



Northern Colorado Plateau Network Landbird Monitoring Protocol Science Review

A Summary of Reviewers' Responses and Recommendations



The Western Meadowlark (*Sturnella neglecta*) is a year-round resident of sagebrush shrublands in the Northern Colorado Plateau Network.

NPS / D. KURTZ

Northern Colorado Plateau Network Landbird Monitoring Protocol Science Review: A Summary of Reviewers' Responses and Recommendations

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Abstract

Beginning in 2020, the Northern Colorado Plateau Inventory and Monitoring Network (NCPN) partnered with the Mediterranean Coast Network (MEDN) and seven other National Park Service Inventory and Monitoring networks to review their collective landbird monitoring protocols in an effort titled the “Western Bird Review”. As part of the overall effort, both NCPN and MEDN conducted a detailed science review of their specific landbird monitoring protocols to assess each program’s scientific integrity, management significance to national parks, and opportunities for improved efficiency and collaboration; this report summarizes the NCPN review. Three peer reviewers and three park employees provided feedback on the protocol and science products. In short, the program has excelled. Reviewers were impressed with the longevity, statistical design, rigor, and frequency of reports and publications being generated by the NCPN bird monitoring protocol for parks. Improvements suggested by reviewers noted that only one trend analysis had been conducted across all years that data had been collected and suggested that moving forward, analyses be conducted and results communicated to the parks more often for timely and effective management. Further, reviewers suggested NCPN integrate how climate change might be impacting the effectiveness of the monitoring protocol such as identifying how/if changes in phenology are affecting the surveys, how climate-influenced changing habitats affect a habitat-based sampling approach, and how to address these changes. Questions posed to three park staff indicated that staff were pleased with the bird monitoring and were receiving information that they wouldn’t have obtained otherwise. The data reassured park managers that currently, there were no declining trends to be concerned about and no management issues currently necessitating the direct use of the information for park management.

Terms and Acronyms

Breeding Bird Survey: a cooperative effort between the U.S. Geological Survey and Environment Canada to monitor the status and trends of North American bird populations

I&M: Former acronym for the Inventory and Monitoring Division of the National Park Service

IMD: Inventory and Monitoring Division of the National Park Service

KLMN: Klamath Network

NCPN: Northern Colorado Plateau Network

NOAA: National Oceanic and Atmospheric Administration

NPS: National Park Service

NRR: Natural Resource Report Series published from 2004 to 2024. This series was used to report information and analysis about natural resources on lands managed by the National Park Service.

NRTR: Natural Resource Technical Report Series published from 1996 to 2014. This series was used for reporting the results of studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service mission.

PACN: Pacific Island Network

PI: Principal investigator

RMBO/ RMB: Rocky Mountain Bird Observatory

SCPN: Southern Colorado Plateau Network

SFAN: San Francisco Bay Area Network

USDA: U.S. Department of Agriculture

Executive Summary

A scientific review of the bird monitoring protocol of the Northern Colorado Plateau Network (NCPN) of the National Park Service (NPS) Inventory and Monitoring Division (IMD), was conducted in 2021 as follow-up to a larger, regional bird monitoring review. The initial review, titled the Western Bird Review, encompassed nine NPS IMD networks interested in evaluating the bird monitoring protocols they had been following, some for longer than a decade. During an online symposium all nine networks provided “snapshot” presentations of their monitoring programs and results to reviewers (and interested and invited participants) for an overview of the varying bird monitoring approaches used across the networks and highlighted the successes and challenges each network faced.

Following scientific presentations of the protocol and results ascertained by the nine networks (i.e., snapshots), in-depth scientific protocol reviews were conducted for two of those networks: the Northern Colorado Plateau and Mediterranean Inventory and Monitoring Networks. These were the only two networks that had published at least one peer-reviewed trend report to-date. This review encompassed a detailed review of each protocol by three peer reviewers along with employees from parks where bird surveys are conducted. The reviews focused on assessing: 1) scientific integrity (i.e., scientifically credible and statistically valid analyses and data conclusions); 2) management significance and impact to NPS parks; and 3) opportunities for improved efficiency, and collaboration, both across networks and outside NPS.

This narrative reflects the bird monitoring protocol review for the Northern Colorado Plateau Network.

In general, reviewers and park resource managers were impressed with the longevity, statistical design, rigor and frequency of reports being generated by Northern Colorado Plateau’s bird monitoring protocol. All felt that the stated objectives were indeed being met. Suggestions for improving the monitoring centered less around problems in design and rather focused more on data analysis and distributing additional information to parks in an efficient and effective manner. For example, there were several comments oriented toward more frequent reporting to parks, and some comments about data that are being collected, but currently not analyzed. For instance, it was pointed out that covariates were being collected and yet not used in analyses. Moreover, it was noted that only one trend analysis had been conducted across all years that data had been collected, and that more analyses need to be conducted more often for timely and effective park management response (i.e., detecting trends before too much time has passed, particularly if park management issues arose where data would be useful). A suggestion was made regarding classifying bird species so that analyses could target species of concern more regularly (e.g., habitat-sensitive species) rather than analyzing for all species. Some concerns related to climate change impacts were expressed, specifically issues related to how changes in phenology are affecting the surveys, how changing habitats affect a habitat-based sampling approach, and how to address these changes. Changing phenology and changing habitats will likely affect the spatial and temporal standardization built into the protocol. Responses to a questionnaire provided to three park staff (two natural resource staff and

one superintendent) indicated that parks were pleased with the bird monitoring, and that it was providing information they wouldn't have otherwise received. So far there were no pressing issues in their parks that necessitated the direct use of the information for park management.

Acknowledgments

The NPS Inventory and Monitoring Program is a visionary endeavor that emerged from the Natural Resource Challenge (1998). From conception through implementation, efforts of Mike Soukup, Gary Williams, Abby Miller, and Steve Fancy made this monitoring program a reality, overcoming significant obstacles in establishing an enduring long-term monitoring program that is relevant to resource management in national parks and monuments. Over the years, the committed staff of the Inventory and Monitoring Division have ensured its continued relevance as evidenced by the impact their results have on the management of national park and monument resources nationwide. From coral reefs in the Caribbean to grasslands in the heartland, deserts in the Southwest, rainforests in the Pacific Northwest, and glaciers and caribou in Alaska, Inventory and Monitoring Division scientists bring forth their expertise to help support management decisions that ensure that national parks are managed in perpetuity with the best available science. We acknowledge and applaud those early visionaries as well as the 400+ staff currently tasked with honoring this obligation. Science reviews, such as this one, continue to honor their commitments to excellence and maintain the value of science in guiding resource management decisions.

Introduction

Science reviews are essential components of all science programs. They help ensure scientific integrity through rigorous peer review, allow for periodic adjustments to efforts to ensure that they cohesively integrate new technologies and analytical approaches into work, help hone relevancy to resource management staff that rely on that information, aid in re-evaluating opportunities for collaboration, and broaden input through time as results uncover new and sometimes unanticipated findings.

The periodic scientific review of monitoring protocols is a best-management practice for long-term monitoring programs and is a requirement in the NPS Inventory and Monitoring Division (Mitchell et al. 2018). This science review is designed as a big-picture assessment of the Northern Colorado Plateau Network's bird monitoring protocol's study design, methods, data analysis and interpretation of ongoing bird monitoring data. It intends to identify insights gained from this monitoring program and the effectiveness of its information transfer and use by land management agencies.

This review will critically examine the relevance of the work as a whole and the progress made towards each objective listed in the original protocol (Table 1). Furthermore, this review will identify and assess any constraints on the current program and recommend ways to improve the program's effectiveness.

Table 1. Objectives from Northern Colorado Plateau Landbird Monitoring Protocol. Taken from Daw et al. (2020; <https://irma.nps.gov/DataStore/Reference/Profile/2257072>).

Objective	Description
Objective 1	Determine the status and trends in breeding-bird species density in sagebrush, pinyon-juniper, and riparian habitats.
Objective 2	The sampling objective of this protocol is an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%.

Background

NPS Vital Signs Monitoring Program

The NPS Vital Signs Monitoring Program (Fancy et al. 2009) was designed to understand and communicate the status and trends in key components and indicators of park ecosystems, and their response over time to natural and human induced changes both from within and outside of park boundaries. Parks were grouped into networks based on geography and shared ecosystems. Each network conducted a vital signs selection process to identify key ecosystem elements to monitor as indicators of the overall health or condition of park resources. Numerous networks, including Northern Colorado Plateau, selected landbird communities as a vital sign because of the value of birds as indicators of ecosystem integrity, concerns about their potential population declines, and because of their high public appeal. In 2005, Northern Colorado Plateau partnered with Rocky Mountain Bird Observatory to initiate a habitat-based landbird monitoring program.

Western Birds Review

The NPS Vital Signs Monitoring Program requires regular reviews to ensure that a monitoring protocol or group of related protocols clearly meets the stated objectives and reflects the highest scientific standards, given resource and other limitations (Mitchell et al. 2018). Reviews also provide an opportunity to integrate best available science from long-term ecological monitoring with management. In 2020, many IMD protocols had accumulated enough information to be able to conduct comprehensive trend analyses with which to determine whether the initial objectives of the protocols were met thus, providing information to conduct a protocol review. IMD network program managers Stacey Ostermann-Kelm (Mediterranean Coast Network), Dusty Perkins (Northern Colorado Plateau Network), Daniel George (Pacific West Region), and Michael Bozek, (Intermountain Region) organized the first landbird protocol science review, titled “Western Birds Review,” between nine IMD networks: Northern Colorado Plateau, Mediterranean Coast, Sierra Nevada, Northern Great Plains, Klamath, Southern Colorado, Upper Columbia Basin, North Coast and Cascades, and San Francisco Bay Area.

This review had three overall goals:

1. initiate scientific reviews of individual networks’ landbird monitoring protocols.
2. attempt to look for opportunities to collaborate.
3. attempt to scale-up the monitoring of landbirds across larger geographic areas using NPS IMD protocols. The review process commenced in early 2021 with three key meetings.

“Snapshots” Meeting: February 8 and 11, 2021

During an online symposium (the online version promulgated by the advent of COVID-19-induced lockdowns), all nine network leads provided 20-minute “snapshot” presentations of their landbird monitoring programs including introductions to their monitoring approach, results to date, and successes and challenges each faced. The “snapshot” presentations were followed by a 2-hour multi-network discussion.

Overview of Review Process Pre-meeting: February 25, 2021

Network program managers and reviewers met for one hour prior to the actual Landbird Protocol Review Meeting to discuss the review process and answer any questions reviewers might have about material they were given to review or about the process itself.

One precondition of the in-depth portion of the review process (the first goal) was that each network was required to have a peer-reviewed trend report completed for reviewers to use to base their review on. At the time of the review, only two networks, Northern Colorado Plateau and Mediterranean Coast, had accomplished this.

Landbird Protocol Review Meeting: March 24, 2021

The paired landbird protocol review was conducted for Mediterranean Coast and Northern Colorado Plateau Networks. For NCPN, protocol presentations were given by protocol leads Sam Roberts and Greg Shriver that led to discussions and refinement of outstanding questions by reviewers regarding the bird monitoring protocol. Discussions centered around evaluating:

1. Monitoring Objectives – evaluation of their relevance, feasibility, and clarity
2. Sampling Design – Are data representative of the target populations and sufficient for meeting monitoring objectives?
3. Field Methods and Metrics – Are the bird detection methods still best for meeting the objectives and for the cost? Are all relevant covariate data collected or available?
4. Data Analysis Methods – Are the analytical approaches appropriate for the trend analysis and for the objectives?
5. Annual Reporting – recommendations to improve the annual reports
6. Linking Monitoring Activities to management needs
7. Boundary-spanning Opportunities – Can data be combined with other networks?
8. Summary of Key Recommendations

Final Written Review Submission

Following the “snapshot” and landbird protocol review meeting presentations and discussions and review of the reports and publications, reviewers (Linnea Hall, Matt Marshall, and Matthew Johnson) provided their written reviews.

The remainder of this document focuses on the Northern Colorado Plateau landbird monitoring protocol science review including summaries (narrative) of the reviews with the complete unedited responses attached in Appendix B.

Northern Colorado Plateau Bird Monitoring Protocol Science Review

Summaries of reviewers' comments, conclusions, and recommendations are provided by Michael Bozek, Inventory and Monitoring Program Manager, Intermountain Region, NPS.

Landbird Monitoring Protocol Leads

Sam Roberts, Research Associate, University of Delaware, Department of Entomology and Wildlife Ecology, Newark, DE

Greg Shriver, Professor of Wildlife Ecology, University of Delaware, Department of Entomology and Wildlife Ecology, Newark, DE

Protocol Reviewers

Three experts from outside the Northern Colorado Plateau Network were recruited to participate in the landbird protocol review and provide their findings. In the following section, the reviewers' specific responses to each question are provided in indented italic text that follows their names.

Linnea Hall, Executive Director and Avian Conservation Biologist, Western Foundation of Vertebrate Zoology, Camarillo, CA

Matthew Marshall, Network Program Manager, Eastern Rivers and Mountains Network, National Park Service, University Park, PA

Matthew Johnson, Network Program Manager, Southern Colorado Plateau Network, Flagstaff, AZ

Park Management Reviewers

Two NCPN park natural resource management team leaders and one park superintendent were selected to anonymously respond to park management questions related to the landbird monitoring program.

Background Material

Reviewers received the following documents to provide review and background material in addition to the "snapshot" presentations of each protocol they viewed:

Daw, S., M. Beer, and S.L. Garman. 2020. Landbird monitoring protocol narrative for park units in the Northern Colorado Plateau Network: Version 1.0. Natural Resource Report NPS/NCPN/NRR-2020/2119. National Park Service, Fort Collins, Colorado.

Fancy, S.G., J.E. Gross, and S.L. Carter. 2009. Monitoring the condition of natural resources in US national parks. *Environmental Monitoring and Assessment* 151: 161–174.

- Mitchell, B., A. Chung-MacCoubrey, J. Comiskey, L. Garrett, M. MacCluskie, B. Moore, T. Philippi, G. Sanders and J.P. Schmit. 2018. Inventory and Monitoring Division protocol review guidance. Natural Resource Report NPS/NRSS/IMD/NRR—2018/1644. National Park Service, Fort Collins, Colorado.
- National Park Service. 2012. Guidance for designing an integrated monitoring program. Natural Resource Report NPS/NRSS/NRR-545. National Park Service, Fort Collins, Colorado.
- Northern Colorado Plateau Network. 2016. Training Observers. Standard Operating Procedure (SOP) #2. Landbird Monitoring Protocol for Park Units in the Northern Colorado Plateau Network. Version 1.01.
- Northern Colorado Plateau Network. 2020. Standard Operating Procedure (SOP) #4. Establishing and Marking Sampling Plots. Landbird Monitoring Protocol for Park Units in the Northern Colorado Plateau Network. Version 1.03.
- Northern Colorado Plateau Network. 2020. Conducting the Survey. Standard Operating Procedure (SOP) #5. Landbird Monitoring Protocol for Park Units in the Northern Colorado Plateau Network. Version 2.00.
- Northern Colorado Plateau Network. 2020. Documenting Habitat Variables. Standard Operating Procedure (SOP) #6. Landbird Monitoring Protocol for Park Units in the Northern Colorado Plateau Network. Version 2.00.
- Oakley, K.L., L.P. Thomas, and S.G. Fancy. 2003. Monitoring protocol guidelines Wildlife Society Bulletin 31: 1000–1003.
- Roberts, S., E. Tymkiw, Z.S. Ladin, and G. Shriver. 2020. Status and trends of landbird populations in the northern Colorado Plateau Network: 2019 field season. Natural Resource Report NPS/NCPN/NRR-2020/2071. National Park Service, Fort Collins, Colorado.

