# The Partners In Flight

# Handbook on

# Species Assessment & Prioritization

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**Prepared by:**

**Arvind Panjabi**
**Partners In Flight Database Manager**

**With significant contributions from:**

**Carol Beardmore**
**Peter Blancher**
**Greg Butcher**
**Mike Carter**
**Dean Demarest**
**Erica Dunn**
**Chuck Hunter**
**David Pashley**
**Ken Rosenberg**
**Terry Rich**
**Tom Will**


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# INTRODUCTION

## A Brief History

In 1991, Partners In Flight (PIF) began developing a process to assess the conservation status of each bird species in North America. The principal objectives of this effort were to establish an unbiased means of identifying bird species that are most in need of conservation attention, and to identify areas where conservation efforts for those species are likely to be most effective. This system, which assigns scores to species in categories pertaining to their biology and conservation, was originally intended to assist in regional conservation priority-setting among breeding birds, specifically in U.S. states and PIF Physiographic Areas (PAs). More recently, the approach was applied at the continental scale to address species at the level of Bird Conservation Regions (BCRs), the common planning units under the North American Bird Conservation Initiative (NABCI). The system has also been appended to address the conservation of wintering birds.

The protocol formerly employed by PIF to assess regional conservation priorities was recently explained by Carter, et al (2000). However, that protocol has since undergone several modifications, with improvements resulting from discussions at recent ad-hoc meetings of PIF technical committees (Winnipeg, Manitoba, Feb. 2000; The Plains, Virginia, July 2000; Brighton, Colorado, Aug. 2001). These modifications have since been instituted, but there has been little documentation of the revised protocol other than in minutes recorded at these meetings.

## The Handbook

The purpose of this handbook is to describe the current PIF assessment and prioritization protocols including all changes that have occurred during their evolution since Carter et al. (2000). It is intended to be a complete guide and should serve to clarify all aspects of the process, including the interpretation and scoring of parameters carried in the PIF Species Assessment Database, and the use of parameter scores and other data to assess conservation priorities.

Today, the Species Assessment Process continues to evolve under the vision of the Multi-Initiative Species Assessment Committee (MISAC), which seeks to unite the various bird conservation initiatives by developing a single, consistently applied approach to assessing the conservation status of all birds. This effort draws heavily from the PIF species assessment approach, yet certain modifications may be necessary to achieve the greater good of a unified process. Although PIF is a fully supportive and active participant of MISAC, it is nonetheless important that PIF promote a clear understanding and justification of its own protocol as it engages in these discussions. Thus, this handbook has an important function not only with regard to current users of the PIF Species Assessment Database, but also to a much broader audience and the efforts of MISAC. This document does not reflect proposed revisions to the process that are pending under MISAC. However, because of ongoing refinements, it is important that users of this handbook ensure that they have a current version. This can be verified by matching the

version number of this handbook with the version number on the Species Assessment Database.

## The Database

Since the inception of PIF, the species assessment and prioritization data generated by PIF have been stored in a database administered by Rocky Mountain Bird Observatory (RMBO; formerly Colorado Bird Observatory). The database includes global (i.e., range-wide) and local (i.e., PA and BCR-specific) assessment scores for all species breeding and wintering in the U.S., and for most areas in Canada. It also includes source fields for each score that identifies the person or organization responsible for assigning the score, or in some cases, the dataset used to determine the score. Also included are the source data for each score, if empirical data were used to set the score. There is also a complete, preliminary dataset of assessment scores for all species breeding in Mexico that will eventually be integrated into the database. Scores can be viewed online via the World Wide Web, and the scores and all other relevant data (e.g., data source fields) can be downloaded as text files from the RMBO website at: http://www.rmbo.org/pif/pifdb.html.

## Assessment versus Prioritization

In this handbook, we distinguish between two components of bird conservation planning: assessment and prioritization. *Assessment* refers to the process of compiling and evaluating data regarding the biological vulnerability of each species, whereas *prioritization* describes the process for utilizing these data in determining relative conservation priorities among species. Confusion sometimes results when the terms are used interchangeably, but we have strived to maintain and elucidate their distinction in this handbook.

Species *assessment* can provide objective, unbiased data that are useful for various conservation applications, of which *prioritization* is one. The PIF approach to species prioritization, described below, follows directly from the species assessment scores and is therefore based primarily on biological vulnerability. Other bird initiatives or conservation efforts may prioritize species differently, taking into account other important factors (e.g., socio-economic influences, opportunities for action, etc.), but all of these methods can draw on a commonly derived species assessment database.

## An Overview of the Assessment Process

Under the PIF Assessment Process, scores are assigned to each species occurring regularly in Canada and the U.S. in six biologically based categories, termed *vulnerability factors*. These include: Relative Abundance (RA), Breeding Distribution (BD), Non-breeding Distribution (ND), Threats to Breeding (TB), Threats to Non-breeding (TN), and Population Trend (PT). Scores for each factor range from 1 (low vulnerability) to 5 (high vulnerability). A seventh factor, Area Importance (AI), reflects local *stewardship responsibility* and is scored on a similar scale based on the seasonal

abundance of each species in a PA/BCR (i.e., 1 reflects low abundance, 5 reflects high abundance). AI may be calculated for breeding or wintering populations. In addition, the percent of total species population (%POP) occurring in each area is included as another measure of stewardship responsibility.

Scores for the six vulnerability factors are generated first on the basis of global (i.e., range-wide) information. Global scores alone may be used in assessing range-wide conservation status (see **U.S. Watch List**, pg. 16). However, certain vulnerability factors can be assessed at multiple scales (e.g. PA, BCR). Therefore, in addition to the global scores, local (regional) scores are generated for TB, TN, and PT, when data are available. Local scores for these factors are used in place of global scores, where appropriate, in area-specific assessments at the PA or BCR level.

