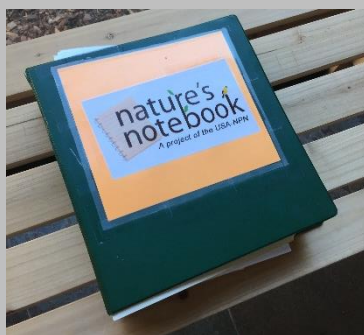
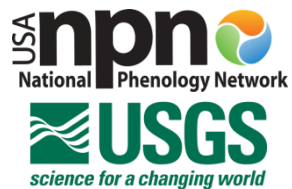


USFWS Phenology Network

A collaboration between the USFWS and the USA-NPN



Phenology for Resource Management and Decision Making Phase I and II Program Evaluation and Final Report April 2017

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USA National Phenology Network

Phenology for Resource Management and Decision Making: Phase I and II Program Evaluation and Final Report

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Phenology for Resource Management and Decision Making

Phase I and II Program Evaluation and Final Report, 2017

A multi-year agreement between the National Wildlife Refuge System of the US Fish and Wildlife Service Inventory and Monitoring Program and the USA National Phenology Network

Project Period: September 1, 2014 - February 14, 2017

Phase I & II Overall Budget: \$333,860

Overview

The partnership between the USA National Phenology Network (USA-NPN) and the US Fish and Wildlife Service's (USFWS) Inventory and Monitoring (I&M) Program was established in 2012 to assist the USFWS with phenological monitoring across the National Wildlife Refuge System (NWRS). Phenology, an important indicator of biological response to climate change, was already being observed and recorded independently and with many different data collection protocols by NWRS units as part of their localized scope of work. The refuges needed standardized, recorded phenological information to meet the goal of the I&M Program's Seven-Year Plan to ensure that phenological monitoring conducted on refuge land is scientifically credible and will be usable to inform climate related management questions at multiple spatial and temporal scales. The USA-NPN provides a standardized methodology for collecting, storing and sharing the phenological data that can be analyzed across time and space.

Relevance and Need for Partnership

Both the I&M Program and the USA-NPN seek to understand and communicate patterns in the phenology of plants, wildlife, and landscapes in response to rapid environmental and climatic change. The I&M Program needed an off-the-shelf, easily accessible data collection and storage interface for phenology information. In many cases, refuges have such data collected and stored in multiple formats and locations. The refuges also lack staff time to collect all of the data needed to answer questions about regional phenological change in response to climate change and general management activities. The USA-NPN seeks long-term, well-distributed phenology observation locations with data on individual plants and animal species collected by trained observers to build a rich National Phenology Database (NPDb) for use in decision-making and research. The USA-NPN's citizen and professional phenology monitoring program, *Nature's Notebook*, meets the phenology-related programmatic goals of both organizations and is the interface for entering data into the NPDb. The USA-NPN's National Coordinating Office (NCO) supports partner organizations in using the data in the NPDb and *Nature's Notebook* through the creation and delivery of programmatic materials that benefit research, management, and educational goals. To be successful, the NCO requires input from on-the-ground researchers, managers, and participants using the monitoring program. The NCO also provides support for a network of citizen

and professional volunteer observers engaged and trained to make accurate phenology observations using *Nature's Notebook*.

This report summarizes the work completed on Phase I and II of the Project from September 1, 2014 through February 14, 2017. Included are the Goals and Objectives for the Project as well as a summary of the achieved outcomes. The Project includes current and ongoing funding for Phase III, beginning on February 15, 2017 lasting through April 30, 2019.

Project Phase I & II - Programmatic Goals and Desired Outcomes

Goal 1. Establish a scientifically credible, standardized methodology for capturing and recording phenological observations on species of interest in select USFWS NWRS Regions.

Desired Outcomes:

- Develop standardized FWS Protocols, implementation plans, and methodologies for using *Nature's Notebook* for phenology data management
- Establish a pilot refuge project utilizing *Nature's Notebook* for management and outreach purposes
- Work with additional refuges using *Nature's Notebook* for phenology and resource management and visitor services
- Create and maintain an online interface for phenology monitoring designed specifically for the NWRS
- Provide training and resources and maintain regular communications with staff and volunteers

Goal 2. Ensure that phenological monitoring conducted on refuges will be used to inform land management and climate-related management questions at multiple spatial and temporal scales.

Desired Outcomes:

- Identify science and management priorities related to phenology for individual refuges
- Develop resources to assist refuges in summarizing phenology and program participant data
- Develop methodology and models for larger scale climate change management and mitigation

Goal 3. Develop recommendations for how phenological information collected on refuge lands, and surrounding managed lands, can be used to inform management actions and forecast climate change related effects.

