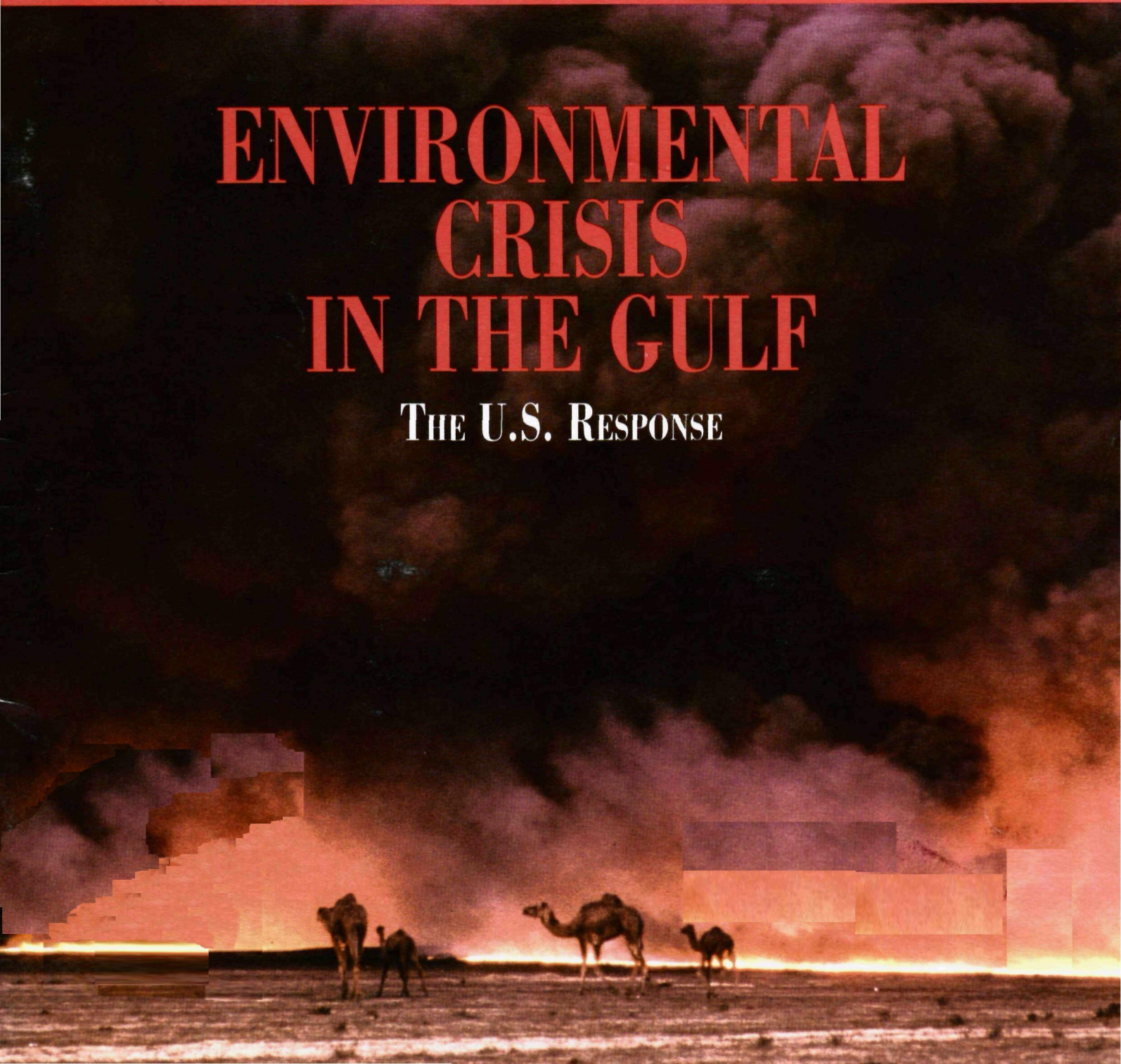
ENVIRONMENTAL CRISIS IN THE GULF

The U.S. Response



January 21, 1991

NOTE TO ALL EPA LIBRARIANS

From: Danielle Franco Danielle
Immediate Office
Communications, Education, and Public Affairs

Enclosed are two copies of "Environmental Crisis in the Gulf: The U.S. Response" prepared by the Gulf Task Force Office. Please add this booklet to your reference library. For additional information on the booklet, please contact Hank Roden of the Gulf Task Force Office at 202-260-2482.

The federal departments and agencies identified here are among those who have contributed human and scientific resources to evaluating or limiting the impact of Iraq's environmental terrorism in the Gulf. They also contributed to the creation of this booklet.

Environmental Protection Agency

Department of State

National Science Foundation

Department of Labor
Occupational Safety and Health Administration

Department of the Interior
Fish and Wildlife Service

Department of Transportation
U. S. Coast Guard

Department of Defense
Army Corps of Engineers
Army Environmental Hygiene Agency

Department of Health and Human Services
Centers for Disease Control
Food and Drug Administration
Public Health Service

Department of Energy

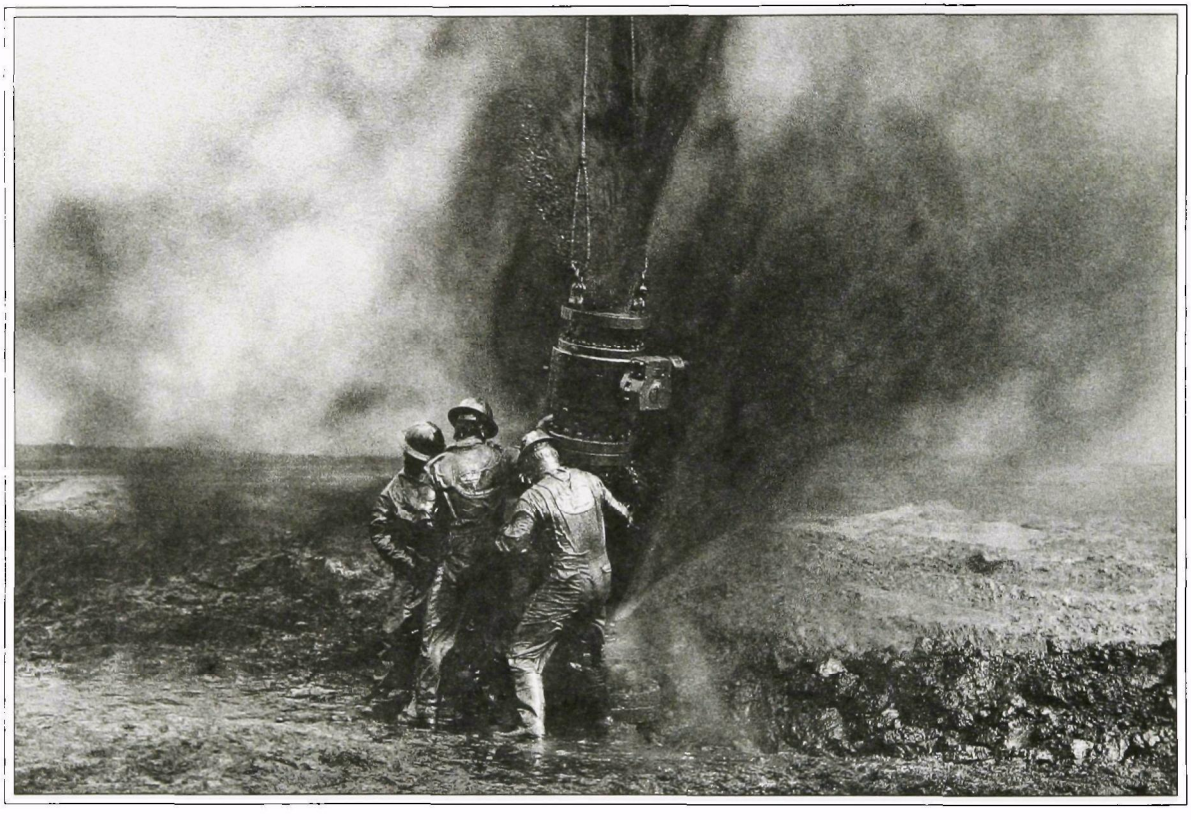
National Aeronautics and Space Administration

Department of Commerce
National Oceanic and Atmospheric Administration
National Institute of Standards and Technology

ENVIRONMENTAL CRISIS IN THE GULF

THE U.S. RESPONSE

U.S. efforts in the Gulf were requested by and conducted in cooperation with the allied Gulf states, under the aegis of various national, regional, and international organizations, including: the United Nations Environmental Programme; the World Health Organization; the World Meteorological Organization; the International Maritime Organization; the International Oceanographic Commission; King Fahd University of Petroleum and Minerals/Research Institute; the Saudi Arabia Meteorological and Environmental Protection Administration; and the Kuwait Environmental Protection Department. Other nations and organizations also provided technical, material, and financial assistance.



