



Parks, Recreation, and Opportunities: A Case Study of East Bay Regional Park District's  
Climate Change Mitigation and Adaptation Strategies

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## ABSTRACT

# PARKS, RECREATION, AND OPPORTUNITIES: A CASE STUDY OF EAST BAY REGIONAL PARK DISTRICT'S CLIMATE CHANGE MITIGATION AND **ADAPTATION STRATEGIES**

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**In** the face of a global climate emergency, community parks & recreation and land management agencies are beginning to adopt a critical role in the fight against climate change. This study gathered information on efforts around the world and created a case study guide to examine the climate change mitigation and adaptation strategies of East Bay Regional Park District in the San Francisco Bay Area of California in the United States. The study was conducted in hopes of shedding light on how small agencies can be proactive and contribute to larger efforts, creating greater regional impacts.



**Keywords:** climate change, parks, recreation, sustainability, adaptation, mitigation, policy.

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## Chapter 1

### INTRODUCTION AND REVIEW OF LITERATURE

#### Background of Study

On November 5<sup>th</sup>, 2019, over 11,000 scientists from 153 countries issued a warning that Earth is facing a “clear and unequivocal climate emergency” and that, according to Ripple, Wolf, Newsome, Barnard, and Moomaw et al. (2019), “An immense increase of scale in endeavors to conserve our biosphere is needed to avoid untold suffering due to the climate crisis.” (p. 1). The effects of climate change are already evident in phenomenon like rising sea levels, intensified wildfires, and extreme weather events, and the effects are predicted to broaden and worsen (National Oceanic and Atmospheric Administration, 2012). The physical effects can complicate society, exacerbating social inequalities and other conflicts. These predictions, in conjunction with warnings like that of November 5<sup>th</sup>, are forcing local governments to acknowledge the crisis and address it in order to serve their people and protect their places.

Local land management and parks & recreation agencies are beginning to adopt a critical role in developing programs to address these effects. Agencies can limit their own negative contributions to the environment, and they can make even greater advancements by preparing their communities for what lies ahead. This kind of preparation includes operational changes in the way natural resources and landscapes are managed and maintained, and redevelopment of land and infrastructure to include more environmental purpose and function. It can also come in the form of recreational and educational programming for community members. Effective programming can benefit not only the

community but also the agencies themselves. Proven effectiveness could draw more government funding for these public agencies. One such agency which has already begun implementing an overarching climate program is East Bay Regional Park District in the San Francisco Bay Area of California.

### Review of Literature

Research for this review of literature was conducted at Robert E. Kennedy Library on the campus of California Polytechnic State University, San Luis Obispo. In addition to books and other resources, the following online databases were utilized: ScienceDirect, AGRICOLA, Web of Science, and GreenFILE. This review of literature includes the following subsections: addressing climate change, local climate policies, challenges to adaptation, and adaptation strategies.

The term climate change has come to represent a plethora of environmental changes and phenomenon that have occurred over the course of history. It's a dynamic term, and the topic is one of great controversy, especially surrounding its possible causes and contributors. Regardless of the reasons behind it, Earth's atmospheric temperature is rising at an alarming rate, which is producing many of the changes that have been observable to society.

As atmospheric temperatures rise, there will be more frequent and extended droughts and heat spells (California Energy Commission, 2019). Polar ice is melting in the heat, causing sea levels to encroach on developed areas. Additionally, warmer ocean surface temperatures create lower pressure weather systems and intensify storms, bringing more precipitation and flooding events over land. Sea waters will intrude on

water infrastructure and even transportation systems, affecting travel efficiency. Higher water temperatures will also affect the quality of fresh water systems, introducing events such as toxic algae blooms (Kirshen, Ruth, and Anderson, 2008).

