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2023 California Envirothon
“Adapting to a Changing Climate”
Current Issue Scenario

Background

Climate change is a result of a long-term shift in global temperature, precipitation, wind patterns and other indicators. Climate change can involve both changes in average conditions and changes in variability, including, for example, extreme events such as atmospheric river rain storms and long periods of drought (a new phenomenon known as “whiplash”).

Climate models project an increase in temperature and predict increases in the frequency of hot days above 86 degrees Fahrenheit as well as changes in precipitation, extreme weather events, sea level rise, water stress, and ocean acidification. As a result, disruptive changes to ecosystems, the economy, and society are expected to occur on both local and global scales.

Ecosystems are changing, and for some, could spell the end of certain landscapes as we have known them. And while some species are adapting, for others, it's not that easy and may take several decades to evolve. Biodiversity is threatened and many species may become extinct.

These changes are due to a buildup of greenhouse gases (GHGs) in our atmosphere and the warming of the planet due to the greenhouse effect. GHGs are emitted from both natural and human-generated sources. Key greenhouse gases are carbon dioxide (i.e., primary gas), methane (sources include agricultural activities, fossil fuel extraction and transport, and natural wetlands), nitrous oxide (sources include ag activities), F-Gases (e.g., chlorofluorocarbons, hydrofluorocarbons, etc.), and ground-level ozone created by a chemical reaction between emissions of Nox and volatile organic compounds from automobiles, power plants, and other industrial and commercial sources in the presence of sunlight.

Evidence suggests many of these extreme changes in climate are connected to rising levels of carbon dioxide and other greenhouse gases in the Earth's atmosphere, and more often than not, the result of human activities.

GHGs from human activities include burning fossil fuels for transportation, heat, and energy, clearing forests, use of synthetic fertilizers, disposing of green waste in landfills, raising livestock, and producing some kinds of industrial goods.

The vast majority of climate scientists agree that global warming observed since the 1950s, is cause for immediate concern. Human-induced emissions of GHG are being released at a quicker rate than natural processes can remove.

The Earth's climate is naturally variable on all time scales. However, its long-term state and average temperature are regulated by the balance between incoming and outgoing energy, which determines the Earth's energy balance. Any factor that causes a sustained change to the amount of incoming energy or the amount of outgoing energy can lead to climate change.

California has witnessed the profound range of impacts from a changing climate throughout the state:

- changing temperatures and precipitation patterns bring about prolonged periods of drought,

- food insecurity, catastrophic wildfires, flooding, and threats to the economy and livelihoods
- increases in ocean temperatures, sea level rise, and acidification
- changes in the frequency, intensity, and duration of extreme weather events
- shifts in regional ecosystem characteristics, such as the length of the growing season, timing of flower blooms, migration of birds, proliferation of pests and pathogens to forests, threats to biodiversity, and loss or degradation of wildlife habitat

Forests

Trees are the largest and longest-lived organisms on the planet. They constitute the framework of ecosystems, provide habitat for fish and wildlife, especially sensitive salmonids and vulnerable species. Forests even create their own weather. Forests are a keystone to the culture and livelihood of Indigenous peoples. Forests within national parks, state and national forests and designated wilderness areas, also provide recreation and tourism to local economies. A healthy forest can slow a wildfire, buffer storm surges from a hurricane, and offer solace to communities.

Human lives depend on the shade that trees cast on scorching city streets. Their roots and leaves filter the water and air. Urban forests and other plant life mitigate the effects of the urban heat island by providing shade and cooling the ambient air from buildings, structures and roads radiating high temperatures (<https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect>).

Forests are key to storing carbon from the atmosphere, providing a supply of water and other ecosystem benefits. The forests in the Sierra Nevada range provide nearly a third of the state's water supply typically from snowpack. In response to climate change, some tree species will shift their ranges and migrate into higher and cooler elevations in which they don't typically grow to escape rising temperatures and changes in precipitation patterns.

