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Authors: Carter, Michael F., Hunter, William C., Pashley, David N., and Rosenberg, Kenneth V.

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CONSERVATION REPORT

SETTING CONSERVATION PRIORITIES FOR LANDBIRDS IN THE UNITED STATES: THE PARTNERS IN FLIGHT APPROACH

MICHAEL F. CARTER,[1,5] WILLIAM C. HUNTER,[2] DAVID N. PASHLEY,[3] AND KENNETH V. ROSENBERG[4]

[1]*Colorado Bird Observatory, 13401 Piccadilly Road, Brighton, Colorado 80601, USA;*
[2]*U.S. Fish and Wildlife Service, 1875 Century Boulevard, Atlanta, Georgia 30345, USA;*
[3]*American Bird Conservancy, P.O. Box 249, The Plains, Virginia 20198, USA; and*
[4]*Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, New York 14850, USA*

Partners in Flight (PIF) was created in 1990 in response to concern for declining populations of Neotropical migratory songbirds (Robbins et al. 1986, Askins et al. 1990) and in the realization that conservation of these species required efforts beyond the ability of any single organization or agency (Finch and Stangel 1993). In subsequent years, PIF expanded its mandate to include all nongame landbirds and succeeded in raising awareness regarding the status of bird populations, but it had difficulty recommending which specific conservation actions were most warranted.

In 1995, PIF began a comprehensive planning effort to conserve nongame landbirds and their habitats throughout the United States. A critical first step in the planning process was to establish clear and consistent priorities among the several hundred landbird species based on their vulnerability and need for conservation action. To this end, PIF developed a species prioritization process for the southeastern United States (Carter and Barker 1993, Hunter et al. 1993) by modifying earlier efforts (Millsap et al. 1990, Master 1991) and later expanded the effort to include all of North America north of Mexico. This prioritization process has been reviewed extensively by local and regional bird experts and most recently by the AOU Conservation Committee (see Beissinger et al. 2000). Here, we describe the species prioritization process and provide the context for its application in conservation.

PIF SPECIES PRIORITIZATION PROCESS

One objective of the PIF process was to develop a system that could be applied consistently to any group of species, in any geographic area, and in any season. Initial development focused on the breeding avifauna of North America north of Mexico, although efforts will be expanded to include breeding birds south of the border and wintering and transient birds. A series of scores is assigned to each species, ranging from 1 (low priority) to 5 (high priority), for seven parameters that reflect different degrees of need for conservation attention. These scores are assigned within physiographic areas, which were modified from Breeding Bird Survey (BBS) physiographic strata (Robbins et al. 1986). The entire matrix of priority scores and accompanying documentation are maintained at the Colorado Bird Observatory <http://www.cbobirds.org>.

The seven parameters in the prioritization process are based on global and local information. Three of the parameters are strictly global in that a single value is assigned for the entire range of a bird. These are Breeding Distribution (BD), Nonbreeding Distribution (ND), and Relative Abundance (RA). Global values are assigned to three other parameters, Threats to Breeding (TB), Threats to Nonbreeding (TN), and Population Trend (PT), but these may be superseded by values assigned specifically to a physiographic area when appropriate and possible. The last parameter, Area Importance (AI), is always assigned locally for a specific physiographic area. Scores for each of these seven variables are determined independently.

Wherever possible, scores are based on quantitative and objective data. For most species, the BBS (Robbins et al. 1986) provides relative abundance and trend data used to assign scores for RA, PT, and AI. Where BBS data are not available, scores may be based on other quan-

[5] E-mail: mike.carter@cbobirds.org

TABLE 1. Criteria used to score Breeding Distribution (BD) and Nonbreeding Distribution (ND) parameters in the Partners in Flight species prioritization process.

BD/ND score	Percent of North America or equivalent area
1	20% or more (>4,411,940 km²)
2	10 to 20%
3	5 to 9.9%
4	2.5 to 4.9%
5	Less than 2.5% (<551,493 km²)

TABLE 2. Criteria used to score the Relative Abundance (RA) parameter in the Partners in Flight species prioritization process.

