National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Bird Monitoring Protocol for National Parks in the Sierra Nevada Network

Natural Resource Report NPS/SIEN/NRR—2010/231






ON THE COVER

Top left, Ash-throated Flycatcher; top right, Canyon Wren; middle left, California Quail; middle right, Band-tailed Pigeon; bottom left, Yellow-rumped Warbler; bottom right, Lazuli Bunting,. Photos by Gary Lindquist.

Bird Monitoring Protocol for National Parks in the Sierra Nevada Network

Natural Resource Report NPS/SIEN/NRR—2010/231

Rodney B. Siegel, Ph.D.
Robert L. Wilkerson

The Institute for Bird Populations
P.O. Box 1346
Point Reyes Station, California 94956-1346
(415) 663-1436
www.birdpop.org

Meryl Goldin Rose

Sierra Nevada Network, Inventory & Monitoring Program
Yosemite Field Station
P.O. Box 700
El Portal, California 95318
(209) 379-3268
http://science.nature.nps.gov/im/units/sien/index.cfm

August 2010

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

THE INSTITUTE FOR BIRD POPULATIONS

This report is available from the Sierra Nevada I&M Network website (http://www.nature.nps.gov/im/units/sien) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/NRPM).

Please cite this publication as:
Siegel, R. B., R. L. Wilkerson, and M. Goldin Rose. 2010. Bird monitoring protocol for national parks in the Sierra Nevada Network. Natural Resource Report NPS/SIEN/NRR—2010/231. National Park Service, Fort Collins, Colorado.

NPS 963/105361, August 2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change
09/19/2007	All authors.	1st draft	Development of protocol
11/26/2007	All authors.	2nd draft.	Development of protocol
12/19/2007	All authors.	3rd draft.	Development of protocol
03/22/2010	Mutch, McKinney, Siegel, & Chung-MacCoubrey	Make changes per reviewer comments	Revisions based on comments from Agee & anonymous reviewers.
05/19/2010	Chung-MacCoubrey	Formatting/spelling errors were fixed. Missing citations added.	In response to comments in Conditional Approval letter from Jim Agee (dated 4/12/10)

Contents

Page

Figures ix

Tables xi

Appendixes xiii

Standard Operating Procedures (SOPs) xv

Acknowledgments xvii

Introduction 1

Chapter 1: Background and Objectives 3

1.1. Background and History 3

1.2. Rationale for Monitoring Birds 4

1.2.1. Importance and Value 4

1.2.2. Threats and Issues 4

1.3. Birds as Sensitive Indicators of Ecosystem Condition 11

1.4. Relationship to Local, Regional, or National Monitoring Efforts 12

1.4.1. Sierra Nevada Bird Information and Other Vital Signs Monitoring 12

1.4.2. Regional and National Linkages 12

1.5. Monitoring Questions and Measurable Objectives 13

1.5.1. Bird Monitoring Protocol Objectives 13

1.5.2. Complementary Monitoring Programs 14

Chapter 2: Sampling Design 17

2.1. Rationale for Selecting this Sampling Design over Others 17

2.2. Large-park Sampling Scheme: Sequoia, Kings Canyon, and Yosemite National Parks 18

2.3. Site Selection in Large Parks 19

2.3.1. Procedures for Selecting Sampling Locations; Stratification, Spatial Design 19

2.4. Sampling Frequency and Replication in Large Parks 20

2.5. Recommended Number and Location of Sampling Units in Large Parks 22

2.6. Level of Detectable Change using Sample Design in Large Parks 24

2.7. Small-park Sampling Design: Devils Postpile National Monument 25

Chapter 3: Field Methods 27

3.1. Permitting and Compliance 27

3.2. Field season Preparations and Equipment Setup 27

3.3. Training and Sequence of Events during the Field Season 27

3.4. Details of Taking Measurements in the Field 28

3.4.1. Sequoia, Kings Canyon, and Yosemite 28

3.4.2. Devils Postpile 30

3.5. End-of-season Procedures 31

Chapter 4: Data Handling, Analysis, and Reporting 33

4.1. Project Information Management Overview 33

4.1.1. The Data Life Cycle 35

4.2. Pre-season Preparations for Information Management 38

4.2.1. Set up Project Workspace 38

4.2.2. GPS Loading and Preparation 38

4.2.3. Implement Working Database Copy 38

4.3. Overview of Database Design 38

4.4. Data Entry, Verification, Processing, and Validation 39

4.4.1. Regular Data Backups 40

4.4.2. Data Verification and Metadata Development 40

4.4.3. GPS Data Procedures ... *40*

4.4.4. Final Verification, Processing, and Validation ... *41*

4.5. Data Documentation and Certification ... 41

4.5.1. Data Edits after Certification ... *41*

4.5.2. Geospatial Data ... *42*

4.5.3. Metadata Procedures ... *42*

4.5.4. Upload Data, Archive Data ... *42*

4.6. Data Analysis and Dissemination ... 42

4.6.1. Correcting Point Count Data for Detectability ... *42*

4.6.2. Trend Detection for Bird Species Densities: SEKI and YOSE ... *43*

4.6.3. Detecting Trends in Bird Distributions ... *44*

4.7. Reporting, Product Development, and Product Delivery ... 45

4.7.1. Report Content ... *45*

4.7.2. Standard Report Format ... *46*

4.7.3. Review Products for Sensitive Information ... *46*

4.8. Product Posting and Distribution ... 47

4.8.1. Holding Period for Project Data ... *47*

4.8.2. Special Procedures for Sensitive Information ... *47*

4.9. Archival and Records Management ... 47

4.9.1. Season Close-out ... *47*

Chapter 5: Personnel Requirements, Training, and Safety ... 49

5.1. Roles and Responsibilities ... 49

5.2. Qualifications ... 49

5.3. Training Procedures ... 51

5.4. Safety ... 51

Chapter 6: Operational requirements........53
6.1. Annual Workload and Field Schedule........53
6.2. Facility and Equipment Needs........53
6.3. Startup Costs and Budget Considerations........54
6.4. Protocol Revisions........56
Chapter 7: References........57

Figures

Page

Figure 1 – 1. Bird populations’ conceptual diagram, illustrating principle interactions of stressors, ecological factors, population limiters, and population processes 10

Figure 1 – 2. Orange-crowned warbler banded at a MAPS station in Yosemite National Park. NPS photo. 14

Figure 2-1. Wildlife Biologist Sarah Stock monitoring birds in Yosemite National Park. NPS photo. 17

Figure 2 – 2. Locations of transect starting points at Yosemite National Park 22

Figure 2 – 3. Locations of transect starting points at Sequoia and Kings Canyon National Parks 23

Figure 2 - 4. The Devils Postpile rock formation for which Devils Postpile National Monument is named. NPS photo by Tom Warner. 25

Figure 2 – 5. Circles indicate location of individual point-count stations at Devils Postpile National Monument. 26

Figure 4-1. Intern Henry Pollack monitors Sierra Nevada birds for The Institute for Bird Populations. Photo by Lisa Vormald, IBP Biologist....33

Figure 4-2. Data management steps during the five stages of project development with data management activities involved in each phase 34

Figure 4 – 3. The data life cycle 37

Figure 4 - 4. Rock Wren. Photo by Gary Lindquist. 38

Tables

Page

Table 1 – 1. Panel design for bird monitoring at YOSE and SEKI. 21

Table 4 – 1. Functional comparison of the master project database and the working database copy...39

Table 5 – 1. Roles and responsibilities of NPS staff and cooperators involved with implementing the bird monitoring program..50

Table 6 – 1. Estimated annual budget for implementing bird monitoring in the Sierra Nevada Network...55

Appendixes

Page

Appendix A: Locations of Transect Starting Points for SIEN Bird Monitoring 69

Appendix B: Yearly Project Task List and Schedule 79

Appendix C: Administrative Record of Protocol...85

Appendix D: Protocol Development Summary 91

Standard Operating Procedures (SOPs)

The following SOPs are attached at the end of this document and are numbered individually to facilitate using them independently and revising or updating them.

SOP 1. Preparing for the Field Season

SOP 2. Safety

SOP 3. Field Tour Preparation

SOP 4. Training Observers

SOP 5. Conducting Point Counts

SOP 6. Classifying Vegetation

SOP 7. Collecting GPS Data

SOP 8. Establishing, Relocating, and Describing Survey Points

SOP 9. Reporting Rare Bird Detections

SOP 10. Special Considerations for Devils Postpile National Monument

SOP 11. After the Field Season

SOP 12. Workspace Setup and Project Records Management

SOP 13. Data Entry and Verification

SOP 14. Metadata Development

SOP 15. Data Quality Review and Certification

SOP 16. Data Analysis and Reporting

SOP 17. Product Delivery Specifications

SOP 18. Revising the Protocol

SOP 19. Sensitive Information Procedures

Acknowledgments

This protocol is patterned very closely after the landbird monitoring protocol developed by R. Siegel, R. Wilkerson, and others for the national parks of the North Coast and Cascades Network (NCCN). We are grateful to our colleagues who worked with us to develop the NCCN protocol: Kurt Jenkins at USGS FRESC, Robert Kuntz II at North Cascades National Park, John Boetsch and Patricia Happe at Olympic National Park, and Jim Schaberl at Mount Rainier National Park. Much of their work is reflected in this protocol.

We thank the following individuals who helped with their participation in SIEN's Bird Monitoring Workgroup:

- Meryl Goldin Rose (Workgroup Lead), Ecologist, Sierra Nevada Network (2004-2008)
- Tom Gardali, PRBO Conservation Science
- Andi Heard, Physical Scientist, Sierra Nevada Network
- Dr. Rachel Mazur, Wildlife Biologist, Sequoia & Kings Canyon National Parks
- Linda Mutch, Coordinator, Sierra Nevada Network (2002- 2009)
- Dr. Leigh Ann Starcevich, University of Idaho (statistician)
- Sarah Stock, Wildlife Biologist, Yosemite National Park
- Steve Thompson, Wildlife Biologist, Yosemite National Park
- Harold Werner, Wildlife Ecologist, Sequoia & Kings Canyon National Parks

Rodney Siegel thanks the following people for assisting him in revising this protocol in response to peer reviews:

- Sandy Graban, SIEN Biological Science Technician did GIS analyses.
- Dr. Shawn McKinney, SIEN Ecologist, and Linda Mutch, former SIEN Coordinator and current SIEN Science Communication Specialist, revised portions of this protocol and responded to a subset of peer review comments.
- Les Chow, SIEN Data Manager, and Dr. Alice Chung-MacCoubrey, SIEN Program Manager, provided review and helpful comments on SOPs and the protocol narrative.

We thank Dr. Penny Latham, PWR Inventory & Monitoring Program Manager, for facilitating the peer reviews and two anonymous reviewers for helpful comments on the draft protocol.

This is Contribution No. 325 of The Institute for Bird Populations.

Introduction

This protocol narrative outlines the rationale, sampling design, and methods for monitoring birds in the Sierra Nevada Monitoring Network (SIEN) during the breeding season. One of 32 networks of parks in the National Park System, SIEN comprises four mountainous, natural-area national park units in California, including three large parks—Sequoia and Kings Canyon National Parks (SEKI, administered as one unit) and Yosemite National Park (YOSE)—and one smaller park, Devils Postpile National Monument (DEPO). The protocol reflects decisions ratified by SIEN's Bird Monitoring Workgroup (comprising NPS personnel and collaborators from The Institute for Bird Populations and PRBO Conservation Science) over the course of several years and culminating in a meeting held in February 2007. It has been developed using the North Coast and Cascades Network's (NCCN) landbird monitoring protocol (Siegel et al. 2007c) as a template. The protocol adheres closely to NCCN methodology in all respects; differences simply reflect minor adaptations for local park conditions, needs, and objectives.

This protocol narrative describes the SIEN bird monitoring program in relatively broad terms, and the protocol's structure and content adhere to the outline and recommendations developed by Oakley et al. (2003) and adopted by the National Park Service Inventory and Monitoring Program. Finer details of methodology are addressed in a stand-alone set of standard operating procedures (SOPs) that accompany the protocol narrative.

Chapter 1: Background and Objectives

1.1. Background and History

The Sierra Nevada Network (SIEN) comprises four national park units:

- Yosemite National Park (YOSE)
- Sequoia National Park (SEQU)
- Kings Canyon National Park (KICA)
- Devils Postpile National Monument (DEPO)

Sequoia and Kings Canyon are administered collectively as a single unit: Sequoia and Kings Canyon National Parks (SEKI).

Sierra Nevada Network parks provide birds over 658,000 hectares (1,600,000 acres) of unusually diverse habitats, ranging from gently sloping foothill grasslands up to windswept alpine wetlands and peaks. National park units in the Sierra Nevada Network collectively range in elevation from around 400 m in the foothills, to 4,418 m at the top of Mt. Whitney, and contain huge tracts of mid-elevation and subalpine conifer forest, as well as substantial acreage of chaparral, oak woodland and savanna, groves of giant sequoia, upland hardwood forest, meadows, and alpine plant communities. In addition, the parks also comprise approximately 4,500 lakes and ponds, plus numerous other ephemeral water bodies and thousands of kilometers of rivers and streams that have some of the highest water quality in the Sierra Nevada. There are four Wild and Scenic Rivers in the parks: the Middle and South Forks of the Kings River (98.5 km) and the North Fork of the Kern River (46.5 km) in Sequoia and Kings Canyon, and the Merced (130.0 km) and Tuolumne (87.0 km) rivers in Yosemite. Water dynamics in the Sierra Nevada are a critical component of the parks' ecosystems, and therefore to its avifauna. The snow pack acts as a temporary reservoir, storing water that will be released during the warmer and drier months.

The Mediterranean climate varies dramatically from the mild winters and hot dry summers that characterize the foothills, through wetter and cooler mid-elevations, up to harsh long winters and short summers in sub-alpine and alpine areas. Since birds are inextricably tied to the passage of seasons, species occupying different elevations follow radically different annual schedules.

While none of the approximately 200 bird species that breed, winter, or migrate through the Sierra Nevada are endemic to the range, the key to its exceptional bird diversity is its extreme elevation gradient and corresponding habitat diversity—the Sierra Nevada supports the most diverse assortment of terrestrial habitats and birds of any bioregion in California (Beedy 1985).

In recognition of the Sierra Nevada's bird diversity and critical breeding, stopover, and wintering habitats, Sequoia, Kings Canyon, and Yosemite National Parks, and a few other large areas in the Sierra Nevada, have been designated by the American Bird Conservancy as "Globally Important Bird Areas."

1.2. Rationale for Monitoring Birds

1.2.1. Importance and Value

Reported declines of many bird species breeding in North America have stimulated interest in avian population trends and mechanisms driving those trends (Robbins et al. 1989, DeSante and George 1994, Peterjohn et al. 1995).

Many populations of birds and other species are now threatened or endangered, or will likely become threatened soon, as a result of anthropogenic climatic and environmental changes (North American Bird Conservation Initiative 2009). The improved ability of scientists to document species population trends has spurred long-term monitoring programs to monitor the health and status of populations, and to investigate the causes of observed population changes.

Data from the North American Breeding Bird Survey indicate that many bird populations in the Sierra Nevada are declining (Siegel and DeSante 1999, Sauer and Hines 2004).

Data from Sierra Nevada parks' MAPS (Monitoring Avian Productivity and Survivorship) program show both significant increases and decreases in numerous bird species. The program in Yosemite (5 demographic monitoring stations at montane wet meadows) has shown declines in many breeding populations of birds. Analyses reveal negative trends in 13 species, and the number of adult birds of all species (pooled) exhibit a highly significant decrease of 23% between 1993 and 2006 (Pyle et al. 2006). Over half the declining species exhibited low *reproductive* success, indicating that conditions on their breeding grounds–i.e., within Yosemite–is a limiting factor to these species' population dynamics. Data from the MAPS monitoring stations in Kings Canyon, though limited in scope (2 demographic monitoring stations), have shown both significant decreases in some species, and significant increases in others (Siegel and Kaschube 2007, Siegel et. al. 2007a).

1.2.2. Threats and Issues

Researchers have identified five main categories of stressors faced by birds in the Sierra Nevada Network parks (DeSante 1995, Graber 1996, Mutch et. al 2008, SIEN Bird Workgroup 2007, pers. comm.)(Figure 1 – 1):

- Anthropogenic Climate Change
- Altered Fire Regime
- Atmospheric Pollution
- Habitat Fragmentation, Loss, Degradation, and Insularization (exurban development)—at both breeding and wintering grounds
- Invasive and Non-native species

Other stressors in the Sierra Nevada include livestock grazing, logging, and increased recreational use. Additional threats also face the Sierra Nevada's migratory birds on their wintering grounds and along migration routes. Although localized stressors (e.g., livestock grazing) would not appear to play a large role in the national parks, data from the MAPS program suggest that the majority of the population declines observed in Yosemite appear to be tied primarily to low productivity–presumably resulting from factors occurring *in the park*–rather than low survival (DeSante et al. 2004, 2005, Siegel et al. 2007b). Such changes could be a result of systemic stressor effects on habitat quality and other ecological factors (Figure 1-1).

1.2.2.1 Anthropogenic Climate Change: Climate change is not a new topic in biology. In fact, it was Grinnell (1917)—in his book about his work in Yosemite—who first elucidated the role of climatic thresholds in constraining the geographic boundaries of many species (Parmesan 2006).

Climatic change may have the greatest potential to affect ecosystems in part because of its pervasiveness and extent across ecosystems as well as synergistic effects with other stressors. The last several decades in the Sierra Nevada were among the warmest of the last millennium (Graumlich 1993). Recent simulations of climate change models suggest that by the years 2050 to 2100, average annual temperature in the Sierra Nevada could increase by as much as 3.8º C (6.8 ºF) (Snyder et al. 2002)—the equivalent of about an 800 m upward displacement in climatic zones. Average temperatures in May could increase by 9º C (16.2 ºF).

Phenological studies indicated that in much of the West, lilacs and honeysuckles are responding to the warming trend by blooming and leafing out earlier (Cayan et al. 2001). Human-influenced temperature patterns are significantly associated with discernible changes in plant and animal (invertebrate, bird, amphibian, tree, shrub) phenological traits (IPCC 2007).

However, there is no *a priori* reason to expect all components of food chains (e.g., birds and insects) will shift their phenology at the same rate (Parmesan and Yohe 2003). Such differential shift will lead to mis-timed reproduction in many species, including seasonally breeding birds (Visser et al. 2004, Parmesan 2006). It is theorized that mis-timing in avian reproduction will occur because there is a substantial delay between the moment of decision-making on when to reproduce and the moment at which selection operates on this decision. Climate change is therefore likely to differentially alter the environment of decision-making and the environment of selection (Visser et al. 2004).

Some habitats (e.g., high alpine) may shrink dramatically or disappear entirely, leading to irreversible loss of some species (e.g., Gray-crowned Rosy Finch *Leucosticte tephrocotis,* American Pipit *Anthus rubescens*, pika *Ochotona princeps*). Two climate models predict significant reductions in Sierra Nevada alpine-subalpine forest by the year 2100: one model predicts 50–75% reduction, the other a 75–90% reduction (Hayhoe et al. 2004)(See also *Habitat Fragmentation, Loss, Degradation, and Insularization* below).

Researchers predict that even a relatively modest mean temperature increase (2.5 °C, 4.5 ºF) would significantly alter precipitation, snow pack, surface water dynamics (e.g., flow), and hydrologic processes in the Sierra Nevada. The most pronounced changes would probably be earlier snowmelt runoff and reduced summer base flows and soil moisture (IPCC 2007), a lower snowpack volume at mid-elevations (Knowles and Cayan 2001), and increased winter and spring flooding (Dettinger et al. 2004). Two climate models predict significant reductions in Sierra Nevada snowpack by the year 2100: one model predicts 30 –70% reduction, the other a 73 – 90% reduction (Hayhoe et al. 2004).

The scientific literature is filled with published accounts of population changes in individual avian species attributable to climate change. In addition, scientists have been compiling and synthesizing data and studies for larger avian groups, for example: nearctic-neotropical migrants (MacMynowski et al. 2007); tree swallow species across North America (Dunn and Winkler 1999); long distance and short distance migrants (Jenni and Kery 2003).

Global climate change is also likely to exacerbate three other systemic stressors of the Sierra Nevada: altered fire regime, air pollution, and non-native invasive species (IPCC 2007)(*See individual stressors, below*).

Over 140 studies have shown that global warming is correlated to biological change and several of these studies have revealed that as temperatures increase, the geographical ranges of numerous species have shifted poleward or moved to a higher elevation (Root et al. 2003, Root et al. 2005). Ecological changes in phenology and distribution of plants and animals are occurring in all well-studied terrestrial, freshwater, and marine groups. Range-restricted species, particularly mountaintop species, show severe range contractions and have been the first groups in which entire species have gone extinct due to climate change (Parmesan 2006).

Recent re-surveys of the early 20th century Grinnell vertebrate transects in the Sierra Nevada found that bird species have experienced changes in their distributional limits (Tingley et al. 2009). This study showed that bird species have tracked changes in the geographical distribution of their climatic niches through time, which suggests that climatic niche modeling may prove of value in predicting future trends in species occurrence under varying models of climate change.

1.2.2.2 Altered Fire Regime: The Sierra Nevada ecosystem was historically dependent upon frequent fire. Fire created complexity across the landscape by opening forests for shrub communities and creating snags, logs, and a varied-age plant structure—all critical features that support diverse and abundant wildlife. Fire exclusion from the Sierra Nevada has contributed to long-term shifts in habitat composition and structure (Gruell 2001) which has negatively affected a diversity of birds, for example, Olive-sided Flycatcher which favor open forest with snags and scattered trees, Brown Creeper and Pileated Woodpecker which rely on older forests with large-diameter trees, and Black-backed Woodpecker which is strongly associated with stands of fire-killed snags (Hutto 1995).

Compounding a predicted increase in lightning strikes and resulting wildfire ignitions as a result of rapid anthropogenic climate change, extreme weather conditions such as drought are likely to result in fires burning larger areas, being more severe, and escaping containment more frequently (Price and Rind 1991, IPCC 2007). Resultant unnatural, large-scale changes in habitat quality and quantity could dramatically affect both resident and migratory species. Other effects of habitat change are discussed below.

1.2.2.3. Habitat Fragmentation, Loss, Degradation, and Insularization: Habitat fragmentation and loss, including increasing exurban development (Duane 1999) with its concomitant increases in land conversion, is one of the biggest problems faced by birds today, and has contributed to the majority of species declines (Neotropical Migratory Bird Conservation Act 2000). Fragmentation of forests across North America has greatly increased the Brown-headed Cowbird's range. The Brown-headed Cowbird is a brood parasite; the female cowbird selects host nests of other species of bird to lay her eggs in, parasitizing many nests and laying up to 40 eggs per season (Lowther 1993, Morrison and Hahn 2002). Perhaps the most endangered songbird in the Sierra Nevada–the Willow Flycatcher (*Empidonax trailii*)–is rapidly disappearing, believed to be a result of land use practices (e.g., grazing, agriculture) that have denuded or destroyed their riparian habitat (McCreedy and Heath 2004). Indeed, the species appears to have been extirpated from former breeding grounds in Yosemite within the last several years (Siegel et al. 2008). Habitat degradation on a regional scale probably affects the viability of bird populations on relatively intact habitats managed inside the parks. Nearctic-Neotropical migratory passerine birds may be exhibiting the most severe population declines because they face habitat destruction and degradation during migration stopover and on both wintering and breeding grounds.

Insularization could be further exacerbated as a result of recent decisions by USDA Forest Service to increase timber harvest and forest thinning efforts to reduce fuels—the parks are bounded primarily by US Forest Service lands (these lands are also mostly designated as wilderness, but have some timber harvest, grazing, reservoirs, and recreation).

1.2.2.4. Air Pollution: The deposition of atmospheric pollutants in California's Sierra Nevada has resulted in the degradation of ecosystems (Duriscoe 1987, Unger 1989) and is thought to play a role in the declines of several wildlife populations (Davidson 2004, Fellers et al. 2004). Environmental pollutants, such as organophosphorous pesticides and ozone, travel upslope from the heavily developed San Joaquin and Sacramento Valleys due to prevailing winds (Zabik and Seiber 1993, LeNoir et al. 1999). The pollutants enter the Sierra Nevada ecosystem via wet and dry deposition, ultimately making their way into the food chain (LeNoir et al. 1999).

Warm temperatures create the perfect conditions for the production of smog and ground-level ozone. Global warming is therefore likely to make air pollution problems worse. Toxic gases (e.g., ozone) and or airborne particulates can have debilitating or destructive effects on birds via a variety of distribution modes (e.g., air or water) and biochemical mechanisms. Compared with mammals, birds have high metabolic rates and distinct physiology; analogous to "the canary in the coal mine", birds have been suggested as sensitive, direct monitors of air quality in a regional or global sense (Furness et al. 1993, Brown 1997, Brown et al. 1997).

Sequoia, Kings Canyon, and Yosemite National Parks experience multiple days where ozone levels exceed the state and national health standard for 8-hour ozone levels, and these parks rank in the top 10 most ozone-polluted parks in the country (Esperanza and van Mantgem 2008). While elevated ozone levels occur in all of these parks, they are consistently and at times substantially, higher in Sequoia and Kings Canyon, due to the geographic location of these parks in relation to regional air flow patterns. For example, in 2003 Sequoia and Kings Canyon exceeded the health standard for ozone (85 ppb, 8-hour average) 72 days, while Yosemite recorded 10 days above the standard (Esperanza and van Mantgem 2008). Unpolluted air ranges between 20–30 ppb, however, global ozone background level has risen at least 10 ppb. In Yosemite, 8-hour ozone averages are usually below 95 ppb (Yosemite National Park, unpublished data). In Sequoia and Kings Canyon, 8-hour averages are usually below the low (100s ppb, however, values do reach between 100–115 ppb on a few days each year. The highest reading on record at Sequoia was in 2003: 129 ppb. There are known health effects to vegetation and humans at levels much lower than the above.

There are only a handful of published studies on the effects of ozone on birds: lung hemorrhage was observed in all three studies, specifically in chicks exposed to 300–500 ppb (Rombout et al. 1991, Bartov et al. 1981, and Quilligan et al. 1958). All three studies were conducted in a laboratory environment, over a short period of time, where birds had no flight exercise. Extrapolation to wild avifauna is difficult, where flight would increase lung exposure to ozone significantly. Nor are there sufficient data to identify the potential effects to birds due to *chronic* exposure to ozone, such as what might be occurring at SEKI, where ozone levels are substantially higher than the other SIEN parks.

A large-scale study has shown a relationship in North America between acid rain and widespread declines across the breeding range of the Wood Thrush (*Hylocichla mustelina*) (Hames et al. 2002). High elevation habitats in the species' range–Adirondack, Appalachian, and Great Smoky Mountains–show long-term declines of up to 5 percent annually. Although the exact mechanism leading to the observed declines is still unknown, it is thought to be related to the leaching of calcium from the soil by acid rain, leading to shortages in calcium-rich foods, such as snails, earthworms, millipedes, centipedes, and pillbugs. At the same time, acidic conditions could increase the amounts of toxic aluminum and heavy metals (e.g., lead, cadmium, and mercury) the Wood Thrush ingests (Hames et al. 2002).

1.2.2.5. Invasive Species (Including Disease-causing Agents): Invasive species, as the term is used here, include both nonnative and native species that are commensal with humans. Nonnative species deleteriously affect native species through competition for resources, predation, and disease transmission. In some areas, such as Lee Vining Canyon, the introduced European Starling and House Sparrow have reduced native populations of Violet-green Swallows, House Wrens, and Mountain Bluebirds (Gaines 1988).

Native species that are commensal with humans (i.e., benefit from human habitation) have expanded their range in the Sierra Nevada because of increased food supplies from stables, picnic areas, campgrounds, and residential areas. Native invasives have increased historically, both in extent of range and abundance (Marzluff 2005). Native invasive species include nest predators, such as Common Raven, Steller's Jay, and Western Scrub-Jay, that depredate eggs and young from nests. Brood parasitism of native species by Brown-headed Cowbirds can also increase in frequency and extent with human development. Generalist species include American Robin, Northern Mockingbird, and blackbirds which are more numerous near campgrounds and residential areas and eventually may limit the size of other native songbird populations if food and nest sites become limited resources. A warmer climate would create conditions that would allow the expansion of species better adapted to such conditions (IPCC 2007).

West Nile Virus

West Nile virus is an infectious vector-borne disease transmitted by mosquitoes; it first appeared in the United States in 1999. It affects a wide variety of bird families: over 317 bird species have died from this disease in the United States (Center for Disease Control, http://www.cdc.gov)

During the past year (2007), West Nile Virus was documented in 198 dead birds from the counties bordering SIEN parks (counties surrounding YOSE=45; counties surrounding SEKI=153).

Avian Malaria

Avian malaria is a vector-borne disease, primarily transmitted by mosquitoes, caused by microscopic parasites of the genera *Plamodium* and *Haemoproteus* (hundreds of species). The parasites cannot be transmitted directly from one bird to another and require transmission via the mosquito. Avian malaria has wide geographic distribution (temperate, tropical, and sub-tropical) and mainly affects birds in the order Passeriformes (perching birds). In addition, for reasons yet to be determined, species differ in susceptibility to the disease. Currently, not much is known about the prevalence of avian malaria in the Sierra Nevada, although research from northern California oak woodland and chaparral habitats is forthcoming (Martinsen et al. 2008).

Avian Influenza

Avian influenza, or "bird flu", is primarily a disease of domestic poultry that is not native to, or currently present in, North America. These viruses occur naturally in birds in a great assortment of sub-types (at least 144 are currently identified). Most sub-types are classified as LPAI (low pathogenic avian influenza), responsible for only mild influenza infections. However, a recent mutation (HPAI–high pathogenic avian influenza) has caused illness and death in wild birds, including birds of prey, sparrows, and corvids) (National Park Service 2006a). Although North America is currently free from the highly pathogenic strain of avian influenza, its arrival could have a devastating effect on local bird populations if introduced when migratory birds arrive via flyways from affected areas.

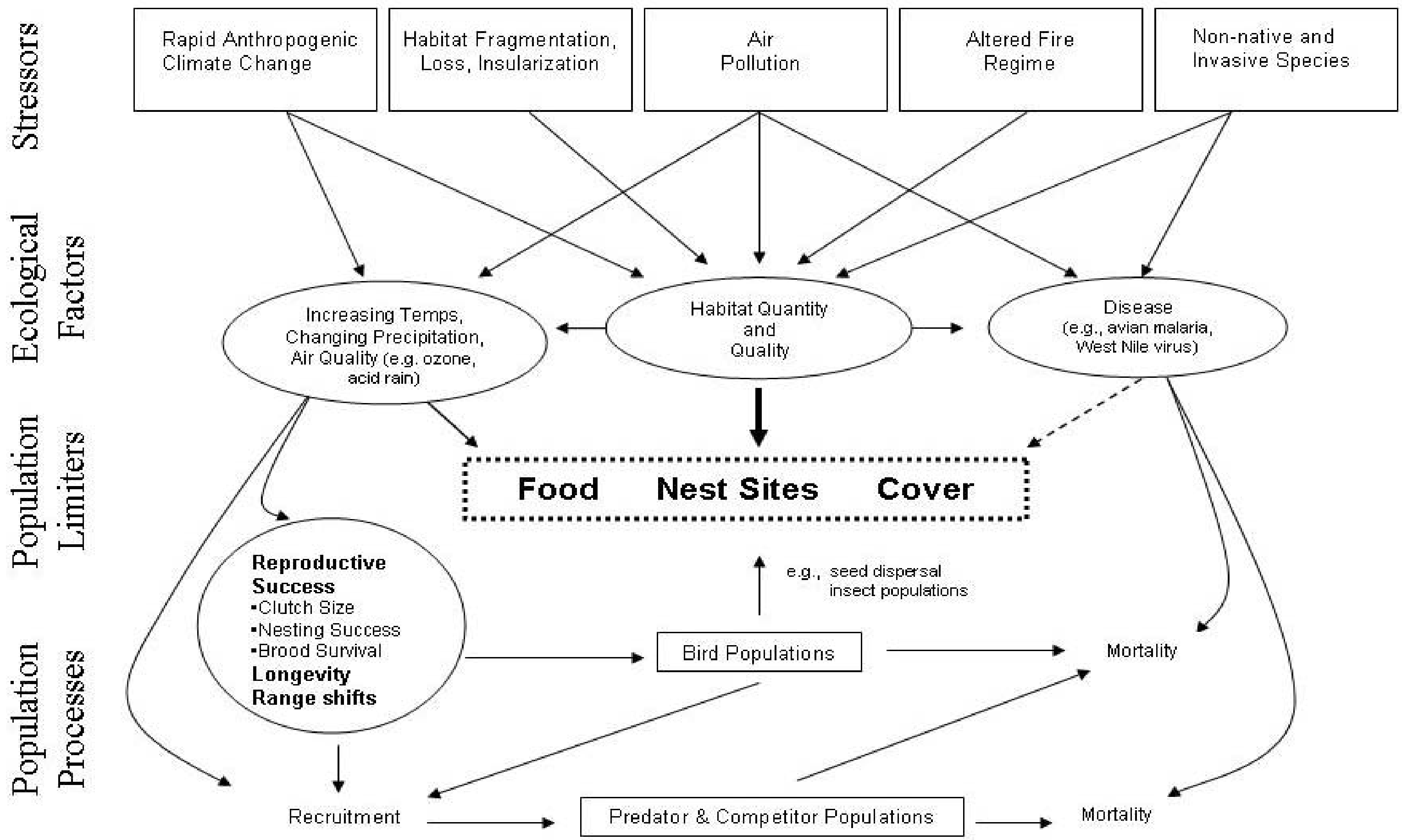


Figure 1 – 1. Bird populations' conceptual diagram, illustrating principle interactions of stressors, ecological factors, population limiters, and population processes (Conceptual model by Sarah Stock, from: Mutch et al. 2008).

1.3. Birds as Sensitive Indicators of Ecosystem Condition

SIEN parks fulfill vital roles as both refuges for bird species dependent on late successional forest conditions, and as “reference sites” (Silsbee and Peterson 1991) for assessing the effects of land use and land cover changes on bird populations throughout the Sierra Nevada region. These changes may result from regional activities such as land conversion and forest management, or from broader-scale processes such as global climate change. Indeed, monitoring population trends at ‘control’ sites, i.e., national parks, is especially important because the parks are among the few sites in the United States where population trends due to large-scale regional or global change patterns are not confounded by local changes in land-use (Simons et al. 1999).

Birds are a good indicator of subtle changes that would be more difficult or expensive to measure otherwise, or when the *biological response* to environmental change is the desired metric (Morrison 1986), as is the case in SIEN. Birds are an appropriate indicator-species of local and regional change in terrestrial ecosystems because their ecology and biology integrates the effects of numerous stressors (Canterbury et al. 2000). Because of their high body temperature, rapid metabolism, and high ecological position on most food webs, birds are excellent integrators of the effects of local, regional and global environmental change on terrestrial ecosystems. Birds have been successfully used as a surrogate metric for quantifying ecological condition of sites based on species’ responses to environmental stress. The method described by Howe et al. (2007) shows that the method is robust and can be applied consistently for species exhibiting strong stress-response functions. Deviations from expected values provided meaningful insights about ecological condition of target habitats.

Furthermore, birds’ abundance and diversity in virtually all terrestrial habitats, diurnal nature, discrete reproductive seasonality, and intermediate longevity facilitate the monitoring of their population and demographic parameters (DeSante et al. 2005). Bird populations were chosen as a scientifically viable vital sign and surrogate for evaluation of network ecosystem condition in Sierra Nevada Network parks for the following reasons:

1. Birds occupy a wide diversity of ecological niches in Sierra parks.
2. Relative to other animal taxa, birds are conspicuous, easily observable, and monitoring is cost effective.
3. Knowledge of the natural history of many bird species has a rich basis in literature.
4. All units in SIEN have a strong foundation of inventory data (Siegel et al. 2002, Siegel and Wilkerson 2004, 2005a, Heath 2004, 2005) upon which to build future monitoring efforts.
5. Monitoring Avian Productivity and Survivorship (MAPS) has occurred at all parks for varying numbers of years and time periods, including at one station in Yosemite (Hodgdon Meadows) since 1990 (e.g., DeSante 1995, 2005; DeSante et al. 2004, 2005; Siegel et al. 2007a, 2007d; Gates and Heath 2003; Heath 2004, 2005, 2007).
6. Bird monitoring is particularly efficient, in the sense that many species can be monitored simultaneously with the same survey protocol, and costs are relatively low.

7. They generally occupy a high position on the food web–secondary consumers (i.e., insectivores)–making them good indicators of ecosystem change (Furness et al. 1993, Greenwood et al. 1993).
8. Bird monitoring across all park ecosystems can serve as an indicator of change at the community level—birds are the only SIEN vital sign which addresses this.

We expect that our project design will allow monitoring of population trend, with a reasonable degree of statistical power, for dozens of species (see Section 2.6—Level of Detectable Change, below). The capacity to capture a fairly broad sector of park resources (i.e. numerous bird species for which we will likely be able to assess population trends) elevates the desirability of monitoring birds over some other taxa, for which expensive projects may only monitor a single species (Croze 1982, Manley et al. 2004). Finally, birds hold high and growing public interest (Cordell et al.1999, Cordell and Herbert 2002) and are perhaps the most visible faunal component of park ecosystems.

1.4. Relationship to Local, Regional, or National Monitoring Efforts

1.4.1. Sierra Nevada Bird Information and Other Vital Signs Monitoring

Substantial knowledge about habitat relationships and bird community structure in the Sierra Nevada (e.g. Beedy and Granholm 1985, Gaines 1992, Siegel and DeSante 1999), as well as more specific information about the current status of birds in the SIEN, already exist and have informed this project design. MAPS (Monitoring Avian Productivity and Survivorship) stations have collected demographic data at multiple meadow and riparian sites in Devils Postpile National Monument and Kings Canyon and Yosemite National Parks (Gates and Heath 2003, Heath 2007, Siegel et al. 2007a, Siegel et al. 2007b) since the first station was established at Yosemite's Hodgdon Meadow in 1990. Spatially extensive bird inventories, utilizing off-trail point counts, have also been completed at each of the SIEN units (Siegel and DeSante 2002, Siegel and Wilkerson 2004, 2005a). These inventory efforts provided opportunities to test and streamline field methodologies and analytical approaches.

During vital signs monitoring planning efforts at SIEN parks, consideration was given to integrating bird monitoring with other monitoring protocols. SIEN I&M and Park staff members considered linking bird monitoring with wetland or forest monitoring protocols. One alternative sampling design proposed in an earlier assessment of bird monitoring alternatives (Siegel and Wilkerson 2005b) was to limit bird monitoring to SIEN wetlands. SIEN and Park staff determined that they wanted to monitor birds across the parks' elevational gradients and in multiple habitat types. Thus, it was not feasible to directly link bird monitoring with other SIEN protocols, due to the broader spatial scale that was desired for bird monitoring.

1.4.2. Regional and National Linkages

Well-developed, standardized data collection methods and analytical procedures for estimating bird population density already exist, and will facilitate comparisons between SIEN results and data from other regional and national efforts. However, the existence of other regional and national bird monitoring efforts, such as the Breeding Bird Survey (Droege 1990, Peterjohn and Sauer 1993) does not suggest that monitoring efforts in the SIEN are unnecessary or redundant. Sierra Nevada BBS routes provide relatively good coverage of mid-elevation conifer forest habitats, but include far fewer points in more geographically limited mid-elevation habitats such as montane meadow and montane chaparral, and fewer still in the foothill, subalpine and alpine zones (Siegel and Wilkerson 2005b). Even within mid-elevation forests, late-successional conditions are generally poorly sampled by the Breeding Bird Survey and other regional bird monitoring activities, but are well represented in SIEN parks. Additionally, although the Breeding Bird Survey has been very valuable in documenting geographically broad population changes, BBS data are collected exclusively at roadsides and are thus of limited value for extending inferences to areas not adjacent to roads (O'Connor 1992, DeSante and George 1994, Sauer 2000), and the resolution of trends is generally too coarse for regional (let alone park-level) decision-making (Sauer and Cooper 2000, Hutto and Young 2002).

Other national parks in the montane west have already implemented or are developing bird monitoring programs with nearly identical methodologies (Siegel et al. 2007c, North Coast and Cascades Network; Stephens et al. 2010, Klamath Network), potentially yielding excellent opportunities for both comparative and collaborative data analysis across parks and networks. Other programs at regional and national levels are assessing changes in bird distributions in relation to climatic change, and data from long-term monitoring of birds in the Sierra Nevada could contribute to these assessments. For example, the National Audubon Society and Audubon California have recently analyzed four decades of Christmas Bird Count data to assess changes in centers of abundance for 300+ species and reported significant northward shifts for 58% of observed species during the first weeks of winter (National Audubon Society 2009).

