Small-Scale Monitoring – Can It be Integrated with Large-scale Programs?[1]

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Introduction

There are dozens of programs and methodologies for monitoring and inventory of bird populations, differing in geographic scope, species focus, field methods and purpose. However, most of the emphasis has been placed on large-scale monitoring programs. People interested in assessing bird numbers and long-term trends in small geographic areas such as a local birding area, or in management units such as parks or regional forests often find it hard to get guidance on which methods would be best for them while also providing useful results. To help meet this need, we have developed a set of recommendations aimed both at land managers and ornithologists who want to conduct detailed and rigorous inventory, population monitoring or comparison of sites, as well as at individuals or groups who simply want to participate in bird monitoring and contribute to cooperative programs or to involve the public in a useful manner. Wherever possible, emphasis is placed on methods that are useful for site-specific monitoring but could also contribute to national programs.

The guidelines for small-scale monitoring outlined in this paper are based on the results of a workshop, held in November 2001, sponsored by the Canadian Wildlife Service and the Environmental Monitoring and Assessment Network, Environment Canada. Because a more detailed paper is planned for publication in the near future, we provide only a short overview of the guidelines we have been developing for monitoring and surveying birds at small geographic scales. For details on techniques, we refer to a variety of publications that provide detailed information and background on the monitoring techniques mentioned in this paper (e.g. Baillie 1990; Ralph et al. 1993, 1995; Bibby 2000; Downes et al. 2000).

For the purposes of this paper, we loosely define the term "small scale" as any area too small for national programs to provide meaningful results; these programs are usually designed to cover an area the size of a province or an entire physiographic region. Our recommendations are suitable for use at sites ranging in size from a few hectares to a large national park (e.g. 10,000 hectares). Our recommendations complement those developed for U.S. National Parks (http://www.nature.nps.gov/im/monitor/birds.htm), but cover a broader range of monitoring goals and participation levels.

Differences Between Small-Scale and Large-Scale Monitoring

We monitor birds to get information about population changes that can help to guide effective bird conservation strategies. The primary role of monitoring is usually to determine what changes are occurring in bird populations. A secondary, but important, role is to get clues as to why population change is occurring. Both large- and small-scale monitoring programs are needed to address these questions. Large-scale monitoring programs, which collect information at the scale of a biogeographic region, country or continent, are usually designed to address the first role. However, large-scale programs are usually too coarse to provide information on changes at specific sites or to provide direct information on the causes of population change. Directed studies are needed to pinpoint why population change is occurring. Small-scale monitoring programs, which are site-specific, give information on local status of bird populations. However, because these sites are not necessarily representative of the broader landscape, changes in the local bird numbers cannot be extrapolated to the population level. Data from small-scale programs are useful for site management but need to be put in the context of population-level change to determine if changes at a particular site are due to local or external factors. In cases where the survey site is protected from development, the data from a small-scale

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monitoring program can also be useful as a benchmark for landscape level change.

The different contributions of small- and large-scale monitoring programs emphasize the value of integrating approaches. The value of small-scale monitoring is greatly increased when the results can be interpreted relative to changes at the population level. Large-scale programs need information across large geographic areas and large sample sizes, but can benefit from comparison with benchmark sites. If carefully designed, small scale programs can contribute to the large-scale programs, and/or provide in-depth information at specific sites. By using compatible techniques, to the extent possible, the usefulness of both large- and small-scale monitoring programs can be maximized. As an additional benefit, managers of small-scale programs can make use of data-management systems, routine analytical programs, and other logistics developed by established programs that they may not have the expertise or facilities to develop on their own. *table 1* shows some examples of established programs that have been developed for large-scale monitoring but that can be used at the single site. However, it must be understood that results from a single sample point in a large-scale program are not adequate for monitoring populations at a local site.