Desired Outcomes:

- Summarize activity and progress of refuges toward meeting their management and outreach goals
- Make recommendations for replication of monitoring projects across refuge units

Appendix A: [Task Timelines for Phase I \(September 1, 2014 - October 30, 2015\)](#)

Appendix B: [Task Timeline for Phase II \(November 1, 2015 - February 1, 2017\)](#)

Project Inputs and Resources

US FWS National Wildlife Refuge System

1. Inventory and Monitoring Chief and Field Staff
2. Refuge lands and natural resources
3. Visitor Services and Science/Management Staff
4. Local Friends groups
5. Communication and connection with local community
6. Science and monitoring protocols and existing methodology
7. Refuge management plans
8. Phenology monitoring goals on a regional and local scale
9. Funding

USA National Phenology Network

1. Vetted, standardized system for recording phenology observations
 2. Vetted system for data summary and visualization
 3. Research and education staff
 4. Program implementation and training materials
 5. Network of researchers, managers, and educators
 6. Time
-

Project Implementation and Analysis

At the outset of the partnership USA-NPN NCO Staff developed a monitoring engagement and implementation plan for refuge participants. To achieve the stated Project goals and outcomes it was necessary to build a framework for *human involvement* and a process by which success could be measured. This framework was designed in service to the outlined goals of the Project (see above) to ensure refuge staff and volunteers were following established methodologies for the engagement of observers in *Nature's Notebook*. Thus Project staff can now make recommendations on how to get the most return for investment from engaging people in collecting accurate scientific phenology observations for a long-term *Nature's Notebook* program, both within and external to the Refuge System.

Participation: Project Staff

USA-NPN Staff

Two permanent staff at the USA-NPN NCO were responsible for facilitating the entire scope of work outlined by the Project's program plan for the duration of the funding period. This included Erin Posthumus, Outreach Coordinator and Liaison to the USFWS (0.5 FTE on this Project) and LoriAnne Barnett, Education Coordinator (0.2 FTE on this Project).

Erin's role in the Project included serving as co-Principal Investigator on the Cooperative Agreement funding; establishing a program plan; networking with potential partners within and external to the NWRS; conducting in-person workshops for NWRS staff and partners; maintaining content on the USFWS Phenology Network website (fws.usanpn.org, initiated in a prior funding effort); conducting site-based needs analyses; developing implementation plans; engaging in regular system wide communications via emails and newsletters; writing protocols, guidance documents, and reports; conducting data analyses; and supervising Regional Project Coordinators.

LoriAnne's role in the Project included serving as Principal Investigator on the Cooperative Agreement; consultant on educational content delivery (such as workshops, volunteer management, and curriculum recommendations); conducting in-person workshops for NWRS Staff and partners; overall Project management including developing task timelines and delivery of outcomes; tracking outcomes and impacts; implementing programmatic evaluation (including survey design and focus groups); and developing of the Project's Evaluation and Final Report.

Other permanent staff at the USA-NPN NCO on the IT and Data Product Teams assisted with developing technical resources, web design, data analysis tools and visualizations. The USA-NPN's Assistant Director provided scientific justification and consultation. In the 2016-2017 academic year, an intern through the NASA Space Grant Program conducted a summary and analysis of phenology data collected through Nature's Notebook across the NWRS.

All USA-NPN Staff were compensated for their project work, based upon FTE status.

USFWS Staff:

No FWS staff were directly paid as part of this project. In the NWRS Regions where monitoring programs were established, the most successful implementations of long-term phenology monitoring involved both Visitor Services (Education and Outreach) and Science and Management Staff. The Chief of Inventory and Monitoring for the USFWS, Jana Newman, was the main point of contact and Project visionary, serving to connect the USA-NPN to her field staff and the System.

Twelve science staff and/or Refuge biologists are collecting ongoing observations at Refuges participating in the project. One Refuge Manager is actively participating in data collection. No Visitor Service staff responded to our final evaluation, but we estimate that there are 7 Visitor Services Staff participating in phenology monitoring on behalf of the NWRS.

Interns:

This Project funded two full time, short term project interns in the field serving as local contacts and volunteer managers. These interns were supervised locally by NWRS Staff and remotely by Erin Posthumus. Interns were recruited and paid through the Americorps Program and the Student Conservation Association. Americorps interns have, or are currently, working at 2 other Wildlife Refuges and are funded by local efforts rather than through this project.

Volunteers:

The power of the *Nature's Notebook* citizen and professional science program is its volunteers. Most data are being collected by regularly visiting adult volunteers or college age students, although several locations have also engaged youth under the age of 18 in the data collection process.

Data collected by Refuges

Over Phases I & II (September 2014 - January 2017), 15 refuges across the country contributed 61,831 phenology observations to *Nature's Notebook*.

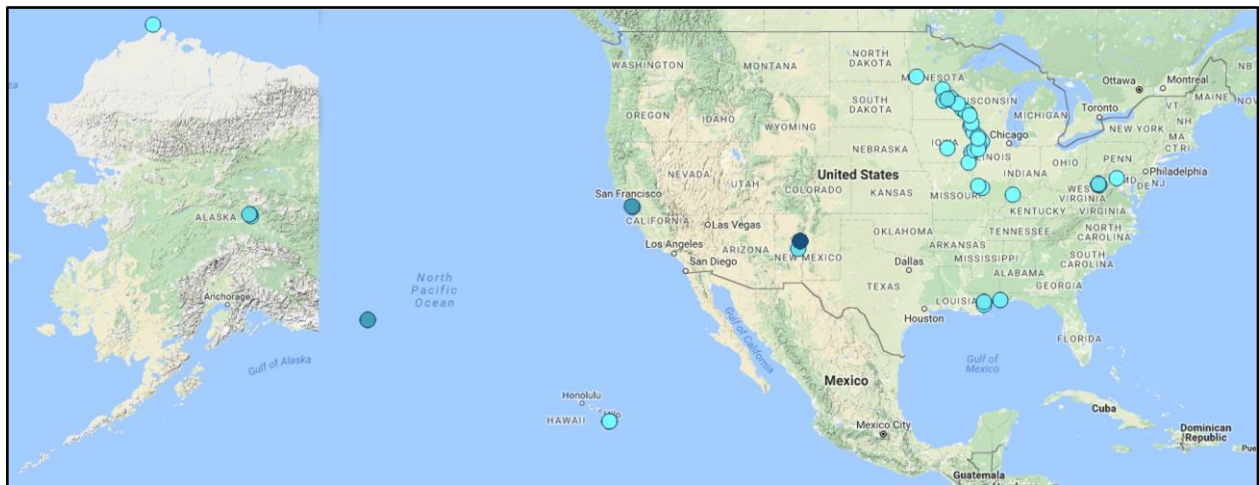


Figure 1 Map of Nature's Notebook sites within the National Wildlife Refuge System in Phases I and II

