Sound signatures may provide clues to the health of park ecosystems

by Bill Schmidt

THE NATIONAL PARK SERVICE RECENTLY completed the first round of a pioneering bioacoustic sampling of environmental sounds in selected locations in Sequoia and Kings Canyon National Parks, California. The work was performed by a team directed by Dr. Bernie Krause of Wild Sanctuary, Inc., in cooperation with Dr. Stuart Gage of the Computational Ecology and Visualization Laboratory at Michigan State University. The NPS Associate Director, Natural Resource Stewardship and Science, sponsored this study with funding from the Natural Resource Preservation Program.

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Dr. Bernie Krause records the "biophony," or the combined sounds made by organisms in a given habitat, on location in Sequoia National Park, California. Bioacoustic recording adds another dimension to ecosystem modeling and allows for comparisons of data among seasons, over time, and with other ecosystems.

The underlying thesis of this project is that interpreting an area's *biophony*—the combined sound that living organisms produce in a given habitat—is a key to understanding the health of that particular biome or ecological community. In contrast to studying the vocalization of organisms in an abstract, individualized manner as has been done historically, this study focused on recording audio samples in the context of the totality of creature sounds in a given setting. The expression of biophony is theorized to depend on location, season, weather conditions, time of day, whether the biome is wet or dry, whether the habitat is primary or secondary growth, whether it is clear-cut or unchanged, and many other factors. If the thesis that each biophony is unique and tied to the health of a particular biome is borne out, the biophonic signature of an area can provide the National Park Service with a clear record of individual place and an indicator of its fitness and age just as a thumbprint identifies individual humans.

The study sought to:

1. Digitally record audio samples from four different habitats in the two parks from October 2001 to July 2002;
2. Process bioacoustic dynamics and characteristics of each habitat;
3. Begin creating an index of acoustic dynamics within each habitat to correlate with traditional biodiversity indexes;
4. Assess habitat degradation and regeneration; and
5. Begin examining the relationship of bioacoustic dynamics to introduced noise, such as from human sources.

Four teams made observations and collected audio samples. Personnel monitored per of the four sites four times per day over a period of three to five days, during fall, winter, spring, and summer, to start characterizing the natural acoustic dynamics of each site. Daily signatures of approximately 60 minutes of acoustic activity were recorded at dawn and dusk, which tend to be the most acoustically active periods, at midday, and two to three hours after sunset (representing nighttime). Park natural resource staff helped select the sites; the investigators selected seasons relative to typical weather patterns at approximate seasonal midpoints.

The results were very encouraging. The teams worked out many of the expected problems with the sampling protocols and equipment. They obtained a rich collection of biophonic information and have been working to establish preliminary correlations with traditional biodiversity indexes. In the words of Dave Graber, Senior Science Advisor for the parks, "recording a soundscape … in Sequoia represents a valuable component of a park's natural resources inventory, much like producing a vegetation map or a list of animal species.… Should concordance among various acoustic elements in a soundscape prove to be a widespread phenomenon, it … holds promise for a window into a whole new aspect of ecosystems that was heretofore undetected."

The results of the field test pointed out several areas for additional work. One is the need for analytical techniques, such as those from landscape ecology, that will allow quantification and more refined statistical analysis of the data. Even relatively short recording sessions such as these generate a tremendous amount of data that must be plotted and sorted by hand. Another need is for additional recording at these and other parks with different physical characteristics to provide multiyear data over a broad range of conditions. ■

