The Niche Hypothesis: How Animals Taught Us to Dance and Sing

By Bernie L. Krause, Ph.D.

Native Americans have long been aware that there is a symphony of natural sounds where each creature voice performs as an integral part of an animal orchestra. They are not alone. Indigenous cultures throughout the world are keenly aware of the power and influence of natural sound in each of their musical creations. As an artist and naturalist, I have long been fascinated by the ways in which hunters from non-industrial societies determine types, numbers, and condition of game and other creatures hundreds of meters distant through dark forest undergrowth by sound where nothing appears to the Western eye or our untrained ear to be especially distinct. As we are primarily a visual culture, no longer connected to what environments can tell us through sound, we've lost aural acuity once central to the dynamic of our lives.

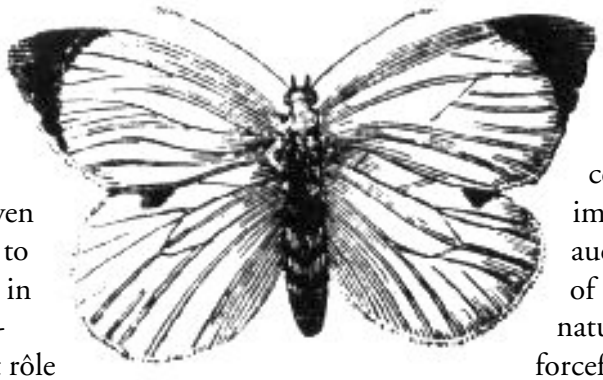
While working with the Nez Perce in Idaho and central Washington in the late 60s and early 70s, a tribal elder by the name of Angus Wilson suddenly became very silent when I told him I was a musician. "You white folks know nothing about music," he said, teasing me. "But I'll teach you something about it if you want." Early the next morning we headed out from Lewiston to Lake Wallowa into northeastern Oregon...to one of the many ancient campsites of Chief Joseph and his small band prior to 1877. Wilson led me to the bank of a small stream coming out of a valley just south of the lake and motioned for me to sit on the ground. I immediately began to shiver in the cold October air but continued to sit for the better part of an hour, every now and then watching Angus, who was sitting quietly about 50 feet away upstream. For a long while, except for a few jays and ravens, nothing happened. Suddenly, a slight breeze coming from up the valley began to stir some of the branches and the forest burst into the sound of a large pipe-organ chord appearing to come from everywhere at once. Angus, seeing the startled look on my face, walked slowly to where I was sitting and said, "Do you know what makes the sound, yet?" "No," I said. "I have no idea." He then walked over to the bank of the stream and, kneeling low to the water's edge, pointed to the different length reeds that had been broken by the wind and weight of the newly formed ice. He took out his knife and cut one at the base, whittled some holes, brought the instrument to his lips and began to play a melody. When he stopped, he said, "This is how we learned our music." It wasn't until ten years later, while recording in the forests of eastern Kenya that that morning at Lake Wallowa came to mind again. It was there that I began to wonder about the importance of natural sound to the entire context of our survival and our cultural success.

Bernie Krause in the field recording

Since the end of the 19th Century, biologists and zoologist have been focusing their

research in large part on the study of singular creatures 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 quantified results have been the proverbial means to heaven's gate...at no little cost to comprehensive knowledge. Indeed, even in the relatively new field of bio-acoustics (bio = life, acoustics = sound) where feasible recording technology first 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 have eluded them altogether.

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, pages 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 rôle 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.



From what we have just begun to see, it appears that ancient human beings had learned well the lessons imparted by natural sounds. Their lives depended as much (if not more) on their ability to hear and understand the audio information imparted by their surroundings as those given by visual cues. Small enclaves like the Jivaro and other tribes of the Amazon Basin survive using this information today. Not only can these extraordinary folks distinguish one creature sound from another but they recognize the subtle differences in sound between the various mini-habitats (as small as 20 sq. meters) in a forest, even when these localities appear to have visually identical biological and geological components. More likely than not, even when travelling in total darkness, these remarkable groups appear to determine their exact location simply by listening. Furthermore, when we closely observe the effects of chimpanzees, Mountain Gorillas and Orang-Utans pounding out complex rhythms on the buttresses of rainforest trees, one cannot help but be struck by the articulation of the message, its effect on other groups of primates in the vicinity of the sounds, and the natural origins of the human art of drumming and making music.

Experienced composers know that in order to achieve an unimpeded resonance the sound of each instrument must have its own unique voice and place in the spectrum of events being orchestrated. 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. Indeed, combining an audition with a graphic print-out of the diversity and structure of natural sounds from a rainforest forcefully demonstrates very special relationships of many insects, birds, mammals, and amphibians to each other. A complex vital beauty emerges that the best of sonic artists in Western culture have yet to achieve. Like the recent acknowledgment that medicine owes much to rainforest flora, it is my hunch that the development our sound arts owes at least as much to the "noise" of our natural environments.

