GATHERING, ORGANIZING, AND ACCESSING DATA FOR USE IN BIRD CONSERVATION ACROSS THE AMERICAS

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Abstract. The U.S. North American Bird Conservation Initiative (NABCI) Monitoring Subcommittee (2007) identified the need for a comprehensive plan for integrating and managing bird population monitoring data, and to adapt this as an integral component for improving monitoring activities across North America. While the Subcommittee provided a basic framework to begin development of this data management strategy, input from stakeholders is needed to identify data management needs and the technical capacity necessary to solve those challenges. We organized a session at the Fourth International Partners in Flight Conference to solicit input from session participants from across the Americas and identify their data management needs. Session speakers and participants provided examples of the challenges encountered with data management and how the Internet is increasingly used to provide access to the data needed for bird conservation decisions. Input provided during the session indicated that data management needs extended beyond technology to include scientific, conservation, social, institutional, and cultural issues. Because data management is intricately related to all aspects of bird conservation, a coordination process that elevates the importance of data management within the bird conservation community is needed, in addition to improving data management associated with bird population monitoring programs. Development of a comprehensive data management strategy for bird population monitoring data would help address the needs and challenges identified during this session.

Key Words: bird monitoring data, data delivery, data management, Internet, web technologies.

OBTENIENDO, ORGANIZANDO Y ACCESANDO DATOS PARA USAR LOS EN CONSERVACIÓN DE AVES ATRAVÉS DE LAS AMERICAS

Resumen. El Subcomité de Monitoreo de la Iniciativa para la Conservación de Aves de América del Norte (NABCI) en Estados Unidos identificó la necesidad de un plan comprensivo para integrar y manejar datos de monitoreo de poblaciones de aves y a la vez adaptar el mismo como un componente integral para la mejora de actividades de monitoreo en Norteamérica. Aunque el Subcomité proveyó un marco básico para comenzar el desarrollo de esta estrategia de manejo de datos, se necesita recopilar las opiniones de todos los que tienen un interés en este tema para identificar las necesidades de manejo de datos y la capacidad técnica necesaria para resolver estos retos. Organizamos una sesión en la Cuarta Conferencia Internacional de Compañeros en Vuelo para solicitar opiniones de actores interesados e identificar sus necesidades de manejo de datos. Los ponentes y participantes en esta sesión proveyeron ejemplos de retos que han encontrado en el manejo de datos y de como la Internet cada vez es más utilizada para proveer acceso a datos necesarios para la toma de decisiones de conservación de aves. Las opiniones provistas durante la sesión indican que las necesidades en el manejo de datos se extienden más allá de la tecnología e incluyen asuntos científicos, de conservación, sociales, institucionales y culturales. Dado que el manejo de datos esta íntimamente relacionado con todos los aspectos de conservación de aves, se necesita un proceso de coordinación que eleve la importancia del manejo de datos dentro de la comunidad de conservación de aves, a la vez de mejorar el manejo de datos asociado con programas de monitoreo poblacional. El desarrollo de una estrategia comprensiva de manejo de datos para los datos de monitoreo poblacional ayudaría a tratar las necesidades y retos identificados durante esta sesión.

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INTRODUCTION

Planning and evaluation of bird conservation activities require use of the best available, most comprehensive and current data on birds and their habitats; especially for migratory birds whose population assessments and conservation require data integration across multiple scales. Birds are one of the most studied groups throughout the Americas. A vast amount of data on birds has been collected over the past 100 years. However, a large proportion of these data are unavailable, dispersed, or insufficient to support decision making for bird management and conservation. The ultimate value of data depends on how they are collected, maintained, accessed, and provided to those who need them. Selection of an appropriate data collection protocol and survey design are important in ensuring that collected data can be used to address a question of interest. But what happens to data after they are collected is also important in dictating their subsequent use. For this reason, data management is increasingly recognized as an important component of successful monitoring programs. Therefore, use of existing data as part of the bird conservation process could be facilitated and improved through effective data management (Ruth et al. 2003).

