



Bird Community Monitoring for Petrified Forest National Park

2009 Summary Report

Natural Resource Data Series NPS/SCPN/NRDS—2012/421



ON THE COVER
Brewer's sparrow
Photography by Dustin Welch

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1 Introduction and background

The National Park Service Inventory and Monitoring Program was designed to determine the current status and monitor long-term trends in the condition of park natural resources, providing park managers with a strong scientific foundation for making decisions and working with other agencies and the public for the protection of park ecosystems. The goal of bird community monitoring is to provide status and trends data on bird communities in several predominant habitats where integrated upland or riparian vegetation monitoring is also occurring.

For Petrified Forest National Park (PEFO), Southern Colorado Plateau Network (SCPN) and park staff selected grassland as an important ecosystem for vegetation and bird community monitoring. This habitat is largely composed of perennial grasses and shrubs, and comprises a large area of the park. The grassland habitat of PEFO's upland bird community faces several threats, including climate change and the invasion of nonnative species. These threats can potentially alter the composition and structure of the grasslands and affect the distribution and abundance of grassland bird species.

In 2009, through a Colorado Plateau Cooperative Ecosystems Study Unit agreement with SCPN, we continued monitoring the upland bird community of the target grassland habitat in PEFO which had been initiated in 2007. In this report, we document monitoring activities in the 2009 field season and summarize the data that were collected.

2 Methods

2.1 Sampling frame

A sampling frame is the area within which we randomly locate our sites, and hence, the area to which statistical inferences can be made based on monitoring data. The sampling frames for vegetation and bird community monitoring at PEFO were derived from the maps of two ecological sites, Clayey Fan and Sandy Loam, developed by the U.S. Natural Resources Conservation Service (NRCS; See Appendix A of DeCoster et al. 2012). Ecological sites are landscape divisions with characteristic soils, hydrology, plant communities, and disturbance regimes and responses, and are based on soil survey data (Butler et al. 2003).

We merged the two ecological sites into one, henceforth referred to as grassland habitat. To complete the bird community monitoring sampling frame, we modified the map of the sampling frame using Geographical Information System (GIS) technology to eliminate

- areas that were not within the target habitat (roads, buildings, and infrastructure)
- areas near paved roads and the park boundary
- areas with slopes $\geq 20\%$ to prevent erosion from occurring as a result of the field work

When monitoring in large target habitats, such as PEFO grassland, we employ a cluster sampling method in which bird sample plots are clustered around a primary sampling unit so that a cluster of plots can be sampled in a single morning. Primary sampling units are selected in a probabilistic manner from a grid of uniformly-spaced points using a Generalized Random-Tessellation Stratified (GRTS) design (Stevens and Olsen 2004). First, the PEFO staff reviewed the sampling plots and rejected those plots that landed in the proximity of archeological sites. Next, the bird monitoring crew evaluated the accessibility of each cluster, rejecting those that were not. The bird monitoring crew then visited and assessed each sampling plot to ensure that (1) it fell within the target habitat, (2) had a slope of less than 20%, and (3) did not contain a major disturbance. Any plots that did not meet these criteria were rejected. Ten clusters were selected for monitoring and 20 clusters were rejected (fig. 1).

2.2 Field methods

We conducted bird sampling at permanent sampling plots, or Variable Circular Plot (VCP) count stations, in grassland habitat at PEFO during two survey periods (table 1). A total of ten clusters, each containing 10 sampling plots, were sampled (fig. 1). A brief description of the field methods we employed is provided here. A more detailed description can be found in Holmes et al. (in preparation).