Table 1. Number of phenology observations and number of species on which data was collected through Nature's Notebook on the National Wildlife Refuge System in Phases I and II.

Region	Refuge	Observations Collected	Number of Species
Region 1	Midway Atoll National Wildlife Refuge	7,819	1
Region 1	Hakalau Forest National Wildlife Refuge	422	2
Region 2	Valle de Oro National Wildlife Refuge	25,783	39
Region 2	Sevilleta National Wildlife Refuge	1,530	4
Region 3	Minnesota Valley National Wildlife Refuge	238	18
Region 3	Prairie Wetlands Learning Center	369	12
Region 3	Mayfly Watch/Upper Mississippi River NWR	1,549	3

Region 3	Sherburne National Wildlife Refuge	363	7
Region 4	Grand Bay NWR/NERR	360	14
Region 4	Big Branch Marsh NWR	401	3
Region 4	St. Marks Visitor Center	615	9
Region 5	Canaan Valley National Wildlife Refuge	7,508	28
Region 7	Arctic NWR	3,755	24
Region 8	Don Edwards NWR	11,119	8

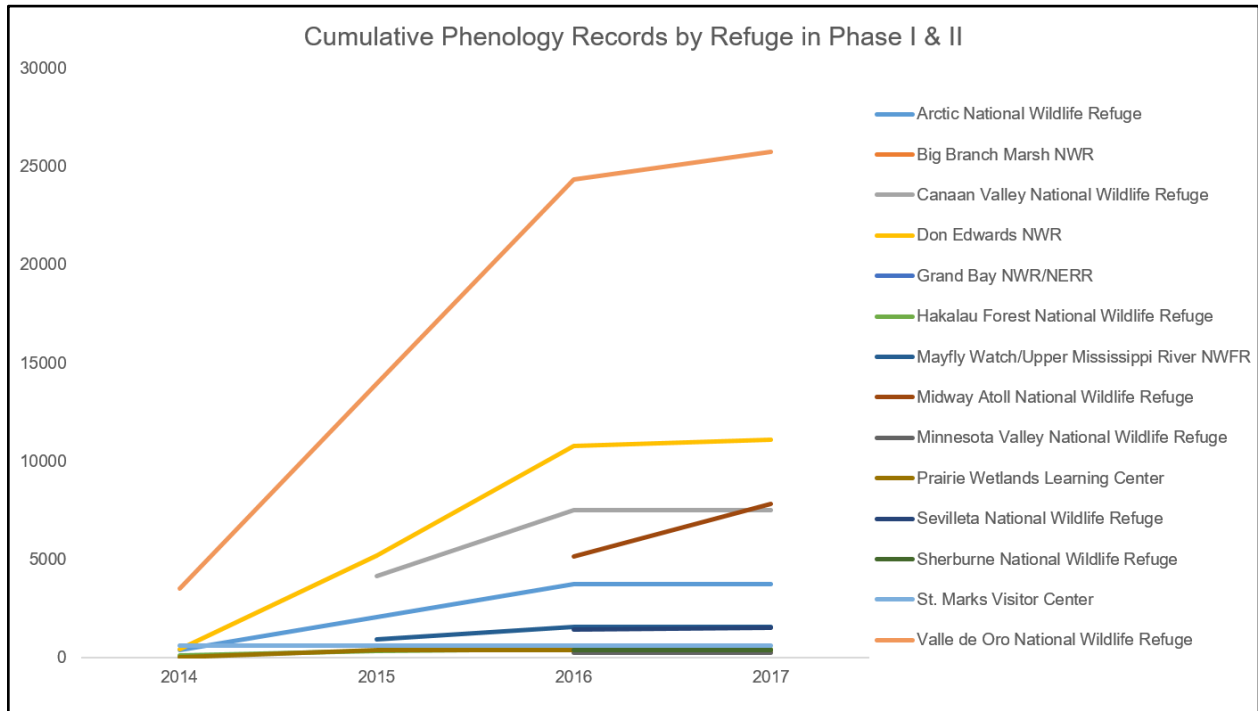


Figure 2 Accumulated phenology records collected through *Nature's Notebook* across the National Wildlife Refuge System in Phases I and II.

Of the 61,831 records collected on refuges in Phases I and II, 36% were collected by 30 staff and paid interns, while 64% were collected by 48 unpaid volunteers.

Project evaluation data

At the conclusion of Phase I & II of the Project a program evaluation and focus group session was conducted to obtain feedback from participants in the field. The evaluation was distributed to 38 people at 16 different National Wildlife Refuges and 11 people from 10 external organizations. Of those, 15 people from 9 refuges provided feedback on the survey and 6 people from 5 external organizations also provided feedback. Of those 15 people, two participated in the Focus Group discussion (**Appendix C: [Copy of Survey](#); Appendix D: [Survey Results](#); Appendix E: [Focus Group Transcript](#)**).