Muscle and steel work to cap a gushing well.
Photo by Sebastiao Salgado, Magnum Photos.

Introduction

On November 5, 1991, the last oil fire in Kuwait was extinguished, bringing to a close a dramatic period of achievement. Extinguishing and capping these wellheads had been Kuwait's highest economic, environmental, and health priority because of feared regional and global consequences. International cooperation, skill, and expertise resulted in a more rapid end to one part of this environmental catastrophe.

Attacks on the environment began in late January, 1991, when the Iraqi government ordered millions of barrels of crude oil released into the Gulf from tankers and oil terminals located off the coast of occupied Kuwait. Less than a month later, as Iraq's armies were driven from that country, they blew up hundreds of Kuwaiti oil wells, setting most of them ablaze.

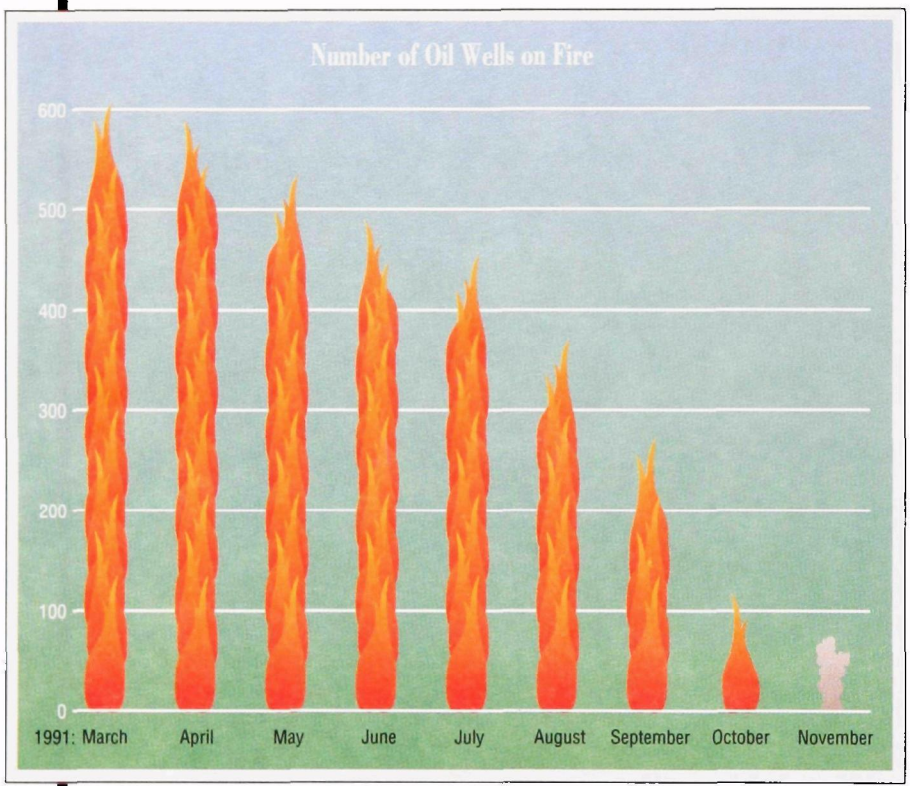
In every war there is damage to the environment. But discharging the oil and igniting the wells had neither economic nor military benefit. ***The Iraqi government waged war against the environment itself****, producing images of blackened waters and skies now burned into the memory of the world community.*

This booklet answers the questions most often asked by Americans about potential effects of this disaster on the environment and on the health of residents of the Gulf region, including American military and civilian personnel stationed there. The booklet briefly describes work performed by U.S. government agencies, in cooperation with allied Gulf nations and the international community, to try to assess, limit, and remedy the damage caused by Iraq's environmental terrorism.

Since April 1991, official U.S. actions have been in concert with international programs responding to the oil release and addressing atmospheric problems from the burning fires. Private U.S. companies helped to extinguish the fires, clean up refuse, repair damage from the war and Iraqi vandalism, and respond to the Gulf oil release.

Even as the air, sea, and ground battles were waged in January and February 1991, the United States, through its multi-agency Emergency Response Team and other units, began mapping the spread of the oil discharges and mobilizing scientific teams to evaluate and mitigate environmental damage in the Gulf. Some of the data collected are still being analyzed, and more are being gathered. Some findings reported here should therefore be considered preliminary.

While outside of the scope of this report, the U.S. Army Corps of Engineers must be cited for its work in helping to rebuild Kuwait's infrastructure including restoration of roads, electrical power, sewer and water systems, the airport, and public buildings. Without these basic systems and the efforts of the Corps, the environmental efforts described below would have been difficult to achieve as quickly.



The unprecedented number of oil fires challenged fire-fighting resources at the outset, but as more crews were brought in, and new techniques honed, the flames were snuffed out far more quickly. Graphic by Jean Wisenbaugh.

1

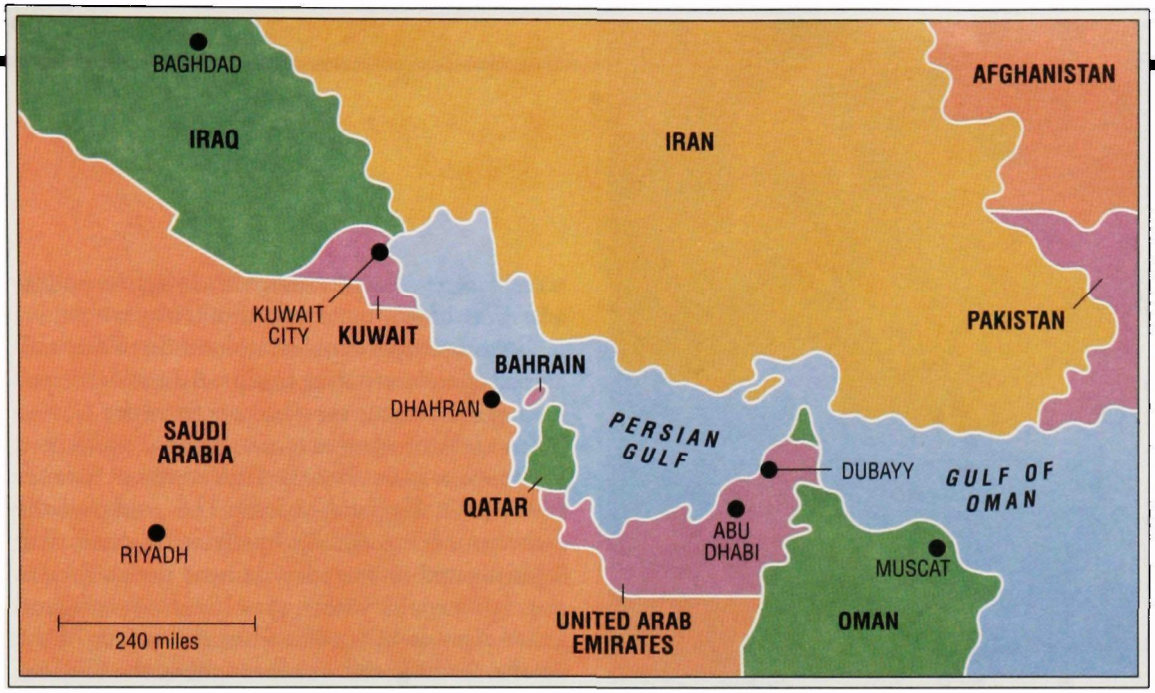
HOW LONG DID IT TAKE TO PUT OUT THE FIRES?

