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Use of eBird as a tool for undergraduate education, research, and biodiversity conservation

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Birds have a long and complex relationship with humans on many levels, from food to culture and myth. Yet over the past 50 years, wild bird populations across the continental United States and Canada have declined by more than 25 percent. eBird is one of the world's largest biodiversity-related projects, accessible to both citizen-scientists and researchers. Data collected through eBird informs scientists on bird distribution, abundance, and habitat use both spatially and temporally. In this workshop, I will explain how eBird can also be applied at the level of undergraduate education to enrich students' understanding, appreciation, and knowledge of birds and their biodiversity. Participation in eBird enhances our human connection to birds. eBird was used as part of an online ornithology course at Saint Peter's University to provide an outside-the-classroom field-based lab experience, but it can also be applied to general biology, ecology, or other field study-based courses. It can be used throughout a semester or for a single laboratory experience. Various aspects of eBird will be explained from data entry to use of summary tools such as bar charts. Ways to develop bird identification skills will be discussed. Participants in this workshop will be able to practice using eBird on their smart phones through free apps provided by eBird and the Cornell Laboratory of Ornithology, such as Merlin Bird ID. Global eBird data is managed by the Cornell Lab of Ornithology and their partners to inform and benefit the cause of bird conservation.

Keywords: bird studies, ornithology, ecology, experiential learning

Introduction

Birds play many roles in human culture as well as being essential components of ecosystems. Despite their long and complex relationship with humanity, from food to culture and myth, many people take birds for granted. In our modern developed societies, people have increasingly lost their connection to nature. This is especially true in the United States and Canada where most people reside in urban and suburban areas. According to the United States Department of Agriculture, only 14% of US residents were living in rural areas in 2020 (Dobis et al. 2021).

Our ability to monitor species over large geographic distances and time scales is better for birds than for any other animal group. Rosenberg et al. (2019) used multiple independent standardized bird monitoring datasets

as well as a continent-wide weather radar network to make determinations of bird population trends since 1970. They found that - while most of us did not notice - wild bird populations across North America declined by 29% over a 48-year time span. This percentage of decline translates to a disappearance of almost 3 billion birds from the North American avifauna (Rosenberg et al. 2019). Birds from almost every taxonomic and ecological grouping showed declines, including widespread and common species that are important components of food webs and ecosystems. This long-term downward trend in bird abundance documents a growing biodiversity crisis in the US and Canada that has been attributed to human-caused mortality factors such as habitat loss and climate change. It is widely agreed among scientists and conservationists that birds are excellent indicators of environmental health and ecosystem integrity (Rosenberg et al. 2019), so the disappearance of so many birds should register as an alarm call.

eBird is a powerful bird-monitoring project that was launched in 2002 (Sullivan et al. 2009). It has become one of the world's largest biodiversity-related citizen science projects. More than 100 million bird sightings are reported on eBird annually, with an approximate 20% growth rate in participation per year (Sullivan et al. 2009). Managed by the Cornell Lab of Ornithology, eBird collaborates with thousands of regional experts and hundreds of partner organizations around the globe. The big **IDEA** of eBird is that everyone who watches birds has unique knowledge and experience to share. Since scientists can't be everywhere, it makes sense to recruit citizen scientists. The **GOAL** of eBird is to gather information in the form of bird sightings, archive it, and make it freely available to all. The **RESULT** is that eBird is a tool that contributes to scientific knowledge, powers data-driven research, informs conservation efforts, and educates (Sullivan et al. 2009).

The heart of eBird is the **checklist**. eBird checklists collectively document bird distribution, abundance, habitat use, and trends over time (Sullivan et al. 2009). When completing a checklist, participants enter **when** they went birding (date, time), **where** (location), and **how** (stationary, traveling distance, etc.). Participants fill in the numbers of individuals on a checklist of species that is presented to them based upon species likely to be encountered at that location on that date. Birds can be identified by sight or sound. eBird checklists can be completed directly at the eBird website on a smart phone or computer, or through a free mobile eBird app that allows offline data collection.