Current Protocol Objective and Rationale

Objective 1: Determine the status and trends in breeding-bird species density in sagebrush, pinyon-juniper, and riparian habitats.

Objective 2: The sampling objective of this protocol is an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%.

Rationale: “NCPN’s collaboration with MCB” (Monitoring Colorado Birds (MCB), currently Bird Conservancy of the Rockies) was intended to provide access to regional trends, as well as trend information based solely on locations in park units. Thus, the unit of analysis for this objective is both the regional scale and the sites within NCPN park units (Daw et al. 2020).

Review Questions

A set of questions was sent to the peer reviewers and a separate, more management-oriented set of questions was sent to resource management team leads and superintendents of parks within the Northern Colorado Plateau Network.

Protocol Review Questions

The questions below were designed to assess:

1. scientific integrity of the monitoring design and statistical rigor,
2. opportunities to scale up the analyses with proximal or regional efforts,
3. detectability of the effects of changing climate and other covariates,
4. effects of funding cuts or opportunity focus for potential funding increases, and
5. the validity of conclusions drawn.

Reviewers were asked to respond to the following 16 questions.

1. Are the objectives for the monitoring program still clear, relevant, and achievable? Have they been answered in reporting and papers?
2. Are the basic bird detection methods still the best for objectives in the protocol and for the cost? Are there alternative measures to consider? If there are new methods, these new methods would need to be cost-effective, and a transition period and data transition approach would need to be discussed.
3. Does the bird monitoring survey design ensure that data are representative of the target populations and sufficient to allow defensible conclusions to be derived about the resources of interest?
4. Are the analytical approaches appropriate for the trend analysis and for the objectives? How has the PI ensured that they are capitalizing on the most relevant statistical methods?
5. Are there any recommended changes to procedures that would enhance the overall quality and usefulness of the data being gathered?
6. Can these data be combined with any other networks in this review; what are the obstacles to larger scale analyses?
7. Is there an advantage to merging approaches at this point? What would they be and how might we achieve that without losing what we've already done?
8. Are all appropriate covariate data being collected? Are the covariate data currently collected being used in analyses?
9. Are the conclusions drawn by major findings appropriate?
10. If we had just a little bit more (\$10,000), how would we change the bird monitoring program? If we had a little bit less, how would we change?

11. How does a changing climate affect the design of the monitoring programs (timing, vegetation changes to target population)?
12. Does the current monitoring program help address climate change effects on birds? Can the current design statistically address climate related changes?
13. Have the results been made available in NRTR annual reports and/or peer reviewed scientific publications? Are there suggestions on how to improve the annual reports?
14. Is the balance of publications between peer-reviewed journals and NRR reports appropriate to scientific findings and implications to management?
15. Are there collaborations the network could take advantage of to share data and findings?
16. Room for individual network questions or concerns.

Park Resource Management Questions

The following management questions addressing the application and value of NCPN's bird monitoring program were sent to one superintendent and two resource team leads.

1. How have you used bird data for management decisions or public education?
2. What do you wish the bird data could provide but does not?
3. What has been the biggest benefit of having a bird monitoring program?
4. What do you feel is the biggest value of the bird monitoring program?
5. Do you get products from the network about the bird monitoring program that are satisfactory to your needs?
6. Other comments.

Summarized Review Responses

The following are the *summarized* review responses received from Linnea Hall, Matt Marshall, and Matthew Johnson, regarding the Northern Colorado Plateau bird monitoring protocol. In the narrative that follows, summarizations of reviewer comments are presented first, followed by portions of reviewers' specific answers in italicized, indented text. The full actual responses can be found in Appendix B.

General Comments

Reviewer Comment Synthesis

Reviewers were impressed with, and complimentary toward, the longevity of the bird monitoring conducted by the Northern Colorado Plateau Network, the large number of reports generated by the network, and the professionalism in analysis and reporting.

Following are the reviewers' overall general comments on the Northern Colorado Plateau bird monitoring program.

Linnea Hall

"Bird monitoring is not easy work, and is very long-term, and so commitments of >10 years are especially laudable. Your program should be commended on continuing this project so faithfully, and on producing a trend report in 2020 that provides meaningful information on the status of many breeding bird species in the Parks that compose the NCPN."

Matthew Marshall

"I was particularly impressed with the continuity of program implementation and data collection over the 15-year period with essentially no major changes to the design or methods. And only one small gap in data collection. The reporting has been impressive as well with a long list of Annual Reports that include species specific trend estimates incorporating the most recent data. The field methods are traditional and sound. And analyses thus far take into account detection probabilities and an important detection covariate (distance from observer)."

Matthew Marshall also commented on areas for potential improvement:

1. *"Evaluate the extensive suite of additional data being collected particularly the habitat data. It seems like a non-trivial effort to train, collect, and manage this info and little has been done with it;*
2. *Evaluate additional analysis approaches besides a singular focus on Distance methods. The largest area of improvement may come from including all years of data in a common analysis as opposed to estimating density one year at a time; and*
3. *Take some time to critically evaluate if you're learning what you want to be learning about the most important species moving forward (now that a 15-year foundation has been established)."*

On the other hand, Matthew Marshall raised an issue about noting which species were noted in reports, and why:

“I don’t think I ever learned which species are most abundant in each habitat or each park. Or which might be priorities for conservation or management or else. If any park managers or other stakeholders are not ‘bird people’ they might be missing the big picture. Update: I do see some of this in the water balance manuscript. This may have been covered in prior reports that I did not look at but I feel like more could be done to call out which are the most abundant species in each park and habitat. Which are of regional conservation status. What have [we] learned about the most iconic species (e.g., Sage Thrasher, Sagebrush Sparrow). Bottom line: What species do we really care about and why? And what have we learned about them (rather than just focusing on the species for which we have the most data which is in essence putting the cart before the horse).”

Matthew Johnson

No general comments.

Question 1: Objectives

Are the objectives for the monitoring program (see below) still clear, relevant, and achievable? Have they been answered in reporting and papers?

Objective 1: The objective of this protocol is to determine the status and trends in breeding-bird species density in sagebrush, pinyon-juniper, and riparian habitats.

Objective 2: The sampling objective of this protocol is an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%.

Summary of Responses

Reviewers varied in their responses regarding whether specific objectives were being met relative to clarity, relevancy, and achievability. Overall, reviewers felt that the objectives outlined were clear, but raised some questions about relevancy and achievability. Per relevancy, one reviewer inquired about the need to shorten the analysis window from 30-year to 5-year intervals to make the information more relevant to management decisions (i.e., huge changes could occur in 30 years and never be discovered in the analysis time frame) while another reviewer questioned the value of the habitat-based approach being used versus a more generalized, non-habitat based monitoring approach. Per achievability, several reviewers pointed out that not all species were able to have trend analyses generated for them; only 63 of 173 species detected had trends analyzed but did not comment further on the fact that 63 species was substantive. Moreover, concerns were expressed regarding power to detect trends.

On Clarity

Linnea Hall stated that *“These objectives together are clear and relevant...”*

On Relevancy

Linnea Hall felt that the objectives, while still technically being relevant, were likely too long-term to be functionally meaningful to resource managers. She suggested reducing the trend detection time frame from a 30-year interval to a 5-year interval to address this; otherwise, any management actions could not be taken in a reasonable amount of time to be effective to stem any declines that might occur in that longer time period.

On Achievability

Linnea Hall could not assess achievability as she saw “*no specific comments made regarding achievability, nor regarding them being answered in reports and papers.*”

On Achievability and Relevancy

Matthew Marshall expressed concerns about achievability and relevancy. Based on the 2020 trend report, he states that in only 63 species could trends be detected, whereas 110 could not.

Specific Responses

Matthew Marshall

“If we take the statistical sampling objective at face value it does not seem achievable for most species based on the analyses done to date.

Based on 2020 report, it looks like 173 species have been detected and trends could be estimated for 63 [species] in at least one habitat (so trends could NOT be estimated for 110 species in any habitat). I know many of the 173 are incidental and don’t regularly breed in these habitats. I also know that the vast majority of detections are probably for these 63 species. But the point remains that we have trouble estimating trends for many if not most species. Especially rare species. This is an issue for all our bird monitoring protocols. It is impossible to build a design that is optimal for all species. But is NCPN learning what it needs to be learning about the species it cares about most?

Significant trends could be detected for 21 species (presentation: down to 11 species with significant trends after most recent data included). Are the remaining populations really ‘stable’ or are you unable to detect trends that may be occurring (a statistical power issue)? Some combination of both most likely which brings us back to the original objective...

The protocol leads mentioned a ‘power analysis’ several times during the review. This is not a bad idea, but it is likely to show little more than ‘we have high power for the 11 species with significant trends and low power for all the others.’ So, it’s circular and we don’t learn much that is new or helpful. The power analysis could be more informative if it also explores how much additional sampling would be needed to detect meaningful trends for additional species. And if the NCPN is willing to consider design changes and/or adding additional transects in order to try and achieve better statistical power for some clearly defined species. Or if we really need to just wait the full 30 years to detect trends for a few more species.

I am not sure how much more time to spend on this. As I said, at face value the objective is not being met for most species. Does that invalidate the program? I don't think so. Additional or different analyses may help. More years of monitoring will also help (the objective is based on 30 years so we could just wait another 15 years to assess). And perhaps that is good enough. But it is important to take a step back and assess the overall program and information gained.

The discussions during the review started to go down the path of revisiting the purpose and objectives which I think is healthy. As a reviewer I am not advocating that a change is needed. But an open, honest discussion about what we've learned so far and is this 'worth it' should happen."

Matthew Johnson

Program objectives are clear and appear achievable; however, power analysis has not been conducted to determine if existing methods have an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%. Population density trends were presented in a NPS report and their correlation with site characteristics (water deficit) have been explored. The objective of monitoring status and trends in riparian, pinyon-juniper, and sagebrush habitats across the NCPN could be more relevant to management by examining spatial variation in population trends (i.e., estimate or control for spatial variation across NCPN when producing density estimates). It also would be nice to see population density modeled with habitat as a predictor variable to compare trends among habitats.

Question 2: Detection

Are the basic bird detection methods still the best for objectives in the protocol and for the cost? Are there alternative measures to consider? If there are new methods, these new methods would need to be cost-effective, and a transition period and data transition approach would need to be discussed.

Summary of Responses

All three reviewers felt that detection methods were reasonable given the objectives, and all three offered minor ideas for improvements while asking a series of questions to address. One reviewer asked if a power analysis had been conducted given that only one survey per season is conducted and, if so, what those results looked like. It was noted that trends for 63 of 173 species could be evaluated for at least one habitat, and given that trends could not be evaluated for the others, questioned if the network and parks had evaluated whether the species they were getting trends on were the species of interest. In short, were the data targeting the species of most concern to parks? One reviewer felt additional power analyses using current data could offer insight into the value of current monitoring methods moving forward. One reviewer felt that a more broad-based design could speak to bird trends across habitats rather than within habitats (which is not the objective of the original habitat-based protocol) and suggested applying Bayesian techniques to elucidate more details from the analyses.

Specific Responses

Linnea Hall

“Overall I found the methodology used for this program (point counts) to be very useful, and other positive design elements include: approximately 650 points counted per year and consistently by only a few experienced observers; the establishment of point-transects in three vegetation types; the collection of simple, descriptive vegetative data each year; and a really good protocol for including/excluding ‘flyovers’ in a count.

However, I did also note a few issues with how the point counts are conducted that I think need some review. Specifically:

- 1. The habitat data should not be collected when first arriving to a point. The birds should be counted first to minimize behavioral impacts to birds.*
- 2. Counting for 5 hours after sunrise in the southwest for passerines is a long time, especially if counts are conducted into late May or early June, and especially as climate warming is expected to increase. I would recommend only counting for 4 hours after dawn; this is more standard practice for the west.*
- 3. The ‘transect count’ for rare birds between points in an interesting methodology, especially since none of the ‘transect’ data have been analyzed to date, and according to your team there are only ever about 10 detections of such birds per survey. I would recommend dropping this and I would suggest that the counts be executed first to get them finished within 4 hours of dawn, and then on the way back rare /new species can be detected. The priority for these counts needs to be the breeding species as opposed to detecting rare/new species.*
- 4. Although consistent observers have been used to date, I think a standardized description of the qualifications needed by observers is needed in the protocol. Specifically, how much experience they need to have with vocalization identification, distance estimation, etc. Also, distance estimation should be re-calibrated among all observers before counts each season.*
- 5. I really liked that 2 surveys were conducted from 2005–2013 but see that only 1 survey of each point was conducted annually thereafter, based on funding. Also, only ~75% of all points are counted per season, so I wonder how these different points are selected each year -- is it random?*
- 6. I wonder if a power analysis has been conducted to determine if there are enough records to analyze well with only one count per season? The Channel Islands landbird program also counts points only once per season, and I strongly feel it is a flaw in the methodology unless we can add a lot more points. In general, Ralph et al (1995) recommends 3 counts per point optimally, so dropping down to only 1 count/point is fraught with potential for anomalous weather, etc, greatly influencing a day’s count.”*

Matthew Marshall

- 1. “Two distance methods: Transects and point-transects.*

2. *Basic methods seem sound and appropriate. But likely room to streamline if desired.*
3. *From presentation: 2–3 observers per year try to get it all done. Very efficient and likely very cost effective for the information gained.*
4. *Double counting individuals. Protocol says you should count the same bird on multiple points if it hasn't moved location (e.g., meadowlark on powerline). This does not seem appropriate. However do not double count a flying raptor. This does. 2020 report seems to address this issue by limiting detections to <125 m.*
5. *SOP 5 page 8 refers to a six-minute count?*
6. *Confusion over 4 letter codes while in the field is real. Do you provide a cheat sheet?*
7. *Have you ever used the subspecies or any of the 45 UNBI [unidentified bird] categories? Is it worth collecting?*
8. *I see you upgrade to 'S' for birds that sing after they were first detected by other means. Have you ever used this (or just 'S' detections)?*
9. *Have you ever used the 'Sex' code for any analyses?*
10. *Have you ever done anything with the squirrel data?*
11. *Have you ever done anything with the '88' species data? What does '88' refer to?*
12. *Have you ever done anything with habitat covariates? Veg or prairie dog? Number of snags?*
13. *Surprising number of plant species your techs are expected to know. Problems with this?"*

Matthew Johnson

"Field methods are suitable for objectives. It is possible that extreme variation in density estimates between consecutive years could be ameliorated by sampling additional areas. Increased sampling effort would not be cost-effective. It is worth exploring whether alternative modeling approaches (Bayesian hierarchical framework) may refine density estimates. It also is worth considering whether a shift from habitat- to space-based monitoring might increase accuracy and precision of network-wide species density estimates and facilitate combining datasets across networks. Shifting to a space-based method may not be cost neutral or may result in reduced sampling in specific habitat categories."

