The Partners in Flight

Avian Conservation Assessment Database Handbook

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Arvind O. Panjabi[1] – Bird Conservancy of the Rockies
Allison E. Shaw – Bird Conservancy of the Rockies
Peter J. Blancher – Emeritus, Canadian Wildlife Service, Environment and Climate Change Canada
Kenneth V. Rosenberg – Emeritus, Cornell Laboratory of Ornithology
Marcel A. Gahbauer – Canadian Wildlife Service, Environment and Climate Change Canada
Brooke Bateman – National Audubon Society
Adam Smith – Canadian Wildlife Service, Environment and Climate Change Canada
Dean W. Demarest – U.S. Fish and Wildlife Service
Wendy E. Easton – Canadian Wildlife Service, Environment and Climate Change Canada
Randy Dettmers – U.S. Fish and Wildlife Service
Tom Will – Emeritus, U.S. Fish and Wildlife Service

and the Partners in Flight Science Committee

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[1] primary contact: arvind.panjabi@birdconservancy.org

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Background

Partners in Flight (PIF) is a cooperative venture of federal, state, provincial and territorial agencies, industry, non-governmental organizations, researchers, and many others whose common goal is the conservation of North American birds. While PIF has traditionally focused primarily on landbirds, it works in conjunction with other partners to promote coordinated conservation of all birds, and now includes all North American bird species in its conservation status assessment database.

PIF follows an iterative, adaptive planning approach that develops a sound scientific basis for decision-making and a logical process for setting, implementing, and evaluating conservation objectives (Pashley et al. 2000, Rich et al. 2004, Berlanga et al. 2010). The steps include:

1. Assessing conservation vulnerability of all bird species;
2. Identifying species most in need of conservation attention at continental and regional scales;
3. Setting of numerical population objectives for species of continental and regional importance;
4. Identifying conservation needs and recommended actions for species and habitats of importance;
5. Implementing strategies for meeting species and habitat objectives at continental and regional scales; and
6. Evaluating success, making revisions, and setting new objectives for the future.

One of the principal tools supporting PIF's approach is the Avian Conservation Assessment Database (ACAD). ACAD represents a compendium of summarized and curated biological data and derived scores (i.e. ranks) intended to permit a consistent, transparent, and objective evaluation of the relative vulnerability of all North American birds to extinction or major extirpation—i.e., species assessment. Based on carefully-designed rulesets and thresholds representing unique individual or aggregate vulnerabilities, information from ACAD is used to classify species of conservation importance to assist with prioritization of resources. ACAD provides species assessments at regional (e.g., Bird Conservation Region or "BCR") and continental scales. ACAD is a joint product of PIF and other major North American bird conservation initiatives including the North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, and North American Waterbird Conservation Plan.

The 2024 *Avian Conservation Assessment Database Handbook* describes the biological assessment factors and data used in the assessment, and documents the rationale, rules and scores underlying the species assessment processes that ACAD captures. The information in ACAD was instrumental in supporting the *Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States* (Rosenberg et al. 2016) and *The State of North America's Birds 2016* (NABCI 2016). Previous versions of the handbook (Panjabi et al. 2001, 2005, 2012, 2017, 2019, 2020, 2021) document past iterations of ACAD, which supported other PIF applications including *Saving Our Shared Birds: Partners in Flight Tri-National Vision for Landbird Conservation* (Berlanga et al. 2010), and the *North American Landbird Conservation Plan* (Rich et al. 2004). All current and past ACAD scores, data sources, handbook versions, and other related information are maintained or archived by the Bird Conservancy of the Rockies. ACAD scores and data can be viewed online and downloaded as Excel files.

The handbook is presented in two principal sections. Part I details the assessment factors and scoring used by PIF to assess the vulnerability of species due to each biological factor (i.e., step 1 of the planning approach above). Each assessment factor is based on biological criteria intended to evaluate distinct components of vulnerability throughout the annual cycle of each species. Part II describes the use of the factors and corresponding scores to classify conservation importance among species at regional and continental scales (i.e., step 2 of the planning approach above). Both the scores and the process have evolved over time (Hunter et al. 1993; Carter et al. 2000; Panjabi et al. 2001, 2005, 2012, 2017, 2019, 2020) and have been updated in response to external review (Beissinger et al. 2000), expansion of scope of ACAD, and the emergence of new data and analytical tools (e.g. Rosenberg et al. 2019, Stanton et al. 2019, Fink et al. 2022).

Scope of ACAD

Taxonomic Scope

ACAD comprises assessment scores and associated data for all 1597 native (and 16 non-native) regularly-occurring bird species in North America, defined as the mainland, islands and waters of Canada south through Panama (excluding species breeding only in Greenland, the West Indies or Hawaii). Although ACAD tracks the status of certain non-native species for informational purposes, they are excluded from receiving any conservation status designation. Presence, taxonomy and nomenclature follow the American Ornithological Society (AOS) Checklist of North and Middle American Birds, 7th Edition, 63rd supplement (Chesser et al. 2022).

ACAD treats only full species (not subspecies) believed to be extant in the wild in North America. Likewise, for regional level assessments, ACAD only treats species determined to be extant within a given assessment region (e.g., BCR). Because the underlying vulnerability assessment is rooted in characteristics (e.g. relative abundance, threats) that require a species be present to be evaluated, ACAD is not readily applicable to extinct or extirpated species. However, because regional assessments incorporate certain local parameters such as trends and threats, in additional to global parameters, they may in part reflect the status of local subspecies. Species that have been regionally extirpated may be carried in ACAD with a designation of “ER” in those regions, but they are not fully assessed, and they are not identified as species of Regional Importance.

The following list comprises those native species omitted from ACAD on the basis of scientific consensus regarding their status as extinct from the wild in North America:

Labrador Duck
Heath Hen
Atitlan Grebe
Passenger Pigeon
Great Auk
White-faced Whistling-Duck
Guadalupe Storm-Petrel
Guadalupe Caracara
Carolina Parakeet
Slender-billed Grackle
Bachman's Warbler

We consulted AOS (Chesser et al. 2022; http://checklist.aou.org/taxa/) as the primary source for the above determinations, but other sources were consulted or a cumulative assessment of evidence was made in a few instances. For species where status remains somewhat equivocal, or where conservation programs continue to treat them as potentially extant, we erred on the side of caution, continuing to include them within ACAD (e.g. Socorro Dove, Eskimo Curlew, Ivory-billed Woodpecker).

Geographic Scope

The ACAD provides biological assessments for the birds of North America, currently defined as the continental mainland from Alaska and Canada south to Panama, including offshore islands and waters. ACAD does not currently include birds found only in Greenland, Hawaii, Guam, or the Caribbean, although northern migrants are now treated in four Caribbean regions, and wintering populations from Greenland (e.g., King Eider, Dovekie, Harlequin Duck) are included in regional avifaunal assessments.

The ACAD provides assessments for North American bird species at two scales: “Global” and “Regional”. However, these commonly used terms can be a bit confusing because both databases include some data at other scales. The Global ACAD, which is used to develop the North American Watch List, contains global assessments of population size and distribution size, but assessments of population trend and threats to breeding populations are limited to North America, even if a species has significant population or range beyond North America. For species that breed only within North America (i.e., most species in ACAD), global and continental scale assessments are the same. For the non-breeding “global” threats assessment, any and all areas used by the North American breeding populations outside of the breeding season are considered.

The Regional ACAD contains season-specific assessments of the avifauna in 54 assessment regions, primarily Bird Conservation Regions (BCRs) in the U.S., Canada and Mexico as defined by North American Bird Conservation Initiative, including combinations of BCRs in parts of Mexico (i.e., “Super-BCRs”), and individual countries in Central America (Appendix D). For the first time, the 2024 version of ACAD also includes four regions in the Caribbean (Greater Antilles, Puerto Rico and Lesser Antilles, Lucayan Archipelago, and Southern Caribbean), although only North American overwintering species and transient migrants are currently assessed in these regions. The Regional ACAD evaluates local population trend and threats, where known, and includes an additional assessment parameter, Area Importance, which is based on the percent of global population in each region in each season. The Regional ACAD also carries the global-scale assessments of population size and distribution size, which are then combined with the regional factors to identify species of Regional Concern and other categories of interest. This combination of global and regional vulnerability perspectives, combined with Area Importance, helps to emphasize conservation of core populations of globally-vulnerable species, and reduce emphasis on peripheral but otherwise widespread or common species.

Although the emphasis of ACAD is mainly on populations of birds that breed in North America, there are a few species that occur exclusively as non-breeders, mainly seabirds in offshore waters. These species are fully assessed in the Global ACAD, but because of the terrestrial nature of BCRs and other PIF assessment regions, regional assessments of seabirds are still a work in progress. Breeding seabird populations are included in avifaunal assessments of terrestrial BCRs. These populations utilize areas both within and outside of the BCR (i.e., in adjacent oceans) during the breeding season, and therefore regional assessments must consider factors such as threats in adjacent waters for these species. Non-breeding populations are currently included in assessments of adjacent terrestrial regions (e.g., BCRs), even though assessment parameters may pertain exclusively to populations and conditions at sea. In the future, marine BCRs may be adopted to better assess pelagic seabird populations during their non-breeding season, but for now including these species with terrestrial BCRs keeps them in sight of conservation planners on land.

Overview of the Species Assessment Process

Each species is assigned scores for six factors assessing largely independent aspects of vulnerability: Population Size (PS), Breeding (BD) and Non-breeding Distribution (ND), Threats during Breeding (TB) and Non-breeding (TN) seasons, and Population Trend (PT). Each score reflects the degree of vulnerability for the species (i.e., risk of significant population decline, major extirpation or extinction) due to that factor, ranging from "1" for low to "5" for high vulnerability. Scores are combined in various ways to produce an overall assessment of vulnerability, determine Watch List status and identify other categories of conservation importance.

PS, BD and ND are always scored at the global scale, as these vulnerabilities are defined by and inherent to the population as a whole. However, PT, TB and TN are scored at the continental scale (i.e. PT-c, TB-c, TN-c) and regional scale (i.e. PT-r, TB-r, TN-r) to reflect "local" variability in trends and threats within a species' range. All regional scores in the USA, Canada and northern Mexico presently use Bird Conservation Regions (BCRs) as the assessment unit. In the rest of Mexico, amalgamations of adjacent, ecologically similar BCRs, referred to as "super-BCRs", are used for the assessment. In Central America, where BCRs have not been defined, each country serves as the regional assessment unit. See Appendix D for more information on PIF assessment regions and recent changes to them.

To further depict local or regional conservation importance in the context of sustaining global/continental populations, PIF also provides a measure of Area Importance (AI) for each species in each region, i.e., the percent of the species' global population encompassed within the region. This information helps emphasize the importance of local or regional conservation attention in core population areas and highlights regions with high *stewardship responsibility* for characteristic species. Area Importance was previously only available for breeding-season avifaunas in each region, but now this measure is calculated for non-breeding avifaunas during migration and winter.

Steps 1 and 2 of the PIF planning approach encompass separate but related elements for identifying bird conservation needs at regional, continental and greater scales: status assessment and determining relative conservation importance. *Assessment* refers to the process of compiling and evaluating data on the biological vulnerability of each species using a standardized approach, whereas *determining level of conservation importance* describes the process for using these data to determine which individual species, species guilds, and habitats warrant attention, and at what level, in order to support PIF goals to maintain native birds in their natural numbers, natural habitats, and natural geographic ranges (Rich et al. 2004).

'*Prioritization*' is often mistakenly used as short-hand for step 2, but it is a more appropriate term applied to step 4 in the PIF planning process where action plans outline priorities for intervention based on biological criteria and may incorporate factors such as feasibility, cost-effectiveness, and political considerations along with the interests and capabilities of partners. Species are assessed for continental or regional conservation importance due to multiple biologically-based criteria, not all of which require immediate intervention. Although it is not the focus of the PIF Species Assessment Process and ACAD, they are valuable tools for setting conservation priorities based on sound, biologically-based information where all bird species are considered using equal and standardized criteria.

Vulnerability Factors:

Population Size (PS) assesses vulnerability due to the total number of adult individuals in the global population.

Distribution (BD/ND) assesses vulnerability due to the geographic extent of a species' range on a global scale, in breeding (BD) and non-breeding (ND) seasons.

Threats (TB/TN) assess vulnerability due to the effects of *current and probable future* extrinsic conditions that threaten the ability of North American populations to survive and successfully reproduce in breeding (TB) and to survive over the non-breeding season (TN).

Population Trend (PT) indicates vulnerability as reflected by the direction and magnitude of changes in North American population size since 1970.

Area Importance Factors:

Percent of Population (%Pop) is the percent of the global population of a species in a given region and has now been adopted as the primary measure of *Area Importance* (AI) in the PIF regional assessment. Whereas previously AI was assessed only for breeding-populations (AI-b), AI is now also assessed for wintering (AI-w) and migrating populations (AI-m) in each PIF region.

Previously, *Relative Density* (RD) was used as the primary measure of regional importance, but RD is no longer carried in ACAD.

PART I. PIF ASSESSMENT FACTORS

Vulnerability Factors

Population Size (PS-g)

Population Size (PS-g) indicates vulnerability due to the total number of breeding-aged adult individuals in the global population. Scoring of population size is based on the assumption that species with small breeding populations are more vulnerable to extirpation or extinction than species with large breeding populations.

PS-g Score	Criterion
1	Global breeding population ≥50,000,000
2	Global breeding population <50,000,000 and ≥5,000,000
3	Global breeding population <5,000,000 and ≥500,000
4	Global breeding population <500,000 and ≥50,000
5	Global breeding population <50,000

For landbird species occurring in Canada and the continental U.S., scores were assigned using population estimates derived primarily from count data collected by the North American Breeding Bird Survey (BBS) with adjustments for species detectability, then extrapolated to range size outside of BBS coverage (per Rosenberg and Blancher 2005); other data were used when appropriate (Rosenberg et al. 2016) with details in the *Handbook to the PIF Landbird Population Estimates Database* (Will et al. 2020). For the first time, these updated BBS-derived estimates include measures of uncertainty, as estimated by Stanton et al. (2019). For shorebirds, population estimates are mostly from the U.S. Shorebird Conservation Plan (2016), which is not limited to U.S. populations. Estimates for waterfowl are primarily from the *North American Waterfowl Management Plan* (NAWMP 2012, 2018), Wetlands International (2017), Conservation of Arctic Flora and Fauna International Secretariat (CAFF 2018), or Birdlife International's Data Zone. Estimates for waterbird species are primarily from Birdlife International (2016), IUCN (2016), Partners in Flight 2016 Central America Workshop, Rosenberg et al. 2019, Birds of North America (now integrated into Birds of the World), or Wetlands International (2017). For waterbirds and waterfowl, we multiplied estimates by 2/3 where it was likely they were based on non-breeding season surveys and thus represented total population (including adults and juveniles), as per instructions in the *Waterbird Population Estimates Database v.5* (Wetlands International 2017) to approximate breeding population size.

For species in Mexico and Central America where no population data were available, we assigned species to PS categories by converting the PS criteria in the table above into range-wide density criteria unique to each species based on the extent of its breeding distribution:

$$\text{PS-g criterion}_{\text{Density}} = \text{PS-g criterion} / \text{Area (km}^2\text{) of species' breeding range}$$

and then selected the most appropriate order-of-magnitude PS-density category for each species, considering published estimates or expert knowledge of the species' density within suitable habitat, availability of habitat across the range and habitat plasticity within the species. This process was also applied to U.S. and Canadian species in order to generate PS-densities and categories for species with existing population estimates and compare these across similar groups of species with and without independent population estimates to help assign the most appropriate PS-density categories for the lesser known species. In some cases, the geometric midpoint (2×10^x) of the range of population size within a PS category was assigned as the global population estimate, in which case the suffix "–PS-g midpoint" was added to the source field PS-g_s.

Breeding and Non-breeding Distributions (BD-g and ND-g)

The breeding distribution (BD-g) and non-breeding distribution (ND-g) scores indicate a species' vulnerability due to the geographic extent of its range in either the breeding or non-breeding seasons separately. The underlying assumption is that species with narrowly distributed populations are more vulnerable to individual risks and threats than species with widely distributed populations, and that this vulnerability can vary seasonally as migratory populations re-distribute. Distribution scores are assessed at a global scale.

BD-g or ND-g Score	Criterion (Extent of Occurrence)
1	≥4,000,000 km^2
2	≥1,000,000 and <4,000,000 km^2
3	≥300,000 and <1,000,000 km^2
4	≥80,000 and <300,000 km^2
5	<80,000 km^2

Distribution scores reflect the areal extent of occurrence (km^2) of adult individuals during the breeding season (BD-g), and the analogous extent of occurrence of all individuals during the portion of the non-breeding season when birds are relatively sedentary (ND-g). For resident species with largely sedentary, year-round populations, BD and ND are the same and scored identically. BD-g and ND-g are calculated using digital range maps available from NatureServe (Ridgely et al. 2007) and Birdlife International (year specified in data source). Range maps were reviewed for accuracy by the international PIF Science Committee and other taxonomic experts, and adjusted based on other data sources or expert knowledge concerning species distributions. The scoring criteria for BD-g and ND-g are complementary to Extent of Occurrence (EOO) criteria applied by the IUCN (2016) in their assessment of extinction risk for the IUCN Red List; the threshold for a PIF score of 5 (<80,000 km^2) is purposely set larger than the IUCN EOO threshold for 'Vulnerable' species (<20,000 km^2) in order to include a slightly broader suite of species in the top tier.

Both the breeding and non-breeding distribution scoring categories were developed primarily with landbirds in mind, but have been applied equally to all species distributed across the continental land masses of the planet. Seabirds nesting primarily on widespread oceanic islands require a slightly different approach due to the small areas occupied during the breeding season relative to their overall range extent including foraging areas. Although BD-g and ND-g do not attempt to measure habitat or portion of range occupied (they are coarse measures of range extent during the respective seasons), additional consideration can be given to the number and geographic distribution of nesting sites with the breeding ranges of island nesting seabirds when assigning BD scores. More work is needed in this area to refine rulesets.

Currently, there is no assessment of distributional area during migration seasons. More work is needed in this area. In the future, BD and ND, and possibly MD (Migration Distribution), could be derived from eBird STEM models, using a percent of population threshold (e.g., 95%) to exclude peripheral areas in each season from this measure.

Threats to Breeding (TB-c, TB-r) and Non-breeding (TN-c, TN-r)

Threats to breeding and non-breeding are scored separately and assess vulnerability due to the effects of current and probable future extrinsic conditions that threaten the ability of populations to survive and successfully reproduce during the breeding season (TB) or to survive over the non-breeding season (TN). The "continental" (in lieu of global) frame of reference for TB-c and TN-c reflects the intent to consider threats faced by populations relevant to North America only (i.e. Panama and north). Thus, for most species, TB-c considers threats occurring to populations within their breeding range in North America, and TN-c considers threats faced by these same populations throughout their entire non-breeding range. For oceanic seabirds, the relationship gets complicated, but the intent is to emphasize threats (breeding and non-breeding seasons) to the population segments that spend time in North America.

Threats are also scored regionally for species breeding (TB-r) or remaining in North America between breeding seasons (TN-r). Here the logic is similar to that described above for TB-c and TN-c, but the frame of reference for evaluating threats becomes those populations relevant to the regional unit (e.g. BCR, biome). We used the same criteria and thresholds to score continental and regional threats. Absent any evidence that regional threats differ from those evaluated continentally, the continental scores are adopted regionally.

Evaluation of TB includes threats to breeding habitats, as well as other factors that interfere with reproduction (e.g., competition with exotic species) or survival (e.g., predators). Evaluation of TN includes threats to habitat as well as other factors affecting survival outside the breeding season. Migration season threats are included in evaluation of TN, especially for birds facing significant known threats at critical migration concentration sites (e.g., many shorebirds). For most birds and especially landbirds, TN largely considers threats faced during the portion of the non-breeding season where birds are relatively sedentary (i.e. "temperate winter").

To score threats, an assessment is made regarding the expected change in the suitability of breeding or non-breeding conditions necessary for maintaining healthy populations of a species over the next 30 years. Threats 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/loss, hybridization, collisions with power lines or other hazards, predicted impacts of climate change or any other factor that reduces the suitability of breeding or non-breeding conditions.

Threats scores for U.S. and Canadian birds were assigned by members of the PIF Science Committee, with review and input from other formal and informal regional or taxonomic working groups, such as the (Trial) Unified Science Team of the U.S. Joint Ventures, the NAWMP National

Science Support Team, the Sea Duck Joint Venture, the Waterbird Working Group, and the U.S. Shorebird Conservation Partnership. Sources of all data and scores are maintained in the database. In Mexico and Central America, threat scores for all birds were assigned by ornithologists and conservation professionals in various national and regional workshops with a facilitator trained in PIF assessment to ensure calibration and consistency in scoring. Although threat scores are the most subjective of the species assessment criteria, the scoring thresholds are robust, and individual scores are calibrated among taxa and across geographic scales within species to promote consistency among species and regions facing similar threats. In practice, PIF has found close agreement among experts on the most appropriate threat scores.

Note that regional threats to non-breeding populations (TN-r), which were first added to ACAD in 2024, have been scored by local experts only in Central America, where it was done for nearly all resident and migratory species, and in Mexico, where it was done for all breeding species and some wintering migrants. TN-r has not yet been evaluated and scored by regional experts on the basis of local knowledge for resident or migratory species wintering in BCRs in the US and Canada, or for most migratory species wintering in Mexico. For now, TN-r has been populated for those species in those regions using TN-c for migrants and TB-r for residents (except in the case of newly added residents, which lack TB-r scores, and thus use TN-c). We hope to review all TB-r and TN-r scores in the future as we incorporate regional -scale climate change vulnerability.

The categorical variables TB-c and TN-c were assigned by placing each species into one of the broad, relative threats categories in the table below. For a species to be given a particular score, it must meet the relevant definition and at least one of the associated scenarios. Although not quantified explicitly, the scope (i.e., proportion of population affected), severity, and timing of threats are implicit considerations in evaluation of threats and assignment of scores. For a species to be assigned a given score, one or more of the example conditions listed *must be <u>significantly affecting a majority of the species' population at present</u>, or be expected to do so within the next 30 years*. In other words, simply being *susceptible* to threats, without actually being affected by such threats in the foreseeable future, is not enough to warrant a high threat score.

