A comparison of North American avian conservation priority ranking systems

David W. Mehlman a,*, Kenneth V. Rosenberg b, Jeffrey V. Wells c,1, Bruce Robertson c,2

a The Nature Conservancy, Wings of the Americas Program, 201 Devonshire Street, 5th floor, Boston, MA 02110, USA
b Partners In Flight, Cornell Lab of Ornithology, 159 Sapsucker Woods Rd., Ithaca, NY 14850, USA
c National Audubon Society, Cornell Lab of Ornithology, 159 Sapsucker Woods Rd., Ithaca, NY 14850, USA

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Abstract

The need to prioritize species based on their perceived endangerment has led to the development of systems for categorizing and assessing their degree of vulnerability. Systems with divergent biological and geographical scopes can result in conflicting lists of high-priority species, potentially confusing conservationists and hampering the efficient allocation of resources. To assess conservation priorities for North American birds, we compare three priority-setting systems; those of the International Union for the Conservation of Nature (IUCN), NatureServe, and Partners in Flight (PIF). We found highest correspondence among the three systems in the highest and lowest categories of the respective systems with lower levels of correspondence in intermediate categories. We suggest that this is because the systems, while using different formulations of criteria, are based on the major factors known to be correlated with extinction risk. The few examples of species listed as a high conservation priority by one group but not one or both of the others appear to be the result of differences in availability or interpretation of data. Better communication and collaboration among those responsible for compiling the priority lists for each system is needed.

A primary difference among the systems was the total number of species identified as conservation priorities. IUCN identified the fewest species (47) and PIF the most (157). This difference is the result of differences in geographic and taxonomic scope of each system. However, when considered as the percent of the total number of taxa evaluated by each system, all systems identified approximately 20% of species as of conservation concern. To reconcile disparate lists, we urge that conservationists use a hierarchical approach that first considers species that meet thresholds for endangerment under global systems, followed by species considered most vulnerable relative to all continental biota.

Keywords: Conservation prioritization; Birds; IUCN; NatureServe; Partners in Flight

1. Introduction

Prioritizing species by their perceived endangerment and need for conservation action has become a standard practice in the field of conservation biology (Rabino-

witz, 1981; TNC, 1988; Master, 1991; Mace and Collar, 1994; Carter et al., 2000; Stein et al., 2000). The need for a priority-setting process is driven by limited conservation resources that necessitate choices among a subset of all possible species in any given geographic area, and distinct differences among species in their apparent vulnerability to extinction or need for conservation action. This need has led to the development of practical systems for categorizing and assessing the degree of vulnerability of various components of biodiversity, particularly vertebrates (e.g., TNC, 1988; IUCN, 1988, 1996; Millsap et al., 1990; Master, 1991; Reed, 1992; Hunter et al., 1993; Martin, 1994; Stotz et al., 1996).
Prioritization systems in use or proposed vary greatly in what factors are considered; how these factors are scored, weighted, and integrated; and how the resulting information is presented and used. Most are based on some estimation of extinction risk, often using multiple surrogates that are thought to directly impact or be predictors of risk, such as population size or trend. Some authors have suggested that factors unrelated to extinction risk could also be considered, such as the importance of the species in the ecosystem (Rohlf, 1991), its value as an umbrella or focal species for an ecosystem (Rohlf, 1991; Lambeck, 1997), or its commercial value (Mace and Hudson, 1999).

One widely used system for prioritizing species at the global scale is that developed through the International Union for the Conservation of Nature (IUCN, 1996). This system is used by national governments, the international conservation community, and the general public to identify species with the greatest risk of extinction for the purposes of developing mechanisms to prevent their loss. The IUCN system ranks as higher conservation priority those species with small populations or restricted ranges and species that have shown large decreases in abundance or habitat (Mace and Hudson, 1999). Closely allied to the IUCN system in concept, the global conservation status rank developed by NatureServe is widely used across the Americas by the network of Natural Heritage Programs, The Nature Conservancy, many state and federal agencies, and other non-governmental organizations (Master, 1991; NatureServe, 2001). These status ranks are used to define conservation priorities, influence development activities, and shape land management efforts by governmental agencies, conservation groups, industry, and private landowners. Though used primarily in the US, the ranks are gaining influence in Latin America and Canada. More recently, Partners in Flight (PIF), a multi-agency consortium of organizations concerned about bird conservation developed a system for prioritizing among the 800+ North American bird species (Pashley et al., 2000). The species prioritizations are used to provide guidance in developing and implementing broad-scale bird conservation plans across the continent and to assist conservationists and land managers in setting priorities for conservation action, management, and monitoring (Carter et al., 2000).