The quality of data submitted to eBird is, of course, critically important for science. To minimize errors and ensure that data submitted to eBird is as accurate as possible, eBird has several layers of quality control. First, as mentioned in the preceding paragraph, each checklist presented to an eBirder shows the birds that are *likely* for that date and region. A bird species that is not on a checklist can still be entered, but written justification is required. Second, eBird applies "checklist filters" that are prepared and updated regularly by regional bird distribution experts. When eBirders report unexpected birds, or unusually high counts, the sightings are automatically "flagged" for review by the experts. In some cases, an email may be sent to the eBirder to ask for more information: Did you double-check your sighting? Did you consider alternative identifications? Can you provide more evidence in the form of notes, photos, or audio? If the regional expert has doubts about the report, the sighting of the bird in question may be withheld from the publicly visible database (but will still appear in a user's own eBird account).

I started using eBird personally in 2014 when participating in the annual Great Backyard Bird Count (GBBC) that is administered by the Cornell Lab of Ornithology. Since then, I have assigned students in general biology courses to use eBird as part of their participation in the GBBC. When teaching an online ornithology course during the Covid-19 pandemic in spring 2020, I developed a semester-long project in which students created weekly eBird checklists accompanied by blog posts to write more about their sightings. This multi-week project provided a substitute for an in-person laboratory. Students engaged in experiential learning about birds through fieldwork that they could participate in while living at home or in their dormitories. One student in the course even participated from Bulgaria where she was living for that semester.

In the case of the semester-long eBird project for my ornithology course, students were required to use additional features of eBird to create a final "summary" of their weekly eBird observations over the time span of several months (February to May). The eBird website includes many optional features or tools beyond the checklist. For example, eBird participants can group checklists made within a localized area into an arrangement that is called a "Yard" or "Patch". eBird can then generate Bar Charts for the Yard or Patch that will reveal the presence of species and their relative abundances over a series of consecutive weeks. **Bar Charts** are a standard feature of eBird that are generated by user data and can be consulted to see what species are expected to occur in a region or location during different weeks of the year. Other standard features that are available in eBird include maps of species locations (**Species Maps**); lists of regional sightings broken down by county, state or province, and country (**Explore Regions**), and detailed information on species (**Explore Species**) that includes photographs, audio recordings, and range maps, all generated by checklist information submitted by eBirders.

Yes, eBirders can add their own photos and sound recordings to their checklists, which I encouraged my students to do.

The basic steps of creating eBird checklists are not difficult to learn. Learning the "best practices" for creating the most accurate and scientifically informative checklists possible can take more time. Some features of eBird are more "advanced" than others. In the exercise that I have created for students, I have broken down the process of creating a basic checklist into a simplified series of steps. The eBird website has a Help Center (https://support.ebird.org/en/support/solutions/48000298808) that contains helpful information and extensive user support, including FAQs. In addition, the eBird website provides a free self-paced course called eBird Essentials that takes about three hours to complete. The eBird Essentials course can serve as a pre-lab activity but is not required for a basic understanding of using eBird. However, I would highly recommend that a student be required to complete this course if preparing for a semester-long eBird project or research. A quick 3-minute video overview of the many features of eBird can be accessed at this link: https://www.youtube.com/watch?v=-t-0xAjxakw.

Students using eBird for the first time will likely be beginners with respect to bird identification. Field guides are available for help with identification of bird species, but there are also many free online resources. Highly recommended for use with eBird is Merlin Bird ID, a free global ID and field guide app that is available for both iPhone and Android devices. Like eBird, the Merlin app was developed by the Cornell Lab of Ornithology. The Merlin app can be used in three modes: (1) to identify an unknown bird in a step-by-step process by answering three questions related to **size**, **color**, and **activity**; (2) to identify an unknown bird by taking a photo of it or uploading a photo already on your phone; and (3) to identify an unknown bird from its song or calls by recording the song or calls through the app.

