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Designing Optimal Landscapes to Meet Bird Conservation Objectives

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In February 2004 at Port Aransas, Texas, Partners in Flight (PIF) and representatives from the other NABCI bird initiatives met to discuss the process of stepping down PIF continental population objectives (Rich et al. 2004) to regional and local scales. Participants also discussed rolling up local population estimates and targets to assess the feasibility of the landscape changes necessary to meet continental objectives. Since the process of stepping-down/rolling-up population objectives shifts focus from identifying priority species to formulating quantitative estimates of *how much* habitat was needed, *where*, and *by when*, the Port Aransas group called the stepping-down/rolling-up process "stepping forward." Participants agreed that stepping forward objectives was the beginning of an inevitably iterative dialog necessary to evaluate the assumptions of PIF population estimates and objectives as well as the methods used to monitor local implementation. To facilitate the translation of continental population objectives into biologically sound, measurable regional and local population-based habitat targets, the Port Aransas group recommended a process now commonly referred to as the ***Five Elements Process***.

In essence, the Five Elements represent components of a process by which biologically-based, spatially-explicit, landscape-oriented habitat objectives can be developed for supporting and sustaining bird populations at levels recommended through the objectives set by PIF (or any of the bird conservation initiatives). The Five Elements comprise a conceptual approach through which conservation partners work together to assess current habitat conditions and ownership patterns, evaluate current species distributions and bird-habitat relationships, and determine where on the landscape sufficient habitat of different types can be delivered for supporting bird population objectives.

The Five Elements Process assumes that population objectives already have been proposed at a regional level (e.g., at a Bird Conservation Region [BCR] or other physiographic area scale) and is intended to facilitate explicit, science-based recommendations on where habitat protection, enhancement, or management would be most efficiently implemented to achieve those population objectives. Thus ***the stepping down of continental population objectives into regional-scale population targets is a preliminary step*** that needs to occur prior to the biological planning recommended by the Five Elements. As suggested by the "stepping forward" concept above, the step-down process should include feedback loops to evaluate the appropriateness of continental population objectives at the regional and local level. Local and regional assessments of population size and population objectives should feed back up to the continental level to help adjust continental objectives to reflect realities on the ground.

The Five Elements Process is not new—it is similar to the implementation planning described by Donovan et al. (2000), is based heavily on the thinking and practice of the biological planners in the Lower Mississippi Valley Joint Venture (JV) and the Habitat and Population Evaluation Teams of the Prairie Pothole JV, and is already being applied in various forms in several other JVs and BCRs across the country. However, by more clearly articulating a process for developing habitat objectives based on current biological thinking, on the best available information on habitats and birds, and on partnerships, PIF hopes this approach to turning bird conservation plans into habitat implementation actions will be more widely and consistently applied by organizations participating in efforts to conserve our North American avifauna.

The Five Elements are presented in a sequential order, but they need not necessarily be undertaken in this sequence, and in some cases it may be most effective to work on several Elements at the same time. In considering each of the Elements, it is important to keep in mind three guiding principles:

► Products are important, but perhaps less so than the process. The actual maps generated by geographic information systems (GIS) are the products of data sets with many limitations and innumerable assumptions, both spatial and biological, and a map isolated from the process can sometimes be more misleading than no map at all. Ideally, decision and policy makers should be as involved in the biological thought process as possible. Even for technical biologists, an interactive workshop that uses tools to evaluate geospatial hypotheses provides a vastly more productive and valid context than does a non-transparent, “black box” process that transfers habitat objectives from coarser to finer scales.

► Good models are central to the process. We use models in the most generic sense: simplifications of reality that serve first and foremost to add organization, clarity, and transparency to the thought process. Good models need not be complex, nor do they even need to be highly technical or mathematical. Rather, good models should be based on clearly defined objectives, should clearly highlight assumptions, and should be as simple as possible relative to the objectives. Asking the right questions at the outset and keeping models on track with those questions is a better guarantee of success than is high technology—as is continually recognizing the distinction between the model world and the real world. For a good introduction to modeling, see Starfield et al. (1990).

