User's Guide to the Midwest Avian Data Center: Version 2.0

January 2016

Introduction

Getting started

At first glance, the Midwest Avian Data Center (MWADC) may seem like a simple website with just a few pages on data management. But there's much more. MWADC is really a portal into an extensive community and set of online resources on avian monitoring and conservation. The best way to get started is to look at the MWADC background summary and that of its parent organization, the Avian Knowledge Network (AKN). Then drill down into the resources that seem most important to you. Both AKN and MWADC are evolving. You may find ways to contribute to their development by becoming a partner.

Background

MWADC is a cooperative effort between Point Blue Conservation Science, the US Fish and Wildlife Service's Midwest Regional Migratory Bird Program, the National Park Service Heartland Inventory and Monitoring (I&M) Network, and the Midwest Coordinated Bird Monitoring Partnership. MWADC serves as a Midwestern regional node of the Avian Knowledge Network (AKN). It is one of ten nodes of the AKN (i.e., AKN Northwest, California Avian Data Center, eBird, Landbird Monitoring Network of the Americas, Nature Counts Canada, Pacific Flyway Shorebird Survey, Rocky Mountain Avian Data Center, Eastern Avian Data Center, and Integrated Waterbird Management and Monitoring Program). With the contributions from these and other resources, the AKN maintains datasets representing monitoring efforts across North America (and beyond). In this brief user's guide, we describe data management and decision support tools offered by MWADC. We also provide an overview of links to outside resources. These tools are designed to manage and analyze bird monitoring data in support of avian conservation and management decisions. There is an emphasis on data management procedures which are

typically needed for long-term monitoring programs. The AKN and its nodes provide excellent resources for data management. In addition to data management, we will also review some exciting new decision support tools hosted on the MWADC site.

More information can be found at the following links:

- Midwest Avian Data Center: http://data.prbo.org/partners/mwadc/
- Avian Knowledge Network: http://www.avianknowledge.net/
- Point Blue Conservation Science: http://www.pointblue.org/
- US Fish and Wildlife Service Midwest Region Migratory Bird Program: http://www.fws.gov/midwest/midwestbird/
- Midwest Coordinated Bird Monitoring Partnership: http://midwestbirdmonitoring.ning.com/
- Griffin Groups (search by tags "AKN" and "MWADC"): http://griffingroups.com

AKN data concepts and philosophy

While most of this guide is about MWADC, an overview of AKN will make it easier to understand the data concepts and philosophy that provide the foundation for MWADC. The AKN approach to conservation is data centric; it is based on the acquisition of monitoring data and the analysis and interpretation of monitoring data for decision support. Scientific rigor is critical for the development of long-term datasets. Monitoring protocols are typically used to implement statistically valid sampling designs, to define data quality assurance and quality control, and to establish continuity of long-term methodology. The AKN also established new standards to promote development and integration of multiple bird monitoring data sets. These data standards are implemented in the form of a schema called the Bird

Monitoring Data Exchange (BMDE). We will explore this again in the <u>Manage Data</u> section.

The AKN is also a partnership between many public and private conservation organizations. Because the AKN consists of many diverse programs, an approach was needed to manage data ownership and data sharing that would meet the requirements of its user-base. The AKN approach, therefore, includes the following components: (1) Institutions and organizations that contribute data or help in AKN developments *are, by definition, AKN partners*; (2) Institutions and organizations that contribute data *always maintain ownership of the data*; (3) Data owners can choose the level of data availability to suit their requirements; and (4) Data access can range from data shared only among coworkers to public access of data sets through data visualization and analytic tools.

About the Midwest Avian Data Center website

The content of the MWADC website is best understood by visiting the website. The web pages are organized into four main topics: About, Manage Data, Explore Data., and Resources. Within the Manage Data topic, there is an individualized data management system called MyMWADC.

News

The latest news of Midwest regional avian monitoring is displayed on the front page of the MWADC site. These are links to articles published in the Midwest

Coordinated Bird Monitoring Partnership's website. Each article describes an event and frequently provides a link to a document or publication. Upcoming workshops, meetings and conferences are also posted here.

About MWADC

It could be said that the most important part of MWADC is not the monitoring data or decision support technologies, but the role of individual and organizational partnerships. MWADC and AKN as a whole are partnerships of diverse conservation organizations. Below, we explore the players behind MWADC. These include the partners and the sponsors who have provided funding to make MWADC possible. Under Goals, we consider the objectives of MWADC. We cover the approach, that is, the actions and operations that work towards meeting the organizational objectives. Finally, there is a section on how you can get involved.