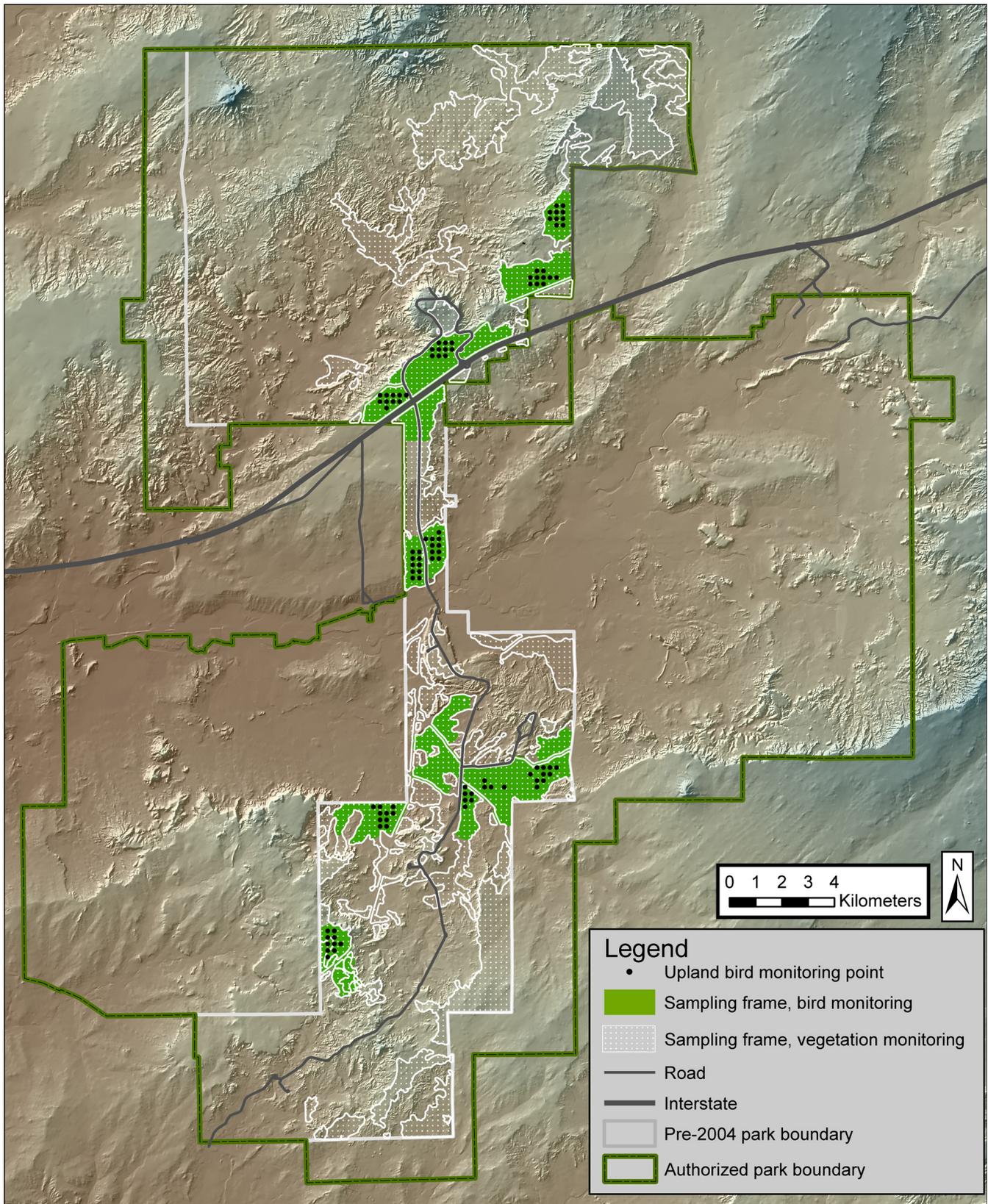


Figure 1. Bird monitoring sampling frame of grassland habitat at Petrified Forest National Park with the 10 clusters of 10 bird and habitat sampling plots and upland vegetation monitoring sampling frame

At each sampling plot, we conducted a VCP count, noting all birds seen or heard during an eight-minute sampling period, regardless of the distance from the observer. We recorded the species, method of detection, gender (if known), and distance from the sampling plot center to the individual bird. Distances were measured to the nearest meter using a laser range finder. During a single morning, approximately ten VCP counts each were

Table 1. Survey periods and sampling effort for bird community monitoring at Petrified Forest National Park in 2009, dates VCP counts were conducted and the number of plots sampled.

Survey Period	Dates (2009)	Number of clusters	Number VCP counts
1	5/6–5/10	10	100
2	6/2–6/6	10	100

conducted by two technicians surveying separate clusters of sampling plots.

Habitat sampling was conducted on a 50 m radius macroplot centered on a VCP sampling plot, and in four subplots within the macroplot. First we estimated and recorded the area occupied by vegetation types and other land-use types in the

macroplot. Then we recorded foliar vegetation cover by functional group (e.g. forbs, shrubs) for the four subplots. Ocular estimates of foliar cover were made using a modified Braun-Blanquet cover class scale.

2.3 Data summary

2.3.1 Variable Circular Plot count data

The following data were summarized for the target habitat (grassland) at PEFO. The sample unit for bird data is the cluster (which contains 10 VCP sampling plots).

