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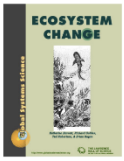
Ecosystem Change



ECOSYSTEM CHANGE is about the interdependence of all living things and the nonliving environment. It is also about how human activities are changing ecosystems around the world. See Overview.

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EC3. Studying Desert Ecosystems
ECOSYSTEM CHANGE
Chapter 3
{ Ecosystem Change Contents }
I. An Interview with Dr. Samira Omar
Desert ecosystems are very vulnerable to overgrazing by domestic animals. Herds people living at the edges of desert ecosystems have often triggered positive feedback mechanisms that have further reduced the productivity of the land both for wildlife and people. Nature's time frame for drought resistant plants to colonize and reclaim desert sand and rock may well be measured in thousands of years. Research on desert range lands around the world reveals a difficult challenge for restoring the productivity and diversity of plants and animals.
Samira Omar has been conducting research on desert range lands for
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conducting research on desert range lands for almost twenty years. Her homeland, Kuwait, is one of Earth's harshest desert areas, with powerful sand storms, drifting dunes, and temperatures that range from below freezing to greater than 40½ Celsius (104 ½ F) in the shade. [See Temperature Scales ↗.] The average yearly rainfall is only 105 millimeters (4 inches).

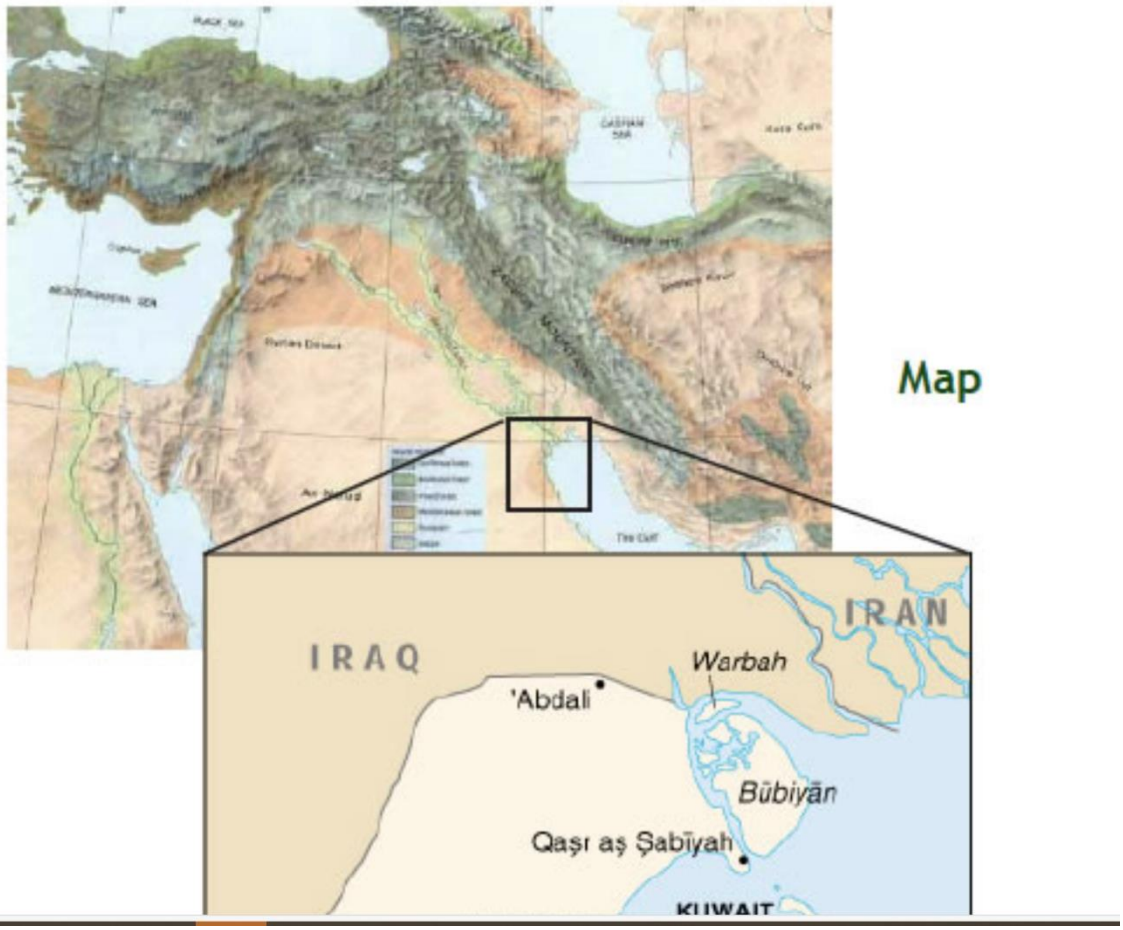
Dr. Samira Omar

Wind blown sand and dust can be a great problem for human developments as well as natural habitats. One of Dr. Omar's projects with the Kuwait Institute for Scientific Research (KISR) has been to investigate the biological, chemical and physical methods for controlling mobile sand. For example, Samira has investigated many species of trees to determine which ones could be planted as a fence and would continue to grow and resprout even when the trunks were covered by sand.