Partners

Organizations that have directly contributed data and/or guided the development of MWADC are listed on this page (with links to each of their websites). The list includes several federal and state agencies, universities and private conservation organizations.

Sponsors

The Midwest Avian Data Center has received funding from the US Fish and Wildlife Service, the Great Lakes Commission, Point Blue Conservation Science (Point Blue), and Waterbird Conservation for the Americas. The US Fish and Wildlife Service is focused on working with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Great Lakes Commission is a public agency comprised of eight US Great Lakes states and the Canadian provinces of Ontario and Quebec. Its mission is, in part, to support

conservation of water resources in the Great Lakes basin. Point Blue is a private conservation organization. It has provided most of the science and technology behind MWADC. Waterbird Conservation for the Americas supports water bird conservation throughout Canada, the United States, Central America, and in several countries of South America.

Goals

The overall goal of MWADC is to conserve birds and their habitats through the sound use of monitoring data, the best available science, and open, collaborative partnerships. MWADC objectives include (1) supporting the development of avian monitoring through the Midwest Coordinated Bird Monitoring Partnership; (2) establishing data management tools linked to standardized monitoring protocols; (3) improving quality and availability of bird monitoring data; (4) advancing monitoring data visualization and analysis techniques; and (5) providing interactive tools to assist in conservation and management of avian populations.

Approach

How does MWADC accomplish these objectives? There are several ways: First, by forming working groups in the [Midwest Coordinated Bird Monitoring Partnership](#). A standardized database schema has been implemented for data exchange across AKN. Data management and data exploration tools have been developed. The US National Grid (USNG) is being implemented to standardize sampling designs and reporting data for avian monitoring. Finally, MWADC develops promotional materials for conferences, workshops, and online.

Get Involved

MWADC is an open organization. You become a partner simply by participation. The following are just a few examples of how you can get involved: (1) Join the Midwest Coordinated Bird Monitoring Partnership (see the link above) and find one

or more groups that most interest you. (2) Join the [MWADC Web Forum](#) (Griffin Groups); here, you can get help and ask any question about MWADC. All posts are emailed to group members, so if you ask a question, you will get a response. (3) Add your data to MWADC.

There are several benefits to using the MWADC data management system; significantly, it is available through any browser at any time, as are several bird conservation decision support tools that employ regional, national, and international datasets.

Manage Data

The "Manage Data" page (Figure 1) is the point-of-entry for the MyMWADC data management tools. It also addresses other data management issues such as AKN data policies and how to discover and acquire data.
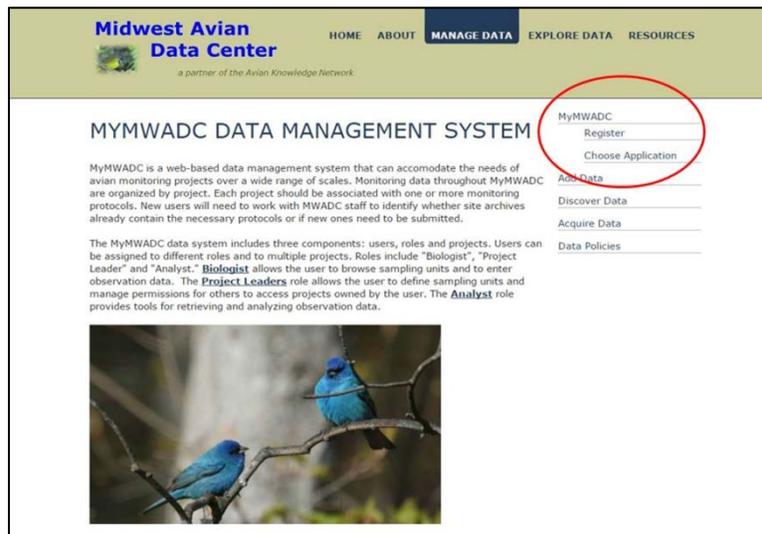

Figure 1. MyMWADC can be entered from the upper right side of the "Manage Data" page.

Overview of MyMWADC Data Management System

MyMWADC is a free web-based database management system specifically designed to manage avian monitoring data. MyMWADC requires a user id and password to

enter the system. It is organized by project. Each user is granted access to one or more projects. Users are also granted permissions that allow them to use certain data management applications. The applications are named after their functional roles: Biologists, Project Leaders and Analyst. A detailed tutorial on how to use MyMWADC is given in Appendix A.

