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**Appendix II**

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*Techniques*

ANYONE CAN ENJOY listening to bird sounds without ever tape recording them or seeing pictures of them, but the recording and seeing can add so much to the enjoyment and appreciation that I include information here on how one could proceed.

*How to Record Bird Sounds*

I must begin with a warning: Tape recording birdsong can become addictive. Oh, it begins harmlessly enough, with the intention of just capturing a few bird sounds in the backyard, and using the simplest of equipment. "I just want to hear the spring thrush this winter, just to remind me in those darkest hours, that's all." First the thrush, then the ovenbird, the robin, and then the inevitable. One after the other "needs" to be captured, better equipment is needed, a tape library is started, and then the traveling begins. Don't tell me I didn't warn you. Read on only if you dare.

I know that you think this warning doesn't apply to you, but here's what happened to the first person who read a rough draft of this book, a draft without the CD and the beautiful sonagrams to match. On February 22, 2004, I received this e-mail message from Marie Alice (name changed to protect the guilty): "I feel I should warn you about the power of your book. Within a few weeks of finishing it, I found myself on the phone ordering the Raven software . . . and then there was the call to Marice Stith . . . and then I was signing up for the summer workshop in the Sierras . . ." Then, late June, I received a postcard from Yuba Pass in the California Sierras: "I am *so* glad that I took the sound recording workshop . . ." Marie Alice bought the tape-recording gear, bought the Raven software from Cornell so that she could see her songs, *and* took the sound recording workshop from the experts. Then, a few months

later, she confessed to ordering a parabola, because the shotgun mike she bought first wasn't good enough. Birdsong has taken over her life. Last warning: read on at your own risk, though this warning is perhaps already too late.

Getting started is almost too easy. Perhaps try this system that I used for a couple of years: a cheap cassette tape recorder with an external microphone input, a microphone, and a plastic funnel, all still available for under \$50. Slit the narrow end of the funnel enough to insert the microphone so that the head of the mike is at the base of the funnel. Connect the mike to the recorder, and you're ready to go. Get as close to your singing bird as you can without disturbing it, point the funnel at the bird so that the sounds collected by the funnel are reflected toward the head of the microphone, and punch "record." If you have some headphones you might try listening as you record (if your recorder will let you), but otherwise you can rewind the tape when you're done recording and listen to it afterward. It's that simple.

Just a couple of comments on that simple system. My hand-held microphone worked better than the microphone built into the recorder, because I could mount it in the funnel and point it at the bird, and because the noise of the recorder made it difficult for the internal microphone to pick up the relatively soft, distant sounds of birds. The "automatic gain control" of the recorder's electronic circuitry automatically boosted recorded sounds to some preset level, so I didn't have to worry about adjusting the recording level. If you upgrade, however, and get serious about recording bird sounds, you'll probably want the manual controls, not the automatic controls (see below).

There are many uses such a simple system could be put to. Record the singing robin, for example, and then listen to the songs over and over in the comfort of your easy chair as you learn how to dissect what he is doing; listen again in late winter as you train your ears for a new season; or listen at your computer as you watch the songs dance by on the monitor (see next section, How to See Bird Sounds). Or record the eastern phoebe at dawn, later listening at your leisure to how he uses his *fee-bee* and *fee-b-be-be* songs. Oh, and how about the eastern wood-pewee, to hear those plaintive *pee-a-wee* and *wee-ooo* and *ah-di-dee* dawn songs from your very own bird in the dead of winter, when he is basking in the Amazon forests? Capture 15 minutes of a mockingbird on tape and then listen to your recording several times as you get to know him better, and estimate how many different songs he can sing. Is that the same wood thrush in my wood lot who was there last year? Quick, compare last year's recordings with this year's . . . yes, same preludes, same favored sequences, same bird! He left last fall, flew those thousands of

miles to the tropics, and then returned to this very place. The possibilities are endless.

Soon you'll be eyeing those equipment catalogs, and well before Christmas. How about a little better tape recorder? A better microphone? If you had better headphones, you'd be able to concentrate better on what you're recording. And perhaps you should take some lessons on how to tape-record better.