All of these changes will affect plant and animal species worldwide and could change their ranges and distributions. For example, as forest health deteriorates in the Pacific Northwest region of the United States, the Northern Spotted Owl is losing its prominence as the more adaptable Barred Owl takes over its habitat (Dugger, Anthony, & Andrews, 2011). These are just a few of the many challenges which climate change is imposing on governments around the world. As governments are created to serve their people, negative effects of climate change are forcing them to plan and take action in not just land management, but also regional planning and public health. Favretto, Dougill, Stringer, Afionis, and Quinn (2018) separated government action into three categories: mitigation, adaptation, and development (p.6). They defined mitigation as “Intervention that reduces greenhouse gases emissions and increases their uptakes by the Earth system” (p. 6). In other words, mitigation is attempting to lessen the effects of climate change by reducing contributions to the problem, via reducing emissions, resource use, etc., and increasing sequestration of carbon to reduce the amount of harmful chemicals in the atmosphere. Adaptation was defined as, “adjustment made to cope with climate impacts, which moderates harm or exploits beneficial opportunities” (p. 6), which means adjusting to new conditions and preparing people and places in order to maintain or improve quality of life. Last is development, which was defined as, “Intervention that enhances short and long-term capabilities, assets and activities required for a means of living” (p. 6). This are usually capital improvement projects that are created in anticipation of the

effects of climate change. While multinational organizations and national governments have overarching climate initiatives, local governments are ultimately where adaptive changes will occur. Local entities around the world are taking on varying levels of mitigation, adaptation, and development (Favretto et al., 2018).

Dannevig, Rauken, and Hovelsrud (2012) studied the progress of eight municipalities in Norway. All eight towns had passed climate initiatives of varying degrees, but they concluded that local climate adaptation in Norway was in a state of infancy despite some positive measures being taken. The town of Bergen increased the minimum elevation required to build new structures to account for rising sea levels. Meanwhile, the town of Stavanger required that no new building would contribute more wastewater into the runoff systems there, because with a growing population, the stormwater diversion system would reach capacity from regular wastewater alone, leaving little volume for mass precipitation events. Hoylandet took action in increasing the diameter of wastewater pipes for the same reason. Stavanger also required all city employees with relatable duties to undergo GIS (geographic information system) training relative to climate change (Dannevig et al., 2012).

Sweden has a unique matrix of land ownership and control. The most sensitive environmental features such as watersheds and wetlands are given maximum legal protection, while surrounding areas are usually left to be managed by the landowner or a management agency (Pettersson and Keskitalo, 2013). This allows the landowners or agencies to make more immediate decisions about the land, as long as it falls in line with a centralized environmental code from the national government, which outlines best practices of sustainable stewardship. This gives localities in Sweden a high “adaptive

capacity”, or the ability to adapt in a short amount of time. Land management agencies there create networks as well where they can share resources with one another in order to be more effective (Pettersson & Keskitalo).

South Africa’s governments have taken a vegetation management mitigation approach by planting flora that has high carbon sequestration potential (Favretto et al., 2018). Vegetation management can include introducing and planting, replacing, removing vegetation, or controlling the volume of vegetation. These practices can take on a role of mitigation and sequestration like in South Africa, or they can take on a more adaptive role by reducing fuels in wildfire prone areas or reducing groundwater uptake to conserve fresh water.

In Brazil, water shortage issues have led to massive development projects. Some areas in the country have had water infrastructure systems installed to pump and transfer water between watersheds in order to maintain a more constant flow between seasons and years (Hunt & Filho, 2018).

In Australia, the Ku Ring Gai local government area applied a loss-distribution model, where they used quantitative formulas to assess wildfire risk areas (Keighley, Longden, Mathew, & Trück, 2018). They then mapped those risks into GIS systems in order to prioritize management objectives. Management agencies were able to use the modeled risks to make reports for decision makers, who ultimately would be able to allocate more resources to those agencies.

While there are plenty of local governments around the world that are finding success in their efforts to adapt to climate change, most agree that there’s a lot more to be done. There are a few trends in the challenges that local governments face, ranging from

leadership to funding. The first trend is that low-level government agencies seek more direction from higher level government offices. More direction may mean definition of responsibilities where local entities are unsure of what role they serve in climate initiatives (Dannevig et al., 2012). In other cases, entities may understand what their roles are, but they lack the financial or administrative resources needed from the central or national government to effectively accomplish their goals, especially in places with dispersed townships like Canada (Lemieux, Beechey, Scott, and Gray, 2011). Risk assessment seems to be a major challenge for agencies because they can't accurately predict costs and severity associated with climate-related hazards (Dannevig et al., 2012). In the New South Wales area of Australia, local governments had trouble measuring and reporting their emissions, so they hired consultants to do the job for them. This led to an inconsistency in reporting between entities and took away from the overall effectiveness of climate mitigation in the region (Fallon and Sullivan, 2014).