RA score	RA criterion no. 1[a]	RA criterion no. 2[b]
1	100 or more	Abundant
2	30 to 99.9	Common (or locally abundant)
3	10 to 29.9	Uncommon to fairly common
4	1 to 9.9	Rare to uncommon
5	Less than 1	Very rare to rare

[a] Mean no. of birds per BBS route.
[b] Expert opinion.

titative data, expert opinions, or may reflect lack of current knowledge. Scores for range size (BD, ND) are based on published maps, and scores for threats are based on expert opinion. In addition, Population Trend Data Quality (PTDQ) assesses BBS sample size and variance to gauge the confidence in data used to assign PT.

Breeding distribution (BD).—Generally, species with the widest breeding distributions are the least vulnerable to deleterious environmental changes and catastrophic events. BD is based on the proportion of North America that is covered by a species' breeding range. We have defined North America to include the main body of the continent (excluding Greenland) through Panama and the islands of the Caribbean, comprising an area of 22,059,680 km² (National Geographic Society 1993). A species inhabiting a breeding area that represents 2.5% or less of North America is assigned a BD score of 5 because species with such small ranges could be significantly and negatively affected by a catastrophic event, such as a hurricane (Table 1). At the other extreme, species inhabiting breeding ranges covering 20% or more of North America should be at relatively low risk from stochastic and other negative environmental events and are assigned a score of 1. Species with ranges between 2.5% and 20% were ranked on a graded scale (Table 1). The primary sources of information for bird distribution for BD and ND (see below) were maps from two well-known field guides (National Geographic Society 1987, Howell and Webb 1995).

Nonbreeding distribution (ND).—Nonbreeding Distribution reflects the proportion of North America or equivalent area that is covered by a species' nonbreeding range. It is scored in the same manner and using the same scale as BD (Table 1). This parameter is based on the smallest nonbreeding range that a species occupies. Therefore, species that move through severe migratory bottlenecks, such as Red Knots (*Calidris canutus*) staging at Delaware Bay, receive high scores to reflect the risks associated with such concentration.

Relative abundance (RA).—Relative Abundance measures the abundance of a species in appropriate habitat within its range relative to other bird species. Species that are uncommon are assumed to be at greater risk and receive higher RA scores. Scores for RA are determined using one of two methods. Where BBS data are available, RA values are assigned on the basis of the mean number of birds on the 10 BBS routes on which a species is most abundant (Table 2) using an analysis derived from Price et al. (1995). A less-quantitative approach is necessary for species for which BBS data are unavailable or unreliable, including many arctic, boreal, and tropical species whose breeding ranges largely fall outside of the area sampled by the BBS. In these cases, RA scores are assigned on a qualitative scale of abundance (Table 2) on the basis of published notes and expert opinions, as described in earlier versions of the PIF prioritization process (Carter and Barker 1993, Hunter et al. 1993). All departures from BBS-derived criteria and justifications for departures are documented in the database.

Threats to breeding (TB) and threats to nonbreeding (TN).—These parameters reflect recent and predicted threats that may put a species at risk of decline or extirpation from an area. TB and TN are scored using a standardized scale for evaluating conditions, including what has happened in the past and what is likely to happen

TABLE 3. Scoring of Threats Breeding (TB) and Threats Nonbreeding (TN) in the Partners in Flight species prioritization process, based on an evaluation of past, present, and future conditions available to support healthy populations of a given species (see text).

Percent of present conditions in future	Percent of past condition remaining today				
	100%+	75 to 99%	50 to 74%	25 to 49%	<25%
100%+	1	1	2	3	4
75 to 99%	2	2	3	4	5
50 to 74%	3	3	4	4	5
25 to 49%	4	4	4	5	5
<25%	5	5	5	5	5

in the future, that affect an area's ability to support healthy populations of a bird (Table 3). These conditions include the amount of suitable habitat, other factors that affect the species' survival or reproductive success, including cowbird parasitism, pesticides, and predation, and the capacity of the species to withstand or recover from negative conditions. Present conditions are based on the percent of conditions that existed around 1945 that still exist today. Future conditions are the percent of current conditions anticipated to exist in subsequent decades.