Question 3: Study Design

Does the bird monitoring survey design ensure that data are representative of the target populations and sufficient to allow defensible conclusions to be derived about the resources of interest?

Summary of Responses

Reviewers felt that the design is adequate for the within-habitat objectives of the protocol with minor caveats. One reviewer suggested conducting additional power analyses addressing whether 15 transects per veg type would be adequate and another to see if park-wide inferences could be made. Another reviewer was concerned about surveys that excluded slopes over 50% and how this criterion

affected overall inferences derived from the surveys. And the third reviewer again talked about the value of park-wide versus habitat wide inferences.

Linnea Hall recommended that a new power analysis be conducted to project forward if the current sampling is still satisfactory to detect trends with 15 transects per veg type, and another power analysis to ascertain how many points would be needed to make parkwide inference about trends in bird populations.

Linnea Hall also suggested that perhaps additional metrics be collected (e.g., nesting success, parasitism) as part of a larger adaptive bird monitoring program.

Matthew Marshall was interested in more information regarding the comprehensiveness of the habitats being sampled given that slopes over 50% were excluded and whether that provides an adequate indexing of each habitat. Moreover, he asked if the current sampling is providing enough information for the birds of most interest to the parks.

Matthew Johnson reiterated his interest in seeing a broader, space-based sampling approach rather than a habitat-based approach.

Specific Responses

Linnea Hall

*“Following from above, a new power analysis is definitely warranted now that there is 14+ years of data collected, to see if the current sampling design will continue to be adequate for sampling the target populations. In addition, although pooling count data across individual parks to arrive at 15 ‘point transects’ per vegetation type can be useful for assessing broad trends, this design does not allow for determination of species trends **within parks**, and very significant declines may be missed with long-term consequences. Thus, I recommend that a power analysis needs to be conducted to determine how many points are needed **within each park** to determine more fine-scaled trends, as well as to determine if the 15 transects per veg type is still sufficient for detecting broad-scaled patterns for species.*

On a separate subject, there are other types of monitoring data that can be collected on species and should be considered, such as nesting success and parasitism rates. I suggest below that such monitoring is also a necessary part of a comprehensive and adaptive bird monitoring program and should be considered for the NCPN as well.”

Matthew Marshall

“In general, yes, the survey design seems appropriate. While I don’t think it invalidates the current design it is likely frustrating that the larger, regional, monitoring effort through RMBO never materialized in the way the early authors of the protocol envisioned.

Would be nice to see a map and summary information on available versus realized target areas/habitats. How much of each habitat is available in each park? How much was removed due to the >50% slope criterion? How much of the remaining was selected for sampling?

Can you make summary statements about sampling intensity ('one transect per X square km of PJ at Dinosaur', etc.)?

What are some of the priority species either because they are abundant, rare, conservation concern, iconic? This could help focus the actual target population now that data have been collected and we have a better feel for what species occur. Is the program meeting your needs for the species you really care about?"

Matthew Johnson

"The survey design is generally fine but see response #4. Monitoring population trends using a space-based approach might increase some species' detection probabilities and provide greater analytical opportunities, versus habitat-based approach. Space-based monitoring, coupled with existing remotely sensed environmental data, would increase the program's scope of inference and opportunity to contribute to understanding bird ecology across habitat types."

Question 4: Appropriateness of Analytical Approaches

Are the analytical approaches appropriate for the trend analysis and for the objectives? How has the PI ensured that they are capitalizing on the most relevant statistical methods?

Summary of Responses

All reviewers thought the analytical approaches were suitable for the data being collected. Each offered additional ideas for further analyses. One reviewer suggested adding a hierarchical distance approach; one suggested using observer as a covariate and reducing sampling distance to 100 m and to try using them as point counts, while the third side-stepped the question focusing on space-based monitoring rather than habitat-based.

Linnea Hall suggested that analyses be conducted more frequently and suggested using a hierarchical distance modelling approach, rather than just the currently used DISTANCE approach. Linnea also suggested conducting analyses for individual parks, even if sample sizes were low.

Matthew Marshall complimented the large number of trend reports generated by the NCPN bird monitoring program. He also made suggestions to have NCPN use observer as a covariate in analyses reducing distance sampling to 100 m and using the data as point counts in addition to distance sampling approaches.

Matthew Johnson, still orienting to his space-based approach, didn't address the question directly but rather talked about the view that space-based monitoring is more meaningful to him.

Specific Responses

Linnea Hall

"The 2020 report on the 2019 breeding season included trend analyses using program DISTANCE. These analyses were useful for determining trends, and very informative for future management actions for many species. However, I suggest that such analyses should

be conducted much more frequently, and recommend every 3–5 years at the longest, if not annually. With climate change we are going to need to get annual feedback from our monitoring efforts to have the most adaptive responses to severe declines in species' numbers or shifts in their distributions.

In addition, Andy Royle has recommended to the Channel Island landbird program that we utilize hierarchical distance analyses rather than DISTANCE analyses sensu Buckland et al. (1993) because they are more flexible and allow one to analyses [analyze] multiple species at a time, for example. It seems like it would be best if all of the networks use the same analyses.

Lastly, to reiterate a suggestion above, I think that analyses should be conducted for each park within the network, even if there are low sample sizes for species, to look for steep declines. These analyses could even be simple regression lines showing changes in relative abundance indices each year."

Matthew Marshall

1. *"Overall, the PIs have done an excellent job keeping on top of analyses and conducting trend analyses in a timely manner after each new year of data collection is complete. Can't emphasize how great this is and the list of annual reports on the NCPN website is impressive.*
2. *The methods and analyses have been very explicit about incorporating 'distance from observer' which is clearly an important detection covariate.*
3. *However, distance from observer is likely not the only important detection covariate and I had trouble determining to what extent other analyses have been explored. I did see mention of including 'Observer' as a covariate somewhere...*
4. *The data are amenable to many other forms of analysis and don't have to include distance. The PIs already truncate the data at 125 m, so why not truncate at 100 m and treat them like regular point counts and explore other analysis methods? When it comes to point count data and analysis options, the sky is the limit!*
5. *I am also increasingly an advocate of exploring trends using the raw or unadjusted count data. We have to accept certain assumptions to do this, but we also have to accept certain assumptions when we rely exclusively on modeled/adjusted estimates. The greatest benefit of using unadjusted data is that we can explore what is happening for ALL species (instead of just the most abundant species).*
6. *There are potentially large benefits to analyzing all the data simultaneously rather than the current approach of trying to estimate density for each year independently. I know the PIs know this but it should be mentioned here regardless. My hunch is that this could be the single biggest opportunity to enable trend estimation for more species. It was for the ERMN [Eastern Rivers and Mountains Inventory and Monitoring Network]."*

Matthew Johnson

“A single density estimate per species/habitat across >100,000 km² does not provide extremely useful network-wide or park-specific population monitoring. Density likely varies within a habitat type. Additional analyses, data or both are needed to detect and interpret density changes across the network and habitats. The Bayesian hierarchical framework approach seems promising. It is not clear whether statistical methods accounted for unequal sampling over time.”

Question 5: Recommended Changes to Sampling

Are there any recommended changes to procedures that would enhance the overall quality and usefulness of the data being gathered?

Summary of Responses

All reviewers like the sampling. Only minor suggestions were offered. One reviewer suggested incorporating vegetation data as a covariate (as was mentioned by another reviewer elsewhere in their responses), while another suggested trying Bayesian approaches as a better analytical approach.

Linnea Hall reiterated her comment regarding more frequent analysis. She acknowledged vegetation data/habitat being incorporated (as did Matthew Marshall and Matthew Johnson), but she felt that it might not be worth the time given other priorities.

Matthew Johnson further indicated that Bayesian approaches might be helpful in habitat-based modelling.

Specific Responses

Linnea Hall

“As mentioned above, I think that the count data should be analyzed more frequently.

In addition, although upland vegetation descriptions are collected each year, they have not been analyzed. Thus, although it would be relatively simple to analyze changes in bird densities over time in association with some/most of these variables, I think that realistically, given the availability of GIS mapping layers, it seems like the time spent on these measurements would be better spent on other work, such as a second count or demographic studies in alternating years, etc. Other analyses that should be conducted regularly are those of the temperature data collected during counts vs bird density data within parks (as well as across them to look for broad-scaled trends) to assess local climate change impacts/relationships.”

Matthew Marshall

“Not that I would suggest now. There may be changes that make sense, but it should be based on the analysis of data collected to date. For example, all the covariate data on vegetation.”

Matthew Johnson

“Population density modeled with habitat and park as predictor variables to compare trends among habitats and inform site-specific management (Bayesian hierarchical framework?). See responses #1-2, 4. It is worth considering whether a shift from habitat to space-based monitoring might increase accuracy and precision of network-wide species density estimates and facilitate combining datasets across networks. Shifting to a space-based method may not be cost neutral or may result in reduced sampling within specific habitat categories.”

Question 6: Possibility of Combining Data with Other Networks

Can these data be combined with any other networks in this review; what are the obstacles to larger scale analyses?

Summary of Responses

Reviewers were varied in their responses. One reviewer acknowledged the value of larger-scale work but cautioned against losing insights garnered about the more local scale. Another reviewer suggested combining data from NCPN with Southern Colorado Plateau Network (SCPN) and Klamath Network (KLMN) which have similar protocols.

Linnea Hall conceptually understood the desire to do larger-scale analyses, but cautioned about not masking local effects.

Matthew Marshall was not sure.

Matthew Johnson saw value in combining data across larger areas and contrasted space-based sampling with habitat-based sampling. He suggested first perhaps combining NCPN, SCPN, and KLMN since they use similar habitat-based approaches and conducting analyses on those.

Specific Responses

Linnea Hall

“I understand the desire for large-scaled analyses, but I think that these could mask more significant declines at smaller scales. We could certainly pool data for the ‘southwest’ or ‘western’ regions to see what the analyses show, but I wonder if the variation wouldn’t make interpretations difficult.”

Matthew Marshall

“Not sure yet. Too early in the review process for other networks to know. But an obvious limitation is that sampling is limited to specific habitat types. SCPN seems like a potential match but not sure about extent of PJ [Pinyon Juniper] and Sage [habitat types] across other networks.”

Matthew Johnson

“KLMN, NCPN and SCPN are habitat-based monitoring programs. A first step might be to combine these datasets (in whole or part) to examine temporal trends. Most other programs used point counts of sufficiently similar length (and methods) that datasets may be culled or

restructured to permit across-network analyses. Habitat based protocols may be a limiting factor when combining datasets across networks as birds are likely monitored in a broader range of habitats in other networks and non-habitat methods may lack adequate sampling in all habitat categories monitored in KLMN, NCPN, SCPN. During the 'snapshot' presentations, I recalled thinking it is unfortunate [San Francisco Bay Area] (SFAN) restricts monitoring to streamside habitats. SFAN noted they monitor in riparian habitats, but I cannot recall if they monitor all riparian habitat or merely streamside habitats. Although riparian zones support diverse bird communities, SFAN's program does not monitor bird trends across the landscape and the data will be limiting when combined with other networks.

Question 7: Assessing Value in Merging Data

Is there an advantage to merging approaches at this point? What would they be and how might we achieve that without losing what we've already done?

Summary of Responses

Only one reviewer made suggestions on this question pointing out that breeding phenology and range changes could be elucidated by merging data with other programs, although no reviewer was eager to promote that.

Linnea Hall questioned whether pooling of data would be worthwhile and deferred to spending time on management actions that could directly help species.

Matthew Marshall felt this question was beyond the scope of the review.

Matthew Johnson felt there could be a great benefit to merge approaches so that larger-scale inferences could be made. He noted that modifications to some designs would be necessary to accomplish that. He also acknowledged that financial and logistical constraints could make this difficult in some cases.

Specific Responses

Linnea Hall

"I am not sure that there is an advantage to pooling, but if there is significant interest among others I think it would be fine to try it. However, I am not a big fan of doing analyses (or publications, see below) when we are losing species, and climate change impacts have only just begun to be felt... I would rather see more effort go into on-the-ground management actions to help species."

Matthew Marshall

"I think this one is beyond the scope of review for now."

Matthew Johnson

"Documented shifts in breeding phenology and range may necessitate merging approaches to adequately monitor populations during this period of climate change. I&M [IMD]"

monitoring programs provide an existing network of opportunity to document and interpret numerical and spatial population change across the Pacific and Intermountain regions. Consolidated monitoring across the landscape can provide context to observed population changes in networks and parks while elucidating patterns of change across regions. Documenting range and habitat shifts and species turnover within park bird communities will inform ongoing climate change adaption discussions (e.g., natural versus facilitated community transitions).

Although not a simple or consistent process across networks, existing protocols can be modified to enable networks to combine datasets for analyses. Protocol modification may reduce some relatively small-scale inference ability within parks while estimating trends at larger scales. Species of conservation concern may require species-specific monitoring efforts (e.g., Pacific Island [PACN] monitoring program) and unique habitats also may require network-level monitoring above and beyond merged protocols developed for larger scale analyses. Financial and logistic constraints will no doubt lead to something falling off the monitoring plate in each network while merging protocols, but we will never lose what has been done. Results from analyses of existing data can be used to balance network- and park-specific monitoring needs when modifying protocols toward larger scale analyses. Merging approaches will provide a landscape perspective to local results, and permit NPS to better utilize recent statistical advances while working at larger scales.”

Question 8: Covariate Data

Are all appropriate covariate data being collected? Are the covariate data currently collected being used in analyses?

Summary of Responses

Reviewers were able to identify a variety of covariates that are collected by, or accessible to the network, but noted that few analyses had used them to date and should start to. Incorporating vegetation into analyses was the predominant suggestion, but all universally agreed that more analyses are warranted given the data collected.

Linnea Hall: *“The covariate data collected in the current monitoring program include weather data (temp, cloud cover, wind speed), and vegetation (habitat) variables. None of these data have been used to date in analyses.”*

Matthew Marshall noted that distance was obviously used, but others had not been, but are being collected.

Matthew Johnson suggested using remote sensing data as a covariate in work currently being conducted.

Specific Responses

Linnea Hall

“The covariate data collected in the current monitoring program include weather data (temp, cloud cover, wind speed), and vegetation (habitat) variables. None of these data have been used to date in analyses, although a related exploration of drought-relationships was conducted with the water deficit paper.

I think that an annual analysis of the weather data and its relationship with bird densities should be conducted annually. For the vegetation data, I think that an analysis of the relationship between bird densities and the vegetation variables (and changes over time) should be conducted from 2005–2020, and then the vegetation data collection should be dropped, since these data are not regularly used AND they are generally readily available through GIS database projects (NDVI, etc.).”

Matthew Marshall

“The protocol outlines substantial effort that has been put into habitat measurements and I did not see any analyses that utilized this information. This seems like large omission especially because of the effort involved with collecting and managing these data. It also appeared that ‘observer’ was the only other covariate potentially used during density estimation (as a detection covariate; obviously ‘distance’ is the primary covariate used explicitly). This is an important topic because it is the covariates that will ultimately help us better understand why we see the trends we see. Some covariates can be generated later. But others, like the local veg measurements collected in the protocol, could prove to be invaluable (or perhaps a waste of time!). I strongly encourage exploring which ones are helpful and assess if and how the rapid veg data collection can or should be modified.”