Samira has loved nature from an early age. She remembers when she was seven and was fascinated with watching insects feed on grasses and wild plants. "My interest in science started very early. Whenever my father went out to inspect the oil fields in the desert, I would go along. I love the desert ecosystem very much and am very devoted to it; that is why I majored in botany. I have a second major in chemistry which was also very fascinating to me. I enjoyed investigations such as watching crystals form."

A pioneer of rangeland ecology in her region, Dr. Omar has led efforts to study the relationships between desert plants, animals, and human activities such as livestock grazing. While working on her doctoral project, Samira developed a hypothetical model for predicting the succession of plant species in rangelands that were subjected to different conditions such as drought and grazing. In 1990, at the Second International Conference on Range Management in the Arabian Gulf, she won an award for her research.

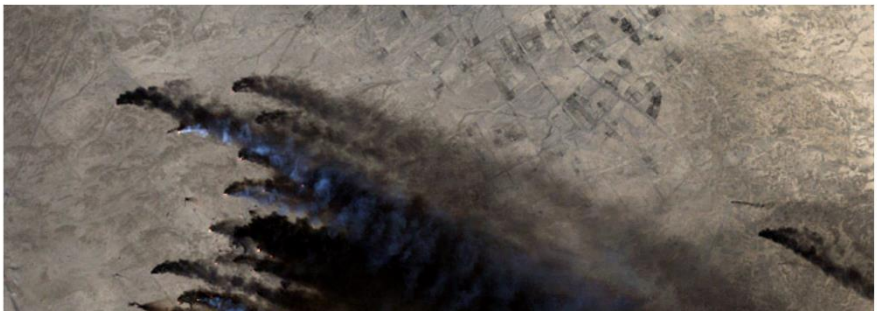
In August 2, 1990, Iraq brutally overran and occupied Samira's homeland, Kuwait. After a combined effort by troops from other nations led by the United States, Iraq was driven from Kuwait. In the aftermath, it was found that significant damage was done on a vast scale to the desert environment by Iraqi troops. They deliberately created massive oil spills and oil fires as they retreated. This devastation is Dr. Omar's latest research project. Her goal is to study the effects of crude oil pollution on vegetation and soils in desert environments and to determine the long term ecological effects on the desert brought about by human interference and destructiveness.

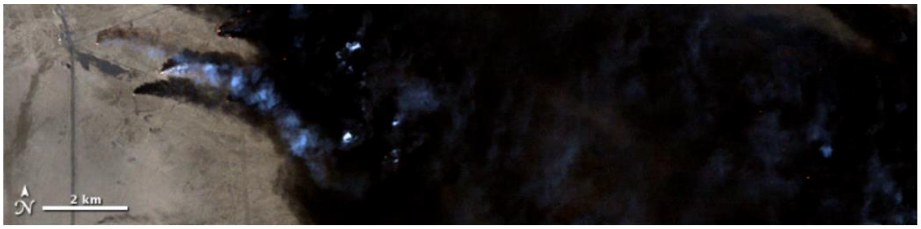


Map

Map of Kuwait

In designing her current experiment, Samira wanted to link the new research on the effects of oil with the seventeen years of data she and her colleagues had collected at KISR. The rangeland research program she started had been monitoring plant species and studying soil samples to establish baseline information that could be used to make informed decisions about conserving the rangelands.





Landsat view of Kuwaiti desert showing plumes of smoke from massive oil spills and oil fires. Image from Landsat image of oil fires in Kuwait - https://visibleearth.nasa.gov/images/78594/kuwait-oil-fires ↗

Although most of the records and photographs of the research were destroyed by the Iraqi army, the hypothetical model and some data remain as valuable tools for predicting and comparing patterns of plant succession in areas with different levels of oil pollution.