Bulk data upload

In addition to using the MyMWADC Data Management System, data can also be entered into MWADC through a bulk upload (fee required for now). Bulk uploads work best if the dataset has a clear design based on a published monitoring protocol. The MWADC website provides a point-of-contact under "Add Data" for managing bulk upload requests. Required details about the dataset are also listed. A cost estimate for bulk uploads of data is based on information provided by the data owner.

Discover data

Avian data can be discovered directly from the MWADC site. For example, many national and regional datasets can be discovered using the MAP tool. Individual data collections managed by MWADC have been used in several scientific publications. Data visualization tools are especially effective for conservation outreach and education. And citizen scientists have contributed to eBird, a MWADC partner, on a global scale. eBird provides online software for the birding community and represents one of the largest biodiversity datasets in existence (eBird 2016).

Acquire data

Data can be acquired through the following means: (1) through the links on the "Manage Data" -> "Acquire Data" page to the North American Breeding Bird Survey and eBird, (2) from one of the decision support tools under the "Explore Data" page, or (3) by following the procedures given on the "Manage Data" -> "Acquire Data"

page. In this last case, you will need to identify your study questions or goals and contact the MWADC representative identified on the web page. You will need to understand the AKN data sharing and data access policies. The requirements and procedures for data acquisition will be determined based on the assigned data access levels for each observation.

Data policies

Data policies address data access, data format standards, and data sharing. Data access is standardized across AKN nodes. Access levels are applied at the record level rather than at the dataset level. Access levels range from 1 (most restricted) to 5 (data are in publically available applications). Data owners also have the option to not expose their data at all to the public. See Appendix B for a full description of data access levels.

Data format standards are defined by the Bird Monitoring Data Exchange (BMDE) schema. The BMDE definition is available from a link on the Data Policies which goes to the BMDE page on Griffin Groups. Alternatively, you can go directly to Griffin Groups ([http://griffingroups.com)](http://griffingroups.com) and search using the tag "BMDE." The data sharing policy applies to users downloading data. While the text of the policy is currently in draft, users should appreciate that datasets are a form of intellectual property; data owners represent private organizations, universities and government agencies; and each type of organization will have different expectations regarding data sharing. The recommended approach for users seeking data is to contact primary data owners for permission, collaboration, and review.

In sum, contributors and requestors should become familiar with AKN data policies regarding data access, formatting standards, and data sharing.

Explore Data

Several Decision Support Tools (DSTs) that allow rapid visualization and analysis of selected avian monitoring datasets are available under the Explore Data tab. These software tools assist biologists and managers in making conservation decisions. MWADC provides several DST examples on its site (on the "Explore Data" page), and provides links to additional DSTs at other websites. Each provides a fascinating illustration of how avian monitoring data can be used to understand temporal and spatial aspects of avian ecology.

Map tool

The MWADC Map Tool (Figure 2) allows users to select data from several datasets using spatial and tabular queries. The tool includes several national datasets such as Breeding Bird Survey, eBird and MAPS Stations. There are also a growing number of regional datasets. The data can be filtered by dataset, species, sub-region, year and month.
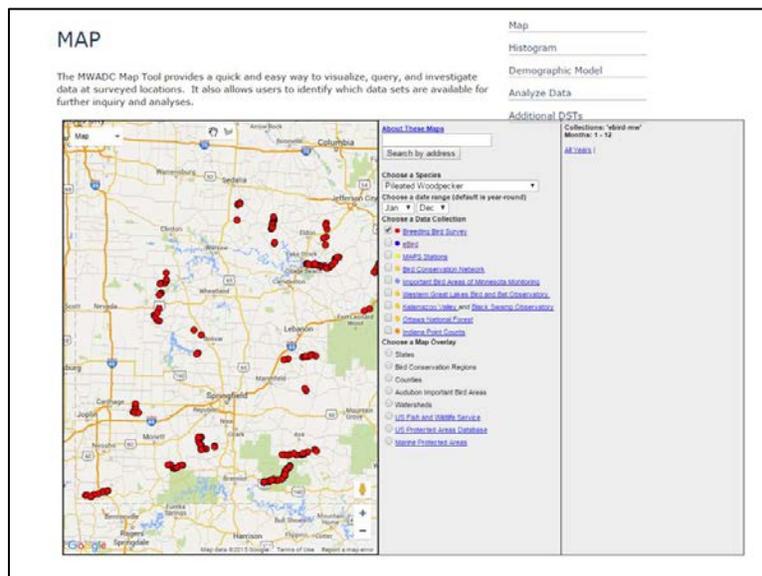

Figure 2. The MWADC mapping tool showing Pileated Woodpecker occurrences in southwest Missouri from Breeding Bird Survey data.