Conservation planning relies heavily on use of monitoring data to assess bird population distribution, status and trends. Although bird monitoring data collection efforts are numerous, data management for many of these efforts has not been a priority or given proper attention. In an era where the goal is to deliver integrated bird conservation across multiple scales, the need to develop a comprehensive data management strategy has become apparent. No comprehensive data management strategy exists for bird population monitoring data in any country in the Americas. This need was recognized by the U.S. North American Bird Conservation Initiative (NABCI) Monitoring Subcommittee, who recommended a coordinated and collaborative approach to data management including development of a comprehensive plan for integrating and managing bird population monitoring data. The U.S. NABCI Monitoring Subcommittee (2007) further recommended the following actions to better integrate and manage bird population monitoring data: 1) "develop a set of standards for data management, quality assurance and control, content, data accessibility, and archiving that apply to bird population monitoring programs," and 2) "improve coordination and efficiency of data

management efforts by providing centralized data repositories that are readily accessible by the monitoring community, analyze 'gaps' in current data management systems to identify additional data repositories that need to be developed, and identify resources necessary to develop and maintain these coordinated data management efforts."

Development of a comprehensive management strategy for bird monitoring data first requires identification of the challenges and constraints encountered by those who use, maintain, or deliver these data; and identification of potential solutions to address those issues. We organized a session at the Fourth International Partners in Flight Conference to solicit stakeholder input on the highest priority issues for bird monitoring data, and to begin identifying the data management needs within the bird conservation community.

The term "data management" often means different things to different people and has been used to denote one or several processes including identification, collection, administration, quality control, security, storage, analysis, and delivery of data, among others. Without an accepted operational definition for what constitutes "data management" within the bird conservation community, we provide definitions of technical terms in order to avoid confusion. For purposes of this document, we define the term "data maintenance" as encompassing those processes and procedures related to data administration, quality control, security and storage; "data delivery" as those procedures that provide access to data; and "data management" as the combination of data maintenance and data delivery processes.

IDENTIFYING STAKEHOLDERS' DATA MANAGEMENT NEEDS

A session—"Gathering, Organizing and Accessing Data for Use in Bird Conservation across the Americas"—was held on February 14, 2008, at the Fourth International Partners in Flight Conference in McAllen, Texas. Over 70 people attended the session representing diverse stakeholder perspectives including data users and data managers, government and non-government organizations, programs conducted at spatial scales varying from local wildlife refuges to national/hemispheric extents, short-term and long-term monitoring programs. This session consisted of a series of presentations on data use, data maintenance, and data delivery, followed by a discussion period with the audience. Speakers were asked to identify the greatest challenges

or constraints they had experienced with data use, maintenance, or delivery in support of bird conservation, and to provide potential solutions to help overcome those challenges. Presentations were focused on:

1. Challenges experienced by the U.S. Fish and Wildlife Service's Habitat and Population Evaluation Team when using web-accessible data for modeling and conservation planning in the Prairie Pothole Joint Venture
2. Development and implementation of data tracking systems supporting the collection, maintenance, and delivery of bird population and habitat data in the Lower Mississippi Valley Joint Venture
3. Development of data management tools by the U.S. Fish and Wildlife Service's National Wildlife Refuge System to address their information needs across multiple spatial scales
4. Data management challenges and solutions implemented by USGS Patuxent Wildlife Research Center for online delivery of the North American Bird Point Count Database
5. Data sharing and solutions implemented by the Avian Knowledge Network including data delivery examples from the Bird Studies Canada Avian Knowledge Network access node
6. Development and implementation of the National Biodiversity Information System by The National Commission for the Knowledge and Use of Biodiversity (CONABIO) and of the Mexican Bird Knowledge Network (AVESMX) to provide quality online data on Mexican bird species
7. Development and implementation of NatureServe's Explorer and InfoNatura systems to provide information on the conservation status, distribution, and management needs of birds throughout the Americas
8. Development and implementation of BirdLife International's online tools to support data gathering, data maintenance, and dissemination of data on bird species and their critical sites throughout the world, and
9. Development and implementation of eBird by the Cornell Lab of Ornithology for the online collection, management, and delivery of observations from birders throughout the Americas.

Presentations provided not only information about data use, maintenance, and delivery challenges, but also examples of successful data management activities providing innovative technical solutions to address existing challenges within each organization. Among the technical solutions highlighted by speakers were data management processes, web-based data collection and decision support tools, Internet technologies providing data summaries and visualizations, and web portals providing multiple levels of access to data based on data sharing permissions.

A thirty-minute discussion followed the presentations. This discussion provided an opportunity for the audience to expand on the challenges and opportunities identified by the speakers and for the speakers to learn about other data management needs identified by the audience. The participants shared their diverse perspectives on the major challenges and solutions needed to improve management of bird monitoring data across the Americas.