1.5. Monitoring Questions and Measurable Objectives

1.5.1. Bird Monitoring Protocol Objectives

The goal of this 'landscape-level' monitoring protocol is to assess park-wide and Network-wide bird population trends by monitoring population densities across the parks' diverse habitats and broad habitat gradients. Results from this long-term monitoring of birds throughout the Network should provide information to inform future decisions on important management issues, including fire management, meadow restoration, the effects of introduced species, and visitor impacts. Additionally, these data will complement other bird research and monitoring efforts discussed in 1.5.2.

The objectives of this monitoring protocol are to:

1. Detect trends in density of bird species that are monitored well by point counts (including most passerines, near-passerines, and galliformes), throughout accessible areas of Sierra Nevada Network parks, during the breeding season.
2. Track changes in breeding-season distribution of bird species throughout accessible areas of Sierra Nevada Network parks.

For commonly detected species, we will be able to detect trends in densities at the level of individual parks, allowing comparisons of trends among the different parks. A shared methodology across SIEN parks will ensure consistency, allow us to avoid the pitfalls that can make comparisons between parks difficult or misleading (Quinn and van Riper 1990, Sauvajot et al. 1990, Silsbee and Peterson 1991), and will facilitate trend assessment at the Network level for numerous species whose rarity will prevent trend assessment at the Park level.

Tracking distributional shifts provides an additional metric for assessing changes in bird communities throughout the individual parks and Network, as some important ecological changes—such as populations moving upslope in response to climate change—may not be discernible by simply looking at aggregate population trends.

1.5.2. Complementary Monitoring Programs

The SIEN's Bird Workgroup decided on the above two objectives for this protocol because they believe distribution and abundance are the best metrics for detecting change in bird populations associated with anthropogenic climate change. Although the workgroup selected this spatially extensive, count-based approach, the decision was difficult because the group also saw great value in a complementary approach to bird monitoring in SIEN parks: demographic monitoring.

Bird population vital rates (primary demographic parameters) are indicators of environmental change that may respond more rapidly than bird population densities and distributions. Environmental stressors and management actions affect vital rates directly, usually without time-lags. Vital rates are essential for understanding: a) the stage of the life cycle where population change is being effected, b) health and viability of populations, and c) habitat quality (DeSante et al. 2005).

DeSante et al. (2005) identified six vital rates upon which management should be based: (1) productivity, (2) survival of young, (3) recruitment of young, (4) annual survival of adults, (5) site fidelity, and (6) immigration. By identifying proximate demographic cause(s) of bird population changes, management guidelines may be formulated to reverse population declines and to evaluate the effectiveness of the management actions implemented.

Figure 1 – 2. Orange-crowned warbler banded at a MAPS station in Yosemite National Park. NPS photo.

Avian demographics are currently collected as part of the Monitoring Avian Productivity and Survivorship (MAPS) program (DeSante et al. 2005) Figure 1 – 2). Researchers have been monitoring demography of bird populations through MAPS stations at YOSE (Siegel et al. 2007a), SEKI (Siegel et al. 2007b), and DEPO (Gates and Heath 2003, Heath 2007) for varying lengths of time, with Yosemite having the longest record (starting in 1990). The parks' MAPS stations have provided valuable information on demography and population trends to biologists and managers at each park, and have also made important contributions to the regional (Siegel and Kaschube 2007) and national (DeSante and Kaschube 2006) MAPS program.

Continued monitoring of these long-term MAPS stations is in jeopardy due to scarce funding. The SIEN bird monitoring workgroup determined that the ideal bird program at SIEN parks would integrate the spatially extensive, count-based approach in this protocol (to provide park-wide inference regarding population trends) with a more intensive, spatially limited, demographic approach (for revealing demographic causes of population trends). Thus, the workgroup recommended that the Network add monitoring at MAPS stations if funds become available.

Chapter 2: Sampling Design

2.1. Rationale for Selecting this Sampling Design over Others

In concordance with other NPS bird monitoring protocols that have recently been developed or are currently under development (Coonan et al. 2001, Peitz et al. 2004, Powell et al. 2007, Siegel et al. 2007c), this protocol describes methods for surveying birds with 5-minute point counts and incorporating distance sampling (Reynolds et al. 1980, Fancy 1997, Nelson and Fancy 1999, Buckland et al. 2001, Rosenstock et al. 2002) (Figure 2 – 1). The rationale for selecting this methodology over other alternatives is discussed in Siegel and Kuntz (2000) and Siegel (2000). Incorporating distance sampling (Buckland et al. 2001) into point counts facilitates the estimation of detection probability—a parameter that may vary greatly by species, habitat, observer, or other factors. Estimates of detection probability permit the estimation of absolute density or abundance of birds across the landscape, much more meaningful metrics than the relative abundance indices that can be produced without methods that quantify detectability. Recent studies (e.g., Simons et al. 2009) have called into question the accuracy of avian density estimates that incorporate distance sampling—or any other existing technique—for estimating detectability during point counts. Nevertheless, there is currently no clear consensus within the ornithological community on the preferred sampling method. Whether distance sampling can truly produce unbiased density estimates, or only adjusted indices of density, the method has been recommended by the NPS Inventory and Monitoring Program (Fancy and Sauer 2000), and has been adopted by multiple networks.

We chose a largely off-trail sampling design for monitoring birds in SIEN. For the safety and logistical reasons outlined below, each point-count transect emanates from a point along a park trail. Although the sampling area of each park is constrained to a 3.25-km (2-mile) corridor surrounding park trails, the sampling plan extends inference well away from trails and covers a significant portion of wilderness in each park. Specific features of the proposed sampling design address several significant challenges in working in vast, rugged parks with large roadless areas. These challenges include:

Figure 2-1. Wildlife Biologist Sarah Stock monitoring birds in Yosemite National Park. NPS photo.

1. **Safety concerns:** Substantial portions of YOSE and SEKI are rendered essentially inaccessible by steep slopes or dangerous river crossings. In support of a safety-based work culture that places safety of people above project objectives, we sought a sample design that would yield as large an area of inference as possible, without putting undue pressure on field staff members to compromise their own safety.
2. **High travel costs**: Substantial portions of the large parks are not only many kilometers away from the nearest road, they are also many kilometers away from the nearest trail.

There are places in the more remote parts of YOSE and SEKI where just a single transect could require over a week of a crew's time to reach, sample, and return. Given the tight financial constraints foreseen to constrain the implementation of this project, attempting to reach such remote places would consume an inordinate proportion of available resources, and would greatly reduce the number of transects that could be surveyed each year.

3. **Diverse habitats:** The large parks span enormous elevational gradients, producing substantial intra-park variation in avian community composition, breeding phenology, and average date of accessibility by crew members.

We will utilize two separate sampling schemes: one for YOSE and SEKI, and another for DEPO. In YOSE and SEKI we will sample avian populations along primarily off-trail and off-road point count transects accessible from the parks' trail systems. Because travel and logistics do not pose significant problems at Devils Postpile, which is much smaller than the other parks, we will sample avian populations there from points distributed as a systematic grid covering the entire park.

2.2. Large-park Sampling Scheme: Sequoia, Kings Canyon, and Yosemite National Parks

To address the first two challenges in sampling large wilderness parks—safety considerations and travel costs—we have restricted our sampling frame to accessible areas of the parks within 1.625 km (1 mile) of a trail. We are defining the more remote portions of the parks (areas farther than 1.625 km from a trail) as a separate stratum, which, under likely funding and staffing constraints, will not be sampled. We considered sampling this 'remote' stratum as part of the current program, with effort stratified in a manner that would ensure that most of our sampling would still occur in the 'accessible' stratum. Unfortunately, with just a two-person crew working in each park (necessary due to financial constraints), there is no minimal amount of effort that could be channeled into the remote stratum without siphoning substantial resources away from sampling in the 'accessible' stratum. If, for example, the crew spent one of their weeklong tours each year working in the remote stratum, this might yield just a single transect, as traveling to and from the starting point could consume the rest of the week. Given the heterogeneity of habitat conditions (including elevation, aspect, weather, and plant community) covered by the 'remote' stratum, a single transect each year could not adequately 'represent' the stratum, and would likely yield spurious results. For similar reasons the North Coast and Cascades (NCCN) Monitoring Network has also chosen to restrict landbird sampling to a corridor around roads and trails (Siegel et al. 2007c).

Restricting our sampling frame to within 1.625 km on each side of trails enhances safety and sample size (hence power), and minimizes costs and logistical hurdles, and we believe, greatly increases the likelihood that this project will persist over a temporal scale of decades rather than years.

Although we will conduct our point counts off-trail, transects will 'start' from selected on-trail points, and run perpendicularly away from the trails. Extending transects from points on trails will greatly facilitate relocating survey points in successive years, as starting points will be much easier to find than would starting points that were hundreds or even thousands of meters off-trail in large, undifferentiated tracts of forest. Not only will crews therefore need to expend less time searching for starting points (which will be marked in a visually unobtrusive manner), consistently being able to find a starting point will mean they are able to find the remaining points along a transect with a much greater level of accuracy.

Under foreseen budgetary and logistic constraints, sampling the ‘remote’ stratum would incur excessive opportunity costs and safety risks, for little if any real benefit. In the future, should existing financial and staffing constraints be relaxed (and safety concerns somehow be resolved), the survey could be augmented with transects in the ‘remote’ stratum. We recognize, however, that our near-term decision not to sample the remote stratum means that our inferences will be limited only to the areas of the parks that we have defined as ‘accessible’. If visitor impacts—which would likely be felt exclusively or primarily in the accessible areas—increase over the life of the monitoring program, it is conceivable that population trends for some species in the accessible stratum may differ from their trends in the remote stratum.

To address the issue of habitat diversity and complexity across the parks, we have selected an ‘augmented, serially alternating’ panel design (Urquhart et al. 1993, Urquhart and Kincaid 1999), wherein half of the annual survey effort will be devoted to surveying transects that are revisited annually, while the remaining survey effort will be devoted to one of four panels of additional transects that will be sampled every four years. A panel design with effort split between annually revisited transects, and transects in the four-year serially alternating panels allows a much larger number of transects (hence, greater representation of habitats and regions of the parks) to be included in the sampling scheme than if each transect were to be revisited annually, but still allows for a substantial amount of year-to-year continuity (Breidt and Fuller 1999, Urquhart and Kincaid 1999, McDonald 2003)(see Section 2.5–Sampling frequency and replication, below).

To optimize allocation of effort while maintaining sample size requirements, we have chosen to visit survey points no more than once each year. While some studies recommend resampling points in a season to account for missed detections and seasonal effects (Ralph and Scott 1981), other researchers have suggested that increasing the number of points sampled, rather than the number of visits to a point, can be more efficient under some conditions (Smith et al. 1995). At an avian sampling workshop held at North Cascades National Park Service Complex in September 2000, avian sampling experts reached consensus in recommending sampling more locations at the expense of resampling points throughout a breeding season (Siegel and Kuntz II 2000); the SIEN bird monitoring workgroup concurred (February 2006).

2.3. Site Selection in Large Parks

2.3.1. Procedures for Selecting Sampling Locations; Stratification, Spatial Design

The sampling frame in the large parks consists of transects starting from points spaced every 250 m along trails in each park and extending perpendicularly away from the access routes. We used GIS data to classify each potential transect as belonging to low-, mid- or high-elevation strata based on the elevation of the starting points. We stratified by elevation in each park in order to distribute sampling effort optimally across the parks’ elevation gradient each year. Due to topographic and geographic differences between Sequoia & Kings Canyon and Yosemite, we used different elevations to define the boundaries among low, mid-, and high elevation strata between these parks.

Sequoia & Kings Canyon, unlike Yosemite, have a substantial foothill zone. While this area is small relative to the overall size of the parks, it is ecologically important and is one of the few protected foothill areas in the Sierra Nevada. We adjusted the elevational stratification at SEKI to ensure that each panel of transects would include a transect in the foothill zone. We did this by setting the boundary between the low- and mid-elevation strata at 1,600 m (5,250 feet), roughly the upper elevational limit of the foothill-associated plant communities. In Sequoia & Kings Canyon, the montane zone extends further upslope than it does in the more northerly Yosemite, so we made the boundary between the mid- and high-elevation strata higher at SEKI. The Sequoia and Kings Canyon elevational strata are thus defined as:

Low elevation	Foothill	<1,600 m (5,250 ft)
Mid-elevation	Montane	1,600–3,000 m (5,250–9,800 ft)
High elevation	Subalpine/Alpine	>3,000 m (>9,800 ft)

In Yosemite, the elevational strata are defined as:

Low elevation	Lower montane	<1,800 m (<5,900 ft)
Mid-elevation	Upper montane	1,800–2,750 m (5,900–9,000 ft)
High elevation	Subalpine/Alpine	>2,750 m (>9,000 ft)

Using an R script (psurvey.design) obtained from Tony Olsen (U.S. EPA, Western Ecology Division, Corvallis) we selected the sample of monitoring transects in each park from the candidate transect starting points, using the Generalized Random-Tessellation Stratified (GRTS) sampling method (Stevens and Olsen 1999, 2003, 2004) with reverse hierarchical ordering. GRTS sampling methods are increasingly being adopted for large-scale environmental monitoring programs, in part because they can create a spatially balanced sampling design that allows additional samples to be added or subtracted without compromising the spatial balance of the overall sample (Stevens and Olsen 2003, 2004).

At YOSE we selected 25 transects in each elevation, and grouped them according to their order in the GRTS sample into 5 panels, each containing 5 transects in each elevation zone. At SEKI, where the landmass is distributed across the elevation zones quite differently than at Yosemite, we selected 5 transects in the low-elevations stratum, 45 transects in the mid-elevation stratum, and 25 transects in the high-elevation stratum; again using the transects' order in the GRTS sampling to group them into 5 panels, each containing 1 low-elevation transect, 9 mid-elevation transects, and 5 high-elevation transects. For each park, this process produced five sampling panels each comprising a spatially balanced sample of independent sampling units, and each including an equal number of low-, mid-, and high-elevation transects.

2.4. Sampling Frequency and Replication in Large Parks

Surveys will begin on or near May 15 and end by July 22 of each year. In YOSE and SEKI, the survey will have an augmented, serially alternating panel design (Table 2 – 1), wherein one panel of 15 transects in each large park will be visited once every year. An additional 60 transects will be distributed into four serially alternating panels of 15 transects each. Each transect consists of 14 point count stations. Each year, all 15 transects in one of the alternating panels will be visited in addition to the panel that is revisited annually yielding a total of 420 count stations sampled each year (14 stations x 30 transects). For example:

> During *Year 1*, a total of 30 transects are sampled: 15 transects in Panel 1, and 15 transects in Panel 2.
>
> During *Year 2*, a total of 30 transects are sampled: the 15 transects in Panel 1 are resampled, as are 15 new transects in Panel 3 (Panel 2 is rested).

Table 2 – 1. Panel design for bird monitoring at YOSE and SEKI. Panel 1 includes 15 transects that will be sampled annually, whereas the other four panels each contain 15 transects that will be surveyed every four years, on a rotating schedule.

Panel	Number of Transects to be Surveyed in Each Park (YOSE AND SEKI)									
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
1	15	15	15	15	15	15	15	15	15	15
2	15				15				15	
3		15				15				15
4			15				15			
5				15				15		

2.5. Recommended Number and Location of Sampling Units in Large Parks

The survey design described above yields a total of 75 unique transects in YOSE and SEKI each. Each park unit will have 15 transects that are surveyed *annually* and an additional sum of 60 transects surveyed *every four years* (Table 1 – 1). The locations of 75 transect starting points in YOSE and SEKI, derived through GRTS sampling, are shown in Figures 2 – 2 and 2 – 3.

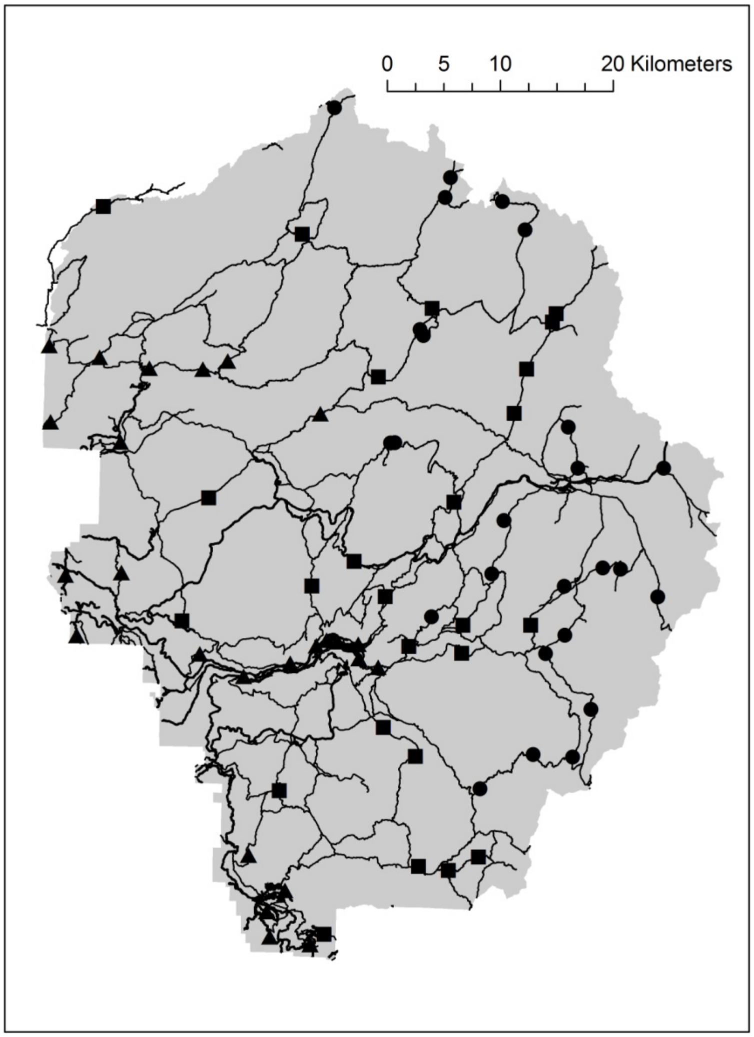


Figure 2 – 2. Locations of transect starting points at Yosemite National Park (trails and roads are indicated with black lines). Starting points were selected using the General Randomized Tessellation Stratified (GRTS) sampling method (Stevens and Olsen 1999, 2003, 2004).Starting points are stratified by elevation, as follows:

- Triangles: low-elevation starting points (<1800 m)
- Squares: mid-elevation points (1,800–2,750 m)
- Circles: high-elevation points (>2,750 m)

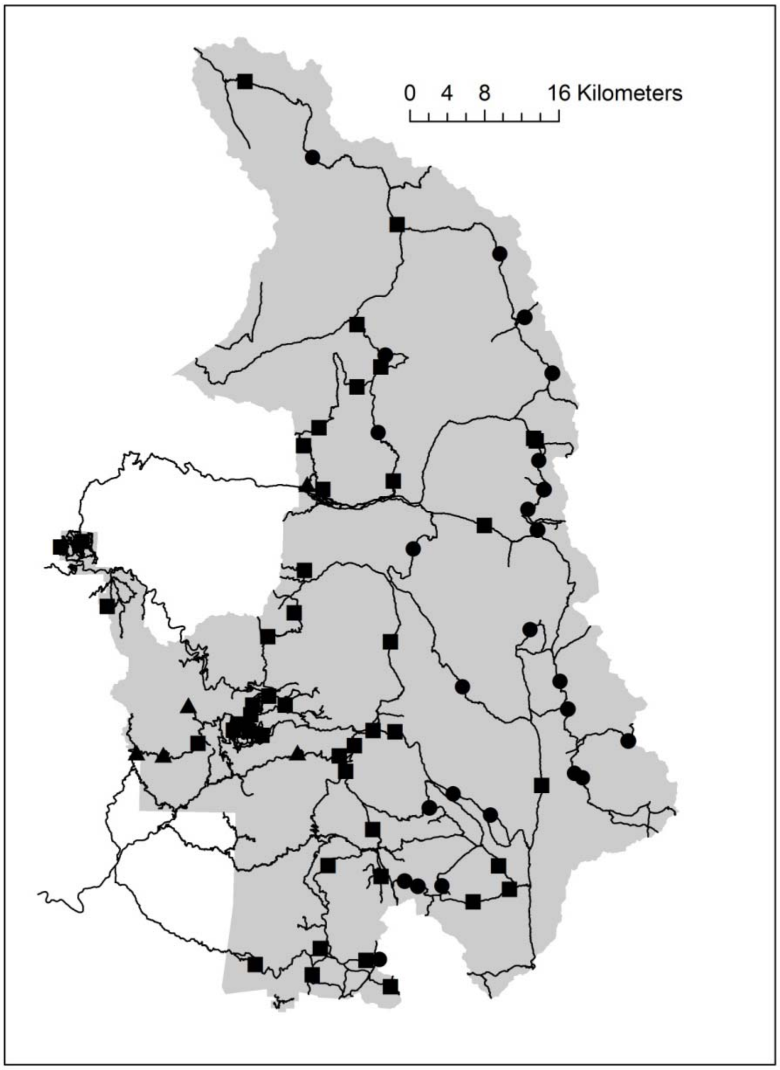


Figure 2 – 3. Locations of transect starting points at Sequoia and Kings Canyon National Parks (trails and roads are indicated with black lines).

Starting points are stratified by elevation, as follows:

- Triangles: low-elevation starting points (<1800 m)
- Squares: mid-elevation points (1,800–2,750 m)
- Circles: high-elevation points (>2,750 m)

Starting points were selected using the General Randomized Tessellation Stratified (GRTS) sampling method (Stevens and Olsen 1999, 2003, 2004). A transect comprises 14 point count stations that are spaced 250 m apart, resulting in a total transect length of 3,250 m (13 x 250 m). Each transect will be oriented perpendicular to the trail, with the center of each transect intersecting the trail at selected points. Seven survey points will extend out from the trail in each direction. The first sampling points will be established 125 m in each direction from the trail ‘starting point’. In instances where barriers such as cliffs or rivers (or, in the foothills, abundant poison-oak) prevent observers from leaving the trail, transects will be established on the trail, rather than perpendicular to it. Experience conducting our inventory projects has shown that seven off-trail points is the maximum number that a crew member can reliably survey during a morning of work in the more challenging SIEN habitats.

2.6. Level of Detectable Change using Sample Design in Large Parks

The statistical power of a very similar sampling program to detect temporal trends in bird populations at national parks in the North Coast and Cascades Network (NCCN) was evaluated through simulation exercises conducted by TerraStat Consulting Group (TerraStat Consulting Group 2005, Siegel et al. 2007c). TerraStat Consulting Group used a profile summary approach to test the null hypothesis that the mean rate of change of 22 bird species simulated on 72 avian monitoring transects did not differ from zero (i.e., slope of log-transformed density indices). The analysis was based on the distribution of site means for 22 avian species derived from the bird inventory conducted in Olympic National Park in 2002–2003 (Siegel et al. 2004). Statistical power analysis requires the assumption of a single alternative hypothesis scenario. In this case, simulations were designed to estimate the probability of detecting 4% exponential trends, if present at all sites. The exponential trend scenario is based on the starting average density of birds–densities at sites with more birds are assumed to increase faster than densities at sites with fewer birds. The observed trends in the simulations vary based on year-to-year variability, including measurement and sampling error. After 10, 20, and 30 years of simulated trend, power to detect 4% per annum increases exceeded 80% for 2, 16, and 20 of the 22 species, respectively. These results indicated that if trends are consistent across the target populations, the proposed monitoring in the NCCN would be sufficient to detect 4% per year increases in the majority of species after four cycles through the sampling rotation. If trends were consistent network-wide (e.g. between individual parks), they would be detected sooner.

For SIEN parks we would like to detect a 4% annual change with the probability of a Type I error equal to the probability of a Type II error, i.e., $\alpha = \beta = 0.2$. We believe that detecting this level of change with 80% confidence within several panel rotations strikes a balance among competing needs.

We have strong reasons to believe that statistical power for the proposed SIEN bird monitoring program will be even greater–perhaps substantially greater–than the statistical power of the NCCN program. Our reasoning is a result of the following: (1) in general, birds are markedly more abundant in SIEN habitats than in NCCN habitats, yielding markedly more bird detections per point at SIEN parks, relative to NCCN parks (Siegel and Wilkerson, unpublished data); (2) additionally, off-trail travel in SIEN parks is generally considerably easier than at NCCN parks (wet conditions and numerous fallen logs in NCCN parks hinder travel), so observers can sample more points per morning; the sample design at NCCN calls for transects consisting of 10 points, whereas we are confident that 14 points per transect (and hence, more bird detections per transect) is feasible in SIEN; and finally (3) weather conditions at SIEN parks during the avian breeding season are much more favorable than at NCCN parks, with few if any potential sampling days lost to rain; consequently a crew of the same size can sample more transects during a breeding season in SIEN, relative to NCCN. For all these reasons—more birds per point, more points per transect, and more transects per person-season—sample sizes at SIEN will be much larger than at NCCN, and therefore statistical power considerably greater.

2.7. Small-park Sampling Design: Devils Postpile National Monument

Due to the small size of the monument (324 ha, or 801 acres), we have developed a sampling design for Devils Postpile that differs substantially from that of the large parks (Figure 2 – 4). Rather than arraying sampling points along transects that start from randomly selected points along trails, we overlaid DEPO with a grid of sample points. This nearly systematic grid was established in the N-S and E-W directions with a random grid starting point (Figure 2 – 5). Each grid point is 250 m apart, yielding 42 sampling points. Five of the points are offset slightly from the grid so that they coincide with five existing riparian point count stations that have been surveyed for several years in association with the MAPS station at Soda Springs Meadow (Gates and Heath 2003, Heath 2007). The same 42-point sampling grid was surveyed in 2003 for the bird inventory at DEPO (Siegel and Wilkerson 2004).

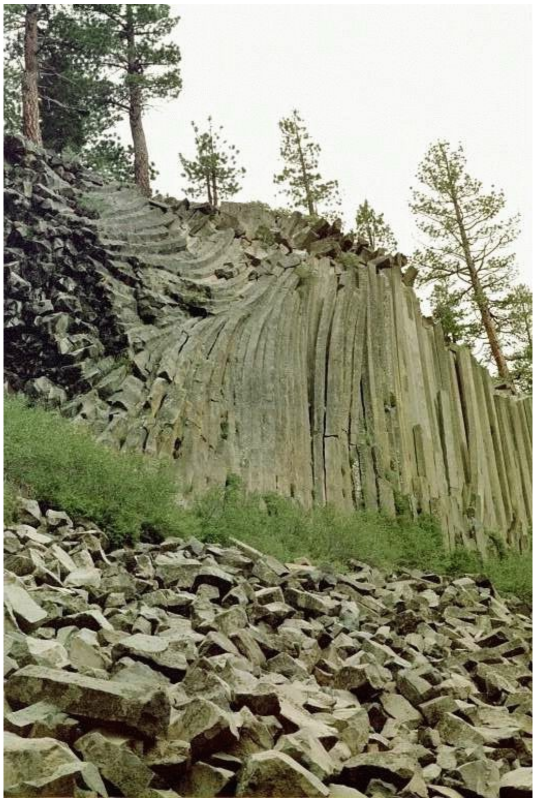


Figure 2 - 4. The Devils Postpile rock formation for which Devils Postpile National Monument is named. NPS photo by Tom Warner.

In the interest of conducting the survey at the height of the breeding season, when most species are singing most intensively, the survey at DEPO should be conducted between approximately June 1 and 15. This time frame will vary somewhat depending on timing of snowmelt, road opening dates to allow access to the monument, and initiation of breeding season each year. We will sample all points at DEPO every year because they can be completed by a small crew in just a few days, with minimal additional cost.

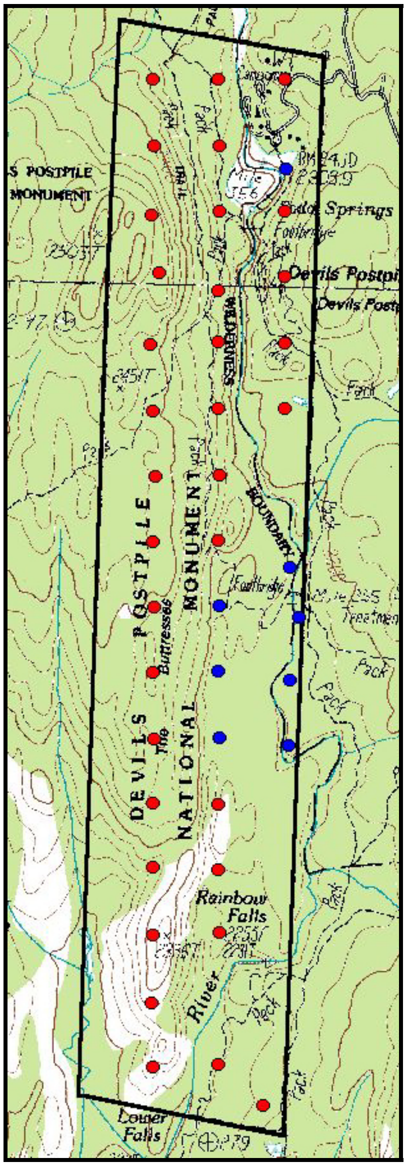


Figure 2 – 5. Circles indicate location of individual point-count stations at Devils Postpile National Monument. These point locations were initially generated for the avian inventory conducted in 2003 (Siegel and Wilkerson 2004).

- Red: uniformly upland habitat
- Blue: areas with riparian inclusions

Chapter 3: Field Methods

3.1. Permitting and Compliance

In developing the SIEN Bird Monitoring Protocol, we designed our sampling strategy using a low impact approach to ensure we are complying with National Park Service and Wilderness Act policy and regulations. Prior to implementation of the program, management staff at each park will review the protocol and sampling strategy to ensure resource protections are adequate, and that we have met "minimum tool" standards appropriate for working in Wilderness. Minimum tool means a "use or activity, determined to be necessary to accomplish an essential task, which makes use of the least intrusive, tool, equipment, device, force, regulation, or practice that will achieve the wilderness management objective" (National Park Service 2006b). We will also apply for permits each season through the NPS Research Permitting program (https://science.nature.nps.gov/research/ac/ResearchIndex).

3.2. Field season Preparations and Equipment Setup

Preparing for the field season requires getting an early start to recruit and hire a well-qualified crew. The importance of securing a well-qualified crew for this project cannot be understated. During the training period at the beginning of the season, protocols can be taught and bird identification skills can be sharpened, but it is essential that all members of Network crews be experienced birders, very physically fit, and comfortable spending extensive time in the backcountry. Every reasonable effort should be made to entice the previous year's observers to return, but it seems likely that at least some new observers will need to be hired in most years. We recommend beginning the recruiting process in December to ensure that maximally experienced, qualified observers can be found. Once new observers are hired, they should be sent species lists and other materials that will enable them to be as familiar as possible with Network birds and their vocalizations prior to the start of the training session in May.

Beginning in February or March, equipment should be inventoried (including testing of breakable items such as GPS units, radios, water filters, etc.) and any needed items should be purchased. Data forms should be printed or copied, and topographic maps (1:24,000 scale) for the year's targeted transects should be printed and assembled. Crew housing needs to be secured at each of the large parks (this process may need to begin earlier if NPS facilities are to be used), and housing, campsites, and other logistic arrangements for the training session need to be made. NPS personnel knowledgeable about back-country conditions in each park should be consulted, to determine (to the degree possible) whether conditions such as washed out bridges, road or trail closures, or unusually heavy snowpack may present novel logistic problems.

Hiring and training considerations and other pre-season, logistical tasks are discussed in more detail in Standard Operating Protocol (SOP) 1: Preparing for Field Season***;*** SOP 2: Safety, and SOP 3: Field Tour Preparation. Additional pre-season tasks pertaining to data management are discussed below in Section 4.2–Pre-season Preparation for Information Management.

3.3. Training and Sequence of Events during the Field Season

We recommend beginning training somewhere between April 25 and May 1, depending on the experience level of crew members. Training details are provided in SOP 4: Training Observers.

Surveys should begin on or around May 15. The lowest-elevation transects are conducted first, with crews gradually moving upslope through the season. All surveys should be completed by July 22. The project sampling scheme is built around an assumption that pairs of observers will work six 7- or 8-day sessions, most of which will be spent entirely in the backcountry.

The sampling at DEPO will be conducted sometime between 1 June and 15 June, and should require approximately six person-days to complete.

3.4. Details of Taking Measurements in the Field

3.4.1. Sequoia, Kings Canyon, and Yosemite

In the large parks (SEKI and YOSE), a pair of observers will work together to conduct a single 14-point transect each morning. The first time each transect is surveyed, observers will be given a map and coordinates that indicate each transect 'starting point', which lies on a trail. From this starting point, the two observers will walk 125 m along the cardinal or semi-cardinal directions that most closely approximate perpendiculars to the trail, in opposite directions from one another. Each observer will conduct a point count, and then continue walking in the same direction, conducting another point count every 250 m until seven point counts have been completed (SOP 5: Conducting Point Counts provides detailed information on how to conduct points in the field; an additional synthesis of the process is provided below). Each point count is flagged for subsequent vegetation data collection (discussed below). Point counts will begin within 10 minutes of official local sunrise, and must be completed by 3.5 hours after official local sunrise, because bird activity tends to decrease later in the morning. Local official sunrise times can be downloaded from the following internet site: http://www.sunrisesunset.com/usa/California.asp.

If a barrier such as a cliff or uncrossable stream is encountered, the observer will return to the last successfully surveyed point and select a new direction of travel. The new direction of travel will be determined as follows:

1. The observer assesses the directions defined by the original direction ±45º.
2. If both appear traversable, one is randomly chosen, and then followed for the remainder of the transect (unless another barrier is encountered).
3. If one direction is traversable and the other is not, the traversable one is followed for the remainder of the transect.
4. If neither direction is traversable, the observer assesses the directions defined by the original direction ±90º, in the same manner as described above.

The new direction of travel is recorded on the data forms and adhered to during future visits.

In some instances—such as when a trail is immediately adjacent to a river—it may not be feasible for one or both of the observers to walk even 125 m away from the trail. In this situation the observer will conduct the point counts directly on the trail, every 250 m in a pre-determined direction. After each successive point count, the observer will reassess the feasibility of returning to the perpendicular bearing, and if it seems promising, leave the trail to conduct the remainder of the transect off-trail, in the cardinal or semi-cardinal direction that best approximates a perpendicular to the trail. This alternative method of routing transects will also be used for the small number of transects that occur in brushy foothill habitats that are extremely difficult to walk though and include substantial poison-oak (*Toxicodendron diversilobum*). We are confident that conducting some of our transects partly or completely on trails will not unduly bias survey results, as landbird inventory work at North Cascades National Park has shown that bird detectability during point counts appears unaffected by whether the counts are conducted on or off trails (Siegel, unpublished data). Additionally, visitor impacts are light enough along most backcountry trail stretches in SIEN parks that it seems unlikely that trail proximity substantially affects avian community composition or abundance.

On the second and all subsequent visits to each transect (i.e. in future years), observers will be provided with maps, coordinates, and descriptions indicating the location of all of their survey points. Unreliable GPS coverage may mean that we will not always be able to precisely relocate survey points, but we expect to reliably conduct point counts within 50 m of the intended location; when GPS coverage is good or prominent landmarks are nearby, geographic errors should be even smaller. Pilot data from the North Coast and Cascades Network has confirmed that this level of geographic precision is indeed achievable. This level of precision should be adequate, as it will usually place the observer in habitat very similar to the intended location and, in any case, the *transect*, rather than survey point, is our primary unit of analysis.

At each point the observer will record the starting time, score the degree of noise interference caused by such factors as flowing water or wind, record the weather conditions (see Point Count Conditions form, SOP 5: Conducting Point Counts); after waiting one minute for any birds disturbed by the approach of the observer to resume their normal activities, begin the five-minute point count. Birds observed in the first three minutes will be recorded separately from those observed in the last two minutes, to allow comparison with Breeding Bird Survey data, which are based on three-minute counts. Observers will estimate the horizontal distance, to the nearest meter, to each bird detected. These estimations will allow detection probabilities to be calculated as a function of distance for each species, and will therefore allow estimation of absolute density. The observer will also record whether the distance estimate was based on an aural or visual detection, and whether the bird ever sang during the point count. These last two pieces of data may facilitate analysis of (a) error associated with estimating distances to unseen birds, and (b) estimation of the density of singing males, rather than all birds pooled. Juvenile birds will not be recorded on the point count data form. All adult birds detected at each point will be noted on the data form, but there is a field for observers to indicate that a particular bird was already detected from a previous point. The form will also provide a separate field for tallying ‘flyovers’, birds that fly above the top of the vegetation canopy, never touch down in the observer’s field of view, and do not appear to be foraging, displaying, or behaving in any other way that might suggest a link to the habitat below them. A sample field form for conducting point counts is provided in SOP 5: Conducting Point Counts.

After completing their last point count each morning, observers will retrace their steps back to the starting point. Along the way they will collect vegetation information at each of the survey points and also collect the flags. The first year a transect is surveyed, the observers will classify the habitat in a 40-m radius circle according to the National Vegetation Classification Standard (NVCS), with modifications for local application at Yosemite and Sequoia and Kings Canyon

National Parks (NatureServe 2003, 2004). During subsequent visits, observers will verify that the habitat classification is correct, and/or note any substantial changes. Our habitat classification field form is provided in SOP 6: Classifying Vegetation.

The objective of the vegetation classification is threefold: (1) to use vegetation class as a covariate in developing detectability functions, (2) determine if there are any coarse-grained changes in vegetation classes (resulting from wildfire, for example), and (3) aid in point relocation in subsequent years. Such information will not be used analytically but will be examined qualitatively if there are obvious changes in vegetation composition or of bird populations observed over the long time frame. Research on the associations between bird populations and structural characteristics of vegetation are beyond the scope of this monitoring program. It is not the objective of the avian monitoring program to understand avian community responses to gradients of vegetation structure, so we made the decision not to measure individual components of vegetation structure at any finer detail. Such measurement would be time-consuming, and would detract considerably from the primary objective of monitoring avian population trends. Detailed data on vegetation structure was collected as part of the preceding avian inventory program (Siegel and DeSante 2002, Siegel and Wilkerson 2004, 2005a) and provide an opportunity to analyze avian community correlates to gradients in vegetation structure as a separate research effort. Nevertheless, habitat classification is likely to facilitate post-stratification of survey data to answer future questions that may arise about bird communities or individual species in particular habitats, particularly when used in conjunction with the parks' existing high-quality habitat maps (NatureServe 2003, 2004).

While classifying vegetation at each point, observers will use GPS units to collect location data (for detailed instructions see SOP 7: Collecting GPS Data), and write a brief narrative description of the point location, to facilitate re-locating the point in subsequent years (see Point Establishment Form, SOP 8: Establishing, Relocating, and Describing Survey Points).

After completing their fieldwork each day, partners will review each other's data forms for missing or incorrectly recorded data, discuss any interesting or surprising bird detections, and complete a Transect Visit Log (data form provided in SOP 8: Establishing, Relocating, and Describing Survey Points). Whenever crew members detect species thought to be rare or difficult to sample in the park, they will complete "Rare Bird Report Forms", including descriptions of the birds' appearance, behavior and location (geographical coordinates). Rare-bird data forms will be completed for birds detected during point counts as well as while observers are sampling vegetation, hiking between transects, relaxing at camp in the evening, or at any other time during the field season, including the pre-season training session. We provide a sample field form for 'rare bird reports' in SOP 9: Reporting Rare Bird Detections.

3.4.2. Devils Postpile

Sample design at DEPO is designed specifically to accommodate its smaller size and maximize data collection balanced with efficiency. Details are described in SOP 10: Special Considerations for Devils Postpile National Monument.

3.5. End-of-season Procedures

The Field Lead will communicate frequently with the Project Lead about progress and any problems that arise throughout the field season. At the end of the season the Field Lead will prepare a brief (generally not more than three pages) field season report that:

1. Clearly enumerates which transects were completed during the season.
2. Describes any logistic difficulties that arose, and explains how they were addressed.
3. Clearly documents and explains any diversions from established protocols
4. Provides information on any interesting or potentially important observations about the parks' bird communities that may have been noted during the field season (e.g., uncommon species, apparent changes in phenology from previous years, notable changes in apparent abundance of particular species, etc.).
5. Provides suggestions for improving the training session or field season logistics in the future.
6. Inventories field equipment and calls attention to items needing repair or replacement.

Field Lead reports will be archived.