In this paper, we compare the conservation priorities identified through ranking systems of IUCN, NatureServe, and PIF for birds in North America. Because each system represents a valid method of codifying value judgements about acceptable levels of risk of endangerment and vulnerability of various taxa, we do not evaluate the “correctness” of resulting priorities. Rather our aim is to understand the implications of species priorities that result from various systems. We evaluate the results of each system in terms of overall distribution of species within prioritization rank categories. We then use species-level examples of congruence or lack thereof to evaluate the underlying biases of each system, as well as the ramifications of their resulting lists for directing conservation resources towards North American birds and their habitats. Finally, we propose a hierarchical approach to reconciling priority-setting systems with differing biological and geographical scopes. We do not compare species listed by the US federal Endangered Species Act in this paper, since the process used for this legislation does not explicitly evaluate all species for endangerment and the final decision to list or not is dependent on many non-biological factors.

2. Methods

2.1. Review of prioritization systems

The IUCN system ranks all the world’s vertebrate species, using multiple criteria for determining the degree of endangerment (Table 1). Very specific quantitative guidelines have been developed for each criterion for each level of endangerment. Any given taxon has to meet at least one of the criteria in order to be considered imperiled. The final product of the IUCN system is either a designation of the taxon as being in one of eight threat categories [extinct, extinct in the wild, critically

<table>
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<tr>
<th>PIF</th>
<th>NatureServe</th>
<th>IUCN</th>
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<tr>
<td>Relative abundance</td>
<td>Number of subpopulations</td>
<td>Known population decline</td>
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<td>Size of the breeding range</td>
<td>Viability of occurrences</td>
<td>Small area of distribution with decline or fluctuation</td>
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<td>Size of the non-breeding range</td>
<td>Trend in number of occurrences, population size, range</td>
<td>Small total population size with decline or fluctuation</td>
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<td>Degree of breeding range threat</td>
<td>Total population size</td>
<td>Very small or restricted population size or range</td>
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<td>Degree of non-breeding range threat</td>
<td>Size of geographic range</td>
<td>Results of population viability analysis indicating probability of extinction ≥ 10% in 100 years</td>
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<td>Importance of the area of consideration</td>
<td>Degree of threat</td>
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<td>Population trend in the area of consideration</td>
<td>Fragility and/or sensitivity to human disturbance</td>
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endangered (CR), endangered (EN), vulnerable (VU), conservation dependent, near threatened (NT), least concern (LC) or that the taxon is not considered at risk. In the analyses for this paper, the categories of extinct and extinct in the wild are not considered and there were no taxa with conservation dependent or least concern designations. Unlike IUCN priority lists completed for other vertebrate groups, the most recent IUCN analysis explicitly reviewed all bird species of the world, including all North American species considered by the NatureServe and PIF ranking systems.

The NatureServe system uses seven criteria, which are deemed to contribute to rarity or endangerment (Table 1). In determining the final conservation priority rank, these criteria are not equally weighted; they are considered in a hierarchical fashion, with number of subpopulations contributing the most information toward priority rank determination and fragility/sensitivity the least. The NatureServe system is based on the fundamental concept of the occurrence, which is roughly equivalent to a subpopulation, but with the additional notion that it represents a potentially conservable site for the species. The final product of the NatureServe system is a conservation priority rank from one to five, with a rank of one indicating highest conservation priority and a rank of five indicating lowest conservation priority. In standard practice, ranks of G1 (critically imperiled), G2 (imperiled), and G3 (vulnerable) are considered of conservation concern and ranks of G4 (apparently secure) or G5 (demonstrably secure) are not of concern. This system also includes two additional ranks for taxa presumed (GX) or possibly (GH) extinct. For these analyses, GX is not considered and we consider GH taxa to have a priority rank of G1 since this category is not shared by the other systems analyzed. NatureServe conservation priority ranks are derived for all North American biota in a hierarchical fashion at global, national, and state (or other sub-national political subdivision) levels (Master, 1991); for this analysis, NatureServe global ranks are used. Some taxa are assigned a range rank when it is not possible or the data does not exist to place it in a single category; in these cases, the rank of highest conservation priority in the range is used in the analyses.