TB or TN Score	Definition	Scenarios	Examples
1	Future conditions for breeding (TB) or non-breeding (TN) populations are expected to significantly improve for the majority of the population.	Species that benefit substantially from human activity such as habitat fragmentation, urbanization, bird-feeding, etc.	Ruddy Ground Dove *(Columbina talpacoti),* Morelet's Seedeater *(Sporophila morelleti),* Shiny Cowbird *(Molothrus bonariensis)*

TB or TN Score	Definition	Scenarios	Examples
2	Future conditions for breeding (TB) or non-breeding (TN) populations are expected to remain stable; no significant threats.	a) no known threats of major significance to population or habitats b) species relatively tolerant of future changes likely to result from human activities or land-use trends (i.e., breeds or survives in altered landscapes, c) potential threats exist, but management or conservation activities have stabilized or increased populations d) threats are assumed to be low	a) Greater Roadrunner (*Geococcyx californianus*), Killdeer (*Charadrius vociferus*). b) Mallard (*Anas platyrhychos*), Gambel's Quail (*Callipela gambelli*). c) Wood Duck (*Aix sponsa*), Osprey (*Pandion haliaetus*), Great Blue Heron (*Ardea herodias*), Eastern Bluebird (*Sialia sialis*). d) Ruby-throated Hummingbird (*Archilochus colubris*)

3	Slight to moderate decline in the future suitability of breeding (TB) or non-breeding (TN) conditions is expected for the majority of the population. This is a broad category that implies anything amounting to "moderate threats."	a) Moderately vulnerable to human activities and land-use trends, with increased human activity expected b) does not occur in highly altered landscapes, with some expectation of increased landscape alteration within breeding or non-breeding range c) area-sensitive species, or sensitive to habitat fragmentation (with fragmentation expected to increase within the area for which scores are being assigned) d) relatively specialized on sensitive habitats (e.g., native grasslands) or successional stages that are limiting populations, or expected to become limiting, due to human activity or natural changes e) requires relatively specialized conditions within habitats that are limiting populations, or expected to become limiting, due to human activity or natural changes f) relatively sensitive to biotic factors that are being exacerbated by human activities, such as cowbird parasitism, predation, overgrazing, climate change, and other phenomena that are limiting populations g) demographic factors (low productivity, single-brooded) may contribute to limiting populations, especially when combined with other threats h) concentration or coloniality increases vulnerability to otherwise minor threats i) threats potentially increasing if present trends/conditions continue	a) American Avocet (*Recurvirostra americana*), Altamira Oriole (*Icterus gularis*) b) Blue-headed Vireo (*Vireo solitarius*), Common Loon (*Gavia immer*) c) White-tailed Ptarmigan (*Lagopus leucura*), Golden Eagle (*Aquila chrysaetos*) d) Eastern Meadowlark (*Sturnella magna*), American Woodcock (*Scolopax minor*). e) Elegant Trogon (*Trogon elegans*), Ferruginous Hawk (*Buteo regalis*), f) Fulvous Whistling-Duck (*Dendrocygna bicolor*),Atlantic Puffin (*Fratercula arctica*), Black-tailed Gnatcatcher (*Polioptila melanura*), Brewer's Sparrow (*Spizella breweri*). g) Some seabird, e.g., Thick-billed Murre (*Uria lomvia*), Red-tailed Tropicbird (*Phaethon rubricauda*) h) Aleutian Tern (*Onychoprion aleuticus*), . White Ibis (*Eudocimus albus*), Horned Puffin (Fratercula coniculata)

TB or TN Score	Definition	Scenarios	Examples
			i) Willow Ptarmigan (*Lagopus lagopus*),Long-tailed Duck (*Clangula hyemalis*), Sanderling (*Calidris alba*), Lark Bunting (*Calamospiza melanocorys*)

TB or TN Score	Definition	Scenarios	Examples
4	Severe deterioration in the future suitability of breeding (TB) or non-breeding (TN) conditions is expected to significantly affect a majority of the population. 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 extinction or extirpation from significant portions of range (TB =5).	a) highly vulnerable to human activities and land-use trends, with increased human activity expected b) highly area sensitive or intolerant of fragmentation (with fragmentation a significant factor within the area for which scores are being assigned) c) highly specialized/dependent on sensitive or undisturbed habitats (e.g., old-growth forest, upper margins of saltmarsh, etc.) that are in short supply, are under threat, or expected to come under threat d) extremely specialized on specific conditions within a habitat (e.g., requires large snags or specific water conditions) that are in short supply, under threat, or expected to decrease in availability e) biotic factors (parasitism, hybridization) currently are having or are expected to have a strong adverse effect on a majority of the breeding population f) concentration or coloniality leads to high vulnerability g) population highly likely to decline and may be in danger of major range contraction if threats continue	a) Muscovy Duck (*Cairina moschata*), Great Currasow (*Crax rubra*), Greater Prairie-Chicken (*Tympanuchus cupido*) b) Black-and-white Owl (Strix nigrolineata), Baird’s Trogon (Trogon bairdii), Bicolored Antibird (Gymnopithys bicolor), c) Bachman’s Sparrow (*Peucaea aestivalis*), Seaside Sparrow (*Ammospiza maritima*). d) Mountain Plover (*Charadrius montanus*), Mealy Parrot (*Amazona farinosa*). e) Mottled Duck (*Anas fulvigula*), Spotted Owl (*Strix occidentalis*), f) Red Knot (*Calidris canutus*), Cassin’s Auklet (*Ptychoramphus aleuticus*) g) Whimbrel (Numenius phaeopus), *Sprague’s Pipit (Anthus spragueii)*, Bell’s Vireo (*Vireo bellii]*), .

TB or TN Score	Definition	Scenarios	Examples
5	Extreme deterioration in the future suitability of breeding (TB-c) or non-breeding (TN-c) conditions is expected.	a) Species that are in danger of extinction b) Species that are at risk of extirpation from substantial portions of range within the area for which scores are being assigned c) Species with a low probability of successful reintroduction across a substantial former range.	a) Horned Guan (*Oreophasis derbianus*), Lesser Prairie-0Chicken (*Tympanuchus pallidicinctus*), Cassia Crossbill (*Loxia sinesciurus*), Saltmarsh Sparrow (*Ammospiza caudacuta*). b) Black Rail (*Laterallus jamaicensis*). Steller's Eider (*Polysticta stelleri*), Yellow-headed Parrot (*Amazona oratrix*), Baird's Sparrow (*Centronyx bairdii*) c) Whooping Crane (*Grus Americana*), Harpy Eagle (*Harpia harpyja*), Socorro Mockingbird (*Mimus graysoni*).

Note: derivation of threat 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 shown above.

Climate Change Vulnerability (CV-b/n)

Previously, threats related to climate change had been incorporated into the above scenarios only where such threats could readily be foreseen, for example for species restricted to alpine tundra, coastal wetlands, and other climate-sensitive environments that are expected to become less extensive and suitable for certain bird species under future climate change scenarios. However, for the vast majority of species, specific threats due to climate change were more difficult to assess. Bateman et al (2020) analyzed species' vulnerability to climate change as a function of a species' climate change exposure, sensitivity and adaptive capacity for 604 species across Canada, the United States, and Mexico using a combination of species distribution models and trait-based information. This analysis provided a basis for incorporating climate change vulnerability into the PIF continental-level threats assessment across a large number of species in the ACAD. Using the ratio of predicted range loss vs. potential range gain during both the breeding and wintering season, we calculated climate change vulnerability (CV) scores ranging from 1-5 for these species and where higher than TB-c/TN-c, averaged the resulting scores (subtracting 1 point if medium-low confidence in score) with existing continental threat scores in each season (TB-c, TN-c) to incorporate the predicted effects of climate change on future habitat suitability into the threats assessment.

Methods – See Appendix F for more details on the analysis and methods used to assign CV scores.

Population Trend (PT-c, PT-r)

Population trend indicates vulnerability due to the direction and magnitude of changes in population size since about 1970. Like the threat scores, population trend scores reflect trends for North American populations only, even for species with ranges that extend beyond the continent. We scored median population trend for a species across the North American continent (PT-c) and within each region (PT-r). Species with steeply declining trends are considered most vulnerable, whereas species with increasing trends are least vulnerable.

In contrast to previous PIF assessments, we have included two trend periods in PT scoring:

- "long-term" trends (LT), those since about 1970, or the longest available if shorter
- "short-term" trends (ST), those covering the most recent 3 generations, or 10 years if 3 generations is less than 10 years for a given species

The main reason for doing so is because the LT trend period is getting longer with each assessment, now at least 50 years for most species; it has become more obvious that recent trajectories of populations with the same LT trend can be very different, suggesting there might be more or less urgency for addressing the same LT declines depending on the most recent trajectory. Including the ST trends thus allows us to bump a PT score derived from LT trend up or down to reflect that ST urgency or lack thereof. Including a ST trend duration of 3 generations or 10 years has other advantages in that it is already being used by IUCN in its global assessment criteria of vulnerability relative to population trend (IUCN Standards and Petitions Committee 2022), and by others such as species assessment for the Canadian Species at Risk Act (COSEWIC 2021). This same emphasis on urgency, using ST trends in addition to LT trends, has been built into the Road to Recovery effort for birds.

The primary trend source for U.S. and Canadian landbirds was the BBS. We also used Christmas Bird Count (CBC) or other specialized data sources where these are the best available breeding or non-breeding data for North American bird population trends. For shorebirds, waterfowl and waterbirds, taxonomic experts considered a variety of surveys and analyses, ranging from BBS and CBC to the International Shorebird Survey (ISS) and others, and selected the most suitable survey for each species. In Mexico and Central America, where population trend data are lacking for nearly all species, scores for PT-c and PT-r were assigned by expert consensus during workshops involving dozens of ornithologists and other wildlife professionals using surrogate data on land cover trends combined with expert knowledge of the species' affinity for certain land cover types/conditions in order to assess population trends. These workshops were conducted between 2002-2005 in Mexico, and between 2014-2016 in Central America. This process included land cover trend data from CONAFOR in Mexico, and from CATHALAC and Global Forest Watch (GFW 2016) in Central America, combined with expert knowledge of the birds, their habitat associations and lands in question. Where empirical data did not exist, population trends scores were assigned by expert opinion using the qualitative definitions below as guidelines.

In this update, we had BBS trends for 1970-2021 from two separate analyses, one from John Sauer of USGS (pers. comm. 2023), the other from Adam Smith of the Canadian Wildlife Service (CWS, pers. comm. 2023). And the same was true for CBC trends to 2019. Results of these two alternative analyses were very similar for most species, though with some differences in ST trends. Trends from the two approaches were averaged in log scale, and used credible intervals (CI) that included the minimum and maximum upper and lower CI values across both, to fully capture uncertainty across both analyses.

Note that while most BBS analyses used a trend period of 1970-2021, for species with little or no coverage in early years, particularly northern species, later start years were used, e.g., 1993 (J. Sauer) or a species-specific start year depending on coverage (A. Smith).

Most waterfowl were scored using BBS or CBC trends. Trends for most arctic-breeding shorebirds were based on migration data from the International Shorebird Survey for 1980-2019, see Smith et al. 2023. Other trend sources varied in the years of data available but the years used are specified in the trend source field.

The table below shows how LT and ST trends were combined into a single PT score. LT trends are given more weight, while ST trends tend to bump the score up or down by a single score.

PT Scores and Criteria			% Pop'n Change from 3-generation Trend							
			≥ 30% Loss		0-30% Loss		0-30% Gain	≥ 30% Gain		
			P ≤ 0.1	ns	P ≤ 0.1	ns	Gain	Gain	**Row**	
% Pop'n Change from Long-term Trend	≥ 75% Loss	P ≤ 0.1	5	5	5	5	5	5	**A**	Very Large LT Loss
		ns	5	5	5	5	4	4	**B**	
	50-75% Loss	P ≤ 0.1	5	5	5	5	4	3	**C**	Large LT Loss
		ns	5	5	4	4	3	3	**D**	
	25-50% Loss	P ≤ 0.1	5	4	4	4	3	3	**E**	Moderate LT Loss
		ns	4	4	3	3	2	2	**F**	
	0-25% Loss	all	4	4	3	3	2	2	**G**	Small LT Loss
	0-50% Gain	ns	4	3	3	2	2	2	**H**	Small LT Gain
		P ≤ 0.1	3	3	2	2	1	1	**J**	
	≥ 50% Gain	ns	3	2	2	1	1	1	**K**	Large LT Gain
		P ≤ 0.1	2	2	1	1	1	1	**L**	
		Column	**1**	**2**	**3**	**4**	**5**	**6**		
			Large ST Loss		Small ST Loss		Small ST Gain	Large ST Gain		

Thus, for example a species such as Sanderling with a LT loss of 43% was elevated from a former PT score of 4 to a current PT score of 5 due to a steep significant ST loss of 48% (cell E-1 in the table above). And Canada Warbler with a LT loss of 62% had PT score lowered to PT=4 due to a ST gain of 23% (cell C-5 above).

A trend reliability filter was used to classify trends as unreliable, and give a PT=3 score, if the following were true:

- Neither LT nor ST trend was statistically different from 0 at P<90%
- Plus at least one of the following:
  - Very low LT trend precision: 90% CI on annual trends of 10% or more (i.e., UCI-LCI > 10%/yr);
  - Very low LT sample size (N): trends based on < 5 BBS routes or sample sites;
  - Very low LT sample size x Relative Abundance (RA): N x RA < 1.0;
  - Low regional range coverage: < 25% of range in a region covered by survey.

Generation times for ST trends were from Bird et al. (2020), adapted by Adam Smith for taxonomic changes.

In the absence of long-term, quantitative, species-specific trend data, PT scores can be assigned based on expert knowledge and/or surrogate datasets such as landcover change, using the qualitative descriptions provided below using the same timeframe (1970-present).

PT score	Qualitative description
1	Significant large increase
2	Significant small increase Possible increase Stable
3	Uncertain population change Possible small decrease Significant small decrease
4	Moderate decrease Possible large decrease
5	Significant large decrease

Because regional trends for non-breeding populations were not available in most regions, PT-r scores for most non-breeding species are based on continental trends (PT-c), except in Central America, where regional experts assigned PT-r scores based on local knowledge combined with landcover trend data from Global Forest Watch.

Methods – See Appendix G for more detail on population trend methods

Area Importance (AI-b, AI-w, AI-m)

Overall approach

The Partners in Flight (PIF) Avian Conservation Assessment Database (ACAD) includes several measures of species vulnerability, but also measures of area importance that have been used in the PIF regional species assessment. Previously, Relative Density (RD) was the primary metric used to assess the importance of various regions across a species' range, but now PIF has adopted the use of *percent of global population (%pop)* as its primary measure of Area Importance (AI). The %pop-based AI measure is more intuitive, simpler to calculate, additive across regions without requiring area-weighting, and removes a significant bias towards small regions that was present with Relative Density, which is simply %Pop / region area. The new AI scores range from 1 to 5, where:

1 = 0.05-0.9%   2 = 1.0-3.9%   3 = 4.0-9.9%   4 = 10.0-24.9%   5 = ≥25%

Note that %pop estimates are rounded to the nearest tenth decimal place when assigning AI scores, or in the case of the lower threshold for AI=1, the nearest one-hundredth decimal place. Species with less than .05% of population can also be assigned AI=1 if another data source, such as BBS, a Breeding Bird Atlas or a regional expert reviewer, confirms its regular occurrence in the region. Other species with values below .05% are assigned AI=0 and considered "peripheral"; these species are no longer carried in ACAD.

Until recently, PIF's assessment of Area Importance was largely based on relative abundance data from the North American Breeding Bird Survey (BBS), and therefore was assigned only for the breeding season. Gaps in scores, or inadequate BBS data, were filled by expert opinion or other survey data. South of the United States, RD scores were based almost entirely on expert opinion.

The eBird database now provides a quantitative means of assessing area importance for almost all North American bird species at any time of the year, well beyond the range of BBS coverage, allowing ACAD to expand to include assessments of non-breeding avifauna in all PIF assessment regions from Canada to Panama. Comparison of relative abundance data from BBS count data and relative frequency data from eBird checklists in regions well-sampled by both surveys showed good agreement between the two.

A particularly important advance has been the recent development of eBird Status and Trends models that are now available for 1,206 bird species in North America, or roughly 75% of all breeding species. This includes 436 species (91%) in Canada, 645 species (90%) in the U.S., 852 species (81%) in Mexico, and 888 species (77%) in Central America. eBird Status and Trend models attempt to control for the influence of effort, habitat, location, timing, and birder expertise on modeled distributions, and subsequent %pop values. Where available, eBird Status and Trends models (Fink et al. 2022) serve as the default data source for AI scores in ACAD.

Where models were not available as of May 2023, raw eBird data (eBird Basic Dataset, 2020; abbreviated EBD) through February 2020 were analyzed to derive AI scores. EBD-based scores performed well in regions with extensive eBird coverage so are a useful substitute, but differences between EBD and model-based scores across regions and seasons do exist. Some species continue to require other sources of area importance in the short term, particularly seabirds, since most eBird models are currently terrestrial.

Relative Density vs. Percent of Population

Switching from a Relative Density-based AI measure to a %Pop-based measure when assessing area importance reduces emphasis on small areas with high densities but otherwise small portions of the total population. It also means that some widespread species may not have high AI scores in any region, a useful change since no region has a high %pop (i.e., high importance) for these species. Gaps in eBird spatial coverage may affect %pop estimates more than relative density estimates for widespread species with a major portion of their distribution in poorly sampled areas, such as parts of Africa and Asia (e.g., Barn Swallow). There are also significant data gaps in the Arctic, in the Amazon, and in off-shore regions. Cornell's eBird Science team continues to work on expanding and refining models and we plan to update AI scores as more species are modeled in the future.

AI scores are calculated for breeding (AI-b) and non-breeding (AI-w) stationary periods based on %pop-b and %pop-w, respectively, and used in combination with vulnerability factor scores to identify Species of Regional Concern in each season while emphasizing conservation of core populations. AI scores are also calculated during migration (AI-m) using a slightly different approach to reflect "net" use during these periods, which is achieved by subtracting breeding and/or wintering populations from calculations of %pop during migration. AI-m scores also account for the length of time any given area is used during migration, given that populations are not stationary during these periods. The higher of the %pop values in spring (%pop-s) or fall (%pop-f) are used to determine AI-m scores, which are only calculated for species with at least 1% of global population in a region (AI-m>1) during either spring or fall, so as to not overwhelm regional species lists with rare migrants and vagrants. Because breeding and migratory periods may overlap for some species (i.e., many shorebirds, some waterbirds, etc.), AI-b scores derived from eBird models do not necessarily indicate breeding in a given region, and may instead reflect transient populations present during the breeding season, unless otherwise indicated. Note that feral populations (e.g., of Muscovy Duck, several Psittacines, etc.), as defined by eBird, are excluded from all %pop estimates.

With the switch to eBird based %pop estimates for all regions in ACAD, regional population estimates for most landbirds now differ from those published in the 2020 PIF Population Estimates Database, version 3.1, which are based on estimates derived from Breeding Bird Survey data. The PIF International Science Committee is working to reconcile these differences in the near future.

Methods - See Appendix E for more detailed analytical methods on deriving AI scores.

PART II. USING THE ASSESSMENT SCORES TO IDENTIFY SPECIES OF CONSERVATION IMPORTANCE

Since its inception, PIF has explored various means of combining assessment scores to highlight the current vulnerability and stewardship responsibility of species and their habitats. Whereas the ACAD serves as a repository for the individual vulnerability scores and their associated source data, it also provides a standardized, biologically-driven tool for identifying species of both continental and regional conservation importance. As federal and state agencies, Joint Ventures, conservation organizations, and other entities set priorities for bird conservation, the ACAD serves as a standard for developing priority species lists at various scales. Just as the IUCN Red List provides the go-to standard for identifying species most at risk of extinction globally, ACAD's Watch List and other products allow for the ranking and prioritization of species still too abundant and widespread to qualify for IUCN's Red List but nonetheless at risk of becoming vulnerable to extirpation or extinction. PIF's proactive approach to bird conservation therefore highlights the threats and needs of bird species across their full annual-cycle and before they become endangered or species at risk.

Species of Continental Importance

PIF recognizes several categories of species of continental conservation importance. The 'Watch List' was first established in the North American Landbird Conservation Plan (Rich et al. 2004. Panjabi et al. 2005). 'Common Birds in Steep Decline' was introduced in *Saving Our Shared Birds: a Tri-National Vision for Landbird Conservation* (Berlanga et al. 2010). Both of these categories are retained in the current ACAD, whereas the 'U.S.-Canada Continental Stewardship' species (Rich et al. 2004) and 'Tri-National Concern' species (Berlanga et al. 2010) are archived.

In this 2023-2024 version, we update the Watch List and the list of Common Birds in Steep Decline with the most recent data and differentiate between causes of concern among species. We also introduce new Tipping Point species categories to reflect the urgency to recover the most steeply declining species, in response to the recent report of nearly 3 billion birds lost from the North American avifauna since 1970 (Rosenberg et al. 2019). Together, the species on these lists reflect a diversity of reasons for recognizing continental importance, including high vulnerability, high stewardship responsibility, steep declines and high threats. This diversity of reasons for conservation importance reflects the large shared avifauna across a large continent and Partners in Flight's mission of helping species at risk, keeping common birds common, and engaging in voluntary partnerships to implement bird conservation.

Watch List Species

The Watch List comprises extant species of greatest conservation concern and includes those that meet a minimum threshold of overall vulnerability based on a combination of small and declining populations, limited distributions, and high threats throughout their ranges. Some of these species are already recognized as Threatened, Endangered, or At Risk at federal levels in various countries. The ACAD Watch List is intended to supplement the IUCN Red List by highlighting and ranking species of conservation concern at the continental scale that might not meet criteria for high global risk of extinction (i.e. ranked 'Least Concern' by IUCN).

To determine which species qualify as Watch List, we summed global scores pertinent to each season to arrive at Continental Combined Scores for breeding (CCS-b) and non-breeding (CCS-n) seasons, as follows:

$$\text{CCS-b} = \text{PS-g} + \text{BD-g} + \text{TB-c} + \text{PT-c}$$

$$\text{CCS-n} = \text{PS-g} + \text{ND-g} + \text{TN-c} + \text{PT-c}$$

The overall Maximum Continental Combined Score (CCS-max) for each species is simply the higher of the two CCS scores:

CCS-max = higher of CCS-b or CCS-n

The CCS-max can range from 4 for a widespread, numerous, and increasing species which is expected to face even more favorable conditions in the future to 20 for a species of the very highest conservation concern. Species are included in the Watch List if they have a CCS-max ≥ 14, or 13 in combination with PT-c = 5. Species that meet these thresholds are considered to exhibit high vulnerability across multiple factors. We further categorized species on the Watch List into three groups to help provide some understanding regarding why they are species of conservation concern:

Red Watch List: *Highly vulnerable and in urgent need of special attention.*

- CCS-max > 16 *OR*
- CCS-max = 16 *AND* [PT-c + (Maximum of TB-c or TN-c) ≥9]

Orange Watch List: *Steep and mostly continuing or accelerating declines and in need of urgent population recovery.*

On Watch List but not considered Red *AND* have either:

a) PS-g + (Maximum of TB-c or TN-c) = 10 *OR*

b) PT-c = 5 *AND*

- Half-Life ≤ 30 years *OR*
- Short-term Loss ≥ 30% *OR*
- Long-term Loss ≥ 75% *OR*
- CCS-max = 16 *OR*
- Any other score (e.g. PS-g, BD-g, ND-g, TB-c, TN-c) = 5

Yellow Watch List: *Moderate overall vulnerability and in need of population recovery or long-term planning to protect existing populations.*

- On Watch List but not considered Red *OR* Orange

Tipping Point Species

As part of the response to the loss of nearly 3 billion birds from the North American avifauna (Rosenberg et al. 2019), the Road to Recovery Initiative has identified a set of Tipping Point species urgently in need of focused and immediate scientific action to pinpoint causes of declines and to support practitioners dedicated to recovering their populations (https://r2rbirds.org/tipping-point-species/). Tipping Point species are further divided into three 'Urgency Alert' categories that correspond with the three categories of the ACAD Watch List:

Red Alert Tipping Point: *Highest urgency based on multiple high vulnerability scores, usually including perilously low population size and steeply declining or unknown population trend*.

- Corresponds with Red Watch List.

Orange Alert Tipping Point: *Large long-term population loss and continued or accelerating recent declines in need of urgent population recovery*.

- Corresponds with Orange Watch List.

Yellow Alert Tipping Point: *Large long-term population loss but improved recent status (may be responding to current conservation efforts but still require recovery to healthier population levels).*

- On Yellow Watch List *AND*
  - PT-c = 5 *OR*
  - Long-term Loss ≥ 50% *AND* Short-term Loss < 10% *OR* PS-g + (Maximum of TB-c or TN-c) ≥ 9

Note that the Tipping Point designation was developed primarily for species in the U.S. and Canada, due to its use of long- and short-term population trend data and quantitative population loss thresholds. The ACAD identifies species in Mexico and Central America that meet alternative criteria for Tipping Point categories, but these lists are still likely incomplete due to lack of trend data for most species in those regions and warrant further review by local experts.

Common Birds in Steep Decline (CBSD)

PIF also highlights a list of Common Birds in Steep Decline (CBSD) (Rosenberg et al. 2016). These are native species that do not exhibit broad levels of vulnerability that warrant Watch List designation, but their populations have declined continentally by an estimated 50% or more since 1970, or they meet current criteria for PT-c = 5 based on accelerating short-term decline. Together these Common Birds in Steep Decline have lost roughly a billion or more breeding birds during this period, raising concern for the vital ecosystem services that they provide. In 2024, PIF also began carrying a designation for Common Birds in Steep Decline at regional scales (CBSD-r) – see below for more information.

Species of Regional Importance

Species of Continental Importance should receive appropriate conservation attention within regions where significant populations occur, but these are not the only species that regional planners should consider. Many species that have moderate or even low Continental Combined Scores may be declining steeply within certain regions, or face higher threats than elsewhere. Species that are concentrated within a region also merit stewardship, even if they are not Watch List species. Here we describe the categories of species that PIF considers to be important at the regional scale and how those are determined. Note that the Area Importance criterion is used in various ways to help define these groups.

