
On the Air!

On the Air!

Sequoia and Kings Canyon National Parks

A century ago residents of the San Joaquin Valley enjoyed riding along the oak-dotted valley floor, admiring the view of the snowcapped Sierra Nevada. Today we can speed along the valley highways never seeing the peaks hidden behind a haze of human-caused pollutants. Air pollution not only restricts our enjoyment of scenic vistas, but also adversely affects our health, the productivity of crops, the vigor of forest and foothill environments, and the fertility of alpine lakes. Yet many of us have come to accept air pollution as an unfortunate, but inevitable, by-product of our lifestyles.

What has happened to our clean air? Why is air quality of such concern at Sequoia and Kings Canyon National Parks? Must we accept air pollution as a consequence of our standard of living, or can we do something about it?

OUR ATMOSPHERE — A MIXTURE

The air we breathe is a mixture of gases, mostly nitrogen and oxygen. Oxygen, in the form of two joined atoms, is essential for life. Also present are such gases as argon, carbon dioxide and water vapor. Human activities have added many other chemicals: oxides of sulfur and nitrogen, hydrocarbons, carbon monoxide, ozone, particulate matter, and additonal carbon dioxide.

Nitrogen Oxides

During high-temperature combustion, such as in a power plant or an automobile engine, nitrogen reacting with oxygen forms gases collectively called nitrogen oxides. Elevated levels of nitrogen oxides can irritate the lungs, contributing to bronchitis or pneumonia. Nitrogen oxides are also a component in acidic deposition ("acid rain").

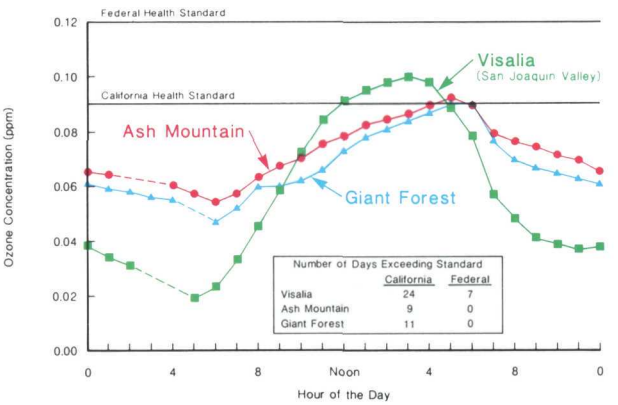
Hydrocarbons

Hydrocarbons are a diverse group of chemicals formed from hydrogen and carbon. Some are produced naturally by plants and animals, but many more are created through human activity. They may be produced by combustion or emitted as vapors from fuels, paint, dry cleaners, oil and gas production and refining, or chemical plants. Hydrocarbons can be toxic and play a primary role in the formation of ozone.

Ozone

Once in the atmosphere, nitrogen oxides and hydrocarbons interact to form ozone — three oxygen atoms linked together instead of the usual two. Since sunlight provides the energy to produce ozone, the amount of ozone in the atmosphere is lower in the early morning and peaks in the late afternoon.

In the upper atmosphere a natural ozone layer screens us from harmful ultra-violet radiation, while ozone near the surface of the earth can impair our health. Humans appear to be among the most sensitive animals to ozone. Exposure to elevated levels damages our lungs and makes breathing more difficult. It also reduces the ability of the lungs to fight infection and remove inhaled particles. Plants, too, are affected by ozone. Exposure to relatively low concentrations can cause reduced growth and vigor, making them more vulnerable to damage from drought, insects or disease.



July 1989 Average Hourly Ozone Concentrations
Sequoia and Kings Canyon National Parks

Front Cover: NPS photo by Richard C. Burns

Carbon Monoxide

Carbon monoxide, a single atom of carbon combined with one of oxygen, is highly toxic. When inhaled, this odorless gas attaches to red blood cells, preventing them from absorbing oxygen. People with heart and lung problems are especially sensitive to this gas. Automobiles contribute the majority of carbon monoxide found in urban areas. Forest fires also produce carbon monoxide, but are temporary and affect only the local area.

Suspended Particulates

Particulates are tiny particles of solids or liquids, such as dust and soot. They come from a variety of sources including soil cultivation, agricultural burning and vehicles; or they result from reactions between other chemicals in the air. Particulates not only limit visibility but also cause health problems. Inhaled particles become trapped in the lungs exposing this sensitive tissue to a variety of potentially damaging compounds.