We illustrate this process for two species that inhabit the Central Shortgrass physiographic area. Much of the shortgrass prairie, the preferred habitat of McCown's Longspur (*Calcarius mccownii*), has been lost or degraded over the last two centuries (Knopf 1994). Perhaps 51 to 75% of the habitat that existed in 1945 has been lost (with 25 to 49% remaining). Using the 25 to 49% remaining column, McCown's Longspur could only score a 3, 4, or 5 (Table 3). Using similar reasoning, we estimate that loss rates of shortgrass habitat will not exceed 50% in the next few decades, but that not all shortgrass prairie that exists today will exist in the future. Therefore, McCown's Longspur in this physiographic area scores a TB of 4. The Horned Lark (*Eremophila alpestris*) also occurs in the same shortgrass prairie habitat but would be scored differently. The conversion of shortgrass to agricultural lands has not been as detrimental to Horned Larks as to many other species, so perhaps 100% of past conditions remain for this species, leaving possible scores of 1 to 5. Because future conditions are likely to favor Horned Larks (i.e. no future loss), the species scores a 1 for TB. Although the scoring process for TB is heavily based on amount of habitat, it also may incorporate factors related to the ability of an area to support a species. For example, if we concluded for Horned Larks that new threats (e.g. pesticides, plowing of nests) existed that could limit breeding success to less than 25% of what would occur under current conditions, then Horned Larks would receive a TB score of 5.

TN is scored using the same criteria as TB (Table 3). As with Nonbreeding Distribution discussed earlier, TN is named and scored to reflect not only wintering conditions but also threats faced during migration. Species that pass through severe ecological bottlenecks during migration may score higher than they would based on winter conditions alone. Species that reside within an area throughout the year are often assigned the same TB and TN scores, but those that change habitats within that area, or are otherwise more or less vulnerable in winter, could receive different scores for the two parameters.

Population trend (PT) and population trend data quality (PTDQ).—Population trend scores, reflecting the magnitude and direction of population change, are assigned globally as well as locally for each physiographic area. When possible, population trend scores are assigned on the basis of BBS data (Table 4) as analyzed by the BBS laboratory of the United States Geological Survey's Biological Resources Division (J. Sauer pers. comm.). Each PT score is linked with a PTDQ score that assesses the quality of BBS data based on sample size and statistical significance.

A population trend must meet the thresholds of magnitude and reliability associated with PTDQ scores of A, B, or C to warrant either a very high (4 or 5, declining) or a very low (1, increasing) score (Table 4). Species not meeting these minimum requirements are assigned a PT of 3 (trend unknown) and receive PTDQ scores of D, E, or F. A PTDQ score of D is assigned to species for which a large sample size indicates positive or negative nonsignificant trends of at least 1%. This often applies to birds whose local populations fluctuate greatly from year to year, possibly reflecting fluctuating habitat conditions and/or possibly obscuring long-term trends. Species assigned a PTDQ

TABLE 4. Criteria for scoring population trend (PT) and population trend data quality (PTDQ). PTDQ depends on number of BBS routes (*n*) within a physiographic area and the statistical significance of the population trend being different from 0 (*P*). In addition, a PTDQ symbol of x should be applied whenever PT is based on data other than the BBS (expert opinion, Christmas Bird Count, etc.); the source should be specified in the database.

PT score	BBS trend (% year^{-1})	PTDQ	*n*	*P*
1 = Significant increase	≥1.0	A1	≥34	≤0.10
		B1	14 to 33	≤0.10
2 = Possible increase	≥1.0	C2	≥14	0.11 to 0.35
		C1	6 to 13	≤0.10
2 = Stable	−1.0 to 1.0	A2	≥34	Any *P*
		B2	14 to 33	Any *P*
3 = Trend uncertain	<−1 or >1.0	D	≥14	>0.35
	Any trend	E1	6 to 13	>0.10
		E2	<6	Any *P*
	No data	F	—	—
4 = Possible decrease	≤−1.0	C2	≥14	0.11 to 0.35
		C1	6 to 13	≤0.10
5 = Significant decrease	≤−1.0	A1	≥34	≤0.10
		B1	14 to 33	≤0.10

score of E1 or E2 have insufficient sample sizes. Species not detected on the BBS in the area are given a PTDQ of F and usually are locally rare or difficult to detect.