► A consideration of appropriate scale is critical at every step. For example, fine-scale spatial habitat data may be useless and misrepresentative at broad regional scales—and may not even be appropriate at all for linking birds to habitat. On the other hand, the seamless data layers available for assessments at regional scales will not provide the management-focused information needed at local scales. The models we propose and the questions we ask of spatial habitat assessments must be tailored to the scale and resolution of the input data sets. Even the form in which population objectives are expressed is scale-dependent—for example, population objectives for local scales may be more appropriately defined as vital rates or demographic parameters than as numbers of individuals.

THE FIVE ELEMENTS

1. **Landscape Characterization and Assessment.** A landscape-scale characterization of the current amount and condition of habitat types across an ecoregion and an assessment of their ability to support and sustain bird populations is fundamental to the development of meaningful population-based habitat objectives. The characterization should not only describe the current amounts of different habitat types across an ecoregion but also summarize patch characteristics and landscape configurations that define the ability of a landscape to sustain healthy bird populations. At the ecoregional scale, habitat classification might be limited to remotely-sensed satellite data sets (e.g., the National Land Cover Database or NLCD), but the best available data should be used. A characterization of the historical range of variability in the configuration of habitats, disturbance regimes, and ecological capacity of the region should also be part of Element 1, when feasible (i.e., what do soil, climate, geology, aspect, etc. suggest about a landscape’s suitability for a particular habitat?). Ultimately, the landscape characterization should provide the capacity to assess the relative contributions of different land parcels to meet conservation objectives most efficiently. The characterization could be done from the perspective of a PIF priority species, a species suite, a representative focal species, or a habitat/systems approach, depending on what the focus of the conservation objectives are. However, if the ultimate goal is to find optimal solutions for providing habitat for species or species suites with conflicting needs, then the characterization should reflect all of the species/habitats of interest.

   The assessment portion of Element 1 should utilize the information from the landscape characterization, along with the best available knowledge on macro-scale bird-habitat relationships, to describe the current ability of the ecoregion to support priority species. Initial emphasis should be on identifying those patches or areas of high-quality habitat that would be most likely to sustain source populations of priority species at the regional level. Models of macro-scale bird-habitat relationships which deal with the spatial configuration and arrangement of habitats across the landscape (i.e., at the patch size up to regional scale) should enable the identification across the ecoregion of habitat types, patch sizes, and landscape configurations that will provide high quality habitat for priority species or habitat suites. The best available information on landscape-level habitat relationships should always be used, but if detailed information is not yet available, starting with relatively simple assumptions about what the relationships might be still will identify important assumptions about macro-scale bird-habitat relationships that can then be tested. With relatively simple conceptual models of bird-habitat relationships at coarse scales, even NLCD data can be used to develop informative decision-support tools. Micro-scale habitat relationships dealing with the associations of bird abundance or density with vegetation structure and composition are also critically important in assessing the ability of a landscape to support a certain population level: these types of models are incorporated in Element 2 of the overall process.

The goal for Element 1 should be a clear understanding of where priority landscapes for bird conservation might be located, given current amounts and configurations of the different habitat types found across an ecoregion.