Acidic Deposition

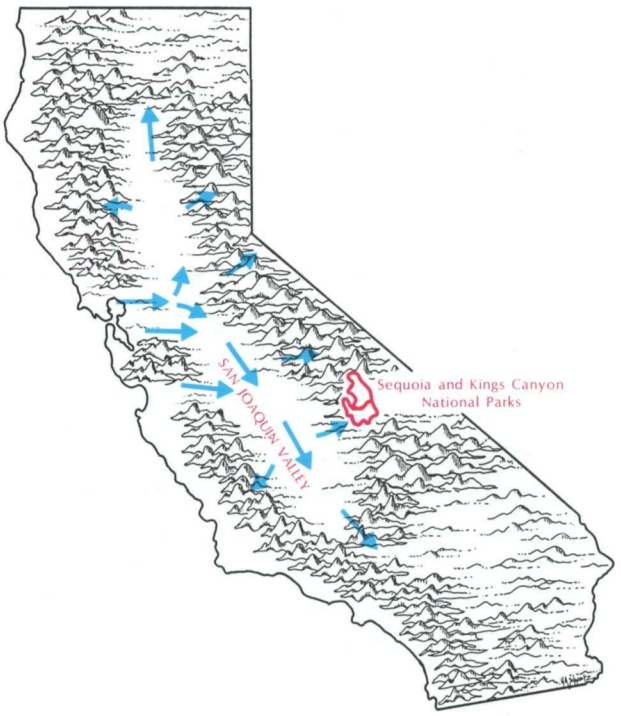
As water travels through the air, it reacts with carbon dioxide, sulfur oxides and nitrogen oxides to form acids. This acid rain or snow changes the chemical balance in the soil and increases the acidity of lakes and streams. Particles settling out of the atmosphere add to the acidic load. In many areas of the world today, researchers believe that lakes and streams are barren due to such increased acidity. The alpine lakes of the Sierra Nevada are very sensitive to acidic deposition, since the soils derived from granitic bedrock cannot neutralize acids well.

AIR POLLUTION IS INCREASING IN THE SAN JOAQUIN VALLEY

When Sequoia and Kings Canyon National Parks were established, boundaries were drawn to protect the parks' natural resources.

National parks are not islands; park boundaries cannot exclude airborne pollutants.

The San Joaquin Valley is ideally shaped to trap pollutants in the atmosphere. Mountain ranges to the west, south and east form the sides of a large basin. Frequent inversions, warmer air on top of cooler air, create an atmospheric lid over the valley. Coastal air enters the valley from the north and flows south, collecting pollutants along the way. The Tehachapi Mountains, a barrier to southward flow, cause an eddy to form in the vicinity of Visalia and Fresno, adjacent to these parks. This circulating load of contaminants is carried into Sequoia and Kings Canyon National Parks by rising daytime air currents.



Summer Windflow Patterns in California

During the past hundred years, we have replaced the marshes, grasslands and oak groves in the San Joaquin Valley with agriculture, cities and industries. Automobiles are one of the major sources of pollutants in this valley, contributing approximately half of the nitrogen oxides, one-third of the particulates, three-fourths of the carbon monoxide, and one-fourth of the hydrocarbons emitted annually.

While the potential health effects due to air pollution are alarming, other areas of our lives are also impacted. Farmers in the San Joaquin Valley currently lose an estimated $200 million annually through decreased productivity. Experiments show that production of oranges decreases approximately 30%, grapes 20%, and alfalfa 10% at current levels of air pollution. Since this is one of the fastest growing areas of California, pollution problems will continue to increase, unless we act now.

It is ironic but true; the by-products of our lifestyles serve to decrease our standard of living.