The Field Lead is also responsible for ensuring that all equipment is properly inventoried, cleaned, and stored (see SOP 11: After the Field Season), and any gate keys or other items that have been checked out from NPS staff are returned.

Additional end-of-season tasks are discussed below in Section 4.10–Season close-out.

Chapter 4: Data Handling, Analysis, and Reporting

This chapter describes the procedures for data handling, analysis, and report development, beginning with a discussion of project development as related to data management activities.

4.1. Project Information Management Overview

Proper management of information includes planning and conducting field data collection (Figure 4 – 1) to a series of post-season steps to facilitate data stewardship and information sharing. Project information management may be best understood as an ongoing process, as shown in Figure 4 – 2, below.

Figure 4-1. Intern Henry Pollack monitors Sierra Nevada birds for The Institute for Bird Populations. Photo by Lisa Vormald, IBP Biologist.

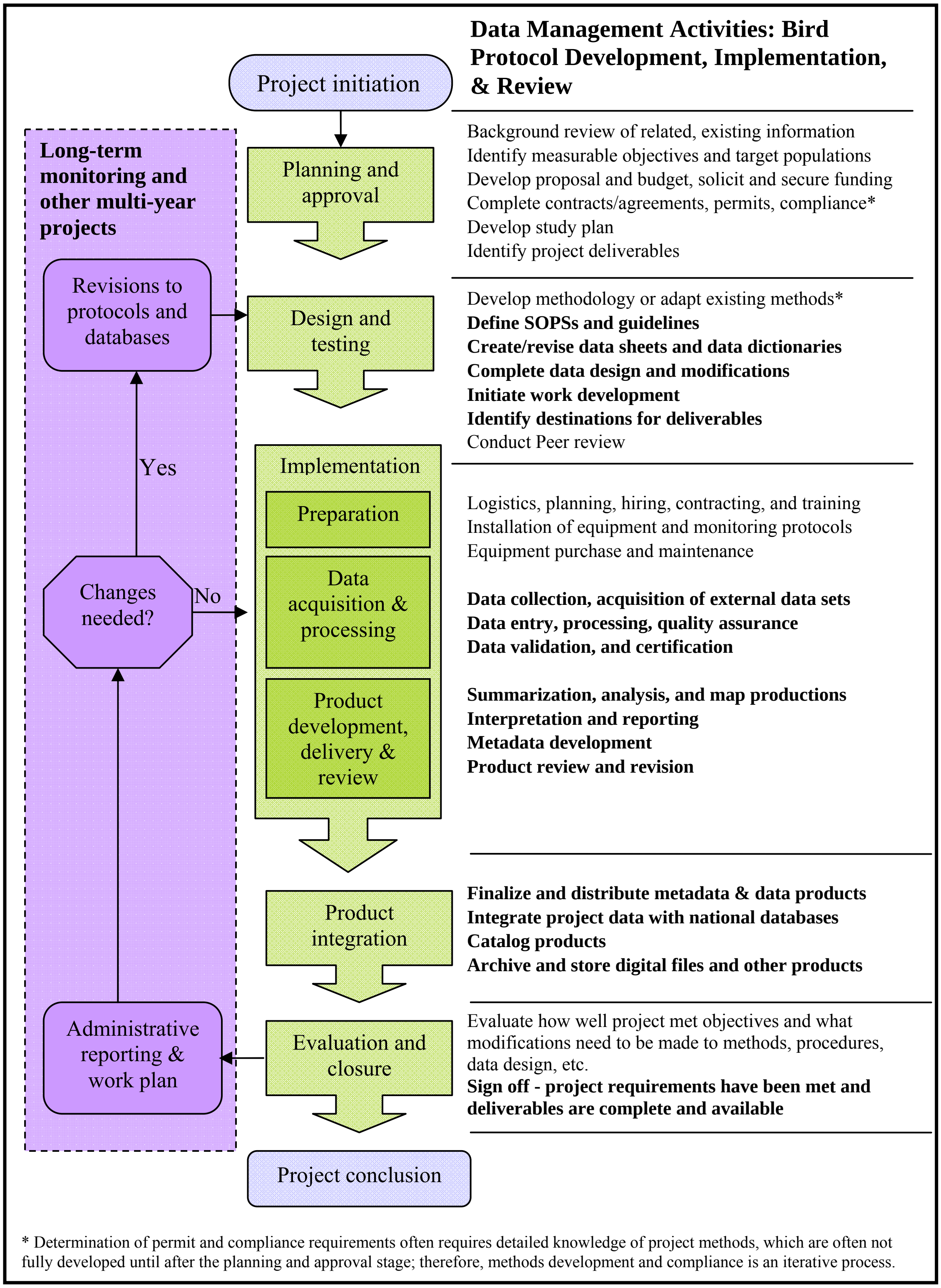


Figure 4-2. Data management steps during the five stages of project development with data management activities involved in each phase (Cook and Lineback 2008). Core activities are in bold.

4.1.1. The Data Life Cycle

Data take on different forms during various phases of a project, and are maintained in different places as they are acquired, processed, documented, analyzed, reported, and distributed. What we refer to as the "data life cycle" is characterized by a series of events that we can model (Figure **4** –4 – 3) and describe to facilitate communication in the rest of this document, as follows (Cook and Lineback 2008):

1. *Acquire data* – Data are acquired in digital or analog form. Digital data can be recorded on handheld computers and PDAs, tablets, or laptop computers. Analog data are entered on field data sheets.
2. *Archive raw data* – Copies of all raw data files are archived intact. Digital files are copied to the digital library (the set of LAN folders created for the project); hard copy forms are either scanned and placed in the digital library or are copied and placed in the archives. Archiving or scanning of hard copy data forms may occur at the end of a season as a means of retaining all marks and edits made during the verification and validation steps.
3. *Enter/import data* – Analog data are entered manually and digital data files are uploaded to the working database.
4. *Verify, process, and validate* – Accurate transcription of the raw data is verified; data are processed to remove missing values and other flaws; and data are validated through visual inspection and queries to capture missing data, out-of-range values, and logical errors.
5. *Documentation and certification* – Develop or update project metadata and certify the data set. Certification is a confirmation by the project leader that the data have passed all quality assurance requirements and are complete and documented. It also means that data and metadata are ready to be posted and delivered.
6. *Upload data* – Certified data are uploaded from the working database to the master project database. This step might be skipped for short-term projects where there is no need to distinguish working data for the current season from the full set of certified project data.
7. *Archive versioned data set* – The SIEN Project Data Certification Form is completed (see SIEN Data Management Plan: *Appendix 3A*, Cook and Lineback 2008). Copies of the certified data and metadata are placed in the digital library. This can be accomplished by storing a compressed copy of the working database or by exporting data to a more software-independent format (e.g., ASCII text).
8. *Disseminate data and update national databases*– Certified data and metadata, and digital image products are posted to national repositories (the NPS Data Store, Biodiversity Data Store, NPS Focus) to make them more broadly available to others. National databases, including NPSpecies, NPSTORET, and ANCS+ are updated with data obtained from certified data sets.
9. *Reporting and analysis* – Certified data are used to generate data products, analyses, and reports, including semi-automated annual summary reports for monitoring projects. Depending on project needs, data might be exported for analysis or summarized within the database.

10. *Distribute information products* – Information products such as reports, maps, and checklists are disseminated to the public through the SIEN website and NPS Focus, and catalogued in NatureBib.
11. *Share data and information* – Data, metadata, reports and other information products can be shared in a variety of ways – by FTP or mailing in response to specific requests, or by providing direct access to project records to park staff and cooperators.
12. *Track changes* **–** All subsequent changes to certified data are documented in an edit log, which accompanies project data and metadata upon distribution. Significant edits will trigger reposting of the data and products to national databases and repositories.
13. *Store products* – Reports and other data products are stored according to format and likely demand, either in the digital library, on off-line media, or in the document archives.
14. *Catalog project products* – Catalog products and all information associated with a project, including results of analyses and paths of dissemination. Project tracking databases can be useful tools for this purpose.

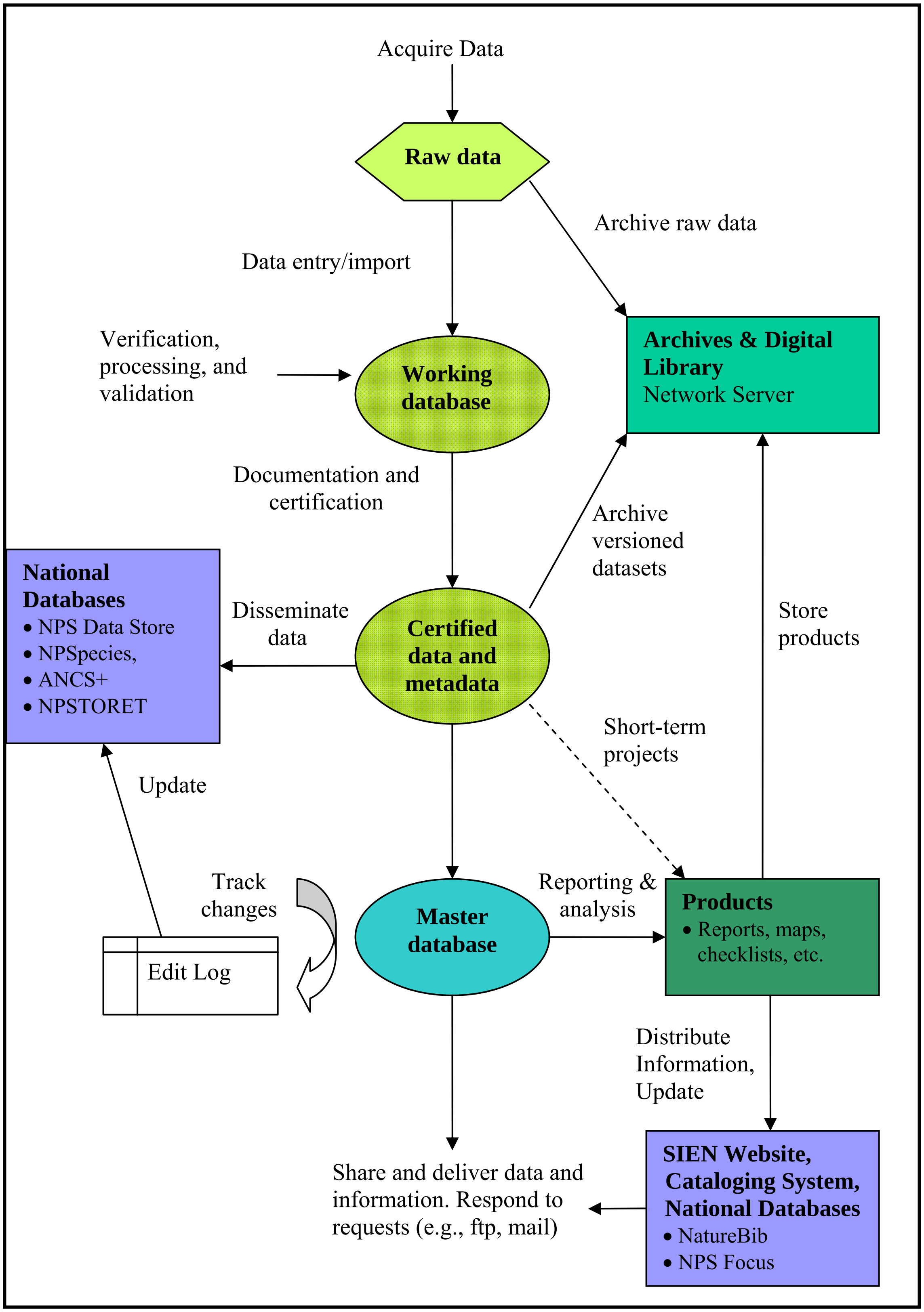


Figure 4 – 3. The data life cycle (Cook and Lineback 2008).

4.2. Pre-season Preparations for Information Management

4.2.1. Set up Project Workspace

A section of the networked file server at each park should reserved for this project, and access permissions should established so that project staff members have access to needed files within this workspace. Prior to each season, the NPS Lead should make sure that network accounts are established for each new staff member, and that the Data Manager is notified to ensure access to the project workspace and databases. Additional details may be found in SOP 12: Workspace Setup and Project Records Management.

4.2.2. GPS Loading and Preparation

The Project Lead should work with the GIS Specialist (if needed) to ensure that target coordinates and data dictionaries are loaded into the GPS units prior to the onset of field work, and that GPS download software is available and ready for use. Additional details on GPS use and GPS data handling may be found in SOP 7: Collecting GPS Data.

Figure 4 - 4. Rock Wren. Photo by Gary Lindquist.

4.2.3. Implement Working Database Copy

Prior to the field season, the Project Lead, in conjunction with the appropriate Data Manager, will implement a blank copy of the working database and ensure proper access on the part of the project staff. Refer to Section 4.3, below, for additional information about the database design and implementation strategy.

4.3. Overview of Database Design

John Boetsch, Data Manager at Olympic National Park, developed a customized relational database application to store and manipulate data associated with the similar landbird monitoring program at parks in NCCN (Siegel et al. 2007c). The design of this database is consistent with NPS I&M standards. The SIEN bird monitoring program will adopt the NCCN database, with minor modifications for use in the SIEN, at the discretion of SIEN's Data Manager.

The database is divided into two components: (1) one for entering, editing and error-checking data for the current season (i.e., the "working database copy"), and (2) another that contains the complete set of certified data for the monitoring project (i.e., the "master project database").

A functional comparison of these two components is provided in Table 4 – 1.

Table 4 – 1. Functional comparison of the master project database and the working database copy.

Project Database Functions and Capabilities	Working Database	Master Database
Software platform for back-end data	MS Access	MS SQL Server
Contains full list of sampling locations and taxa	●	●
Portable for remote data entry	●	
Forms for entering and editing current year data	●	
Quality assurance and data validation tools	●	●
Preliminary data summarization capabilities	●	
Full analysis, summarization and export tools		●
Pre-formatted report output		●
Contains certified data for all observation years		●
Limited editing capabilities, edits are logged		●
Full automated backups and transaction logging		●

Each database component (working and master) is based on an identical underlying data structure (tables, fields, and relationships). The working database is implemented in Microsoft Access to permit greater flexibility when implementing on computers with limited or unreliable network access. The master database is implemented in Microsoft SQL Server to take advantage of the backup and transaction logging capabilities of this enterprise database software.

Both components have an associated front-end database application ("user interface" with forms, queries, etc.) implemented in Microsoft Access. The working database application has separate screens for data entry, data review, and data quality validation tools. The master database application contains analysis and summarization tools, including pre-formatted report output and exports to other software (e.g., Distance).

Each data entry technician (if there are more than one) will be provided with his or her own copy of a working database into which they enter, process, and quality-check data for the current season (refer to Section 4.4, below, and SOP 13: Data Entry and Verification). Once data for the field season have been certified, they will be uploaded into the master database, which is then used to inform all reporting and analysis. This upload process is performed by the Data Manager, using a series of pre-built append queries.

4.4. Data Entry, Verification, Processing, and Validation

After the field season–and after original field data are copied and archived–a data entry technician will have to be recruited to enter all data into the project database. Ideally, data entry will be completed by one or more members of the field crew, whose field experience and familiarity with the project will allow them to identify errors in the data, and to avoid introducing new ones during the data entry process.

The working database application will be found in the project workspace. For enhanced performance, it is recommended that users copy the front-end database onto their workstation hard drives and open it there. This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as a pointer to the data that reside in the back-end working database. Whenever updates to the front-end application are made available by the Data Manager, a fresh copy should be made from the project workspace to the workstation hard drive.

The functional components for data entry into the working database are described in SOP 13: Data Entry and Verification. The flow of data entry, into the database, should generally proceed as follows:

1. Point establishment form
2. Transect visit log
3. Point count conditions
4. Point count data
5. Habitat classification
6. Rare bird observations

Each data entry form is patterned after the structure of the field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged only to use these pre-built forms as a way of ensuring the maximum level of quality assurance.

4.4.1. Regular Data Backups

Upon opening the working database, the user will be prompted to make a backup of the underlying data (see SOP 13: Data Entry and Verification). It is recommended that this be done on a regular basis – perhaps every day that new data are entered – to save time in case of mistakes or database file corruption. These periodic backup files should be compressed to save drive space, and may be deleted once enough subsequent backups are made. All such backups may be deleted after the data have passed the quality review and been certified.

4.4.2. Data Verification and Metadata Development

As data are being entered, the person entering the data should visually review them to make sure that the data on screen match the field forms. This should be done for each record prior to moving to the next form for data entry. At regular intervals and at the end of the field season the Project Lead should inspect the data being entered to check for completeness and perhaps catch avoidable errors.

A record of the verification process for each dataset, including number of iterations and results, will be prepared by the project leader as part of formal metadata generation (additional details regarding metadata requirements are described in SOP 14: Metadata Development)

4.4.3. GPS Data Procedures

When GPS data files are collected in the field, the following general procedures should be followed (see SOP 7: Collecting GPS Data):

1. GPS data should be downloaded by the field crew from the units at the end of each field trip and stored in the project workspace (see SOP 12: Workspace Setup and Project Records Management).

2. Raw files should be processed and corrected as soon as is feasible. The Project Lead is responsible for ensuring that this happens.
3. The processed data will be stored in the project workspace.

The Project Lead is responsible for ensuring that corrected coordinate information are uploaded into the database.

4.4.4. Final Verification, Processing, and Validation

After the data have been entered and processed, they need to be reviewed by the Project Lead for quality, completeness, and logical consistency. Accurate transcription of the raw data is verified; data are processed to remove missing values and other flaws; and data are validated through visual inspection and queries. The working database application facilitates the query process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values. The user may then fix these problems and document the fixes. Not all errors and inconsistencies can be fixed, in which case a description of the resulting errors and why edits were not made is then documented and included in the metadata and certification report (see Sections 4F and 4G, and SOP 15: Data Quality Review, Validation, and Certification).

4.5. Data Documentation and Certification

Data certification is a benchmark in the project information management process that indicates that: (1) the data are complete for the period of record; (2) they have undergone and passed the quality assurance checks (described above, and within SOP 15: Data Quality Review, Validation, and Certification); and (3) that they are appropriately documented and in a condition for archiving, posting, and distribution as appropriate.

Certification is not intended to imply that the data are completely free of errors or inconsistencies which may or may not have been detected during quality assurance reviews. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is primarily responsible for completing a Project Data Certification Form, and providing it to SIEN Data Manager. This brief form should be submitted with the certified data. For specific instructions, refer to SOP 15: Data Quality Review, Validation, and Certification.

4.5.1. Data Edits after Certification

Once data are certified, any data changes and/or corrections to the master database must be logged. However, corrections or changes made during data entry and/or prior to data certification do not need to be logged, as many such changes will involve simple corrections or additions to rectify any errors introduced during data entry. Prior to certification, daily backups of the working database provide a crude means of restoring data to the previous day’s state. After certification, all data edits in the master database are tracked in an edit log so that future data users will be aware of changes made after certification. In case future users need to restore data to the certified version, we also retain a separate, read-only copy of the original, certified data for each year.

4.5.2. Geospatial Data

The Project Lead will review the surveyed coordinates and other geospatial data for accuracy. The purpose of this joint review is to make sure that geospatial data are complete and reasonably accurate, and also to determine which year's coordinates will be used for subsequent mapping and field work, in the event that collected coordinates vary slightly from year to year

4.5.3. Metadata Procedures

Data documentation is a critical step toward ensuring that data sets are usable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, condition and other characteristics of a given data set. Additionally, metadata provide the means to catalog and search among data sets, thus making them available to a broad range of potential data users. Metadata for all SIEN monitoring data will conform to Federal Geographic Data Committee (FGDC) guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed and synthesized.

At the conclusion of the field season, the NPS Lead and Project Lead will be jointly responsible for providing completed, up-to-date metadata to the Data Manager, according to Network specifications.

4.5.4. Upload Data, Archive Data

Certified data are uploaded from the working database to the master project database.

Complete SIEN Project Data Certification Form. Copies of certified data and metadata are archived in the digital library (see ***SIEN Data Management Plan***, Appendix 3A)(Cook and Lineback 2008).

4.6. Data Analysis and Dissemination

In the interest of keeping costs low, annual reports will include little data analysis beyond simple tabulation and summary of the year's data, with particular emphasis on raw count results obtained from the annual panel of transects in each of the larger parks. Every four years (when each of the alternating panels has been sampled) we will produce a more comprehensive report that provides a detailed analysis of data gathered to date. For a more detailed description of analytical procedures, refer to SOP 16: Data Analysis and Reporting. The analytical procedures summarized below will be conducted every four years.

4.6.1. Correcting Point Count Data for Detectability

At the end of every four-year interval, we will conduct a complete analysis of factors influencing the detectability of birds and will develop detectability models to be used in estimating density of birds from the raw counts. We will use the software program Distance (Thomas et al. 2002) to model relationships between detectability and distance from the observer, and then use those models to adjust detection rates for detectability, thereby producing estimates of absolute density (Buckland et al. 2001). Numerous factors may influence detectability, including species, habitat, observer, year, and perhaps other variables. Some of these factors are likely to vary over time or space, and therefore must be accounted for before density estimates can be made and trends in density can be assessed. However, we recognize that it may not be possible to adequately quantify some of these factors due to sample size limitations.

Because avian detection probabilities may depend upon habitat structure, we will test whether separately derived detection models for each species in relatively open-canopy habitats (e.g., meadow, subalpine forest) versus relatively closed-canopy habitats (e.g. low- and mid-elevation forests) are preferable to using a single model incorporating data from all habitats.

Detection probability may also vary with observer. Ideally, detectability could be modeled separately for each combination of species, habitat, and observer, but in practice this is rarely possible, as at least 60–80 detections are generally necessary for reliably modeling detection functions (Buckland et al. 2001). We are unlikely to amass an adequate number of detections by each observer in both open and dense habitats for all but the most common species. Nevertheless, for some species we may be able to model observer as a covariate, rather than attempting a completely separate analysis for each observer (Buckland et al. 2001, 2004). When data are insufficient to assess variation among observers, we will pool data from multiple observers to model detectability.

For the more common species it may be possible to model observer-specific detectability functions, at least for some observers in some habitats. When this is possible, we will do so, and use an information-theoretic approach (Akaike 1973, Burnham and Anderson 1998) to determine whether observer-specific models are preferable to ‘pooled observer’ models. Unless we discover substantial temporal changes or observer effects in detectability, pooled observer models may include data from all years of the survey, as well as data collected during the avian inventory projects conducted between 2001 and 2004 (Siegel and DeSante 2002, Siegel and Wilkerson 2004, 2005a) using a similar field methodology. For some rarer species we may never gather enough data to even test for year or observer effects; in such cases we may simply use the ‘pooled observer’ models. For all species, we will use the data at our disposal to construct the best possible detectability functions that data and sample sizes will permit, accounting for multiples sources of variation in detectability, including species, observer, habitat, and year.

4.6.2. Trend Detection for Bird Species Densities: SEKI and YOSE

Park-specific trends will be assessed for each species using a profile-summary approach for the repeated measurements on transects. The profile for each transect will consist of the temporal record of bird densities, computed from point count results corrected for detectability. For each species in each year, log-transformed bird densities will be calculated as the mean of the point counts for each transect and serve as the response variable for trend analyses. The slope of the linear time trend model will be tested for differences from zero using a modified t-test approach.

Prior to trend analyses we will identify and correct for spatial autocorrelation among transects by: 1) Using the (semi)variogram method to identify the spatial distance (or range = a) at which the semivariance levels off and two transects are not spatially autocorrelated; 2) mapping all transects and using GIS to identify groups of transects that are < a from each other; and then 3) adjusting for autocorrelation by weighting a given transect mean value using the following equation:

$y_j = \mu_y + \Sigma f(y_i - \mu_y) + \varepsilon_j$

Where y_j is the value observed at site j and assumed to be the overall mean of the process (μ_y)– bird species density– plus a weighted sum of the centered values (y_i - μ_y) at surrounding sites i, plus an independent error term ε_j. The values of the y_i’s are the values of $\mathbf{y}$ at other sites located within distance *a*, i.e., the zone of spatial influence generating the autocorrelation (Legendre and Legendre 1998).

The proposed trend analysis approach assumes that the slope estimates are independent random samples from a population with common mean. The proposed analysis treats years as fixed effects, which means that the analysis reveals trends over the specific years measured and does not discriminate random year effects or causes of year effects. Although we are interested in random year effects such as those due to weather variation in long-term data sets, examination of such patterns is beyond the scope of this protocol and will require more in depth analysis with the assistance of statisticians. Additional details and an example of our trend analysis method, prepared by TerraStat Consulting Group, are provided in Siegel et al. (2007c).

After each four-year round of sampling, the summary report will include an assessment of park-specific and Network trends in avian densities. Because a spatially dispersed set of sites is assigned to the annual panel, it will be possible to assess population trends in the first few years of the program by examining just the annual panel. After eight years, all transects will be included. It will not be possible to estimate trends in the densities of rare species, particularly those species found on only a few transects each sampling cycle.

Custom-designed, R-based software to conduct the analyses described above has been developed for NCCN by TerraStat Consulting Group (TerraStat 2005, Siegel et al. 2007c), and will need only minor changes to accommodate the minor differences in the SIEN monitoring program.

Density estimation and trend detection: DEPO
The simpler sample design at DEPO, which relies not on transects but rather on a systematic grid of points, will not require the profile-summary approach described above. Instead we will use Distance to produce a single park-specific estimate of density and variance for each species. Additionally, we will not use a panel design for DEPO, but instead will survey all points every year. We will then use linear regression to assess trends in density estimates over time. Although the sampling designs and corresponding analytical methods differ slightly from those utilized in the large parks, they should nevertheless provide unbiased estimates, and therefore be comparable to results from the other network parks. As with analysis of data from the larger parks, density estimates and trends in the small parks will be assessed every four years. Annual reports during the intervening years will simply summarize and tabulate data, without attempting to model detectability, estimate density, or evaluate trends in density.

Detailed specifications and formats for reporting program results for the small parks and the large parks are provided in SOP 16: Data Analysis and Reporting.

4.6.3. Detecting Trends in Bird Distributions
Specific questions regarding distributional change are much harder to anticipate than those regarding population trend (has the population increased or decreased?). For distribution, there are many different kinds of questions that may be asked—has a particular species shifted its upper elevation boundary? Its lower elevation boundary? Has it disappeared from particular habitats or regions of the park?

Since it is reasonable to expect temporal (annual or greater) variation in distributions, it will likely take many years to detect a trend. That is, initially we will likely be describing the temporal variation associated with distribution patterns.

The following types of analyses of bird distributions may be pursued, depending on the primary questions of interest and the opportunities to form partnerships with others to do larger regional-scale analyses of bird distributions:

- Within Sequoia and Kings Canyon and Yosemite, determine the centers of abundance for a subset of species that have large enough population sizes to be recorded at numerous sample points and transects. For a particular species, its center of abundance would be the elevation at which half of the recorded individuals are found at lower elevations and half at higher elevations. These could be determined annually and plotted on graphs (by year and elevation). Eventually (after several panel rotations), there would be enough points to do a trend analysis to determine if centers of abundance are shifting.
- Seek regional partnerships where there are opportunities to combine our data with other similar data collected across California and the Pacific Northwest to assess regional scale changes in bird distributions through tracking centers of abundance latitudinally (as in: National Audubon Society 2009).
- Periodically (every 2–3 panel rotations or 8–12 years) explore the use of niche and occupancy modeling in combination with local weather/climate data to assess whether birds are moving spatially to track their defined climatic niche – employ methods developed by Tingley et al. 2009, or work with University of California research scientists who are using these methods with similar data sets.
- Seek expertise in other spatial analysis techniques (such as geostatistical-temporal modeling) and for those species that are sufficiently abundant, identify whether or not the spatial patterns in mean densities are changing over time.

4.7. Reporting, Product Development, and Product Delivery

4.7.1. Report Content

In the interest of keeping costs down, we recommend that a summary report be produced annually, with a more detailed report produced every four years. The annual report should:

- List project personnel and their roles.
- List transects completed during the current year.
- Provide a summary history of the number of transects completed during each year of the study (enumerated by elevation and park).
- List all bird species detected in the parks during the current year.
- Indicate the number of individuals of each bird species detected during the current year, in each park as a whole, and on the annual panel of transects only.
- Indicate the number of transects on which each species was detected, in each park as a whole, and on the annual panel of transects only.

- Identify any data quality concerns and/or deviations from protocols that affect data quality and interpretability.
- Include information on any rare species or species of management concern, or other information of interest to park managers or the public.

Detailed reporting guidelines and table structures are provided in SOP 16: Data Analysis and Reporting.

A more in-depth analysis and report should be produced every four years, as the full set of panels is completed. In addition to the above, the four-year report should also:

- Provide annual density estimates for each species during the previous four years.
- Provide summary and detailed trend results for each species with an adequate sample size for estimating density and assessing trend.
- Provide the detectability parameters used for estimating each species' density.
- Assess spatial patterns in the density estimates.
- Identify any possible distributional changes within the parks.
- Use results from regional efforts such as the BBS or MAPS to assess whether any observed trends are consistent with, or in contrast to, bird population changes throughout the Sierra Nevada.
- Evaluate operational aspects of the monitoring program, such as whether any transects need to be eliminated or moved due to access problems, whether the sampling period remains appropriate (the optimal sampling season could conceivably change over time in response to climate change), etc.
- Investigate ways to share results with a wider audience, including other land managers in the Sierra Nevada and elsewhere.

Details regarding requirements are provided in SOP 17: ***Product Delivery Specifications***.

4.7.2. Standard Report Format

Annual reports and trend analysis reports will use the NPS Natural Resource Publications templates, pre-formatted Microsoft Word or InDesign template documents based on current NPS formatting standards. Annual reports will use the Natural Resource Data Series template, and trend analysis and other peer-reviewed technical reports will use the Natural Resource Technical Report template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

4.7.3. Review Products for Sensitive Information

Certain project information related to the specific locations of rare or threatened taxa may meet criteria for protection and as such should not be shared outside NPS except where a written confidentiality agreement is in place prior to sharing. Certain information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release.

4.8. Product Posting and Distribution

4.8.1. Holding Period for Project Data

When working with outside collaborators, NPS contract or agreement specifications may have project data requirements which preclude the following. However, where appropriate and to permit sufficient time for priority in publication, certified project data will be held upon delivery for a period not to exceed 2 years after it was originally collected. After the 2 year period has elapsed, all certified, non-sensitive data will be posted to the NPS Data Store. Note that this hold only applies to raw data, and not to metadata, reports or other products which are posted to NPS clearinghouses immediately after being received and processed.

4.8.2. Special Procedures for Sensitive Information

Products that have been identified upon submission by the Project Lead and/or NPS Lead as containing sensitive information will either be revised into a form that does not disclose the locations of sensitive resources, or withheld from posting and distribution. When requests for distribution of the unedited version of products are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full data set that includes protected information) may be shared only after a confidentiality agreement is established between NPS and the other organization.

All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

4.9. Archival and Records Management

All project files should be reviewed, cleaned up and organized by the Project Lead and NPS Lead on a regular basis (e.g., annually in January). Decisions on what to retain and what to destroy should be made following guidelines stipulated in NPS Director's Order 19, which provides a schedule indicating the amount of time that the various kinds of records should be retained. Refer to SOP 12: Workspace Setup and Project Records Management.

4.9.1. Season Close-out

After the conclusion of the field season, the Project Lead and Data Manager should meet to discuss the recent field season, and to document any needed changes to the field sampling protocols, the working database application, or to any of the SOPs associated with the protocol. Refer to Section 3.5 for additional close-out procedures not specifically related to project information management.

Chapter 5: Personnel Requirements, Training, and Safety

5.1. Roles and Responsibilities

Field operations for this program were designed to be staffed by a 4-person crew: three Field Technicians and a Field Lead. In addition to collecting data alongside the other crew members, the Field Lead will be principally responsible for training and testing the crew, providing quality assurance, trouble-shooting logistic problems throughout the field season, reviewing completed data forms throughout the field season, and preparing the end-of-season field report.

In the NCCN, long-term landbird monitoring has been implemented, at least initially, as a partnership between NPS personnel and The Institute for Bird Populations, wherein IBP personnel fulfill the role of Project Lead, and work in close conjunction with an NPS Biologist at one of the parks, who is referred to as the NPS Lead. This protocol is written as though a similar arrangement would be made between IBP and SIEN, although SIEN might of course choose to implement the program differently in the future.

Other personnel who will provide key roles in the implementation of this program include Park Biologists or Resource Managers at each of the parks, the Data Manager, the Data Technician and the Network Program Manager. Table 5 – 1 provides an overview of the roles and responsibilities of those who we expect at this time will be most involved in implementing a bird monitoring program.

5.2. Qualifications

The Field Lead each year must be a highly skilled birder with experience conducting point counts with distance sampling and familiarity with Sierra Nevada birds and plant communities. Familiarity with one or more of the SIEN parks is also desirable. Ideally, the Field Lead will have supervised field crews before and/or previously served as a SIEN bird monitoring crew member. Finally s/he must be very physically fit and prepared to spend extended periods of time in the backcountry.

Field Technicians should have prior birding experience, including substantial experience with SIEN birds or a demonstrated ability to quickly learn the songs and calls of new bird species. They must also be very physically fit and prepared to spend extended periods of time in the backcountry. Substantial backpacking experience and experience conducting point counts with distance sampling are also desirable.

More detailed descriptions of desired qualifications for the Field Lead and Field Technicians are provided in SOP 1: Preparing for the Field Season.

Table 5 – 1. Roles and responsibilities of NPS staff and cooperators involved with implementing the bird monitoring program.

Role	Responsibilities	Position
NPS Lead	• Oversee and administer project. • Facilitate communications between NPS and cooperators. • Manage cooperative agreement. • Review annual, 4-year trend reports and other project deliverables for completeness and compliance with I&M program specifications. • Maintain and archive project records. • Coordinate updates and revisions to protocol.	SIEN Program Manager
Principal Investigator	• Oversee project operations and implementation. • Perform data summaries and analyses, interpretation, and report preparation.	IBP Research Scientist
Project Lead	• Oversee project operations and implementation. • Certify each season's data for quality and completeness. • Complete reports, metadata, and other products according to schedule. • Hire, train and ensure safety of field crews. • Plan and execute field visits. • Acquire and maintain field equipment. • Oversee data collection and entry, verify accurate data transcription into database. • Complete a field season report.	IBP Research Scientist and Field Lead
Technicians and Interns	• Collect, record, enter, and verify data.	IBP technicians and interns
Data Manager	• Consult on data management activities. • Facilitate check-in, review, and posting of data, metadata, reports, and other products to SIEN network drive, and as appropriate, national data clearinghouses. • Maintain and update database application. • Provide database training as needed.	SIEN Data Manager
Data Technician and Data Manager	• Consult on spatial data collection, GPS use, and spatial analysis techniques. • Facilitate spatial data development and map generation. • Work with Project Lead and PI to analyze spatial data and develop metadata for spatial data products. • Act as a primary steward of GIS data and products.	SIEN Data Technician and Data Manager
Park Biologists	• Facilitate logistics planning and coordination. • Ensure project compliance with park requirements. • Review reports, data, and other project deliverables.	Wildlife Biologists and Resource Managers

5.3. Training Procedures

A comprehensive and well-designed training program is critical to the success of this project, as it will maximize observer consistency—both within and between years. Past experience has shown us that particularly experienced or talented crew members can be adequately trained in two weeks or less, but we recommend allowing up to three weeks for the training period, to maximize the likelihood that all observers will be qualified to conduct point counts at the end of the training session, and to allow ample time for any required meetings between the crew and NPS personnel (e.g., Park Biologists, Data Manager, Data Technician, etc.). The details of how the training session should be conducted are addressed in SOP 4: Training Observers, but in general terms the session should provide instruction in the following topics:

1. Bird identification by sight and sound
2. Estimating distance to birds
3. Conducting point counts
4. Plant identification and habitat classification
5. Completing field forms
6. Orienteering and collecting GPS data
7. First aid and backcountry safety
8. Discussion of optimal scheduling and access routes for sites in the current panels, including review of past years' efforts

At the end of the training session, all Field Technicians must pass a rigorous bird identification exam, which certifies that they can competently identify by sight and sound all species they are expected to encounter during the field season.

5.4. Safety

Safety has been a driving consideration during the development of this sample design, and limitations thereto. Please refer to SOP 2 (Safety) for detailed information that is necessary to provide to all field personnel.

Chapter 6: Operational requirements

6.1. Annual Workload and Field Schedule

Preparation for the field season must begin well in advance of the pre-season training session. Appendix B provides a Yearly Project Task List and Schedule that identifies each task by project stage, indicates who is responsible, and establishes the timing for its execution. We recommend beginning the process of recruiting and hiring qualified crew members no later than December of the preceding year. Crew training should begin between April 25 and May 1. Point count surveys should begin around May 15. The sampling design assumes that a pair of observers will work together to survey 30 transects at SEKI (plus any additional 'reference' transects), and another pair of observers will work together to survey 30 transects at YOSE (plus any additional 'reference' transects). One or both of the pairs will also be responsible for completing the survey grid at DEPO in early June. We recommend providing observers with a three-day break after each seven-day 'tour' conducting fieldwork. Depending on hiking distances and geographic proximity of transects to one another, observers should be able to complete up to five transects per seven-day tour. Sampling will begin with the lower elevation transects in each park, and observers will gradually progress upslope throughout the season. The final transect must be completed by July 22 of each calendar year. Data collected later than this are unreliable, because birds vocalize much less as the breeding season ends.

Fieldwork initiation and completion dates will need to be re-assessed over time, if climate change or other factors affect the phenology of avian reproduction in the Sierra Nevada. The field season must be timed so that it begins after most or all migratory birds have arrived on their breeding territories in the low-elevation portions of the parks, and is completed before most breeding birds have stopped singing on their high-elevation territories in the parks.

Data entry technicians will enter data into the custom-designed database shortly after the completion of the field season. Detailed data entry instructions are provided in SOP 13: Data Entry and Verification.

We recommend that, at the end of each field season, data verification and certification be completed by the end of November, and data analysis and the preparation of the annual report should be completed by the end of April, before the next field season begins.

6.2. Facility and Equipment Needs

This project requires minimal special facilities and equipment. The crew will require housing in the vicinity of each large park for the duration of the season (early May–late July). Crew members will provide their own backpacking gear and personal vehicles. Computer access is necessary during the training session and throughout the field season so that crew members can enter their own data. Based on two 2-person crews, the following equipment will be required:

- 2 park radios
- 4 two-way radios
- 4 GPS units
- 4 compasses

- 4 bear-proof food canisters
- 2 water filters
- 4 clipboards
- 2 first-aid kits
- data forms, maps, pens, and pencils
- safety protocols (e.g., lightning, rattlesnakes)

6.3. Startup Costs and Budget Considerations

This project will incur minimal startup costs beyond the cooperative agreement (between the Sierra Nevada Network and The Institute for Bird Populations–IBP), which funded the development of this protocol narrative, appendices, and Standard Operating Procedures. Additional startup costs associated with the above equipment needs are approximately $7,500; these funds are not incorporated into the annual budget in Table 6 – 1, but rather are considered one-time startup needs. These equipment may need to periodically be replaced but will be done through the overall SIEN I&M Program budget.

We present an estimated annual budget which is modified from the North Coast and Cascades Network bird monitoring protocol (Siegel et al. 2007c) (Table 6 – 1). Because of their extensive experience doing bird inventory, monitoring, and research projects, we plan to rely on The Institute for Bird Populations, through a cooperative agreement, to do the majority of the bird monitoring work. Administrative oversight and data management support will be provided by SIEN I&M staff, and park staff will assist us with logistics, permitting, Wilderness minimum requirement analyses, and report reviews.

Annual reports for the SIEN bird monitoring program will tabulate and summarize raw count results, and complex data analyses will be conducted only every four years (to reduce annual costs). At the end of every four-year interval, each of the alternating panels will have been sampled, the annual panel will have been sampled four times, and a comprehensive data analysis will be conducted. This analysis will include trend analyses at YOSE/SEKI and DEPO, assessments of apparent distributional changes, and an evaluation of temporal change in density and/or distribution in the context of other regional and/or national monitoring programs. To conduct these extensive analyses and prepare the associated reports every four years, the cooperator will require an additional estimated $13,500 every fourth year (through the cooperative agreement). Every fourth year, NPS will also re-evaluate implementation costs and determine whether it is cost-effective to renew our cooperative agreement with IBP.

Table 6 – 1. Estimated annual budget for implementing bird monitoring in the Sierra Nevada Network. Personnel costs include salary and benefits. Abbreviations: PM= SIEN Program Manager, DM=SIEN Data Manager, IBP= The Institute for Bird Populations, pp= one 2-week pay period.