Before Starting

The importance of carefully thinking through the study objectives, logistics and data management procedures before starting a monitoring program cannot be over emphasized. The reasons for wanting to establish a monitoring program should be carefully considered and the goals clearly established. Available resources and logistics should be considered, including the lifespan of the project, availability of participants and their skill level, data management and analytical capabilities, and reporting needs. It is important to consider not only the initial resources available, but the level of commitment that can be sustained into the future, if the objectives involve longer term goals such as population monitoring. The types of auxiliary data to be collected should be identified, such as weather, habitat descriptions, observer names and so on. Deciding on the best techniques will depend on the goals of the monitoring program, the species being monitored and the season of monitoring.

Monitoring Goals and Suggested Methods

For individuals or groups not previously involved in bird monitoring it is sometimes difficult to develop an appropriate and useful goal for a monitoring program. Here we discuss the three main types of data that are collected in monitoring programs and suggest useful questions that can be addressed by these data, depending on the techniques used. For each type of data we divide our recommendations on the most appropriate technique into one or more of three categories and give examples of questions that can be addressed in each category: "basic" monitoring techniques where objectives require less statistical rigor, and "intermediate" and "advanced" methods that should be used when results must meet targets of increasing statistical reliability (*table 2*). Uses of monitoring data that require statistically reliable results include assessing effectiveness of management, comparing quality of sites, or examining population trends within a site as compared to trends in a broader area.

Table 1-- *Examples of large-scale programs to which participants in small-scale monitoring may usefully contribute. Note that some of these surveys, such as the Breeding Bird Survey, involve random route selection and, even if they intersect a particular site of interest, may go beyond its borders. The website http://www.americanbirding.org/opps/voldiindex.htm gives a list of volunteer ornithological projects (including most of the surveys listed below) with details on survey goals, skill level and time commitment required, as well as contacts and links to project-specific websites. For surveys in table 1 not listed in this website (indicated by *) a reference is included in the list of references at the end of this paper.*

Purpose	Example of established project
Inventory	Project FeederWatch
	Christmas Bird Count
	*Checklist surveys
	Atlases
Abundance	Breeding Bird Survey
	Project FeederWatch
	Christmas Bird Count
	Owl monitoring
	Marsh monitoring
	Ontario Forest Bird Monitoring Program (Cadman et al. 1998)
Demography	Productivity: Nest Record Schemes (with repeated visits to nests)
	*BBird, MAPS

Species Inventory

A basic inventory program consists simply of a list of the presence or absence of species in a particular site. Provided that dates and locations of observations are recorded, such data can be used to compare species composition among sites or seasons, or to document critical sites based on presence of particular species or

a high diversity of species. A simple species inventory program can be a useful educational tool because the techniques are relatively simple and can include a wide range of skills from beginners to experts; unlike many other programs, checklists do not require that the same person take observations each year. A visiting school group, for example, can usefully participate in a simple species list in a park. We recommend the "Checklist technique" for basic species inventory, emphasizing that the value of the results will increase by using a standardized and organized approach. Guidelines on the development of a standardized checklist program that will fit into existing national checklist programs are available (Dunn 1995; see also the Ebird project website at http://www.ebird.org/content/). An Area Search approach is the best method for species inventory; it is essentially a "checklist" (sensu Dunn 1995) approach recording all species in a designated area that is searched in a standardized, systematic way.

Abundance Monitoring

Monitoring for abundance is the most common form of bird monitoring. It involves obtaining an estimate of the population size and/or an index of population abundance. In the short term, such data can be used to compare bird abundance among sites or habitat, and to evaluate the effect of management practices on a site. If counts are repeated over time, long-term population change or trends can be monitored. Long-term monitoring can be used to assess species status, determine conservation priorities, and detect whether species are responding to management activities. All these goals require a monitoring program that will give results that are statistically reliable.

Our recommendation for the "basic" technique is the standardized Checklist approach described in the above section. Checklists can detect large changes in abundance. However, for more detailed and reliable data some combination of index or density estimators should be used (Ralph et al. 1993, 1995; Bibby et al. 2000; Thompson 2002). Density estimators, which allow for adjustment of counts for birds that are present but not detected, are more robust but require greater effort. All methods require a well-designed plan to ensure results are not biased. Target species may need to be selected, spatial and temporal sampling should be non-biased, and appropriate auxiliary data should be collected.