One example of the effects of climate change, is the iconic, spiky Joshua trees. The western Joshua trees are nearing extinction by the end of the century. They only live in the area near southern California's Joshua Tree National Park in the Mojave Desert. Due to changing desert conditions, the Joshua trees have been moving to higher, cooler climates in the national park where more groundwater is available. Wildfire activity and smog from Los Angeles deposit nitrogen on the ground which acts as a fertilizer for non-native grasses to increase the region's wildfire risk. It makes it harder for seedlings to grow and the warming climate will make the environment unsuitable in the future. A whole ecosystem relies on the Joshua trees for food and shelter, such as animals like the yucca moth, the only pollinator of these trees, and desert night lizard.

U.S. Department of Agriculture, Forest Service, in a recent aerial survey report, estimated 36.3 million trees died in 2022 in California. This is a colossal increase from the 9.5 million trees reported in 2021. From mid-July to early October, researchers surveyed nearly 40 million acres, including federal, state and private land. The dead trees span nearly 2.6 million acres compared to 1.2 million acres in 2021, with the average severity of mortality becoming “significantly higher.” The highest mortality rates were in the central Sierra Nevada Range and in Northern California near Redding, including the Shasta-Trinity National Forest. These decimated forests have become known as “zombie” forests.

Douglas fir trees showed the highest mortality rate increase (3 million, an increase of 1,650%) followed by white fir trees (12 million, an increase of 691%) and red firs (15 million, an increase of 242%). The trees were killed by the effects of prolonged drought in its overgrown forests, insect outbreaks such as the bark beetle, and disease. Trees stressed by climate change become vulnerable to marauding

insects and fungi. Prolonged droughts deprive trees of the water they need to produce resin, the sticky substance they use to seal up wounds and trap potential invaders.

Forest officials say the high number of dead trees has become a prime fuel source setting up conditions for a grim fire season. The increase in dead trees will continue to be a problem for years to come as rain levels, in general, remain low and another beetle, fir engravers, continue to infest and kill trees.

<https://mail.google.com/mail/u/0?ui=2&ik=029fb03c6b&attid=0h.4&permmsgid=msg-f:1760472604257424034&th=186e7481959212a2&view=att&disp=safe>

Watersheds

Factors that make each watershed distinctive include its mosaic of land uses, soil types, geology, topography, and climate. Climate change alters a watershed's hydrology by changing the quantity, quality, timing, movement and distribution of water. The cumulative impacts of past land uses, water withdrawals or diversions, and disturbances in a watershed are all exacerbated by climate change.

Ensuring long-term watershed health is essential to building resilience to counter the effects of a changing climate. Healthy and functioning watersheds improve water quality, enhance water storage, naturally regulate streamflows, reduce flood damages and stormwater runoff, replenish groundwater and provide many ecosystem services. Significant changes in temperature and precipitation present challenges to its ecosystems such as sensitive and unique riparian areas, wetlands, and biodiversity.

A healthy wetland ecosystem not only sequesters large amounts of carbon but it acts as a sponge to soak up floodwaters to soften the impacts of climate change. During drought periods, all the plants living in a floodplain rely on stored water in the soil to stay green and healthy as the stored water is slowly released during drought episodes. These wetlands also function as a firebreak during intense wildfires.

Droughts and higher temperatures are destroying wetlands which are a source of food and habitat for resting migratory waterfowl and settle pollutants, such as sediment, from waterways or flood flows.

By reintroducing the beaver to areas with the loss of wetlands and meadows, it may be possible to halt this process and restore them to their natural state ([Beaver and Process-Based Restoration Build Momentum in California!](#)). These rodents are a nature-based solution partner as they build dams on waterways to create a pond and cause flooding. In effect, beaver dams slow, spread and sink water. The dam slows down the flow of water and keeps it on the landscape longer and transforms the stream into a thriving complex wetland ecosystem, advances biodiversity, such as frogs and insects, provides habitat and shelter for fish such as salmon and trout, invertebrates, and other wildlife such as otters. As the water flow slows, it allows sediment to settle thereby improving water quality and establishing meadow habitat of grasses and other non-woody plants.

(<https://www.eastbaytimes.com/2017/03/25/a-decade-of-beavers-mostly-in-martinez/>)

<https://youtu.be/6iT5W32xRN4>

Oceans: Sea Level Rise, Acidification, and Increasing Temperatures

Ocean currents or atmospheric circulation, can also influence the climate for short periods of time. This natural internal climate variability is superimposed on the long-term forced climate change.