An additional feature of the eBird website that can be used with students for instructional purposes is their "Photo + Sound Quiz" (Sullivan et al. 2009). This quiz can provide a fun and interactive learning experience for students or a chance for an instructor to assess student learning. The quiz is customizable, and every quiz is unique. Quiz content is extracted from The Macaulay Library (the Cornell Lab of Ornithology's media database) which contains millions of photos and audio recordings submitted by eBirders. Photos and audio are of varying quality, and during the quiz, the participant is asked to rate the photo or audio on a scale from one to five stars. To generate the quiz, one must select a **location** (such as a region), a **date**, and **photos** or **sounds**. eBird then creates the quiz using 20 photos or audio recordings, and each photo or sound is accompanied by four possible multiple-choice answers. The sound file is accompanied by a visual image (spectrogram) of the sound. By rating the photos and audio during the quiz, an eBirder is also helping The Macaulay Library evaluate the quality of the submissions made by eBirders.

Finally, eBird can be used for independent student research projects. All eBird data are open-access and can be downloaded for free. When any checklist is submitted, these observations become available to the global community of researchers, educators, conservationists, etc. When data is retrieved from the eBird website and used in a publication, there is a specific format to use for the citation (eBird 2021). There is another format for citing data from an individual checklist. eBird data have been used in hundreds of peer-reviewed papers and thousands of student projects. Open access of eBird data is critical to its many applications, including research, monitoring species, managing species, habitat protection, and informing law and policy.

The goal of this laboratory exercise is to introduce students to eBird. Specifically, students will (1) sign up for a free eBird account, (2) learn the basic protocols for using eBird, (3) create eBird checklists, (4) become familiar with free resources that help with bird identification, (5) observe and learn about birds experientially, and (6) understand how eBird can be used as a research tool.

Student Outline

Use of eBird as a Tool for Undergraduate Education, Research, and Biodiversity Conservation

Objectives

In this activity, you will:

1. Sign up for a free eBird account
2. Learn the basic protocols for using eBird
3. Create eBird checklists
4. Become familiar with free resources that help with bird identification

5. Observe and learn about birds experientially
6. Understand how eBird can be used as a research tool

Introduction

In addition to being essential components of ecosystems, birds have played many roles in human culture over the ages (Sax, 2021). In ancient Egypt, the soul of Re – the sun god – was depicted on the walls of temples and tombs as a heron and was called the benu (Figure 1a). The Greek historian Herodotus linked the benu with the legend of the phoenix, the mythical bird that is cyclically reborn from fire and ashes. The mythical Chinese phoenix, known as a fenghuang, is also associated with the sun and immortality. The fenghuang's partner, the Chinese dragon, is often shown flying in the clouds as the bringer of storms and rain. Native American peoples tell tales of the thunderbird, a spirit that flaps its wings to cause a storm and blinks its eyes to create lightning. Likely inspired by the bald eagle, the thunderbird is powerful enough to lift a whale and like the phoenix, it can be resurrected from its ashes (Sax, 2021). The peacock (or Indian jungle fowl) is one of the most spectacular and colorful *living* birds and is also associated with immortality and rebirth in many cultures and religions (Figure 1b). The peacock loses its magnificent tail feathers every autumn and regrows them each spring (Kang 2013).