Matthew Johnson

“Covariate data collected (overstory, shrub layer, ground cover) have not been used. Analyses incorporating these vegetation covariates is of interest. I suspect limited funding has precluded efforts to expand modeling to include these covariates. Most covariate data of interest can be estimated via remote sensing methods. It would be useful to incorporate spatial and environmental covariate data in future modeling. Controlling for site specific conditions requires thoughtful investment of limited resources to acquire and analyze relevant covariates over space and time. Collection, processing and applying remotely sensed covariate data requires work not currently undertaken but see NCPN water deficit manuscript. I have enjoyed thinking about reported correlations between bird densities and water deficit in the three NCPN habitats monitored. This approach may prove useful in developing predictive models of bird population trends and species’ vulnerabilities to climate change. Future analyses should apply remotely sensed covariates with known or testable mechanisms impacting bird populations.”

Question 9: Appropriateness of Conclusions

Are the conclusions drawn by major findings appropriate?

Summary of Responses

Reviewers felt that too few analyses had been performed to answer this question definitively but felt that the monitoring program was being conducted appropriately.

Linnea Hall and Matthew Johnson identified the water deficit paper as showing promise and providing a framework for future analyses.

Specific Responses

Linnea Hall

“The only analyses presented for the program so far (that I was given) are: (1) the 14-yr trends for species (in the 2020 report on the 2019 season), and (2) the water deficit analysis. There were no conclusions from the 14-yr analysis; the report primarily called for more years of count data collection on species that are showing declines. The report also called for future, more intensive analyses: ‘In future analyses, we will evaluate the driving landscape and climate variables affecting long-term, transect-level bird population trends of the species in greatest decline... Using land-cover and climate variables, we will evaluate the drivers of density trends for individual species, allowing us to identify prominent threats to declining species and estimate causes of variance in these trends across the NCPN.’ I think it will be great to get these done as soon as possible so that more conclusions about the status of species can be made.

In the water deficit paper, the analysis was aimed at ‘identifying species-specific vulnerability to climate change... This study provides a framework for identifying bird species sensitive to water deficit’ in the arid southwest. I think that this analysis was very interesting and provided some significant findings on sensitivities of particular species to droughts – and by extension, to climate warming – in particular vegetation types, which could be very useful.”

Matthew Marshall

“From what I can tell yes. With the caveat that we don’t know if the species with non-significant trends are actually stable (versus insufficient power to detect trends that may be occurring).”

Matthew Johnson

“No conclusions were drawn in monitoring reports. The water deficit manuscript reports correlations between population density and water deficit (which varied across species within a habitat type and within some species across habitat types). The manuscript suggests water deficit may be a useful metric for future efforts seeking to predict changes in population persistence and distribution.”

Question 10a: Application of Additional \$10K in Funding

If we had just a little bit more (\$10,000), how would we change the bird monitoring program?

Summary of Responses

Only one reviewer provided a definitive response to this question. She suggested incorporating additional demographic data into the current, annual monitoring on alternate years. She further suggested analyzing data against NOAA climate datasets, and conducting power analysis to ensure future trends can be attained with the current design.

Specific Responses

Linnea Hall

“If more funding was available, I would start adding alternating year demographic studies – possibly in lieu of counting every year – to determine nest success, mortality factors for adults and juveniles, predation and other impacts, and habitat use – for species in decline. This information will provide specific feedback on demographic factors separate from the densities of birds – which we know can be a misleading indicator of habitat quality (sensu Beatrice Van Horne’s (1983) famous paper on the subject). Nest monitoring should be targeted at federal/state protected species, and at species found to be declining in specific parks within the network (or across the network) and to be sensitive to decline, such as those species identified in the water deficit paper.

Also, given the importance of climate analyses, I would analyze the bird data versus NOAA or other climate data over the 14/15 year period to see what has/is changing. Also, analyze data by park, even just using basic regressions to look for significant declines within parks.

Lastly, I would conduct a power analysis and determine if there are enough points within each park to adequately assess trends there. If there are not enough points, I would establish more and then spend some of the extra money hiring good observers to conduct the extra point count sampling.”

Matthew Marshall

“I like this question but hard to address. How much does NCPN currently spend on this protocol?”

Matthew Johnson

“Additional support could be used to analyze data and sample additional space.”

Question 10b: Reduced Funding Options

If we had a little bit less (money), how would we change?

Summary of Responses

Only **Linnea Hall** answered this question with any detail. She suggested moving to an alternate year sampling framework and conducting nest searches for a subset of species in intervening years. She also suggested automating the reporting, so that the analyses and trend are autogenerated and very little writing is required.

Specific Responses

Linnea Hall

"I would conduct counts every other year, and in the in-between year, conduct some amount of nest searching and monitoring in a subset of parks for key declining or protected species. I would also automate the annual report to generate trend and other analyses so that very little writing of the report is necessary each year."

Matthew Marshall

No response

Matthew Johnson

"Reduction in funding would reduce the network's ability to detect change in bird populations."

Question 11: Climate Effects on Monitoring Design

How does a changing climate affect the design of the monitoring programs (timing, vegetation change to target population)?

Summary of Responses

Reviewers felt that changing climate might require observers to adapt their design to the shifting phenology of migration, nesting, etc., and felt that more frequent analyses to capture those changes as they occur would be necessary to adapt sampling windows appropriately.

As such, Linnea Hall suggested adding a second count to the April-June period when variability is high due to temperature increases. Matthew Johnson also pinpointed phenology as a confounding factor and suggested more frequent analyses that experimentally assess the design, and that the timing of surveys be adjusted to track phenological changes.

Specific Responses

Linnea Hall

"Because of the concern about temperature and precipitation impacts from climate change, I suggest that there is a need to analyze data more frequently and to be proactive with field measures to assist species in steep declines. In regard to monitoring design specifically, I would think that the high variability between April and early June counts because of temperature increases necessitates a second count per point. We MUST capture more of the variability across the sampling period, or we will miss some of the impacts of climate change on our bird populations."

In addition, I would not change the timing of the counts, because we need to see how populations themselves are changing within the period that we have been sampling since monitoring first started. If we change the timing of our counts, we will miss the declines or other relative changes."

Matthew Marshall

“Perhaps the biggest concern is that the habitats are likely to change as the climate changes. But I am still trying to get my head around whether or not this is a bad thing or a good thing. The habitat approach to monitoring could be a real positive in this regard. But the protocol team alludes in many places to the fact that these habitats are intermixed and like all things in ecology are somewhat messy. I keep coming back to the fact that there appears to be a wealth of vegetation data collected at each point count station that should be looked at that could potentially help here too.”

Matthew Johnson

“See first paragraph of response #7. Phenological and vegetation community changes in response to climate change require birds and ornithologists adapt. Monitoring results should be assessed frequently, and protocol modifications should be considered to maintain high bird detection rates. Protocol modifications (e.g., sampling earlier in the season) to improve detection probability would do well to experimentally evaluate proposed modifications to ensure future analyses adequately account for methodological changes. Within and across network productivity could be increased by combining existing datasets (and standardizing future methods) to evaluate population changes in relation to existing large-scale datasets (environmental covariates).”

Question 12: Current Monitoring Contributing to Climate Change Issues

Does the current monitoring program help address climate change effects on birds? Can the current design statistically address climate related changes?

Summary of Responses

All reviewers agreed that the current bird monitoring protocol does not address climate change effects directly other than as addressed in the water balance paper published by NCPN and that the data are suitable for statistically addressing climate related changes with additional analyses using covariates.

Matthew Johnson suggested expanding the analyses across networks and beyond park boundaries to better elucidate effects of climate change on bird populations.

Specific Responses

Linnea Hall

“The current program doesn’t address climate change effects directly, but the effects can be inferred from the data. Of course, monitoring data are usually used in a correlative way, rather than in an effects-testing way, but it also is possible to use some point transects as controls (where less change over time is expected) vs ‘treatments’ where more change over time is expected, and [then] analyze the data accordingly.”

The water deficit paper was a good use of the data to determine possible effects on the 3 vegetation types with impacts from coming climate change. It was a creative and informative analysis of the bird data.”

Matthew Marshall

“I guess I would say ‘unknown’ at this point. But clearly the water balance analyses and manuscript are a first step in trying to understand climate effects on arid land birds. I also have to say that the manuscript shows some really interesting results but seems to beg more questions than it answers. So, the team is really just starting to dig into this issue.”

Matthew Johnson

“Yes, the water deficit manuscript is an example. Combining datasets for analyses would likely increase the program’s ability to document climate change effects on birds, see second paragraph of response #7. The network also could incorporate environmental variables in models to assess, or partially control for variation in, conditions over space and time to understand observed density patterns. See responses #5 and #8.

It is valuable to understand temporal and spatial shifts in bird phenology and distribution associated with climate change. Analyzing within and across network datasets with a Bayesian hierarchical framework approach should increase ability to track density trends over time. It is worth considering occupancy modeling within and between parks to quantify spatial changes in distribution over time. Statistically rigorous extrapolation outside sampling sites (parks) is needed to meaningfully use occupancy models to track spatial patterns. Extrapolated-to areas would need to be part of a sampling frame from which I&M [IMD] sites were selected. It may be possible to integrate intensively sampled areas within parks with much spatially broader Breeding Bird Survey data (which were sampled from a very large sampling frame) to produce useful occupancy results.”

Question 13a: Availability of Information

Have the results been made available in NRTR annual reports and/or peer reviewed scientific publications?

Summary of Responses

While one reviewer commended NCPN for a wide array of publications, another noted that only one had trends in them. The third reviewer commented that the information in reports was conveyed in a digestible manner.

Matthew Marshall commended NCPN for their wide array of reports and other publications.

Linnea Hall pointed out that only one of the documents reviewed actually had trends in them. She also suggested automating some of the reports and suggested identifying each of the field staff involved in each report.

Matthew Johnson thought the reporting was presented in a digestible format.

Specific Responses

Linnea Hall

“Trends seem to have only been summarized in one NPS report (the 2020 report on 2019 season data) since 2005.

The NCPN does produce an annual ‘Brief’ and a ‘Web Article’ that summarize the annual reports for the public. These seem very helpful.”

Matthew Marshall

“Yes. Impressive set of NRRs, Briefs, and Articles. Looks like something for every year of monitoring which is amazing. Based on a quick skim through several of them it appears each one builds off the prior year; incorporating the most recent year of data collection. So clearly the protocol leads have been staying on top of basic data analyses and providing the information to the network/parks.”

Matthew Johnson

“Yes, results were presented in a clear and easily digestible format. Results could be interpreted in reports with management considerations discussed”.

Question 13b: Improvement of Information

Are there suggestions on how to improve the annual reports?

Specific Responses

Linnea Hall

“To shorten the amount of time needed to produce each report, I suggest that the reports should be automated as much as possible.

In addition, it would be helpful if the observers involved in each field season were listed in the annual reports. This way not only are they given credit, but the reader can also see which observers counted the most points, etc.”

Matthew Marshall

No direct response to this question provided.

Matthew Johnson

No direct response to this question provided.

Question 14: Balance Between Peer-Review Publications and Technical Reports

Is the balance of publications between peer-reviewed journals and NRR reports appropriate to scientific findings and implications to management?

Summary of Responses

Reviewers were not concerned. One reviewer stressed that trends were the most important aspect for management; the other two reviewers were pleased just to see trend analyses starting. No one questioned the lack of peer-reviewed publications.

Linnea Hall stressed the need to work toward actions that help declining species rather than on publications and felt that peer-reviewed publications offer low return in that regard, especially given the rapid decline in birds.

Matthew Marshall and Matthew Johnson were not concerned given that trends are only now starting to be analyzed.

Specific Responses

Linnea Hall

"I do not think that writing peer-reviewed publications should be a goal of monitoring program staff, although I realize that as a person who is not part of the NPS I may not know exactly how it works within the service. However, I do know that publications take a huge amount of time for low benefit overall. I think that if there is extra time, that monitoring staff should instead work with Park managers to focus on enacting additional monitoring (i.e., of nest success) of declining species, or implementing population-enhancing activities. Actions that could be taken include: habitat restoration; pollution reduction; construction of pools/tanks for water in areas where high temperatures will cause drought and sources of water to dry up for wildlife; controlling predators and nest parasites etc., as droughts, fires, and or other climate-related events occur. For example, funds could be raised within the network so that there is a 'pool' available for 'emergency interventions' for birds.

I am just not a fan of continuing to write more when our birds are declining at such utterly alarming rates. We are truly in an emergency situation."

Matthew Marshall

"Hard to assess but from what I can tell the first peer-reviewed journal article is under review (accepted?) right now. I would consider pausing the 'routine' annual reports and focus a year (or three) on different analyses and publications. Clearly a lot of data at hand to work with and explore."

Matthew Johnson

"I suspect sample sizes only recently permitted trend analyses, and the program has reported results evenly between peer-viewed papers and internal reports. The water deficit manuscript presented a potential tool to address management needs. The report did not present management implications. Analyses incorporating a Bayesian hierarchical framework (and covariates) would likely permit asking several questions of interest to management and contribute to knowledge of bird ecology."

Question 15: Collaboration Possibilities

Are there collaborations the network could take advantage of to share data and findings?

Summary of Responses

No specific approaches offered. Two reviewers suggested sharing data across networks whereas one suggested sharing with wider ornithological community.

Linnea Hall and Matthew Johnson suggested sharing data across networks.

Matthew Johnson suggested approaching the wider ornithological community and sister agencies to see how to partner with their work but acknowledged it would be a monumental effort.

Specific Responses

Linnea Hall

“This is not a question that I can answer well, although it would be great to continue to work with the NCPN. Perhaps the Channel Island landbird program, the NCPN program, and other western states programs could analyze all of our bird data for shared bird species and see how our trends and responses to climate variables vary among the networks and parks...”

Matthew Marshall

“I’m curious about the original partnership with Rocky Mountain Bird Observatory and stated goal to share methods and data across these habitats throughout several Western states. What happened? Update: This was addressed during Q&A.”

Matthew Johnson

“There is great opportunity to share data across networks. It might take a year to collate existing data before a usable dataset is available. Combining datasets across networks will provide a powerful tool that would produce numerous products for many years.

Externally, the USDA Forest Service routinely uses point counts to conduct wide-spread bird monitoring across the western US and collaboration with this sister agency could be fruitful. However, coordinating across multiple Forest Service regions is challenging with little certainty of success. I (probably) would not recommend making this investment.

There are numerous datasets that are compatible with I&M’s [IMD]. A general call for data and collaboration to the ornithological community (and sister agencies) would likely produce good response. It would be a monumental effort to coordinate, compile and standardize data, and design analyses to take advantage of such a theoretical dataset. However, improved understanding of population trends across the western US would be amazingly useful to bird conservation in our parks.”

Question 16: Additional Concerns

Room for individual network questions or concerns (Additional questions and comments).

Summary of Responses

One reviewer suggested highlighting specific management actions taken in response to monitoring results. Another reviewer suggested assessing bird connectivity issues at larger scales.

