Bicknell's Thrush: A Twenty-year Retrospective on the Northeast's Most Vulnerable Songbird

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Figure 1. A male Bicknell's Thrush in full song (photography by Larry Master)

Nearly half a century has passed since the gyrating song and piercing nasal calls of Bicknell's Thrush *(Catharus bicknelli)* rang from Mount Greylock's summit in northwestern Massachusetts. The disappearance of the species from this peak, its only known haunt in the state, was well documented by birders during the 1900s and provided one of the earliest warning signals that all might not be well. Twenty years ago, *Bird Observer* published our first cautionary alarm for Bicknell's Thrush, at that time a recognized subspecies of Gray-cheeked Thrush *(C. minimus)* and one of eastern North America's most rare and poorly known songbirds (Rimmer et al. 1993). Now a distinct species (AOU 1995) and one of the region's highest conservation priority Nearctic-Neotropical migrants, Bicknell's Thrush has been the subject of much intensive study. Yet, it remains as rare and vulnerable as ever, likely more so.

This enigmatic songbird has not yielded its secrets easily. Occupying windswept mountaintop conifer forests in summer and dense broadleaf cloud forests in winter, Bicknell's Thrush has kept its biographers at bay. However, a determined cadre of scientists and conservationists, combining "brute force biology" with technology and resourcefulness, has made remarkable inroads during the past two decades into understanding this bird. Concerted actions are now underway to conserve Bicknell's Thrush—actions we hope will reverse disturbing trends that have led to the recently proposed listing for this at-risk species under the U.S. Endangered and Threatened Species Act (Matteson 2012).

What have we learned since sounding the alarm twenty years ago? How have our findings shaped conservation actions? Will Bicknell's Thrush ever again sing from Mount Greylock's balsam fir spires? A brief history is in order.

When we first ventured into the Bicknell's Thrush arena in 1992 with Jon Atwood, then at Manomet Center for Conservation Sciences, our starting point was virtually ground zero. There existed no baseline scientific information on population trends or distribution, let alone ecology or demography. George Wallace's classic mid-1930s natural history study of Mount Mansfield, Vermont's highest peak, shed the only real light on this reclusive songbird (Wallace 1939). However, Wallace's work provided no context to assess the conservation status of Bicknell's Thrush. We knew

Figure 2. The ridgeline of Mt. Mansfield, Vermont's highest peak and the site of VCE's ongoing 20-year population study of Bicknell's Thrush (photograph by K.P. McFarland)

that mountaintops in the Northeast were under siege from acidic precipitation, atmospheric pollution, and recreational development (climate change was barely on the radar then). We realized that here in our regional backyard a little-known songbird whose taxonomy hadn't even been settled might prove to be a lightning rod for conservation in the Northeast's iconic mountains. We eagerly took the plunge.

Our first step involved documenting distribution of Bicknell's Thrush in the United States. We coordinated a network of hardy volunteers to survey high peaks and scattered lower elevation sites from New York to Maine. To our surprise, we found Bicknell's Thrush at 234 locations, of which 91% were more than 915 meters (3000 feet) in elevation (Atwood et al. 1996). Encouragingly, the species was still present on 63 of 73 known historic (pre-1992) sites, suggesting that no widespread or catastrophic declines had occurred. Yet local extirpations from Mount Greylock and several Canadian Maritime sites, all at the periphery of the breeding range, were worrisome. These, combined with an absence of information on abundance or trends, held our attention and concern.

The ascendancy of Bicknell's Thrush to full species status in 1995 (Ouellet 1993, AOU 1995) coincided with our full-fledged immersion into BITHnology (not yet a *Merriam and Webster* term, but we may propose it). Not only did this reclassification sharpen conservation focus on Bicknell's Thrush, it also increased the currency of the species among birders (e.g., Rimmer 1996). Our Mount Mansfield study site became a magnet—and still is—for birders wanting to add this enigmatic songbird to their life lists. Suddenly, Bicknell's Thrush was on the ornithological radar. We were willing participants in an unfolding drama, one whose trajectory we could never have predicted.