Designated due to Continental Importance in Region –2 Categories

Watch List: Species must meet all of the following criteria:

- Meet criteria for PIF Watch List (see above)
- Occur regularly in significant numbers in the region, i.e., AI > 1
- Future conditions are not expected to improve, i.e., Threat Score > 1

Common Birds in Steep Decline (CBSD): species must meet all of the following criteria:

- Meet criteria for Common Bird in Steep Decline continental designation (see above)
- Occur regularly in significant numbers in the region, i.e., AI > 1
- Future conditions are not expected to improve, i.e., Threat Score > 1

Designated due to Regional Importance – 3 Categories

Regional Combined Scores (RCS) are calculated for each species according to which season(s) (breeding or winter) they are present in the region with AI>1. The formulae include a mix of global and regional scores pertinent to each season. The Regional Combined Score for the breeding season (RCS-b) is a simple total of 5 scores:

RCS-b = BD-g + PS-g + PT-r + TB-r + AI-b

Regional Combined Scores for the non-breeding stationary (i.e. winter) period (RCS-w) are calculated by replacing breeding season values with non-breeding values:

RCS-w = ND-g + PS-g + PT-r + TN-r + AI-w

Regional Combined Scores for each season can range from 5 to 25. Currently RCS is not calculated for transient migrant populations due to the lack of corresponding distribution assessment scores for migration seasons.

Note that the Regional Combined Scores differ from the Continental Combined Scores in that they incorporate an Area Importance score (AI). Regional scores therefore include an element of stewardship responsibility, giving greater weight to those species in a group of equal vulnerability that have a higher proportion of the global population in the planning region.

The three categories of Regional Importance are:

Regional Concern (RC): Species must meet all criteria in the seasons for which they are listed:

- Regional Combined Score > 13
- High Regional Threats (TB-r/TN-r > 3), *OR* Moderate Regional Threats (3) combined with moderate to large regional population declines (PT-r > 3)
- Occur regularly in significant numbers in the BCR, i.e., AI > 1
- Native to North America (not “Introduced” as listed in AOS checklist)

Common Bird in Steep Decline in Region (CBSD-r): Species must meet all criteria:

- Does not meet criteria for Regional Concern
- Long-term regional decline of at least 50% *OR* PT-r=5
- Occurs regularly in significant numbers during the breeding season in the BCR, i.e., AI-b>1
- Future conditions are not expected to improve, i.e., TB-r > 1
- Native to North America (not “Introduced” as listed in AOS checklist)

Regional Stewardship (RS): Species must meet all criteria in the season(s) for which they are listed:

- High importance of the BCR to the species; %Pop> 25 (i.e., AI = 5)
- Future conditions are not expected to improve, i.e., TB-r or TN-r > 1
- Native to North America (not "Introduced" as listed in AOS checklist)

It is critical to note that while many species of conservation importance require immediate conservation effort, not every species highlighted from the assessment process should receive the same level of management attention or conservation action in every region. A few species are highlighted, at least in part, because of their relatively high concentration in a region and may be quite common and abundant. These species of "stewardship responsibility" are often missed when assessments consider only local conditions without the context of the global criteria. Partners in Flight identifies these species to support these birds, characteristic of a region, staying common.

Currently, transient migrant populations, i.e. those that neither breeder nor over-winter in a region but occur only during migration, cannot qualify for Regional Concern due to the lack of a Regional Combined Score, as explained above, nor can they qualify for Common Bird in Steep Decline in Region (CBSD-r) due to lack of regional population trend data for such species. However, transient migrant populations can qualify for Continental Importance in Region, as explained above, as well as for Regional Stewardship. Similarly, wintering populations also cannot currently qualify for CBSD-r, due to a lack of regional population trend data in ACAD for these species.

Using Species Assessment Data to Set Priorities for Action

While conservation assessment and planning happen at international, national and ecoregional scales, action is best taken locally by those who know how the lands, water, human, and natural communities will respond. The PIF Avian Conservation Assessment Database (ACAD) contains all scores for all assessment factors and conservation importance categories described above and can be used to generate a pool of regionally important species based on uniformly applied biological criteria. Regional planners may wish to add certain species to the pool, such as listed species at risk, species of cultural significance or economically important species (such as hunted species or targets of eco-tourism and birders) that do not meet the PIF criteria for a particular region. While these additional species should not be the main targets of regional conservation plans, their needs may often be addressed simultaneously with those of the regionally important species if all are considered together during conservation planning.

Action Codes

Additional information derived from biologically based criteria can be used to provide some guidance on priorities for taking action. For example, the PIF tables for preliminary BCR pools of important species also include codes for general categories of action most needed for improving or maintaining current population status of each species, defined from the PIF scores as described below.

CR (Critical Recovery)	Regional Concern species subject to extreme regional threats (TB-r or TN-r=5). Critical recovery actions are needed to prevent likely extirpation.
IM (Immediate Management)	Regional Concern species subject to high regional threats (TB-r or TN-r =4) combined with a large population decline (PT-r=5). Conservation action is needed to reduce and mitigate threats and reverse or stabilize significant, long-term population declines. Lack of action may put species at risk of extirpation.
MA (Management Attention)	Regional Concern species with moderate threats (TB-r or TN-r =3) and undergoing moderate to large declines (PT-r=4 or 5), *OR* with high regional threats (TB-r or TN-r =4) but no large decline (PT-r<5). Management or other on-the-ground conservation actions are needed to reverse or stabilize significant, long-term population declines where threats are moderate, or to reduce high threats in species within unknown or stable population trends.
PR (Planning and Responsibility)	Species of Continental or Regional Importance, but not Regional Concern (i.e., Continental Importance in Region due to Watch List, Common Birds in Steep Decline, or Regional Stewardship). Long-term planning actions are needed to ensure that sustainable populations are maintained in regions with high responsibility for these species. Actions often target many species at once, for example long-term multi-species monitoring programs, or broad plans/programs targeting suites of species sharing a habitat.

These codes indicate that not all species require immediate conservation attention, even though they may appear high on the Species of Regional Importance list, and for some species it may be sufficient to continue monitoring or periodic assessment to ensure that populations remain stable. Other species require more direct conservation action to identify and remedy factors causing population declines or limiting population growth. Sorting the pool of species by action codes can help planners identify groups of species with similar needs, promoting comprehensive planning to address many needs simultaneously.

Conservation Urgency Metric (half-life)

Central to maintaining a healthy avifauna is maintaining the abundance of birds fundamental for healthy habitats and functioning ecosystems in all regions and terrestrial habitats. As birds are excellent indicators of overall environmental health and their loss signals danger, we developed a Conservation Urgency Metric, a species' 'half-life', to reflect urgency for species predicted to experience rapid declines in the near future if current trends continue. *Half-life is the predicted number of years it would take for a species to lose half of its current estimated North American population, assuming no change to the most recent (short-term) continental trend.* First introduced in PIF's 2016 Landbird Conservation Plan, half-life estimates have been extended to all bird species and updated using the most up-to-date trend data for each species. Species have a half-life displayed only if they 1) are a PIF Watch List species or Common Bird in Steep Decline , and 2) have a half-life of 30 years or less with a short-term statistically significant trend, and a long-term negative trend.

Habitat and Geography

Because loss, degradation, and threats to habitat are likely the biggest factors resulting in population declines and high concern for bird species, the ability to group species by habitat and geography is an important component of conservation planning at continental and regional scales. Although information on habitat associations and other ecological requirements (e.g., food supply, nest site) can be compiled from the literature for each species (e.g., accounts in Birds of the World 2020), until recently there was no standardized terminology to describe avian habitats for all North American species, or standardized classification schemes for describing avian geographical distribution.

Although PIF has carried avifaunal biomes in ACAD since 2004, and habitat classifications since 2017, in 2021 we simplified and standardized the existing habitat and geography fields for all North American birds. Our goal was to create easily sortable groupings at a very broad scale, at the same time respecting the many hours of thought and deliberation that went into classifications of biomes in the 2004 *North American Landbird Conservation Plan* (Rich et al. 2004); analyses in *Saving Our Shared Birds* (Berlanga et al. 2010); habitats in the 2016 *Landbird Conservation Plan Revision* (Rosenberg et al. 2016); the *State of North America's Birds* (NABCI 2016) report that included major habitats for all species in Canada, U.S., and Mexico; habitat classification for the Central American PIF Species Assessment, which relied heavily on Stotz et al. (1996); and the habitat groupings underlying the analyses presented in the recent *Science* paper documenting the loss of abundance in the North American avifauna (Rosenberg et al. 2019).

As anyone who has tried to categorize bird species by either habitat or geography can attest, birds—by the very nature of their spectacular ecological diversity and omnipresence—are experts at thwarting human efforts to pigeon-hole [sic] them into neatly mutually exclusive bins. No system works perfectly, and human experts will go back and forth for hours over which categories make the most sense. The deeper we dove into systematic specificity (at least with the objective of finding mutually exclusive categories), the more we found that bird distributions and occurrences defied our efforts. So in the current ACAD classification, we attempted to create *categories that would be useful for comparing levels of concern across groups of species at a broad continental scale.* Also, recognizing the inevitable relationship between geography and habitat, we tried our best to *separate geography and habitat* as much as possible. In this way, by pairing a geography and a primary habitat for a species, it is possible to generate a relatively succinct (albeit simplified) description of its distribution and major habitat association.

The global ACAD provides **Breeding and Non-breeding Biome**, as well as **Primary and Secondary Breeding Habitat** and **Primary and Secondary Non-breeding Habitat** for all North American bird species. For species with global distributions, our focus is on the North American continent; for species populations migrating from North America to South American or Old World destinations, we designate the specific regions and habitats to which those North American populations are known to travel—to the extent our present limited knowledge allows.

Methods – See Appendix H for definitions of Avifaunal Biomes and Habitat Classifications and details on how they were derived.

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Appendix A. Database Dictionary

The following list explains the field headings (in alphabetical order) in the Partners in Flight Avian Conservation Assessment Database (https://pif.birdconservancy.org/avian-conservation-assessment-database/), including fields found only in the downloadable table. The database should be used in consultation with this Handbook, which further defines the terms listed below.

field	definition
%pop-b	Percent of global population in region during breeding season
%pop-w	Percent of global pop in region during winter (stationary non-breeding season)
%use-f	Percent use value for fall migration, incorporating "net" abundance (i.e. %pop-b and %pop-w subtracted from migration's %use) and duration of use
%use-m	Maximum of percent of global pop's spring vs. fall migration period spent in this region
%use-s	Percent use value for spring migration, incorporating "net" abundance (i.e. %pop-b and %pop-w subtracted from migration's %use) and duration of use
Action Code	The broad level of action recommended to address conservation needs. CR=Critical Recovery; IM=Immediate Management; MA=Management Attention; PR=Planning and Responsibility)
Agriculture	Species found frequently in agricultural habitats during breeding (b), winter (w) or both (b,w).
AI-b	Area Importance score of the region during breeding season (including non-breeders present)
AI-b#	Numeric format of AI-b field, where Extirpated Regionally (ER) species are assigned a 0.
AI-b_s	Data source for %pop-b and AI-b fields. See handbook to decode sources.
AI-f	Area Importance score of the region during fall migration for species classified as migrants
AI-f_s	Data source for AI-f field. See handbook to decode sources.
AI-m	Area Importance score of the region based on the migration season (spring or fall) with highest migration through this region
AI-m_s	Data source for AI-m field. See handbook to decode sources.
AI-s	Area Importance score of the region during spring migration for species classified as migrants
AI-s_s	Data source for AI-s field. See handbook to decode sources.
AI-w	Area Importance score of the region during winter (stationary non-breeding season)
AI-w#	Numeric format of AI-w field, where Extirpated Regionally (ER) species are assigned a 0.
AI-w_s	Data source for %pop-w and AI-w fields. See handbook to decode sources.
BCR	Bird Conservation Region, with map available at http://nabci-us.org/resources/bird-conservation-regions-map/. See handbook where region has asterisk.
BD area	Area estimate (in km2) of global breeding distribution
BD-g	Assessment score for global breeding distribution (breeding range size)
BD-g_com	Comments for global breeding distribution score

BD-g_s	Source for global breeding distribution score
Breeding Biome	The main geographic region in which a species occurs during its breeding season.
breeds	Breeding confirmed in the region based on regional reviewer input.
C America	Occurs in Central America
Canada	Occurs in Canada
CBSD-r	Regional Common Bird in Steep Decline. Limited to breeding season, so marked as "b".
CCS-b	Continental Combined Score for breeding season
CCS-max	The higher of CCS-b and CCS-n
CCS-n	Continental Combined Score for non-breeding season
CIR CBSD-c	The season(s) in which a species qualifies for Continental Importance in Region due to Common Bird in Steep Decline (continental designation).
CIR Watch List - season	PIF Watch List category and season (b = breeding season, w = winter, m = migration) in which it qualifies for Continental Importance in Region
Common Name	English Common Name following the AOS 7th Edition Check-list, 63rd supplement (Chesser et al. 2022)
Continental Importance	Category of Continental Importance: Red, Orange and Yellow Watch List, Tipping Point, and Common Bird in Steep Decline. Previously Watch List species are also identified here.
core/extended BBS	Breeding Bird Survey extent for trend estimates from US Geological Survey (1=just core BBS survey area was analyzed; 2=extended BBS survey area was analyzed).
coverage	Estimate of the proportion of breeding season pop that occurs within degree-blocks (cells of 1x1 degree latitude by longitude) that have BBS routes that contribute data to the trend model for that species in that region.
CV-b	Climate Change Vulnerability score for breeding populations
CV-b certainty	Climate Change Vulnerability score certainty rank for breeding populations
CV-w	Climate Change Vulnerability score for wintering populations
CV-w certainty	Climate Change Vulnerability score certainty rank for wintering populations
family	Family according to AOS 7th edition checklist, 63rd supplement
Global Pop Size	Estimate of global population size (breeding-aged individuals) in text format to include </> signs
Global Pop Size#	Estimate of global population size (breeding-aged individuals) in numeric format to allow sorting
group	Type of bird (waterbird, waterfowl, shorebird, landbird)
Half-Life	Projected timeframe (in years) until 50% of remaining population is lost.
Introduced	1=Introduced species in North America, according to AOS 7th edition checklist, 63rd supplement
IUCN Red List 2023	Conservation status according to the IUCN Red List of Threatened Species (2023): EW: Extinct in the Wild; CR: Critically Endangered; PE: Possibly Extinct; EN: Endangered; VU: Vulnerable; NT: Near Threatened; DD: Data Deficient. If no code listed, then Least Concern (LC).
LT % change	Estimated cumulative change in population size over the Long Term trend period listed in the PT-r_s field. If not defined, the period is 1970-2021.

LT CI width	Long Term trend 90% Upper Credible Interval Limit minus Lower Credible Interval Limit
LT sig	If 1: Long Term 90% Credible Interval excludes zero. If blank, not statistically significant at 90% Credible Interval.
LT Trend (%/yr)	Estimated annual % change in population size over the Long Term trend period listed in the PT-r_s field. If not defined, the period is 1970-2021.
LT trend 90% lcl	Long Term trend 90% Lower Credible Interval Limit
LT trend 90% ucl	Long Term trend 90% Upper Credible Interval Limit
Mexico	Occurs in Mexico
Mig Status	R = Resident, M = Migrant or partial migrant
N	Number of BBS routes in which species was ever detected during the long term trend period within the core BBS survey coverage
ND area	Area estimate (in sq. km) of global non-breeding distribution
ND-g	Assessment score for global non-breeding distribution (winter range size)
ND-g_com	Comments for global non-breeding distribution score
ND-g_s	Source for global non-breeding distribution score
Nonbreeding Biome	Primary geographic region in which species occurs during its stationary nonbreeding season
Nonbreeding only	1 = occurs only as a non-breeder in North America, according to AOS 7th edition checklist, 63rd supplement
NxRA	BBS routes that ever detected the species, multiplied by median relative abundance
order	Order according to AOU 7th edition checklist, 63rd supplement
Pop Size_US-Ca	Current population size estimate (breeding-aged individuals) for continental U.S. and Canada in text format to include </> signs
Pop Size_US-Ca#	Current population size estimate (breeding-aged individuals) for continental U.S. and Canada in numeric format to allow sorting
Pop Size_US-Ca_com	Comments regarding continental U.S. and Canada population size
Pop Size_US-Ca_s	Source for continental U.S. and Canada population estimate
PopYr	Year associated with Pop Size_US-Ca population size estimates, or primary year or average year if many years involved; in most cases this indicates the year(s) the survey was conducted, but in some cases (e.g. USSCP 2016) it indicates the year of publication of estimates (e.g. Andres et al. 2012).
Primary Breeding Habitat	The broad habitat class (e.g. Forests) and more specific habitat description (e.g, Tropical Lowland Evergreen), of the primary breeding habitat used by each species.
Primary Nonbreeding Habitat	The broad habitat class (e.g. Forests) and more specific habitat description (e.g, Tropical Lowland Evergreen), of the primary non-breeding habitat used by each species.
PS-g	Assessment score for global population size (breeding-aged individuals)
PS-g_com	Comments regarding global population size and score
PS-g_s	Source of global population size estimate (breeding-aged individuals)
PT-c	Assessment score for continental population trend
PT-c_com	Comments for continental population trend score
PT-c_s	Source for continental population trend score

PT-r	Assessment score for regional population trend
PT-r_com	Comments for current regional population trend score
PT-r_s	Source for current regional population trend score and trend. See handbook to decode sources.
RA	Relative Abundance: (1) for PT-c, average of the annual index of the 3 middle years of the long-term trend period, (2) for PT-r, median annual index over the long term trend period
RC	Season(s) in which species qualifies for Regional Concern (b=breeding, w=winter). Currently, species can not qualify during migration.
RCS-b	Regional Combined Score for breeding season
RCS-w	Regional Combined Score for winter
region	Geographic scope of regional conservation assessment. In Central America, countries. In Canada, USA, and USA/Mexico border, Bird Conservation Regions. See handbook for Mexican regions and asterisks.
Regional Importance	Categories of Regional Importance the species qualifies for in the region
RI season	Season(s) in which species qualifies for Regional Importance (b = breeding season, w = winter, m = migration)
RS	Season (b = breeding season, w = winter, m = migration) in which species qualifies for Regional Stewardship list
Scientific Name	Scientific Name following the AOS 7th Edition Check-list, 63rd supplement (Chesser et al. 2022)
Secondary Breeding Habitat	The broad habitat class (e.g. Forests) and more specific habitat description (e.g, Tropical Lowland Evergreen), of the secondary breeding habitat used by each species (if applicable).
Secondary Nonbreeding Habitat	The broad habitat class (e.g. Forests) and more specific habitat description (e.g, Tropical Lowland Evergreen), of the secondary non-breeding habitat used by each species (if applicable).
sort	Order according to AOU 7th edition checklist, 63rd supplement (Chesser et al. 2022)
ST % change	Estimated cumulative % change in population size over the Short Term trend period listed in the ST years field
ST sig	If 1: Short Term 90% Credible Interval excludes zero. If blank, not statistically significant at 90% Credible Interval.
ST Trend (%/yr)	Estimated annual % change in population size over the Short Term trend period listed in the ST years field
ST trend 90% lcl	Short term trend lower credible interval limit
ST trend 90% ucl	Short term trend upper credible interval limit
ST years	Number of years included in the Short Term trend period
taxonomic notes	Annotations on taxonomy and recent changes from AOU 7th edition checklist, 63rd supplement, with additions
TB-c	Assessment score for continental threats-breeding
TB-c_com	Comments for continental threats-breeding score
TB-c_s	Source for continental threats-breeding score
TB-r	Assessment score for regional threats-breeding
TB-r_com	Comments for regional threats-breeding score
TB-r_s	Source for regional threats-breeding score

TN-c	Assessment score for continental threats-non-breeding
TN-c_com	Comments for continental threats-non-breeding score
TN-c_s	Source for current continental threats-non-breeding score
TN-r	Assessment score for regional threats-non-breeding
TN-r_com	Comments for regional threats-non-breeding score
TN-r_s	Source for current regional threats-non-breeding score
trend source	Source of trend data displayed (even if not used to assign PT-r score). See Handbook for more details.
Urban	"yes" indicates species is commonly associated with urban and suburban habitats during the breeding season
USA	Occurs in continental USA

Appendix B: Key to Data Sources

source	definition
2017 PIPL Regional Summary for Eastern Canada	2017 Piping Plover Regional Summary for Eastern Canada
2018 PF Databook	Olson, S. M. Compiler. 2018. Pacific Flyway Data Book, 2018. U.S. Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Vancouver, Washington.
A. Panjabi	Arvind Panjabi, Bird Conservancy of the Rockies
Altman	Bob Altman, American Bird Conservancy
AMJV 2018	Appalachian Mountain Joint Venture, 2018
Ammon 2018	Elisabeth Ammon, Great Basin Bird Observatory, 2018
AMOY Working Group 2018	American Oystercatcher Working Group (amoywg.org)
Andres	Brad Andres, retired from U.S. Fish and Wildlife Service
Andres et al. 2012	Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. Population estimates of North American shorebirds, 2012. Wader Study Group Bulletin 119: 178–194. http://www.shorebirdplan.org/wp-content/uploads/2013/03/ShorePopulationAndresEtAl2012.pdf
AOU	American Ornithologists' Union (AOU). 1998. Check-list of North American Birds, 7th ed. American Ornithologists' Union, Washington, D.C.
AOU Checklist 57th Suppl.	Chesser, R.T., K.J. Burns, C. Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, P.C. Rasmussen, J.V. Remsen, Jr., J.D. Rising, D.F. Stotz, and K. Winker. 2016. Fifty-seventh Supplement to the American Ornithologists' Union Check-list of North American Birds. Auk 133: 544–560.
Atlantic Coast shorebird experts 2018	David Mizrahi, Caleb Spiegel, Dan Catlan
AZ Game & Fish	Arizona Department of Game and Fish
AZBBA	Corman, T. E., & Wise-Gervais, C. 2005. The Arizona breeding bird atlas. Albuquerque: University of New Mexico Press.
AZ-PIF	Arizona Partners in Flight
B. Andres	Brad Andres, retired from U.S. Fish and Wildlife Service
Ball et al. 2016	Ball, J. R., P. Sólymos, F. K. A. Schmiegelow, S. Hache, J. Schieck, and E. Bayne. 2016. Regional habitat needs of a nationally listed species, Canada Warbler (Cardellina canadensis), in Alberta, Canada. Avian Conservation and Ecology 11(2):10. http://dx.doi.org/10.5751/ACE-00916-110210.
Balshi et al. 2009	Balshi MS, et al. (2009) Assessing the response of area burned to changing climate in western boreal North America using a Multivariate Adaptive Regression Splines (MARS) approach. Glob Change Biol 15(3):578–600.
Bank Swallow Tech. Advisory Comm. 2013	Bank Swallow Technical Advisory Committee. 2013. Bank Swallow (Riparia riparia) Conservation Strategy for the Sacramento River Watershed, California. Version 1.0. www.sacramentoriver.org/bans
Barrett et al. 2011	Barrett, K., McGuire, A. D., Hoy, E. E. & Kasischke, E. S. (2011). Ecological Applications 21, 2380–2396;
BBS	Breeding Bird Survey data