Project Tasks	IBP	NPS I&M	NPS other
Administration			
NPS (PM: 1.5 pp and DM: 1 pp) - oversight		9,605	
Field Season Preparation			
NPS (SEKI & YOSE Biologists: 0.75 pp total) permitting, compliance, logistics		2,250	
NPS (SIEN– 0.5 pp- DM/Data Technician) data mgt/logistics			2,100
IBP staff (through Cooperative Agreement)	3,600		
Equipment and Supplies	2,600		
Crew Training and Certification			
NPS (PM: 0.2 pp, DM: 0.5 pp, Data Tech: 0.2 pp)		2,945	
IBP staff (through Cooperative Agreement)	8,000		
Data Collection			
NPS (Park biologists: 0.5 pp)			1,725
IBP field crew (through Cooperative Agreement)	18,000		
Housing for field crews	6,000		
Travel for field crews	4,000		
Data Management			
NPS (Data Manager: 1.5 pp, Data Technician: 1 pp)		7,177	
IBP staff (through Cooperative Agreement)	14,000		
Data Analysis and Reporting			
NPS (PM: 0.5 pp, Park Biologists: 0.5 pp, Data Technician: 0.5 pp)		3,100	1,725
IBP staff (through Cooperative Agreement)	13,800		
Additional Data Analysis and Reporting (every 4 years) IBP staff (through Cooperative Agreement)	[13,500]		
Total (typical annual) **(every fourth year for additional data analysis)**	**$70,000** **[$83,500]**	**$25,077** **same**	**$5,550** **same**

6.4. Protocol Revisions

All protocol revisions will be documented in the revision log (placed at the beginning of this protocol, page ii). Small changes to the protocol (e.g., adding or modifying a habitat variable) will be reviewed and approved by the Project Lead and NPS Lead. More substantive changes (e.g., modifications to the sample design or analytical methods for trend detection) will trigger an outside review to be conducted by the NPS Pacific West Regional Office or designated review panel as directed by the NPS Inventory and Monitoring Program.

Detailed instructions for making and tracking changes to the SIEN Bird Monitoring Protocol, including its accompanying SOPs and Appendices, are provided in SOP 18: Revising the Protocol.

Chapter 7: References

Akaike, H. 1973. Information theory as an extension of the maximum likelihood principle. Pages 267–281 *in* B. N. Petrov and F. Csaki, editors. Second international symposium on information theory Akademiai Kiado, Budapest.

Bartov, I., P. Budowksi, Y. Dror, U. Sandbank, and J.J. Bubis. 1981. Effect of ozone exposure on growth, nutritional encephalopathy, and fatty acid composition of cerebellum and lungs in the young chick. Poultry Science 60:532–540.

Beedy, E. C. and S. L. Granholm. 1985. Discovering Sierra birds. Yosemite Association, El Portal, California.

Breidt, F. J. and W. A. Fuller. 1999. Design of supplemented panel surveys with application to the national resources inventory. Journal of Agricultural, Biological and Environmental statistics 4:391–403.

Brown, K. S., Jr., 1997. Diversity, disturbance, and sustainable use of Neotropical forests: insects as indicators for conservation monitoring. Journal of Insect Conservation 1:25–42.

Brown, R.E., J.D. Brain, and N. Wang. 1997. The avian respiratory system: a unique model for studies of respiratory toxicosis and for monitoring air quality. Environmental Health Perspectives 105:188–200.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, Oxford.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2004. Advanced distance sampling: Estimating abundance of biological populations. Oxford University Press, Oxford.

Burnham, K. P., and D. R. Anderson. 1998. Model Selection and inference: a Practical information-theoretic approach. Springer, New York.

Canterbury, G. E., T. E. Martin, D. R. Petit, L. J. Petit, and D. F. Bradford. 2000. Bird communities and habitat as ecological indicators of forest condition in regional monitoring. Conservation Biology 14:544–558.

Cayan, D. R., S. A. Kammerdiener, M. D. Dettinger, J. M. Caprio, and D. H. Peterson. 2001. Changes in the onset of spring in the western United States. Bulletin of the American Meteorological Society 82:399–415.

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR—2008/070. National Park Service, Fort Collins, Colorado.

Coonan, T. J., G. Austin, and L. C. Dye. 2001. Landbird monitoring: Channel Islands National Park 1995–2000 annual report. Technical Report 2001-03. National Park Service, Channel Islands National Park.

Cordell, H. K. and N. G. Herbert. 2002. The popularity of birding is still growing. Birding Feb.:54–61.

Cordell, H. K., N. G. Herbert, and F. Pandolfi. 1999. The growing popularity of birding in the United States. Birding 3:168–176.

Croze, H. 1982. Monitoring within and outside protected areas. Pages 628–633 *in* J. A. McNeeley and K. R. Miller, editors. National parks, conservation, and development: the roles of protected areas in sustaining society. Proceedings of the World Congress on National Parks. Smithsonian Institution Press, Washington, D.C.

Davidson, C. 2004. Declining downwind: Amphibian population declines in California and historical pesticide use. Ecological Applications 14:1892–1902.

DeSante, D. F. 1995. The status, distribution, abundance, population trends, demographics, and risks of the landbird avifauna of the Sierra Nevada mountains. The Institute for Bird Populations, Pt. Reyes Station, California.

DeSante, D. F. and L. George. 1994. Population trends in the landbirds of western North America. Pages 173–190 *in* J. R. Jehl, Jr. and N. K. Johnson, editors. A century of avifaunal change in western North America. Studies in Avian Biology No. 15.

DeSante, D. F., K. M. Burton, P. Velez, and D. Froehlich. 2007. MAPS Manual: 2007 Protocol. Contribution No. 127 of The Institute for Bird Populations.

DeSante, D. F. D. R. Kaschube. 2006. The Monitoring Avian Productivity and Survivorship (MAPS) Program 1999, 2000, and 2001 Report. Bird Populations **7**:23–89.

DeSante, D. F., P. Pyle, and D. R. Kaschube. 2004. The 2003 annual report of the Monitoring Avian Productivity and Survivorship (MAPS) Program in Yosemite National Park. The Institute for Bird Populations, Pt. Reyes Station, California.

Dettinger, M. D., D. R. Cayan, M. Meyer, and A. E. Jeton. 2004. Simulated hydrologic responses to climate variations and change in the Merced, Carson, and American River basins, Sierra Nevada, California, 1900–2099. Climatic Change 62:283–317.

DeSante, D. F., P. Pyle, and D. R. Kaschube. 2005. The Monitoring Avian Productivity and Survivorship (MAPS) Program in Sequoia and Kings Canyon and Yosemite National Parks and Devil's Postpile National Monument: A comparison between time periods and locations. The Institute for Bird Populations, Pt. Reyes Station, California.

Droege, S. 1990. The North American breeding bird survey. Pages 1–4 *in* J. R. Sauer and S. Droege, editors. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildlife Service, Washington, D.C.

Duane. 1999. Shaping the Sierra: Nature, culture, and conflict in the changing west. University of California, Berkeley.

Dunn, P. O. and D. W. Winkler. 1999. Climate change has affected the breeding date of tree swallows throughout North America. Proceedings of the Royal Society of London. Series B: Biological Sciences 266: 2487–2490.

Duriscoe, D. M. 1987. Evaluation of ozone injury to selected tree species in Sequoia and Kings Canyon National Parks, 1985 survey results. Air Quality Division, National Park Service, Denver, CO.

Esperanza, A. and L. van Mantgem. 2008. Appendix C. Air quality synthesis for Sierra Nevada Network parks. *In* Mutch, L. S., M. Goldin Rose, A. M. Heard, R. R. Cook, and G. L. Entsminger. 2008. Sierra Nevada Network vital signs monitoring plan. Natural Resource Report NPS/SIEN/NRR—2008/072. National Park Service, Fort Collins, Colorado.

Fancy, S. G. 1997. A new approach for analyzing bird densities from variable circular-plot counts. Pacific Science 51:107–114.

Fancy, S. G. and J. R. Sauer. 2000. Recommended methods for inventorying and monitoring landbirds in the National Parks. Retrieved January 25, 2007, from: http://science.nature.nps.gov/im/monitor/protocols/npsbird.doc

Fellers, G. M., L. L. McConnell, D. Pratt, and S. Datta. 2004. Pesticides in mountain yellow-legged frogs (Rana muscosa) from the Sierra Nevada Mountains of California, USA. Environmental Toxicology and Chemistry 23:2170–2177.

Furness, R. W., J. J. D. Greenwood, and P. J. Jarvis. 1993. Can birds be used to monitor the environment? Pages 1–41 *in* R. W. Furness, and J. J. D. Greenwood, editors. Birds as monitors of environmental change. Chapman and Hall, London.

Gaines, D. 1988. Birds of Yosemite and the East Slope. Artemesia Press Books, Lee Vining, California.

Gaines, D. 1992. Birds of Yosemite and the east slope. Artemisia Press, Lee Vining, California.

Gates, H. R. and S. K. Heath. 2003. Bird monitoring, habitat assessment and visitor education in montane meadow and riparian habitats of Devils Postpile National Monument: results from the 2002 and 2003 field season. PRBO Conservation Science, Stinson Beach, California.

Graber, D. M. 1996. Status of terrestrial vertebrates. Pages 709–734 *in* Sierra Nevada Ecosystem Project: Final Report to Congress. Sierra Nevada Ecosystems Project, Final report to

Congress. Vol. II, Assessments and scientific basis of for management options. Centers for Water and Wildland Resources, University of California at Davis.

Graumlich, L. J. 1993. A 1000-year record of temperature and precipitation in the Sierra Nevada. Quaternary Research 39:249–255.

Greenwood, J. J. D., S. R. Baillie, H. Q. P. Crick, J. H. Marchant, and W. J. Peach. 1993. Integrated population monitoring: detecting the effects of diverse changes. Pages 267–342 *in* R. W. Furness and J. J. D. Greenwood, editors. Birds as monitors of environmental change. Chapman and Hall, London.

Grinnell, J. 1917. Field tests of theories concerning distributional control. American Naturalist 51:115–128.

Gruell, G. E. 2001. Fire in Sierra Nevada forests: A photographic interpretation of ecological change since 1849. Mountain Press, Missoula.

Hames, R. S., K. V. Rosenberg, J. D. Lowe, S. E. Barker, and A. A. Dhondt. 2002. Adverse effects of acid rain on the distribution of the Wood Thrush, *Hylocichia mustelina*, in North America. Proceedings of the National Academy of Sciences 99:11,235–11,240.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. Emissions pathways, climate change, and impacts on California. National Academy of Sciences 101:12,422–12,427.

Heath, S. K. 2004. Bird monitoring in montane meadow and riparian habitats of Devils Postpile National Monument: Final report 2002–2004. Contribution #1237 of the Point Reyes Bird Observatory, Stinson Beach, California.

Heath, S. K. 2005. Bird monitoring and education at Devils Postpile National Monument. Contribution #1304 of the Point Reyes Bird Observatory, Stinson Beach, California.

Heath, S. K. 2007. Avian demography monitoring and visitor education at Devils Postpile National Monument, 2002–2006. Contribution #1552 of the Point Reyes Bird Observatory, Petaluma, California.

Howe, R. W., R. R. Regal, G. J. Niemi, N. P. Danz, and J. M. Hanowski. 2007. A probability-based indicator of ecological condition. Ecological Indicators **7**:793–806.

Hutto, R. L. 1995. Composition of bird communities following stand-replacement fires in northern Rocky Mountain (USA) conifer forests. Conservation Biology 9:1041–1058.

Hutto, R. L. and J. S. Young. 2002. Regional landbird monitoring: perspectives from the Northern Rocky Mountains. Wildlife Society Bulletin 31:738–750.

IPCC. 2007. Climate Change 2007: Climate change impacts, adaptation, and vulnerability. Summary for Policymakers.

Jenni, L., and M. Kery. 2003. Timing of autumn bird migration under climate change: advances in long-distance migrants, delays in short-distance migrants. Proceedings of the Royal Society of London. Series B: Biological Sciences 270:1467–1471.

Knowles, N., and D. R. Cayan. 2001. Global climate change: potential effects on the Sacramento/San Joaquin watershed and the San Francisco estuary. IEP Newsletter 14:23–29.

Legendre, P. and L. Legendre. 1998. Numerical Ecology second edition. Elsevier Science, Amsterdam,The Netherlands.

LeNoir, J. S., L. L. McConnell, G. M. Fellers, T. M. Cahill, and J. N. Seiber. 1999. Summertime transport of current-use pesticides from California's Central Valley to the Sierra Nevada Mountain Range, USA. Environmental Toxicology and Chemistry 18:2715–2722.

Lowther, P. E. 1993. Brown-headed cowbird : *Molothrus ater*. The birds of North America. No. 47. The American Ornithologists' Union, Washington, D.C.

MacMynowski, D.P., T.L. Root, G. Ballard, and G. R. Geupel. 2007. Changes in spring arrival of Nearctic-Neotropical migrants attributed to multiscalar climate. Global Change Biology 13:1–13.

Manley, P. N., W. J. Zielinski, M. D. Schlesinger, and S. R. Mori. 2004. Evaluation of a multiple-species approach to monitoring species at the ecoregional scale. Ecological Applications 14:296–310.

Martinsen, E., B. J. Blumberg, R. J. Eisen, and J. J. Schall. 2008. Avian haemosporidian parasites (phylum Apicomplexa) from northern California oak woodland and chaparral habitats. Journal of Wildlife Diseases 44:260–268.

Marzluff, J. M. 2005. Island biogeography for an urbanizing world: how extinction and colonization may determine biological diversity in human-dominated landscapes. Urban Ecosystems 8:157–177.

McCreedy, C. and S. K. Heath. 2004. Atypical Willow Flycatcher nesting sites in a recovering riparian corridor at Mono Lake, California. Western Birds 35:186–196.

McDonald, T. L. 2003. Review of environmental monitoring methods: survey designs. Environmental Monitoring and Assessment 85:277–292.

Mooney, K. 2007. Tritrophic effects of birds and ants on a canopy food web, tree growth and phytochemistry. Ecology 88(8):2005–2014.

Morrison, J. L., and D. C. Hahn. 2002. Geographic variation in cowbird distribution, abundance, and parasitism. Pages 65–72 *in* T. L. George and D. S. Dobkin, editors. Effects of habitat fragmentation on birds in western landscapes: contrasts with paradigms from the eastern United States. Studies in Avian Biology 25.

Morrison, M. L. 1986. Bird populations as indicators of environmental change. Current Ornithology 3: 429–451.

Mutch, L. S., M. Goldin Rose, A. M. Heard, R. R. Cook, and G .L. Entsminger. 2008. Sierra Nevada Network vital signs monitoring plan. Natural Resources Report NPS/SIEN/NRR—2008/072. National Park Service, Fort Collins, Colorado.

National Audubon Society. 2009. Birds and climate change – Ecological disruption in motion. A briefing for policymakers and concerned citizens. National Audubon Society, Inc., New York, NY 10014. Available at http://birdsandclimate.audubon.org/ (accessed 26 February 2010).

National Park Service. 2006a. Highly pathogenic avian influenza in wildlife preparedness and communication plan. Wildlife Health Program. NPS Biological Resources Management Division, Fort Collins, Colorado.

National Park Service. 2006b. Chapter 6. Wilderness Preservation and Management, *In* Management Policies 2006. US Department of Interior, National Park Service, Washington, D.C. Available at http://www.nps.gov/policy/MP2006.pdf (accessed 26 February 2010).

NatureServe 2003. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono Counties, California. Report to National Park Service in cooperation with the California Native Plant Society and California Natural Heritage Program, Wildlife and Habitat Data Analysis Branch, California Department of Fish and Game, Sacramento, California.

NatureServe 2004. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono Counties, California. Modified for use in Sequoia and Kings Canyon National Parks. Report to National Park Service in cooperation with the California Native Plant Society and California Natural Heritage Program, Wildlife and Habitat Data Analysis Branch, California Department of Fish and Game, Sacramento, California.

Nelson, J. T. and S. G. Fancy. 1999. A test of the variable circular-plot method when exact density of a bird population was known. Pacific Conservation Biology 5:139–143.

North American Bird Conservation Initiative, U.S. Committee, 2009. The state of the birds, United States of America, 2009. U.S. Department of Interior, Washington, DC. 36 pages.

Availble at http://www.stateofthebirds.org/pdf_files/State_of_the_Birds_2009.pdf (accessed 10 June 2010).

O'Connor, R. J. 1992. Population variation in relation to migrancy status in some North American birds. Pages 46–74 *in* J. M. Hagan, III, and D. W. Johnson, editors. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Oakley, K. L., L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. Wildlife Society Bulletin 31:1000–1003.

Parmesan, C. 2006. Ecological and Evolutionary Responses to Recent Climate Change. Annual Review of Ecology, Evolution, and Systematics 37:637–669.

Parmesan, C., and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37–42.

Peitz, D. G, S. G. Fancy, L. P. Thomas, G. A. Rowell, and M. D. DeBacker. 2004. Bird monitoring protocol for Agate Fossil Beds National Monument, Nebraska and Tallgrass Prairie National Preserve, Kansas. Prairie Cluster Prototype Monitoring Program, National Park Service, Republic, MO.

Peterjohn, B. G., and J. R. Sauer. 1993. North American Breeding Bird Survey annual summary 1990–1991. Bird Populations 1:1–15.

Peterjohn, B. G., J. R. Sauer, and C. S. Robbins. 1995. Population trends from North American breeding bird survey. Pages 3–39 *in* T. E. Martin and D. M. Finch, editors. Ecology and management of neotropical migratory birds. Oxford Press, New York.

Powell, B. F., A. D. Flesch, T. Mau-Crimmins, D. Angell, K. Beaupre, and W. L. Halvorson. 2007. Landbird monitoring protocol and standard operating procedures for the Sonoran Desert Network. Natural Resource Technical Report NPS/SODN/NRTR-2007/00X. http://www.southwestlearning.org/subproducts/98/72 (accessed 21 June 2010).

Price, C. and D. Rind. 1991. Lightning activity in a greenhouse world. Proceedings of the 11th Conference of Fire and Forest Meteorology, Bethesda, MD.

Pyle, P., D. R. Kaschube, R. B. Siegel, and D. F. DeSante. 2006. The 2005 Annual report of the Monitoring Avian Productivity and Survivorship (MAPS) program in Yosemite National Park. The Institute for Bird Populations, Point Reyes Station, California.

Quilligan, J. J., R. D. Boche, H. L. Falk, and P. Kotin. 1958. Toxicity of ozone for young chicks. Archives of Industrial Health 18:16.

Quinn, J. F. and C. van Riper III. 1990. Design considerations for national park inventory databases. Pages 5–14 *in* C. van Riper et al., editors. Examples of resource inventory and monitoring in national parks of California. Proceedings of the Third Biennial Conference on Research in California's National Parks, September 13–15, 1990, University of California, Davis.

Ralph, C. J. and J. M. Scott, editors. 1981. Estimating numbers of terrestrial birds. Studies in Avian Biology No. 6, Cooper Ornithological Society, Boise, Idaho, USA.

Reynolds, R. T., J. M. Scott, and R. A. Nussbaum. 1980. A variable circular-plot method for estimating bird numbers. Condor 82:309–313.

Robbins, C. S., J. R. Sauer, R. Greenburg and S. Droege. 1989. Population declines in North American birds that migrate to the neotropics. Proceedings of the National Academy of Sciences 86:7658–7662.

Rombout, P. J. A., A. M. A. Dormans, L. VanBree, and M. Marra. 1991. Structural and biochemical effects in lungs of Japanese quail following a 1-week exposure to ozone. Environmental Research 54:39–51.

Root, T. L., D. P. MacMynowski, M. D. Mastrandrea, and S. H. Schneider. 2005. Human-modified temperatures induce species changes: Joint attribution. National Academy of Sciences 102:7465–7469.

Root, T. L., J. T. Price, K. R. Hall, S. H. Schneider, C. Rosenzweigk, and J. A. Pounds. 2003. Fingerprints of global warming on wild animals and plants. Nature 421:57–60.

Rosenstock, S. S., D. R. Anderson, K. M. Giesen, T. Leukering, and M. F. Carter. 2002. Landbird counting techniques: current practices and an alternative. Auk 119:46–53.

Sauer, J. R. 2000. Combining information from monitoring programs: complications associated with indices and geographic scale. Pages 124–126 *in* R. Bonney, D. N. Pashley, R. J. Cooper, and L. Niles, editors. Strategies for bird conservation: The Partners in Flight planning process. Proceedings of the 3rd Partners in Flight workshop; 1995 October 1-5; Cape May, New Jersey. Proceedings RMRS_P_16. USDA Forest Service, Ogden, Utah. Available at http://www.birds.cornell.edu/pifcapemay/ (accessed 11 June 2010).

Sauer, J. R., and R. J. Cooper. 2000. Population and habitat assessment: monitoring bird populations over large areas. Pages 113–114 *in* R. Bonney, D. N. Pashley, R. J. Cooper, and L. Niles, editors. Strategies for bird conservation: the Partners in Flight planning process. Proceedings of the 3rd Partners in Flight workshop; 1995 October 1-5; Cape May, New Jersey. Proceedings RMRS_P_16,. USDA Forest Service, Ogden, Utah. Available at http://www.birds.cornell.edu/pifcapemay/ (accessed 11 June 2010).

Sauer, J. R. and J. E. Hines. 2004. The North American breeding bird survey, results and analysis 1966–2003. Version 2003.0. USGS Patuxent Wildlife Research Center, Laurel, MD.

Sauvajot, R. M. J. E. Quinn, C. van Riper III, and C. Farmer. 1990. Comparative analyses of bird inventory databases from California National Parks. Pages 15–48 *in* C. van Riper et al., editors. Examples of resource inventory and monitoring in National Parks of California. Proceedings of the Third Biennial Conference on Research in California's National Parks, September 13–15, 1990, University of California, Davis.

Siegel, R. B. 2000. Methods for monitoring landbirds. USDI NPS Technical Report NPS/NRNOCA/NRTR/00-03. National Park Service, Fort Collins, Colorado.

Siegel, R. B., and D. F. DeSante. 1999. Draft avian conservation plan for the Sierra Nevada Bioregion: A report to California Partners in Flight. The Institute for Bird Populations, Pt. Reyes Station, California.

Siegel, R. B., and D. F. DeSante. 2002. Avian inventory of Yosemite National Park (1998–2000). The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., and D. R. Kaschube. 2007. Landbird monitoring results from the Monitoring Avian Productivity and Survivorship (MAPS) Program in the Sierra Nevada. Contribution No. 300 of The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., and R. C. Kuntz, II. 2000. Designing a landbird monitoring program at North Cascades National Park Service Complex: summary recommendations from a September 2000 workshop. USDI Technical Report NPS/NRNOCA/NRTR/00-04. National Park Service, Fort Collins, Colorado.

Siegel, R. S., P. Pyle, D. F. DeSante, and D. R. Kaschube. 2007a. The Monitoring Avian Productivity and Survivorship (MAPS) Program in Sequoia and Kings Canyon National Park: a summary of the 2006 field season, an assessment of recent trends, and a comparison with results from the MAPS Program in Yosemite National Park. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. S., P. Pyle, D. F. DeSante, and D. R. Kaschube. 2007b. The 2006 annual report of the Monitoring Avian Survivorship and Productivity (MAPS) Program in Yosemite National Park. Contribution 299 of The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., and R. L. Wilkerson. 2004. Landbird inventory for Devils Postpile National Monument. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B,. and R. L. Wilkerson. 2005a. Landbird inventory for Sequoia and Kings Canyon National Parks (2003–2004). The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., and R. L. Wilkerson. 2005b. Sample designs for avian monitoring alternatives in Sierra Nevada Network parks. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., R. L. Wilkerson, and D. F. DeSante. 2008. Extirpation of the Willow Flycatcher from Yosemite National Park. Western Birds 39:8–21.

Siegel, R. B., R. L. Wilkerson, and S. Hall. 2004. Landbird inventory for Olympic National Park (2002–2003). The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007c. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

Siegel, R. B., R. L. Wilkerson, R. C. Kuntz II, J. and F. McLaughlin. 2004. Landbird inventory for North Cascades National Park Service Complex. The Institute for Bird Populations, Point Reyes Station, California.

Silsbee, G. G. and D. L. Peterson. 1991. Designing and implementing comprehensive long-term inventory and monitoring programs for National Park System lands. Natural Resources Report NPS/NRUW/NRR-91/04, Denver, CO.

Simons, T. R., K. N. Rabenold, D. A. Buehler, J. A. Collazo, and K. E. Fransreb. 1999. The role of indicator species: neotropical migratory song birds. Pages 187–208 *in* J. D. Peine, editor. Ecosystem management for sustainability: Principles and practices illustrated by a regional biosphere reserve cooperative. Lewis Publishers. New York.

Simons, T. R., K. H. Pollack, J. M. Wettroth, M. W. Alldredge, K. Pacifici, and J. Brewster. 2009. Sources of measurement error, misclassification error, and bias in auditory avian point count data. Pages 237–254 *in* D. L. Thomson et al., editors. Modeling demographic processes in marked populations. Environmental and ecological statistics Volume 3. Springer Science+Business Media, LLC. DOI 10.1007/978-0-387-78151-8_10.

Smith, W. P., D. J. Twedt, R. J. Cooper, D. A. Wiedenfeld, P. B. Hamel, and R P. Ford. 1995. Sample size and allocation of effort in point count sampling of birds in bottomland hardwood forests. Pages 7–17 *in* C. J. Ralph, J. R. Sauer, and S. Droege, editors. monitoring bird populations by point counts. General Technical Report PSW-GTR-149. USDA Forest Service, Berkeley, California. Available http://www.fs.fed.us/psw/publications/documents/psw_gtr149/ (accessed 10 June 2010).

Snyder, M. A., J. L. Bell, L. C. Sloan, P. B. Duffy, and B. Govindasamy. 2002. Climate responses to a doubling of atmospheric carbon dioxide for a climatically vulnerable region. Geophysical Research Letters 29: 1-4.

Stephens, J. L., S. R. Mohren, J. D. Alexander, D. A. Sarr, and K. M. Irvine. 2010. Klamath Network: Draft landbird monitoring protocol. Natural Resource Report NPS/KLMN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado.

Stevens, D. L., Jr., and A. R. Olsen. 1999. Spatially restricted surveys over time for aquatic resources. Journal of Agricultural, Biological, and Environmental Statistics 4:415–428.

Stevens, D. L., Jr., and A. R. Olsen. 2003. Variance estimation for spatially balanced samples of environmental resources. EnvironMetrics 14:593–610.

Stevens, D. L., Jr., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262–278.

TerraStat Consulting Group. 2005. Protocols for analyzing and reporting trends in avian abundance in SIEN parks-Task 2 Report. Unpublished Report available from USGS, 600 E. Park Avenue, Port Angeles, WA 98362.

Thomas, L., J. L. Laake, S. Strindberg, F. F. C. Marques, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. L. Hedley, and J. H. Pollard. 2002. Distance 4.0. Release 2. Research Unit for Wildlife Populations Assessment, University of St. Andrews, UK. Retrieved January 25, 2007, from: http://www.ruwpa.st-and.ac.uk/distance/.

Tingley, M. W., W. B. Monahan, S. R. Beisinger, and C. Moritz. 2009. Birds track their Grinnellian niche through a century of climate change. Proceedings of the National Academy of Sciences (USA) 106, suppl. 2:19,637–19,643.

Unger, C. D. 1989. Analysis of summertime acid rain event in the Sierra Nevada. . Air and Waste Management Association Symposium on Effects of Air Pollution on Western Forests, Anaheim, California, Anaheim, California.

Urquhart, N. S., W. S. Overton, and D. S. Birkes. 1993. Comparing sampling designs for monitoring ecological status and trends: Impact of temporal patterns. *In* V. Barnett and K. F. Turkman, editors. Statistics for the Environment. John Wiley and Sons Ltd.

Urquhart, N.S. and T.M. Kincaid. 1999. Trend detection in repeated surveys of ecological responses. Journal of Agricultural, Biological, and Environmental Statistics 4:404–414.

Visser, M., C. Both, and M. Lambrechts. 2004. Global climate change leads to mistimed avian reproduction. Advances in Ecological Research 35:89–110.

Wilkerson, R. L. R. B. Siegel, and J. Schaberl. 2005. Landbird inventory for Mount Rainier National Park (2003–2004). The Institute for Bird Populations, Point Reyes Station, California.

Zabik, J. M., and J. N. Seiber. 1993. Atmospheric transport of organophosphate pesticides from California's Central Valley to the Sierra Nevada mountains. Journal of Environmental Quality 22:80–90.

Appendix A: Locations of Transect Starting Points for SIEN Bird Monitoring

This Appendix provides three tables containing the random starting points–for transects–generated for SEKI (Table A – 1), YOSE (Table A – 2), and DEPO (Table A – 3).

Revision History Log:

Revision Date	Author	Changes Made	Reason for Change

Table A – 1. Sampling point locations at Sequoia and Kings Canyon National Parks (SEKI), along with stratum and panel membership. Sample points were drawn and grouped into panels using the Generalized Random-Tessellation Stratified (GRTS) sampling method with reverse hierarchical ordering. See Landbird Monitoring Protocol narrative (Chapter 2) for details.

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
SEKI	SEKI01-003	365243	4041154	High	1,289	ANN1	3,124
SEKI	SEKI01-007	379100	4042881	High	1,289	ANN1	3,264
SEKI	SEKI01-011	366231	4052640	High	1,289	ANN1	3,411
SEKI	SEKI01-004	373227	4071692	High	1,289	ANN1	3,387
SEKI	SEKI01-012	350144	4109516	High	1,289	ANN1	3,510
SEKI	SEKI01-021	331247	4045593	Low	425	ANN1	688
SEKI	SEKI01-005	358484	4020438	Mid	3,303	ANN1	2,505
SEKI	SEKI01-002	353003	4045201	Mid	3,303	ANN1	1,978
SEKI	SEKI01-013	343354	4047859	Mid	3,303	ANN1	2,131
SEKI	SEKI01-009	342148	4048648	Mid	3,303	ANN1	2,040
SEKI	SEKI01-006	345442	4051635	Mid	3,303	ANN1	2,295
SEKI	SEKI01-001	328129	4061278	Mid	3,303	ANN1	2,119
SEKI	SEKI01-017	323113	4067670	Mid	3,303	ANN1	1,777
SEKI	SEKI01-010	351250	4073844	Mid	3,303	ANN1	1,820
SEKI	SEKI01-008	350817	4080484	Mid	3,303	ANN1	2,660
SEKI	SEKI01-014	364012	4031281	High	1,289	ALT2	3,260
SEKI	SEKI01-019	369219	4038881	High	1,289	ALT2	3,076
SEKI	SEKI01-015	376709	4053235	High	1,289	ALT2	3,487
SEKI	SEKI01-020	374398	4076951	High	1,289	ALT2	3,129
SEKI	SEKI01-016	370225	4099151	High	1,289	ALT2	3,682
SEKI	SEKI01-034	336832	4050670	Low	425	ALT2	1,435
SEKI	SEKI01-025	350970	4024529	Mid	3,303	ALT2	2,622
SEKI	SEKI01-035	371260	4030882	Mid	3,303	ALT2	2,465
SEKI	SEKI01-030	370097	4033407	Mid	3,303	ALT2	2,637
SEKI	SEKI01-018	354631	4046310	Mid	3,303	ALT2	1,902
SEKI	SEKI01-029	343500	4049638	Mid	3,303	ALT2	2,110
SEKI	SEKI01-022	345354	4058036	Mid	3,303	ALT2	2,632
SEKI	SEKI01-033	325432	4068231	Mid	3,303	ALT2	2,140
SEKI	SEKI01-032	374131	4079050	Mid	3,303	ALT2	2,903
SEKI	SEKI01-024	354905	4084843	Mid	3,303	ALT2	2,957
SEKI	SEKI01-026	357318	4023354	High	1,289	ALT3	3,017
SEKI	SEKI01-023	378243	4043338	High	1,289	ALT3	3,255
SEKI	SEKI01-031	373487	4058790	High	1,289	ALT3	3,443
SEKI	SEKI01-027	360942	4067464	High	1,289	ALT3	3,008
SEKI	SEKI01-028	357201	4079948	High	1,289	ALT3	3,052
SEKI	SEKI01-045	348509	4045606	Low	425	ALT3	1,447
SEKI	SEKI01-049	350099	4021711	Mid	3,303	ALT3	2,657

Table A – 1. Sampling point locations at Sequoia and Kings Canyon National Parks (SEKI), along with stratum and panel membership (continued).

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
SEKI	SEKI01-041	355869	4023251	Mid	3,303	ALT3	2,906
SEKI	SEKI01-051	374734	4042050	Mid	3,303	ALT3	2,245
SEKI	SEKI01-037	337839	4046579	Mid	3,303	ALT3	1,639
SEKI	SEKI01-050	343737	4050667	Mid	3,303	ALT3	2,211
SEKI	SEKI01-038	348169	4060579	Mid	3,303	ALT3	2,714
SEKI	SEKI01-043	358810	4074726	Mid	3,303	ALT3	2,069
SEKI	SEKI01-052	349168	4078529	Mid	3,303	ALT3	2,160
SEKI	SEKI01-040	354906	4091546	Mid	3,303	ALT3	2,048
SEKI	SEKI01-042	360022	4031793	High	1,289	ALT4	3,174
SEKI	SEKI01-046	362660	4039671	High	1,289	ALT4	3,191
SEKI	SEKI01-039	384006	4046839	High	1,289	ALT4	3,861
SEKI	SEKI01-036	384397	4046948	High	1,289	ALT4	4,151
SEKI	SEKI01-044	357960	4088271	High	1,289	ALT4	3,059
SEKI	SEKI01-075	334131	4045372	Low	425	ALT4	1,109
SEKI	SEKI01-057	351817	4033439	Mid	3,303	ALT4	2,533
SEKI	SEKI01-061	356596	4037322	Mid	3,303	ALT4	2,757
SEKI	SEKI01-062	358990	4047809	Mid	3,303	ALT4	2,684
SEKI	SEKI01-053	341659	4047994	Mid	3,303	ALT4	1,941
SEKI	SEKI01-055	358511	4057475	Mid	3,303	ALT4	2,677
SEKI	SEKI01-054	349271	4065126	Mid	3,303	ALT4	2,441
SEKI	SEKI01-059	368578	4069965	Mid	3,303	ALT4	2,250
SEKI	SEKI01-060	359206	4102283	Mid	3,303	ALT4	2,504
SEKI	SEKI01-056	342903	4117663	Mid	3,303	ALT4	2,826
SEKI	SEKI01-058	361447	4031237	High	1,289	ALT5	3,541
SEKI	SEKI01-047	377512	4050260	High	1,289	ALT5	3,242
SEKI	SEKI01-063	374275	4069496	High	1,289	ALT5	3,111
SEKI	SEKI01-048	375870	4086323	High	1,289	ALT5	3,343
SEKI	SEKI01-064	372912	4092362	High	1,289	ALT5	3,369
SEKI	SEKI01-095	349568	4074434	Low	425	ALT5	1,538
SEKI	SEKI01-069	343985	4022826	Mid	3,303	ALT5	1,612
SEKI	SEKI01-071	367364	4029555	Mid	3,303	ALT5	2,810
SEKI	SEKI01-077	357500	4032274	Mid	3,303	ALT5	2,712
SEKI	SEKI01-065	353709	4043561	Mid	3,303	ALT5	1,880
SEKI	SEKI01-079	344730	4047422	Mid	3,303	ALT5	2,161
SEKI	SEKI01-073	356636	4047940	Mid	3,303	ALT5	2,254
SEKI	SEKI01-067	347197	4050685	Mid	3,303	ALT5	2,471
SEKI	SEKI01-072	373871	4079326	Mid	3,303	ALT5	2,883
SEKI	SEKI01-078	357461	4087005	Mid	3,303	ALT5	2,950
SEKI	SEKI01-066	374951	4073852	High	1,289	EXTR	3,215
SEKI	SEKI01-068	356681	4081164	High	1,289	EXTR	3,085

Table A – 2. Sampling point locations at Yosemite National Park (YOSE), along with stratum and panel membership. Sample points were drawn and grouped into panels using the Generalized Random-Tessellation Stratified (GRTS) sampling method with reverse hierarchical ordering. See Landbird Monitoring Protocol narrative (Chapter 2) for details.

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
YOSE	YOSE01-019	294901	4174511	HIGH	1,020	ANN1	3,044
YOSE	YOSE01-023	300816	4184449	HIGH	1,020	ANN1	2,785
YOSE	YOSE01-014	286114	4186485	HIGH	1,020	ANN1	2,840
YOSE	YOSE01-016	292888	4199460	HIGH	1,020	ANN1	3,002
YOSE	YOSE01-028	287043	4219378	HIGH	1,020	ANN1	2,874
YOSE	YOSE01-017	266167	4156656	LOW	1,419	ANN1	1,242
YOSE	YOSE01-022	274293	4180269	LOW	1,419	ANN1	1,217
YOSE	YOSE01-018	271486	4180628	LOW	1,419	ANN1	1,207
YOSE	YOSE01-021	253313	4186612	LOW	1,419	ANN1	1,516
YOSE	YOSE01-015	260543	4204574	LOW	1,419	ANN1	1,249
YOSE	YOSE01-029	279359	4170370	MID	3,359	ANN1	2,211
YOSE	YOSE01-034	276524	4172923	MID	3,359	ANN1	2,057
YOSE	YOSE01-026	278778	4180073	MID	3,359	ANN1	2,082
YOSE	YOSE01-032	291473	4208733	MID	3,359	ANN1	2,625
YOSE	YOSE01-040	269342	4216480	MID	3,359	ANN1	2,552
YOSE	YOSE01-003	290879	4179452	HIGH	1,020	ALT2	2,829
YOSE	YOSE01-007	295949	4187012	HIGH	1,020	ALT2	3,179
YOSE	YOSE01-004	277158	4198044	HIGH	1,020	ALT2	2,920
YOSE	YOSE01-008	279764	4208061	HIGH	1,020	ALT2	2,819
YOSE	YOSE01-012	281981	4219717	HIGH	1,020	ALT2	2,833
YOSE	YOSE01-001	266444	4154453	LOW	1,419	ALT2	1,546
YOSE	YOSE01-002	270578	4180141	LOW	1,419	ALT2	1,225
YOSE	YOSE01-006	272464	4180492	LOW	1,419	ALT2	1,208
YOSE	YOSE01-005	248381	4186380	LOW	1,419	ALT2	1,477
YOSE	YOSE01-011	246928	4206649	LOW	1,419	ALT2	1,423
YOSE	YOSE01-013	279633	4160660	MID	3,359	ALT2	2,682
YOSE	YOSE01-009	258691	4182326	MID	3,359	ALT2	1,936
YOSE	YOSE01-010	276669	4184484	MID	3,359	ALT2	2,137
YOSE	YOSE01-020	276069	4203882	MID	3,359	ALT2	2,504
YOSE	YOSE01-024	280831	4209919	MID	3,359	ALT2	2,654
YOSE	YOSE01-045	285064	4167520	HIGH	1,020	ALT3	2,762
YOSE	YOSE01-042	280790	4182685	HIGH	1,020	ALT3	3,000
YOSE	YOSE01-035	292519	4185384	HIGH	1,020	ALT3	2,998
YOSE	YOSE01-030	287194	4191197	HIGH	1,020	ALT3	2,838
YOSE	YOSE01-036	277541	4198062	HIGH	1,020	ALT3	2,801
YOSE	YOSE01-025	270030	4153747	LOW	1,419	ALT3	1,772
YOSE	YOSE01-033	264567	4161656	LOW	1,419	ALT3	1,763

Table A – 2. Sampling point locations at Yosemite National Park (YOSE), along with stratum and panel membership (continued).

