National Park Service
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Natural Resource Program Center

Landbird Monitoring Protocol

Great Lakes Inventory and Monitoring Network

Natural Resource Report NPS/GLKN/NRR—2010/225



ON THE COVER
Common Yellowthroat, *Geothlypis trichas*.
Photo by: Sam Smyrk, National Park Service/Great Lakes Inventory and Monitoring Network

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Abstract

The Great Lakes Inventory and Monitoring Program worked with the nine national park units in the Great Lakes Network to identify indicators (called Vital Signs) important to protecting the most important natural resources in the region. Landbird Communities is one of the Vital Signs that ranked highly for the nine parks. Landbird monitoring is used by many land management agencies and organizations because of its relatively easy implementation and low cost. The Great Lakes I&M Program worked with the U.S. Fish and Wildlife Service, Regions 3 and 5; the Natural Resources Research Institute at the University of Minnesota Duluth; the Cofrin Center for Biological Diversity at the University of Wisconsin-Green Bay; and the Northeast Temperate Network to develop this standardized protocol that we hope will facilitate data comparisons across a broad swath of the northern United States. More locally, this protocol was developed to standardize data collection across the nine parks of the Great Lakes Network (GLKN), many of whom have been collecting such data for more than ten years. This standardized protocol, implemented across the Great Lakes Network parks, will allow for regional comparisons while still giving parks the freedom to analyze and identify trends within their boundaries.

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Introduction

The purpose of the National Park Service Inventory and Monitoring (NPS I&M) Program is to identify and monitor ecological indicators (referred to as "Vital Signs") of park ecosystem health. Vital Signs are a select group of attributes that are particularly rich in information needed for understanding and managing NPS areas. Twenty-one Vital Signs, including Bird Communities, were selected by the resource managers of the nine Great Lakes Network (GLKN) parks. This protocol and the attached standard operating procedures (SOPs) provide the basis and specific methods for monitoring breeding landbird communities in the Great Lakes Network parks.

Rationale for Monitoring Landbird Populations

Landbird monitoring is used by a number of land management agencies and organizations in part because of its low cost and relatively easy implementation. Additionally, multi-agency groups focused on landbird monitoring are working to clarify objectives, coordinate monitoring efforts, and identify information gaps in North America (Pashley et al. 2000; Bart and Ralph 2005; Hutto and Ralph 2005).

The nine national parks in the Great Lakes Network provide important breeding and nesting habitat for migratory and resident birds. The variety of aquatic habitats (including the Great Lakes themselves) and the complexity of terrestrial landscapes (e.g., sand dunes, old fields, temperate hardwoods, and southern boreal forest) found in the GLKN parks provide ideal habitats that are protected from extensive human development and subsequent fragmentation. For these reasons, landbird monitoring can serve as an early warning sign of habitat degradation in the parks, but landbird monitoring is also important from an ecological perspective for the following reasons:

1. Birds account for high biotic diversity in a given area, and they contribute to seed dispersal and the control of pest populations. Alternatively, they are also disease vectors and spread exotic plants and animals.
2. Some corridors (e.g., Mississippi and St. Croix rivers and Great Lakes shorelines) act as major flyways so that measures of bird use can represent species abundance across large regions.
3. Birds are mid- to high-level organisms that bioaccumulate toxins and heavy metals in measurable quantities.

Also, relative to park management:

1. Birds are of high interest to the public, and
2. Several species are threatened, endangered, or otherwise of special concern, particularly species of wetlands and open sand beaches, neotropical migrants, and grassland birds.

Finally, bird monitoring is ideal because it is feasible for parks; standard methods exist, there are abundant baseline datasets, and equipment needs are minimal.

History of Landbird Monitoring in Great Lakes Network Parks

Seven of the nine GLKN parks have established landbird monitoring programs: Apostle Islands National Lakeshore (APIS), Grand Portage National Monument (GRPO), Indiana Dunes National Lakeshore (INDU), Isle Royale National Park (ISRO), St. Croix National Scenic Riverway (SACN), Sleeping Bear Dunes National Lakeshore (SLBE), and Voyageurs National Park (VOYA) (Table 1). The Mississippi National River and Recreation Area (MISS) is surveyed by volunteers through the Minnesota Audubon Society, and Pictured Rocks National Lakeshore (PIRO) will develop a landbird monitoring program based on this protocol.

