Three Perspectives on Louisiana Waterthrush Research

Felicity L. Newell's feature article ("A Tale of Two Streams: What Louisiana Waterthrushes Tell us About Water Quality") in the May 2011 issue of *Birding* does a great job of telling us about cutting-edge ornithological research *and the human dimension* of that research. In this *Birding* WebExtra, we hear from three of the principals in the Louisiana Waterthrush story. —*Editor*

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"Seiurus serendipitous"

Of the "Aquatic Wood-Wagtail" John James Audubon wrote:

> Much and justly as the song of the [Common] Nightingale is admired, I am inclined, after having often listened to it, to pronounce it in no degree superior to that of the [Louisiana Waterthrush]. The notes of the latter bird are as powerful and mellow, and at times as varied.
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> [I]ts melodies are heard to a considerable distance, its voice being nearly as loud as that of the Wood Thrush [with] sounds so approaching two octaves of a good piano-forte, as almost to induce the hearer to imagine that the keys of that instrument are used on the occasion.
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> When alighted, its body is continually vibrating, the tail being at the same time alternately jerked out and closed again. It walks prettily along the branches, or on the ground, but never hops.

Indeed, there is much to like about Louisiana Waterthrushes. They live in one of the nicest habitats on the planet—clear, cold, rushing, mountain streams, shaded by tall trees and strewn with mossy rocks and logs. They have one of the loudest, richest songs of any warbler. And they don't just hop or walk; they teeter and bob!

I might never have known the pleasures and rewards of studying this acoustically accomplished and appealingly animated songbird. For many years I pursued what can only be described as esoteric ornithological research—for example, measuring and analyzing small differences within and among species in the kinds and numbers of wing feathers molted and in the relative lengths of individual flight feathers—with the goal of obtaining a multivariate description of wing-shape variation. In fact, for a decade beginning in the mid-1980s I worked dutifully to document my research findings on these and similarly narrow subjects via published journal articles and presentations at professional meetings, sharing them with a small cadre of ornithologists similarly interested in morphological minutiae. (You know who you are!)

Among these, I am proud to say, was the late Dr. Kenneth C. Parkes, of Humphrey–Parkes molt terminology fame. As Senior Curator of Birds at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, Dr. Parkes oversaw the bird-banding program at Powdermill Nature Reserve through its first few decades of operation. His keen interest in and eye for molt and plumage variation certainly rubbed off on me and greatly influenced my professional career at Powdermill.

But I have the Louisiana Waterthrush to thank for my entry into the much wider world of *exoteric* research—that is, research whose point and purpose is explicable, easily understood findings, with conclusions that are broadly relevant to professional and general audiences alike. Only in retrospect is it clear how serendipitous was my decision to study this species. And, true to the meaning of the word, many good and fortuitous things have resulted from it.

My initial intent, way back in 1995, was simply to begin in-depth monitoring of the breeding population of some "model" neotropical migratory, forest-nesting songbird at Powdermill, as a complement to the long-term population monitoring that Robert S. Leberman (the founder of the Powdermill bird-banding program) and I had been doing through the steady collection and periodic analysis of long-term migration banding data at the reserve. After weighing the pros and cons of focusing on several possible study species, including the Wood Thrush, the American Redstart, and the Hooded Warbler, I ultimately settled on the Louisiana Waterthrush, because it is common and convenient enough to study (long reaches of two forested headwater streams cut across the 2,000-acre Powdermill property), and because its breeding ecology had not been investigated much since Stephen Eaton's classic life history study of the species, published in the *Wilson Bulletin* in 1958.

In making my initial plans to study the Louisiana Waterthrush at Powdermill, beginning with the 1996 field season, I solicited help from a handful of volunteer interns—drafted from among the ranks of local college students who often came to Powdermill on class field trips to see the bird-banding operation. In making arrangements to identify the best access to the two streams that I planned to establish as my study areas, I learned that one of those streams, Laurel Run, had serious water-quality issues related to highly acidic drainage into its headwaters from an abandoned hand-dug coal mine. Furthermore, Laurel Run was slated for passive remediation to treat the mine drainage as early as the fall of 1997.