Histogram Tool

Seasonal abundance can be analyzed using the MWADC Histogram Tool under the "Explore Data" tab. This tool allows you to explore the seasonal frequency of one or more bird species. Select observations for a given state or county between January and December for specified years (one year, several years, or all years available). Choose from any combination of datasets, species, states, counties, and beginning and ending years to plot species abundance. Figure 3 shows a comparison among three fairly common bird species in Michigan.
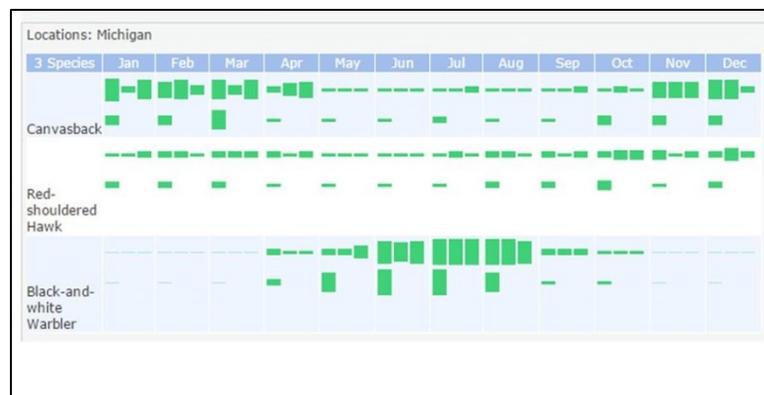
Figure 3. Example output from Avian Data Histogram application.

Demographic Model

The Demographic Model (Figure 4) is based on Monitoring Avian Productivity and Survivorship (MAPS) bird banding data. MAPS stations are operated during the breeding season. They provide mark-recapture and in-the-hand information that can be used to model population age structure, productivity, and other population metrics. They are especially useful for species of concern. Read more in the full report (Nott, 2011) at the link provided on the "Demographic Model" page.

Figure 4. Blue-winged Warbler productivity at MAPS stations in the vicinity of Fort Leonard Wood, Missouri.

Analyze Data (Ravian)

The "Analyze Data" page under the "Explore Data" tab discusses some of the underlying analytics software supporting the MWADC website. The software package is called Ravian. It was developed by Point Blue Conservation Science. Ravian is server-bas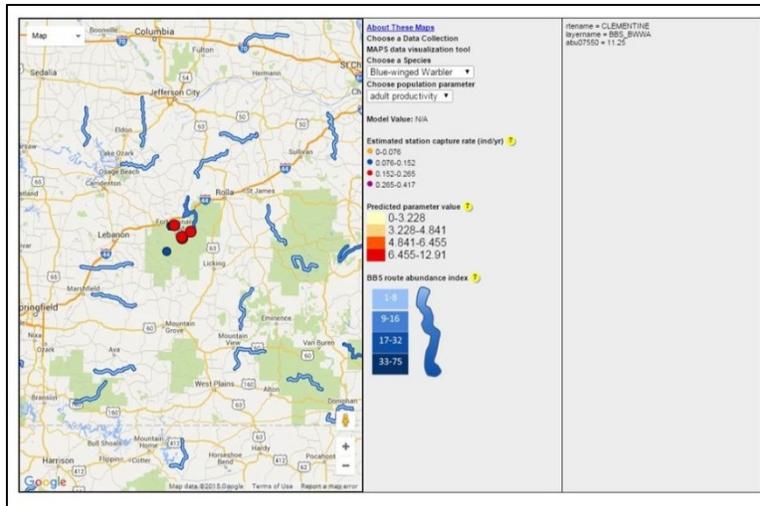ed; that is, it runs as a web-application on MyMWADC but is hosted from a remote server. Ravian was developed as an open-source Application Programming Interface (API) and provides access to the R statistical system. Because Ravian is developed for R, it can potentially draw from the many statistical libraries available in R. You can take Ravian for a test drive. Once you have a MyMWADC account, log into the Analyst application and try out Ravian analytics on population and community data.

Links to other decision support tools

Finally, the "Explore Data" tab has a separate page for additional decision support tools. This includes an annotated list of tools maintained on outside websites. These decision support tools focus primarily Midwest birds and habitats.

Resources

The "Resources" page serves as a collection of documents and links that form the knowledge base for MWADC. Materials are organized by protocols, recommendations, citizen science opportunities, training materials, and conservation partnership opportunities.