We also sent the evaluation to 3 other refuges that had been collecting data prior to the start of Phase I, but were no longer collecting data at the time of the evaluation. We did not receive a response from any of the people from these refuges, and received undeliverable messages from two refuges indicating that the staff members had moved on from their positions.

Of the surveys returned, respondents reported utilizing 175 volunteers to collect observations for *Nature's Notebook* at each of the reporting refuges. Of those, approximately 1/3 of those (or 50) volunteers are submitting regular observations on a weekly basis throughout the year. Those volunteers have contributed approximately 39,098 observation records to the National Phenology Database.

There is a limited amount of bias in the results of the program evaluation, due to survey respondents reporting only from active and marginally successful refuges and units. One issue continues to be staff turnover at refuges and other units - if a Project contact using *Nature's Notebook* moves on, and there is no way to follow up with them, then Project staff were unable to collect information from that Refuge or unit. The NCO also knows that it takes approximately 3 years for sustainable on-the-ground programs to form, and this evaluation was conducted right at the 3 year mark for the Project funding - thus some of the refuges began their programs relatively recently. Their outcomes will be assessed annually moving forward.

Additionally, if *Nature's Notebook* was implemented because it was important to only one staff person or intern who has since moved on, and they did not leave documentation about what was done or why the Project is, or may be, important to the refuge or unit, then the project was almost certainly discontinued. This was clear from the lack of response from previously active refuges not responding to the survey or indicating otherwise that the program was discontinued. Refuges such as Tetlin and Kenai NWRs are no longer supporting *Nature's Notebook* programs because the sole staff person responsible for the program left their position and there was neither interest nor time available among other staff to continue the program.

Regardless, the information gathered from the program evaluation will be used to determine best practices and make recommendations moving forward.

Outputs

Participation: Locations with established monitoring programs

Thirteen units, on and off refuge lands submitted information for this Program Evaluation. Six out of 8 FWS Regions have active units participating in *Nature's Notebook* Phenology Monitoring. Among the respondents of the survey, those units are representative of the most active Project partners.

Below is a breakdown of the Regions and number of active units who responded to the Project program evaluation:

Table 2. National Wildlife Refuges and Phenology Trail Partner Organizations responding to the Phase I and II Evaluation Survey.

USFWS Region	Active Refuges and Phenology Trail Partner Organizations	Number of respondents	
		Survey	Focus Group
Region 1	Midway Atoll NWR	2	1
2	Rio Grande Phenology Trail	4	0
	Sevilleta NWR		
	Albuquerque BioPark Botanic Gardens		
	Bosque Ecosystem Monitoring Program		
3	Prairie Wetlands Learning Center - Fergus Falls WMD	1	0
4	Grand Bay National Estuarine Research Reserve	6	1
	Grand Bay NWR		
	Mississippi Habitat Stewards		
	St. Marks NWR		
	Southern Louisiana NWR Complex		
5	Canaan Valley NWR	1	0
7	n/a	0	0
8	Don Edwards-San Francisco Bay NWR	1	0
9	n/a	0	0

As part of this Project, two regional Phenology Trails (a regional series of *Nature's Notebook* monitoring sites) were established to collect observations at locations both on and off NWRS lands. The Phenology Trails include the Rio Grande Phenology Trail in Region 2 and the Gulf Coast Phenology Trail in Region 4. Both are staffed by interns and have benefitted from USA-NPN Staff visiting the regional locations to assist with program training and implementation, with funding provided by this Project.

There are three other units in Region 3 which were engaged and became active during the Project period who did not respond to the program evaluation call.

Networking and conversation among participants was the most common way to engage people within refuge units in the *Nature's Notebook* Project. Five people reported hearing about the opportunity to

participate in this partnership from a friend or colleague, 3 from a local partner organization, and 3 from participating in a hosted workshop. Four out of 15 respondents were required by a supervisor to participate in this project, two of them were interns. Of the 15 respondents, 9 have participated in an in person training conducted by a USA-NPN Staff member.

Those participating in the survey (15 out of 15) have a clear understanding of how *Nature's Notebook* can help them achieve goals outlined on their personal work statements.

Local Project Planning and Outcomes

In order for refuges and units to be successful, USA-NPN Staff recommend developing not only an implementation plan for using *Nature's Notebook* to answer science and management questions but also a local project plan for engaging people in the use of *Nature's Notebook*. Each of the units were provided with program planning materials either via the website or at in-person trainings. They were encouraged to conduct a needs assessment, to document outcomes, and think about activities which would support the desired outcomes. Those responding to the evaluation were then asked a series of questions to determine if their outcomes had changed over the duration of the Project period. Within the program planning process it was also recommended they develop a local science or management question which *Nature's Notebook* phenology data may help to answer, to produce vested value and further engage local volunteers and staff and process of using *Nature's Notebook*.

Of the 15 respondents, 9 stated that they were interested in using *Nature's Notebook* to both achieve local education/outreach and science/management goals. Four respondents chose to use *Nature's Notebook* specifically for a science or management purpose and two chose to use *Nature's Notebook* specifically for education alone.

Broader desired outcomes included engaging the public in science (5); learning more about the phenology of species of interest (4); gathering baseline data on species at the location (3); collecting and comparing phenology data within a region (2); collecting rigorous data for management; using *Nature's Notebook* for a standardized methodology for phenology data collection; and being able to search phenological records easily.

