by Paul Hess

More Benefits of V-formation?

Somewhere, sometime long ago, someone watched geese flying in a V-formation and became the first person to wonder why. Untold ages later, two aeronautical engineers at the California Institute of Technology turned to modern aerodynamics for an answer. In 1970 P.B.S. Lissaman and Carl E. Shollenberger presented substantial theoretical evidence for an energy-saving advantage (*Science* 168:1003–1005). Their analysis suggested that a large bird flying in a V could obtain a surprising amount of extra power from air vortices trailing off the wing tips of the bird ahead. Theoretically, the authors said, this benefit could enable a goose to travel as much as 71 percent farther with the same energy expenditure as a lone bird's. The Lissaman-Shollenberger assumptions were later revised and refined by other experts, but the basic aerodynamic values proposed by the Caltech engineers have withstood many empirical tests. A second advantage of the V, suggested by others, is that it offers the optimal orientation for large, long-winged birds to maintain a close formation. It gives the birds a clear field of vision ahead and an angular view of other flock members, enabling them to maintain consistent positions and spacing from one another. Prominent among the researchers who have emphasized this hypothesis were Lisa L. Gould and Frank Heppner at the University of Rhode Island in 1974 (*Auk* 91:494–506) and C.J. Cutts and J.R. Speakman at Aberdeen University, Scotland, in 1994 (*Journal of Experimental Biology* 189:251–261).

Why do birds (like these **Snow Geese**) fly in V-formation? The standard answer is that it is energetically efficient to do so. But is that the entire answer? Recent research by Malte Andersson and Johan Wallander suggests that genetic relatedness among individuals in a flock may play a key role. *Sand Lake National Wildlife Refuge, South Dakota; 5 November 2003. © Stan Tekiela.*

An additional aspect of formation flight, this one involving the evolutionary concepts of kin selection and inclusive fitness, was proposed by Malte Andersson and Johan Wallander of Göteborg University in Sweden in 2004 (*Behavioral Ecology* 15:158–162). Kin selection is a mechanism hypothesized to explain apparent altruism in terms of natural selection. The principle is that an individual's genes affecting survival and reproduction—its "fitness"—are passed on to future generations not only through its own descendants but inclusively through other relatives (hence, the idea of "inclusive fitness") who share its genes. The authors suggested that kin selection might explain why some flocks of waterfowl fly in an acute V and others in a broad, obtuse arc. In an acute V, although the leading position offers no energy-saving advantage, perhaps the point-bird's effort could benefit its inclusive fitness. If the followers were the leader's offspring, the result would be what Andersson and Wallander called "a form of aerial parental care". If the followers also included an extended family of gene-sharing relatives, kin selection could expand the leader's care by allowing the other relatives to share the energy-savings. Conversely, the authors noted that wide arcs are typically unstable and egalitarian, offering little or no more aerodynamic advantage to one bird than to another. Birds in these flocks might be unrelated, and the foremost bird in the arc would have no basis in kin selection for expending extra energy to assist the other flock members.

Andersson and Wallander suggested reciprocity as a further possible reason why a bird might willingly accept the energy-expensive point position in an acute V. Perhaps the leader sacrifices energy temporarily in expectation that others will reciprocate by sacrificing their energy-saving positions in the future. This could easily explain the behavior sometimes observed when the leading position is exchanged among members of the flock. The authors listed many ways in which the hypothetical roles of kin selection and reciprocity can—and need to be—tested to find out whether factors far beyond aerodynamics may influence the V-formation.

Saving Our Landbirds

PS, BD, ND, TB, TN, and PT may not ring a bell for most birders, but the acronyms represent information essential to maintaining the Western Hemisphere's avian diversity. Combined by Partners in Flight, those six types of data shape the *North American Landbird Conservation Plan*—the most extensive, most detailed, and most important assessment ever assembled to evaluate landbird conservation needs. Partners in Flight (well known by its own PIF acronym) is a cooperative effort among government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals to conserve bird populations in the Americas. The Plan, outlined in a colorful report written by 18 authors and published by the Cornell Laboratory of Ornithology in 2004, recommends conservation priorities for 448 landbirds that regularly breed in the U.S. and Canada.