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
YOSE	YOSE01-037	260266	4179419	LOW	1,419	ALT3	1,689
YOSE	YOSE01-031	262738	4205273	LOW	1,419	ALT3	1,749
YOSE	YOSE01-027	251392	4205621	LOW	1,419	ALT3	1,544
YOSE	YOSE01-057	267312	4167355	MID	3,359	ALT3	1,977
YOSE	YOSE01-054	270180	4185427	MID	3,359	ALT3	2,096
YOSE	YOSE01-052	282763	4192824	MID	3,359	ALT3	2,655
YOSE	YOSE01-044	288106	4200658	MID	3,359	ALT3	2,582
YOSE	YOSE01-047	251732	4218915	MID	3,359	ALT3	2,405
YOSE	YOSE01-046	289781	4170522	HIGH	1,020	ALT4	3,028
YOSE	YOSE01-076	282466	4221489	HIGH	1,020	ALT4	2,858
YOSE	YOSE01-048	301319	4195816	HIGH	1,020	ALT4	2,939
YOSE	YOSE01-060	293735	4195817	HIGH	1,020	ALT4	2,780
YOSE	YOSE01-056	272209	4227659	HIGH	1,020	ALT4	2,845
YOSE	YOSE01-041	267788	4158528	LOW	1,419	ALT4	1,277
YOSE	YOSE01-038	276059	4178241	LOW	1,419	ALT4	1,603
YOSE	YOSE01-049	249349	4181051	LOW	1,419	ALT4	1,789
YOSE	YOSE01-039	247039	4199912	LOW	1,419	ALT4	1,578
YOSE	YOSE01-043	255805	4204635	LOW	1,419	ALT4	1,196
YOSE	YOSE01-077	282277	4160294	MID	3,359	ALT4	2,451
YOSE	YOSE01-058	283572	4181941	MID	3,359	ALT4	2,574
YOSE	YOSE01-074	273941	4187580	MID	3,359	ALT4	2,476
YOSE	YOSE01-059	261042	4193209	MID	3,359	ALT4	2,082
YOSE	YOSE01-080	289191	4204575	MID	3,359	ALT4	2,651
YOSE	YOSE01-062	293273	4170319	HIGH	1,020	ALT5	2,773
YOSE	YOSE01-067	292575	4181070	HIGH	1,020	ALT5	2,818
YOSE	YOSE01-071	297505	4186906	HIGH	1,020	ALT5	3,194
YOSE	YOSE01-072	280057	4207546	HIGH	1,020	ALT5	2,752
YOSE	YOSE01-064	289059	4216860	HIGH	1,020	ALT5	2,947
YOSE	YOSE01-053	264147	4177429	LOW	1,419	ALT5	1,334
YOSE	YOSE01-061	268267	4178601	LOW	1,419	ALT5	1,206
YOSE	YOSE01-050	274349	4179007	LOW	1,419	ALT5	1,229
YOSE	YOSE01-055	253250	4198120	LOW	1,419	ALT5	1,508
YOSE	YOSE01-063	270940	4200642	LOW	1,419	ALT5	1,336
YOSE	YOSE01-089	271263	4154666	MID	3,359	ALT5	2,064
YOSE	YOSE01-093	284938	4161477	MID	3,359	ALT5	2,495
YOSE	YOSE01-090	283456	4179472	MID	3,359	ALT5	2,090
YOSE	YOSE01-083	289554	4181954	MID	3,359	ALT5	2,715
YOSE	YOSE01-096	291810	4209456	MID	3,359	ALT5	2,629
YOSE	YOSE01-078	286766	4186658	HIGH	1,020	EXTR	2,851
YOSE	YOSE01-084	273501	4210985	HIGH	1,020	EXTR	2,770
YOSE	YOSE01-087	298715	4187520	HIGH	1,020	EXTR	2,931

Table A – 2. Sampling point locations at Yosemite National Park (YOSE), along with stratum and panel membership (continued).

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
YOSE	YOSE01-088	283991	4210141	HIGH	1,020	EXTR	3,078
YOSE	YOSE01-092	289613	4193606	HIGH	1,020	EXTR	2,780
YOSE	YOSE01-094	287642	4160803	HIGH	1,020	EXTR	2,819
YOSE	YOSE01-099	291874	4191123	HIGH	1,020	EXTR	2,896
YOSE	YOSE01-100	279171	4197681	HIGH	1,020	EXTR	2,864
YOSE	YOSE01-106	281504	4183343	HIGH	1,020	EXTR	2,861
YOSE	YOSE01-108	291078	4198861	HIGH	1,020	EXTR	2,913
YOSE	YOSE01-109	287255	4169041	HIGH	1,020	EXTR	3,054
YOSE	YOSE01-110	291762	4169560	HIGH	1,020	EXTR	2,899
YOSE	YOSE01-112	303445	4192847	HIGH	1,020	EXTR	3,049
YOSE	YOSE01-115	293872	4186276	HIGH	1,020	EXTR	3,034
YOSE	YOSE01-120	272649	4228034	HIGH	1,020	EXTR	2,863
YOSE	YOSE01-124	295744	4192475	HIGH	1,020	EXTR	2,777
YOSE	YOSE01-126	294270	4170359	HIGH	1,020	EXTR	2,944
YOSE	YOSE01-128	288695	4219179	HIGH	1,020	EXTR	2,970
YOSE	YOSE01-131	294601	4171506	HIGH	1,020	EXTR	2,973
YOSE	YOSE01-135	301138	4181567	HIGH	1,020	EXTR	3,205
YOSE	YOSE01-136	280800	4209166	HIGH	1,020	EXTR	2,863
YOSE	YOSE01-140	283647	4219276	HIGH	1,020	EXTR	3,057
YOSE	YOSE01-141	278585	4163324	HIGH	1,020	EXTR	2,778
YOSE	YOSE01-144	287979	4208760	HIGH	1,020	EXTR	2,887
YOSE	YOSE01-147	290331	4183655	HIGH	1,020	EXTR	2,855
YOSE	YOSE01-148	281343	4192248	HIGH	1,020	EXTR	2,838
YOSE	YOSE01-152	285043	4210526	HIGH	1,020	EXTR	2,889
YOSE	YOSE01-157	284488	4165186	HIGH	1,020	EXTR	2,795
YOSE	YOSE01-158	288118	4162433	HIGH	1,020	EXTR	2,832
YOSE	YOSE01-163	293822	4183829	HIGH	1,020	EXTR	3,241
YOSE	YOSE01-164	280096	4197906	HIGH	1,020	EXTR	2,874
YOSE	YOSE01-172	292488	4201147	HIGH	1,020	EXTR	2,975
YOSE	YOSE01-174	294337	4167916	HIGH	1,020	EXTR	3,084
YOSE	YOSE01-176	303309	4193316	HIGH	1,020	EXTR	3,034
YOSE	YOSE01-179	294793	4186656	HIGH	1,020	EXTR	3,158
YOSE	YOSE01-065	266734	4155208	LOW	1,419	EXTR	1,394
YOSE	YOSE01-066	270861	4180910	LOW	1,419	EXTR	1,586
YOSE	YOSE01-068	276510	4201765	LOW	1,419	EXTR	1,503
YOSE	YOSE01-069	249345	4182311	LOW	1,419	EXTR	1,785
YOSE	YOSE01-070	272666	4180892	LOW	1,419	EXTR	1,218
YOSE	YOSE01-073	257256	4187809	LOW	1,419	EXTR	1,769
YOSE	YOSE01-075	248709	4205422	LOW	1,419	EXTR	1,552
YOSE	YOSE01-079	261863	4204268	LOW	1,419	EXTR	1,415
YOSE	YOSE01-081	264865	4158845	LOW	1,419	EXTR	1,378

Table A – 2. Sampling point locations at Yosemite National Park (YOSE), along with stratum and panel membership (continued).

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
YOSE	YOSE01-082	271116	4181484	LOW	1,419	EXTR	1,562
YOSE	YOSE01-085	252904	4189203	LOW	1,419	EXTR	1,685
YOSE	YOSE01-086	274741	4180207	LOW	1,419	EXTR	1,220
YOSE	YOSE01-091	248363	4209568	LOW	1,419	EXTR	1,699
YOSE	YOSE01-095	263751	4205893	LOW	1,419	EXTR	1,702
YOSE	YOSE01-097	265522	4164421	LOW	1,419	EXTR	1,779
YOSE	YOSE01-102	275308	4180338	LOW	1,419	EXTR	1,237
YOSE	YOSE01-103	251399	4198099	LOW	1,419	EXTR	1,581
YOSE	YOSE01-105	268145	4160383	LOW	1,419	EXTR	1,711
YOSE	YOSE01-107	255141	4205109	LOW	1,419	EXTR	1,531
YOSE	YOSE01-113	255209	4178134	LOW	1,419	EXTR	1,373
YOSE	YOSE01-114	272266	4180147	LOW	1,419	EXTR	1,215
YOSE	YOSE01-119	252196	4200385	LOW	1,419	EXTR	1,012
YOSE	YOSE01-125	268869	4177805	LOW	1,419	EXTR	1,219
YOSE	YOSE01-129	263917	4159329	LOW	1,419	EXTR	1,467
YOSE	YOSE01-130	271433	4179834	LOW	1,419	EXTR	1,205
YOSE	YOSE01-133	248383	4187790	LOW	1,419	EXTR	1,405
YOSE	YOSE01-134	273591	4179833	LOW	1,419	EXTR	1,212
YOSE	YOSE01-137	267382	4154185	LOW	1,419	EXTR	1,561
YOSE	YOSE01-139	248562	4207037	LOW	1,419	EXTR	1,487
YOSE	YOSE01-146	271582	4180775	LOW	1,419	EXTR	1,207
YOSE	YOSE01-150	273941	4180414	LOW	1,419	EXTR	1,216
YOSE	YOSE01-153	267770	4156173	LOW	1,419	EXTR	1,320
YOSE	YOSE01-166	275291	4180779	LOW	1,419	EXTR	1,254
YOSE	YOSE01-177	256177	4178090	LOW	1,419	EXTR	1,458
YOSE	YOSE01-178	273000	4179732	LOW	1,419	EXTR	1,215
YOSE	YOSE01-098	275739	4176313	MID	3,359	EXTR	2,066
YOSE	YOSE01-101	264497	4171523	MID	3,359	EXTR	2,216
YOSE	YOSE01-104	270304	4219265	MID	3,359	EXTR	2,705
YOSE	YOSE01-111	266056	4224050	MID	3,359	EXTR	2,651
YOSE	YOSE01-116	284553	4195669	MID	3,359	EXTR	2,533
YOSE	YOSE01-117	262535	4180388	MID	3,359	EXTR	1,967
YOSE	YOSE01-118	269802	4188536	MID	3,359	EXTR	2,260
YOSE	YOSE01-121	270705	4168795	MID	3,359	EXTR	2,160
YOSE	YOSE01-122	283245	4184708	MID	3,359	EXTR	2,718
YOSE	YOSE01-123	263839	4195379	MID	3,359	EXTR	2,160
YOSE	YOSE01-127	273293	4192347	MID	3,359	EXTR	2,288
YOSE	YOSE01-132	270753	4205101	MID	3,359	EXTR	2,598
YOSE	YOSE01-138	276104	4186893	MID	3,359	EXTR	2,431
YOSE	YOSE01-142	283150	4190210	MID	3,359	EXTR	2,516
YOSE	YOSE01-143	260037	4210220	MID	3,359	EXTR	2,025

Table A – 2. Sampling point locations at Yosemite National Park (YOSE), along with stratum and panel membership (continued).

Park	Site ID[1]	Easting (NAD 27)	Northing (NAD 27)	Stratum	No. Points in Sample Frame	Panel[2]	Elev. (m)
YOSE	YOSE01-145	260635	4169582	MID	3,359	EXTR	1,907
YOSE	YOSE01-149	256527	4191033	MID	3,359	EXTR	1,893
YOSE	YOSE01-151	299492	4188787	MID	3,359	EXTR	2,709
YOSE	YOSE01-154	284710	4180891	MID	3,359	EXTR	2,333
YOSE	YOSE01-155	249266	4211533	MID	3,359	EXTR	1,907
YOSE	YOSE01-156	290386	4194142	MID	3,359	EXTR	2,618
YOSE	YOSE01-159	264115	4207260	MID	3,359	EXTR	2,110
YOSE	YOSE01-160	293293	4210582	MID	3,359	EXTR	2,681
YOSE	YOSE01-161	262240	4169418	MID	3,359	EXTR	1,873
YOSE	YOSE01-162	273017	4178714	MID	3,359	EXTR	2,149
YOSE	YOSE01-165	265059	4176233	MID	3,359	EXTR	2,051
YOSE	YOSE01-167	255433	4193165	MID	3,359	EXTR	2,115
YOSE	YOSE01-168	273398	4214597	MID	3,359	EXTR	2,652
YOSE	YOSE01-169	269174	4165837	MID	3,359	EXTR	2,231
YOSE	YOSE01-170	281968	4188628	MID	3,359	EXTR	2,508
YOSE	YOSE01-171	254135	4208451	MID	3,359	EXTR	1,990
YOSE	YOSE01-173	268387	4172516	MID	3,359	EXTR	2,131
YOSE	YOSE01-175	268054	4194803	MID	3,359	EXTR	2,401
YOSE	YOSE01-180	283640	4200691	MID	3,359	EXTR	1,946

[1]Site ID indicates the order in which points were drawn (i.e., generated) in the GRTS sampling process.

[2]The annually-sampled panel is indicated by ‘ANN1’. The four alternating panels are indicated by ‘ALT2’, ‘ALT3’, ‘ALT4’, and ‘ALT5’. ‘EXTR’ indicates points that have not been allocated to a panel, but are available for inclusion in the sample design if substitutions or additions are required due to safety or other factors.

Table A – 3. Sampling point locations at Devils Postpile National Monument (DEPO). Points comprise a nearly systematic, 250-m grid covering the entire Monument. See Landbird Monitoring Protocol narrative (Chapter 2) for details.

Point Count Station	Easting (NAD 27)	Northing (NAD 27)
DEPO-01	315662	4166834
DEPO-02	315662	4166584
DEPO-03	315662	4166334
DEPO-04	315662	4166084
DEPO-05	315662	4165834
DEPO-06	315662	4165584
DEPO-07	315662	4165334
DEPO-08	315662	4165084
DEPO-09	315662	4164834
DEPO-10	315662	4164584
DEPO-11	315662	4164334
DEPO-12	315662	4164084
DEPO-13	315662	4163834
DEPO-14	315662	4163584
DEPO-15	315662	4163334
DEPO-16	315662	4163084
DEPO-17	315912	4166834
DEPO-18	315912	4166584
DEPO-19	315912	4166334
DEPO-20	315912	4166084
DEPO-21	315912	4165834
DEPO-22	315912	4165584
DEPO-23	315912	4165334
DEPO-24	315912	4165084
DEPO-25	315912	4164834
DEPO-26	315912	4164584
DEPO-27	315912	4164334
DEPO-28	315912	4164084
DEPO-29	315912	4163834
DEPO-30	315912	4163584
DEPO-31	315912	4163084
DEPO-32	316162	4166834
DEPO-33	316162	4166497
DEPO-34	316162	4166334
DEPO-35	316162	4166084
DEPO-36	316162	4165834
DEPO-37	316162	4165584
DEPO-38	316183	4164981
DEPO-39	316216	4164793
DEPO-40	316183	4164551
DEPO-41	316177	4164303
DEPO-42	316082	4162934

Appendix B: Yearly Project Task List and Schedule

This Appendix provides a table giving a detailed overview of the annual protocol tasks at each stage of the project and notes who is responsible and the time schedule.

Revision History Log:

Revision Date	Author	Changes Made	Reason for Change

Table B-1. This table identifies each task by project stage, indicates who is responsible, and establishes the timing for its execution (adapted from Siegel et al. 2007). Protocol sections and SOPs are referred to as appropriate.

Project Stage	Task Description	Responsibility	Timing
Preparation	Initiate announcements for seasonal technician positions, begin hiring.	Project Lead	Nov–Jan
Per Sections 3.1–3.4	Notify Data Manager and Data Technician of needs for the coming season (maps, GPS support, training).	Project Lead	By Dec 1
4.2 & SOPs 1–3, 12	Meet (or conference call) to recap past field season, discuss the upcoming field season, and document any needed changes to SOPs or database.	Project Lead, NPS Facilitator, Park Biologists, Data Manager	January
	Ensure all project compliance needs are completed for the coming season.	Park Biologists	February
	Provide names of field crew to NPS Facilitator.	Project Lead	By Mar 15
	Plan schedule and logistics, including ordering any needed equipment and supplies.	Project Lead, NPS Data Technician	By Mar 31
	Generate field navigation reports, roster of sample points, and coordinates from the database.	Project Lead	By Mar 31
	Prepare and print field maps.	Project Lead	By April 15
	Update and load data dictionary, background maps, and target coordinates into GPS units.	Data Technician or Project Lead	By April 15
	Ensure that project work space is ready for use and GPS download software is loaded at each park.	Data Manager, Data Technician	By April 30
	Implement working database copy;	Data Manager	By May 1
	Initiate computer access and key requests, if needed.	NPS Facilitator	By May 1
	Provide field crew email addresses and user logins to Data Manager – unless crew does not need NPS computer access.	NPS IT Specialists	May
	Provide database/GPS training as needed.	Data Manager and Data Technician	May
	Train field crew in bird identification, distance estimation, sampling protocols, vegetation alliance identification, and safety;	Field Lead, NPS Facilitator, Park Biologists	May
	Examination and certification of field observer qualifications, enter training results into database.	Field Lead	May
Data Acquisition	Notify Project Lead and NPS Facilitator of tour itinerary.	Technicians	Before each tour
Per Sections 3.4 & SOPs 4–10	Collect field observations and position data during field trips.	Technicians	May–July
	Review data forms after each day.	Technicians	Daily
	Check in with NPS contact (Park Wilderness offices, Dispatch, or I&M staff).	Technicians	After each tour
	De-brief crew on operations, field methods, gear	Field Lead	After each tour

Table B-1. This table identifies each task by project stage, indicates who is responsible, and establishes the timing for its execution (continued).

Project Stage	Task Description	Responsibility	Timing
	needs.		
Data Entry and Processing Per Section 4.4 & SOPs 8, 14, 16	Download GPS data and email files to Data Technician for correction.	Technicians	After each tour
	Enter data into working copy of the database.	Technicians	After each tour
	Verify accurate transcription as data are entered.	Technicians	After each tour
	Correct GPS data and send screen capture to Field Lead and Project Lead for review.	Data Technician	After each tour
	Periodic review of GPS location data and database entries for completeness and accuracy.	Field Lead	Bi-weekly
	Merge, correct, and export GPS data. Upload processed and verified coordinates to database.	Data Technician	August
Product Development Per SOP 11	Complete field season report.	Field Lead	July–August
Quality Review Per Section 4.4 & SOP 16	Quality review and data validation using database tools.	Project Lead	Aug–Oct
	Prepare coordinate summaries and/or GIS layers and data sets as needed for spatial data review.	Data Technician	By Sept 30
	Joint quality review of GIS data, determine best coordinates for subsequent mapping and field work.	Project Lead and Data Technician	Sept–Oct
Metadata Per Section 4.5.3 & SOP 15	Update project metadata records.	Project Lead and Data Technician	Aug–Oct
Data Certification and Delivery Per Sections 4.4–4.5 & SOPs 16, 18	Certify the season's data and complete the certification report.	Project Lead	Nov
	Deliver certification report, certified data, and updated metadata to Data Manager.	Project Lead	By Nov 30
	Upload certified data into master project database, store data files on SIEN network drive.	Data Manager	Dec–Jan
	Notify Project Lead of uploaded data ready for analysis and reporting.	Data Manager	By Jan 15
	Update project GIS data sets, layers and associated metadata records.	Data Technician	Dec–Jan
	Finalize and parse metadata records, store on SIEN network drive.	Data Manager and Data Technician	By Mar 15
Data Analysis for trends – Done every 4 years	Conduct trend analysis of bird densities using BirdTrend software, as described in SOP 16.	Project Lead	Feb–Mar

Table B-1. This table identifies each task by project stage, indicates who is responsible, and establishes the timing for its execution (continued).

Project Stage	Task Description	Responsibility	Timing
Reporting & Product Development Per Sections 4.6–4.7 & SOP 17	Export automated summary queries and reports from database.	Project Lead	Feb–Mar
	Produce park-wide and transect-specific map output for archives.	Project Lead with Data Technician	Jan–Mar
	Generate report-quality map output for reports.	Data Technician	Feb–Mar
	Create annual report using Data Series template from Natural Resource Publications website.	Project Lead	Feb–Apr
	Prepare draft report and distribute to NPS Park Biologists for preliminary review.	Project Lead	By Apr 1
Product Delivery Per Section 4.9 & SOP 18	Submit draft I&M report to Network Program Manager for review.	Project Lead	By Apr 30
	Review report for formatting and completeness, notify Project Lead of approval or need for changes.	Network Program Manager	May
	Upload completed report to SIEN network drive folder to appropriate location.	Network Program Manager	Upon approval
	Deliver other products according to the delivery schedule and specifications in SOP 17.	Project Lead	Upon completion
	Review products and place appropriately in network file structure.	Data Manager	Upon receipt
Posting & Distribution	Submit metadata to NPS Data Store.	Data Manager	By Mar 15
	Create NatureBib record, post reports to NPS website.	Data Manager	Upon receipt
	Update NPSpecies records according to data observations.	Data Manager	Dec–Mar
Archival & Records Management Per Section 4.9 & SOP 12	Store finished products on SIEN network drive.	Data Manager	Upon receipt
	Review, clean up and store/and/or dispose of project files according to NPS Director's Order 19.	Project Lead and NPS Facilitator	Jan
Season Close-out Per Section 4.10 & SOPs 12, 17, 19	Inventory equipment and supplies.	Field Lead	By Aug
	Conference call to discuss recent field season (close out), discuss who needs to do what to get data ready for analysis.	Project Lead, Data Manager, Data Technician, I&M Program Manager	By Oct 15
	Discuss and document needed changes to analysis and reporting procedures.	Project Lead, Data Manager, I&M Facilitator	By Apr 30

References Cited

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

Appendix C: Administrative Record of Protocol

This appendix provides two tables that give an overview of the information sources and key steps that supported protocol development. It also includes the Protocol Development Summary.

Revision History Log:

Revision Date	Author	Changes Made	Reason for Change

Table C-1. Important information sources that informed the Sierra Nevada Network bird protocol development.

Date(s)	Information Source
Sierra Nevada Bird Inventories	
1998–2000	Yosemite Bird Inventory (Siegel et al. 2002)
2003–2004	Sequoia and Kings Canyon Bird Inventory (Siegel and Wilkerson 2005)
2003–2004	Devils Postpile Bird Inventory (Siegel and Wilkerson 2004)
1911–2006	A re-survey of the historic Grinnell-Storer vertebrate transects in Yosemite (Moritz et al. 2010)
Sierra Nevada Monitoring Avian Productivity and Survivorship (MAPS)	
1990–2009	Yosemite MAPS (many annual reports, only a few cited here: DeSante et al. 2004, DeSante et al. 2005, Pyle et al. 2006, Siegel et al. 2007a)
1991–1993; 2001–2009	Kings Canyon MAPS (DeSante et al. 2005, Siegel et al. 2007a)
2002–2009	Devils Postpile MAPS (Gates and Heath 2003, Heath 2004, 2005, 2007; DeSante et al. 2005)
Broader Regional Bird Information	
1992	Birds of Yosemite and the East Slope (Gaines 1992)
1995	Status, distribution, abundance, population trends, demographics, and risks of Sierra Nevada landbirds (DeSante 1995)
2007	Landbird monitoring results from Sierra Nevada MAPS programs (Siegel and Kaschube 2007)
1966–2005	Bird centers of abundance and climate change (National Audubon Society 2009)
1996	Status of terrestrial vertebrates (Graber-SNEP report 1996)
1911–2008	Climatic niche tracking in Sierra Nevada bird species (Tingley et al. 2009)
1999	Avian conservation plan for the Sierra Nevada bioregion (Siegel and DeSante 1999)
2008	Sensitive species and extirpations – Willow Flycatcher (Siegel et al. 2008)
Network Vital Signs Prioritization and Selection Process, Programmatic Context	
2004–2008	Sierra Nevada Network vital signs monitoring plan (Mutch et al. 2008)
National I&M Program Guidance and Protocols from Other Networks	
1997, 2000	Methods for monitoring bird densities (Fancy 1997, Fancy and Sauer 2000)
2003	Guidelines for long-term monitoring protocols (Oakley et al. 2003)
2000, 2007	Landbird monitoring protocol for North Coast and Cascades Network (Siegel and Kunz, II, 2000, Siegel et al. 2007c)
Sampling Design Alternatives	
2005	Sampling designs for avian monitoring alternatives in Sierra Nevada Network parks (Siegel and Wilkerson 2005b)

Table C-2. Timeline of key protocol development events.

Date	Event
July 2004	**A task agreement** was established (through an existing Yosemite cooperative agreement) with IBP called "A sample design for avian monitoring alternatives in Sierra Nevada Network Parks" for $21,853. The purpose was to evaluate these four bird monitoring alternatives: • Monitor 'landscape level' avian population trends. • Monitor avian population trends in montane meadows. • Monitor avian population trends in high-elevation (subalpine and alpine) habitats. • Monitor avian population trends in low-elevation (foothill) habitats.
Oct 6, 2004	**Meeting:** SIEN work group and staff from IBP– purpose of meeting was to discuss sampling design alternatives for monitoring birds at SIEN parks to get local feedback for IBP to help guide their work for the above task agreement. Notes located on SEKI network drive: J:\sien\I_M\monitoring\birds\administration\meeting_notes\2004
May 5, 2005	**Final report** received *Sample Designs for Avian Monitoring Alternatives in Sierra Nevada Network Parks* (Siegel and Wilkerson 2005b)
Jan 18, 2006	**Meeting:** SIEN bird work– discussed Siegel and Wilkerson report and began to formulate monitoring questions and objectives. Notes located on SEKI network drive: J:\sien\I_M\monitoring\birds\administration\meeting_notes\2006
Mar–Apr 2006	**Review:** NCCN Landbird Monitoring Protocol
May–Jun 2006	**First draft of Protocol Development Summary** developed, reviewed and revised by Meryl Rose and work group
July 2006	**Contract** initiated with The Institute for Bird Populations to adapt NCCN protocol for SIEN's bird monitoring program, due to overlap in objectives and design needs: $24,806
Dec 5, 2006	**Meeting:** The SIEN Board of Directors determined that the SIEN I&M program needed to focus its limited resources on fewer vital signs. They voted on the network's planned protocols and the bird protocol ranked as a lower priority for implementation relative to most of the other protocols. The decision was to complete protocol development (which was already under contract), but to then shelve the protocol until the time when more resources might be available. Notes can be found on the SEKI network drive: J:\sien\I_M\admin\meetings\network\board_of_directors\fy2007\20061205
Feb 7, 2007	**Meeting:** SIEN work group and IBP staff met to discuss protocol development, the implications of the Board's decision, and the need to reduce the scope of the protocol. They made a decision to omit MAPS from the protocol at this time and focus the protocol exclusively on a spatially extensive design, using point count transects. Notes can be found on the SEKI network drive: J:\sien\I_M\monitoring\birds\administration\meeting_notes\2007
Fall 2007	**Protocol Development Summary** updated and is included in Appendix D.
Jan–Mar 2008	**Bird protocol and SOPs finalized** by Siegel, Wilkerson, and Rose and submitted to the PWR peer review process in March 2008.
June 2008	**Protocol peer reviews** received from Dr. Jim Agee of University of Washington – the protocol was evaluated as "Acceptable with Minor Revision".
Oct 2008	SIEN's Ecologist Meryl Rose moved out of state and her term position ended. Delay in re-filling her position and the unfunded status of this protocol delayed revisions.
2009–2010	**Protocol revisions completed** by R. Siegel, Shawn McKinney, and Linda Mutch and protocol re-submitted to J. Agee March 2010.

References Cited

DeSante, D. F. 1995. The status, distribution, abundance, population trends, demographics, and risks of the landbird avifauna of the Sierra Nevada mountains. The Institute for Bird Populations, Pt. Reyes Station, California.

DeSante, D. F., P. Pyle, and D. R. Kaschube. 2004. The 2003 annual report of the Monitoring Avian Productivity and Survivorship (MAPS) Program in Yosemite National Park. The Institute for Bird Populations, Pt. Reyes Station, California.

DeSante, D. F., P. Pyle, and D. R. Kaschube. 2005. The Monitoring Avian Productivity and Survivorship (MAPS) Program in Sequoia and Kings Canyon and Yosemite National Parks and Devils Postpile National Monument: a comparison between time periods and locations. The Institute for Bird Populations, Pt. Reyes Station, California.

Fancy, S. G. 1997. A new approach for analyzing bird densities from variable circular-plot counts. Pacific Science 51:107–114.

Fancy, S. G. and J. R. Sauer. 2000. Recommended methods for inventorying and monitoring landbirds in the National Parks. Retrieved January 25, 2007, from: http://science.nature.nps.gov/im/monitor/protocols/npsbird.doc

Gaines, D. 1992. Birds of Yosemite and the east slope. Artemisia Press, Lee Vining, California.

Gates, H. R. and S. K. Heath. 2003. Bird monitoring, habitat assessment and visitor education in montane meadow and riparian habitats of Devils Postpile National Monument: results from the 2002 and 2003 field season. PRBO Conservation Science, Stinson Beach, California.

Graber, D. M. 1996. Status of terrestrial vertebrates. Pages 709–734 *In:* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options. University of California, Centers for Water and Wildland Resources, Davis, California.

Heath, S.K. 2004. Bird monitoring in montane meadow and riparian habitats of Devils Postpile National Monument: Final report 2002–2004. Contribution #1237 of the Point Reyes Bird Observatory, Stinson Beach, California.

Heath, S.K. 2005. Bird monitoring and education at Devils Postpile National Monument. Contribution #1304 of the Point Reyes Bird Observatory, Stinson Beach, California.

Heath, S.K. 2007. Avian demography monitoring and visitor education at Devils Postpile National Monument, 2002–2006. Contribution #1552 of the Point Reyes Bird Observatory, Petaluma, California.

Moritz, C., J.L. Patton, C.J. Conroy, A. Leache, A. Rush, and S.J. Beissinger. 2010. A re-survey of the historic Grinnell-Storer vertebrate transects through Yosemite National Park. Report submitted to Sierra Nevada Network and Yosemite National Park.

Mutch, L.S., M. Goldin Rose, A.M. Heard, R.R. Cook, and G.L. Entsminger. 2008. Sierra Nevada Network vital signs monitoring plan. Natural Resources Report NPS/SIEN/NRR—2008/072. National Park Service, Fort Collins, Colorado.

National Audubon Society. 2009. Birds and climate change – ecological disruption in motion. A briefing for policymakers and concerned citizens. National Audubon Society, Inc., New York, NY 10014. Available at: http://birdsandclimate.audubon.org/ (accessed 26 February 2010).

North American Bird Conservation Initiative, U.S. Committee, 2009. The State of the Birds, United States of America, 2009. U.S. Department of Interior: Washington, DC. 36 pages.

Oakley, K. L., L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. Wildlife Society Bulletin 31:1000–1003.

Pyle, P., D.R. Kaschube, R.B. Siegel, and D.F. DeSante. 2006. The 2005 Annual Report of the Monitoring Avian Productivity and Survivorship (MAPS) program in Yosemite National Park, The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B. and D. F. DeSante. 1999. Draft avian conservation plan for the Sierra Nevada Bioregion: a report to California Partners in Flight. The Institute for Bird Populations, Pt. Reyes Station, California.

Siegel, R. B. and D. F. DeSante. 2002. Avian inventory of Yosemite National Park (1998–2000). The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B. and D. R. Kaschube. 2007. Landbird monitoring results from the Monitoring Avian Productivity and Survivorship (MAPS) Program in the Sierra Nevada. Contribution No. 300 of The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B. and R. C. Kuntz, II. 2000. Designing a landbird monitoring program at North Cascades National Park Service Complex: summary recommendations from a September 2000 workshop. USDI Technical Report NPS/NRNOCA/NRTR/00-04.

Siegel, R. S., P. Pyle, D. F. DeSante, and D. R. Kaschube. 2007a. The Monitoring Avian Productivity and Survivorship (MAPS) Program in Sequoia and Kings Canyon National Park: a summary of the 2006 field season, an assessment of recent trends, and a comparison with results from the MAPS Program in Yosemite National Park. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. S., P. Pyle, D. F. DeSante, and D. R. Kaschube. 2007b. The 2006 annual report of the Monitoring Avian Survivorship and Productivity (MAPS) Program in Yosemite National Park. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B. and R. L. Wilkerson. 2004. Landbird inventory for Devils Postpile National Monument. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B. and R. L. Wilkerson. 2005a. Landbird inventory for Sequoia and Kings Canyon National Parks (2003–2004). The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B. and R. L. Wilkerson. 2005b. Sample designs for avian monitoring alternatives in Sierra Nevada Network parks. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., R. L. Wilkerson, and D. F. DeSante. 2008. Extirpation of the Willow Flycatcher from Yosemite National Park. Western Birds **39**:8–21.

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007c. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6.

Tingley, M. W., W. B. Monahan, S. R. Beisinger, and C. Moritz. 2009. Birds track their Grinnellian niche through a century of climate change. Proceedings of the National Academy of Sciences (USA) 106, suppl. 2:19637–19643.

Appendix D: Protocol Development Summary

This Appendix gives an overview of the justification for monitoring birds and the protocol development approach.

Revision History Log:

Revision Date	Author	Changes Made	Reason for Change

Protocol Development Summary

Parks Where Protocol Will be Implemented (when or if funds are available)

Devils Postpile National Monument (DEPO)
Sequoia and Kings Canyon National Parks (SEKI)
Yosemite National Park (YOSE)

Vital Signs Addressed by Protocol

Birds

Justification

Increasingly, birds are seen as appropriate indicator species of local and regional change in terrestrial ecosystems. The Sierra Nevada Network parks—Sequoia and Kings Canyon National Parks (SEKI), Yosemite National Park (YOSE), and Devils Postpile National Monument (DEPO)—together provide over 1,600,000 acres of habitat for over 200 species of birds, including many neotropical migrants. Critical breeding, stopover, and wintering grounds occur from lands adjacent to the parks and monument to land as far south as Patagonia. SEKI, YOSE, and a few other large habitat areas in the Sierra Nevada have been designated by the American Bird Conservancy as Globally Important Bird Areas (IBA). Analysis of North American Breeding Bird Survey data indicates that numerous bird species exhibit declining long-term population trends in the Sierra Nevada region.

Bird Monitoring is the only SIEN vital sign that would monitor multiple species across the entire elevational gradient.

Background Information

Researchers have identified eight potential Sierra-wide risks faced by Sierra Nevada birds: livestock grazing, logging, fire suppression, exurban development, increased recreational use, pesticide use, habitat destruction and degradation on wintering grounds, and large-scale climate change (DeSante 1995; Graber 1996). Data from the MAPS (Monitoring Avian Productivity and Survivorship) program suggest that populations of numerous species are declining in Yosemite, and that the majority of those declines appear to be tied to low productivity (presumably resulting from factors occurring in the park where breeding habitat is found), rather than low survival on wintering grounds (DeSante et al. 2005). Birds generally occupy a high position on the food web, and they provide important ecological functions such as seed dispersal and insect predation, making them good indicators of change in ecosystems.

Because of their high body temperature, rapid metabolism, and high ecological position on most food webs, birds are excellent indicators of the effects of local, regional, and global environmental change on terrestrial ecosystems. Furthermore, their abundance and diversity in virtually all terrestrial habitats, diurnal nature, discrete reproductive seasonality, and intermediate longevity facilitate the monitoring of their population and demographic parameters (DeSante et al. 2005).

Bird populations provide an attractive vital sign and provide the opportunity for detailed evaluation of network ecosystem condition because birds (1) occupy a wide diversity of ecological niches in the parks and (2) are conspicuous and easily observable.

In addition, (1) knowledge of the natural history of many bird species has a rich basis in literature, (2) all units in SIEN have a strong foundation of inventory data upon which to build future monitoring efforts, and (3) monitoring of avian productivity and survivorship has occurred at all parks for varying numbers of years and time periods. Monitoring Avian Productivity and Survivorship (MAPS) programs have been operating in Sierra Nevada Parks for many years, and at one station in Yosemite for 17 years.

Forest birds throughout the Sierra Nevada face numerous potential stressors and changes, including pollution and pesticide up-drift from the Central Valley, increasing exurban development (Duane 1999) with its concomitant increases in land conversion, habitat fragmentation, facilitation of Brown-headed Cowbird parasitism, and long-term shifts in habitat composition and structure resulting from fire exclusion (Helj 1994; Chang 1996; Gruell 2001), projected climate change (Lenihan et al. 2003; Hayhoe, Cayan et al. 2004), and recent decisions by the USDA Forest Service to increase timber harvest and forest thinning efforts to reduce fuels.

Specific Monitoring Questions and Objectives

Monitoring Objectives

Our bird monitoring protocol addresses three of eleven broad monitoring objectives developed for the Network's long-term monitoring program:

1. Document rates and types of change in animal communities in response to changes in landscape characteristics, biotic interactions, and human use
2. Understand the ecological relationships between terrestrial landscape elements and animal distributions
3. Monitor trends in the distribution and abundance of focal species

Monitoring Questions

The Sierra Nevada Network Bird Workgroup established broad monitoring questions at its first meeting in FY2006. However, after continued investigation of other Network approaches and experiences (discussed below, Protocol Development & Status), the workgroup realizes that Network-wide and park-level inference may not be feasible because the parks are so large—their size presents logistical issues and financial challenges associated with sampling remote locations (excepting Devils Postpile). Further, because of the topographic complexity of our parks, it may be necessary and efficient to focus on specific bird habitats (e.g., foothill oak woodland, subalpine meadow, white fir forest, riparian) or species thought most affected by the stressors affecting Network parks. Monitoring questions were refined during early 2007, as follows:

1. Detect trends in the density of those landbird species monitored well by point counts, throughout accessible areas of SIEN parks during the breeding season
2. Track changes in breeding-season distribution of landbird species throughout accessible areas of SIEN parks

Potential Measures
Density, relative abundance, diversity as a function of habitat type, and, possibly, productivity & survivorship, in limited locations.

Basic Approach
In FY2004–2005, before a formal Bird Workgroup was established, the Sierra Nevada Network contracted with The Institute for Bird Populations (IBP) to make general recommendations for avian monitoring sample design alternatives for monitoring (1) trends at the landscape level, and (2) trends in subalpine meadows (Siegel and Wilkerson 2005). Data from avian inventories, Monitoring Productivity and Survivorship (MAPS), and Breeding Bird Surveys were used to provide a preliminary assessment of power to detect population trends using a landscape-level monitoring program, and an assessment using meadow monitoring. In addition, Breeding Bird Survey data were used to assess which habitats are under-sampled by existing Sierra Nevada-wide bird monitoring efforts. Preliminary implementation budgets were also provided.

In FY2006, the network established a formal Bird Workgroup (comprising park and network staff) to establish broad avian monitoring objectives. In addition, a contract was established with IBP to facilitate decision-making and develop SIEN's bird monitoring protocol. In January 2007, the workgroup met (with IBP and several additional outside experts with experience monitoring birds in the Sierra) to refine monitoring objectives, devise an approach to protocol development, and–in light of the previous two decisions–determine feasibility and value of continuing the collection MAPS data.

Protocol Development & Status
The Institute for Bird Populations will apply its extensive experience developing and refining a bird monitoring protocol for the North Coast Cascades Network (NCCN) (Siegel et al. 2007).

Tentative Sampling Methods & Design
The SIEN bird monitoring protocol will follow that of NCCN, and will therefore consist of Variable Circular Plot (VCP) methodology at points along transects (spatial) at the three large park units of SIEN, including an array or riparian design at DEPO. Numerous discussions of the costs and benefits of different types of bird monitoring programs (e.g., MAPS versus VCP), conducted elsewhere, was again recapped at this meeting (in addition to discussions over the past several years), and the group feels confident that the above-method will best achieve SIENs monitoring objectives. Reasoning: the current predicted 70% change in snowpack will cause significant change in habitats, which argues for a spatial design (i.e., VCP).

The Bird Workgroup decided to include an explicit statement in the monitoring protocol to include MAPS monitoring—as an important component of a comprehensive SIEN bird monitoring protocol—while noting (and understanding) that it is currently an unfunded part of bird monitoring in SIEN. Members of the Bird Workgroup are committed to finding additional funding to continue the MAPS program in SIEN.

NCCN and Terrastat Consulting performed power analyses and found the following: 4% per annual change in a park is detectable after 15–20 yrs for 20+ species. IBP is confident that SIEN data would meet or exceed this power. Because of this, the Bird Workgroup decided that power analyses of our current data (inventory) are unnecessary; instead, power analysis of the data would be conducted after five years of SIEN data (monitoring) had been collected.