Several additional comments/concerns were raised by the reviewers.

Linnea Hall asked if it was known what management actions may have been implemented for the declines in 13 species identified so far. Given that the purpose of the monitoring is to enable management actions to be taken, she wondered what if any had been started. Moreover, she stressed that getting observers into the field to further augment what we know about declines is imperative.

Matthew Marshall raised concerns about data archiving, and QA/QC [quality assurance/ quality control]. He was not aware that the archival location is an NPS facility. He also reiterated earlier concerns that he still did not ascertain which species were the most abundant nor which species were of most interest to parks using these data.

Matthew Johnson emphasized the need to look at these data through a larger geographic lens and start to find opportunities to collaborate to address connectivity issues.

Specific Responses

Linnea Hall

*“I have just one other comment: The 2020 Trend Report identified 13 species with significant declines. I wonder what management actions have already been triggered for these species? It seems like getting observers out into the field this season to see what’s happening with those species is imperative. The real need for monitoring programs nationwide is to specifically detail what we do **when** our trend analyses indicate steep declines for species. These declines should trigger **specific** actions to save those species within/across our networks.”*

Matthew Marshall

“Curious about archiving data, field sheets, and other materials at Western Archeological and Conservation Center. Not an NPS facility? And not within the NCPN? Tradeoffs but I feel like we should own the data and then disseminate to other stakeholders/interested parties. I worry there is substantial backlog of QC [quality control] and data management needs that are not being addressed by punting responsibility for the data to a third party. I suggest bringing it home.

It dawned on me that after reading the 2020 report and several briefs and articles I don’t think I ever learned which species are most abundant in each habitat or each park. Or which might be priorities for conservation or management or else. If any park managers or other stakeholders are not ‘bird people’ they might be missing the big picture. Update: I do see some of this in the water balance manuscript. This may have been covered in prior reports that I did not look at, but I feel like more could be done to call out which are the most

abundant species in each park and habitat. Which are of regional conservation status. What have learned about the most iconic species (e.g., Sage Thrasher, Sagebrush Sparrow). Bottom line: What species do we really care about and why? And what have we learned about them (rather than just focusing on the species for which we have the most data which is in essence putting the cart before the horse).”

Matthew Johnson

“Across I&M [IMD], migratory birds that breed in parks occupy National Park Service lands for a portion of the annual cycle. Environmental conditions outside of parks influence bird demographic rates, and monitoring efforts in parks are not able to assess causes of population change without knowledge of factors impacting birds throughout the annual cycle. Improved understanding of migratory connectivity (the degree of linkage between different parts of an animal’s migratory range due to the movement trajectories of individuals) is necessary to examine causes of population change in parks.”

Conclusions and Recommendations

In general, reviewers commended NCPN for their bird monitoring work thus far. They found the protocol to be sound, objectives were being met, and that the numbers of reports and publications generated from this work underscore a well-designed and healthy monitoring program from a science integrity and delivery standpoint. In contrast, reviewers did make considerable numbers of observations and comments about the work offering a wide array of suggestions that might improve the monitoring, analysis, and reporting. However, they also clearly pointed out one shortcoming: that the link between monitoring results and management application was not clear, nor emphasized anywhere in the review material that was provided. Comments were made regarding the reporting venues used, and in particular, suggested that park-oriented reports should be the main focus rather than peer-reviewed publications. They suggested that, in the future, the network report on how the data and analyses are helping parks manage resources affecting birds.

One reviewer questioned the relevancy of the monitoring information given that the reporting cycle is designed for 30 years. That reviewer suggested the frequency of analyses and reporting be increased to an “at-minimum” 5-year cycle to improve success of early detection and opportunity for a faster management response by park resource managers.

Another suggestion by one reviewer was to report abundance data, although what that presentation would look like was unclear. The reviewer found it curious that it doesn’t exist in any of the reports and publications. Similarly, another concern expressed was that trends were available for only 63 of the 173 species, which they also noted, was understandable for bird monitoring. Some comments implied that an examination of the significance of species and guilds that do not have enough data to establish trends is still important, warranted, and needs to be addressed. Further, knowledge gaps, such as an understanding of the cause of any species declines need to be highlighted so they can be addressed and thus co-variables are essential. One reviewer wanted to have migration connectivity considered in this work, and while that is a valid concern, it certainly was beyond the scope of the objectives of this monitoring program.

The most poignant observation and related recommendation regarding analyses was that covariate data on climate and habitat were available but not incorporated into the analyses. Incorporating these data into the analyses could help address climate impacts on habitat and phenology and how these changes are affecting birds. Finally, several reviewers recommended that a power analysis be conducted to determine if trends can be detected for the species that have not had trend analyses conducted. Numerous suggestions were made regarding alternate analysis approaches that the network should consider moving forward. Additional attention was also given to questioning how phenological changes might affect monitoring, although no specific recommendations on how to address that issue was provided.

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Appendix A: NPS Western Bird Review Overview

The following document was sent to all participants in the Bird Review as an overview document explaining the review process.

Introduction to the Overview Document

Periodic scientific reviews of science programs are prerequisite to ensuring excellent science is conducted that attains the highest integrity of scientific standards for the particular type of science being reviewed, that effective use of that information is being undertaken, and that effective collaboration is engaged to maximize the scientific impact of that work. Scientific review of NPS monitoring protocols is an institutional requirement in the NPS Inventory and Monitoring Division (Mitchell et al. 2018). These reviews of Pacific West, Midwest, and Intermountain NPS IMD networks' bird monitoring protocols are intended as comprehensive reviews of the study design, methods, data analyses and interpretation, and publication of these scientific endeavors, as well as review and sharing of insights gained from these monitoring efforts to date, their effective transfer and use of that information to NPS park units and use by other land management agencies, and use more broadly among bird conservation and migratory bird efforts. This multi-network review provides an opportunity to expand our impact by exploring opportunities to work more effectively across networks, and to weave this effort into larger scale, hemispherical bird monitoring programs.

NPS Inventory and Monitoring networks have been monitoring birds for over a decade, and this effort is the first comprehensive effort to evaluate a large portion of the program simultaneously: that portion lying in the western U.S. To date, nine networks have committed to being part of this comprehensive regional, cross-network review. However, this nine-network review configuration offers some challenges that are not apparent at first cut. First, these IMD networks vary in their bird monitoring designs; many have implemented different study designs and statistical approaches to analyzing their data, thus requiring specific attention to different designs and analytical issues by reviewers (i.e., one review panel might be insufficient to review all networks due to broad difficulties of that challenge). Second, not all networks are at the same point in the implementation, analysis, and reporting/publication of their monitoring, thus far. Therefore, some that are further along are more amenable to a current review while others will require additional time to get their analysis and reporting to a good point thus allowing for review.

Outcome

The outcome of this particular effort would be a comprehensive scientific peer-review of the bird monitoring protocols being used across participating IMD networks (in the case of the first two networks in the review: Mediterranean Network and the Northern Colorado Plateau Network), that improves our ability to make inferences about trends in bird monitoring within and among national parks. The scope of the review would include: 1) a critical scientific peer-review of individual network bird monitoring approaches that would be based on completed trend reports and papers and may include recommendations for improvement to the current approaches, 2) a larger assessment of opportunities to collate bird monitoring trends across networks in order to obtain more region-wide inferences on trends, 3) assess opportunities to merge methods and databases being used, 4) assess

opportunities for wider collaboration using staff across participating networks, and 5) explore opportunities for greater scientific impact through collaborations, publications, and presentations of the information.

Steps in the Review Process

To help organize the review and orient the participants to the review process, the current overall structure of the process is as follows:

Snapshot Presentations: All Networks

Presentations by protocol leads at each network to describe what the protocol consists of, its objectives (with particular focus on the link to the monitoring design), and the status of their fieldwork, data analysis, and reporting/publishing. This will help orient decisions regarding the order of detailed reviews.

Core Pieces of Presentation for All Networks at Review

1. Background as to why parks selected birds to monitor.
2. Objectives of bird monitoring program (specific and quantitative).
3. Overview of methods – but reviewers should have already looked at the protocol narratives and key SOPs suggested by the network.
4. Examples of bird trend analytical methods and results.
5. Overview of key publications and findings across reports.
6. Limitations of the approach now evident after the analyses.
7. Lessons Learned: What do we know now that we did not know before monitoring began?
8. How have data been used in management decisions?
9. What are you planning to do next for analyses and reports?

Additional Pieces of Presentation that May Not Be Applicable to All Networks

1. Has the monitoring altered the way system dynamics are viewed, or has it reaffirmed traditional thinking?
2. Have the data from the monitoring program resulted in a policy change at the park or region level?
3. Have the data from monitoring efforts resulted in other proposals/efforts to answer questions that have arisen from the monitoring data?
4. Have ecological thresholds or management triggers been identified? If not, what efforts is the network making to develop these criteria?
5. What obstacles or problems has the network encountered in trying to accomplish its goals of providing scientific information for park management?

6. What would be done if there were more funding?
7. What could be cut if funding decreased?

Outline for Snapshot Presentations

1. Objectives
2. Methods
3. Analyses/results
4. Key findings
5. Integration of bird data with others - within network, parks, outside partners
6. Data uses in park management
7. Existing science or methods questions that your network wants to look into
8. Hurdles - what is preventing your bird data from being published/analyzed/reported/ next steps
9. What are you planning to do next?

Actual Review

Conducted per each network or paired networks. This will occur serially (schedule pending).

The review will consist of a:

1. Pre-review orientation for reviewers and networks outlining process, expectations, and deadlines.
2. Actual review providing more in-depth presentations and discussions.
3. Post-review meeting addressing additional questions.
4. Written reports by reviewers to RPMs (Regional Program Managers).
5. Post Review Symposium.

There is considerable interest in getting networks and other collaborators working more cohesively together. This could be achieved by collaboratively focusing on the combined overall reviews that had been conducted on the analytical components of the protocols, but then focus on collaboration, standardization, data management, opportunities for integration into parks and other land-use agencies, and impact. Discussions herein would provide the inertia to have a larger impact with our large geographically oriented efforts.

The steps in the review process will allow for reviewers to addresses three dimensions of the current program:

1. A comprehensive science critique of each individual networks' bird monitoring program as it's currently being conducted, including offering insights and ideas into the strengths and weaknesses of the program, while offering better alternatives where appropriate.
2. A careful review of how the work is meeting current information needs of parks and other partners and recommendations for prioritizing monitoring activities.
3. Opportunities to engage in collaborative work that can increase the impact of bird monitoring both within individual networks and parks (intra-ecological impact) and across networks and parks (inter-ecological impact).

Reviewers conducting the review will be given relevant materials prior to the review (see list of reference materials below). The reviewers will attend (or watch the recordings) of the bird snapshots that precede their formal review deliberations.

Expectations of Reviewers

Each network will have three-to-four peer reviewers assigned prior to a network presentation of the state of their respective bird monitoring program. The review of each network's bird program will occur in several steps.

In the first step, reviewers would review initial bird monitoring material prepared by the network (see Homework for Peer Reviewers section below) prior to the network presentation. Reviewers would then attend the "Network Snapshot Presentations" whereby each network provides an overview of their program. Next, reviewers would attend more detailed network-specific presentations whereby the network would present their monitoring programs and then engage in an open discussion/critique of the findings from the homework and the initial presentation. Reviewers would then combine their initial review with their review of the presentation and discussion to produce a final report with recommendations. If recommendations on changes to methods or analyses are made, then the network, not the reviewers, would be required to document these changes and make appropriate protocol updates after the review following I&M guidance. The final product of this process would be a 3–5-page report for each network. The goal would be to have this document within three weeks of the presentation.

In general, the report would:

1. Assess if the methods being used are producing effective, statistically significant, long-term monitoring trends per the objectives outlined in each protocol.
2. Highlight what the network is doing well.
3. Outline the challenges the network is facing.
4. Suggest additional or alternative analytical methods and approaches.
5. Recommend additional publications and outlets beyond current products.
6. Recommend potential collaborators for future efforts.
7. Suggest other stakeholders that might be interested in these data.

8. Recommend any changes to science communication products.

Questions/Goals of Review Addressed by Peer Reviewers

1. Are the objectives for the monitoring program still clear, relevant, and achievable? Have they been answered in reporting and papers?
2. Are the basic bird detection methods still the best for objectives in the protocol and for the cost? Are there alternative measures to consider? If there are new methods, these new methods would need to be cost-effective and a transition period and data transition approach would need to be discussed.
3. Does the bird monitoring survey design ensure that data are representative of the target populations and sufficient to allow defensible conclusions to be derived about the resources of interest?
4. Are the analytical approaches appropriate for the trend analysis and for the objectives? How has the PI ensured that they are capitalizing on the most relevant statistical methods?
5. Are there any recommended changes to procedures that would enhance the overall quality and usefulness of the data being gathered?
6. Can these data be combined with any other networks in this review; what are the obstacles to larger scale analyses?
7. Is there an advantage to merging approaches at this point? What would they be and how might we achieve that without losing what we've already done?
8. Are all appropriate covariate data being collected? Are the covariate data currently collected being used in analyses?
9. Are the conclusions drawn by major findings appropriate?
10. If we had just a little bit more (\$10,000), how would we change the bird monitoring program? If we had a little bit less, how would we change?
11. How does a changing climate affect the design of the monitoring programs (timing, vegetation change to target population)?
12. Does the current monitoring program help address climate change effects on birds? Can the current design statistically address climate related changes?
13. Have the results been made available in NRTR annual reports and/or peer reviewed scientific publications? Are there suggestions on how to improve the annual reports?
14. Is the balance of publications between peer-reviewed journals and NRR reports appropriate to scientific findings and implications to management?
15. Are there collaborations the network could take advantage of to share data and findings?
16. Room for individual network questions or concerns.

Management Questionnaire for Network Parks to Be Completed Ahead of Network Review

1. Have you found the bird monitoring data to be useful to your park? In what ways?
2. How have you used bird data for specific management decisions or public education? Please elaborate.
3. What do you wish the bird data could provide but currently does not?
4. What has been the biggest benefit of having a bird monitoring program?
5. What do you feel is the biggest value of the bird monitoring program?
6. What bird monitoring products do you get from network staff? Are they satisfactory to your needs?
7. Other comments.

Homework for Peer Reviewers

1. Protocol narrative and relevant SOPs (No need for reading “prepping for field season”, “data management”, etc.).
2. Most recent annual/regular report.
3. Trend reports/in depth synthesis reports/past reviews.
4. Up to two key papers/reports produced by network or PI.
5. Examples of data used in management context regardless of whether it was published.
6. Monitoring briefs.
7. NCPN specific homework would be:
 - Roberts, S., E. Tymkiw, Z. S. Ladin, and G. Shriver. 2020. Status and trends of landbird populations in the Northern Colorado Plateau Network: 2019 field season. Natural Resource Report NPS/NCPN/NRR—2020/2071. National Park Service, Fort Collins, Colorado.
 - Roberts, S., D. P. Thoma, D. W. Perkins, E. L. Tymkiw, Z. S. Ladin, and W. G. Shriver. In Review. Bird Community Sensitivity to Climate in National Parks of the Northern Colorado Plateau. Submitted to Auk.
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 - SOP 2: Training Observers
 - SOP 4: Establishing and Marking Sampling Plots
 - SOP 5: Conducting the Survey

- SOP 6: Documenting Habitat Variables
- Papers about monitoring and IMD
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Presentation—Guidelines for Review So All Networks Are Presenting the Same Information

1. Core pieces of presentation for all networks at review.
2. Background as to why parks selected birds to monitor.
3. Objectives of bird monitoring program (specific and quantitative).
4. Overview of methods – but reviewers should have already looked at the protocol narratives and key SOPs suggested by the network.
5. Examples of bird trend analytical methods and results.
6. Overview of key publications and findings across reports.
7. Limitations of the approach now evident after the analyses.
8. Lessons learned: What do we know now that we did not know before monitoring began?
9. How have data been used in management decisions?
10. What are you planning to do next for analyses and reports?