- *Observed species richness* (unadjusted for detectability) is the number of species detected within a given area and specified time.
- *Mean number of individuals detected* for each species is reported as the average number of individuals detected per 8-minute VCP count. To calculate mean number of individuals detected for each species, the data for a given cluster are averaged across the two survey periods, and a mean number of individuals detected and standard deviation are calculated. Then the cluster means are used to calculate the mean number of individuals detected and standard deviation for the target habitat. Detectability-based density estimates are not reported here, but they will be derived for multi-year trend reports.
- *Mean frequency* is the proportion of plots “occupied” by each species. To calculate species frequency, we first calculated the proportion of plots in each cluster where the species was detected. For example, if black-throated sparrows were detected on 2 of the 10 plots in a cluster, during any or all of the two visits to that plot, the proportion of plots occupied in that cluster is 0.20 (20%). We then calculate the mean proportion of plots occupied across the ten clusters for the target habitat.

2.3.2 Habitat data

Habitat data will be used with bird sampling data to examine bird-habitat relationships. For PEFO, habitat data were collected within a circular 0.8 ha macroplot which contained four subplots and was centered on each bird sampling plot. Data were summarized at three levels: the macroplot, the cluster, and the target habitat. The means and standard deviations for the cluster were calculated from the macroplot data. The means and standard deviations for the target habitat were calculated from the cluster data.

Vegetation cover types. For PEFO, we classified four vegetation cover types and two non-vegetation cover types, as shown in Table 2. For each cover type, we calculated

- *mean percent cover*, by calculating the mean cover per cluster for each vegetation or other cover type (using the cover class midpoints), and then calculating the mean of the cluster means to determine the mean and standard deviation for the target habitat
- *frequency*, by calculating the number of macroplots within a cluster where a specific cover type had been recorded, as a proportion of the 10 macroplots per cluster, then calculating the mean and standard deviation of the proportion of macroplots per cluster for the target habitat

Foliar cover of functional groups. The mean foliar cover for each functional group was calculated for the macroplot (using the cover class midpoints), then for the cluster. The mean and standard deviation were then calculated for the target habitat.

Table 2. Vegetation cover types and other landcover types in grassland habitat at Petrified Forest National Park, 2009

Vegetation and other landcover types	Description
Grassland: Clayey Fan	Vegetation includes mix of low shrubs and grass. Typically mound saltbush (<i>Atriplex oobvata</i>) and alkali sacaton (<i>Sporobolus airoides</i>) dominate, with blue grama (<i>Bouteloua gracilis</i>), galleta grass (<i>Pleuraphis jamesii</i>), four-wing saltbush (<i>Atriplex canescens</i>), and shadscale (<i>Atriplex confertifolia</i>) also present.
Grassland: Sandy Loam Upland	This complex of ecosites occurs over gently rolling topology in the park. Sandier areas occur on slight hills or ridges, and contain a mix of shrubs and grasses. Four-wing saltbush, sandsage (<i>Artemisia filifolia</i>), blue grama, galleta grass, muhly (<i>Muhlenbergia</i> spp), and various <i>Sporobolus</i> spp are typically present. In low areas, soils have more clay (often showing typical 'shrink-swell' crack lines), and there is more variation in plant species. This type is sometimes expressed as a wide, shallow valley consisting of a virtual monoculture of alkali sacaton, with little to no shrubs. It can also be a mix of grass and shrubs, with galleta grass and four-wing saltbush as the dominants.
Barren: Claysprings Soils	These areas have highly cracked soil surfaces and are barren of vegetation, or contain only small annual species. They are highly clayey and may have standing pools of water or show evidence of flooding.
Grassland: Sheppard Soils	These areas look like dunes or small hillocks. The soils are deep and very sandy. Shrubs are noticeably taller and more diverse, generally some sandsage and four-wing salt-bush and/or shadscale, with little to no mound saltbush. Grasses on these sites are usually more diverse than on the Clayey Fan ecosites, and often include spike dropseed (<i>Sporobolus contractus</i>).
Roads	Paved or unpaved roads
Dry Arroyo	Dry wash with little or no grass or shrubs

3 Results

3.1 Summary of bird community data

In 2009, we conducted a total of 200 VCP counts in grassland habitat at PEFO (table 1), and detected 1,388 individuals of 29 species (table 3). The most commonly detected species were the horned lark and the black-throated sparrow, which together comprised 74.06% of the total number of individuals detected.

