A Common Currency: Using Landbirds to Guide and Evaluate Conservation Action

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Abstract

Landbirds include a large number of species with a diverse range of ecological requirements, geographic distributions, ecological threats and management issues. Conservation planning must address this variation, but also identify and focus on priority activities at practical and relevant management scales. We show how international standards developed by Partners in Flight are integrated with regional indices to assess bird species, set priorities and focus conservation efforts within ecologically-based Bird Conservation Regions. This approach highlights the components of successful conservation strategies. The proactive assessments identify secure species characteristic of British Columbia and vulnerable species requiring more immediate conservation action. As a habitat-based approach, the biological needs of a suite of sensitive focal species help define an 'ideal' landscape. We suggest how to select focal species. The needs of focal species and those single species with unique requirements are used to set quantifiable population and habitat objectives and recommend conservation activities. We discuss alternatives for setting objectives both qualitative and quantitative, particularly where data are limited. Finally, we outline assumptions and a method to evaluate the effectiveness of actions and guide adaptive processes, critical for the successful conservation of functioning ecosystems. The impact of local action should be evaluated in the context of larger scale population dynamics.

Scope of the Challenge

Landbirds as Candidates for Conservation

As a group, landbird species cover an immense range of ecological requirements, geographic distributions, and conservation threats. With principally terrestrial lifecycles, Canadian landbirds encompass 10 taxonomic orders, including raptors, upland game birds, cuckoos, nightjars, swifts, hummingbirds, kingfishers, woodpeckers, and passerines. They are strongly influenced by changes in vegetation and structural patterns of habitat, more so than reptiles and invertebrates (MacNally et al. 2002), and over large spatial scales (Temple and Wiens 1989). Most landbird species are visible, widespread, relatively abundant and measurable. All of these factors make landbirds a prime candidate for tracking and evaluating environmental conditions.

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Citation: Easton, W.E., S. A. Pelech, and K.L. De Groot. 2007. A Common Currency: Using Landbirds to Guide and Evaluate Conservation Action Paper presented at the "Monitoring the Effectiveness of Biological Conservation" conference, 2-4 November 2004, Richmond, BC. Available at: http://www.forrex.org/events/mebc/papers.html

Many of these same characteristics, however, also impose challenges to effectively monitor and conserve this large and varied group. Of the 270 regularly occurring native landbird species in Canada, 221 (82%) spend some portion of their lifecycle within British Columbia. Broad scale monitoring (e.g., Breeding Bird Survey) provides population trend information for just over half (128) of these species in BC. Yet, 81 (63%) of these trends are either uncertain or absent, with 38 species significantly declining and 9 increasing. Still, British Columbia is one of the most diverse and ecologically significant avifaunal management regions in North America. Over two-thirds (149) of British Columbia's landbirds have a large proportion of their North American range within the province, 136 are Partners in Flight priority species, 55 are provincially or federally listed endangered or threatened populations and species. Below, we outline our current approach to address some of the challenges inherent in conserving and evaluating landbirds and their habitats.

Characteristics of Successful Conservation Strategies

Although there is no set recipe, components of successful conservation strategies include broad partnerships, clear goals, objective assessments, good understanding of the biology and mechanisms of population change, and multi-species approaches (Table 1). To be effective, conservation approaches should be as diverse and broad as the ecological requirements and conservation issues of the target species or ecosystem. Recognizing the conservation of landbirds was too large for any single management or conservation group, British Columbia and Yukon joined the Partners in Flight initiative (www.partnersinflight.org) in 1998. Partners in Flight is a coalition of countries, government, industry, non-government organizations, First Nations, academic institutions and citizens with the vision of, "keeping common birds common".

The Partners in Flight approach delivers the elements of successful conservation strategies (Table 1). Local partners and regional experts assess, select and implement conservation activities within the context of an objective, standardized, scientifically-reviewed (Beissinger et al. 2000) assessment process (Panjabi et al. 2005). The biological criteria within the species' assessments are proactive, considering current and future threats, different scales of population trend, as well as different scales of population trends. The underlying mechanisms of species' declines and their limiting factors are considered when proposing conservation actions within the multi-species framework. All steps are facilitated within a strong, international conservation network. Using similar elements (e.g., species, assessment criteria, monitoring programs) amongst partners provides a common currency for facilitating conservation across ecological, management and political borders.