Nature's Notebook Activities

Some of the activities that respondents implemented to achieve their goals for using *Nature's Notebook* included:

- Conducting weekly monitoring (4)
- Recruiting additional sites to participate in a phenology trail (4)
- Recruiting a volunteer group for their site (3)
- Tracking phenology via *Nature's Notebook* (2)
- Creating a model for obtaining funding for paid staff position to facilitate education and management (2)
- Hosting volunteer trainings (2)

- Collecting data with school groups
- Conducting teacher trainings
- Using visualization tools to demonstrate what data have been collected
- Hosting an educational forum
- Hosting an outreach event
- Hosting volunteer social events
- Developing marketing materials
- Seeking volunteer coordinators

Twelve out of 15 respondents felt as though they have been able to successfully achieve their goals. Only two out of 15 respondents reported that their purpose for using *Nature's Notebook* had changed from when they first began. One stated that it had begun for personal interests in phenology and now has progressed into a much larger effort. The second stated that it started out as a way to engage visitors in climate change but has since changed to become a peaceful experience for volunteers.

Locally available resources

The respondents indicated that having people-power helped them to implement the activities outlined above. Five respondents reported having volunteers willing to collect data, and five reported having refuge staff, and the refuge in general, available to support their work. Two had access to Americorps staff, one reported having volunteers who were actively leading workshops and developing their own tools for engagement, and one reported having local area experts available.

Only 4 out of 15 respondents reported meeting regularly with their volunteers. They define regularly as once a month.

Other resources included having a diverse natural environment (2); iPads and the smartphone app for use in the field (3); how-to binders, documentation about the project and plan available prior to beginning work; access to an educational center; monitoring sites that are easily accessible; regional climate change questions already developed which phenology data can answer; and lots of data already recorded that could be entered into *Nature's Notebook*.

Easiest part of using Nature's Notebook

Many respondents thought, in general, *Nature's Notebook* is easy to use. Six reported the benefits of having the smartphone app to use in the field. Four thought the data entry process was easy, and one thought that having an online data entry process and place to store the data helped to keep the program organized. One person thought the program is well designed and having a computer checklist was helpful. Another thought *Nature's Notebook* is user friendly. One person thought the phenophase definitions were easy to use. And one person reported that *Nature's Notebook* is helpful to getting people outdoors.

Needed resources and barriers to participation

The top two stated resources that are still needed include more volunteers to collect the data (3) and training for staff. Others indicated that they needed funding to continue the intern who was working as a coordinator or simply a volunteer coordinator to step up moving forward. One person indicated that they needed to be more organized on the ground. One person indicated a desire to purchase tablets or iPads for participants to use in the field. FWS Regions, refuges, and funding staff may choose to consider putting resources toward either an externally hired intern or designating someone on staff to make *Nature's Notebook* part of their work statements. The Phase III project evaluation will explore the successful transition from intern to staff, should there be no more funding to continue to support a project coordinator for phenology monitoring via *Nature's Notebook*.

Two people indicated limitations to the *Nature's Notebook* program itself - the ability to record other information about the plants being monitored (growth height of plants - related to management of the invasive species) and the addition of several species to the database which they did not have time to request. When asked about the difficulty of *Nature's Notebook* to implement, 6 respondents reported that it was harder than they thought it would be, although 7 reported that it was not difficult at all. Two reported having no opinion.

Only two people out of 15 reported that the *Nature's Notebook* website is hard to navigate. One person indicated it has a lot of great resources but managing users online is not easy. One person indicated it is also difficult for some to enter observations online, and that having a system that would send Phenology Leaders updates on when volunteers are or are not submitting data would be helpful.

One person out of 15 reported that they had a hard time getting in touch with an NCO staff member when they needed help.

The biggest barriers to using *Nature's Notebook* include:

- Determining the intensity values when making observations (3)
- Knowing what to look for in the phenophase definitions (2)
- Finding time to participate and analyze data (2)
- Difficult to use visualization tools
- Not having all data fields download when info is in the comments
- Manipulating the raw data
- Nurturing beginning volunteers and managing volunteers
- A very involved set up
- Getting started

When asked what was required from the NCO staff to get the monitoring programs off the ground respondents reported the following needs:

- Help developing a program plan (5)
- Help analyzing the data (4)

- Help recruiting volunteers to come to the site (3)
- Help connecting with the science staff at my refuge to provide local value (3)
- More flexible volunteer training materials to help me recruit and train (3)
- Help developing a science or educational objective to justify the use of NN to my Supervisor (3)
- Help identifying other regional NGO or non-profit partners for a trail (3)
- None of the above (3)
- Personal Training on how to use NN (2)
- More user friendly video tutorials on how to use NN and how to get started (1)

Another need described by 9 out of 15 respondents are materials to help organize volunteers to take ownership of the project.

One person stated that it would be helpful to have a mandate from a “higher-up” person (inferred: Refuge manager, Regional manager, Chief) requiring FWS staff to use *Nature’s Notebook*.

Three people said they had all that they needed to continue monitoring.

The information obtained from barriers to participation and needs will be utilized by the NCO staff moving forward to target new materials for development which can be shared beyond the scope of the FWS Partnership.

Outcomes

Project outcomes and impact

The Project provided an opportunity to do a preliminary analysis of phenology monitoring already occurring on the refuges; an opportunity to create, deliver and test educational engagement materials and science and management phenology methodologies; and a series of implementation plans and data summarization materials.