The mean number of individuals detected per species during a VCP count, and the mean frequency of plots with detections (averaged across the frequency for each sampling cluster), for each species detected in PEFO grassland habitat are presented in Table 4. The horned lark had the highest mean number of individuals, with an average of 3.65 individuals detected during an eight-minute count. They also range throughout the park and were detected in every plot. The brown-headed cowbird had a relatively low number of detections (0.09 detections/VCP count), but was widely distributed and detected on 70.00% of the plots (table 4).

Table 3. Bird species and total number of detections during VCP counts in grassland habitat at Petrified Forest National Park. Data are from VCP counts conducted in 2009. Species are listed in descending order of the total number of individuals detected.

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
horned lark	<i>Eremophila alpestris</i>	730	52.59
black-throated sparrow	<i>Amphispiza bilineata</i>	298	21.47
Brewer's sparrow	<i>Spizella breweri</i>	87	6.27
eastern meadowlark	<i>Sturnella magna</i>	84	6.05
common raven	<i>Corvus corax</i>	32	2.31
scaled quail	<i>Callipepla squamata</i>	23	1.66
northern mockingbird	<i>Mimus polyglottos</i>	22	1.59
brown-headed cowbird	<i>Molothrus ater</i>	18	1.30
mourning dove	<i>Zenaida macroura</i>	17	1.22
western meadowlark	<i>Sturnella neglecta</i>	12	0.86
violet-green swallow	<i>Tachycineta thalassina</i>	10	0.72
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	7	0.50
house finch	<i>Carpodacus mexicanus</i>	5	0.36
loggerhead shrike	<i>Lanius ludovicianus</i>	5	0.36
rock wren	<i>Salpinctes obsoletus</i>	5	0.36
Say's phoebe	<i>Sayornis saya</i>	5	0.36
Cassin's kingbird	<i>Tyrannus vociferans</i>	4	0.29
gray flycatcher	<i>Empidonax wrightii</i>	4	0.29
lark sparrow	<i>Chondestes grammacus</i>	4	0.29
Cassin's sparrow	<i>Aimophila cassinii</i>	3	0.22
golden eagle	<i>Aquila chrysaetos</i>	3	0.22
American kestrel	<i>Falco sparverius</i>	2	0.14
burrowing owl	<i>Athene cunicularia</i>	2	0.14
barn swallow	<i>Hirundo rustica</i>	1	0.07
house sparrow	<i>Passer domesticus</i>	1	0.07
turkey vulture	<i>Cathartes aura</i>	1	0.07
vesper sparrow	<i>Pooecetes gramineus</i>	1	0.07
western kingbird	<i>Tyrannus verticalis</i>	1	0.07
yellow-rumped warbler	<i>Dendroica coronada</i>	1	0.07

Table 4. Mean number of individuals detected per VCP count, mean frequency of occupied plots, and proportions of clusters occupied in grassland habitat at Petrified Forest National Park, 2009

Species	Mean # of individuals	SD	Mean frequency occupied plots (%)	% Clusters occupied
horned lark	3.65	1.08	100.00	100.00
black-throated sparrow	1.49	0.95	78.00	100.00
Brewer's sparrow	0.44	0.41	39.00	70.00
eastern meadowlark	0.42	0.37	50.00	90.00
common raven	0.16	0.15	24.00	80.00
scaled quail	0.12	0.19	15.00	50.00
northern mockingbird	0.11	0.18	16.00	50.00
brown-headed cowbird	0.09	0.13	11.00	70.00
mourning dove	0.09	0.12	12.00	40.00
western meadowlark	0.06	0.09	12.00	40.00
violet-green swallow	0.05	0.09	6.00	40.00
broad-tailed hummingbird	0.04	0.05	7.00	40.00
house finch	0.03	0.05	4.00	20.00
loggerhead shrike	0.03	0.04	5.00	30.00
rock wren	0.03	0.05	4.00	30.00
Say's phoebe	0.03	0.04	5.00	40.00
Cassin's kingbird	0.02	0.06	3.00	10.00
gray flycatcher	0.02	0.05	3.00	20.00
lark sparrow	0.02	0.03	4.00	30.00
Cassin's sparrow	0.02	0.03	3.00	20.00
golden eagle	0.02	0.05	3.00	10.00
American kestrel	0.01	0.03	2.00	10.00
burrowing owl	0.01	0.03	2.00	10.00
barn swallow	0.01	0.02	1.00	10.00
house sparrow	0.01	0.02	1.00	10.00
turkey vulture	0.01	0.02	1.00	10.00
vesper sparrow	0.01	0.02	1.00	10.00
western kingbird	0.01	0.02	1.00	10.00
yellow-rumped warbler	0.01	0.02	1.00	10.00