Protocols

"Protocols" are a good place to start because they are a prerequisite for any long-term avian monitoring program. They are guidance and implementation documents that layout the objectives and ecological context. They also define the necessary field sampling methods and appropriate data analysis. Protocols typically go through extensive peer-review before the monitoring begins. This is essential in order to apply correct methodology. Further, successful trend analysis depends on maintaining as few changes as possible in sampling methods. The "Protocols" page provides an annotated list of several widely accepted monitoring protocols and websites with further protocol resources. Some are specific to the Midwest, while others are more continental in scale. Together, they provide an excellent place to start to learn more about the monitoring protocol.

Monitoring recommendations

The "Monitoring Recommendations" page offers guidance for avian monitoring efforts. Here you will find an extensive collection of websites, documents, and articles addressing avian monitoring or ecological monitoring in general. Major themes include: forming the right questions, protocols strengths and weaknesses, data management considerations, program conceptual models, and conservation management goals. These resources serve as basic resources for the science and application of avian monitoring methodology.

Citizen science

The study of birds is significantly enhanced by the help of citizen scientists. In fact, our knowledge of the occurrence and distribution of birds is largely due to the efforts of well-informed volunteers either working alone or along with avian ecologists. The "Citizen Science" page provides a list of some of the monitoring opportunities for volunteers in the Midwest. Each of these programs directly contributes to our knowledge about the ecology of birds in our region. New volunteers can learn from experienced birders and ecologists and have fun being outdoors in nature.

Training materials

The "Training Materials" page describes some of the MWADC training events that have been held throughout the Midwest Region. There is also a small archive of training materials. Additional materials including presentations from MWADC workshops will be posted at this page in the near future. Currently, there are no entries in the MWADC YouTube channel. However, Point Blue Conservation Science has created several YouTube videos (https://www.youtube.com/channel/UC3ktJM4Ddz3k-aClyxtntqg/videos) that will help new users with the MyMWADC applications.

Partnering for birds

MWADC provides information and news about organizations, universities, and agencies that partner to contribute to MWADC. One of the major contributors towards the development of MWADC has been the Midwest Coordinated Bird Monitoring Partnership. This partnership is a regional umbrella organization that coordinated the formation of several bird working groups. Links to the working groups are given on this page.

Several other MWADC partners are listed on this page. Some of these organizations are based in specific states such as the Missouri Bird Conservation Initiative, the Ohio Bird Conservation Initiative, and the Wisconsin Bird Initiative, whereas others are based on ecoregions and flyways, such as the Central Hardwoods Joint Venture, the Mississippi Flyway Council, Prairie Pothole Joint Venture, and the Upper Mississippi River and Great Lakes Region Joint Venture. Still other organizations represent a diversity of interests in addition to bird conservation (e.g., Landscape Conservation Cooperatives). Avian monitoring activities provide an important role for conservation actions of each of these partners.

Literature Cited

eBird. 2012. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: January 15, 2016]).

Nott, M.P. 2011. Mapping landbird diversity and population performance metrics across the Midwest landscape: an analysis of long-term monitoring avian productivity and survivorship (MAPS) data. A report to the US Fish and Wildlife Service Region 3. September 30th, 2011.

Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr. and W.A. Link. 2014. The North American Breeding Bird Survey. Results and Analysis. 1966 - 2013. Version 01.30.2015 USGS Patuxent Wildlife Research Center, Laurel, MD

Recommended Citation

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Appendix A: Managing your own data using MyMWADC

Introduction to MyMWADC

MyMWADC is the information system that you can use to manage data on the Midwest Avian Data Center website. MyMWADC system components consist of users, applications and projects. Applications include Biologist, Project Leader, and Analyst. Each user may be assigned permissions to use one or more applications in a given project.

USER		APPLICATION		PROJECT
[Your Account]	**->**	**Biologist**	**->**	**[Project Name]**
		Project Leader		
		Analyst		

Tutorial Overview

The exercises will give you a chance to try each application: Project Leader, Biologist and Analyst. We will use the test project called DMWADC. The first and second steps of each exercise are basically the same, that is, to state the purpose of the exercise and to navigate to the application. The third step and onwards takes you through data operations in the application. There are sample data for data entry/editing at the back of the tutorial.

Tutorial 1. Adding a new sampling location (Project Leader Application)

1. **Objective: To enter a new sampling location using the Project Leader Application.** This exercise will use the Project Leader Application to manage the DMWADC project.