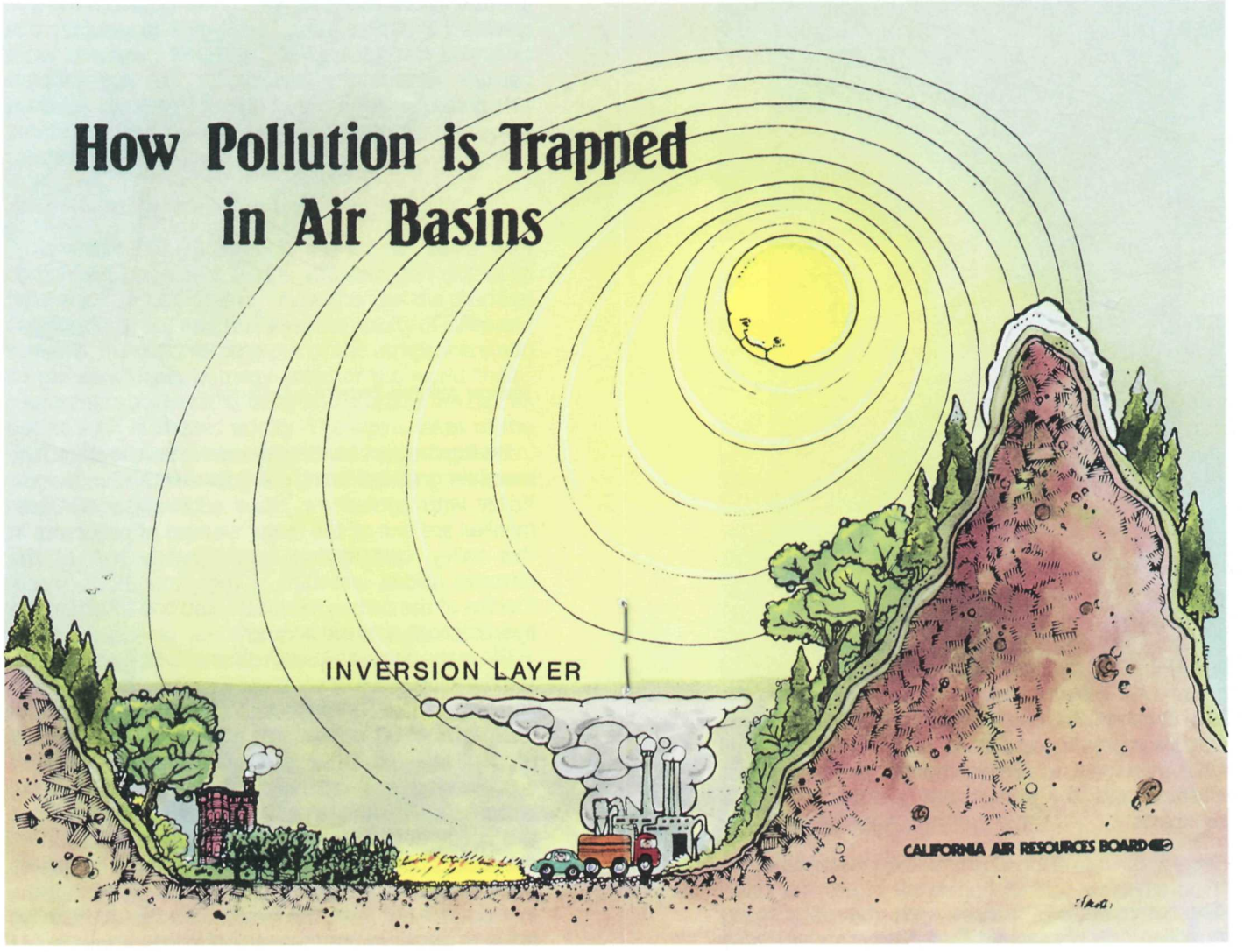
NATIONAL PARK SERVICE INVOLVEMENT

Studies/Research

Since most of the pollutants in these parks originate outside their boundaries, the role of the National Park Service in controlling these sources is limited. However, the agency is legally responsible for protecting air quality and related resources, including plants, animals and scenic vistas. The National Park Service participates in local and state air quality planning efforts. In order to define the extent of the problem, research stations have been established in the parks to monitor ozone, carbon monoxide, particulates, acid deposition, and visibility. Research continues into the effects of pollutants on park resources.

Vegetation Damage from Ozone

Ozone levels in Sequoia and Kings Canyon National Parks approach and often exceed state and occasionally federal health and welfare standards during the summer. Damage to the vegetation of the parks is of concern. Some plants, such as certain species of oaks and ponderosa and Jeffrey pines, are more sensitive to ozone than others. Even individual plants differ in their sensitivity to pollutants. A study



conducted in Sequoia and Kings Canyon National Parks in the mid-1980s revealed that two of every five ponderosa and Jeffrey pines surveyed exhibited needle damage caused by ozone. Injury was most severe on western slopes closest to the San Joaquin Valley. Research continues on the giant sequoias. Experiments have documented that sequoia seedlings show damage to needles and reduced growth when exposed to elevated levels of ozone.