3.2 Summary of bird habitat data

We found three vegetation cover types (grassland: sandy loam upland, grassland: clayey fan, and grassland: sheppard soils) and one other cover type (dry arroyo) in the macroplots (0.8 ha circular plots centered on each bird sampling plot) in the PEFO sampling area (table 5). When we calculated the mean percent cover for each vegetation type, Sandy Loam Upland was the most common cover type, accounting for, on average, 64.88% of the overall vegetative cover of the macroplots.

The grassland habitat at PEFO had, on average, total foliar cover of 17.32%. The amount of shrub cover varied considerably, ranging from 1.30% to 7.54%, as did perennial grass cover, which ranged from 2.18% to 9.75% (table 6).

Table 5. Mean cover of vegetation and other cover types, standard deviation (SD), and range; and frequency (%) in target grassland habitat in Petrified Forest National Park, 2009

Vegetation or other cover type	Cover (%)	SD	Range	Frequency (%)
Grassland: Sandy Loam Upland	64.88	37.03	0.00–87.50	75.00
Grassland: Clayey Fan	19.60	34.43	0.00–87.50	26.00
Grassland: Sheppard Soils	2.55	8.06	0.00–25.50	4.00
Dry Arroyo	0.69	1.92	0.00–6.10	5.00

Table 6. Foliar cover of functional groups in target grassland habitat in Petrified Forest National Park, 2009

Functional groups	Mean foliar cover (%)	Standard deviation	Range
Total foliar cover	17.32	6.68	5.45–29.50
Perennial grasses, graminoids	5.74	2.53	2.18–9.75
Annual grasses	0.57	0.19	0.50–1.10
Forbs	0.65	0.24	0.50–1.18
Shrubs	5.07	2.33	1.30–7.54
Understory trees (<1.4 m height)	0.51	0.02	0.50–0.56
Standing dead herbaceous	5.28	3.65	2.74–14.94
Standing dead woody	0.96	0.31	0.63–1.35

4 Discussion

These data represent the second year of bird monitoring for the grassland bird community at PEFO. The PEFO grasslands are home to five common bird species—the eastern meadowlark, loggerhead shrike, black-throated sparrow, lark sparrow, and horned lark—that are among the “top 20 common birds in decline” in the United States (Butcher and Niven 2007). The eastern meadowlark, which was the fourth most detected species in PEFO grasslands, has declined by an estimated 72% nationwide in the last 40 years. Five percent or less of the eastern meadowlark’s distribution is on public lands (U.S. North American Bird Conservation Initiative Committee 2011), including NPS lands. The loggerhead shrike was estimated to have declined by 70%, the black-throated sparrow and the lark sparrow each by 63%, and the horned lark by 56% nationwide (Butcher and Niven 2007). Continued monitoring at PEFO should provide data to track changes in these species abundance, occurrence, and habitat over time.

The Brewer’s sparrow was also among the most common species in PEFO grasslands. Breeding Bird Survey (BBS) data for the Brewer’s sparrow from 1968 to 2009 (Sauer et al. 2011) reveal negative trends in population size in the Southern Rockies/Colorado Plateau Region, as well as the Western BBS Region, and the entire United States. This species is on the Yellow WatchList of declining species, part of the United States WatchList of Birds of Conservation Concern (Butcher et al. 2007), as well as the federal list of Birds of Conservation Concern (U.S. Fish and Wildlife Service 2002). In addition, the Partners in Flight’s North American Landbird Conservation Plan (Rich et al. 2004) lists the Brewer’s sparrow on its watchlist of species of national conservation concern, and the Arizona Bird Conservation Plan (Latta et al. 1999) considers it a high priority for conservation. Brewer’s sparrows are thought to be common nesters in appropriate habitat in Arizona, during wet or normal precipitation years, but they can be nearly absent when winter and spring precipitation is low (Corman and Wise-Gervais 2005). Continued monitoring should provide insight into the relationship between precipitation and Brewer’s sparrow distribution and abundance.

Our long-range plan is to conduct VCP counts every three years to track changes in bird species abundance, distribution, and habitat metrics over time. Each year’s data will be compared to previously collected data to detect changes in bird species abundance, occurrence, and density (for species with adequate sample size) over time. Trend analyses will be conducted once sufficient data have been collected.

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