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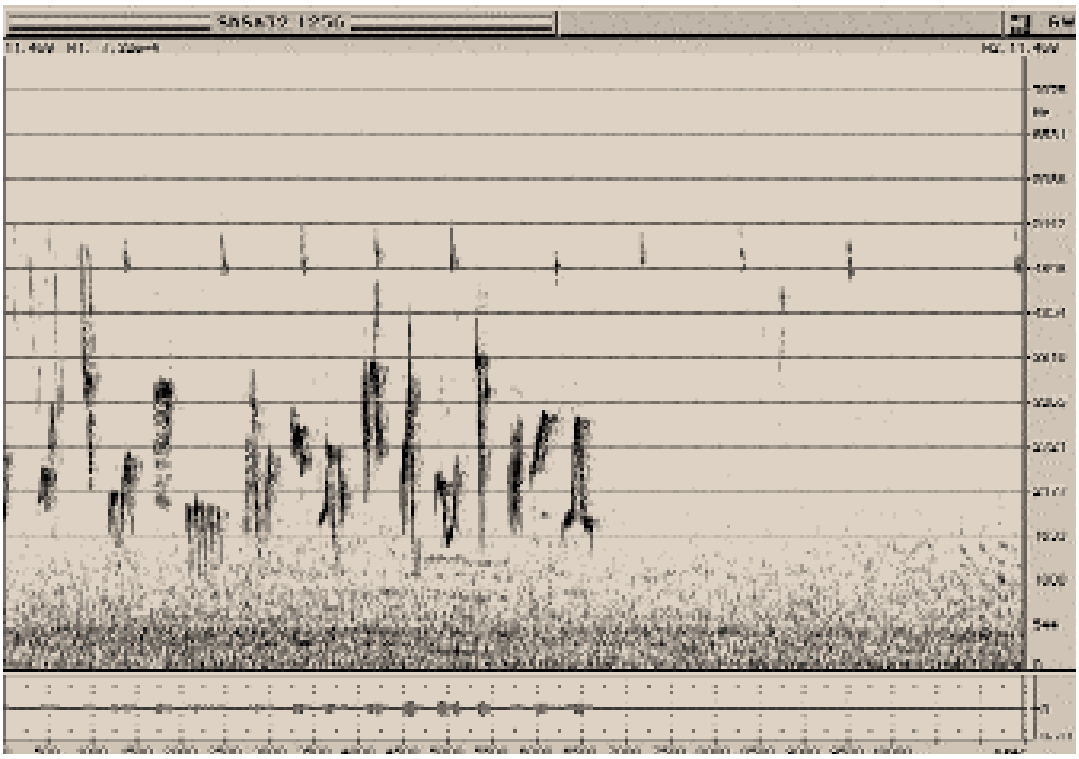

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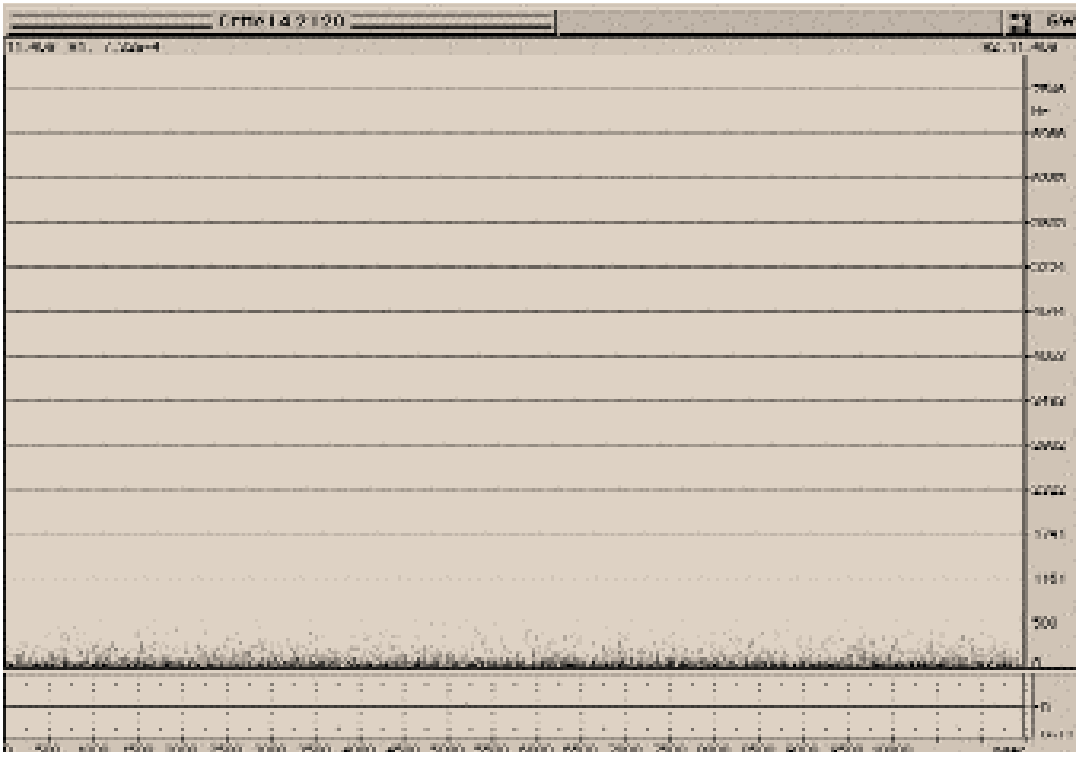

Spectrograms contrasting rich (above) and barren (below) biomes, Sequoia and Kings Canyon National Parks, California.