The seas are rising the main cause being glacial melt. The foods we grow and eat are threatened. Ocean acidification is increasing and has a range of negative impacts to marine life such as oysters and coral

reefs. It may also alter marine food chains and food supply to humans. Loss of coral reefs and tidal wetlands will reduce protection to coastal communities from intense storm surges from hurricanes and harm local economies dependent on tourism and recreation.

A new study conducted by the University of Washington found that everything from plankton and seaweeds to fish and marine mammals and birds face immense challenges presented by a changing climate. Their ability to grow, move, and take oxygen and consume food will be affected due to changes in water temperature, oxygen and carbon dioxide predicted by the end of the century.

On the positive side, the kelp forest, an important habitat to many types of marine mammals, fish and shellfish, is expected to grow faster as the ocean absorbs more carbon dioxide. On the negative side, kelp forests growth is cut short, or even decimated, when the ocean warms and marine heat waves appear and leaves the an imbalance in the ecosystem (<https://www.sfchronicle.com/climate/article/monterey-kelp-forest-decline-heatwave-17852449.php>).

A warming ocean and other conditions can create harmful toxic algal blooms effecting marine mammals and fish, their migration patterns, food availability, mortality, and the loss of critical habitat such as nurseries.

Rising seas are presenting risks and threats to low-lying residential areas, ecosystems, and critical infrastructure such as wastewater treatment plants, roads and highways, airports, rail, underground fiber optic cable systems, electrical transmission towers, municipal drinking water lines, cultural sites of Indigenous tribes, coastal farming, and boat ramps. There are long term concerns about nuclear waste storage facilities along coastal bluffs. The King tides provide a preview of what's in store when highways are flooded, sloughs become bloated pools, and cities at sea level are inundated. Wave action from extreme storm events batter shorelines, threaten coastal communities with devastation, and create erosion particularly problematic for farmers.

What is clear, is sea level rise must become a priority among all public officials and a mitigation plan prepared to protect vulnerable communities and infrastructure. The gold standard for responding to the threat is known as “managed retreat” as a last resort such as moving infrastructure, relocating low-lying homes, or retrofit houses and buildings to rise above ground on stilts. In any case, it is certain to be expensive and years away.

But there are other solutions and adaptations suggested to guide planners, policy makers, and regulatory agencies beyond the status quo of traditional shoreline protections: riprap, sea walls, and other steel and concrete revetments. The concept is to create clear, nature-based scientific guidelines for sea level rise adaptation that works with all the creeks and shorelines especially around bays and coastal waterways. The idea is to use nature-based adaptation measures to develop a protection strategy together with a robust vulnerability assessment and combined with science, engineering, and stakeholder planning (<https://baynature.org/2019/05/>) <https://www.sfei.org/adaptationatlas> <https://www.sfei.org/news/sfeis-and-spurs-adaptation-atlas-shared-multiple-media-outlets#sthash.gLPG6Bu0.dpbs> <https://www.sfchronicle.com/>

Examples of such nature-based adaptation measures include restoration of a marsh or wetlands, the construction of an ecotone levee (<https://www.insightsonindia.com/environment/basic-concepts-of-ecosystem/ecotone-ecological-niche/ecotone/>), or the placement of a beach to mitigate flood risk and provide ecological benefits of sea level rise. In many cases individual measures are combined with other measures in recognizing the holistic approach to adaptation.

In Eureka, former pastureland is being transformed to enhance the Elk River Estuary. Excavators are digging a channel that will snake south from the river and turn 114 acres back into tidal marshland. Among other benefits of the project is the protection of a section of the nearby highway 101 from flooding as it provides room for floodwaters to flow from both the river and to sea during storm events. This once naturally occurred before the wetlands were filled.

Just south of the project, the Wiyot Tribe is planning to restore an ecologically and culturally significant area called Mouralherwaqh. The Tribe recently purchased a 46-acre parcel with state grant funds and will use habitat conservation as a nature-based solution to sea level rise while also providing opportunities for environmental justice and indigenous land return.

Agriculture

The agricultural sector is most susceptible to the effects of a changing climate. Oscillating temperature extremes, water scarcity and unreliability, severe and intense weather events, all impact the livelihood of farmers, ranchers and farm workers as well as the economies locally, nationally, and globally. This year, a record number of atmospheric river storm events have flooded fields, destroyed crops, breached levees, submerged roads, inundated communities, compromised infrastructure, and ruined the local economy. It creates the uncertainty in food and fiber production.