Each of the existing landbird monitoring programs in GLKN parks collect data during the breeding season (usually June to early July) through the use of point counts (Ralph et al. 1993: p. 30). However, Minnesota Audubon's monitoring at MISS occurs during the migratory period between April and May, with two surveys run in early June (M. Martell, Minnesota Audubon Society, personal communication). Lind et al. (2005) reviewed the existing park protocols and presented a brief description of each park's objectives, cumulative years of data collection, overall sampling design, number of survey points, and data collection procedures (Table 1). As part of their review, power analyses were performed on the existing data to determine whether trends could be reliably detected over time. They found that most park monitoring programs provide sufficient data to detect significant trends in common species over relatively short timeframes (10 to 15 years). However, the authors recommended some changes to enhance the reliability, repeatability, statistical power, and regional consistency of the protocols. In most cases, the existing protocols could be easily revised and new, more rigorous standards adopted in the field.

The need for a standardized protocol for monitoring landbirds in the Great Lakes region was identified by Howe et al. (1997), who subsequently offered a model that could be used. Three of the six parks currently conducting landbird monitoring (APIS, GRPO, and VOYA) would require only minor adjustments to be in full compliance with Howe et al.'s protocol. The other three parks (ISRO, SACN, and INDU) would require some procedural changes including additional data collection. Implementing a standardized landbird monitoring protocol for GLKN parks will streamline monitoring plans for park biologists; help ensure that data can be shared among other federal land managers (e.g., U.S. Fish and Wildlife Service, U.S. Forest Service) and non-federal partners; and will ensure the data have value for future meta-analyses, such as assessing regional or national status and trends, or examining habitat relationships at large spatial scales.

Table 1. Summary of landbird monitoring programs in Great Lakes Network parks.

Park	Year Established	No. of Points	Objectives
Apostle Islands National Lakeshore	1990	106	1) monitor long-term trends of avian populations that breed within the lakeshore; 2) describe important breeding bird habitats within the lakeshore including how various species are using them; 3) place the Apostle Islands in a regional context by determining what the park is providing to nesting species; and 4) make data available for comparative use by other established breeding bird surveys, particularly those being conducted within the Lake Superior region.
Grand Portage National Monument	1999	38	1) determine relative abundance among spp., within habitats and the region; 2) contribute to a regional picture of breeding bird success/failure; and 3) track abundance trends.
Indiana Dunes National Lakeshore	1993	50	1) long-term assessment of presence/absence and major changes in population sizes and species diversity, and 2) contribute to the national breeding bird database.
Isle Royale National Park	1994	130	1) measure composition and general size of populations over time, 2) make general comparisons from year to year, and 3) compare results with regional/national datasets.
Mississippi National River and Recreation Area			1) identify land bird species present in the Mississippi River Twin Cities Important Bird Area (IBA); 2) determine which species are using the IBA habitats during what time periods (i.e., spring migration, breeding, fall migration, over-wintering); 3) estimate relative abundances of various land bird species in the IBA across time; and 4) in the long-term, monitor trends in land bird species in the IBA.
St. Croix National Scenic Riverway	1982	50	1) determine distribution and range and the changes over time for individual species both within the park and regionally, 2) construct clear abundance categories for bird watching and checklist information, 3) contribute to regional population trend information, and 4) analyze within-park species trends, however gross the scale.

Table 1. Summary of landbird monitoring programs in Great Lakes Network parks (continued).

Park	Year Established	No. of Points	Objectives
Sleeping Bear Dunes National Lakeshore	2004	40	1) determine presence and abundance of bird species nesting in designated habitat types, 2) make population comparisons from year to year, and 3) provide information for checklists and breeding bird databases.
Voyageurs National Park	1995	80	1) conduct long-term monitoring of bird species breeding within the park and determine species trend information; 2) make data available for comparative use by other established breeding bird surveys, particularly those being conducted in northeast Minnesota and the western Great Lakes basin; 3) describe important breeding bird habitats within the park and show how various species are using them; 4) use the breeding bird data to help interpret the breeding birds of the park to neighbors, visitors and staff.