Based on R. Murray Schafer's exceptional vision of sound, the premise that soundscape ecology or the study of sound in any environment provides important clues as to "the effects of the acoustic environment... or the physical responses or behavioural characteristics of those living within it" (Handbook for Acoustic Ecology, B. Truax, Ed., ARC Publications, 1978), we are just beginning to

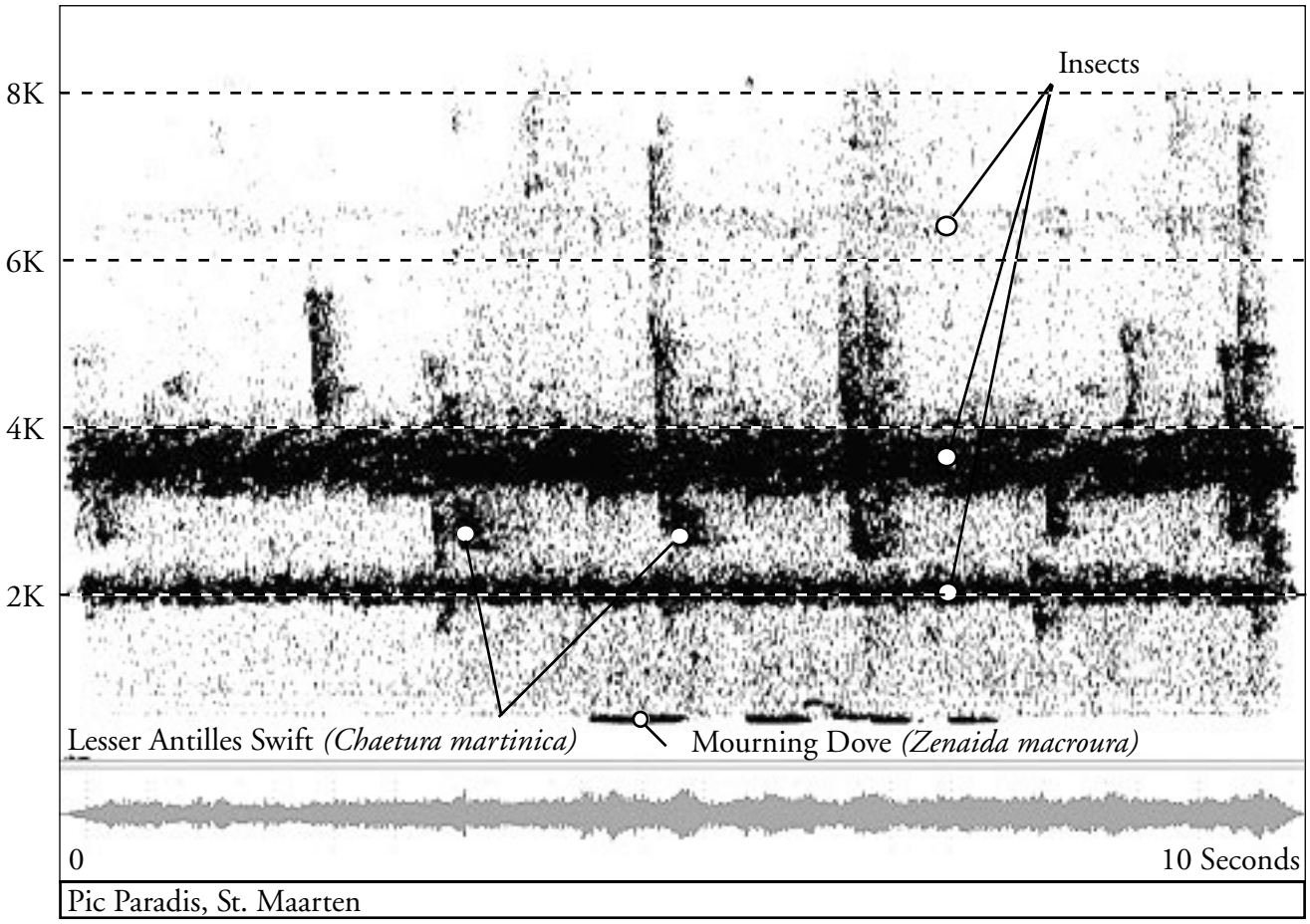


Figure 1

listen more symbiotically to sound in our varied environments. What our ancestors knew and what successfully guides many forest inhabitants today is the knowledge that every zone in any given environment, where the natural habitat is still completely intact, has its own unique voice. Sometimes, if one moves just 10 or 20 meters in one direction or another in any old-growth habitat, the sound will be quite different even where there is similar vegetation and climate.