About nine months - far faster than many had expected. The rate at which the fires were extinguished climbed from one every few days in the early weeks to seven a day in the fall.

On February 15, 1991, the retreating Iraqi army began systematically dynamiting oil wells, storage tanks, refineries, and other facilities located in seven oil fields north and south of Kuwait City (*see map*). Approximately three-quarters of the facilities in these fields—a total of 749—were either set on fire, turned into oil gushers or otherwise damaged. An estimated nine hundred million barrels were burned or spilled onto the land during these 9 months, enough oil to supply the United States for 50 days.

Firefighting teams from the United States, Canada, Kuwait, and later other nations, worked steadily to douse the fires and cap the gushing wells. The work was made even more difficult by explosives surrounding the wells and by the scarcity of water, which had to be pumped in from miles away.

Nonetheless, once the equipment was in place and the firefighting teams gained more experience, the work progressed far faster than originally expected. (Some had estimated it would take up to



Graphic by Jean Wisenbaugh.

five years to control the fires.) While by mid-May, just 80 of the burning wells had been extinguished, half were out by August, and by early November, the last of the fires were doused.

With over 80% of the world's oil-fire fighting expertise in Kuwait, this disaster spawned ingenuity and competition among the international teams. Tested methods were measured against new technologies including jet engines mounted on tanks to "blow" the fires out and liquid nitrogen to displace oxygen, suffocating the flames.

2

HOW WIDESPREAD WAS THE POLLUTION FROM THE FIRES?

The consensus of the international scientific community is that airborne emissions from the fires primarily affected southern Kuwait and a 200 mile stretch of eastern Saudi Arabia. Effects beyond the Gulf region have been slight.

As the fires burned, they threw soot particles, chemical pollutants, and other emissions into the air. Carried aloft by the force of the heat, these emissions drifted away in dense plumes of smoke. Most of the large, heavier droplets of unburned oil, fell out of the smoke plume quickly and did not

U.S. government officials, including EPA Administrator William K. Reilly, above, survey the blazing oil fields. Photo by EPA.

Wind patterns generally moved the smoke plume, accentuated at right, over the southern desert region. Graphic by Jean Wisenbaugh.

travel far from the oil fields. Other, lighter pollutants were blown hundreds of miles by winds.

Because Iraqi troops had stolen most of Kuwait's air pollution monitoring equipment and destroyed its major laboratories, scientists from the United States and several other nations rushed equipment to the scene soon after the fires were set. Science teams from England and the U.S. sampled the contents of the smoke by flying aircraft with sophisticated instruments as near to the fires as they safely could (within a few hundred yards) and as far away as 600 miles from the source of the smoke. Ground stations throughout the Gulf region also took air samples. Kuwaiti stations were supplemented by equipment from France, Germany, Japan, Norway, and the United States.

During the spring and summer, prevailing winds from the north and breezes off the Gulf generally kept the plumes aloft and moving south over the desert, away from Kuwait City, the nearest population center. The plumes combined and were carried over eastern Saudi Arabia and Bahrain.

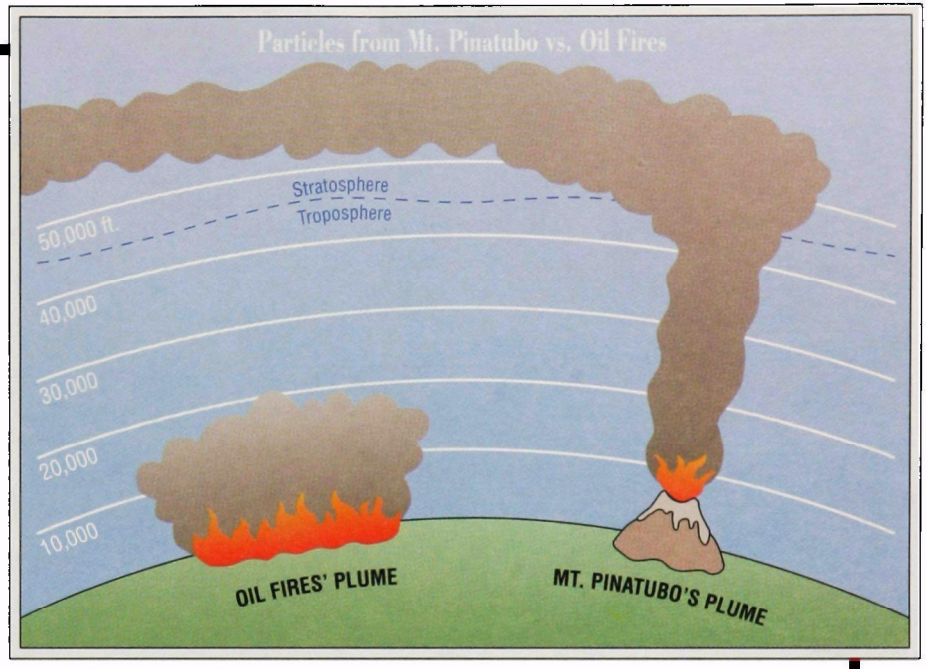
The smoke dimmed sunlight, apparently producing cooler regional temperatures for a period. Bahrain, for example, experienced its coldest May in 35 years with temperatures more than 7.2° F below average for that month. As the fires were extinguished, however, this local cooling effect diminished.

Not long after the fires were set, "black snow" reportedly fell in the Kashmir region of northern India, and sooty rain was reported in nearby Iran. There were reports of very small amounts of soot particles high in the air over Hawaii and Wyoming, but these anecdotal observations could not be positively linked to the Kuwait fires. Overall, there has been no clear evidence that the oil fire

emissions traveled beyond the region in significant amounts. Combustion products from the fires may still be detectable in trace amounts at great distances, however, as they were expected to remain in the atmosphere for several weeks.

Some computer models predicted that sulfur dioxide from the fires could lead to acid rain in Kuwait, Iran, and even as far away as China. The lack of rainfall in the Gulf during the time when the fires were burning minimized that potential problem.

While new emissions are no longer spewing into the atmosphere now that the fires have been extinguished, pollution already deposited may still be blown around by winds. Monitoring of the region's air quality and weather must continue.



Particles from the 1991 explosion of the Filipino volcano, Mt. Pinatubo, reached the stratosphere and spread around the globe. The oil fires' smoke particles did not reach heights necessary for a global effect. Graphic by Jean Wisenbaugh.

3

HAS SMOKE FROM THE OIL FIRES AFFECTED GLOBAL CLIMATE?

There is no evidence that the emissions reached altitudes high enough to be carried by winds around the globe.

Material that reaches the stratosphere *can* be dispersed around the globe by high-altitude winds. But satellite images, along with observations and air sampling from aircraft, have shown that the oil fire smoke generally rose to altitudes of 12,000 to 13,000 feet, with a maximum observed height of 19,000 feet, well below the 40,000-foot lower limit of the stratosphere. As one researcher from the National Center for Atmospheric Research put it, "As large as the smoke looks, and as ugly as it is, it's still pretty small on a global scale."

By contrast, smoke from the June 1991 eruption of Mt. Pinatubo in the Philippines lofted millions of tons of sulfur dioxide and dust well into the stratosphere, where it has spread around the globe. Mt. Pinatubo's material is expected to remain in the stratosphere for years, possibly even having a very slight worldwide cooling effect. Some parts of the world may witness particularly vibrant sunsets as a result of sunlight reflecting off the dust particles.

