by Paul Hess

Conservation Plan for Shorebirds

It is June at Polar Bear Cove on Bathurst Island, where male Buff-breasted Sandpipers flutter-jump, tiptoe, and wing-stretch in courtship dances on their tundra leks. It is Labor Day at a sod farm in New Jersey, where birders scan the grass for juveniles on their way to South America. It is May on the tilled fields of Nebraska, where flocks stop to rest and feed before hurrying on toward the high-Arctic summer. The future of that wondrous cycle has become an increasingly urgent concern. Buff-breasted Sandpiper is one of three taxa newly ranked as "highly imperiled" in a 2004 update of the United States Shorebird Conservation Plan. The other two are the endemic Hawaiian subspecies (*knudseni*) of Black-necked Stilt and the Canadian-Arctic subspecies (*rufa*) of Red Knot. At this highest level of concern are species and populations listed as threatened or endangered nationally, plus those showing significant declines, low population sizes, or other high-risk factors. Snowy Plover, Piping Plover, Mountain Plover, and Long-billed Curlew retain the highly-imperiled status they were given when the Plan was adopted in 2001.

Ranked as "highly imperiled" in a 2004 update of the U.S. Shorebird Conservation Plan, the **Buff-breasted Sandpiper** is declining sharply and faces serious threats on the wintering grounds. The U.S. Plan, along with a companion Canadian Plan, provides a detailed "conservation assessment" for each shorebird species that breeds in North America. *North Slope, Alaska; June 1995. © Kevin T. Karlson*

One step down in the rankings are two dozen taxa of "high concern", which are species or populations known or thought to be declining as well as facing known or potential threats. At this level are 14 species whose breeding ranges are largely confined to North America: American Golden-Plover, Black Oystercatcher, Solitary Sandpiper, Upland Sandpiper, Bristle-thighed Curlew, Hudsonian Godwit, Marbled Godwit, Black Turnstone, Surfbird, Western Sandpiper, Rock Sandpiper, Short-billed Dowitcher, American Woodcock, and Wilson's Phalarope. Also at this rank are North American populations of eight species that breed widely elsewhere: Wilson's Plover, American Oystercatcher, Whimbrel, Bar-tailed Godwit, Ruddy Turnstone, Red Knot populations other than the Canadian-Arctic race, Sanderling, and Dunlin of the Alaska – East Asia and Alaska – Pacific Coast populations.

As a context for those rankings, consider the status of all 72 species and subspecies whose trends were assessed for the Plan by a panel of prominent shorebird biologists. Thirty-three were classified as endangered or showed population declines that the panel considered "significant" or "apparent". Thirty-eight had populations that were apparently stable, or whose trends were unknown. Only two (Purple Sandpiper and Long-billed Dowitcher) had apparent population increases. And not a single species or subspecies showed a documentable upward trend. The aim of the Plan is to reverse that imbalance—to "stabilize populations of all shorebird species known or suspected [to be] in decline due to limiting factors within the U.S., while ensuring that stable populations are secure."

The U.S. Plan and its companion Canadian Plan are cooperative efforts among government agencies, conservation organizations, and individual researchers. Web sites explaining the Plans' goals, methods, and strategies are sponsored by the U.S. Fish & Wildlife Service at <shorebirdplan.fws.gov/USShorebird.htm> and the Canadian Wildlife Service at <www.cws-scf.ec.gc.ca/birds/sh_or_e.cfm>. An important feature of the Plans is a detailed "conservation assessment" for each species. For example, the Buff-breasted Sandpiper rates the highest priority based on an apparently severe decline from historical numbers (although precise information is lacking), a small population size (estimated at only 15,000), potential threats during the non-breeding period (such as exposure to pesticides or agricultural development in its winter habitat in South America), and a relatively small winter range (which could increase its risk from local threats). Not many birders will see Buff-breasted Sandpipers dance as J. P. Prevett and J. F. Barr saw them on the Yukon tundra one June "in the soft light of the night

hours when the sun was low in the sky" (*Wilson Bulletin* 88:500–503). Whether it is seen or not, the show will go on, but perhaps only if Shorebird Plan partners succeed in their conservation mission.

Kirtland's Warbler Winter Ecology

Many attempts to study wintering Kirtland's Warblers in the Bahamas have been studies in frustration because the birds have been so difficult to find. Josselyn Van Tyne and Harold Mayfield, the foremost scholars of Kirtland's Warbler breeding biology, searched for 59 days without seeing one. James Bond, a leading expert on birds of the West Indies, encountered only one in 100 days of trying. John T. Emlen, the author of an important monograph on Bahamian landbirds, saw none in 500 hours of effort. Unsuccessful until her third trip to the islands, Mary Clench of the Carnegie Museum in Pittsburgh wrote with palpable joy in the Audubon Society of Western Pennsylvania *Bulletin* in June 1978: "After years of searching the length and breadth of the Bahamas in winter, I was finally looking at a Kirtland's Warbler."

