# Federal Interagency Committee on Aviation Noise
# FICAN Position on Research on Natural Quiet

September 2000

The Federal Interagency Committee on Aviation Noise (FICAN) cosponsored a symposium on the Preservation of Natural Quiet with the Acoustical Society of America in Columbus, Ohio in November, 1999. Presentations were given by a number of researchers on a variety of topics dealing with this issue.

The members of FICAN find that considerable progress is being made in developing unique approaches and research strategies for the preservation of natural soundscapes. This progress is characterized by four trends: (1) Development of a science of acoustic ecology, (2) Development of appropriate tools for computer modeling, (3) Improved procedures for inventories of the natural soundscape, and (4) Improved procedures for measuring the effects of noise on park users.

The variety and depth of papers in this symposium shows that the involved Federal agencies are actively engaged in developing an understanding of how to assess and preserve natural soundscapes. Consequently, the members of FICAN prefer to monitor progress rather than recommending new lines of research. FICAN encourages the NPS and other land management agencies to continue to refine their approaches to dealing with the unique problems of low noise environments, publish and disseminate the results of their studies, and share results with other members of FICAN.

## BACKGROUND

On November 3, 1999, the Federal Interagency Committee on Aviation Noise (FICAN) cosponsored a symposium on the Preservation of Natural Quiet with the Acoustical Society of America in Columbus, Ohio. Presentations were given by a number of researchers on a variety of topics dealing with this issue, as identified in the table below. The presentations given at this symposium are available on the FICAN website, http://www.fican.org.

**SYMPOSIUM PRESENTATIONS**

| Topic | Speaker(s) |
|---|---|
| National Park Service noise issues | Wesley R. Henry, William B. Schmidt, and Rick Ernenwein (National Park Service, 1849 C St., NW, Washington, DC 20240) |
| Loss of natural soundscapes within the Americas. | Bernie Krause (Wild Sanctuary, Inc., 13012 Henno Rd., Glen Ellen, CA 95442, www.wildsanctuary.com) |
| Guidelines for the measurements and assessment of low-level ambient noise. | Gregg Fleming (Acoustics Facility, Volpe Center, Kendall Square, Cambridge, MA 02142) |
| Measurement of the natural soundscapes in south Florida national parks | Micah Downing, Christopher Hobbs, and Eric Stusnick (Wyle Labs., 2001 Jefferson Davis Hwy., Suite 701, Arlington, VA 22202) |
| Challenges of modeling aircraft noise in national parks | Kenneth J. Plotkin (Wyle Labs., 2001 Jefferson Davis Hwy., Suite 701, Arlington, VA 22202) |
| Using visitor responses to rank order national park soundscapes | Nicholas P. Miller (Harris Miller Miller & Hanson Inc., 30 New England Executive Park, Burlington, MA 01803) |
| Respondents' interpretations of impact measures for dose-response studies | Robert Baumgartner (Hagler Bailly Consulting, 455 Science Drive, Madison, WI 53711) |
| Educating national park users on preserving natural soundscapes | Rick Ernenwein, Wesley R. Henry, and William B. Schmidt (National Park Service, 1849 C St., NW, Washington, DC 20240) |

## SUMMARY

The members of FICAN find that considerable progress is being made in developing unique approaches and research strategies for the preservation of natural soundscapes. This progress is characterized by four trends:

- Development of a science of acoustic ecology.
- Development of appropriate tools for computer modeling.
- Improved procedures for inventories of the natural soundscape.
- Improved procedures for measuring the effects of noise on park users.

## Acoustic Ecology

"*Acoustic ecology,*" as used here, refers to the way a species adapts its communication to the physical constraints of an ecological niche (e.g. forest, savannah, seashore, etc) and to the physiological constraints of its vocalization and auditory systems in concert with other species in that ecological niche. Describing the acoustic ecology in natural areas is important for two reasons: (1) Preserving the natural soundscapes, and (2) Predicting whether a particular sound will have an adverse impact on a given species. Acoustic ecology is a more sophisticated approach to studying the effects of noise on wildlife than employed in the past. The earliest work in this area consisted of "laundry lists" of studies reporting some effect of noise on the behavior of animals. An example is EPA Report UTID 300.5, *Effects of Noise on Wildlife and Other Animals*, December 1971. Today, researchers look at the spectrum of the intruding sound and compare it to the auditory sensitivity of the species being studied. Researchers also look for a relationship between noise and the effect of that noise on a species. Acoustic ecology moves beyond the noise-to-species relationship and looks at the noise-to-ecosystem relationship. Examples include the USAF study of the effect of aircraft noise on the predator-prey relationship in the desert kit fox, and Dr. Krause's observation of increased predation suffered by endangered toads when aircraft noise disrupted their sequence of vocalizations. Dr. Krause described an approach by which bioacoustic measurements can also validate the health of entire habitats by measuring the biophony – creature voices within whole biomes as they relate to one another in real time context. By defining the acoustic interaction within the ecological niche, acoustic ecology offers an approach for a more complete assessment of vulnerabilities and protection of the biota.

