



Riparian Landbird Monitoring Protocol for Golden Gate National Recreation Area and Point Reyes National Seashore

Version 4.6 – 2019 Revision

Natural Resource Report NPS/SFAN/NRR—2020/2098



ON THE COVER

Spotted Towhee (*Pipilo maculatus*)

Photograph by: Rick Lewis

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Natural Resource Report NPS/SFAN/NRR—2020/2098

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Revision History Log

Revision log:

Prev. Version #	Revision Date	Author(s) (of changes)	Changes Made	Reason for Change	New Version #
N/A	September 2003	Thomas Gardali, Grant Ballard, Geoffrey R. Geupel, and Sarah Allen	Added stream miles table for GPRA goals, addressed comments from WRD on QA/QC, added SOP 1	Clarification of existing information, minor edits	2.0
2.0	December 2004	Bill Merkle, Tom Gardali, Sarah Allen	Incorporated comments from internal peer review. Several small changes; sampling design change; QAPP changes	Clarification of existing information, addition of information, refining methods and parameters	NA
N/A	November 2006	Thomas Gardali, Diana Humple, Marcus Koenen, David Press, William W. Merkle, Sarah Allen, Geoffrey R. Geupel, Grant Ballard	Addressed comments by internal review.	Complete formal internal review and submit for peer review. To meet new guidelines outlined by Pacific West Region Review Checklist.	3.1
3.1	June 2009	Thomas Gardali, Mark Herzog	Addressed external reviewer comments; added power analysis; changed focus to riparian habitat only; dropped PINN surveys; new study site map; added transect narratives and coordinates and mist-net station maps and coordinates to Establishing and Marking Sampling Plots SOP 3; modified data management SOP 6; fully revised Data Reporting SOP 10; added an Appendix to SOP 8 Data Management to showcase database documentation; detailed analysis protocols	Address comments from formal external review as well as from Penelope Latham and James Agee	4.1
4.1	July 2009	Marcus Koenen, Dave Press, Sarah Allen, Kirk Steinhorst	Minor changes after conducting internal review.	Clarifications	4.2
4.2	Sept 2009	T. Gardali	Response to edits.	Clarifications	4.3
4.3	Sept 2009	M. Koenen	Response to final review.	Clarifications	4.4
4.4	April 2018	Daniel George	Minor passage edit, p.18	Clarification	4.5
4.5	October 2018	Mark Dettling, Diana Humple, Lise Grace, Daniel George	Separated Protocol Narrative from SOPs; updated text to reflect minor changes reported in annual reports & others	Ease of updating individual SOPs in separate documents	4.6

Executive Summary

This document describes a monitoring program for riparian landbirds in two National Park Service units of the San Francisco Bay Area Network (SFAN) in central-coastal California. The purpose of the monitoring program is to detect population trends and underlying demographic rates (productivity and survival) in order to provide information essential to managing network resources. This monitoring plan provides background on past landbird monitoring in the parks, lists measurable objectives for the monitoring program, and summarizes the monitoring scheme, field methods, and data management and analysis. Landbirds are herein defined as passerine (songbirds) and near-passerine (e.g., woodpeckers, hummingbirds) species. The two largest SFAN parks are included in this monitoring plan: Golden Gate National Recreation Area (GOGA) and Point Reyes National Seashore (PORE). A single focal habitat, riparian, is targeted for monitoring due to its importance to landbirds, ecosystem function, and prevalence in the parks.

The diversity and abundance of landbirds in central-coastal California is extraordinary. The PORE bird list alone includes nearly 490 species (Stallcup 2000). Many of these species nest in the region, are year-round or winter residents, or are regular migrants through the area. The region has a long history of ornithological research and monitoring because of this diversity. Recently, the National Inventory and Monitoring Program funded an inventory of landbirds at the San Francisco Bay Area Network of parks between 1998 and 2002 (Flannery et al. 2001, Hammond and Geupel 2001, Haff et al. 2003). In addition to conducting these inventories, Point Blue Conservation Science (hereafter Point Blue; formerly PRBO Conservation Science) has been conducting landbird monitoring in the region since 1965, when the organization was founded and work began at PORE (see Ballard et al. 2003, Howell and Gardali 2003). Monitoring has been done continually at Point Blue's Palomarin Field Station since 1966, and the program helped give birth to such nationally standardized programs as Monitoring Avian Productivity and Survivorship (MAPS, DeSante et al. 2000) and the Breeding Biology and Research Database (BBIRD, Martin and Geupel 1993, Martin et al. 1997). Point Blue has also been conducting annual, standardized point count surveys, nest searching, and constant effort mist-netting at select locations within PORE and GOGA for nearly over a decade (Holmes et al. 1998, Scoggin et al. 2000, Gardali et al. 2003a, Gardali et al. 2003b, Michaud et al. 2004, Samuels et al. 2005). Point Blue continues to do intensive long-term monitoring in PORE that is outside of the scope of this monitoring plan (e.g., at the Palomarin Field Station) but that can be used in conjunction with the data collected as part of the National Park Service vital signs monitoring program.

The relationship between the National Park Service and Point Blue serves as a model partnership that deserves the continued long-term commitment of both entities.

Specific objectives of the long-term monitoring program of landbirds are to:

1. Determine population trends for as many landbird species as possible in riparian habitat during the breeding, fall migration, and winter seasons.
2. Estimate reproductive success and annual survival for as many landbird species as possible in riparian habitat.

Coordination outside of the network is necessary to interpret results produced locally and, importantly, to protect these species because their movements during migration, foraging, and molting can sometimes range outside park boundaries. Point Blue protocols can be integrated with other resource agencies for compatible population analysis. The SFAN monitoring program contributes to California State and U.S. National efforts to assess landbird population status and trends. Point Blue contributes landbird data to MAPS, BBIRD, The Bird Banding Lab (USGS, BBL, Patuxent, MD), California Partners in Flight (CalPIF; www.prbo.org/calpif/; Accessed: June 9, 2009), and to the Avian Knowledge Network (AKN; <http://www.avianknowledge.net/>; Accessed: June 9, 2009) via the California Avian Data Center (www.prbo.org/cadc/; Accessed: June 9, 2009).

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Background and Objectives

Monitoring Rationale

In 1992, the National Park Service's (NPS) Inventory and Monitoring Program (I&M) developed a national policy "to better understand [the] dynamic nature and condition" of natural resources, to detect or predict changes that may require intervention, and to serve as reference points for more altered parts of the environment. By integrating this information into NPS planning, management and decision-making, scientific knowledge of natural resources will improve NPS stewardship of our heritage lands (NPS 75: Natural Resources Inventory and Monitoring Guideline 1992). The I&M Program identified all parks in the NPS system with significant natural resources and in 1998 created 32 "networks" or groupings of parks linked by geography and shared natural resource characteristics. The goals of the networks are to work together to develop common monitoring methodologies for data comparability, to reduce the level of effort, and to share resources. The San Francisco Bay Area Network (SFAN) is one of eight networks in the Pacific West Region of the NPS.

The objectives of the monitoring plan presented here (see below) are not designed to specifically evaluate management actions. Instead, the results of the monitoring program will be used to evaluate ecosystem health (i.e., provide early warning of resource change) and thereby inform managers when management actions are warranted and research is needed. However, it is possible, under some circumstances, to detect changes due to management actions – e.g., monitoring is taking place during a situation where a management action with marked consequences occurred (Johnson 2002). Point Blue's monitoring work that occurred before and after Vision Fire in the Point Reyes National Seashore (PORE) provides a local example of this type of benefit of monitoring (Gardali et al. 2003a, 2005). Additionally, the monitoring approach herein focuses on more than simply counting birds, and as such will provide much more than an "early warning system" (DeSante and Rosenberg 2001, Gardali et al. 2001). Ultimately, the uses of these data will depend on the magnitude of trend, the conservation status of individual species, as well as societal and cultural values and the potential for management actions to effect change.

This monitoring approach has the advantage of being able to evaluate multiple species (community-level) in riparian habitat. The benefit of this approach is that we can look for patterns common to species with similar ecological requirements, which could in turn yield valuable information about the condition of different ecosystem attributes.