Imagine, then, a research team's exhilaration after finding 60 Kirtland's Warblers at 15 locations on Eleuthera Island during the winter of 2003–2004. This count was not merely unprecedented; it was equivalent to nearly one-third of the entire total of reports from the Bahamas between 1879, when Charles B. Cory collected the first specimen, and 1997, when all accessible historical records were compiled by J. Christopher Haney, David S. Lee, and Martha Walsh-McGehee (*Condor* 100:201–217). Many of the unsuccessful attempts were made as the Kirtland's Warbler was approaching extinction and very few birds were present on the islands. The search is easier now, because the population has increased substantially, but the discoveries are no less significant.

Kirtland's Warbler has long been considered fiendishly difficult to find on its wintering grounds in the Bahamas. But a recent mistnetting-and-banding study, funded in part by the U.S. Forest Service and conducted by a research team that includes Bahamian students, has been highly successful. Since 2002, the team has banded 50 Kirtland's Warblers on the island of Eleuthera alone. *Eleuthera Island, Bahamas; April 2004. © Dave Currie.*

The team, which included two student trainees, was part of the Kirtland's Warbler Training and Research Project, a cooperative venture by the Bahamian and U.S. governments, the College of the Bahamas, the Ornithology Group of the Bahamas National Trust, and The Nature Conservancy. Three leaders, Eric Carey, Joseph M. Wunderle, Jr., and David N. Ewert, explained the team's goals in 2004 (*Journal of Caribbean Ornithology* 17:81–85). In contrast to intensive conservation management on Kirtland's Warbler breeding grounds in Michigan, no such activities had been con-

ducted on the wintering grounds in the Bahamas. The project was designed to study the winter distribution and ecology of this endangered species, as well as the year-round ecology of poorly-studied Bahamian endemics, and to teach Bahamian citizens how to manage all the birds' habitats. "Unfortunately," Carey and his colleagues wrote, "the Bahamas, as well as many other island territories of the Caribbean, lacks citizens who are trained in natural resources management or other closely related fields." With a grant from the U.S. Forest Service, the project began in 2002 when two biology students at the College of the Bahamas were trained in field research methods. By the 2004–2005 winter, five students had participated. "The project is building Bahamian biologists," Field Director Dave Currie said (personal communication).

The research team has banded more than 50 Kirtland's Warblers on Eleuthera since 2002, including six at a site initially discovered by the Ornithology Group of the Bahamas National Trust. Many of the banded birds have returned to the same territories in subsequent winters. One banded on the Michigan breeding grounds in 1995 was back on the island in the fall of 2004—at least nine years old and after more than 25,000 miles of migrations. To develop effective conservation efforts, the researchers must learn what ecological features make the sites on Eleuthera so attractive. Currie said the project will continue to add knowledge of Kirtland's winter habitat requirements, increase emphasis on studies of endemic Bahamian species, and train more students in field techniques. Fifty-six years since Van Tyne's and Mayfield's frustration, a new era of Kirtland's Warbler research is flourishing.

Gloger's Rule posits that populations of birds (and other organisms) tend to be darker in humid environments and paler in arid climes. For example, the *lilianae* subspecies of **Eastern Meadowlark** in the Desert Southwest is notably paler than populations of this species in less-arid climates. What is the mechanistic basis of the pattern known as Gloger's Rule? A recent study indicates that feather-degrading bacteria, which are more abundant in humid environments, are thwarted by darker, more-melanized pigments. *Sierra Vista, Arizona; February 2003. © Rick & Nora Bowers.*

Gloger's Rule Revisited

German zoologist Constantin Lambert Gloger's name is forever linked to an ecological pattern of plumage variation that he described in 1833. "Gloger's Rule" is the tendency within a species for populations in regions of high relative humidity to be more heavily pigmented than populations of the same species in regions of low relative humidity. The phenomenon is conspicuous in many avian families. Robert M. Zink and J. V. Remsen, Jr., examined studies of 52 North American species and concluded in 1986 that 50 of those species supported the rule (*Current Ornithology* 4:1–69). Among familiar examples are darkly-colored subspecies of the humid Pacific Northwest such as the "Black" Merlin (*suckleyi*) and the "Sooty" Fox Sparrow group (*unalaschcensis* and closely related races). Well-known pale races of the dry Southwest include "Desert" (*saltonis*) Song Sparrow and "Lilian's" (*lilianae*) Eastern Meadowlark. The tendency does not refer only to those populations classified as subspecies; for example, unnamed House Sparrow populations in the Pacific Northwest are darker than those elsewhere on the continent, as Richard F. Johnston and Robert K. Selander reported in 1971 (*Evolution* 25:1–28). Nor is Gloger's Rule applicable only to birds; mammals, land snails, and many insect taxa show the same tendency.