BBS[start year][end year]-AS	North American Breeding Bird Survey (BBS) Trends (Canadian Wildlife Service). See handbook for details.
BBS[start year][end year]-AS,JS	North American Breeding Bird Survey (BBS) Trends (United States Geological Survey and Canadian Wildlife Service results averaged in log scale, with credible intervals that included the minimum and maximum upper and lower CI values across both results). See handbook for details.
BBS[start year][end year]-JS	North American Breeding Bird Survey (BBS) Trends (United States Geological Survey). See handbook for details.
bbs0615(BBS)	BBS counts from 2006-2015 were averaged across routes within BCRs (weighted by size of provinces/states in BCRs), for the continental US & Canada, including some extrapolations to range uncovered by BBS
bbs14	RD-b score based on BBS average counts from 2005 to 2014, standardized to BCR with highest average count. RD=5 if relative density ("rdens14" below) was 50% or more, else RD=4 if rdens14 > 25%, else RD=3 if rdens14 > 10%, else RD=2 if rdens14 > 1.0%, else RD=1 if rdens14 > 0
bbs14adj	When eBird indicated that a commonly encountered species was found more frequently in region(s) outside continental US/Canada, adjusted BBS values (rdens14 times max eBird frequency in continental US/Canada divided by max eBird frequency in any region) were used to account for lower global importance of regions within continental US/Canada (Area Importance measures such as RD and %Pop are assessed globally)
BBS7015	Hierarchical linear regression analysis of Breeding Bird Survey data (1970-2015) provided by John Sauer to Partners In Flight, BCR-level results
BBS7021	BCR 34 & 35 trends in Sauer 70-21 analysis
BC BBA	Davidson, P.J.A., R.J. Cannings, A.R. Couturier, D. Lepage, and C.M. Di Corrado (eds.). 2015. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Bird Studies Canada, Delta, B.C. Available at http://www.birdatlas.bc.ca.
BCR 11 review team 2018	Scott Somershoe, Sean Fields, Alaine Camfield with additional CWS staff input
BCR 13 Review Team 2018	Canadian experts: Mike Cadman, Christian Roy, François Shaffer, Josée Tardif, Bruno Drolet, Christine Lepage, Josée Lefebvre, Jean-François Rail, Yves Aubry. US experts: Randy Dettmers, Ken Rosenberg, Doug Gross, Caleb Spiegel.
BCR 1-3 Review Team 2018	Brad Andres and Natalie Savoie
BCR 14 Review Team 2018	Canadian experts: Christian Roy, Sabine Whilhelm, Greg Campbell, Julie Paquet, François Shaffer and Josée Tardif, Bruno Drolet, Christine Lepage, Josée Lefebvre, Jean-François Rail, Yves Aubry. US experts: Randy Dettmers, Pam Hunt, Danielle D'Auria, Linda Welch, Lindsay Tudor, Caleb Spiegel, Ken Rosenberg, Adrienne Leppold, Jenny Dickson.
BCR 16 Review Team 2018	Edwin Juarez, Troy Corman, Carol Beardmore, Russell Norvell, Adam Brewerton, Christopher Rustay, Corrie Borgman, Arvind Panjabi
BCR 24 Review Team 2018	Kate Slankard, Sarah Kendrick, David Hanni, Doreen Mengel, Heath Hagy, Chuck Hunter, Dean Demarest, Tom Will, Allisyn Gillet, John Brunjes, Jane Fitzgerald, Allison Fowler

BCR 25 Review Team 2018	Anne Mini, Dean Demarest, Bill Holliman, Mark Howery, Chuck Hunter, Dale James, Karen Rowe, Cliff Shackelford, and Michael Seymour
BCR 26 Review Team 2018	Anne Mini, Dean Demarest, Chuck Hunter, Dale James, Mark Woodrey
BCR 27 Review Team 2018	Dean Demarest, Chuck Hunter
BCR 28 Review Team 2018	Dean Demarest, Randy Dettmers, Becky Keller, Rich Bailey, Sergio Harding, Dan Brauning, Chris Kelly, David Hanni, Sharon Petzinger, Carol Croy, Suzanne Treyger, Gwen Brewer, Laura Kearns, Petra Wood, Kate Slankard
BCR 29 Review Team 2018	Dean Demarest, Chuck Hunter, Randy Dettmers
BCR 31 Review Team 2018	Dean Demarest, Chuck Hunter
BCR 37 Review Team 2017	Brent Ortego; Michael Seymour; Cliff Shackelford; Clay Green; Erik Johnson; Paul Leberg; David Newstead; Susan Heath; Donna Dittmann; Steven W Cardiff; Mary Gustafson; Matt Brady; Jesús Franco; Jim Giocomo; Barry Wilson; Anne Mini; Mike Brasher; Dean Demarest
BCR 4 Review Team 2018	Pam Sinclair
BCR 6 Review Team 2018	Steve Van Wilgenburg, Samuel Hache, Christian Roy
BCR 8 Review Team 2018	Christian Friis, Steve Van Wilgenburg, Christian Roy, François Shaffer and Josée Tardif, Bruno Drolet, Christine Lepage, Josée Lefebvre, Jean-François Rail, Yves Aubry
Beardmore	Carol Beardmore, retired from Sonoran Joint Venture
Beedy et al. 2013	Beedy, E. C., and E. R. Pandolfino; illustrated by K. Hansen. 2013. Birds of the Sierra Nevada. University of California Press, Berkeley, California, USA.
Benkman	Craig Benkman, University of Wyoming
Bergeron et al. 2010	Bergeron Y, Cyr D, Girardin MP, Carcaillet C (2010) Will climate change drive 21st century burn rates in Canadian boreal forest outside of its natural variability: Collating global climate model experiments with sedimentary charcoal data. Int J Wildland Fire 19(8):1127–1139.
Bernier et al. 2023	Bernier, K., A. Seglund, and E.S. Zavaleta. 2023. Brown-capped Rosy-Finch population assessment and breeding range resource selection. Colorado Parks and Wildlife, internal report.
Bielefeld 2008	Bielefeld, R.R. 2008. A report on the results of the 2008 mottled duck survey. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, Florida, USA.
Bird Conservancy of the Rockies	changes to scores due on taxonomic changes and/or ACAD region boundary changes based on other sources listed, implemented by Allison Shaw
BirdLife (International)	If BirdLife (Int.) 2000: BirdLife International. 2000. Threatened birds of the world. Barcelona and Cambridge, UK: Lynx Edicions and BirdLife International. All other years: BirdLife International IUCN Red List for birds. Downloaded from http://www.birdlife.org.
Blancher	Peter Blancher, retired from Environment and Climate Change Canada

BNA	Goudie, R. I., G. J. Robertson, and A. Reed (2020). Common Eider (Somateria mollissima), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.comeid.01
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BNA Bryan 2002	Bryan, D. C. (2002). Limpkin (Aramus guarauna), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.627
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BNA Diamond & Schreiber 2002	Diamond, Anthony W. and Elizabeth A. Schreiber. (2002). Magnificent Frigatebird (Fregata magnificens), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna-org.prxy4.ursus.maine.edu/Species-Account/bna/species/magfri

BNA Dumas 2000	Dumas, J. V. (2000). Roseate Spoonbill (Platalea ajaja), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.490
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BNA Koczur et al. 2019	Koczur, L. M., M. C. Green, B. M. Ballard, P. E. Lowther, and R. T. Paul (2020). Reddish Egret (Egretta rufescens), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.redegr.01
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BNA Molina et al. 2014	Molina, K. C., J. F. Parnell, and R. M. Erwin (2014). Gull-billed Tern (Gelochelidon nilotica), version 2.0. In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.140
BNA Montevecchi & Stenhouse 2002	Montevecchi, W. A. and I. J. Stenhouse (2002). Dovekie (Alle alle), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.701
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BNA Mowbray 2002b	Mowbray, T. B. (2002). Northern Gannet (Morus bassanus), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.693

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BNA Nisbet et al. 2017	Nisbet, I. C. T., D. V. Weseloh, C. E. Hebert, M. L. Mallory, A. F. Poole, J. C. Ellis, P. Pyle, and M. A. Patten (2017). Herring Gull (Larus argentatus), version 3.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.hergul.03
BNA North 2013	North, M. R. 2013. Aleutian Tern (Onychoprion aleuticus), version 2.0. In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.291
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BNA Shealer et al. 2016	Shealer, D., J. S. Liechty, A. R. Pierce, P. Pyle, and M. A. Patten (2016). Sandwich Tern (Thalasseus sandvicensis), version 3.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.santer1.03
BNA Shields 2014	Shields, M. (2014). Brown Pelican (Pelecanus occidentalis), version 2.0. In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.609
BNA Wallace & Wallace 1998	Wallace, E. A. and G. E. Wallace (1998). Brandt's Cormorant (Phalacrocorax penicillatus), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.362
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BNA White et al. 2002	White, C. M., N. J. Clum, T. J. Cade, and W. G. Hunt (2002). Peregrine Falcon (Falco peregrinus), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.660
BNA Woolfenden & Fitzpatrick 1996	Woolfenden, Glen E. and John W. Fitzpatrick. (1996). Florida Scrub-Jay (Aphelocoma coerulescens), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/flsjay

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BNA1994	Gochfeld, M. and J. Burger (1994). Black Skimmer (Rynchops niger), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.108
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BNA2014	Gerber, Brian D., James F. Dwyer, Stephen A. Nesbitt, Rod C. Drewien, Carol D. Littlefield, T. C. Tacha and P. A. Vohs. (2014). Sandhill Crane (Antigone canadensis), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/sancra
BNA2016	Shealer, D., J. S. Liechty, A. R. Pierce, P. Pyle, and M. A. Patten (2016). Sandwich Tern (Thalasseus sandvicensis), version 3.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.santer1.03
BNA2017	Nisbet, I. C. T., D. V. Weseloh, C. E. Hebert, M. L. Mallory, A. F. Poole, J. C. Ellis, P. Pyle, and M. A. Patten (2017). Herring Gull (Larus argentatus), version 3.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.hergul.03
Boettcher 2018	Ruth Boettcher, Virginia Department of Game and Inland Fisheries 2018
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BOTW Drilling et al. 2020	Drilling, N., S. O. Williams III, R. D. Titman, and F. McKinney (2020). Mexican Duck (Anas diazi), version 1.0. In Birds of the World (P. G. Rodewald and B. K. Keeney, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.mexduc.01
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Brad Andres 2015	Brad Andres, retired from U.S. Fish and Wildlife Service
Brown et al. 2001	Brown, S., Hickey, C., Harrington, B., and Gill, R. (eds.) 2001. The U. S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, MA.
C. Dwyer (USFWS) 2018	Chris Dwyer, US Fish and Wildlife Service

C. Friis 2018	Christian Friis, Canadian Wildlife Service
C. Hunter 2017	William "Chuck" Hunter, U.S. Fish and Wildlife Service
C. Roy 2018	Christian Roy, Canadian Wildlife Service
C. Rustay	Christopher Rustay, Playa Lakes Joint Venture
CACO Recovery Program 2023 Annual Pop. Status	U.S. Fish and Wildlife Service. 2023. California Condor Recovery Program 2023 Annual Condor Population Status Report.
CAFF	CAFF18: population estimate from the following publication.
	CAFF7016, CAFF7516, CAFF8516, CAFF8916: population trend starting from 1970, 1975, 1985, 1989, respectively, and ending in 2016, from the following publication.
	CAFF. 2018. A Global audit of the status and trends of Arctic and Northern Hemisphere goose population. Conservation of Arctic Flora and Fauna International Secretariat, Akureyri, Iceland.
California Condor Recovery Team 2017	U.S. Fish and Wildlife Service. 2017. California Condor Recovery Program 2017 Annual Condor Population Status. https://www.fws.gov/cno/es/CalCondor/PDF_files/2017-CA-condor-population-status.pdf
Camfield-17	Alaine Camfield, Canadian Wildlife Service, 2017
Camill 2005	Camill, P. (2005). Permafrost thaw accelerates in boreal peatlands during late-20th century climate warming. Climatic Change, 68(1), 135-152.
Carter	Michael Carter, Playa Lakes Joint Venture
Casey	Daniel Casey, Northern Great Plains Joint Venture
CBC	Audubon Christmas Bird Count
CBC7019-TM,JS	
CBO	Colorado Bird Observatory (now Bird Conservancy of the Rockies)
CDTT	Chihuahuan Desert Technical Team of the Rio Grande Joint Venture
Chasmer & Hopkinson 2017	Chasmer, L., & Hopkinson, C. (2017). Threshold loss of discontinuous permafrost and landscape evolution. Global change biology, 23(7), 2672-2686.
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Colonial Seabird Monitoring Program 2018	Colonial Seabird Monitoring Program, Canadian Wildlife Service, 2018
CONABIO	Shapefiles of species' range after taxonomic splits from Victor Vargas, Comision Nacional para el Conocimiento y Uso de la Biodiversidad, 2022
Conklin et al. 2016	Conklin, Jesse & Lok, Tamar & Melville, David & C Riegen, Adrian & Schuckard, Rob & Piersma, Theunis & Battley, Phil. (2016). Declining adult survival of New Zealand Bar-tailed Godwits during 2005–2012 despite apparent population stability. The Emu: official organ of the Australasian Ornithologists' Union. 116. 147-157. 10.1071/MU15058.
CO-PIF	Colorado Partners in Flight
Corman 2018	Troy Corman, Arizona Department of Game and Fish, 2018

Corner Brook 2008	Newfoundland landbird conservation plan meeting, at which scores were reviewed by experts
Correll et al. 2017	Correll, M. D., W. A. Wiest, T. P. Hodgman, W. G. Shriver, C. S. Elphick, B. J. McGill, K. M. O'Brien, and B. J. Olsen. 2017. Predictors of specialist avifaunal decline in coastal marshes. Conservation Biology 31: 172– 182.
COSEWIC (in press)	Draft Ivory gull (Pagophila eburnea) COSEWIC assessment and status report
COSEWIC 2008	The Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2008. COSEWIC Annual Report 2007-2008. Retrieved from http://publications.gc.ca/collections/collection_2013/ec/CW70-18-2008-eng.pdf.
COSEWIC 2012	COSEWIC. 2012. COSEWIC assessment and status report on the Marbled Murrelet Brachyramphus marmoratus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 82 pp.
COSEWIC 2014a	COSEWIC. 2014. COSEWIC assessment and status report on the Cassin's Auklet Ptychoramphus aleuticus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 69 pp. (Species at Risk Public Registry).
COSEWIC 2014b	COSEWIC. 2014. COSEWIC assessment and status report on the Western Grebe (Aechmophorus occidentalis) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 55 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).
COSEWIC 2017	COSEWIC. 2017. COSEWIC assessment and status report on the Peregrine Falcon Falco peregrinus (pealei subspecies – Falco peregrinus pealei and anatum/tundrius – Falco peregrinus anatum/tundrius) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xviii + 108 pp. (http://www.registrelep-sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1).
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CWS reviewers/review team 20018	Canadian Wildlife Service review team 2018
CWS - QC reviewers 2018	Canadian Wildlife Service, Quebec Regional Office
CWS BCR database	Canadian Wildlife Service. 2014. National Database to Support Bird Conservation Region Planning in Canada. Request data or information: ec.oiseauxmigrateurs-migratorybirds.ec@canada.ca
CWS-Atl 2018	Canadian Wildlife Service, Atlantic Regional Office
CWS-ON 2018	Canadian Wildlife Service, Ontario Regional Office
CWS-ON & QC 2018	Canadian Wildlife Service, Ontario & Quebec Regional Offices
CWS-QC & ATL	Canadian Wildlife Service, Quebec & Atlantic Regional Offices
CWS-QC/Quebec	Canadian Wildlife Service, Quebec Regional Office
D Haukos, pers. comm. 2015	Dave Haukos, Kansas Cooperative Fish and Wildlife Research Unit Leader, US Geological Survey/Kansas State University
Dale	Brenda Dale, Canadian Wildlife Service

Danielle D'Auria, Maine DIFW 2018	Danielle D'Auria, Maine Department of Inland Fisheries and Wildlife, 2018
Dave Moore CWS 2018	Dave Moore, Canadian Wildlife Service, 2018
Defenders of Wildlife 2007	Defenders of Wildlife. 2007. Navigating the Arctic Meltdown: Ivory Gulls. Washington D.C.: Defenders of Wildlife.
Demarest	Dean Demarest, US Fish and Wildlife Service
Derksen et al. 2015	Derksen, D. V., M. R. Petersen, and J-P. L. Savard. 2015. Pp. 469-527 in Savard et al., eds. Ecology and Conservation of North American Sea Ducks. Studies in Avian Biology 46.
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Dettmers	Randy Dettmers, U.S. Fish and Wildlife Service
Devers & Collins 2011	Devers, P.K., and B. Collins. 2011. Conservation action plan for the American black duck, First Edition. U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD, USA.
DiGaudio 2018	Ryan DiGaudio, Point Blue Conservation Science
Dubovsky 2016	Dubovsky, J.A. 2016. Status and harvests of sandhill cranes: Mid-Continent, Rocky Mountain,Lower Colorado River Valley and Eastern Populations. Administrative Report, U.S. Fish and Wildlife Service, Lakewood, Colorado. 15pp.
Dubovsky 2017	Dubovsky, J.A. 2017. Status and harvests of sandhill cranes: Mid-Continent, Rocky Mountain, Lower Colorado River Valley and Eastern Populations. Administrative Report, U.S. Fish and Wildlife Service, Lakewood, Colorado.
Dunn	Erica Dunn, Environment and Climate Change Canada
E Nol, Pers Comm.	Erica Noel, Trent University
Easton	Wendy Easton, Canadian Wildlife Service
EBD20	Raw eBird Basic Dataset analysis by Pete Blancher, described in handbook
eBird[year]	ebird Data Explorer from all years (as of the year listed). Cornell Lab of Ornithology, Ithaca, New York. Available at https://ebird.org/map.
eBird S&T	Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, A. Rodewald, C. Wood, I. Davies, A. Spencer. 2022. eBird Status and Trends, Data Version: 2021; Released: 2022. Cornell Lab of Ornithology, Ithaca, New York. https://doi.org/10.2173/ebirdst.2021
eBird17/eBird7017(UsCa,WHem,Glob)	Relative Frequency (RF) score based on eBird bar chart data, 1970 to mid-January 2017 (downloaded Jan 17, 2017). eBird frequencies per region were weighted by region size to approximate %Pops per Region (%Freqs), generally for species with poor BBS data, or for regions without BBS data; UsCa indicates BCRs 1 to 37 without Mexican portions of border BCRs, WHem indicates regions outside of BBS coverage in the Western Hemisphere, Glob indicates parts of range outside the Western Hemisphere
eMod20	Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, O. Robinson, S. Ligocki, W. Hochachka, C. Wood, I. Davies, M. Iliff, L. Seitz. 2020. eBird Status and Trends, Data Version: 2019; Released: 2020. Cornell Lab of Ornithology, Ithaca, New York. https://doi.org/10.2173/ebirdst.2019

eMod20/21	percents based on 2020 eBird model which was Western hemispheric, adjusted to global based on 2021 eBird model
eMod20adj	Adjustment of western hemisphere model maximim densities from eMod20 by higher maximums in the eastern hemisphere using EBD20 dataset
eMod21	The following models applied to ACAD region boundaries by eBird Status & Trends team: Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, A. Rodewald, C. Wood, I. Davies, A. Spencer. 2022. eBird Status and Trends, Data Version: 2021; Released: 2022. Cornell Lab of Ornithology, Ithaca, New York. https://link.edgepilot.com/s/57e8b840/XcY5pbk8aEWdaU07fXyViA?u=https://doi.org/10.2173/ebirdst.2021
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Eriksen et al. 2016	Eriksen, R.E., Akridge, M.D., Brown, T.A., Hughes, T.W., Penner, C.A., Scott, K.B. 2016. Status and distribution of wild turkeys in the United States: 2014 status. Proceedings of the National Wild Turkey Symposium 11: 7–18.
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Fink et al. 2021	Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, A. Rodewald, C. Wood, I. Davies, A. Spencer. 2022. eBird Status and Trends, Data Version: 2021; Released: 2022. Cornell Lab of Ornithology, Ithaca, New York. https://doi.org/10.2173/ebirdst.2021
Fink et al. 2022	Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, C. Crowley, K. Dunham, A. Stillman, I. Davies, A. Rodewald, V. Ruiz-Gutierrez, C. Wood. 2023. eBird Status and Trends, Data Version: 2022; Released: 2023. Cornell Lab of Ornithology, Ithaca, New York. https://doi.org/10.2173/ebirdst.2022
Fitzgerald	Jane Fitzgerald, American Bird Conservancy
FL FWCC 2011	Florida Fish and Wildlife Conservation Commission. 2011. White-crowned Pigeon Biological Status Review.
Flannigan et al. 2005	Flannigan MD, Logan KA, Amiro BD, Skinner WR, Stocks BJ (2005) Future Area Burned in Canada. Clim Change 72(1-2):1–16.
Fletcher et al. 2016	Fletcher et al. 2016. Annual Progress Report on Snail Kite Demography. USGS Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville.
Franke 2016	Franke, A. 2016. Population Estimates for Northern Juvenile Peregrine Falcons with Implications for Harvest Levels in North America. Journal of Fish and Wildlife Management. 7. 10.3996/062015-JFWM-050.
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FWS Mig Birds/ Sea Duck JV 2017	U.S. Fish & Wildlife Service Division of Migratory Bird Management/ Sea Duck Joint Venture expert consensus, 2017
FWS R7	US Fish & Wildlife Service Alaska Region 7 flyway staff
FWS-16	U.S. Fish and Wildlife Service. 2016. Waterfowl population status, 2016. U.S. Department of the Interior, Washington, D.C. USA.
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GBE	Great Basin Experts (-YEAR)
Gibson and Byrd 2007	Gibson, D. D., & Byrd, G. V. 2007. Birds of the Aleutian Islands, Alaska. Cambridge, Mass: Nuttall Ornithological Club.
Gomez-Panjabi	Hector Gomez de Silva (Eagle-eye Tours, formerly with National Autonomous University of Mexico, UNAM) and Arvind Panjabi, Bird Conservancy of the Rockies. The suffix "–PS-g midpoint" appended to the source code indicates a population estimate based on the midpoint of the ACAD PS-g category range.
Gonzalez-Prieto et al. 2017	González-Prieto, A. M., Bayly, N. J., Colorado, G. J., & Hobson, K. A. (2017). Topography of the Andes Mountains shapes the wintering distribution of a migratory bird. Diversity and Distributions, 23(2), 118-129.
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Green et al. 2022	Green, M. Clay, Dean W. Demarest, Bryan C. Tarbox, W. Andrew Cox, Jesús G. Franco, Salvador Narváez Torres, Kelli L. Stone and William G. Vermillion. 2022. Conservation Action Plan for the Reddish Egret (Egretta rufescens), 2022 Update. Reddish Egret International Working Group.
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Gustafson	Mary Gustafson, retired from American Bird Conservancy
Hannah & Hoyt 2004	Hannah, K. C., & Hoyt, J. S. (2004).The Condor, 106(2), 420-423;
Hansen et al. 2013	Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, J. R. G. Townshend. (2013). High-resolution global maps of 21st-century forest cover change. Science, 342(6160), 850-853.
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Hobson & Schieck 1999	Hobson, K. A., & Schieck, J. (1999). Changes in bird communities in boreal mixedwood forest: harvest and wildfire effects over 30 years. Ecological Applications, 9(3), 849-863.
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Hunt et al. 2017	Hunt, A. R., Bayne, E. M., & Haché, S. (2017). Forestry and conspecifics influence Canada Warbler (Cardellina canadensis) habitat use and reproductive activity in boreal Alberta, Canada. The Condor, 119(4), 832-847.
Hunter	William "Chuck" Hunter, U.S. Fish and Wildlife Service
Hunter-Rosenberg 2003	William "Chuck" Hunter, U.S. Fish and Wildlife Service and Ken Rosenberg, retired from Cornell Lab of Ornithology
ID-PIF	Idaho Partners in Flight
Igl	Larry Igl, Northern Prairies Research Station, USGS
IMWJV 2018	Intermountain West Joint Venture, 2018
insufficient data	Breeding Bird Survey data, degrees of freedom < 6
International Bicknell's Thrush Conservation Group 2017	Lloyd, J.D. and K.P. McFarland, Eds. 2017. A Conservation Action Plan for Bicknell's Thrush (Catharus bicknelli). International Bicknell's Thrush Conservation Group (IBTCG). International Bicknell's Thrush Conservation Group. Available at https://bicknellsthrush.org/conservation-action-plan/conservation-action-plan-for-bicknells-thrush/ or 10.6084/m9.figshare.4962608.
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IUCN	IUCN. 2016. The IUCN Red List of Threatened Species. Version 2016-3. www.iucnredlist.org.
J Paquet, CWS 2018	Julie Paquet, Canadian Wildlife Service, 2018
J. Valenzuela Pers. Comm.	Jorge Valenzuela, Centro de Estudios y Conservación del Patrimonio Natural (CECPAN), Chile
J.W. Fitzpatrick	John Fitzpatrick, Cornell Lab of Ornithology
Jim Tietz 2018	Jim Tietz, Point Blue Conservation Science, 2018
John Brett, CWS-ON 2018	John Brett, Canadian Wildlife Service, Ontario Region, 2018
Johnson and Herter 1990	Johnson S.R, Herter D.R. 1990. Bird migration in the Arctic: a review. In: Gwinner E, editor. Bird migration. Berlin, Germany: Springer. pp. 22–43.
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Kathy Martin	Kathy Martin, University of British Columbia; Environment and Climate Change Canada
KBS	Kevin Shelley, North Dakota Ecological Services Field Office, US Fish & Wildlife Service
Kelly 1995	Kelly, J. 1995. Preliminary checklist of the birds of St. Lawrence Island, Alaska. Unpublished report.
Ken Tuininga, CWS-ON 2018	Ken Tuininga, Canadian Wildlife Service, Ontario Region, 2018
KIWA Census	Kirtland's Warbler Census Results--see https://www.fws.gov/midwest/endangered/birds/Kirtland/Kwpop.html
KIWA Conservation Team 2015	Kirtland's Warbler Conservation Team--see http://www.kwconservation.org/
Koivula & Schmiegelow 2007	Koivula, M. J., & Schmiegelow, F. K. (2007). Boreal woodpecker assemblages in recently burned forested landscapes in Alberta, Canada: effects of post-fire harvesting and burn severity. Forest Ecology and Management, 242(2), 606-618.
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Lappo et al. 2012	Lappo, E.G., Tomkovich, P.S., & Syroechkovskiy, E. 2012. Atlas of the breeding waders in the Russian Arctic. UF Ofsetnaya Pechat, Moscow.
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Lindsay Tudor, Maine DIFW 2018	Lindsay Tudor, Maine Department of Inland Fisheries and Wildlife, 2018
M. Brasher pers. comm. 2019	Mike Brasher, Ducks Unlimited, personal communication
Mahon et al. 2014	Mahon, C. L., E. M. Bayne, P.r Sólymos, S. M. Matsuoka, M. Carlson, E. Dzus, F. K. A. Schmiegelow, and S. J. Song. (2014) Does expected future landscape condition support proposed population objectives for boreal birds? Forest ecology and management 312: 28-39.
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Matsuoka	Steve Matsuoka, U.S. Fish and Wildlife Service
Matsuoka & Johnson 2008	Matsuoka, S.M. and J.A. Johnson, Using A Multimodel Approach to Estimate the Population Size of Mckay's Buntings, The Condor: Ornithological Applications, Volume 110, Issue 2, 1 May 2008, Pages 371–376, https://doi.org/10.1525/cond.2008.8492
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McDearman 2018	Will McDearman, USFWS Red-cockaded Woodpecker Recovery Team, Dec. 2018
Meese 2017	Meese, R.J. 2017. Results of the 2017 Tricolored Blackbird Statewide Survey. Calif. Dept. of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program Report 2017-XX, Sacramento, CA. 27 pp. + appendices.
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Meyer	Ken Meyer, Avian Research and Conservation Institute
Mig8019	Smith, P. A., A. C. Smith, B. Andres, C. M. Francis, B. Harrington, C. Friis, R. I. G. Morrison, J. Paquet, B. Winn, and S. Brown (2023). Accelerating declines of North America’s shorebirds signal the need for urgent conservation action. Ornithological Applications 125:duad003.
Mike Cadman, CWS-ON 2018	Mike Cadman, Canadian Wildlife Service, Ontario Region, 2018
Miller et al. 2023	Miller, Robert A., Jennifer Boisvert, Brittanie Loftin, Jay D. Carlisle, and Craig W. Benkman (2023). Cassia Crossbill 2021/2022 Summary Report, Version 1.0. Boise, Idaho: Boise State University, Intermountain Bird Observatory.
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MPS-2015	Redig et al. 2015. 2015 Midwest Peregrine Season Narrative. Midwest Peregrine Society.
MX-NSAC	Mexican National Species Assessment Committee, YEAR. The suffix "–PS-g midpoint" appended to the source code indicates a population estimate based on the midpoint of the ACAD PS-g category range.

