climate-Driven Changes	Potential Impacts on Rivers and Streams
Changes in precipitation and increased drought *Variable annual precipitation volume and timing; longer, more severe droughts with drought years twice as likely to occur*	• Decreased flow and prolonged duration of low- and no-flow conditions • Altered stream morphology and habitat complexity • Reduced water availability for riparian vegetation and a corresponding increase in drought-tolerant shrubs • Shifts in the composition of macroinvertebrate communities, primarily at the genera and species levels
Altered stream flows *Higher spring peak flows, prolonged periods of low- or no-flow conditions*	• Reduced water quality, including increased salinity and/or alkalinity and increased concentrations of pollutants • Altered channel structure due to sediment and vegetation • Increased isolation of pools and stream reaches • Decreased extent of riparian and aquatic habitats
Increased temperature *+2.5 to +9°C by 2100*	• Increased water temperature and associated declines in cool- and cold-water aquatic species • Loss of stream habitat complexity and thermal refugia

Adaptive Capacity

Factors that enhance adaptive capacity:
+ Disturbance-adapted community with relatively quick recovery time
+ High biodiversity, harboring many endemic and threatened or endangered species
+ Provides variety of ecosystem services: water supply, water quality, flood and erosion protection, sediment transport, and biodiversity

Factors that undermine adaptive capacity:
- Already heavily altered and/or degraded by human activity (e.g., dams and water diversions)
- Modified rivers and streams are slow to recover and vulnerable to additional stressors
- Low connectivity prevents species movement
- Potential conflicts with urban and agricultural communities for water resources

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What kinds of adaptation options are there?

Enhance Resistance ➜ Prevent climate change from affecting a resource

Promote Resilience ➜ Help resources weather climate change impacts by avoiding the effects of or recovering from changes

Facilitate Transition ➜ Accommodate change and/or enable resources to adaptively respond to variable conditions

Increase Knowledge ➜ Gather information about climate impacts and/or management effectiveness in addressing climate change challenges

Engage Collaboration ➜ Coordinate efforts and capacity across landscapes and agencies

Adaptation Category	Adaptation Strategy	Specific Management Actions
Enhance Resistance	Protect streams down-gradient of State Water Project (SWP) lakes/dams	• Continue with dam releases to maintain flows downstream of SWP lakes/dams • Monitor water supply in SWP lakes and reservoirs
	Manage invasive species	• Remove arundo and tamarisk to reduce competition with native species for limited water resources
	Restore native species to disturbed areas	• Plant native species in riparian areas after disturbances (e.g., wildfire, infrastructure improvements)
	Improve water quality by reducing sedimentation	• Optimize grazing management practices to reduce sediment production
Promote Resilience	Reconnect streams to allow movement of sediment and aquatic organisms	• Remove or replace perched ford stream crossings with bottomless arch culverts or bridges in Core 1 watersheds
Facilitate Transition	Identify and protect refugia	• Designate conservation easements to extend riparian buffers along rivers and streams
Increase Knowledge	Build an information base for timely response to future disturbance events (e.g. flooding, pollution, fire)	• Continue installing and monitoring river/stream gages and snotel sites and consider additional needs for monitoring data (e.g., precipitation) • Incorporate water flow information into integrated watershed management plans
Engage Collaboration	Increase partnerships to facilitate the protection of aquatic organisms	• Increase coordination among partners for aquatic organism passage projects to improve cooperation and leverage funding and local knowledge

*Actions presented are those evaluated as having higher effectiveness and/or feasibility.

Management Implications

This information can be used in a variety of ways:

✔ Forest Plan Revisions

✔ U.S. Forest Service Climate Change Performance Scorecard: Element 6 - "Assessing Vulnerability" and Element 7 - "Adaptation Actions"

✔ Bureau of Land Management Resource Management Plan Revisions

Resilient management requires implementing a variety of adaptation options

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Meeting the challenges of climate change

Further information and citations can be found in source reports, *Climate Change Vulnerability Assessment for Focal Habitats of Southern California* and *Climate Change Adaptation Strategies for Focal Habitats of Southern California*, available online at the EcoAdapt Library: http://ecoadapt.org/library.