Basic Approach

We have explicitly stated the goals and objectives for landbird monitoring at each park and prepared a written protocol and SOPs that are as consistent as possible with Howe et al. (1997) and with NPS protocol standards (Oakley et al. 2003). To a great degree, the methods we prescribe are compatible with current efforts at GLKN parks, so historical data sets can be maintained. However, each of the current park protocols will need to be revised to incorporate the criteria of Howe et al. (1997) and also to meet standards set by the NPS Inventory and Monitoring Program. Network staff will work with park staff to develop and/or revise park protocols and databases and provide training tools to park-based observers. Those observers will conduct fieldwork and/or work closely with volunteers who assist the parks in this effort. The Network will then summarize and analyze the data and report on the results to park resource management staff.

The locations of existing sampling points will be documented using GIS, and where possible we will examine potential biases in the habitats sampled and their proximity to natural features and human developments. Recommendations for changes and/or appropriate qualifying statements for future analysis and use of the data are included in this protocol. Certifying survey participants (both NPS staff and volunteers) in the identification of landbirds will be accomplished through a web-based testing procedure, which is being developed (as of Fall 2008) in collaboration with several agencies and hosted by the University of Wisconsin – Green Bay. The web site will provide bird species lists from previous park surveys and will incorporate bird song recordings collected at GLKN parks.

Goals and Objectives

The overall goal of this protocol is to improve the consistency, comparability, quality, and access to landbird monitoring data being collected each year by Network parks, and to periodically analyze these data and report the findings to park managers. To accomplish this, we will:

1. Develop and use a standardized sampling method that is flexible enough to fit the unique sampling challenges at each park but still yield data that are comparable across parks and can be integrated at regional and national levels.
2. Develop and integrate quality control measures such as training and certification for observers.
3. Provide a Network-wide database for storage and retrieval of data.
4. Disseminate information to partners and other interested parties. (This may be done by the individual parks or by the Network, but any release of data by the Network will be subject to approval by the affected park(s).)

Within the parameters of these objectives, we have developed specific questions that we hope to address under this monitoring protocol. These include:

1. **What are the long-term trends in population indices for key landbird birds or suites of birds?**
   We do not intend to directly estimate the abundance of landbirds, but knowledge of population trends is important to species conservation and for directing future management decisions.
2. **How do indices of population trends and habitat associations in the parks compare to those from other monitoring programs in the region?**
   Such comparison is important for understanding the parks' contribution to regional diversity. Several existing monitoring programs (e.g., national forests, North American Breeding Bird Survey) can be used for regional comparisons of trends and habitat associations when it is scientifically valid to do so.
3. **What are the habitat associations of observed landbird species?**
   Some bird species are closely associated with specific habitat types during the breeding season and their presence or absence may be helpful in evaluating environmental conditions.

Sampling Design

The primary purpose of the sampling design for a monitoring program is to establish the rules for selecting study sites, the schedule of revisits to sites, and the approach for making inferences to the target population. The rules and processes for collecting data at the selected study sites is termed response design and is the focus of SOP #5.

The Target Population

One of the essential components of a sampling design is a clear identification of the target population, (i.e., the ecological resource about which information is wanted). For landbird monitoring programs, the target population is often a continuous area with boundaries, as in forested lands within a national park. Statistical surveys use probabilistic methods to select sampling sites that are representative of the target population. For continuous areas, using probabilistic methods means first defining a list of all points that could be selected (i.e., the sampling frame) and then selecting sites in a systematic or random manner so that all sites have a known, non-zero chance of being included in the sample (Cochran 1965). There is often incomplete knowledge of the spatial location, size, or numbers of sampling units in the population, which creates practical difficulties in developing an accurate sampling frame and representative sample. Incorporating randomization in the design minimizes the influence of bias – a systematic difference between the sample and the population. Inferences from the sample to the entire population can be made through the use of sampling theory and statistics (Cochran 1965).