Principal Investigator, NPS Lead, Workgroup Members, and Collaborators

NPS Lead
Meryl Rose, Ecologist
Sierra Nevada Network
meryl_rose@nps.gov

Workgroup Members
Sara Stock, Wildlife Biologist
Yosemite National Park

Steve Thompson, Branch Chief, Wildlife Biology
Yosemite National Park

Rachel Mazur, Wildlife Biologist
Sequoia and Kings Canyon National Parks

Harold Werner, Wildlife Ecologist
Sequoia and Kings Canyon National Parks

Collaborators
Dr. Rodney Siegel (PI, Protocol Development)
Institute for Bird Populations
Pt Reyes Station, CA 94956
rsiegel@birdpop.org

Bob Wilkerson
Institute for Bird Populations

Leigh Ann Harrod, Statistician
University of Idaho

Tom Gardali
PRBO Conservation Science

Schedule (protocol development)

April 2006	Define broad bird monitoring objectives
July 2006	Establish contract with Institute for Bird Populations (IBP)
Winter 2006–2007	IBP facilitates workgroup refinement of monitoring and sampling objectives
April 2007	Database development (review/modify NCCN for SIEN)
April 2007	IBP begins drafting of Bird Monitoring Protocol

June 2007	Draft sample design complete
September 2007	Draft protocol complete (for YOSE & SEKI)
September 2007	Meet with PI to discuss sample design for DEPO
January 2008	Final protocol to peer review

Budget*

$24,800	Contract with IBP (Tasks 1–4, above)
$15,500	*In-kind* Park Staff Time

****No additional funds for protocol testing or implementation are available, at the current time (Spring 2007).***

Literature Cited

Chang, C. 1996. Ecosystem response to fire and variations in fire regimes. Pages 1071–1100 in Sierra Nevada Ecosystem Project, final report to Congress, Vol. II: assessments and scientific basis for management options. Wildland Resources Center Report No. 37, Univ. of California, Davis.

DeSante, D. F., P. Pyle and D. R. Kaschube. 2005. The Monitoring Avian Productivity and Survivorship (MAPS) program in Sequoia and Kings Canyon and Yosemite National Parks and Devils Postpile National Monument: A comparison between time periods and locations. The Institute for Bird Populations, Pt. Reyes Station, California.

Duane, T.P. 1999. Shaping the Sierra: Nature, Culture and Conflict in the Changing West. University of California, Berkeley.

Graber, D. M. 1996. Status of terrestrial vertebrates. Pages 709–734 *in:* Sierra Nevada Ecosystem Project: Final Report to Congress. Vol. II, Assessments and Scientific Basis for Management Options. University of California, Centers for Water and Wildland Resources, Davis, CA.

Gruell, G. E. 2001. Fire in Sierra Nevada forests: A photographic interpretation of ecological change since 1849. Mountain Press, Missoula, Montana.

Heath, S. K. 2004. Bird monitoring in montane meadow and riparian habitats of Devils Postpile National Monument: Final report 2002–2004.

Hejl, S. J. 1994. Human induced changes in bird populations in coniferous forests in western North America during the past 100 years. Studies in Avian Biology 15: 232–246.

Institute for Bird Populations**.** 1990–2004. Annual Reports of the Monitoring Avian Productivity and Survivorship (MAPS) Program in Yosemite National Park**.**

Lenihan, J.M., R. Drapek, D. Bachelet, and R.P. Neilson. 2003. Climate change effects on vegetation distribution, carbon, and fire in California. Ecological Applications 13: 1667–1681.

Siegel, R.B. and D.F. DeSante. 2002 Establishing a southern Sierra meadows Important Bird Area: Results from meadow surveys at Stanislaus, Sierra, and Sequoia National Forests, and Yosemite and Sequoia/Kings Canyon National Parks; Appendix One *in* Avian Inventory of Yosemite National Park (1998–2000).

Siegel, R.B., and D.F. DeSante. 2002 . A bird inventory of Yosemite National Park. The Institute for Bird Populations, Pt. Reyes Station, California.

Siegel, R.B. and R.L. Wilkerson. 2005. Sample designs for avian monitoring alternatives in Sierra Nevada Network Parks. The Institute for Bird Populations, Pt. Reyes Station CA.

Siegel, R.B. and R.L. Wilkerson. 2004. Landbird inventory for Devils Postpile National Monument. The Institute for Bird Populations, Pt. Reyes Station, California.

Siegel, R.B. and R.L. Wilkerson. 2005. Landbird inventory for Sequoia and Kings Canyon National Parks (2003–2004). The Institute for Bird Populations, Pt. Reyes Station, California.

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

Sierra Nevada Network Bird Monitoring Protocol

Standard Operating Procedures

Page

SOP 01: Preparing for the Field Season 1.1

SOP 02: Safety...2.1

SOP 03: Field Tour Preparation..3.1

SOP 04: Training Observers...4.1

SOP 05: Conducting Point Counts..5.1

SOP 06: Classifying Vegetation 6.1

SOP 07: Collecting GPS Data...7.1

SOP 08: Establishing, Relocating, and Describing Survey Points 8.1

SOP 09: Reporting Rare Bird Detections 9.1

SOP 10: Special Considerations for Devils Postpile National Monument 10.1

SOP 11: After the Field Season 11.1

SOP 12: Workspace Setup and Project Records Management......................................12.1

SOP 13: Data Entry and Verification..13.1

SOP 14: Metadata Development..14.1

SOP 15: Data Quality Review, Validation, and Certification 15.1

SOP 16: Data Analysis and Reporting...16.1

SOP 17: Project Delivery Specifications 17.1

SOP 18: Revising the Protocol 18.1

SOP 19: Sensitive Information 19.1

Standard Operating Procedure (SOP) 01: Preparing for the Field Season

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction
This SOP identifies steps to taken in preparation for the field season.

Hiring the Field Crew

Hiring the Field Lead
If the Field Lead is to be a seasonal rather than year-round employee, then the Field Lead recruiting process should begin in late November or early December of the preceding year. Qualities to seek in potential Field Leads include the following:

- Proficiency at identifying western Sierra birds by sight and sound.
- Bird survey experience, preferably conducting point counts with distance estimation.
- Substantial backcountry orienteering and backpacking experience.
- High level of physical fitness.
- Familiarity with one or more of the SIEN parks.
- Familiarity with Sierra plant communities.
- Leadership experience.
- Strong organizational skills.
- Ability to get along well with others in a field crew setting.
- Knowledge of (or preferably, certification in) wilderness first aid.
- Possession of a reliable vehicle.

If at all possible, priority consideration should be given to previous years' Field Leads or Field Technicians, to maximize year-to-year consistency in field operations and methods. Once selected, the Field Lead, especially if new, should review all relevant sections of the protocol and discuss any questions with the Project Lead.

Hiring the Field Technicians
Recruitment of the rest of the field crew should begin by late December of the preceding year. As with hiring the Field Lead, initiating the recruitment process early is critical for ensuring that well-qualified candidates can be found. Although the Field Technicians do not need to have the same level of experience nor all of the required skills as the Field Lead, similar general qualities should be sought:

- Proficiency at identifying Sierra by sight and sound. If a full pre-season training session is planned (see SOP #4**: *Training Observers***) then this requirement may be relaxed *slightly*. Successful candidates should at least be nearly proficient at identifying Sierra birds by sight and sound, or be proficient at identifying birds of other regions by sight and sound and be able to demonstrate enthusiasm and ability to learn to identify new species.

- High level of physical fitness.

- Ability to get along well with others in a field crew setting.

- Bird survey experience, preferably conducting point counts with distance sampling. If a full training session is planned, this requirement can be eliminated. However, experience with some kind of formal data collection is still highly desirable.

- Backpacking experience and proficiency at backcountry orienteering. The orienteering requirement may be waived if it orienteering will be emphasized during training.

- Familiarity with Sierra plant communities (desirable but not required).

- Knowledge of (or preferably, certification in) wilderness first aid (desirable but not required)

- Possession of a reliable vehicle. Note that unless NPS vehicles are available for field work, at least half of the crew will need to provide personal vehicles.

While the first three of the above qualities should be considered mandatory, the others are desirable but not strictly required. As with selection of the Field Lead, priority consideration should be given to returning crew members, to maximize year-to-year consistency in field operations and methods.

Soon after being hired, Field Technicians should be sent the following:

- A written description of expectations, duties, and responsibilities, to be signed and returned.

- A list of all bird species likely to be encountered during the field season (see SOP #4**: *Training Observers***).

- Song recordings and other materials that will assist Field Technicians in improving their individual bird identification skills prior to the field season.

- A list of required and recommended personal equipment.

Organizing Supplies and Equipment

An equipment list should be compiled, and equipment organized and made ready for the field season several weeks in advance of the training session. This allows time to make needed repairs and order equipment. **Table SOP 1 – 1** provides a list of field equipment needs for each *pair* of crew members.

Table SOP 1 – 1. Field equipment list for each pair of crew members. Asterisks indicate items that crew members are required to supply for themselves.

Number Needed	Item
Survey Equipment	
2	Binoculars*
2	GPS units
2	Wristwatches*
2	Clipboards
many	Pens or pencils
4 rolls	Flagging
2	2-way radios
1	Park radio
2	Compasses
many	Aluminum tree tags
many	Nails
2	Lightweight hammers
General Backpacking Gear	
1	First aid kit
1	Tent*
2	Sleeping bags*
2	Sleeping pads*
1	Stove*
2	Mess kits*
2	Bear-proof food containers
1	Water filter
2	Backpacks*
2	Daypacks or other means of carrying gear during surveys*

In addition to the equipment specified above, crews need access to field guides to aid them in bird and plant identification. Recommended field guides and reference materials for bird surveys and associated vegetation assessments in the SIEN parks are listed below.

1. Beedy, E. C. and S. L. Granholm. 1985. Discovering Sierra birds. Yosemite Natural History Association and Sequoia Natural History Association.

2. Gaines, D. 1992. Birds of Yosemite and the east slope. Artemisia Press, Lee Vining, CA.

3. National Geographic. 1987. Field Guide to Birds of North America, 3rd Edition. National Geographic, Washington, D.C.

4. NatureServe. 2003. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono Counties, California. Modified for use in Sequoia and Kings Canyon National Parks (2004). Sacramento, CA.

5. Sibley, D. A. 2003. The Sibley field guide to birds of western North America. Alfred A. Knopf, New York.

6. Weeden, N. F. 1996. A. Sierra Nevada Flora. Wilderness Press, Berkeley.

Scheduling Field Work

Point counts surveys should begin no sooner than May 15 at YOSE and SEKI, and no sooner than 1 June at DEPO. Surveys conducted earlier than this will be compromised because many migratory birds will likely not yet be on their breeding territories. Surveys should be completed by July 21 at YOSE and SEKI, and by 15 June at DEPO. By sampling the Network's low-elevation sites first, then the mid-elevation sites, and finally the high-elevation sites, crews can ensure that sampling coincides with the peak of breeding activity for most species within each elevation zone. However, a limited amount of flexibility in scheduling is permissible; for example, it may be appropriate to sample the first high-elevation transect during the same backcountry trip in which the last mid-elevation transects are sampled, if this would result in saving substantial travel time, and snow cover at the site is minimal. As a general rule, survey locations should be nearly free of snow cover before they are surveyed. Unpredictable weather precludes the scheduling of sampling events to specific annual dates, as annually variable snowpack will affect the dates at which sites can be accessed.

Prior to the start of the field season, transect location maps and directions for all transects in the annual panel and the appropriate alternating panel in the large parks, along with field maps for DEPO, should be prepared by the Project Lead. The Project Lead and Field Lead should plan the optimal order to sample the necessary transects in each park, even though weather or other unpredictable events may require that the plan be revised during the field season. Knowledgeable park personnel should be consulted as to whether any bridges have been washed out, or especially heavy snowpack or other factors might alter the accessibility of any transects. To maximize efficiency, we recommend that field crews work a schedule of approximately seven days working, and then three days free. This will allow time for six seven-day 'tours', plus a few extra days, for each pair of workers.

Additional Miscellaneous Tasks to Complete before the Field Season

- If housing is to be provided for the field crew, housing needs to be arranged.

- Any necessary campground arrangements should be made in advance, if possible.

- The pre-season training session needs to be planned in detail, including preparing any teaching materials, scheduling the session to make sure all necessary topics are covered, coordinating with park personnel who may need to meet with the crew (this may include Park Biologists, Rangers, Data Managers, etc.) and arranging camping or lodging for the crew throughout the training session.

- An adequate number of data forms to fulfill training needs and provide for the first seven-day tour (at least) should be printed or copied. Additional data forms will need to be copied or printed throughout the field season, if they are not produced in advance.

Standard Operating Procedure (SOP) 02: Safety

Revision History Log

Revision Date	Author	Changes Made	Reason for Change
7/8/2010	L. Mutch	Replaced emergency contact form, added two additional JHGs, updated links.	Make safety SOP more complete and consistent with Park Resources Mgt. SOPs.

Appendixes

Page

Appendix SOP 2A. Emergency Contact Form (Office). .... SOP 2.9

Appendix SOP 2B. Local Contacts for Field Personnel .... SOP 2.10

Appendix SOP 2C. General Safety Equipment Checklist .... SOP 2.11

Appendix SOP 2D. Personal Protective Equipment Checklist... SOP 2.12

Appendix SOP 2E. Vehicle Checklist .... SOP 2.13

Appendix SOP 2F. SIEN Job Hazard Guideline: Driving Safety..................................... SOP 2.16

Appendix SOP 2G. SIEN Job Hazard Guideline: Wilderness Travel .... SOP 2.22

Appendix SOP 2H. SIEN Job Hazard Guideline: Environmental Hazards....................... SOP 2.25

Introduction

This SOP provides safety information, checklists and forms for the Sierra Nevada Network and contract personnel who are involved with field activities. This SOP is meant to be used in conjunction with more comprehensive manuals, regulations, and recommendations that apply to specific locales and field conditions. In an attempt to make this a readable document with practical field application, this document does not attempt to comprehensively cover every safety issue. This document is intended to engage all personnel and initiate a synergistic creative environment to address field safety identifies steps to taken in preparation for the field season. It was originally prepared by Donald W. Schweizer for the SIEN Lake Monitoring Protocol (October 2007). It was modified by Meryl Rose for use in SIEN Bird Monitoring Protocol (February 2008) and additional information was added by Linda Mutch in 2010 (updated emergency contact form to be consistent with SEKI Dispatch's form, added two additional Job Hazard Guidelines).

The Sierra Nevada Network complies with the NPSafe program and with local park safety programs. NPSafe is a National Park Service employee safety and health implementation plan (NPS 2004). NPSafe outlines the following beliefs, goals and objectives:

Beliefs

- Healthy productive employees are our most important resource, and employee safety is our most important value
- Injuries and occupational illnesses are unacceptable
- At risk behaviors can be eliminated
- Operating hazards and risks can be controlled
- Safety is everyone's responsibility
- Managing for safety excellence can enhance employee productivity, save millions of dollars in workers compensation costs, and improve overall management effectiveness.

Goals

- The NPS becomes the safest place to work in the Department of the Interior
- Safety is integrated into all NPS activities
- The NPS organizational culture values employee safety as much as it values protecting resources and serving visitors
- Employees, supervisors, and managers demonstrate unwavering commitment to continuous improvement in employee health and safety.

Objectives

- Managerial decisions and actions demonstrate a commitment and dedication to the health and safety of the employees of the Service.
- Employees, supervisors, and managers are knowledgeable of the NPS safety vision, are involved in the safety program, and demonstrate the competencies to get the job done safely.
- Every park and program unit has consistent and timely access to Safety and Industrial Hygiene resources/services.
- Every park and program unit implements a comprehensive and effective safety program per Director's Order 50-B.

- All non-NPS organizations performing work in parks must operate safety programs that meet all applicable standards and guidelines.
- NPS has no fatalities and its “lost time accident rate” and “total incident rate” are below all other DOI agencies.

Scope and Applicability

Safety of field personnel should always be the first concern in conducting a sampling program and in the selection of sampling sites. Numerous safety issues and concerns are associated with implementing a long-term, service-wide monitoring program that includes extensive fieldwork and sampling by network staff or other cooperators/contractors. Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Field personnel routinely come in direct and indirect contact with waterborne pathogens, chemicals and potentially hazardous plants and animals. Advanced planning can reduce or eliminate many safety hazards.

Field sampling requires planning that anticipates the risks and dangers that field personnel may be exposed to so precautions may be taken to limit threats to human safety as much as possible.

Roles and Responsibilities

Division Chiefs or Network Coordinator

- Communicate vision clearly and continually.
- Monitor employee/unit performance, recognize successes, and take corrective actions when needed.
- Incorporate safety as a critical result in all supervisors’ and employees’ performance plans.
- Incorporate safety into all decision-making processes.
- Ensure requests are submitted for adequate funding of required safety programs and safety training.
- Integrate audit findings into existing performance management and training processes.
- Ensure all employees understand their roles and responsibilities in implementing a safety program.
- Ensure all employees are aware of their job hazards.

Line Supervisors

- Monitor employee/unit performance, recognize successes, and take corrective actions when needed.
- Incorporate safety into all decision-making processes.
- Incorporate safety as a critical result in all employees’ performance plans.
- Develop and use employee safety and health orientation checklist identifying job specific hazards and safety concerns.
- Develop and continuously improve Job Hazard Analyses or Guidelines for all tasks and jobs.
- Integrate audit findings into existing performance management and training processes.
- Ensure all employees understand their roles and responsibilities in implementing a safety program.

- Ensure all employees are aware of and control their job hazards.
- Investigate all accidents and near misses, and implement corrective actions for identified hazards.

Employees

- Collaborate with supervisor on Job Hazard Analyses development and use employee safety and health orientation checklist.
- Integrate audit findings into existing performance management and training processes.
- Incorporate safety into all decision-making processes and job tasks.
- Ensure all employees understand their roles and responsibilities in implementing a safety program.
- Ensure all employees are aware of and control their job hazards.
- Identify and report hazards to immediate supervisor or park management.

Basic Safety Preparation

It is desirable to begin training well before the field season begins to allow adequate time for thorough understanding of field and laboratory procedures and to obtain required certifications. Field crews must be familiar with the general safety protocol in the following sections and complete any required training that is protocol specific.

Protocol and SOP Understanding

A basic understanding of the system being studied is necessary for collecting good data. Recognition of bad or illogical data in the field can improve safety and efficiency by eliminating unnecessary sampling trips. Recognition of the problem at the time it occurs allows for immediate adjustment in the field. Individual protocol SOPs will establish the training necessary to understand the system of study.

Reading and understanding the entire protocol and all SOPs are crucial prior to initiating field work. The protocol lead will allow adequate time for all field crew members to complete this step to ensure success of the project. Field and laboratory related SOPs will also be covered as part of the hands-on training.

Hands-on training and practice prior to the first sampling period will help ensure high quality data collection. Familiarity with the use and maintenance of equipment, procedures for collecting and processing water samples, techniques for cleaning field and laboratory equipment, and lake and stream safety are essential to the success of the lake and stream monitoring project. Field crew leaders are required to complete all of the following training. Field crew members should also complete the training, if possible, although it is not required.

First Aid and CPR

Training in basic first aid and CPR is encouraged for all crew members. When feasible, the Network will facilitate having crew members take advantage of park first aid and CPR trainings. Certification is valid for two years. Protocol lead is responsible for providing all crew members with basic first aid information and supplies for field work.

Basic Safety

This SOP is meant to be used in conjunction with other safety manuals such as Chapter A9 of the USGS National Field Manual (Lane and Fay 1997), and national, regional, and individual park safety standards. National standards from the Risk Management Division of WASO are at http://inside.nps.gov/waso/waso.cfm?lv=2&prg=46. The Pacific West Region Safety and Health Website at http://inside.nps.gov/regions/region.cfm?rgn=70&lv=2 provides links to many safety tools including national, regional, and local safety protocol and online sites. The protocol and crew lead are responsible for updating SIEN safety protocol to keep it current with all standards. Park safety offices should be consulted to ensure SIEN crews are consistent with all park specific safety policies. The crew lead will contact individual park safety officers or resource managers for information on reporting injuries and safety concerns, park radio safety procedures, wilderness travel protocols, local problems and issues, such as dangerous or nuisance animals (e.g., black bears), insect-and tick-borne diseases (e.g., Lyme disease, encephalitis, West Nile disease), and other issues specific to each park. The crew lead is responsible for disseminating this information to the crew.

Sequoia and Kings Canyon safety information can be found on the Sharepoint site at http://inpsekihq3/sites/insideseki/safety/default.aspx. This site provides links to SEKI Accident/Incident Reporting Requirements, Job Hazard Guidelines (JHGs), and general safety policies, guidelines, and management directives.

Yosemite safety information can be found in the Yosemite Safety Web page at http://www.yose.nps.gov/yosenet/safety/default.htm. This site provides links to the current Wilderness Travel Policy, a Job Hazard Analysis (JHA) page, the YOSE Incident/Accident Reporting and Investigation policy, and many other safety links.

Safety of field personnel is always the first concern in selection of sampling sites, and in conducting a sampling program. No sample or sampling site is worth the risk of injury or death. Every sampling trip, at any time, if there is a perceived risk, the task should be stopped and the risk mitigated. This includes any travel to and from sites, and with any of the protocol steps. Numerous safety issues and concerns are associated with implementing a monitoring project that includes extensive field work and sampling. Field personnel routinely come into direct and indirect contact with waterborne pathogens, chemicals, and potentially hazardous plants and animals.

Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Advanced planning can reduce or eliminate many safety hazards. An integral part of informed awareness and successful mitigation of potential hazards is a process that helps to reveal hazards. SIEN is using the Job Hazard Guidelines (JHGs) to critically examine tasks, identify specific hazards, and reduce or eliminate these risks (see Appendixes SOP 2.E–G). A JHG is created (or adapted) for each protocol, or distinctly different process in the protocol, prior to field implementation, and evolves with the input of subsequent employees to remain a current and effective safety tool. All employees are expected to know, understand, and contribute to the JHGs.

Field work should be done in pairs. Always carry a park radio and if possible, a cellular telephone. Carry basic safety equipment, including first aid kit, flashlight, boots, rain gear, antibacterial soap or hand cleaner, matches or lighter, etc. Be aware of changing weather conditions and the potential for storms. Be aware of potential hazards at a monitoring site. Carry general safety items in each vehicle (see checklist).

At a minimum, a trip plan for each field trip must be completed and left it at a designated location in the office. The trip plan should include the following information:

- Field trip participants, including guests and observers, with emergency contact information
- Departure and expected return time(s) and date(s)
- Hotel and campground contact information (for overnight trips)
- Basic itinerary, including where and when sampling will occur
- Phone numbers for cellular phones or radio frequencies

Incidents or Accidents

In the event of an incident or accident, get *immediate* medical attention if required. To report an accident or incident, local park policy should be followed (see YOSE Incident/Accident Reporting and Investigation). At a minimum, the employee will report any injury to their immediate supervisor as soon as possible. The supervisor needs to report the incident/accident to appropriate personnel, and complete any park specific reporting forms (SEKI-134B the Sequoia and Kings Canyon NP Incident/Accident Report, or the Yosemite National Park Supervisor Incident/Accident or Close-Call Reporting Form (2-1a)). Supervisors and employees are required to complete a Department of Labor Form CA-1 (Federal Employee's Notice of Traumatic Injury and Claim for Continuation of Pay/Compensation) or CA-2 (Notice of Occupational Disease and Claim for Compensation) when work related injuries or diseases require medical treatment. The Safety Management Information System (SMIS) is the automated system for reporting Form CA-1 or CA-2 for the Department of the Interior (https://www.smis.doi.gov). Employees complete a CA-1/2 electronically at https://www.smis.doi.gov before the end of the next work shift after an accident. After the employee completes the CA-1/2, the supervisor logs onto SMIS and completes the supervisor portion of the electronic CA-1/2. The supervisor takes any corrective action necessary to prevent similar incidents.

Bears

Most of the information in this section is from the Sierra Interagency Black Bear Group website: http://www.sierrawildbear.gov/. This website should be checked for the most up to date information on approved food storage containers.

It is critical that I&M employees use proper food storage and maintain safe distances from bears. While black bears are wonderful to observe in the wild, it is important to keep a safe distance from bears and other wild animals. Bears will change their behavior if they become habituated to humans, which will happen if we crowd them or observe them too closely. Bears also change their behavior if they obtain human food—even just one time. They begin to break into cars, tents, and cabins and may become aggressive. If a bear becomes a safety hazard, it sometimes has to be destroyed. Other habituated and food-conditioned bears are killed by cars because they spend more time along roads and in campgrounds.

Encountering bears in natural areas can be a great experience. The following rules will help to ensure a safe encounter with Sierra Nevada bears:

- Stay together (especially if children are present)
- Give the bear(s) lots of room (300 feet or more)
- Don't get between a sow and her cubs
- Don't linger too long
- Use a telephoto lens or binoculars instead of approaching too closely

Bears need to be "hazed" out of developed areas so they don't feel welcome and don't get habituated or get food. Please help keep bears wild by following the suggestions below—these are especially important if a bear enters your campsite or picnic area.

- Check to make sure all your food and food related items are stored properly
- Get everyone together, look big, and make a lot of noise (yelling, banging pots, etc.)
- Never surround a bear – they need an escape route
- Never separate a sow from her cubs (sometimes cubs are up a nearby tree)
- If a bear huffs at you and shows its profile, it may be ready to bluff charge. Stand your ground or back away slowly. Do not run.
- Never try to take food back from a bear

It is not uncommon for a black bear to show its dominance by bluff charging. If this happens, look big, raise your arms, and stand your ground. As soon as the bear backs away, you should back away as well. The bear may be guarding food or cubs and view you as a threat.

While it is extremely unusual for black bears to harm humans, injuries are reported every year in the Sierra Nevada. In the unlikely event that a bear does make contact with you, roll into a ball, face down with your hands over your neck. If the bear continues its aggression, bear experts advise that you fight back.

While some backcountry sites have metal food storage boxes available, many areas do not, and approved food storage containers are required when you are in these areas. The most up-to-date information on approved food storage containers can be found at: http://www.sierrawildbear.gov/foodstorage/index.htm.

Conditional approval is given to any container that has passed visual inspection, an impact test, and a zoo test. Full approval is given to any container that has done the above and has been successful during three months of field-trials in the summer. Either type of approval may be revoked due to unexpected problems in the field that either lead to failures, injuries, or resource damage.

If a bear enters your camp, make noise and try to scare it away. However, if a bear does take possession of your food storage container, DO NOT try to take the container back from the bear, and advise Wildlife Managers in the park you are working in of the outcome.

Driver Safety

Driving in Sierra Nevada parks presents the typical hazards inherent to driving anywhere, in addition to hazards that are characteristic of driving in the mountains. Some hazards specific to driving in mountainous areas and popular national parks are:

- Wildlife in road
- Visitors not accustomed to driving mountainous roads
- Cars parked in road to view scenery or wildlife
- Winding, steep-gradient roads
- Fallen trees or rock slides in roads
- Ice and snow on roads
- Poor visibility from storms or smoke

When driving on park roads for work purposes, a park radio should be carried to report any accidents, broken down vehicles, inappropriate behavior around wildlife (such as feeding) or other road-related problems to Park Dispatch (see Appendix SOP 2.F).

Forms and Checklists

The following pages contain medical forms and equipment checklists for field personnel (adapted from Lane and Fay 1997, and local park documents) (Appendixes SOP 2.A–E). Prior to the field season, complete the medical information as thoroughly as possible. Confirm all contact information annually. Medical information sheets should be completed for each individual venturing into the field.

Checklists are helpful for ensuring that personnel have the appropriate safety equipment available during field trips. Field crew members should consider their specific needs and should customize the checklists as necessary. The field crew and project manager will discuss the checklists and determine which items are necessary.

Appendix SOP2A. Emergency Contact Form (Office)

This form is used by the SEKI Dispatch Office. Dispatch answers all incoming calls and is responsible for keeping a database of Park Employees. In keeping this information up to date, they request this form be completed. This information facilitates the proper routing of emergency and non-emergency calls, memos and other related topics to Park Employees.

NAME: ________________________________SUPERVISOR: ________________________
[PLEASE PRINT]

POSITION TITLE: _______________________ WORK AREA: _________________________

RADIO CALL NUMBER__________________

STATUS: Permanent: _____ Seasonal: _____ BEGINNING OF SEASON: _________________

ANTICIPATED END OF SEASON: __________________Work Phone Ext.________________

CURRENT ADDRESS: ____

CONTACT PHONE # HOME___________________ CELL___________________________

WILL YOU BE OCCUPYING PARK HOUSING: YES / NO (Temporary / Permanent)

VEHICLE MAKE:____________ COLOR______________ LICENSE/STATE #____________

EMERGENCY CONTACT INFORMATION

(Please list two contacts)

Name ______________________________________ Relationship ________________________
Address_____________________________________ Phone (H) __________________________
City ________________________ State ____ Zip _______ (W)__________________________

Name ______________________________________ Relationship ________________________
Address _____________________________________Phone (H) __________________________
City ________________________ State ____ Zip _______ (W)__________________________

Please list all Medical Conditions or special medications a medical provider might need to be aware of in an emergency: ____
____

Physician Name/Phone #:____

In accordance with the Privacy Act and Office of Personnel Management regulations, home telephone numbers and/or home addresses of employees are not given out over the phone unless there is a signed release on file with this office. Please be assured that if for any reason you wish to change your release you may do so at any time. By regulation this memo will remain on file. If you have any questions please contact Dispatch at Ext. 3196. Thank you for your assistance.

"I authorize the release of my home phone number and/or home address to callers requesting it."

(Green all callers – Yellow only NPS personnel - check one)

SIGNATURE: ______________________________ DATE: __________ GREEN _____ YELLOW_____

"I Do Not authorize the release of my home phone number and/or home address to callers requesting it."
SIGNATURE: ______________________________ DATE: _______________ **RED (DO NOT)** _______

Appendix SOP 2B. Local Emergency Contacts for Field Personnel (or call 911)

Hospital Phone: ____
Address: ____
Other medical facility (24-hour care) Phone: _________________________________
Address: ____
Devils Postpile Dispatch ____
Sequoia & Kings Canyon Dispatch ____
Sequoia & Kings Canyon Fire ____
Sequoia & Kings Maintenance ____
Yosemite Dispatch ____
Yosemite Fire ____
Yosemite Maintenance ____

Appendix SOP 2C. Basic Safety Equipment Checklist.

Checked items are those needed for bird protocol.

Basic Safety Equipment Checklist	
√	List of emergency phone numbers and office contacts
√	List of radio call numbers
√	First aid kit (in vehicle and in backcountry trip supplies)
√	Fire extinguisher (in vehicle)
√	Park radio
√	Cellular phone
√	Flashlight and spare batteries
√	Fluids (e.g., water, sports drinks)
√	Tool box with basic tools
√	Antibacterial soap or hand cleaner
	Spill kit
√	Material safety data sheets (MSDS) – for propane gas
	Hand-held eye wash unit
	Protective goggles
√	Accident reporting forms
√	JHG(s)

Appendix SOP 2D. Personal Protective Equipment Checklist

Personal Protective Equipment (PPE) must be selected based on the hazards likely to be encountered. The Sierra Nevada Network is required to supply appropriate PPE, and field personnel are required to use it. Items needed for Bird Monitoring Protocol are checked.

PPE Checklist	
	Aprons
	Eye/Face splash guards
	Gloves (vinyl and/or latex or nitrile)
	Protective suits
	Respirators (certification required for use)
√	Boots
√	Shoes to wear when sampling in wetlands (tevas, crocs)
√	Hat with a brim
√	Insect repellent
√	Rain gear
√	Sunglasses
√	Sunscreen
√	Work gloves
√	Lightweight long-sleeve shirt and pants for sun protection
√	Wool or polypropylene long underwear
√	Lightweight warm hat and gloves
	Flotation vests and jackets
√	Traffic vests (keep in vehicle)
	Cones and traffic signs
	Hard hat
	Hearing protection
	Waders, hip boots, rubber knee boots

Appendix SOP 2E. Vehicle Checklist

Items needed for Bird Monitoring Protocol are checked.

Vehicle Checklist:	
√	**Chemical protection and storage**
	Chemical spill kit
	Eye wash kit (replace old or expired wash solution)
√	Material Safety Data Sheets (MSDS)
√	Chemical reagents (stored in appropriate area) – bleach only
√	Flammable solvents (stored in appropriate dedicated area) – stove fuel
	Pressurized gases (stored in appropriate area)
√	**Communications and instructions**
√	Field folder (including maps, emergency phone numbers for medical facilities, office contacts, family contacts)
√	Cellular phone/park radio (check that the service is operational for the area to be
√	**First aid and protective equipment**
√	Complete change of clothes (stored in dry area)
√	Fire extinguisher (safely secured)
√	First aid kit and manual (check for missing or old, expired items and replace if necessary)
√	Orange reflective vest
√	**Miscellaneous equipment**
√	Bungie cords (to secure loose articles)
√	Flagging
√	Flares
√	Flashlight (including fresh batteries)
√	Tool kit

Field Safety

Prior to the field season, the field crew will be trained in the correct use and maintenance of all equipment to be used in the field (e.g., camping gear, binoculars, tools). The protocol lead will ensure all crew members understand, and can safely complete all aspects of the monitoring protocol safely and efficiently. The Safety SOP will be reviewed by all crew members. Protocol specific safety concerns will be addressed by the protocol lead.

Pre Trip

Before leaving for the field site, the field lead will ensure all required safety and work equipment (including vehicles) are available, maintained, and in good working condition. The field lead will notify all appropriate personnel about the location and time required for the sampling trip. All emergency contact information will be given to the protocol lead. The field lead will make sure all park specific wilderness protocol requirements are fulfilled.

Job Hazard Guidelines and Specific Safety Concerns

All the staff is required to participate in the production and evolution of job hazard guidelines (JHGs) specific to the field implementation of the bird monitoring protocol. The field lead is responsible for documentation of improvements to the JHGs during field implementation. The protocol lead incorporates changes into the protocol.

Principal steps in the implementation of the bird monitoring protocol include travel to and from the site and travel off trail while conducting point counts. Potential safety and health concerns include dehydration, heat stress, hypothermia, lightning, falls, sunburn, animal encounters, stream crossings, drowning, and motor vehicle accidents. See the detailed JHGs attached to the end of this safety protocol (Appendixes 2.F-H). They address: Backcountry Travel, Environmental Hazards, and Driving Safely. The JHGs are used as a catalyst for crew discussion and understanding of all safety concerns for the bird monitoring protocol. Discussions address safety concerns including all aspects of safe wilderness travel to and from the site (such as traveling over rough terrain, high water crossings with and without a backpack, trip planning and notification, lightning and other weather events, heat and cold exposure, high elevation, snow travel, map and compass, GPS) with emphasis on the specific area being accessed and current local conditions.

Dress appropriately for weather conditions. Weather can change quickly in the Sierra Nevada. Be prepared for sunny and hot conditions by drinking plenty of water and protecting yourself from exposure to sun with the use of sunscreen, a hat, and sunglasses. Anticipate bad weather by bringing raingear, extra layers, and extra food. Be alert to changing weather by watching for developing clouds, wind shifts, and the sound of thunder. Lightning can strike even when there are no clouds overhead. If there is lightning in the area, get inside a building or car. If this is not possible, go to lower areas such as valleys and canyons. Do not remain near large solitary trees or in the middle of open areas.

This safety protocol is not designed to attempt to comprehensively cover all safety issues that may be encountered. It is to be used as a starting point for field work where everyone is involved in creatively enhancing and bringing personal additions to the process. Safety is a responsibility of everyone. The JHGs and other aspects of the safety protocol should be constantly assessed to remove redundant and less useful items, and improved with the addition of new ideas and concepts. The field lead documents changes and new ideas gained from the crew and works with the protocol lead to keep the JHGs and safety protocol current and pertinent.

.

Appendix SOP 2F. SIEN Job Hazard Guideline: Driving Safety

From Sequoia and Kings Canyon NP Division of Resources Management and Science. This safety protocol is not designed to comprehensively cover all safety issues that may be encountered. It is to be used as a starting point for field work where everyone is involved in creatively enhancing and bringing personal additions to the process.

SIEN Job Hazard Guideline

Job Description: Driving Safely			Date of last update: July 22, 2009
Division with primary responsibility for this JHG: SIEN, DRMS- SEKI	Last updated by: John Austin	Reviewed by: Linda Mutch	Approved by: Bob Montgomery

Required standards & general notes:	Both general and winter driver safety training provided by the park Maintenance standards set by the auto shop This JHG does not cover the proper use of bicycles, motorcycles, ATVs, mules, or similar vehicles.
Recommended personal protective equipment:	Two or more high-visibility safety road vests, two or more traffic cones, stop/slow paddle First-aid kit Radio
Typical tools & equipment:	Emergency and unusual condition equipment such as ice scraper, fire extinguisher, snow chains, jack, and lug wrench

Activity	Potential Hazards	Safe Action or Procedure
Vehicle Maintenance	Vehicle malfunctions leading to breakdown, injury, or accident.	• Take the vehicle in for regular scheduled maintenance or when any problem arises with vehicle performance.
Pre-driving inspections	Vehicle malfunctions leading to breakdown, injury, or accident. Lack of crucial equipment that might be needed. Accidents or injuries caused from unsecured loads.	• During winter, check road conditions before leaving, carry additional clothing, and make sure that someone knows where you are going and when you should be back. • Ensure that vehicle has appropriate equipment such as first-aid kit, snow chains, ice scraper, and cones. • Do a walk around of vehicle, inspecting it for damage and potential hazards. Secure all items that might become projectiles in the event of a crash. • Familiarize yourself with jack, spare tire, tools and other equipment. • Familiarize yourself with the use of the lights, wipers, radio, climate control system, and cruise control. It is not safe to be trying to figure these out while you’re driving.