The PIF conservation priority ranking system was designed specifically for prioritizing North American bird species for conservation purposes and is the only one of the three systems with such a taxon-specific focus. It has been in use since the early 1990s and has gone through several design iterations (Hunter et al., 1993; Carter and Barker, 1993; Carter et al., 2000). Although first developed for prioritizing nearctic-neotropical migrant species, it has been used for all bird species in North America, regardless of migratory status (Pashley et al., 2000). The PIF system consists of six vulnerability criteria (Table 1); each criterion is given a score ranging from one to five, with one indicating a low threat to survival of the taxon and five indicating a very high degree of threat (Panjabi et al., 2001). To compute a global priority score, all criteria are weighted equally and the scores for the criteria are added together. The PIF global score for a species can range from six (lowest priority) to 30 (highest priority). The summed score is used to place the species in a risk category: a sum >23 is recognized as extremely high priority (EH), scores 21–22 as moderately high priority (MH), and scores of 19–20 and a significantly declining trend as moderate priority (m) (Pashley et al., 2000).

The three prioritization systems discussed in this paper can be viewed as independent assessments of the conservation priorities of the taxa evaluated. Although at some level all systems have access to the same published and unpublished literature, the actual evaluations are done by different people using the distinct prioritization systems outlined above. For IUCN, the evaluations are done by BirdLife International staff (BirdLife International, 2000); for NatureServe, the evaluations are performed by a combination of staff of NatureServe itself with input from the network of Natural Heritage Programs (NatureServe, 2001); and for PIF, the evaluations are done by the species assessment working group (Panjabi et al., 2001). We know of no cases where the same persons have been involved in more than one evaluation system.

2.2. Comparisons among systems

The data set used for this analysis contained NatureServe global ranks, IUCN threat categories for all taxa, and PIF scores for the 710 bird species that occur regularly in North America north of Mexico. Taxa used were full species of birds regularly occurring in North America north of Mexico as defined by AOU (1998), supplemented by AOU (2000). IUCN threat categories came from the most recent published list for birds (BirdLife International, 2000). NatureServe ranks are continuously updated and, for the purposes of this analysis, were current as of March 2001 (NatureServe, 2001). PIF conservation priority scores used in this analysis were current as of June 2001 (Rocky Mountain Bird Observatory, 2001).

3. Results

3.1. Between-system comparisons

The three prioritization systems differed in the overall number of species placed in any risk category, with the PIF system having 22.1% (157) of North American bird species as compared to 7.3% (52) in NatureServe and 6.6% (47) in IUCN systems. The three systems showed a
closer correspondence in the species recognized as most at-risk. The NatureServe and IUCN systems showed overall correspondence in the degree to which species are considered of conservation concern; all IUCN critically endangered and endangered species were ranked G1 or G2, the highest NatureServe ranks (Fig. 1(a)). Only two species ranked demonstrably secure (G5) by NatureServe fell into any IUCN threat category (Fig. 1(b); Black-footed Albatross [*Phoebastria nigripes*], VU; Long-billed Curlew [*Numenius americanus*], NT). Only one species ranked critically imperiled by NatureServe was not considered vulnerable or higher by IUCN.

Fig. 1. Correspondence between IUCN threat category and NatureServe global rank. (a) Percent of species in each IUCN category by NatureServe global rank. (b) Percent of species in each NatureServe rank by IUCN category. Prioritization categories for both systems are explained in Section 2.
(Island Scrub-Jay \( \text{[Aphelocoma insularis]} \), NT). However, the intermediate categories of endangerment in both systems showed a lower degree of correspondence. For example, species in the vulnerable (VU) and near-threatened (NT) categories of IUCN fell into all five NatureServe ranks (Fig. 1(a)), and species with a NatureServe rank of G2 (imperiled) fell into four IUCN categories, including “none” (Fig. 1(b)).

Conservation priorities showed a coarse degree of correspondence between the NatureServe and PIF systems. For example, all species ranked critically imperiled (G1) by NatureServe were considered extremely high priority in the PIF system (Fig. 2(a)). The percentage of extremely high priority PIF in NatureServe rank categories declined with decreasing rank priority (Fig. 2(b)). However, a great deal of variation occurred within any specific category of either system, as shown by the multiple NatureServe ranks for any given PIF category (Fig. 2(a)) and the multiple PIF categories for the lower NatureServe ranks (Fig. 2(b)). Because of the larger number of species ranked as warranting conservation attention by PIF, it is not surprising that most species in the moderate and moderately high categories were not considered of conservation concern by NatureServe. In contrast, only 12 of 54 species with ranks of G1 to G3 did not score high enough to make the PIF’s priority list. These conservation “mismatches” are considered in greater detail below.