Because this planning strategy must include economizing the monitoring workload with the prioritized objectives and, most importantly, budget constraints, we are recommending volunteer monitoring in the smaller urban parks and not including these in the core monitoring scheme. We feel that it is more important to continue and replicate ongoing monitoring projects than to establish new ones in small urban parks that lack significant "natural" areas (e.g., some Historic Sites). Therefore we are only proposing monitoring in the Golden Gate National Recreation Area (GOGA) and PORE. Consequently, although inventories have been done in the other parks (Pinnacles, Fort Point National Historic Site, Eugene O'Neill National Historic Site, John Muir National Historic Site, San Francisco

Maritime National Historic Park, and the Presidio of San Francisco), we only present the monitoring history for the two parks we will monitor as part of this plan.

Additionally, we will focus on one major habitat type – riparian. This is a priority habitat type in SFAN as well as California and the entire West (see below for further discussion). Focusing on this one general habitat is also cost effective; the habitat diversity and total land area in SFAN is great and obtaining adequate samples throughout would be cost prohibitive.

Landbirds as Vital Signs

In 2003, SFAN biologists and cooperators completed a vital sign indicator selection process that ranked resource indicators in priority order for the network (Adams et al. 2006). Vital signs, as used by the NPS, are defined as any measurable feature of the environment that provides insights into changes in the state of the ecosystem. Vital signs are intended to track changes in a subset of park resources and processes that are determined to be the most significant indicators of ecological condition of those specific resources that are of the greatest concern to each park. The SFAN used four criteria to rank indicators: ecological significance, management significance, legal mandate, and cost and feasibility. The SFAN ranked landbirds as the 17th most important resource indicator to monitor out of 63 considered indicators (Adams et al. 2006). This selection was largely because:

- Landbirds are recognized as indicators of ecological change (Carignan and Villard 2002), and they are relatively easy to monitor.
- Landbirds in SFAN have already been shown to be sensitive indicators of climate change (MacMynowski et al 2007).
- Parks in the SFAN network have a long history of monitoring landbirds. Some sites at Point Blue's Palomarin Field Station (in PORE) have been monitored since 1966, with several other sites consistently monitored since 1997. In addition, many sites have a history of inventory and other survey work for landbirds.
- Monitoring is done using standardized methods, with data contributed to larger regional, national, and international databases.
- Landbirds are one of the few vital signs indicators that allow for monitoring a suite of species, including common species and rare species, with diverse ecological requirements.
- Landbirds are an important natural resource throughout the network. Landbirds are a highly visible resource with a great deal of public interest: many bird watchers come to the parks, birds are observable by any park visitor, songs and calls/ behavior are inspiring.
- Monitoring is focused within riparian communities that is a priority habitat within the parks and will contribute to other SFAN needs. Riparian habitat was ranked 16th as a vital signs indicator for the network.
- Several landbird species that occur regularly in the parks are state species of special concern, while others are California Partners in Flight Focal Species (Table 1).

History of landbird monitoring in SFAN Parks

Landbird monitoring has been conducted in many units of SFAN at various levels of intensity, with various combinations of methods, and in several seasons depending on study site (Table 2). Many study sites throughout all the parks were located in riparian areas because of their recognized importance to landbirds.

The park units within the SFAN have excellent information on landbird distribution from previous surveys and inventory work, collections, documented reports, and ongoing monitoring efforts. Existing park resources include checklists for all bird taxa (e.g., Stallcup 2000, Emmons, 2006), county breeding bird atlases (e.g., Roberson and Tenney 1993, Shuford 1993), and habitat- and site-specific landbird inventories (Flannery et al. 2001, Hammond and Geupel 2001, Haff et al. 2003). Flannery et al. (2001) and Haff et al. (2003) assessed the adequacy of coverage to detect at least 80% of species during the landbird breeding season. The various SFAN parks have recently completed and uploaded certified bird species lists to the NPS biodiversity database NPSpecies, along with associated reference, voucher, and observation records.

Golden Gate National Recreation Area

Much of the historic monitoring at GOGA was done in combination with landbird monitoring at PORE. Point Blue began monitoring at Lagunitas and Redwood creeks in 1997 as part of a monitoring project focused on breeding birds in riparian habitat. Point counts were a continuation of the Kern River Research's Center Brown-headed Cowbird (*Molothrus ater*) Project initiated in 1995 and were continued for monitoring purposes (Halterman et al. 1999, Halterman and Laymon 2000).

Additional point count transects were surveyed as part of the inventory in 1999–2000. Nest searching was initiated in 1997 in order to examine breeding productivity in an important habitat type in the region critical to a diverse group and high abundance of birds (riparian), and to evaluate effects of non-native vegetation and habitat restoration on breeding birds; nest searching was discontinued in 2004 due to lack of funding. Mist-netting was initiated in 2001 as part of the NPS Park Flight program to monitor Neotropical migrants and to collaborate with Latin American biologists and continues today at the same two riparian sites studied in the nest monitoring program. Mist-netting takes place both during the breeding season as well as during migration. Focusing long-term monitoring in the park on these legacy sites for which we have extensive data increases our power to detect long-term trends.

Table 1. California Bird Species of Special Concern and California Partners in Flight (CalPIF) Focal Species regularly occurring within any of the SFAN parks.

Species	Scientific Name	Season of Occurrence	Bird Species of Special Concern ¹	CalPIF Focal Species*
Northern Harrier	<i>Circus cyaneus</i>	Year-round	x	x3
Ferruginous Hawk	<i>Buteo regalis</i>	Winter	—	x3
Burrowing Owl	<i>Athene cunicularia</i>	Winter	x	x3, 7
Acorn Woodpecker	<i>Melanerpes erythrocephalus</i>	Year-round	—	x4
Nuttall's Woodpecker	<i>Picoides nuttallii</i>	Year-round	—	x4
Pileated Woodpecker	<i>Dryocopus pileatus</i>	Year-round	—	x2
Olive-sided Flycatcher	<i>Contopus cooperi</i>	breeding/migration	x	x2
Willow Flycatcher	<i>Empidonax traillii</i>	Migration	—	x6
4 Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	breeding/migration	—	x7
Loggerhead Shrike	<i>Lanius ludovicianus</i>	Winter	x	x8
Warbling Vireo	<i>Vireo gilvus</i>	breeding/migration	—	x6
Western Scrub-Jay	<i>Aphelocoma californica</i>	Year-round	—	x4
Yellow-billed Magpie	<i>Pica nuttalli</i>	Year-round	—	x4
Common Raven	<i>Corvus corax</i>	Year-round	—	x7
Tree Swallow	<i>Tachycineta bicolor</i>	breeding/migration	—	x6
Oak Titmouse	<i>Baeolophus inornatus</i>	Year-round	—	x4

* 1 = CDFW Bird Species of Special Concern; 2 = CalPIF 2002b; 3 = CalPIF 2000; 4 = CalPIF 2002a; 5 = CalPIF 2004; 6 = RHJV 2004; 7 = CalPIF 2006; 8 = CalPIF 2005

Table 1 (continued). California Bird Species of Special Concern and California Partners in Flight (CalPIF) Focal Species regularly occurring within any of the SFAN parks.

Species	Scientific Name	Season of Occurrence	Bird Species of Special Concern ¹	CalPIF Focal Species*
Red-breasted Nuthatch	<i>Sitta Canadensis</i>	Year-round	—	x2
Brown Creeper	<i>Certhia Americana</i>	Year-round	—	x2
Wrentit	<i>Chamaea fasciata</i>	Year-round	—	x5
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Year-round	—	x2
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	Year-round	—	x4
Western Bluebird	<i>Sialia Mexicana</i>	breeding/migration	—	x4
Swainson's Thrush	<i>Catharus ustulatus</i>	breeding/migration	—	x6
Phainopepla	<i>Phainopepla nitens</i>	Breeding	—	x7
Yellow Warbler	<i>Dendroica petechia</i>	breeding/migration	—	x6
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	winter/migration	—	x2
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	breeding/migration	—	x2
Common Yellowthroat	<i>Geothlypis trichas</i>	Year-round	x	x6
Wilson's Warbler	<i>Wilsonia pusilla</i>	breeding/migration	—	x6
Yellow-breasted Chat	<i>Icteria virens</i>	breeding/migration	x	x6
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	breeding/migration	—	x6
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	breeding/migration	—	x5

* 1 = CDFW Bird Species of Special Concern; 2 = CalPIF 2002b; 3 = CalPIF 2000; 4 = CalPIF 2002a; 5 = CalPIF 2004; 6 = RHJV 2004; 7 = CalPIF 2006; 8 = CalPIF 2005

Table 1 (continued). California Bird Species of Special Concern and California Partners in Flight (CalPIF) Focal Species regularly occurring within any of the SFAN parks.