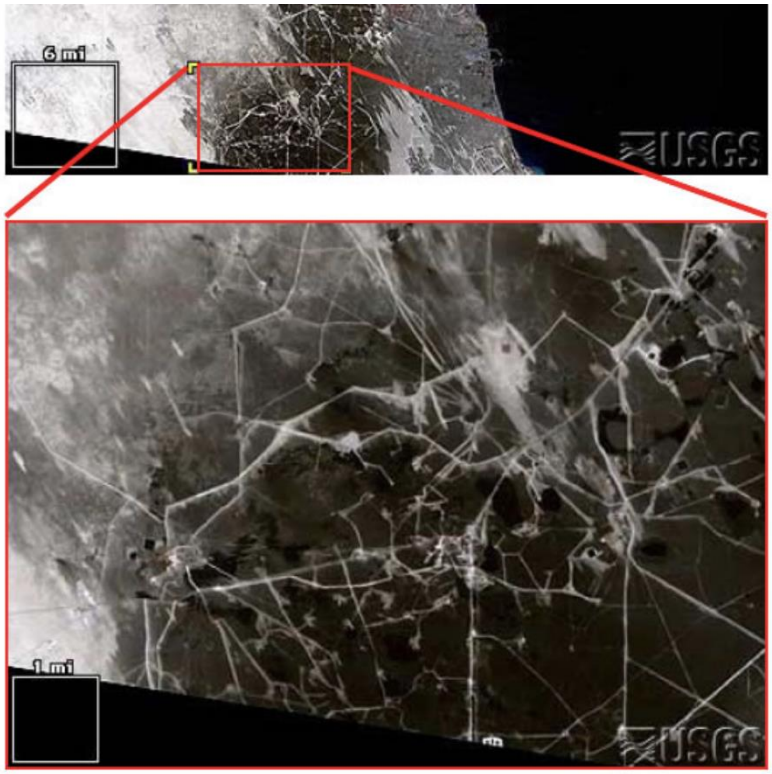
Because the facilities at KISR were destroyed, Dr. Omar has taken a leave of absence from her position as a program manager to conduct the laboratory portion of her research at the University of California at Berkeley. We asked Samira how she found the inspiration to reconstruct a research project in the face of such enormous difficulties.

NASA Landsat photos of the oil fields

(large scale view top, close-up bottom)

Aug 1990: Before the Gulf War fires

Feb 1991: During the Gulf War fires



Nov 1991: After the Gulf War fires

"I am so anxious to know what is happening to the environment, and I am enthusiastic about doing the research myself because I developed a succession model on the range plants of Kuwait for my Ph.D. It is a theoretical model, but it gives us a good understanding about what is happening in the desert ecosystem. It takes into consideration many factors, such as human impact on the range, livestock, and environmental factors such as rainfall and temperature. And now there is a new factor—oil."

"That is a challenge to me; I want to make a model to study the correlation between petroleum pollutants in the soil and potential plant uptake of such compounds so I can predict the effects of oil on desert ecosystems."

In August of 1991, Samira began collecting samples at three study sites in Kuwait. One study site is at the Burgon oil fields, which once were so white that she had to use polarizing filters on her camera to photograph the vegetation. Now the area is

polarizing filters on her camera to photograph the vegetation. Now the area is completely black, and where the oil lakes were burned the land is covered with a thick coat of crude oil. Here, and at Ahmadi, a second study site, camels, sheep, and goats still graze despite the oil. The third study site is at the Sulaybia Field Station of the Kuwait Institute for Scientific Research.