Our next step was to seriously tackle the breeding ecology of Bicknell's Thrush. We established intensive study sites on two Vermont mountaintops: Mount Mansfield and Stratton Mountain. Setting up a summer-long residence in the unused ski patrol huts on both peaks, our field crews gamely endured punishing hours and field conditions. We netted and banded, censused and mapped, searched nests, radio-tagged adults and fledglings, drew blood, snipped feather tips, affixed solar geolocators, counted cones and squirrels, and—swatted black flies. George Wallace's (1939) remark dogged and defined us: "Only a freak ornithologist would think of leaving the trails [on Mount Mansfield] for more than a few feet [due to] the discouragingly dense tangles" of vegetation. The challenges were daunting and rewards came slowly, but we persisted.

Figure 3. A female Bicknell's Thrush brooding on Stratton Mountain, Vermont (photograph by K.P. McFarland)

Early on, we discovered that Bicknell's Thrush has a highly unusual mating system. Spurred by an incidental observation of two color-banded males sequentially feeding young at a Stratton Mountain nest, we delved further by placing video cameras at nearly one hundred nests to identify feeders. Then we analyzed mitochondrial DNA of nestlings and adults. To our and many others' great surprise, we found that two to as many as four males attended 75% of the nests, but never more than a single female did so. Coincidentally, we learned that males do not hold traditional territories but wander widely over home ranges of up to 20 hectares (50 acres), each bird broadly overlapping its movements with those of up to seven other males. Females, in contrast, occupy and defend much smaller, non-overlapping territories. The plot thickened when we analyzed paternity, which was highly mixed in 70% of nests! In short (see Goetz et al. 2003 for details), both male and female Bicknell's Thrushes mate with multiple partners, some males feed multiple broods concurrently, some males feed broods in which they have no paternity, and females on higher quality territories (as defined by arthropod prey biomass) fledge more chicks and have fewer males feeding them (Strong et al. 2004). This complex breeding system, termed "female-defense polygynandry,"

Figure 4. Bicknell's Thrush nestlings, Stratton Mountain, Vermont (photograph by K.P. McFarland)

is known in only one other North American songbird, Smith's Longspur (Briskie 1993).

An additional twist emerged with our finding of a highly skewed sex ratio among breeding adults. From sites as distant as Stratton Mountain and the Gaspe Peninsula, we and our Canadian colleagues documented a male:female ratio of more than 2:1. This perplexing discovery raised a host of questions, but it seemed likely to account, at least in part, for the bizarre mating system of the Bicknell's Thrush. With relatively fewer females in the adult population, there presumably exists intense competition among males for mating access to those females. Differences in habitat quality may push females to manipulate males to acquire the amount of provisioning needed to raise young. A strange system indeed, but what caused the imbalanced sex ratio? The answer lay outside nests, where our genetic studies confirmed that male:female ratios were nearly 1:1 at hatching and fledging. We could only assume that at some point between leaving the nest as fledglings and returning as breeding adults, female Bicknell's Thrushes were getting the squeeze. But where and when? During the post-fledging period? In migration? In winter? Insights would have to wait.

Realizing that conservation of any migratory animal requires understanding its full annual cycle, we had already turned our attention to the wintering grounds, about which precious little was known. Scant anecdotal and museum records indicated that Bicknell's Thrush overwintered on only four islands in the Caribbean Greater Antilles: Hispaniola, Cuba, Jamaica, and Puerto Rico. Staggering ongoing forest loss on these islands—up to 99% in Haiti—put us on high conservation alert. Such an unsustainable pace of deforestation might well tip the precarious balance for a songbird already facing serious threats on its breeding range. Investigating the overwinter conservation status of Bicknell's Thrush became an immediate, urgent priority.