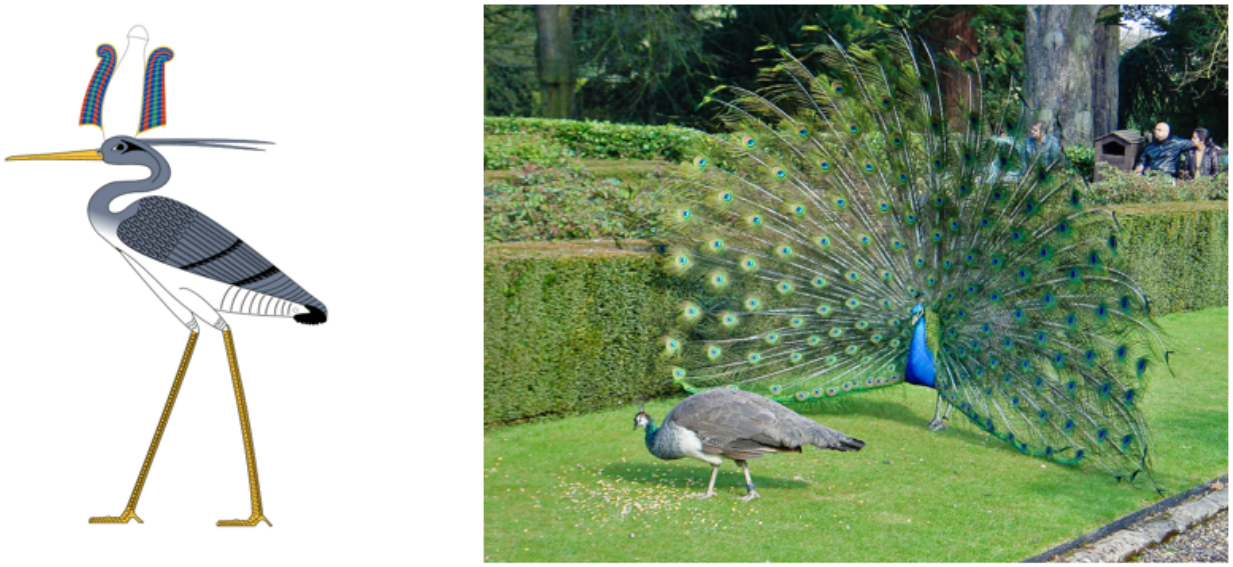

Figure 1. (a) In ancient Egyptian tomb paintings, the benu bird was often depicted as a heron wearing a crown. The benu represented the sun god, Re, and is believed to be an original source of the legends of the phoenix. Image: Jeff Dahl, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/0/03/Bennu_bird.svg (b) The Indian jungle fowl, commonly known as the peacock, is one of the most spectacular and colorful living birds. Shown here is a male displaying to a female. Image: ToastyKen, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons. https://upload.wikimedia.org/wikipedia/commons/6/62/Peacock_Wooing_Peahen.jpg

While the phoenix and thunderbird exist only in myth, more than ten thousand *living* species of birds on Earth also delight, inspire, and support humanity. Other than humans, birds are the only class (*Aves*) of vertebrates that are found on all seven continents. A scientific way to summarize the value of birds is to look at them in terms of their *ecosystem services*. Ecosystem services are benefits derived from the natural world. Within ecosystems, birds perform many roles, including predation (controlling harmful insects and rodents), pollination, scavenging, nutrient cycling, seed dispersion, food, and ecosystem engineering. Woodpeckers, for example, are ecosystem engineers that create nest cavities in trees that are necessary for the shelter and reproduction of many other species.

Although birds may be all around us, they should never be taken for granted. In 2019, Rosenberg et al.

published a landmark study in the journal Science, entitled “Decline of the North American Avifauna”. Their investigation examined multiple sets of data going back to 1970, and their inescapable conclusion was that wild bird populations have declined by 29 percent over nearly 50 years, a loss of almost 3 billion birds across the United States and Canada. Almost every group of birds and every biome was affected (Rosenberg et al. 2019). The report documented a long term but overlooked biodiversity crisis that affects even common and widespread species that are important components of food webs and ecosystems. Habitat loss, climate change, and other human-induced forms of mortality are contributing factors. However, the news was not all bad. Waterfowl and birds of prey showed significant rebounds in their population numbers thanks to targeted conservation interventions made on their behalf over the same time period. It is widely agreed upon by scientists and conservationists that birds are excellent indicators of the health of the environment, so it is important to pay attention to what the news about birds is telling us.

eBird was launched in 2002 and is one of the world’s largest biodiversity-related citizen science projects (Sullivan et al. 2009). More than 100 million bird sightings are reported on eBird every year, with an approximate 20% growth rate in participation per year. eBird is managed by the Cornell Lab of Ornithology but collaborates with thousands of regional experts and hundreds of partner organizations around the globe. The big **IDEA** of eBird is that everyone who watches birds has unique knowledge and experience that is worth sharing. Since scientists can’t be everywhere, it makes sense to recruit citizen scientists. The **GOAL** of eBird is to gather information in the form of bird sightings, archive it, and make it freely available to all. The **RESULT** is that eBird is a tool that contributes to scientific knowledge, powers data-driven research, informs conservation efforts, and educates (Sullivan et al. 2009)!

The heart of eBird is the **checklist**. eBird checklists document bird distribution, abundance, habitat use, and trends over time (Sullivan et al. 2009). When completing a checklist, participants enter the following:

When they went birding (date, time)

Where (location)

How (stationary, traveling distance, etc.)

