BERNARD L. KRAUSE, Ph.D.

The Habitat Niche Hypothesis: A Hidden Symphony of Animal Sounds

A SYMPHONY OF NATURAL SOUNDS where each creature voice performs as an integral part of an animal orchestra? Hogwash, you say. Well, perhaps we need to look (or listen) a little more closely.

Since the end of the 19th Century, biologists and zooligists have been focusing their research in large part on the study of singular creatures and issues in an effort to understand an organism's connection to the whole environment. Isolated studies were always easier to grasp and measure within the canons of pure and carefully considered academic terms. Study controls were easier to impose. And the results tended to be far more elegant. Indeed, even in the new science of bio-acoustics (*bio* = life, *acoustics* = sound) where feasible recording technology emerged in the late '60s, field researchers have earnestly sampled single creature sounds and have tried to isolate individual animal vocalizations only to find that significant parts of the messages probably lie elsewhere.

In a recent essay on this subject, Stephen Jay Gould spoke of ". . . the invisibility of larger contexts caused by too much focus upon single items, otherwise known as missing the forest through the trees" ("Abolish the Recent," *Natural History*, May 1991, 16-21). Later in the article Gould suggested that we have a great deal of difficulty grasping the larger, more complex concepts – even when they may hold the key to simpler truths. Bearing this in mind, we are just now beginning to realize the important role ambient sound plays in our environment. Abstracting the voice of a single creature from a habitat and trying to understand it out of context is a little like trying to play Samuel Barber's "Adagio for Strings" absent a violin section as part of the orchestra.

Ancient human beings had learned well the lessons imparted by natural sounds. Absolutely fundamental to their survival was the ability to hear and understand the information imparted by their surroundings. Not only could these extraordinary folks distinguish one creature sound from another but our ancestors knew the subtle differences in sound between the various mini-habitats (20 sq. meters) in a forest, even when they appeared to have visually identical biological and geological components. Because these habitats constantly seemed to reproduce themselves from visual and aural perspectives, they were considered to be living organisms. Blinded or travelling in total darkness, forest inhabitants could

tell exactly where they were by simply listening. Our ancient grandparents also knew instinctively what Beethoven and Bach took lifetimes to learn and what the New Kids on the Block never will. Experienced composers know that in order to achieve an unimpeded connection, the sound of each instrument must have its own unique voice and place in the spectrum of events so that it can be heard. All too little attention has been paid to the fact that insects, birds, and mammals in any given environment have been finding their aural niche since the beginning of time . . . and much more successfully then we might have imagined.

What our ancestors knew and what some of the more knowledgeable remote human forest inhabitants still know is that each place in any given environment, where the natural habitat is still completely intact, has its own voice. Sometimes, if one moves just 10 or 20 meters in one direction or another in any old-growth habitat, the sound, even where there are similar vegetation and geological components, will be quite different. Well, so what?

There must be a reason why each creature seems to have its own sonic niche (channel, or space) in the frequency spectrum and/or time slot occupied by no other at that particular moment. The sounds of each of these sub-habitats are so unique and important to creature life in a given location that if one creature stops vocalizing, another immediately joins the chorus to keep that audio bio-spectrum intact. An audio bio-spectrum is an acoustical spectrographic mapping of any particular habitat by frequency and amplitude (loudness) over short periods of time . . . usually 10 seconds.

The vocalizations of some tropical rainforest animals are highly specialized in that their voices occupy several niches of the audio bio-spectrum, thus laying territorial claim to several audio channels at the same time. We suspect that not a few migrating eastern American songbirds, able to learn only one song and call in their lives, find themselves unable to adjust to the changes in ambient sound when they fly to their disappearing Latin American winter nesting grounds. Where these environments have been deforested, and when birds try to successfully immigrate to nearby and ostensibly similar habitats, they discover that they are unable to be heard. There is a strong likelihood that survival might be impaired because territorial and/or gender related communications are masked.

Figures 1 and 2 show simple and complex habitat ambient niches where consistent dark lines running horizontally across the page (letter "A") represent a unique mixture of insect voices shown occupying several "bands" of a 20 - 20,000 Hertz frequency spectrum. The darker the line, the louder the sound in that particular range. The short lines toward the bottom of the page in Figure 1 (letter "B") represent the low voice of a

Zenaida dove, a species of bird living in the Virgin Islands on St. Maarten. This sample was taken on *Pic Paradis*, a 400m mountain on the French side. The Figure 2 sample was recorded recently in Borneo. Again, the consistent horizontal lines running across the middle of the page represent insect voices (letter "A"). However, notice the tropical sparrow vocalizations at both the left and right sides of the page. Its voice is made up of three harmonic components called formants. And they fit uniquely and exactly into several niches where there is little or no vocal energy represented by the light or white spaces (letter "C"). It turns out that in every unaltered habitat we have recorded, many birds, mammals, and amphibians find and learn to vocalize in acoustical niches unimpeded by the voices of less mobile creatures such as near-ranging insects.