From the early bio-acoustic studies we have done, I believe we have recently discovered some evidence of the roots of ancient musical composition...something which has evolved over time and from which ancient human beings learned some pretty complex formulae. First of all, these folks seem to have been aware that each creature appears 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. Taking a giant leap when considering the habitat as a whole, the sounds of each of these zones are so unique and important to creature life in a given location, if one creature stops vocalizing, another immediately joins the chorus to keep that audio bio-spectrum intact. An audio bio-spectrum is a acoustical spectrographic mapping of any particular habitat by frequency (pitch, sometimes tone) and amplitude (loudness) over short periods of time.

Territory is now defined in dimensions well beyond the 3-D topographical. In younger habitats birds and mammals will occupy only one niche at a time.

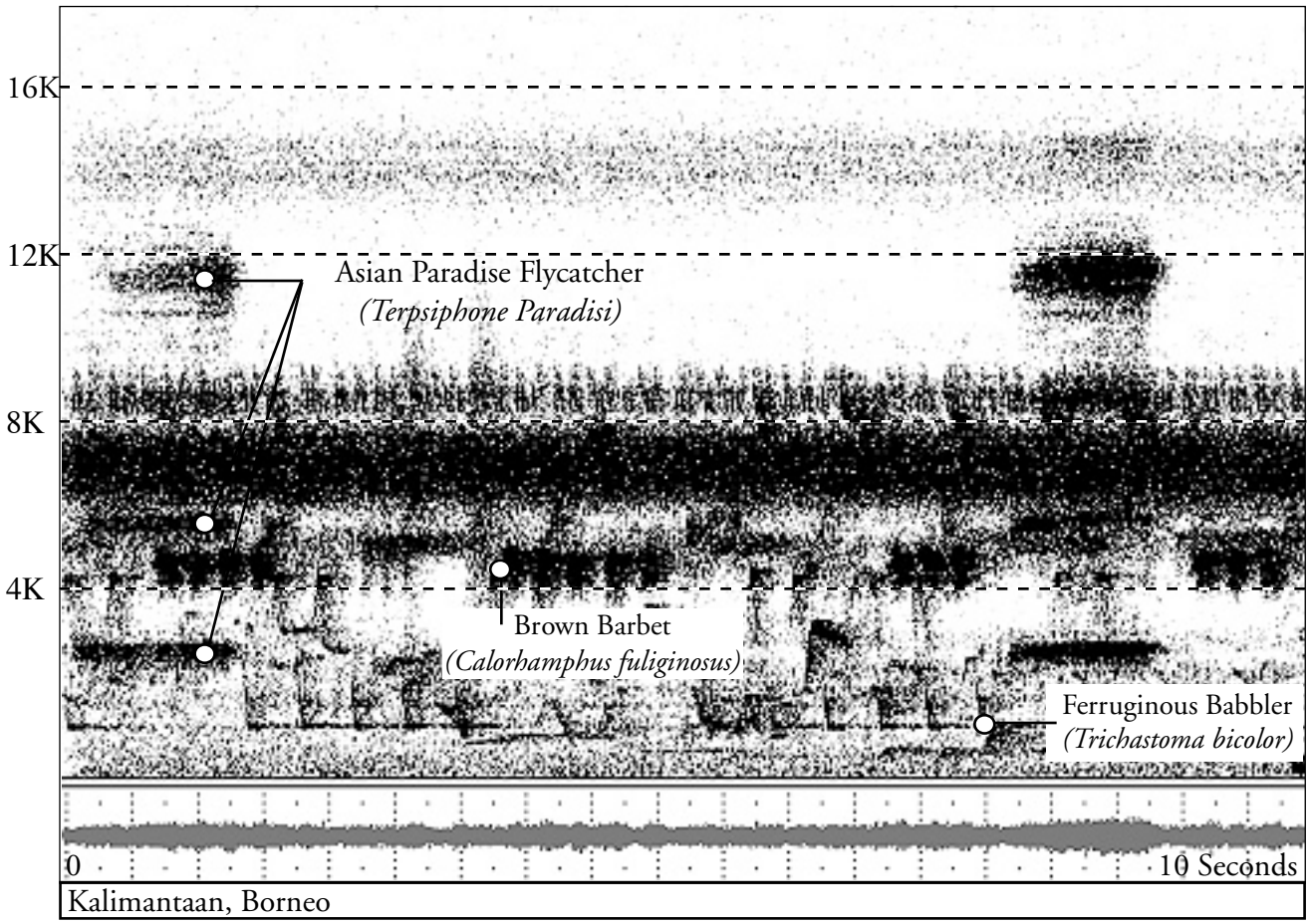
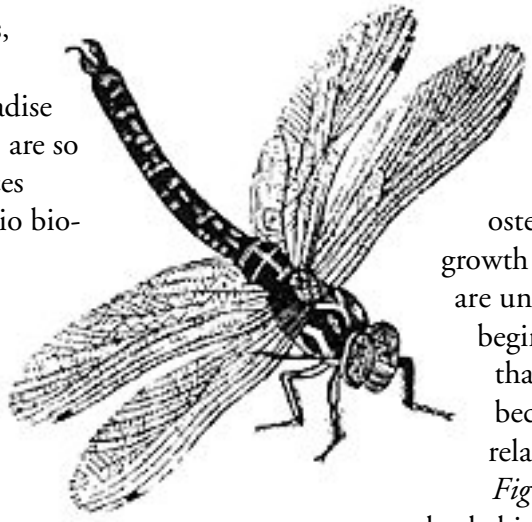