A PT score of 2 reflects two possibilities that are differentiated from each other by the PTDQ score and the magnitude of the trend. A PT of 2 with a PTDQ of A2 or B2 and a trend between ±1% indicates a well-sampled species whose population is essentially stable. A PT of 2 with a PTDQ of C1 or C2 and an increasing trend (at least 1% per year) reflects a species that is probably increasing, but without statistical certainty.

In cases where BBS data are unsatisfactory, other population trend data or the opinions of local experts may be substituted with the scoring mimicking the criteria in Table 4. PT scores not derived from the BBS are assigned a PTDQ score of X, and the origin of the information is noted in the database.

Area importance (AI).—This variable is intended to evaluate how important a particular physiographic area is to the conservation of a given species. AI scores compare the abundance of a species within a physiographic area relative to other areas throughout its range (Table 5). Because these scores are based on an index of relative abundance, they are not influenced by the size of the geographic unit in question. Data for this criterion are derived from the BBS, when they are adequate. The first step is to identify the physiographic area within the bird's range with the maximum mean number of individuals per BBS route. Mean numbers of birds per route for other physiographic areas are compared with the physiographic area maximum. For cases in which BBS data are not available or seem to be misleading, AI can be assigned on the basis of local review by experts knowledgeable about the distribution and abundance of the species, following as closely as possible the rationale behind the quantitative method.

Other data quality and supplemental scores.—Although PTDQ is the only supplemental value

TABLE 5. Criteria for scoring Area Importance (AI) in the Partners in Flight species prioritization process.

AI score	AI criterion no. 1[a]	AI criterion no. 2[b]
1	0 to 0.9	Accidental to peripheral
2	1.0 to 9.9	Occurs regularly but is uncommon
3	10.0 to 24.9	Present in low relative abundance
4	25.0 to 49.9	Present in moderate to high relative abundance
5	50 or more	Present in highest relative abundance

[a] Percent of maximum BBS abundance.
[b] Expert opinion.

currently assigned, it may be beneficial to document the quality of information used in developing scores for other variables. In the past, PIF has assigned some data quality scores for TB and TN, but these have been rarely used or have caused confusion. Hunter et al. (1993), following Millsap et al. (1990), described a potentially useful supplemental score termed ''Management Needs'' that documents the amount of management attention that a species is receiving. This could assist in differentiating among species that are receiving an adequate amount of attention from those with similar prioritization scores that may require additional management effort.

Interpretation and Application of Priority Scores

As accurate as individual scores in a prioritization database may be, their usefulness depends on how they are interpreted and applied to conservation actions. In the following section we suggest various uses of the species prioritization database, address issues regarding interpretation of scores, and give examples of their current application. A simple application is a summation of the seven parameter scores to indicate overall conservation priority. This total, which can range from 7 to 35, is a potentially useful number, but only when considered in the context of its component parts. Relying solely on total scores to set conservation goals can be misleading and is perhaps the most common misuse of the prioritization process and the numbers it generates. Beissinger et al. (2000) suggest a categorical approach that determines an overall level of priority based on combinations of scores, emphasizing declining population trend and high threats to populations. PIF bird conservation plans, described below, use a combination of approaches, including the sum of all scores, as a flexible tool to indicate priority status.

Weighting and sorting.—At present, the seven variables in the prioritization process are equally weighted in the database. When the database was initially developed, suggestions were made to weight certain parameters in situations where one factor might be considered more important than another. A particular score may be emphasized or de-emphasized by being multiplied by a factor greater than or less than 1 and used to generate a new total score. We caution against such weighting, however, because the relative contribution of the seven parameters to the overall vulnerability of a species usually is unclear. Rather, we suggest that using parameters as sorting factors may result in conservation priorities that are easier to interpret.