For the oil fires, however, research proved false an initial speculation that plumes would self-loft into the stratosphere causing cooling analogous to the "nuclear winter" scenario. There are several reasons why emissions from the oil fires did not reach these altitudes. They were not thrown upward with great enough force, as in the case of a

Under a desert sun partially masked by smoke from oil fires, a U.S. scientist installs air-monitoring equipment atop a plane. In the spring of 1991, specially equipped aircraft flew over the Gulf region to examine air pollutants and wind patterns as part of an international, multi-agency environmental assessment. Two planes were supplied by the University of Washington and the National Center for Atmospheric Research, through a U.S. National Science Foundation program conducted with the assistance of the National Geographic Society. Another aircraft, supplied by the Department of Energy, sampled the plumes a month later during different meteorological conditions. In addition, a helicopter, supplied and operated by the Saudi Arabian Air Force, lifted off from Kuwait City airport, carrying scientists from the National Aeronautics and Space Administration, Environmental Protection Agency, Kuwait and Saudi Arabia. The multi-national team flew next to blazing wells to gather emission samples later evaluated by a number of U.S. government scientists. Photo by National Institute of Science and Technology.

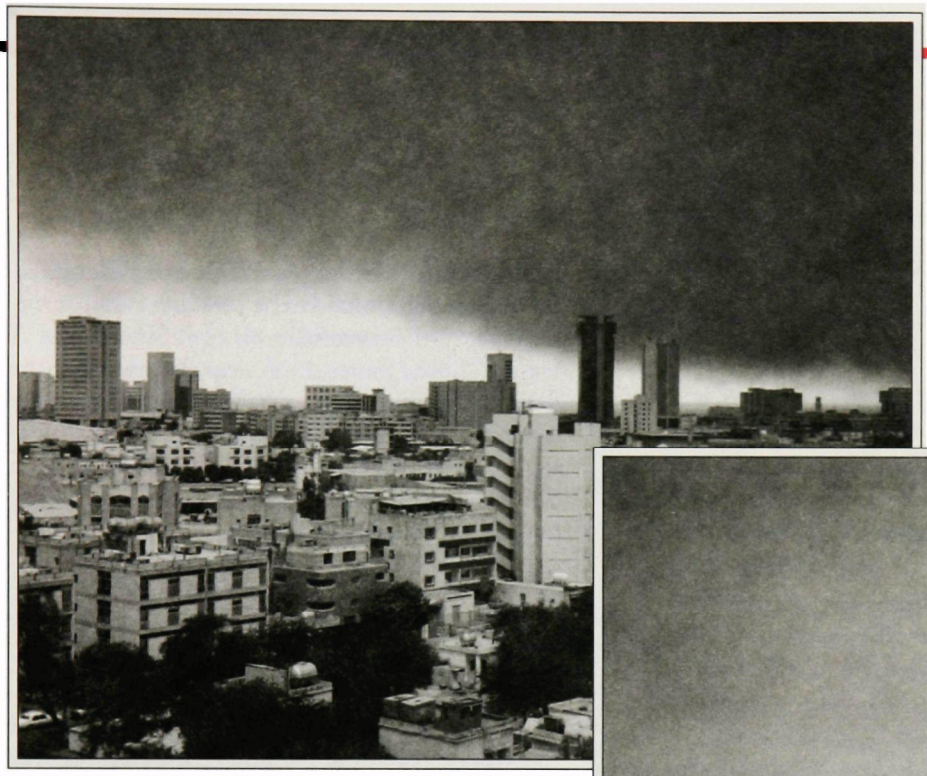
volcanic explosion. The smoke plumes also were not sufficiently warmed by absorbing solar energy, which would have lofted them higher into the atmosphere.

In the first few months after the fires were set, the fires were adding carbon dioxide to the atmosphere at an estimated three percent of the worldwide industrial emission rate. This rate dropped as more and more fires were extinguished. The fires' carbon dioxide output, according to atmospheric scientists, was too small and temporary to contribute significantly to any worldwide "greenhouse effect."

4

DID THE EMISSIONS POSE AN IMMEDIATE HEALTH THREAT TO PEOPLE IN THE GULF REGION?

Air quality measurements taken while the fires were burning showed no acute threat to the general population, although fine particles in the air did pose an increased risk of respiratory problems for some groups. Fortunately, because of prevailing winds, there were no long periods of exposure to high concentrations of pollutants.

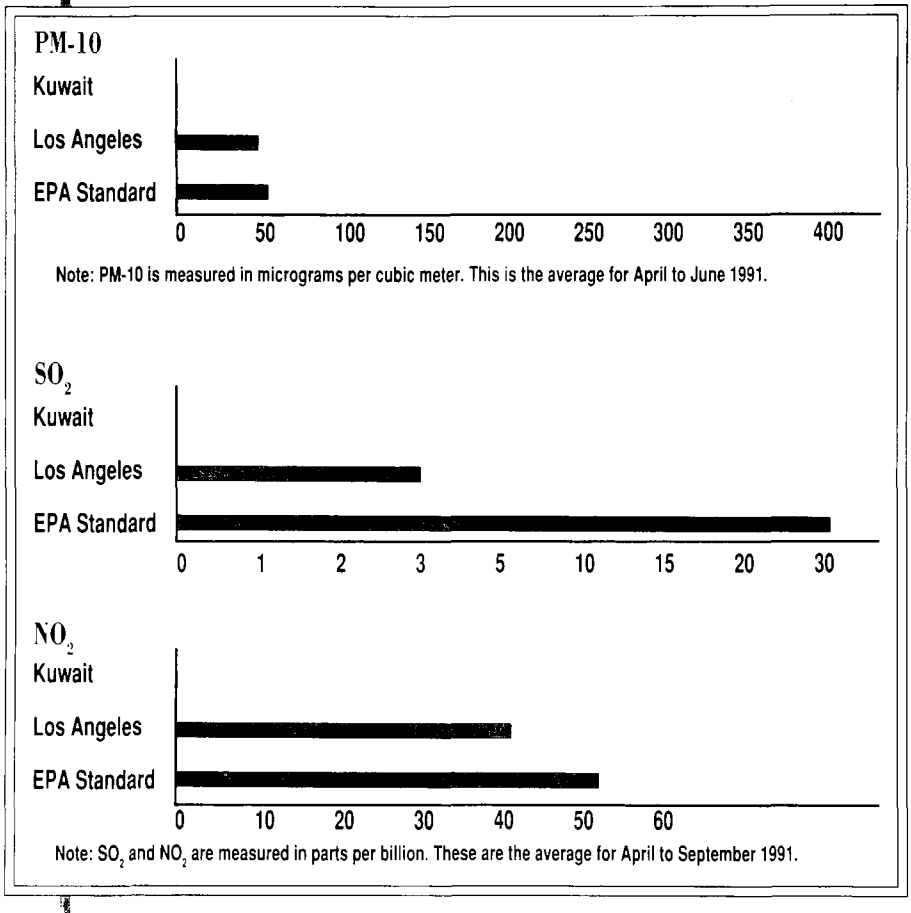


Smoke plumes occasionally darkened skies over Kuwait City (left), but on most days, the skies over the city were relatively clear (below). Photos by Steve Levy, EPA.

At the request of the Saudi government, the U.S. Interagency Air Assessment Team (USIAAT) was dispatched to the Gulf soon after the fires were started to assess the immediate, acute health threat. This "quick look," conducted from March through May 1991, involved researchers from several U.S. government agencies. The team sampled air near the burning wells, flew instrumented airplanes into smoke plumes, and sampled the air at various locations in the path of the smoke, including population centers in Kuwait and Saudi Arabia.

Based on this limited preliminary study, the team publicly reported in April that emissions from the oil fires were not immediately life-threatening. The ingredients of the smoke plumes varied from fire to fire, but in general they were the same pollutants one might find in the exhaust of a poorly functioning automobile: soot particles; organic compounds; trace metals; and gaseous pollutants such as sulfur dioxide, hydrogen sulfide, and carbon monoxide.