As an initial step in the PIF Prioritization Process, the six vulnerability factor scores are summed with AI to produce a single index of the overall conservation status for each species breeding or wintering in each PA or BCR. These *Total Assessment Scores*, along with other combinations of individual factor scores, are then used to generate *Priority Species Pools*, which focus conservation attention on the most important species in each region (see **PIF SPECIES PRIORITIZATION**, pg. 15).

In general, scores for RA, PT, and AI are derived using empirical data generated by the Breeding Bird Survey (BBS). Where BBS data are lacking, other available data sets are incorporated into the process, or expert opinion can be used to set scores (see below). Cut-offs between scores in each category are set so that the resultant distribution of scores among species is approximately normal (i.e., relatively few species receive scores of 1 or 5, more receive scores of 2 and 4, most receive 3). Although the current cut-offs for RA, PT, and AI are based on BBS data, the assessment process is designed to accommodate any data set, and equivalent thresholds can be established to produce parallel results using data other than those derived from BBS.

## Review of Scores & the Use of Expert Opinion in Scoring

Although the PIF approach to species assessment relies heavily on BBS data, for many species and regions, BBS data do not provide a clear picture of the parameter they are intended to reflect. Therefore, to ensure that the scores maintained in the database reflect the best available information, all scores should be reviewed periodically for accuracy.

Reviews are conducted by regional or species experts, who submit recommended changes to PIF Regional Coordinators on standardized review forms. *When assigning scores based on expert opinion, it is imperative that reviewers adhere strictly to the criteria provided in this document that delineate the cut-offs between scores.* Expert scoring independent of knowledge of these criteria is extremely dangerous, as the resulting scores may be skewed from the distribution of the rest of the scores in the database. Upon approval of the PIF Regional Coordinator, suggested changes are submitted to the Database Manager at RMBO for incorporation into the database. The database is updated on a periodic basis to reflect revised scores, and a new version number is assigned to the

database to acknowledge the changes. Records of the edited scores are stored (electronically, and as hard copies) at RMBO.

Instructions for submitting recommended changes to scores in the database, as well as the standardized " PIF Change of Score" forms, will soon be available on the RMBO website. RMBO also intends to develop a link on their website that will provide updates of recent changes to the database, so that users can easily maintain awareness of revised scores. RMBO plans to institute these features soon.

# THE PIF SPECIES ASSESSMENT FACTORS

## Relative Abundance – (RA)

***Relative Abundance (RA)*** *is a measure of the component of vulnerability that reflects the abundance of breeding individuals of a species, within its range, relative to other species.*

The premise behind the Relative Abundance vulnerability factor is based on the assumption that species that are rare or uncommon are more vulnerable to decline or extinction than species that are more common. Because RA is intended to reflect the rarity of a species across its range, it is calculated only at the global (i.e., range-wide) level.

Relative Abundance is derived for most species by calculating the average number of individuals detected per BBS route, using all the routes on which the species was detected across its range over the last 10 years (1990s). This number, rounded to the nearest tenth, is then applied against a set of abundance thresholds to determine the categorical variable RA (Table 1). Note that although conceptually similar, the method described in Carter et al. (2000) differs in that only the 10 BBS routes with the highest abundance were evaluated for each species. The exception to this rule for determining RA scores is for shorebirds, for which current RA scores have been derived using estimated total population size and were provided to the database by the U.S. Shorebird Conservation Plan (see Brown, et al 2001, for details on thresholds). Note that total population size is used in place of RA for other species of water birds, but these scores have not yet been provided to the database. In cases where no data exist to determine Relative Abundance, RA can be assigned by expert opinion using the equivalent verbal definitions, and by comparisons with better-known species.

**Table 1. Categorical thresholds for scoring Relative Abundance (RA).**

| RA Score | Criterion (avg. # birds/route*) | Definition |
|---|---|---|
| 1 | 25 | Occurs in highest relative abundance |
| 2 | 9, <25 | Occurs in high relative abundance |
| 3 | 3, <9 | Occurs moderate relative abundance |
| 4 | 1.5, <3 | Occurs in low relative abundance |
| 5 | <1.5 | Occurs in lowest relative abundance |

*Determined using only BBS routes upon which the species was detected.

## Breeding Distribution – (BD)

***Breeding Distribution (BD)*** *is a measure of the component of vulnerability that reflects the global distribution of breeding individuals of a species during the breeding season.*

The Breeding Distribution vulnerability factor is based on the assumption that species with a narrowly distributed breeding population are more vulnerable than species with a widely distributed breeding population. Because BD is an inherent feature of a species, it is calculated only at the global (i.e., range-wide) level.

Breeding Distribution is calculated by determining the area (in $km^2$), or amount of linear coastline (km), occupied by breeding-aged individuals during the breeding season, using range maps for the species in well-known field guides (e.g. Harrison 1983, National Geographic Society 1987, Howell and Webb 1995), as well as other information. The categorical variable BD is derived by applying the area occupied by the species against a set of area thresholds (Table 2). All birds are scored on the basis of their global range, except for those species distributed outside the western hemisphere that have named subspecies or disjunct populations within North America; such species are scored based on the global range of the appropriate taxon occurring in the western hemisphere. Note that thresholds for BD differ slightly from those described in Carter et al. (2000) and are no longer expressed as a percentage of North America.

**Table 2. Categorical thresholds for scoring Breeding Distribution (BD).**

| BD Score | Criterion |
|---|---|
| 1 | 4,000,000 $km^2$, or >8,000 km of coast |
| 2 | 2,000,000 and <4,000,000 $km^2$, or >5,000 to 8,000 km of coast |
| 3 | 1,000,000 and <2,000,000 $km^2$, or >1,600 to 5,000 km of coast |
| 4 | 500,000 and <1,000,000 $km^2$, or 1,600 km of coast |
| 5 | <500,000 $km^2$, or very restricted coastal areas or interior uplands |

## Non-breeding Distribution – (ND)

***Non-breeding Distribution (ND)*** *is a measure of the component of vulnerability that reflects the global distribution of a species during the non-breeding season.*

The Non-breeding Distribution vulnerability factor is based on the assumption that species with a narrowly distributed non-breeding population are more vulnerable than species with a widely distributed non-breeding population. Because ND is an inherent feature of a species, it is calculated only at the global (i.e., range-wide) level.