Sharp, Lemieux, Thompson, and Dawson (2014) found in their studies of North America that government entities trying to adapt faced downfalls in a number of areas in their efforts including poor conservation leadership. Agencies often lack capacity for what they set out to accomplish or take action based on hypothetical theories and expect solutions. Without considering "side effects" of their actions, this lack of positive leadership led to wasted resources and unachieved goals. Better leadership in organizing adaptation efforts included focusing on specific hazards of climate change, which led to more extensive climate plans than those plans that didn't specify the hazards needing attention (Koski & Siulagi, 2016). Additionally, leaders should be keeping their climate initiatives up-to-date, yet in places like New South Wales, more than one-third of the

towns studied by Fallon and Sullivan (2014) had climate initiatives which predated the year 2000.

Aside from a lack of direction and poor leadership, climate initiative efforts often are disorganized by a lack of cooperation between stakeholders. Koski and Siulagi (2016) described the importance of, “transmunicipal climate networks”, or collaborations between local governments to foster a greater positive impact regionally and beyond. In some places, networks are well developed, but other places have yet to catch up. According to Pettersson and Keskitalo (2013) in their research of biodiversity protection, a serious barrier to success is clashing goals between property owners, with some aimed towards preservation, some towards conservation, some towards multiple-use, and others towards mass harvesting. Interconnectedness between open spaces is a valuable characteristic of a healthy landscape (Hannah, Midgley, & Millar, 2002) and uncooperative stakeholders make that nearly impossible. On a similar note, the public should be involved in planning climate programs, but in many places, the programs that impact the public aren’t well communicated to the public. They should be recognized as a key stakeholder because projects with positive public interest are much more attainable than those with little public support (Koski & Siulagi, 2016). Koski and Siulagi also stressed the need for cooperation between interest groups focused on mitigation and interest groups focused on adaptation. The private sector, which usually is capable of large-scale mitigation, is often is not considered in public education communications. Some government agencies could increase their mitigative effectiveness by better communicating benefits of mitigation and adaptation to private businesses so that, they

too, take action and contribute to the overall progress of a place or region (Koski & Siulagi, 2016).

Another trend that's been consistently observed throughout the world is that there is a positive correlation between government size and the effectiveness of their climate programs. Generally, in more developed places, climate adaptation programs are more developed. However, in less developed places, adaptation is focused solely around profitable natural resources such as agriculture, fisheries, or forestry, where income could be harmed by the effects of climate change (Berrang-Ford, Ford, & Paterson, 2011). The most important factor in adaptation in these kinds of areas could be clearer education about risks and hazards that come along with climate change (Paterson & Charles, 2019).

After examining the efforts which have been put forth by local governments around the world and taking into consideration the challenges they have faced, there starts to form an idea of what successful adaptation entails. To begin with, the highest levels of government should have clear roles and responsibilities defined for lower levels of government. From there, managers in charge of climate programs should be open to collaboration and flexible to a dynamic future. Dannevig et al. (2012) found that the most successful towns had environmental or emergency services officials working on climate initiatives. An effective leader also involves the community in planning, because although some projects may not be an agency's priority, it may be the public's priority, and if it's completed, it may be easier to accomplish the more prioritized tasks of the agency once the public is satisfied (Sharp et al., 2014). From a legal standpoint, local entities should be advocating for adaptive legislation that gives them more financial and

administrative resources and legislation that is flexible to unpredicted effects of climate change (Pettersson & Keskitalo, 2013).

At a more operational level, positive adaptation planning includes gathering as many resources as possible before moving forward with decisions. This includes collecting mass amounts of research and data and integrating them with models into GIS systems (Hunt & Filho, 2018). When planning, predictions are important for models, but it should be recognized that predictions could be wrong, so adaptation plans should prepare communities to be more resilient in all directions, not just towards the most-likely conditions (Hannah et al., 2002).