Temperature increases add more frost free and growing degree days that could improve yields and enable new cropping options in some regions. Less freezing temperature in the winter is detrimental to certain tree fruit crops (e.g., stone fruit) needing cold temperatures to induce dormancy to produce fruit. Moreover, less fog in ag producing valleys effects crop yield.

Water scarcity and unreliability is attributed to the drought bringing less precipitation and low snowpack in the mountain ranges. This results in less water storage in reservoirs, contributes to groundwater depletion, curtailing surface water deliveries, and reduced soil moisture, all very impactful throughout the growing season.

The ag sector, in partnership with local, state, and federal agencies, scientists and researchers, study its carbon footprint from concentrated animal feeding operations (producing livestock manure and methane and nitrogen oxide emissions) to the application of synthetic fertilizer, and use of fossil fuels for farm equipment and pesticide applications. The latter is known to be lethal to pollinators.

Ag is aware of their opportunity as a major player and leader to address climate change impacts. The 2023 Farm Bill, now being negotiated in Congress, may be the vehicle to provide new technical and financial assistance as well as research, crop insurance, assistance programs to rural areas, and conservation funding, to help and incentivize farmers and ranchers to adapt and mitigate the effects of climate change and make farming more sustainable.

Examples of actions/recommendations for adaptation strategies that could further help ag's efforts to reduce its carbon footprint, retrofit watersheds, and implement practices to reduce greenhouse gases:

- application of organic compost to build soil health
- use less synthetic fertilizers
- soil carbon sequestration
- plant cover crops to reduce use of pesticides, rodenticides, and herbicides
- reduce till or no till of fields (also improves soil health by retaining carbon)

- broaden floodplains to accommodate intense storm events (e.g., atmospheric river storms and high Sierra snowpack melt)
- change or modify livestock feed to reduce methane emissions such as feeding seaweed
- expand technology such as anaerobic biodigesters at dairies and feedlots to utilize manure as a renewable energy source and prevent water contamination
- provide incentives to farmers to convert to electric farm equipment such as tractors
- nature-based solutions such as buffers and wetlands restoration to protect coastal ag from storm surges, sea level rise, and salt water intrusion to groundwater basins
- research and demonstrate the viability of vertical agriculture to grow specialty crops such as tomatoes and leafy greens toward building water resilience and efficiency.

Wildlife

Climate change has produced a number of grave threats to wildlife throughout California (e.g., national parks and forests) and globally (e.g., the Amazon, the Galapagos, the Arctic, etc.). Rising temperatures lower many species survival rates due to changes that lead to less food, less successful reproduction, competition for diminishing resources such as water, and degraded habitat for native wildlife. Animals most affected by climate change include, but not limited to, the polar bear, snow leopard, green sea turtles, and the Monarch butterfly. Some species populations may decline, many will shift their ranges substantially, and still others will face increased risk of extinction.

(<https://www.fws.gov/initiative/climate-change>)

Examples of climate change affecting wildlife:

- fish mortality, especially for migrating and spawning salmon, due to drought, warmer waters, reduced stream flows, toxic algal blooms, and loss of habitat
<https://www.bbc.com/news/science-environment-58171814>
- migration of Desert Bighorn Sheep to higher and cooler elevations for survival
- threats to migratory birds on the move given reduced or loss of habitat and food during prolonged droughts
- Monarch butterflies and other pollinators due to droughts, frost, the loss of their food source, native milkweed, and warming temperatures

Climate change informs wildlife managers in strategies for wildlife conservation, land and species management, and habitat restoration. Public education and outreach are important tools to bring about awareness and support to the plight of wildlife in adapting to a changing climate.

Communities

Vulnerable low income communities of color are disproportionately harmed by climate change. Many already have little to no access to safe drinking water, live in poverty, and cannot afford the basics of food, health care, and adequate housing. They are primarily working class labor as farm workers, construction, industrial work, domestic, retail, and hospitality. When agriculture, tourism and recreation are rocked by extreme weather events, they lose work, wages, and are further left behind without resources or aid. This is true globally and the plight of climate change refugees all over the world is only a matter of time and reckoning. Equity, social and environmental justice are issues of great concern and needs attention and swift redress.