Let me tell you about the system that I now use, the system I can't imagine going to the field without. I want to tell you of its advantages (and disadvantages), and once you understand them, you can look at the components of my system and make some intelligent decisions for the system you put together for yourself.

**THE MICROPHONE.** It's the mike that catches the bird sounds and converts the sounds to electrical impulses, so it's the logical place to start. Basically, two types of microphones are used by people who record birds. One is a hand-held, highly directional "shotgun" mike, so named because it looks like a gun barrel (and is sometimes mistaken for one). It's convenient, packs easily for trips, and is as easy to use as pointing your own finger at the singing bird.

The other microphone system uses a parabolic reflector, or dish, as it is sometimes called. The dish comes in various sizes, from a foot in diameter to three or more feet. When the parabola is pointed at a singing bird, all of the sound that strikes the parabola is reflected to a focal point, which is where the microphone is placed, of course.

Here's why I wouldn't be caught dead in the field with only a shotgun mike. On a remote hillside in Costa Rica, Julio Sánchez and I were standing side by side, he with his shotgun mike, me with my parabola. A good 100 yards up on the hillside was a singing black-thighed grosbeak, one of the finest and most melodious of singers I have ever heard anywhere. Julio dropped his headphones to his ears, pointed his shotgun mike, and with a serious look on his face began to record. I did the same, but with a smile on my face. (Normally, mind you, I am far more serious than Julio.) Eyeing Julio, I knew what had to be done. "Here, Julio, try my headphones." I kept the sights of my parabola aimed at the distant bird, and, unaware of the power of a parabola, Julio slipped my headphones on. It took just one song from the finch to transform this shotgun user to a lifelong convert of the parabola. Into his ears were now streaming songs that were loud and pure, and his beaming face and hanging jaw made me realize how expensive this moment was. I lost my parabola on that hillside in 1995, and to this day the parabola and Julio's

smile travel together in Costa Rica. It was a small price to pay for the joy it put into Julio's life.

Or take the unsuspecting tourists who walk the trails of the Monteverde cloud forests in Costa Rica. They round a corner in the trail and encounter me, standing there in my camouflage clothes with all of my gear, parabola aimed up into the canopy. They hear the three-wattled bellbird up there, but they usually can't see it. If the group lingers, searching for this mysterious singer, I offer my headphones to one of them and wait for the reaction. *BONK!* The listener is typically blown back a step on the trail, the mouth wide open, the eyes bulging, the knees buckling, so effective is the parabola at bringing a sound up close. (Well, okay, sometimes I turn the volume up a little on the headphones, just for the effect.)

The professional side of me says I should objectively weigh the advantages and disadvantages of the two systems. Okay. The shotgun mike is more convenient to use, the parabola rather cumbersome; but that's not so much of a problem with a parabola that rolls up and fits in my sleeve (such as the Telinga parabola—see page 407). A good shotgun mike treats all frequencies of the bird's sound almost equally (that is, it has a "flat frequency response"), but the parabola distorts the sound a little, amplifying some frequencies more than others (a trivial matter for most purposes, I feel—I'm just trying to be fair and thorough). The flat frequency response of the shotgun mike is important for low frequency sounds, because parabolas are ineffective below frequencies at which the wavelength of the sound is equal to the diameter of the reflector. A 24-inch parabola, for example, is ineffective below 565 Hz. Fortunately, most bird sounds are above 1,000 Hz, the point at which a relatively small 13-inch parabolic reflector can become effective. Both the parabola and shotgun make you look suspicious, but the only time I've been chased by police was when I was biking and terrorizing Martha's Vineyard and its chickadees with my "shotgun."