A common pattern across diverse phyla leads to the question, Why? What adaptive values might such variation offer? The late evolutionary biologist Ernst Mayr was baffled in 1963 when he wrote in *Animal Species and Evolution*, "The precise selective factors responsible for Gloger's Rule are still a mystery." Various adaptive factors have been proposed—none of them mutually exclusive. Perhaps the value is cryptic background-matching of darker plumage in dark, humid forests and paler plumage in bright, dry deserts. Perhaps different advantages in thermoregulation are afforded by dark plumage in shaded, wet environments and by pale plumage in sunny, arid surroundings. Or, as more recent research has suggested, perhaps feather-degrading bacteria are an agent of natural selection for dark, melanin-based plumage. Edward H. Burtt, Jr., and Jann M. Ichida took a step toward this hypothesis in 1999 after discovering feather-degrading bacteria in the plumage of living, wild birds (*Auk* 116:364–372). Without yet making a connection to Gloger's Rule, they wondered how seriously birds might be affected by bacterial damage to the feathers.

By 2004, evidence for a bacterial role in Gloger's Rule began to emerge from the laboratories of Ohio Wesleyan University. Using domestic chicken feathers, Gerald Goldstein

and five colleagues demonstrated experimentally that the abundant soil bacterium *Bacillus licheniformis* degrades white, unmelanized feathers quickly but black, melanin-based feathers slowly or not at all (*Auk* 121:656–659). The authors suggested that the resistance offered by melanin might be especially important to birds in humid environments where bacteria are abundant. In a companion study, Burtt and Ichida tested that hypothesis with feathers of Song Sparrows (*Condor* 106:681–686). They found that strains of *licheniformis* in the dark *morphna* race of the Pacific Northwest, where relative humidity is high, degraded feathers more rapidly and completely than strains in the pale subspecies *fallax* of southern Arizona, where relative humidity is low. Birds in the Northwest may thus face strong selection pressure for darker plumage that is more resistant to bacterial degradation. In a separate commentary (*Auk* 121:652–655), Matthew D. Shawkey and Geoffrey E. Hill praised the two studies highly: "The potential for new discoveries at the intersection between microbiology and ornithology is enormous. ... By using both microscopes and binoculars, we are likely to achieve a better understanding of the function and evolution of feather coloration."

Bicknell's Thrush Populations

Solved: the case of the missing Bicknell's Thrushes. Analysis of stable hydrogen isotopes in thrushes on their Caribbean wintering grounds enabled Keith A. Hobson, Yves Aubry, and Leonard I. Wassenaar to discover two previously unknown breeding populations of this species in Québec. The investigation, which they reported in 2004 (*Condor* 106:905–909), was a novel application of stable isotope techniques that are being used more and more widely to track individual birds throughout the year. The technique in this case was based on the fact that deuterium isotope ratios in precipitation show a strong latitudinal gradient in North America. Because plants obtain most of their hydrogen from rainfall, the plants' tissues have a corresponding geographic pattern. A plant's deuterium value is transferred up the food chain through herbivorous insects to insectivorous birds, where the value serves as a "fingerprint" in the feathers during the birds' entire cycle from one molt until the next. For birds that molt on the breeding grounds, the isotopic ratio measured in winter identifies the latitude at which the birds have bred.

The Bicknell's Thrush mystery originated in previous research reported by Hobson and four coauthors in 2001 (*Auk* 118:16–23). In that study, they compared deuterium values in 83 Bicknell's Thrushes wintering in the Dominican Republic with values in 64 Bicknell's Thrushes at six breeding sites in Nova Scotia, New Brunswick, Québec, Vermont, and New York. Isotopic values in some of the wintering birds did not match any breeding population that Hobson's team had sampled. Evidently, the species was nesting at undiscovered localities. The winterers' deuterium suggested that the "missing" populations were somewhere at the northern limit of Bicknell's known range—most likely in southern Québec. After searching several hundred square kilometers of suitable breeding habitat, Hobson, Aubry, and Wassenaar confirmed their suspicion. They found deuterium ratios in Bicknell's Thrushes at two locations, Mine Madeleine on the northeastern Gaspé Peninsula and Mont Gosford near the Québec-Maine border, that corresponded with the wintering birds' values.

How might an ornithologist map the breeding range of the threatened **Bicknell's Thrush**? The old-fashioned way, of course, would have been to have canvassed potential nesting habitat for singing males. But the recent discovery of previously unknown breeding populations in Québec was made by researchers working on the Caribbean *wintering* grounds of the thrush. These wintering thrushes showed a stable isotope signature that placed them in Québec earlier in the year. *Stratton Mountain, Vermont; date unknown. © Tim Laman / VIREO.*

This detective work by Hobson and his colleagues points to an important new role for stable isotope analysis in conservation management. Bicknell's Thrush is a high-priority species in the North American Landbird Conservation Plan adopted by Partners in Flight. Its small population size, its sharply limited breeding and nonbreeding ranges, and its vulnerability to habitat threats rank it among the species "most in need of conservation attention". Knowledge of particular nesting localities is especially useful for management of a species with a greatly fragmented breeding distribution, such as Bicknell's Thrush. The hydrogen content in birds on a subtropical island is linked directly to an area where they may need help in the boreal forest. For this species, it may be a critical long-distance connection.