Goal 1. Establish a scientifically credible, standardized methodology for capturing and recording phenological observations on species of interest in select USFWS NWRS Regions.

Stated outcomes	Achieved outcomes/results
Develop standardized protocols, implementation plans, and methodologies	<ul style="list-style-type: none"> - Valle de Oro NWR Implementation Plan - Valle de Oro NWR Monitoring Protocol - Region 3 Implementation Plan - Gulf Coast Program Planning Document
Establish a pilot refuge project utilizing <i>Nature’s Notebook</i>	<ul style="list-style-type: none"> - Valle de Oro NWR - Rio Grande Phenology Trail

Work with additional refuges using <i>Nature's Notebook</i> for phenology and resource management and visitor services (during the scope of this Project)	<ul style="list-style-type: none"> - Midway Atoll NWR - Hakalau NWR - Arctic NWR - Kenai NWR - Don Edwards NWR - Ventura Fish & Wildlife Office - Sevilleta NWR - Upper Mississippi NWR - Minnesota Valley NWR - Sherburne NWR - Prairie Wetlands Learning Center - Grand Bay NWR/NERR - Gulf Coast Phenology Trail - Canaan Valley NWR - St. Marks NWR
Create and maintain online interface for phenology monitoring	<ul style="list-style-type: none"> - fws.usanpn.org
Provide training and resources and maintain regular communications with staff and volunteers	<ul style="list-style-type: none"> - Quarterly newsletter - Webinars for biologists and educators - Workshops for participants - Program planning guidance - Landing page with all available FWS resources

Goal 2. Ensure that phenological monitoring conducted on refuges will be used to inform land management and climate-related management questions at multiple spatial and temporal scales.

Stated outcomes	Achieved outcomes/results	
Identify science and management priorities related to phenology	Arctic NWR	Impact of hot and dry summer season on phenology of local species (aspen, diamondleaf willow)
	Don Edwards NWR	Educating the public about climate change impacts on the refuge
	Valle de Oro NWR	Collect baseline data on species richness and abundance; Timing of native vs. invasive tree seeds; Long-term changes to phenology due to climate

		change and restoration
	Canaan Valley NWR	Comparison of phenology of focal species at refuge to other parts of their range
	Midway Atoll NWR	Timing of invasive <i>Verbesina encelioides</i> fruiting
	Mayfly Watch/Upper Mississippi River NWFR	Timing of mayfly emergence
Develop resources to assist with summarization	- Phenology Report Guide	
Develop methodology and models	<ul style="list-style-type: none"> - Spring Indices on the visualization tool - Plan in place for a refuge-specific analysis focusing on migratory pathways 	

Goal 3. Develop recommendations for how phenological information collected on refuge lands, and surrounding managed lands, can be used to inform management actions and forecast climate change related effects.

Stated outcomes	Achieved outcomes/results
Summarize activity and progress of refuges	<ul style="list-style-type: none"> - 2014-2015 Valle de Oro Phenology Report - One-page summary document on Midway Atoll NWR
Make recommendations for replication of monitoring projects across refuge units	<ul style="list-style-type: none"> - Valle de Oro Pilot Project Summary and Recommendations Document - Two-page overview of recommendations - Guide to downloading and visualizing data

Future recommendations for the USA-NPN and USFWS Partnership for Phenology Monitoring

Feedback from the program evaluation provided clear recommendations for assisting new refuge staff and volunteers interesting in establishing a long-term *Nature's Notebook* monitoring program.

Throughout Phase III's evaluative process the NCO will be able to make further recommendations for sustaining the monitoring programs developed during Phase I & II.

Broadly, the USA-NPN NCO seeks to develop materials for all partners to easily understand the protocols for monitoring, both scientifically and for managing the staff and volunteer citizen scientists. Working

with refuge contacts on the ground enables the NCO team to obtain valuable feedback for developing tools and materials and also helps to make recommendations to new refuge partners about best practices for designing a sustainable and scientifically sound program.

Implementing a *Nature's Notebook* phenology monitoring program makes good business sense. The data are collected and stored in a consistent format, training materials are in place to recruit volunteers (who are a cost saving to the refuge in staff time), and refuges can compare their data to those across the species range both at other refuges and outside of refuges to enhance the understanding of long-term changes in phenological patterns. The most difficult part of beginning a monitoring program involves sometime taking the time to think about a plan for management and engagement and recruiting a few people to assist.

In addition to collecting, storing, and sharing phenology data in a secure location accessible by others, the protocols and methodologies for data collection and quality assurance control have been vetted by experts in the fields of research, management, and education. A common misconception is that using *Nature's Notebook* is difficult to implement and that it will be hard to convert existing data to a new system.

Rather, the NCO has guidance materials and documentation available to make the process of data collection as easy as possible. There is also opportunity to cross-walk existing data collected with external protocols and do bulk uploads (on a case-by-case basis). NCO staff are available to work directly with refuge contacts and partners to ease the transition and provide assistance to make the program a success. They work one-on-one with visitor services and management staff to obtain a clear understanding of local ecosystem management needs and local species of interest such that the monitoring program can be as successful as it can be.