NEEDED ACTIONS FOR IMPROVING DATA MANAGEMENT

The following list of needs are grouped by disciplinary field and component of data management when appropriate, and are not otherwise ranked or categorized. This summary should not be interpreted as an all encompassing list because input was only received from those in attendance at the session. However, these needs represent a starting point for identifying major issues and discussing strategies to address these issues in a comprehensive manner.

SCIENCE / CONSERVATION

1. Incorporate data maintenance and delivery into the planning and development of bird monitoring programs.
2. Define conservation and wildlife management goals, objectives, and priorities at every geographic scale in order to obtain appropriate data.
3. Identify gaps between conservation / wildlife management needs and monitoring efforts.
4. Expand monitoring programs to include biological response monitoring and its associated data.
5. Develop methodological and analytical approaches that accurately use data resources at appropriate geographic scales, from fine-grained resolution for local and regional analyses to coarse resolution for continental and hemispheric analyses.

<small>TECHNOLOGY</small>

General

1. Define the roles, relationships, and responsibilities of data providers, managers and users.
2. Clarify technical terminology to avoid confusion.
3. Design information systems with the goal of no data loss recognizing that data sets most relevant for effective bird conservation and management will have higher priority during the implementation of a comprehensive data management strategy.
4. Recognize that centralized and distributed approaches to data maintenance and delivery have advantages and disadvantages, and can provide equally adequate solutions to data management.
5. Recognize that data management strategies and solutions are goal- and scale-dependent, and reflect different levels of data needs.

Data Maintenance

1. Develop data maintenance strategies and repositories for historical and orphaned data sets in danger of disappearing.
2. Describe monitoring data sets with well-defined data field descriptions and archiving strategy allowing access and understanding of the data even after a program is completed.
3. Develop data maintenance systems and data repositories that allow for more efficient use of limited resources.
4. Increase standardization of data maintenance protocols.

Data Delivery

1. Develop data delivery methods that allow users to assess the circumstances where data may be successfully applied, appropriate geographic scale(s) for their application, and potential biases of data that may limit inferences. A potential solution that could be readily implemented to address this need is:
   a) Develop metadata records summarizing data aspects that increase understanding of potential uses and biases of data, keeping in mind that users may not critically examine the fine details of lengthy metadata descriptions.
2. Develop data delivery systems that achieve economies of scale to provide access to

bird monitoring data. Data delivery mechanisms from well-managed data sources have demonstrated their usefulness in providing data access to wider audiences.
3. Increase interdisciplinary input and standardization of data delivery protocols to improve coordination across programs.
4. Develop tools for data analyses, data visualization, and decision support that provide tangible benefits, requiring feedback to provide appropriate products to diverse user communities.

<small>SOCIAL / INSTITUTIONAL / CULTURAL</small>

1. Provide institutional leadership to address bird monitoring data management issues.
2. Increase coordination across monitoring programs concerning why data are collected, how data are collected, and how data are stored.
3. Identify constraints and develop incentives for improving data sharing and existing data management practices.
4. Expand data sharing opportunities by promoting actions that engage institutions and individuals regarding data ownership and data use, especially where the need to produce peer reviewed publications or "control the message" is perceived to conflict with improved data access.
5. Improve institutional leadership and increase funding for data management to successfully integrate data resources into effective bird conservation action, reflecting the important relationship between data management, decision making, and policy development.
6. Engage target audiences in monitoring programs by tailoring data products to the users and demonstrating the conservation value of these efforts.

DATA MANAGEMENT RECOMMENDATIONS

Session participants recognized data management as a critical component of successful bird monitoring programs. While some of the needs and issues identified above could potentially be resolved with increased funding, issues related to improved coordination and changing attitudes may require development of novel incentives/rewards to generate and maintain buy in by the diverse stakeholders of the bird conservation community.

Two major areas in need of improvement became apparent during the discussion period.

The first area encompasses components within the realm of science and monitoring, such as better planning for data collection and program design. The second area involves improvement of data management infrastructure, the primary focus of this session, and it includes aspects of technology, standards, and data management protocols used to appropriately integrate data. These two major areas are interrelated. Data management is intricately related to all aspects of bird conservation. Understanding what data to collect and how to collect them reflects issues related to survey design, protocol selection, and data analysis. Knowledge of how these data will be used to promote better management and conservation requires addressing issues related to data maintenance and delivery.