To narrow this literature review into the scope of this study, it's important to understand how climate change is affecting the state of California in the United States. The California Energy Commission (2019) offered a publicly available resource called Climate Tools, which outlines nine of the most major effects of climate change in the state and provides data about each:

First, *annual average temperatures* will change as global atmospheric temperatures rise. According to the data, these changes in annual averages could pose severe threats, “to the state's ecosystem health, agricultural production, water use and availability, and energy demand”, and the smallest of changes could impact those ecosystems because, “water resources are nearly fully utilized.” Then, *extreme precipitation events* may increase in frequency and include flooding, mudslides, and related damages.

Third, *extreme heat* could become “one of the more serious threats to the public health of Californians”, leading to more cases of heat-related illness, especially in

sensitive populations. *Sea level rise* is already threatening coastal communities and will encroach into water infrastructure and intensify flooding, because floodwaters are not as easily diverted.

Fifth, *snowpack* trends are changing, with more precipitation falling in winter months rather than snow, which affects the winter recreation industry, changes water availability the rest of the year, and brings about water management issues for hydropower generation. Sixth, which makes it into the media often are *wildfires*, which are increasing in frequency, size, and intensity.

Seventh, *Cooling and heating degree days* reflect higher demands for energy to cool or heat buildings as average temperatures change. Eighth, *stream flows* could change in timing, which may be catastrophic to agriculture if irrigation demand in the valleys does not line up with water availability. Last, *extended droughts* may become more severe in the future, bringing about challenges to public health and agriculture and exacerbating all of the other issues already listed (California Energy Commission, 2019).

In California, an agency that serves an area which faces all of these trends should be addressing all of them in order to best serve its people. Parks & recreation and land management agencies can adopt a leading role in taking the right steps, as they are responsible for programs and operations which can make an extensive positive impact on their communities and regions.

#### Purpose of the Study

The purpose of this study was to examine the climate change mitigation and adaptation strategies of East Bay Regional Park District.

## Research Questions

This study attempted to answer the following research questions:

1. What are East Bay Regional Park District's climate change mitigation strategies?
2. What are East Bay Regional Park District's climate change adaptation strategies?
3. How effective are East Bay Regional Park District's climate change mitigation strategies?
4. How effective are East Bay Regional Park District's climate change adaptation strategies?

## Chapter 2

### METHODS

The purpose of this study was to examine the climate change mitigation and adaptation strategies of East Bay Regional Park District. This chapter includes the following sections: description of organization/s, description of instrument, and description of procedures.

#### Description of Organization/s

East Bay Regional Park District (~~East Bay Regional Park District~~, 2019) is a special district headquartered in Oakland, California. The District was formed in 1934 and has since grown to span over Alameda and Contra Costa Counties, managing 73 parks, close to 125,000 acres of land, over 1,330 miles of trail, and provides recreation and interpretive services. Their landscapes include saltwater shorelines, estuaries, freshwater lakes and streams, forests, and grasslands.

The District's mission is:

The East Bay Regional Park District preserves a rich heritage of natural and cultural resources and provides open space, parks, trails, safe and healthful recreation and environmental education. An environmental ethic guides the District in all of its activities.

The District's vision statement is:

The District envisions an extraordinary and well-managed system of open space parkland in Alameda and Contra Costa counties, which will forever provide the opportunity for a growing and diverse community to experience nature nearby.

The District's values are respect, resilience, relationships, responsiveness, and transparency. Their organizational chart places the public at the top, who the board of directors listens to. The board advises the general manager, who oversees the deputy general manager and their operations divisions, a legislative branch, and legal, public affairs, and public safety branches.

### Description of Instrument

The instrument utilized in this study was a case study guide developed by the researcher (see Appendix A). It was designed based on the information collected in the review of literature about other organizations' practices and climate predictions. In order to define the scope of the study, the instrument was created to analyze only East Bay Regional Park District's climate change-related efforts. The instrument divided the District's strategies into mitigation and adaptation, like in the research by Favretto et al. (2018). Favretto et al.'s third defined practice of development was excluded as specific criteria because development could be included under mitigation or adaptation, depending on the purpose and function of the development. It would be difficult to compare the District's strategies with other organizations without assessing it in the context of its place, so the adaptation effectiveness criteria were measured based on the California State Energy Commission's nine areas of climate impacts in the state as identified in the review of literature. A pilot test of the instrument was conducted on October 30, 2019, and it was deemed necessary to add "other" categories in both the mitigation and adaptation areas in order to take into account any climate action being taken by the organization that would not fall under one of the specific categories.