ND is calculated by determining the *smallest* area (in $km^2$), or amount of linear coastline (km), occupied by the population at any given time during the non-breeding season, thus taking into account some concentration factors important for shorebirds and other

species. ND is calculated using range maps for the species in well-known field guides (e.g. Harrison 1983, National Geographic Society 1987, Howell and Webb 1995), as well as other information. The categorical variable ND is derived by applying the area occupied by the species against the same set of area thresholds used in determining BD (Table 3). All birds are scored on the basis of their global range, except for those species distributed outside the western hemisphere that have named subspecies or disjunct populations within North America; such species are scored based on the global range of the appropriate taxon occurring in the western hemisphere.

**Table 3. Categorical thresholds for scoring Non-breeding Distribution (ND).**

| ND Score | Criterion |
|---|---|
| 1 | 4,000,000 $km^2$, or >8,000 km of coast |
| 2 | 2,000,000 and <4,000,000 $km^2$, or >5,000 to 8,000 km of coast |
| 3 | 1,000,000 and <2,000,000 $km^2$, or >1,600 to 5,000 km of coast |
| 4 | 500,000 and <1,000,000 $km^2$, or 1,600 km of coast |
| 5 | <500,000 $km^2$, or very restricted coastal areas or interior uplands |

## Threats to Breeding – (TB)

***Threats to Breeding (TB)*** *is an evaluation of the component of vulnerability that reflects the effects of current and future extrinsic conditions on the ability of a species to maintain healthy populations through successful reproduction.*

Scoring of TB involves assessing the expected change over the next 30 years in the suitability of breeding conditions necessary for maintaining healthy populations of a species. Threats to suitable breeding conditions are defined as any extrinsic factor that reduces the likelihood of the persistence of a population, and can include predation, poaching, parasitism, poisoning from pesticides or other environmental contaminants, habitat fragmentation, deterioration, or loss, hybridization, collisions with power lines or other hazards, and other extrinsic factors that reduce the suitability of breeding conditions. Although TB is considered to be one of the most subjective aspects of species assessments, it is nonetheless a valuable component of the Assessment Process, as TB scores are calibrated among taxa and subject to review. Threats scores in the database have been assigned by regional or local experts; the sources of all scores are maintained in the database.

The categorical variable TB is derived according to a multiple-choice list of scenarios (Appendix A) that place the species into one of the broad, relative threats categories (Table 4). It is important to understand that TB scores must be based on a species' ability to meet both the criteria given in the definition *and* one of the examples listed under that definition in Appendix A. Threats to Breeding is assessed at both the global (i.e., range-wide) and local (e.g., PA, BCR) level. In assessments of breeding species, local TB scores are used where available. Where local TB scores are unavailable, global TB scores are used as a substitute. Note that derivation of threats scores differs from that described in Carter et al. (2000) in that past conditions are no longer considered, and a

semi-quantitative matrix of conditions has been abandoned in favor of the more descriptive list of scenarios (Appendix A).

**Table 4. Category definitions for scoring Threats to Breeding (TB).***

| TB Score | Definition |
|---|---|
| 1 | Expected future conditions for breeding populations are enhanced by human activities or land-uses; potentially a 'problem' species |
| 2 | Expected future conditions for breeding populations are expected to remain stable; no known threats |
| 3 | Slight to moderate decline in the future suitability of breeding conditions is expected |
| 4 | Severe deterioration in the future suitability of breeding conditions is expected |
| 5 | Extreme deterioration in the future suitability of breeding conditions is expected; species is in danger of regional extirpation or major range contraction, or has a low probability of successful reintroduction where already extirpated |

* Note that actual scores are derived based on the list of possible scenarios in Appendix A.

## Threats to Non-breeding – (TN)

***Threats to Non-Breeding (TN)*** *is an evaluation of the component of vulnerability that reflects the effects of current and future extrinsic conditions on the ability of a species to maintain healthy populations through successful survival over the non-breeding season.*

Scoring of TN involves assessing the expected change over the next 30 years in the suitability of non-breeding conditions necessary for maintaining healthy populations of a species. Threats to the suitability of non-breeding conditions are defined as any extrinsic factor that reduces the likelihood of the persistence of a population, and can include predation, poaching, poisoning from pesticides or other environmental contaminants, disease, habitat fragmentation, deterioration or loss, collisions with power lines or other hazards, and other extrinsic factors that reduce the suitability of non-breeding conditions. Although TN is considered to be one of the most subjective aspects of species assessments, it is nonetheless a valuable component of the assessment process, as TN scores are calibrated among taxa and subject to review. Threats scores in the database have been assigned by regional or local experts; the sources of all scores are maintained in the database.

The categorical variable TN is derived according to a multiple-choice list of scenarios (Appendix B) that place the species into one of the broad, relative threats categories (Table 5). It is important to understand that TN scores must be based on a species' ability to meet both the criteria given in the definition *and* one of the examples listed under that definition in Appendix B. Threats to Non-breeding is assessed at both the global (i.e., range-wide) and local (e.g., PA, BCR) level. Note that derivation of threats scores differs from that described in Carter et al. (2000) in that past conditions are no longer

considered, and a semi-quantitative matrix of conditions has been abandoned in favor of the more descriptive list of scenarios (Appendix A).

**Table 5. Category definitions for scoring Threats to Non-breeding (TN).***

| TN Score | Definition |
|---|---|
| 1 | Expected future conditions for non-breeding populations are enhanced by human activities or land-uses; potentially a 'problem' species |
| 2 | Expected future conditions for non-breeding populations are expected to remain stable; no known threats |
| 3 | Slight to moderate decline in the future suitability of non-breeding conditions is expected |
| 4 | Severe deterioration in the future suitability of non-breeding conditions is expected |
| 5 | Extreme deterioration in the future suitability of non-breeding conditions is expected; Species is in danger of regional extirpation or major range contraction, or has a low probability of successful reintroduction where already extirpated |

* Note that actual scores are derived based on the list of possible scenarios in Appendix A.