Activity	Potential Hazards	Safe Action or Procedure
		• Adjust seat and mirrors to fit the driver. • Do not ride in the back of a truck or anywhere else that is not equipped with a seatbelt. All vehicle occupants must have seat belts fastened before vehicle begins to move. Seatbelts should remain fastened whenever the vehicle is moving. • Leave early enough so that you don’t feel rushed and tempted to compromise your safety.
Driving speed	Accidents caused from following a vehicle too closely or driving too fast for conditions.	• Obey speed limits. Drive at a reasonable speed. Getting to your destination a few minutes quicker is not worth exposing yourself or others to an accident. • Allow at least two seconds between your vehicle and the one in front of you. This is the minimum for ideal conditions. Increase this cushion at night or during adverse driving conditions.
Stopping quickly	Being hit from behind. Whiplash.	• Watch for traffic making unexpected turns or stops, especially near intersections. • Watch for pedestrians unexpectedly stepping into the roadway, especially at intersections and near parked cars. • Watch for potholes and for fallen rocks and trees. Use caution when driving in areas of known rock slide potential such as the section of 180 leading down into Kings Canyon. Pay particularly care during the spring when moisture combined with freezing increases the risk of rockfall and slides. If you find a new or active slide do not drive by it until you evaluate the safety of it. Stop well outside of the fall area and listen and look for sliding debris, if there is active movement do not drive through. Be extremely cautious when clearing debris from the roadway. Evaluate the safety of the area before you go into it, again spend some time listening and looking for movement. If there is any recent or active movement do not go into the area. If you decide you are going to clear debris make sure you have a spotter to warn you if rocks start moving again. • Scan well ahead, drive defensively. • Drive at speeds that are safe for the road conditions, thus allowing for reasonable stopping. • Check rear-view mirror regularly.
Distractions	Accidents (collisions, driving off road, etc.)	• Do not talk on a cell phone or text while driving. Even when used hands free, a cell phone is still a significant distraction. NPS employees and volunteers are prohibited from using a cell phone while driving, even if used with a hands-free device. Texting is particularly distracting; don’t do it. NPS employees are prohibited from reading, composing, or sending text messages or e-mails while driving. The prohibitions against

Activity	Potential Hazards	Safe Action or Procedure
		using a cell phone or texting while driving applies whenever you're on official business, regardless of whether the vehicle you're operating is owned by the government, leased, rented, or is a private vehicle. NPS employees and volunteers are permitted to talk on the park radio while driving, but be aware that this is still a significant distraction. • Don't take your eyes off the road to retrieve something on the seat, untangle a radio cord, read the display on your Blackberry, etc. If something demands your attention, stop the vehicle before dealing with it. Getting to your destination a few minutes quicker is not worth exposing yourself or others to an accident. • Always keep at least one hand on the steering wheel. It's best to have two hands on the steering wheel whenever possible. • Don't check your appearance in the mirror while driving. • Be careful when drinking while driving. Exercise even greater care when eating while driving. In some cases, eating while you drive may increase your alertness and therefore your safety. Snacks are comparatively safe, but eating a double cheeseburger while driving is pushing your luck. • Don't let yourself become distracted by events taking place outside of the vehicle (gawking at accident, arrival at destination, etc.).
Driving when visibility is impaired due to elements (rain, fog, smoke, snow, dust, etc.)	Accidents (collisions, driving off road, etc.)	• Reduce speed. • Allow at least four seconds between you and the vehicle ahead of you to allow stopping time. • Keep windshield clean and clear. • Turn on headlights. Also turn on four-way flashers if conditions warrant. • If conditions are too bad to drive safely, find a safe place to pull off the road and stop.
Driving narrow and/or winding roads	Head-on collisions	• Where possible, avoid roads such as the Hogback that don't have at least a stripe to separate traffic lanes. When a choice of two roads is available; take the safer route. Getting to your destination a few minutes quicker is not worth exposing yourself or others to an accident. • Be especially careful on curves. Stay within your lane. • If you must drive a road without a lane divider, reduce speed and allow at least four seconds between you and the vehicle ahead of you. • Scan ahead for oncoming traffic and slow down when approaching blind curves. When

Activity	Potential Hazards	Safe Action or Procedure
		sight distance is limited, anticipate that oncoming traffic may be driving in your lane. • If a vehicle wants to travel faster than you, find a safe place to pull off the road and let them by. Do this even if you think they are wrong to want to drive faster than you. Your ego will survive and the other driver won't be tempted to pass you in an unsafe area.
Driving on unpaved or damaged roads	Accidents (collisions, driving off road, etc.)	• Reduce speed. • Allow at least four seconds between you and the vehicle ahead of you to allow stopping time. • When a choice of two roads is available; take the safer route. Getting to your destination a few minutes quicker is not worth exposing yourself or others to an accident. • Be especially careful on curves. Stay within your lane. • On very bad roads, scout ahead if in doubt. • Report hazards such as fallen rocks or trees to park dispatch.
Driving when road is slippery (rain, ice, snow, etc.)	Accidents (collisions, driving off road, etc.)	• Reduce speed. • Allow at least four seconds between you and the vehicle ahead of you to allow stopping time. • When a choice of two roads is available; take the safer route. Getting to your destination a few minutes quicker is not worth exposing yourself or others to an accident. • Use proper equipment as stated by road signs (chains, 4-wheel-drive, etc.)
Driving on closed roads	Accidents (collisions, driving off road, etc.)	• Use caution when traveling the closed portion of any road. Notify Dispatch when entering the closed area, also notify Dispatch when you have cleared the closed area.
Night driving	Pedestrians, animals, obstacles not visible, glare from oncoming traffic.	• Turn headlights on; keep windshield clean. • Allow at least four seconds between you and the vehicle ahead of you to allow stopping time.
Following vehicles with different characteristics (i.e., motorcycles and trucks)	Collisions	• Reduce speed. • Allow at least four seconds between you and the vehicle ahead of you to allow stopping time.
Towing trailer	Collisions	• Reduce speed. • Allow at least four seconds between you and the vehicle ahead of you to allow stopping

Activity	Potential Hazards	Safe Action or Procedure
		time. Extra weight of load requires greater stopping distance. • Be aware of extra length added to your vehicle when making turns
	Back-up problems	• Practice backing up with a trailer in a safe environment such as an empty parking lot.
Emergency/breakdown (your vehicle or when stopping to assist others)	Exposure due to being stranded. Being hit by passing vehicles.	• If possible, pull off road • If there is risk of being hit by passing traffic, turn on four-way flashers. Use cones or flares to provide a buffer around your vehicle. • If you need to stand on or near the roadway (e.g., to direct traffic), wear a safety road vest. If possible, stand in a location with good sight distance. • Report all accidents to park dispatch. Let them know what help is required such as medics, ambulances, people to direct traffic, etc.
Physical and mental fatigue	Falling asleep at wheel, accidents	• Get needed rest, avoid driving when tired, and take breaks as needed. Be particularly cautious when driving late at night. • If a replacement driver is available, trade off driving when you start to feel tired. If you get tired and no replacement driver is available, pull off the road and take a break or a nap. If you’re yawning, you probably shouldn’t be driving; take a break. • Plan the trip so that no person will be driving more than ten hours (behind the wheel) within any duty-day. If an unexpected situation develops and there is no good alternative, then it is okay to drive longer than ten hours. But such situations should rarely happen. • Plan the trip so that no person will be driving unless they have had at least eight consecutive hours off duty before beginning a shift. Exception to the minimum off-duty hour requirement is allowed when essential to address immediate and critical employee or public safety issues (e.g., emergency bear management call-out in the middle of the night). Exception is also allowed when an unexpected situation develops and there is no good alternative. • Mitigation measures must be taken to reduce fatigue for drivers who exceed 16 hour work shifts. This is required regardless of whether the driver is still compliant with the 10 hour individual (behind the wheel) driving time limitations.
Ascending steep grades	Overheating leading to breakdown	• Watch temperature gauge. • Turn-off air conditioning if vehicle starts to overheat.
Descending steep grades	Brake failure	• Reduce speed.

Activity	Potential Hazards	Safe Action or Procedure
	Loss of control	• Shift to a lower gear to conserve brakes.
Passing traffic	Collision when changing lanes	• Look carefully before changing lanes. Visually check any blind spots left by mirrors. • Signal before changing lanes.
U-turns	Collision with on-coming traffic, road barriers or off-road features	• Ensure that point selected for turn has good view of oncoming traffic and space to negotiate turn. Position lookouts/flaggers when needed.
Parking	Collision with rock, pedestrian, or other hazard while backing into or out of a parking site; exhaust system igniting a grass fire. Parked vehicle moving on its own.	• Park off of the road or in a designated parking area. Find a safe location to park that will provide safe exiting. • Ensure that fuels are clear beneath vehicle so as not to start a fire. • Use a backer to guide you into a safe place that will be easy to pull forward out of later. Use mirrors, or look over your shoulder, and be sure that you can see the backer and that you understand the hand signals being used. If no backer is available, then look behind the vehicle before backing. • Put transmission in Park or in low gear. If parking on a slope, set parking brake.

Appendix SOP 2G. SIEN Job Hazard Guideline: Wilderness Travel

This safety protocol is not designed to attempt to comprehensively cover all safety issues that may be encountered. It is to be used as a starting point for field work where everyone is involved in creatively enhancing and bringing personal additions to the process.

SIEN Job Hazard Guideline

Job Description: Wilderness Travel			Date of last update: June 23, 2009
Division with primary responsibility for this JHG: Resources Management & Science and Sierra Nevada Network	Last updated by: Linda Mutch	Reviewed by:	Approved by: Bill Putre

Required standards & general notes	Employees are traveling in groups of two or more, or they report daily by radio if traveling alone. Supervisor knows destination and route and return date.
Required personal protective equipment	Radio, first-aid kit, cold and wet-weather gear, appropriate foot wear, solar protection (hat, bandana, and/or sun block), appropriate water purification equipment (usually a filter), flashlight, minimal pack weight (1/3 of body weight), snow axe and crampons when on firm snow or ice.
Typical tools & equipment	Backpack (or rucksack if traveling by stock), bear-proof food storage canister or pannier, cold and wet-weather gear, appropriate foot wear (boots for rugged areas, footwear for wading streams, etc.), tent (optional), adequate sleeping bag, solar protection (hat, bandana, and/or sun block), water purification equipment (usually a filter), food and food preparation equipment, first aid kit (including snake bite kit), park radio, mosquito repellent (optional), compass and map, flashlight, work gear

Activity	Potential Hazards	Safe Action or Procedure
Backpacking with heavy loads	Heavy loads	Carry no more than 1/3 of your body weight while traveling in the backcountry.
	Load instability	When carrying heavy loads, pack the gear so that heavy equipment is carried low on your back to increase stability. Consider using hiking poles.
	Excessive loads	Assess equipment needs to ensure only required equipment is being carried.
	Muscular pain & soreness	Start slowly to ensure muscle groups are given adequate time to warm up. Use stretching exercises before starting.
	Fatigue	Take frequent breaks for food & water. Stop hiking for the day after reasonable distance is achieved.
	Back strain	Lift loads with your legs to avoid back injuries.
Hiking on steep or rough terrain off trail	Steep slopes & poor footing (falls)	Move slowly & deliberately across steep areas. Use trees & solid rocks for handholds when they are available. Check footholds before using them. Fall into the slope if you slip or slide. Have a companion spot you from a more secure location.

Activity	Potential Hazards	Safe Action or Procedure
	Footing	Plan to cross snow or ice fields late in the day for better footing; cross streams early before flow increases due to increased run-off & unbuckle waist belt on pack—use hiking poles.
	People above you or below you	Never be above or below someone on a loose or unstable slope. Be aware of the ground surface in front of you - watch for slick, sloped & unstable areas surfaced by loose rock, leaves or sticks. Members of a party should move up such slopes one at a time, together at the same elevation at all times, or parallel to each other & out of rock fall danger.
Route finding	Hazardous obstacles	Plan routes to avoid or limit exposure to known hazards such as steep slopes, river crossings, poisonous vegetation, etc.
	Disorientation	Ensure all personnel are knowledgeable with map & compass as well as GPS usage.
		Keep track of current position & location of prominent landmarks with frequent map updates.
		Whenever possible, stick to established trails.
Inclement weather	Unfamiliarity with current & forecasted weather	Obtain weather forecasts prior to beginning back country travel & monitor weather broadcasts via radio during trip.
	Inappropriate gear for the conditions	Assess anticipated routes, elevations, & weather conditions when planning what gear to carry.
		Always carry rain gear, a warm hat, gloves, & a warm jacket when traveling in the backcountry.
	Thunderstorms	Avoid exposed ridge tops and being on or near lakes, meadows or other exposed areas if thunderstorms are approaching or developing nearby.
		Move to lower elevations away from tall trees as storms approach.
		If hair begins to stand up, immediately minimize exposure by moving to lower elevations away from isolated trees & crouch down on the balls of your feet to reduce ground contact.
	White outs	In the event of white out conditions, immediately seek shelter & wait for conditions to improve. Do not attempt to "feel your way" over the pass.
	Hypothermia	Layer your clothing such that it will be easy to regulate your body temperature by adding or subtracting layers. DO NOT wear cotton as a layer.
	Heat stress	Drink plenty of liquids, keep hydrated, & take frequent breaks for snacks & water.
Camp cleanliness & health	Contamination of shared food	Wash hands thoroughly with dirt, silt, duff, sand, or if available hand sanitizer before handling food, dishes, utensils, etc.
	Contamination of shared water	Wash hands before gathering and/or filtering water; avoid contaminating filtered water with

Activity	Potential Hazards	Safe Action or Procedure
		unfiltered water at source.
	Contamination of anything common (i.e., tools, dishes, paperwork, etc)	Wash hands (especially after bathrooming) before handling anything common to the crew. Crew health and morale depends on it; project success the same.
	Bathroom habits in the backcountry	Before touching anything common, WASH!
	Bears & other wildlife	Properly store food, thoroughly wash dishes and keep a clean camp area. Fermenting seed heads become odoriferous & attractive to wildlife. STORE SEED HEADS IN BEAR BOX, BURN OR PACK OUT IMMEDIATELY.

Appendix SOP 2H. SIEN Job Hazard Guideline: Environmental Hazards

SIEN Job Hazard Guideline

Job Description:			Date of last update:
Environmental Hazards: Living and Working in the Sierra Foothills & Mountains			June 23, 2009
Division with primary responsibility for this JHG:	Last updated by:	Reviewed by:	Approved by:
Resources Management & Science, SIEN I&M	Linda Mutch		

Required standards & general notes:	Employees are aware of potential hazards and know how to minimize risk.
Required personal protective equipment:	First aid kit, radio, protective clothing where appropriate, snake leggings where appropriate.
Typical tools & equipment:	Protective clothing and knowledge of and how to avoid hazards, bear-proof food storage containers.

Potential Hazards	Safe Action or Procedure
Transmission of blood borne pathogens (bacteria, viruses, protozoa, & parasites) from tick bites (including Lyme disease, rocky mountain spotted fever, ehrlichiosis, tick relapsing fever, tularemia, Colorado tick fever, babesiosis, & tick paralysis) or flea bites (especially plague).	Wear a long sleeve shirt, long pants, & a hat when working in high tick areas. Light colored clothing makes them more visible. Tuck pant legs into socks or tape pant legs to boots. Tuck long sleeves into gloves. Consider using physical tick barriers such as Rynoskin, or chemical repellents such as Permethrin. After returning from the field, check the body thoroughly. It takes hours for ticks to attach themselves. Remove ticks using tweezers by gently pulling from head/mouth parts. Save the tick in a plastic bag or jar so it can be analyzed for pathogens if necessary. If a reaction occurs, including swelling of lymph nodes, soreness, & a black (necrotic) center, visit a doctor as soon as possible.
Poison Oak: This is an abundant plant in the foothills and found in all sorts of both xeric and mesic sites.	Learn what the plant looks like at all times of the year. Try to avoid contact with the plant, or anything that has come into contact with it (tools, clothing, pets). Wear long clothing. If you are sensitive or are not sure, use Ivy Block before exposure and Tecnu after exposure. If Tecnu isn't available, wash with soap & water as soon as possible. Wipe tools with alcohol to remove oils. ***Avoid smoke from burning poison oak plants - this can be extremely dangerous to the airway.

Encounters with large carnivores (mountain lions, bears, etc.)	Lions -- Minimize hiking alone, especially at dawn or dusk. Do not run if you encounter a lion. Act big, raise arms, be aggressive. Throw rocks and yell. If attacked, fight back. Bears—Properly store food, stay at safe distance. If bluff-charged, look big, raise arms, stand your ground. If attacked (rare in SN), first roll into ball with face toward ground and hands over neck. If attack continues, fight back.
Kissing Bugs: Other common names: Blood sucking, cone nose beetles or assassin bugs. Kissing bugs are ¾" long, dark brown to black, with a concave back & a reddish orange X pattern defining the wings. It has a long proboscis, which it carries tucked under its body until ready to bite. It is a poor flyer - often crawls. It likes dark, sheltered places. It is often associated with pack rat nests or other rodents. Kissing bug bites can cause extremely serious allergic reactions in sensitive individuals.	Try to close unnecessary openings into your housing. Remove woodpiles near your dwelling to discourage rodents. Shake out clothing/shoes prior to putting them on. Check furniture before sitting down. Kissing bugs normally bite people at night while they are sleeping.
Bees, wasps, and yellow jackets: Solo bees generally do not sting when unprovoked. Beehives can be a problem if they are disturbed. Hives can be found in the ground, as a paper hive above ground or in trees, or in the base of burned out trees. Honeybees leave their stinger in the wound, while some other bees & wasps sting repeatedly.	Watch for bees around food & drinks. Wearing protective clothing such as boots, long pants, long sleeved shirts & gloves may help to avoid stings. Watch your footing keeping an eye out for nests. If you spot a nest, let others know its location. Flag it. Keep Benadryl, & if necessary, a bee sting kit, with you at all times.
Spiders: Two spiders are of concern in the local area: Brown Recluse & Black Widow. Brown recluse spiders are often found in undisturbed dry locations. Black widows are most often encountered around buildings – storage sheds, garages, wood piles, etc. Both may produce serious bites.	Avoid putting your hands in places that you cannot see - especially areas that have been undisturbed for a long time. Be sure to shake out clothing & shoes before putting them on. Careful when moving things outside, such as rocks & wood. Be careful when using privies.

Rattlesnakes: Western Diamondback Rattlesnakes can be found at most elevations of the park. They can reach five feet in length. Their bite can be very dangerous.	Learn to recognize rattlesnakes. Always scan the ground ahead when walking around your home, as well as the woods. Be cautious placing your hands in amongst rocks & other areas where a snake may be hiding. Be especially cautious around running water in the summer. The running water can obscure hearing a snake rattle, and the foothill snakes seem to be attracted to the cooler riparian environments. Wear snake leggings wear there is risk with obscured visibility.

References

Lane S. L., Fay, R. G. October 1997. Safety in field activities: U.S. Geologic Survey Techniques of Water-Resources Investigations, book 9, chap.A9, accessed 8/28/2007 at http://pubs.water.usgs.gov/twri9A9/.

National Park Service (NPS). 2004. National Park Service Safety & Health Implementation Plan. Accessed 6/22/2010 at: http://www.nps.gov/training/tel/Guides/npsafe_mgrs_pguide_081404.pdf.

Standard Operating Procedure (SOP) 03: Field Tour Preparation

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction
This SOP details procedures for preparing to go on a 'field tour' (generally +/- seven days of continuous work, followed by 4 days of leave), including determining which transects to sample, planning travel routes, arranging travel logistics, securing permits, and assembling field equipment and food.

Determining Which Transects to Sample
Before beginning a field tour, crews must determine which transects to sample on the tour. The Field Lead should provide a list of transects to be sampled and the elevation strata to which they belong. Transects should be sampled as seasonal phenology allows, with the lower sites visited early in the season and higher sites visited as the season progresses. Once a transect has been sampled it should be marked as such on the season's transect list. The Field Lead should determine which transects should be sampled during the upcoming tour by referring to the transect list and considering elevation and accessibility. Once the set of transects to be sampled has been established, maps for each of the transects should be assembled. All survey maps should have been prepared prior to the beginning of the field season (SOP #1**:** ***Preparing for the Field Season***). For transects that have been sampled in previous years, transect summary information should be compiled and taken into the field to assist in locating sample points.

Planning Travel Routes, Arranging Travel Logistics, and Securing Backcountry Permits
Careful consideration should be given to determining a travel route and order for sampling transects. If one or more of transects has been sampled in a previous year, information on accessing them should be available and referred to in determining travel routes. In planning their routes, observers should examine trail maps to determine accessibility. If current trail conditions are not already known, they should be checked at the proper ranger station to ensure that passes and necessary trails are open. If special travel methods need to be organized, such as boat transport or car rides to trailheads, those should be organized as soon as possible. Backcountry camping and travel permits, if necessary, must also be secured. Finally, the trip itinerary will be provided to the Project Lead and the appropriate Park Biologist, who must then be contacted again when the crew returns from the field.

Field Gear
Crew members should take care to bring all of the necessary clothing and equipment into the backcountry. Shared equipment will likely include: a tent, a stove, a ground tarp, a water purification filter, and cookware. Individual camping equipment should include: a sleeping bag and pad, a backpack, a day pack (or something suitable for carrying food and field equipment while conducting transects), raingear, a flashlight, and warm clothing (wool or polypropylene).

Survey equipment (per person) should include the following:

Compass	Data forms and maps
Clipboard	GPS unit
Safety whistle	Pens or pencils (several)
Binoculars	Flagging
Aluminum flags	Walkie-talkie

Hammer and nails	First aid kit
Ground stakes	Park radio

Food

The final consideration to make before entering the backcountry on a field tour is to *carry enough food* to support each person for the duration of the tour. Crew members should keep in mind that they will be working long days and hiking both on- and off-trail for much of the day during each day spent in the field. Caloric requirements will typically be much higher than usual. At the same time, space (and weight) is often at a premium, and time for preparation may be limited. Dinners are typically shared between crew members; all other food is typically taken care of on an individual basis.

All food taken into the backcountry must be stored in bear-proof food containers at all times.

Standard Operating Procedure (SOP) 04:
Training Observers

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP identifies procedures and topics to be included in observer training.

We recommend conducting an intensive training program immediately prior to the field season. The optimal duration of this program will depend somewhat on the skill and experience level of the crew members, but our experience training crews for the SIEN bird inventory projects has shown that even relatively experienced and/or skilled observers can benefit from two full weeks of training to hone their skills and fully prepare themselves for field work. Less experienced individuals may require up to three weeks of training to truly be prepared to collect reliable data at the beginning of the field season.

The training session must be carefully planned and scheduled to ensure that all necessary topics are adequately covered, and that crew members receive adequate exposure to as many of the network's bird species as possible. This may best be achieved by starting training in the foothill zone at SEKI, and then moving to the lower montane zone at YOSE.

Below we enumerate 12 topics that need to be covered during the training session, and provide some guidance on effective ways of presenting them. We assume that training will be led by the Field Lead, perhaps with assistance from the Project Lead.

Identification of Birds by Sight and Sound

For this monitoring program to produce meaningful results, all observers must be fully competent at identifying SIEN birds by sight and sound (See **Table SOP 4 – 1** for lists of bird species encountered at SIEN parks during the SIEN avian inventory projects). Ensuring that Field Technicians are fully competent by the end of the training session is a process that must begin well before the training session. Every effort must be made to recruit and hire observers who are already proficient or nearly proficient at identifying Sierra species by sight and sound, or who are proficient at identifying birds from other regions by sight and sound and can demonstrate an enthusiasm and ability to quickly learn to identify new species (see SOP #1**:** ***Preparing for the Field Season***). No matter how well-executed the training session is, most observers who do not have substantial birding experience will not be adequately prepared to conduct point counts by the end of the training session.

Soon after being hired, Field Technicians should be sent species lists and other training materials, and be urged to begin preparing themselves prior to the start of the training session. The bird field guides listed in SOP #1**:** ***Preparing for the Field Season*** may be helpful in this process. Throughout the training session, every day should begin with the Field Technicians birding at sunrise, either with the trainer(s) (usually the Field Lead, perhaps with assistance from the Project Lead, the NPS Lead, or another qualified person). Observers learn to identify new species most quickly when they actually see and hear them in the field. The crew should visit as wide a variety of habitats and locales as possible during the training session, to maximize the number of species encountered in the field.

In addition to observing and listening to birds in the field, Field Technicians should spend time throughout the training session studying field guides, listening to recordings, and using instructional software to review plumages and vocalizations and to test themselves. We have found it most useful to conduct group reviews every other evening during training. These reviews have been most effective when the trainer used an instructional CD ROM to present images and/or recordings of the species encountered that morning, as well as other species the group a) may be having trouble distinguishing from one another or b) may be unlikely to encounter during training (e.g., high-elevation species). The trainer leads the crew in a discussion of field marks and distinguishing characteristics of vocalizations, and also quizzes the crew. During the evenings that are not occupied by group review sessions, Field Technicians should use a variety of materials (field guides, recordings from multiple sources, their own field notes) to study independently or in small groups.

Around halfway through the training session, the Field Technicians should be given a practice evaluation of their bird identification skills. The practice evaluation should be structured similarly to the formal evaluation crew members will need to pass before they are certified to conduct point counts (see below). The practice evaluation helps crew members assess their own strengths and weaknesses, and also helps the trainer(s) identify individual species or groups of species that the crew may be having particular trouble learning.

Certifying Observers to Conduct Point Counts

Before they can collect point count data for the SIEN bird monitoring program, Field Technicians must pass a rigorous bird identification exam. We recommend that the exam involve identifying approximately 60 recorded vocalizations, including all the more common bird species in the parks, and many of the rarer ones. In addition, two or more groups of approximately ten recordings each should be grouped together in rapid succession to produce ‘simulated point counts’, which test crew member’s ability to rapidly identify vocalizations, as is often required in the field. Field Technicians should also have to identify 30-40 photographic images of birds, generally rarer species or less obvious female plumages (computer CD ROM programs work well for this). Passing the exam should require a near-perfect score. Field Technicians who do not pass should be given feedback on which species they misidentified, and be allowed to take the full exam again after a few days or a week. The exam needs to be remade (i.e. the order, if not the identity, of the recordings and pictures needs to be changed) before it can be administered again.

Pacing

Practicing distance estimation is greatly facilitated by being able to reliably measure distance by pacing. Accurate pacing also greatly helps in finding point count stations. Field Technicians should be taught to measure distance by pacing within the first few days of training. The trainer should measure out a 50-m walking route— somewhere fairly flat where the crew can walk freely and repeatedly. Field Technicians should walk the route and count their steps multiple times, and then commit to memory their average number of paces needed to travel 50 m and 10 m. Experienced observers should conduct this exercise as well, as an individual’s pacing can change slightly from year to year.

Estimating Distances

Estimating Distance to Seen Objects

The Field Lead should begin training observers by placing flagging at 10 m, 25 m, 50 m, 100 m and 200 m from a central point and having observers estimate distances to trees, rocks and flagging that are visible from the central point. Distances should be estimated to the nearest meter—observers must resist the tendency to round off estimates to the nearest 5 m or 10 m. As proficiency increases, Field Technicians should begin estimating distances to other visible objects (including birds) that are not within the vicinity of the measured-out flags. Distances to birds should be estimated and measured as the horizontal distance only; that is, the distance to a bird in the canopy should be estimated as the distance to the location on the ground underneath the bird. After estimating a distance, Field Technicians should use pacing, measuring tapes, or laser rangefinders to determine the actual distance. Both the estimated and actual distance should be recorded in a notebook, so that Field Technicians can assess their own tendencies to overestimate or underestimate distances, and thereby improve their estimates.

This exercise should be repeated many times over a period of days, in various habitats and on flat ground as well as steeper slopes. We have found that, with practice, Field Technicians can learn to estimate most distances within 10-15% of the actual distance. Accuracy may be reduced somewhat for particularly distant birds or objects (>100 m), but this is not of great concern, as far-off detections have less effect on detectability models than do closer detections.

Estimating Distance to Singing Birds

When Field Technicians have become relatively proficient at estimating distances to seen birds, they should start estimating distances to singing—but unseen—birds. The importance of this skill cannot be overstated, as the great majority of birds detected during point counts are heard but not seen.

Estimating distances to unseen birds is challenging because birds can sound louder or quieter depending not just on how far away they are, but also on how much vegetation is present to muffle the sound, how loud they are actually singing, and the acoustic properties of the particular species’ vocalizations. Nevertheless, observers can greatly improve their estimates with practice.

As with estimating distances to seen birds, measuring the actual distance to unseen birds is needed to assess the accuracy of the estimates. Measuring distances to unseen birds can be quite challenging, especially in habitats where thick undergrowth makes walking noisy or difficult. Singing birds will often retreat as the observer approaches, resulting in no measurement, or in a measurement that does not really reflect the distance to the bird when the estimate was made. A useful exercise for dealing with this problem is to have a group of observers remain at a mock point count location, while one or two others serve as 'scouts' who walk out of sight of the group and locate with certainty a singing bird. The scouts then call the group via walkie-talkie and call the group's attention to the located bird when it sings. Each member of the group independently estimates the distance to the singing bird, and the scouts then measure the actual distance from the bird back to the group. Although this exercise can be time-consuming and even feel tedious at times, it is worth the effort, and should be repeated with multiple species in a variety of habitats.

The Institute for Bird Populations has developed and successfully implemented these distance estimation training measures over nearly a decade of implementing projects incorporating point counts with distance estimation in national parks throughout the Sierra Nevada and the Pacific Northwest.

Conducting Point Counts

When Field Technicians can identify most species and have begun practicing distance estimation, part of each training day should be devoted to conducting simultaneous point counts. Working in groups of 2 or more, Field Technicians should conduct practice point counts at the same time in the same location. At the end of each count, they should compare notes and discuss any discrepancies in the species detected and the estimated distances to them. Continue these simultaneous counts until there is consistency among observers in the species and distances recorded. While conducting these practice point counts, Field Technicians should adhere to all aspects of the field protocol (see SOP #5: ***Conducting Point Counts*****)** with one possible exception: it is often more useful to shorten the duration of the practice point counts to 3 minutes rather than 5 minutes. This makes it easier for observers to remember when and where they heard specific vocalizations when they are discussing their results after the point count.

Identifying Plants and Collecting Habitat Data

Throughout the training session the trainer(s) need to teach the Field Technicians to identify all the trees as well as the most common shrubs in the parks. Studying birds in different locations each morning should facilitate exposure to a wide variety of plant species and plant communities, but observers will also need to study plant guides and receive some instruction to be prepared to identify plants in higher-elevation plant communities that will not be accessible during the training session.

The crew should also practice collecting habitat data, as a group, in order to standardize assessments (See SOP #6: ***Classifying Vegetation***).

Orienteering
During the training session all Field Technicians must become proficient at off-trail orienteering, including the proper use of a compass and GPS unit, and the ability to read topographic maps. GPS units can be lost, broken, or simply fail to gather an adequate signal, so observers must become proficient at determining their own location as well as traveling to a distant, unseen destination using only a compass and topographic map. These skills should be practiced until all observers are proficient and confident.

Recording Data
Field Technicians must be instructed how to complete each of the data forms, and have an opportunity to practice completing them during training, so that questions can arise and be resolved before official data collection begins.

Conducting Transect Data Collection
Once all the constituent skills have been practiced, observers should conduct practice transects in small groups. Working in groups allows crew members to standardize the assessment of safe versus unsafe terrain, and test against one another their accuracy of pacing and following a compass bearing.

First aid, Safety, and Emergency Procedures
Pairs of crew members will work together for up to a week at a time in remote, rugged areas of the large parks, with a substantial portion of each day spent working off-trail. It is, therefore, essential that everyone, to the extent possible, be prepared for emergency situations. Please refer to SOP#2: ***Safety***.

Although providing full-scale training in wilderness first aid is beyond the scope of the bird monitoring training program, we will requiring that the crew read and discuss in detail a simple wilderness first aid booklet prior to beginning data collection. Crews should also brainstorm potential responses to theoretical emergency situations, and have a clear understanding of what to do if a partner should become seriously injured or go missing.

Backcountry Rules and Ethics
Field Technicians should receive instruction on backcountry regulations, including permit requirements and procedures, campsite restrictions, food storage, etc. If possible, arrangements should be made for a backcountry ranger or other qualified NPS employee to meet with the crew to discuss these topics. Regardless, it is the Field Lead’s responsibility to make sure that all crew members understand the rules they must follow.

Coordination with Park Biologists
Arrangements should be made for crews to meet with park biologists and other personnel (e.g., Data Manager, Ranger, etc.) as needed. This will provide opportunities to:

- Clarify expectations and procedures for crews to notify park biologists of their schedule and whereabouts in the park.
- Arrange computer access, if needed.
- Arrange acquisition of gate keys, if needed.

- Clarify procedures for obtaining backcountry permits.

Note that park biologists require at least 2-4 weeks (preferably even more) notice to arrange computer access, keys, etc., for individual crew members.

Computer Data Entry

During the pre-season training program, Field Technicians must receive adequate instruction on data entry procedures (see SOP #13**: *Date Entry and Verification***), so that they can complete their data entry during the field season. If NPS computers are to be used for data entry, crew members may need security clearances or other specific authorization, which may have to be arranged well in advance of the field season.

References

Siegel, R. B., and D. F. DeSante. 2002. Avian inventory of Yosemite National Park (1998–2000). The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B., and R. L. Wilkerson. 2004. Landbird inventory for Devils Postpile National Monument. The Institute for Bird Populations, Point Reyes Station, California.

Siegel, R. B,. and R. L. Wilkerson. 2005a. Landbird inventory for Sequoia and Kings Canyon National Parks (2003–2004). The Institute for Bird Populations, Point Reyes Station, California.

Table SOP 4 – 1. Bird species encountered in the SIEN parks during the avian inventory projects at DEPO (Siegel and Wilkerson 2004), SEKI (Siegel and Wilkerson 2005), and YOSE (Siegel and DeSante 2002).

.

Common Name	**Genus**	**Species**	**Code[a]**
Pied-billed Grebe	*Podilymbus*	*podiceps*	PBGR
Great Blue Heron	*Ardea*	*herodias*	GBHE
Turkey Vulture	*Cathartes*	*aura*	TUVU
Mallard	*Anas*	*platyrhynchos*	MALL
Ring-necked Duck	*Aythya*	*collaris*	RNDU
Bufflehead	*Bucephala*	*albeola*	BUFF
Common Merganser	*Mergus*	*merganser*	COME
Osprey	*Pandion*	*haliaetus*	OSPR
Bald Eagle	*Haliaeetus*	*leucocephalus*	BAEA
Northern Harrier	*Circus*	*cyaneus*	NOHA
Sharp-shinned Hawk	*Accipiter*	*striatus*	SSHA
Cooper's Hawk	*Accipiter*	*cooperii*	COHA
Northern Goshawk	*Accipiter*	*gentilis*	NOGO
Red-shouldered Hawk	*Buteo*	*lineatus*	RSHA
Red-tailed Hawk	*Buteo*	*jamaicensis*	RTHA
Golden Eagle	*Aquila*	*chrysaetos*	GOEA
American Kestrel	*Falco*	*sparverius*	AMKE
Peregrine Falcon	*Falco*	*peregrinus*	PEFA
White-tailed Ptarmigan	*Lagopus*	*leucura*	WTPT
Sooty Grouse	*Dendragapus*	*fuliginosus*	SOGR
Mountain Quail	*Oreortyx*	*pictus*	MOUQ
California Quail	*Callipepla*	*californica*	CAQU
Virginia Rail	*Rallus*	*limicola*	VIRA
American Coot	*Fulica*	*americana*	AMCO
Killdeer	*Charadrius*	*vociferus*	KILL
Spotted Sandpiper	*Actitis*	*macularius*	SPSA
Common Snipe	*Gallinago*	*gallinago*	COSN

Table SOP 4 – 1. Bird species encountered in the SIEN parks during the avian inventory projects at DEPO, SEKI, and YOSE (continued).

Common Name	Genus	Species	Code[a]
California Gull	*Larus*	*californicus*	CAGU
Band-tailed Pigeon	*Patagioenas*	*fasciata*	BTPI
Mourning Dove	*Zenaida*	*macroura*	MODO
Flammulated Owl	*Otus*	*flammeolus*	FLOW
Western Screech-Owl	*Megascops*	*kennicottii*	WESO
Great Horned Owl	*Bubo*	*virginianus*	GHOW
Northern Pygmy-Owl	*Glaucidium*	*gnoma*	NOPO
Spotted Owl	*Strix*	*occidentalis*	SPOW
Great Gray Owl	*Strix*	*nebulosa*	GGOW
Northern Saw-whet Owl	*Aegolius*	*acadicus*	NSWO
Common Nighthawk	*Chordeiles*	*minor*	CONI
Common Poorwill	*Phalaenoptilus*	*nuttallii*	COPO
Black Swift	*Cypseloides*	*niger*	BLSW
Vaux's Swift	*Chaetura*	*vauxi*	VASW
White-throated Swift	*Aeronautes*	*saxatalis*	WTSW
Black-chinned Hummingbird	*Archilochus*	*alexandri*	BCHU
Anna's Hummingbird	*Calypte*	*anna*	ANHU
Calliope Hummingbird	*Stellula*	*calliope*	CAHU
Rufous Hummingbird	*Selasphorus*	*rufus*	RUHU
Belted Kingfisher	*Ceryle*	*alcyon*	BEKI
Acorn Woodpecker	*Melanerpes*	*formicivorus*	ACWO
Williamson's Sapsucker	*Sphyrapicus*	*thyroideus*	WISA
Red-breasted Sapsucker	*Sphyrapicus*	*ruber*	RBSA
Nuttall's Woodpecker	*Picoides*	*nuttallii*	NUWO
Downy Woodpecker	*Picoides*	*pubescens*	DOWO
Hairy Woodpecker	*Picoides*	*villosus*	HAWO
White-headed Woodpecker	*Picoides*	*albolarvatus*	WHWO
Black-backed Woodpecker	*Picoides*	*arcticus*	BBWO
Northern Flicker	*Colaptes*	*auratus*	NOFL

Table SOP 4 – 1. Bird species encountered in the SIEN parks during the avian inventory projects at DEPO, SEKI, and YOSE (continued).

Common Name	Genus	Species	Code[a]
Pileated Woodpecker	*Dryocopus*	*pileatus*	PIWO
Olive-sided Flycatcher	*Contopus*	*cooperi*	OSFL
Western Wood-Pewee	*Contopus*	*sordidulus*	WEWP
Willow Flycatcher	*Empidonax*	*traillii*	WIFL
Hammond's Flycatcher	*Empidonax*	*hammondii*	HAFL
Gray Flycatcher	*Empidonax*	*wrightii*	GRFL
Dusky Flycatcher	*Empidonax*	*oberholseri*	DUFL
Pacific-slope Flycatcher	*Empidonax*	*difficilis*	PSFL
Black Phoebe	*Sayornis*	*nigricans*	BLPH
Say's Phoebe	*Sayornis*	*saya*	SAPH
Ash-throated Flycatcher	*Myiarchus*	*cinerascens*	ATFL
Western Kingbird	*Tyrannus*	*verticalis*	WEKI
Cassin's Vireo	*Vireo*	*cassinii*	CAVI
Hutton's Vireo	*Vireo*	*huttoni*	HUVI
Warbling Vireo	*Vireo*	*gilvus*	WAVI
Steller's Jay	*Cyanocitta*	*stelleri*	STJA
Western Scrub-Jay	*Aphelocoma*	*californica*	WESJ
Clark's Nutcracker	*Nucifraga*	*columbiana*	CLNU
Common Raven	*Corvus*	*corax*	CORA
Horned Lark	*Eremophila*	*alpestris*	HOLA
Tree Swallow	*Tachycineta*	*bicolor*	TRES
Violet-green Swallow	*Tachycineta*	*thalassina*	VGSW
Northern Rough-winged Swallow	*Stelgidopteryx*	*serripennis*	NRWS
Cliff Swallow	*Petrochelidon*	*pyrrhonota*	CLSW
Mountain Chickadee	*Poecile*	*gambeli*	MOCH
Chestnut-backed Chickadee	*Poecile*	*rufescens*	CBCH
Oak Titmouse	*Baeolophus*	*inornatus*	OATI
Bushtit	*Psaltriparus*	*minimus*	BUSH
Red-breasted Nuthatch	*Sitta*	*canadensis*	RBNU

Table SOP 4 – 1. Bird species encountered in the SIEN parks during the avian inventory projects at DEPO, SEKI, and YOSE (continued).

Common Name	Genus	Species	Code[a]
White-breasted Nuthatch	*Sitta*	*carolinensis*	WBNU
Pygmy Nuthatch	*Sitta*	*pygmaea*	PYNU
Brown Creeper	*Certhia*	*americana*	BRCR
Rock Wren	*Salpinctes*	*obsoletus*	ROWR
Canyon Wren	*Catherpes*	*mexicanus*	CANW
Bewick's Wren	*Thryomanes*	*bewickii*	BEWR
House Wren	*Troglodytes*	*aedon*	HOWR
Winter Wren	*Troglodytes*	*troglodytes*	WIWR
American Dipper	*Cinclus*	*mexicanus*	AMDI
Golden-crowned Kinglet	*Regulus*	*satrapa*	GCKI
Ruby-crowned Kinglet	*Regulus*	*calendula*	RCKI
Blue-gray Gnatcatcher	*Polioptila*	*caerulea*	BGGN
Western Bluebird	*Sialia*	*mexicana*	WEBL
Mountain Bluebird	*Sialia*	*currucoides*	MOBL
Townsend's Solitaire	*Myadestes*	*townsendi*	TOSO
Swainson's Thrush	*Catharus*	*ustulatus*	SWTH
Hermit Thrush	*Catharus*	*guttatus*	HETH
American Robin	*Turdus*	*migratorius*	AMRO
Wrentit	*Chamaea*	*fasciata*	WREN
California Thrasher	*Toxostoma*	*redivivum*	CATH
European Starling	*Sturnus*	*vulgaris*	EUST
American Pipit	*Anthus*	*rubescens*	AMPI
Cedar Waxwing	*Bombycilla*	*cedrorum*	CEDW
Phainopepla	*Phainopepla*	*nitens*	PHAI
Orange-crowned Warbler	*Vermivora*	*celata*	OCWA
Nashville Warbler	*Vermivora*	*ruficapilla*	NAWA
Yellow Warbler	*Dendroica*	*petechia*	YWAR
Magnolia Warbler	*Dendroica*	*magnolia*	MAWA
Yellow-rumped Warbler	*Dendroica*	*coronata*	YRWA

Table SOP 4 – 1. Bird species encountered in the SIEN parks during the avian inventory projects at DEPO, SEKI, and YOSE (continued).

Common Name	Genus	Species	Code[a]
Black-throated Gray Warbler	*Dendroica*	*nigrescens*	BTYW
Townsend's Warbler	*Dendroica*	*townsendi*	TOWA
Hermit Warbler	*Dendroica*	*occidentalis*	HEWA
American Redstart	*Setophaga*	*ruticilla*	AMRE
MacGillivray's Warbler	*Oporornis*	*tolmiei*	MGWA
Common Yellowthroat	*Geothlypis*	*trichas*	COYE
Wilson's Warbler	*Wilsonia*	*pusilla*	WIWA
Yellow-breasted Chat	*Icteria*	*virens*	YBCH
Western Tanager	*Piranga*	*ludoviciana*	WETA
Green-tailed Towhee	*Pipilo*	*chlorurus*	GTTO
Spotted Towhee	*Pipilo*	*maculatus*	SPTO
California Towhee	*Pipilo*	*crissalis*	CALT
Rufous-crowned Sparrow	*Aimophila*	*ruficeps*	RCSP
Chipping Sparrow	*Spizella*	*passerina*	CHSP
Brewer's Sparrow	*Spizella*	*breweri*	BRSP
Black-chinned Sparrow	*Spizella*	*atrogularis*	BCSP
Black-throated Sparrow	*Amphispiza*	*bilineata*	BTSP
Savannah Sparrow	*Passerculus*	*sandwichensis*	SAVS
Fox Sparrow	*Passerella*	*iliaca*	FOSP
Song Sparrow	*Melospiza*	*melodia*	SOSP
Lincoln's Sparrow	*Melospiza*	*lincolnii*	LISP
White-crowned Sparrow	*Zonotrichia*	*leucophrys*	WCSP
Dark-eyed Junco	*Junco*	*hyemalis*	DEJU
Rose-breasted Grosbeak	*Pheucticus*	*ludovicianus*	RBGR
Black-headed Grosbeak	*Pheucticus*	*melanocephalus*	BHGR
Blue Grosbeak	*Passerina*	*caerulea*	BLGR
Lazuli Bunting	*Passerina*	*amoena*	LAZB
Indigo Bunting	*Passerina*	*cyanea*	INBU
Red-winged Blackbird	*Agelaius*	*phoeniceus*	RWBL

Table SOP 4 – 1. Bird species encountered in the SIEN parks during the avian inventory projects at DEPO, SEKI, and YOSE (continued).