The Planning Process

A key challenge of conservation planning for landbirds is addressing the ecological variation and vulnerability of species, while at the same time identifying and focusing on priority activities at practical and relevant management scales. Partners in Flight successfully combines the detail and achievability of a bottom-up model, with the challenging objectives typical of a top-down approach. On the ground, regional partners are involved in the assessment process, deriving quantifiable objectives that reflect the needs of the species' and ecosystem both locally and beyond their areas of management interest, within ecologically meaningful Bird Conservation Regions. By following a standard road map (Figure 1) and using similar monitoring tools at multiple scales, successes and failures are tracked. Engaged partners work together from the onset, sharing knowledge and resources, through all of the steps to achieve our common goals.

Table 1. Characteristics of successful conservation strategies consistent with the Partners in Flight (PIF) approach.

Successful Characteristics	PIF Approach
-engage broad partnership at all stages (Hatch et al. 2002; Morris et al. 2002)	-several workshops throughout British Columbia and Yukon (Kelowna, Vancouver, Whitehorse) involving over 130 participants from over 40 groups of industry, 3 levels of government, USA, First Nations, academia, non-government organizations, and citizens to assess threats, set priorities and act -collaboration with international PIF groups
-clear goals and objective assessments (Landres et al. 1988)	-standard, peer-reviewed (Beissinger et al. 2000) assessment (Panjabi et al. 2005) by scientists and local experts -clear goals and measurable objectives (e.g. increase current population of <100 Grasshopper Sparrows in BC's Great Basin, Bezener et al. 2003)
-good biological understanding of system (many authors) -actions required to understand underlying mechanism of population change (Campbell et al. 2002) -vital rates used in Population Viability Analyses (Morris et al. 2002)	-assessment includes biological criteria along ecological borders of population (e.g. breadth of distribution) rather than within a jurisdiction or local site (e.g., park or forest block) of interest -all available literature and current work is reviewed by local scientists and experts to assess ecological issues -focuses actions (e.g., determining demographic rates) and evaluation on impact to populations along with associated habitats -recommends research where data are deficient, mechanisms unclear or suggested action does not enhance target species
-threats incorporated into assessments (Lawler et al. 2002) -threats linked with subsequent recovery action (Crouse et al. 2002)	-experts assess threats (e.g., loss of southern lowland forest due to urbanization) both locally and regionally for population -habitat-based approach addresses needs of similarly threatened species (e.g., riparian shrub nesters) in addition to single-species needs (e.g., Burrowing Owl) -targets action on species considered most vulnerable now and in future
-multi-species approaches address larger landscapes, more ecological conditions and threats (Fleishman et al. 2000; Crouse et al. 2002), but can suffer from a poorer understanding of the species-specific biology and are often less likely to be revised or used in context of adaptive management (Clark and Harvey 2002) -multi-species plans advocated if species with similar threats are grouped (Clark and Harvey 2002).	-a range of focal species used to develop recommendations for a range of habitats and scales (e.g., Yellow Warbler for willow shrubs, Veery for shady, deciduous undergrowth, Western Screech-Owls for large patches with large live trees and snags) -we outline a 'road-map' (Figure 1) to evaluate and alter action if recommendations are not working -group and target species with similar limiting factors (e.g., need for large cottonwood trees) and threats for further action -integrate needs, including research on basic biology and mechanisms for single species not addressed by target groups of species

Goals

Partners in Flight in British Columbia, set two goals:

1. to sustain and enhance long-term viability of breeding, migrating and over-wintering populations of native landbirds, and
2. to maintain and enhance sufficient high quality habitat to support healthy populations of landbirds throughout their range.

Throughout a species' life history stages, we need to:

- determine status, trends and threats,
- assess biological vulnerability and regional stewardship responsibility,
- set priorities based on assessment and security of population,
- for priority species, evaluate ecological needs, limiting factors, and gaps in knowledge,
- set measurable objectives and identify appropriate management action including determining underlying mechanisms driving negative trends,
- implement and evaluate the effectiveness of management and conservation on target populations and habitats.