Species	Scientific Name	Season of Occurrence	Bird Species of Special Concern ¹	CalPIF Focal Species*
Sage Sparrow	<i>Amphispiza belli</i>	Year-round	—	x5, 8
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	breeding/migration	x	x3
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Year-round	—	x3
Nuttall's White-crowned Sparrow	<i>Zonotrichia leucophrys nuttalli</i>	Year-round	—	x5
Fox Sparrow	<i>Passerella iliaca</i>	Migration	—	x2
Song Sparrow	<i>Melospiza melodia</i>	Year-round	—	x6
Dark-eyed Junco	<i>Junco hyemalis</i>	Year-round	—	x2
Western Meadowlark	<i>Sturnella neglecta</i>	Winter	—	x3, 8
Tricolored Blackbird	<i>Agelaius tricolor</i>	Winter	x	x6

* 1 = CDFW Bird Species of Special Concern; 2 = CalPIF 2002b; 3 = CalPIF 2000; 4 = CalPIF 2002a; 5 = CalPIF 2004; 6 = RHJV 2004; 7 = CalPIF 2006; 8 = CalPIF 2005

Table 2. Study sites, study site code, season of monitoring, methods, and number of years site has been monitored up to 2009 in riparian areas in PORE and GOGA. “Other sites” include sites within or outside SFAN parks where Point Blue conducts monitoring and are relevant to this protocol.

Park	Site Name	Code	Season	Methods Used ¹	# of Previous Years
GOGA	Lagunitas Creek	LACR	Breeding, Fall	PC, MN	13
	Redwood Creek 1	RECR	Breeding, Fall	PC, MN	13
	Redwood Creek 2	RECR	Breeding	PC	11
	Gerbode Valley	GERB	Breeding	PC	3
	Tennessee Valley	TEVA	Breeding	PC	3
PORE	Arroyo Honda	ARHO	Breeding	PC	17
	Abbott's / Kehoe	ABKE	Breeding	PC	2
	Lower Olema Creek	LOOL	Breeding	PC	6
	Muddy Hollow	MUHO	Year-round	PC, MN	14
	Bear Valley	BEVA	Breeding	PC	2
	Coast Camp	COCA	Breeding	PC	3
	Coast Trail Laguna	CTLA	Breeding	PC	2
	Upper Olema	UPOL	Breeding	PC	3
	M Ranch	MRAN	Breeding	PC	2
Other	Pine Gulch	PIGU	Year-round	PC, MN	11
	Palomarin (PORE)	PALO	Year-round	MN	41

¹ PC = point counts, MN = mist-netting; more methods (e.g., area search) have been used at many of these sites but only those relevant to this protocol are noted

Point Reyes National Seashore

The monitoring at the Palomarin Field Station under cooperative agreement with and within the Point Reyes National Seashore is not part of this monitoring plan. Although the Palomarin is funded by other sources it is mentioned here because it is a crucial component of the landbird monitoring taking place in the SFAN and will be an outstanding complement to this protocol. Continuous long-term monitoring began at Palomarin in 1966 a year after Point Blue was founded, when their headquarters became established at Palomarin. The field station is now the headquarters of Point Blue's Terrestrial Ecology Division. Constant effort mist-netting began at Palomarin that year and has been done in a standardized fashion year-round since 1976. Point Blue has been nest monitoring there since 1979, point counts nearby there since 1992, running a second mist-netting station at the site since 1992, conducting fall area search surveys since 2003, conducting year-round area search surveys since 2005, and doing Winter Bird Population Studies since 1980. Habitat and bird/habitat association data is collected at all of these sites. It is a top priority to continue monitoring at this site as it is one of the

most long-term landbird monitoring stations in North America and is the longest run banding station in the United States.

Point Blue began long-term monitoring at another site (Muddy Hollow) in 1995 as part of a larger study examining the effects of the Mount Vision Fire on landbirds (Gardali et al. 2005); this study includes point counts and mist-netting (for a shorter duration at a second burned site, Coast Trail, as well), and historically included nest searching as well (Haltermann et al. 1999). Much of the historic monitoring at PORE was done in combination with landbird monitoring at GOGA. Many point counts stations we surveyed were also a continuation of a project initiated by NPS in cooperation with the Kern River Research Center in 1995, as was the case with GOGA to study Brown-headed Cowbird effects on Neotropical migratory birds. Additional point count transects were surveyed as part of the inventory in 1999–2000. Other point count sites were established in 2002 as part of the Wildland Urban Interface (WUI) project of PORE.

Relevant Sites Outside the Scope of This Monitoring Plan

Point Blue conducts year-round constant effort mist-netting; point counts; and area search surveys at Pine Gulch in the Bolinas Lagoon Open Space Preserve, managed by Marin County Parks. This site has been surveyed since 1994 and is included herein as it will be used as a replicate site for work conducted in the SFAN.

Measurable Objectives

The following objectives provide the basis for the landbird monitoring program for the network. See Figure 1 for the relationships among objectives, methods, and monitoring season.

Objective 1. Population trends of landbirds

Determine population trends for as many riparian-associated landbird species as possible during breeding season (mist-netting, point counts), fall migration (mist-netting), and winter (mist-netting). The objective is the ability to detect a 50% change in the population size (i.e., abundance) over a 20-year period, with an 80% probability of detecting change if it occurs (Bart et al. 2004, Siegel et al. 2007).

Objective 2. Productivity and survival

Determine long-term changes in productivity and annual survival for as many riparian-associated landbird species as possible. This is done using mist-netting.

Linkages Between This and Other Monitoring Projects

This protocol is independent and may be implemented without reliance on any other efforts.

However, the protocol does have linkages to other monitoring programs especially those that also focus on riparian habitat.

Plant Community Change Protocol

The plant community change protocol focuses on gross change to vegetation communities in the San Francisco Bay Area. However, the plant community change protocol is in early draft; specific commonalities will be discussed once they are identified.

Salmonid Monitoring Protocol

The salmonid monitoring protocol focuses on changes of the population numbers of coho salmon at GOGA and PORE. In particular, the coho monitoring focuses on multiple lifestages including spawning, juvenile, and smolt stages. Monitoring is conducted in the vicinity of point count transects including those at Lagunita, Olema, Pine Gulch, and Redwood Creek.

Spotted Owl Protocol

Spotted Owl monitoring has occurred at GOGA and PORE since the mid 1990's. Monitoring data provide estimates on occupancy and reproductive success. Spotted Owls inhabit forested areas that are commonly adjacent to riparian habitat. Survey areas include those that coincide with landbird transects.

Streamflow and Water Quality Monitoring Protocols

Streamflow is monitored at gaging stages within each park including Lagunitas, Olema, Pine Gulch, and Redwood Creek. Water quality data are collected throughout the network. Parameters include dissolved oxygen, temperature, conductivity, and pH. Point count transects are located in the vicinity of the streamflow and water quality monitoring sampling sites.

Wetland Monitoring Protocol

The wetland monitoring protocol focuses on the amount of wetland cover and quality throughout the network. The protocol for wetland monitoring is still in early draft. Specific commonalities will be discussed once they are identified.

Each protocol will provide insight into the respective resource being monitored. Taken together, these protocols will provide a strong foundation for understanding complex ecological relationships in riparian habitats. For example, changes in hydrology may imply long-term changes in water quality, stream fish populations, stream wetland characteristics, vegetation communities and associated wildlife populations including landbirds. Specific analyses will be identified as the protocols continue to be developed.

Augmenting the Protocol

As noted above, landbird inventories have been conducted at a variety of riparian sites throughout the network including at Pinnacles National Monument (PINN) and GOGA (Presidio, Milagra Ridge, and Sweeney Ridge). Because of limited funds not all of these areas are covered by this protocol. Both PINN and GOGA have also acquired new lands that cover significant riparian habitats such as those at Cattle Hill, Corral de Tierra, Mori Point, Pedro Point Headlands, Picardo Ranch, Phleger Estate, and Pillar Point. As more funding or in-kind services become available, riparian habitats at PINN and GOGA will be evaluated and considered for inclusion in future versions of this protocol. Monitoring at new sites, however, will only be implemented once future versions of the protocol are properly peer reviewed.