## Development of Appropriate Models

Use of computers to predict environmental noise exposures is the primary tool in land use planning in the noise environment around airports, highways and railroads. Available computer models include INM, NOISEMAP (and a related model, NIMSIM) for aircraft noise, and the FHWA model for traffic noise. The designers of these models anticipated usage to be limited to urban environments in which the background noise is 45 dBA at night. For U.S. parks, models must be designed for environments in which the background noise drops to 20 dBA and below. The potential for using computer models to manage noise in parks is great. Computer models can be used to explore various combinations of air routes, roads, snowmobile routes and watercraft areas to ensure the preservation of the natural soundscape in critical areas. To accomplish this task, the computer model must also be applicable in terms of terrain, vegetation and weather, all of which influence the propagation of sound. NPS pioneered one of the first low noise computer models – NODSS – used extensively at Grand Canyon. Useful though this model has been, it cannot easily be applied to other parks. Fortunately, improvements in computational power and improved algorithms for predicting sound propagation have reduced the cost of creating an even more appropriate model.

## Inventories of Natural Soundscapes

The National Park Service has two mission mandates. The first and primary mandate is resource protection. The second is visitor enjoyment. The natural soundscape of parks, i.e., the soundscape absent human-caused noises, is a natural resource – one that the NPS has found to be increasingly threatened by the effects of civilization. NPS has a need to inventory its parks to determine the character of their natural soundscapes and ensure their protection from future acoustic interference. One way that had been used in the past is to conduct an inventory with a trained listener. Two techniques have been used: (1) an NPS procedure (LOWNOMS) in which a listener logs the percentage of time during selected one hour periods over a number of days that an audible intrusive sound is dominant using a "button box," data logger, and associated acoustic equipment, (2) a procedure from the FAA (VOLARE) in which the listener logs the source of noise according to a strict hierarchy of sound categories with similar equipment for 3 hour periods on selected days. The major difference is the "dominant sound" versus the hierarchy of sounds regardless of dominance and there is no consensus between the agencies on the better approach. The NPS is finding that this approach is both costly and inefficient for the type of comprehensive soundscape assessment needed for the parks. An alternative being favored more by the NPS is the use of long term (weeks, months or years) unattended monitoring supplemented by periodic attended monitoring to identify the nature of noise intrusions. Automated monitoring is, in theory, more cost-effective, and it appears that monitoring to determine the L90 (the level of sound exceeded 90% of the time) would be a good way to develop baseline information needed to describe natural soundscapes.

## Characterizing Effects on People

When researchers began studying the effects of noise on park users, they first tried a tool developed for assessing noise in residential neighborhoods – the noise annoyance survey. In the annoyance survey, people are asking to rate their annoyance about noise on a numerical scale, e.g. a scale of 1 to 5. On a five-point scale, the adjectives are usually "not annoyed", "slightly annoyed", "moderately annoyed," "very annoyed" and "extremely annoyed." Schultz (1978) found a reliable relationship between the percentage of people choosing the top two adjectives ("highly annoyed") and residential noise exposure. Schultz's definition of "percent highly annoyed" became the touchstone of Federal policy on environmental noise. When this procedure was applied to park users, however, the relationship used included "moderately annoyed" as well as the top two annoyance categories; the park goal was to ensure that visitors enjoyed their stay, not merely that they were not "highly annoyed." This refinement in annoyance proved to yield good correlation between measures of aircraft noise and the visitor ratings of annoyance, and provided "dose-response relationships" more attuned to park goals of providing for visitor enjoyment.

Parks, however, are interested in providing a high quality visitor experience that includes not only absence of annoyance, but uninterrupted enjoyment. Consequently, visitors were also asked to rate the degree to which aircraft sound interfered with their appreciation of natural quiet and the sounds of nature. As with annoyance, a five point scale was used. This measure of interference also correlated well with measures of aircraft noise, but proved to be more sensitive: visitors felt that aircraft sound interfered with their experience even though it might not have been considered annoying. These two measures of visitor reaction, annoyance and interference, can provide park management with considerable flexibility in making management decisions about preserving the visitor experience.

Finally, combining the visitor reaction data with the aircraft sound level data yields dose-response relationships that provide possible guidelines for determining the degree of impact (annoyance or interference) that may result from aircraft noise. By estimating or measuring both the percent of time aircraft could be audible and by quantifying the sound energy of the aircraft relative to the background, it is possible to categorize how significantly the noise may adversely affect visitors.

## RECOMMENDATIONS

The variety and depth of papers in this symposium shows that the involved Federal agencies are actively engaged in developing an understanding of how to assess and preserve natural soundscapes. Consequently, the members of FICAN prefer to monitor progress rather than recommending new lines of research. FICAN encourages the NPS and other land management agencies to continue to refine their approaches to dealing with the unique problems of low noise environments, publish and disseminate the results of their studies, and share results with other members of FICAN.

## ADDITIONAL INFORMATION

Additional information can also be found at the FICAN web site: www.fican.org.

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