### Description of Procedures

A case study was conducted on East Bay Regional Park District's climate initiatives. The instrument used was a case study guide created by the researcher, based on nine areas of climate change effects in the State of California and from other research in the review of literature. Research for this study was conducted during a two-week period in November 2019. The case study criteria were separated into mitigation and adaptation areas. Mitigation was divided into emissions and resources in order to distinguish differences in what the District was doing at the time to mitigate the effects of climate change by reducing emissions and managing resources. Adaptation was divided into nine areas of climate change effects expected in California's future. All of the mitigation and adaptation efforts were analyzed in context of the best practices outlined in the review of literature. The majority of information was collected from East Bay Regional Park District's website, with some being gathered from other sources.

## Chapter 3

### PRESENTATION OF THE RESULTS

The purpose of this study was to examine the climate change mitigation and adaptation strategies of East Bay Regional Park District. A case study was utilized to examine the District. This chapter includes the following sections: mitigation strategies and adaptation strategies.

#### Mitigation Strategies

East Bay Regional Park District (The District) has mitigation measures in place for both emissions management and resources management. A strategic energy plan was developed in 2014, where a consulting firm addressed lighting, space heating, pumping and hot water systems in the District. The District uses electricity, gas, and propane in their parks and facilities, and the most power (about half) is drawn to operate water pumps for irrigation and swimming facilities. In 2014, the greenhouse gas emissions from the District's energy use totaled to 1,156 tons of carbon dioxide equivalent per year. At the time, it was estimated that for an investment of about \$8.4 million, the District could save 78% more energy and have a payback period of 13.4 years. This plan would reduce greenhouse gas emissions by 771 tons of carbon dioxide equivalent per year. Most light bulbs used in the district at the time were already fluorescent, though some were incandescent in historical sites in order to preserve cultural value. As part of the plan, the District installed a 1.2-Megawatt solar panel system at Shadow Cliffs Regional Park in Pleasanton, which now offsets almost all of the District's energy use. Shadow Cliffs also

had three electric car charging stations installed. Solar panels were also installed on top of the headquarters building in Oakland.

Externally, the District is implementing mitigation by increasing the accessibility of “green transportation” in the East Bay Area. The District is involved in regional planning and operates under California Senate Bill Number 375, the Association of Bay Area Governments, and the Metropolitan Transportation Commission, which all have linked housing development with green transportation in regional planning. In 2015, the District also passed a resolution to uphold the Paris Climate Accords. The District maintains about 300 miles of trail as well, which serve as routes for people to commute by walking, biking, or other green methods of transportation as opposed to driving.

The District also manages emissions by carbon sequestration. One report identified their methods of sequestration to include avoided conversion of forest, improved forest management, restoration and enhancement of coastal wetlands, restoration and enhancement of tidal wetlands, urban forest management and biochar. Botanists and other staff regularly take inventories of vegetation and soils in the district and calculate total carbon storage potential. The upland forests in the District have been identified as having the greatest carbon storage capacity, followed by grasslands, shrubs, and wetlands, respectively. The District’s lands sequester over 300,000 tons of carbon dioxide per year, which is equivalent to removing over 59,000 passenger cars from the road. Meanwhile, however, the District still does release emissions from its operations. Some contributing activities include grazing animals, operating buildings, equipment, vehicles, and more.

The District mitigates effects of climate change as well by managing natural resources. They have transitioned to using recycled water for irrigation in many of its parks. Organization-wide objectives also place sustainability in the form of improved recycling, composting, and other waste management as a priority. They also target invasive species for removal across their landscapes to prevent them from negatively impacting carbon sequestration, future wildfire risk, and more.