The main reason I favor the parabola is because it is far more effective at capturing distant or soft sounds. The reason is simple: the amount of sound captured by the area at the opening of the parabola is much greater than that captured by the area of the shotgun microphone's head. If the radius of a "two-foot" parabola is 30 centimeters and that of the shotgun's head only 1 centimeter, for example, the parabola will capture 900 times more sound energy than will the shotgun ( $3.14 r^2$  is the formula for area, with  $r$  being the radius, so  $3.14 \times 30^2 \div 3.14 \times 1^2 = 900$ ). It is this 900x factor that produced Julio's smile on that Costa Rican hillside, the factor that makes an enormous

difference in the quality of sound recorded from any distance. This reason for preferring a parabola is less important with loud, close sounds, conditions under which the choice between the shotgun microphone and the parabola would, for me, become more of a tossup.

For one more reason I give the nod to the parabola. The shotgun is said to capture bird sounds more like we hear them, whereas the parabola produces a much shriller sound. That may sound like a vote for a shotgun, but for me it's not. Take a black-capped chickadee singing *hey-sweetie* up in the tree, for example. The sound leaves the birds' bill and radiates out in all directions; some of the song reaches our ears directly, but this song takes other paths to our ears, too, bouncing off leaves and then arriving at our ears slightly delayed, so that the sharp, crisp *hey-sweetie* that left the bird's bill is now somewhat blurred. It is that blurring that distresses me. With the shotgun, the blurring can be enough to obscure that amplitude drop in the middle of the *sweetie* portion of the song. Because the parabola is much more directional than the shotgun, it can eliminate those echoes (and other background sounds) from the recording, thereby recording the sound that comes on a direct path from the bird's bill. These differences are readily seen in sonagrams: A "shotgun sonagram" shows the trailing echoes and smudges after the bird's song, but the "parabola sonagram" is much sharper and crisper (almost all sonagrams in this book are parabola sonagrams). So a shotgun mike may record sounds as we hear them, with lots of natural reverberation and echo, but the parabola captures the songs more like the bird sang them, as if reaching out and grabbing the sound directly from the bird's bill. I want the parabola.

**HEADPHONES.** I like the heavy, padded headphones that fit snugly over my ears and block out everything except what I am recording. Such headphones let me focus and concentrate better on what is going to the recorder. Other recordists who want to hear more of what is going on around them prefer the "open-air" headphones, which have foam pads that fit lightly over the ears, but with them I never know for sure what is on the tape and what I'm hearing from the environment around me.

**TAPE RECORDER.** Recording technology changes rapidly. In the late 1960s I started with open-reel tape recorders, and only in the mid 1990s did I finally convert to the standard analog cassette recorder. Until 2002, I was using a stereo, analog cassette recorder, a Sony TCD5ProII. Somewhat to the chagrin of professional purists, I bought an HHB minidisc recorder mid-2002, because it has some advantages over the analog cassette (better speed control was cru-

cial for recording bellbirds—see page 89). These minidisc recorders are convenient and relatively inexpensive and are becoming increasingly popular.

The problem with minidisc technology is that it has been based on how we humans hear sounds, not on how birds hear them. If our ears can't detect certain features of a sound, the minidisc is programmed to omit that part of the sound from the recording (the sound is "compressed"). As a result, the signal recorded from a bird is not the same as what the bird sang. That's fine for most purposes, but not for all. I would not want to use a minidisc recording that distorted sounds, for example, if I wanted to analyze the fine structure of a song, because I'd be studying some unknown mix of what the bird sang and how the recorder modified the song. Nor would I want to use minidisc recordings to study how birds respond to the fine details of their own songs, if I were doing an experiment that required me to ask them in a "playback" experiment, because the birds most likely can detect some of the odd things that the minidisc recorder does to the songs. New minidisc models introduced in 2004, however, promise to avoid these distortions and allow high-quality recordings. They're called HiMD recorders, made by Sony. Discussions and arguments about these matters are favorite topics among bioacousticians, and you can read all about it on the appropriate Web sites (such as <http://cetus.pmel.noaa.gov/Bioacoustics.html>). For all practical, nonprofessional purposes, even the minidisc recorders that compress sounds are terrific recorders, because the convenience and ease of use make having fun easier—and that's what this is all about, just in case you forgot.

