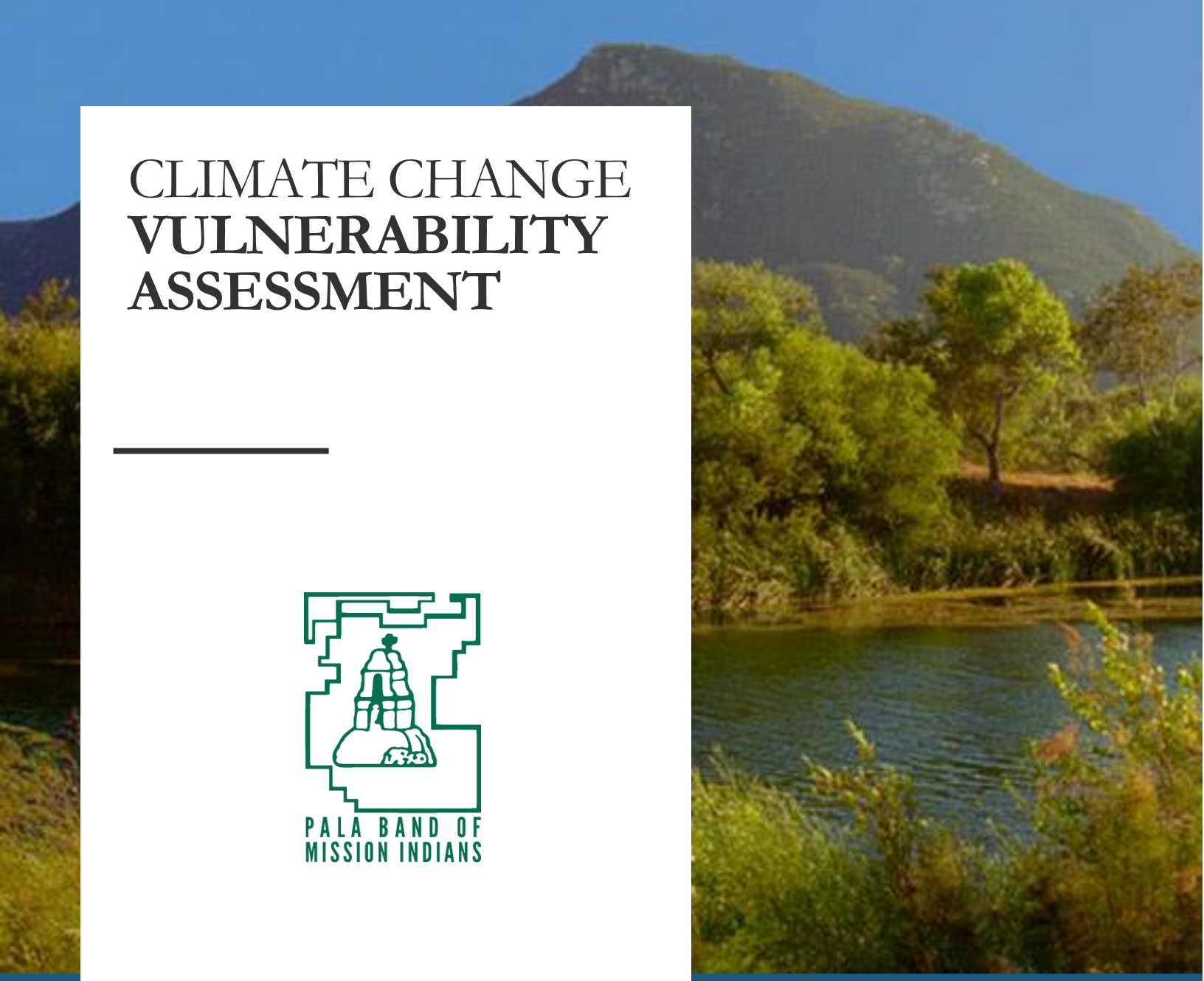


CLIMATE CHANGE **VULNERABILITY ASSESSMENT**

PALA BAND OF MISSION INDIANS

Prepared by:

Prosper Sustainably

February 2019

PALA BAND OF MISSION INDIANS

CONTENTS

Tribal Chairman's Message

The Pala people have a deep history of adapting to changes that have altered our traditional way of life. In recent years, our people have shared growing concern about a new set of threats, including more severe wildfire, drought, temperatures, and flooding. Our climate is changing. In response to these concerns, our tribal government has assessed the effects of climate change on our health, social, natural and built environments. The findings, detailed in this report, show that it is time to summon the same strength and resilience that the people of Pala have demonstrated for thousands of years as they adapted to disruptions to their lands, wellbeing, resources, and culture.

In fact, Pala is already on its way to becoming more resilient. We are implementing projects to secure our infrastructure and protect our people. We are expanding collaborations with tribes and other partners in our region that can leverage knowledge and resources to help us move faster.

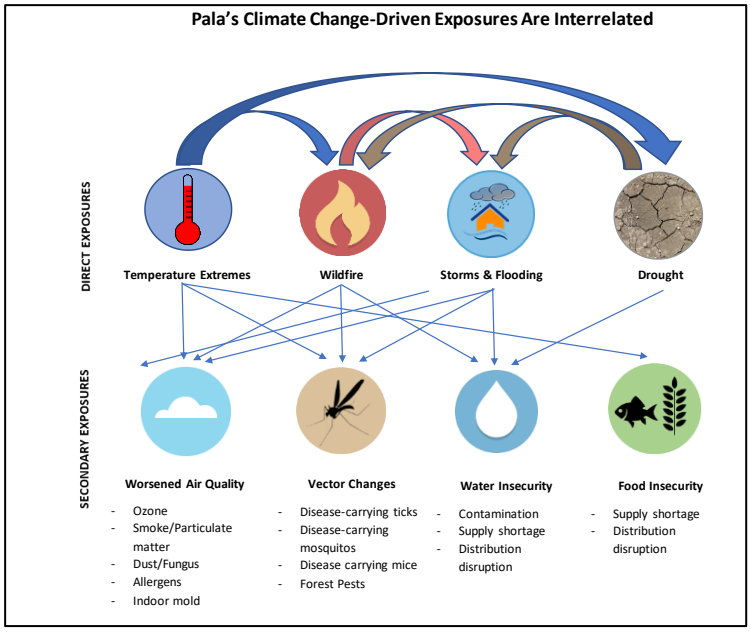
We encourage all members of the Pala community to learn about the effects of climate change, not just on Pala, but throughout Mother Earth. We also hope you will join us as we move ahead to create and implement solutions that will help us thrive in the face of new vulnerabilities and build upon our community's traditional strengths and ability to innovate. We can and will adapt again.

Robert Smith
Tribal Chairman

Executive Summary

The Pala Band of Mission Indians has assessed its vulnerability to climate change, which is summarized in this report. Climate change refers to long-term changes in usual or expected weather patterns resulting from an increase in greenhouse gases in the atmosphere. To determine Pala's climate change vulnerability, this process entailed review of literature, data, staff knowledge, and community observations to determine to what extent Pala may be exposed to various climate changes now and in the future. This report concludes that the following exposures (and sub-bulleted secondary exposures) present the most significant and interrelated risks for Pala. The report is organized by these four exposure areas:

1. **Elevated temperature**
    a. Worsened air ozone levels
    b. Food insecurity
    c. Vector changes
2. **Wildfire**
    a. Worsened particulate matter in air (smoke)
    b. Water insecurity
    c. Vector changes
3. **Storms and Flooding**
    a. Worsened indoor mold in air
    b. Water insecurity
    c. Vector changes
4. **Drought**
    a. Water insecurity
    b. Worsened dust and fungus particles and allergens in air



This review also revealed the potential impacts resulting from such exposures, and the community characteristics that make Pala more sensitive or more adaptable to these impacts. The impacts are organized into three categories: 1) those that affect Pala's Health & Social Environment, 2) those that affect its Natural Environment, and 3) those that affect its Built Environment. This analysis concludes that the impacts listed below are of highest concern for Pala in the foreseeable future. The report provides details about each of these impacts as they relate to each of the four exposure areas outlined above.

Health & Social Environment

Human Health

- Heat-related stress, illness, and death
- Traumatic injury or death from wildfire and storms and flooding
- Mental health and psychosocial consequences associated with stress and trauma
- Inability to access emergency or health services due to infrastructure and public service disruptions or failures (e.g. power, roads, communications, water treatment)
- Respiratory illness due to higher levels of ozone, particulate matter (including smoke and dust), and indoor mold infestations
- Decrease in fitness activity levels due to heat or unsafe outdoor conditions
- Interruptions of drinking water supply

- Infections due to contact with or ingestion of contaminated water
- Infections due to tick or mosquito borne illness
- Reduced access to affordable and nutritious food due to global crop changes
- Carbon monoxide poisoning due to power outages and use of generators

Cultural and Spiritual Health

- Decline of culturally important plants and animals
- Disruption of community functions or ceremonies
- Loss of sacred or historical sites due to wildfire and storms and flooding
- Short- or long-term dislocation or relocation due to wildfire and storms and flooding

Socio-economic Health

- School closures or absences impacting educational opportunities
- Business closures or inability to travel to work impacting economic opportunities

Natural Environment

- Disruptions and stresses to habitats, waterways, and important or sensitive plant and wildlife species, including habitat loss and fragmentation, loss and migration of species, reduced riparian floodplain absorption, and increases in the presence and prevalence of invasive species

Built Environment

- Damage to homes and critical facilities
- Disruption to public services and infrastructure (e.g. power outages, roads, telecommunications, water systems)
- Disruption to agricultural operations

These impacts are anticipated to threaten a variety of Pala's community assets and values, ranging from water resources to human health and tribal sovereignty. The findings presented in this report are intended to increase Pala's awareness of how the Tribe is likely to be affected by climate change. This information is needed for Pala to consider potential actions to address or adapt to any of the threats posed by climate change, which is typically done through the development of an adaptation plan. Pala is currently developing its adaptation plan based on the findings of this Vulnerability Assessment, which will be published in a subsequent report.

Introduction

Pala's climate is changing. Stories and observations shared by Pala's residents match the scientific evidence and latest literature. Climate change refers to long-term changes in usual or expected weather patterns resulting from an increase in greenhouse gases in the atmosphere. Much of the literature suggests that, as a tribal community, Pala is particularly vulnerable to climate change.[1] However, having overcome ecological and human changes on their lands for thousands of years, the people of Pala have also demonstrated exceptional strength, resourcefulness and resilience.

By conducting this Vulnerability Assessment, the Pala Band of Mission Indians has taken an important step in understanding and adapting to new changes anticipated to result from climate change in the foreseeable future, which are summarized in this report.

Purpose

The purpose of this Vulnerability Analysis is to identify the most significant climate change vulnerabilities for the Pala community with a focus on the health, social, natural and built environments on the Pala Reservation. Vulnerability to climate change is the degree to which geophysical, biological, and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change.

Evidence indicates that climate change is increasingly affecting many, if not all, aspects of life on Pala, from the natural environment to community health, economics, and tribal culture. Projections show that these changes will become more extreme in the coming decades. The Fourth National Climate Assessment released in 2018 indicates that "The health risks of climate change are expected to compound existing health issues in Native American and Alaska Native communities, in part due to the loss of traditional foods and practices, the mental stress from permanent community displacement, increased injuries from lack of permafrost, storm damage and flooding, smoke inhalation, damage to water and sanitation systems, decreased food security, and new infectious diseases.[2] Conducting this analysis is an important step in deciding how to best prepare for and adapt to these impacts.

The scope of this analysis is limited to identifying and prioritizing vulnerabilities and does not include analysis of opportunities to address or adapt to such vulnerabilities, which is typically done through developing an adaptation

[1] Jantarasami, L.C., R. Novak, R. Delgado, E. Marino, S. McNeeley, C. Narducci, J. Raymond-Yakoubian, L. Singletary, and K. Powys Whyte. Tribes and Indigenous Peoples. In Impacts, Risks, and Adaptation. *In: Fourth National Climate Assessment, Volume II* (U.S. Global Change Research Program, 2018), https://nca2018.globalchange.gov/chapter/15/

[2] Ebi, K.L., J.M. Balbus, G. Luber, A. Bole, A. Crimmins, G. Glass, S. Saha, M.M. Shimamoto, J. Trtanj, and J.L. White-Newsome. Human Health. In Impacts, Risks, and Adaptation. *In: Fourth National Climate Assessment, Volume II* (U.S. Global Change Research Program, 2018), https://nca2018.globalchange.gov/chapter/14/

plan. This report also does not delve into the topic of greenhouse gas mitigation, which is an effort to address the human activities that contribute to climate change.

Background

Description of Pala's Community and Reservation

The Pala Band of Mission Indians is a federally-recognized Native American Indian Tribe that has a current enrollment of approximately 983 tribal members. Pala's Tribal Government consists of a General Council which is made up of approximately 800 adult members (18 years of age and older) and a 6-member Executive Committee that that is elected by the General Council.

The Pala Band has jurisdiction over the federally-recognized Pala Indian Reservation that was established in 1875. The Pala Indian Reservation is located on approximately 13,000 acres in northern San Diego County roughly 30 miles east of the Pacific Ocean. The Pala Reservation sits next to the Palomar Mountain range that runs along 5,000 square miles of California desert. California State Highway 76 runs through the reservation and is the primary road used to enter or exit the reservation, which is located seven miles east of Interstate 15. Adjacent to the reservation is the Cleveland National Forest to the north and east and private agricultural lands to the south and west. The current population of the Pala Reservation is approximately 1,500 people.

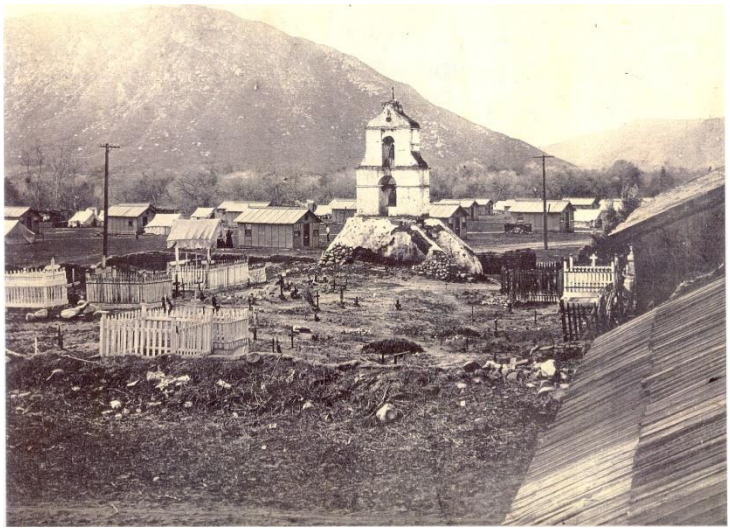
FIGURE 3: PALA RESERVATION

The reservation lies within an alluvial valley surrounded by steep granite mountains and is divided into two areas by the San Luis Rey River (SLR); these are referred to as the north side and the south side. The north side contains most of the homes and development; however, there are also approximately 100 homes and structures south of the river. Elevations range from approximately 340 feet above mean sea level (MSL) at the valley floor to approximately 1,250 feet above MSL in the northern and southern mountainous areas, with most residential, agricultural, and industrial activities occurring in the lower elevations of the reservation.

While approximately 88% of the land is currently undeveloped, land uses include agricultural, mining, pasture land, commercial businesses including gaming, and residential uses. Rapid development occurring in the surrounding areas has increased the burden on natural resources and degraded ecosystems and habitats.

Pala's climate is currently characterized by moist, mild winters and dry, warm summers, also known as 'Mediterranean summers.' Temperatures in the Pala Valley are typically relatively moderate, ranging from an average of 60 degrees Fahrenheit during the winter months to an average of 80 degrees Fahrenheit during the summer. Annual precipitation within the Pala Valley averages about 10-12 inches a year, and between 25 to 45 inches in the Palomar Mountains. Roughly 75% of the annual precipitation falls within the basin between December and March.[3] The South Coast of California where Pala is located is home to one of the world's biodiversity hotspots. The projected climate changes in this area are expected to mainly intensify patterns that are characteristic of a semi-arid Mediterranean climate (periodic droughts, intense cyclonic rainstorms, dry and hot summers).[4]

Prior to the construction of the Lake Henshaw Reservoir and Dam in 1923, Pala had access to the San Luis Rey River's perennial water supply. A complex history of water diversion by new settlers and legal battles ultimately led to a Congressional settlement that was signed into law that quantified the Tribe's prior and paramount water rights and provided for the construction of water projects to facilitate the exercise of Pala's rights. The source of the reservation's domestic water supply is the aquifer and underground stream of the Pala Groundwater Basin, which is drawn from wells scattered throughout the reservation. The Basin lies directly underneath the San Luis Rey River & the Pala village area. It is replenished by rain events and surface water flows from local creeks and rivers.[5]



A Resilient People

The people of the Pala Band of Mission Indians have lived for thousands of years in this part of Southern California. Pala's tribal members have a rich and diverse tribal history with members that come from both Cupeño and Luiseño ancestry. They have endured and adapted to many significant impacts on their lands and community which have disrupted many of their culture and traditions, political and social systems, and ecological environments over hundreds of years beginning with the arrival of Spanish missionaries in 1769.[6] In 1903 the Cupeño Indians were forcibly removed from Warner Springs to Pala, joining with the Luiseño Indians already living here, ultimately combining to make the Pala Band. Ongoing development by communities in the surrounding area has continued to impact the Pala community's ability to continue its hunting, fishing and agricultural operations. The Pala people, however, continue to thrive, buoyed by their strong community and culture connectedness, co-existence with nature, and spiritual connections.

[3] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[4] California Department of Fish and Wildlife, *South Coast Province Chapter In State Wildlife Action Plan: A Conservation Legacy for Californians* (2015), https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109212&inline
[5] Pala Band of Mission Indians. *Annual Water Quality Report* (2017)
[6] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: Summary Report from Tribal and Indigenous Communities with California* (2018), http://www.climateassessment.ca.gov/state/docs/20180827-TribalCommunitySummary.pdf

Pala's Commitment to Its Future

Pala's leadership is committed to protecting the tribe against the impacts of climate change.

FIGURE 5: PALA SCHOOL CHILDREN

In fact, Pala has already taken several steps that improve the community's resilience to anticipated climate change impacts, that include:

- Developed and updated a Hazard Mitigation Plan
- Designated disaster relocation centers and cooling centers
- Provide emergency notifications to residents, including on-site air quality monitoring
- Built new water storage tanks and drilled additional wells
- Built solar arrays on fire station and transfer station
- Installing back-up generators on the casino, administration building, and radio station
- Established intertribal emergency consortium and cooperative agreements to provide mutual assistance during wildfire and other disasters
- San Diego County, with partial funding from the Tribe, installed several culverts along Pala Temecula Road to avoid flooding which has closed the road in the past.
- Retrofitted and widened old Route 76 bridge that crosses Pala Creek with help from CalTrans
- Conduct wildfire management strategies within Reservation and in adjacent forest lands
- Install stream monitoring gages for early flood warning
- Developing a Tribal Habitat Conservation Plan and conservation easements for protected species
- Developed a Drought Contingency Plan
- Conducting climate change education and youth efforts

Vulnerability Assessment Process

Vulnerability assessments compile and analyze accessible information on possible harms and risks that are currently or expected to affect a community. This analysis is typically completed before a climate change adaptation plan is conducted.