2. **Navigate:** Go to the MWADC site. Click on the "Manage Data" tab, and click on "Choose Application" on the right. Enter the **Project Leader** application. You will be prompted to give your user and password. Enter your email address and the password you have chosen. Under Projects, select the DMWADC project.
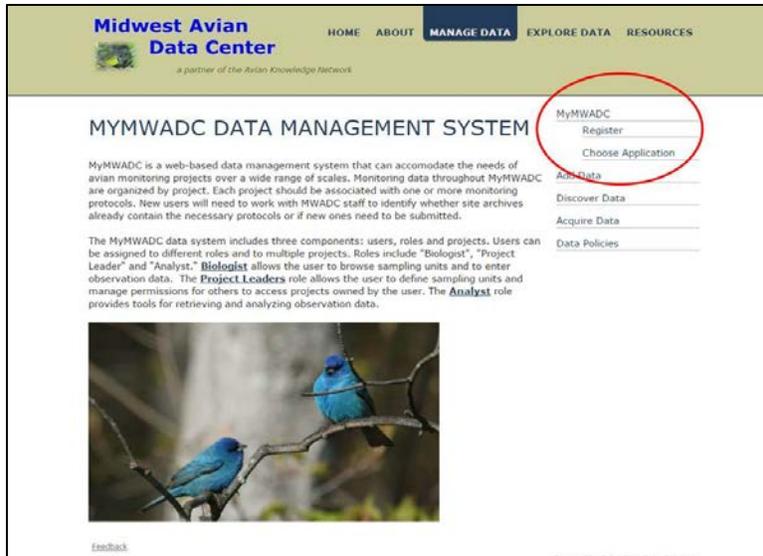
Figure 1. MyMWADC can be entered from the upper right side of the "Manage Data" page.

3. You should be at the Project Leader Application home page. On top, it reads "What you can do in Project Leader?"

4. In a new project, you will need to define sampling units. Under "What you can do in Project Leader", go to the section Sampling Units.

5. Click on Create and Manage Sampling Units. Select the Project DMWADC. Expand the sampling point hierarchy on the left.
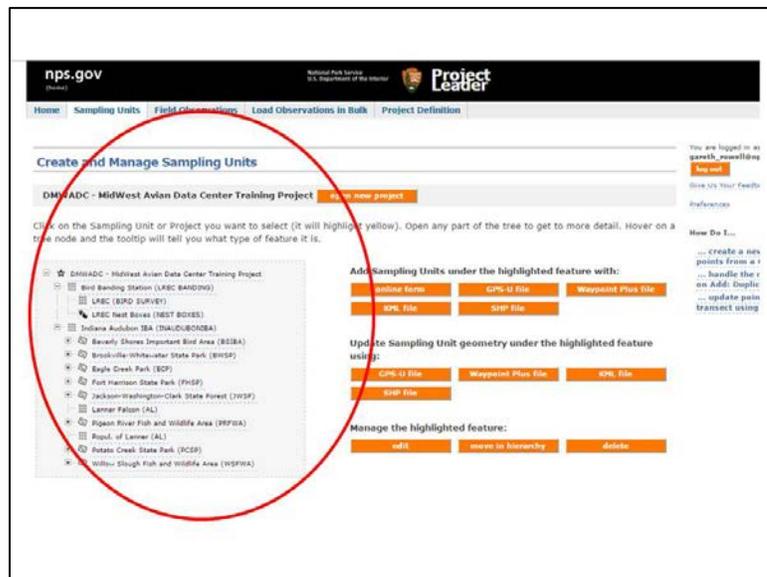
Figure 2. Managing sample units from the Project Manager application.

6. Pick one of the Indiana Audubon IBAs and add a sampling point. For example, click on Beverly Shores IBA. It will be highlighted in yellow. Click on the button "online form". Here you can add a sampling point.

7. Fill in the required fields (they have *'s) and click on the button to digitize the location. Then click on save. Your new sampling unit should appear under Beverly Shores IBA.

8. Repeat steps 8 through 10 to create a few new sampling units.

Tutorial 2. Entering and Proofing Data (Biologist Application)

1. **Objective: To enter and proof data with the Biologist application.** In the Biologist application, there are several types of data you can work on. The list under project observation types includes Point Count Surveys, Secretive Marshbird Surveys, Site Conditions, Area Search Surveys and Site Conditions.

2. **Navigate:** Click on the "Manage Data" tab, and click on "Choose Application" on the right. Enter the **Biologist** application. You may be prompted to give your user and password. Enter your email address and the password you have chosen. Under Projects, select the DMWADC project.

3. Click on Point Count Surveys. Under Point Count Transects or Routes you will see the locations of Indiana Audubon IBA sampling units. As part of the tutorial, we will be entering bird observations for a specific visit at **Eagle Creek Park IBA** which is located at Indiana Dunes National Lakeshore and vicinity.