Non-random sampling designs can also be useful, but sampling theory cannot be relied upon, to assess the degree to which the sample is different from the target population (Cochran 1965). Many of the GLKN landbird monitoring programs were initiated in the 1990s and have been collecting important data since. During the sampling design of these programs, standardized design protocols were implemented to varying degrees to minimize bias and maximize statistical reliability (Hanowski and Niemi 1995, Howe et al. 1997), but the target population may not have been clearly identified and probabilistic sampling methods may not have been completely employed. For example, many programs use point counts along trails that are stratified by habitat type, but it is unknown how the specific trails were selected or whether there were some areas that were excluded from consideration. Additionally, if points were strategically placed in interior habitat areas (avoiding edges), as is sometimes done to document bird-habitat relationships (Hanowski and Niemi 1995), then the sampled population may not include edge habitats or edge-associated bird species. Thus, it is sometimes not clear what the intended domain of statistical inference was or whether the sample is in fact representative. This is not to say that the monitoring information is not useful, however. Indeed, the information may be very meaningful if accompanied by qualifying statements that lay out guidelines for interpretation and inference. Given the financial resources of GLKN, it is desirable to adopt and build upon these existing efforts while increasing statistical reliability rather than employing new sampling designs. In this way, we can maintain historical and regional continuity that these datasets provide.

Spatial and Temporal Allocation of Samples

Sampling designs should strive to achieve spatial balance by spreading sites geographically throughout the population of interest to avoid bias that may arise from a clumped sample (Stevens and Olsen 2004). All of the existing monitoring programs in the Network explicitly considered the geographic distribution of samples during sampling design. Four programs (APIS, GRPO, ISRO, VOYA) sample primarily along trails, while SACN samples along rivers, and INDU surveys along roadsides. Three Network programs are located in federal wilderness areas (APIS, ISRO, VOYA). All Network programs exceeded the minimum recommended distance of 250 m between points to avoid double-counting of individual birds (Ralph et al. 1995). Five of the six existing programs visit points annually, while SACN is the only program that employs visits to sites in alternate years.

Lind et al. (2005) carried out retrospective power analyses for six existing Network programs and found that all programs had sufficient power to detect a 5% change in abundance of common species over moderate time frames (10-15 years). For less abundant or rare species, sufficient statistical power to detect a trend will require more years of monitoring. Although Lind et al. (2005) did not evaluate the number of samples required for a specified level of power, they concluded that most parks had a sufficient number of survey stations. Thompson et al. (2002) found that 100-300 surveys stations were adequate for monitoring on the spatial scale of a national forest (at least twice the size of most of the GLKN parks) over a 10-year period.

Field Methods

Field Season Preparations, Field Schedule, and Equipment Setup

Depending on availability and existing protocols for individual parks, surveys will be conducted by either a single observer/recorder or by a two-person crew consisting of one observer, who conducts the actual survey, and one recorder, who records the detections of the observer on standardized data sheets. It is important that only one person be designated as the observer and that the second person, if available, only records the data. It is possible to carry out this protocol with just one person doing the observing and recording, but it may be more difficult. In addition, observers working alone in the field present some safety considerations.

The following are some tasks that need to be completed by the Resource Management Specialist (RMS) or their designee ("Park Coordinator") for each park prior to conducting surveys:

1. If new monitoring points need to be selected, select a sampling design using SOP #1 before the field season begins (we recommend at least six months) and consult a qualified statistician to verify that the sampling design will meet the defined management and monitoring objectives, given the specifics of the study area.
2. Review the pre-season tasks described in SOP #2 and ensure observers are hired and adequately trained (SOP #3). Training is particularly important each year, as the misidentification of a species is perhaps the most serious error that can be made during a bird count. Misidentification is more serious than errors in estimating distances or double-counting a bird.
3. The Park Coordinator should schedule sampling dates and organize logistics at least two months before the start of each field season. This is important, particularly for ensuring transportation to sampling plots that require logistical support (i.e., boat transportation). Unpredictable weather and other logistics necessitate maintaining some flexibility in scheduling the sequence and duration of sampling trips. Locations in the southern Great Lakes (MISS, INDU) may have earlier breeding phenology, so sampling may begin in those locations earlier.
4. Review this entire protocol, including all of the SOPs, with all survey crew members before the field season.
5. All of the equipment and supplies listed in SOP #2 should be organized and made ready. Ensure that sufficient copies of the field data forms (found in SOP #5) are available on "Rite-in-the-Rain"® paper.