Additional Pieces of Presentation That May Not Be Applicable to All Networks

1. Has the monitoring altered the way system dynamics are viewed, or has it reaffirmed traditional thinking?
2. Have the data from the monitoring program resulted in a policy change at the park or region level?
3. Have the data from monitoring efforts resulted in other proposals/efforts to answer questions that have arisen from the monitoring data?
4. Have ecological thresholds or management triggers been identified? If not, what efforts is the network making to develop these criteria?

5. What obstacles or problems has the network encountered in trying to accomplish its goals of providing scientific information for park management?
6. What would be done if there were more funding?
7. What could be cut if funding decreased?

Pre-presentation Products

Table summarizing network, years of monitoring, current methodology, have there been any substantial changes to the program and if so a brief summary, current PI, etc.

Networks need to ensure that current protocol and SOPs reflect current practices before going to peer reviewers.

Appendix B. Complete Review Comments

Linnea Hall

Executive Director and Avian Conservation Biologist, Western Foundation of Vertebrate Zoology, Camarillo, CA

General Comments

Thank you for the opportunity to review this landbird monitoring program. As a true fan of bird monitoring, I was very happy to learn more about your program, and to see the level of dedication to it that the NCPN has maintained since 2005. Bird monitoring is not easy work, and is very long-term, and so commitments of >10 years are especially laudable. Your program should be commended on continuing this project so faithfully, and on producing a trend report in 2020 that provides meaningful information on the status of many breeding bird species in the Parks that compose the NCPN.

The following review comments are provided with the goal of continuing to raise the bar for the NCPN bird monitoring program, since coming climate changes and known precipitous declines in bird populations throughout the U.S. mean that we have to strive to make our programs as strong – and RESPONSIVE on the ground – as they can possibly be.

Questions/Goals of Review to Be Addressed by Peer Reviewers

Question 1: Are The Objectives for the Monitoring Program Still Clear, Relevant, and Achievable? Have They Been Answered in Reporting and Papers?

The objectives for the monitoring program are relatively specific, but are projected out over a very long time period:

“The objective...is to determine the status and trends in breeding-bird species density in sagebrush, pinyon-juniper, and riparian habitats.”

Also:

“The sampling objective... is an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%.”

These objectives together are clear and relevant, but the sampling objective is probably too long-term to be meaningful, since for management purposes (and to forestall any new or continuing declines in our poor bird species), detection of a significant decline in species’ densities should be done within a much shorter time period. For example, I would suggest that the sampling objective be stated for a maximum of 5 years, otherwise management actions cannot be taken within a reasonable time period.

Question 2: Are the Basic Bird Detection Methods Still the Best for Objectives in the Protocol and for the Cost? Are There Alternative Measures to Consider? If There Are New Methods, These New Methods Would Need to Be Cost-Effective and a Transition.

Overall I found the methodology used for this program (point counts) to be very useful, and other positive design elements include: approximately 650 points counted per year and consistently by only a few experienced observers; the establishment of point-transects in three vegetation types; the collection of simple, descriptive vegetative data each year; and a really good protocol for including/excluding “flyovers” in a count.

However, I did also note a few issues with how the point counts are conducted that I think need some review. Specifically:

1. The habitat data should not be collected when first arriving to a point. The birds should be counted first to minimize behavioral impacts to birds.
2. Counting for 5 hours after sunrise in the southwest for passerines is a long time, especially if counts are conducted into late May or early June, and especially as climate warming is expected to increase. I would recommend only counting for 4 hours after dawn; this is more standard practice for the west.
3. The “transect count” for rare birds between points in an interesting methodology, especially since none of the “transect” data have been analyzed to date, and according to your team there are only ever about 10 detections of such birds per survey. I would recommend dropping this and I would suggest that the counts be executed first to get them finished within 4 hours of dawn, and then on the way back rare /new species can be detected. The priority for these counts needs to be the breeding species as opposed to detecting rare/new species.
4. Although consistent observers have been used to date, I think a standardized description of the qualifications needed by observers is needed in the protocol. Specifically, how much experience they need to have with vocalization identification, distance estimation, etc. Also, distance estimation should be re-calibrated among all observers before counts each season.
5. I really liked that 2 surveys were conducted from 2005–2013, but see that only 1 survey of each point was conducted annually thereafter, based on funding. Also, only ~75% of all points are counted per season, so I wonder how these different points are selected each year - is it random?
6. I wonder if a power analysis has been conducted to determine if there are enough records to analyze well with only one count per season? The Channel Islands landbird program also counts points only once per season, and I strongly feel it is a flaw in the methodology unless we can add a lot more points. In general, Ralph et al (1995) recommends 3 counts per point optimally, so dropping down to only 1 count/point is fraught with potential for anomalous weather, etc, greatly influencing a day’s count.

Question 3: Does the Bird Monitoring Survey Design Ensure That Data Are Representative of the Target Populations and Sufficient to Allow Defensible Conclusions to Be Derived About the Resources of Interest?

Following from above, a new power analysis is definitely warranted now that there are 14+ years of data collected, to see if the current sampling design will continue to be adequate for sampling the target populations. In addition, although pooling count data across individual parks to arrive at 15 “point transects” per vegetation type can be useful for assessing broad trends, this design does not allow for determination of species trends **within Parks**, and very significant declines may be missed with long-term consequences. Thus, I recommend that a power analysis needs to be conducted to determine how many points are needed **within each Park** to determine more fine-scaled trends, as well as to determine if the 15 transects per veg type is still sufficient for detecting broad-scaled patterns for species.

On a separate subject, there are other types of monitoring data that can be collected on species and should be considered, such as nesting success and parasitism rates. I suggest below that such monitoring is also a necessary part of a comprehensive and adaptive bird monitoring program and should be considered for the NCPN as well.

Question 4: Are the Analytical Approaches Appropriate for the Trend Analysis and for the Objectives? How Has the PI Ensured That They Are Capitalizing on the Most Relevant Statistical Methods?

The 2020 report on the 2019 breeding season included trend analyses using program DISTANCE. These analyses were useful for determining trends, and very informative for future management actions for many species. However, I suggest that such analyses should be conducted much more frequently, and recommend every 3–5 years at the longest, if not annually. With climate change we are going to need to get annual feedback from our monitoring efforts to have the most adaptive responses to severe declines in species’ numbers, or shifts in their distributions.

In addition, Andy Royle has recommended to the Channel Island landbird program that we utilize hierarchical distance analyses rather than DISTANCE analyses sensu Buckland et al. because they are more flexible and allow one to analyses multiple species at a time, for example. It seems like it would be best if all of the Networks use the same analyses.

Lastly, to reiterate a suggestion above, I think that analyses should be conducted for each Park within the Network, even if there are low sample sizes for species, to look for steep declines. These analyses could even be simple regression lines showing changes in relative abundance indices each year.

Question 5: Are There Any Recommended Changes to Procedures That Would Enhance the Overall Quality and Usefulness of the Data Being Gathered?

As mentioned above, I think that the count data should be analyzed more frequently.

In addition, although upland vegetation descriptions are collected each year, they have not been analyzed. Thus, although it would be relatively simple to analyze changes in bird densities over time in association with some/most of these variables, I think that realistically, given the availability of

GIS mapping layers, it seems like the time spent on these measurements would be better spent on other work, such as a second count or demographic studies in alternating years, etc. Other analyses that should be conducted regularly are those of the temperature data collected during counts vs bird density data within Parks (as well as across them to look for broad-scaled trends) to assess **local** climate change impacts/relationships.

Question 6: Can These Data Be Combined with Any Other Networks in This Review; What Are the Obstacles to Larger Scale Analyses?

I understand the desire for large-scaled analyses, but I think that these could mask more significant declines at smaller scales. We could certainly pool data for the “southwest” or “western” regions to see what the analyses show, but I wonder if the variation wouldn’t make interpretations difficult.

Question 7: Is There an Advantage to Merging Approaches at This Point? What Would They Be and How Might We Achieve That Without Losing What We’ve Already Done?

I am not sure that there is an advantage to pooling, but if there is significant interest among others I think it would be fine to try it. However, I am not a big fan of doing analyses (or publications; see below) when we are losing species, and climate change impacts have only just begun to be felt... I would rather see more effort go into on-the-ground management actions to help species.

Question 8: Are All Appropriate Covariate Data Being Collected? Are the Covariate Data Currently Collected Being Used in Analyses?

The covariate data collected in the current monitoring program include weather data (temp, cloud cover, wind speed), and vegetation (habitat) variables. None of these data have been used to date in analyses, although a related exploration of drought-relationships was conducted with the water deficit paper.

I think that an annual analysis of the weather data and its relationship with bird densities should be conducted annually. For the vegetation data, I think that an analysis of the relationship between bird densities and the vegetation variables (and changes over time) should be conducted from 2005–2020, and then the vegetation data collection should be dropped, since these data are not regularly used AND they are generally readily available through GIS database projects (NDVI, etc).

Question 9: Are the Conclusions Drawn by Major Findings Appropriate?

The only analyses presented for the program so far (that I was given) are: (1) the 14-yr trends for species (in the 2020 report on the 2019 season), and (2) the water deficit analysis. There were no conclusions from the 14-yr analysis; the report primarily called for more years of count data collection on species that are showing declines. The report also called for future, more intensive analyses: *“In future analyses, we will evaluate the driving landscape and climate variables affecting long-term, transect-level bird population trends of the species in greatest decline... Using land-cover and climate variables, we will evaluate the drivers of density trends for individual species, allowing us to identify prominent threats to declining species and estimate causes of variance in these trends across the NCPN.”* I think it will be great to get these done as soon as possible so that more conclusions about the status of species can be made.

In the water deficit paper, the analysis was aimed at “*identifying species-specific vulnerability to climate change... This study provides a framework for identifying bird species sensitive to water deficit*” in the arid southwest. I think that this analysis was very interesting and provided some significant findings on sensitivities of particular species to droughts – and by extension, to climate warming – in particular vegetation types, which could be very useful.

Question 10a: If We Had Just a Little Bit More (\$10,000), How Would We Change the Bird Monitoring Program?

If more funding was available I would start adding alternating year demographic studies – possibly in lieu of counting every year – to determine nest success, mortality factors for adults and juveniles, predation and other impacts, and habitat use – for species in decline. This information will provide specific feedback on demographic factors separate from the densities of birds – which we know can be a misleading indicator of habitat quality (sensu Beatrice Van Horne’s famous paper on the subject). Nest monitoring should be targeted at federal/state protected species, and at species found to be declining in specific Parks within the Network (or across the Network) and to be sensitive to decline, such as those species identified in the water deficit paper.

Also, given the importance of climate analyses, I would analyze the bird data versus NOAA or other climate data over the 14/15 year period to see what has/is changing. Also, analyze data by Park, even just using basic regressions to look for significant declines within parks.

Lastly, I would conduct a power analysis and determine if there are enough points within each park to adequately assess trends there. If there are not enough points, I would establish more and then spend some of the extra money hiring good observers to conduct the extra point count sampling.

Question 10b: If We had a Little Bit Less, How Would We Change?

I would conduct counts every other year, and in the in-between year, conduct some amount of nest searching and monitoring in a subset of Parks for key declining or protected species. I would also automate the annual report to generate trend and other analyses so that very little writing of the report is necessary each year.

Question 11: How Does a Changing Climate Affect the Design of the Monitoring Programs (Timing, Vegetation Change to Target Population)?

Because of the concern about temperature and precipitation impacts from climate change, I suggest that there is a need to analyze data more frequently and to be proactive with field measures to assist species in steep declines. In regard to monitoring design specifically, I would think that the high variability between April and early June counts because of temperature increases necessitates a second count per point. We MUST capture more of the variability across the sampling period, or we will miss some of the impacts of climate change on our bird populations.

In addition, I would not change the timing of the counts, because we need to see how populations themselves are changing within the period that we have been sampling since monitoring first started. If we change the timing of our counts we will miss the declines or other relative changes.

Question 12: Does the Current Monitoring Program Help Address Climate Change Effects on Birds?
Can the Current Design Statistically Address Climate Related Changes?

The current program doesn't address climate change effects directly, but the effects can be inferred from the data. Of course, monitoring data are usually used in a correlative way, rather than in an effects-testing way, but it also is possible to use some point transects as controls (where less change over time is expected) vs "treatments" where more change over time is expected, and analyze the data accordingly.

The water deficit paper was a good use of the data to determine possible effects on the 3 vegetation types with impacts from coming climate change. It was a creative and informative analysis of the bird data.

Question 13a: Have the Results Been Made Available in NRTR Annual Reports and/or Peer Reviewed Scientific Publications?

Trends seem to have only been summarized in one NPS report (the 2020 report on 2019 season data) since 2005.

The NCPN does produce an annual "Brief" and a "Web Article" that summarize the annual reports for the public. These seem very helpful.

Question 13b: Are There Suggestions on How to Improve the Annual Reports?

To shorten the amount of time needed to produce each report, I suggest that the reports should be automated as much as possible.

In addition, it would be helpful if the observers involved in each field season were listed in the annual reports. This way not only are they given credit, but the reader can also see which observers counted the most points, etc.

Question 14: Is the Balance of Publications Between Peer-Reviewed Journals and NRR Reports Appropriate to Scientific Findings and Implications to Management?

I do not think that writing peer-reviewed publications should be a goal of monitoring program staff, although I realize that as a person who is not part of the NPS I may not know exactly how it works within the Service. However, I do know that publications take a huge amount of time for low benefit overall. I think that if there is extra time, that monitoring staff should instead work with Park managers to focus on enacting additional monitoring (i.e., of nest success) of declining species, or implementing population-enhancing activities. Actions that could be taken include: habitat restoration; pollution reduction; construction of pools/tanks for water in areas where high temperatures will cause drought and sources of water to dry up for wildlife; controlling predators and nest parasites etc., as droughts, fires, and or other climate-related events occur. For example, funds could be raised within the Network so that there is a "pool" available for "emergency interventions" for birds.

I am just not a fan of continuing to write more when our birds are declining at such utterly alarming rates. We are truly in an emergency situation.

Question 15: Are There Collaborations the Network Could Take Advantage of to Share Data and Findings?

This is not a question that I can answer well, although it would be great to continue to work with the NCPN. Perhaps the Channel Island landbird program, the NCPN program, and other western states programs could analyze all of our bird data for shared bird species and see how our trends and responses to climate variables vary among the Networks and Parks...