The USIAAT paid particular attention to measuring hydrogen sulfide, sulfur dioxide, and fine soot particles in the smoke, which are known acute health hazards at high concentrations. The two chemical pollutants with the greatest potential



Air monitoring in Kuwait City showed some anomalies: some pollutant levels were *lower* this spring than the year before, apparently because the Iraqi invasion had stopped most industrial activity and civilian vehicle use. These charts compare the levels of fine particulates (PM-10), sulfur dioxide, and nitrogen dioxide for the 1991 April to September average in Kuwait City to Los Angeles' 1989 levels and to EPA standards for annual average 24-hour readings. A very high PM-10 reading in Kuwait City is usual for that region, the result of blowing dust and sand.

health hazard—hydrogen sulfide and sulfur dioxide—were determined to be present in concentrations below the harmful levels established by EPA for the United States, both near the source of the fires and at locations sampled downwind. The USIAAT measured high concentrations of particles in the smoke, however, which remained a cause for concern while the fires were burning. Under certain weather conditions these fine particles can cause respiratory problems for individuals with asthma and other obstructive lung diseases, as well as other "high-risk" population groups—including the elderly, children, and pregnant women.

Subsequent studies supported the findings of the USIAAT. An air sampling mission in May and June, sponsored by the U.S. National Science Foundation (NSF), found that hydrogen sulfide was being burned quickly in the fires, as it did not appear in significant concentrations in the smoke. As for sulfur dioxide, the NSF team measurements showed small amounts but not enough to cause a significant acute health threat to populations in the path of the smoke, since winds tended to reduce the concentration.

The USIAAT also reviewed Saudi and Kuwaiti air quality and meteorological data, and evaluated the local health care system's ability to deal with potential acute effects from the fires. The U.N. prepared an interagency strategy for air monitoring in the area and air quality is still being monitored continuously at sampling stations throughout the Gulf region.

The number of air quality and weather monitoring stations are to be increased beyond what was in place prior to the hostilities and the 15 to 20 portable stations left behind by the U.S. air assess-

ment team. In addition, an "early warning system," developed by the U.S. National Oceanic and Atmospheric Administration and other agencies was placed in Kuwait to alert the local population if severe pollution levels posed a significant health threat. Public education programs also were created to inform local citizens about potential hazards from airborne pollutants.

IF THINGS HAD BEEN DIFFERENT...

Even though there is no evidence to date that smoke from the Kuwaiti oil fires created acute health problems, air pollution can be deadly under certain conditions.

In October 1948, severe pollution over the town of Donora, Pennsylvania resulted in 20 deaths—17 in a single 14-hour period. A high pressure area kept winds to a minimum for several days straight, allowing a cold, dense fog containing sulfur dioxide, fine particles, and carbon monoxide to linger in the industrial valley where Donora is located.

A more severe episode occurred in London in December 1952, when a thick, four-day fog resulted in thousands of deaths due to inhalation of particles and sulfur dioxide.

In both these cases, dense, polluted air remained trapped over a populated area for several days. Fortunately, this was never the case in Kuwait. Prevailing winds effectively dispersed smoke from the oil fires during the time when most of the wells were burning, and most fires were extinguished before the beginning of the winter season when weather inversions would have been more likely to cause extended periods of stagnant air over Kuwait City. Also, a key pollutant in the Donora and London episodes—sulfur dioxide—did not appear in high concentrations in the smoke over the Gulf.

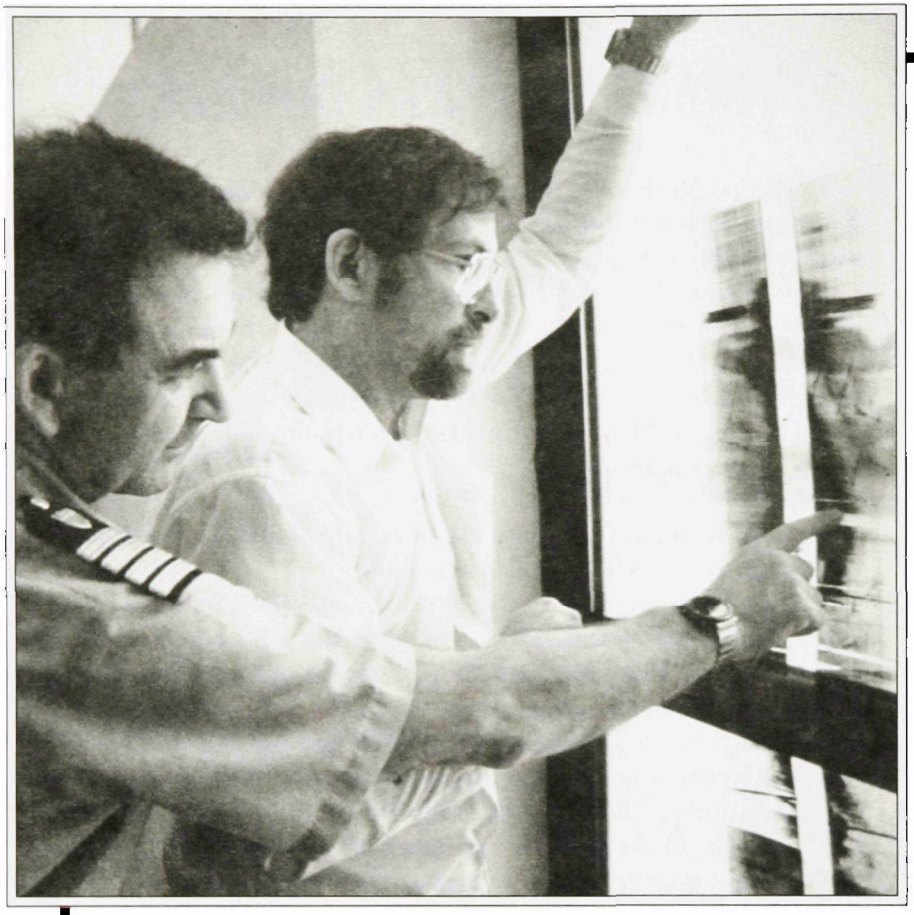
5

WITH ALL THOSE POLLUTANTS IN THE SMOKE, WHY WEREN'T MORE HEALTH PROBLEMS REPORTED?

The most severe levels of pollution were found in the plumes far above ground level, and weather patterns generally kept the smoke away from population centers.

Early in the crisis, there were predictions from some observers that the fires would have catastrophic health effects. But the nature and amount of pollution in the smoke, the behavior of the plumes in the atmosphere, and local weather conditions served to limit the impact of the fires on the human population.

The largest particles and oil droplets from the fires fell out of the smoke relatively near to the burning wells, in areas that were largely uninhabited. The spread of other, lighter airborne pollutants was determined by daily and seasonal local weather patterns. Winds thinned the smoke, thereby reducing the concentration of pollutants, and also kept the plume away from Kuwait City. Breezes from the Gulf itself helped protect other shoreline population centers. Thus, Kuwait City rarely was exposed to the plume for more than 48 hours at a time, even though the nearest oil field is less than two miles from the city's suburbs.



U.S. advisors examine a radar film showing the placement and movement of oil spills. Photo by U.S. Coast Guard.

6

WHAT ABOUT LONG-TERM HEALTH EFFECTS?

The unique nature of the situation—intermittent exposure to pollution from a large yet declining number of fires—will make long-term health assessments extremely difficult. Research and health studies are continuing.

Long-term health effects from air pollution are determined primarily by the amount of exposure, which considers not only the concentration of a pollutant, but the length of time individuals are exposed to it. There were only a few days in which the population was subjected to high levels of pollution from the fires.

One problem in identifying long-term effects is that natural or normal "background" causes of disease and mortality first have to be factored out. Fine soot particles from the fires are of major concern because they can penetrate deeply into the lungs. But since Kuwait and Saudi Arabia are prone to sandstorms, the air normally carries extremely high levels of airborne particulates. Researchers must first examine long-term health data on the local population to find what is "usual" before determining if there have been changes from the fires. For example, Kuwaitis are known to have a high incidence of asthma.