As a first step in sorting priority scores, an AI threshold can be chosen that eliminates a species from the peripheral parts of its range, where conservation efforts would be ineffective. Efforts in a physiographic area generally should be limited to species with an AI score of 2 or higher. A three-tiered sorting of species with an AI score of 4 or 5 in the top rank, 3 or 2 in the second rank, and 1 in the third rank would increase emphasis on species for which an area has the greatest conservation responsibility. When reliable BBS data exist, PT scores provide a useful second sorting, after AI, in that PT ultimately is the parameter that is the object and measure of conservation action. Birds with high scores for PT may be more in need of conservation action than are birds with low scores. An additional sorting on the basis of TB in breeding habitat and TN in wintering or migration habitat will also focus conservation actions where they potentially can do the most good, particularly where local PT is uncertain. In addition, sorting by PTDQ may be useful because species that receive both a high total score and a PTDQ that indicates poor data generally are those that are most in need of attention in developing monitoring programs.

Total scores and independence among parameters.—Beissinger et al. (2000) caution against summing the seven rank scores to derive a single value because of the potential for lack of independence among the parameters. Although scores for some parameters can be shown to be correlated, this does not necessarily result from lack of biological independence. For example, a species may have a small breeding distribution (high BD score) but occur in high relative abundance (low RA score), and its populations may or may not be threatened (high or low TB). The seven parameters in the species prioritization process were selected partly because of our ability to score them independently. That in practice some species exhibit correlations among scores suggests to us patterns of conservation need, rather than lack of independence. Species that score high on multiple parameters, and therefore have high total scores, exhibit compounding evidence of vulnerability. These species may have a small total distribution, occur in low relative abundance, show threats to breeding and wintering populations, *and* exhibit a significantly declining population trend. Other species that show vulnerability only in one or two of these categories would have moderate total scores, the meaning of which is unclear without inspection of the component scores. Very low and very high total scores, however, have easily interpretable meanings in terms of whether some sort of conservation attention is warranted.

Beissinger et al. (2000) suggested a categorical approach that sorts species primarily according to thresholds of scores for Population Trend, Relative Abundance, and threats. In their analysis of the breeding bird species of New York state, categorical rank (e.g. high vs. moderate concern) was highly correlated (r_s = 0.76) with the sum of the seven parameter scores. More important, the same species of greatest conservation concern were clearly identified by both approaches. A rigid categorical approach has a drawback, however, in that the greatest emphasis (weighting) may inadvertently be placed on parameters for which scientific data are unreliable. The combination of approaches used by PIF in its planning process (see below) places species into priority categories based on their total scores as well as on combinations of scores for the component parameters, especially AI and PT. This is essentially a categorical approach in which a species can enter the priority pool by exceeding any one of several thresholds.

Responsibility versus concern.—Not all species identified through the prioritization process as high priority are of immediate conservation concern or require immediate management actions in all areas. Rosenberg and Wells (1995, 2000) introduced the concept of ''area responsibility'' to highlight an area's share in the responsibility for long-term conservation of species, including those that are not currently declining or threatened in that area. Such species may have relatively high total scores, including high AI, BD, or RA, but low to moderate locally derived PT and TB (or TN for wintering birds) scores. These may be species for which the physiographic area should assume conservation responsibility and for which close monitoring is warranted. Area responsibility also is a prominent component of species prioritization efforts in Canada (Dunn et al. 1999). In contrast, species that are most in need of on-the-ground conservation actions in a region receive high scores for local concern (PT and TB) and global priority (very high total scores) but may score high or low for area responsibility (AI). Focusing on high-responsibility species or global-priority species that are of immediate concern is an improvement over many state threatened and endangered species lists, which often contain peripheral populations that are locally rare and declining and that may have little consequence for long-term conservation of the listed species.