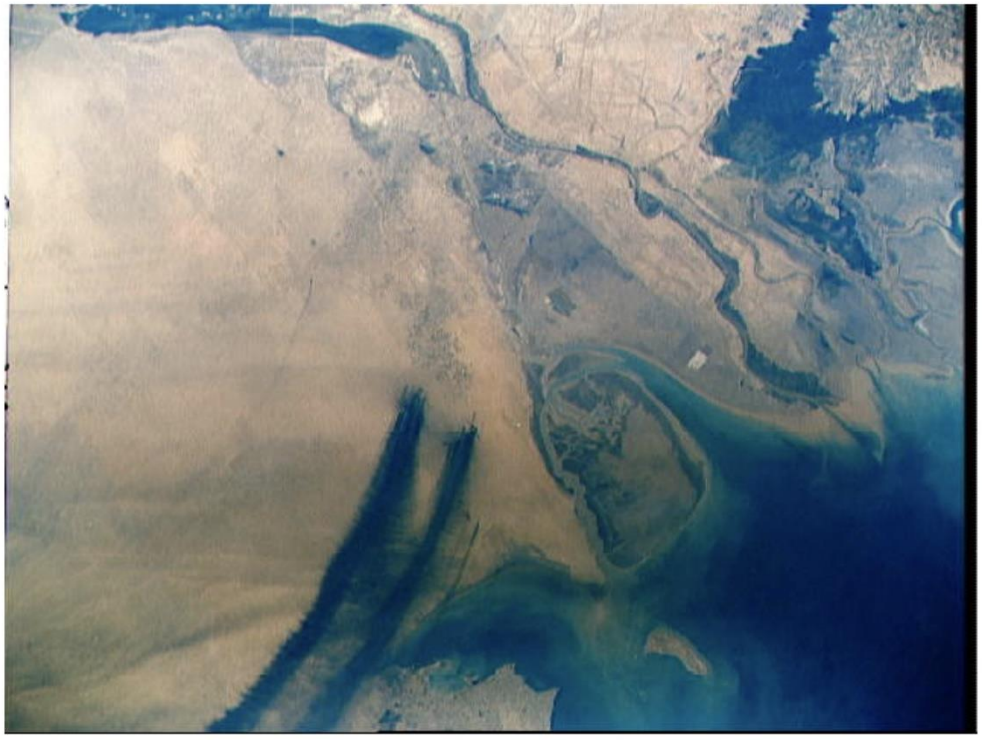


Photo from Space Shuttle flight STS37

Undaunted by the lack of research equipment and the hazards of working in a former war zone, Samira took a shovel, meter stick, camera, notebook, and pencil out to her study sites. She dug a series of deep soil pits along a transect that started with the heavily polluted areas and continued outward to less contaminated areas.

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Kuwaiti rangelands

Down in the Burgun soil pits she found that the oil had formed two layers: a molasses-like syrup which was "stuck" on the surface, and a thin gasoline-like component which soaked into the sand forming a dark brown layer. Samira measured the layers and their depth, collected samples, and described and sampled the vegetation. She will continue to collect samples over many years to monitor the changes in levels of chemicals in the soils, vegetation, and animals, as well as changes in the growth and distribution of plant species.

Digging soil at the Burgan Oil Fields

Collecting vegetation sample

With bags of plants and Kuwaiti soil in hand, Samira returned to UC Berkeley where she has access to equipment, such as a mass spectrophotometer, for analyzing the proportions of various chemical compounds in the soil and plants.

Growing Kuwait rangeland plants in Coalinga soil.

But Samira needed uncontaminated soil to which she could add known quantities of oil compounds and then grow plants under controlled conditions.

With the help of soil scientists, she determined that soil from Coalinga, California, was similar to Kuwaiti soil. Ecological projects such as the Kuwait oil and rangeland study, require cooperation and input from scientists who work in several different fields.

In the UC Berkeley greenhouses Samira is using the Coalinga soil to grow three different species of plants native to Kuwait rangelands. For each species, she is testing the plants' responses to different levels of crude oil applied at specific times in the plants' growth cycle. The greenhouse study will provide information for understanding and predicting changes in Kuwait's environment.

The oil is a mixture of many carbon compounds and heavy metals. Samira is analyzing what components of the crude oil are taken up by the plant, what remains in the soil, and what evaporates or breaks down quickly. She predicts that some species of plants may appear to recover well. But one worrisome question is the degree to which cancer causing compounds and heavy metals pass from the plants into the food chain as wild animals and livestock graze

“My botany professor encouraged my love of plants and I was greatly influenced by his love of nature. I also had a supervisor at KISR who introduced me to a very beautiful area that was a large depression where water accumulated and iris bloomed in the spring. Both of these people died, and because I liked them a lot, I made a promise that I would work to make this area a national park. I wanted some role in the government that would enable me to dedicate and preserve this special place. And I did. In 1986, this area became Kuwait’s National Park. The 250 square kilometers includes a variety of ecosystems such as a desert plateau and a coastal area with cliffs and sand dunes.”

The project greenhouse in Berkeley, California

As part of her program at KISR, Samira worked to conserve offshore islands as breeding sites for terns and other marine birds and sea turtles. She prepared a program to reintroduce species of Arabian gazelle on Falika Island, and planned to test the feasibility of using the island as a self-contained area for the reintroduction of wildlife. Today Kuwait’s only national park is full of abandoned military equipment, mines and bombs from Iraq. The islands and their wildlife habitats have been heavily damaged.

The project greenhouse in Berkeley, California

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We asked Dr. Omar about her view of the Gaia Hypothesis, the idea that the Earth is one giant self-regulating system that functions somewhat like a giant organism.

"Nature is very strong and mighty. Whatever we do, it seems to be able to take care of itself. But I do have doubts, and I am worried that this may not be true. Man can destroy part of nature in seconds. But in the long term, nature heals itself because everything is part of it. I think we should be very worried about the health and survival of humans as a species as well as other living things."

See ***Staying current for this chapter***.