On learning of the severity of those impacts on fish and macroinvertebrates, my planned, casual, long-term monitoring project for waterthrushes quickly took on a new focus and greater urgency. How would differences in water quality between two streams in adjacent forested watersheds affect certain aspects of waterthrush biology—for example, their breeding density, foraging behavior, nesting success, and productivity? And how rapid and extensive might the ecological recovery of an acidified stream be, using the waterthush as an indicator? It became a high priority to obtain baseline data for the two streams. Indeed, had neither of the two possible study streams at Powdermill suffered from acidification, then the waterthrush research project at Powdermill likely would have taken a very different direction and proceeded at a much slower pace.

In short, by choosing to study the Louisiana Waterthrush (and not some other neotropical migrant forest-nesting species), I ended up giving myself the chance to study something that not only appealed to my natural curiosity and academic interest in birds, but which also had many practical applications and, ultimately, conservation implications. And, because—again, serendipitously—several colleagues in Pennsylvania had begun studying the waterthrush at about the same time, albeit for different reasons, the stage was set for some very productive cooperative and collaborative research that ultimately has led to a substantial body of information we all hope and believe has broad relevance and importance.

Second only to the air we breathe, the purity of the water we drink is paramount to our health and well-being, a fact well known or intuitively understood by people from all walks of life and every corner of the world. The Louisiana Waterthrush embodies the

diversity of healthy life that is supported by the clear, clean, flowing waters that spring from forested mountains from New England to the southern Appalachians and all the way to Mexico, Central America, and the West Indies. As I wrote in an article in *Carnegie Magazine* following the first year of the waterthrush study, "Ultimately, we think that this multi-faceted songbird, with its thrush-like appearance, sandpiper-like locomotion, and trout-like eating habits, can tell us a lot about an ecosystem that is the sum of a great many parts."

Fifteen years later, I am heartened to see that our studies of the Louisiana Waterthrush have contributed directly to the setting of conservation priorities and land management recommendations. Our research has spawned numerous, productive, long-term professional collaborations—and friendships. Importantly, our work has provided some of the first field research opportunities for dozens of fledgling field ornithologists, including the talented author of a feature article in this issue of *Birding*, Felicity L. Newell. Newell and many other students who first "got their feet wet" studying waterthrushes now are full-fledged ornithologists in their own right, making important contributions to science-based conservation efforts for the birds that we all love to watch.

Finally, I can't help but smile at this recent serendipitous turn of events: My favorite bird, once known by the scientific name *Seiurus motacilla*, has been renamed *Parkesia motacilla* for my favorite ornithologist, in honor of his astute—dare I say, esoteric?—observations concerning the distinctness of the juvenile feathering of waterthrushes compared to the formerly congeneric Ovenbird.

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The Louisiana Waterthrush: Fulfilling the Holy Grail of Migrant Bird Ecology

As Felicity L. Newell's fine article shows, the Louisiana Waterthrush has been negatively impacted in Pennsylvania by stream acidification resulting from acid mine drainage and acid rain. The long-term study initiated by Robert S. Mulvihill and colleagues has the added benefits of providing a firm foundation for current studies of how other human activities may impact waterthrush breeding success, and more broadly, how population size is determined by events throughout a bird's annual cycle. With these studies, this species promises to fulfill a much sought-after mission of ornithologists—some would say the Holy Grail of migratory bird ecology and conservation—by taking good, field-based data and using them to model which events in the life cycle of a migratory bird are most important in setting the number of individuals of that species.

Breeding success is a key component of avian demography, and understanding what contributes to reproductive success is critical to conservation measures for any species. Among terrestrial bird populations, declines have often been attributed to fragmentation of forest habitats and conversion of native habitats for agricultural or urban land uses. But the causes of declines of *riparian* bird species are less well understood. In addition to acidification, breeding success is likely linked to sedimentation and other forms of stream contamination, combined with the loss of surrounding vegetative cover in the riparian corridor. We are currently working to identify landscape-level factors, along with specific territory characteristics and stream quality measures associated with reproductive success. Preliminary results suggest that older, more mature forests with relatively high canopy cover, coupled with perennial streams that do not run dry in mid-summer

droughts, are key drivers of reproductive success for such bird species.

