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Mr. Chairman and members of the subcommittee, thank you very much for the opportunity to present testimony on the role of the National Park Servicce (NPS) in addressing climate change impacts on national park lands and their resources. I am the Superintendent of Point Reyes National Seashore along the California coast north of San Francisco. Over my 26-year career in the NPS, I have worked at Glacier Bay National Park, the Presidio, and the NPS Denver Service Center, in addition to Point Reyes.

Today my testimony will focus on our observations of the effects of climate change in national parks and more specifically, at Point Reyes National Seashore and the actions we are taking to prepare for the current and predicted changes from climate change.

Point Reyes National Seashore is one of 74 coastal units in the National Park System encompassing more than 5,100 miles of coast and three million acres of submerged resources including beaches, estuaries, coral reefs, kelp forests, and wetlands. These parks attract more than 75 million visitors every year, and generate over $2.5 billion in economic benefits to local communities. To conserve and restore these tremendous recreational and biological values, NPS Director Mary Bomar recently announced the Ocean Park Stewardship Action Plan (Plan), as called for by the President's U.S. Ocean Action Plan. This Plan sharpens our scientific focus and heightens our emphasis on conserving marine, estuarine and coastal resources in the National Park System. It acknowledges that we must expand collaborations with the states, the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS) and academia to better understand and respond to impacts on ocean park resources from climate change and other issues.

National parks represent a wide range of ecosystems scattered across the nation, and present us with a tremendous opportunity to observe the effects of climate change on resource conditions that scientists and managers have documented over decades. More recently, the NPS Natural Resources Challenge Initiative that began in 2000 ensured that parks across the nation complete inventories and initiate monitoring of natural resources. The combination of these sources of information (long-term legacy monitoring data and new inventories) has provided us with timely examples of the effects of climate change in parks now.

Within the Intermountain and Pacific West Regions of the NPS, here are a few examples of what superintendents are observing, some of which may be associated with climate change:

- From 1850-1993, at Glacier National Park, there has been a 73% reduction in the area covered by glaciers and numerous smaller glaciers have disappeared altogether. Only 27 km^2 of glaciers remain from the 99 km^2 which previously existed. Similar reductions are occurring at Mount Rainier, Olympic, and North Cascades National Parks.
- In the western mountain parks, such as North Cascades, Yosemite, Rocky Mountain, and Glacier National Parks, snow pack is reduced and lower water content is present in the snow. This has led to water shortages throughout California and lower runoff to the ocean, which exacerbates already contentious issues over wildlife (salmon and other endangered fish species) versus agricultural and urban needs for water. This year the snow pack in the Sierras was down approximately 30 percent.
- In high elevation parks, the ranges of animals and plants are shifting upward in elevation because of the warming of habitats with several species, such as picas, predicted to be lost with the loss of the boreal zone. This shift was documented in Yosemite by a recent repeat survey of areas that naturalist Grinnell surveyed in the 1930s.
- Coral reef die-off in Pacific island parks and kelp forests' loss in the Pacific coastal parks such as the Channel Islands National Park has been documented during El Nino events such as the one that occurred in 1998 due to the rise in average Pacific Ocean water temperatures.
- Dead zones off the coast of Oregon for the past 5 years have caused large pulses of nutrient input and phytoplankton blooms. These "dead zones," which suffocate crabs, fish, sea stars, and anemones on the ocean floor, have continued with those of 2006 now on the books as the largest, most severe, and longest lasting on record for the West Coast. These dead zones differ from those that have occurred elsewhere in the United States and widely around the world, because they are related to warm water rather than nutrient pollution. Redwood National Park is on the edge of a dead zone that is predicted to expand into California.
- Populations of six species of nearshore fish in California have collapsed due to lack of recruitment over the past 25 years. Over fishing, potentially combined with warming climate, could have decimated reproductive success in these nearshore rockfishes. These rockfish species are important as food for local marine species in all coastal parks from Redwood National Park to Cabrillo National Monument and to local fisherman.