NatGeo	National Geographic Society. 1987. Field Guide to the Birds of North America, 2nd edition. National Geographic Society, Washington, D.C.
NATS6815/NATSS15	Groves, D.J. 2017. The 2015 North American trumpeter swan survey. U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Juneau, AK. Unpublished report.
Natureserve	Natureserve Range Maps, version 3.0
NAWMP 2004	North American Waterfowl Management Plan, Plan Committee. 2004. North American Waterfowl Management Plan 2004. Implementation Framework: Strengthening the Biological Foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales, 106 pp. Available at https://www.fws.gov/migratorybirds/pdf/management/NAWMP/2004NAWMP-Framework.pdf.
NAWMP 2012	North American Waterfowl Management Plan. 2012. North American Waterfowl Management Plan: people conserving waterfowl and wetlands. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Amiente y Recursos Naturales.
NAWMP 2018	North American Waterfowl Management Plan. 2018. North American Waterfowl Management Plan: connecting people, waterfowl and wetlands. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Amiente y Recursos Naturales.
NE-G&P	Nebraska Game and Parks
NE-PIF	Northeast Partners in Flight
NFWG-17	Northern Forests Working Group (Tom Will and others) (-YEAR)
Ng et al. 2018	Ng, J.W., E.C. Knight, A.L. Scarpignato, A.-L. Harrison, E.M. Bayne, P.P. Marra. (2018). First full annual cycle tracking of a declining aerial insectivorous bird, the Common Nighthawk (Chordeiles minor), identifies migration routes, nonbreeding habitat, and breeding site fidelity. Canadian Journal of Zoology, 96:869-875, https://doi.org/10.1139/cjz-2017-0098.
NM-PIF	New Mexico Partners in Flight
Northeast Landbird Review Group 2018	Dettmers, Rosenberg, Hunt, Dickson, Gross, Leppold, Shriver
Northeast Shorebird Review Group 2018	Boettcher, Welch, Tudor, Mizrahi, Spiegel, Hunt, Dettmers, Jones
Northeast Waterbird Review Group 2018	D'Auria, Boettcher, Welch, Tudor, Catlan, Mizrahi, Spiegel, Hunt, Dettmers, Jones
NPPWCP	Beyersbergen, G.W., N. D. Niemuth, and M.R. Norton, coordinators. 2004. Northern Prairie & Parkland Waterbird Conservation Plan. A plan associated with the Waterbird Conservation for the Americas initiative. Published by the Prairie Pothole Joint Venture, Denver, Colorado. 183pp.
NV-PIF	Nevada Partners in Flight
nwt9501	Northwest Territories & Nunavut Checklist survey data (1995-2001) combined with Breeding Bird Census data
NY BBA	McGowan, K. J., & Corwin, K. (Eds.). 2008. The second atlas of breeding birds in New York State. Comstock Pub. Associates.

ona0105/onatl/ON BBA	Bird Studies Canada, Environment Canada's Canadian Wildlife Service, Ontario Nature, Ontario Field Ornithologists and Ontario Ministry of Natural Resources. 2006. Ontario Breeding Bird Atlas Database, 31 January 2008. http://www.birdsontario.org/atlas/aboutdata.jsp?lang=en
ONOS-16	Bird Studies Canada Ontario Nocturnal Owl Survey, 1995-2016
OPJV	Oaks and Prairies Joint Venture
PA BBA	Wilson, A.M., D.W. Brauning and R.S. Mulvihill (eds). 2012. Second Atlas of Breeding Birds in Pennsylvania. The Penn State University Press. University Park, PA.
Panjabi	Arvind Panjabi, Bird Conservancy of the Rockies
Pete Blancher	Peter Blancher, retired from Environment and Climate Change Canada
Phinney	Mark Phinney, LP Forest Resources Division, LP Corp
PIF CAW	Partners in Flight Central America Workshop, YEAR. The suffix "–PS-g midpoint" appended to the source code indicates a population estimate based on the midpoint of the ACAD PS-g category range.
PIFcalc19	Partners in Flight (PIF) population estimate from Stanton et al. (2019). Sources listed in descending order by proportion of population estimate: "bbs0615" = North American Breeding Bird Survey (2006–2015); "nwt9501" = Northwest Territories & Nunavut Checklist survey data (1995-2001) combined with Breeding Bird Census data; "ona0105" = Ontario 2nd Breeding Bird Atlas point counts (2001-2005); "eBird" = eBird relative frequency data for June and 1st week of July (1970-2017) used to extrapolate to the Western Hemisphere south of USA; "rng" = range map-based extrapolation to the Eastern Hemisphere; "PIF" = estimated by Partners in Flight Science Committee. "UsCa" indicates source was used for USA & Canada estimate. "WHem" indicates source used for extrapolation to regions outside of BBS coverage in the Western Hemisphere. "Glob" indicates source used for extrapolation to parts of range outside the Western Hemisphere.
PIF-ON	Ontario Partners in Flight
PIFSC	Partners in Flight Science Committee, YEAR. The suffix "–PS-g midpoint" or "–PS-g" appended to the source code indicates a population estimate based on the midpoint of the ACAD PS-g category range.
PIFSC-CVS 2022	Partners in Flight Climate Vulnerability Subcommittee's adaptation of Audubon models (Bateman et al., 2020; Wilsey et al., 2019). See handbook for details.
PIFTC	Partners in Flight Technical Committee (now Partners in Flight Science Committee), YEAR. The suffix "–PS-g midpoint" appended to the source code indicates a population estimate based on the midpoint of the ACAD PS-g category range.
PIFTC–NBCI	6.7M in 1999 from Dimmick, R., M. Gudlin and D. McKenzie. The Northern Bobwhite Conservation Initiative: A Plan for Quail Population Recovery. PIF Technical Committee adjusted to 5.8M in 2007 based on declining BBS trend.
PIPL Recovery Team 2018	Piping Plover Recover Team--see https://www.greatlakespipingplover.org/
PLJV 2018	Playa Lakes Joint Venture, 2018

Population status of migratory game birds in Canada 2021	Canadian Wildlife Service Waterfowl Committee. 2022. Population Status of Migratory Game Birds in Canada - 2021. CWS Migratory Birds Regulatory Report Number 55.
Population status of migratory game birds in Canada, Nov. 2017	Canadian Wildlife Service Waterfowl Committee. 2017. Population Status of Migratory Game Birds in Canada: November 2017. CWS Migratory Birds Regulatory Report Number 49
Potapov and Sale 2012	Potapov, E. & Sale, R. The Snowy Owl. London: T & AD Poyser, 2012.
Quebec BBA/QC BBA 2	Gauthier J. and Aubry Y. (eds.) 1996. The breeding birds of Québec: atlas of the breeding birds of southern Québec. Association Québécoise des Groupes d'Ornithologues, Province of Québec Society for the Protection of Birds, Canadian Wildlife Service, Environnement Canada (Québec region), Montréal, Québec, Canada.
Maritimes BBA	Stewart, R. L. M., K. A. Bredin, A. R. Couturier, A. G. Horn, D. Lepage, S. Makepeace, P. D. Taylor, M.-A. Villard, and R. M. Whittam (eds). 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, 528 + 28 pp
R. Bowman	Reed Bowman, Archbold Biological Station
RGJV 2018	Rio Grande Joint Venture, 2018
RGJV-Science 2018	Rio Grande Joint Venture Science Team, 2018
Riordan et al. 2006	Riordan, B., Verbyla, D., & McGuire, A. D. (2006). Shrinking ponds in subarctic Alaska based on 1950–2002 remotely sensed images. Journal of Geophysical Research: Biogeosciences, 111(G4).
Rivera	Frank Rivera, US Fish and Wildlife Service
RMBO	Rocky Mountain Bird Observatory, now Bird Conservancy of the Rockies
Robert Mesta (USFWS)	Roberta Mesta, retired from US Fish & Wildlife Service
Rodriguez-Estrella et al. 1992	Rodriguez-Estrella, R., Mata, E., & Rivera, L. (1992). Ecological Notes on the Green Parakeet of Isla Socorro, Mexico. The Condor, 94(2), 523-525. doi:10.2307/1369224
Rosenberg	Ken Rosenberg, retired from Cornell Lab of Ornithology
RPD-18	Randy Dettmers, US Fish & Wildlife Service, 2018
Ruffed Grouse Conservation Plan 2006	Dessecker, D.R., G.W. Norman, and S.J. Williamson, eds. 2006. Ruffed Grouse Conservation Plan. Association of Fish and Wildlife Agencies, Resident Game Bird Working Group. Available at https://ruffedgrousesociety.org/wp-content/uploads/2019/07/RG_ConservationPlan-ExecRep.pdf.
Russell	Robert Russell, U.S. Fish and Wildlife Service
Rustay	Christopher Rustay, Playa Lakes Joint Venture
RWBJV 2018	Rainwater Basin Joint Venture, 2018
Ryan Burnett 2018	Ryan Burnett, Point Blue Conservation Science, 2018
S. Fields 2018	Sean Fields, retired from US Fish & Wildlife
S. Gibson	Scott Gibson, Utah Division of Wildlife Resources

SARA Registry	Species At Risk Public Registry. 2018. Government of Canada. Retrieved from: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html
SCDNR unpublished data	South Carolina Department of Natural Resources Mottled Duck surveys, 2009-2011
Schieck & Song (2006)	Schieck, J., & Song, S. J. (2006). Changes in bird communities throughout succession following fire and harvest in boreal forests of western North America: literature review and meta-analyses. Canadian Journal of Forest Research, 36(5), 1299-1318.
Scott Morrison, July 2008	Scott Morrison, The Nature Conservancy, July 2008
Sea Duck JV	Sea Duck Joint Venture
SE-PIF	Southeast Partners in Flight
SGS-17	Special analysis performed by John Sauer for PIF of American Woodcock Singing Ground Survey (https://migbirdapps.fws.gov/mbdc/databases/awsgs/aboutwcsgs.htm) data, 1970-2017
SGS-17_adj	Special analysis performed by John Sauer for PIF of American Woodcock Singing Ground Survey (https://migbirdapps.fws.gov/mbdc/databases/awsgs/aboutwcsgs.htm) data from 1970-2017 adjusted by Pete Blancher to account for proportion of BCR outside of breeding range
Shaw	Allison Shaw, Bird Conservancy of the Rockies
Shuford and Gardali 2008	Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=10425&inline
Shuford et al. 2001	Shuford, W. D., Humphrey, J. M., & Nur, N. 2001. Breeding status of the Black Tern in California. Western Birds, 32(4).
Sinclair	Pam Sinclair, Canadian Wildlife Service
Sinclair et al. 2003	Sinclair, P. H., Nixon, W. A., Eckert, C. D., & Hughes, N. L. 2003. Birds of the Yukon Territory. UBC Press, Vancouver.
SJV-SWG 2017	Sonoran Joint Venture Science Working Group, 2017
Smith 1996	Smith. P.W. 1996. Antillean Nighthawk. In Rodgers, Kale, & Smith, eds., Rare & Endangered Biota of Florida. Vol. 5. U. Florida Press, Gainesville.
Soulliere-17	Greg Soulliere, Upper Mississippi River and Great Lakes Region Joint Venture (2017)

Spautz et al. 2005	Spautz, H., Nur, N., & Stralberg, D. (2005). California Black Rail (Laterallus jamaicensis coturniculus) distribution and abundance in relation to habitat and landscape features in the San Francisco Bay Estuary. In In: Ralph, C. John; Rich, Terrell D., editors 2005. Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. 2002 March 20-24; Asilomar, California, Volume 1 Gen. Tech. Rep. PSW-GTR-191. Albany, CA: US Dept. of Agriculture, Forest Service, Pacific Southwest Research Station: p. 465-468 (Vol. 191).
Status of Birds in Canada 2014	Environment and Climate Change Canada. 2015. The Status of Birds in Canada Website, Data-version 2014. Environment and Climate Change Canada, Gatineau, Quebec, K1A 0H3
STEM-21	Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, A. Rodewald, C. Wood, I. Davies, A. Spencer. 2022. eBird Status and Trends, Data Version: 2021; Released: 2022. Cornell Lab of Ornithology, Ithaca, New York. https://link.edgepilot.com/s/57e8b840/XcY5pbk8aEWdaU07fXyViA?u=https://doi.org/10.2173/ebirdst.2021
Stralberg et al. 2015	Stralberg, D., S. M. Matsuoka, A. Hamann, E. M. Bayne, P. Sólymos, F. K. A. Schmiegelow, X. Wang, S. G. Cumming, S. J. Song (2015). Projecting boreal bird responses to climate change: the signal exceeds the noise. Ecological Applications, 25(1), 52-69.
Svedarsky-99	Svedarsky, Hier, and Silvy, eds., 1999 The Greater Prairie Chicken: A National Look. U. Minn. Misc. Publ. 99 -- 1999.
Thomas et al. 2012	Thomas, Susan M., James E. Lyons, Brad A. Andres, Elise Elliot T-Smith, Eduardo Palacios, John F. Cavitt, J. Andrew Royle, Suzanne D. Fellows, Kendra Maty, William H. Howe, Eric Mellink, Stefani Melvin, Tara Zimmerman. 2012. Population Size of Snowy Plovers Breeding in North America. Waterbirds, 35(1), 1-14.
TOS Handbook 2004	Texas Ornithological Society Handbook, 2004
TrUST	Trial Unified Science Team of the U.S. Migratory Bird Habitat Joint Ventures (now the Unified Science Team)
UMJV-17	Upper Mississippi River and Great Lakes Region Joint Venture Science Team (2017)
UMJVWFS-17	Upper Mississippi River and Great Lakes Region Joint Venture Waterfowl Strategy (2017)
unreliable trend	Data source failed trend reliability criteria described in handbook. PT-c: data source listed in parentheses; PT-r: data source listed in "trend source" field.
USFWS 2006	U.S. Fish and Wildlife Service. 2006. Alaska Seabird Information Series: Pelagic Cormorant [fact sheet]. Retrieved from https://www.fws.gov/alaska/mbsp/mbm/seabirds/pdf/peco.pdf.
USFWS 2007	U.S. Fish and Wildlife Service. Feb. 2007. RefugeNet E-Bulletin. http://refugeassociation.org/wp-content/uploads/2011/10/sbc-feb07.pdf.
USFWS 2014	U.S. Fish and Wildlife Service. 2014. Species assessment report yellow-billed loon (Gavia adamsii). Fairbanks: U.S. Fish and Wildlife Service, Ecological Services

USFWS 2018	U.S. Fish and Wildlife Service. 2018. 2018 Western Gulf Coast Mottled Duck Survey. Laurel, MD: USFWS Division of Migratory Bird Management.
USFWS 2019 (D. Demarest, T. Mecklenborg pers. comm.)	Dean Demarest & Todd Mecklenborg, U.S. Fish & Wildlife Service
USFWS Eagle Rule Revision 2016	U.S. Fish and Wildlife Service. 2016. Bald and Golden Eagles: Population demographics and estimation of sustainable take in the United States, 2016 update. Division of Migratory Bird Management, Washington D.C., USA.
USFWS GUSG fact sheet	https://www.fws.gov/mountain-prairie/es/species/birds/gunnisonsagegrouse/January2013FactSheet.pdf
USSCP 2016	US Shorebird Conservation Partnership 2016, which relied upon Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. Population estimates of North American shorebirds, 2012. Wader Study Group Bulletin 119: 178–194. http://www.shorebirdplan.org/science/assessment-conservation-status-shorebirds.
UT-PIF	Utah Partners in Flight
Van Wilgenburg & Hobson 2008	Van Wilgenburg, S. L., & Hobson, K. A. (2008). Landscape-scale disturbance and boreal forest birds: Can large single-pass harvest approximate fires?. Forest ecology and management, 256(1), 136-146.
Venier et al. 2014	Venier, L. A., I. D. Thompson, R. Fleming, J. Malcolm, I. Aubin, J. A. Trofymow, D. Langor, R. Sturrock, C. Patry, R. O. Outerbridge, S. B. Holmes, S. Haeussler, L. De Grandpré, H. Y. H. Chen, E. Bayne, A. Arsenault, J. P. Brandt. (2014). Effects of natural resource development on the terrestrial biodiversity of Canadian boreal forests. Environ. Rev. 22, 457–490. 10.1139/er-2013-0075doi:10.1139/er-2013-0075
Vermillion	Bill Vermillion, U.S. Fish and Wildlife Service
WAFWA 2015	Western Association of Fish and Wildlife Agencies. 2015. GREATER SAGE-GROUSE POPULATION TRENDS: AN ANALYSIS OF LEK COUNT DATABASES. 1965-2015. http://www.wafwa.org/Documents%20and%20Settings/37/Site%20Documents/News/Lek%20Trend%20Analysis%20final%208-14-15.pdf
WAFWA/WEST 2017	McDonald, L., K. Nasman, T. Rintz, F. Hornsby, and G. Gardner. 2017. Range-wide population size of the Lesser Prairie-Chicken: 2012-2017. Western EcoSystems Technology, Inc. (WEST), Laramie, Wyoming, USA.
Waterbird Working Group 2017	S. Schwietzer, C. Hunter, B. Andres, B. Ortego, C. Green, A. Mini, W. Vermillion
Watts 2016	Watts, B. D. 2016. Status and distribution of the eastern black rail along the Atlantic and Gulf Coasts of North America. The Center for Conservation Biology Technical Report Series, CCBTR-16-09. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA. 148 pp. Retrieved from http://www.ccbbirds.org/wp-content/uploads/2017/01/CCBTR-16-09_BLRA-State-Assessment_final_reduced.pdf

Watts et al. 2012	Watts, J. D., Kimball, J. S., Jones, L. A., Schroeder, R., & McDonald, K. C. (2012). Satellite Microwave remote sensing of contrasting surface water inundation changes within the Arctic–Boreal Region. Remote sensing of environment, 127, 223-236.
Wheeler et al. 2021	Wheeler, J., Satgé, Y., Brown, A., Goetz, J., Keitt, B., Nevins, H. and Rupp, E. 2021. Black-capped Petrel Conservation Update and Action Plan. Conserving the Diablotin. International Black-capped Petrel Conservation Group. https://www.birdscaribbean.org/our-work/working-groups/black-capped-petrel-wg/
Whelan et al 2017	Whelan, S., Strickland, D., Morand-Ferron, J., & Norris, D. R. (2017). Reduced reproductive performance associated with warmer ambient temperatures during incubation in a winter-breeding, food-storing passerine. Ecology and evolution, 7(9), 3029-3036.
Wiest et al. 2019	Wiest, W.A., M.D. Correll, B.G. Marcot, B.J. Olsen, C.S. Elphick, T.P. Hodgman, G.R. Guntenspergen, and W.G. Shriver. 2019. Estimates of tidal-marsh bird densities using Bayesian networks. J. Wildlife Management 83 (1): 109-120.
Wilhelm 2018	Sabina Wilhelm, Canadian Wildlife Service
Will	Tom Will, retired from U.S. Fish & Wildlife Service
Williamson et al 2008	Williamson, S.J., D. Keppie, R. Davison, D. Budeau, S. Carrière, D. Rabe and M. Schroeder. 2008. Spruce grouse conservation plan. Association of Fish and Wildlife Agencies. Washington, DC. 73 pages.
WPE5	Wetlands International (2017). "Waterbird Population Estimates". http://wpe.wetlands.org.
WWG	Western Working Group of Partners in Flight
Wylie	Jim Wylie, US Geological Survey
Zimmerman et al. 2019; update to 2018	Zimmerman, G.S., B.A. Millsap, M.L. Avery, J.R. Sauer, M.C. Runge, and K.D. Richkus. 2019. Allowable take of Black Vultures in the eastern United States. Journal of Wildlife Management 83(2): 272–282. Methods followed Zimmerman et al. (2019) based on the most recent BBS annual index (2018).

Appendix C: Changes Since Recent Versions of the Database

Version 2024

Changes since version 2023

The 2024 version of ACAD contains updates primarily to the regional assessment database, along with a few minor updates to the global database as described below.

Taxonomy – The taxonomy of species included in the Regional ACAD has been updated to reflect the 63rd Supplement to the AOS Check-list of North American Birds, as have the assessments for any affected species.