NPS photo by Kenneth W. Stolte

Healthy (left) and ozone injured (right) ponderosa pine trees

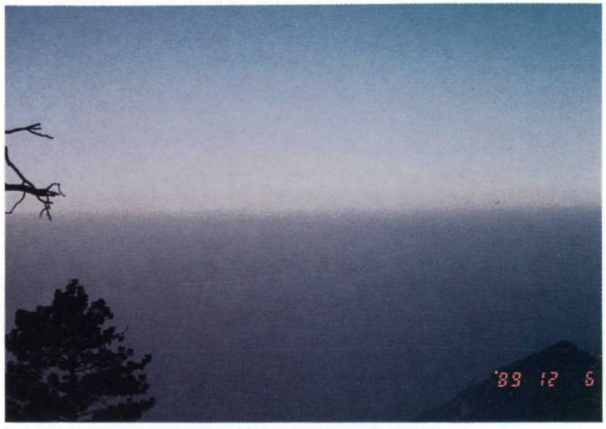
Acidic Deposition

Research, including a seven-year, intensive study of the Emerald Lake watershed, was conducted in the 1980s to establish the effects of acidic deposition upon subalpine vegetation and lakes. Such baseline data will enable managers to assess changes in atmospheric deposition and the subsequent effects on natural ecosystems.

Visibility

The scenic vistas of the parks are viewed by nearly two million visitors annually. The vistas, especially in the summer, are highly obscured by regional haze. Studies have demonstrated that visitors place a high importance on the pristine condition of national parks and that visitor enjoyment is adversely affected by air pollution. An automated camera located in Giant Forest documents visibility. Only a few days during the year are the San Joaquin Valley and coastal mountains visible. Few visitors have the good fortune to experience such a spectacular view.

View from Sequoia and Kings Canyon National Parks looking west towards the San Joaquin Valley on a clear day.



Same view on a poor day. Note decreased visibility.

YOU CAN MAKE A DIFFERENCE

The air quality problem in Sequoia and Kings Canyon National Parks is not unique. Similar problems exist in many other parts of the United States and throughout the world. We all must support efforts to restrict the

production of additional pollutants and to improve the quality of the environment.

Drive Less/Drive Smart

Automobiles are a major source of pollutants in the United States. An older car burning leaded gasoline may emit up to ten times more pollutants than a newer, unleaded model. By purchasing efficient automobiles, maintaining pollution control devices in good working condition, and limiting the use of our vehicles, this source of pollutants can be reduced. Car pools, mass transit, bicycling and walking are conscientious alternatives to the use of private vehicles.

Conserve Energy

Energy production is another major contributor of pollutants. We should use all forms of energy sparingly and wisely. Choose an energy source that has minimal impacts on the environment. For example, heating with electricity or natural gas produces far fewer pollutants than does a wood-burning stove. Similarly, electric motors are cleaner than gasoline or diesel engines.

Recycle

Actively participate in recycling programs. Recycling conserves both energy and our natural resources. Purchase products with minimal packaging made of recycled and recyclable material.

Support New Technologies

Pollution control technology is developing rapidly. Support the use of these new technologies, even if it increases the cost of some products or services. It costs less to prevent pollution than to clean it up.

SUMMARY

Many questions remain to be answered. For example, spring snowmelt and heavy rains can flush high levels of pollutants into park lakes and streams. Are plants and aquatic ecosystems more affected by short-term exposure to high levels of pollutants or long-term exposure to more moderate concentrations? How do drought and ozone interact and affect the mixed-conifer forests? The prospects of further changes to our atmosphere, some predictable and others unforeseen, make long-term monitoring projects extremely important. Can we develop methods to predict how these changes will affect area ecosystems? How important are scenic vistas and can we reverse trends of decreasing visibility?

Progress can be made against the deterioration of air quality, but the path to clean air is a long and difficult one. With support from everyone, the majestic peaks of the Sierra Nevada once again may be a common sight from the San Joaquin Valley.

A rare view of the Sierra (60-80 kilometers distant) from Visalia, California

Typical hazy view of Sierra from Visalia, California

Tulare County Air Pollution Control District

NOTES

Acknowledgments:

Publication of this brochure was made possible by the California Air Resources Board in Sacramento, California (Clark Brink, project manager and Greg Spencer, graphic services). Primary author was Thomas A. Pittenger of the National Park Service.

91 82254

Printed on recycled paper.