An exploratory field trip in December 1994 found us in the Dominican Republic's remote Sierra de Bahoruco, where a small band of local ornithologists and park rangers ushered us at dawn into a pristine broadleaf cloud forest. Not ten meters in, our hearts jumped as a familiar *beeer* call sounded from thick understory. Thus began a new chapter in our efforts to understand Bicknell's Thrush, a quest that has convinced us that conserving Caribbean forests holds the key to its tenuous future. Guided by the conservation axiom that you can't conserve something if you don't know where it lives, we first undertook an ambitious survey of Bicknell's Thrush distribution and habitat use throughout the Greater Antilles. Targeting forest habitats at all elevations, we documented the presence of Bicknell's Thrush from sea level to 2200 meters (7218 feet), with most birds inhabiting wet, near-impenetrable montane forests greater than 1000 meters (3281 feet) in elevation (Rimmer et al. 2001, McFarland et al. 2013).

Our field surveys suggested that Hispaniola harbored the mother lode of overwintering Bicknell's Thrushes, as we found relatively few birds in the mountains of Cuba, Jamaica or Puerto Rico. On all four islands, most birds occurred in government-owned protected areas. However, we quickly learned that few of these areas were protected in reality; charcoal production, subsistence agriculture, logging,

and squatting persisted unchecked. As we began to study the species more intensively at several Dominican Republic sites, a number of intriguing and unsettling findings emerged. Radio telemetry confirmed that all ages and sexes hold discrete, defended winter territories of about one hectare (2.47 acres) in size (Townsend et al. 2010), and banding revealed that many birds return to the exact same piece of turf each winter. An unexpected and sobering result was that introduced rats take a heavy toll—5 of 53 (9%) radio-tagged thrushes at two forest sites were killed by arboreal rats. Nocturnal rat depredation may lead to an unusual roosting behavior, whereby birds leave their daytime broadleaf forest territories to roost overnight in adjacent pine forests, where rat densities are much lower (Townsend et al. 2009). Sadly, there appears to be no habitat on Hispaniola that is immune to these invasive and destructive rodents.

Figure 5. Bicknell's Thrush calling from a tree fern on its wintering grounds, Sierra de Bahoruco, Dominican Republic (photograph by Pedro Genaro)

Our most significantes finding to date on Hispaniola is that overwintering male and female Bicknell's Thrush effectively segregate by habitat type. In relatively pristine, high-elevation cloud forests, males predominate over females by a ratio of 3:1, but in lower-elevation, more disturbed rain forests, the two sexes occur at close to parity. Overall on Hispaniola, males outnumber females by nearly 2:1 (Townsend et al. 2011). Further, a dense forest understory and an arthropod-rich prey base characterize male habitats, but female habitats feature a more open understory, higher levels of human disturbance, and a food base that is heavy in fruit. Although proof is elusive, we believe that intersexual competition forces smaller-bodied female Bicknell's Thrushes to occupy inferior-quality rainforest habitat, which is among Hispaniola's most severely threatened forest types (Kerchner et al. 2010). On an island that appears to lack sufficient habitat to accommodate all thrushes, female survivorship may suffer relative to that of males, exacerbating the sex ratio skew of the species throughout its range. This argues compellingly for conservation of rainforest habitats, which may prove vital to long-term viability of Bicknell's Thrush.

Twenty years after our initial foray into the realm of Bicknell's Thrush, one conclusion is clear. We humans have stacked the deck decidedly against this globally rare and vulnerable species. We've fragmented its mountaintop breeding haunts with ski areas, towers, and turbines. Our warming climate threatens to push the Northeast's montane fir forests to extinction, with predicted losses of more than 90% with as little as a 2^{o} C rise in summer temperatures (Rodenhouse et al. 2008). We have discovered surprisingly high burdens of toxic mercury in the blood and feathers of every thrush sampled from Canada to the Catskills and from Cuba to Hispaniola (Rimmer et al. 2005, 2009; Townsend et al. 2013). We are watching its limited winter habitats

disappear before our eyes. And, we now know, thanks largely to a legion of Mountain Birdwatch volunteers in the U.S. and Canada <http://www.vtecostudies.org/MBW>, that Bicknell's Thrush breeding populations are declining overall. In New England and New York, regional trends appear mixed, with evidence of declines in core areas like the White Mountains (Lambert et al. 2008), but no clear increases or decreases in others (IBTCG 2010, Scarl 2011). Maritime Canadian populations, however, are in free fall, with sharp annual declines of 11.5% in New Brunswick and 7.4% in Nova Scotia (Campbell and Stewart 2012). Quebec trends are less certain, but also indicate declines (IBTCG 2010). Continued monitoring across the breeding range is a high priority, and Mountain Birdwatch volunteers are always needed.