Scientists also must have a full understanding

of which substances actually reached the people, and in what amounts. As part of the World Health Organization's plan for dealing with effects of the oil fires, a formal study is being conducted in Kuwait to determine whether local populations are being exposed to higher levels of fine particles in the air.

Included in the particulate matter emitted by the oil fires were polycyclic aromatic hydrocarbons and trace metals such as nickel, chromium and vanadium, which are known or suspected cancer-causing agents. These were detected in small amounts in smoke and soils near the source of the fires, but not at sampling stations located downwind.

Left, a U.S. Coast Guard plane tracks an oil slick to help local officials plan control and cleanup operations.

All oil spills are not the same in their chemical makeup. A U.S. scientist (below) scoops up oil samples for analysis to assist in evaluation of how the spill will affect the environment. Photos by U.S. Coast Guard.

7

WHAT ABOUT THE HEALTH OF U.S. TROOPS AND CIVILIANS?

There has been no evidence of fire-related health problems occurring among U.S. military or civilian personnel assigned to the region.

A survey by the U.S. Navy of 2,700 Marines serving in the Gulf theater found no increase in sick call rates based on proximity to the fires. Similarly, initial results from a survey of 2,500 U.S. Department of Defense employees in the

SOME MAJOR OIL SPILLS

Date	Spill /Location	Estimated volume in millions of gallons
1991	Gulf War, Kuwait/Persian Gulf (On Land)	420-4200
1979-80	Ixtoc I, Mexico	139-428
1991	Gulf War, Persian Gulf (On Water)	252-336
1983	Nowruz Oil Field, Persian Gulf	80-185
1983	*Castillo de Beviller*, South Africa	50-80
1978	*Amoco Cadiz*, France	67-76
1979	*Aegean Captain*, Tobago	49
1989	*Exxon Valdez*, Alaska	10.8

region did not indicate a significant likelihood of long-term health effects. Military personnel generally are not in those groups considered to be highly susceptible to the effects of pollution—the very young, the elderly and those with severe asthma.

The U.S. Army is continuing its air monitoring activities, in addition to the civilian monitoring at existing regional sampling stations, as long as U.S. military personnel are in the region. Furthermore, new civilian and military personnel being assigned to the area, including those conducting environmental research, are being examined before departure from the U.S. to determine the status of their health. They will be examined again after their stay in the Gulf region to determine if the pollution has any health effects. Naturally, as the fires were extinguished, the potential for such effects diminished.

8

HAS THE OIL IN THE GULF BEEN CLEANED UP?

Over a million barrels of oil were removed from the Gulf by April. One third of the total released is estimated to have evaporated. Despite this record recovery of surface oil and significant evaporation, much of the oil sank, and about 400 miles of the western shoreline of the Gulf is contaminated with congealed oil.

In January 1991, Iraq dumped an estimated six to eight million barrels of oil into the upper Gulf from tankers and terminals located off the coast of Iraq and Kuwait. Military actions produced some smaller additional spillage.

Taken as a whole, the Gulf release ranks among the largest in history, up to 30 times the amount of oil spilled in the 1989 Exxon Valdez accident. A substantial amount of soot and oil from the well fires also fell into the Gulf waters while the fires were burning, adding to the pollution from the oil spill. The total amount of contaminants and their effects are unknown.

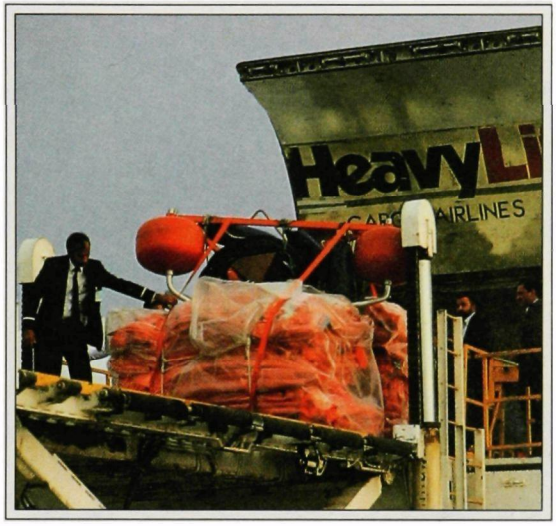
The then-ongoing war limited but did not prevent all actions to stop the flow of oil at the time of release: Kuwaiti employees at the Mina Al Ahmadi facility secretly closed the valves to one group of storage tanks to prevent release of millions of additional barrels of oil. Later, coalition

aircraft were able to use "smart bombs" to cut off much of the flow from the Mina Al Ahmadi facility off Kuwait, the source of the main release.

The released oil, carried by tides and currents and driven by prevailing winds, moved southward to Saudi Arabia. Shortly after the oil was first detected, that country requested technical assistance from the United States, which sent a U.S. Coast Guard-led team to the Gulf to help assess the oil slick's magnitude and impact. Despite the hostilities, daily overflights by scientists and the military, satellite imagery and onshore sightings helped track the oil's progress, and U.S. advisors assisted Saudi officials in planning a response strategy.

The slick covered an estimated 600 square miles of sea surface. Under the provisions of Saudi Arabia's National Oil Spill Contingency Plan, the highest priority for early protection was the desalination plant at Jubayl. The largest such facility in the world, Jubayl provides the Saudi capital of Riyadh with 80 percent of its water. Work crews successfully protected the plant by installing booms around inlet areas and skimming oil from the surface. The crews also were able to protect other desalination plants, power plants, and oil facilities designated as high priorities.

The initial clean-up operations were aimed at recovering free-floating oil from the water's surface. Using skimming vessels under contract to the Saudi-owned oil company, ARAMCO, crews isolated sections of the spill and scooped an unprecedented 1.4 million barrels of oil from the waters by mid-April. One third of the oil released is thought to have evaporated naturally from the surface of the water. Much sank to the bottom of the Gulf.



Additional oil containment, cleaning, and absorption material was brought to the Gulf (left).

Some booms protected inlets for critical water desalination plants (below). A record amount of oil was scooped up, but much remains. Photos by U.S. Coast Guard.

Oil sullies Gulf beaches. Photo by Jim Lukoski, Black Star.

Along the western shoreline, crews contracted by the Saudi government, using containment booms from several nations and guidance from the Coast Guard and ARAMCO, scavenged oil from bays where it collected naturally and built berms extending out from the shore to capture even more. The crews dug trenches to trap oil riding in on tides, and pumped the collected oil into containment pits. Despite these efforts, oil contaminated much of the shoreline, with the area between Safaniya and Abu Ali Island in Saudi Arabia bearing the worst pollution. On this stretch of the coast, which also was severely affected by a spill from an oil field in 1983, tarballs appear on the beaches, and oil mixing with sand forms an asphalt crust a foot thick in some places.

The Gulf waters take more than five years to flush naturally through the Straits of Hormuz, and background levels of oil pollution in the Gulf are high. Even before the 1991 release, many beaches showed evidence of earlier contamination. According to a 1983 estimate, a quarter of a million barrels of oil are accidentally spilled every year into the Gulf through normal operations.