Along with these examples, we have observed a number of specific impacts at Point Reyes National Seashore:

- The California rocky intertidal species` range shifted northward from 1931 to 1994.
- Almost every year, Point Reyes National Seashore experiences severe winter storm damage that requires emergency funding. Some parks are experiencing wetter winters with more rain in shorter periods, which results in increased erosion, flooding, and storm damage. Dryer summers and autumns lead to increased fire danger.

- Nearly one-third of all plants are non-native and an invasive plant pathogen called Sudden Oak Death is rapidly spreading throughout the park and other parks in the West. Non-native invasive species spread more rapidly with fire because they have a greater advantage in disturbed and rapidly changing environments, displacing native species.
- Seals were washed away by elevated sea levels and large waves in 1998 during an El Nino event. One western snowy plover nesting beach at Point Reyes is no longer usable because of over wash at high tides. The habitat of this federally threatened species will continue to diminish with sea level rise. Sea level rise also will cause loss of breeding and roosting habitat for seabirds and pinnipeds (seals and sea lions).
- Point Reyes is considered one of the foggiest places in the world, but in 2004 and 2005, the amount and timing of summer fogs were reduced because nearshore waters were warm. The fog patterns changed due to increased nearshore sea surface temperatures. Many forest and scrub species derive much of their moisture from fog drip.
- In 2005 and 2006, Point Reyes researchers documented very low krill populations off Point Reyes and Golden Gate National Recreation Area, resulting in complete breeding failure for the seabird, Cassin's Auklets. These are the first breeding failures recorded for this species in 30 years.

These impacts are not the only ones expected for our parks. Others are anticipated with the Intergovernmental Panel on Climate Change reporting that sea levels are rising and predicting that they will rise up to 7-23 inches this century. A Shoreline Vulnerability map for Point Reyes and other parks of the nation, created by the U.S. Geological Survey (USGS), predicts that rising seas will erode beaches and coastlines, submerge wetlands and swallow up Native American cultural artifacts at coastal national parks. Inundation of coastal estuaries, intertidal zones, and beaches will result in overall beach loss. Estuaries (which are fish nurseries, filter pollutants, and protect the coast from storm surges) will be submerged faster than new sediment can build up. Valuable habitat for eelgrass beds, foraging waterbirds, shorebirds and nearshore fish will be lost.

Stronger and more frequent El Nino events may promote harmful algal blooms that are toxic to seals, seabirds, and fish, and can poison shellfish and the humans that consume them. Over the past decade the number and frequency of California sea lions exposed to toxic domoic acid from harmful algae have increased dramatically. Changes in the timing of upwelling bring nutrients and food to salmon that feed at sea too late. Salmon are a critical species protected by streams and nearshore ocean waters of Point Reyes. Global climate change may undermine extensive restoration efforts by NPS to improve stream habitat for salmon while the salmon starve at sea. The salmon go out to sea in mid-April to mid-May, but in 2005 they found nothing to eat at sea and by the time upwelling started, they were dead from starvation.

Additionally, wildfire intensity is increasing in the West. Nationwide, the 2006 wildland fire season set new records in both the number of reported fires as well as acres burned. A total of 96,385 fires and 9,873,429 acres burned were reported. This season was 125

percent above the 10-year average. Also, predictive climate models suggest there will be no Joshua trees in the future at Joshua Tree National Park.

Each of the above examples has ecological and economic costs associated with them. Wildfires damage ecosystems but also burn down private homes that are on the borders of parks. Sea level rise and storm surges result in erosion of shoreline and damage shoreline infrastructure such as roads and lighthouses.

Facing these scenarios of predicted change, how can parks prepare to preserve the nation's natural and cultural treasures, protect the supporting infrastructure, and inform the public? What is the role of national parks in this national and global challenge?

I want to assure you that the NPS is proactively addressing these issues, and in the Pacific West Region, climate change has been identified by park managers and scientists as their highest priority. In 2006, Jon Jarvis, the Pacific West regional director hosted three one-day workshops of park superintendents, scientists, interpreters, and resource managers to discuss global climate change and the National Park System. The workshops were held in Washington State, California and Hawaii.