For this report, Pala's Environmental Department staff worked with outside consultants (EFC West and Prosper Sustainably) to compile and analyze applicable literature, reports, and data (locally-specific, where available) to determine how various climate change exposures are anticipated to impact Pala, and to determine how severely Pala would be affected given various community characteristics (e.g. indicators of population sensitivity and adaptive capacity). This information was compiled and analyzed in detailed Pala Vulnerability Worksheets, which are in the possession of the Pala Environmental Department (PED). These worksheets were used by PED staff to rank impacts of greatest concern. In determining greatest impact risks, staff were encouraged to factor in the community assets (resources and values) that are of greatest importance to Pala to protect, based on results of a community survey of tribal members (detailed in the next section).

Information Sources

Throughout the report, information sources are cited in footnotes. These include local, state, and national reports; databases; studies and literature generated by Pala, such as its Hazard Mitigation Plan; environmental assessments; and water utility reports. Where possible, this report prioritized information that was specific to the Pala Reservation. In many cases, the most useful data was only available at a county or larger scale and relies on information provided by credible California State or federal agencies, where a high degree of accuracy is likely. However, this report cannot verify the accuracy of all data. For example, data retrieved for the Pala census area from the California Health Performance Index depends on the accuracy of demographic and other information from the US Census and other databases.

Community Engagement

Collaborations are vital to community planning, particularly when planning for future resilience to climate change. They help develop solutions that are grounded in shared values and understanding. By involving different perspectives, collaborations also increase the implementation viability of adaptation plans. This development of this Vulnerability Assessment involved the participation and input of the Pala community in the following ways:

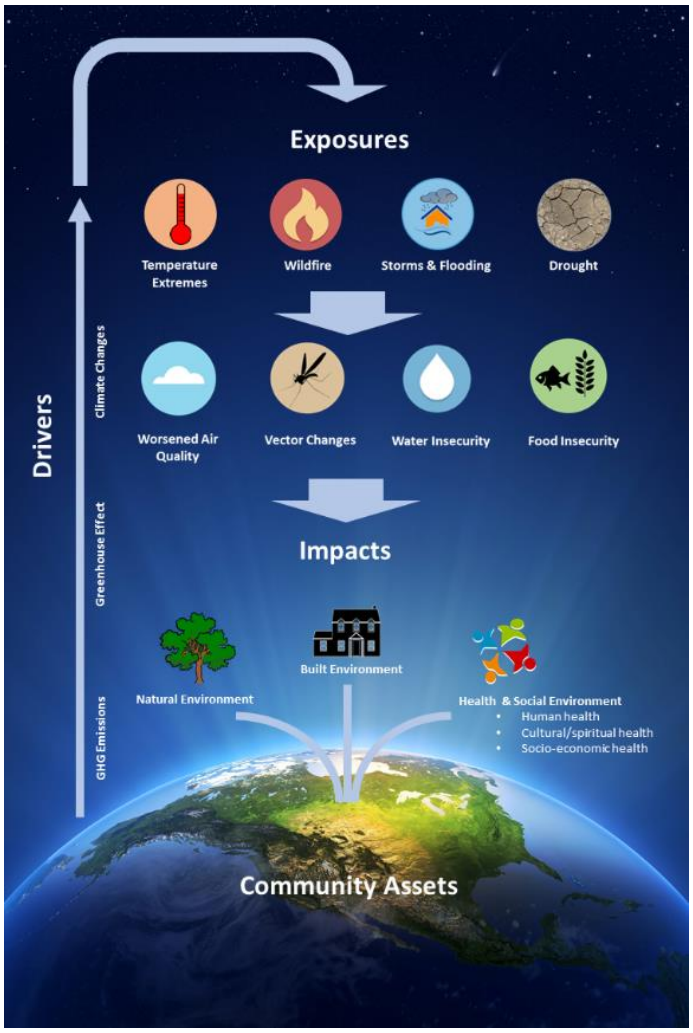
- Oversight and key contributions by PED staff
- Review of materials and reports generated by a variety of Pala departments
- Meetings and workshops with community members and advisors including Pala staff from various departments including Pala Utilities Department, Pala Tribal Services, Pala Fire Department, Pala Business Office, Pala Casino Spa & Resort, and the Pala Executive Committee.
- Survey conducted to better understand the Pala tribal members' perceptions, experiences, concerns and priorities related to climate change.[7]
- Online outreach (e.g. social media and a dedicated webpage) and in-person outreach (e.g. events and community meetings) to build awareness of Pala's progress on climate change adaptation
- Review of vulnerability findings by key internal stakeholders

[7] The questionnaire was completed by 20 tribal members. Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

What Climate Change Means for Pala

Changing Exposures and Impacts

Life on Earth depends on, is shaped by, and affects the climate. Climate change refers to long-term changes in usual or expected weather patterns. Anthropogenic (human-caused) climate change is primarily driven by global warming, which is caused by increased concentrations of greenhouse gases, which form a blanket around the Earth, trapping heat and warming the surface of the Earth and its lower atmosphere. The warming results in a cascade of effects, from melting ice caps to changing precipitation and ocean circulation patterns. These affects trigger a variety of potentially harmful and interrelated disasters that this report refers to as exposures, which include severe storms, heat waves, wildfire, droughts. As illustrated in Figure 7, these exposures impact the health, social, natural, and built environments of communities all over the world to varying degrees, based on location and other community characteristics.



Pala's location within the southwest region of the United States, and within the inland valley and mountainous areas of San Diego County, makes it susceptible to a variety of interrelated exposures as well as secondary exposures. These secondary exposures occur as a result of an initial exposure (e.g. worsened air quality, water insecurity, etc.). The sections under Findings describe the anticipated vulnerability impacts these exposures present to Pala's health, social, natural, and built environments. These findings are consistent with California's recently released Fourth Climate Assessment, which summarizes the following historical and expected climate impacts in California (Figure 8).[8]

[8] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018), http://www.climateassessment.ca.gov/state/docs/20180827-StatewideSummary.pdf

CLIMATE IMPACT	HISTORICAL TRENDS	FUTURE DIRECTION OF CHANGE	CONFIDENCE FOR FUTURE CHANGE
Temperature	Warming (last 100+ years)	Warming	Very High
Sea Levels	Rising (last 100+ years)	Rising	Very High
Snowpack	Declining (last 60+ years)	Declining	Very High
Annual Precipitation	No significant trends (last 100+ years)	Unknown	Low
Intensity of heavy precipitation events	No significant trends (last 100 years)	Increasing	Medium-High
Frequency of Drought	No significant trends (last 100+ years)	Increasing	Medium-High
Frequency and intensity of Santa Ana Winds	No significant trends (last 60+ years)	Unknown	Low
Marine Layer Clouds	Some downward trends; mostly not significant (last 60+ years)	Unknown	Low
Acres Burned by Wildfire	Increasing (last 30+ years)	Increasing	Medium-High

FIGURE 8: CALIFORNIA'S FOURTH CLIMATE ASSESSMENT: A QUALITATIVE DESCRIPTION OF CURRENT UNDERSTANDING OF HISTORICAL AND EXPECTED CLIMATE IMPACTS IN CALIFORNIA

According to California's Fourth Climate Assessment, San Diego County is subject to rapid population growth and urbanization, which is expected to exacerbate the climate-related stresses on infrastructure, land use, water supply, and electricity.[9]

This Vulnerability Assessment factors in certain characteristics that make Pala either more sensitive to possible impacts of climate change, or more capable of adapting to these impacts. For example, Pala has 21 buildings considered at high risk from flood and 22 critical facilities in a high-risk wildfire area, according to its Hazard Mitigation Plan.[10] In addition, only 53% of residents have air conditioning in their homes to buffer them from

[9] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018), http://www.climateassessment.ca.gov/regions/docs/20180928-SanDiego.pdf

[10] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

anticipated heat impacts.[11] However, Pala also has more tree canopy cover, lower percentages of impervious surfaces, and a lower urban heat island index than most census tracts in CA,[12] which may help buffer residents from expected impacts of extreme heat. While only 77% of the Pala's adult residents have health insurance,[13] all tribal members have access to affordable health services through the San Diego American Indian Health Center, which can help them better manage health related impacts associated with climate change.

Changes Observed by Pala Tribal Members

The Pala Environmental Department conducted a survey to gauge Pala tribal members' perceptions, experiences, knowledge, observations, and priorities about climate change. On a scale from 1-5 (5 being the most concerned), Pala survey respondents scored their concern about climate change's effects on Pala at a 4.3. Of responses received, only 5% were "not at all concerned" about climate change and 60% of respondents said they were "very concerned" about climate change at Pala. Approximately 90% of respondents said they feel that the climate in Pala has changed from what they remember. Specific observations are quoted in this report in the applicable vulnerability sections under Findings. Those surveyed were most concerned about wildfire, drought, cultural traditions, and human health as shown in Figure 9 below.[14]

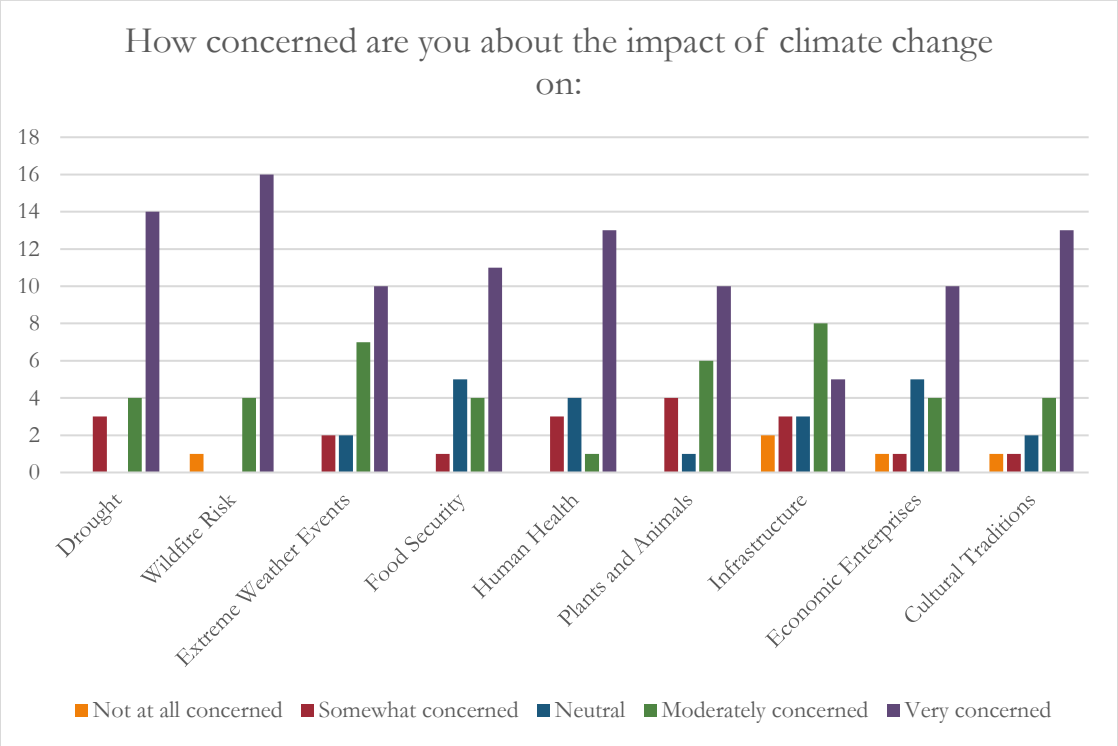


FIGURE 9: SURVEY RESPONSES ON CLIMATE CONCERNS

[11] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018), https://healthyplacesindex.org
[12] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)
[13] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)
[14] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

A community workshop held on February 20, 2019 for community members and staff also asked attendees to share which of the four direct exposures they felt was the top priority to address. As shown in Figure 10 below, most attendees voted for Drought.[15] Vulnerabilities associated with each exposure are outlined in the Findings sections.

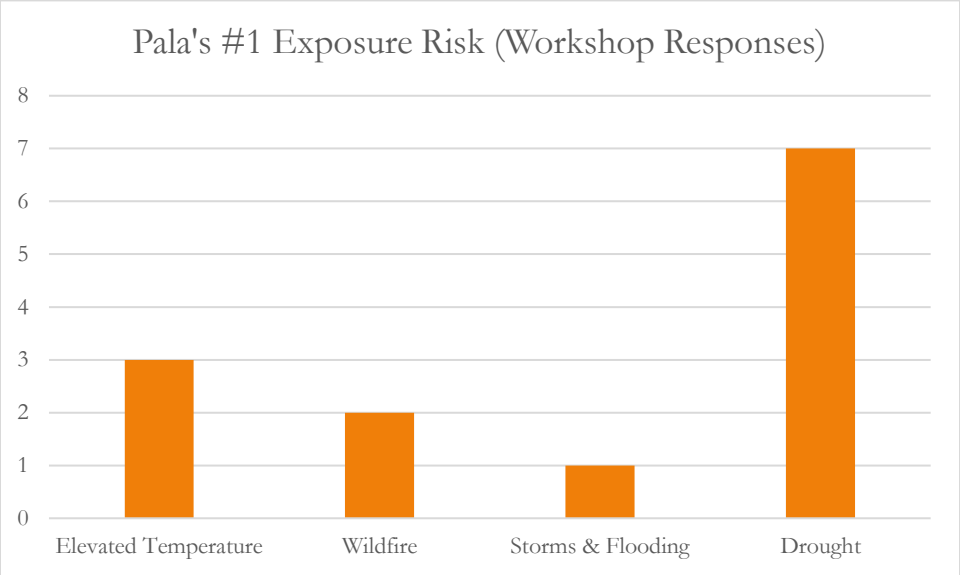


FIGURE 10: WORKSHOP RESPONSES ON PALA'S #1 EXPOSURE RISK

Threatened Community Assets

Pala possesses a wide variety of resources and values (referred to as "community assets" in this report) that the tribal community considers important and wants to protect from threats associated with climate change. Pala's Hazard Mitigation Plan provides estimates of the value of hazard exposures of different types of building assets.[16] However, Pala defines assets more broadly to include social and natural assets and community values. These community assets are listed and ranked in

	Building Exposure	Content Exposure	Total Exposure
Agricultural	$12,829,000	$12,829,000	$25,658,000
Commercial	$52,663,000	$54,770,000	$107,433,000
Education	$10,999,000	$11,752,000	$22,751,000
Government	$8,899,000	$10,586,000	$19,485,000
Industrial	$11,140,000	$14,833,000	$25,973,000
Religious	$5,112,000	$5,112,000	$10,224,000
Residential	$518,342,000	$259,522,000	$777,864,000
TOTAL	$619,984,000	$369,404,000	$989,388,000

[15] Prosper Sustainably, *Planet Pala Adaptation Workshop* (February 21, 2019)
[16] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

Figure 12 below. The rankings are derived from input obtained at community engagement sessions, where attendees ranked each asset as high (3), medium (2), or low (1) priority. [17]

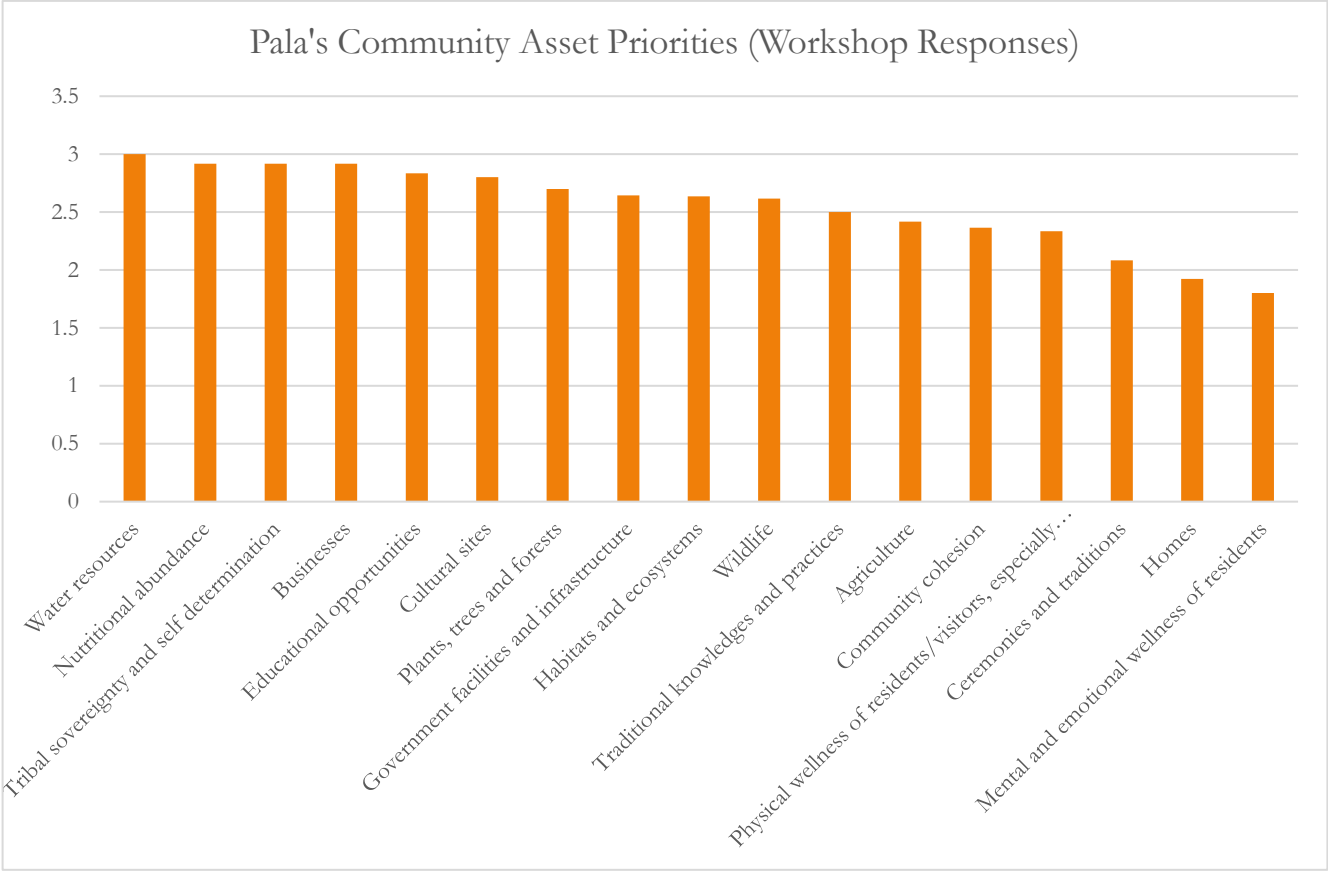


FIGURE 12: WORKSHOP RESPONSES ON PALA'S COMMUNITY ASSET PRIORITIES

On average survey respondents believed that most of the community assets were of at least medium importance with respect to the threats associated with climate change. As illustrated in Figure 12, of the 17 assets presented, the top five assets were:

1) Water resources
2) Nutritional abundance
3) Tribal sovereignty and self determination
4) Businesses
5) Educational Opportunities

These rankings provide useful indicators of Pala's unique community values. In this assessment, they are used as a key factor in determining which climate change impacts are considered of highest concern (see vulnerability findings in each Section below). This information can also be used by the tribe in deciding how to protect its most important assets by developing adaptation strategies, which can be done through developing an adaptation plan.