Since data are the foundation for the formulation of management actions and conservation policies, data management should be considered at the earliest stages of monitoring/inventory program development, not as an afterthought after the data are collected. Because data management does not exist in a vacuum, developing fully functional data management systems requires coordination with scientists, informatics specialists, and managers in order to gather and manage the appropriate data to address the complex issues facing bird conservation today. Likewise, development of successful data management strategies requires support from the entire bird conservation community and must be fully integrated with monitoring, research, management, and conservation efforts at all geographic scales. A coordination process will be necessary to elevate the importance of data management within the bird conservation community and expand the involvement of this community in data related issues.

The need to improve data management associated with bird population monitoring programs was identified as an equally important area in bird conservation. While innovative approaches that addressed some data management issues were described during this session, many problems still remain, for example, addressing issues of scale in data delivery methods, improving data access, improving data quality assessments, standardizing data maintenance and delivery protocols, and maintaining historical and orphaned data sets, among others. Resolving these problems requires a comprehensive management strategy for bird population monitoring data that provides a detailed outline of how data should be processed, maintained, accessed, and archived to meet the ever-changing needs of the bird conservation community. Development of a comprehensive data management strategy for bird monitoring data should be a primary focus of our efforts to improve use and accessibility of bird monitoring data. The creation of this data management strategy will depend upon leadership from scientists, informatics specialists, NGO and government project managers, educators, and the bird conservation community. Creating this strategy should begin immediately and occur in parallel with raising the importance of data management in the bird conservation community.

RECOMMENDED ACTIONS

Based on the input received during this session, we recommend the following actions be taken by NABCI, Partners in Flight, and the entire bird conservation community to address the data management challenges, constraints, and needs in bird conservation:

1. Determine if current data maintenance and delivery activities are effectively supporting bird conservation priorities.
2. Identify changes needed to better integrate data maintenance and delivery activities with bird conservation and wildlife management programs, including:
   a) Develop incentives to better integrate data maintenance and delivery into the planning and development of bird monitoring programs, and
   b) Develop data maintenance and delivery strategies that support conservation and management goals at appropriate geographic scales, recognizing that data maintenance and delivery needs vary considerably across regions and countries depending upon their conservation priorities.
3. Identify data maintenance and delivery systems of critical importance to the bird conservation community and obtain commitments of long-term institutional support sufficient to ensure the continued operation of these important data management systems.
4. Implement data maintenance strategies to prioritize and capture historic and abandoned data sets before they disappear.
5. Improve methods and procedures to maintain and deliver monitoring data and achieve economies of scale by:
   a) Identifying constraints and incentives to improve data maintenance and data delivery
   b) Improving access to data in a variety of formats
   c) Developing and implementing standards for data maintenance and delivery, and

d) Providing data maintenance and data delivery systems that meet the needs of stakeholders and facilitate use by the bird conservation community.

6. Ensure that bird monitoring data maintenance and delivery systems follow the best practices developed by the bioinformatics community, including:
   a) Describing data properly with well-defined data fields
   b) Implementing secure data curation strategies, and
   c) Creating and maintaining descriptive metadata to better understand the potential uses of all data sets.

7. Develop a comprehensive data management strategy for bird monitoring data under the auspices of the U.S. NABCI Monitoring Subcommittee, as NABCI provides a venue to bring together the biological, data management, and conservation expertise needed to produce this strategy. A comprehensive data management strategy should improve linking data management with bird conservation, guide future data management actions, and include the following components:
   a) Review and evaluate existing major data holdings, identify gaps, and prioritize data needs based on needs of the bird conservation community
   b) Outline the standard components of data management systems
   c) Establish priorities for data management systems to meet identified data needs, and
   d) Identify institutions to play leadership roles in the development and implementation of coordinated data management efforts.

8. Keep abreast with data management developments in the general bioinformatics community and ensure that bird monitoring data management systems are compatible.

Participants indicated that even though the focus of this session was data management, issues surrounding this topic extend beyond technology and reflect the importance of integrating data management into all aspects of bird conservation. Data maintenance and delivery should not be an afterthought once a monitoring program is initiated; rather, plans for the maintenance and delivery of data acquired through a monitoring project should be required prior to initiating the collection of data. With an ever-increasing need that data crossing political and geographic boundaries be integrated across spatial and temporal scales, now is the time for the bird conservation community to recognize, promote, increase support, and coordinate data management activities that will effectively support bird conservation throughout the Americas. We are hopeful this call for action will be heeded by the bird conservation community. The future of our birds may depend on how well we are able to successfully coordinate effective data management into our bird conservation activities.

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