Participants fill in the numbers of individuals on a checklist of species that is presented to them based upon species likely to be encountered at that location on that date. Birds can be identified by sight or sound. eBird checklists can be completed directly at the eBird website on a smart phone or computer, or through a free mobile eBird app that allows offline data collection anywhere in the world.

In this laboratory activity, you will create a free account on eBird, learn the basic protocols for using eBird, create eBird checklists, become familiar with free resources that assist with bird identification, observe and learn about birds from your own experience, and become aware of how eBird can be used as a research tool.

Methods and Data Collection

How to Use eBird - Best Practices

Helpful information and extensive user support, including FAQs, are available at the Help Center on the eBird website: https://support.ebird.org/en/support/solutions/48000298808. In addition, there is a free self-paced course called eBird Essentials that takes about three hours to complete and can serve as a pre-lab activity or as preparation for a longer-term eBird study: https://academy.allaboutbirds.org/product/ebird-essentials/. A quick 3-minute video overview of the many features of eBird can be accessed at this link: https://www.youtube.com/watch?v=-t-0xAjxakw.

Free Resources for Help with Bird Identification

Most students taking this lab will likely be beginners with respect to bird identification. Field guides are available for help with identification of bird species, but there are also many free online resources. Highly recommended for use with this exercise is Merlin Bird ID, a free global ID and field guide app that is available for both iPhone and Android devices. Like eBird, the Merlin app was developed by the Cornell Lab of Ornithology. The Merlin app can be used in three modes: 1) To identify an unknown bird in a step-by-step process by answering three questions related to **size**, **color**, and **activity**. After answering these questions and based on your location and the date, Merlin will suggest species for you. 2) To identify an unknown bird by taking a photo of

it or uploading a photo already on your phone. 3) To identify an unknown bird from its song or calls by recording the sounds using your app.

Procedure:

You can work singly, in groups, or together as a class to follow the steps outlined below. Check with your instructor. Instructions below for following eBird protocols are modified from the eBird website (Sullivan et al. 2009).

Part I: Laboratory Activity: Creating eBird Checklists

In today's activity, you will be guided through all the steps from creating a free eBird account to creating checklists using correct eBird protocols. You will need birds to observe, so check with your instructor on this process. If an established feeder is available that receives regular visits from birds, observations can be made through a window or from outdoors, depending on the situation. Alternatively, the class could go for a walk on campus or make bird observations during a field trip. A third option is to watch birds through an active "live" video camera set up. Several "bird cam" options are available on the internet and can be researched in advance.

1. Create an eBird Account – Free!

To work in eBird and save your observations, you need to create an account using a computer with an internet connection or a smart phone. (If you have participated in any Cornell Lab of Ornithology projects in the past, such as Project FeederWatch or the Great Backyard Bird Count, you can use the same account.) To sign in or create a new account, just type "eBird" in your browser and the tabs (or menu options) will appear at the upper right of the page: https://ebird.org/explore

2. Two Options for Setting Up Your eBird Checklists

Select one of the two options below for setting up your checklists:

A. **The eBird.org website**. On the main eBird.org page, click the Submit tab (top left).

B**. The eBird mobile app**. Enter the app, press "Submit" or adjust the "Start Time" (if needed) and press "Start Checklist". Using the app, you can keep a running checklist "in the field" with or without an internet connection. If working offline in the field, submit the finalized checklist later when you are connected.

3. The "Basic" Steps for Creating an eBird Checklist

When you enter your bird identifications on the eBird website or eBird mobile app, every checklist should include:

A. **Where** you went birding – a single location
B. **When** you went birding **–** a single calendar date (day, month, year)
C. **How** you went birding – an observation type. Choose a **Protocol** (see **#4** below).
D. **Which species** you identified and how many individuals of each. (For **Counting**, see **#5** below)
E. **Is the Checklist complete?** Yes or No. An incomplete checklist only includes "highlights" and not all the birds that you could identify.

4. Choosing a Protocol for "How You Went Birding"

A Quick Guide: Was birding your primary purpose?