Interpretation and recreation services are a key part of the District's purpose, and surely any environmental education program has some value towards mitigating climate change by educating the community about nature and the environment. More emphasis in their educational programming on climate change, however, may have significant benefits for the future of the East Bay Area in preparing the people of the East Bay for what lies ahead, and therefore creating a more resilient population.

### Adaptation Strategies

As for adaptation strategies, the District has begun to implement measures in response to changing average temperatures. Buildings with controlled climates are offered as community cooling centers during extreme heat events. These visitor centers and other facilities are being forced to adjust their programming to be held indoors and accommodate more people. At times, programs may have to be cancelled. Additionally, park planning is including more tree planting in order to create more shaded areas, and the solar panel project has a dual purpose in being able to provide shade as well. The District has already noticed changes in water quality as a result of rising average temperatures. In response, the District performs weekly water quality monitoring by

testing waters for coliform, fecal coliform, e. coli, enterococcus, and blue-green algae. The results are updated online and posted in parks weekly with a green/yellow/red light warning system to allow, warn of, or prohibit swimming in those waters.

One of the ways the District is preparing and responding to extreme precipitation is by restoring wetlands. The wetlands act as natural flood buffer zones. The District is restoring wetlands at many of its sites such as Big Break Regional Shoreline and the Dotson Family Marsh. In order to adapt to sea level rise, the District is working with the State of California and other regional planning agencies on a case-by-case basis. Their management practices include dredging, repairs of levees, canals, and construction of new features. For example, the District is part of a Joint Powers Authority at their Hayward Shoreline site along with Hayward Area Recreation and Park District and the City of Hayward. The three agencies belong to the larger Hayward Area Shoreline Planning Agency, which is adapting and preparing for sea level rise by planning over 200 million dollars in projects to reroute trails farther inland and reinforce structures to account for stronger wave energy and build larger levees to protect water treatment infrastructure threatened by rising water tables farther inland. At their Bay Point location, the District is retreating developed park land farther inland and plans to use intertidal wetlands to serve as a self-sustaining future buffer zone for rising tides.

The District has planned to manage wildfire risks in a number of ways. They developed a plan known as the Wildfire hazard reduction and resource management plan, which identifies the goals for the District to be reduction of fire hazards on district-owned lands in the wildland-urban interface to an acceptable level of risk, maintenance and enhancement of ecological values for habitat consistent with fire reduction goals,

preservation of aesthetic landscapes, and a cost-effective vegetation management plan. The objectives that follow include evaluating fire breaks in the District, providing options for vegetation management methods, evaluating the environmental impact of those methods, minimizing effects on species of concern, maintaining habitat and ecological function, developing a plan that allows the district to be adaptive and protect its people and resources, and involve diverse stakeholder groups in planning.

Their vegetation management methods include hand labor, mechanical treatment, chemical treatment, prescribed burning, and grazing. Their vegetation management plan lists specific guidelines on how different landscapes and vegetation sites should be managed to mitigate wildfire risks. This includes identifying high-risk features such as vegetation that creates flames over eight feet in height, understory thinning, removing trees on ridgetops to prevent ember flight, and more specific policies such as managing and preserving invasive Eucalyptus stands instead of converting them to other vegetation. Data has been collected over many years and wildfire risks are mapped into GIS software using a system called FlamMap.

The District manages multiple bodies of water which are prone to the climate-related stream flow changes and extended drought impacts. The District manages its water resources in conjunction with the State and other local agencies to maintain its reservoirs and ponds for grazing and recreation and maintains stream flows for water quality and species of concern. The District has its own fisheries management branch.

On a broader scale, the District is addressing climate change with local ballot measures AA and WW. Measure AA was passed in 1988 and provided bonds to the District and gave allowance to local towns and community agencies for environmental

protection and conservation. In 2008, Measure WW gave \$500 million in bonds to expand regional parks, trails, and other environmental efforts. \$125 million of that is allocated to 46 different local agencies for their efforts. The District involves itself in government by supporting bills, lobbying, and maintaining relationships with government officials to pass legislation to support not only the District but also environmental practices across the state and country. They are currently working on developing more framework for what they call Green Bonds in order to secure more funding for climate-related projects.

As for other impacts that climate change is imposing on the East Bay Area, the District is addressing many of them through its day to day operations, including in its biological and ecological services and stewardship planning.