Sampling Methods

Sampling locations should be permanently marked as allowed for by individual park policies. Observers may need to use a GPS unit (refer to SOP #4) when returning to previously marked sample points, but crews should always have a map and compass as well.

When possible, bird survey crew members should arrive at the park a few days before the first day of sampling to familiarize themselves with the area and the birds present and to complete any mandatory onsite training. The Park Coordinator will determine beginning and ending dates for surveys.

Standard Operating Procedure #5 provides details on how to conduct variable circular plot (VCP) counts during the breeding season and for filling in data forms. In summary, counts are conducted during the early morning hours, beginning 30 minutes before sunrise and finishing no later than four hours after sunrise. Counts are up to 10 minutes in duration. Birds flushed from the plot when approached by the observer will be recorded once the count is started, which is one minute after the observer is at plot center. New bird observations are listed each minute up to 10 minutes. Recording observations at one-minute intervals allows for comparisons to be made with other regional and national surveys that conduct point counts <10 minutes in duration. This will also be useful for analysis of detection probabilities and the potential inclusion of adjustments of bird detection among years (Etterson et al. 2009).

A small timer is placed on the clipboard and observations are recorded to the whole minute (e.g., minute 1, minute 2). Individual birds are recorded only once (the first time they are heard), not in each time interval they are heard. Observers/recorders note the name of the bird using standardized four-letter AOU codes (see Appendix A of SOP #5), the time (minute interval), the detection type (seen, heard, flyover), and the bird's distance from the point center. Distance estimates are recorded as one of the following: 0-50, 51-100, and >100 m from the point center.

At the end of each point count, observers and recorders are to complete the data forms before moving on to the next point. Observers should be able to complete an average of 10-12 points per day in good weather and with favorable walking conditions. Points located along off-trail transects will take longer, averaging six-to-eight points completed per day, depending on walking conditions and the ability to locate points.

Before leaving the field each day, data sheets are checked for completeness and readability. All information pertinent to the plots sampled that day is recorded to avoid repeating or skipping sampling plots. The Park Coordinator is responsible for the safekeeping and organization of the data sheets, and for ensuring that data are entered into the database.

Habitat Monitoring

One objective of landbird monitoring is to assess how bird communities respond to changes in landscape structure and vegetation (Ralph et al. 1993: pp.30, 37). Fire, windstorms, disease, and insects play an important role in shaping the structure and composition of vegetation communities. By influencing the composition and successional stages of plant communities, these natural disturbances are important in structuring the composition of animal communities (Matsuoka et al. 2001). Large-scale changes in vegetation are likely to have cascading effects on avian communities. Therefore, an important component of the landbird monitoring program is to document any coarse change in vegetation so that it can be associated to indices of bird abundance (Ralph et al. 1993: p. 37).

Not all GLKN parks are correlating birds with habitat. For those that are, it is up to the Park Coordinator to select an appropriate habitat monitoring protocol, based on the specific objectives of the park's bird monitoring program. In some situations, vegetation data are being collected by another agency or another field crew for another purpose. It may be possible, depending upon objectives, to co-locate bird sampling sites with vegetation sampling sites to maximize efficiency. At a minimum, the Park Coordinator should develop a list of vegetation communities

present on the monitoring plots, using the USGS National Land Cover Database (see SOP #6, Appendix A). More advanced programs may want to also use the National Vegetation Classification System (NVCS, http://www.natureserve.org/explorer/classeco.htm).

Data Management, Analysis, and Reporting

Database Design

Landbird data will be entered into a Network-specific database that is being developed as part of the ArcIMS web site. When it is completed, information entered in the ArcIMS database will be automatically uploaded to the USGS Breeding Bird Survey database.

The USGS Bird Point Count Database accommodates bird point counts and transect and area search methods, and it is open to any agency or organization that chooses to contribute data. The database has recently been upgraded to improve the recording of metadata, including information about objectives, sampling design, sampling frame, point groupings (habitat or management unit), and target season. Simple summary reports are also available with plans to expand reporting and download capabilities in the future. USGS adheres to federal requirements for data quality and integrity. See SOP #8 for details regarding data entry, verification, editing, metadata procedures, and archival procedures.