2. **Bird Population Response Modeling.** Incorporated with the macro-scale relationships from Element 1, more sophisticated models relating micro-scale vegetation structure with demographic parameters provide powerful tools for assessing, predicting, and monitoring how bird populations will respond to landscape change and land management activities. Such tools need to be more widely developed and applied, with the recognition that they will require a greater commitment of resources. The simplest models used to translate population objectives into habitat objectives simply divide a species population objective by its average habitat-specific breeding density in the region to produce a target number of hectares of the given habitat. The more informative response models we recommend are intended to help answer questions such as how species respond to changes in patch size, amounts of edge, interconnectivity of habitat parcels, landscape context, predator density, or specific management practices (silviculture, prescribed burning regimes) that alter vegetation structure or seral stage. These models should help us to evaluate the potential effects of different management alternatives on bird populations within an ecoregion and thereby allow us to develop hypotheses regarding what set of management actions are most likely to result in population responses that will move existing bird populations toward stated population objectives. It is important to remember that such models should be developed to fit conservation objectives, not the other way around. We should build “purposeful” models—models that are sensitive to clearly defined objectives and to the scale of their relevance. Models that evaluate regional environmental sensitivity (macro-scale models incorporating elements of landscape configuration) are different from models that evaluate management actions (micro-scale models incorporating elements of vegetation response or changes in seral stages), but they both are needed to help us determine “how much is enough” with regard to translating bird population objectives into habitat objectives.

   The end product of Element 2 should be spatially-explicit habitat goals for supporting population objectives of priority species.

   Other things to consider in building population response models to help set habitat objectives:

   - For local scales—and perhaps even for some regional scales—population objectives should be expressed in terms consistent with monitoring and evaluation parameters that can provide useful information about the effectiveness of management. These kinds of population objectives are sometimes referred to as “P_2 objectives” —objectives expressed in terms of vital rates (e.g., recruitment, reproductive success, survival) rather than population abundance. At the local scale, population size is often influenced by factors outside of the local area, so monitoring vital rates can provide a better indication of how a local area is contributing to population goals at larger scales (see further discussion under Element 5). P_2 objectives provide a link between continental and local population objectives and also between regional planning and management.
   - These models can be developed for single species, for a suite of priority species, or for other targets appropriate for a given ecoregion. The relative cost of developing more sophisticated models suggests that the most economical and effective approach might be to start with a suite of ***focal species*** that would capture most of the needs of priority species in a habitat class at broad regional scales or which would reflect particular “management opportunities” at finer scales within a habitat class (e.g., early-successional Jack Pine barrens, broadleaf forest thinned to create a well-developed understory, hayed grasslands with embedded small wetlands).

- Relative to the degree a landscape has changed from its historical condition, solutions and the modeling approaches needed to arrive at those solutions can be very different in different systems. In highly degraded systems, models might be needed to target acquisition strategies (e.g., historic wetland basins). At the other end of the spectrum, in less degraded systems (e.g. heavily forested areas), models might focus on management or policy (shifting mosaic strategies).
- Within the adaptive management framework, good models create a connection between management and science in that they articulate the assumptions that generate the hypotheses requiring testing in the next iteration of research.

3. **Conservation Opportunities Assessment.** Not all patches of similar habitat will have similar futures, depending in part on who owns and manages the land. Models developed in Elements 1 and 2 can be used to quantify the cumulative contributions of current holdings in the traditional conservation estate (mostly public lands) as well as the capacity of (mostly private) lands owned by others to contribute toward population objectives for priority species within an ecoregion. The assessment of conservation opportunity should also include recommendations on how land management activities might be modified to improve both the quantity and quality of priority habitats. Lands owned by people outside the traditional conservation partnership can contribute substantially to meeting habitat needs for priority species, but practical management opportunities on these lands may be limited. The development of useful strategies to help willing landowners to contribute meaningfully to conservation objectives need to be carefully articulated. A recent example of the application of the concepts of Element 3 is the approach developed for the New England/Mid-Atlantic Coast (BCR 30) by the College of William and Mary Center for Conservation Biology (http://fsweb.wm.edu/ccb/habitat/habitat_home.cfm). The Nature Conservancy, the U.S. Forest Service, and the Bureau of Land Management also have assessed opportunity in their regional land planning processes.