Governance: *the action or manner of governing; the process of making and enforcing decisions within an organization or society; the process of interactions through the laws, social norms, power (political and social); the process of choosing the right course in a collective problem*

Government agencies have key roles to address the effects of a changing climate. At the federal level, Congress legislates, sets policies, and provides federal agencies the statutory and regulatory authority, and budget, to protect the environment, public health, wildlife, fisheries, landscapes, to address and prepare for climate change. These laws include, but are not limited to, the Clean Water Act (CWA), Safe Drinking Water Act, Clean Air Act, Endangered Species Act, and the National Environmental Quality Act.

The Farm Bill (<https://crsreports.congress.gov/product/pdf/IF/IF12047>) is administered and implemented by the USDA agencies Natural Resources Conservation Service, Farm Services Agency, and Forest Service. It provides support for a variety of agricultural, food programs, and rural services through technical and financial assistance.

California and other states have their own environmental laws, some preceding enactments by Congress and the Executive Branch. For example, the Porter-Cologne Act pre-dates the 1972 CWA and addresses water quality, water supply, and protection of beneficial uses to water as well as being the authority to issue water rights permits.

The California Constitution (Article X, Section 4) established the state's role as trustee, to hold in the public's trust, navigable waters, tidelands, wildlife, and natural resources.

Addressing climate change will require aligning state and federal policies including opportunities for public and private partnerships (e.g., environmental, social justice, farming, and conservation organizations). Resources such as funding and staffing will leverage dollars and create a synergy in collectively tackling issues.

Each agency brings to the table different and related tools in the figurative toolbox such as legal authority, funds, ideas, and research. Government has the ability to inform legislation, create policy, form partnerships for action, enable and convene the public and important stakeholders, and make strategic decisions. They can provide the leadership to invest in programs focused on adapting to a changing climate.

Non-governmental organizations such as nonprofits (e.g., Cal Trout) and trade associations (e.g., California Rice Commission) are able to lobby and influence legislative bodies for new policies, legislative action, funding, and change.

Examples of those government agencies at the forefront of climate change policy, regulations, science and research, and have the ability to lead efforts to recalibrate of their organizations and policies include, and are not limited to:

Federal: Department of the Interior agencies include National Park Service, Bureau of Land Management, Bureau of Reclamation, Fish & Wildlife Service; Department of Commerce: National Oceans and Atmospheric Administration-National Marine Fisheries; U.S. EPA; USDA: U.S. Forest Service and the Natural Resources Conservation Service

California State: Department of Water Resources, Natural Resources Agency, Department of Fish and Wildlife, Department of Food & Agriculture, State Water Resources Control Board, and nine local Regional Water Quality Boards, Cal Fire, State Parks, Air Resource Board and local air pollution control districts

Setting the Stage

California is a global leader in reducing greenhouse gas emissions and transitioning to a carbon-neutral future. Its economy has continued to grow as carbon pollution has gradually decreased. It is fair to say that the several catastrophic wildfires throughout the state in the past few years has increased carbon pollution and cut into carbon reduction gains.

As carbon neutrality is pushed, the protection of communities and the natural environment from climate crisis is already here. In the last decade, Californians have endured severe droughts, historic flooding, major wildfires, rising seas, threats to biodiversity, and record temperatures all driven by climate change. Californians now see, feel, and breathe what scientists have been explaining for decades: greenhouse gas pollution is warming our planet and generating threats to life on earth. The world's leading climate scientists have made it clear---our window to avoid the worst impacts of climate change is narrowing faster than expected, and success requires unprecedented collective effort, cooperation, coordination, and collaboration toward transformational change and action.

California Climate Adaptation Strategy

California is required by statute (Assembly Bill 1482, 2015) to issue a statewide strategy to adapt to the impacts of climate change every three years. This climate adaptation strategy is known as “California Climate Adaptation Strategy” (CAS). <https://www.climate resilience.ca.gov>

Governor Gavin Newsom and his administration are leading the efforts to prepare, implement, update and revise the CAS. Previous iterations of this Strategy have been referred to as “Safeguarding California.” The last update was released in 2018 and it now provides a framework for bold adaptation solutions that fully integrate equity into its climate resilience programs. It also integrates key elements of sector-specific plans, such as the Natural and Working Lands Climate Smart Strategy, Wildfire and Forest Resilience Action Plan, Climate Action Plan for Transportation Infrastructure, and Water Resilience Portfolio.