Parks will maintain files of the hard-copy data sheets, while the Network office will only keep data in the electronic format.

Data Analysis

The primary aim of data analysis is to provide reliable answers to the questions in the monitoring program objectives. The chosen analytical steps will follow naturally from the objectives and sampling design, although there may be multiple statistical or analytical techniques that are appropriate. For the GLKN parks, the overall objectives are to evaluate bird population trends. There is a wealth of information in the scientific literature about the reliable analysis of point count data (Sauer and Droege 1990, Ralph et al. 1995, Nur et al. 1999, Etterson et al. 2009), so it is possible to devise a way to account for particular differences among parks. Standard Operating Procedure #9 includes greater detail about recommended statistical approaches for the analysis of trends and habitat associations.

Two primary analytical issues should be considered regardless of the statistical methods chosen:

1) Sources of variability – in addition to true variability of bird abundance in space or time, many additional factors can directly influence the number of birds observed during a point count survey. These include, among other things, wind, rain, time of day, and observer differences. While the 10-minute VCP protocol has features built-in to minimize many of these sources of variability, their potential influence will be incorporated into analyses done at the Network level and will periodically be investigated explicitly in cooperation with parks.

2) The index assumption – the point count is a method for surveying rather than completely enumerating all birds in an area (i.e., a census). Thus, the raw number of observations recorded during a point count is not a measure of density. For trend analysis, the goal is often to make conclusions about the trend of the entire population through time even though the entire population is not censused. If the raw counts of birds are a constant proportion of true population size, it may be

possible to use unadjusted counts as an index of the population. However, if the chance of observing a bird is not constant through time or between habitats – that is, if there is heterogeneity in the detection probability – then the raw counts will not be an unbiased index of population size. Similarly for bird-habitat associations, detectability may not be constant across habitat types, which may confound the true habitat responses of birds (Etterson et al. 2009). The VCP survey protocol (SOP #5) will allow analysis and incorporation of detection probabilities using both distance-based approaches (Buckland et al. 1993) and time-removal methods (Farnsworth et al. 2002). At this time, we recommend periodic evaluation of detection probabilities using both distance and time-removal approaches to evaluate detection probabilities.

There will be a combination of annual and periodic analyses that achieve different objectives; see SOP #9 for specific details. Annual analyses will summarize information on the status of the bird populations and communities, including tables, graphs, maps, and figures that summarize species observations, community composition, and richness across individual parks. More in-depth analyses of population trends and habitat associations will be conducted approximately every three years using appropriate statistical methods. Statistical methods for trend analysis will be primarily regression-based approaches to model the relationship between population size, or an index thereof, and time. A wider variety of options exist for analyzing habitat associations, including regression, ordination, analysis of variance (ANOVA), indicator value analysis, and classification and regression trees. Habitat analyses may use predictors summarized on varying spatial scales, such as micro-scale vegetation measurements or land-use in larger spatial buffers. Periodic assessments of bird population change in relation to changes in vegetation structure and composition will provide insight into the relationships among ecosystem components, and improve our understanding of breeding bird-habitat relationships and the effects of large scale perturbations.

Reporting

A primary goal of the NPS I&M Program is to ensure that the results and knowledge gleaned are shared with all appropriate parties, especially the parks and their natural resource managers. However, the Network's role in the landbird monitoring program is limited to facilitating the development of standardized methods, providing quality assurance/quality control to the Network dataset, and facilitating the periodic inter-park comparisons. Therefore, the Park Coordinators are responsible for protocol implementation, data management, quality assurance/quality control, and summary and analysis for their park's data on an annual basis. The Network Landbird Monitoring Program Manager will assist the parks with these tasks in any way possible and will serve as the communications conduit for the parks as required by the national I&M Program.

While the Network primarily addresses concerns of the parks, its monitoring program has the potential to serve a much broader community. For example, monitoring projects can provide a starting point for external scientific research (especially to establish cause-effect relationships) and can provide insights for adaptive management on other public lands. The Network is also accountable to multiple organizations within the federal government, including the national NPS I&M Program and the U.S. Congress. To provide accountability and to meet the requests of all

parties, we will provide multiple types of reports and communications. These are described in more detail in SOP #10 and include the following:

Analysis and Synthesis Reports

Periodically (ca. every 3 years), analysis and synthesis reports will be written to document population trends and habitat associations. These reports will be written according to the format and standards of the National Park Service Natural Resource Technical Reports and will include complete documentation of statistical methods used and interpretation of results. These reports may also include retrospective power analysis to determine the effectiveness of the monitoring program.