**Note on the use of TB and TN scores for assessments of breeding and wintering populations:** Because the specific wintering areas of most breeding populations of migratory birds (and the threats relevant to birds wintering there) are not precisely known, *global TN scores are used in the overall assessments of most breeding birds*. Local TN scores may be used when the specific wintering grounds of a breeding population are known.

*Conversely, global TB scores are used in assessments of wintering birds*, as the specific breeding areas of most wintering populations of migratory birds (and the threats relevant to birds breeding there) are not precisely known. Local TN scores are used in assessments of wintering birds (TN_W). Where local TN scores are unavailable for assessments of wintering birds, global TN scores are used as a substitute.

For unambiguously sedentary populations (residents), both local TB and local TN scores may be used in regional assessments.

## Population Trend (PT)

***Population Trend (PT)*** *is a measure of the component of vulnerability reflected by the direction and magnitude of changes in population size over the past 30 years.*

The premise behind the Population Trend thresholds is that concern over trends should be based on what level of change is acceptable from a conservation standpoint over a relatively long period of time. Under the PIF assessment process, *all changes in population size are assessed over a 30-year period*. PIF has deemed a 50% decrease in population size over 30 years as intolerable, and thus species with negative trends yielding changes of such magnitude are given the highest PT score of 5. For the sake of

symmetry, species with trends yielding a  50% increase in population size over the same time period receive the lowest score of 1. PIF has agreed that trends yielding less than a +/-15% change over 30 years are considered stable. Species that have known stable trends or show a possible or moderate increase (i.e., <50%) over 30 years receive a moderately low score of 2. Likewise, species that show a possible or moderate decrease (<50%, but  15%) are given a moderately high score of 4.

For all the preceding cases, it is important to realize that such PT scores are assigned *only when the data upon which the trend is based are of a reliable quality* (see **Population Trend Data Quality**, pg. 12). Species for which the 30-yr trend is uncertain, either because of highly variable data or poor sample size, receive a score of 3; the reasoning being that uncertain trends invoke more concern than stable ones, and should therefore receive higher scores. Any species that receives a PT score of 3 as a result of BBS data (or a lack thereof) should be reviewed by experts so a that a more appropriate score can be assigned if more is known about the species' population trend.

PT is calculated at the global level (i.e., range-wide) for each species, using either Christmas Bird Count (CBC) or BBS trend data (analyzed and supplied by the BBS laboratory of the U.S. Geological Survey's Biological Resource Division), whichever is deemed more reliable. If both are considered equally reliable, that which yields the highest score is used. The rationale for this is that because of the limited coverage of both the CBC and BBS, either one or the other may be a better index to population trend, depending on the location of the breeding and wintering ranges of the species. Other long-term datasets can also be used, as long as trends are interpreted using thresholds equivalent to those presented here (Table 6). PT is also calculated at the local level (i.e., BCR, PA) using BBS or other data, and where available, local PT is always used in the assessment process for breeding species. Until better data become available for wintering populations, global PT is used in the assessment process for wintering birds.

Note that at present (November, 2001), trends based on CBC data are limited to the period 1959-1988, analyzed by John Sauer at Patuxent. A more complete analysis of CBC trends is underway, and all scores based on the initial analysis should be considered preliminary.

The categorical variable PT is assigned based on whether the trend data meet the thresholds for percent change in population size over the past 30 years (Table 6) *and* whether the quality of the trend data meet all three PTDQ thresholds (Table 7).

**Table 6. Categorical thresholds and definitions for scoring Population Trend (PT).**

| PT score | % Change over 30 yrs | Equivalent % annual change | Verbal Definitions (over past 30 years) |
|---|---|---|---|
| 1 | 50% increase | 1.41% | Large population increase |
| 2<br><br>2 | 15 - 49% increase,<br>OR<br><15% change | 0.63 to 1.41%,<br>OR<br>-0.77 to 0.63% | Possible or moderate population increase,<br>OR<br>Population stable |

| | | | |
|---|---|---|---|
| 3 | Highly variable, OR unknown | N/A | Uncertain population trend |
| 4 | 15% decrease | < -0.77 to > -2.36% | Possible or moderate population decrease |
| 5 | 50% decrease | -2.36% | Large population decrease |

**Population Trend Data Quality (PTDQ)**

Each local PT score has an associated Population Trend Data Quality (PTDQ) score that is an assessment of the reliability of the population trend data, based on the degrees of freedom (*N-1*) and the statistical significance (*p value*) of that trend. Thus, PTDQ reflects not only the quality of the trend data used to determine PT, but also the certainty that can be applied to any given trend value. PTDQ scores range from A1 (high quality) to F (poor quality), and should be considered alongside with PT. These scores are assigned based on three characteristics of the data: magnitude of the trend, degrees of freedom (e.g. number of BBS routes), and statistical significance of the estimated trend. PTDQ therefore takes into account problems associated with small sample size, high variability in the trend data, and small magnitude of change, all of which may reduce our confidence in a given trend estimate. For example, a score of C1 is assigned to a species that shows a strong and significant declining trend, but is based on a small sample of routes; this species has a PT of "4" ("possible decline"). Similarly, a score of D2 is assigned to a species showing a moderate declining trend, based on a large sample of routes, but with a high *P* value indicating high year-to-year variability in the data; this species has a PT of "3" ("uncertain trend"). Note that PTDQ is only an indicator of the reliability of PT, and is not an independent vulnerability factor used in the assessment process.

Although the PTDQ thresholds in Table 7 are based on BBS data, parallel thresholds could be designed using any dataset. Where empirical data do not exist for Population Trend, PT can be assigned by expert opinion, using the verbal definitions as guidelines. In these cases, PTDQ is assigned an "X" for expert opinion.