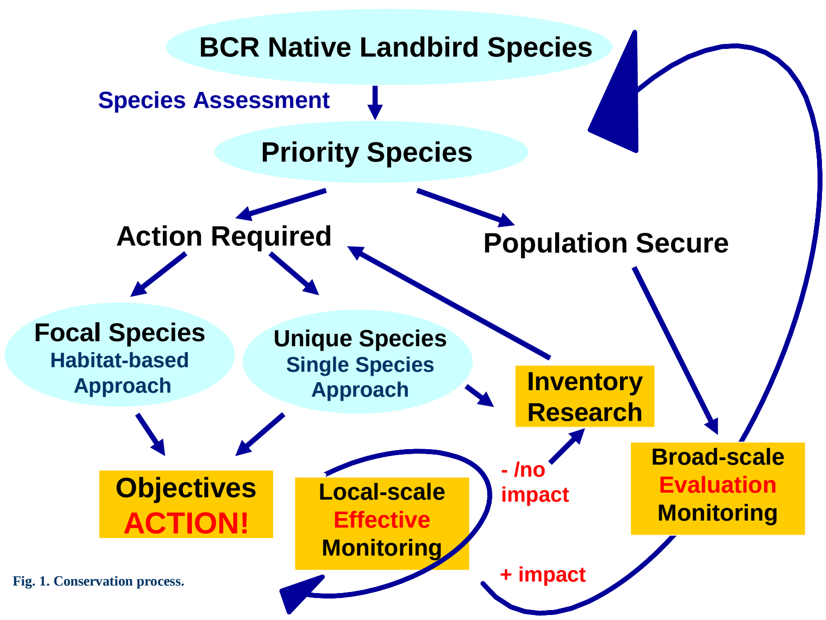

Fig. 1. Conservation process.

Bird Conservation Regions

Bird Conservation Regions (BCR) are areas with similar physical features, vegetation, bird communities and habitat-related issues (NABCI 2005). They were developed from the North American Commission for Environmental Cooperation's ecoregions. In BC, these boundaries were based on ecosystem classifications of BC (Demarchi 1996). As ecologically-based units, BCRs reflect similar bird communities and habitat-related issues, provide practical management units for landscape-oriented actions, and are more effective towards all bird conservation than political regions. Five BCRs are found within British Columbia: Northern Pacific Rainforest, Great Basin, Northern Rockies, Northern Interior Forest, and Boreal and Taiga Plains. Four out of five of the BCRs in BC cross international borders and the fifth spans portions of 4 provinces and 2 territories.

Criteria for Assessing Species

In British Columbia, native landbird species are assessed within each BCR as recommended by Partners in Flight (Rich et al. 2004; Panjabi et al. 2005), reviewed and accepted by scientists of the American Ornithological Union (Beissinger et al. 2000) to indicate a species' vulnerability and our stewardship responsibility. Significantly, these criteria reflect a pro-active approach to bird conservation. They move beyond current "at risk" status, so that population of future concern can be identified before they reach critical levels.

For each criterion, every species is assigned a score ranging from one (low vulnerability) to five (high vulnerability). Some scores are global (breeding and non-breeding distribution, population size) and are assigned once per species over its entire distribution. Two criteria (relative density and percent population) are regional parameters, scored once per species in each BCR. The remaining criteria (population trend, threats to breeding and non-breeding) symbolize current and future conservation concern. They can be assigned globally. However, regional variation in population connectivity and threats, means regional (within the BCR), and local (within the Canadian portion of a BCR) assignments by regional experts, are only biologically relevant for regional plans. As trends and threats can vary across jurisdictional boundaries, we took a conservative approach and used the highest score (e.g., the most vulnerable) of either the BCR or local score. The criteria are combined in a non-weighted manner according to relevant season for the species of focus (e.g., only breeding indices for Neotropical migrants in BC). For all of the criteria, details on thresholds and scoring can be found in the protocols (Rich et al. 2004, Panjabi et al. 2005). Global and BCR scores are from the Partners in Flight Database (2005), and regional scores are from the authors. After the initial pool of priority species is created (e.g., Canadian Wildlife Service, Pacific and Yukon Region 2003), regional experts review and adjust the list (e.g., Bezener et al. 2003).