**THE RECORDING SYSTEM FOR YOU?** When (not "if") you get hooked on recording and are ready to upgrade that very simple funnel system, you have lots of choices, perhaps too many. Here's what I'd recommend doing. Go to the Web site of the Macaulay Library of Natural Sounds at Cornell University's Laboratory of Ornithology ([www.birds.cornell.edu/macaulaylibrary](http://www.birds.cornell.edu/macaulaylibrary)). They have lots of good advice about equipment and about how to record, including a full-length article about how to record birds in the tropics, which is pretty much how you'd record them in the temperate zone, too. Then go to one of my favorite catalogs, that of Marice Stith Recording Services ([www.stithrecording.com](http://www.stithrecording.com)), where you can read all about recorders and microphones and headphones. Or check out what is available at Mineroff Electronics ([www.mineroff.com](http://www.mineroff.com)).

Then ask yourself how serious you want to be. When I'm most serious, I use my Telinga parabola with a Sennheiser ME62 microphone, AKG K-240DF tight-fitting headphones, and an HHB minidisc recorder—total cost as of

winter 2004 about \$2,400. The parabola is clear plastic, lightweight and easy to hold up for hours on end, and it can be rolled up into a coat sleeve for traveling. But when I'm out for capturing some memories and taking them home with me, just for fun, I take my tiny Sony minidisc recorder (models change rapidly, but my latest is the MZ-NF810), which fits in the palm of my hand; a "short shotgun" microphone (Sennheiser ME66); and no headphones. Using this less expensive system (perhaps \$700) enabled me to capture hours upon hours of good sounds during a recent cross-country bicycle trip.

Improvise and come up with your own system, on your own budget. Try whittling back on the cost of my systems, if you wish. Go to Edmund Scientific ([www.scientificsonline.com](http://www.scientificsonline.com)), for example, and purchase a parabola for tens rather than hundreds of dollars. Get an inexpensive microphone from Radio Shack and rig up some way to hold the microphone at the focal point of the parabola. Consider a lower-end analog cassette recorder, perhaps the Sony TCM-5000EV (a favorite of many birders and tour guides), for a little under \$500, or try the cheapest possible cassette recorder you can find at Radio Shack and see what results you get. Remember, you don't have to make professional-quality recordings, and you don't need the best of all possible equipment. Don't forget why you're doing this: you're simply out to have some fun.

Should you take lessons in how to record? Why not. Join others for the weeklong recording course taught by the Cornell group, and you will forever be hooked. During 2001 I spent a week with this course in the California Sierras, feasting on Brewer's sparrows and sage thrashers, among others, and had the time of my life. I found that I still had a lot to learn from this group.

Pretty soon you'll be on e-mail lists with others like you. You'll frequent Web sites that tell about the study of bioacoustics (such as [www.birds.cornell.edu/brp](http://www.birds.cornell.edu/brp); or a site "dedicated to the recording of bird vocalizations with simple, inexpensive equipment," at [ourworld.compuserve.com/homepages/G\\_Kunkel](http://ourworld.compuserve.com/homepages/G_Kunkel)). You may join the Nature Sounds Association ([www.nature-sounds.org](http://www.nature-sounds.org)) or a group of nature recordists on-line (<http://groups.yahoo.com/group/naturerecordists>). Perhaps you'll upgrade your gear and begin contributing to the sound archives at places like Cornell University or Ohio State University ([blb.biosci.ohio-state.edu/](http://blb.biosci.ohio-state.edu/)), or perhaps to the National Sound Archive in the British Library in London ([www.bl.uk/collections/sound-archive/wild.html](http://www.bl.uk/collections/sound-archive/wild.html)). Recording in your backyard will no longer satisfy you, and you'll be off to Costa Rica, Brazil, or even Africa. And all that start-

ed with a simple 50-cent funnel that you pulled from your garage shelf. I warned you.