4. Click on the location called Eagle Creek Park IBA. The first thing to notice is that there is a choice of protocols. The data entry fields are determined by the selected protocol. For this exercise, we will use the Observation protocol 3_5_10m50_100M+Fly-3,5,10min w/50,100,>100m & flyover and the Site condition protocol IND_IBA_Weather Conditions.

5. Click on Start. Use the attached spreadsheet at the end of Appendix A to enter data for your New Point Count Visit. You should use your own visit date to avoid creating duplicate records with other workshop participants.

6. Enter the data from the spreadsheet, and, when you are finished, click on the Save to Database.

7. After you have saved to the database, the application will tell you if the data saved correctly. Once you have saved with no errors, the status of the data is RAW. You are given the opportunity to review and make changes to the data after you have saved them. After you save from the review, your data are now CLEAN.
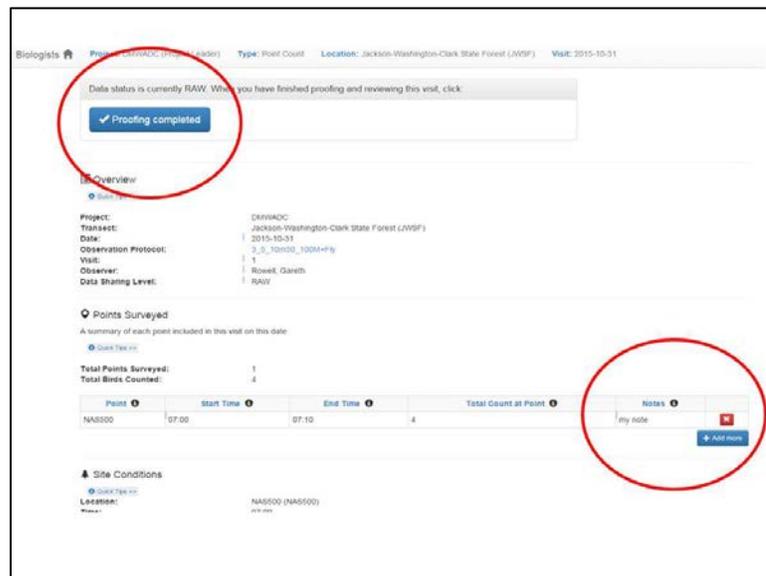

Figure 3. Proofing site conditions in a Sampling Event from the Biologist application.

Tutorial 3. Analyzing MWADC Data (Analyst Application)

1. **Objective: To use the Analysis application to retrieve and analyze field data.** In the Analyst application, there are built-in analysis tools for three types of data: point counts, area searches and banding. We will focus on the analysis of point count data.

2. **Navigate:** Click on the "Manage Data" tab, and click on "Choose Application" on the right. Enter the **Analyst** application. Under Projects, select the DMWADC project.

3. In the Analyst application, you will see Point Counts, Area Searches and Banding. Click on Point Counts.

4. Once you are in the Point Count Analysis page, go to step 2: Select locations from the tree below. Click on select all. On step 3. Leave all fields as default. On Step 4, explore the analyses: Select summary Information.

5. In the summary information, near the top, you will see a list of all the tables in the summary results. Scroll down to see the summaries of the data. Go back to the previous page.

6. There will not be sufficient data for population analysis of single species in our training dataset.   Density and Abundance analysis will not be very meaningful. However, you can still pick a single species with data, BHCO, for example, just to see how the analysis works.

7. Finally, try the Species Richness analysis with all data. Here you will find mean species richness reported by transect x year in table and graph format and simple linear trends of richness.

Other Tutorials:

Registering a new user

1. The first step is to create a user account. Go to the [MWADC] site. Go to the "Manage Data" tab on the MWADC website.

2. On the "Manage Data" page on the right-hand side, you will see the link "Register" under "MyMWADC". Click on "Register" to go to the registration form. Fill out the form and submit it. Note: your email address will become your account user ID.

3. Once your account is created, you can log into MyMWADC and begin to explore the system.

4. Go to the MWADC website, click on the "Manage Data" tab, and click on "Choose Application" on the right.

Starting a New Project (Project Leader Application)

1. **Objective: To start a new project using the Project Leader Application**
Note: Creating a new project requires requesting the project and 3 - 6 letter identifier code during the registration process. Alternatively, you can request that a project be initiated by contacting MWADC webmasters (visit http://data.pointblue.org/partners/mwadc/index.php?page=add-data for more information). Once the project has been created, there are several steps needed to manage it. This exercise will use the Project Leader Application to manage DMWADC as a new project.