Global Score: Population Size (PS):

- An estimate of "current" population size that include measures of accuracy and precision (Appendix B in Rich et al. 2004, Rosenberg and Blancher, in press). Less abundant species score higher (e.g. less common Golden Eagle versus abundant Common Yellowthroat) as small populations may be more vulnerable to extirpation or extinction.

Global Scores: Breeding (BD) and Non-Breeding Distribution (ND):

- Species with a narrow global distribution score higher (e.g., more limited Gray Flycatcher vs. widespread Song Sparrow) denoting a greater vulnerability to threats or extinction.

BCR Score: Relative Density (RD):

- BCR in which a species population is most concentrated scores highest (e.g., Pacific-slope Flycatcher is most concentrated on the BC coast), implying that the core of a species' range is more critical for its persistence.
- It is a score of relative density and is unaffected by the size of the BCR.

BCR Score: Percent of Population (Pct POP):

- Proportion of the species' population contained within a BCR during the breeding season (e.g. Chestnut-backed Chickadee density greater on the west coast than interior). It is a density measure and is affected by the size of the BCR.

Local/BCR/Global Scores: Population Trend (PT):

- Species with a significantly declining population trend score higher (e.g., declining Barn Swallow vs. increasing Bald Eagle). The score includes a measure of data quality based on number of routes and statistical significance.
- BCR scores are based on U.S. analyses of Breeding Bird Survey (BBS) trend. Local scores (based on Dunn 1997) for the Canadian portion of BCR are calculated from longest run of available BBS data for BCR (Downes et al. 2003).

Local/BCR/Global Scores: Threats to Breeding (TB) and Non-Breeding (TN):

- Local and BCR experts assess the expected change over the next 30 years in suitability of breeding conditions for maintaining viable populations of the species. Threats can include habitat loss and degradation, hunting, ecological sensitivities to parasitism, depredation, contaminants, etc. and flexibility of a species to respond to changing environments. Local scores (Canadian portion of BCR) are assigned by local experts (Table 2).

Table 2. Guidelines for scoring local threats

SCORE	DEFINITION
1	Species Enhanced by Human Activity Habitat increasing or stable; potentially a 'problem' species
2	No Threat e.g., Habitat increasing or stable, or an ecological generalist
3	Minor to Moderate Threat e.g., Habitat loss/degradation between 1% & 25% or moderate ecological generalist
4	Severe Threat e.g., Habitat loss/degradation between 26% & 50%, or an ecological specialist
5	Extreme Threat e.g., Habitat loss/degradation between 51% & 100%, or an extreme ecological specialist

Additional Criteria (other criteria by which priority species are selected):
Recognizing current data are incomplete and with consensus of regional experts and partners, species **may** also be considered as priorities to ensure consistencies with other programs and interests by including:

1. Provincial and national 'at risk' status.
2. Species of local management interest.

What Does "Priority" Status Mean?

It is critical to note that while many priority species require immediate conservation effort, not every species emerging as a priority from this process should receive this same level of management attention or conservation action. Many species are considered priorities due, at least in part, to their relative 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 ensure these birds, characteristic of a region, stay common.

Similar to the PIF Continental Plan (Rich et al. 2004) and others previously (Dunn 1997; Dunn et al. 1999), we consider species with higher threats and declining population trends as a higher conservation concern (e.g., Lewis' Woodpecker, Willow Flycatcher, Brewer's Sparrow). Species with a high proportion of their global range or population in the Canadian portion of the BCR, but with no immediate conservation concerns are considered species of high stewardship responsibility (e.g., Hammond's Flycatcher and Varied Thrush on BC's west coast; Lazuli Bunting and Dusky Flycatcher in BC's southern interior). If populations appear secure, we suggest continued monitoring rather than immediate conservation action for these species (Figure 1).