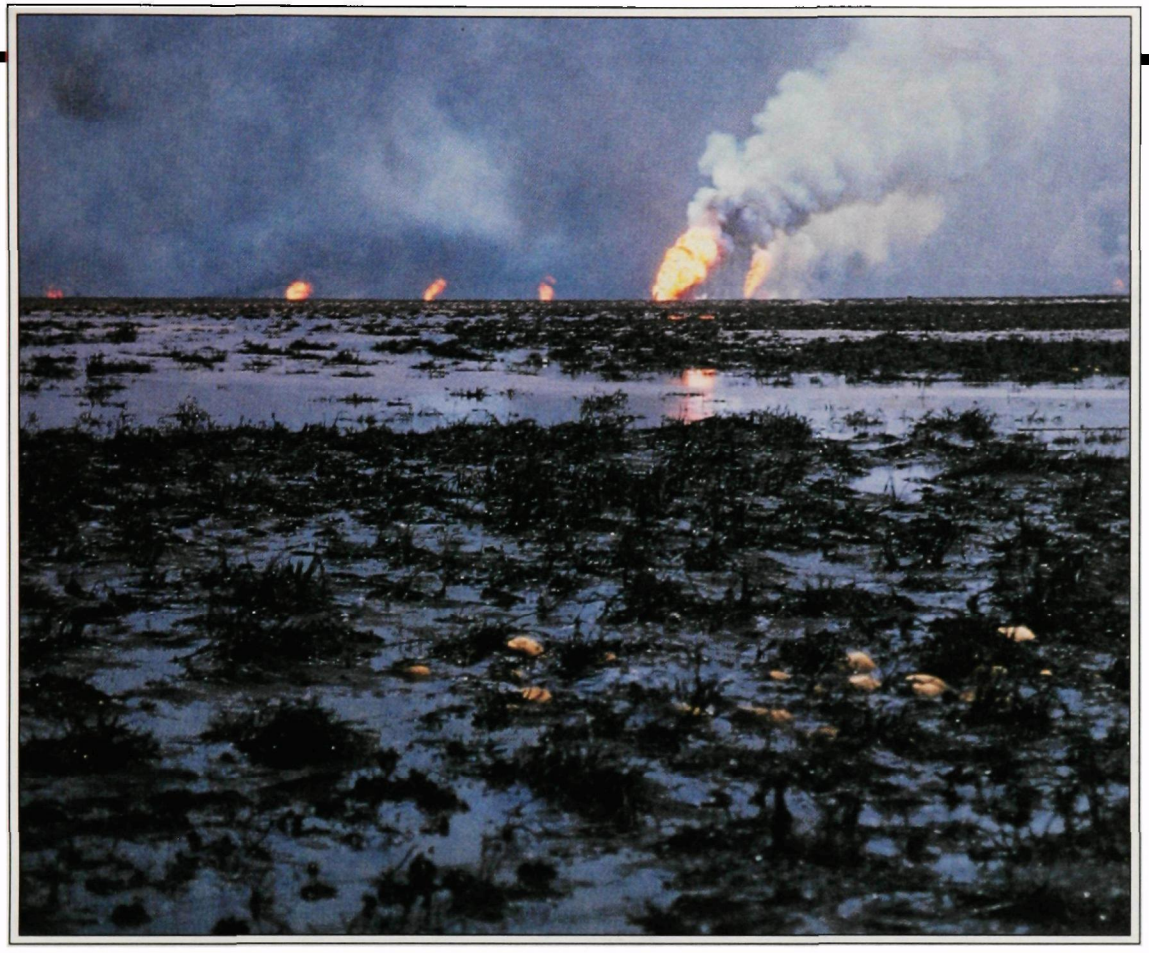
In late March 1991, the Saudi Arabian Meteorology and Environmental Protection Administration signed contracts with private corporations to begin clean-up operations along the coast, but absent significant funding from international donors, little change is expected.

9

WHAT HAS BEEN THE EFFECT ON THE GULF'S ECOSYSTEMS?

The western shore of the Gulf is severely polluted. Assessment of the ecological damage is continuing and the full effects may not be known for years.

The coastal waters of the western Gulf are shallow, with wide intertidal zones—regions between high and low tides—that are contaminated with oil.

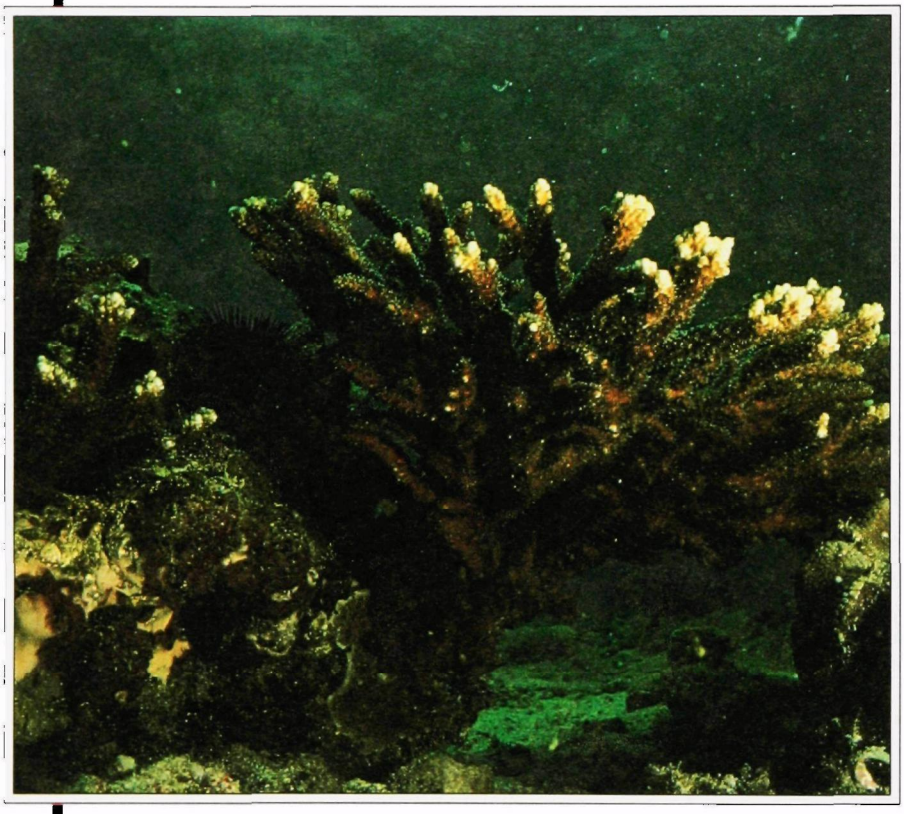


As fires burn in the distance, oil from unfired but damaged wells coats desert grasses. New growth of plantlife was evident in some areas within months, but the long-term effects are unknown. Photo by Abbas, Magnum Photos.

The rich ecosystem in these shallow waters includes salt marshes, mangrove swamps, beds of sea grass, and intertidal mud flats where fish and animals feed on algae. Coastal wetlands and islands provide nesting areas for many native and migratory birds, including flamingos and the endangered Socotra Cormorant. The oil also threatened shellfish, turtles, and coral.

Due to the size of the release and the impossibility of a full response during the war, many ecologically sensitive areas could not be protected. There were private wildlife rescue projects that saved some fowl and turtle nesting areas, but many shore birds fell victim to the oil slick. Some species of wildlife in the Gulf have shown remarkable resiliency following major oil spills in the past. Unfortunately, the most heavily polluted salt marshes are unlikely to survive, which surely will reduce bird populations. While coral in shallow water shows the black stain of oil that sank below the surface, coral in deeper water apparently are not severely contaminated. Deep water fish are expected to fare better than marine life that spawns and feeds in shallow water.

Following a section-by-section examination of the coastline by Saudi and U.S. scientists, a database ranking the most ecologically sensitive areas along the coast has been prepared as a guide for



Oil that sank coats coral; prognosis unknown. Photo by Dr. Sylvia Earle, NOAA.

clean-up operations. Saudi environmental authorities are considering different strategies for cleaning up the oil, including the possible use of fertilizers to enhance the work of natural microbes that break down oil.

