Migration Monitoring in Shorebirds and Landbirds: Commonalities and Differences[1]

Susan K. Skagen[2] and Jonathan Bart[3]

Abstract

Several aspects of a developing program to monitor shorebirds in the western hemisphere are pertinent to migration monitoring of landbirds. Goals of the Program for Regional and International Shorebird Monitoring (PRISM) include estimating population size and population trends of 74 species, sub-species and distinct populations of North American shorebirds, monitoring shorebird use at stopover locations, and assisting local managers in meeting management goals. Migration monitoring, one of three components of PRISM, works in concert with breeding and wintering surveys to achieve these goals. Existing and emerging migration surveys across several regions are now being integrated with a major focus on reducing potential sources of bias (frame, selection, and measurement). Experience with shorebirds suggests that migration monitoring might also be achievable with landbirds, though different and innovative approaches would have to be developed. We discuss an approach to the selection of monitoring sites in an extensive dynamic ecosystem where birds are broadly and unpredictably dispersed during migration.

Key Words: dynamics, ecosystem, landbirds, migration, monitoring, shorebirds.

Introduction

Several aspects of a developing program to monitor shorebirds in the western hemisphere are pertinent to current discussions of migration monitoring of landbirds. Although there is considerable debate over whether surveys during migration can provide useful information about population trends, there is general agreement that migration surveys can monitor use at stopover locations, elucidate habitat relationships during this period, help local managers meet management goals, and supplement trend information from breeding surveys. For these reasons, and because some people believe that migration surveys do have potential value in trend estimation, a bi-national committee is designing and implementing a comprehensive shorebird survey with the intent that potential problems will be identified and minimized, and that the reliability of the resulting program will be carefully assessed. Components of this program may prove useful in the development of landbird migration monitoring programs.

Program for Regional and International Shorebird Monitoring

The Program for Regional and International Shorebird Monitoring (PRISM) has the overall goals of estimating population size and population trends of North American shorebirds, monitoring shorebird use at stopover locations, and assisting local managers in meeting their shorebird management goals. Ultimately PRISM will address 74 taxa including 49 species, 17 of which have 2-3 subspecies or distinct populations (Bart et al. 2002).

Migration monitoring, one of three components of PRISM, works in concert with arctic, boreal, and temperate breeding surveys and wintering neotropical surveys to achieve these goals. An important role of migration monitoring is to provide an early warning of population declines; independent data from breeding ground surveys may then support or refute such declines. For more complete descriptions of PRISM, see Bart et al. (2002) at http://wss.wr.usgs.gov and Bart et al. (this volume).

Integration of existing and emerging temperate nonbreeding surveys across several regions is now underway. These programs include the International Shorebird Survey (ISS), Maritimes Shorebird Survey (MSS), Western Shorebird Survey (WSS), the South Atlantic Migratory Bird Initiative, and surveys of Prairie Canada, the Great Salt Lake, Delaware Bay, the Lower Mississippi Alluvial Valley, and the northern Great Plains. The challenges in using nonbreeding surveys to

---

[1]A version of this paper was presented at the **Third International Partners in Flight Conference, March 20-24, 2002, Asilomar Conference Grounds, California.**

[2]U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Bldg. C, Fort Collins, CO 80526, 970-226-9461,970-226-9230(fax), susan_skagen@usgs.gov.

[3]U.S. Geological Survey Snake River Field Station, 970 Lusk Street, Boise, ID 83706.

estimate trends in population size are to provide a good index of the number of birds in the study area during the study period and to reduce the likelihood of a long-term trend in the ratio of this index, or survey result, to population size (the "index ratio").

Potential for bias is the major problem to be solved in designing the nonbreeding surveys. Here we focus on three sources of bias: frame bias, selection bias, and measurement bias. Frame bias is a long-term trend in the proportion of birds in the population that are in the study area during the study period, as discussed above. Frame bias occurs at the largest spatial scale (the entire study area) if there is incomplete coverage of migration areas or periods. It can be avoided if the study area is large and inclusive (such as southern Canada and all of the United States, extending southward) and if the study period is long. Selection bias is a long-term trend in the proportion of the birds in the study area during the study period that are in inaccessible or uncounted areas.

Selection bias occurs at the regional scale when portions of the study area have a 0.0 probability of entering the sample. It can be minimized if most sites with potential shorebird habitat have a chance at entering the sample so that there is little chance of a long-term net movement between surveyed and non-surveyed sites. Measurement bias is a long-term trend in the ratio of birds recorded to birds present during surveys. Measurement bias occurs at the local or site scale when there is a change in detection of birds present during surveys. It can be avoided if survey methods (ground counts, counts from boats, aerial counts/photography) that count all birds present are used or if detection rates can be estimated and applied.

The general approach of the migration monitoring component of PRISM is to define the outer bounds of the study area, to delineate shorebird survey regions within that area, and to conduct surveys to estimate shorebird-days within each region. This permits combination across survey sites and rigorous (though not completely bias-free) estimation of population trends. Regional assessments define or refine sampling plans, evaluate and undertake site selection procedures, and define and evaluate standardized field and analytical approaches. To minimize selection bias, each region is subdivided into (a) "Type 1" habitat that is regularly used by shorebirds and will be surveyed (usually by sampling) 3-6 times annually, (b) "Type 2" habitat that contains few, but some, shorebirds and will be surveyed every several years to document continued low use, and (c) "Type 3" habitat which is assumed to have virtually no shorebirds and will not be surveyed regularly (but will be occasionally viewed by local biologists and bird watchers). Survey sites and survey period will be identified based on all existing information on shorebird distribution and timing of use in the region. Finally, site maps and survey protocols will be developed and the potential for bias evaluated.