### *How to See Bird Sounds*

By the time you read these words in this appendix, I hope you are a convert to the power of seeing birdsongs in the form of sonagrams. Personally, I can't imagine a world without sonagrams, as I can't imagine listening without also seeing. I have combined the listening and seeing throughout this book, and I hope that you will continue this practice on your own. Take a CD of bird sounds off your shelf and play it into your computer, now seeing the songs come to life, appreciating the details and the differences among them. Make your own recordings, bringing them home to gorge yourself on the details of how a robin or thrush or warbler sings. Or try the ultimate in techie birding—get the appropriate software program (see below), a laptop computer, and a microphone, and you can watch the songs dance across your computer monitor in the great out-of-doors as you listen to birds there. Listen as you see, and you will hear a different world singing to you.

Although graphing a bird's sound not too long ago required equipment costing thousands of dollars, most of us already have all that we need in our personal computers. These computers routinely have sound cards, and with the appropriate software our home computers can come alive with sights and sounds that change the way we experience singing birds.

What software is right for you? Because the availability of software can change rapidly, I can make no guarantee that what is available as I write this will be available by the time these words are in print. So let me begin with the surest of bets, that the software now available from the venerable Bioacoustics Research Program at the Cornell Laboratory of Ornithology will remain available long into the future.

The software from Cornell University is called "Raven." This marvelous program runs on both Macs and PCs and was designed by researchers who have spent decades devising new ways to record and analyze animal sounds for their work. I love this advanced program that is designed for professional use by researchers, and I used it to produce all of the sonagrams in this book. Even better news, however, is that most readers of this book will be thoroughly happy with the simplified and far less expensive version of Raven that is now available. The cost of the simpler version is a small price to pay for Raven's ease of use and the world of joy that this program can bring. You can visit the



Raven Web site ([www.birds.cornell.edu/Raven](http://www.birds.cornell.edu/Raven)) and download a free trial version of either the advanced or simplified Raven. Go ahead, give Raven a try.

It's always nice to get a full working version of something for free, too, and there will always be free software programs available for graphing birdsongs. For the PC, one free yet powerful program called Sound Analysis Pro is designed for researchers ([http://ofer.sci.ccny.cuny.edu/html/body\\_sound\\_analysis.html](http://ofer.sci.ccny.cuny.edu/html/body_sound_analysis.html)). A simpler PC program is Syrinx ([www.syrinxpc.com](http://www.syrinxpc.com)). One for the Mac is WildSpectra, available from a professor at the University of North Carolina ([www.unc.edu/~rhwiley/wildspectra](http://www.unc.edu/~rhwiley/wildspectra)). A host of other "freeware" is available, too (for example, see <http://cetus.pmel.noaa.gov/Bioacoustics.html>). Some of this software is excellent and easy to use, but most of it will not have the institutional backing and support that Cornell supplies for Raven. As a result, using some of this other software might be cash-free but somewhat more expensive in time, and perhaps exasperation. "You get what you pay for," says the adage.

There's not much more I can tell you. Take your recording and put it into the player, or put the CD into the CD player. Use a standard audio cable to run from the "line-out" of the player to the "line-in" of the sound card on the computer. Or use the CD player built into your computer. Start your software program. Start your player. And watch the world of birdsong dance before your eyes.

Many questions that you hadn't even thought of asking before reading this book are now not only "askable," but answerable. Is that the same robin or thrush or ovenbird that was singing from those bushes in your backyard last year? Use your simple tape-recording setup to capture some songs in successive years and then compare the songs—for many songbirds (though not all), different songs mean different individuals. How many different songs does that song sparrow or cardinal or titmouse have? Tape-record him or her for a little while and then start printing out a few sonagrams until he seems to have nothing new to say—you now know his song repertoire.

It was in using these simple techniques that I learned how to distinguish male and female barred owls, how to hear the magic in the songs of hermit thrushes and wood thrushes. Indeed, every account in this book contains answers that were found by the simple processes of tape-recording and then studying the sonagrams.

I can't help but feel a bit exposed at this point, now that all of my secrets are revealed. There's no longer any mystique to what I have done all these years. Anyone can do this kind of stuff. And anyone should.