Three *Vermivora* warblers exemplify the Plan's methods and results. Each species rests on a different level of concern based on population size (PS), breeding distribution (BD), nonbreeding distribution (ND), threats to breeding (TB), threats in the nonbreeding period (TN), and population trend (PT). Combined, the factors provide an assessment score representing the current vulnerability of each species to serious decline or extinction. The warblers' ratings are as follows:

- Golden-winged Warbler is highly vulnerable because it is at risk in all six categories: relatively small population size, limited breeding and nonbreeding distribution, threats in both its breeding and nonbreeding ranges, and steeply declining population. It receives a high-priority position on PIF's "Watch List" of 100 landbird species most urgently in need of conservation.
- Tennessee Warbler fares at least moderately well in four of the categories, but it is threatened seriously in its nonbreeding range and its population is declining. PIF lists it among 158 "Stewardship Species" meriting special management attention and long-term planning for conservation.
- Orange-crowned Warbler shows a significant risk of population decline, but it is rated as relatively safe in the five other categories and does not require immediate action or special attention. Nevertheless, it warrants monitoring because PIF wants not only to help species at risk but also to "keep common birds common" by detecting problems long before they become serious.

As presented numerically in the Plan, the rating system is easy to grasp. It offers a straightforward path to determine vulnerability to threats, to set goals for an adequate population size, to identify further monitoring and research needs, and to recommend conservation measures. PIF emphasizes that broad continental-scale conservation programs are only a beginning and that the ultimate strategies must take place at state, provincial, and even local levels. In this light, besides assessing the continental status of each species, PIF interprets the data in a series of three "step-downs" to progressively smaller geographic units. The first is an assessment within seven broad avifaunal biomes termed Arctic, Northern Forest, Pacific, Intermountain West, Southwest, Prairie, and Eastern. The second is within 37 large Bird Conservation Regions such as the Atlantic Northern Forest or the Southeastern Coastal Plain, which are defined as ecologically distinct regions with similar bird communities, habitats, and resource management issues. The third is within 93 standard physiographic areas such as the Northern Tallgrass Prairie and the Mojave Desert. Every step is critical to the conservation goals.

A major new offering from Partners in Flight, the North American Landbird Conservation Plan, outlines conservation priorities for 448 landbird species that breed in the U.S. and Canada. Consider the example of the **Tennessee Warbler**: The plan identifies population declines and serious threats away from the breeding grounds, and recommends long-term planning for conservation of this potentially vulnerable species. *Carver County, Minnesota; May 2004. © Stan Tekiela.*

Analyses for the physiographic areas and for some states, as well as information about PIF research and publications, are available at <www.partnersinflight.org>. For a copy of the report, which is available only in print, contact PIF National Coordinator Terry Rich at <terry_rich@fws.gov>. There is no charge for up to five copies. For more, the charge is $10 each to help defray costs.

Rock Ptarmigan Conservation

The Rock Ptarmigan is a common resident in much of its remote breeding stronghold—a vast circumpolar span of "rock deserts", barren slopes of Arctic mountains, and bleak tundra on the northernmost coasts. Such a widespread and hardy bird might not seem a likely candidate for urgent conservation action, a view that Steve Madge and Phil McGowan expressed succinctly in their Princeton identification guide, *Pheasants, Partridges, and Grouse*, in 2002: "[P]opulations remain fairly healthy. The few local extinctions known are of little importance at [the] global level." However, three researchers at Queen's University in Ontario offered a starkly contrasting opinion in 2004: "Local population extirpations can result in the loss of substantial within-species diversity, especially when a population represents the only member of an evolutionarily independent lineage within a species." Karen Holder, Robert Montgomerie, and Vicki L. Friesen made the comment in a report of genetic variation and population trends among 11 subspecies of Rock Ptarmigan in North America (*Canadian Journal of Zoology* 82:564–575). To maintain present levels of diversity in the species and to reduce the threat of extirpation of isolated populations, the authors concluded that five Nearctic subspecies "merit the highest priorities when ranking populations for targeted management or conservation."