Similarities and Differences with Landbird Systems

Conceptualizing a migration monitoring program may be initially easier for shorebirds than for landbirds. PRISM is feasible because there are relatively few shorebird species/taxa to address, and most of these species are habitat specialists, primarily wetland associates. Furthermore, coastal shorebirds generally concentrate year after year in the same sites. Experience with shorebirds suggests that migration monitoring might also be achievable with landbirds though different and innovative approaches would have to be developed.

An early step in landbird migration monitoring would be to identify a set of northerly breeding species for which migration surveys would serve as an early warning for declines. Syntheses of existing data on en route distribution and chronology of these targeted species (e.g., as for shorebirds in Skagen et al. 1999) would be extremely useful in delineating regions and methodologies.Information on the dispersion of individuals (whether broadly dispersed or concentrated in a few sites) and habitat relationships would help determine if random or non-random approaches to site selection would be desirable.

Site selection is of paramount importance for migration monitoring of en route migrant landbirds that disperse broadly and whose distributions shift continually through the season and probably between years. These characteristics are exhibited by shorebirds migrating across extensive ephemeral wetland systems of northern Great Plains (Skagen et al., this volume). Monitoring, therefore, would have similar challenges. The feasibility of monitoring shorebirds under these dynamic conditions using a combination of methods is currently being tested. With this approach, one stratum of sites (high probability of use, similar to "Type 1" above) is selected using all existing information, including expert opinion and past survey history. Stratum 1 sites are then surveyed three times during each survey season, spring or fall. A second stratum of sites (lower or unknown probability of use, similar to "Type 2" above) is chosen using habitat and landscape models to subdivide the landscape into 'types' based on important attributes (such as wetland area and cropland area), followed by random selection of survey sites (townships) within the landscape types.

Total shorebird-days across the landscapes are then determined by extrapolation of the survey results to the

landscape types based on models generated under different weather/climate scenarios, using adjustments for species chronology and assumptions of length-of-stay. Shorebird-days for Strata 1 and 2 are summed to yield total shorebird-days in the region. The feasibility of the approach is highly dependent upon a base of volunteers to adequately carry out the surveys. Because the task is large relative to the volunteer pool in this region of the country, surveys may be undertaken at only 5-yr intervals.

The dynamic nature of habitats has important implications for long-term monitoring programs, whether change occurs over a short time scale as days, months, or years or over longer time scales of decades and centuries. As mentioned above, distributions of en route shorebirds that inhabit wetlands in the US interior shift as wetland conditions and habitat availability vary (Skagen and Knopf 1993, 1994). Similarly, distributions of grassland birds respond to changes grassland structure tied to variability in precipitation, fire regimes, and land management practices (Vickery and Herkert 1999, Winter 1999). Composition of forest bird communities shifts as forest structure responds to the interplay of forest succession, fire, and other disturbances. At longer time scales, even riparian forests in arid landscapes of the western US change through time in response to geomorphic processes, anthropogenic disturbance, land use practices, and vegetation succession (Scott et al. 2003).

Migration monitoring of landbirds will be challenging because of the need to incorporate methods that can continue to track populations as they shift to new sites in future years. Initial studies on habitat and landscape relationships of en route migrants may utilize GIS and remote-sensing (with ground-truthing to confirm habitat types), delineation of strata by habitat types of interest, and random sampling of sites within the strata (if birds are broadly dispersed). We see the need for new and innovative approaches to site selection for long-term monitoring of systems in which temporal heterogeneity plays a dominant role.

Literature Cited

Bart, J., B. Andres, S. Brown, G. Donaldson, B. Harrington, H. Johnson, V. Johnston, S. Jones, R. I. G. Morrison, M. Sallaberry, S. K. Skagen, and N. Warnock. 2002. **Program for Regional and International Shorebird Monitoring (PRISM), version 0.7**. http://wss.wr.usgs.gov/data/PRISM Overview_01.doc.

Bart, J., B. Andres, S. Brown, G. Donaldson, B. Harrington, V. Johnston, S. Jones, R. I. G. Morrison, and S. K. Skagen. This volume. **The Program for Regional and International Shorebird Monitoring (PRISM).**

Scott, M. L., S. K. Skagen, and M. F. Mergliano. 2003. **Relating geomorphic change and grazing to avian communities in riparian forests.** Conservation Biology 17: 1-14.

Skagen, S. K., S. Brown, and R. R. Johnson. This volume. **Implications of different shorebird migration strategies for habitat conservation**.

Skagen, S. K., and F. L. Knopf. 1993. **Toward conservation of midcontinental shorebird migrations.** Conservation Biology 7: 533-541.

Skagen, S. K., and F. L. Knopf. 1994. **Migrating shorebirds and habitat dynamics at a prairie wetland complex.** Wilson Bulletin 106: 91-105.

Skagen, S. K., P. B. Sharpe, R. G. Waltermire, and M. B. Dillon. 1999. **Biogeographical profiles of shorebird migration in midcontinental North America**. Biological Science Report USGS/BRD/BSR 2000-0003. Denver, CO: U.S. Government Printing Office; 167 p. http://www.fort.usgs.gov/shorebirds.

Vickery, P. D., and J. R. Herkert, editors. 1999. **Ecology and conservation of grassland birds of the western hemisphere**. Studies in Avian Biology No. 19.

Winter, M. 1999. **Relationship of fire history to territory size, breeding density, and habitat of Baird's Sparrow in North Dakota.** In: Vickery, P. D., and J. R. Herkert, editors. Ecology and conservation of grassland birds of the western hemisphere. Studies in Avian Biology 19; 178-186.