   Suggested activities of a patch-based GIS analysis of conservation opportunities include:

   - Identification of land ownership, on a parcel by parcel basis, within a region.
   - Identification of land managers/contacts for partner-owned lands in order to develop a communications network for distributing information on collective capacity and management recommendations for meeting conservation objectives. To the extent possible, it would be helpful to do the same for lands owned outside of the conservation partnership—especially with regard to recruiting nontraditional partners and for making management guidelines readily available to those who might be interested.
   - Using models developed through Elements 1 and 2, an assessment of the cumulative capacity of priority habitats under various ownerships to support population objectives of priority species.
   - A status evaluation of partner-owned (and all) lands relative to regional conservation objectives: To what extent do partners contribute toward regional objectives? Across all lands, are the regional objectives being met? Are there shortfalls in reaching regional objectives?
   - Development of parcel-specific recommendations to direct local management toward achieving regional conservation objections as well as a strategy to communicate these management recommendations to the specific land managers/contacts for those parcels.
   - Consideration of other means for achieving regional conservation objectives, such as bringing additional land-owners into the conservation partnership or otherwise influencing management of lands not already under the influence of the partnership.

4. **Optimal Landscape Design.** A huge challenge of all-bird conservation planning is the development of synthetic models that bring together conservation strategies and landscape design—models that integrate the needs of priority species, landscape capability, opportunity cost (economics), and partnership potential into proposed optimal solutions for meeting the conservation objectives of the entire set of priority bird/habitat suites within an ecoregion. Landscape designs that accommodate all the needs of all priority birds within a region will inevitably involve mutually exclusive choices at

local levels (e.g., managing for forest vs. shrubland vs. grassland). It is important to realize at the outset that resolving opportunity trade-offs will require social resources typically found outside the purview of biologists—thoughtful meeting management, skillful and flexible facilitation, conflict resolution, decision analysis, and professional communication of transparent decision-making. Social resource tools need to be included in the conservation toolbox along with the biological models of Elements 1 and 2. For examples of the facilitation of multi-stakeholder collaboration, see the publications page of the U.S. Institute for Environmental Conflict Resolution (http://www.ecr.gov/s_publications.htm); for an introduction to decision analysis, see Skinner (1999).

Implementation of a proposed optimal conservation landscape design requires a shared conservation strategy among entire communities of partners. The development of successful "community-based" conservation strategies will likely require a major paradigm shift in the way we typically practice management. Partners at all local scales need to move from the attempt to attract a hand-picked range of diversity to their parcels toward a perspective that asks the question: How can we best contribute toward overall regional conservation goals? Successful implementation will also require major partnership involvement across spatial and jurisdictional scales throughout the entire process of biological landscape design and conservation strategy development—including Elements 1, 2, 3, and 5.

5. **Monitoring and Evaluation**. In principle, incorporation of Element 5 into the recommended framework for achieving continental objectives seems self-evident: we need to monitor in order to gauge our progress and success, and we need to evaluate the validity of the assumptions used in meeting the other four Elements. In practice, however, very careful thought needs to go into the selection and design of appropriate monitoring and evaluation tools, and these tools are in turn intimately related to the careful articulation of clear objectives and purposeful models. Good models, with their clear articulation of assumptions, also provide the link between management and research: model assumptions define the research questions that should be incorporated from the very beginning into the adaptive framework leading from population objectives to habitat management and back to population objectives.

   If monitoring outcomes are to be used as performance indicators, objectives and monitoring must be explicitly integrated from the outset—objectives must be expressed in terms that match existing or planned monitoring programs, which in turn must match the temporal and spatial scales of the management/conservation actions that are being evaluated. Abundance-based objectives (so-called P_1 objectives) are most useful for large spatial extents (continental or ecoregional scales) where they provide a meaningful framework for building consensus among partners and where they can be monitored with some degree of confidence. Performance-based objectives (the so-called P_2 objectives mentioned in Element 2—reproductive rates, survival rates, body condition of migrants, recruitment rates—are more relevant for smaller spatial extents (local and landscape scales) where they can be tied to specific management actions and can help identify and catalyze research on potential factors limiting population growth. Under the scenarios of Elements 2 and 3, it is also important that monitoring be closely aligned with the models used to project future management directions in order to facilitate the cumulative accounting of conservation stewardship responsibility among partners and regions.

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