The CAS acknowledges the value and importance of partnerships with California Native tribes for climate adaptation. It is recognized that tribal cultural resources are significantly threatened by the effects of climate. Native peoples hold the use of traditional ecological knowledge and nature-based solutions (<https://www.climate resilience.ca.gov/overview/tribes.html>).

The updated strategy reflects recent efforts to double down on protecting communities, the economy, and nature from the impacts of climate change as follows:

1. *Organizes the state's climate adaptation efforts around six outcome-based resilience priorities, and increases the ability to measure progress.*

These priorities reflect and reinforce regional climate change resilience priorities; were developed through robust public engagement and in consultation with California Native American tribes; and specify timeframes and metrics to drive progress and enable accountability.

2. *Breaks down silos and unifies collective climate adaptation efforts across all sectors and regions.*

An outcome-based approach sets strategic direction, supports coordinated, integrated efforts,

recognizes how climate adaptation is implemented on the ground, and reflects our commitment to integrating climate resilience into the work of all state agencies and partnerships with local and federal agencies, and non-governmental organizations.

3. *Makes it easier for Californians to understand and contribute to California's climate resilience agenda.*

Presented as an interactive website, the CAS provides a central hub for information on the state's climate resilience actions. The website will stay updated to track progress and adjustments, and integrate emerging best available science.

Important Terminology

The CAS further provides the distinction between the terms “adaptation” and “resilience” as:

- *Adaptation* is an action or set of actions that reduce physical climate risk.
- *Resilience* describes a state of readiness to face climate risks.

California is taking steps to prepare for the impacts of a changing climate at the state, regional, and local levels. Preparing for these changes is called adaptation. A series of adaptive steps contribute to resilience.

Scenario

The California Natural Resources Agency (CNRA) (<https://resources.ca.gov>) convened a series of ten regional workshops to receive public input on the California Climate Adaptation Strategy. The Strategy's goals, strategic direction, and priorities were presented and a summary of all stakeholder input prepared. The purpose was to ensure the Strategy reflects and reinforces regional priorities, draws connections from collective efforts, and serves as a useful resource for all Californians.

The CNRA has created three panels of experts to review the public responses from the ten virtual workshops held throughout the state. Each panel is assigned three or more geographic regions to identify common themes, regional priorities, opportunities for collaboration, public/private partnerships, and how to support regional planning.

Each panel's report will provide a framework to strengthen the strategy by laying out approaches to address priorities, with specific and measurable actions for collective efforts across sectors and regions.

Recommendations will include a portfolio of projects to address adaptation and mitigation to climate change (e.g., nature-based solutions), sources for technical and financial assistance, proposals for legislation and/or local laws, policies, tax credits, and funding, and key partnerships for collective action and implementation.

Your team has been selected one of the special panels given your known expertise in soil, forestry, aquatic ecosystems, and wildlife as well as having a broad understanding of the connectivity among these topics. You will choose one or two of the following to focus your report:

- San Joaquin Valley
- Southern Sierra
- North Coast
- San Francisco Bay Area

You will present your findings and recommendations for a cohesive policy plan before the California Natural Resources Agency's scheduled hearing on May 30, 2023, before the opening of the new 2023-24 legislative session. Your report will be instrumental to informing actions for adaptation to climate change and building resilience to climate risks in the next year and into the future.