A coalition of scientists, natural resource managers, and conservationists from across the hemisphere are now translating knowledge into action. The International Bicknell's Thrush Conservation Group (IBTCG) was formed in 2007 with an explicit aim to advance conservation of the species. Nearly one hundred members strong, the IBTCG released in 2010 a detailed and formal action plan, with an ambitious goal "to increase the global population of Bicknell's Thrush by 25% over the next fifty years (2011–2060), with no further net loss of distribution" (IBTCG 2010). Recommended actions concentrate on range-wide research, monitoring, and habitat conservation. Importantly, the plan directs foremost attention to stronger protection of its dwindling winter habitats.

Tangible evidence of this commitment took form at a November 2010 workshop in Santo Domingo, where sixty participants from seven countries (representing four languages) gathered for three days. Our efforts focused on increasing cooperation between Caribbean and North American IBTCG partners via hands-on implementation of the Conservation Action Plan. The group's immediate and resounding recommendation was to hire a full-time IBTCG Caribbean Coordinator. Juan Carlos Martínez-Sánchez came on board during the fall of 2012, and already the wheels of positive change are turning in Haiti and the Dominican Republic. Martínez-Sánchez brings a conservation philosophy that is simple and intuitive—put responsibility squarely in the hands of local partners where it belongs by building their capacity and promoting their independence. This approach, although challenging to execute in countries chronically plagued by scarce resources, is bearing fruit after only a year. Working closely with our Dominican partners in the Cordillera Septentrional, an area of high importance for female Bicknell's Thrushes, we are helping our local counterparts design and implement on-the-ground actions to conserve essential rainforest habitats.

Ultimately, conservation is about changing people's behavior: combatting climate change, managing industrial forests in Canada, properly siting high-elevation wind turbines, or providing viable incentives for locally-based conservation of Caribbean broadleaf forests. With a global population that probably numbers fewer than 100,000 individuals, and a multitude of threats across its migratory range, Bicknell's Thrush faces daunting odds. But conservationists are by nature optimists. Although the future for Bicknell's Thrush may appear bleak on many levels, we are making progress. People are taking notice. Support has been forthcoming, if slowly.

Volunteers are turning out in droves for Mountain Birdwatch routes. Canadian forestry companies are adopting Best Management Practices. Policymakers are crafting laws to reduce mercury emissions, using Bicknell's Thrush as a bio-indicator. Climate change scientists cite the species as a bellwether of our warming planet. Land acquisitions and conservation easements in North America and the Caribbean increasingly center on Bicknell's Thrush.

Will Bicknell's Thrush regularly pour forth its song again from Mount Greylock's summit? It is unlikely. Can we ensure that this reclusive, intriguing songbird continues its annual passage from our mountaintops to its winter quarters in Caribbean wet forests, and back? Maybe. We know what needs to be done. There will always be more to learn—and we will never stop seeking answers—but we must now focus our energies on action. Bicknell's Thrush may be closer than we realize to an ecological tipping point. Only through concerted, collective hemispheric conservation action can we avoid reaching that point from which no return is possible. To be clear, our conservation quest goes far beyond Bicknell's Thrush. Need convincing? Find yourself at dusk in mid-June on a windswept Green or White Mountain ridgeline. Listen to the chorus of thrushes and White-throated Sparrows. Make your way in January or February to a Dominican cloud forest, where the haunting songs of Rufous-throated Solitaires mingle with the subdued calls of Bicknell's Thrush. You will be convinced.

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