Survival of juvenile birds once they leave the nest is a related but infrequently studied component of avian life histories. Survival of fledglings to breeding age likely varies across landscapes, streams, and territories of varying quality. Our studies with radio transmitters suggest that fledglings prefer distinct micro-habitats characterized by very shallow, slow-moving water, high numbers of rocks and mosses, and large amounts of brushy cover. Yet nearly two thirds of fledglings die before leaving their natal territory. Many appear to be killed by avian predators, but we have also seen preliminary evidence of possible negative influence of human recreational activities on the survival of Louisiana Waterthrush fledglings.

Understanding reproductive success is only part of the puzzle, however. Recent approaches to the conservation of migratory birds recognize that bird populations can be regulated by influences on the breeding grounds, the wintering grounds, and during migration between these sites. Unfortunately, most research on migrant birds on their wintering grounds has focused on a few forest and scrub species, and almost no work has focused on riparian species. Furthermore, the process of stream degradation, especially the effect of degraded streams and riparian habitat on wintering migratory birds, has been little studied in the New World tropics.

On the wintering grounds, success for a Louisiana Waterthrush is measured by survival and maintenance of a body condition sufficient to complete the return migration to the breeding grounds. With key collaborators from the Dominican Republic, Danilo Mejía and Marisabel Paulino, I have been studying factors affecting the winter survival of the Louisiana Waterthrush. Water quality is a significant issue in the Dominican Republic. Many streams and rivers are severely impacted by sedimentation, agricultural run-off, and untreated human and animal wastes, while still serving as a primary source for wash water and irrigation.

By selecting study streams in organic cacao plantations (the source of chocolate), as well as streams originating and/or passing primarily outside of these plantations, we are testing the importance of a range of water qualities on waterthrush survival, as well as working to elucidate the benefits of organic agriculture on stream ecosystems. In addition, as on the breeding grounds, we are quantifying habitat characteristics at the landscape and territory-scale for more than 120 individuals, including water quality, macroinvertebrate assemblages, stream morphology, forest cover, land use, human population size, and other physical variables at these wintering sites. Preliminary results suggest high levels of winter site persistence, but relatively low annual return rates. Using genetic sexing techniques, we have found, as in some other migratory warblers, a partial segregation of males and females among streams, with males presumably occupying higher-quality streams. Waterthrushes seldom stray far from their streamside territories, but they do utilize the uplands when shaded organic cacao is grown.

Impacts on the breeding and wintering grounds are tied together by what happens during migration. Survival through migration is thought to often depend on the body condition of an individual bird—and thus the quality of the habitat occupied in the season prior to migration. New technologies such as geolocators, which record a bird's position based on local sunrise and day length, are allowing us to explore migration. And studies of stable isotopes and hormones found in blood and feathers are allowing us to better understand how conditions found in one season affect birds and carry over to impact events in the following season.

Ties between north and south also guide capacity-building efforts among Louisiana

Waterthrush researchers and host communities. Our work on the Louisiana Waterthrush has become a training ground for a variety of students and aspiring ornithologists, with many coming from the Dominican Republic. Participants learn protocols for bird captures, measurements, and the characterization and quantification of habitat variables. This building of capacity at a multinational scale is a critical component of the project.

In addition, our Louisiana Waterthrush work in the Dominican Republic has played a critical role in conservation and public health education efforts in that country's human communities. A national conservation organization, the Grupo Acción Ecológica (Ecological Action Group), has built on our research by communicating formally and informally to neighbors about how water quality affects birds, other wildlife, and humans; about potential sources of contamination; and about health issues related to water quality. This group also works with the local organic cacao-growing cooperative to improve agricultural practices. Beginning in 2011, the group expects to host a Peace Corp volunteer who will work with us to build a bi-national education program for school children focused on water quality issues. This has particular resonance in the Dominican Republic, due to the recent introduction of cholera, which thrives in conditions with compromised water quality.

The Louisiana Waterthrush research program, which began as an effort to understand the impacts of stream acidification, has blossomed into an international effort to determine which factors influence population size in migratory species, with the goal of providing diverse tools for the conservation and management of migratory birds. Our work continues to broaden that research while also building capacity among students and young professionals, guiding community education and local conservation efforts, and promoting public health priorities.