[17] Prosper Sustainably, *Planet Pala Adaptation Workshop* (February 21, 2019)

Findings

The following sections summarize the findings of the vulnerability analysis under four interrelated exposure areas, that include elevated temperature, wildfire, drought, and storms and flooding. These exposure areas and their relationships to one another are shown in Figure 13 below. For each exposure area, this report describes the anticipated impacts to Pala's health and social environment and its natural environment resulting from both direct exposures and secondary exposures.

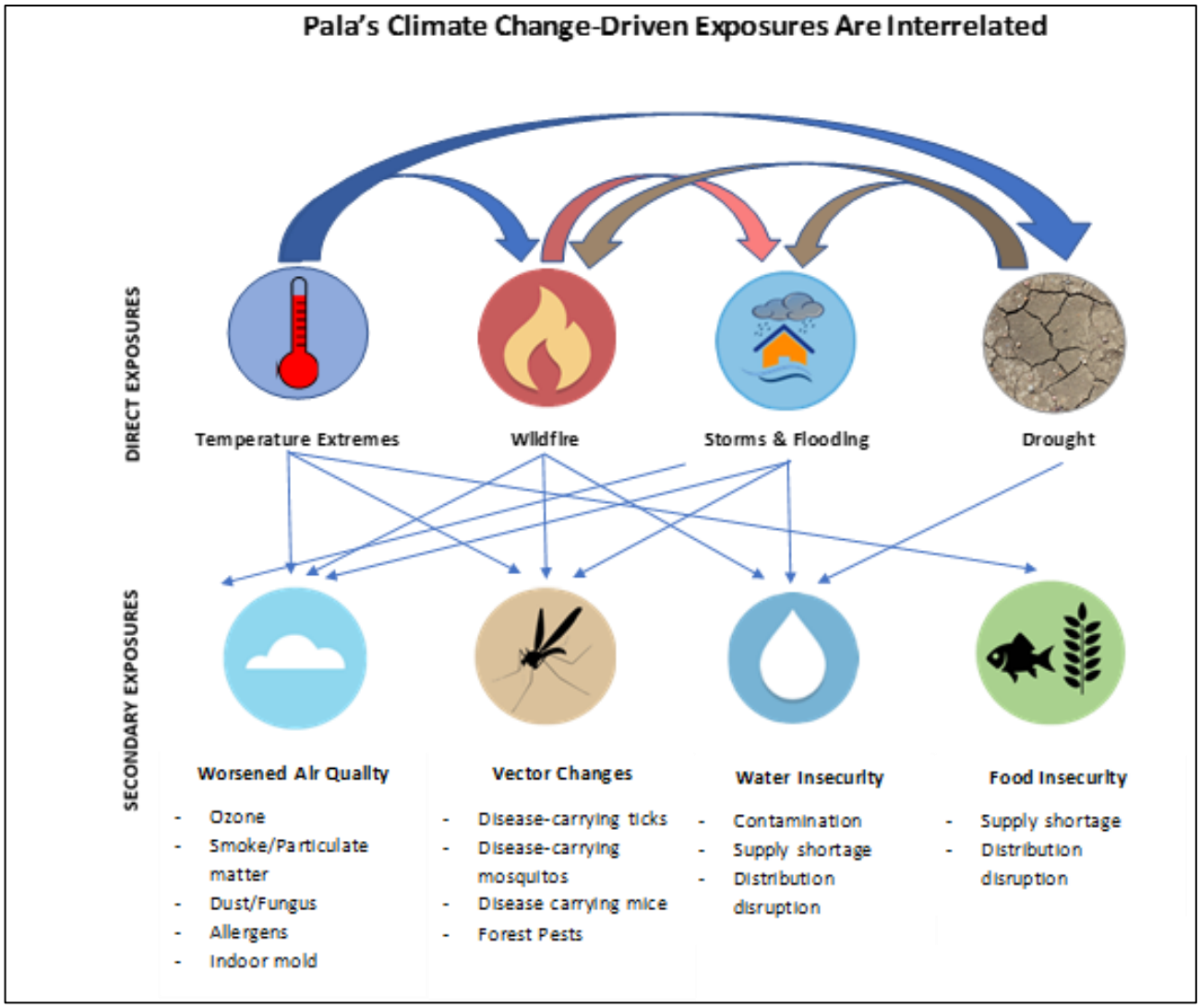


FIGURE 13: PALA'S CLIMATE CHANGE-DRIVEN EXPOSURES

ELEVATED TEMPERATURE

HIGH RISK EXPOSURE

Key Climate Exposure Facts

According to the 2017 Climate Science Special Report (CSSR), temperatures in the US are projected to increase 2.8 – 7.3 degrees Fahrenheit on average by 2071 – 2100.[18] The US Southwest, where Pala is located, is particularly prone to heat waves.[19] The California Department of Public Health estimates that San Diego County will experience a 5 - 6 degree average temperature increase in January by 2100 along with a 5 – 10 degree increase in July. Heat waves have been historically infrequent in San Diego County; however, climate change is projected to significantly increase the frequency of heat waves.[20]

Heat extremes are considered a high-risk exposure for the Pala tribe. The tribe has experienced 18 heat-related events between 1997 – 2014.[21] Several of the tribal members that responded to a survey said they were concerned about temperature extremes. Cal-adapt, a climate adaptation tool developed by the State of California, projects that days over 99.9 degrees will increase by 750% by 2070-2099.[22] That means Pala residents will experience extreme heat days 1 out of every 10 days.

OTHER EXPOSURES TRIGGERED

Wildfire

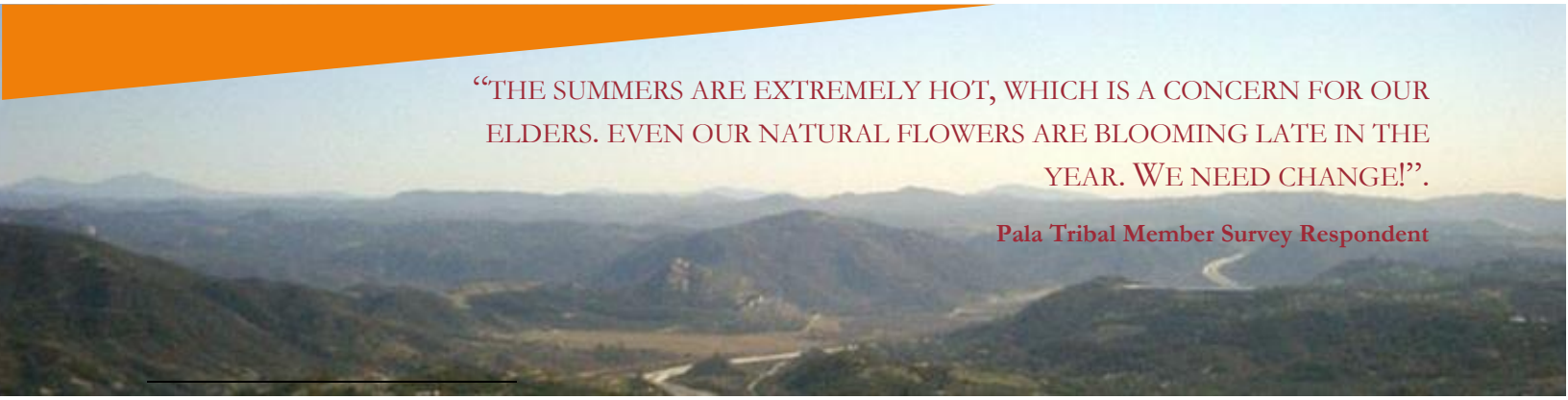
Drought

SECONDARY EXPOSURES

Ground level ozone in air

Disease-carrying mosquitos

Food supply disruption



"THE SUMMERS ARE EXTREMELY HOT, WHICH IS A CONCERN FOR OUR ELDERS. EVEN OUR NATURAL FLOWERS ARE BLOOMING LATE IN THE YEAR. WE NEED CHANGE!".

Pala Tribal Member Survey Respondent

[18] Vose, R.S., D.R. Easterling, K.E. Kunkel, A.N. LeGrande, and M.F. Wehner, *Temperature changes in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I* (U.S. Global Change Research Program, 2018), https://science2017.globalchange.gov/chapter/6/

[19] U.S. Environmental Protection Agency (EPA), *Climate Impacts in the Southwest,* https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-southwest_.html (2018)

[20] County of San Diego. *Climate Change Vulnerability, Resiliency, and Adaptation. In: Climate Action Plan*, https://www.sandiegocounty.gov/content/dam/sdc/pds/advance/cap/publicreviewdocuments/CAPfilespublicreview/Chapter%204%20Climate%20Change%20Vulnerability%2C%20Resiliency%2C%20and%20Adaptation.pdf

[21] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

[22] Geospatial Innovation Facility (UC Berkeley). *Cal-adapt,* http://cal-adapt.org (2018)

Vulnerabilities by Impact Area

The following sections detail impacts to the Health and Social Environment, the Natural Environment, and the Built Environment, which are summarized in Figure 22.

Health and Social Environment

Elevated heat affects human health, cultural and spiritual health, and socio-economic health. These impacts are described in detail below.

HUMAN HEALTH

Heat-Related Illness and Death

Sustained high heat waves can affect human health through heat-related illnesses, such as heat stroke, heat exhaustion, and dehydration. They can also cause illnesses and premature deaths from cardiovascular or respiratory disease, as illustrated in Figure 14 below.[23]

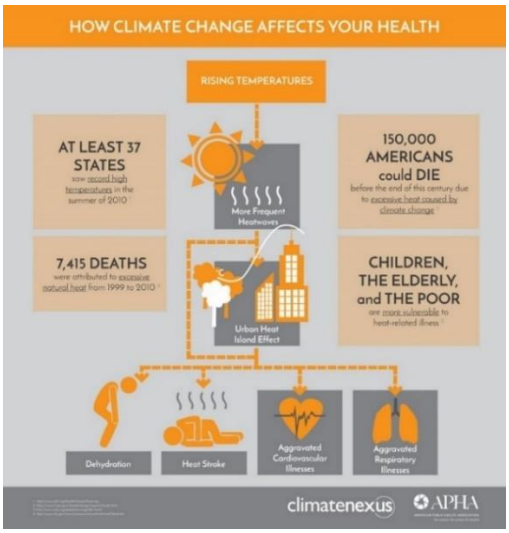


FIGURE 14: EFFECT OF CLIMATE CHANGE ON RISING TEMPERATURES AND HEALTH

In 2014, 587 people in California were hospitalized for heat stress, and 42 people died due to heat-related illness.[24] The California Public Health Department (CPHD) reports that, in 2016, 206 people out of 100,000 people in San Diego County were admitted to the emergency room for heat-related illnesses such as heat stroke, as well as cardiovascular, kidney, or respiratory disorders.[25]

Certain populations are more sensitive to heat-related illness. At most risk are elders (over 65), children, outdoor workers, and people living in poverty. Pala's demographics for these populations are typical compared to communities across California, which may indicate that the Pala community is at average risk for heat-related illness.[26] One survey respondent shared concern about "higher temperatures that children have to be out in."[27]

Prompt access to treatment can help lower risk of heat-related illness. While just 80% of adults and children in Pala's census tract have health insurance,[28] Native American residents can access Indian Health Center for medical treatment.

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[23] American Public Health Association (APHA), *How Climate Change Affects Your Health,* https://www.apha.org/news-and-media/multimedia/infographics/how-climate-change-affects-your-health (2018)

[24] U.S. Center for Disease Control (CDC), *National Environmental Public Health Tracking,* https://ephtracking.cdc.gov/DataExplorer/# (2018)

[25] Maizlish et al, *Climate Change and Health Profile Report: San Diego County,* (Office of Health Equity, California Department of Public Health https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHPRs/CHPR073SanDiego_County2-23-17.pdf (2017)

[26] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)

[27] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

[28] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018),

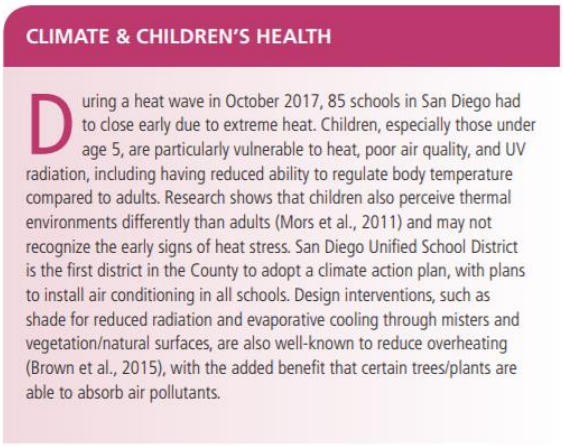

FIGURE 15: CLIMATE & CHILDREN'S HEALTH FROM THE CA FOURTH CLIMATE ASSESSMENT[29]

There are certain community characteristics that make Pala either more sensitive to or more capable of adapting to climate changes like temperature. For example, less than half of Pala households have air conditioning, which may increase the community's vulnerability to heat. However, Pala has a lower Urban Heat Island Index than most other California communities, meaning it has less local heat-producing manmade surfaces. Pala also has a higher percentage of area covered by tree canopy (6.8%) than 65% of California communities, meaning that the community has some well-shaded areas that can help reduce vulnerability to heat.[30]

Health Risks Due to Disruptions to Critical Infrastructure

Increased demand for electricity for air conditioning during extreme heat events can result in power outages. Power outages can limit access to services such as air-conditioning, telecommunications, and emergency and healthcare services that help protect against heat-related illness. Outages may also result in carbon monoxide poisoning associated with the use of generators.

Pala gets most of its power from San Diego Gas and Electric (SDG&E) and exists at the end of the power distribution line, making it particularly vulnerable to extended outages. The tribe has built large scale solar installations to improve resilience to power outages. However, these grid-tied systems are not connected to storage systems and the solar panels automatically shut down during an outage to avoid back feeding electricity into the grid.

Increased Ozone & Allergens in Air

Increased heat intensifies photochemical reactions that produce ground level ozone, a key component of smog associated with motor vehicles, wildfires, and power generation. Ozone and smog irritate the human respiratory system and can contribute to and exacerbate respiratory diseases.

Ozone is a problem in San Diego County. The Center for Disease Control (CDC) reports that residents of San Diego County were exposed to 32 days of unhealthy levels of ozone in 2014.[31] The CDPH reports that San Diego County already has almost 6 times more days when ozone concentration is above standard than the rest of the state.[32] The EPA's Air Quality Index indicates that ozone was the main air pollutant in San Diego County for 238 days in 2017.[33]

Projections for increased heat mean that Pala residents will be exposed to even higher levels of ozone. As a result, Pala residents may experience more cases of decreased lung function, respiratory symptoms, hospitalizations for cardiopulmonary causes, emergency room visits for asthma, and premature

[29] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018), http://www.climateassessment.ca.gov/regions/docs/20180928-SanDiego.pdf, p. 83

[30] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)

[31] U.S. Center for Disease Control (CDC), *National Environmental Public Health Tracking,* https://ephtracking.cdc.gov/InfoByLocation/(2018)

[32] California Department of Public Health (CDPH), *Climate Change & Health Vulnerability Indicators for California (CCHVIs)*, https://discovery.cdph.ca.gov/ohe/CCHVIz/ (2018)

[33] U.S. EPA, *Outdoor Air Quality Data.* https://www.epa.gov/outdoor-air-quality-data/air-quality-index-report (2018)

death. Elders, children, outdoor workers and those with existing medical conditions are particularly susceptible to these impacts.

Pala's population has a lower rate of emergency room visits (per 10,000 ER visits) than 90.5% of the other census tracts in the State.[34] It's unclear if this is because treatment events are not well documented.

In addition, pollen levels are known to increase with higher temperatures and higher levels of CO^2.[35] Pala residents also report increases in severe allergy symptoms in recent years.

Increases in Infections from Vectors, Water and Food

Increased temperatures are changing the abundance and timing of vectors that can infect Pala residents. Some species of mosquitos are responsible for vector-borne diseases like West-Nile virus and Zika, which are becoming more prevalent in Southern California. Pala considers disease carrying mosquitos to be a growing concern in the foreseeable future.

Since West Nile virus first appeared in the U.S. in 1999 and in the state in 2002, California has reported more than 4,800 cases of West Nile virus (WNV), the highest of any state in the country.[36] In 2016, there were 1-2.49 cases of West Nile per 100,000 people in San Diego County. Of those infected with WNV, 20% to 30% develop acute systemic febrile illness, which may include headache, myalgias (muscle pains), rash, or gastrointestinal symptoms; fewer than 1% experience neuroinvasive disease, which may include meningitis (inflammation around the brain and spinal cord), encephalitis (inflammation of the brain), or myelitis (inflammation of the spinal cord). According to the US Environmental Protection Agency (EPA), by 2090, annual national cases of West Nile neuroinvasive disease are projected to increase by 1,700 – 3,300 annual cases (compared to 1995).[37]

Projections from the latest IPCC show that the mosquitoes *Aedes aegypti* and *Ades albopictus* – the principal vectors for Zika virus – are projected to increase in number, with a larger geographic range by the 2030s.[38] There were 49 cases of Zika disease in CA in 2017.[39] In recent years, invasive Aedes mosquitoes have massively expanded.[40] While there have yet to be any known locally-acquired human cases of these diseases, there remains the possibility of local transmission occurring as travelers return from affected regions.[41] Zika can be passed from a pregnant woman to her fetus. Infection during pregnancy can cause certain birth defects. While both the County and the Tribe have mosquito abatement and control programs, this disease is a growing concern for Pala.

In addition to mosquitos, Pala should monitor a growing population of ticks carrying Lyme disease in the region. Typical symptoms of Lyme disease include fever, headache, fatigue, and a characteristic skin rash called erythema migrans. If left untreated, infection can

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[34] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)

[35] Scott, Michon, *Climate & Allergies* (National Oceanic and Atmospheric Administration (NOAA), 2018), https://www.climate.gov/news-features/climate-and/climate-allergies

[36] Public Health Institute, Center for Climate Change and Health, *Infectious Disease, Climate Change and Health* (2016), http://climatehealthconnect.org/wp-content/uploads/2016/09/InfectiousDisease.pdf

[37] EPA, *U.S. Multi-Model Framework for Quantitative Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2018), https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=OAP&dirEntryId=335095

[38] Ebi, Kristie, Campell-Lendrum, Diarmid, Wyns, Arthur, *The 1.5 Health Report: Synthesis on Health & Climate Science in the IPCC SR1.5* (Climate Tracker, 2018), http://climatetracker.org/wp-content/uploads/2018/10/The-1.5-Health-Report.pdf

[39] U.S. Centers for Disease Control and Prevention (CDC), *Zika Virus: 2017 Case Counts in the US* (2017) https://www.cdc.gov/zika/reporting/2017-case-counts.html

[40] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018), http://climateassessment.ca.gov/regions/docs/20180928-SanDiego.pdf

[41] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018)

spread to joints, the heart, and the nervous system. There were 8 average annual cases of Lyme disease per 100,000 people in San Diego County in 2014-2016.[42] Vector-borne disease impacts are illustrated further in Figure 16.[43]

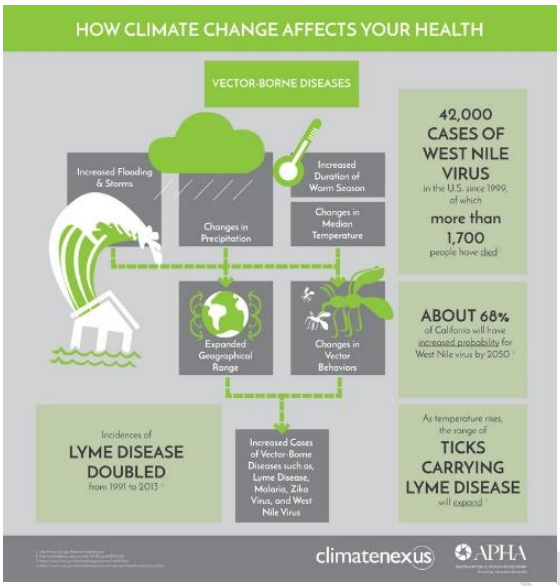


FIGURE 16: EFFECT OF CLIMATE CHANGE ON VECTOR BORNE DISEASE

Pala Environmental Department staff also note that rodents are a vector of concern. Rodents such as deer mouse and white-footed mouse in the US can carry diseases such as hantavirus.