**Table 7. Thresholds for scoring Population Trend Data Quality (PTDQ).**

| PTDQ score | % Annual change | Degrees of Freedom (N-1) | P-value | Associated PTs |
|---|---|---|---|---|
| A1 | 1.41 or - 2.36 | 34 | 0.10 | 1, 5 |
| A2 | 0.63 to -0.77 | 34 | Any *P* | 2 |
| B1 | 1.41 or - 2.36 | 14-33 | 0.10 | 1, 5 |
| B2 | 0.63 to -0.77 | 14-33 | Any *P* | 2 |
| C1 | 1.41 or - 2.36 | 6-13 | 0.10 | 2, 4 |
| C2 | 1.41 or - 2.36 | 34 | > 0.10 and 0.35 | 2, 4 |
| C3 | 1.41 or - 2.36 | 14-33 | > 0.10 and 0.35 | 2, 4 |
| C4 | 0.63 to 1.41, or -0.77 to -2.36 | 14-33 | 0.10 | 2, 4 |
| C5 | 0.63 to 1.41, or | 34 | 0.35 | 2, 4 |

| | | | | |
|---|---|---|---|---|
| | -0.77 to -2.36 | | | |
| D1 | > 0.63 or < - 0.77 | 6-13 | >0.10 and 0.35 | 3 |
| D2 | > 0.63 or < - 0.77 | 34 | > 0.35 | 3 |
| D3 | > 0.63 or < - 0.77 | 1-5 | 0.35 | 3 |
| D4 | > 0.63 or < - 0.77 | 1-33 | > 0.35 | 3 |
| E | 0.63 to -0.77 | 1-13 | Any *P* | 3 |
| F | No Data | N/A | N/A | 3 |
| X | Any trend, Expert Opinion | N/A | N/A | 1,2,4,5 |

## Area Importance – (AI)

***Area Importance (AI)*** *reflects the relative importance of an area to a species and its conservation, based on the abundance of the species in that area relative to other areas.*

The reasoning behind the Area Importance concept is that conservation measures for species are likely to be most effective if enacted in core areas of the species' population rather than on the periphery. Because AI is based on an index of relative abundance (derived from the BBS, where appropriate), it is therefore not influenced by the size of the geographic region in question. Instead, AI reflects the per-hectare value of habitat in a given planning region and therefore can be useful in determining which areas may provide the greatest return (in terms of number of individuals protected) when enacting habitat conservation measures for a species.

For species sampled by the BBS, AI is calculated by first identifying the region (e.g., BCR, PA) with the highest mean number of individuals per BBS route, across all the BBS routes in that region, to derive a maximum abundance value. The mean numbers of birds per route in other regions are then scaled against this maximum abundance value, with the categorical variable AI scored based on the percent of the maximum abundance attained in a given region (Table 8). Therefore, all AI scores for a given species are relative to scores for that same species in different areas. AI scores can also be determined for wintering birds using an analogous method with CBC data. When BBS or other data do not exist for the species in question, AI can be scored by expert opinion using the verbal definitions as guidelines.

**Table 8. Categorical thresholds and definitions for scoring Area Importance (AI).**

| AI Score | Criterion (% of maximum abundance) | Definitions |
|---|---|---|
| 1 | < 1.0 | Does not occur in manageable numbers; could include species of accidental or sporadic occurrence |
| 2 | 1.0 to 9.9 | Present in low relative abundance, but occurs in manageable numbers in at least part of the region |
| 3 | 10.0 to 24.9 | Present in moderate relative abundance, |

| | | |
|---|---|---|
| | | relative to other parts of a species' range |
| 4 | 25.0 to 49.9 | Present in high relative abundance, relative to other parts of a species' range |
| 5 | 50 or more | Present in highest relative abundance within a species' range |

For some species sampled by BBS, relative abundance scores will fall below the "1% of maximum" threshold, even in areas where the species is a regular breeder. For example, Horned Lark occurs in such high abundance in the Central Shortgrass Prairie region (>160 birds per route), that its abundance is less than 1% of that value in many areas where the species is still fairly common. In these cases, the AI score may be changed from "1" to "2" by a regional expert, to indicate that the species does occur in manageable populations within a given region; all such changes are documented in the database.

**Percent of Population (%POP)**

In addition to the categorical variable AI, the percent of a species' total population that occurs in a given region is maintained in the database as a separate measure of the importance of an area to a species. However, percent of population (%POP) is not assigned a categorical score and is not used in the PIF Assessment Process. Instead, %POP values are used in relation to Area Thresholds to assign species to priority pools under the PIF Prioritization Process (see Tier II. High Regional Priority, pg. 18). Unlike AI, which is a relative measure, %POP is an absolute measure that *does* reflect the size of a given region; i.e., larger regions will support larger percentages of a species' population than smaller regions. Therefore, rather than indicating the per-hectare value of habitat in a region to a given species, %POP indicates the value of actions across an entire region to the conservation of the entire species.

The percent of species' populations may be estimated using BBS relative abundance data. For species sampled by the BBS, the relative abundance value for each region is multiplied by the size of that area ($km^2$) and then summed across all the regions in which the species occurred to yield a total "BBS population." The area-weighted value for each region is then divided by this total to yield the proportion of the total population in that area. Thus:

$$\%\ POP_{(Region)} = \frac{\text{Relative Abundance}_{(Region)} * \text{Region Area } (km^2)}{{}_{(All\ regions)}\ (\text{Relative Abundance}_{(Region)} * \text{Region Area})}$$

Estimates of % POP are not dependent on the accuracy of relative abundance values for individual routes; i.e., even if BBS greatly underestimates absolute abundance of "poorly sampled" species, such as nightjars and raptors, relative abundance values and %POP estimates should be valid, *as long as the detectability of a species on BBS routes is*

*relatively constant across the range of the species*. These estimates are more questionable for species occupying very patchy habitats (e.g. wetlands) in regions where BBS routes do not adequately sample these habitats. Also, %POP estimates could be misleading if applied to regions where BBS sampling is biased to only a small part of the area of interest; in such cases, a better measure of %POP could be applied, as described below. However, note that average relative abundance values for a species may be based on very few BBS routes recording that species, as long as the total number of routes sampled in a region is adequate. Therefore, relative abundance (and subsequent %POP) estimates do not suffer from problems of low sample size of detections on routes, as do trend estimates.