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The Legacy of the Louisiana Waterthrush

When a male Louisiana Waterthrush landed on the speaker broadcasting the species' ringing song along Slateford Creek in the Delaware Water Gap National Recreation Area, we knew we had our bird. That was in 1993, when I was contemplating a songbird species to use as a research model. Only two years later, my graduate student, Fred Terranova, and I would band the "Old Guy" who is discussed and pictured in Felicity L. Newell's wonderful feature article on our Louisiana Waterthrush research. The thought process involved in choosing this species is remarkably similar to that described here by my friend and colleague, Robert S. Mulvihill. Indeed, our fruitful collaboration over the years on a variety of fronts, and cooperation with many other researchers who had the good sense to choose this species, are enduring legacies of the Louisiana Waterthrush storyline.

Now back to the choice. The study system had to be amenable to the relatively short-duration studies conducted by the masters degree students who have populated the Avian Ecology and Behavior Lab at East Stroudsburg University of Pennsylvania. The birds had to be common, conspicuous and catchable; that they were also characteristic of beautiful, rushing, hemlock-lined, headwater streams was a bonus. The intimate connection between bird and stream was one that several of us would make independently of each other over the next few years. Somehow, Mulvihill, Rob Brooks, Tim O'Connell, and I found each other, wrote a grant and ultimately obtained U.S. Environmental Protection Agency funding in 1997 to begin a three-year investigation of the Louisiana Waterthrush as a "bio-indicator" of headwater stream ecological integrity. The ensuing three-year study would prove to be a fruitful collaboration and a "watershed" (pardon

the pun) moment for all of us. In particular, it sent Mulvihill and me on a waterthrush-centered research trajectory from which we have never fully recovered, fortunately.

The oft-preferred protocol for choosing a study system is that a *question* should be identified first, followed by a search for the organism whose characteristics are deemed best for answering the question. For my part, interests and practicalities hijacked that logic, but the choice has certainly turned out to be a fortuitous one for me, my graduate students, and the many researchers mentioned in Felicity's article.

This Louisiana Waterthrush has proved valuable in answering some major questions, as Steven C. Latta has so thoroughly outlined. The species has also prompted new questions—for example, what are the behavioral implications of linear vs. three-dimensional territories? This bird has been a wonderful teacher to my students, who have learned about basic songbird biology the waterthrush way: wading up streams, squinting to read band combinations of males singing high in the canopy, searching root overhangs for nests, braving black flies during behavioral observations, and generally getting wet and dirty. No pain, no gain, as they say. The students have acquired valuable experience through such activities as banding, nest finding, quantifying behavior, characterizing abiotic and biotic stream parameters, analyzing data, and presenting results in, among other exotic destinations, Québec City, San Francisco, and Monterey, Mexico. Along the way, I even managed to convince the Waterbird Society that waterthrushes are indeed wading birds, albeit small ones. That led to a symposium dedicated to riparian songbirds, held at the Waterbird Society's annual meeting in Plymouth, Massachusetts, in 2000.

More recent research by former graduate student Greg George investigated competitive interactions among wintering Louisiana Waterthrushes and two additional obligate riparian songbirds, Torrent Tyrannulets and American Dippers, in Costa Rica. Currently, graduate student Nick Ernst is comparing habitat use, foraging behavior, and nesting success between two types of hemlock-dominated headwater streams: those flowing swiftly through narrow valleys (ravines) with steep gradients vs. those meandering slowly across flat floodplains (benches). These metrics may provide a basis upon which to compare overall productivity of the two hemlock habitats and to prioritize efforts to control the ongoing hemlock woolly adelgid infestation that is threatening the tree with extinction.

Having extolled their virtues, I now have to admit that Louisiana Waterthrushes are not perfect. They have one bad characteristic from our point of view: They return to their Pennsylvania breeding streams too early! The middle of the spring semester is a busy time, when students and faculty alike are contemplating midterms and juggling other demands on their time and energy. But they are *nearly* perfect. The Louisiana Waterthrush has taken good care of me professionally, having provided opportunities to travel, collaborate, publish, and experience the gratification of seeing former students—Jim Sheehan and Greg George among them—continue on to doctoral programs at major universities.

Most importantly though, the Louisiana Waterthrush has taught several generations of graduate students, and a few undergrads along the way, about patience, careful observation. and the enduring value of "old-fashioned" natural history-based studies. This is the ultimate legacy of the Louisiana Waterthrush to me.