More specifically, the following recommendations emerged from the Project's program evaluation. Moving forward, NCO staff can continue to work with refuge representatives to develop:

- Specific, clear checklists for site-specific implementation of *Nature's Notebook* for education and management
- Training for staff and regional networking with other Local Phenology Leaders to share the training burden. The NCO offers a Local Phenology Leader Certification Program in which **FWS staff are given priority enrollment**. It is recommended that a representative from the refuge or region participate in this program to serve on the ground as a liaison between the refuge and the NCO's FWS Liaison.
- Sustainable program planning models and assistance for refuges and regional phenology trails
- Assistance connecting science staff to visitor services staff within refuges and regions to help provide local science and educational value
- Assistance developing phenology research and management questions based upon local species of interest

- Connections to Friends Groups or other engaged volunteers, via other off-refuge locations in close proximity. These partnerships strengthen the value of the refuge in each community by inviting people to help collect observations or learn about ongoing research. These other Local Phenology Projects can be leveraged by refuges for in-person trainings, resources, and volunteers
- Guidelines for managing and retaining volunteers, including how to create a volunteer engagement schedule
- Phenology report guidelines to track the progress of the phenology monitoring program toward meeting refuge goals
- Examples of how refuges have implemented a phenology monitoring program to meet management and/or outreach objectives
- Assistance and guidance on how to analyze collected phenology data

On their own, refuges and the Refuge System as a whole can and should:

- Determine how phenology monitoring will be used for management and/or outreach purposes, and, to the extent possible, fit into the refuges current scope of work.
- Seek or use existing funding for interns to serve as Phenology Trail Coordinators who would establish regional monitoring programs. If that is not possible, elect a staff person, perhaps in connection with Visitor Services (if available) to manage the project and the volunteers for consistency. The volunteers can be responsible for collecting the observations, but the staff person should manage the monitoring schedule, communication with volunteers, and data quality control. The most effective programs have a dedicated person, either a paid staff or volunteer, who is a Certified Local Phenology Leader.
- Recruit people (staff and volunteers) to own pieces of the program. Create a list of jobs that are required for the program to be successful: data manager, researcher with a management question, volunteer engagement specialist/manager, trail coordinator. The more staff and volunteers share the workload, the more successful the program will be.
- Support directives from regional staff for units to place existing phenology monitoring data into the National Phenology Database.
- Seek partnerships with off-refuge nonprofits and NGOs who can provide environmental education expertise or a regional ecological management framework

Next Steps: Phase III of the Phenology Monitoring for Resource Management Project

Phase III of this Project was proposed to incorporate the next steps realized from this evaluation. The goals for the Project are similar but the desired outcomes are enhanced to provide specific resources to assist refuges with beginning or maintaining a long-term *Nature's Notebook* monitoring program.

Goal 1. Working with additional refuges to utilize *Nature's Notebook*, a scientifically credible and standardized methodology for capturing and recording phenological observations on species of interest.

Desired outcomes:

- Provide guidance on how to begin monitoring with *Nature's Notebook* using the standardized methodology

Tasks:

- Reboot the FWS Phenology Website and *Nature's Notebook* Mobile Application
 - Design refuge-specific web pages with data summaries for the refuge groups
 - Create mobile app enhancements
 - Rewrite guiding text on website for understandability
- Expand existing phenology trail projects, and continue to seek other regional opportunities, ensuring data collection on target species occurs on and off Refuge
- Develop tutorials for visualization tool and make them more visible on the website

Goal 2. Ensure that phenological monitoring conducted on refuges will be used to inform land management and climate related management questions at multiple spatial and temporal scales.

Desired outcomes:

- Develop the Spring indices within the Refuges

Task:

- Replicate the work done by Monahan et al (2016) to analyze how climate change is advancing spring onset in the National Parks for the National Wildlife Refuge System, via USGS contractors

Goal 3. Deliver recommendations for how phenological information collected on refuges, and surrounding managed lands, can be used to inform management actions and forecast climate change related effects.

Desired outcomes:

- Refuges are informed and make decisions using recommendations for phenology monitoring

Tasks

- Make data analysis methodologies more visible on the website
- Make the species request form more visible to FWS partners
- Communicate early successes stemming from FWS and USA-NPN Partnership