In cases where additional survey data for groups of species are available (e.g. waterfowl, colonial waterbirds), relative abundance and %POP estimates should be calculated with these data to compare with or replace BBS data. For some species (e.g. Piping Plover), direct censuses of populations exist and should be used to calculate the percentage of the total population in each region. In cases where quantitative data on relative abundance are unavailable or likely to be misleading, %POP may be approximated using the percent of a species range occurring in a given region.

# PIF SPECIES PRIORITIZATION

## Using the Assessment Factor Scores

As part of the PIF planning process, the factor scores described above are used to complete a conservation assessment for each species in each planning region. The species assessment process involves looking at various combinations of factor scores that indicate different categories of overall vulnerability to regional extirpation or major population declines. This includes the *Total Assessment Scores*, which give a single measure of overall vulnerability averaged across all the factors, as well as specific combinations of scores that can identify species that are particularly threatened or are of high stewardship importance in a given region. This assessment process is then used to set species priorities within each PIF landbird conservation plan.

An initial step in determining overall assessment is to consider the Total Assessment Scores. These are calculated for both breeding and wintering birds, using a combination of global and local vulnerability scores and either breeding or wintering Area Importance (AI) scores, as indicated below.

## Total Breeding Score (B_TotalScore)

Total Breeding Score is calculated using the following formula:

RA+BD+ND+TB_L+G_TN+PT_B+AI_B=B_TotalScore

where "_L" denotes a local score, "G_" denotes a global score, and "_B" denotes a breeding score. Because Relative Abundance (RA), Breeding Distribution (BD), and Non-breeding Distribution (ND) are inherent to a species, they are derived only at the global level. Local Threats to Breeding (TB) and Population Trend (PT) scores are used in calculating Total Breeding Scores, as those scores reflect area-specific information regarding those vulnerability factors. Because the specific wintering areas (and hence the threats relevant to those areas) of known breeding populations of migratory birds generally cannot be specified, global Threats to Non-breeding (TN) scores are used in determining Total Breeding Score. Area Importance (AI) is always local, and as one would expect, the AI for breeding populations is used in calculating Total Breeding Score.

## Total Wintering Score (W_TotalScore)

Total Wintering Score is calculated using the following formula:

RA+BD+ND+G_TB+TN_W+G_PT+AI_W=W_TotalScore

where "G_" denotes a global score, and "_W" denotes a wintering score. Because Relative Abundance (RA), Breeding Distribution (BD), and Non-breeding Distribution (ND) are inherent to a species, they are derived only at the global level. Local Threats to Non-breeding (TN) are used in calculating Total Wintering Scores, as those scores reflect area-specific information regarding threats during the non-breeding season. Because the specific breeding areas (and hence the threats and trends relevant in those areas) of known wintering populations of migratory birds generally cannot be specified, global Threats to Breeding (TB) and Population Trend (PT) scores are used in determining Total Wintering Score. Area Importance (AI) is always local, and as one would expect, the AI for wintering populations is used in calculating Total Wintering Score.

## U.S. Watch List

The PIF U.S. Watch List is one application of the Assessment Process that has been developed to highlight those birds of the continental United States that most warrant conservation attention based on their global (range-wide) scores, but that are not already afforded protection under the Endangered Species Act (Pashley, et al 2000). It is both an early warning system for birds that may be at risk and a device to draw national attention to the general condition of our avifauna.

Bird species not listed under the Endangered Species Act or peripheral to the U.S. whose global scores for Relative Abundance, Breeding Distribution, Non-breeding Distribution, Threats to Breeding, Threats to Non-breeding, and Population Trend sum to ≥ 19 are included on the list. For birds scoring 19 and 20, PT must be 5 and ≥ 3, respectively.

Birds on the list are categorized as Extremely High Priority (≥ 23), Moderately High Priority (21-22), and Moderate Priority (19-20). However, because the basis for categorization is a summed score, there is no single explanation as to why species may be

included. Some may be relatively common but undergoing steep population declines, while others may be rare but actually increasing in population size. Others still may be rare and declining, etc. Thus, the Watch List is not intended to drive local conservation agendas. Local agendas should be based on priorities identified within each PA or BCR.

## Priority Species Pools

To highlight those species most warranting conservation attention in a given area (e.g., PA or BCR), PIF generates a *Priority Species Pool* using various combinations of the six vulnerability factors, Area Importance, Percent of Population, as well as additional information. Priority species pools serve to guide regional conservation by focusing both planning and implementation efforts on a manageable subset of key species. Within PIF bird conservation plans, species in priority pools are then sorted into habitat-species suites, which become the targets of subsequent conservation efforts in a given planning unit. Population and acreage objectives for each habitat-species suite are then used to guide on-the-ground implementation of the PIF plan.

The Priority Species Pools, although organized into a series of *tiers*, are not necessarily intended to imply a hierarchical prioritization among the high priority species, but rather explain the reason for each species' inclusion in the priority pool. All species in the pool should be considered of conservation significance, with reliance placed on PIF bird conservation plans to discuss the actions warranted based on the means of entry. There are several means by which a species can be entered into this pool, as described below.

## Priority Pool Tiers

### Tier I. High Overall Priority

This tier includes species that are typically of conservation concern throughout their range. These are species showing high vulnerability in a number of factors, expressed as any combination of high factor scores leading to an average score > 3 (the midpoint). The Total Assessment Score must be 22, and AI must be 2 so that species without manageable populations in a region are omitted.

There are two proposed methods for subdividing Tier I, although neither has been officially adopted by PIF:

Method 1 (proposed for the Southeast US):
*Tier IA. Extremely High Priority:* Total Assessment Score 28, and AI 2.

*Tier IB. High Priority:* Total Assessment Score 22 and 27, and AI 2.