Region names – The full descriptive name of each region is now used as the region name to be more user-friendly for people not familiar with BCR numbers.

Caribbean assessment regions - The regional ACAD now includes four regions in the Caribbean: Greater Antilles, Puerto Rico and Lesser Antilles, Lucayan Archipelago, and Southern Caribbean. Only migratory species from North America are currently treated in these regions; resident and Caribbean-endemic bird species have not been evaluated.

Winter and migration-season regional avifaunal assessments - The regional ACAD now includes conservation assessments of all North American bird species in all regions in any season, including for the first time, the stationary non-breeding period (commonly referred to as "winter") and during migration, in addition to the breeding season as in previous versions.

Area Importance scores – Percent of global population (%pop) has replaced relative density as the primary measure of Area Importance (AI), which now replaces the Relative Density (RD) assessment score. This is due in part to the advent of range-wide abundance models produced by the Cornell Lab of Ornithology using eBird data through 2021, which were available for roughly 75% of North American bird species. For species without models, we used raw eBird data to generate %pop estimates by region in each season. The %pop estimates in breeding (%pop-b) and winter (%pop-w) are used to derive AI-b and AI-w scores, whereas "net percent use" values are calculated during spring (%use-s) and fall (%use-f) migration to generate AI-s and AI-f scores, the higher of which is used to assign an overall AI-m score for migration. The "percent use" values account for the length of time a species spends in any given region during migration, in addition to its abundance there, and the "net" values subtract out %pop values from areas where a species also breeds or winters to reflect the additional importance of regions during migration, beyond breeding or winter. AI-m scores are presented only when >1 to avoid overwhelming regional lists with peripheral migrants. In some cases, particularly seabirds, other population data, such as such as colony counts, were used to calculate %pop values, and along with other resources, used to assign AI scores for breeding and winter. See the Handbook for more details.

Breeds field – Non-breeding birds present in a region during breeding season are now included in %pop-b estimates, given that breeding and migration periods often overlap, and eBird models and data do not distinguish breeding vs. non-breeding individuals. Therefore, a "breeds" field has been added in the downloadable version of ACAD to indicate if species is known to breed in a given region based on previous expert reviews.

Peripheral species – Peripheral species, i.e. those with AI scores of 0 (or "P"), are no longer displayed in ACAD.

Extirpated and Nearly Extirpated species – Most species previously classified as nearly extirpated in a given region have now been assigned AI-b = 1. Extirpated species are no longer considered in regional assessments.

AI comment fields no longer displayed – Because AI scores have been updated based on 2021 eBird models, previous comments regarding presence/absence or AI scores are no longer displayed.

Population Trends – Regional Population Trend (PT-r) data and scores have been updated in line with the methodology applied to continental data and scores (PT-c). See the 2023 ACAD Update below for more details.

Common Bird in Steep Decline – The Common Bird in Steep Decline (CBSD) designation that has been applied at the continental scale since 2017 has now been adapted and also applied to the regional PIF assessment. CBSD-r is assigned to native species that do not meet Regional Concern criteria but have either PT-r = 5 OR a long-term population loss of 50% or more, and AI-b > 1 and TB-r > 1.

Last reviewed fields – These fields for regional scores are no longer displayed.

IUCN Red List – The IUCN Red List status in the global ACAD has been updated to 2023 classifications.

Species-specific data and score changes –

- Population estimates were updated for Cassia Crossbill, Whooping Crane, California Condor, and Brown-capped Rosy-Finch, but these did not change any PS-g scores.
- PT-c was updated for Scaled Quail, Mangrove Hummingbird, Whooping Crane, California Condor, Lewis's Woodpecker, Gray-crowned Rosy-Finch, and Cassia Crossbill.
- TB-c and TN-c were increased for Kirtland's Warbler to reflect its dependence on forest management practices.

Version 2023

Changes since version 2021

The 2023 version of ACAD includes the following updates to the global assessment database.

Climate Vulnerability Score - For the first time, ACAD now includes Climate Vulnerability (CV) scores for 604 species, mostly in the U.S., Canada and parts of Mexico, based on a National Audubon Society analysis of predicted range losses and gains in both breeding (CV-b) and non-breeding seasons (CV-w) under a 2-degree C warming scenario. The Partners in Flight Science Committee used the ratio of predicted range loss vs range gain to develop a 1-5 score, similar to other PIF assessment factors that considers both modeled changes in range size and model uncertainty. These scores have been integrated into the continental threat assessments (TB-c/TN-c) by averaging the CV-b and CV-w scores with the respective TB-c and TN-c scores for each species where CV is higher than TB-c/TN-c and has at least moderately high certainty. The CV scores are also available as standalone scores in the downloadable version of the ACAD.

Incorporating Urgency into Trend Score - Because we now have longer time-series of monitoring data for assessing population trends (>50 years for most species), ACAD now incorporates both long-term and short-term trajectories into the continental Population Trend (PT-c) score. Specifically, PT-c scores are adjusted when the short-term trajectory differs from the long-term trend. For example, it gives greater urgency (higher score) to species with long-term declines of 50% or more (since 1970) that also have lost at least 30% of their population within the last three generations (or 10 years, whichever is greater), and less urgency (lower score) to species with long-term declines of 50% or more that have recently leveled off or increased.

Data inputs for ACAD trend estimates now incorporate a combination of U.S. Geological Survey and Canadian Wildlife Service analyses of BBS survey data through 2021 and CBC data through 2019, to make use of both analytical approaches; in most cases, trend estimates represent an average between the two analyses. As in the past, trends for each species were assessed separately based on the most appropriate survey data source.

Half-life Estimates - Half-life estimates have been updated using the most up-to-date, continental-scale short-term (previously included long-term) population trend data for each species. Species have a half-life displayed only if the following four criteria are all met: 1) the species is on the PIF Watch List or Common Bird in Steep Decline list, 2) the short-term continental trend is statistically significant, 3) the half-life estimate is 30 years or less, 4) the long-term trend is not positive. The purpose of limiting half-life estimates to these scenarios is to focus attention on those species that are of concern continentally and show the greatest magnitude and certainty of recent declines.

PIF Watch List - The PIF North American Watch List has been updated to reflect the above updates to continental Threats (TB-c, TN-c) and Population Trend (PT-c) scores. The Watch List subcategories have also been revised to better reflect urgency among Watch List species and to clarify the previous Watch List subcategories (Red, Yellow-D and Yellow-R). The new subcategories are Red, Orange and Yellow and incorporate additional trend criteria used by Road to Recovery (R2R) to define Tipping Point species and categories. The PIF Red Watch List, which still identifies species with multiple cause for concern, now aligns with the R2R Red Alert Tipping Point list, and the Orange Watch List, which is a new category highlighting species with long-term and accelerating declines, aligns with the R2R Orange Alert Tipping Point list. A subset of the PIF Yellow Watch List aligns with the R2R Yellow Alert Tipping Point list, whereas another subset is not considered “Tipping Point”. The Yellow Watch List no longer distinguishes between Yellow “R” (range restricted; small populations_ and Yellow “D” (steep declines, high threats) lists. Please refer to the Handbook for further details.

Common Bird in Steep Decline – The criteria for CBSD has been updated to reflect either PT-c = 5 OR a long-term 50% population loss.

Taxonomy and affected species assessments - updated to reflect the 63rd Supplement to the AOS Check-list of North American Birds.

Migratory Status - updated to follow eBird Status and Trends classification, reclassifying all partial migrants (PM) as migrants (M)

Population Estimates - The global and US/Canada population estimates for Ivory Gull were updated using the most recent data available from Canadian Wildlife Service (COSEWIC).

Percentages by geography – The estimates of %GL_WH, %WH_US-Ca, and % Breeding Pop in US & Canada have been removed since these are not readily calculable from the eBird data and model outputs, which are at the scale of BCRs and other PIF regions.

Version 2021

Changes since version 2020

- Simplified and standardized geography and habitat classification for all species, eliminating former columns (Breeding Habitat Description, Winter Habitat Description, Primary Winter Habitat, Major Habitat_C America, Primary Habitats_PIF16, Primary Breeding Habitat_PIF16, Primary Wintering Geography) and substituting Breeding and Nonbreeding Biome, Primary and Secondary Breeding Habitat, Primary and Secondary Nonbreeding Habitat.
- Added Urban and Agriculture columns.
- Abbreviated the field names Continental Importance (now CI), Continental Importance in Region (CIR), Regional Concern (RC), Regional Stewardship (RS), Regional Importance (RI).
- Changed Mexican regions as explained in Appendix D.
- Removed non-breeding-only birds in Central American regions from the Regional ACAD.
- Removed pelagic species that were never scored due to lack of pelagic experts in the 2005 Mexican Regional Assessment in the former Mexican regions ISRE (Islas Revillagigedo, now merged into BCR33*) and CEPL (Central Mexican Pacific Lowlands, now merged into SCPL, Southcentral Pacific Lowlands). CONABIO is planning to eventually convene pelagic experts at which time those species will be added.
- Added when scores were last reviewed for Mexican and Central American regions.
- Changed to "not reviewed" for the latest review field for data-driven RD-b scores (BCRs 10 and 32) and PT-r scores (BCR 10) that were not reviewed by regional experts.
- Corrected RD-b scores for American Woodcock for BCRs 8, 13, and 23.
- Corrected Singing Ground Survey citation details for %Pop and RD-b for American Woodcock.

Changes since version 2019

- Updated taxonomy and AOS sequence number to AOS 60th supplement (Chesser et al 2019)
- Species listed as extinct or extirpated from North America in Chesser et al. (2019) have been removed from the ACAD.
- Added suffix to PS-g_s to indicate which global population estimates are geometric midpoints of PS-g population range rather than more precise estimates.
- Updated population estimates and trend data and resulting PS-g and PT-g scores, primarily based on sources used by Rosenberg et al. 2019.
- The field PopYr was added to the Global ACAD where population estimates from Rosenberg et al. 2019 were used.

- The years of trend data used were explicitly added to the trend source, e.g. BBS7017.
- Restored "pop change" field with updated estimates
- A handful of a species in BCR's 2 and 4 changed PT-r source to expanded BBS9317 to obtain a score more informative than 3 for insufficient data.
- "Intro in BCR" field dropped from Regional ACAD due to inconsistencies in its application across BCR's.
- The field "%WH_US-Ca-b" was added.
- Values for "%Breeding Pop in US & Canada" for species with breeding phenology significantly different from the June + 1st week of July window used in the Regional ACAD %Pop analysis of eBird data were changed from the sum of regional %Pop estimates in continental U.S. and Canada to (a) the continental US/Canada population estimate divided by the global population estimate where we had greater confidence in these population estimates than in the regional %Pop estimates, or (b) null where global and continental US/Canada estimates were based on different data sources that may not be appropriate to compare and/or we lacked confidence in the global population estimate.
- Corrected "Mig Status" field.
- Eliminated erroneous comments "migrants only" from RD-b_com field for BCR 19.
- Truncated comments were restored to full comments.
- Restored comments regarding continental US/Canada estimates from the 2012 version of the database that were lost when this comment field was eliminated in the 2017 version.
- "_last reviewed" fields were added to the continental U.S./Canada Regional ACAD to indicate when a score was last reviewed to alert users to possibly obsolete scores, since not all review teams were able to review all scores.
- Applied changes made to TB-c in calibration process (see explanation in following section) to the TB-r scores that were based on TB-c.
- TB-r scores were copied into gaps in TN-r for species in Guatemala and Costa Rica where known to be residents locally even if partial migrants range-wide.
- Added sources for Mexican and Central American regional scores.
- Corrected PR action code.

Changes since version 2017

- Data sources changed for many species for PS-g, PT-c, RD-b, PT-r, and TB-r based on expert review determining that a more appropriate data set existed for a given species.
- The field "%GL_WH-b" was updated with new data.
- Population estimates for continental USA/Canada were added for many species.
- A comment field for continental U.S./Canada population estimates, "Pop Size_US-Ca_com", was added.

- Where previous TB-r was based on old TB-c, updated TB-r to current TB-c. TB-c and TB-r scores were calibrated by comparing the weighted mean TB-r (for species where %Pop estimates were available to weight by) to TB-c. Those with >0.5 difference between mean TB-r and TB-c were reviewed and in most cases either TB-r or TB-c scores were adjusted based on expert opinion to bring the two scales into agreement.

- Added trend metadata (degrees of freedom, confidence intervals, relative abundance, etc.) to Global ACAD. Trends with decimals truncated were corrected. PT-c scores were updated to include data through 2017. CBC analysis for PT-c scores was clarified to be a custom analysis, not that of Soykan et al. 2016, and the citation for the latest version was added. CBC trends were corrected after an error was discovered in the CBS analysis. PT-r scores generated using erroneous scoring thresholds or precision criteria for BBS trends were corrected. Sister species traditionally lumped by BBS were split by John Sauer to generate species-specific trends and PT-c/PT-r scores.

- Typographic errors in the handbook were corrected. The only significant errors corrected were:
    - Definitions for CCSb and CCSn in Appendix A, the dictionary of database field names.
    - Years used for determining population trend scores
- The term "Continental Concern" was replaced with "Continental Importance" to clarify that Common Birds in Steep Decline (CBSD) are included in this field, not just Watch List species. For a species to qualify for Continental Importance in a region, we reduced the criteria for Watch List (but not CBSD) species from RD > 1 to RD > 0 (i.e. not peripheral).

- The criteria for CBSD has been simplified to PT-c = 5, eliminating the criteria that PS-g < 4, BD-g < 4, and ND –g < 4 that were designed to limit this category to common species, but these criteria are unnecessary since any species with PT-c = 5 that is rare or has a restricted range is already on the watch list. Removing these criteria has no effect on which species qualify as CBSD as long as the watch list criteria allow species with CCSmax = 13 and PT-c = 5 to make the watch list.

- International Union for Conservation of Nature (IUCN) Red List status was updated for each species to the 2018 version of the Red List.

- Non-landbirds were added back to the Regional ACAD.

- Central American and Mexican regional assessments were added via a downloadable spreadsheet.

- Added the codes ER (Extirpated Regionally), and NE (Nearly Extirpated) as options for RD-b and made these species eligible for Regional Importance.

- For both Continental Importance in Region species qualifying via Watch List (as opposed to via CBSD) and for Regional Concern (RC), the threshold for the criteria that a species must occur regularly in significant numbers in the BCR was lowered to RD > 0 instead of >1 to address the problem that reviewers would inflate RD scores to ensure that species of interest made it onto these lists.

- The criteria for Regional Stewardship (RS) was simplified to %Pop> 25%, eliminating species with RD=5 and %Pop between 5 and 25% to limit species on this list to those with a higher proportion of their total population in the BCR and focus stewardship efforts on a shorter more relevant list of species.

- Removed the action code CX (possibly extinct) since only relevant to a couple of species.

Appendix D: Assessment Regions

Fifty-four assessment regions form the geographic basis for the PIF regional assessment and ACAD, from Canada and Alaska south through Panama (Figure 2). Bird Conservation Regions (BCRs) serve as the assessment regions in the U.S., Canada and Mexico (although see details below on aggregations of certain BCRs in Mexico into "Super-BCRs"), whereas in Central America, individual countries serve as the assessment regions. This is because BCRs have not been defined or adopted beyond the U.S., Canada and Mexico, and because the status and vulnerability of many birds and their habitats in this region may differ sharply across political borders. For the first time, the 2024 ACAD integrates four new regions, all the in the Caribbean, into the Regional ACAD: Greater Antilles, Puerto Rico and Lesser Antilles, Lucayan Archipelago and Southern Caribbean. However, only transient and wintering populations of northern migratory species are currently evaluated in these areas.

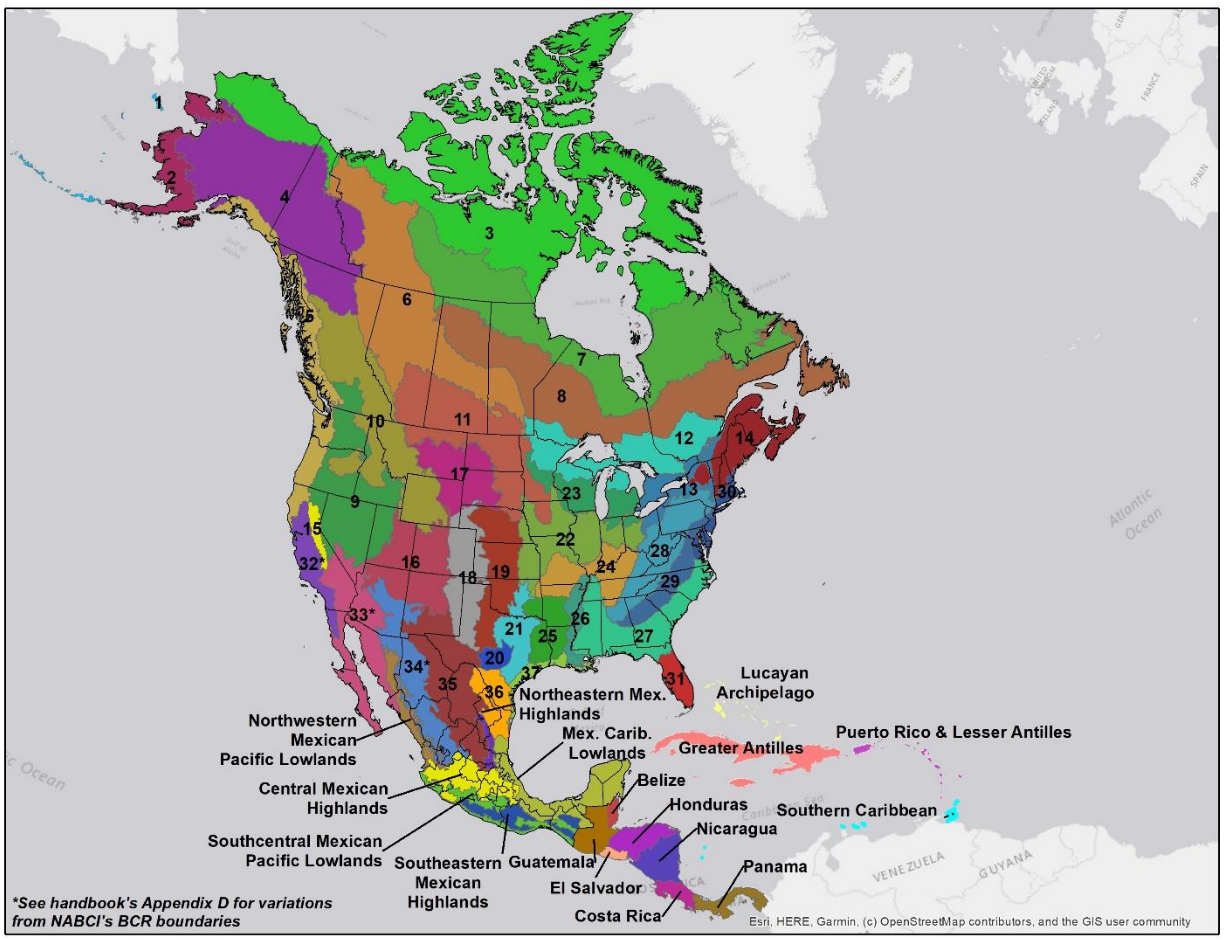

Figure 2. ACAD assessment regions as of 2024.

A more detailed breakdown of the assessment regions in Mexico, including the current aggregation of certain BCRs into Super-BCRs and minor deviations from current BCR boundaries due to how the original assessment workshops were conducted (see 2021 version of ACAD Handbook for more details), is provided below. These regions will be updated in future versions of ACAD to align with revised BCR boundaries in Mexico that are expected in the near future, although lumping of some regions will likely continue due to data limitations in small BCRs. The BCR boundary update is also expected to significantly affect BCRs in Canada.

Mexican assessment regions

Current assessment regions in Mexico

See Figure 3 below for a map of the regions described as follows:

- Coastal California* (BCRs 32 & 39)
- Sonoran and Mojave Deserts* (BCRs 33, 40, 41, 42, 62 & 63)
- Sierra Madre Occidental* (BCR 34, excluding Aguascalientes, Guanajuato, San Luis Potosí and parts of Jalisco; BCR 46 in Zacatecas)
- Chihuahuan Desert (BCR 35)
- Tamaulipan Brushlands (BCR 36)
- Gulf Coast Prairie (BCR 37)
- Northwest Mexican Pacific Lowlands (BCRs 38, 43 & 44; portion of BCR 45 in Nayarit)
- Southcentral Mexican Pacific Lowlands (BCRs 45 (except Nayarit portion), 50, 53 (small disjunct part ~20 km west of Presa Benito Juarez only), 59 & 61)
- Northeastern Mexican Highlands (BCR 48 in Coahuila, Nuevo León, Tamaulipas, San Luis Potosí, Guanajuato, Querétaro)
- Central Mexican Highlands (BCR 34 in Aguascalientes, Jalisco, Guanajuato, & San Luis Potosí; BCR 46 except portion in Zacatecas; BCR 47; BCR 48 in Hidalgo, Veracruz, Puebla; BCR 51 in Puebla; BCR 54 in Puebla & Veracruz)
- Southeastern Mexican Highlands (BCR 51 in Oaxaca; BCR 53 except small disjunct part ~20 km west of Presa Benito Juarez; BCR 54 in Oaxaca; BCR 58; BCR 60)
- Mexican Caribbean Lowlands (BCRs 49, 52, 55, 56, 57, 64, 65 & 66)

**only the largest BCR is listed in the BCR field that combines multiple BCRs*

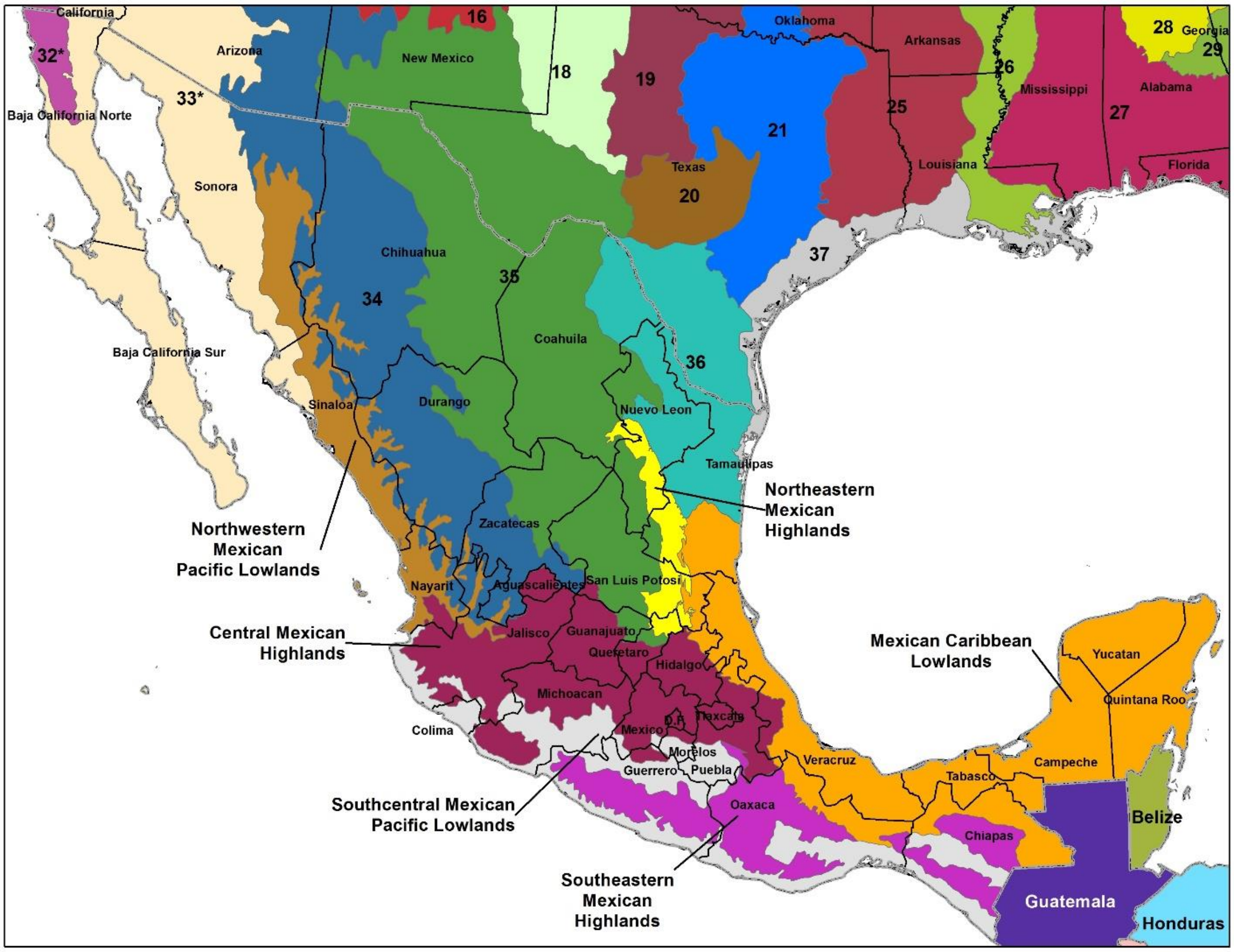

Figure 3. Color-coded ACAD assessment regions in Mexico as of 2024.