A point count transect was established during the inventory phase of this project at John Muir National Historic Site. This transect is not included in this protocol because the site is isolated from the rest of the network, does not include riparian habitat, and small sample size / single site makes our ability to detect population trends unlikely. Monitoring at this site, however, would provide the

park with interesting information about species site-specific changes in diversity and abundance given that the historic site represents an island in a rapidly urbanizing landscape. To provide information to the park, data can be collected through a volunteer citizen science effort and then contributed to the California Avian Data Center (CADC). CADC allows park managers to look at changes in species diversity, abundance, etc. even if statistically robust population trends cannot be detected.

Sampling Design and Field Methods

Populations Being Monitored

Populations of riparian-associated landbirds (including passerines and near passerines) in the parks during three seasonal periods (breeding, fall migration, and winter) are the focus of this monitoring program. This includes year-round residents, Neotropical migrants, short-distance migrants, and winter residents. While some studies focus exclusively on the breeding season, doing so overlooks the potentially population-limiting role these other time periods have for landbirds, and overlooks as well that the parks are used by species and populations occurring solely outside of the breeding season and that equally would benefit from monitoring and management. We will focus on the full landbird communities associated with riparian habitat but acknowledge that some analyses (e.g., adult survival) will necessarily focus on species where sample sizes are sufficient. Some species will be excluded from analyses; these include those that are not appropriately sampled by the methods we employ here (e.g., shorebirds, waterfowl, wading birds, raptors). However, we will record all species observed during point counts and mist-netting in order to have the most complete picture of the local bird communities and to increase our knowledge of the presence, distribution, and phenologies of those species.

Rationale for Sampling Design Selection

It is a challenge to develop a sampling design for long-term monitoring (e.g., >20 years) versus designs formulated to answer short-term (e.g., three to five years) research questions. This is because many unforeseeable factors will likely act to bias or make interpretation and inference of monitoring results difficult (e.g., habitat succession, Ballard et al. 2003). Often the questions to be asked of long term monitoring cannot be anticipated (Johnson 2002). Still, a good design attempts to maximize the ability to make inferences for an entire area (e.g., National Park unit) or habitat (e.g., riparian with a park) while minimizing sampling effort. A design that takes too few samples will not be able to adequately measure an important change and therefore place the resource at risk whereas too many samples will waste time and money.

Estimation of Power to Detect Trends for the Amount of Sampling Being Instituted

The statistical power of our sampling design was evaluated by examining existing point count data from our legacy dataset. Annual density and variance estimates were calculated based on distance sampling methods (Buckland et al. 2004) and Program Distance (Thomas et al. 2006). Parameters estimates were derived using over nine years of data from multiple sites for multiple species (Tables 3 and 4). All data were retrieved from the California Avian Data Center (<http://www.prbo.org/cadc/>; Accessed: June 11, 2009) using the “Ravian” package (www.prbo.org/Ravian; Accessed: June 11, 2009). Ravian is an open-source set of quantitative tools for avian scientists developed by Point Blue for the R statistical programming language (R Development Core Team 2009).

Since 1997, Point Blue has implemented several point count protocols. These protocols differed primarily in how the “distance-from-observer” for a detection was recorded. We removed data collected in 1997, 1998, and 2000, as we did not believe this protocol was comparable enough to

current and future survey methods, nor did the data contain adequate information for distance sampling methods.

Table 3. Inventory of historic protocols used across years through 2008 for riparian sites surveyed by Point Blue Conservation Science within Point Reyes National Seashore and Golden Gate National Recreation Area.

Site Name	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Abbot's / Kehoe ¹	A ²	A	–	–	–	–	–	–	–	–	–	–
Arroyo Hondo	A	A	B ³	A	B	C ⁴	D ⁵	D	D	D	B	B
Bear Valley	A	A	–	–	–	–	–	–	–	–	–	–
Coast Trail Laguna	A	A	–	–	–	C	–	–	–	–	–	–
Gerbode Valley ¹	A	A	–	–	–	–	–	–	D	–	–	–
Lagunitas Creek	A	A	B	A	B	C	D	D	D	D	B	B
Lower Olema Creek	A	A	–	–	–	C	D	D	D	D	–	–
Muddy Hollow	A	A	B	A	B	C	D	D	D	D	B	B
Pine Gulch	A	A	B	A	B	C	D	D	D	D	B	B
Redwood Creek	A	A	B	A	B	C	D	D	D	D	B	B
Tennessee Valley ¹	A	A	–	–	–	–	–	–	–	–	–	–
Upper Olema Creek	A	A	–	–	–	–	–	–	D	–	–	–

¹ Site was not used in density estimation / power analysis

² Protocol Code A = FR50: Detections were reported within 2 bins (0–50m, and 50+) – not used for power analysis

³ Protocol Code B = VCP10_50: Detections were reported within bins (0–10m, 10–20m, 20–30m, 30–40m, 40–50m, 50–100m, 100+)

⁴ Protocol Code C = VCP25: Detections were reported within bins (0–10m, 10–20m, 20–30m, 30–40m, 40–50m, 50–75m, 75–100m, 100+)

⁵ Protocol Code D = VCP10_30: Detections were reported within bins (0–10m, 10–20m, 20–30m, 30–50m, 50–100m, 100+)

Table 4. List of species for which a power analysis was performed.

Common Name	Scientific Name
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Song Sparrow	<i>Melospiza melodia</i>
Swainson's Thrush	<i>Catharus ustulatus</i>
Warbling Vireo	<i>Vireo gilvus</i>
Wilson's Warbler	<i>Wilsonia pusilla</i>

Power analyses were performed using TRENDS software (Gerrodette 1993). In this analysis we wanted to understand the power of the current survey methodologies to detect a 50% increase or decline in population size over 21–22 year period for each species. We evaluated power at two significance levels: $\alpha = 0.05$ and $\alpha = 0.10$. For each species, the following steps were taken to estimate the power of the survey protocol:

1. Used Ravian to retrieve data from California Avian Data Center and export into required structure for analyses in Program *Distance* (see Tables 3 and 4, for list of sites and species, respectively).
2. Estimated global densities and variances for each species for each year between 1999–2008 using Program *Distance*.
3. Estimated initial coefficient of variation (CV1) as the Root Mean Squared Error (RMSE) of the log-linear regression of historical data (1999–2008; see Gerrodette 1987).
4. The following parameters were entered into TRENDS to generate an estimate of power (see Table 5 for results):
 - a. **Duration of study:** 22 years (for sampling every third year), 21 years (for sampling every other year or sampling every year)
 - b. **Overall change for duration of study:** 0.5 (50% increase or decline)
 - c. **Coefficient of variation (CV1):** (see Table 5 for species specific values)
 - d. **Significance level:** $\alpha = 0.05$ and $\alpha = 0.10$
 - e. **Rate of change:** negative
 - f. **Tails for significance test:** 2 tail
 - g. **Type of change:** Exponential
 - h. **How CV changes with abundance (A):** CV constant with A
 - i. **Intervals between sampling occasions are:** Equal
 - j. **Effort multiplier:** 1.0

Table 5. Results of density estimation and power analysis. Estimate of power is the probability to detect a 50% decline in the population of interest over a 21–22 year period at two significance levels.

Common Name	Mean Density (# birds / ha)	Standard Error (Mean Density)	Initial CV (CV1)	Power when surveyed for 21–22 yrs ($\alpha = 0.05$), every:			Power when surveyed for 21–22 yrs ($\alpha = 0.10$), every:		
				3 rd Year ¹	2 nd Year ²	Year ²	3 rd Year ¹	2 nd Year ²	Year ²
Black-headed Grosbeak	0.689	0.060	0.247	0.6	0.76	0.96	0.75	0.87	0.98
Common Yellowthroat	0.269	0.038	0.371	0.33	0.44	0.72	0.48	0.59	0.83
Song Sparrow	4.34	0.22	0.1	1.00	1.00	1.00	1.00	1.00	1.00
Swainson's Thrush	2.96	0.23	0.198	0.78	0.91	1.00	0.89	0.96	1.00
Warbling Vireo	0.754	0.036	0.146	0.95	1.00	1.00	0.99	1.00	1.00
Wilson's Warbler	2.68	0.087	0.094	1.00	1.00	1.00	1.00	1.00	1.00

¹ Based on 22 years of surveys completed

² Based on 21 years of surveys completed

As expected, annual surveys had the greatest power to detect a 50% increase or decline after ~ 20 years followed by surveys every other year and then every third. Because our protocol is currently to survey all sites every three years, we are most interested in these results: When significance was set at $\alpha = 0.05$, power exceeded 80% for three of the six species and near 80% (0.78) for another. When significance was $\alpha = 0.10$, power exceeded 80% for four of the six species and was nearly 80% (0.75) for a fifth species. These results suggest that the proposed monitoring protocol for point counts will be sufficient.