Higher temperatures can also help harmful pathogens like bacteria and viruses flourish in food and water. These pathogens can lead to increases in foodborne (e.g. Salmonella, *E. coli*) and waterborne (e.g. Vibrio) infection and illnesses. Waterborne pathogens are estimated to cause 8.5% to 12% of acute gastrointestinal illness cases in the United States, affecting between 12 million and 19 million people annually.[44] A survey respondent noted that water quality was a key concern.[45] Pala's Water Quality Reports[46] show that water quality in Pala's wells have stayed within the standard range. Pala's Public Water System is tested twice a month for bacteria and quarterly for non-bacterial contaminants and results are submitted to U.S. EPA.

Warmer water also fosters the growth of harmful toxic algal blooms, which can contaminate fish and water.

Food and Water Insecurity

Elevated temperatures at Pala are projected to increase water evaporation and lower water levels in rivers, streams, and aquifers, a challenging scenario as Pala already relies on groundwater for domestic water and irrigation. Increased water demand from development in the region, coupled with declining water supply from CA snowpack and the Colorado River, will place additional burden on local water resources.

Pala is not currently at risk of running out of water, but Pala environmental staff continue to monitor changes. Several survey respondents shared concerns about water shortages, which is addressed further under the Drought section.

Pala is somewhat concerned about food security as well. A survey respondent shared concerns about "food shortages."[47] There are several historical, economic, and ecological factors that have led Pala to no longer rely on local subsistence or agriculture. Compounding these factors, elevated heat and greater CO_2 levels are also expected to affect crop production and nutritional quality on a local and global scale, affecting the availability and quality of affordable food accessible to Pala residents through local markets.

[42] U.S. Centers for Disease Control and Prevention (CDC), *Lyme Disease Data and Statistics* (2018), https://www.cdc.gov/lyme/stats/index.html
[43] American Public Health Association (APHA), *How Climate Change Affects Your Health.*
[44] Trtanj, J., L. Jantarasami, J. Brunkard, T. Collier, J. Jacobs, E. Lipp, S. McLellan, S. Moore, H. Paerl, J. Ravenscroft, M. Sengco, and J. Thurston. *Ch. 6: Climate Impacts on Water-Related Illness. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (U.S. Global Change Research Program, 2016), https://health2016.globalchange.gov/water-related-illness
[45] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018
[46] Pala Band of Mission Indians. *Annual Water Quality Report* (2017)
[47] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

Mental Health Consequences

Mental, behavioral, and cognitive disorders can be triggered or exacerbated by heat waves, particularly for populations with existing mental health conditions. Studies have linked extreme heat with increases in aggressive behavior, alcohol and drug use, violence, and crime.[48]

Extreme heat can also inhibit outdoor activities that can promote wellbeing. A survey respondent noted concern that children have to be outside in higher temperatures.[49]

CULTURAL AND SPIRITUAL HEALTH

The Pala Reservation is the ancestral home of the Cupeño and Luiseño people, and a habitable climate is critical to protecting tribal sovereignty, culture, and community cohesion. Projections for frequent extreme heat days can threaten cultural identity and traditional ways of life at Pala, including disruptions to culturally important activities such as traditional gatherings, annual ceremonies, traditional food foraging, bird songs, and basket weaving. Over time, as temperatures continue to rise, residents may opt out of these traditions, or relocate their household out of the area, which would affect community cohesion and cultural identity and sovereignty. Extended power outages may force temporary relocations.

As detailed under the Natural Environment section, increased temperatures also result in a variety of ecosystem disruptions. For tribes, that can mean declines or disappearance of culturally important plants and animals. At Pala, survey respondents were concerned about culturally important plants such as those required for baskets (juncus and *Rhus trilobata*), acorns, sage, willow, and tobacco.[50]

FIGURE 17: PALA POWWOW

SOCIO-ECONOMIC HEALTH

According to the CA Fourth Climate Change Assessment, by 2050, high ambient temperatures are estimated to result in $50 billion/year in additional costs associated with human mortality resulting from high temperatures in California. Increased electricity demand resulting from high temperatures is estimated to cost approximately $200 million/year.[51]

A tribe's social and economic institutions are an important factor in its overall community health. Extreme heat and its effects on human health (as described above) can result in a variety of negative socio-economic impacts. Health impacts and power disruptions triggered by extreme heat can result in lost work days and revenues for tribal businesses. For Pala, critical economic drivers include gaming, entertainment, hospitality, and other business ventures.

Health impacts and power outages can also result in lost school days and closures of school and afterschool activities that impact Pala's youth. Higher ozone concentrations driven by higher temperatures are known to increase respiratory health risks and school

[48] Dodgen, D., D. Donato, N. Kelly, A. La Greca, J. Morganstein, J. Reser, J. Ruzek, S. Schweitzer, M.M. Shimamoto, K. Thigpen Tart, and R. Ursano, *Ch. 8: Mental Health and Wellbeing. In The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (*U.S. Global Change Research Program, 2016), https://health2016.globalchange.gov/mental-health-and-well-being

[49] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

[50] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

[51] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)

absences,[52] affecting educational opportunities, which was ranked as a highly important community asset by survey respondents.[53]

FIGURE 18: PALA STUDENTS

Natural Environment

For over 10,000 years, Native Americans from diverse tribes have been practicing natural resource management. The Pala people rely upon and respect nature and are committed to protecting natural resources so that future generations may experience and enjoy them. Pala members are concerned about the future of their natural resources. One survey respondent said "the old wild plants are not coming back."[54]

California has the highest number of native and endemic plant species of any U.S. state and is recognized as one of 34 global hotspots for plant diversity. The intersection of biological resources and urbanization has made the "South Coast Province," where Pala is located, the most-threatened biologically diverse area in the continental U.S.[55] According to the CA Fourth Climate Assessment, San Diego's natural lands are some of the most biodiverse in the United States and are home to approximately 200 taxa of plants and animals that are at risk.[56]

Climate change is one of the biggest threats to conserving the rich biodiversity found in the region. [57] Elevated temperature alters the natural environment in many ways. Pala identified the elements and species discussed below as significant concerns for their natural environment.

PLANT SPECIES

Climate change driven extreme heat and associated water evaporation, season shifts, and insect and pest outbreaks can weaken plants, trees, and forests or shift growth patterns. Temperature changes can alter the timing of ecological activities such as flowering. There is ample evidence of such impacts in Southern California.

Some vegetation types in Southern California (e.g. chaparral and coastal sage scrub) have experienced declines in vegetation greenness over the last 17 years.[58] The California Fish and Wildlife map in Figure 19 projects vegetation climate exposure for the region.[59]

[52] California Department of Public Health, UC Davis, *California Building Resilience Against Climate Effects*, (CalBRACE) Project: Three-year Ozone Concentration Exceedance, https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHVIs/BRACE_Ozone_801_Narrative_11-8-2016.pdf

[53] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

[54] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)

[55] California Natural Resources Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy* (2018), http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

[56] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018),

[57] California Natural Resources Agency, *Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy* (2018)

[58] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Los Angeles Region Report* (2018), p. 53

[59] California Department of Fish and Wildlife, *Biogeographical Information and Observation System (BIOS)* (2018), https://map.dfg.ca.gov/bios/?dslist=2653,2654,2655,2656

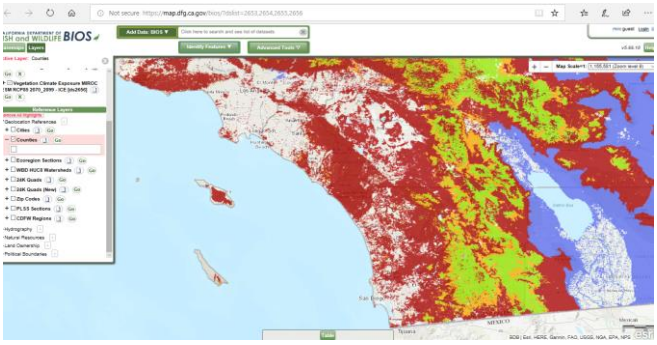


FIGURE 19: VEGETATION CLIMATE EXPOSURE IN REGION

San Diego County hosts thirty different vegetation types, with the largest percentage being chaparral followed by desert scrub and coastal scrub.[60]

Pala Environmental Department staff note declining numbers of Englemann and coast live oak trees, which are considered culturally important. The coast live oak was known as wi'awlet to the Cupeño people. For many tribes, oak trees were a key source of nutrition (acorn mush or wi'wish) and are a symbol of life, growth, and the cycle of the seasons. CA's Fourth Climate Change Assessment indicates that the potential ranges of California endemic oaks may shrink by over 50% and shift northward.[61] Goldspotted oak borer beetle is a concern for the oak groves on the reservation, particularly in light of the increased drought which has taken a toll on oak species.

Pala Environmental Department staff also note that manzanita and other upland plants are moving into the riverbed as riparian vegetation and wetlands dry up. Reduced riparian vegetation lowers natural capacity to absorb storm water, which exacerbates flooding threats in the Reservation.

Climate change is particularly concerning for sensitive species. According to Pala Environmental Department's Wildlife Biologist, Pala's reservation is home to endangered or threatened plant species including Parry's tetracoccus and Rainbow manzanita.

Declining trees and plants provide resources that support the Tribe's cultural traditions. For example, the tribes of Southern California relied heavily on acorns, preparing them to make nutritious wiwish (acorn mush). Community members report that culturally important plants like basket brush and ferns have become harder to find.

Climate changes like increased temperature also creates conditions for certain non-native, invasive species to thrive, altering both their impact and distribution. Examples of invasive species present on the Pala Reservation are eucalyptus, arundo, and tamarisk. These species can lower habitat quality for wildlife and contribute to increased wildfire frequencies.

HABITATS AND ECOSYSTEMS

Pala's wildlife depend on healthy, large, and connected habitats to roam, breed, and hunt. Climate-related changes are adding pressure to ecosystems already stressed by habitat loss and fragmentation, pollution, disease, population growth, and other human-related impacts.[62]

As a result of temperature changes, the population distributions of some North American species are expected to move northward in latitude and upward in elevation. Changes in the timing of seasonal life-cycle events can lead to mismatches in the timing of wildlife migration, breeding, pollination, and food availability. [63] San Diego County is home to increasingly disconnected landscapes and fragmented habitats.[64]

[60] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018), p. 49
[61] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Los Angeles Region Report* (2018), p. 53
[62] California Natural Resources Agency, *Safeguarding California: Reducing Climate Risk, An update to the 2009 California Climate Adaptation Strategy* (2014), http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf
[63] California Natural Resources Agency, *Safeguarding California: Reducing Climate Risk, An update to the 2009 California Climate Adaptation Strategy* (2014)
[64] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A*

As temperatures increase, Pala's Environmental Department staff note declining levels of important habitats including chaparral, native grasslands, wetlands, riparian, and upland habitats and increasing levels of non-native grasslands. In addition to heat, increased CO^2 can lead to changes in species distribution and community composition in Pala's shrublands.[65]

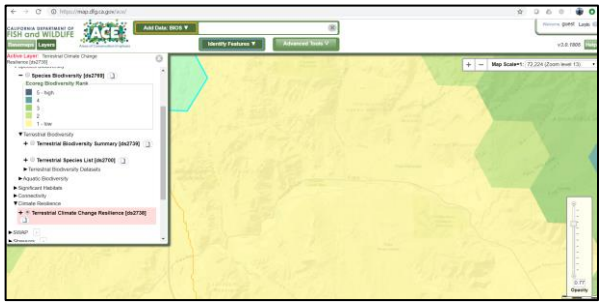


FIGURE 20: PALA CLIMATE RESILIENCE FOR TERRESTRIAL SPECIES

The State Wildlife Conservation Action (2015) plan lists climate change as a key pressure on targeted conservation habitats in the grasslands and riparian woodlands prevalent in the region of Southern California where Pala is located.[66] Similarly, the CA Department of Fish and Wildlife (CDFW) indicates that climate change is a key pressure for Southern California Mountain and Valley wildlife habitat were Pala is located.[67] The CDFW's Area of Conservation Emphasis (ACE) tool ranks the Pala Reservation as low in "climate resilience" for its terrestrial species as shown in Figure 20 above.[68]

Pala's environmental staff area developing a Habitat Conservation Plan to better understand and address changes in Pala's delicate habitats.

WILDLIFE SPECIES

Extreme heat events can exceed the physiological thresholds for temperature tolerance for some land and aquatic species. The Intergovernmental Panel on Climate Change (IPCC) estimates that 20-30% of the plant and animal species evaluated so far in climate change studies are at risk of extinction if temperatures reach levels projected to occur by the end of this century.[69]

These climate changes are causing certain native animal populations to decline in Pala's region. Temperature increases are altering habitat suitability for endemic species like the federally endangered quinco checkerspot butterfly and California gnatcatcher, for which range shifts have been observed. [70] Additionally, heat related water evaporation, coupled with burgeoning human development and populations in the region, reduce natural waterways needed to support fish and terrestrial wildlife needs.

Report for California's Fourth Climate Change Assessment (2018), http://www.climateassessment.ca.gov/techreports/docs/20180827-Biodiversity_CCCA4-EXT-2018-010.pdf

[65] Association of Fish and Wildlife Agencies, Council on Environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, *Chapter 2: Impacts of Climate Change and Ocean Acidification in the National Fish, Wildlife, and Plants Climate Adaptation Strategy (2012)*, https://www.wildlifeadaptationstrategy.gov/pdf/NFWPCAS-Chapter-2.pdf

[66] California Department of Fish and Wildlife, *South Coast Province Chapter In State Wildlife Action Plan: A Conservation Legacy for Californians* (2015), https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109212&inline

[67] California Department of Fish and Wildlife, *South Coast Province Chapter In State Wildlife Action Plan: A Conservation Legacy for Californians* (2015)

[68] California Department of Fish and Wildlife, *Areas of Conservation Emphasis (ACE)* (2018), https://map.dfg.ca.gov/ace/

[69] California Natural Resources Agency, *Safeguarding California: Reducing Climate Risk, An update to the 2009 California Climate Adaptation Strategy* (2014), http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf

[70] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018), p. 16

Pala is home to several federally endangered or threatened species. These include least Bell's vireo[71], southwest willow flycatcher, coastal California gnatcatcher, quino checkerspot butterfly[72], and the arroyo toad. Other species of importance to Pala include golden eagle, coyote, bobcat, and mountain lion.

FIGURE 21: COYOTE AT PALA

As temperatures warm, milder winter temperatures in some parts of the country may lead to year-round survival of pests and diseases that compromise wildlife health. For example, Argentine ants are considered an invasive animal that outcompete native ants (e.g. harvester ants), which are the natural diet of horned lizards. Boring beetles and shot hole borer are invasive pests that cause tree damage and mortality. In general, climate change is projected to accelerate the spread of invasive species that pose threats to native fish, wildlife, and plants.

To protect sensitive wildlife species, Pala monitors certain species and is developing its own Habitat Conservation Plan. For example, Pala conducted a survey of southwestern willow flycatchers in 2013

and only detected two, and none breeding.[73]

The State Wildlife Action Plan (2015) provides a list of species in Pala's region (by habitat) that are considered at greatest need of conservation (see Appendix A), based in part on climate change vulnerability assessments conducted or funded by the California Department of Fish and Wildlife.[74] Many of the wildlife species listed are consistent with those mentioned above as sensitive or culturally important. This list can be useful to Pala as it works to further address risks to wildlife.

WATERWAYS

Water evaporation can lower water levels in Pala's rivers, streams, and aquifers, a challenging scenario as Pala is already relying on groundwater withdrawals for irrigation and drinking water supplies.

Pala staff have recorded steadily dropping groundwater levels over the last 10 years, due to precipitation changes and overuse of groundwater from upriver basins

Increasing temperatures and spring warming can also trigger extensive and prolonged algal blooms, which can impact the productivity of instream communities for aquatic species like the federally endangered arroyo toad.[75]

Built Environment

Pala's built environment is an important element of sustaining and protecting Pala's way of life. Elevated temperature alters the built environment in many ways.

HOMES AND BUSINESSES

Homes and businesses are not likely to be severely damaged by extreme heat. However, Pala staff note cracked seals and damaged electrical equipment at the Pala Casino Spa & Resort. Homes and businesses are

[71] Kidd Bioloigical, Inc. *2013 Results of Focused Surveys for the Least Bell's Vireo on the Pala Reservation.* (2013)
[72] Osborne, Ken H. *Year 2016 Non-protocol Adult surveys for Quino Checkerspot Butterfly on the Pala Indian Reservation.* (2016)
[73] Kidd Bioloigical, Inc. *2013 Results of Focused Surveys for the Southwestern Willow Flycatcher on the Pala Reservation.* (2013)
[74] California Department of Fish and Wildlife, *South Coast Province Chapter In State Wildlife Action Plan: A Conservation Legacy for Californians* (2015)
[75] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)

vulnerable to power outages due to increased demand for electricity during extreme heat events, which can affect both human health and business revenues. The Pala Casino has back-up diesel generators and is prepared for short power outages.

TRIBAL FACILITIES AND INFRASTRUCTURE

The predicted extreme heat and more frequent extreme weather events may cause impacts to transportation, power, and water systems.

Pala's transportation infrastructure is vulnerable to accelerated asphalt deterioration, pavement buckling, and deterioration of bridges and culverts as a result of increased temperatures. Extreme heat makes resilient transportation infrastructure more important to ensure residents and visitors can travel to cooling centers or healthcare services. The Fourth National Climate Assessment recommends that recognizing the importance of "resident mobility (geographic movements at various scales such as commuting, migration and evacuation)" is an important part of building community resilience to climate change.[76]

Due to resource limitations, geographical isolation, and limited multi-agency coordination, Pala already lacks sufficient public transit options and its existing transportation infrastructure is in need of remediation and expansion. Pala has applied for CalTrans funding to plan for addressing its short and long-term transportation resilience vulnerabilities and needs. Such a plan can increase Pala's capacity to integrate climate change considerations into material requirements, infrastructure design, and improvements, as recommended by the CA Fourth Climate Assessment: San Diego Report.[77]

Functioning power and water systems (including Pala water treatment facilities) are critical to human health and tribal commercial facilities. Power outages are frequent during heat waves and could mean short or extended closure of critical facility operations including the casino and resort.