Figure 2

However, in older environments, some tropical rainforest animal vocalizations, like the Asian paradise flycatcher *(Terpsiphone paradisi)*, are so highly specialized that their voices occupy several niches of the audio bio-spectrum at the same time thus laying territorial claim to several audio channels. From our observations of the Asian paradise flycatcher, we suspect that we will soon be able to utilize this acoustical methodology to help determine the age of certain habitats. Not a few migrating eastern American warblers, 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 move to nearby and ostensibly similar or secondary growth habitats, they discover that they are unable to be heard. Our studies are beginning to show 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 represent a unique mixtures of insect voices shown occupying several "bands" of a 20 - 10,000 Hertz frequency spectrum in *Figure 1* and a 20 - 20kHz

spectrum in *Figure* 2. The darker the line, the greater the amplitude in that particular range. The short lines toward the bottom of the page in *Figure 1* 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. However, notice the Asian Paradise flycatcher *(Terpsiphone paradisi)* 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. 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.

Krause in the field

We first noticed this phenomenon while working in Africa in the early 80s. Many habitats have been recorded since. To obtain these recordings we would typically spend 500 hours on site to get 15 minutes of usable material...a ratio of 2,000:1. The long wait is due primarily to the introduction of human-induced mechanical noise(s) like chain saws (from 20 miles away), aircraft, motorized riverboats, etc. To date, our library consists of approximately 3,500 hours of material...20% of it from now-extinct habitats.

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, the voices appeared to fit in relation to all of the natural sounds of the immediate environment in terms of frequency and prosody (rhythm). Over a number of years we would return to the same sites only to find, when the recordings were analyzed, that each place showed incredible bio-acoustic consistency...much like we would expect to find from fingerprint matching. 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, early analysis indicates similar results from each of the biomes we have visited and recorded.

While the audio bio-spectra of each location remain essentially constant, large habitats of the same region will show local variability and regional similarities, all at the same time. However, each area generates its own unique voiceprint and can be identified by sonogram. We find this to be particularly true where the density of living organisms is greater such as tropical rainforest habitats. As more creatures vie for acoustical space, the ability to clearly articulate a voice within that space is more critical to each species' survival. As would be expected,

acoustical definition changes as we move away from the equator north or south to more temperate zones. In these habitats, creature voices and well-defined acoustical spaces are determined by more loosely tangible criteria.

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, timbre, and duration of sound, then there is a clear acoustical message being sent as to the biological health of these 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...especially for the development of eco-tourism. '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 and at an increasing rate. 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, we have found a profound lack of bio-diversity evidenced first by the obvious monoculture of corn-rowed stands of fast-growing pines and very little supporting vegetation growing on the forest floor, but more so by the overwhelming silence. Compare these recordings with those of nearby healthy old-growth forests and the measurable differences are astounding.

Research continues on the issues suggested by this hypothesis. The study of acoustic ecology began in the late 70s and has just recently begun to be considered as a valuable tool for defining the health of both marine and terrestrial habitats around the world. Adding this information to the body of knowledge is important for many reasons not the least of which is rediscovery of a direct cultural link to our natural surroundings before they all disappear. For the past two centuries Western academics, writers, and artists have labored at some length to keep ourselves separated from the notion of "nature." The use of the very word, itself, sets us apart. It is interesting to note that no Native American word for "nature" exists in any language of the 500 nations. We do not to use it to describe any of our work.

Natural orchestrations, the sounds of our unaltered temperate, tropical, arctic, desert and marine habitats, are becoming exceedingly rare and difficult to find. The keys to our musical past and the origins of complex intra-species connection may be learned from the acoustic output of these wonderful places. We are beginning to learn that the isolated voice of a song bird cannot give us very much useful information. It is the acoustical fabric into which that song is woven that offers up an elixir of formidable intelligence that enlightens us about ourselves, our past, and the very creatures we have longed to know so well.

Glen Ellen, California

Wild Sanctuary

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