YES, it was, AND I know the start time, duration, and distance ***Stationary*** or ***Traveling***
(If you did not travel more than 100 feet, select ***Stationary***)

YES, but I do not know start time, duration, and distance ***Historical***

NO, it was not my primary purpose. ***Incidental***

5. Counting Tips – How Many Birds Should I Report?

There is an option to enter an "X" instead of an exact number. "X" indicates "present". However, it is always more useful to give your best estimate of numbers! An X could mean 1 or 1,000,000.

General numbers are fine! If you estimate a flock to be 50 birds, when in reality there were actually 40 or even 65, that is okay!

Avoid giving a false impression of precision – if you see a flock, it is best to estimate by 10s, 100s, etc rather than to say "83" if you did not actually do a precise count.

Counting gets easier with practice!

6. How To Edit Checklists That Have Been Submitted.

Important note: Delete any lists of birds that you make for practice *IF* they are not "real". Newly submitted checklists will not normally appear on eBird for approximately one hour after they are submitted, so if you delete the checklists promptly, they will never appear on the eBird website.

A. How to edit your checklists in eBird
Go to the eBird.org main page and click on My eBird (the tab is on the top row of tabs on the page).
Click on Manage My Checklists (on the left side of the screen).
Scroll down and click on the highlighted date of the desired checklist.
Select the blue tab on the right called Checklist tools. (Options appear on a dropdown menu).
Be sure to **save your changes** when finished.

Note: If you are using eBird Mobile and have not submitted your checklist yet, do the following: Tap on the "Checklists" icon, tap the checklist you want to edit, and then simply edit as needed.

B. How to delete a checklist
From the My eBird section of the website, select Manage My Checklists, then Checklist Tools. From the bottom of the dropdown menu, select Delete.
From the eBird Mobile app, first go to "Checklists". Swipe left along the checklist you want to delete and press the "delete" button and/or trash icon that appears.
WARNING: Once you erase a checklist from your personal eBird account, it is gone forever from the database.

7. Managing Media – Adding Photos or Sound Recordings
Photos and sound recordings can be added to your eBird checklists. For instructions, see the eBird Help Center online at https://support.ebird.org/en/support/home

Part II: Optional Multi-Week Project: Summarizing eBird Observations

This eBird activity can become an extended multi-week project, from several weeks to an entire semester.

Suggested Instructions:

A. **Create two eBird checklists per week**. Spend at least 15 minutes observing birds for each checklist. Write one to two descriptive paragraphs to accompany each checklist, sharing any special notes about the birds, such as their behavior, and add some personal reflections. If an online learning platform (e.g., Blackboard) is used for your class, post your paragraphs as weekly blog posts on a discussion board where classmates can read and comment on your blogs. Embed the link for your eBird checklist within the blog so that it can be accessed by other students. Read and comment on at least two other blog posts made by your classmates each week.

B. **Create a "Yard" or "Patch" on eBird** at the end of your multi-week project or semester. The Yard or Patch options on eBird allow you to select and group eBird checklists with a specified local area such as your yard (private property) or a neighborhood, park, or route where you walk or drive to view birds. eBird then will summarize the information from the grouped checklists. Instructions are found at the eBird Help Center:
https://support.ebird.org/en/support/solutions/articles/48001049078-patch-and-yard-lists-in-ebird

C. **Generate a Bar Chart from your Yard or Patch**. Once you have created a Yard or Patch, an icon for a Bar Chart will appear at the bottom of your Yard or Patch display. A Bar Chart is one of the standard features on eBird that allows eBirders to visualize and know what birds to expect at various times of the year. Click on the icon and you will see a summary of the birds that you identified over the consecutive weeks of your grouped checklists along with their relative abundances. An example of a

Bar Chart generated by student checklists is shown in Figure 2. Be prepared to discuss your results in class or as a written assignment (check with your instructor).