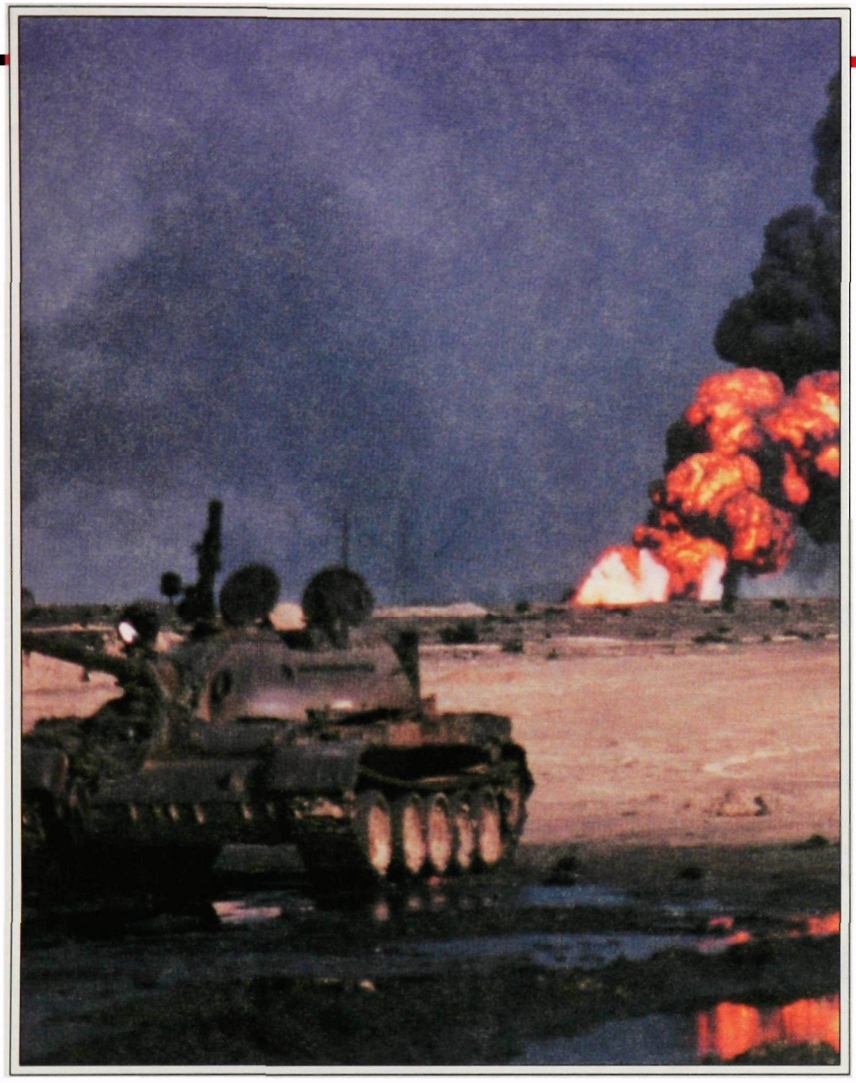
10

WHAT OTHER ENVIRONMENTAL DAMAGE HAS THERE BEEN?

Oil pooling on the ground near the burning wells, raw sewage pouring into the Gulf, and disruption of desert plant life and surface soil are additional ecological concerns facing the region.

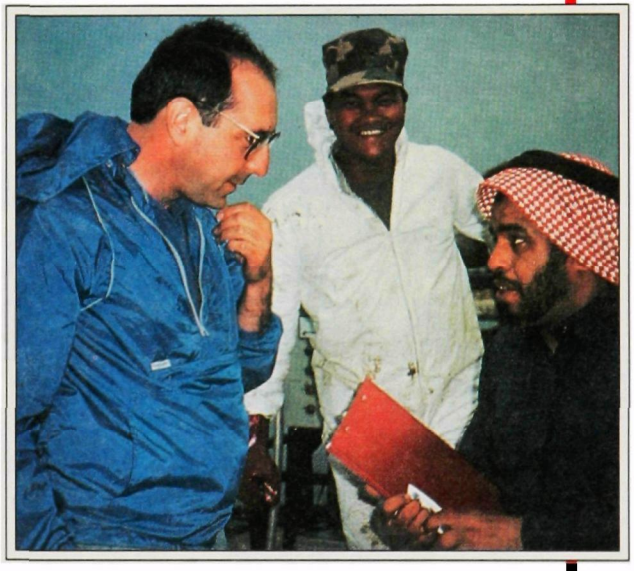
Millions of barrels of crude oil (estimates range from 10 to 100 million barrels) spilled onto the ground from wells damaged but not successfully ignited by the Iraqis. The spills formed ponds, some of which were ignited by nearby burning wells, adding more smoke and pollutants to the air and blackening the desert in the immediate vicinity.

Near the source, a large amount of the oil remained unburned, forming more pools. Some oil, baked by nearby fires, hardened into asphalt on the surface. Some of it seeped into the sand, but indications are that the oil has not seeped deep



Environmental problems included oil pools, fires, and the debris of war (left). Unexploded munitions continue to be a special hazard for clean-up crews and the civilian population. Photo by Ken Stroech, EPA.

Below, a NOAA Scientist (at left), confers with local officials on monitoring the environmental damage. Photo by Dr. Sylvia Earle, NOAA.



enough to reach freshwater underground aquifers. Kuwaiti officials are surveying the oil pools to assess potential ecological damage and possibilities for recovering the oil. The unhardened pools also represent a continuing hazard to wildlife, particularly for birds who mistake the oil ponds for water.

In addition, unburned oil droplets from the smoke have coated mangroves and other wild plants in southeast Kuwait. The level of plant mortality and the ability of the plants to recover are not yet known; in some areas new growth already has been spotted.

Also uncertain is the extent of the damage to the desert surface. The damage comes not only from oil, but also from the movements of thousands of heavy military vehicles and from the Iraqi Army's digging of trenches. One concern is that, because the desert's natural crust has been broken by these multiple impacts, more severe sandstorms

and movement of sand dunes could result.

The disposal of unexploded military munitions and of chemicals from damaged industrial plants created further burdens, as did Iraqi sabotage of sewage treatment plants, which increased the amount of raw sewage dumped into the Gulf until the plants could be repaired. Massive amounts of waste still litter the landscape and range from asbestos construction debris to PCB's from damaged power stations.

11

WHAT ROLE WILL GULF NATIONS AND THE UNITED STATES PLAY IN THE CONTINUING ENVIRONMENTAL AND HEALTH ISSUES?

The Gulf nations have taken responsibility for clean-up and recovery operations; the United States continues to provide technical assistance in accordance with international response plans and requests from governments in the region.

U.S. government efforts have evolved from initial emergency response to helping Kuwait and Saudi Arabia address medium- and long-term recovery. For example, the United States helped reestablish and expand air quality and weather monitoring systems so that local authorities were alerted about possible incidents of severe air pollution. Those authorities could then take, or urge residents to take, actions to reduce the pollution levels or exposure.

The U.S. offered this technical assistance in part because Kuwait's scientific infrastructure was severely damaged during the Iraqi occupation. The United States supplied Kuwait with monitoring equipment to replace equipment stolen or destroyed by Iraq, and has provided considerable scientific expertise as well. By October 1991, the U.S. government had spent nearly $10 million on health and environmental protection activities in the Gulf. (This amount does not include the time of U.S. personnel.)

Although scientists have preliminary data on the effects of the fires and oil discharges, there is more to be learned. For example, the U.S. has proposed sending public health experts to the area to try to determine the effects oil soot and droplets may have on local food supplies, including marine life. Other U.S. government personnel are advising Kuwaiti scientists measuring the amount of small particles, outdoors and indoors, that could be inhaled by local residents. U.S. government agencies also may be involved in more scientific research on the effects of the shoreline oil. A complete understanding of the severity of the threats to public health and the environment will take many months, even years.

This investment of U.S. government time and resources to date reflects the concern of our citizens for the human health and environment of Kuwait and Saudi Arabia. When all is said and done, by helping the Gulf region respond to this disaster, the community of nations can learn new strategies and new methods for coping with future environmental crises. If we do, and if we encourage new modes of regional and international cooperation, then we will have drawn what benefits we could from this human and environmental tragedy.

This booklet was produced by the U.S. Gulf Task Force.

Photo by Jim Lukoski, Black Star. Cover photo by Bruno Barbey, Magnum Photos.