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Final Research Paper

Big Sur Natural Area

Along the central coast of California, there is an area that covers roughly 90 miles of beautiful coastline, stunning views, coastal mountains, and state parks. It includes many rare and endangered species, is vastly biodiverse, and has several marine protected areas offshore. This spectacular region is known as Big Sur, and due to its stunning aspects, many people have fought for protections in order to preserve its natural beauty. Big Sur has come a long way in terms of legal protections, but now another threat is approaching: climate change. Being a coastal area, and one so biodiverse, there will be many impacts of climate change that Big Sur will have to face. But, through adaptation, mitigation, and communication, the area will be prepared and ready for what lies ahead. Fighting against climate change will be essential to preserving many natural areas all over the world- including this one, which has a rich history, and holds sentimental value to many people.

Today, the area is home to only about 1,000 year-round residents due to the high real estate prices, environmental restrictions, and mountainous terrain- but it is a big tourist location, attracting roughly 3 million tourists annually. Until 1937 when the road currently known as Highway 1 was opened, the Big Sur area was one of the most remote in the state due to how difficult it was to access. It was when Dr. John L. Roberts traveled and photographed the land in 1897 that its beauty was recognized. He then prompted for a road to be built so there was access to the area. (Longfellow, 2015) After the end of World War II, travel to Big Sur skyrocketed, and tourism boomed along the coast. The

creation of the highway completely changed the local economy, but starting early on, local residents and conservationists fought for the preservation of the land.

1962 marked an important long-term victory for conservationists: the Coast Master Plan was finalized. The plan identified preservation of the landscape in Big Sur as the principal goal, and recommended “future growth be controlled in a manner that was harmonious with the natural setting.” (Walton, 2007) This was a radical new vision for Big Sur, and showed that there was a new kind of environmental awareness developing. This happened a full decade before standards that were similar would be applied statewide in the Coastal Initiative. After this, an awakening of environmental interest both regionally and nationally occurred in the 1970’s.

In 1976, the California Coastal Act passed in legislature, which established the California Coastal Commission. The commission worked with oceanfront counties and city governments to set standards for construction and public access, protection of marine life and coastal wildlife, restoration of sensitive habitats, and the protection of scenic beauty. (Walton, 2007) However, conflict arose when there were concerns that the commission would impose regulations that went against local interests and threatened the consensus that was reached in the 1962 Coast Master Plan. In April 1980, an even bigger conflict arose for the Big Sur locals: the senator proposed a bill that would appropriate \$100 million for land acquisition on the coast of Big Sur over ten years in order to form the nation’s first national scenic area. After mostly negative testament in the Senate, the bill was shelved. Another plan was made that would cause final authority in Big Sur to rest with the federal agency, casting aside the Coastal Commission. This also died in the Senate- but both situations created a tension and bitter feelings for the local residents,

who considered themselves the true stewards of the land. (Walton, 2007) This set the tone of conflicting interests and groups when trying to conserve the Big Sur area, as Walton stated: “The story of conservation in Big Sur has been a tempestuous one, featuring pitched battles between local property owners and outsiders, among locals, and even among well-meaning environmentalists.” (2007, page 47) John Woolfenden describes this the “battle for the wilderness”, which still continues on.

Although there has been conflict, through the cooperation of the different actors, Big Sur has become an exemplary case when it comes to environmental protection. The Big Sur Land Trust was established in 1978, and has since protected more than 30,000 acres of coastal land. The Monterey Peninsula Regional Park District was created in 1971, and it currently manages 5,500 acres of land in the Big Sur area. The Big Sur Coast LUP was approved in 1986, and it superseded the Coast Master Plan. The plan stated “The overall direction for the future of the Big Sur Coast is based around the theme of preserving the outstanding natural environment The County’s basic policy is to prohibit all future public or private development visible from Highway I.” (Walton, 2007, page 62) It has been said that the plan is one of the strongest local environmental programs in the United States. (Walton, 2007)

Today, there are several other actors that play a role in the protection of Big Sur. Some of these are the California State Parks Department, the U.S. Forest District, the Bureau of Land Management, and state- and federal-designated wilderness areas and national marine sanctuaries. There are at least a dozen environmental organizations, both public and private, involved in the protection of Big Sur. Big Sur is also part of the Monterey Bay National Marine Sanctuary, so offshore areas- “Point Sur State Marine

Reserve and Marine Conservation Area” and “Big Creek State Marine Reserve and Big Creek State Marine Conservation Area”- are designated as Marine Protected Areas.