2. **Navigate:** Go to the MWADC site. Click on the "Manage Data" tab, and click on "Choose Application" on the right. Enter the **Project Leader** application. You will be prompted to give your user name and password. Enter your email address and the password you have chosen.   Under Projects, select the DMWADC project.

3. You should be at the Project Leader Application home page. On top, it reads "What you can do in Project Leader?"

4. We need to start by defining the project. Go to the **Project Definition** section. Explore the "Researchers Access" and "Protocols Used" subsections. These areas allow you to define your project based on the protocol you choose and designate who will have access to it.

5. Enter "Researcher Access". Here, you grant other researchers access to your project. You also may give them "Project Leader" permission on your project if you need this. The other option is when a researcher is given "Project Leader" status to your project, are they allowed to manage email requests to join your project.

Requesting and Accessing MWADC Data (Project Leader, Analyst Applications)

1. **Objective: To request and access bird monitoring data.** MWADC users should be familiar with the Avian Knowledge Network (AKN) data policies before requesting data. See the Manage Data page. The user will need to contact the data owner to access projects and project data. The data owner,

in turn, will access the MyMWADC Project Leader application to add the user to the project. The user will need access the Analyst applications to download the data. Once the user has been added to the project, follow these steps:

2. **Navigate:** Click on the "Manage Data" tab, and click on "Choose Application" on the right. Enter the **Project Leader** application. Under Projects, select the DMWADC project.   Under "What you can do in Project Leader," go to "Sampling Units Download". Select all sampling units and download them in several different formats.

3. Return to the Project Leader home page. Go to Field Observations Download. Select all sampling units and download them in the desired format. Leave the Project Leader application.

4. Data can also be downloaded from the Analyst application. Enter the Analyst application. Click on Point Counts. Select all sampling units. On Step 4, below the analyses, try exporting the data in CSV format

New Point Count Visit

Date	Visit	Data Sharing	Observer	Temperature	Wind Speed (0-4)	Sky (0-5)	Other
[your date]	1	RAW	[your name]	30	0	0	

Points Surveyed

Point	Start Time	End Time	Detections	Notes
NAS221	6:11	0:21	yes	light fog
NAS222	6:29	6:39	yes	
NAS223	6:45	6:55	yes	

Observations

#	Point	Time	Species	Time Bin	0-50	50-100	>100	NR Breeding Note
1	NAS221	6:11	MAWR	0_3min	1			
2	NAS221	6:11	VIRA	3_5min		1		
3	NAS222	6:29	MAWR	5_10min	1			
4	NAS223	6:45	WIFL	0_3min	1			

Appendix B: Avian Knowledge Network Data Access Levels

The following are the Avian Knowledge Network's data access levels. These are applicable to each and every record in the network individually, so that different records may have different access levels. Data owners can specify how their data can be used in the data views, with the option that their data are not exposed to the public at all.

Level 1 - Some information is made available to others than project members about the data. Specifically, only metadata about the datasets are made available to any application or service.

Level 2 - Same as Level 1 with the following addition: data can be used in certain publicly available, predefined visualizations (i.e. maps and graphs), but direct access to the data is restricted.

Level 3 - Data are used in publicly available, predefined visualizations (i.e. maps and graphs). Additionally, the complete BMDE data set is available upon request, subject to approval from the original data provider.

Level 4 - Data can be used in publicly available, predefined visualizations (i.e. maps and graphs) and also may be available upon request. Additionally, some components of the data are made available to existing bioinformatic efforts (GBIF and ORNIS). These bioinformatic efforts only provide the data "marked-up" to Darwin Core, used to describe primary occurrence (location, date and species for example).

Level 5 - Data are used in publicly available, predefined visualizations (i.e. maps and graphs) and are available to existing bioinformatic efforts. Additionally, the complete BMDE data set is available for download directly via download tools.

Some nodes have extended these levels to include additional levels to help users manage the entire data lifecycle. Their extended levels include:

Raw - Data were input but no further review or processing has taken place. Data are available for project use only and not to the AKN.

Clean - Data were input and reviewed by member(s) of the project team. Data are available for project use only and not to the AKN.

Approved - Data were reviewed by project management, but no indication has been made of AKN data sharing levels. Data are available for project use only and not to the AKN.

Restricted - Same as APPROVED and not distributed and shared to other AKN partners automatically. All access to data must come through requests to the contributing institution project management.