Analysis of power was not done for mist-netting. However, we have already published population trend results in peer-reviewed journals from a single site (Palomarin), for several species, in two seasons in PORE (Johnson and Geupel 1996, Chase et al. 1997, Gardali et al. 2000, Ballard et al. 2003). A power analysis has already been done for the fall season at a single site in PORE (Palomarin) which indicated that the median power (90% chance of detecting a 50% decline in a species' population over a 25 year period with $\alpha = 0.05$) for six species ranged from 0.59 when sampling was done 1 day per week to 0.78 when sampling frequency was seven days per week (Thomas et al. 2004). Our mist-netting protocol will build on Palomarin with the addition of four banding stations. Hence we are confident we will have sufficient power for several species. Finally, mist-netting will provide much more than simple trend estimates including information on reproduction and survival which will complement trends (see below).

We would like to point out that even species with low power using our criterion or any other for that matter will show a statistically significant trend if the rate of change is steep enough and if there are enough years of data. In addition, results that indicate consistent trends across many species and at

many sites, from the two methods, will provide the manager and analyst robust information that will be useful in assessing and interpreting population status.

Multiple Methods

Most discussions of sampling designs discuss the important topics of site selection, randomization, stratification, and statistical power, for example. We note, however, that even a well-designed study can suffer from the use of a single, perhaps poor, sampling method with no ability to validate the results (see Silkey et al. 1999, Ballard et al. 2004, Nur et al. 2004 for SFAN examples of the utility of using multiple methods for validation). This protocol also recognizes the importance of using multiple methods to validate trends and to examine different but complementary objectives (Figure 1). For example, we can assess trends from surveys of population size and examine primary demographic data (e.g., productivity and survival) to determine the key parameters responsible for population increases or decreases. Hence, this approach can provide managers with more useful information on which to base management actions and research priorities (DeSante and Rosenberg 2001).

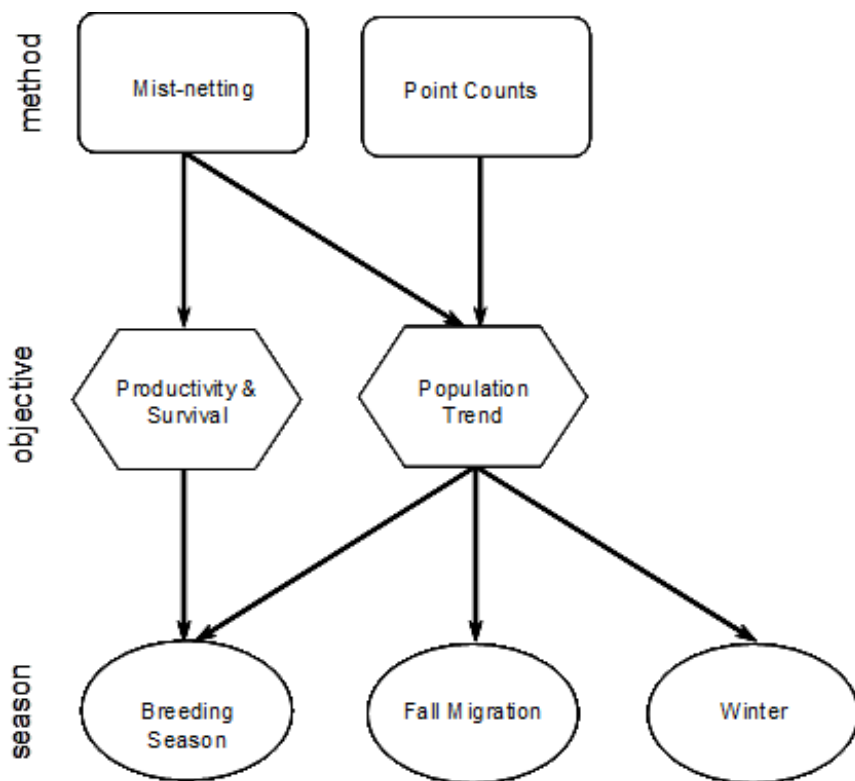


Figure 1. Relationships among field methods, monitoring plan objectives, and monitoring seasons.

Areas of Special Interest

Consistent with the objectives outlined above and following NPS monitoring design recommendations, we have selected “Areas of Special Interest” to focus our monitoring efforts. “Areas” in this case refers to one habitat type: riparian woodland. Riparian habitat was ranked as a relatively high monitoring priority for the SFAN (number 16 of 63 for vital signs indicators; Adams

et al. 2006). Riparian habitat may be the most important habitat for landbirds in California and is the most critical habitat for landbirds in the West (Miller 1951, Manley and Davidson 1993, Donovan et al. 2002, RHJV 2004). It provides critical breeding grounds, overwintering grounds, migration stopover sites, and movement corridors for a diverse and abundant group of birds, many of which are dependent on this habitat for survival (RHJV 2004). The density of birds breeding within this habitat is higher than in any other in California. However, this habitat has been severely degraded in the Western U.S., with such loss and degradation thought to be the leading cause of population decline of landbirds (DeSante and George 1994, RHJV 2004) and resulting in state and region-wide emphasis on riparian bird species (RHJV 2004). Riparian ecosystems are naturally resilient, provide habitat connectivity, link aquatic and terrestrial ecosystems, and create thermal refugia for wildlife, all characteristics that can contribute to ecological adaptation to climate change (Seavy et al. 2009).

The choice of a single habitat is also pragmatic in that the high diversity of habitat types in the SFAN would make sufficient sampling cost prohibitive. Additionally, the approach to focus on riparian habitat is further justified by our desire to continue to build upon existing monitoring programs. See also site selection below for a discussion of the strengths and shortcomings of this approach.

Legacy Data

In general, our approach prioritizes and relies heavily on “legacy” datasets, and as such strongly defines our monitoring design and philosophy. Legacy data simply refers to sites where we have existing data (Table 2). The results from our legacy data to date (e.g., DeSante and Geupel 1987, Johnson and Geupel 1996, Chase et al. 1997, Gardali et al. 2000, Chase 2002, Ballard et al. 2003, Gardali et al. 2003a, MacMynowski et al. 2007) make a strong case for the utility of our monitoring scheme to NPS land managers. PORE and GOGA have had monitoring in place long enough to provide species status information.

Monitoring Scale

Our monitoring plan focuses on the spatial scale of PORE and GOGA combined. Local changes may occur due to changes in habitat quality or quantity, for example. However, effective and efficient management actions must have knowledge of larger-scale patterns. Local management actions may be ineffective if larger-scale processes (e.g., weather or landscape) are the primary system drivers. We believe our proposal will provide adequate precision at the local scale and will benefit from being part of, and informed by, larger-scale monitoring efforts (e.g., MAPS, BBIRD, Breeding Bird Survey, CalPIF, Christmas Bird Count).

Known Limitations

This monitoring design approach has several limitations. First, because we are focusing on landbirds in only one habitat type, some species will be monitored minimally or not at all. However, we feel that it is useful to continue and augment our long-term monitoring efforts in riparian habitats. Additionally, riparian areas have the highest diversity birds in PORE and GOGA (Flannery et al. 2001). Second, our focus on a single habitat type may make long term analysis difficult because habitats change – either through succession or overall boundaries. We believe, however, that succession would be an issue regardless of sampling design and that landbird population response to ecological changes like habitat succession are part of our monitoring objectives and the interpretation

of our results. The overall boundaries of riparian areas are not likely to change like they might in other vegetation communities. Third, because our choice of study sites was not random, our ability to make strong inferences to other areas are limited. We recognize that our area of inference is restricted to those areas sampled. However, we believe that we have included extensive areas of riparian habitat within PORE and GOGA. Also, we note that our methods will be replicated and agree with Johnson (2002) that randomization is less important than replication in selecting study units. Further, productivity indices generated from mist-net stations provide a landscape-level, rather than site-specific, measure of productivity (see Site Selection below).