In the first half of each workshop, scientists working in the field of climate research presented the "state of knowledge" of global climate change in order to build first a basic understanding among the participants of what we have learned from climate data around the world and particularly in the West. Scientists also presented likely outcomes of global climate change such as sea level rise, changes to oceanic currents, trade wind variations, animal migrations, and fire regime changes. The second half of each workshop was an open dialogue on what field managers are already seeing in the parks, the role the NPS might play in global climate change and the actions we should take next.

Out of these workshops, the parks are strategically advancing in five areas: 1) consolidating information from existing sources and through inventories to establish a baseline of condition; 2) monitoring resources to detect changes in trends of resource condition and to provide an early warning of changes; 3) developing a systematic approach so that parks adaptively manage to preserve and protect resources; 4) informing the public through example; and 5) collaborating with partners locally, regionally and nationally so that we provide a seamless network amongst land and ocean managers.

Collaboration is vital to success. Point Reyes along with other coastal parks in the Pacific West Region is working with state and federal agencies, and universities to advance this strategy. Some examples include:

- The parks are coordinating with state and county fire fighting agencies to train and respond to wildfires, and reduce fire hazards.
- USGS will monitor shoreline change using Light Detection and Ranging (LIDAR) remote sensing technologies.

- Point Reyes is working with the NOAA Integrated Ocean Observing Systems (IOOS) and the California IOOS is monitoring nearshore ocean currents and essential fish habitat.
- Coastal parks are providing data to the California eMARINE regional program to monitor changes in intertidal communities and to detect invasive aquatic species, latitudinal shifts in species and recruitment level impacts from global climate change.
- The park is monitoring trends in populations of marine bird, marine mammal, and krill, and monitoring changes in water quality and oceanography with the U.S. Fish and Wildlife Service and NOAA's Marine Sanctuaries.
- The California parks are working with the state and USGS to map nearshore habitats and to create Marine Protected Areas. MPAs will protect biodiversity from over-fishing and climate change by allowing species some time to adapt to new conditions without concurrently suffering population stress from harvesting. Channel Islands National Park was the first pilot MPA designated in the state and Point Reyes and Golden Gate are now working with the state.
- The parks are accelerating restoration of degraded coastal ecosystems such as estuaries and streams flowing into estuaries, so that the ecosystems become more resilient. A line item construction project that will start this year will restore Drakes Estero at Point Reyes by removing old dams and abandoned roads. A commercial oyster operation lease, a source of habitat degradation to the estuary, is scheduled to expire in 2012. The resiliency of ecosystems to climate change is greatly enhanced by removing destructive activities. For many ecosystems, it is truly a death by a thousand cuts.

Parks are a conduit for information and ideas provided by scientists in other agencies and institutions. We can provide real examples of how changes are occurring and steps that can be taken to protect and preserve resources. Two million visitors come through Point Reyes National Seashore every year, providing an exceptional opportunity to communicate the science of global climate change and its effects on communities, and to demonstrate examples of how to conserve biodiversity. Through resource stewardship, parks can set a standard and be models of sustainability. By using biodiesel, photovoltaic cells, electric and hybrid vehicles, and recycled materials, the parks demonstrate how to reduce energy consumption. By so doing, parks can serve as a catalyst for generating momentum and action in the larger community.

Finally, through the Research Learning Centers in park networks, middle-school and high school students have the opportunity to work alongside scientists and science educators to understand their future careers and life choices. Of all the actions we are undertaking in the Pacific West, and actions we are planning to do, the most important is to be positive and creative. The esteemed scientist Peter Raven stated in a recent editorial in the Journal *Science* that global climate change is a challenge for all of us, but if we act quickly, we can do something to slow it down and to prepare for the changes that are coming. The nation's parks are preparing for that challenge.

Thank you for the opportunity to present this testimony. I will be pleased to answer questions you and other members of the subcommittee might have.