Fig. 2. Correspondence between PIF conservation priority and NatureServe global rank. (a) Percent of species in each PIF priority by NatureServe rank. (b) Percent of species in each NatureServe rank category by PIF conservation priority. Prioritization categories for both systems are explained in Section 2.
The IUCN and PIF systems also showed a coarse degree of correspondence, with all species categorized as endangered or critically endangered by IUCN considered as extremely high priority in the PIF system except one (Fig. 3(b); Cook’s Petrel [Pterodroma cookii]) and only seven of 546 species not considered a PIF priority had an IUCN category (Fig. 3(a)). Much variability existed, however, among any given category for both systems; for example, species considered vulnerable or near-threatened by IUCN fell into all four PIF priority categories (Fig. 3(b)) and species in PIF’s extremely high category fell into five IUCN categories, including “none” (Fig. 3(a)). A total of 26 species were considered extremely high priority by PIF but were not placed in any threat category by IUCN; these mismatches are discussed below.

3.2. Conservation priority mismatches

We define a conservation priority mismatch as a case where the different systems classify the same species in widely varying conservation priority categories. We also assigned a category for the mismatch based on our knowledge of each species’ distribution and ecology. Mismatches in conservation prioritization between at least one of the possible pair-wise combinations of systems were found for 139 species (19.6%). Encouragingly, only two species showed mismatches between all three systems: Black Rail (Laterallus jamaicensis; IUCN: NT; NatureServe: G4; PIF: EH) and Saltmarsh Sharp-tailed Sparrow (Ammodramus caudacutus; IUCN: NT; NatureServe: G4; PIF: EH). Complete lists of all species mismatches between the different systems are available upon request from the corresponding author.

By far the largest number of mismatches involved the PIF system, where 125 species had a higher priority in PIF than in IUCN, NatureServe, or both. This is partly a reflection of the fact that the PIF system identified as conservation priorities over three times as many species as both of each of the other systems. The mismatches involving PIF fell primarily into three categories of species: a group of 33 (26.4%) with relatively small total geographic ranges, but often with relatively high abundance within the range; a group of 40 (32.0%) which are only of peripheral occurrence in North America north of Mexico; and a group of 46 (36.8%) that have well-documented, range-wide population declines and threats, yet are still relatively widespread and numerous. Six additional species of pelagic or highly colonial breeders were involved in mismatches between PIF and the other two systems.

A relatively small total of 13 species was identified by IUCN or NatureServe or both as of higher conservation priority than by the PIF system. Ten (76.9%) of these were pelagic or highly colonial breeding species. The remaining species consisted of two of peripheral occurrence in North America and one widespread, but declining. The NatureServe and IUCN systems showed 26 mismatches. These consisted of ten (38.5%) pelagic or highly colonial species, nine (34.6%) with relatively small geographic ranges, two peripheral in North America, and five widespread but declining species.

4. Discussion

The three conservation prioritization systems discussed in this paper share a common conceptual approach of utilizing multiple potential endangerment criteria to derive conservation priority ranks over many taxa. The systems differ, however, in the extent to which the component criteria are weighted to derive the final priority score or rank. IUCN is the most quantitative of the three systems in that very specific numeric targets are specified for every category of endangerment, but a taxon only has to meet at least one of the criteria to be considered at risk. The NatureServe system uses unequal weighting, with the criteria being considered in a hierarchical fashion. Under this system, criteria at the top of the list (Table 1) contribute much more weight to the final priority rank than subsequent criteria. The PIF system utilizes equal weighting, in which each criterion contributes the same “importance” to the final priority score.
The three systems identified a higher degree or correspondence in identified conservation priorities at the highest and lowest levels of conservation concern than at intermediate levels. For example, all species considered critically endangered by IUCN were in the critically imperiled category of NatureServe (Fig. 1(a)) and the extremely high category of PIF (Fig. 3(b)), and the species not considered of conservation priority by PIF were in the large part in the lowest categories of NatureServe (Fig. 2(a)) and IUCN (Fig. 3(a)). This indicates that differences among the systems in how criteria are developed and weighted did not have much effect in identifying the highest priority species. Similarity among species lists results from all the systems using criteria that are known to determine or be closely correlated with extinction risk, even though the formulations and applications of the criteria differ among systems. At the broadest conceptual level these criteria encompass extinction risks posed from demographic stochasticity (criteria related to population size and density), environmental stochasticity (criteria related to range size), and population growth rate (criteria related to population trends and potential threats).