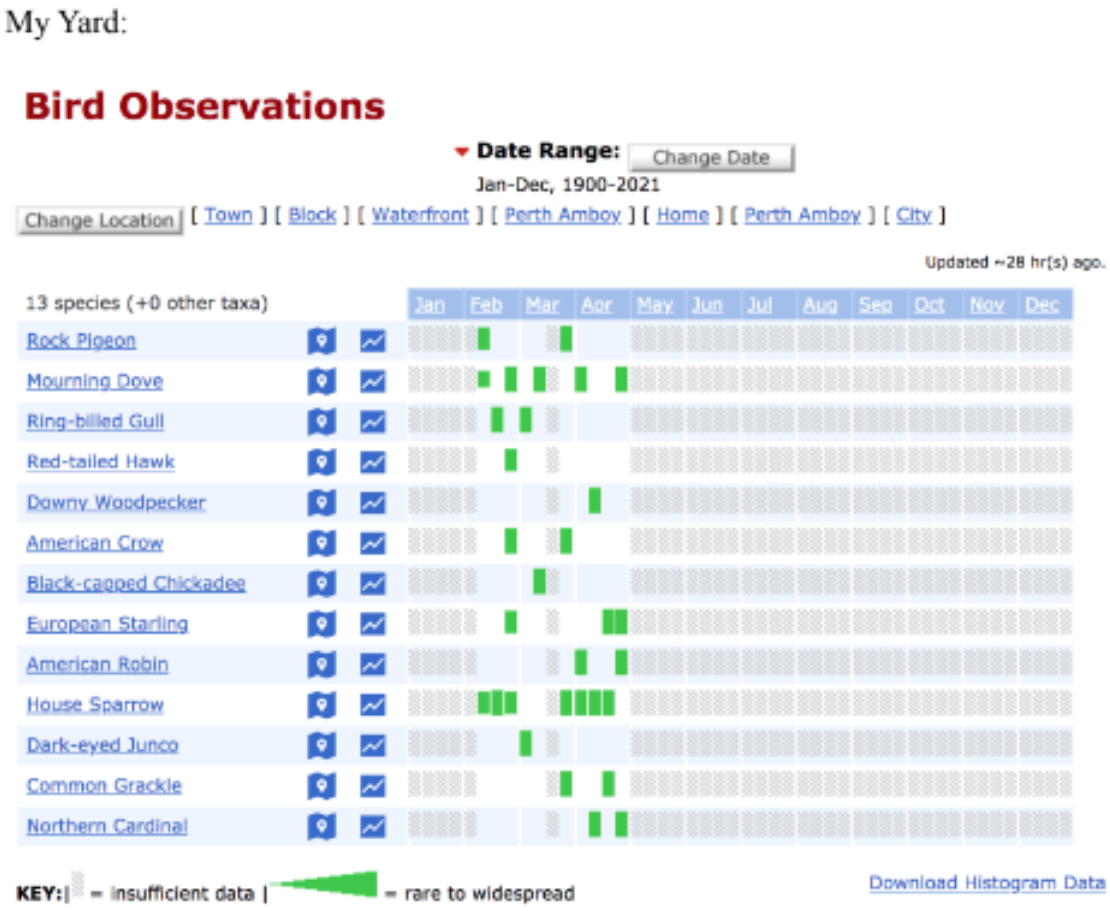

Figure 2. The Bar Chart shown above was generated by student checklist data that was aggregated into a Yard. This student observed 13 species over a period of 12 weeks. The Bar Chart summarizes this information in a visual format that allows a viewer to see when each species was seen, how often, and if any trends are apparent. Bar Charts that are created for a region on eBird, or even for any site that is birded repeatedly for many years, have predictive value as they can tell what species are expected in that locality.

Discussion

During this laboratory, you will have had a chance to observe birds, practice your identification skills, and gain experience in the scientific process of entering data in an eBird checklist. You will have learned more about the birds on your campus, neighborhood, and/or nearby nature preserves and parks. Hopefully, you now have a better appreciation for the important roles that birds play in the environment and local ecosystems. It is also hoped that your encounter with birds has made you more curious about them and more convinced of the value of preserving and protecting birds and their habitats.

Whether you created one checklist or many, participated in one laboratory session or in a multi-week project involving eBird, you have made a valuable addition to the eBird database. Your participation has added to our scientific knowledge of birds and their population trends. Your contribution has become part of an open-access set of data that will be accessed by researchers and conservationists around the globe. eBird will continue to be a powerful source of information as well as a tool for research, monitoring species, managing species, habitat protection, and informing law and policy.