Question 16: Room for Individual Network Questions or Concerns (Additional Questions and Comments).

I have just one other comment: The 2020 Trend Report identified 13 species with significant declines. I wonder what management actions have already been triggered for these species? It seems like getting observers out into the field this season to see what's happening with those species is imperative. The real need for monitoring programs nationwide is to specifically detail what we do **when** our trend analyses indicate steep declines for species. These declines should trigger **specific** actions to save those species within/across our Networks.

Thank you again for the opportunity to review this great program. Congratulations on all of your efforts at collecting data on the birds we care so much about.

Sincerely,

Linnea Hall
Western Foundation of Vertebrate Zoology
805-340-7687

Matt Marshall

Network Program Manager, NPS Eastern Rivers and Mountains Network, National Park Service,
University Park, PA

Matt Marshall review of NCPN Landbird Monitoring Protocol, Last updated April 1, 2020

Most of my review comments are laid out below following each specific review topic/question. Overall, I was really impressed with this effort and there is a lot to like. I was particularly impressed with the continuity of program implementation and data collection over the 15 year period with essentially no major changes to the design or methods. And only one small gap in data collection. The reporting has been impressive as well with a long list of Annual Reports that include species specific trend estimates incorporating the most recent data. The field methods are traditional and sound. And analyses thus far take into account detection probabilities and an important detection covariate (distance from observer). The NCPN and their colleagues have done a really nice job in my opinion. Hopefully my thoughts and comments below will help improve what is already a good program. The most obvious areas for improvement are 1) evaluate the extensive suite of additional data being collected particularly the habitat data. It seems like a non-trivial effort to train, collect, and manage this info and little has been done with it; 2) evaluate additional analysis approaches besides a singular focus on Distance methods. The largest area of improvement may come from including all

years of data in a common analysis as opposed to estimating density one year at a time; and 3) take some time to critically evaluate if you're learning what you want to be learning about the most important species moving forward (now that a 15 year foundation has been established).

-Matt

In general, the report would:

1. Assess if the methods being used are producing effective, statistically significant, long-term monitoring trends per the objectives outlined in each protocol.
2. Highlight what the network is doing well.
3. Outline the challenges the network is facing.
4. Suggest additional or alternative analytical methods and approaches.
5. Recommend additional publications and outlets beyond current products.
6. Recommend potential collaborators for future efforts.
7. Suggest other stakeholders that might be interested in these data.
8. Recommend any changes to science communication products.

Questions/Goals of Review Addressed by Peer Reviewers

Question 1: Are the Objectives for the Monitoring Program Still Clear, Relevant, and Achievable? Have They Been Answered in Reporting and Papers?

Notes and observations:

Protocol states 3 reasons for monitoring birds: 1) ecological indicators, 2) possible declines, and 3) high public appeal. Also states the explicit desire to collaborate with regional bird monitoring efforts meant NCPN adopted existing methods of the Rocky Mountain Bird Observatory (so data can be combined with the "1000 or so transects in four other Western states").

From the protocol: "The objective of this protocol is to determine the status and trends in breeding-bird species density in sagebrush, pinyon-juniper, and riparian habitats. NCPN's collaboration with RMBO was intended to provide access to regional trends, as well as trend information based solely on locations in park units. Thus, the unit of analysis for this objective is both the regional scale and the sites within NCPN park units. The sampling objective of this protocol is an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%."

Target population: "Diurnal breeding birds" of "three habitat types"

Comments:

1. If we take the statistical sampling objective at face value it does not seem achievable for most species based on the analyses done to date.

2. Based on 2020 report, it looks like 173 species have been detected and trends could be estimated for 63 in at least one habitat (so trends could NOT be estimated for 110 species in any habitat). I know many of the 173 are incidental and don't regularly breed in these habitats. I also know that the vast majority of detections are probably for these 63 species. But the point remains that we have trouble estimating trends for many if not most species. Especially rare species. This is an issue for all our bird monitoring protocols. It is impossible to build a design that is optimal for all species. But is NCPN learning what it needs to be learning about the species it cares about most?
3. Significant trends could be detected for 21 species (presentation: down to 11 species with significant trends after most recent data included). Are the remaining populations really "stable" or are you unable to detect trends that may be occurring (a statistical power issue)? Some combination of both most likely which brings us back to the original objective...
4. The protocol leads mentioned a "power analysis" several times during the review. This is not a bad idea, but it is likely to show little more than "we have high power for the 11 species with significant trends and low power for all the others." So, it's circular and we don't learn much that is new or helpful. The power analysis could be more informative if it also explores how much additional sampling would be needed to detect meaningful trends for additional species. And if the NCPN is willing to consider design changes and/or adding additional transects in order to try and achieve better statistical power for some clearly defined species. Or if we really need to just wait the full 30 years to detect trends for a few more species.
5. I am not sure how much more time to spend on this. As I said, at face value the objective is not being met for most species. Does that invalidate the program? I don't think so. Additional or different analyses may help. More years of monitoring will also help (the objective is based on 30 years so we could just wait another 15 years to assess). And perhaps that is good enough. But it is important to take a step back and assess the overall program and information gained.
6. The discussions during the review started to go down the path of revisiting the purpose and objectives which I think is healthy. As a reviewer I am not advocating that a change is needed. But an open, honest discussion about what we've learned so far and is this "worth it" should happen.

Question 2: Are the Basic Bird Detection Methods Still the Best for Objectives in the Protocol and for the Cost? Are There Alternative Measures to Consider? If There Are New Methods, These New Methods Would Need to Be Cost-Effective and a Transition Period and Data Transition Approach Would Need to Be Discussed.

Notes and observations:

1. Two distance methods: Transects and point-transects
2. 15 transects per habitat and 15 point count stations per transect (250m apart). Max counts per year equals 225 in each habitat (675 across all three habitats).
3. 2020 Report: 75% of planned surveys completed each year on average.

4. Transects randomly distributed within a habitat patch
5. 5 minute point count (species, sex, method of detection, minute of detection, radial distance)
6. While walking along transect observations of low-density, rare, or unusual species are recorded.
7. Majority of trend information is derived from point counts.
8. “Each transect is treated as a sample; point count stations are sub-samples.”
9. Point count stations are not permanently marked.
10. Sampling occurs annually (one transect per day typically).
11. Two visits per year 2005–2013 (to try and meet the suggested 60–80 detections per species as per Buckland). Since 2014 one visit per year. “New protocol in 2014”.
12. 2020 report: “Bird Conservancy of the Rockies from 2005–2015. Hiatus in 2016. University of Delaware starting in 2017”.
13. Weather impacts on counts. Observers can use a rule and suggest data not be used for analysis: “if you detected very few birds or almost all were visual...”
14. Typical constraints on sampling: time of day, day of year, little wind, minimal precip.
15. Habitat data also collected: 50m radius before count every visit (% cover, mean height, dominant species composition, % cover of ground cover classes).
16. 5-day training for observers.

Comments:

1. Basic methods seem sound and appropriate. But likely room to streamline if desired.
2. From presentation: 2–3 observers per year try to get it all done. Very efficient and likely very cost effective for the information gained.
3. Double counting individuals. Protocol says you should count the same bird on multiple points if it hasn’t moved location (e.g., meadowlark on powerline). This does not seem appropriate. However do not double count a flying raptor. This does. 2020 report seems to address this issue by limiting detections to <125 m.
4. SOP 5 page 8 refers to a six minute count?
5. Confusion over 4 letter codes while in the field is real. Do you provide a cheat sheet?
6. Have you ever used the subspecies or any of the 45 UNBI categories? Is it worth collecting?
7. I see you upgrade to “S” for birds that sing after they were first detected by other means. Have you ever used this (or just “S” detections)?
8. Have you ever used the “Sex” code for any analyses?
9. Have you ever done anything with the squirrel data?

10. Have you ever done anything with the “88” species data? What does “88” refer to? Hopefully not the Cleveland Browns 1981 playoff game versus Oakland when the Browns ran a play called “red right 88” and proceeded to lose the game.
11. Have you ever done anything with habitat covariates? Veg or prairie dog? Number of snags?
12. Surprising number of plant species your techs are expected to know. Problems with this?

Question 3: Does the Bird Monitoring Survey Design Ensure That Data Are Representative of the Target Populations and Sufficient to Allow Defensible Conclusions to Be Derived About the Resources of Interest?

Notes and observations:

1. Park unit inclusion determined by availability of appropriate habitat.
2. Excluded areas >50% slopes.
3. Inference at the habitat level (not the park) for SB and PJ.
4. Riparian is limited to wadeable streams and are handpicked due to limited availability.

Comments:

1. In general, yes, the survey design seems appropriate. While I don’t think it invalidates the current design it is likely frustrating that the larger, regional, monitoring effort through RMBO never materialized in the way the early authors of the protocol envisioned.
2. Would be nice to see a map and summary information on available versus realized target areas/habitats. How much of each habitat is available in each park? How much was removed due to the >50% slope criterion? How much of the remaining was selected for sampling? Can you make summary statements about sampling intensity (one transect per X square km of PJ at Dinosaur”, etc.)?
3. What are some of the priority species either because they are abundant, rare, conservation concern, iconic? This could help focus the actual target population now that data have been collected and we have a better feel for what species occur. Is the program meeting your needs for the species you really care about?

Question 4: Are the Analytical Approaches Appropriate for the Trend Analysis and for the Objectives? How Has the PI Ensured That They Are Capitalizing on the Most Relevant Statistical Methods?

Notes and observations:

1. Protocol mentions Program Distance to estimate density that incorporates a detection probability.
2. 2020 report states that an R package that implements program Distance is used.

3. “Density is not intended as an end product, but rather as an index of population trend that is not confounded by detectability issues” (**This is an awkward sentence and the only detection issue included so far is distance from observer. There are lots of others...)
4. Status and trend information are analyzed at multiple levels: ecoregion, management unit (NCPN park units versus other), and habitat. (**I don’t see analysis at multiple levels yet).
5. 2020 report: Annual estimates for each species/habitat and then linear model for trend. Not all species/habitat/year combinations had estimates (**sample sizes given for number of years an estimate is available. I liked this.).

Comments:

1. Overall, the PIs have done an excellent job keeping on top of analyses and conducting trend analyses in a timely manner after each new year of data collection is complete. Can’t emphasize how great this is and the list of Annual Reports on the NCPN website is impressive.
2. The methods and analyses have been very explicit about incorporating “distance from observer” which is clearly an important detection covariate.
3. However, distance from observer is likely not the only important detection covariate and I had trouble determining to what extent other analyses have been explored. I did see mention of including “Observer” as a covariate somewhere...
4. The data are amenable to many other forms of analysis and don’t *have* to include distance. The PIs already truncate the data at 125 m, so why not truncate at 100 m and treat them like regular point counts and explore other analysis methods? When it comes to point count data and analysis options, the sky is the limit!
5. I am also increasingly an advocate of exploring trends using the raw or unadjusted count data. We have to accept certain assumptions to do this, but we also have to accept certain assumptions when we rely exclusively on modeled/adjusted estimates. The greatest benefit of using unadjusted data is that we can explore what is happening for ALL species (instead of just the most abundant species).
6. There are potentially large benefits to analyzing all the data simultaneously rather than the current approach of trying to estimate density for each year independently. I know the PIs know this but it should be mentioned here regardless. My hunch is that this could be the single biggest opportunity to enable trend estimation for more species. It was for the ERMN.

Question 5: Are There Any Recommended Changes to Procedures That Would Enhance the Overall Quality and Usefulness of the Data Being Gathered?

Not that I would suggest now. There may be changes that make sense but it should be based on the analysis of data collected to date. For example all the covariate data on vegetation.

Question 6: Can These Data Be Combined with Any Other Networks in This Review; What Are the Obstacles to Larger Scale Analyses?

Not sure yet. Too early in the review process for other networks to know. But an obvious limitation is that sampling is limited to specific habitat types. SCPN seems like a potential match but not sure about extent of PJ and Sage across other networks.

Question 7: Is There an Advantage to Merging Approaches at This Point? What Would They Be and How Might We Achieve That Without Losing What We've Already Done?

I think this one is beyond the scope of review for now.

Question 8: Are All Appropriate Covariate Data Being Collected? Are the Covariate Data Currently Collected Being Used in Analyses?

The protocol outlines substantial effort that has been put into habitat measurements and I did not see any analyses that utilized this information. This seems like large omission especially because of the effort involved with collecting and managing these data. It also appeared that “observer” was the only other covariate potentially used during density estimation (as a detection covariate; obviously “distance” is the primary covariate used explicitly). This is an important topic because it is the covariates that will ultimately help us better understand why we see the trends we see. Some covariates can be generated later. But others, like the local veg measurements collected in the protocol, could prove to be invaluable (or perhaps a waste of time!). I strongly encourage exploring which ones are helpful and assess if and how the rapid veg data collection can or should be modified.

Question 9: Are the Conclusions Drawn by Major Findings Appropriate?

From what I can tell yes. With the caveat that we don't know if the species with non-significant trends are actually stable (versus insufficient power to detect trends that may be occurring).

Question 10: If We Had Just a Little Bit More (\$10,000), How Would We Change the Bird Monitoring Program? If We Had a Little Bit Less, How Would We Change?

I like this question but hard to address. How much does NCPN currently spend on this protocol?

Question 11: How Does a Changing Climate Affect the Design of the Monitoring Programs (Timing, Vegetation Change to Target Population)?

Perhaps the biggest concern is that the habitats are likely to change as the climate changes. But I am still trying to get my head around whether or not this is a bad thing or a good thing. The habitat approach to monitoring could be a real positive in this regard. But the protocol team alludes in many places to the fact that these habitats are intermixed and like all things in ecology are somewhat messy. I keep coming back to the fact that there appears to be a wealth of vegetation data collected at each point count station that should be looked at that could potentially help here too.

Question 12: Does the Current Monitoring Program Help Address Climate Change Effects on Birds? Can the Current Design Statistically Address Climate Related Changes?

I guess I would say “unknown” at this point. But clearly the water balance analyses and manuscript are a first step in trying to understand climate effects on aridland birds. I also have to say that the

manuscript shows some really interesting results but seems to beg more questions than it answers. So, the team is really just starting to dig into this issue.

Question 13: Have the Results Been Made Available in NRTR Annual Reports and/or Peer Reviewed Scientific Publications? Are There Suggestions on How to Improve the Annual Reports?

Yes. Impressive set of NRRs, Briefs, and Articles. Looks like something for every year of monitoring which is amazing. Based on a quick skim through several of them it appears each one builds off the prior year; incorporating the most recent year of data collection. So clearly the protocol leads have been staying on top of basic data analyses and providing the information to the network/parks.

Question 14: Is the Balance of Publications Between Peer-Reviewed Journals and NRR Reports Appropriate to Scientific Findings and Implications to Management?

Hard to assess but from what I can tell the first peer-reviewed journal article is under review (accepted?) right now. I would consider pausing the “routine” annual reports and focus a year (or three) on different analyses and publications. Clearly a lot of data at hand to work with and explore.

Question 15: Are There Collaborations the Network Could Take Advantage of to Share Data and Findings?