We first noticed this phenomenon while working in Africa in the early '80s. Field recording requires phenomenal patience. Typically, we would spend 500 hours on site to get 15 minutes of usable material . . . a ratio of 2,000:1. While recording species-specific creatures, we would often wait for up to 30 hours in one location for a desired event to take place. Out of boredom and because there was nothing else to do at the time, we began to record pure ambient sounds. When a bird sang or a mammal or amphibian vocalized, we noticed that the voices seemed to fit incredibly well both in terms of frequency and prosody (rhythm). We would return to the same location at the same time of year over a number of years both in Africa and the Amazon only to find, when the recordings were analyzed spectrographically, that each place showed incredible bio-acoustic consistency. The bird, mammal, and frog vocalizations we recorded all seemed to fit neatly into their respective niches. And the bio-acoustic niches from the same locations all remained the same (given time of year, day, and weather patterns). Having just begun to work in Indonesian rainforests, we suspect from early analyses that we will realize similar results from these habitats as well.

While the audio bio-spectrum of each location remains essentially constant, large habitats of the same region will show local variability and regional similarities, all at the same time. However, each area will have its own unique sonic "thumbprint."

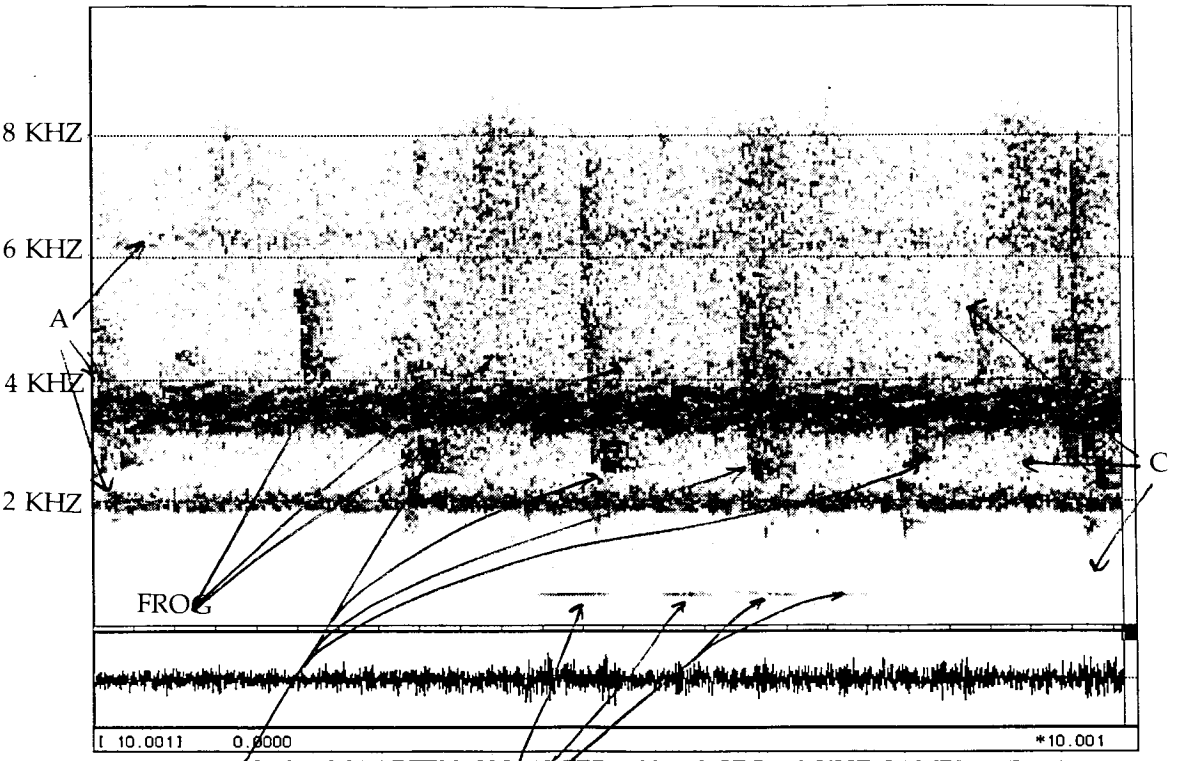
If, as we are suggesting, the ambient sound of primary growth habitats functions much as a modern day orchestra with each creature voice occupying its own place on the environmental music staff relative to frequency, amplitude, and duration of sound, then there is a clear acoustical message being sent as to the biological well-being of those locations. Some people, believing that fragile environments can be continuously and endlessly developed, must begin to listen, as well as observe what changes are taking place. Developmental advocates suggest that if just small biological islands are preserved, that will be

enough. Life is too short not to get as much as we can out of it. However, it has been shown in our own country from work done in North American national parks that species are becoming extinct, and that they are doing so in an inverse relationship to the size and age of the parks. The smaller the park, the faster the decay. When we have tried to record in new stands of trees planted in the Olympic peninsula by Georgia-Pacific and other lumber companies, what we have found is a profound lack of bio-diversity evidenced first by a monotone of sound. Compare these recordings with those of a healthy, old-growth forest and the differences in sound are astounding.