A Review of Your Results: Questions to Consider

Answer the following questions at the end of your eBird activity. Questions #6-10 are only for students who participated in eBird as a multi-week project.

1. Which species of birds did you report most often in your eBird checklists? Was it hard to find birds?
2. How confident do you feel in your ability to accurately identify the species of a bird? Are some birds easier to identify than others? Explain.
3. Did you observe any interesting bird behaviors? If so, please describe.
4. Do you have a favorite species? If so, explain why you find this species especially interesting or admirable.
5. Based on your use of eBird so far, explain how eBird is a valuable tool for research, education, and conservation.
6. Did you create a Yard or Patch from your eBird checklists over the weeks of your project? How many species did you observe in total? Were any species observed every week, or for most weeks? If so, which ones?
7. If you created a Bar Chart of your Yard or Patch, describe any trends that you see over the weeks. Can you think of possible reasons for any trends in birds that you see? Can the difference in sightings over time be due to seasonal changes (e.g., winter to spring), birding in different habitats or locations, spending more time birding, or due to your growing skills at bird identification?
8. Did you notice any associations between weather conditions and numbers of species or individuals? If so, describe.
9. Does your eBird data suggest any questions that you could investigate for a future research project? If so, describe one question and hypothesis that you could test using eBird as a tool.
10. Did participation in this project change how you feel about birds? If so, how? Please explain.

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Materials

A computer with Internet access is required for each pair of students. Alternatively, students can use their smart phones or tablets and work individually. Both the eBird and Merlin Bird ID apps are free and can be downloaded onto mobile phones from the App Store for iPhones or Google Play Store for Android phones. Field guides to bird identification in print form can also be purchased and these may cost in the range of $15 to $25 each.

A source of birds for observation during the lab is needed. There are several options. If an established bird feeder is available that receives regular visits from birds, observations can be made through a window or from outdoors, depending on the situation. If a feeder is to be set up specifically for the laboratory, it should be established several weeks in advance of the date of the lab because it often takes at least 2 to 3 weeks for birds to find and accept a new feeder. Alternatively, the class could go for a walk on campus or make bird observations during a field trip. A third option is to watch birds through an active "live" video camera set up. Several "bird cam" options are available on the internet and can be researched in advance. If this option is selected, it is best to find a bird cam that is in your region. One example of a reliable bird cam that is typically continuously visited by feeder birds during the daytime is the Cornell FeederWatch Cam maintained by the Cornell Lab of Ornithology in Ithaca, New York (Tomkins County): https://www.allaboutbirds.org/cams/cornell-lab-feederwatch/. This bird cam has its own designated "Sapsucker Woods Hotspot" on eBird for direct entry of birds from a checklist. If you are in a different region or time zone, keep in mind that the eBird checklist of bird species presented to you may differ from the birds viewed on the webcam.

Notes for the Instructor

This laboratory investigation and associated activities are adaptable for on-site and online learning (or a combination). They are also adaptable to different student groups (i.e., novice to advanced). They promote engaging and interactive experiential learning, including reflective writing components that can be assigned.

One of the challenges faced is providing a source of birds for students to identify. There are several solutions to this challenge that have been suggested under Materials. Students can observe a feeder from a window or from an outdoor vantage point, they can go for a walk on campus, or a field trip to observe birds can be arranged.

A second challenge involves bird identification. The majority of student participants will be beginners at bird identification. Students should be encouraged to make use of resources such as the free Merlin ID app, which is very helpful. Students should also be encouraged to take their time and identify birds with care, especially when they are first starting out. They should not be afraid to make occasional mistakes, but they need to be open to advice and not be too quick to identify an unknown bird. They should also be advised to leave birds off their checklist if the identification is truly just a "guess". In my experience, most students are serious about trying to make accurate identifications of birds. However, I have had one or two students who seemed to make "wild guesses" and I have had to speak to those students in a gentle way to address the situation.

If students are participating in eBird as a multi-week or semester-long project, they should be required to complete the free self-paced eBird Essentials course. At the end of the course, which takes about 3 hours to complete, students will receive a certificate which can be presented to you, the instructor, as evidence of their completion of the course.

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