Sampling Protocol and Field Methods

We will use nationally standardized monitoring protocols for mist netting (MAPS; DeSante et al. 2000); all data will be contributed to this program. At all point count survey stations we will use the Variable Circular Plot method. In general, we will follow monitoring guidelines outlined in Ralph et al. (1993, <https://www.fs.fed.us/psw/publications/documents/gtr-144/00-front.html>; Accessed: June 9, 2009) and the NPS recommended methods <https://irma.nps.gov/Datastore/Reference/Profile/622905> (Accessed: June 9, 2009). All Point Blue protocols, data structures, field data forms, and programs for data management and analysis are available at <http://www.prbo.org/cadc/> (Accessed: June 9, 2009, Ballard et al. 2008). Field season preparations are provided in more detail in the first Standard Operating Procedure (SOP 1): Preparations and Equipment Setup. Complete protocols for actual field methods (specifically, variable circular plot point count surveys; and mist-netting and banding) and sample data sheets are provided in SOP 4 and SOP 5 and therefore are only introduced here.

Site Selection

Our monitoring efforts are focused on riparian areas, due to the benefits of conducting intensive rather than just extensive monitoring, in order to both examine trends and better understand underlying demographic processes (see also discussion above). The majority of the existing monitoring in SFAN has occurred in riparian habitats. Hence, priority is placed on continuing to monitor at these sites to make the most of previously collected data. By using legacy sites, we will be sampling the majority of willow-alder riparian areas in PORE and GOGA. Legacy point count transect locations were chosen for PORE and GOGA based on number of previous years monitoring and overlap with other methods (Table 2, Figure 2).



Figure 2. Location of point count survey stations and mist-netting stations in riparian habitat, Point Reyes National Seashore and Golden Gate National Recreation Area. One mist netting site, Lagunitas Creek, was dropped after 2016.

All mist-netting locations are from existing sites, and point count transects overlap with these. Mist net stations were picked based on NPS interest within a particular riparian area; Muddy Hollow because of fire, Redwood Creek because of habitat restoration, and Lagunitas Creek and Pine Gulch Creek serve as reference sites. Individual net locations within each station were picked based on expert opinion of their likelihood to capture birds (e.g., appropriate vegetation structure). In many ways, riparian corridors are ideal for establishing mist net stations as they tend to congregate birds from the greater landscape. Additionally, productivity indices generated from mist-net stations provide a landscape-level, rather than site-specific, measure of productivity (see below). This is because the young birds captured include many dispersing individuals from the surrounding landscape, as well as a few individuals that may have fledged from nests nearby the actual netting station. Data on the dispersal characteristics of young and adult birds after the breeding season but before fall migration are just now being obtained for a very few species from radio-telemetry studies (Anders et al. 1997, Vega Rivera et al. 1998) including locally derived studies in GOGA (White et al. 2005). These studies suggest that the landscape from which the dispersing young originate may be on the order of several thousand hectares (perhaps about 10,000–12,000 acres).

For detailed site narratives including GPS coordinates see SOP 4.

Mist-netting

This protocol uses a standardized constant-effort mist-netting protocol at a network of stations. Each station typically consists of about ten permanent net sites located opportunistically, but rather uniformly, within the interior eight ha of a 20-ha (49.4 ac) study area (DeSante et al. 2001). Typically, one 12-m, 30 mm mesh mist net is operated at each net site for six morning hours per day, for one day during each of ten consecutive 10-day periods. Starting dates for the MAPS breeding season period are approximately 1 May and operation continues through the ten-day period ending August 8. Point Blue continues to run these sites outside the breeding season as well. The fall migration period differs in that periods are shorter (7 days) to avoid missing windows of migration and goes from mid-August through the end of October. Winter mist-netting stations return to the 10-day period approach and continue from the beginning of November through April. In addition, Point Blue runs a more intensive mist-netting station at Palomarin in PORE (3–6 days per week). All birds captured are identified to species, age, and sex using criteria in Pyle (1997) and, if unmarked, are banded with a uniquely numbered aluminum band provided by the U.S. Geological Survey/Biological Resources Division Bird Banding Laboratory. Specifics of the MAPS protocol can be found at <https://www.birdpop.org/pages/mapsDataForms.php> (Accessed: June 9, 2009), and SOP 7 defines how Point Blue protocols differ from MAPS protocols.

Point Count Surveys

Variable Circular Plot Counts are a point count methodology that incorporates a measure of detectability into population estimates. In the SFAN these are done during the breeding season. All birds seen or heard at each plot are recorded during a 5-minute sampling period. All birds, regardless of distance detected from the observer are counted and recorded. For all species, each individual bird will be recorded as a separate observation. Distances will be estimated to the nearest 10, 20- or 50-

meter interval. Specifics of the Point Blue VCP method used at these sites can be found in SOP 6 and also at: <http://data.prbo.org/cadc2/index.php?page=songbird-point-counts> (Accessed: June 9, 2009).

Sampling Frequency and Schedule

Mist-netting will be conducted every year (Table 6). Mist netting is conducted year-round in PORE at Point Blue's Palomarin Field Station and at Muddy Hollow; year-round at Pine Gulch in the Bolinas Lagoon Open Space Preserve, included in this narrative as it is used as a replicate site for park sites; and in spring through fall in GOGA at Redwood Creek (Table 7; also see Table 2 for more details). Mist netting at Lagunitas Creek was originally part of this protocol (< Version 4.6) and adhered to the same frequency and schedule as Redwood Creek, but this mist-netting site was dropped after 2016 due to significant hydrological changes at the site as part of a salmonid restoration effort that impacted net locations and access. Mist-netting data are contributed to MAPS, but we also prioritize running them outside of the breeding season in order to sample different species, and to monitor species and individuals during equally critical time periods. The SFAN monitoring program is not only for breeding landbirds but also for other landbird species using the parks, some of which are only present outside the breeding season but are present in numbers for which population trends could be detected (see Ballard et al. 2003). At the main Palomarin site, nets are run six days per week May through November and three days per week December through April. At all other sites, nets are run approximately once every 10 days May through mid-August, once every seven days mid-August through October, and, when winter mist-netting is done, once every 10 days November through April. There are 20 nets at Palomarin, 11 at Redwood Creek, and 10 at each of the other sites. Since this mist netting effort is made possible through funding sources outside of and independent of the NPS, in some years the extent of this effort may be constrained by funding and at the discretion of Point Blue.

Point counts will be conducted once every third year (Table 6). Point count transects will be surveyed twice per year during the peak landbird breeding season. The first visit will be in May and the second in June (Table 7), with a minimum of 10 days between surveys of each transect.

Table 6. Sampling and reporting schedule from 2011 to 2020.

Activity	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mist Netting	X	X	X	X	X	X	X	X	X	X
Point Count	X	–	–	X	–	–	X	–	–	X
Progress Reports	X	–	–	X	–	–	X	–	–	X
Analysis & Synthesis	–	X	–	–	–	–	–	X	–	–

X = sampling and / or reporting (also shaded)

Table 7. Monthly sampling schedule for mist-netting and point counts surveys.

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mist Netting (Muddy Hollow, Pine Gulch, Palomarin)	X	X	X	X	X	X	X	X	X	X	X	X
Mist Netting* (Redwood)	–	–	X	X	X	X	X	X	X	X	–	–
Point Counts (all sites)	–	–	–	–	X	X	–	–	–	–	–	–

X = sampling (also shaded)

* = occurred at this same frequency for Lagunitas Creek through 2016, after which site was dropped

Field Season Preparations and Equipment Setup

The field season for mist-netting is year round and hence equipment is regularly inventoried, checked for accuracy (e.g., scales), wear (e.g., nets), and resupplied or repaired as needed. Point counts occur during the breeding season and will be conducted by staff already trained in the songs and call of all birds in the area. More detail (e.g., equipment check lists) can be found in SOP 1.

Field Safety

Field work in the parks of the SFAN presents a variety of safety considerations. Details are provided in the San Francisco Bay Area Network Field Safety SOP 1.1. Safety considerations including excerpts from a Job Hazard Analysis specific to this protocol are also highlighted in SOP 2.

Standard Operating Procedures

Several SOPs are published separately and can be found in the Integrated Resource Management Applications (IRMA) Data Store. <https://irma.nps.gov/DataStore/Reference/Profile/2267907>.

