Vulnerability and Recoverability of the Mojave Desert Ecosystem

It is ironic that in a desert surrounded by eight million people, USGS scientists are best able to understand long-term effects of land disturbance by studying how the environment has changed in places people have abandoned. In 1908 when the top picture was taken, Rhyolite, Nevada was at its zenith, a mining town with major stone buildings including a bank and a jailhouse. Almost all of the valley had been disturbed by the townsite, and very little of the native vegetation remained. But by 1986 when USGS scientists first saw Mojave ghost towns as a laboratory for understanding recovery rates, most of the buildings were gone and desert vegetation had returned. A third picture was taken in 1998 showing even more vegetation recovery.

In contrast to ghost towns like Rhyolite, Kunze, and Greenwater, tank tracks made during General Patton's training maneuvers during World War II still remain in many places. USGS scientists, intrigued by these vast differences in ecosystem recovery rates, hypothesize that they result from environmental differences among sites in the desert. Landscape of a certain geology, slope, soil, micro-climate, and botanic habitat will bounce back from human abuse; landscape of a different type will remain scarred and unproductive. USGS scientists are trying to learn more about what factors are most important.

Land managers from both the Departments of the Interior and Defense need to know which parts of the desert are more vulnerable to disturbance than others, which parts are likely to recover fastest, and which not at all. The Mojave Desert is home to four National Park units and six major military training bases. It also contains the nation's fastest growing city, Las Vegas, and is within driving distance of Los Angeles, San Diego, and Phoenix. Land managers are faced with the need to make sound decisions on land use policies that will allow for economic, recreation, and military use, while still keeping the desert ecosystem in shape to ensure the survival of threatened species like the desert tortoise.

Disturbance of the desert fabric, both natural and human-induced, results in changes that are measureable as soil compaction, wind erosion, and water erosion. USGS scientists are busy trying to understand the physical and biological processes that result when disturbance occurs and what effects varying types and amounts of disturbance have on ecosystem functioning. And they're committed to translating the resulting insights into information that can be easily used by land managers.

The key to this program is a real use of an integrated science approach. Recognizing that geologic, hydrologic, geographic, and biologic processes are all inter-related, USGS scientists are working together.

For example, to determine what effect foot, animal, or vehicle tracking has on desert surfaces held together by cyanobacteria, USGS scientists are conducting experiments to measure resistance of the surface to wind erosion given ranges of both disturbances and wind speed. These measurements are being done over a variety of landscapes, testing the hypothesis that not all desert is equally vulnerable to disturbance. Underlying geology or slope or climate must also be considered when predicting the impact of disturbance.

To determine vulnerability of the desert to soil compaction, sites that have been disturbed (such as the ghost towns) are examined. Soil compaction and vegetation is determined for sites known to have been disturbed and then left to recover. These measurements are compared to nearby control sites that have not been disturbed. When these experiments are done for sites representative of different combinations of physical and biological landscape elements, a basis is formed for predicting which landscape sites are most vulnerable to disturbance and which sites are more likely to recover.

In all cases, geologists, hydrologists, biologists, and geographers are supplying information about the various elements of the landscape for the examined sites in detail, and the larger area through extrapolation using known data points and remote sensing.

Biologists are collecting information on species abundance and diversity along transects that are matched to the recoverability studies and which show the relationships among landscape elements, disturbance, and the biota.

All of this data is scientifically valuable but rather meaningless to land managers until it can be turned into specific information that can be used to guide land management decisions. That is where the entire program comes together and relies on the integrated science approach to construct landscape and biotic models of vulnerability and recoverability that can be employed in decision support systems. Much like a weather forecast delivers meteorological observation and analyses to the public, these models bring the best insights of integrated science to the land manager. In fact, the results may be likened to interactive weather maps, showing vulnerability to potential disturbance as ranges of colors that may intensify with increased use and become subdued over time as the disturbance passes.

When the program is completed in several years, USGS scientists will be able to tell the story of places like Rhyolite and the Patton tank tracks and use the insights obtained to help desert land managers ensure the survivability of the desert and the species that depend on it even as economic, recreation, and military uses continue.

For more information, visit our World Wide Web site:
http://geology.wr.usgs.gov/MojaveEco/

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