Linking Priority Species with Conservation Action

Conserving species is not as simple as preserving single habitats used by priority species or maintaining areas with high species richness. Since not all habitats are created equal, conservation biologists often use a smaller subset of species to represent or track ecosystem health or elements, a broader range of species, conservation issues, etc. Despite the widespread use of surrogate species in conservation, there is often confusion regarding the specific terms (Caro and O'Doherty 1999). Surrogate species are indicator, flagship or umbrella species; keystone species (Mills et al. 1993) is an ecological concept where a species' impact on the ecosystem is disproportionately large relative to its abundance (Caro and O'Doherty 1999). Although used synonymously with surrogate species by some, Lambeck (1997) specifically describes focal species as a suite of umbrella species used to define processes, spatial and compositional attributes within a landscape.

In British Columbia, Partners in Flight adopts the focal species approach (Lambeck 1997) to set measurable biological objectives and link a subset of priority species with specific conservation recommendations (Figure 1). It is a multi-species model, in which the ecological requirements of a suite of focal species are used to define an "ideal landscape". This landscape should maintain all of the different processes, habitat attributes, and range of stages required by landbirds and representative of a healthy ecosystem. Each focal species is identified as being most vulnerable to or most limited by a specific habitat component, ecological process or landscape condition (e.g., snags, fire, or patch connectivity).

These focal species are often fairly common, priority species. They are usually undergoing a decline suggesting the need for conservation action. Consequently, their population numbers and demographic rates may be measured and used to assess the health of their habitat or ecosystem. Similar to others (Chase and Geupel, in press), we use several criteria to select focal species, including:

- strong sensitivity to limited feature or process in the landscape,
- requirements represent needs of a subset of other species,
- relatively common throughout habitat and region to allow for an adequate sample size for statistical comparison and the ability to rapidly assess response to changes in management,
- evidence or suggestion of a decline in range or numbers because it suggests action is needed for species' persistence,
- priority species (but not necessary),
- full suite of focal species represent a full range of limited successional stages in the identified ecosystem.

Setting Biological Objectives and Recommendations

Once identified, the needs of focal species and additional single species with unique needs are used to develop an explicit set of measurable population and habitat objectives (Figure 1). Succinct, active recommendations are derived to meet the objectives. They may include specifics regarding the composition, structure, quantity and distribution of habitat patches and other management regimes necessary to ensure healthy populations of focal species in the landscape. The assumption is that if the requirements of a suite of focal species with the most demanding ecological needs are used to define the minimum acceptable levels of attributes then all birds, including other priority species and many other taxa will be conserved.

Population objectives reflect the current knowledge of the status of each species and, where possible, are quantitative. This is often challenging for landbirds, where the most appropriate target may involve stabilizing or reversing declining trends and shrinking distributions. Preliminary work on devising population estimates from current indices of population size (Rich et al. 2004; Rosenberg and Blancher in press) is currently limited by assumptions surrounding the ability to detect birds, variation of data quality between species, temporal variation of population numbers, and extrapolation to areas and habitats outside of the Breeding Bird Survey (Thogmartin et al., in press). Until we can be more precise, we advocate following the methods set by Partners in Flight BCR plans (Bezener et al. 2003; Rich et al. 2004), where objectives include double, increase by 50%, or maintain populations. For smaller spatial scales, it may be more appropriate to frame objectives in terms of demographic rates or parameters as population size is often influence by factors outside of the local area (Wills et al. 2005).

Habitat objectives are based on best available knowledge of the requirements of the focal species. These may involve targets on the composition, structure, size, quantity and distribution of high quality habitat patches and implying links of habitat characteristics with demographic parameters. However, any habitat objective should ultimately be linked back to the impact to the target species and underlying assumptions tested. In many cases, basic inventory, population status, habitat requirements or knowledge of processes influencing population dynamics of landbirds are poorly understood. This lack of understanding may form the basis of some recommendations. For the few cases where the needs of a species are unique, we determine species-specific objectives and conservation actions.

Evaluation of Conservation Action

In order to evaluate success of conservation action and determine further steps, the impact of the recommendation must be measured against the response of population (Figure 1). Good monitoring is key for assessing the response of landbird populations to management action (Gibbs et al. 1999) and for tracking environmental change against 'natural' patterns of population variability (Baillie 1990). Reliance on a single method and scale for monitoring populations is ill-advised because different methods possess a suite of varying outcomes and statistical power, sampling populations and inferences, and assumptions and biases.