MPAs protect the ocean by helping to ensure that the ocean’s bounty and beauty are protected and maintained for use and enjoyment by future generations. (2014) Since designation in 1992, the MBNMS has brought a host of federal protections to the area. The Big Sur area also now includes nine state parks, as well as six points of interest. (Walton, 2007) It is no doubt that Big Sur has come a very long way when it comes to environmental protection.

Although Big Sur has made great strides in terms of legal protections, a new looming threat lies ahead: climate change. Big Sur is already experiencing the effects of climate change, including sea level rise, increasing sea surface temperatures, erosion, and ocean acidification. A statewide study by the California Energy Commission found that roughly 4.4 square miles of coastline in Monterey County is susceptible to erosion from the expected sea level rise caused by climate change. It also predicts that coastal dunes and cliffs will retreat by up to 1,300 feet and 720 feet. (SIMoN) Erosion caused by sea level rise along with the expected rise in storm and wave intensity could place many oceanfront facilities at risk, and may cause damage to private residences, transportation infrastructure, major sewage pipelines, and beachfront businesses. Some studies suggest that 3,420 people in Monterey and Santa Cruz counties could lose their homes because of climate change and this erosion. (SIMoN) This could also impact the tourism aspects of Big Sur: there are already only a select few businesses in the area. Because of this, travelers have few options when it comes to staying overnight in Big Sur and dining in

the area. If businesses, homes, and transportation infrastructures are impacted by climate change, this could greatly alter the potential for tourism.

Another large impact climate change is feared to have on Monterey County, which includes most of Big Sur, is saltwater intrusion. Over 80 percent of Monterey County's total water use comes from local groundwater reserves. Saltwater intrusion is the process by which coastal groundwater aquifers become contaminated by seawater: this could affect much of the water used in the Big Sur area, which not only effects local ecosystems, but tourism and local residents as well. Ocean acidification is also a big impact climate change is having on Big Sur. It happens when the elevated CO₂ levels from fossil fuels cause the oceans pH levels to decline. Oceanic pH measurements in the area over the last 20 years show that ocean pH is indeed on the decline, which correlates with the global trends. (SIMoN) Perhaps one of the largest impacts climate change has- and will have- on Big Sur is sea level rise. Along the California coast, sea levels have already risen about 7 inches this past century. If global warming persists and that sea level rises higher, there's no telling how big of an impact it could have on the area. The sea level rise, which is expected to increase three meters by 2050 or 2060, coupled with erosion, could be devastating for the beautiful coast and cliffs of Big Sur.

An impact that Big Sur is already experiencing due to climate change is temperature changes. Studies have shown that the number of extreme warm summer days has increased in frequency, and overall patterns since the mid-1990s suggest that diurnal temperature ranges are widening, with cooler nighttime temperatures and slightly above-average daytime temperatures. (Potter, 2014) Warming temperatures impact the marine food chain, and could shift populations of small marine mammals, which would greatly

affect larger marine mammals. That's not the only thing that could impact wildlife in the area: climate change and global warming often leads to a decrease in biodiversity. Big Sur is a very biodiverse region and is home to a huge variety of species, including endangered ones. Climate change could impact species in the area and lead to a decrease in biodiversity, which would be devastating to the area and all who love and protect Big Sur and its ecosystems. This is just one more example of how Big Sur's ecosystems are being impacted because of climate change, and it will worsen unless human-induced climate change is put to an end.

There are many efforts being made towards adaptation, mitigation, and communication of climate change in the Big Sur area. One organization in particular that is leading in these efforts is the Monterey Bay National Marine Sanctuary, which protects offshore areas in Big Sur. They have a whole section on their website that is dedicated to climate change, which makes information about climate change and its impacts readily available to the public. The sanctuary staff is also collaborating with local and state governments in order to face the challenges of climate change, through mitigation and adaptation. (SIMoN) The sanctuary has worked with the Center for Ocean Solutions to try and bring multiple different efforts together for focused conversations about coordinated adaptation efforts throughout the region. (SIMoN) These focused conversations are known as "Progress Towards Preparing for the Future: Climate Change and the Monterey Bay Shoreline". They bring together state and local government planning staff to learn and share information about preparing for sea level rise and other coastal hazard issues along the coastline. Two of these have already been held in Monterey, and there is currently planning for a third public engagement workshop.