For the few cases in which one system ranked a species as a very high conservation priority but one or both of the other systems did not, the difference was largely attributable to the interpretation of basic population data rather than the application of the systems' endangerment criteria. As the priority ranking systems evolve to incorporate new and better information in species conservation status and threats, we expect the resulting priority lists to become even more similar. In fact, the PIF system is now being revised to better reflect information on global population size of species, as well as putting a greater emphasis on declining population trend. Nearly all species found to be ranking higher in the IUCN or NatureServe systems would now be ranked as higher priorities under the revised PIF system. Nevertheless, most of the species prioritization differences seem to indicate both a difference in interpretation of available information on range size and degree of threat. These differences suggest a need for re-evaluation by one or more of the systems involved. We suggest that those involved in developing and applying species prioritization systems work directly together to resolve and eliminate differences among priorities that are the result of differences in data availability and interpretation. This should include the sharing of all pertinent data, including that which is primarily available at local and national levels and which may be inaccessible internationally.

A notable difference between the PIF prioritization system and the two other systems is in the larger number of species recognized as needing conservation attention. In addition to identifying the same highest-priority species as IUCN and NatureServe, PIF identifies a large number of species that clearly are not in the same category of endangerment. Although some of these additional species are considered priorities due to their limited range in North America, many nonetheless show consistent indications of vulnerability that suggest concern for their overall populations might increase in the future. Indicators that appear, based on this analysis, to be interpreted differently by the prioritization systems considered include small geographic range size not accompanied by small total population size; a large geographic range associated with low abundance within the range, known threats, or documented declines; pelagic species; and highly colonial species. By recognizing these types of vulnerability, the PIF system includes an additional level of more forward-looking conservation prioritization, with the explicit goal of keeping relatively common species from reaching more dangerous levels of endangerment (Pashley et al., 2000).

The three prioritization systems compared here differ primarily in the scope of the taxa being compared, in both a geographic and a biological sense. The PIF system is designed and used for birds in North America only; it has a narrow biological scope (one taxonomic class) and applies to one continent. The NatureServe system was developed to prioritize conservation actions in North America, but is designed to be used for any taxonomic entity, including such non-taxonomic elements of biodiversity as natural communities (Noss, 1987). Hence, the NatureServe system has a narrow geographic scope and a wide biological scope. Finally, the IUCN system is applied to many different taxonomic groups across the planet and therefore has a wide biological and geographical scope.

These differences in scope are consistent with each system’s view of how many bird species in North America are considered of conservation concern. The system with the widest biological and geographical scope (IUCN) identifies the smallest number of species of concern in this data set. Conversely, PIF, with the narrowest biological and geographic scope, identifies the greatest number of species of conservation concern, with NatureServe intermediate in extent of the number of species identified. Hence, differences in scope of the prioritization system may be more important than differences in underlying philosophy in determining the proportion of species of birds of North America considered of conservation concern by each system.

To further illustrate this point, we estimated the total number of species considered of conservation concern over the complete biological and geographic scope of each prioritization system being compared. For IUCN, we used the percent of species of birds of the world in the threatened, near-threatened, and conservation dependent categories of Collar et al. (1994). For NatureServe, we calculated the percent of full species of vertebrates and invertebrates that have global conservation priority ranks of G1, G2, or G3. For PIF, we
computed the percent of North American bird species that were identified as of conservation priority (Pashley et al., 2000). When considered over their entire geographic and taxonomic scope, each system identified roughly 20% of the component taxa as being of conservation concern. We suggest that this result points to the robustness of all three systems in identifying the species of greatest concern within their particular taxonomic and geographic focus.

Our analyses suggest that identical taxon-level priorities across systems cannot be expected, given differences in biological and geographical scopes, and that conservationists may have to accept and understand the use of multiple systems. This is particularly true given that the “think globally, act locally” axiom requires conservationists and managers to think across different biological and geographic scopes. To reconcile the practical need for multiple scopes and potentially conflicting priority-setting systems, we suggest that conservation practitioners consider hierarchically nested species sets, in which the priorities of the system with the widest scope are nested within the next smallest, which are in turn nested within the system with the narrowest scope. In this way, species that meet thresholds for endangerment under global systems (e.g., IUCN) will be given top priority, followed by species considered most vulnerable relative to all continental biota (e.g., NatureServe). The PIF system, while also capturing the majority of globally and continentally vulnerable bird species, provides a second tier of species for consideration in proactive conservation planning.

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The effort that has gone into developing the three prioritization systems evaluated here and in assessing the taxa evaluated is enormous and impossible to estimate. However, we thank the countless individuals involved, whose work is critical for conservation purposes and without which we could not have written this paper. Comments from two anonymous reviewers considerably improved earlier drafts of the paper.

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