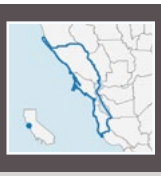
Coho Salmon & Steelhead Trout

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



Species Description

Coho salmon (*Oncorhynchus kisutch*) and steelhead trout (O. *mykiss*) are anadromous fish that utilize a wide range of freshwater and estuarine habitats as well as marine areas, making them highly dependent on habitat connectivity and availability of suitable conditions for each life stage. Coho and steelhead are also dependent on specific conditions for reproduction and egg development, including access to spawning gravel, cool temperatures, and ample flowing water. Steelhead populations located within the Golden Gate Biosphere (GGB) region are listed federally as threatened, while coho salmon are listed as endangered under both the federal Endangered Species Act and the California Endangered Species Act.

Species Vulnerability - *High*

Sensitivity & Exposure - *High*

Projected Changes	Trend
Water temperature	▲ Increase
Precipitation	▲▼ Varies
Drought	▲ Increase
Stream flow	▲▼ Varies
Wildfire	▲ Increase
Pathogens	▲ Increase

Potential Impacts:

- Increased heat stress and mortality as a result of warmer water temperatures, particularly during periods of drought
- Habitat loss, reduced water quality, and threats to stream connectivity caused by increased severity/length of droughts
- Limited habitat accessibility for spawning and damage to nesting locations through altered stream flows
- Increased mortality risk as a result of pathogen outbreaks
- Loss of riparian habitat and corresponding decreases in insect populations that support juveniles due to increased wildfire

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

- *Dams, water diversions, and flood control activities* impede access to spawning areas and influence rearing habitat conditions by altering flow regimes and streambed composition
- *Urban development* fragments wetlands, reduces floodplain connectivity critical for streamflow regulation and water quality, and increases stormwater runoff
- *Livestock grazing* and *agriculture* contribute to reduced in-stream flows, affecting juvenile steelhead survival, and can also reduce water quality by introducing pollutants
- *Invasive species* can threaten the survival of juveniles and influence habitat quality
- *Fire exclusion and suppression* alters plant community composition and increases forest density, increasing the risk of high-intensity fire that alters stream habitats
- *Hatchery production* increases resource competition within freshwater and marine environments

Coho and steelhead are highly sensitive to climate stressors that drive altered flow regimes and warmer water temperatures, which impact habitat availability and quality as well as fish survival, recruitment, and migration.

Species Vulnerability - *High*

Adaptive Capacity - *Low*

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

Enhance:

- High life history and behavioral diversity, enhancing ability to adapt to climate change
- Potential for steelhead to utilize varied habitats including estuaries and lagoons

Undermine:

- Population declines and decreases in genetic diversity due to habitat loss, fragmentation, and degradation
- Both species at or near the southern extent of their range

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

Enhance:

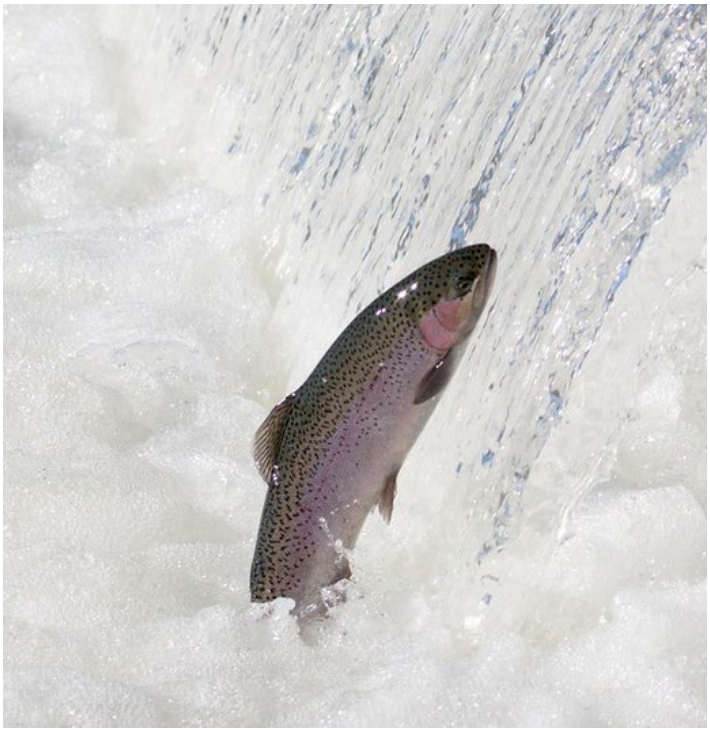
- High public and societal value increase support for management
- Receive significant regulatory support as endangered/threatened species

Undermine:

- Human impacts (e.g., dams/diversions, habitat fragmentation and loss via development) can be expensive and politically challenging to address
- Unable to manage coho within their marine life stage

Although coho and steelhead have diverse life histories and behavioral patterns, challenges such as small population size, threats to genetic diversity, and reduced habitat availability and suitability are likely to decrease their resilience to climate change.

California Sea Grant, Flickr (CC BY 2.0)



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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
Increase water supply, retention, and quality in coho and steelhead habitat	• Pull from recovery plans where they identify specific watershed priorities that are relevant to the GGB region **(K/C)** • Enhance groundwater recharge and store winter water to offset summer use (within Sonoma County) **(R)** • Increase shade in riparian areas to reduce water temperatures **(R)**
Remove artificial barriers to upstream migration	• Identify and prioritize barriers for removal **(K)** • Remove barriers and modify road culverts to allow fish passage **(R)** • Support monitoring activities that help assess the effectiveness of barrier removal projects **(K)**
Identify and aggregate needs for monitoring salmon	• Coordinate and standardize monitoring of salmon populations **(K/C)** • Identify where there are gaps in existing monitoring efforts within the Network **(K)**
Enhance habitat quality and availability for salmon	• Identify areas where impervious surfaces can be removed or upland habitat restored to reduce water velocity/quantity from intense rain events **(R)** • Acquire or create floodplain and back-channel habitat to slow and spread water and create flood refugia **(R)** • Implement channel restoration projects in high-priority streams with the goal of increasing channel complexity and substrate quality **(R)** • Protect lagoon and other rearing habitat/habitat migration impacted by sea level rise **(R)**
Maintain genetic/life history diversity and abundance of salmon	• Protect and restore population viability to all remaining stocks **(R)**

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