Topics include:

Standard Operating Procedure 1: Preparations and Equipment Set

Standard Operating Procedure 2: Site Visits and Field Safety

Standard Operating Procedure 3: Training Observers

Standard Operating Procedure 4: Marking and Relocating Sampling Plot

Standard Operating Procedure 5: Using GPS

Standard Operating Procedure 6: Conducting Variable Circular Plot (VCP) Point Count Survey

Standard Operating Procedure 7: Conducting Mist-netting and Banding

Standard Operating Procedure 8: Data Management

Standard Operating Procedure 9: Data Analysis

Standard Operating Procedure 10: Data Reporting

Standard Operating Procedure 11: Revising the Protocol

Data Management, Analysis, and Reporting

Data Management

In order for the landbird monitoring program to meet I&M Program goals, a detailed management plan is needed to ensure data quality, interpretability, security, longevity and availability. The data collected by Point Blue at the SFAN parks are entered and proofed following formats developed in Visual FoxPro by Point Blue that have been in use for over 10 years and available through the California Avian Data Center (see SOP 8). Data are then managed in larger, regional data sets, and also made available to other users and submitted to larger networks. Digital data are transferred annually to the SFAN data manager who converts the data into a relational Microsoft Access XP database that meets I&M standards. By means of a variety of methods, including scanned PDF versions of datasheets, off-site storage, and server back-ups, these data are archived and kept secure for the long-term at both SFAN and Point Blue. Following guidance from the NPS I&M Program, a metadata record for the SFAN landbird database will be developed in accordance with current NPS standards and posted to the NR-GIS Data Store.

Standard Operating Procedure #8: Data Management describes in further detail how the SFAN landbird monitoring protocol meets the data management objectives through data entry specifications, database design, quality assurance and control measures, metadata development, data maintenance, data storage and archiving, and data distribution. These procedures are explained for the two types of landbird data included in this monitoring plan that are collected by Point Blue for the SFAN: point count surveys and mist-netting. See the data dictionary and other documentation in Appendix 1 of SOP #8.

Data Analysis

Point Blue will provide information on timing, effort, and locations of surveys on 3-year schedule consistent with progress reports. Point Blue will provide formal analyses of all types of data every sixth year when no fieldwork will be conducted (with the exception of mist-netting which is dependent on outside funding sources). The data analysis for the riparian landbird monitoring program will generally include the following:

- Conduct analyses of long-term trends for individual species over time.
- Conduct analyses of trends in reproductive success as indexed by capture rates of the ratio of adult to young and/or total captures of young.
- Conduct analyses of adult annual survival for a subset of species using Program MARK (White and Burnham 1999).

Point Count Data

We will use linear (log-linear) regression models of avian density data using point count data for PORE and GOGA combined. Program *Distance* (Buckland et al. 2001, 2004) will be used to calculate densities for those species with sufficient sample sizes. See SOP 9 for more information.

Mist-netting Data

We will examine population trends (as indexed from capture rates) from mist-netting data. These will be presented for species with sufficient sample sizes. We will use regression models of log transformed capture rates (see Ballard et al 2003 for an example). Capture rates of young birds (Hatch-year) will be presented as an index to reproductive productivity and we will look for annual trends in these. Annual apparent survival estimates may be provided for some species depending on sample sizes using Program Mark (White and Burnham 1999). See SOP 9.

Reporting

The two reports developed for this program will be a (1) simple progress report and (2) periodic analysis and synthesis report (see Table 6 for reporting schedule). An overview is provided in this section with further details presented in SOP 10. Templates are available on the NPS Natural Resources Report Series website: <https://www.nps.gov/im/publication-series.htm> (Accessed: March 25, 2020). In addition, Table 8 summarizes all reports, updates (e.g., I&M Updates, website updates), and outreach products developed through the SFAN I&M Program.

Progress Reports

Progress reports will provide a general overview of activities from each year's field season. They will be due 15 November of each year on three year cycles (Table 6). The progress report and responsibilities include:

1. Archive old data
2. Document monitoring activities
3. Document changes in the monitoring protocol
4. Public interest highlights

It should be noted that the California Avian Data Center will be developing online analysis tools that will provide live trend estimates for mist-net and point count data. Hence, annual trend reports for the SFAN will become automated.

Analysis and Synthesis Reports

Analysis and Synthesis Reports will be completed every six years (Table 6) and will provide detailed analyses of population trends and / or another focused analysis. Results will be interpreted to provide specific information related to the measurable monitoring objectives. The content of the Analysis and Synthesis reports will vary and evolve as more data are collected, priorities reassessed, analysis/visualization tools developed (via the California Avian Data Center), and analytical techniques refined. However, in general these reports will cover the following:

1. Estimate patterns and trends in abundance
2. Estimate vital demographic rates such as breeding productivity and survivorship
3. Evaluate the efficacy of current monitoring scheme to achieve objectives
4. Interpret data for the park within a multi-park, regional, or national context
5. Recommend changes to monitoring and management practices

6. Recommend research priorities
7. Public interest highlights

Program and Protocol Reviews

Program reviews will be conducted every six to 10 years in order to ensure that the protocol is meeting stated objectives. The reviews will be conducted by scientists who are not directly involved with the implementation of the protocol. The reviewers may be associated with the NPS, other government agencies (e.g., USGS) or through cooperative agreements (e.g., Cooperative Ecosystem Studies Units).

The protocol reviews include the following and detailed in Table 8:

1. Formal reviews of operations and results and reports
2. Review of protocol design and products to determine if changes are needed
3. Evaluation of methods and objectives

Table 8. Summary of reporting and communication products.

Product	Lead	Audience	Schedule	Summary
Progress Report	Point Blue Conservation Science	Park Resource Managers	3 years	• Archive data and document monitoring activities • Document changes (if any) in the monitoring protocol • Increase communication within the park and network
Analysis and Synthesis Report	Point Blue Conservation Science	Park Resource Managers	6 years	• Determine abundance patterns • Analyze data to determine the level of change that can be detected using the existing sampling scheme • Provide context, interpret data for the park within a multi-park, regional, or national context • Interpret data in context of trends from other riparian vital signs • Recommend changes to management practices

Table 8 (continued). Summary of reporting and communication products.

Product	Lead	Audience	Schedule	Summary
Program and Protocol Reviews	Network Program Manager	Program Lead, I&M Technical Steering Committee	6–10 years	• Periodic formal reviews of operations and results • Review of protocol design and product to determine if changes are needed • Part of the quality assurance – peer review process
Executive Briefing	Network Program Manager	Program Managers, Superintendents, Front line interpretation staff	3 years (upon completion of annual report)	Two-page summary that lists monitoring objectives and questions, discusses annual results, and provides a regional context.
Vital Sign Report Card	Network Program Manager	Program Managers, Superintendents, Front line interpretation staff	6 years (upon completion of Analysis and Synthesis Report)	Two-page summary that aggregates trend data into an index.
Web Site Intranet	Network Program Manager	Park Staff	Annually or as needed	Post all completed reports
Web Site Internet	Network Program Manager	Park Staff, General Public	Annually or as needed	Post all Executive Briefings, Report Cards
Park Presentations	Point Blue Conservation Science	Park Staff	6 years	Provide a presentation to park staff during senior staff, all employee, or division meetings at each park upon request. Gives staff an opportunity to ask questions about the program.
IM Update	Network Program Manager	Park Staff	Quarterly	This one-page monthly e-mail provides park staff with a short update on vital signs projects. Text should be no more than one paragraph.
Photos	Point Blue Conservation Science	For all reports and publication	Continuous	High quality publication quality photos are needed to support all communication products. For digital photos that means 300 pixels per inch resolution in a plain or compressed TIF format. Specialist should make every effort to document ongoing work, special incidents, site visits for communication purposes.

Operations

Principal Cooperators and NPS Lead

Protocol development was completed through a cooperative agreement with Point Blue Conservation Science. Principal cooperators at the time of initial protocol development and publication were Thomas Gardali, Diana Humple, Mark Herzog, Grant Ballard, and Geoffrey R. Geupel from Point Blue; William Merkle, GOGA Wildlife Biologist, Marcus Koenen, SFAN Network Program Manager, David Press, SFAN Data Manager, and Sarah Allen, PORE Senior Science Advisor. Principal cooperators are subject to change based on personnel changes within a given role within the collaborating institutions.

In past years, Point Blue has been in a cooperative agreement with NPS to conduct monitoring at GOGA and PORE. Point Blue has an intensive and extensive training program for the study of landbirds.

Key roles for implementing the landbird monitoring program include:

Point Blue Project Lead – Landbird Ecologist

Coordinates Point Blue activities. Trains and supervises field staff, coordinates site visits, oversees data entry, manages and archives data, develops annual reports, analysis and syntheses reports.