Much more thorough research on this theory needs to be done because there is an abundance of knowledge to be gained from this approach to environmental study. Among the questions we need to address are: (1) How can we find locations on earth that are free of human-induced noise? (2) How can we gather recorded samples from many different locations simultaneously with a minimum of human resources over an extended period of time? (3) How do more-or-less stationary inhabitants of any location use biologically produced ambient sound in non-species-specific ways? (4) Assuming a base-line habitat ambience, when normal bio-spectrum patterns change, in what ways might they be signaling other alterations in the environment? (5) Is there any kind of meaningful information useful to the understanding of migration patterns of birds as in their use of acoustical homing beacons?

Natural orchestrations, the sounds of our unaltered environments, are quite precious and are becoming exceedingly rare and difficult to find these days. Not only is there a great deal of enjoyment to be garnered from these wonderful places, but also some valuable science as well. It is no longer just the single voice of a song bird that holds and piques our interest. It is the acoustical fabric into which that song is woven that we believe will provide important new environmental messages and insights if we wish to have the opportunity to live lives of enchanted quality.

FIG. 1 SPECTROGRAM OF RECORDING MADE ON ST. MAARTEN

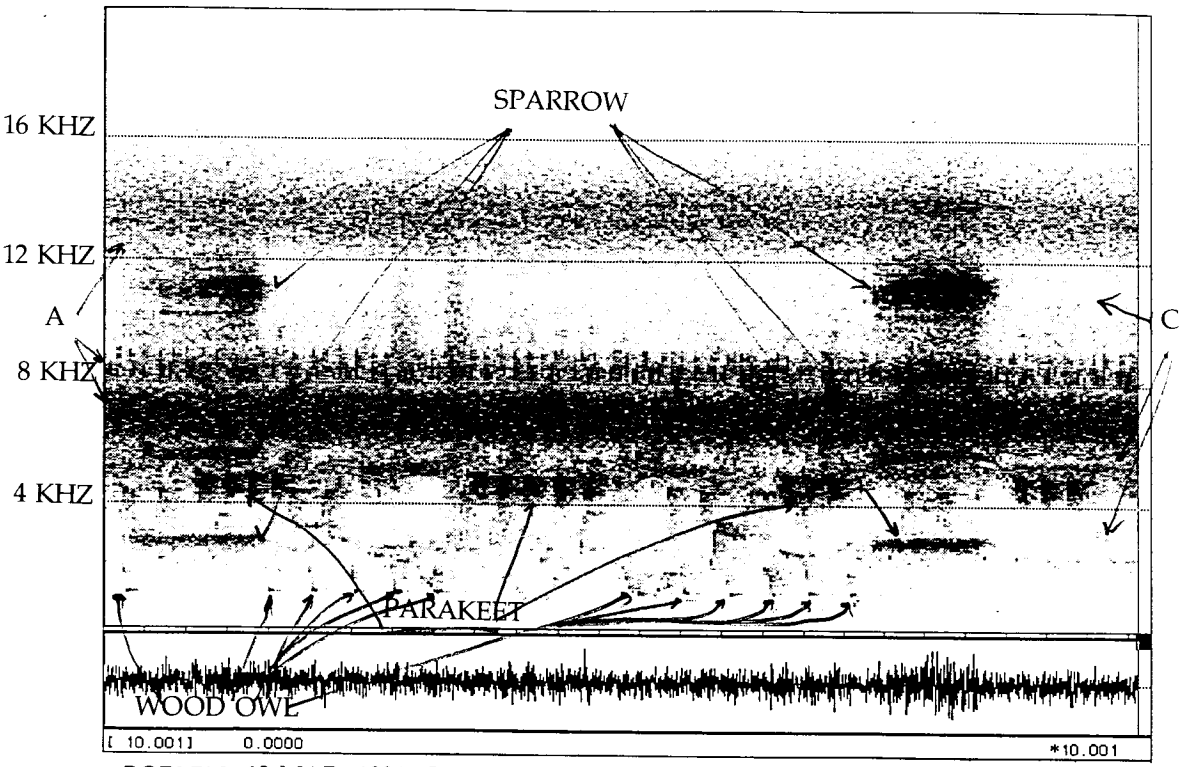


PIC PARADIS, ST. MAARTEN, V.I. 18 FEB. 1987 10 SEC. 10 KHZ SAMPLE VI 6 208360

FINCH ZENAIDA DOVE

B

FIG. 2 SPECTROGRAM OF RECORDING MADE IN KALIMANTAN, BORNEO



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