Appendix E. Area Importance Score Methods

Generation of % of Global Population (%Pops) by Season

Two different eBird data sources were used as detailed below under sections (a) and (b).

a) eBird Status and Trends models

We used the eBird Status and Trends model results released in December 2022, which are based on data from 2007 – 2021, to assess the percent of global population (%pop) in each region in each season (Fink et al. 2022). Model outputs were provided by Cornell Lab of Ornithology upon a special request for data at the scale of PIF assessment regions in North America (see Handbook Appendix D), Mexico, Central America and the Caribbean, and eBird regions outside North America (generally countries).

Models estimated relative abundance across the species' range, by week, with predictions intended to reflect the count of individuals of a given species by an expert eBirder at the optimal time of day at that time of year; estimates accounted for not only birder skill and search effort, but also local habitat, elevation, and topography at each location. For migrants, the 52 weeks of the year were assigned to four seasons: winter (stationary period), spring migration, breeding (stationary period), and fall migration; these season assignments were species-specific, based on examination of weekly abundance maps for stationary periods versus movement periods. For year-round residents, all weeks of the year were included in a single period. However, for both migrants and year-round residents, some weeks were excluded if they appeared to be transitional between seasons, or there were insufficient data. Abundances at each location were then rolled up into regional % of global population (%Pop) estimates for each season.

The following criteria were used to filter data incorporated into eBird models to improve model quality:

- checklists were complete (all bird species detected and identified were included) with counts of the species (not 'x');
- they were from the primary checklist in a shared checklist;
- checklists used the traveling protocol (not longer than 10 km) or stationary protocol, not incidental observations;
- checklists were not longer than 24 hours in duration, with info on start time, duration, protocol, number of observers, and distance traveled.

More model details are available from the Status and Trends FAQ page https://ebird.org/science/status-and-trends/faq.

b) Raw eBird Basic Dataset (EBD)

This dataset was necessary because not all species in the ACAD had eBird models at the time of analysis, and some species had models for some seasons but not others, due to limited sample sizes or species detectability in some parts of species' ranges. We have filled most of these gaps using the EBD, downloaded in March 2020 to cover the period January 1, 2000 to February 29, 2020. This analysis includes older data to help increase sample sizes for species and regions with gaps in models.

Similar data quality screening criteria to those used in the creation of eBird models (see above under a) were applied to the raw dataset to make the output comparable, with the additional criterion that Great Backyard Bird Count data were excluded, and area, random, travelling, property specific, and BBS protocols were included. Weekly assignments from eBird models were used for all species for which they were available. Otherwise, year-round residents used data from all 52 weeks; for migrants, weeks were assigned to season by Partners in Flight Science Committee members, using eBird maps and bar charts to help with assignments.

Regions analyzed with EBD data in the Western Hemisphere were mostly the same as those used by the 2022 eBird models. However, in Brazil, Argentina, BCRs 6-8 and BCRs 32-37, sub-regions were created to assign area-weights to eBird checklist data, to ensure poorly birded areas within a region were not swamped by observations from more frequently birded areas. Regions were created outside the Western Hemisphere to account for populations of shared species in the Old World. These regions comprised selections of countries, or aggregations of states/provinces, to provide reasonable sample sizes as well as similar biogeographic extents as regions in the western hemisphere.

Two separate analyses were conducted with EBD data – one using only frequency of occurrence on eBird checklists, the other using average counts in the same checklists. In each case, regional %Pops in each season were determined by weighting the results from each region by region area, summing across regions, and taking the regional proportion of the global sum for that season. Each of the two measures provides some advantages and disadvantages when calculated from raw EBD data, therefore %Pops from relative abundance and relative frequency were averaged in each season.

<u>Net %Pops in migration seasons</u>

Estimates of %Pop from migration seasons tended to reflect breeding or wintering %Pops in many regions, due to many individuals arriving before, or leaving after, the stationary dates. To focus attention on regions that are important to migrants in transit, we calculated a net %Pop for migration seasons that removed %Pops for stationary periods in the same region. Thus, the net spring %Pop in a region = spring %Pop – max (breeding %Pop, winter %Pop), with no spring %Pop if negative. Net fall %Pop was calculated the same way, and a net migration %Pop was simply the max of net spring and net fall %Pops.

<u>Generation of default AI scores</u>

Area importance scores (AI) were then derived from %Pops for each season, using net %Pops during migration, as follows:

1 = 0.05% to 0.9% of the global population in a given season
2 = 1.0-3.9% of the global population in a given season
3 = 4.0-9.9% of the global population in a given season
4 = 10.0-24.9% of the global population in a given season
5 = $\geq$25% of the global population in a given season

Note that %pop estimates are rounded to the nearest tenth decimal when assigning AI scores, or in the case of the lower threshold for AI=1, the nearest one-hundredth decimal. When %pop estimates were below 0.05%, it was assumed that the species did not occur regularly in the region, so that an AI score of 1-5 was not assigned, unless the species was included previously in ACAD on a regional breeding-season list based on other data sources such as BBS or a PIF regional expert, in which case it was assigned AI-b=1 to indicate regular occurrence during the breeding season.

AI-b denotes the breeding season Area Importance score, AI-w the winter score, AI-s the net spring migration score, AI-f the net fall migration score. AI-m represents the maximum of the net spring and fall migration scores.

Combining results from ACAD, eBird models, and EBD analyses

We used model-based %pop estimates for the default AI score for all species and seasons where available, and used EBD-based %pop estimates only for species and seasons without eBird models. However, for seabirds and Arctic species we used the following interim approaches.

For most seabirds that breed in North America, we compiled colony count data and other population estimates from Birds of the World Population Status accounts, assigned them to BCRs, and transformed them into percentages (%pop-b) using the global population estimate in the denominator to assign AI-b scores. We then used information on distribution and seasonal movements from Birds of the World accounts, along with eBird raw observation maps, to assign AI-w scores. We did not attempt to assign AI-m scores, due to the incomplete nature of migration in some seabirds, and our limited knowledge of it. Because PIF assessment regions are currently all land-based, AI-w scores for seabirds were assigned to BCRs and other terrestrial regions with the intention to reflect abundance of those species in adjacent coastal waters, at least out to the continental shelf. Further work is need to define marine assessment regions for seabirds, and refine and update assessment data for them. The AI scores should be considered preliminary until they can be reviewed by seabird experts. Seabirds that occur only as non-breeders in North America are currently not assessed by PIF regionally, but we hope to include them in future versions of the ACAD.

For BCRs 1-3 (arctic regions), eBird coverage is sparse, so the existing ACAD expert-based RD scores were used by default rather than eBird-based AI scores, and were interpreted as having the mean relative density for a given score (e.g., RD = 5 ranges from 0.5-1.0 of the maximum density, so relative density was assigned as 0.75), which was then converted into %pop using region size to yield a %pop-based AI score.

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Appendix F. Calculation of Climate Change Vulnerability scores

Methods

The Climate Change Vulnerability (CV) scores were derived from species vulnerability scores for 604 species across Canada, the United States, and Mexico from previously published models of species' projected climate change related range shifts (Bateman et al., 2020; Wilsey et al., 2019). These models were developed using a combination of species distribution models (SDMs) and trait-based information for both the breeding and non-breeding seasons, projected under global warming. Each species was modeled within a habitat group context (e.g., eastern forest), using a combination of ecologically relevant variables based on climate and habitat-based environmental predictors across North America at a 1 km resolution. The modeling effort included a multi-step expert review process where an expert visually assessed the mapped bird occurrence data, modeled current range, and projected future range for each species and season, including a final threshold selection that aligned with expert opinion and minimized a decrease in model performance. Each species' vulnerability was defined as a function of a species' *exposure* (climate change scenario considered, here under a 2.0°C climate change scenario)*, sensitivity* (the negative impact of climate change on a species through range loss), and *adaptive capacity* (the ability of a species to respond to climate change through range gain relative to range loss based on each species' trait-based dispersal ability) (Bateman et al., 2020; Foden & Young, 2016; Moritz & Agudo, 2013; Wilsey et al., 2019). Bateman et al (2020) classified the vulnerability of each species for each season and scenario under a four-category system of neutral, low, moderate, or high based on projected range loss (i.e. currently suitable but projected to become unsuitable) and potential range gain (i.e. not currently suitable but projected to become suitable). Each species also was assigned a model certainty score, where certainty was derived from model agreement across the GCM ensemble and three individual GCM scenarios, and was assessed as Low (L), Moderately Low (M-L), Moderately High (M-H), or High (H) model agreement. For more information on modeling methods of the original vulnerability scoring, please see Bateman et al (2020) and Wilsey et al (2019).

For the ACAD database, we developed this scoring system under a 2.0°C climate change scenario, which was based on the greenhouse gas representation concentration pathway (RCP) of RCP 8.5 during the 2050s (2041-2070). We modified the original scoring system of Bateman et al. (2020) to align with the current ACAD five-category scoring system, where one is the lowest CV rank and five the highest. These changes were incorporated to further reflect the species' needs to be able to disperse to new areas in areas of range gain. The original scoring method of Bateman et al. (2020) used a polygon scoring system, where in some adjacent ratios of loss and gain at the boundaries between polygons inferred a two-score convergence of points (i.e., a score of neutral adjacent to a score of moderate, which is a jump of 2 points). The new scoring system implements parallel lines to separate ratios of loss and gain on the scoring plot, which avoids jumps of more than one point (Fig. 1). The parallel thresholds were implemented with a slope of 2 (retained from the original methodology), so that range loss was weighted double the impact of range gain, reflecting the cost of adaptation to new range areas. We applied a minimum 20% difference in range loss between each score. For the highest CV category of 5, we modified the intercepts to 60% range loss, meaning any species with over 60% range loss or more would be ranked as a score of 5. These new criteria align CV scoring with the PIF Population Trend (PT) score criteria with a score of 2 indicating a stable population (PT) or no range gain or loss (CV). The modified scoring was based on the following formula:

TotPts2 = SUM(2,M/0.2,-N/0.4)

- where M is Prop.Loss, N is Prop.Gain
- Within the parentheses, the number '2' indicates that the base CVb score is 2 if no gain or loss (same as ACAD PT score)
- The 'M/0.2' converts %Loss to a score, where each 20% of Loss adds 1 to the total score
- The '-N/0.4' converts %Gain to a negative score, where each 40% of Gain subtracts 1 from the total score; this means Loss has twice as much effect as Gain on the species score, reflecting that Gains in range have an adaptation cost

Exception: if 1.0 < (2 + prop.loss/0.2 - prop.gain/0.4) < 1.5, then CV =2

CV is then truncated at 5 and 1:
if CV < 1, then CV = 1, if CV > 5, then CV = 5

CV=IF(R>=4.5,5,IF(R>=3.5,4,IF(R>=2.5,3,IF(R>=1,2,IF(R>-9,1)))))

- where R is TotPts2 value
- This formula is simply converting the TotPts value to a CV score between 1 and 5, i.e., TotPts2 of 4.5 or more are converted to a score of 5, etc. Note that scores of 2 have a slightly wider range of TotPts2 (1 to 2.5)

To incorporate the new CV scores into the ACAD database, new CV scores on the 1-5 scale were developed for all 597 species in the breeding season, and were also applied to 544 species in the non-breeding season (total of 604 species across both seasons). For each species that had a CV score that was greater than its TB/TN score, we averaged CV and TB/TN, then rounded up to get the final score. Our rationale was that just increasing the TB/TN scores by one may be insufficient if the climate threat is high.

CV scores with Low (L) or Moderately Low (M-L) certainty were adjusted by one point towards the middle (e.g. from 4 to 3, or 1 to 2, no change if already 3) to exercise caution due to our low confidence in them.

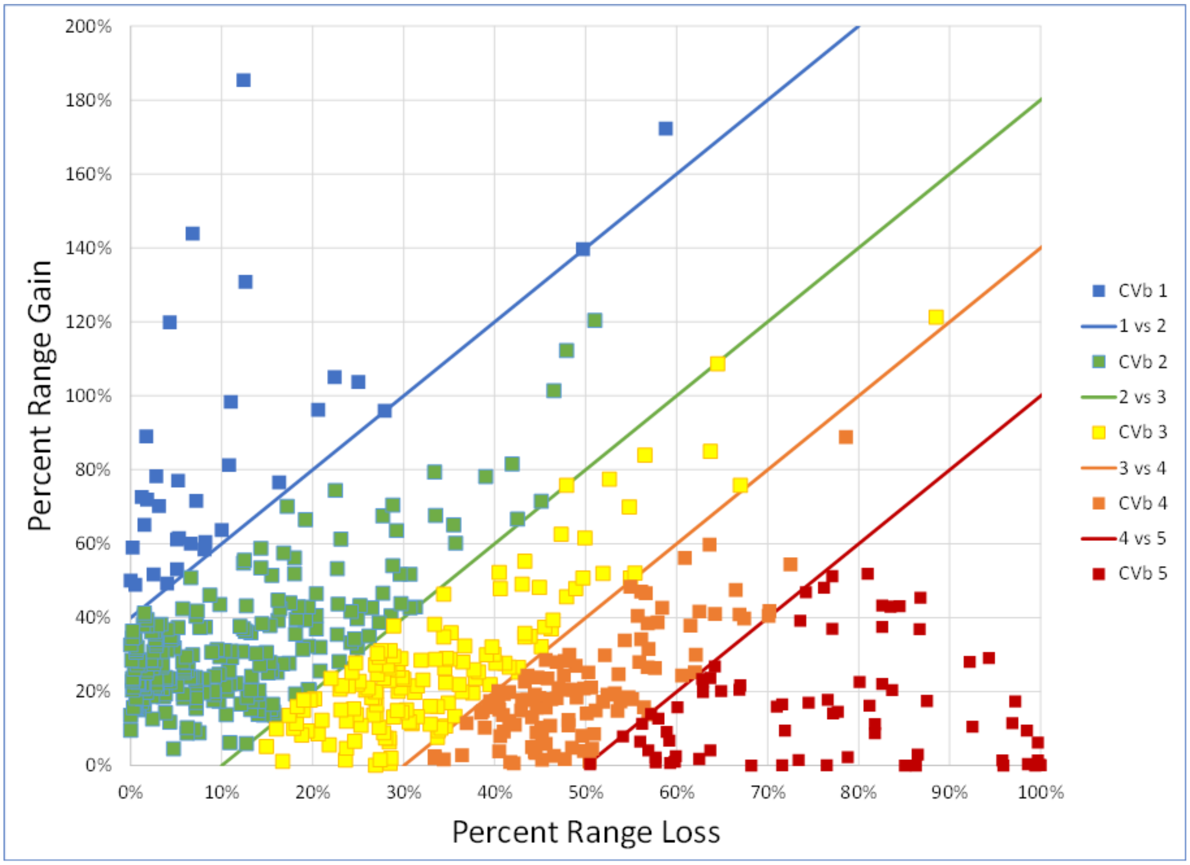

Figure 1. Graph showing CV breeding season scores (CVb in legend) for 598 species based on their predicted range gain and range loss by 2050.

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Appendix G. Population Trend Analysis Methods

North American Breeding Bird Survey (BBS) Trends (United States Geological Survey)
United States Geological Survey (USGS) analyzes BBS data using hierarchical overdispersed Poisson regression models, implemented in the Bayesian framework (Sauer and Link 2011). These models account for variation between observers, routes, and regions as well as first-year observer effects. The analysis is conducted within strata formed by the intersections of states/provinces and Bird Conservation Regions (BCR). USGS performed model selection for each species to find the model of year-to-year variation and overdispersion in a set of four models that best predicts the BBS data for that species, and uses that model to estimate abundance indices by strata and year (Link et al. 2020).
The BBS survey was not conducted in 2020 due to pandemic restrictions. Annual BBS indexes listed for 2020 are interpolations of adjacent data produced by the hierarchical model. The method USGS uses to provide population trends for PIF differs from that used in their published analysis (https://doi.org/10.5066/P9GS9K64; Hostetler et al. 2023). Whereas the published BBS analysis uses the end points of the trend period to determine the overall trend, the analysis for PIF applies a linear fit to the log-scale annual abundance indices, thus diminishing the influence of the end points and providing greater stability in trend scores across updates. Trends are presented as percentage change per year.

North American Breeding Bird Survey (BBS) Trends (Canadian Wildlife Service)
The Canadian Wildlife Service analyzes the BBS data using a hierarchical Bayesian model that estimates non-linear patterns of population change in local strata, while accounting for the effects of variation among observers and routes, first-year observer effects, regional variations in abundance, and annual population fluctuations. The model estimates the pattern of population change through time (the trajectory) using a non-linear smooth component (hierarchical generalized additive model) and annual fluctuations around the smooth (random fluctuations within each stratum). Trends from this model are calculated based on the non-linear smooth component, after removing the influence of annual fluctuations and so are less sensitive to the specific years in which the trends are assessed. The model is described in Smith and Edwards (2020) and Smith et al. 2024, and fit using the R-package bbsBayes2 (Edwards et al. 2023).
The CWS estimates trends from 1970 for all regions in the BBS dataset, because the population trajectories (and therefore trends) in each geographic stratum are estimated in a way that shares some information across the species' range. The model considers trend estimates from other regions to improve estimates of a species' trends in areas where the local data are relatively sparse, but the estimates are essentially unaffected in areas where there are many data. As a result, estimates of population trajectories in strata with relatively few data are more similar to the species' range-wide average trajectory and estimated trends in regions with relatively sparse data are generally more precise and less extreme (relative to the species' range-wide mean trend) than estimates from models that do not share information across the species' range.

Migrating Shorebird Surveys (ISS, ACSS, OSS)
The Canadian Wildlife Service analyses the Migrating Shorebird Surveys (International Shorebird Survey, Atlantic Canada Shorebird Survey, and Ontario Shorebird Survey) using a hierarchical and spatially explicit Bayesian model described in Smith et al. 2023 and Smith et al. 2024. This model

estimates non-linear patterns of population change, while accounting for the variation in trends among regions of North America (primarily eastern North America), variation in abundance among surveys sites, survey timing during the fall migration season, and annual population fluctuations. The shorebird model is also a hierarchical model that shares information among regions on population trends and trajectories and it uses explicit spatial relationships among the survey regions to share information. This spatial component assumes that trends from a given region are likely more similar to trends from neighboring regions than from regions that are further away.

Arctic Geese (CAFF)
Trends for arctic breeding geese were estimated directly for the ACAD using hierarchical Bayesian non-linear smooths of estimated annual population sizes. The annual population sizes were estimated with Lincoln Estimators that use banding and harvest data (Alisauskas et al. 2022). The trend models accounted for the uncertainty of each annual population estimate and fit a non-linear smooth using a Generalized Additive Model, following methods in Rosenberg et al. (2019). Trends (estimates of %-change) were estimated as geometric mean annual rates of change between two points on the estimated smooths for start and end years.

Christmas Bird Count (CBC)
The National Audubon Society analyzes trends from the Christmas Bird Count (CBC) survey using a linear regression model (Meehan et al. 2018) similar to the USGS Bayesian hierarchical modeling approach for BBS data described above, where the counts within each stratum (i.e. BCR) are modeled as overdispersed Poisson random variables, and the linear slope is calculated for each of the posterior samples of the annual indices, and the mean and credible intervals of the slopes are based on all of the posterior samples, as described further in Soykan et al (2016).

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Appendix H. Avifaunal Biomes and Habitat Classifications

Avifaunal Biomes

The concept of avifaunal biomes was first introduced by PIF in the 2004 Landbird Conservation Plan (Rich et al. 2004) to organize bird species according to their similar eco-geographic affinities and to assign stewardship responsibility for the conservation of suites of species in broad geographic areas. The original seven Avifaunal Biomes in the U.S. and Canada were derived based on a cluster analysis of the percent of global population for each of 429 landbird species across 37 Bird Conservation Regions (BCRs; see the map on the inside back cover of Rich et al. 2004). These Avifaunal Biomes represent patterns of endemism across geographic regions of North America and include many characteristic species that are restricted to a single biome. Note that the large regions resulting from this cluster analysis are very similar to the CEC Level 1 Ecoregions used to create BCRs (NABCI 2000), but because clusters were defined based on similarities in bird distributions, the boundaries do not exactly align with the CEC regions.

For the current ACAD, we have extended the avifaunal biome concept in several directions, building on the original 2004 presentation. First, we have assigned all breeding non-landbird species, including shorebirds, waterbirds, and waterfowl, to the same original seven avifaunal biomes in the U.S. and Canada. Next, to assign all North American species to avifaunal biomes, we needed to extend the biomes through Mexico, Central, and South America. In Mexico, BCRs have been modified and combined into four regions (PIF Science Committee, unpublished data, see *Fig. 1*) for the purpose of species conservation assessment. For this 2021 biome assessment, we extended three of these four regions south through Central America, essentially representing the Gulf-Caribbean Lowlands, Pacific Lowlands, and Highlands regions. We further extended the biomes to accommodate species occurring largely in marine or oceanic regions, using the previously described Marine Ecoregions of the World (Spalding et al. 2007).

As part of PIF's emphasis on full annual cycle conservation for migratory species, we previously identified the Primary Winter Region for all species that migrate south of the U.S. and Canada (Rosenberg et al. 2016: Appendix A). Those winter geographies closely match the avifaunal biomes used in this 2021 analysis for Mexico and Central America, and they allow us to extend the biome concept even farther south into South America. To accommodate the hundreds of resident Neotropical species in Mexico and Central America, part of our process was to review the winter geographies used for migratory birds in light of the distributions of Neotropical resident species. This process resulted in a refinement of the Neotropical biomes within Central and South America to better represent the endemism within this diverse avifauna while still grouping important suites of migratory species from the U.S. and Canada. Because many seabird species visit North America only in the nonbreeding season, Wintering Avifaunal Biomes were also established to define the nonbreeding distributions of seabirds.