## Chapter 4

### DISCUSSION AND CONCLUSIONS

This study was conducted in part to shed light on how local parks & recreation and land management agencies can combat the effects of climate change. East Bay Regional Park District is one such agency, and it was examined in hopes of exhibiting strengths, weaknesses, and opportunities which the industry can learn from. This concluding chapter includes the following: a discussion of the findings, limitations of the research, conclusions based on research questions, and recommendations for the future.

#### Discussion

East Bay Regional Park District (the District) is mitigating the effects of climate change, especially through managing emissions. Their solar energy project at Shadow Cliffs which is powering almost the entire District proves their commitment to sustainability and reducing greenhouse gas emissions. It's also an example of how a development like that described by Favretto et al. (2018) can be both a mitigation and adaptation strategy, as the solar panels serve the dual purpose of creating shade structures to adapt to rising average temperatures and extreme heat events. The District was able to make both of these achievements while also reaping financial benefit from its energy savings. These savings can then be used by the District for more climate change action. Considering that space is becoming a high-priced commodity in the Bay Area, East Bay Regional Parks could become places where renewable energy infrastructure can be built

without having considerable environmental impact. Carbon sequestration is another strength of the District, though perhaps that's primarily because of the sheer amount of land that the District owns and manages. The District has identified specific areas and vegetation types which are the most effective in sequestering emissions, which is important in planning to protect and expand such areas. Making these kinds of specific identifications allows the District to remain ambitious in its initiatives while still achieving successful mitigation and adaptation by avoiding uncertain and nonrealistic goals, as found by Koski and Siulagi (2016). To round out the District's approach to emissions management, their construction and maintenance of commuter-friendly trails removes even more cars from the road and again serves a dual purpose by improving their developed park lands. The District's targeting of invasive species has high mitigative value not only in fire prevention, but also by preventing loss of native species as the East Bay's landscape changes, avoiding domination by invasive species as in the case of the Northern Spotted Owl in the Pacific Northwest (Dugger et al., 2011).

The District seems to be adapting to climate change proactively and effectively. Their strength again comes with the identification of specific hazards that need attention. They see the need to adjust to changing average temperatures (in a warmer direction in the San Francisco Bay Area) and extreme heat events and have taken action by offering their community cooling centers and creating more shaded areas. Their water toxicity data collection and warning system informs the public of climate-related hazards and could even be considered a mitigation strategy to prevent threats to public health. The rise of water quality issues may emphasize the need to maintain or construct new swimming facilities, which may increase the energy needed for pumps and filtration

systems, considering almost half of the District's power is already routed to water management.

In adapting to mass precipitation, the District is taking measures to restore wetlands and reinforce existing infrastructure. No information was found on more specific actions being taken such as increasing storm water diversion system capacities like some cities are doing (Dannevig et al., 2012). Considering the District manages more open space and less so community parks, the need for flood control on a small scale may not be as necessary as it is for smaller towns and more developed communities. The District is taking major action in preparation for sea level rise and while levels have not risen much yet, the District is creating effective plans and has already begun some projects which will protect its land and people from encroaching tides. Some of the success they have found has been by working with other agencies, which isn't surprising after Koski and Siulagi's (2016) emphasis on the importance of transmunicipal climate networks. The extreme costs of these projects only further exhibit the need for more agency collaboration. In regard to the Hayward Shoreline project, the District's belonging to the planning agency and their involvement as a joint power authority is a great example of how clear and defined roles are helping them achieve objectives, just as Dannevig et al. (2012) described.

It makes sense that the District has developed a strong wildfire adaptation program considering the immense wildfire destruction California has recently experienced. Again, the District lists very specific objectives and has created a thorough management plan to reduce the risk of wildfires. Similar to government entities in Australia (Keighley et al., 2018), the District has logged wildfire risk data into GIS software using the FlamMap

system. Then on an operational level, the District has begun implementing an intensive vegetation management policy, comparable or more developed than in places like South Africa, where Favretto et al. (2018) found agencies to be using mass vegetation management as well. Another strength that the District exhibits in its wildfire adaptation planning is involving the community in planning, which, as according to Koski & Siulagi (2016), is critical in effectively addressing climate change.