(2015) This is very important for climate change, because communicating the effects of climate change to the citizens in Monterey County is especially important when it comes to fighting against climate change in Big Sur.

The Monterey Bay region is home to leading research centers of climate change and ocean acidification. It has research institutions that are world leaders in oceanographic research, including the effects of increased ocean CO₂ levels and ocean acidification. There is an experiment called FOCE, or Free-Ocean Carbon enrichment, that has occurred at the MARS cabled ocean observatory 900 meters below the surface of Monterey Bay. It involves a semi-enclosed tested area on the seafloor, where the pH of the seawater can be controlled for extended periods. Small seafloor animals are put in the testing chamber, and their behavior and physiological responses are monitored. Local research has also investigated the effects of carbon sequestration in the oceans on deep-sea biological communities. The area's prominence in oceanographic research has attracted international scientific meetings, such as "The Ocean in a High-CO₂ World Symposium". (SIMoN)

Besides research and communication of climate change, efforts have been made towards the adaptation and mitigation of climate change. Throughout the central coast and Monterey Bay region, communities are becoming more and more aware of the risks climate change poses on the Big Sur area. Local governments, state and federal agencies, and regional collaborations have hosted several conferences and workshops to share some strategies for building resilience and adapting to climate change. (SIMoN) The ADAPT MONTEREY BAY Project coordinates adaption efforts around the Monterey Bay area, which is in the same region as Big Sur. The project works with other ongoing

adaptation projects throughout the area to coordinate efforts as well as streamline demands on stakeholder time.

Monterey County, funded by the Ocean Protection Council, is partnering with multiple agencies and organizations on a regional project aimed at bring together adaptation efforts. This is called the Collaborative Efforts to Assess Sea Level Rise Impacts and Evaluate Policy Options for the Monterey Bay Coast, and it provides the initial steps to applying the Coastal Commission Guidance on assessing vulnerabilities and strategies of adaptation to inform cities and aid Local Coastal Program updates. The project's goals are to identify what coastal infrastructure will be compromised due to sea level rise for 2030, 2060, and 2100; identify the increase flooding risk to coastal communities in the face of rising seas; and define response strategies for these risks, and discuss with regional partners the different program and policy options that can be adopted to address these climate change risks to the region. (2016)

Another adaptation method that is being implemented is coastal armoring strategies. Some of these strategies, such as sea walls, bulkheads, and revetments, are already common in areas included in the Monterey Bay National Marine Sanctuary. As private landowners and local governments become aware of risks associated with sea level rise, coastal armoring projects are likely to become more common. (SIMoN) More agencies involved in the protection of Big Sur, such as the Big Sur Land Trust, are also thinking about climate change. They are incorporating the potential impacts of climate change into its program management and conservation plans. They are working towards anticipating the impacts of climate change and preparing management strategies that will address these expectations. (Feifel, 2010)

Overall, Big Sur and the surrounding areas are working hard to address climate change, communicate the impacts of climate change to the public, and adapt to these impacts. Although climate change can be a frightening matter- especially when it comes to coastal regions like Big Sur- they are standing up against the issue, instead of hiding from it or ignoring it like you see in many cases. Monterey County is a leader in terms of research that deals with climate change effects on the coast and marine life, and local organizations and groups are making huge efforts to start conversations about climate change and planning for the impacts it will have.

The next step for Big Sur will hopefully be implementing regulations and plans in the face of climate change. As mentioned earlier in the paper, there has been conflict between outside organizations, local governments, and local residents when it comes to agreeing on legal protections of Big Sur. In the face of this, however, they managed to come great lengths in terms of protecting this beautiful coast and its magnificent natural areas. In the future, these same organizations, agencies, and people will have to once again join forces and fight against climate change together- and they are already making great progress towards this. Although climate change itself is a very disheartening situation, areas like Monterey County that are so passionate about fighting against it give hope that when people put their minds to it and come together, anything could be possible- even fighting against and adapting to climate change.

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