The **Rock Ptarmigan** is something of a conservation paradox. Globally, its numbers are secure and its range extensive. Locally, however, individual populations—and their genetic uniqueness—are threatened. A recent study by Karen Holder and colleagues documents the threats to local populations and proposes conservation measures. *Nome, Alaska; June 2002. © Stan Tekiela.*

The populations most seriously at risk are insular, genetically distinct subspecies on the Aleutian Islands and on the island of Newfoundland. The Aleutian races of highest conservation priority are *evermanni* on Attu Island and a group of three closely related subspecies, *atkhensis*, *chamberlaini*, and *sanfordi*, on the Andreanof Islands of the central Aleutians. The endemic race on Newfoundland is *welchi*. Dangers to the troubled populations differ at opposite ends of the continent. The threat on the Aleutians is predation by arctic foxes, which were introduced by Russians in the eighteenth and nineteenth centuries for fur farming. After the fox arrived, the Rock Ptarmigan (as well as some seabirds and waterfowl) disappeared from many islands and declined severely on others. On islands where foxes were subsequently eliminated by natural causes or by eradication programs, ptarmigan populations have rebounded. But on islands where foxes remain, ptarmigan densities continue at low levels. In that light, the management objective for the Aleutians is obvious. Meanwhile, the threat on Newfoundland is small-game hunting, for which the authors recommended immediate changes in regulations. They called, first, for an end to lumping Rock Ptarmigan and Willow Ptarmigan in a single ptarmigan bag-limit category and, second, for a great reduction in annual quotas for the threatened Rock relative to quotas for the more-common Willow. In essence, this study of the Rock Ptarmigan exemplifies the increasing emphasis on the importance of conserving biological diversity beyond the species level. "As a first step," Holder and her colleagues urged that "populations with a history of genetic isolation, coupled with current threats like hunting and predation pressures, should be managed separately."

Vast Resources on Two Web Sites

Do you need a checklist of the birds of Maine, Mali, Manitoba, Mindanao, Moldova, Morocco, or the Mentawai Archipelago? Why is a common North American bird, the Little Brown Crane (*Megalornis mexicanus*), missing from all of your checklists in both its English and its scientific names? For such information and infinitely more, see two astonishingly detailed web sites: Avibase, <www.bsc-eoc.org/avibase/avibase.jsp>, by Denis Lepage of Québec, and the Bird Data Project, <worldbirdinfo.net>, by John Penhallurick of Australia. Take the crane as an example. Search

Avibase to discover that it is what we call the Sandhill Crane, to find its name in 13 languages, to learn that it has six subspecies, and to compare its classification and nomenclature in five taxonomic systems. If that information is not enough, go on to search the Bird Data Project for *Megalornis mexicanus* and find 70 references to the unfamiliar name's scientific synonyms—a complete bibliographic history spanning two-and-a-half centuries of taxonomy since Linnaeus in 1758. Importantly, both sites' creators continually update their information.

Lepage's cyber-library, hosted by Bird Studies Canada, offers more than 500 checklists by continent, region, country, state, province, island, and even particular locations such as Long Point, Ontario. Each list is displayed in the American Ornithologists' Union, "Sibley and Monroe", "Clements", and "Howard and Moore" taxonomic systems. For each you can find out which species are endemic and which are ranked as globally threatened by BirdLife International. For many of the 10,000 species and 22,000 subspecies covered, there are maps of global distribution and names of the locales where they occur. Emphasizing that the lists are subject to inaccuracy, Lepage requests reports of errors. He provides valuable links to dozens of other bird-related web sites (although some seem to be inactive). Lepage welcomes the site's visitors with justifiable pride: "Avibase has been a work in progress for nearly 12 years, and I am pleased to offer it as a service to the bird-watching and scientific community." Both of those communities should thank him.

One of the well-known challenges of working through the ornithological literature is making sense of the multitude of names for the world's birds. For example, the species shown here has been called the Little Brown Crane, *Megalornis mexicanus*. (It is better known to ABA-area birders as the **Sandhill Crane**, *Grus canadensis*.) Two web sites, *Avibase* and *The Bird Data Project*, provide comprehensive accounting of ornithological nomenclature and many other matters. *Myakka River State Park, Florida; 21 January 2004. © Stan Tekiela.*

Penhallurick is justifiably proud as well: "I have been working for some time on what I hope will be the most comprehensive database about the birds of the world, both extant and extinct since 1600." By "some time", he means off-and-on for 20 years. Like Lepage, he solicits comments, corrections, and more-precise information. His aim for every species is to list its English, French, German, Spanish, and scientific names; its family as classified by several taxonomic authorities; its habitat and distribution; its subspecies; its threatened or endangered status, if applicable; and its English and scientific synonyms. Most ambitious of all, he plans an annotated synonymy for every generic, subgeneric, specific, and subspecific name in the world avifauna. By mid-2004 Penhallurick had completed 85 of the world's families, partially completed 13, and had yet to begin 150 more—a good reason besides simple courtesy to wish him a long and productive life.