I’m curious about the original partnership with Rocky Mountain Bird Observatory and stated goal to share methods and data across these habitats throughout several Western states. What happened? Update: This was addressed during Q&A.

Question 16: Room for Individual Network Questions or Concerns

1. Curious about archiving data, field sheets, and other materials at Western Archeological and Conservation Center. Not an NPS facility? And not within the NCPN? Tradeoffs but I feel like we should own the data and then disseminate to other stakeholders/interested parties. I worry there is substantial backlog of QC and data management needs that are not being addressed by punting responsibility for the data to a third party. I suggest bringing it home.
2. It dawned on me that after reading the 2020 report and several briefs and articles I don’t think I ever learned which species are most abundant in each habitat or each park. Or which might be priorities for conservation or management or else. If any park managers or other stakeholders are not “bird people” they might be missing the big picture. Update: I do see some of this in the water balance manuscript. This may have been covered in prior reports that I did not look at but I feel like more could be done to call out which are the most abundant species in each park and habitat. Which are of regional conservation status. What have learned about the most iconic species (e.g., Sage Thrasher, Sagebrush Sparrow). Bottom line: What species do we really care about and why? And what have we learned about them (rather than just focusing on the species for which we have the most data which is in essence putting the cart before the horse).

Matthew Johnson

Network Program Manager, NPS Southern Colorado Plateau Network, National Park Service, Flagstaff, AZ

Questions/Goals of Review Addressed by Peer Reviewers

Question 1: Are the Objectives for the Monitoring Program Still Clear, Relevant, and Achievable? Have They Been Answered in Reporting and Papers?

Program objectives are clear and appear achievable; however, power analysis has not been conducted to determine if existing methods have an 80% probability of detecting a 3% decline in species density over a 30-year period, with a Type I error rate of 10%. Population density trends were presented in a NPS report and their correlation with site characteristics (water deficit) have been explored. The objective of monitoring status and trends in riparian, pinyon-juniper, and sagebrush habitats across the NCPN could be more relevant to management by examining spatial variation in population trends (i.e., estimate or control for spatial variation across NCPN when producing density estimates). It also would be nice to see population density modeled with habitat as a predictor variable to compare trends among habitats.

Question 2: Are the Basic Bird Detection Methods Still the Best for Objectives in the Protocol and for the Cost? Are There Alternative Measures to Consider? If There Are New Methods, These New Methods Would Need to Be Cost-Effective and a Transition Period and CMOS Data Transition Approach Would Need to Be Discussed.

Field methods are suitable for objectives. It is possible that extreme variation in density estimates between consecutive years could be ameliorated by sampling additional areas. Increased sampling effort would not be cost-effective. It is worth exploring whether alternative modeling approaches (Bayesian hierarchical framework) may refine density estimates. It also is worth considering whether a shift from habitat- to space-based monitoring might increase accuracy and precision of network-wide species density estimates and facilitate combining datasets across networks. Shifting to a space-based method may not be cost neutral or may result in reduced sampling in specific habitat categories.

Question 3: Does the Bird Monitoring Survey Design Ensure That Data Are Representative of the Target Populations and Sufficient to Allow Defensible Conclusions to Be Derived About the Resources of Interest?

The survey design is generally fine but see response #4. Monitoring population trends using a space-based approach might increase some species' detection probabilities and provide greater analytical opportunities, versus habitat-based approach. Space-based monitoring, coupled with existing remotely sensed environmental data, would increase the program's scope of inference and opportunity to contribute to understanding bird ecology across habitat types.

Question 4: Are the Analytical Approaches Appropriate for the Trend Analysis and for the Objectives? How Has the PI Ensured That They Are Capitalizing on the Most Relevant Statistical Methods?

A single density estimate per species/habitat across $>100,000 \text{ km}^2$ does not provide extremely useful network wide or park specific population monitoring. Density likely varies within a habitat type. Additional analyses, data or both are needed to detect and interpret density changes across the network and habitats. The Bayesian hierarchical framework approach seems promising. It is not clear whether statistical methods accounted for unequal sampling over time.

Question 5: Are There Any Recommended Changes to Procedures That Would Enhance the Overall Quality and Usefulness of the Data Being Gathered?

Population density modeled with habitat and park as predictor variables to compare trends among habitats and inform site-specific management (Bayesian hierarchical framework?). See responses #1-2,4. It is worth considering whether a shift from habitat- to space-based monitoring might increase accuracy and precision of network-wide species density estimates and facilitate combining datasets across networks. Shifting to a space-based method may not be cost neutral or may result in reduced sampling within specific habitat categories.

Question 6: Can These Data Be Combined with Any Other Networks in This Review; What Are the Obstacles to Larger Scale Analyses?

KLMN, NCPN and SCPN are habitat-based monitoring programs. A first step might be to combine these datasets (in whole or part) to examine temporal trends. Most other programs used point counts of sufficiently similar length (and methods) that datasets may be culled or restructured to permit across-network analyses. Habitat based protocols may be a limiting factor when combining datasets across networks as birds are likely monitored in a broader range of habitats in other networks and non-habitat methods may lack adequate sampling in all habitat categories monitored in KLM, NCPN, SCPN. During the “snap-shot” presentations, I recalled thinking it is unfortunate SFAN restricts monitoring to streamside habitats. SFAN noted they monitor in riparian habitats, but I cannot recall if they monitor all riparian habitat or merely streamside habitats. Although riparian zones support diverse bird communities, SFAN’s program does not monitor bird trends across the landscape and the data will be limiting when combined with other networks.

Question 7: Is There an Advantage to Merging Approaches at This Point? What Would They Be and How Might We Achieve That Without Losing What We’ve Already Done?

Documented shifts in breeding phenology and range may necessitate merging approaches to adequately monitor populations during this period of climate change. I&M monitoring programs provide an existing network of opportunity to document and interpret numerical and spatial population change across the Pacific and Intermountain regions. Consolidated monitoring across the landscape can provide context to observed population changes in networks and parks while elucidating patterns of change across regions. Documenting range and habitat shifts and species turnover within park bird communities will inform ongoing climate change adaptation discussions (e.g., natural versus facilitated community transitions).

Although not a simple or consistent process across networks, existing protocols can be modified to enable networks to combine datasets for analyses. Protocol modification may reduce some relatively small-scale inference ability within parks while estimating trends at larger scales. Species of conservation concern may require species-specific monitoring efforts (e.g., PACN monitoring program) and unique habitats also may require network-level monitoring above and beyond merged protocols developed for larger scale analyses. Financial and logistic constraints will no doubt lead to something falling off the monitoring plate in each network while merging protocols, but we will never lose what has been done. Results from analyses of existing data can be used to balance network- and park-specific monitoring needs when modifying protocols toward larger scale analyses.

Merging approaches will provide a landscape perspective to local results, and permit NPS to better utilize recent statistical advances while working at larger scales.

Question 8: Are All Appropriate Covariate Data Being Collected? Are the Covariate Data Currently Collected Being Used in Analyses?

Covariate data collected (overstory, shrub layer, ground cover) have not been used. Analyses incorporating these vegetation covariates is of interest. I suspect limited funding has precluded efforts to expand modeling to include these covariates. Most covariate data of interest can be estimated via remote sensing methods. It would be useful to incorporate spatial and environmental covariate data in future modeling. Controlling for site specific conditions requires thoughtful investment of limited resources to acquire and analyze relevant covariates over space and time. Collection, processing and applying remotely sensed covariate data requires work not currently undertaken, but see NCPN water deficit manuscript. I have enjoyed thinking about reported correlations between bird densities and water deficit in the three NCPN habitats monitored. This approach may prove useful in developing predictive models of bird population trends and species' vulnerabilities to climate change. Future analyses should apply remotely sensed covariates with known or testable mechanisms impacting bird populations.

Question 9: Are the Conclusions Drawn by Major Findings Appropriate?

No conclusions were drawn in monitoring reports. The water deficit manuscript reports correlations between population density and water deficit (which varied across species within a habitat type and within some species across habitat types). The manuscript suggests water deficit may be a useful metric for future efforts seeking to predict changes in population persistence and distribution.

Question 10: If We Had Just a Little Bit More (\$10,000), How Would We Change the Bird Monitoring Program? If We Had a Little Bit Less, How Would We Change?

Additional support could be used to analyze data and sample additional space. Reduction in funding would reduce the network's ability to detect change in bird populations.

Question 11: How does a changing climate affect the design of the monitoring programs (timing, vegetation change to target population)?

See first paragraph of response #7. Phenological and vegetation community changes in response to climate change require birds and ornithologists adapt. Monitoring results should be assessed frequently, and protocol modifications should be considered to maintain high bird detection rates. Protocol modifications (e.g., sampling earlier in the season) to improve detection probability would do well to experimentally evaluate proposed modifications to ensure future analyses adequately account for methodological changes. Within and across network productivity could be increased by combining existing datasets (and standardizing future methods) to evaluate populations change in relation to existing large-scale datasets (environmental covariates).

Question 12: Does the Current Monitoring Program Help Address Climate Change Effects on Birds?
Can the Current Design Statistically Address Climate Related Changes?

Yes, the water deficit manuscript is an example. Combining datasets for analyses would likely increase the program's ability to document climate change effects on birds, see second paragraph of response #7. The network also could incorporate environmental variables in models to assess, or partially control for variation in, conditions over space and time to understand observed density patterns. See responses #5 and #8.

It is valuable to understand temporal and spatial shifts in bird phenology and distribution associated with climate change. Analyzing within and across network datasets with a Bayesian hierarchical framework approach should increase ability to track density trends over time. It is worth considering occupancy modeling within and between parks to quantify spatial changes in distribution over time. Statistically rigorous extrapolation outside sampling sites (parks) is needed to meaningfully use occupancy models to track spatial patterns. Extrapolated-to areas would need to be part of a sampling frame from which I&M sites were selected. It may be possible to integrate intensively sampled areas within parks with much spatially broader Breeding Bird Survey data (which were sampled from a very large sampling frame) to produce useful occupancy results.

Question 13: Have the Results Been Made Available in NRTR Annual Reports and/or Peer Reviewed Scientific Publications? Are There Suggestions on How to Improve the Annual Reports?

Yes, results were presented in a clear and easily digestible format. Results could be interpreted in reports with management considerations discussed. See response #9.

Question 14: Is the Balance of Publications Between Peer-Reviewed Journals and NRR Reports Appropriate to Scientific Findings and Implications to Management?

I suspect sample sizes only recently permitted trend analyses, and the program has reported results evenly between peer-viewed papers and internal reports. The water deficit manuscript presented a potential tool to address management needs. The report did not present management implications. Analyses incorporating a Bayesian hierarchical framework (and covariates) would likely permit asking several questions of interest to management and contribute to knowledge of bird ecology.

Question 15: Are There Collaborations the Network Could Take Advantage of to Share Data and Findings?

There is great opportunity to share data across networks. It might take a year to collate existing data before a usable dataset is available. Combining datasets across networks will provide a powerful tool that would produce numerous products for many years.

Externally, the USDA Forest Service routinely uses point counts to conduct wide-spread bird monitoring across the western US and collaboration with this sister agency could be fruitful. However, coordinating across multiple Forest Service regions is challenging with little certainty of success. I (probably) would not recommend making this investment.

There are numerous datasets that are compatible with I&M's. A general call for data and collaboration to the ornithological community (and sister agencies) would likely produce good

response. It would be a monumental effort to coordinate, compile & standardize data, and design analyses to take advantage of such a theoretical dataset. However, improved understanding of population trends across the western US would be amazingly useful to bird conservation in our parks.

Additional Note

Across I&M, migratory birds that breed in parks occupy National Park Service Lands for a portion of the annual cycle. Environmental conditions outside of parks influence bird demographic rates, and monitoring efforts in parks are not able to assess causes of population change without knowledge of factors impacting birds throughout the annual cycle. Improved understanding of migratory connectivity (the degree of linkage between different parts of an animal's migratory range due to the movement trajectories of individuals) is necessary to examine causes of population change in parks.

Appendix C: Park Management Responses

Question 1: Have You Found the Bird Monitoring Data to Be Useful to Your Park? In What Ways?

NR1: I'm very glad we are collecting the data. It is not used a lot, but for certain projects or research requests it is important to have the data. For example, with air tour management planning, concessionaire tour planning, or park infrastructure projects. And as a general evaluation of trends over time.

NR2: Yes, the NCPN bird species list provides us information we would not have otherwise, and would have to seek outside fund sources to acquire. Combining data to monitor trends across the Colorado Plateau is useful knowledge in the face of climate change.

Superintendent: I have not been able to delve very deeply, but have not been able to find any detailed monitoring results for our park. So I guess I have to say No.

Question 2: How Have You Used Bird Data for Specific Management Decisions or Public Education?

NR1: Similar to above answer regarding park infrastructure or other planning efforts. Not for public education that I'm aware of.

NR2: The NCPN species lists are shared with curious visitors and local residents who are seeking to increase their knowledge of the biodiversity that Colorado National Monument supports. The landbird species list is often referenced against the Migratory Bird Treaty Act protected species, and any state species of concern to be considered in National Environmental Policy Act (NEPA) compliance during park project discussions.

Superintendent: I do not know of any use for management decisions. Data were probably useful in helping determine locations for the Christmas Bird Count in the park for public education purposes, though.

Question 3: What Do You Wish the Bird Data Could Provide but Currently Does Not?

NR1: No opinion on this.

NR2: I really appreciated the 2015 infographic about species of concern by habitat. That breakdown is helpful when developing ecological restoration priorities and the quick snapshot is useful in project planning. A short presentation/webinar or phone call about what these results might be telling our specific park could be helpful for resource managers without wildlife backgrounds.

Superintendent: My apologies if it exists, but if not, then we need to understand if there are any migratory birds of concern to consider for park projects that may disturb these species, especially their nesting habits. Also, knowing frequency of species would be good. Or at least a recommendation in the reports that helps the park justify funding for such monitoring as the MAPS [Monitoring Aviation Productivity and Survivorship] program.

Question 4: What Has Been the Biggest Benefit of Having a Bird Monitoring Program?

NR1: Trends over time, and information that we otherwise would not have and never get.

NR2: I really appreciated the 2015 infographic about species of concern by habitat. That breakdown is helpful when developing ecological restoration priorities and the quick snapshot is useful in project planning. A short presentation/webinar or phone call about what these results might be telling our specific park could be helpful for resource managers without wildlife backgrounds.

Superintendent: I'm not sure.

Question 5: What Bird Monitoring Products Has Your Network Program Provided to You? Are They Satisfactory to Your Needs?

NR1: Annual reports and trend analyses. Yes, they meet our needs.

NR2: Updated species lists are meeting our needs. Reports are meeting our needs.

Superintendent: All I know is the links on the Landbird page. There was a brief and a link to the full 2019 report which only talked about Pipe Spring. I could find nothing that would inform management decisions for our park.

Question 6: Please Share Any Other Comments You Would Like to Add.

NR1: None.

NR2: None

Superintendent: It's great to read about trends across mostly disconnected units of the NPS. But it doesn't really inform management decisions at the park level. I'm sorry, I do love this program, but can find no basis to give very positive feedback as far as informing management decisions. If there could be a way to add a Recommendation section to your reports that provides specifics on what a park should be looking to fund to glean such information, that would be great.

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