It was difficult to find some efforts that the District is making towards combatting climate change effects, such as snowpack and streamflow changes. The fact that the District has well-developed environmental planning and stewardship branches suggests, however, that addressing these issues, among many more, is part of everyday activities in the organization. For example, the District's fisheries branch must be managing stream flows in order to protect and enhance habitat for native aquatic species, which shows how the district is both directly addressing effects of climate change and approaching problems from multiple disciplines. This being said, there is always room to improve. The District publishes information about their climate planning and action, but there is no single comprehensive report which identifies climate change related impacts for every operational activity of the organization. A single report which quantifies impacts for every activity, from the benefits of wildfire adaptation to the emissions released by power tools, should be compiled in order to assess the present and future value of the District to the East Bay Area.

As public entities, community parks & recreation agencies like the District exist to enhance quality of life. Focusing on the present without precaution for the future, though, can sacrifice posterity. With overwhelming evidence and a sincere warning of an

imminent climate emergency, these agencies must first admit that climate change exists and then recognize that, with such capacity to make great changes, that it is their responsibility to take immediate action. Community parks & recreation and land management agencies have potential to become the leaders in the efforts to mitigate climate change and adapt to its effects, saving places and people.

Some of the limitations that this study faced include a short time period of data collection, use of a single organization to case study, and researcher bias. There was only enough time to collect data for two weeks under the circumstances of this study, so only the surface of information about what the District is doing to address climate change was reached. If more time was allowed, more information could have been pulled from the website and other sources. Ideally, with more time, this study would include not only what the District is doing to address climate change, but also specifically how they are doing that, with in-depth descriptions of their operations and methods. Additionally, many of the District's operations contribute to their climate change efforts but might be considered a part of their climate initiative. The use of East Bay Regional Park District was effective in presenting a well-developed organization; however, it lessens the generality of the study by limiting the comparative value that a comparative analysis or industry survey might have had. While it was attempted to remain objective as possible, the researcher was employed as an intern of the District for a summer season, which introduces a possible bias promoting the organization. The researcher also is a resident of the East Bay Area and may introduce bias in their experiences from the area.

## Conclusions

Based on the findings of this study, the following conclusions are drawn:

1. The District is mitigating the effects of climate change by improving their energy efficiency, enhancing carbon sequestration, and increasing access to green transportation in their region.
2. The District is adapting to the effects of climate change by identifying specific hazards such as wildfires and constructing more resilient infrastructure and updating landscape management policies to adjust to new conditions.
3. The District has effective mitigation strategies but on a limited scale.
4. The District's adaptation strategies are well developed and effective in comparison to most local land management agencies.

## Recommendations

Based on the conclusions of this study, the following recommendations are made:

1. Parks & recreation agencies should be taking a proactive and aggressive role in mitigating climate change and adapting their communities to its effects.
2. East Bay Regional Park District should create a single extensive report which quantifiably details all of their contributions to climate change and their efforts to mitigate and adapt to it.
3. The District should expand their public education efforts around climate change.
4. The District should build more renewable energy infrastructure in their parks to provide power for other community resources.

5. In order to get a broader sense of how parks & recreation agencies can contribute to community climate change mitigation and adaptation, a larger study encompassing all agencies in a single area should be conducted in order to quantify the total impact which these agencies have on a region.
6. Narrower studies on industry-wide climate mitigation and adaptation methods which outline best practices are needed to provide resources for agencies looking to begin their own efforts. Examples would be a study of carbon sequestration practices, or a study of wildfire prevention and mitigation methods of local governments.

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## REFERENCES

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## APPENDIXES

Appendix A

Instrument

INSTRUMENT

	<b>Addressed? Yes/No</b>	<b>Policies</b>	<b>Practices</b>	<b>Notes</b>
<b>Mitigation Areas</b>				
Emissions Management				
Resources Management				
Other				
<b>Adaptation Areas</b>				
Average Temperatures				
Extreme Precipitation				
Extreme Heat				
Sea Level Rise				
Snowpack				
Wildfires				
Cooling/Heating Degree Days				
Stream Flows				
Extended Droughts				
Other				