Protocol Review Reports

These will also be completed periodically for the purpose of evaluating operational procedures and results and determining if changes are needed.

Scientific Journal Articles, Book Chapters, Symposia, Meetings, and Workshops

These additional forms of reporting are encouraged by the Great Lakes I&M Program to document advances in scientific knowledge, to increase communication among park biologists and scientists, and to identify emerging issues.

Personnel Requirements and Training

Roles and Responsibilities

Park Coordinator

The Park Coordinator (PC) duties will vary depending on his/her supervisor and other park-specific factors. In general, the PC will (or contract with others to): (1) train observers, (2) implement the study protocol in the field, (3) supervise data entry and quality assurance, (4) analyze the data, and (5) report results. The PC supervises biological technicians and other field crew members. Depending upon the scale of the monitoring effort, one or more field crew leaders may be hired and will report to the PC. Because of the need for a high level of training and consistency in implementing the protocol, the PC will oversee the hiring and training of the field crews and, when possible, will be one of the persons conducting at least some of the point counts annually.

The PC will delegate to the appropriate staff functions such as preparing all field gear and data collection equipment, supplies, and data forms for the field season; entering field data into the database; and cleaning, repairing, and storing field equipment. The PC is responsible for ensuring that data entry and proofing procedures meet quality standards.

Typically, the PC is responsible for data collection, data entry, data verification and validation, as well as data summary, analysis, and reporting. The PC is also responsible for the safekeeping and organization of the data sheets, and ensuring that data are entered into the database.

Network Program Manager

The Great Lakes Network Landbird Monitoring Program Manager (Network Program Manager) is responsible for facilitating the multi-year summary and analyses of data collected by all of the participating parks. The Great Lakes Network office is responsible for designing the Network database and for data archiving, security, and dissemination. The Network Program Manager and Network Data Manager work with park PCs to develop data entry forms and other database features, and to automate report generation. The Network office is responsible for ensuring that adequate QA/QC procedures are built into the database management system and that appropriate data handling procedures are followed.

Qualifications and Training

Standard Operating Procedure #3 provides details on hiring and training all personnel associated with the landbird monitoring program. Observer bias is a major source of variability in trend analyses of bird populations (Sauer et al. 1994; Kendall et al. 1996), so competent observers are the essential element in collecting credible, high-quality data on birds. Further, it is best to have the same observer(s) conduct the point counts each year to ensure consistency.

Training has been shown to improve the ability of observers to detect birds (McLaren and Cadman 1999). Recordings of birds in the study area, especially for the less common or unexpected species, should be provided to observers. Good hearing ability and knowledge of bird songs and calls is essential because many birds, particularly in forested habitats, are detected by sound only. Observers must be capable of identifying by sight and sound ≥90% of the birds

likely to be encountered. Additionally, volunteers must be proficient at estimating abundance of birds detected and their horizontal distance from the observer. Volunteers must also be capable of hiking 40 km (20 mi) over variable terrain (depending on park and transect route) and arriving at their first survey point by 0500 hrs.

At a minimum, observers should be certified for identifying birds by sight and sound using the Western Great Lakes States Birder Certification web site (www.uwgb.edu/birds/certification/index-1.htm). Observers can undergo practice sessions on the site and/or use a tape or CD that has songs and calls of the park's target bird species (lists are provided on the web site or should be provided by the Park Coordinator). All observers should be certified as a Level 2 observer for the habitats appropriate for each park, and observers should be re-certified annually. In addition, each observer should become acquainted with the distance categories by marking off an area with a 100 m tape measure and spending time listening for birds and placing them in the correct distance categories. Laser rangefinders will be provided to aid observers in measuring distances during survey periods.