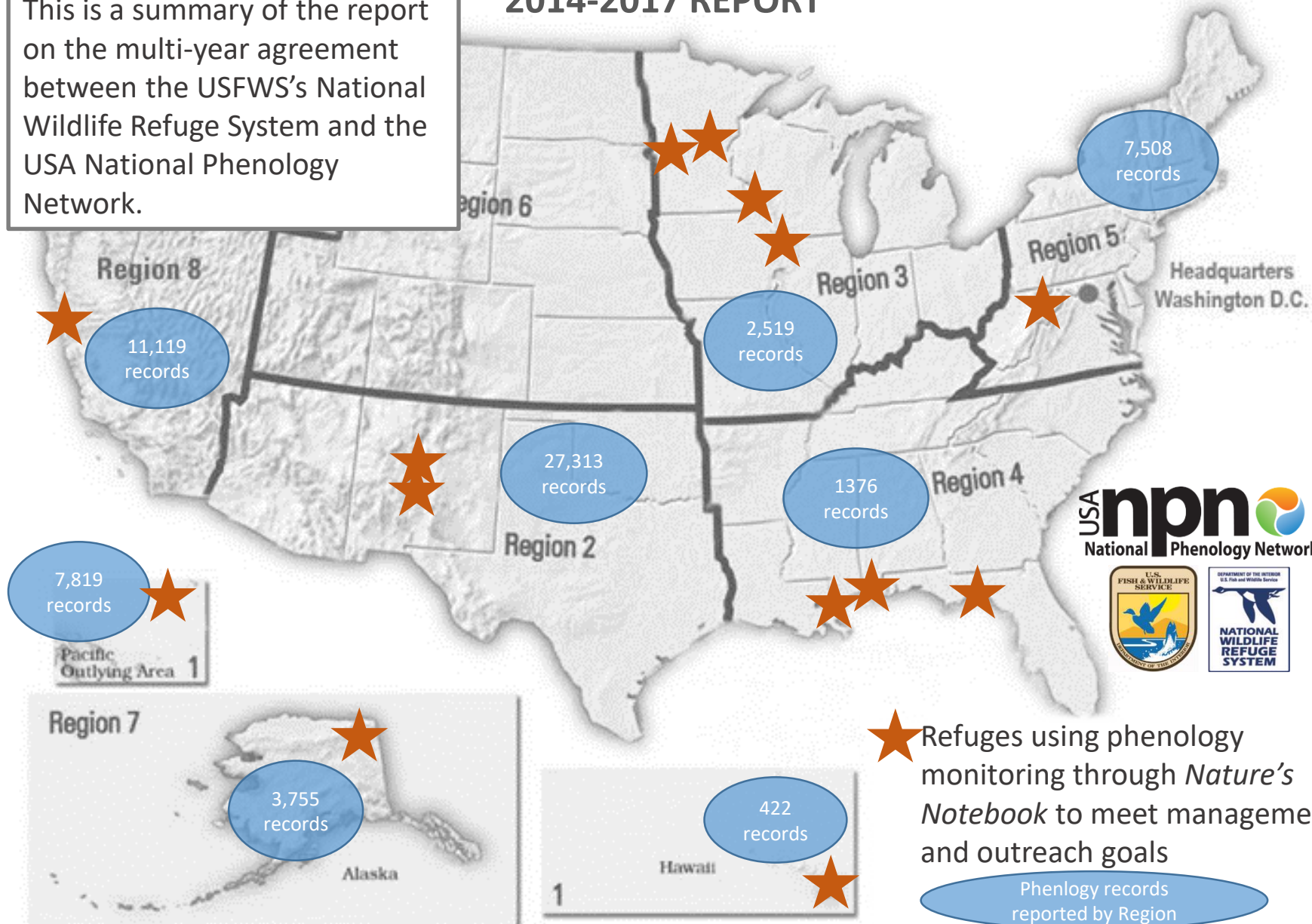
Concluding statement

The Project could not have been successful without seed funding and vision provided by the Chief of the FWS Inventory and Monitoring Program, Jana Newman. Together we seek to develop a rich resource of in-situ phenology data to be used by the refuge system and beyond for a better understanding of how species are responding to environmental and climatic change. We look forward to a continued partnership and enhancing the programmatic work being done by both the FWS NWRS and the USA-NPN in service to science and society.

PHENOLOGY FOR RESOURCE MANAGEMENT AND DECISION MAKING

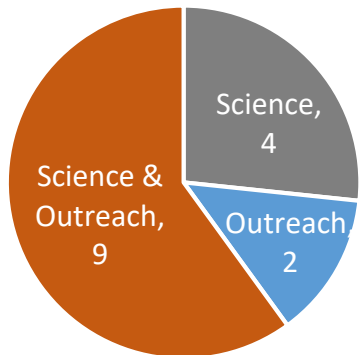
2014-2017 REPORT

This is a summary of the report on the multi-year agreement between the USFWS's National Wildlife Refuge System and the USA National Phenology Network.

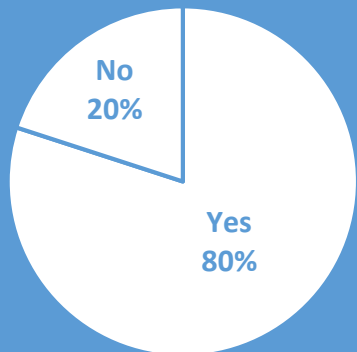


Base Map courtesy of Esri B. Toth (www.tothgraphix.com)

Purpose for using *Nature's Notebook*



NUMBER OF REFUGES MEETING THEIR GOALS

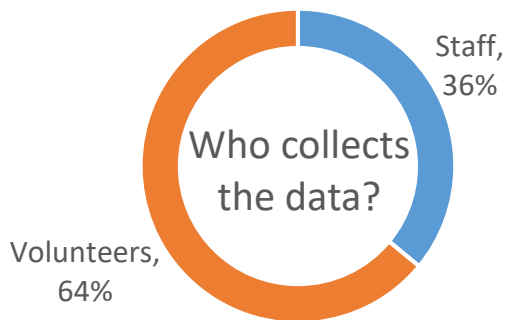


Half of refuges are not using their data because:

- They have not yet collected enough data
- Lack of time or other priorities taking precedence
- Lack of training caused the observations to be inconsistent

DESIRED OUTCOMES FROM USING NATURE'S NOTEBOOK:

- Engage the public in science **5**
- Learn more about the phenology of focal species **4**
- Gather baseline data for impact of long-term changes **3**
- Collect and compare data across a region **2**
- Help people learn to pay attention to nature **2**
- Collect rigorous data for management **2**
- Ensure sustainability of programs despite staff turnover **1**
- Enter existing data into national database **1**



HOW THE DATA ARE USED:

Invasive species management

Baseline data on focal species

Flowering data for pollinators

Informing restoration activities

Presentations for visitors