Method 2 (proposed for the Northeast US):

*Tier IA. High Overall Priority-High Regional Responsibility:* Includes species for which the region shares in major conservation responsibility; i.e., conservation in this region is critical to the overall health of this species. Total Assessment Score is 22, with AI 3.

*Tier IB. High Overall Priority-Low Regional Responsibility:* Includes species for which the region can contribute to range-wide conservation objectives where the species occurs. Total Assessment Score 22, but AI = 2.

**Tier II. High Regional Priority**

This tier includes species that are of moderate overall priority, but are important to consider for conservation within a region because of various combinations of high parameter scores as defined below. Total Assessment Score 19 and 21, and AI 2. There are currently three subdivisions of Tier II that have been adopted by PIF:

*Tier IIA. High Regional Concern.* Includes species that are experiencing declines in the core of their range and require short-term conservation action to reverse or stabilize trends. These are species with a combination of high area importance and declining (or unknown) population trend; Total Assessment Score = 19-21, with AI + PT 8.

*Tier IIB. High Regional Responsibility.* Includes additional species for which this region shares in the responsibility for long-term conservation, even if they are not currently declining or threatened. These are species of moderate overall priority with a disproportionately high proportion of their total population in the region; Total Assessment Score 19 and 21; with % POP > Area Threshold value for that region, roughly equal to the percentage of the regional area relative to North America south of boreal forest X 5 (Table 9). This rule applies to all areas except for the largest and smallest BCRs, which are capped at 25% and 3%, respectively.

**Table 9. %POP Area Thresholds for BCRs and PAs, used in assigning Tier IIB.**

| Area Threshold | Regions at given threshold |
|---|---|
| 1% | PAs 1, 26 |
| 2% | PAs 9, 10, 12, 15, 21, 23, 27, 44, 81 |
| 3% | BCRs 1, 15; PAs 2, 6, 13, 17, 22, 53, 69, 96 |
| 4% | BCRs 20, 30, 37; PAs 7, 66, 83, 84 |
| 5% | BCR 31; PAs 5, 8, 18, 24, 62, 82 |
| 6% | BCR 26; PAs 11, 42, 54, 86, 90 |
| 7% | PAs 4, 19, 36, 38, 40, 55, 85 |
| 8% | BCR 36; PAs 14, 16, 56 |
| 9% | BCRs 13, 21, 29, 32; PAs 31, 34, 93, 94 |
| 10% | BCR 25; PAs 3, 32, 33, 87 |
| 12% | BCR 23 |
| 13% | PA 37 |
| 15% | BCRs 2, 14, 17, 18, 19, 24, 33; PAs 28, 89 |
| 16% | PA 80 |
| 17% | PA 30 |

| | |
|---|---|
| 18% | PA 20, 39 |
| 20% | BCRs 5, 16, 22, 27, 28, 34, 35 |
| 25% | BCRs 3, 4, 6, 7, 8, 9, 10, 11, 12 |
| 26% | PA 64 |
| 48% | PAs 25, 68 |

*Tier IIC. High Regional Threats.* Includes additional species of moderate overall priority whose remaining populations are threatened, usually because of extreme threats to sensitive habitats; these species may be relatively uncommon in a region (low AI). These are species with high breeding threats scores within the region (or in combination with high non-breeding threats outside the region); Total Assessment Score 19 and 21, with TB + TN > 6, or local TB or TN = 5.

**Tier III. Additional Watch List Species**

This tier includes species that are on the U.S. Watch List (see Pashley et al. 2000), but are not included in the above tiers. These species score highly based on global criteria alone (sum of six global scores 20, or 19 with PT = 5), and warrant conservation attention wherever they occur with an AI 2. Species in this category are usually of moderate overall priority, but have stable or even increasing populations in a given region.

**Tier IV. Additional Federally listed Species**

Includes species listed under the Endangered Species Act in the U.S or Canada that are not already included in the pool. These species receive conservation attention wherever they occur; this tier captures those additional federally listed species that occur in the area with an AI 2.

**Tier V. Additional Species of Local Management Interest**

This tier is extremely flexible, and is the place where a species that is of local management concern, for any one of numerous reasons, can be entered into the priority pool. For example, species that are legally listed in states or provinces may be included here, as well as species with high socio-economic or cultural values, or species that are already included in other conservation plans.

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## Appendix A: Guidelines for determining Threats to Breeding (TB) scores

Threats are scored according to a multiple-choice list of possible scenarios, with different scenarios placing a species into one of five broad, relative threats categories. In order for a species to be placed a particular category, it must meet the criteria of that threats category definition, and meet one or more of the examples listed under the possible scenarios where given. It is important to understand that in order for a species to be assigned a given score, one or more of the example conditions listed *must actually be affecting the species at present, or be expected to impact the species within the next 30 years*. In other words, simply being susceptible to threats, without actually being impacted by such threats in the foreseeable future, is alone not enough to warrant being considered threatened.

**TB=1** **Definition:** ***Expected future conditions for breeding populations are enhanced by human activities or land-uses.***

This category includes potential problem species (e.g. cormorants, *resident* Canada Geese, House Finch, European Starling), along with other species that benefit from human activity, such as nest-boxes (e.g., American Robin, Tree Swallow, House Wren).