Demographic Monitoring

Demographic monitoring refers to the measurement of survivorship and productivity. These data can provide clues as to why bird populations are changing, thus addressing the secondary goal of monitoring programs. Productivity estimates can be used to compare specific study plots in order to detect differences in habitat quality or to evaluate treatments. Over the long term these data can be used to detect changes related to habitat quality, predator levels and weather. Basic data on productivity can be obtained by observing behavioral indicators of success. Nest finding and monitoring are probably the best techniques for monitoring productivity at a specific site. Nest monitoring requires intensive effort and in many cases it will be best to concentrate efforts on selected focal species. For details on nest monitoring techniques see Martin and Geupel (1993) and the Breeding Biology Research and Monitoring Database (BBird) program protocol http://pica.wru.umt.edu/BBIRD/info.htm). Constant effort mist-netting may be used to obtain productivity information at the regional level. This method is also time intensive and requires the participation of trained bird banders. The Monitoring Avian Productivity and Survivorship (MAPS) program (http://www.birdpop.org/maps.htm) provides an example protocol of constant effort mist-netting.

Because survivorship of birds is strongly influenced by factors external to the study site, it is difficult to determine the extent to which site-related effects influence survivorship. Nevertheless, site-specific studies can make important contributions to national programs designed to monitor survivorship, such as MAPS. Again, such projects require intensive effort as well as skilled workers (e.g. experienced, licensed banders) and will only be feasible in some projects and areas.

Conclusions

Monitoring can address a wide variety of questions related to the occurrence of species in space and time, how populations are changing, and clues to the causes of such change. Results can be used to assess the effectiveness of management activities and to establish future conservation priorities. Monitoring programs also provide an excellent opportunity for public education and participation. The choice of monitoring techniques and study design will depend on the questions being asked and will vary, among other reasons, depending on whether results have to be statistically robust. If the main goal at a site is to provide opportunities for public education and participation it may be more effective to establish a sampling site for an established project (e.g. Christmas Bird Count, Ontario Forest Bird Monitoring Program [see Cadman et al. 1998], MAPS) rather than to design a separate monitoring program. While this will not generate data sufficient for monitoring populations at a particular site, it will provide ways for participants to contribute useful data to larger programs while conducting work at a favorite site.

Table 2—*Recommended methods for monitoring at small geographic scales.*

Purpose	Basic	Intermediate	Advanced
Inventory	Checklist technique with repeated visits in target season(s)	1) Checklist with repeated visits; good spatial sampling 2) Atlas project	As for "intermediate," but with evidence (e.g. from statistical analysis of multiple checklists) that coverage meets targets
Abundance	Checklist with standards for counts and good spatial sampling and repeated visits	Standardized index counts with good sampling design	Density estimators with good sampling design
Demography	Behavioral indicators of success	Behavioral indicators of success with good sampling design	Intensive nest search with good sampling design

Small- and large-scale monitoring programs can be mutually beneficial. Interpreting the results of a site-specific monitoring program requires knowledge of what is happening in the surrounding region. The smaller the site the less likely that on-site trends will reflect those at a large scale and trends from small sites should not be used to infer status of species beyond the borders of the study area. However, if standardized and established techniques are used, the results can be comparable among sites and can contribute to established large-scale programs. Site managers need such large-scale data in order to put their own site-specific results in context. Similarly, if sites participate in established programs it will help increase sample sizes and the geographic range of large-scale monitoring programs. Observers trained at small-scale monitoring programs will increase the pool of skilled observers for both small- and large-scale monitoring. We emphasize the importance of contributing to both, and hope site managers will see the value of contributing to large-scale monitoring programs even if those are outside their jurisdiction. Once the manuscript on the recommendations for small-scale monitoring are finalized, we hope they will be widely adopted and thus help to ensure the results of both small-and large-scale monitoring efforts are maximized.

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