Shared Regional Concerns

The common themes found among these regions regarding climate change impacts of most concern are summarized as:

- sea level rise and warming temperatures; threats to infrastructure, low lying communities, coastal agriculture
- ecosystem and biodiversity impacts (e.g., loss of wetlands, warmer stream temperature and low flows, vulnerable and threatened species, and declining health of ecosystems)
- major precipitation events (extreme atmospheric river storms, flooding, record snowpack of 235% of average in 2023, economic losses)
- drought and water scarcity (e.g., changes in precipitation and snowpack)
- extreme heat and extended urban heat island effect
- forest and overall watershed management and restoration

Propose Recommendations

The report your team will prepare shall comment on the following topics and include recommendations for comprehensive actions to adapt and mitigate the effects of climate change. You will also describe and give examples of solutions and approaches, replicable actions, specific projects (regionally, statewide or locally), opportunities for collaboration and funding, and potential policies to include for consideration:

- *Infrastructure Recommendations*
- *Nature-based Solutions and Use of Traditional Ecological Knowledge*
- *Science-based Solutions*
- *Technical Assistance, Guidance, and Capacity Building*
- *Funding/Financing Actions and Solutions*
- *Cross-Cutting Adaptation Strategies and Agreements*
- *Monitoring and Research*
- *Policy and Legislative Recommendations*
- *Plan Supporting Diversity, Equity, and Inclusion of Tribal Knowledge and Public Engagement*

San Joaquin Valley

Description

- primarily agriculture: irrigated farm land, crops, nut trees, rice, alfalfa, cotton, corn, specialty crops, livestock operations, etc.
- extended heat waves increasing and the heat island effect in urban centers
- disadvantaged/underserved communities (especially vulnerable to flood events in low lying areas)
- San Joaquin River and its three major tributaries, the Merced, Tuolumne, and Stanislaus rivers
- listed fisheries under the Endangered Species Act (<https://www.fisheries.noaa.gov/west-coast/habitat-conservation/san-joaquin-river-basin>) as well as plants, mammals and terrestrial

- species
- migratory birds and national wildlife refuges
- upper watershed forest ecosystems (biodiversity, water supply, tourism and recreation)
- rural economies dependent on tourism and recreation and timber harvesting/processing
- wildfire, flooding, loss of habitat, drought
- water supply and water quality (surface and groundwater)
- air quality pollution (notably, designated by USEPA as a non-attainment area for green house gases: nitrogen oxides, methane, volatile organic compounds, and PM 2.5)

Climate Change Concerns

- Drought and water scarcity
- Extreme heat and urban heat island effect
- Changes to precipitation
- Wildfires in the Sierra Nevada range
- Flooding (including snowmelt)
- Air quality

Southern Sierra

Description

- Sierra Nevada Range watersheds are headwaters to major river systems: San Joaquin, Stanislaus, Merced, Tuolumne, Kern, and Kings and is a significant source of the state's water supply and other ecosystem services; these rivers have protections given through either or both the National and California Wild and Scenic Rivers Act.
- Major tourist destinations for recreation: Yosemite, Kings Canyon-Sequoia national parks, national monuments, national forests, and designated wilderness areas.
- Complex and unique ecosystems and habitat (e.g., native trout, and threatened or endangered species such as the California wolverine, Pacific Fisher, bighorn sheep, and the Sierra Nevada red fox)
- Mostly rural communities dependent on tourism/recreation as their economic base
- Bakersfield and Fresno largest cities on its western edge
- Ancestral home to many tribal bands of Indigenous peoples such as the Miwok, Mono Lake Kutzadika'a, Mono/Monache, Paiute, Shoshone (Newe, Timbi-Sha, Utu Utu Gwaitu Paiute and Washoe. Public lands hold their burial grounds, cultural resources, spiritual ceremonies and they continue to live in the region. They share their traditional and ecological knowledge with participating agencies and other Tribes.
- Nearly a third of the southern Sierra forests have been killed by drought, beetle infestation, and wildfire in the last decade

Climate Change Concerns

- Wildfire
- Tree mortality, density, and increasing forest fuel loads
- Habitat and biodiversity loss
- Drought
- Extreme storm events (i.e., flooding, mudslides, record snow fall levels, avalanches)