AGRICULTURE

Rising temperatures, heat waves, and lower soil moisture can affect agricultural crops ranging from livestock to plants. For example, crops such as fruit trees need a certain number of chilling hours in the winter when temperatures are between 32 – 50 degrees. Chilling will be insufficient in much of California for the types of fruit trees found in the state today.[78] Heat can also impact soil health and lead to increases in pest infestation.

Global changes in agricultural productivity are expected to lead to food shortages and increased food prices.

Pala has noted impacts to production of certain crops cultivated on the Reservation, including avocado and citrus fruit. Approximately 5% of Pala's land is dedicated to agricultural operations, which represents a relatively small, but significant, source of income for the tribe. Agricultural disruption and losses can affect Pala's economy. Hotter temperatures may also increase the need for irrigation during growing seasons, which can be costly.

Pala's Highest Vulnerability Impacts

The sections above summarize a more extensive set of findings that were reviewed by Pala's environmental staff and consultants. For each possible climate change impact, Pala analyzed the following types of data to determine the likelihood and extent of risks: exposure indicators (historical, baseline and projected), impact indicators (historical,

[76] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018)

[77] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018)

[78] U.S. Environmental Protection Agency. *What Climate Change Means for California.* https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ca.pdf (2016)

baseline, and projected), and population sensitivity and adaptive capacity indicators. Pala gave particular consideration to impacts that were expected to threaten the community assets deemed of most importance (described on page 13).

The table below (Figure 22) summarizes impacts that Pala determined present the most significant climate change vulnerabilities related to Elevated Temperature. High risks are color coded in red, and medium risks are color coded in orange.

EXPOSURES	POSSIBLE IMPACTS		
	HEALTH/SOCIAL ENVIRONMENT	NATURAL ENVIRONMENT	BUILT ENVIRONMENT
ELEVATED TEMPERATURE	Heat-related stress illness & death Mental health consequences Decline of culturally important plants/animals Lost work, school, or business days Decrease in fitness activity level Disruptions of community functions or ceremonies Carbon monoxide poisoning	Heat-related ecosystem decline and disruption (habitat, wildlife, vegetation, waterways)	Disruption to public services and infrastructure (e.g. power outages) Disruption to agricultural operations
Secondary Exposures			
WORSENED AIR QUALITY *(more ozone)*	Respiratory illness, allergic disease		
FOOD INSECURITY *(shortage/supply, production, distribution disruption)*	Food prices may affect economic drivers (e.g. casino resort)		
VECTOR CHANGES *(mosquitos, mice)*	Lyme illness and death, West Nile, Zika illness and death		

FIGURE 22: SUMMARY OF PALA'S HIGH AND MEDIUM RISK TEMPERATURE-RELATED IMPACT VULNERABILITIES

WILDFIRE

HIGH RISK EXPOSURE

Key Climate Exposure Facts

The incidence of large forest fires in the western United States and Alaska has increased since the early 1980s and is projected to further increase in those regions as the climate warms. [79] There is also evidence that the fire season is getting longer in southern California.[80] Three of California's largest wildfires were in San Diego County. According to the CA Fourth Climate Assessment, the annual average of area burned in San Diego County is expected to increase by up to 50% by 2070 – 2099.[81]

Wildfires are considered a high-risk exposure for the Pala tribe, particularly in the Sycamore neighborhood. Pala is currently located in a fire hazard severity zone.[82] Until recently, large, high intensity fires occurred regularly but infrequently in the region due to the low frequency of natural ingnition sources. As human urbanization increased in the area, human-caused ignitions have increased dramatically. There were 38 fires from 1920 – 2012 that affected Pala. Recent fires have burned significant portions of Pala's lands and have forced evacuations at the Pala Casino Spa and Resort.[83] Climate factors including Southern California's uniquely intense Santa Ana winds,[84] increasing temperature, and more severe drought conditions (resulting in drier autumns and more dead vegetation fuel) are increasing the wildfire risk at Pala. Pala survey respondents ranked wildfire as the highest risk area.

OTHER EXPOSURES TRIGGERED

Storms and flooding

SECONDARY EXPOSURES

Smoke and particulate matter in air

Disease carrying pests

Water supply disruption

"HISTORICALLY MANY WILDFIRES HAVE AFFECTED THE RESERVATION AND THE REGION. THE POOMACHA FIRE BURNED 17% OF THE TOTAL RESERVATION."

Pala Hazard Mitigation Plan

[79] Wehner, M.F., J.R. Arnold, T. Knutson, K.E. Kunkel, and A.N. LeGrande, *Droughts, floods, and wildfires. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I* (U.S. Global Change Research Program, 2018), https://science2017.globalchange.gov/chapter/8/

[80] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Los Angeles Region Report* (2018), p. 53

[81] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018)

[82] Maizlish et al, *Climate Change and Health Profile Report: San Diego County,* (Office of Health Equity, California Department of Public Health, 2017)

[83] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

[84] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018)

Vulnerabilities by Impact Area

The following sections detail impacts to the Health and Social Environment, the Natural Environment and the Built Environment, which are summarized in Figure 31.

Health and Social Environment

Wildfire impacts human health, cultural and spiritual health and socio-economic health. These impacts are described in detail below.

HUMAN HEALTH

Wildfire-Related Injury and Death

Wildfires can cause traumatic injuries and deaths. Pala area fires including the Pechanga Wildfire (2000) and the Poomacha Wildfire (2007) have threatened Pala residents and visitors. During the Poomacha Wildfire, approximately 400 Pala tribal members were first evacuated to the Pala Casino but later needed to be evacuated to the Pechanga Casino, which is operated by the Pechanga Band of Luiseño Indians in Temecula. Evacuees were sent to homes of relatives, free hotel rooms, or RV spaces offered by Pechanga.[85]

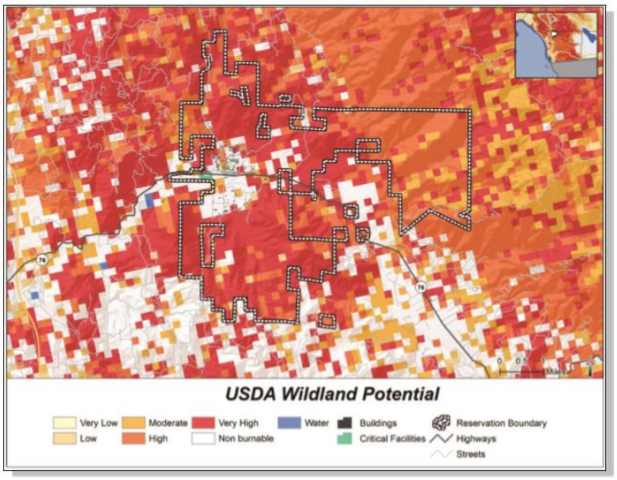


FIGURE 23: PALA WILDLAND FIRE POTENTIAL

Pala's Hazard Mitigation Plan provides a map of wildland fire potential, provided in Figure 23.[86] Several resorts, recreational areas, businesses, and industries are located within high wildfire hazard areas.

Nearly a third of Pala's population lives in a high-risk wildfire area. [87] Individuals with existing health conditions or disabilities may be unable to escape quickly. At Pala, 5% of the population is physically disabled and may require additional assistance during a wildfire. [88]

Burned areas that are subjected to heavy rain present added risk of injury or death due to landslides and rockfalls. The highest risk areas are on or adjacent to steep slopes. Large rain events after wildfires have caused extensive flooding and mudslides on the reservation in the past.

FIGURE 24: FIRE DEBRIS-SATURATED FLOOD WATERS FOLLOWING THE 2007 POOMACHA WILDFIRE

[85] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[86] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[87] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)
[88] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)

Health Risks Due to Disruptions to Critical Public Services and Infrastructure

Disasters like wildfires can disrupt or damage essential services and infrastructure that help protect health.[89] As detailed under Elevated Temperature, Pala gets most of its power from San Diego Gas and Electric, with limited backup power infrastructure on critical facilities, making it particularly vulnerable to extended outages. Pala staff are also aware that California electric utilities may shut down power to certain communities during extreme fire risk. Outages may also result in carbon monoxide poisoning associated with the use of generators.

Wildfires can disrupt telecommunications infrastructure and roads, which can prevent individuals from fleeing a wildfire or receiving necessary assistance. Wildfires can also threaten water towers and water supply.

In addition, wildfires can overburden emergency, health care, and public health services, particularly in areas with limited resources. For example, wildfires often necessitate large evacuations, requiring extensive public health resources, including shelter and treatment. People with existing health conditions may have difficulty accessing regular health services during a wildfire emergency.[90]

Increased Particulate Matter Air Pollution and Respiratory Illness

Exposure to smoke-related air pollutants, including particulate matter (PM) from wildfires has been associated with a wide range of human health effects, including cardiovascular consequences, early deaths and low infant birth weight, with the strongest evidence for acute respiratory illness. Children, older adults, pregnant women, and persons with underlying respiratory and cardiovascular conditions are considered most vulnerable, such as those Pala residents that suffer from asthma, particularly those living downwind from wildfire smoke.

Air quality-related respiratory illness is a general problem in San Diego County. CDC reports that 36 out of 10,000 residents of San Diego County went to the emergency room for asthma in 2014.[91] Pala has a lower incidence of asthma ER admissions than other CA communities;[92] however, residents observe that asthma symptoms are becoming more severe and frequent. It is not clear how much of these problems are related to smoke from wildfires.

CDC does provide short term daily predictions for wildfire smoke concentrations. On December 6, 2018, for example, CDC predicted that over 3.2 million residents of San Diego were vulnerable to surface smoke from wildfires.[93]

A National Institutes of Health (NIH) study reviewed Medi-Cal records related to smoke exposure during the 2007 fires in San Diego. It concluded that respiratory diagnoses, especially asthma, were elevated during the wildfires and persisted past the initial exposure period.[94]

Another recent study[95] concluded that in the Western US from 2004 – 2009, on days exceeding regulatory

[89] Bell, J.E., S.C. Herring, L. Jantarasami, C. Adrianopoli, K. Benedict, K. Conlon, V. Escobar, J. Hess, J. Luvall, C.P. Garcia-Pando, D. Quattrochi, J. Runkle, and C.J. Schreck, III, *Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (*U.S. Global Change Research Program, 2016), https://health2016.globalchange.gov/extreme-events

[90] Bell, J.E. et al, *Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (*U.S. Global Change Research Program, 2016)

[91] U.S. Center for Disease Control (CDC), *National Environmental Public Health Tracking* (2018)

[92] The Public Health Alliance of Southern California. *The California Healthy Places Index (HPI)* (2018)

[93] U.S. Center for Disease Control (CDC), *National Environmental Public Health Tracking* (2018)

[94] Hutchinson JA, Vargo J, Milet M, French NHF, Billmire M, Johnson J, Hoshiko. *The San Diego 2007 wildfires and Medi-Cal emergency department presentations, inpatient hospitalizations, and outpatient visits: An observational study of smoke exposure periods and a bidirectional case-crossover analysis.* (PLOS Medicine, 2018) https://www.ncbi.nlm.nih.gov/pubmed/29990362

[95] Jia Coco Liu, Loretta J. Mickley, Melissa P. Sulprizio, Francesca Dominici, Xu Yue, Keita Ebisu, Georgiana Brooke Anderson, Rafi F. A. Khan,1 Mercedes A. Bravo,

$PM^{2.5}$ (particulate matter) standards, wildfires contributed an average of 71.3% of total $PM^{2.5}$. It projects that 82 million individuals will experience a 57% increase in the frequency and 31% increase in the intensity of "Smoke Waves," which are defined as more than two consecutive days with high wildfire-specific $PM^{2.5}$. The map below (Figure 25) shows that .04 - 5% of total $PM^{2.5}$ is attributed to wildfires in San Diego County.

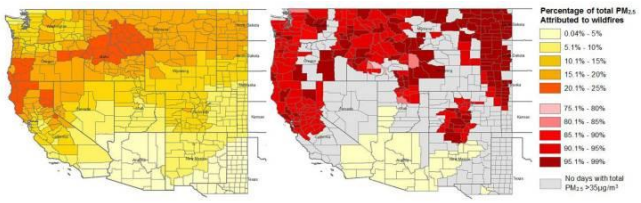


FIGURE 25: SMOKE AND PARTICULATE MATTER

Increases in Infections from Vectors, Water, and Food

Wildfire can initially increase the abundance of ticks and increase the risk of Lyme disease.[96] As detailed under Elevated Temperatures, there have been cases of Lyme disease in the region in recent years. Wildfire can also increase pest infestations and disease vectors affecting forest health (e.g. bark beetles, fungus, shothole borer).

Pala residents could also be at risk of gastrointestinal and other infections after wildfire if they come into contact with contaminated water. Soil erosion and runoff from wildfires can contaminate water supplies far downstream from the fire site, negatively impacting the quality and availability of safe freshwater supplies. Pala Water Consumer Reports over the last decade show that levels of nitrates (a contaminant caused by runoff) in Pala's wells have stayed within the standard range.[97] This is further addressed under the Storms and Flooding section.

Food and Water Insecurity

At Pala, water security is an ongoing concern. Wildfire can further stress water supplies if watersheds, water, or water treatment infrastructure is damaged during a wildfire, or if domestic water supplies are used to combat the fire.

FIGURE 26: RETARDANT DROP ON FIRE NEAR PALA

Extended wildfires can also result in damaged or closed roads, limiting import of drinking water and food supplies. Pala has not experienced incidents of food or water insecurity due to wildfire, but staff indicate that it is not uncommon for roads on the reservation to close during disasters.

Mental Health Consequences

Wildfires can result in mental health impacts including post-traumatic stress, anxiety, depression, or other

and Michelle L. Bell. *Particulate Air Pollution from Wildfires in the Western US under Climate Change* (Climate Change Journal, 2016) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5476308/

[96] MacDonald, Andrew J., Hyon, David W., McDaniels, Akira, O'Connor, Kerry E., Swei, Andrew, Briggs, Cheryl J., *Risk of vector tick exposure initially increases, then declines through time in response to wildfire in California* (Ecosphere, 2018), https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecs2.2227

[97] Pala Band of Mission Indians. *Annual Water Quality Report* (2017)

psychological reactions, particularly for populations with existing mental health conditions.[98]

In some cases, wildfire has led to evacuations and displacement, exacerbating these stresses. Additional stress can be caused in situations where there are extended official warnings to stay indoors due to poor air quality, limiting residents from doing outdoor activities that contribute to mental and emotional wellbeing.

Building human psychosocial resilience, such as strengthening strong social networks, social capital, and psycho-social skills, can help individuals cope with the trauma and stress associated with disasters. Pala staff report that the Pala community has a track record of coordination and cooperation during disasters as evidenced by working with tribal leadership, various departments, and outside agencies.

CULTURAL AND SPIRITUAL HEALTH

Wildfire resulting from climate change can destroy culturally important ecosystems, sacred sites, and points of access to culturally important places.

Staff suggest that the numerous cultural sites, functions or traditions may be in danger of wildfire encroachment and damage. If excessive damage is caused, or repeated events demonstrate that the reservation is not safe, longer time relocation may be necessary, which can threaten Pala's traditional practices, sovereignty, and community cohesion, which are considered highly important community assets to survey respondents.[99] Relocation to new tribal lands – often federal trust land – is administratively difficult, prohibitively expensive, takes years or decades to accomplish, and is fraught with cultural, social, and economic upheaval.[100]

As detailed under the Natural Environment section, increased and extended wildfire can also result in declines or disappearance of culturally important plants and animals, such as those required for baskets (juncus and *Rhus trilobata*), acorns, sage, willow, and tobacco.[101]

SOCIO-ECONOMIC HEALTH

Wildfires can result in severe damage and economic losses for both property owners and businesses. There are 300 structures in the fire risk area on the Pala Reservation, including 22 critical facilities.

While Pala's economy is not reliant upon forest-based industries like timber or paper mills, wildfires have caused evacuations and disruptions of the Pala Casino Spa and Resort, Pala's biggest economic driver. For example, the Poomacha Wildfire in 2007 resulted in evacuation of 400 tribal members and closure of the Pala Casino, causing temporary but significant impacts to educational and economic opportunities.[102] Fires at Pala have also disrupted telecommunication lines, hampering the tribe's ability to do business.

According to the CA Fourth Climate Change Assessment, insurance premiums are expected to increase by 18% by 2055 in the highest wildfire risk areas.[103]

The health impacts of smoke from wildfires can also result in school absences, school and afterschool-program closures, and business closures.

[98] Dodgen et al, *Ch. 8: Mental Health and Wellbeing. In The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (*U.S. Global Change Research Program, 2016)
[99] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)
[100] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)
[101] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)
[102] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[103] State of California Governor's Office of Planning and Research, Energy Commission and Natural Resources Agency, *California's Fourth Climate Change Assessment: Key Findings* (2018)
http://www.climateassessment.ca.gov/state/overview/#wildfire

Natural Environment

Wildfire is a natural process that is necessary to maintain the region's healthy, biodiverse ecosystems.

The increase in frequency, size, and severity of the wildfires near Pala can result in profound changes to the region's natural environment and abundant biodiversity, and contribute to the risk of landslides, erosion, and mudslides (see Storms and Floods).

PLANTS, TREES, AND FORESTS

Although wildfires have long played an important role in California's forests, significant vegetation changes have occurred in the region over the last 150 years, in part due to human development, increased heat, and extended drought, which create conditions conducive to more intense and frequent wildfire. Projected changes in moisture deficit during extended droughts in the region are provided below (Figure 27). [104]

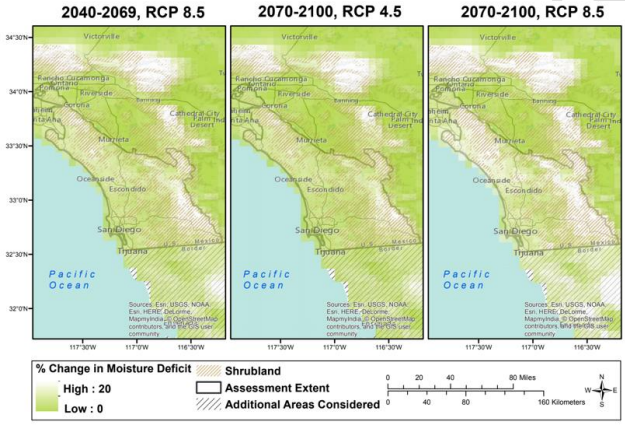


FIGURE 27: MOISTURE DEFICIT SCENARIOS

For example, the drought-deciduous shrub species, California sagebrush, is highly flammable when leaves die off to conserve water and energy during dry periods.[105]

Repeated wildfires at intervals too short to allow recovery of nature vegetation facilitate the conversion of natural woody shrublands (e.g. coastal sage scrub) to weedy, flammable annual grasses. For example, the large fire events of 2007 in San Diego resulted in nearly 74,000 acres (~30,000 ha) of overlap with the four-year-old recovering vegetation that burned in the 2003 Cedar Fire. At Pala, the Poomacha fire burned most of the scrub vegetation in the eastern mountainous region, and the area is now dominated by scrub and non-native grasses.[106] During dry season, these grasses can become fuel, forming a positive feedback cycle that could irreversibly eliminate some of the region's rich biodiversity. The US Forest Service documented that shrublands have converted to non-native annual grasslands on a widespread scale across the Cleveland National Forest, which borders the Pala Reservation.[107]

FIGURE 28: NORMAL PALA HILLSIDE WITH WILDFLOWERS

Invasive forest pests and species both increase wildfire risk and are also made worse by wildfire. Pala environmental staff observe an increase in diseased

[104] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)
[105] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)
[106] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[107] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: San Diego Region Report* (2018)

trees and an overall decline in oak trees as a result of invasive forest pests.