Cooperative or contractual agreements with bird observatories or Audubon clubs are possible sources of staff or volunteers with bird identification and other skills. The Network Program Manager will identify and enlist the services (through in-kind support or contract) of a statistician or quantitative ecologist to help with data analysis and reporting.

Operational Requirements

Annual Workload and Field Schedule

The sampling period for breeding birds will be defined by the Park Coordinator to coincide with the peak in breeding activities of landbirds in their area. In most parks of the Great Lakes region this will be during the month of June. Two-person field crews are strongly advised, although one person could conduct the field sampling. When two-person crews are used, it is important that only one person makes all observations and the second person records the data. This is to reduce the sampling bias that might occur with two observers. The time required for completing sampling depends on the number and location of points. Crews should strive to complete 8-to-12 points each field day.

Facility and Equipment Needs

The nature of bird survey work does not require special facilities beyond normal office space and equipment storage needs. Standard Operating Procedure #2 contains a list of the equipment needed by survey crews.

Startup Costs and Budget

Personnel expenses for field work should be based on two-person crews to conduct the field work and a GS-5 or GS-7 biological technician to assist the Park Coordinator with preparations for the field season, training, field work, data entry, and data analysis. Field costs will vary depending on logistics. Table 2 provides a budget format for estimating costs associated with conducting a landbird monitoring program in one park. Travel costs include travel to field sampling sites and *per diem*. Startup cost includes the purchase of equipment and supplies, as well as maintenance and or replacement of equipment shared among multiple projects (e.g., GPS units, cameras).

Table 2. Format of a budget to estimate the costs of conducting an annual landbird monitoring program in one park unit.

Estimated Costs	Year 1	Year 2	Year 3	TOTAL
Salaries and Contracts	$	$	$	$
Travel (including field work)	$	$	$	$
Equipment	$	$	$	$
Supplies	$	$	$	$
Total	$	$	$	$

Procedure for Revising and Archiving Previous Versions of the Protocol

Over time, it is expected that revisions to both the Protocol Narrative and to specific Standard Operating Procedures will be necessary. Careful documentation of changes to the protocol and a library of previous protocol versions are essential for maintaining consistency in data collection and for appropriate treatment of the data during data summary and analysis.

Standard Operating Procedure #11 outlines the steps for changing either the Protocol Narrative or the SOPs. Each SOP contains a SOP Revision History Log that explains the changes and

assigns a new version number to the revised SOP. The new version of the SOP and/or Protocol Narrative is then archived in a Protocol Library. We plan to cooperate with the Natural Resource Monitoring Partnership (http://biology.usgs.gov/status_trends/nrmp/MonitoringPartnership.htm) by recording the protocol on that public website.

The rationale for dividing a sampling protocol into a Protocol Narrative with supporting SOPs is based on the following:

- The Protocol Narrative is a general overview of the protocol that gives the history and justification for doing the work and an overview of the sampling methods, but it does not provide all of the procedural details. The Protocol Narrative will only be revised if major changes are made to the protocol.
- The SOPs are specific step-by-step instructions for performing a given task. They are expected to be revised more frequently than the Protocol Narrative.
- In most cases, when a SOP is revised, it is not necessary to revise the Protocol Narrative to reflect the specific changes made to the SOP.
- All versions of the Protocol Narrative and SOPs will be archived in a Protocol Library.

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Appendix. Index to Standard Operating Procedures

Eleven standard operating procedures (SOPs) provide thorough details for carrying out the landbird monitoring program. Because each SOP is a relatively large document and because all the SOPs are dynamic and can change more frequently than this protocol narrative, they are not included here. Readers interested in the more complex details of landbird monitoring can find the SOPs on the Great Lakes Inventory and Monitoring Network website - http://science.nature.nps.gov/im/units/GLKN/monitor/landbird/landbird.cfm.

SOP 1. Sample Designs

SOP 2. Before the Field Season

SOP 3. Hiring and Training Observers

SOP 4. Using GPS to Locate and Mark Sampling Points

SOP 5. Conducting the Bird Point Count

SOP 6. Vegetation Monitoring

SOP 7. After the Field Season

SOP 8. Data Management – IN DEVELOPMENT

SOP 9. Data Analysis – IN DEVELOPMENT

SOP 10. Reporting

SOP 11. Revising the Protocol

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