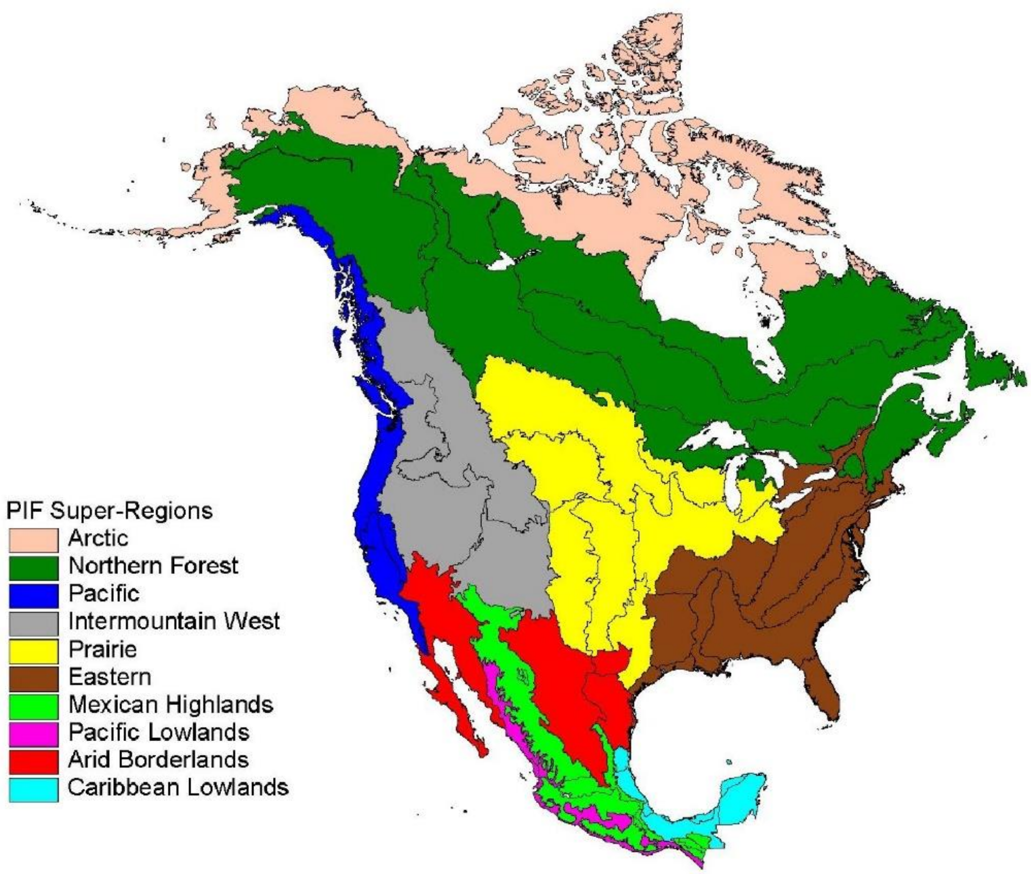

Figure 1. Partners in Flight Avifaunal Biomes for Canada, United States of America, and Mexico.

Our process resulted in 24 unique terrestrial and marine Avifaunal Biomes from the Arctic to Temperate South America and the Southern Ocean and including regions outside the Western Hemisphere to which species migrate in the breeding or nonbreeding seasons (see Definitions below). We also used several composite biome regions to represent combinations of biomes within a larger region (e.g., Nearctic, Mesoamerican). Species that occur in multiple biomes across regions or are especially difficult to assign to a single biome are designated as Widespread. Species introduced in North America are not considered as part of any native avifaunal assemblage and are not assigned to an Avifaunal Biome.

Although we were not able to repeat a cluster analysis for all species throughout North America, we did use a summary of eBird frequency and abundance data (Blancher, unpublished analysis) to help assign species to a primary Avifaunal Breeding and Nonbreeding Biome. We also consulted range maps and descriptions in Birds of the World (2020) accounts as well as eBird distribution maps and models (Fink et al. 2020). We did not follow strict quantitative rule sets in assigning species to Avifaunal Biomes, because available data varied greatly among taxonomic groups and because avifaunal affinities were not always represented in regions with greatest abundance. Many species with broad ranges were difficult to assign to a single Avifaunal Biome and were assigned to either larger composite biomes (e.g. Neotropical) or were considered Widespread, even if a majority of the species' population occurred in a single region. In the end our goal remained to identify groupings or affinities of species that represent patterns of endemism across the full North American avifauna. Assignment of avian species to biomes using a data-driven approach and quantitative rule set is a potential future task, although similar results are already available since the Regional ACAD database presents AI scores and %Pop at the finer BCR scale.

Avifaunal Biome Definitions

Arctic Same as CEC Level 1 and PIF 2004 Avifaunal Biome; includes BCR 1, 2, 3. Most bird species in this group are Holarctic in distribution, and we do not distinguish a separate North American Arctic biome; includes coastal and marine portions of Greenland, Labrador, Arctic Canada, Alaska, and the Bering Sea.

Caribbean Includes the entire West Indies plus Bermuda; some species also occur along the immediate Caribbean coast of Central or South America but often on offshore cays or islands. Includes marine portions of Caribbean Basin.

Central and South American Highlands Defined originally as a Winter Geography (PIF 2016); includes mountain cordilleras from Costa Rica and Panama south through the South American Andes and other mountainous areas of northern South America.

Eastern Indo-Pacific (Marine) Defined by Spalding et al. (2007), Marine Ecoregions of the World; includes Hawaiian Islands, Marshall Islands, and Polynesian chains.

Eastern Temperate Eastern United States and southeastern Canada, south of the Northern Forest; corresponds with Eastern Avifaunal Biome of PIF 2004 (BCRs: 13, 24–31, 37).

Great Plains Central U.S. and Canada as defined by the Prairie Avifaunal Biome of PIF 2004 (BCRs 11, 17–23).

Gulf-Caribbean Lowlands Defined originally as a Winter Geography (PIF 2016); includes the Mexican species assessment region, MX-CarLo, extending from NE Mexico (south of Tamaulipan Brushlands) south through eastern Mexico, including the Yucatan Peninsula; extends south along the Caribbean slope of Central America to the northern Caribbean lowlands of Colombia. Note that for many Caribbean Slope species that extend into the Pacific lowlands of Costa Rica and Panama, we use the broader biome Mesoamerican; for species largely restricted to the southern Central American lowlands in southwestern Costa Rica, Panama, and the lowlands of South America north and west of the Andes, we use the biome Trans-Andean Lowlands.

Intermountain West Interior western U.S. and Canada; corresponds with Intermountain West Avifaunal Biome of PIF 2004 (BCRs 9, 19, 16).

Introduced Species not native to North America and therefore not associated with any native avifaunal grouping. Note that these species, although not assigned to biomes, are assigned to habitats.

Mesoamerican Refers to Mexico plus Central America; assigned to species that occur in more than one biome within this broader region (e.g., many species that occur on both Gulf-Caribbean and Pacific slopes).

Mesoamerican Highlands Mountainous areas from northern Mexico (extending into southeastern Arizona and New Mexico) south to northern Nicaragua; an extension of the Mexican Species Assessment region MX-High (Sierra Madre Occidental, Central Mexican Highlands, Northeastern Mexican Highlands, Southeastern Mexican Highlands). Some species extend into Costa Rica and Panama, but if the majority of their range is to the north, or if they are clearly restricted to higher elevation cordilleran mountains of Costa Rica and Panama, we use Mesoamerican Highlands.

Mesoamerican Pacific Lowlands Defined originally as a Winter Geography (PIF 2016), Pacific Lowlands or Pacific Slope; same as Mexican species assessment region MX-PacLo, including Northwestern Mexican Pacific Lowlands and South Central Mexican Pacific Lowlands; extending south along the Pacific Slope of Central America to Costa Rica, including coastal (mangrove) areas and offshore islands. Note that a unique set of species endemic to southwestern Costa Rica are also assigned to this biome.

Nearctic As defined elsewhere; refers to broad region of North America north of the Tropic of Cancer in Mexico; used for species that occur in multiple biomes of the U.S. and Canada, often in both the East and West or along both Atlantic and Pacific coasts.

Neotropical As defined elsewhere; refers to broad region of Mesoamerica and South America south of the Tropic of Cancer; used for species that occur in multiple biomes across Central and South America and/or the Caribbean.

North American Southwest Arid regions of southwestern U.S. and northern Mexico; roughly the same as the Southwest Avifaunal Biome of PIF 2004 (BCR 33, 35, 36, 20), but BCR 34 is now part of Mesoamerican Highlands; includes much of the CEC Level 1 region North American Deserts.

Northern Forest Corresponds to Northern Forest Avifaunal Biome of PIF 2004 (BCRs 4,6,7,8,12,14); broad region from Newfoundland to western Alaska including boreal and taiga regions as well as northern hardwood and transitional forests of northeastern U.S.

Pacific North America Corresponds to Pacific Avifaunal Biome of PIF 2004 (BCRs 5, 15, 32), including coastal areas.

Pacific Ocean Used for a few species that range widely over the Pacific Ocean, including two or more Marine Ecoregions.

Palearctic As defined elsewhere, referring to the Old World regions including all of Eurasia.

Paleotropics As defined elsewhere, referring to the Old World tropical regions including Southeast Asia and Africa.

Pantropical (Marine) Used for species that range widely across the tropical Pacific, Atlantic, and Indian Ocean regions.

South American Lowlands Defined originally as a Winter Geography (PIF 2016); includes all tropical lowland areas of South America, primarily east of the Andes, including the Amazon Basin, Llanos, Pantanal, Chaco, and Cerrado bioregions. Note that species occurring only west or north of the Andes in South America are assigned to either Trans-Andean or Gulf-Caribbean Lowlands biomes; species occurring primarily south of the Tropic of Capricorn in the Pampas or Gran Chaco or coastal areas are in Temperate South America.

Southern Ocean Defined by Spalding et al. (2007), Marine Ecoregions of the World; includes Antarctica and adjacent islands and marine waters.

Temperate Australasia Defined by Spalding et al. (2007), Marine Ecoregions of the World; includes marine areas of southern Australia and New Zeeland.

Temperate Northern Atlantic (Marine) Defined by Spalding et al. (2007), Marine Ecoregions of the World; includes marine areas of Atlantic Canada, southern Iceland, western Europe, Mediterranean, and north Africa, including Azores, Canary, and Madeira islands.

Temperate Northern Pacific (Marine) Defined by Spalding et al. (2007), Marine Ecoregions of the World; includes marine waters of Pacific North America, southern Alaska, Aleutians, Japan, and northern China.

Temperate South America Region south of Tropic of Capricorn, including the area referred to as Southern Cone, and also the Gran Chaco of Argentina and Paraguay, and coastal and marine areas of Argentina (including Falklands), Chile, and Peru.

Trans-Andean Lowlands Refers to lowland region north and west of the Andes in northwestern South America (Colombia and Ecuador); the distinct Choco avifauna found here usually extends into Central America, either just into Darien, Panama, to southwestern Costa Rica, or in some cases farther north in Central America. Note that it was often difficult to delimit a boundary with the Gulf-Caribbean Lowlands, as many species occur throughout the entire lowland region; the resident avifauna are fairly distinct, and only a few North American migrants are restricted to this biome in winter (e.g., Bay-breasted Warbler, Acadian Flycatcher).

Tropical Eastern Pacific (Marine) Defined by Spalding et al. (2007), Marine Ecoregions of the World; includes marine waters off northwestern South America (including Galápagos) and Central America to western Mexico (Clipperton, Revillagigedos).

Western Temperate Combines Intermountain West and Pacific North America for species that are found roughly equally in both biomes.

Widespread For species found in many biomes that are difficult to define using a single composite region; includes coastal birds that occur throughout most of the Western Hemisphere and some oceanic birds that occur in several parts of the world.

Habitats

As noted above, the habitat classification in this 2021 version of the ACAD builds on previous efforts in *Saving Our Shared Birds* (Berlanga et al. 2010), the 2016 *Landbird Conservation Plan Revision* (Rosenberg et al. 2016), *State of North America's Birds* (NABCI 2009, 2014, and especially NABCI 2016; NABCI-Canada 2012, 2019), the Central American Species Assessment process, and Rosenberg et al. (2019)—at the same time striving for consistency in category labels using a system applicable across all taxa and throughout the North American continent. A primary goal was a scheme useful for high-level sorting of species into broad categories that is otherwise unavailable in more detailed, species-specific treatments. To achieve this goal, we settled on (1) a **hierarchy with two levels**: a very broad Level 1, Habitat Class (e.g. Forests, Grasslands), and a more descriptive Level 2 sub-category, Habitat (e.g. Forests: Boreal; Grasslands: Chihuahuan) for both breeding and stationary non-breeding seasons; and (2) **two designations for proportional occurrence** across Habitat Classes and Habitats: **Primary and Secondary**, also for both breeding and non-breeding seasons. In addition, we provide two independent columns designating species that are associated with agricultural and urban/suburban habitats, regardless of their Habitat Class or Habitat.

There is little information available at the continental scale for quantitatively assigning species to Habitat Classes or Habitats. For this 2021 version of the ACAD, we relied on the previous efforts mentioned above, reinforced by repeated visits to both distribution maps and habitat descriptions in species accounts in Birds of the World (2020), and expert review by PIF Science Committee members. Short of a complex and costly geospatial analysis, and recognizing that opinions will inevitably vary based on local knowledge, we feel this was a reasonable approach to assigning habitat affinities at broad scales.

For species for which two Habitat Classes or Habitats are *roughly equal* in importance, both are listed, with the Habitat that represents greater proportional occurrence for the species designated as Primary and the other as Secondary. (In some cases, this Primary/Secondary assignment was admittedly an expert opinion that varied among reviewers.) In cases where a species is known to occur in other types of Habitat, but in substantially smaller numbers relative to the Primary Habitat assignment, no Secondary Habitat is listed. Finally, species that are represented in *roughly equal* numbers in *three or more* Habitat categories are designated as Generalists (e.g., Wetland: Generalist).

For reasons of space, only the Primary Breeding Habitat or Primary Nonbreeding Habitat are presented on the web version of the ACAD, depending on whether the Breeding or Nonbreeding filter is active. In the downloadable version of the ACAD, we provide four Habitat columns (Primary and Secondary Breeding, Primary and Secondary Nonbreeding) with the Level 1 (Habitat Class) separated by a colon and two spaces (:) from the Level 2 (Habitat) assignment, as described below.

The ***Hierarchy and Definitions of Habitat Classes and Habitats*** follow, with the Habitat Classes (Level 1) left-justified and the constituent Habitats (Level 2) indented beneath the broader Habitat Classes:

Tundra Open habitats characterized by sedges, grasses, mosses, lichen, and dwarf shrubs; in general, more xeric than habitat described as *Wetlands: Tundra*.

Tundra: Arctic Tundra in the Arctic biome beyond treeline but not associated with wetlands or coastal tidal influence.

Tundra: Alpine Montane tundra above treeline, often characterized by relatively bare ground and snowfield borders.

Tundra: Páramo High, tropical, montane vegetation above the continuous timberline dominated by grasses, giant rosette plants, and shrubs.

Wetlands Freshwater inland wetlands of all types, excluding coastal marshes.

Wetlands: Tundra Wetlands embedded in tundra habitat; in arctic and northern boreal zones, shallow wetlands characterized by permafrost substrate and vegetation ranging from tundra grasses and forbs to tundra/taiga shrubs.

Wetlands: Boreal Bogs, fens, muskeg, marshes, and other wetlands within the boreal forest zone; species assigned to this habitat category are dependent ecologically on the aquatic resource, although trees may be utilized for nesting, roosting, or perching.

Wetlands: Lakes and Rivers Freshwater lakes, ponds, rivers, and streams, and their immediate shorelines (e.g., alkaline flats); characterized by substantial areas of open water.

Wetlands: Freshwater Marsh Permanent or semi-permanent freshwater wetlands with emergent aquatic vegetation (cattails, rushes, etc.); marsh can be embedded within other habitat types (e.g., grasslands or forests).

Wetlands: Forested Permanent or frequently flooded wetlands in temperate or tropical zones with stunted to mature trees and open water: swamps, bottomland hardwood forests, etc.; species assigned to this habitat category are dependent ecologically on the aquatic resource, although trees may be utilized for nesting, roosting, or perching.

Wetlands: Seasonally Wet Grasslands Ephemeral or seasonal wetlands dominated by grasses or sedges (as opposed to taller emergents like cattails), including temperate Prairie Wetlands.

Wetlands: Generalist Species that use a wide variety of wetland types (three or more categories in roughly equal proportions) for nesting and breeding-season foraging—including, in this case, coastal saltmarsh. Nesting can occur in/on a variety of substrates (trees, rushes, shore, etc.), but species is ecologically dependent on the aquatic resource.

Coasts Interface between continental terrestrial habitats and saltwater oceans, bays, gulfs, and estuaries; all habitats associated with the coastal zone, including mangroves.

Coasts: Tundra Intertidal saline or low-lying tundra immediately bordering the Arctic coastline, distinct from other temperate zone coastlines (including coastal areas of western and southern Alaska, Labrador, etc.) due to the unique scouring effects of sea ice and permafrost substrate.

Coasts: Beach and Estuary Sandy beaches, sandbars, and tidally influenced adjacent shallow waters.

Coasts: Saltmarsh Emergent marsh in the upper coastal intertidal zone dominated by salt-tolerant grasses, herbs, and/or low shrubs; includes brackish marshes.

Coasts: Rocky Intertidal Intertidal zone and rocky beaches dominated by rocks and coarse gravel (including rock jetties) as opposed to sandy beaches or mudflats.

Coasts: Marine Waters Coasts and continental shelf waters (essentially the zone occupied by most gulls), including bays and deep estuaries.

Coasts: Cliffs and Islands Nesting sites on coastal rocky cliffs or on nearshore islands that could include cliffs or flat vegetated areas.

Coasts: Mangroves Coastal mangrove swamps.

Islands Isolated marine islands.

Islands: Terrestrial Habitats Oceanic or nearshore marine island terrestrial habitats;

category used primarily for island-restricted species occupying virtually all terrestrial habitats on the island (e.g., Socorro Wren, Cocos Flycatcher).

Islands: Oceanic Isolated oceanic islands beyond the continental shelf or continental coastal marine zone; used primarily for nesting seabirds.

Oceans Open marine habitat beyond continental shelves.

Oceans: Arctic Polynyas Areas of unfrozen seawater within otherwise contiguous pack or sea ice in the Arctic Ocean or Bering Sea.

Oceans: Pelagic Open ocean beyond the continental shelf and/or beyond *Coasts: Marine Waters*.

Grasslands Native and surrogate grasslands (e.g., hayfields and rangeland), but excluding row-crop agricultural systems.

Grasslands: Temperate Shortgrass, tallgrass, and mixed-grass native prairies and rangelands in north temperate latitudes that support grassland birds.

Grasslands: Chihuahuan Arid grasslands of northern Mexico and the southwestern U.S. centered on the Mexican state of Chihuahua.

Grasslands: Tropical Grasslands between the Tropic of Cancer and Capricorn, including high-elevation grasslands in Mesoamerican sierras (excluding páramo), lowland tropical savannas, and the Llanos of South America.

Grasslands: Pampas and Campos Grasslands and rangelands south of the Tropic of Capricorn, including the Pampas, Campos, and Southern Cone grasslands.

Aridlands All arid shrub-dominated communities.

Aridlands: Sagebrush Mostly but not exclusively sagebrush-dominated desert and steppes (shrub-steppe) of the Great Basin of western U.S. and southwestern Canada.

Aridlands: Chaparral Mediterranean forest, woodland, and shrub communities, primarily coastal California and Baja (including coastal sage) and similar shrub habitats in the interior Southwest.

Aridlands: Desert Scrub Broad range of desert shrub communities including Mojave, Sonoran, Chihuahuan, and Mexican Central Plateau deserts.

Aridlands: Desert Riparian Mesic shrub and tree communities along rivers and other wetlands in otherwise predominantly desert ecosystems.

Aridlands: Tropical Arid Scrub Desert shrub communities in tropical arid coastal, lowland, high-elevation montane, and xeric intermontane valleys.

Open Country Broad array of habitat classes dominated by open horizons and non-contiguous patches of landcover types.

Open Country: Habitat Mosaic Predominantly open country characterized by a mosaic of different, mostly native, habitat types; e.g., a combination of forest or woodland patches, gallery forest, brushy edges, regenerating forest, freshwater marsh, and/or pastures; differs from habitat generalist occurrence in that assigned species are dependent on the array of different habitat types rather than simply occurring in different habitats; e.g., Red-tailed Hawk, Roadside Hawk.

Open Country: Developed/Disturbed Similar to *Open Country: Habitat Mosaic*, but dominated by occurrence in human-altered landcover: agriculture (especially row-crop), urban spaces and structures, parks, roadsides, drainage ditches, gardens.

Forests All forest and woodland types, from old-growth conifers and tropical rainforests to arid thorn forest, *including all seral stages* (e.g., early successional, second-growth).

Forests: Boreal Boreal forests of Canada and Alaska and extending into the boreal zone (primarily spruce-fir) of high mountains in the western and northeastern U.S.; also the boreal/hardwood transition of the Upper Midwest and Appalachian and associated mountain ridges (in cases where species occurrence is not more strongly associated with Temperate Eastern Forest types). Species assigned to this habitat category are ecologically dependent on forest vegetation and associated resources (vs. aquatic resources, as in *Wetlands: Boreal* or *Wetlands: Forested* categories).

Forests: Temperate Eastern All forest types of eastern U.S. and southeastern Canada (south of the Boreal), including northern hardwoods, northern pine, oak-hickory, pine-oak, maple-basswood, southern pine, and bottomland hardwood associations.

Forests: Temperate Western All forest types of western U.S., Canada (south of the Boreal), and extending in high mountains south into northwestern Mexico. Includes Pacific Northwest rainforest; all western conifer, aspen, oak-dominated, and riparian forests; pinyon-juniper; Edward's Plateau juniper-oak woodlands; and high-elevation conifer forests of northwestern Mexico (above the pine-oak zone).

Forests: Temperate Generalist Species occurs in roughly equal abundance in three or more temperate or boreal forest habitat types.

Forests: Mesoamerican Highland High elevation conifer-dominated forests from central Mexico south to Honduras above pine-oak forest zone. Includes some tropical elements (e.g., epiphytes) not present in *Forests: Temperate Western* but lacks broadleaf diversity of *Forests: Tropical Montane Evergreen*.

Forests: Mesoamerican Pine-Oak Distinctive Madrean pine-oak forests from "sky islands" of southeastern Arizona to western Texas, through the Mexican cordilleras, and south through Central America to El Salvador and northern Nicaragua. Ratio of pine/oak may vary from predominantly pine to predominantly oak.

Forests: Tropical Montane Evergreen High elevation tropical broadleaf evergreen forest that is wet throughout the year, with tree branches and trunks typically covered with epiphytes. Includes pre-montane and humid montane forests as well as Cloud Forest.

Forests: Tropical Lowland Evergreen Humid forests ("rainforests") of tropical lowlands and lower montane slopes (i.e., includes upper tropical and/or subtropical zones).

Forests: Tropical Dry Broad array of deciduous and semi-deciduous forests, including arid thorn forest; found primarily on Pacific slope from northwestern Mexico to northwestern Costa Rica, but also including Tamaulipan thorn-scrub and dry forests of Yucatan and other transitional areas.

Forests: Tropical Generalist Species occurs in roughly equal abundance in three or more tropical forest habitat types.

Forests: Generalist Widespread species that occurs in roughly equal abundance in three or more major forest habitat categories (which can include both temperate and tropical forest types).

[xxx] Aerial Denotes the airspace as essential habitat, reserved for non-seabird species that spend the predominant portion of their day in flight; a *Habitat Class* (i.e., Level 1) with prefix denoting a species' primary non-aerial Habitat Class association (e.g., Aridlands Aerial, Forest Aerial, etc.) over which it is most frequently observed.

In addition, we provide two additional columns in the downloadable ACAD. These are not considered habitat classes per se, but are provided for users to sort the avifauna by two human-dominated landscape types:

Urban Species commonly associated with urban/suburban landscapes during the breeding season and generally commensal with people in those landscapes—e.g., birds of developed urban spaces, urban/suburban parks, domestic gardens, etc. Currently no strict criteria for inclusion other than expert opinion, and so subject to further review. Denoted by "yes" in column, with the expectation of upcoming designations for both breeding and nonbreeding seasons.

Agriculture Species that can be found frequently in agricultural systems and landscapes, including row-crop agriculture, pastures, orchards, etc. No strict criteria for inclusion other than being mentioned in composite habitat columns in previous versions of the ACAD. Denoted in database column by "b" for breeding season, "w" for winter (stationary nonbreeding season), and "b,w" for both seasons.

Determining the significant habitats for each species in the pool of regionally important species—and developing specific conservation actions to protect or improve those habitats—are key elements in regional and continental bird conservation plans developed by Partners in Flight, Joint Ventures, and State bird initiatives (http://www.partnersinflight.org/resources). Species can be grouped into suites that share habitats or other ecological needs, either using the broad Biome and Habitat categories assigned to species at range-wide scales or by using locally important habitat designations. These ecological groupings serve to identify habitats that are a priority because conservation actions there can efficiently meet the needs of many species of regional importance at once (Rosenberg 2016). Nonetheless, the broad groupings presented in the ACAD are not intended to be a substitute for the much finer habitat designations useful for specific management actions at local scales. These more local designations and accompanying management guidelines, often dependent on species-specific habitat suitability models, are the purview of Joint Ventures or similar planning efforts that depend on consideration of unique local vegetation structure and ecological processes.