Keys to this evaluation process are twofold (Figure 1). First, we suggest using local scale, short-term "effectiveness monitoring" to detect causal relationships between environmental factors and to assess the effectiveness of action on target bird populations at the project level. Here, the sampling intensity (Gibbs et al. 1999) will be greater, using controls and before and after designs. When the population has not responded positively to action, more detailed investigation of factors causing population change and refinement of recommendations is needed. Secondly, we advocate using broad scale, long-term “evaluation monitoring” (e.g., Breeding Bird Survey, Migration Monitoring, and Monitoring Avian Productivity and Survivorship programs) to evaluate regional changes of bird populations and the subsequent population impact of multiple conservation projects. Long-term monitoring provides a better understanding of normal patterns of population variability, distinguishing anthropogenic changes from ‘natural’ fluctuations in populations (Baillie 1990) and may detect large-scale environmental effects such as climate change. Further, using similar survey methods may allow direct comparisons between the two levels of monitoring and increase efficiencies. This input from monitoring, including data from “secure” populations, is then fed back into the assessment process (Figure 1).

When designing a monitoring program, in addition to considering temporal and spatial scales, it is essential to identify the appropriate parameters for monitoring. It is critical to understand the demographic mechanism of decline (Green 1999) where possible. There can be problems when rates of population change and external variables are assumed to indicate causation (Caughley 1994), because many factors unrelated to ecological integrity may affect population status and complicate interpretation of trends (Carignan and Villard 2002). Environmental stressors and management actions often affect demographic rates (e.g., survival, productivity, immigration, etc.) directly without substantial time lags (Temple and Wiens 1989). Demographic parameters in general are thought to be more effective than abundance measures in delineating the health and viability of populations and indicating habitat quality (Van Horne 1983; DeSante and Rosenberg 1998; Easton and Martin 1998). These demographic measures can be compared with more tractable measures commonly used as surrogates to infer population viability and habitat quality (e.g., abundance, compositional, structural and spatial attributes of habitats) to determine where and when such measure may be applicable. Often, such vital rates can often give a better indication of how a local area is contributing to population abundance or size at larger scales (Wills et al. 2005). Thus, throughout both levels of monitoring, assessing and tracking avian demographic parameters are critical to determine both causal mechanisms and provide the most effective management recommendations.

It is unrealistic one scheme will conserve all biodiversity (Schultz and Gerber 2002). Although we chose a multi-species approach to define and evaluate conservation objectives for each focal species, our certainty regarding the type and magnitude of the limiting factors, causal links between the environment and trends, and relationships to other species vary. More work is required on setting thresholds for ‘secure’ population status and consequent triggers for management and conservation action. Thus, like all planning approaches, it is not without flaw, and the approach and recommendations are best viewed as hypotheses to be tested (see Lambeck 2002; Lindenmayer et al. 2002; De Groot unpublished data). Research to test assumptions, investigate critical gaps in knowledge, test and refine objectives, and understand limiting factors and underlying mechanisms, are key and integrated throughout our conservation strategy. This is particularly true when recommendations fail to produce the expected outcomes (Figure 1). However, the common currencies that result from integrating monitoring with conservation and management activities, using standard biological criteria and assessments, and coordinating monitoring and survey techniques, will make us more strategic and efficient in testing our assumptions. We will increase the robustness of our measures and understanding, and improve our conservation work for bird populations.

Acknowledgements

This paper stems from an enormous amount of discussion with many of our insightful and experienced conservation partners. Although the interpretation is ours, many of the ideas stem directly from Partners in Flight including members of the British Columbia and Yukon and Great Basin Steering Committees, participants of the Kelowna, Vancouver, and Whitehorse workshops, Partners in Flight-Canada and the Western Working Group of Partners in Flight-U.S.. We thank you! Finally, we gratefully acknowledge thoughtful reviews from P. Blancher, E. Krebs, N. Mahony and one anonymous reviewer.

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