**TB=2** **Definition:** ***Expected future conditions for breeding populations are expected to remain stable; no known threats.***

One or more of the following statements should be true:

- no known threats to breeding population or habitats
- species relatively tolerant of human activities or land-use trends (i.e. breeds in altered landscapes)
- potential threats exist, but management or conservation activities have stabilized or increased populations (e.g. Osprey)
- "threats assumed to be low" (shorebirds plan)
- "population demonstrably secure" (shorebirds plan has this as TB=1)

**TB=3** **Definition:** ***Slight to moderate decline in the future suitability of breeding conditions is expected.***

This is a broad category that implies anything amounting to "moderate threats." One or more of the following statements should be true:

- moderately vulnerable to human activities and land-use trends
- does not breed in highly altered landscapes

- area-sensitive species; or sensitive to habitat fragmentation (with fragmentation actually occurring within a region)
- relatively specialized on sensitive habitats (e.g. native grasslands) or successional stages
- requires relatively specialized conditions within habitats
- relatively sensitive to biotic factors, such as cowbird parasitism, predation, overgrazing, etc.
- demographic factors contribute to vulnerability (low productivity, single-brooded)
- concentration or coloniality contributes to moderate vulnerability
- threats potentially increasing if present trends conditions continue
- population likely to decline in future if trends conditions continue
- no available information (shorebird plan)

**TB=4** **Definition:** ***Severe deterioration in the future suitability of breeding conditions is expected.***

This is essentially a "high threats" category, with basically more severe versions of the above list for TB=3, but for species that are not quite in danger of regional extirpation (TB=5). One or more of the following statements should be true:

- highly vulnerable to human activities and land-use trends
- highly area sensitive or intolerant of fragmentation (with fragmentation a significant factor within a region)
- highly specialized/ dependent on sensitive or undisturbed habitats (e.g. old-growth-dependent, upper margins of saltmarsh, etc.) that are in short supply or are under threat
- extremely specialized on specific conditions within a habitat (e.g. requires large snags or specific water levels) that are in short supply of under threat
- biotic factors (parasitism, hybridization) presently adversely affecting local or regional breeding populations
- concentration or coloniality makes populations highly vulnerable within the region
- threats ongoing -- presently affecting populations and likely to continue
- significant potential threats (e.g. oil spill) exist, but have not actually occurred (shorebird plan)
- population certain to decline and may reach level where in danger of extirpation if threats continue

**TB=5** **Definition:** ***Extreme deterioration in the future suitability of breeding conditions is expected; Species is in danger of regional extirpation or major range contraction, or has a low probability of successful reintroduction where already extirpated***

This designation should only be applied to species that are in danger of regional extirpation, or have been extirpated locally (e.g. Piping Plover, Loggerhead Shrike, Henslow's Sparrow, Red-cockaded Woodpecker), or when "known threats are actually occurring and can be documented", if these threats are severe enough to endanger regional populations.

## Appendix B: Guidelines for determining Threats to Non-breeding (TN) scores

Threats can be scored according to a multiple-choice list of possible scenarios, with different scenarios placing a species into one of five broad, relative threats categories. In order for a species to be scored, it must meet the criteria of the threats category definition and meet one or more of the examples listed under the possible scenarios where given. It is important to understand that in order for a species to be assigned a given score, one or more of the example conditions listed *must actually be affecting the species at present, or be expected to impact the species within the next 30 years*. In other words, simply being susceptible to threats, without actually being impacted by such threats in the foreseeable future, is alone not enough to warrant being considered threatened.

**TN=1** **Definition:** ***Expected future conditions for non-breeding populations are enhanced by human activities or land-uses.***

This category includes potential problem species (e.g. cormorants, *resident* Canada Geese, House Finch, European Starling), along with other species that benefit from human activity, such as bird-feeding (e.g., American Robin, Blue Jay, Black-capped Chickadee).

**TN=2** **Definition:** ***Expected future conditions for non-breeding populations are expected to remain stable; no known threats.***

One or more of the following statements should be true:

- no known threats to non-breeding population or habitats
- species relatively tolerant of human activities or land-use trends (i.e. over-winters in altered landscapes)
- potential threats exist, but management or conservation activities have stabilized or increased populations (e.g. Osprey)
- "threats assumed to be low" (shorebirds plan)
- "population demonstrably secure" (shorebirds plan has this as TN=1)

**TN=3** **Definition:** ***Slight to moderate decline in the future suitability of non-breeding conditions is expected.***

This is a broad category that implies anything amounting to "moderate threats." One or more of the following statements should be true:

- moderately vulnerable to human activities and land-use trends
- does not over-winter in highly altered landscapes
- area-sensitive species; or sensitive to habitat fragmentation (with fragmentation actually occurring within a region)
- relatively specialized on sensitive habitats (e.g. native grasslands) or successional stages
- requires relatively specialized conditions within habitats
- relatively sensitive to biotic factors, such as predation, intra- or inter-specific competition, overgrazing, etc.
- concentration (e.g. winter roosts) contributes to moderate vulnerability
- threats potentially increasing if present trends in conditions continue
- population likely to decline in future if trends in conditions continue
- no available information (shorebird plan)

**TN=4** **Definition:** ***Severe deterioration in the future suitability of non-breeding conditions is expected.***

This is essentially a "high threats" category, with basically more severe versions of the above list for TB=3, but for species that are not quite in danger of regional extirpation (TB=5). One or more of the following statements should be true:

- highly vulnerable to human activities and land-use trends
- highly area sensitive or intolerant of fragmentation (with fragmentation a significant factor within a region)
- highly specialized/ dependent on sensitive or undisturbed habitats (e.g. mature rainforest, mangroves, etc.)
- extremely specialized on specific conditions within a habitat (e.g. requires large snags or specific water levels)
- biotic factors (e.g., predation, competition) presently adversely affecting local or regional non-breeding populations
- abiotic factors (contaminants, over-hunting) presently adversely affecting local or regional non-breeding populations.
- concentration makes populations highly vulnerable within the region
- threats ongoing -- presently affecting populations and likely to continue
- significant potential threats (e.g. oil spill) exist, but have not actually occurred (shorebird plan)
- population certain to decline and may reach level where in danger of extirpation if threats continue

**TN=5** **Definition:** ***Extreme deterioration in the future suitability of non-breeding conditions is expected; Species is in danger of regional***

***extirpation or major range contraction, or has a low probability of successful reintroduction where already extirpated***

This designation should only be applied to species that are in danger of regional extirpation, or have been extirpated locally (e.g. Piping Plover, Loggerhead Shrike, Henslow's Sparrow, Red-cockaded Woodpecker), or when "known threats are actually occurring and can be documented", if these threats are severe enough to endanger regional populations.