North Coast

Description

- Stretches from San Francisco Bay to Humboldt Bay
- Renowned for its old growth redwood trees, coastal redwoods, Douglas fir and oak forests
- Remote wilderness areas (e.g., Trinity Alps, Lost Coast, Marble Mountains), Redwood National and State Parks, and national forests such as the Shasta Trinity, Six Rivers, and the Klamath , are all important to the local economies (i.e., recreation, tourism, fishing, hunting, etc.)
- Major rivers include the Sacramento, Trinity, Klamath, McCloud, Smith, Eel, Salmon and the Russian
- South of Mt. Shasta is the Shasta Dam and Shasta Reservoir, key facilities in the U.S. Bureau of Reclamation's Central Valley Project completed in 1945. It dams the Sacramento, Pit and McCloud rivers for irrigation, municipal, hydropower, and industrial purposes. Shasta Dam's operations are harmful to migrating salmon as it blocks the fish from their historic spawning grounds. Moreover, below the dam, river water temperatures can increase in warmer months due to low flows and fish are vulnerable to predators. This is dangerous to the survival of the fisheries as a listed species and injurious to tribal culture and livelihoods.
- Hydroelectric dams along the Klamath River will be removed to restore a free-flowing river, protect water quality and improve fisheries, and restore a healthy ecosystem
- It is the traditional homeland of the Hupa, Shasta, Karok, Tolowa, Wiyot, Winnemem Wintu, and Yurok peoples who remain to this day and continue their cultural and spiritual practices. They are reliant on salmon returning home to spawn, mainly the adult fall-run Chinook, Coho salmon, steelhead trout, and other fish for their livelihood and traditions.
- The economic base includes tourism and recreation, commercial and sports fishing, irrigated agriculture, fruit and olive orchards. marijuana grows, timber logging (though it has greatly diminished), cattle ranching, and wine grape growing and wineries.
- Mostly rural communities; low income, at or below the poverty line, and underserved

Climate Change Concerns

- Drought and water supply
- Wildfire
- Flooding
- Sea level rise (Humboldt Bay and vulnerable coastal communities is a priority)
- Ecosystem and biodiversity impacts (native fish such as steelhead trout, chinook and coho salmon)

San Francisco Bay Area

Description

- Nine counties with a population of approximately 9.5 million
- San Francisco Bay dominates the landscape. Areas of SF Bay include San Pablo Bay, Suisun Bay. The landscape features include the East Bay Hills, Mount Tamalpais (part of the Coastal Range), and the Diablo Mountain Range with the prominent landmark, Mt. Diablo at 3849 feet elevation
- The region's economy is the sixth largest in the U.S. based primarily on tourism, recreation, financial businesses, and technology industries (Silicon Valley), commercial, manufacturing, transportation hubs, the Port of Oakland, and a commercial fishing, crabbing industry, agriculture, etc.
- The Bay Area coastal infrastructure is threatened by sea level rise: major airports include San Francisco, Oakland and San Jose; wastewater treatment plants, railway freight and public transportation, communication systems, road and highway systems, and commercial and

residential

- Stormwater runoff is often high especially during extreme storm events given urban density and the high percentage of impervious surfaces such as roads/highways/streets, rooftops, parking lots, and capacity of storm drains. Municipal officials need green infrastructure to capture high stormwater flows and put to beneficial uses (<https://www.epa.gov/G3/why-you-should-consider-green-stormwater-infrastructure-your-community>).¹³
- The region is troubled with poverty, gentrification, and social inequity: the unsheltered homeless encampments, the mentally ill homeless, drug addiction, and crime amidst the wealth and privilege where home prices soar from \$1 million and much more. The impacts of climate change will be disproportionate to these communities and the Indigenous peoples.
- Citizens have long supported open space, regional parks, restoration of ecosystem (e.g. South Bay Salt Ponds), habitat for fish and wildlife, and the overall health of San Francisco Bay especially the importance of river flows from the Sacramento-San Joaquin Delta. The region is popular for its network of city, regional, state, and national parks (e.g., Golden Gate National Recreation Area, Muir Woods National Park, East Bay Regional Parks, etc.)
- The Muwekma Ohlone Tribe has members around the Bay Area and south to the Monterey Bay Area. They are the predominant Indigenous group, including the Chochenyo, and the Karkin in the East Bay.
- The region's population is diverse and leans toward protections for the environment, social and environmental justice, biodiversity, equity, and assistance to disadvantaged and vulnerable communities.

Climate Change Concerns

- Sea level rise and infrastructure
- Warming bay waters and ocean temperatures
- Wildfire and smoke
- Ecosystem and biodiversity impacts, loss of wetlands, health of the Bay's ecosystem (such as warmer temperatures creating toxic algae leading to fish mortality in the Bay, its estuary, and coastal streams)
- Flooding and high winds
- Rising heat in urban centers prone to heat island effect