HABITATS AND ECOSYSTEMS

Pala's wildlife depend on healthy, large, and connected habitats to roam, breed, and hunt. Climate-related changes are adding pressure to ecosystems already stressed by habitat loss and fragmentation, pollution, disease, population growth, and other human-related impacts.[108]

Key impacts of wildfire include habitat loss, degradation, and fragmentation that have resulted in genetic isolation. Burned areas are subject to increased erosion resulting in the siltation of creeks, streams, and rivers. This can result in channel aggradation (wider, slower channels). Steep slopes are also destabilized due to the burning of vegetation.[109]

Pala environmental staff are developing a Habitat Conservation Plan to better understand and address changes in Pala's delicate habitats.

WILDLIFE

Many wildlife species that occur in the Mediterranean-type ecosystems of southern California have adapted to wildfires. For example, during a fire, many burrowing small mammals like kangaroo rats or species that estivate, like the arroyo toad, escape the passing flame front underground and can thrive in the post-fire environment.[110]

However, wildfire and its impact on vegetation conversion, habitat connectivity, food, and freshwater supplies can force animal species to migrate from the area. In San Diego County, repeated fires reduce habitat for shrubland threatened species like the California gnatcatcher.[111] According to Pala staff, a recent fire off Pala Temecula Road impacted bird habitat area, and the birds have not returned.

See a full list of the region's "Species of Greatest Conservation Need" due to climate vulnerability and other factors in Appendix A. Species important to Pala include acorn woodpeckers, least Bell's vireo, deer, bobcat, squirrels, coyote, and horned lizard, as well as endangered species such as the southwest willow flycatcher, coastal California gnatcatcher, and the arroyo toad.

WATERWAYS

Wildfires have a range of short- and long-term effects on watersheds that have the potential to change water quality, quantity, availability, and treatability downstream from the burned area. Soil erosion, debris flows, and runoff after wildfires can contaminate water supplies far downstream from the fire site, negatively impacting the quality, quantity, and availability of safe freshwater supplies for local wildlife.

Built Environment

Wildfires can severely damage Pala's built environment. Based on information from tribal officials, past fires have damaged land and threatened life and property, but no structures have been lost. However, according to Pala's Hazard Mitigation Plan (2016), a majority of the reservation is categorized as "high" to "very high" potential for wildland fire potential, and several areas have an interface with vegetated, wildfire prone lands[112].

HOMES AND BUSINESSES

A total of over 300 structures are located in the Wildland Urban Interface area, including 263

[108] California Natural Resources Agency, *Safeguarding California: Reducing Climate Risk, An update to the 2009 California Climate Adaptation Strategy* (2014)

[110] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)

[111] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)

[112] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

residential properties.

Building Type	Number In Interface WUI	Number In Intermix WUI
Residential (Mobile Home)	50	67
Residential (Single Family)	213	142
Miscellaneous	15	5
Other	22	10
Critical Facilities	22	7
TOTAL	322 (52% of total buildings)	231 (38% of total buildings)

FIGURE 29: BUILDINGS IN WILDFIRE URBAN INTERFACE

TRIBAL FACILITIES AND INFRASTRUCTURE

A total of 22 critical facilities are located in the Wildfire Urban Interface. This includes the Pala Administration Building and Pala Fitness Center, which are typically used for community evacuation shelters.

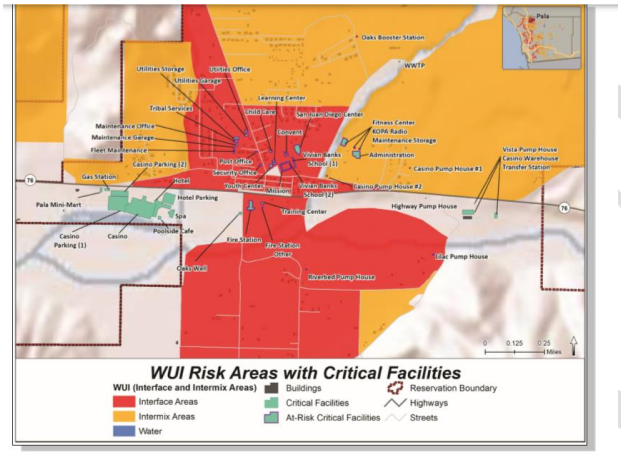


FIGURE 30: CRITICAL FACILITIES IN THE WUI

Disasters like wildfire pose clear risks of overburdening, damaging, and disrupting already-limited and aging transportation infrastructure and transit services. Pala's Hazard Mitigation Plan points to hazards associated with disruption of roads, bridges and other corridors necessary to travel in, out or within tribal lands during wildfire.[113] Pala has three access routes in and out of the Reservation. Highway 76 is the main access road. Lilac Road is difficult to access, and Pala Temecula Road is often impassable during extreme events. Limited redundancy may mean that residents and visitors could be unable to evacuate to escape danger or access healthcare services, and rescue and recovery efforts may be unable to enter. Tribal residents have voiced stress and concern that about being "trapped" during disasters. Pala staff indicate that "being stuck is as much of a problem as being evacuated" and that "key people cannot get in."[114]

Wildfire has recently affected telecommunications lines and cell towers resulting in phone outages for several days and internet service disruption for a month.[115]

AGRICULTURE

Pala has noted impacts to its production of certain crops, including avocado and citrus fruit. Losses can affect Pala's economy.

Pala's Highest Vulnerability Impacts

The sections above summarize a more extensive set of findings that were reviewed by Pala's environmental staff and consultants. For each possible climate change impact, Pala analyzed the following types of data to determine the likelihood and extent of risks: exposure indicators (historical, baseline, and projected), impact indicators (historical,

[113] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[114] Prosper Sustainably. *Pala staff comments during 5/22 workshop* (2018)
[115] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

baseline, and projected), and population sensitivity and adaptive capacity indicators. Pala gave particular consideration to impacts that were expected to threaten the community assets deemed of most importance (described on page 13).

The table below (Figure 31) summarizes impacts that Pala determined present the most significant climate change vulnerabilities related to Wildfire. High risks are color coded in red, and medium risks are color coded in orange.

EXPOSURES	POSSIBLE IMPACTS		
	HEALTH/SOCIAL ENVIRONMENT	NATURAL ENVIRONMENT	BUILT ENVIRONMENT
WILDFIRE	Wildfire-related injury and death Mental health consequences Short or long-term relocation Loss of sacred or historical sites Lost work, school, or business days Carbon monoxide poisoning Decrease in fitness activity level Disruptions of community functions	Wildfire-related ecosystem disruption (habitat, wildlife, vegetation, waterways)	Damage to homes and critical facilities Disruption to public services and infrastructure (telecommunications) Stress on water supplies
Secondary Exposures			
WORSENED AIR QUALITY *(smoke and particulate matter)*	Respiratory illness		
WATER INSECURITY *(shortage/supply, production, distribution disruption)*	Drinking water supply interruption		
VECTOR CHANGES *(forest pests)*		Greater pest infestations disrupting forest ecosystems	

FIGURE 31: SUMMARY OF PALA'S HIGH AND MEDIUM RISK WILDFIRE-RELATED IMPACT VULNERABILITIES

STORMS & FLOODING

HIGH RISK EXPOSURE

Key Climate Exposure Facts

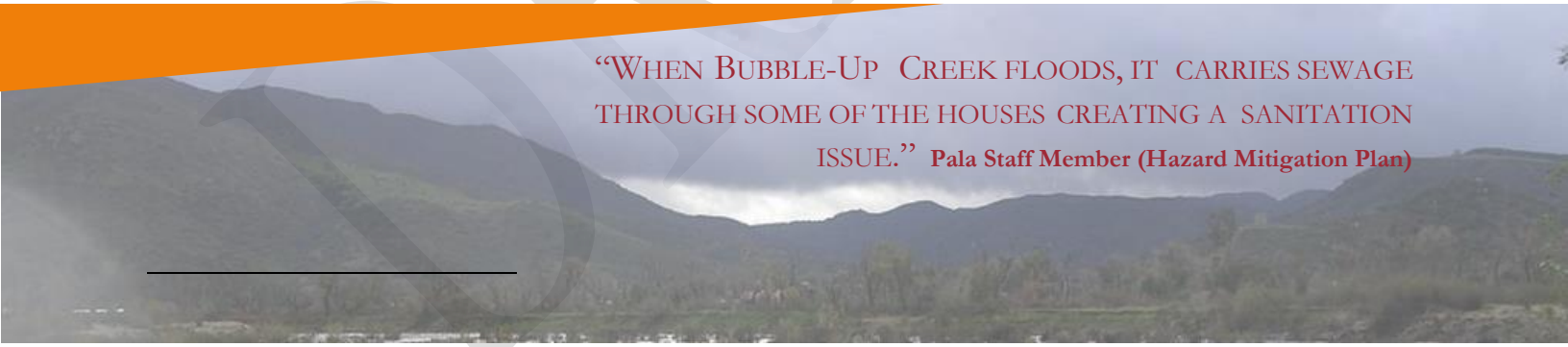
Extreme rainfall events are becoming increasingly frequent and severe in the United States as a result of climate change. Severe storms can trigger flash floods along smaller rivers and creeks, prolonged flooding along major rivers, and urban flooding, especially when exacerbated by sea level rise.[116] The EPA projects the number of 100-year floods in the contiguous United States to rise steadily for the remainder of the century under high emission scenarios.[117]

In San Diego County, the drying that is projected with increased drought intensity and longer seasonal dry periods is offset with a projected increase in the wettest days. This means that storms will be less frequent and occasionally stronger.[118] Greater drought conditions and lower soil moisture lead to flash floods in inland areas, as well as mudslides and landslides, especially in areas recently affected by wildfire. By 2100, CDPH predicts that 40% more land in San Diego County will become vulnerable to 100 and/or 500-year flood events.

Flooding is a high concern for Pala. Flooding events are common and associated with water drainage problems on the Reservation. Surveyed community members observe that less rainfall is happening in general.[119] However, according to staff, rain events are becoming more intense on the Reservation, causing flooding that rises and falls quickly.[120] The Pala Environmental Department tracks rainfall, water flows, stream levels, storm damage, and flooding at multiple locations on the Reservation.[121] Flooding is a regular occurrence and six major flood events occurred between 1916 and 2014.[122] Major events in 1998, 2005, 2010, and 2017 flooded roads, damaged property and trapped residents. Strong wind events and thunderstorms are also a noted hazard at Pala.[123]

OTHER EXPOSURES TRIGGERED

- Indoor mold
- Disease-carrying mosquitos
- Water contamination and supply disruption



"WHEN BUBBLE-UP CREEK FLOODS, IT CARRIES SEWAGE THROUGH SOME OF THE HOUSES CREATING A SANITATION ISSUE." **Pala Staff Member (Hazard Mitigation Plan)**

[116] Bell, J.E. et al, *Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (U.S. Global Change Research Program, 2016)
[117] EPA, *U.S. Multi-Model Framework for Quantitative Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2018)
[118] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018
[119] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)
[120] Prosper Sustainably. *Pala staff comments during 5/22 workshop* (2018)
[121] Pala Environmental Department. *2017-2018 Log for Storm Events* (2018)
[122] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[123] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

Vulnerabilities by Impact Area

The following sections detail impacts to the Health and Social Environment, Natural Environment, and Built Environment, which are summarized on Figure 38.

Health and Social Environment

Storms and flooding impact human health, cultural and spiritual health, and socio-economic health. These impacts are described in detail below.

HUMAN HEALTH

Storm and Flooding-Related Injury and Death

Floods are one of the deadliest weather-related hazards in the U.S. – second only to heat.[124] Health impacts can occur during severe storms and floods, during post-event clean up, or as a result of property damage, destruction of assets, economic impacts, environmental degradation, etc. Health impacts include deaths and injuries from drowning, being struck by objects, fire, explosions, electrocution, or exposure to toxic materials.

At Pala, several storms have caused road overflows that have trapped residents at home or while driving. A storm event in 2017 flooded tribal members' yards and homes in the Sycamore subdivision, but no injuries or illnesses were reported.[125]

FIGURE 32: FLOODING BY PALA HOME

There are certain community characteristics that improve or reduce Pala's capacity to adapt to severe storms and flooding. For example, 21 buildings are located in areas at high risk of flooding. Populations that live in areas adjacent to the San Luis Rey River, Pala Creek, Bubble Up Creek, and Trujillo Creek may be threatened during 100-year or 500-year storms, particularly areas within Pala's flood plain (shown below in Figure 32). There are three homes considered at risk of riverline flooding. [126]

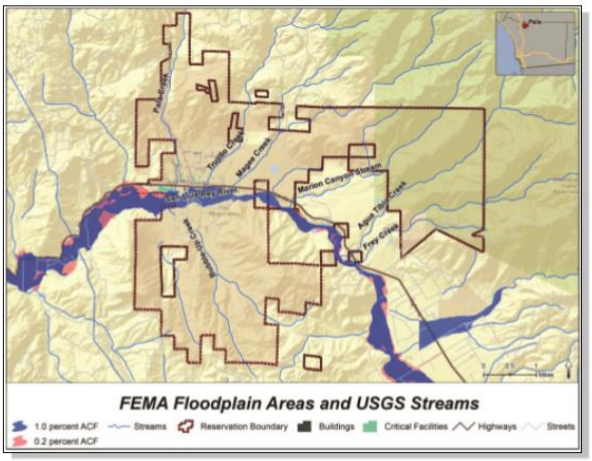


FIGURE 33: PALA FEMA FLOODPLAIN MAP

Certain populations are more sensitive to storm and flood risks. At most risk are individuals that lack proper clothing and/or decent housing conditions, such as poor or homeless individuals. Elders, pregnant women, and individuals with disabilities or existing medical conditions are also highly vulnerable to storms and flooding. Three homes in Pala are located within the 100-year floodplain.[127]

Health Risks Due to Disruptions of Critical Services and Infrastructure

[124] U.S. Center for Disease Control (CDC), American Public Health Association (APHA), *Extreme Rainfall and Drought*, https://www.cdc.gov/climateandhealth/pubs/precip-final_508.pdf
[125] Pala Environmental Department. *Storm Damages Log* (2018)
[126] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[127] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)

Extreme events like storms, high winds, and floods disrupt public services and infrastructure such as power, water, housing, school, transportation, and communication systems that are critical to maintaining access to health care and emergency response services, including Tribal Law Enforcement and news broadcasts. Disruptions to these services can cause a cascade of infrastructure and service failures that lowers adaptive capacity and may cause short or long-term displacement.

Road closures due to flooding are particularly concerning because they can trap people in dangerous situations as occurred during floods in 1980, 1998, 2005, and 2010. Road access in, out, and throughout the Reservation is normally limited. There are only four routes to get in and out of the reservation, two of which are along State Highway 76. These routes become congested with heavy automobile traffic on a daily basis.

Flooding regularly occurs on Lilac Extension Road, Pala Mission Road, Quashish Road, Pala Temecula Road, Apapas Road, Welmas Road, Valenzuela Road, and Salvador Road. The Hazard Mitigation Plan points to several specific transportation infrastructure vulnerabilities in need of re-engineering, repair, or relocation.[128]

FIGURE 34: FLOODING ACROSS LILAC EXTENSION ROAD AT PALA

Storms, wind, and floods can cause sporadic or extended power outages. Outages may also result in carbon monoxide poisoning associated with the use of generators and affect wastewater pumping stations, leading to failures that could contaminate water (see Increases in Infections from Vectors, Water and Food). Storms of greater intensity will make local stormwater capture and use more difficult, requiring larger surface storage and infiltration capacity to recharge groundwater basins.[129]

Reduced Indoor Air Quality from Mold

After flooding, buildings and homes inundated with water can grow mold. When breathed in by inhabitants, mold spores can cause serious health impacts. According to the CDC, exposure to molds can lead to symptoms such as stuffy nose, wheezing, and red or itchy eyes or skin. Severe reactions may include fever and shortness of breath.[130]

Increases in Infections from Vectors, Water, and Food

As shown in Figure 35 below, severe storms, flooding, and runoff can contaminate water supplies with bacteria, viruses, and other pathogens and toxins, limiting the availability of safe drinking water. For example, the 2017 flood event at Pala exposed drinking water pipelines and caused a substantial rise in influent into the wastewater treatment plant. Low-lying flooding can also cause septic system failures, potentially spreading E. coli and other bacteria-

[128] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[129] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Los Angeles Region Report* (2018), p. 61
[130] U.S. Center for Disease Control (CDC), *Mold: Basic Facts.* https://www.cdc.gov/mold/faqs.htm#affect (2018)

contaminated pollutants into both surface and groundwater resources, which is a health hazard.

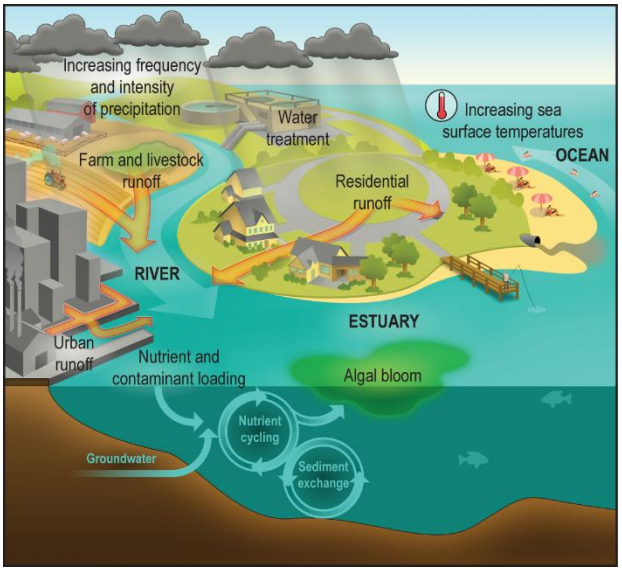


FIGURE 35: RUNOFF AND WATER CONTAMINATION

Health impacts of water contamination can include gastrointestinal illness and other infections due to contact with or ingestion of pathogens.

According to Pala's 2017 Annual Water Quality Report, all eight wells within both of Pala's water distribution systems (North and South) are within normal ranges of all tested contaminants, including nitrates (a contaminant caused by runoff).[131] However, Pala's 2017- 2018 log of storm events shows that no water quality samples were able to be taken during the 12 storm events, due to a complete lack of surface water available. Most of Pala's waters are now considered ephemeral, or intermittent at best, with flow only during storm events, if at all.[132]

Storms and flooding can also leave behind stagnant water that creates breeding grounds for mosquitos. Some species of mosquitos are responsible for vector-borne diseases like West-Nile virus and Zika, which are becoming more prevalent in Southern California. Local transmission rates for these diseases were discussed in detail under Elevated Temperature. Pala considers disease carrying mosquitos to be a growing concern in the foreseeable future.

Food and Water Insecurity

Severe storms and flooding can disrupt water systems and food production, distribution, and supply, leading to water and food insecurity. Over prolonged periods, communities can suffer from malnutrition from lack of access to subsistence food. Pala is not reliant upon food produced on the reservation and has not reported any incidents during which the reservation could not access sufficient food or water supplies. However, severe storms that affect major roads and bridges can cut off transport of food and water into the reservation.