PIF bird conservation plans.—We believe that the most important application of priority scores to date is their use in the drafting of Bird Conservation Plans for all of the physiographic areas and/or states of the continental United States. From among the breeding avifauna of each physiographic area, a priority species pool is derived using a combination of criteria from the prioritization database. A species may be included in this pool if it is in immediate need of conservation action, has a global high-priority status, or has a large population for which there is high local responsibility. All species in this priority pool are then grouped into habitat-species suites, each consisting of one or more co-occurring species. Within habitat-species suites, specific conservation needs or actions may be suggested by patterns of priority scores. If, for example, there are consistently poor PTDQs for species in a suite, increased monitoring effort may be required in that habitat. Habitats used by one or more species with very high total scores, high PT and TB, and high AI scores may be in need of rapid remedial management or other conservation actions. Conditions in habitats for suites that consist of many birds with high total scores and high AI scores but low PT and TB scores may be adequate at present but in need of long-term maintenance.

The plans will also include quantitative population and habitat objectives for habitat-species suites, suggestions for implementation actions to achieve conservation objectives, and an adequate program to evaluate the success or failure of those actions. The overall intent of the

PIF planning process is to guide the efficient expenditure of conservation resources to ensure the long-term health of populations of landbirds throughout the United States, with an understanding that comparable efforts may be required in other countries to provide sufficient wintering and migration habitat for many migratory species.

Watch lists.—PIF prioritization scores have been used to generate a national Watch List for the United States (Carter et al. 1996, Pashley 1996) that is based on the sum of global scores for six parameters (AI is omitted because it never receives a global score). The value of a national Watch List is to highlight species that may be in need of conservation attention throughout their range and to attract interest in bird conservation. Such a national list based on summed global scores is less useful for conservation planning at regional or local scales than are physiographic area scores in which AI, PT, and TB are scored locally. Therefore, we urge caution in the use of the national Watch List, or any other compilation of species at an inappropriate geographic scale, as a guide for conservation priorities.

Discussion

Because species prioritization is a critical component of the conservation planning process, prioritization scores must reflect the best scientific information available. The current database has been reviewed extensively by state and regional experts, as well as by specialists on various taxonomic groups. The AOU Conservation Committee supported the overall structure of the database, as well as the relevance of the seven categories used for evaluating vulnerability (Beissinger et al. 2000). Nevertheless, improvements regarding several issues are needed.

Because of reliance on the BBS for population data, many species (i.e. some raptors, nocturnal birds, marsh birds, colonial waterbirds, and other patchily distributed or low-density breeders) receive an unknown score for population trend (PT = 3). Where alternative or additional survey data exist, incorporation of more reliable trend estimates will greatly strengthen the database. In addition, for many species that are peripheral in the United States or Canada, assigning priority scores is hampered by poor knowledge of distributions, abundance, population trends, and sometimes taxonomy beyond those borders.

At present, only full species are assigned scores in the database. Several of the highest-scoring species throughout North America only recently have been recognized as full species (AOU 1998), such as Oak Titmouse (*Baeolophus inornatus*), Bicknell's Thrush (*Catharus bicknelli*), and Saltmarsh Sharp-tailed Sparrow (*Ammodramus caudacutus*). Some taxa are legally recognized at the subspecies level for their high conservation importance (e.g. Least Bell's Vireo [*Vireo bellii pusillus*], Southwestern Willow Flycatcher [*Empidonax traillii extimus*]). Many others are worthy of conservation attention, and some, such as the Appalachian Bewick's Wren (*Thryomanes bewickii altus*), may be slipping toward extinction, partly as a result of inattention given to subspecies. Our ongoing efforts to remedy this gap in conservation efforts will require input from taxonomic specialists, as well as additional studies of geographic variation and population structure.

As a tool for conservation planning, the species prioritization process is helping to identify conservation priorities for the hundreds of breeding landbird species in North America. The database will also assist in the integration of conservation objectives for priority landbirds with objectives for taxa, such as waterfowl and other game birds, that traditionally are included in wildlife conservation efforts. Prioritization has been useful in illuminating gaps in our understanding of bird distribution and population status. For example, many species with uncertain population trends and poor PTDQ scores are in need of better or new monitoring efforts. As new information becomes available, the importance of maintaining an active and adaptive prioritization process cannot be overemphasized. To ensure that conservation is based on the best science available, we invite the academic and ornithological communities to participate in continued review and refinement of this database.

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