Point Blue Data Manager

Reviews and enters data into Point Blue databases. Runs queries and prepares data for progress and analysis and syntheses reports.

Point Blue Statistician

Conducted power analysis. Responsible for data analysis presented in analysis and trend reports. Also involved in preparing and reviewing data for analyses.

Point Blue Senior Biologist, Banding Supervisor, Field Staff, and Interns

Field work is lead by the Point Blue senior biologist and banding supervisor. Each year, staff and up to 12 interns (4 at a time) are hired to run mist-nets. Point Blue staff will conduct all point counts. Both staff and interns will enter data and be responsible for error checking.

SFAN I&M Program Manager

Responsible for overseeing the cooperative agreement. Key liaison between Point Blue and parks. Is responsible for internal oversight and program review. Reviews annual and long-term trend reports. Oversees the process for publication and distribution of reports.

SFAN I&M Data Manager

Transfers data from Point Blue to the Network and works with Point Blue to construct the metadata record.

Wildlife Ecologist and Science Advisor

Review protocol, progress reports, and analysis and synthesis reports.

Cooperative Agreement

Point Blue has a long relationship with the National Park Service because they established their original headquarters at the Point Reyes National Seashore in 1965, shortly after the park was established, and have continuously run a banding lab and visitor center in the park since 1966. The monitoring program was originally exercised under a cooperative agreement between Point Reyes National Seashore and Point Blue Conservation Science (Agreement number 1443-CA-8530-00-044) that had been in place for several years. Under this agreement, the cooperators share resources, personnel and equipment. This agreement is periodically updated between Point Blue and the NPS.

Research Permits

This sampling strategy is an extension of ongoing work within PORE and GOGA and was considered originally to have already been permitted and deemed in compliance with local park-level and national standards. Additionally, Point Blue was asked to apply for and was granted a separate Scientific Research and Collecting Permit (Permit Number PORE-2017-SCI-0045, good for years 2017–2022). Point Blue is authorized to capture and mark birds by the U.S. Department of Interior, U.S. Geological Survey Biological Resources Division Bird Banding Laboratory (permit Number 09316), and Point Blue applies for subpermits for all banders once their training is sufficient to allow them to band independently. All researchers are required to have copies of permits on hand when in the field. Details for the permit application process are provided in the SOP 2: Site Visits.

Scheduling

General schedules for fieldwork and reporting can be found in Tables 6 and 7. Other scheduling details can be found in the Standard Operating Procedures: e.g., scheduling field crews (SOP 1); obtaining site visit permission (SOP 2); training field crews (SOP 3).

Budget

The annual cost (estimated in 2009) for monitoring ranges between \$93,588.00 and \$157,108.00. The program budget is presented separately for: (1) overall program FY11–15 (Table 9), (2) mist-netting (Table 10), (3) point count surveys (Table 11), (4) project management (Table 12), and (5) Analysis and Synthesis Reports (Table 13). Project management includes salaries for Point Blue Project Leader and Point Blue Data Manager to provide program oversight along with quality assurance and quality control of all data.

The funds needed to implement this program are contributed by NPS Inventory and Monitoring Program, Point Blue, and, occasionally, by other partners. Point Blue contributes in kind costs for all surveys at the Palomarin Field Station, all mist-netting operations, and most of the data management prior to its transfer to NPS (Tables 9 – 13). Both GOGA and PORE provide in kind support through involvement of the Wildlife Ecologist and Science Advisor. The NPS Inventory and Monitoring Program provides in kind support through involvement of the data manager and network program manager.

Although data management time is not presented as a line item in the budget, data management is part of all staff members including interns, field staff, senior field biologist, banding supervisor, project leader, and statistician. In addition, the NPS network data manager reviews data and

completes metadata. We estimate that approximately 1/3 of total project cost is directed toward data management, reporting and analysis.

The SFAN will cover \$44,520.00 of the total during years when point counts are conducted and will support the project with \$25,000 during years that Analysis and Syntheses Reports are completed. Point Blue will cover each year's balance.

Table 9. Overall program budget scenarios FY11–FY15 (per estimates from 2009).

Income/ Expense	Description	FY11	FY12	FY13	FY14	FY15
Income	NPS Inventory and Monitoring Program Funding	\$44,520	25,000	–	\$44,520	–
	NPS In-kind*	\$24,000	\$24,000	–	\$24,000	–
	Point Blue In-kind	\$73,771	\$84,108	\$93,588	\$36,071	\$93,588
	Total Income	\$118,291	\$133,108	\$93,588	\$104,591	\$93,588
Expense	Mist Netting (See Table 10)	\$79,888	\$79,888	\$79,888	\$79,888	\$79,888
	Point Count Surveys (See Table 11)	\$24,703	–	–	\$24,703	–
	Project Management (See Table 12)	\$13,700**	\$13,700	\$13,700	\$13,700**	\$13,700
	Analysis and Synthesis Report (See Table 13)	–	\$39,520	–	–	–
Total Project Cost		\$118,291	\$133,108	\$93,588	\$104,591	\$93,588

* NPS in-kind contribution includes approximately 1 pay period each for GOGA wildlife ecologist, PORE science advisor, I&M program manager, and I&M data manager.

** Includes cost of progress reports

Table 10. Point Blue Budget for mist netting (per estimates from 2009).

Expense Type	Expense	Hourly Rate	#Months	Total Salaries
Salaries & Benefits	Project Leader	\$41.24	–	–
	Banding Supervisor (includes some data mgt.)	\$31.12	4	\$21,578
	Data Manager	\$34.19	–	–
	Total Salaries & Benefits	–	–	\$21,578
Other Direct Costs	Interns (4 interns x \$826 per month)	–	–	\$39,648
	Project Supplies & Equipment	–	–	\$3,000
	Travel (mileage, gas, etc.)	–	–	\$4,000
	Total Other Direct Costs	–	–	\$46,648
Total Direct Costs	–	–	–	\$68,226
Overhead *	–	–	–	\$11,662
Total Mist Netting Costs	–	–	–	\$79,888

* Overhead is 25% of non-salary expenses

Table 11. Point Blue Budget for point count surveys (per estimates from 2009).

Expense Type	Expense	Hourly Rate	#Months	Total Salaries
Salaries & Benefits	Project Leader	\$41.24	–	–
	Senior Field Biologist (includes some data mgt.)	\$31.12	4	\$21,578
	Data Manager	\$34.19	–	–
	Total Salaries & Benefits	–	–	\$21,578
Other Direct Costs	Project Supplies & Equipment	–	–	\$500
	Travel (mileage, gas, etc.)	–	–	\$2,000
	Total Other Direct Costs	–	–	\$2,500
Total Direct Costs	–	–	–	\$24,078
Overhead *	–	–	–	\$625
Total Point Count Costs	–	–	–	\$24,703

* Overhead is 25% of non-salary expenses

Table 12. Point Blue Budget for project management (per estimates from 2009).

Expense Type	Expense	Hourly Rate	#Months	Total Salaries
Salaries & Benefits	Project Leader (includes some data mgt.)	\$41.24	1	\$7,148
	Senior Field Biologist	\$31.12	–	–
	Data Manager	\$34.19	1	\$5,927
	Total Salaries & Benefits	–	–	\$13,075
Other Direct Costs	Travel (mileage, gas, etc.)	–	–	\$500
	Total Other Direct Costs	–	–	\$500
Total Direct Costs	–	–	–	\$13,575
Overhead *	–	–	–	\$125
Total Point Count Costs	–	–	–	\$13,700

* Overhead is 25% of non-salary expenses

Table 13. Point Blue Budget for Analysis and Synthesis Report (per estimates from 2009).

Expense Type	Expense	Hourly Rate	#Months	Total Salaries
Salaries & Benefits	Project Leader (includes some data mgt.)	\$41.24	2	\$16,440
	Senior Field Biologist	\$31.12	–	–
	Statistician (includes some data mgt.)	\$52.27	2.5	\$22,648
	Total Salaries & Benefits	–	–	\$39,088
Other Direct Costs	Travel (mileage, gas, etc.)	–	–	\$200
	Total Other Direct Costs	–	–	\$200
Total Direct Costs	–	–	–	\$39,288
Overhead *	–	–	–	\$50
Total Point Count Costs	–	–	–	\$39,338

* Overhead is 25% of non-salary expenses

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The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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