Mental Health Consequences

Many people exposed to climate- or weather-related natural disasters experience stress reactions and serious mental health consequences, including symptoms of post-traumatic stress disorder (PTSD), depression, and general anxiety, which often occur simultaneously. Mental health effects include grief/bereavement, increased substance use or misuse, and suicidal thoughts. All these reactions have the potential to interfere with the individual's functioning and well-being and are especially problematic for certain groups.

Flood-related mental health impacts are associated with direct and longer-term losses, social impacts, stress, and economic hardship. Women, children, older adults, low-income populations, and those in poor health, with prior mental health issues, or with weak social networks may be especially vulnerable to the mental health impacts of floods.[133]

Building human psychosocial resilience, such as strengthening strong social networks, social capital, and psycho-social skills, can help individuals cope with the trauma and stress associated with disasters. Pala staff report that the Pala community has a track record

[131] Pala Band of Mission Indians. *Annual Water Quality Report* (2017)
[132] Pala Environmental Department. *Storm Damage Log* (2018)

[133] Bell, J.E. et al, *Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (U.S. Global Change Research Program, 2016)

of coordination and cooperation during disasters as evidenced by working with tribal leadership, various departments, and outside agencies.

CULTURAL AND SPIRITUAL HEALTH

Storms can damage numerous cultural sites and gathering areas and can disrupt cultural ceremonies such as traditional gatherings. There is no record of storm inundation at the Cupa Cultural Center, which contains historic artifacts and documents.

Depending on the severity of the storm, storms may prompt evacuations. If excessive damage is caused, or repeated events demonstrate that the reservation is not safe, longer term relocation may be necessary, which can threaten Pala's traditional practices, sovereignty, and community cohesion, which are considered highly important community assets to survey respondents.[134]

SOCIO-ECONOMIC HEALTH

Storm, flooding, and mudflow damage (or related power or water disruptions) to homes and critical economic facilities, such as the casino and resort, can result in overwhelming recovery costs that can impact Pala's economy for a long time.

California estimates that "mega-floods" may cost approximately $42 billion a year by 2050.[135] A total of 80 wind events and approximately $8 million in damages were reported for the general area.[136]

There have been several costly storm and flooding events at Pala; however, specific values were not provided in the Hazard Mitigation Plan. Predicted exposures are provided in Figure 36.

Table 21 Hazus-MH Estimated Losses from the 1.0-percent Annual Chance Flood

	100-year Building Loss	Content Loss	Inventory Loss	Other	Total Loss	Percent of Total Exposure
Agricultural	$0	$1,000	$0	$0	$1,000	0.0%
Commercial	$46,000	$155,000		$1,000	$202,000	0.2%
Education	$0	$0	$0	$0	$0	0.0%
Government	$0	$0	$0	$0	$0	0.0%
Industrial	$0	$0	$0	$0	$0	0.0%
Religious	$0	$0	$0	$0	$0	0.0%
Residential	$889,000	$538,000	$0	$0	$1,427,000	0.2%
TOTAL	$935,000	$694,000	$0	$1,000	$1,630,000	0.2%

Table 22 Hazus-MH Estimated Losses from the 0.2-percent Annual Chance Flood

	500-year Building Loss	Content Loss	Inventory Loss	Other	Total Loss	Percent of Exposure
Agricultural	$1,000	$2,000	$0	$0	$3,000	0.0%
Commercial	$115,000	$335,000	$0	$2,000	$452,000	0.4%
Education	$4,000	$26,000	$0	$2,000	$32,000	0.1%
Government	$0	$0	$0	$0	$0	0.0%
Industrial	$0	$0	$0	$0	$0	0.0%
Religious	$0	$0	$0	$0	$0	0.0%
Residential	$3,665,000	$2,232,000	$0	$2,000	$5,899,000	0.8%
TOTAL	$3,785,000	$2,595,000	$0	$6,000	$6,386,000	0.6%

FIGURE 36: ESTIMATED FLOOD EXPOSURE AND LOSSES

Aside from costs associated with repair of property or infrastructure damage repair, the socioeconomic impacts of severe storm and flooding events also include lost business revenues and school days.

Natural Environment

Normal storms and associated scouring are beneficial and important for a healthy environment. Changing and intensifying storm and flooding patterns, however, can have harmful effects on the natural environment. The effects of a changing precipitation regime are uncertain because the difficulty in predicting future rainfall is compounded by uncertainty in how much the inherent resiliency of plants and animals adapted for dry, variable climates can accommodate changing conditions.[137]

PLANTS, TREES AND FORESTS

Storms and flooding can weaken and remove vegetation and soil leading to downed trees, erosion, and mudslides. Pala staff have observed that floods have shifted riparian habitats. For example, shifting

[134] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)
[135] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)
[136] Pala Band of Mission Indians, *2016 Hazard Mitigation Plan Update* (2016)
[137] California Energy Commission and California Natural Resources Agency, *San Diego County Ecosystems: The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)

river sediments and braided water flows during heavy storms have created new San Luis Rey River channels in some areas, while silting in previous flow channels in other areas. This leads to a shifting riparian regime that can change between major flood events.

In addition, loss of riparian vegetation caused by climate changes reduces the ability of floodplain to naturally absorb and manage high levels of stormwater.

Certain invasive species, such as giant reed (*Arundo donax*) and tamarisk can spread in flood conditions.

HABITATS AND ECOSYSTEMS

Severe storms and landslides can result in habitat shifts and less stabilizing streamside vegetation and increased erosion. Aquatic habitats can also become contaminated by runoff. Conservation and management of Pala's natural infrastructure such as healthy watersheds and soils can build local resilience by improving soil water-holding capacity and reducing flooding and erosion.[138]

WILDLIFE

Because water levels have been so low in the river and streams, aquatic species are no longer present in significant enough populations to be affected. Animals that depend on the riparian habitat and may be temporarily or permanently displaced by storms and flooding including endangered species such as the southwest willow flycatcher, yellow-billed cuckoo, coastal California gnatcatcher, and the arroyo toad.

For example, yellow-billed cuckoos historically nested on or near the San Luis Rey River. According to a recent study, habitat at Bubble Up Creek and Pala Creek (south of the San Luis Rey River), was of poor quality and unsuitable for breeding, due in part to the minimal width of the riparian habitat.[139] Native fish, birds, and other biota can benefit from floodplain management practices.[140]

See a full list of the region's "Species of Greatest Conservation Need" due to climate vulnerability and other factors in Appendix A.

WATERWAYS

Severe storms are projected to overwhelm Pala's intermittent streams. In 2017, severe storms scoured out the riverbed due to large volumes and speed of surface flow.[141] Bubble-Up Creek and Pala Creek are known to overflow during flooding events.[142]

Waterways can become polluted by intense storms that result in untreated urban runoff.

Built Environment

All of Pala's current and future buildings may be considered at some risk from storms and flooding. There are seven critical facilities in the 100-year flood zone where Pala Creek flows into the San Luis Rey directly behind the Pala Casino facilities. Overall Pala may be exposed to over $6 million dollars in damages across all building types on the reservation.[143] The tribe has constructed retaining walls and culverts along the San Luis Rey; however, there is currently no water diversion or green infrastructure mitigation on the Reservation.

HOMES AND BUSINESSES

Some homes and businesses at Pala are considered to be at high risk of being severely damaged by extreme storms and flooding. In particular, the Sycamore neighborhood, located at the bottom of steep slopes, can be isolated during major storm events when Pala Creek gets too high. When Bubble-up Creek floods, it

[138] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)
[139] H.T. Harvey & Associates. *Pala Band of Mission Indians: Yellow-billed Cuckoo Desktop Habitat Assessment* (2015).
[140] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)
[141] Prosper Sustainably, *Interview with Shasta Gaughen* (2018)
[142] Pala Band of Mission Indians, *2016 Hazard Mitigation Plan Update* (2016)
[143] Pala Band of Mission Indians, *2016 Hazard Mitigation Plan Update* (2016)

carries sewage through some of the houses, creating a sanitation issue.[144]

Loss of power or water systems is likely to affect critical economic facilities like Pala Casino Spa and Resort. Additionally, floods have previously impacted Pala RV Park operations, which represent a small proportion of overall tribal revenues.

TRIBAL FACILITIES AND INFRASTRUCTURE

Many of the Tribal Government facilities are either not in the flood zones (e.g. Administration Building) or are designed and engineered to withstand significant flooding (e.g. Fire Station and Emergency Operations Center).

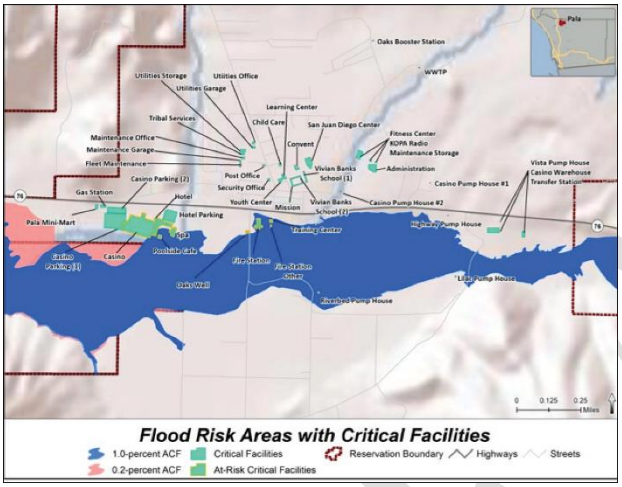


FIGURE 37: AREAS SUBJECT TO FLOODING

However, disasters like floods often over-burden, damage, and disrupt already-limited and aging transportation infrastructure and transit services. Major storm events, such as those that occurred in January 2017, are regularly eroding and covering critical roads in mud and debris, and inundating roads and bridges. Roads at risk for flooding include Lilac Extension Road, Pala Mission Road, Quashish Road, Pala Temecula Road, Welmas Road, Salvador Road, Valenzuela Road, and the west end of Apapas Road. Areas along Highway 76 are also prone to flooding.[145] Pala staff note that "being stuck here is as much of a problem as being evacuated" and that at times "key people can't get back in" during flood emergencies.[146] The Hazard Mitigation Plan points to specific transportation infrastructure vulnerabilities in need of re-engineering, repair, or relocation.

Storms and flooding can also damage communications infrastructure, such as cell and radio towers and above ground fiber cables, which are critical for accessing timely emergency services and information.

Power and water systems (including Pala water treatment and sewage facilities) can also fail during severe storms, resulting in consequences to human health and tribal economic facilities. According to Pala staff, Pala is currently phasing out its septic tanks on the north side of the reservation and has installed backup generators for its sewer lift stations. There are in-holding (non-tribal) properties with septic systems that fail during storms, however Pala does not have jurisdiction to regulate these systems.

AGRICULTURE

Severe storms and floods can disrupt production of certain crops, including avocado and citrus fruit. Losses can affect Pala's economy.

Pala's Highest Vulnerability Impacts

The sections above summarize a more extensive set of findings that were reviewed by Pala's staff and consultants. For each possible climate change impact, Pala analyzed the following types of data to determine the likelihood and extent of risks: exposure indicators (historical, baseline, and projected), impact indicators (historical, baseline, and projected),

[144] EFC West. *Pala Vulnerability Study Worksheets* (2017)
[145] Pala Environmental Department. *Storm Damage Log* (2018)
[146] Prosper Sustainably. *Pala staff comments during 5/22 workshop* (2018)

and population sensitivity and adaptive capacity indicators. Pala gave particular consideration to impacts that were expected to threaten the community assets deemed of most importance (described on page 13).

The table below (Figure 38) summarizes impacts that Pala determined present the most significant climate change vulnerabilities related to Storms & Flooding. High risks are color coded in red, and medium risks are color coded in orange.

EXPOSURES	POSSIBLE IMPACTS		
	HEALTH/SOCIAL ENVIRONMENT	NATURAL ENVIRONMENT	BUILT ENVIRONMENT
STORMS AND FLOODING	Storm/flooding related injury/death Illness due to inability to access critical services Mental health consequences Short or long-term relocation Lost work, school, or business days Carbon monoxide poisoning	Storm/flood-related ecosystem disruption (habitat, wildlife, vegetation, waterways)	Damage to homes and critical facilities Disruption to public services and infrastructure (roads, tele-communications)
Secondary Exposures			
Worsened air quality (mold)	Illness due to mold infestation in homes and businesses		
Water insecurity (contamination and shortage/supply, production, distribution disruption)	Infections due to contact/ingestion of pathogens Short or long-term relocation Drinking water supply interruption Lost work, school, or business days		
Vectors (mosquitos)	West Nile, Zika illness or death		

FIGURE 38: SUMMARY OF PALA'S HIGH AND MEDIUM RISK STORM AND FLOODING-RELATED IMPACT VULNERABILITIES

DROUGHT

HIGH RISK EXPOSURE

Key Climate Exposure Facts

Drought is defined as a prolonged period of abnormally low rainfall resulting in water deficits and low soil moisture. It is one of the most pervasive climate-induced weather exposures for tribes and can increase the risk of wildfire (see Wildfire) and flooding (see Storms and Flooding). Recent droughts have reached record intensity in some regions of the US such as the Southwest.[147] Climate projections suggest the Southwest may transition to a more arid climate on a permanent basis over the next century and beyond.[148]

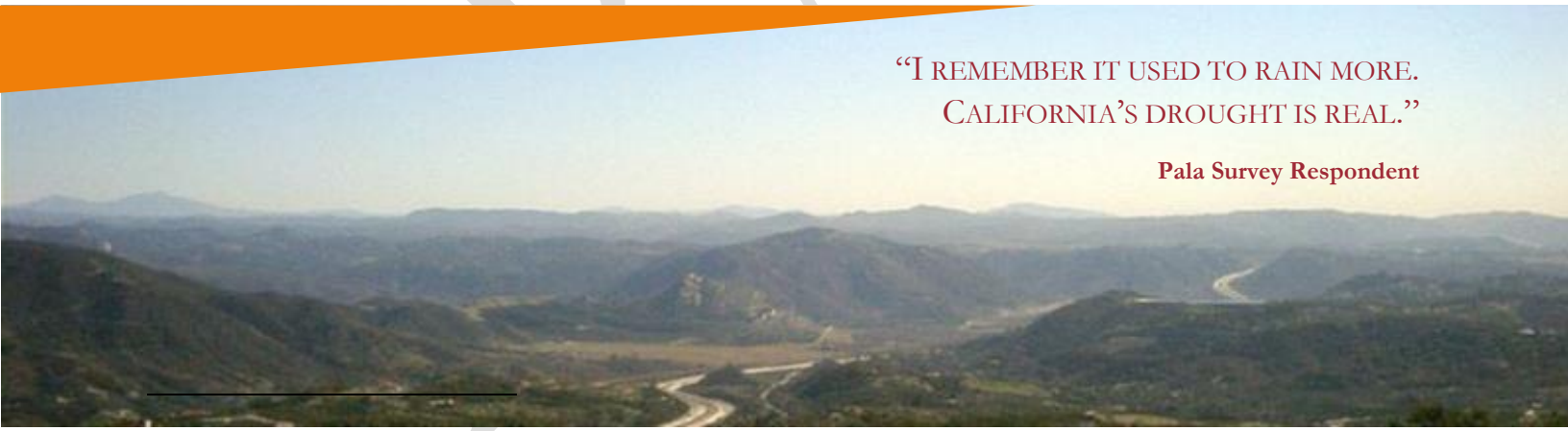
Although the 2017 rain season was somewhat wet in Southern CA, San Diego County is currently in a severe drought, which is projected to persist.[149] Pala's 2016 Hazard Mitigation Plan indicates that drought conditions were reported in 10 of the last 16 years and are likely in the future.[150] Several survey respondents observed that there has been less rainfall than historically fell in Pala.[151] Prolonged low average annual rainfall rates are expected to exacerbate water shortages on the Reservation resulting from growing water demand in the region and a complex history of water diversion by new settlers and legal battles over water rights. Pala staff report that the San Luis Rey River and Pala Creek no longer have regular flow.[152] For purposes of this report, drought exposure resulting from climate change is considered a high risk.

OTHER EXPOSURES TRIGGERED

- Wildfire
- Storms and flooding

SECONDARY EXPOSURES

- Ground level ozone, dust particles/fungus, and allergens
- Disease-carrying vectors
- Water supply disruption



"I REMEMBER IT USED TO RAIN MORE. CALIFORNIA'S DROUGHT IS REAL."

Pala Survey Respondent

[147] Wehner, M.F., et al, *Droughts, floods, and wildfires. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I* (U.S. Global Change Research Program, 2018),
[148] EPA, *U.S. Multi-Model Framework for Quantitative Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2018)
[149] National Integrated Drought Information System, *U.S. Drought Portal: Regions* (2018), https://www.drought.gov/drought/regions
[150] Pala Band of Mission Indians. *2016 Hazard Mitigation Plan Update* (2016)
[151] Prosper Sustainably, *Pala Climate Vulnerability Experiences and Priorities Survey* (2018)
[152] Pala Environmental Department. *2017-2018 Log for Storm Events* (2018)

Vulnerabilities by Impact Area

The following sections detail impacts to the Health and Social Environment, the Natural Environment, and the Built Environment, which are summarized in Figure 40.

Health and Social Environment

Drought impacts human health, cultural and spiritual health, and socio-economic health. These impacts are described in detail below.

HUMAN HEALTH

Limited Direct Human Health Impacts

While water is essential to life, drought does not typically impose urgent or emergency health risks directly. Drought is a gradual process that is more likely to force humans to identify new water sources or leave an area in search of better water sources, rather than stay and experience prolonged thirst or other health impacts of water shortage.

If Pala's local aquifer levels are significantly reduced by drought, Pala's water utility may have to limit water services. Pala already encourages voluntary conservation of water supplies by residents and businesses on the reservation. Further restrictions are unlikely to impact drinking water but may limit water available for sanitation and other domestic uses that contribute to health.

Drought contributes to health hazards resulting from wildfires, extreme heat events, and flash flooding, along with the secondary exposure health impacts as described below.[153]

Reduced Air Quality, Dust, and Air-borne Illness

As temperatures and drought increase, soils dry out and dust levels increase. In some arid regions including the U.S. Southwest, the spores of the *Coccidioides immitis* fungus are carried on dust. Inhaling these spores causes Coccidioidomycosis, also known as cocci or "Valley fever." Valley fever is characterized by coughing, chest pain and fever, as well as headaches, joint pain and rash.[154]

Cases of Valley fever in the U.S. have risen about 15% each year from 1998 to 2011. People are most likely to acquire Valley fever in areas where the fungus spores become airborne and are inhaled during windy, dusty conditions. Human cases of Valley fever in nearby Los Angeles County have increased steadily since 2009, with a 37% increase between 2015 and 2016. Although the reasons for this increase are unclear, drought conditions exacerbated by climate change may contribute to higher dust levels, and consequently increased risk for Valley fever.[155]

There is evidence to suggest that drought also increases ozone levels. As already mentioned under the Elevated Temperature section, Pala's ozone levels are sometimes above standard, which can exacerbate respiratory illness.

Increases in Infections from Vectors

In some regions of the United States, drought has been associated with increased incidence of West Nile virus disease. Human exposure risk to West Nile virus may increase during drought conditions due to a higher prevalence of the virus in mosquito and bird populations because of closer contact between birds (virus hosts) and mosquitoes (vectors) as they congregate around remaining water sources.[156]

Increases in rodent populations have been associated with droughts followed by periods of heavy rainfall, primarily in the Southwest. This could lead to

[153] Maizlish et al, *Climate Change and Health Profile Report: San Diego County,* (Office of Health Equity, California Department of Public Health, 2017)
[154] Center for Climate Change & Health, Public Health Institute, *Infectious Disease, Climate Change and Health* (2016), http://climatehealthconnect.org/wp-content/uploads/2016/09/InfectiousDisease.pdf
[155] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Los Angeles Region Report* (2018)
[156] Bell, J.E. et al, *Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (*U.S. Global Change Research Program, 2016)

increased exposures to rodent allergens and rodent-borne diseases, such as hantavirus cardiopulmonary syndrome, which is a severe, sometimes fatal respiratory disease.[157]

Food and Water Insecurity

Water security concerns are not new for Pala. The San Luis Rey River used to be almost perennially-flowing. Since the construction of the Lake Henshaw Dam in 1923, and subsequent Escondido Canal Diversion, surface flows in the San Luis Rey River and ephemeral water bodies as well s recharge of groundwater have been intermittent or absent. Further, litigation over the Tribe's water rights has been ongoing for decades, and as of this report has yet to result in any significant restoration of water supplies.

Pala's water source is the Pala Groundwater Basin. Alongside lower precipitation levels, regional water demand has depleted Pala's groundwater resources and reduced input into Pala's aquifer. Over the years, Pala has improved its well system to achieve greater water security. Currently, water aquifer levels and groundwater well levels (at eight wells north and south of San Luis Rey River) are stable but are lower than usual due to extended drought.[158]

Pala is currently not reliant upon food produced on the Reservation and has not reported any incidents when the reservation could not access sufficient food supply. There is not a foreseeable concern regarding Pala's ability to access food supplies due to drought.

Mental Health Consequences

Mental health issues have been observed during drought periods through research primarily conducted in Australia. Rural areas can experience a rise in mental health issues related to economic insecurity from drought. Drought can cause people to experience intense feelings of anxiety, grief, helplessness, and hopelessness, as well as a deep-seated sense of dislocation and loss due to damage done to their local environment.[159]

For some tribal communities, severe drought could make Reservation lands uninhabitable. As a last resort, tribes may be forced to relocate, which would be a long, challenging and stressful process.

CULTURAL AND SPIRITUAL HEALTH

Many tribal communities have distinct cultural and spiritual connections to water and consider it sacred. Water is also necessary to support culturally important plants and animals.

For tribes in extreme and prolonged drought conditions, the loss of sufficient water supply may mean that a tribe would have to consider relocation, which would threaten traditional ways of life, tribal sovereignty, and community cohesion. Relocation to new tribal lands – often federal trust land – is administratively difficult, prohibitively expensive, takes years or decades to accomplish, and is fraught with cultural, social, and economic upheaval.[160]

Pala does not currently believe it is at risk of losing access to sufficient water. Pala staff do note concern that, in the distant future, decreasing water supplies may force Pala to migrate from its existing land.

SOCIO-ECONOMIC HEALTH

Severe water shortages could impact Pala's key economic drivers, including agriculture leases, gaming, entertainment, hospitality and other business ventures.

CA's Fourth Climate Change Assessment projects that statewide water shortages could cost from $.1 - $1 billion per year.[161]

[157] CDC, *Hantavirus Pulmonary Syndrome* (2018), https://www.cdc.gov/hantavirus/hps/index.html
[158] Pala Band of Mission Indians. *Annual Water Quality Report* (2017)
[159] Dodgen et al, *Ch. 8: Mental Health and Wellbeing. In The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (*U.S. Global Change Research Program, 2016)
[160] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)
[161] State of California Governor's Office of Planning and Research et al, *California's Fourth Climate Change Assessment: Statewide Summary Report* (2018)

Natural Environment

Water is essential to all components of the natural environment. While San Diego County is home to a naturally arid and drought-tolerant natural environment, precipitation pattern changes driven by climate change are projected to make dry areas drier.[162] Extreme drought has the potential to change ecological community composition and structure at the landscape scale in part because drought operates at a larger spatial scale than other disturbances such as fire. Pala considers its natural environment to be at high risk due to drought.

PLANTS, TREES AND FORESTS

Coastal sage scrub, chaparral, and some annual grasses in Southern California are naturally drought tolerant and adapted to thrive in highly variable climates. In San Diego County, oak trees experienced stress and die off during the 2012-2016 drought. At Pala, drought has contributed to losses of Englemann and coast live oak trees and willow trees. Loss of tree shade is impacting other vegetation such as crops and culturally significant plants.

As illustrated below, soil moisture is projected to diminish significantly year-round in southern CA.[163]

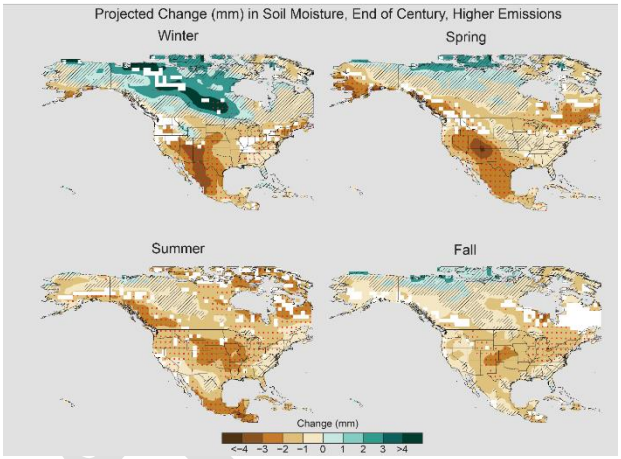


FIGURE 39: PROJECTED US SOIL MOISTURE

Drought can increase pest infestations and disease vectors affecting plant and forest health (e.g. bark beetles, fungus, shothole borer). For example, less rain may encourage the growth of invasive plant species like tamarisk, which is present at Pala, but naturally scoured away annually in non-drought conditions.[164]

HABITATS AND ECOSYSTEMS

Pala's chaparral plant communities are naturally drought tolerant and are characterized by a greater component of woody species, including chamise, manzanita, California lilac, and scrub oak.[165] However, riparian communities rely on seasonal peak flows to support breeding and rearing habitat. Periodic scouring flows are important to prevent senescence, clean spawning gravels, import fresh sediment, and promote habitat complexity.[166]

According to Pala environmental staff, long term drought has caused a decline in its chaparral, grasslands, wetlands, riparian, and upland habitats, impacting important wildlife movement corridors, as

[162] Association of Fish and Wildlife Agencies et al, *Chapter 2: Impacts of Climate Change and Ocean Acidification in the National Fish, Wildlife, and Plants Climate Adaptation Strategy* (2012)
[163] Wehner, M.F. et al, *Droughts, floods, and wildfires. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I* (U.S. Global Change Research Program, 2018), https://science2017.globalchange.gov/chapter/8/
[164]
[165] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)
[166] California Energy Commission and California Natural Resources Agency, San Diego County Ecosystems: *The Ecological Impacts of Climate Change on a Biodiversity Hotspot, A Report for California's Fourth Climate Change Assessment* (2018)

well as habitat for multiple species and traditional use plants.

WILDLIFE

Changes in precipitation are expected to contribute to species migration and range shifting.[167] For example, certain bird species are dependent on coastal sage scrub for habitat, which can decline during severe drought. At Pala, tree and habitat losses have affected bird species. Pala has observed negative impacts on species tied to oak trees such as acorn woodpeckers. See a full list of the region's "Species of Greatest Conservation Need" due to climate vulnerability and other factors in Appendix A.

WATERWAYS

Pala Creek used to flow for many days after a substantial precipitation event, but that is no longer the case since the drought has decreased the groundwater basin. Pala staff report that the San Luis Rey River and Pala Creek do not have regular flow. Aquifers supporting Pala water sources continue to drop.

Built Environment

It is assumed that all current and future buildings, populations, and critical facilities on the Pala Reservation are at risk of drought. The tribe's built environment depends on local groundwater aquifers and a system of wells for all water on the Reservation.

Pala's Groundwater Basin recovers more slowly during drought resulting in greater risk of floods (see Storms and Floods).

HOMES AND BUSINESSES

The Pala Casino Spa & Resort is the largest water consumer and is in jeopardy during times of drought. Without water, the casino and other area businesses could not operate, which would trigger economic losses related to tourism and restaurants.

TRIBAL FACILITIES AND INFRASTRUCTURE

Functioning power and water systems (including Pala water treatment facilities) are critical to human health and tribal economic facilities. Loss of power or water systems could mean short or extended closure of operations including the casino and resort.

AGRICULTURE

Water availability is becoming a problem for Pala's agricultural operations. Agricultural operators on the Reservation have noted impacts to production of certain crops, including avocado and citrus fruit. Pala has recently drilled new, deeper wells for the avocado groves on the south side of the Reservation in order to supply enough irrigation water. In addition, Pala has recently begun purchasing water from the local water district for Robert's Ranch, an off-reservation property owned by Pala, because the wells have dried up. Agriculture represents a relatively small proportion of tribal revenue.

Pala's Highest Vulnerability Impacts

The sections above summarize a more extensive set of findings that were reviewed by Pala's staff and consultants. For each possible climate change impact, Pala analyzed the following types of data to determine the likelihood and extent of risks: exposure indicators (historical, baseline, and projected), impact indicators (historical, baseline, and projected), and population sensitivity and adaptive capacity indicators. Pala gave particular consideration to impacts that were expected to threaten the community assets deemed of most importance (described on page 13).

The table below (Figure 40) summarizes impacts that Pala determined present the most significant climate change vulnerabilities related to Drought. High risks are color coded in red, and medium risks are color coded in orange.

EXPOSURES	IMPACTS

[167] Association of Fish and Wildlife Agencies et al, *Chapter 2: Impacts of Climate Change and Ocean Acidification in the National Fish, Wildlife, and Plants Climate Adaptation Strategy* (2012)

	HEALTH/SOCIAL ENVIRONMENT	NATURAL ENVIRONMENT	BUILT ENVIRONMENT
DROUGHT	Decline of culturally important plants/animals	Drought-related ecosystem disruption (habitat, wildlife, vegetation, waterways)	
Secondary Exposures			
WORSENED AIR QUALITY (*more ozone, PM/Dust*)	Respiratory illness, Valley fever		
VECTOR CHANGES (*mosquitos, forest pests*)	West Nile illness or death	Greater pest infestations disrupting forest ecosystems	
WATER INSECURITY (*shortage/supply, production, distribution disruption*)	Short or long-term relocation Lost business revenues Drinking water supply interruption		

FIGURE 40: SUMMARY OF PALA'S HIGH AND MEDIUM RISK DROUGHT-RELATED IMPACT VULNERABILITIES

Conclusion

This report presents the purpose, process, and findings of a climate change vulnerability analysis for the Pala Band of Mission Indians. Based on this analysis, this report concludes that elevated temperature, wildfire, storms and flooding, and drought present high-risk climate change exposures for Pala. Each of these exposures result in significant impacts to Pala's health, social, natural and built environments, and is anticipated to threaten community assets that are valued by tribal members and residents. The impacts that Pala determined were of high or medium risk are detailed within each of the exposure areas under the Findings Sections and are summarized in Figures 22, 31, 38, and 40.

These findings identify areas of vulnerability that Pala may wish to address or prepare for. Costs associated with these impacts were not analyzed as part of this report but are anticipated to vary widely and potentially become overwhelming. A financial plan to manage these expenses is recommended.

The indicators and data sources used for this analysis are outlined in the Pala Vulnerability Worksheets, which were provided to the Pala Environmental Department. These worksheets can be used to track exposures and impacts on an ongoing basis. Based on the report findings, priority recommendations for further investigation and data gathering include regular monitoring of groundwater levels and trends, local transmission rates of climate-related diseases, and sensitive or culturally-important native plant and animal species.

A vulnerability analysis is the first major step in a community's climate change adaptation strategy. The next major step involves conducting an adaptation plan to determine how to implement strategies that address the vulnerabilities identified in this analysis. An adaptation plan can help Pala better understand its capacity to adapt, identify available resources, and determine how to cost-effectively build on its existing strengths. Certain strategies can also help to reduce Pala's greenhouse gas emissions that contribute to climate change as well as achieve other co-benefits to health, tribal fiscal condition and economy, and other areas of community concern.

Adaptation strategy options range widely from community engagement, to better data monitoring, and major infrastructural improvements, which entail varying levels of resource investment where feasible. The latest research shows that some of the most effective strategies may be those that help deepen social capital (bonding, bridging, and linking), social networks, and psycho-social skills to cope and cooperate during the stresses and trauma associated with climate impacts.[168] Finally, it is recommended that further adaptation activities involve community stakeholders with different perspectives because collaboration can substantially increase the implementation viability of an adaptation plan.

Acknowledgements

Thank you to the Pala staff that contributed to this analysis and to the Pala Band of Mission Indians Executive Committee for their continued leadership and stewardship of Pala's valued assets and resources.

[168] Doppelt, Bob, *Transformational Resilience: How Building Human Resilience to Climate Disruption Can Safeguard Society and Increase Wellbeing* (Greenleaf Publishing Limited, 2016)

Appendix A

The State Wildfire Action Plan 2015[169] lists the following wildlife species as "Species of Greatest Conservation Need" based on many factors, including climate vulnerability, in the South Coast Providence where Pala is located. Applicable habitats for Pala are those listed under Southern California Mountain and Valley.

Table 5.5-3 Focal Species of Conservation Strategies Developed for Conservation Targets – South Coast Province

Common Name	Scientific Name	Conservation Units and Targets[a]						
		Southern California Coast			Southern California Mountain and Valley		Southern California Coastal HUC 1807	
		American Southwest Riparian Forest and Woodland	California Grassland and Flowerfields	Freshwater Marsh	American Southwest Riparian Forest and Woodland	California Grassland and Flowerfields	Native Fish Assemblage	South Coast Native Aquatic Herp Assemblage
Invertebrates								
Quino checkerspot butterfly*	*Euphydryas editha quino*		X					
Fishes								
Arroyo chub*	*Gila orcuttii*						X	
Santa Ana speckled dace*	*Rhinichthys osculus* ssp.						X	
Santa Ana sucker*	*Catostomus santaanae*						X	
Unarmored threespine stickleback*	*Gasterosteus aculeatus williamsoni*						X	
Tidewater goby*	*Eucyclogobius newberryi*						X	
Amphibians								
California Tiger salamander*	*Ambystoma californiense*	X	X		X	X		X
California newt* (Monterey County and South)	*Taricha torosa*	X			X			X
Western spadefoot*	*Spea hammondii*	X	X	X	X	X		
Arroyo toad*	*Anaxyrus californicus*	X	X		X	X		X
California red-legged frog*	*Rana draytonii*	X	X	X	X	X		X
Southern mountain yellow-legged frog*	*Rana muscosa*	X			X			X
Reptiles								
Southern western pond turtle*	*Actinemys pallida*	X	X	X	X	X		X
Two-striped gartersnake*	*Thamnophis hammondii*	X			X			X
Birds								
White-faced ibis	*Plegadis chihi*	X	X		X	X		
Great egret	*Ardea alba*	X			X			
Great blue heron	*Ardea herodias*			X				
Black-crowned night heron	*Nycticorax nycticorax*		X	X		X		
Least bittern*	*Ixobrychus exilis*			X				
California condor*	*Gymnogyps californianus*		X			X		
Osprey	*Pandion haliaetus*	X		X	X			
Golden eagle*	*Aquila chrysaetos*		X	X		X		
Ferruginous hawk	*Buteo regalis*		X			X		
Swainson's hawk*	*Buteo swainsoni*	X			X			
Northern harrier*	*Circus cyaneus*	X	X	X	X	X		
White-tailed kite*	*Elanus leucurus*	X	X	X	X	X		

[169] California Department of Fish and Wildlife, *South Coast Province Chapter In State Wildlife Action Plan: A Conservation Legacy for Californians* (2015)

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		American Southwest Riparian Forest and Woodland	California Grassland and Flowerfields	Freshwater Marsh	American Southwest Riparian Forest and Woodland	California Grassland and Flowerfields	Native Fish Assemblage	South Coast Native Aquatic Herp Assemblage	
Long-billed curlew	*Numenius americanus*		X			X			
Yellow-billed cuckoo*	*Coccyzus americanus*	X			X				
Greater roadrunner*	*Geococcyx californianus*		X			X			
Short-eared owl*	*Asio flammeus*		X	X		X			
Long-eared owl*	*Asio otus*	X	X		X	X			
Burrowing owl*	*Athene cunicularia*		X			X			
Belted kingfisher	*Megaceryle alcyon*	X			X				
Southwestern willow flycatcher*	*Empidonax traillii extimus*	X			X				
Vermilion flycatcher*	*Pyrocephalus rubinus*	X			X				
Loggerhead shrike*	*Lanius ludovicianus*		X			X			
Least Bell's vireo*	*Vireo bellii pusillus*	X			X				
Cactus wren*	*Campylorhynchus brunneicapillus*		X			X			
Yellow-breasted chat*	*Icteria virens*	X			X				
Summer tanager*	*Piranga rubra*	X			X				
Tricolored blackbird*	*Agelaius tricolor*	X	X	X	X	X			
Yellow-headed blackbird*	*Xanthocephalus xanthocephalus*	X			X				
Mammals									
California leaf-nosed bat*	*Macrotus californicus*	X			X				
Pallid bat*	*Antrozous pallidus*		X			X			
Western red bat*	*Lasiurus blossevillii*	X			X				
Hoary bat	*Lasiurus cinereus*	X			X				
Long-eared bat*	*Myotis evotis*	X			X				
Yuma myotis	*Myotis yumanensis*	X			X				
Western mastiff bat*	*Eumops perotis californicus*		X	X		X			
Pocketed free-tailed bat*	*Nyctinomops femorosaccus*	X			X				
Big free-tailed bat*	*Nyctinomops macrotis*	X			X				
San Diego black-tailed jackrabbit*	*Lepus californicus bennettii*		X			X			
Pallid San Diego pocket mouse*	*Chaetodipus fallax pallidus*	X	X		X	X			
Jacumba pocket mouse*	*Perognathus longimembris internationalis*	X			X				
Southern grasshopper mouse*	*Onychomys torridus ramona*	X	X		X	X			
Ringtail	*Bassariscus astutus*	X			X				

Table 5.5-3 Focal Species of Conservation Strategies Developed for Conservation Targets – South Coast Province									
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		American Southwest Riparian Forest and Woodland	California Grassland and Flowerfields	Freshwater Marsh	American Southwest Riparian Forest and Woodland	California Grassland and Flowerfields	Native Fish Assemblage	South Coast Native Aquatic Herp Assemblage	

American badger*	*Taxidea taxus*		X			X			
Western spotted skunk	*Spilogale gracilis*	X			X				

[1] A species is shown for a particular conservation unit only if it is associated with specific conservation targets identified for the unit. For a complete list of SGCN associated with each habitat type by ecoregion see Appendix C.

* Denotes a species on the SGCN list. Non-asterisked species are not SGCN but are identified as important species by CDFW staff.