Common Name	Genus	Species	Code[a]
Western Meadowlark	*Sturnella*	*neglecta*	WEME
Brewer's Blackbird	*Euphagus*	*cyanocephalus*	BRBL
Brown-headed Cowbird	*Molothrus*	*ater*	BHCO
Bullock's Oriole	*Icterus*	*bullockii*	BUOR
Gray-crowned Rosy-Finch	*Leucosticte*	*tephrocotis*	GCRF
Pine Grosbeak	*Pinicola*	*enucleator*	PIGR
Purple Finch	*Carpodacus*	*purpureus*	PUFI
Cassin's Finch	*Carpodacus*	*cassinii*	CAFI
House Finch	*Carpodacus*	*mexicanus*	HOFI
Red Crossbill	*Loxia*	*curvirostra*	RECR
Pine Siskin	*Carduelis*	*pinus*	PISI
Lesser Goldfinch	*Carduelis*	*psaltria*	LEGO
Lawrence's Goldfinch	*Carduelis*	*lawrencei*	LAGO
American Goldfinch	*Carduelis*	*tristis*	AMGO
Evening Grosbeak	*Coccothraustes*	*vespertinus*	EVGR
House Sparrow	*Passer*	*domesticus*	HOSP

[a]These four-letter codes should be used to indicate species on the point count data forms.

Standard Operating Procedure (SOP) 05: Conducting Point Counts

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP gives step-by-step instructions for surveying birds with unlimited-radius, 5-minute point counts with distance sampling, including completion of the Point Count Conditions Form and Point Count Form, which are provided at the end of the SOP. Procedures for locating point count stations are described in SOP 08: Establishing, Relocating, and Describing Survey Points.

This survey utilizes 5-minute, unlimited-radius point counts with distance sampling. Recording the distance to each bird detected allows estimation of detection probability, an essential analytical component of this study. Partitioning the data into birds detected during the first three minutes and the last two minutes of the point count facilitates comparison with results from the continent-wide Breeding Bird Survey (BBS), which utilizes 3-minute point counts.

Completing the Point Count Conditions Form

Before beginning each transect, complete the top section of the Point Count Conditions Form, as follows:

- **Park:** Enter SEKI, YOSE, OR DEPO.
- **Transect:** Enter the 4-digit transect number.
- **Date:** Enter the date as mm/dd/yyyy
- **Observer:** Enter the first and last name of the observer.

Upon arriving at each sample point, immediately mark the site with a vinyl flag differing in color from the flags used for marking the travel route. The next step is to complete a line of data in the table on the Point Count Conditions Form, as follows.

Point: Enter the 4-character point name. The first two characters indicate the semi-cardinal direction traveled from the origination point to the first point (e.g. NW for northwest, or NN for north). The last two characters indicate the sequential order of the point along the half-transect (e.g. the first point surveyed by a particular observer would be 01; the second point would be 02, etc.).

Noise (1-5): Record the noise interference during the point count using the following codes:

Noise Code	Explanation
1	No noise.
2	Slight noise, but probably not missing birds.
3	Moderate noise, might be missing some high-pitched songs/calls of distant birds.
4	Substantial noise, detection radius is probably substantially reduced.
5	Loud noise, probably detecting only the closest/loudest birds.

Wind (0-6): Record the wind conditions during the point count using the following codes:

Wind Code (Beaufort Scale)	Explanation
0	Calm; smoke rises vertically (<2 km/h)
1	Light air; smoke drifts (2-5 km/h)

2	Light breeze; wind felt on face, leaves rustle (6-12 km/h)
3	Gentle breeze; leaves and twigs in constant motion (13-19 km/h)
4	Moderate breeze; small branches move; raises loose paper; dust rises (20-29 km/h)
5	Fresh breeze; small trees sway (30-39 km/h)
6	Strong breeze; large branches moving, wind whistling (40-50 km/h)
Wind stronger than this precludes point counts.	

Precip (1-3): Record the rain conditions during the point count using the following codes:

Rain Code	Explanation
1	No rain.
2	Mist or fog.
3	Light drizzle.
Rain stronger than this precludes point counts.	

Point Comment: If any additional information is needed to explain your entries for the preceding fields, provide it here.

Transect Comments: Space is provided here for any more general observations about weather or other conditions present.

Completing the Point Count Form

After all data on the Point Count Conditions form have been collected, prepare to conduct the point count. Make yourself comfortable by taking off your backpack and situating binoculars so that they are in a comfortable and accessible position around your neck. Place the point count data form on the top of your clipboard and complete the top portion of the form as follows:

- **Park:** Enter SEKI, YOSE, OR DEPO.
- **Transect:** Enter the 4-digit transect number.
- **Date:** Enter the date as mm/dd/yyyy
- **Observer:** Enter the first and last name of the observer.

When you are ready, set your stop watch to begin the count. During the 5-minute point count, record data as follows:

Point: Enter the 4-character point name. The first two characters indicate the semi-cardinal direction traveled from the origination point to the first point (e.g. NW for northwest, or NN for north). The last two characters indicate the order of the point along the half-transect, starting from the origination point (e.g. the first point surveyed by a particular observer would be 01; the second point would be 02, etc.). For each point, you must write the point name on the first row of data (describing the first bird detection) only. This space may be left blank for subsequent detections at the same point.

Start Time: Record the 4-digit time of day the point count began (ex. 0620). For each point you must write the start time on the first row of data (describing each point's first bird detection). This space may be left blank for subsequent detections at the same point.

Species: Enter the 4-letter bird species code (refer to SOP #4: ***Training Observers*** for a complete list of 4-letter species codes). Juvenile birds should not be recorded on the data form. It can be difficult to age birds during point counts but in general you should count a bird unless you are confident it is a juvenile. Juvenile birds are defined as birds that hatched during the current breeding season. Clues to look for which may indicate a young bird include: the presence of family groups of birds, birds wearing juvenile plumage, weak-flying birds, and begging from or being fed by parents. Be familiar with the typical signs of young birds; species-specific plumage varies but in general look for downy, fluffy plumage that often looks quite different from that of an adult of the same species, a fleshy gape (often bright in color and contrasting with the bill color), and heavy body molt (plumage will look unusually messy with new body feathers growing in and replacing downy pre-juvenal feathers). Once birds have dispersed from the immediate breeding area it can become much more difficult to identify a young bird. The seasonal timing of this survey should ensure that juvenile birds are encountered rarely, except at higher elevations, where upslope migrating birds (that hatched at lower elevations) may appear before the local young have fledged.

In rare instances, it may not be possible for observers to identify particular birds to species. The following 4-letter codes for incompletely identified birds are acceptable, but should be used judiciously.

Species Code	Explanation
UNAH	Unidentified *Accipiter* Hawk
UNBI	Unidentified Bird
UCFI	Unidentified *Carpodacus* Finch
UNDU	Unidentified Duck
UEFL	Unidentified *Empidonax* Flycatcher
UNFL	Unidentified Flycatcher
UNGU	Unidentified Gull
UNHA	Unidentified Hawk
UNHU	Unidentified Hummingbird
UNOW	Unidentified Owl
UPCH	Unidentified *Poecile* Chickadee
UNSA	Unidentified Sapsucker
UNSP	Unidentified Sparrow
USWA	Unidentified Swallow
USWI	Unidentified Swift
UNTH	Unidentified Thrush
UNWA	Unidentified Warbler
UNWO	Unidentified Woodpecker
UNWR	Unidentified Wren

Using these 'unidentified' codes is preferable to possibly mis-identifying birds, which results in two errors--the wrong species is recorded and the correct species is missed.

Distance: Record the horizontal distance in meters to a bird when it was first detected. If the bird moves closer to you later during the count, do not change the distance estimation. Record distances for all birds except individuals or groups classified as 'flyovers' (see below).

Seen First (Y/N): 'Y' indicates the distance to the bird was estimated *after* visually locating the bird. 'N' indicates the distance to the bird was estimated without first seeing the bird.

Ever Sang (Y/N): 'Y' indicates the bird sang at least once during the five-minute point count. 'N' indicates the bird did not sing during the five-minute point count. Here we provide guidelines for differentiating songs from calls. Most songbirds have a typical song that is generally not confused with typical call notes. An example is the Black-headed Grosbeak, whose song can be described as a high, drunken, rolling warble and whose call is a high, sharp *pik* note. Groups of birds that we will often encounter in the field that have less well-defined songs and calls include hawks and falcons, grouse and quail, owls, woodpeckers, flycatchers, jays and crows,. The general rule, to follow for distinguishing between songs and calls for all species, is to defer to vocalization descriptions in <u>The Sibley Field Guide to Birds of Western North America</u>, with a few clarifications, as described below.

<u>Hawks and falcons</u>: Never sing; regard all vocalizations as calls.

<u>Grouse and quail</u>: Low hoot of SOGR is classified as song, all other vocalizations areclassified as calls. *Quark* of MOUQ and *Chi ca go* of CAQU are classified as songs, all other vocalizations are calls.

<u>Owls</u>: Songs are defined as the typical series of hoots a male defending territory would give. This does not include any of the female and juvenile calls. The NOPO's 'submarine sonar' vocalizations and FLOW's *poop* are classified as songs.

<u>Woodpeckers</u>: Songs are limited to rattles for most species. Calls are defined as all contact calls, drumming and any other vocalizations. For NOFL and PIWO the similar sounding *wuk wuk wuk wuk wuk* vocalizations are classified as songs; all other vocalizations are calls.

<u>Flycatchers</u>: Well-defined by Sibley. Typical two- and three-note vocalizations from *empidonax* flycatchers are classified as songs.

<u>Jays and crows</u>: Never sing; regard all vocalizations as calls.

<u>Chickadees</u>: MOCH's *cheeseburger* is classified as a song. CBCH does not sing.

Time Interval: Circle ‘3’ if the bird was first detected in the first three minutes of the point count, and ‘2’ if the bird was first detected during the last two minutes of the point count.

Prev. Obs.: Enter ‘Y’ to indicate that the same individual bird was recorded on more than one point count. The ‘Y’ should be associated with the count on which the species was at a greater distance from the observer. Otherwise this field should be left blank.

Flyover: ‘Y’ indicates the detection was a ‘flyover’--a bird or birds that flew over the top of the vegetation canopy, never touched down in the observer’s field of view, and did not appear to be foraging, displaying, or behaving in any other way that might suggest a link to the habitat below. The space should simply be left blank when the detection is not a flyover.

Group Size: A blank field indicates a single individual, whereas a numerical entry indicates the number of birds in a flock. Bird species for which group size entries may be greater than one are limited to species that may flock during the breeding season, such as: swallow species, Cedar Waxwing, Red Crossbill, Evening Grosbeak, Pine Siskin, Gray-crowned Rosy-Finch, and late-season, high-elevation aggregations of Golden-crowned Kinglet and Dark-eyed Junco. Even for these species, only record birds together as a flock if they are clearly behaving as a flock. Multiple birds singing in the same general area, or chasing each other do not qualify as a flock. For all other birds, even if you see multiple individuals moving together or interacting, provide a separate line of data for each individual. Note that clusters of individuals of species that do not normally flock may be post-fledging family groups, in which case the juveniles should not be counted.

Comments: Use this field only for essential comments about a particular bird detection, such as noting any uncertainty about species identification.

Miscellaneous Things to Keep in Mind while Conducting Point Counts

- Approach each point as quietly as possible. If you need to repack your things or add or remove clothing, try to postpone doing so until after the point count.

- Be sure to periodically rotate your body so that you do not spend the entire point count facing the same direction; you must do your best to track birds around you in all directions.

- Try to keep track of individual birds, so that if they move you will not mistake them for additional individuals.

- Do not forget to record the common species—they are easy to tune out as you are concentrating on detecting and identifying rarer species.

- When estimating distances to birds, do not round to the nearest 5 m or 10 m; make your best estimate to the nearest meter.

SIEN Bird Monitoring—Point Count Conditions Form

Park:_________ Transect:______________ Date:______/______/______ Observer:_____________________

Point	Noise (1-5)[1]	Wind (0-6)[2]	Rain (1-4)[3]	Point Comment

Transect Comments:

[1]Noise Code	Explanation
1	No noise.
2	Slight noise, but probably not missing birds.
3	Moderate noise, might be missing some high-pitched songs/calls of distant birds.
4	Substantial noise, detection radius is probably substantially reduced.
5	Loud noise, probably detecting only the closest/loudest birds.

[2]Wind Code (Beaufort Scale)	Explanation
0	Calm; smoke rises vertically (<2 km/h)
1	Light air; smoke drifts (2-5 km/h)
2	Light breeze; wind felt on face, leaves rustle (6-12 km/h)
3	Gentle breeze; leaves and twigs in constant motion (13-19 km/h)
4	Moderate breeze; small branches move; raises loose paper; dust rises (20-29 km/h)
5	Fresh breeze; small trees sway (30-39 km/h)
6	Strong breeze; large branches moving, wind whistling (40-50 km/h)
Wind stronger than this precludes point counts.	

[3]Rain Code	Explanation
1	No rain.
2	Mist or fog.
3	Light drizzle.
Rain stronger than this precludes point counts.	

SIEN Bird Monitoring—Point Count Form

Park:_________ Transect:______________ Date:______/______/______ Observer:____

Point	**Start Time** (hh:mm)	**Species code** (4 char)	**Dist.** (m)	**Seen First** (Y/N)	**Ever Sang** (Y/N)	**Time Interval**[1]	**Prev. Obs.**[2] (Y/__)	**Flyover**[2] (Y/__)	**Group Size**	**Comments**
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				
						3 2				

[1]Time Interval: **3**=first detected during first 3 minutes of point count; **2=**first detected during last 2 minutes. [2]Mark Y (for yes) when positive; if negative leave blank

Standard Operating Procedure (SOP) 06: Classifying Vegetation

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP gives step-by-step instructions for classifying vegetation at each point count location.

The objective of habitat classification at each of the point count stations is to: (1) use vegetation class as a covariate in developing detectability functions, (2) determine if there are any coarse-grained changes in vegetation classes associated with avian monitoring points over time, and (3) aid in point relocation in subsequent years. Vegetation is to be classified at each location where a point count is conducted, but is not required for transect origin points. Vegetation will be classified within a 50-m radius circle centered at the point count. All vegetation within the 50-m radius circle should be considered when classifying the habitat. The Habitat Classification Form is provided at the end of this SOP.

Habitat Classification Form

Use the following methods when completing the Habitat Classification Form:

- **Park:** Enter SEKI, YOSE, OR DEPO.
- **Transect:** Enter the 4-digit transect number.
- **Date:** Enter the date as mm/dd/yyyy.
- **Observer:** Enter the first and last name of the observer.

Point: Enter the 4-character point name. The first two characters indicate the semi-cardinal direction traveled from the origination point to the first point (e.g. NW for northwest, or NN for north). The last two characters indicate the order of the point along the half-transect, starting from the origination point (e.g. the first point surveyed by a particular observer would be 01; the second point would be 02, etc.).

Hab1 and Hab2: Space is provided to enter habitat data for up to 2 habitats at each point. Habitat designations follow the National Vegetation Classification System (NVCS) habitat classification developed by Natureserve (2003, 2004), and should be made at the level of alliance (rather than association). If there is only one NVCS alliance present within the 50-m radius plot, complete the fields for Hab1 only. If two NVCS alliances are present, determine which one occupies a greater proportion of the vegetation plot, and enter data for it after Hab1. Enter data for the other habitat after Hab2.

NVCS Alliance Name: Write out the full name of the appropriate alliance for the primary habitat and secondary habitat (if present) on the plot.

NVCS Alliance Code: Enter the code of the appropriate alliance for the primary habitat and secondary habitat (if present) on the plot.

Notes: Provide any comments or notes needed to elaborate on the classification of the habitat within 50 m of the survey point.

References

NatureServe 2003. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono Counties, California.

NatureServe 2004. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono Counties, California. Modified for use in Sequoia and Kings Canyon National Parks.

Habitat Classification Form—SIEN Bird Monitoring

Park:__________ Transect:________________ Date:_______/_______/_______ Observer:_

Point		NVCS Alliance Name	NVCS Alliance Code	Notes
	Hab1			
	Hab2			
	Hab1			
	Hab2			
	Hab1			
	Hab2			
	Hab1			
	Hab2			
	Hab1			
	Hab2			
	Hab1			
	Hab2			
	Hab1			
	Hab2			

Standard Operating Procedure (SOP) 07: Collecting GPS Data

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP refers to SIEN's Data Management Plan and another network's step-by-step instructions for collecting position information using the GPS receiver model available to the bird monitoring field crew.

Collecting and processing GPS data will follow standard Network procedures (Chapter 6 and Appendix 6-B in Cook and Lineback 2008). At the current time, SIEN plans to use the Thales Mobile Mapper for collecting GPS data for this bird monitoring protocol. Personal training by park staff will be provided. Detailed instructions for this GPS unit can be found in SOP #10 *in* Landbird Monitoring Protocol for National Parks in the North Coast and Cascades Network (Siegel et al. 2007) and will be provided to field personnel in addition to personal training.

References

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR--2008/070. National Park Service, Fort Collins, Colorado. Available at: https://science1.nature.nps.gov/naturebib/biodiversity/2008-11-26/SIENDMP_CompletePlan_20081125.pdf (accessed 14 June 2010).

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

Standard Operating Procedure (SOP) 08:
Establishing, Relocating, and Describing Survey Points

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP explains the procedures for establishing, marking, and relocating sampling points at SEKI and YOSE, including completion of the Point Establishment Form and the Transect Visit Log. Note that all data forms referred to in this SOP can be found at the end of the SOP. Procedures for establishing, marking and relocating sampling points at DEPO differ somewhat, and the differences are addressed in SOP #15: Special Considerations for Devils Postpile National Monument. Detailed instructions for collecting location coordinates are not provided in this SOP, but instead are presented in SOP #7: Collecting GPS Data, supra.

Establishing a New Transect

The Day before Conducting Point Counts

A pair of observers will split up to conduct the two halves of a single transect during each morning of sampling. For each transect, observers will be given maps and coordinates indicating a transect 'origin' point that lies on a trail. Observers should make every effort to reach this point the afternoon before the planned survey. If camp has been established somewhere prior to reaching the transect origin, it may be tempting to forego visiting the site until the morning of the survey, but this should be avoided, as it is likely to lead to delays and problems the following morning if the point proves difficult to locate. Additionally, by timing the trip back from the origin point to camp, observers can determine with certainty what time they will need to set out towards the point in the morning.

The first time a transect is surveyed (the serially alternating portion of the sample design ensures that this will happen for at least the first four years of the project), the observers should mark the origin point and the first survey point in each direction along the transect. Instructions for installing permanent markers are provided below in section 4 (Installing permanent markers) of this SOP.

In addition to marking the origin point, observers should mark the first two off-trail points of the transect, i.e., the first point on each transect half. These will usually be the first two points of the transect, but if, for example, the first two points heading northeast need to be placed on the trail, the first northeast point would not be marked, but instead the third northeast point—the first one to be conducted off-trail—should be marked.

The first two off-trail points should be marked using the guidelines below in section 4 (Installing permanent markers) of this SOP. These points can be marked the afternoon before the point counts are conducted, or the following morning, after the point counts have been completed. Either way, observers must be sure to record all the relevant information in the Permanent Marker Information section at the bottom of the Point Establishment Form for the appropriate points.

Once the origin point and the first two off-trail points have been marked, the observers can return to camp for the night. They should be sure to time the walk, so that the proper time to leave camp the next morning can be determined.

The Day of the Point Count Survey

Observers should arrive at the transect origin the next morning with plenty of time to then separate and reach their first point count stations, such that their first point counts can begin within 10 minutes of official sunrise.

Determining the Direction of Travel when Establishing a New Transect: The direction of travel from the transect origin to the first point count station in each direction should be determined as follows:

a) Using a topographic map and a ruler, rotate the ruler around the origin point until the ruler intersects the trail at a distance of 250 m from the origin point. Mark this 250-m linear intersection from the origin point on both lengths of the trail. If this segment of trail is straight, then simply mark the points that are 250 m ‘up trail’ and 250 m ‘down trail’ from the origin. If the trail bends or turns, however, instead mark points that are 250 m from the origin, ‘as the crow flies’.

b) Place the ruler on the map with the edge touching both of the 250-m intersections and draw a line between the two points (now known as the ‘perpendicular line’).

c) Place the edge of the ruler on the origin point and rotate the ruler until it forms a right angle with the newly drawn perpendicular line. Hold the ruler at this right angle and draw a line on the map along the edge of the ruler; this is the direction of travel indicator line.

d) The direction of off-trail travel is the cardinal or semi-cardinal direction (NN, NE, EE, SE, SS, SW, WW, or NW) that most closely matches the travel indicator line drawn on the map.

The direction of travel selected will determine the name of the points on each half of the transect. Each point is named with a unique 8-character string that consists of the transect number + the direction of travel from the origin point + the sequential point number along that half of the transect. For example, if an observer heads southwest from the origin point 3005, the first point will be called 3005SW01, the second point will be called 3005SW02, and so on. Even if for some reason the observer must change direction somewhere along the transect, all points surveyed on that half-transect will still be named according to the original direction of travel; in this case they will all contain ‘SW’. Note that traveling due north from the origin point would yield points with “NN” in their names, due south would yield points with “SS”, and so on.

Once the direction of off-trail travel has been determined, use pacing to measure 125 m in the indicated direction. Use vinyl flagging to mark the route, with flags spaced such that the next flag is visible from each flag. Stop at 125 m, and use a different color flag to mark the first point count station. Then conduct a point count, following the instructions in **SOP #5: *Conducting Point Counts***.

After conducting the first point count, continue walking in the same cardinal or semi-cardinal direction followed to reach the first point count station. Fifty meters out from the point count station, leave two flags of the same color as the route-marking flags right next to each other. This double flag serves two functions. It signals the boundary of the vegetation plot when you return later to assess the vegetation at the point count station, and it also will warn that you are nearing a survey point, and prevent you from accidentally bypassing the point when you return to collect vegetation data. Then continue on to the remainder of the points, remembering to flag the route, to place a double flag 50 m beyond each point, and to mark each point with a flag that is a different color than the route-marking flags.

What To Do When an Obstacle is Encountered: In some instances it will not be possible to travel 125 m off-trail in the indicated direction, or for that matter, in any off-trail direction, from the transect origin. This will most commonly occur where the trail crosses very steep terrain, or where it lies adjacent to an uncrossable stream. When this occurs, instead travel 125 m along the trail, in whichever direction will lead further away from your partner's planned route. Conduct the first point count on the trail, using pacing, the field map, and the GPS unit to ensure that the point is 125 m from the origin, as the crow flies. Note that if there are switchbacks or the trail doubles back, then it may be necessary to walk more than 125 m to end up 125 m from the origin. Name the point (and all subsequent points) according to the cardinal or semi-cardinal direction that most closely approximates the direction the trail follows between the origin and the point. Do not install a permanent marker at the first point count station if it lies on the trail. After conducting a point count at the point, assess again whether it is now possible to walk 250 m perpendicular to the trail. If it is, proceed in that direction for the duration of this transect. If the path is still blocked by an obstacle, continue along the trail, placing additional points at 250-m intervals (as the crow flies) along the trail. After each point count, leave the trail and head off-trail in the manner described above if it is possible. If and when it is finally possible to conduct a point count off-trail, install a permanent marker at the point according to the procedures described below in section 4 of this SOP.

Observers will sometimes encounter impassable obstacles, such as cliffs or rivers, between successive off-trail points. In this situation, the direction of travel should be revised as follows:

1. If you have already left the previous point count station, you must return to it before altering your direction of travel. Then assess the directions defined by the original direction of travel +/- 45º. If both appear traversable, randomly select one of them, and then follow it for the remainder of the transect (unless another barrier is encountered). If one direction is traversable and the other is not, follow the traversable one for the remainder of the transect. If neither direction is traversable, assess the directions defined by the original direction +/- 90º, in the same manner as described above.

2. Follow this new direction of travel for the duration of this transect unless another impassable barrier is encountered, in which case follow the above methods again to determine another new direction of travel. Regardless of how many times the direction of travel must be changed, all points along the half-transect will be named according to the original direction of travel, the one followed to reach the first point from the transect origin.

When establishing a new transect, it is important that both observers are careful to ensure they do not allow their separate halves of the transect to overlap with one another. Observers should examine the topographic map and coordinate with one another in planning their intended travel routes before beginning the transect. It is essential that all survey points be placed at least 250 m from one another.

Observers should stop conducting point counts when another point count cannot be completed before 3.5 hours after sunrise.

Relocating an Existing Transect

The Day before Conducting Point Counts

As when establishing a new transect, observers should find the transect origin point the afternoon prior to conducting the point count survey. If the origin point was marked in a previous year, and can be relocated, do not complete the Permanent Marker Information section on the Point Establishment Form. If the previously installed marker cannot be relocated, a new marker must be installed, and the Permanent Marker Information section of the Point Establishment Form for the transect origin must be completed. Detailed instructions for installing permanent markers are provided below in section 4 of this SOP.

When visiting a transect that was marked previously, the last task before heading back to camp the afternoon prior to conducting the survey is to find the markers that were placed at the first two off-trail point count stations (first off-trail station in each direction). Using the information provided from the Point Establishment Forms that were completed when the points were marked in a previous year, follow the indicated bearing for 100 m in each direction, and find the markers indicating where the morning's first two point counts should be conducted. As with finding the marker for the transect origin, if a marker that was placed during a previous visit cannot be relocated, it is necessary to install a new permanent marker and complete the Permanent Marker Information section of the Point Establishment Form. Be sure to note in the Marker Comments section that the previously installed marker could not be relocated. Then use flagging to mark the point conspicuously, and also to indicate the route between the transect origin and the first survey point. This will save time and effort in the morning.

The Day of the Point Count Survey

As when conducting a new transect, observers should be in place to conduct their first point counts at the correct location within 10 minutes of official sunrise. After completing the first point count, the bearing and directions provided on the Point Establishment Form from a previous year should be followed to orienteer to each successive point count station along the transect. Every effort should be made to conduct point counts at all the previously established point count stations before 3.5 hours after sunrise. Occasionally this may not be possible; however, no point counts should be conducted later than 3.5 hours after sunrise, even if this means that one or more points will go un-surveyed. Conversely, sometimes an established transect will be completed well before 3.5 hours after sunrise. In this circumstance, continue in the same direction of travel, and establish and survey as many more points as can be completed before 3.5 hours after sunrise.

Completing the Point Establishment Form

After completing the last point count for the morning, take a rest if needed. Then start retracing the route back toward the transect origin, collecting flagging along the way. When establishing new points, complete a Habitat Assessment Form (see **SOP #6: Classifying Vegetation**), and a Point Establishment Form for each point. When surveying points that have been surveyed previously, it is necessary to complete the Point Establishment Form only if the following circumstances arise:

a. In the field, it is discovered that all or part of an established transect has become inaccessible due to some change (a landslide, for example) since the time it was last visited. It is necessary to re-route the transect.
b. You believe that you are not at the location where the previous observer conducted the point count, and for whatever reason you are unable to get to that location.
c. You wish to correct or improve upon the previous observer’s description of the point or the travel features (see explanation of the Point Establishment Form, below).

When surveying points that have been previously surveyed,, and none of the three conditions above applies, it is not necessary to complete a full Point Establishment Form; rather, a Point Revisit Form, which is simply an abbreviated version of the Point Establishment Form, may be completed. Note that each field on the Point Revisit Form should be completed according to the instructions for the corresponding field on the Point Establishment Form.

The Point Establishment Form should be completed as follows.

Park: Enter SEKI, YOSE, or DEPO.

Transect: Enter the 4-digit transect number.

Date: Enter the date as mm/dd/yyyy

Observer: Enter the first and last name of the observer.

Point: Enter the 4-character point name. The first two characters indicate the cardinal or semi-cardinal direction traveled from the origin point to the first point (e.g. NW for northwest, or NN for north). The last two characters indicate the sequential order of the point along the half-transect, starting from the origin point (e.g. the first point surveyed by an observer who traveled northwest from the origin to the first point would be NW01; the second point would be NW02, even if the observer encountered a barrier and had to change directions after the first point count. When completing a Point Establishment Form for the origin point, simply enter 'T.O.' (Transect Origin).

Point Type: Circle 'Origin' if the point is an origin point; otherwise circle 'Survey'.

Bearing to Point: Enter the compass bearing (in declinated degrees) to the point, from the previous point (or from the origin point, if completing for point 01). Leave this space blank on the Point Establishment Form for the origin point. If the trail was deliberately followed, rather than an off-trail bearing, to the present point, then write 'Trail' rather than providing a compass bearing.

Change of Direction: Enter 'Y' if it was necessary to change the direction of travel to reach this point (that is, if it was necessary to change direction after conducting the *previous* point count). Enter 'N' if direction was not changed, or when completing the form for the origin point or for the first point on either half-transect.

Reason: If 'Y' was entered for Change of Direction, provide here a *brief* explanation of why you had to change directions. Example entries include 'Steep slope' or 'Un-crossable stream'.

Coordinate Source: Circle 'Map only' if coordinates could not be obtained from a GPS unit, and instead the location was estimated solely by using the field map. Circle 'GPS' if coordinates were obtained from the GPS unit (it is assumed that the GPS unit was used in conjunction with a map).

Elevation: Enter the elevation and indicate whether the units are feet or meters.

Elevation Source: Circle the primary method used to obtain the elevation (Altimeter=altimeter and map; GPS=GPS unit and map; map=map only). Do not use elevation measurements obtained from Garmin or equivalent GPS units.

Aspect: Enter the aspect in degrees.

GPS Model: Enter name of the GPS unit you are using (example: "Thales Mobile Mapper" or "Garmin eTrex".

GPS file name: If you saved a GPS file, indicate the name.

Easting: UTM easting (based on NAD83) of the survey point.

Northing: UTM northing (based on NAD83) of the survey point.

GPS Error: Error in meters, as provided by the GPS unit. Leave blank if no GPS unit was used.

Datum: Enter the datum on which the coordinates are based. Field maps are based on NAD83.

Travel Feature 1: Indicate a prominent landscape feature (e.g. a creek or a ridge top) encountered along the way between the previous point and the indicated point. Include the name of the landscape feature, if it is indicated on the topographic map.

Distance from previous point: The approximate distance (based on pacing) from the previous point to the indicated landscape feature.

Travel Feature 2: Indicate a second prominent landscape feature (if available) encountered along the way between the previous point and the indicated point. Include the name of the landscape feature, if it is indicated on the topographic map.

Distance from previous point: The approximate distance (based on pacing) from the previous point to the indicated landscape feature.

Travel Feature 3: Indicate a third prominent landscape feature (if available) encountered along the way between the previous point and the indicated point. Include the name of the landscape feature, if it is indicated on the topographic map.

Distance from previous point: The approximate distance (based on pacing) from the previous point to the indicated landscape feature.

Travel Feature 4: Indicate a fourth prominent landscape feature (if available) encountered along the way between the previous point and the indicated point. Include the name of the landscape feature, if it is indicated on the topographic map.

Distance from previous point: The approximate distance (based on pacing) from the previous point to the indicated landscape feature.

Notes regarding travel between points: Provide any additional notes that might assist subsequent observers in finding their way to the correct place to conduct the point count.

Conspicuous Features Seen From Point

- **Description:** Indicate up to three visible features that will help future observers confirm they are at the correct location. Visible features could include permanent geographical features (such as mountain peaks or ridgelines) or conspicuous features closer to the point, such as boulders, bodies of water, or large, distinctive trees.
- **Distance (m):** Indicate the distance from the survey point to the feature.
- **Bearing (º):** Provide the declinated compass bearing *from the survey point to the feature.*

Description of Point: Provide any additional notes that might assist subsequent observers in confirming that they are in the right location.

Permanent Marker Information: See section 4 of this SOP, below.

Installing Permanent Markers

Permanent markers can aid in the efficient relocation of survey points from year to year. However it should be noted that GPS reception is generally quite good in SIEN parks, and this project therefore remains logistically feasible even without the use of permanent markers.

Follow the instructions below when installing permanent markers at origin points or the first off-trail point count stations on each half of a transect. No other point count stations should receive permanent markers.

If there are trees within 20 m of the point, use an aluminum tag to mark the nearest tree, or another nearby tree if for some reason it is more prominent than the nearest tree. Use a nail to inscribe the tag with the following information:

- [4-character park code] + "I&M" (example: YOSE I&M)
- "Bird Mon."
- Transect number + "T.O." (specifying transect origin; e.g., 5035T.O.) or transect number + direction of travel + point number (for point count stations; e.g., 5035SS01)
- Today's date (mm/dd/yyyy)

Then use a permanent marker pen to write the same information again on the other side of the tag. Nail the tag to the back side of the tree you selected, being sure to fold it so it juts out perpendicularly from the trunk, leaving both the inscribed label and the permanent marker label visible.

If there are no trees within 20 m of the origin point, use a plastic ground stake to mark the point. Use permanent marker pen to write the information indicated above for aluminum tags on the stake, and then hammer the stake part-way into the ground, within a few meters of the edge of the trail. Make sure that the marker will not be visible to the casual hiker.

For origin points and for the first off-trail point counts on each half-transect only, regardless of which type of marker is used or even if for some reason no marker is used, it is necessary to complete the section called "Permanent Marker Information" at the bottom of the appropriate Point Establishment Form. The fields in this section of the form should be completed as follows:

Marker Number: Enter the transect number + "T.O." (transect origin) or transect number + the point name (i.e. 5035SS01). If for some reason you did not mark a point that did not already have a marker, write “None” in this field, and provide explanation at the bottom of the form, after “Marker Comments”.

Install Date: Today’s date in the mm/dd/yyyy format.

Removal Date: Leave blank unless removing a pre-installed marker, in which case enter the current date.

Marker Type: Indicate ‘aluminum tag’ or ‘ground stake’.

Marker Substrate: If an aluminum tree tag was used, indicate the scientific name of the tree species to which the tag was nailed. If a ground stake was used, simply write ‘ground’.

Height Above Ground: For tree tags indicate the approximate height above ground, in centimeters. For ground stakes, indicate the approximate height to which the stake protrudes from the ground, in centimeters.

Offset Dist: Indicate the distance between the actual survey point and the marker, in meters.

Offset Bearing: Indicate the declinated compass bearing *from the point to the marker*.

Marker Comments: Provide any additional information that might help someone find the marker in the future, including a brief description of how to find the marker from the sampling point.

Completing the Transect Visit Log

When both partners have finished collecting habitat and location data at all of their points, they should meet at the transect origin point, where they can work together to complete the Transect Visit Log, as follows.

Park: Enter SEKI, YOSE, OR DEPO.

Transect: Enter the 4-digit transect number.

Date: Enter the date as mm/dd/yyyy.

Observer1: Enter the first and last name of one of the observers.

Observer2: Enter the first and last name of the other observer.

Use the large table to summarize the data collected for each point on the transect; each point should receive its own line of data in the table. If more space is needed, attach a second sheet.

Transect Arm Code: For each point, indicate the 2-character direction code used to name the points along the half-transect (‘SW’, ‘SS’, etc.).

Point: Enter the 2-digit point code (‘01’ for the first point, ‘02’ for the second point, etc.).

Intended Location: Enter ‘N’ if you have any reason to believe you were not in the intended location for this point count. This might occur if you were unable to find the marker for a previously marked point, or if a new landslide prevented you from following the route taken the last time the transect was surveyed. Enter ‘Y’ if you believe you conducted the point count in the place where it was conducted previously (for previously established transects), or if you determined the location by correctly following the protocol (for new transects).

Comment: If you answered ‘N’ to the previous question, provide a brief explanation here.

Site Data: Enter Y or N to indicate whether new site data was collected for the Point Establishment Form.

Coordinates: Enter Y if new coordinates were collected for the survey point, even if they differ little or not at all from previous coordinates collected. Enter ‘N’ if for some reason no coordinates were collected.

Travel Feature Desc.: Enter Y or N to indicate whether new travel feature descriptions were collected for the Point Establishment Form.

Point Marking: Enter Y or N to indicate whether a new marker was installed.

Comments: Provide any additional information needed to explain the entries in the previous fields.

Below the table, additional general information is requested about the transect as a whole.

Transect Comments: Indicate anything else that seems important to note about the transect, including the general level of difficulty presented by the terrain. It would also be helpful to future crews to indicate where you camped the night before, and the amount of time needed to travel from the campsite to the transect origin. Also provide detail about any problems experienced in reaching, finding, or marking the transect or any of the points, or about any other logistic problems encountered.

Other interesting wildlife observations and/or plant phenology observations: Describe any interesting wildlife observations (birds as well as other animals) and indicate anything notable about plant phenology—have deciduous shrubs fully leafed out yet? Are many forbs blooming?

Nest Observations: Incidental nest observations may provide important information about breeding phenology. If any active nests were observed while visiting this transect (though not necessarily at a survey point) please indicate the species (4-letter code), and indicate the nesting stage by circling one of the choices provided.

The fields in the box at the lower right corner of the form are intended for office use, and should not be completed in the field.

After completing the last of the data forms, partners should trade data sheets. Review each other's sheets for missing or incorrectly recorded data, make any needed corrections, and discuss any interesting or surprising bird detections.

Standard Operating Procedure (SOP) 09: Reporting Rare Bird Detections

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP gives step-by-step instructions for reporting rare or incidental bird detections using the Rare Bird Report Form, which is provided at the end of this SOP.

Rare Bird Report Forms should be completed for all diurnal raptors, all owls, Willow Flycatcher, Swainson’s Thrush, and any other species you believe to be rare, unusual in the park, or outside of its normal elevational limits.

Note that many of the species requiring Rare Bird Report Forms are not truly “rare” within the parks; they are just rarely detected with morning point counts (e.g. owls). Also note that “rare” birds require report forms if they are detected in an SIEN park anytime during the field season, including during point counts, during the pre-season training session and during days off. Complete the fields on the Rare Bird Report Form as follows:

Park: Enter SEKI, YOSE, or DEPO.

Date: Date of the observation in mm/dd/yyyy format.

Time: Time of the observation in 24-hour format.

Observer 1: First and last name of the person who collected the most detailed notes on the bird detection.

Observer 2: First and last name of secondary observer; if none, leave blank.

Species Name: Full common name of the detected species.

Species Code: Four-letter species code.

Quantity: Enter the number of individuals of the species detected.

Location Name: Record the colloquial name of the observation location here. If there is no colloquial name leave this space blank.

Coordinate Source: Circle ‘Map’ if coordinates could not be obtained from a GPS unit, and instead the location was estimated solely by using the field map. Circle ‘GPS’ if coordinates were obtained from the GPS unit.

GPS Model: Enter name of the GPS unit you are using (example: “Thales Mobile Mapper”.

Easting: UTM easting (based on NAD83) of the detection location.

Northing: UTM northing (based on NAD83) of the detection location.

GPS Error: Error in meters, as provided by the GPS unit. Leave blank if no GPS unit was used.

Datum: Enter the datum on which the coordinates are based. Field maps are based on NAD83.

Transect and Point: Record the transect and point number if the bird was detected during a point count; otherwise, leave blank.

Nesting Stage: If a nest was observed in conjunction with this detection, indicate the nesting stage. If no nest was observed, do not mark any of the choices.

Description: Use this space to thoroughly document the rare bird sighting. Include diagnostic field marks and/or vocalizations that would separate the species from similar sounding or appearing species. For truly rare species, the documentation should be thorough enough to convince reviewers that the observation is authentic. Record the sex of the individual (if possible) as well as any nest sightings or activity indicative of nesting.

SIEN Bird Monitoring—Rare Bird Report Form

Park:__________ **Date**____/____/____ **Time:**________ **Observer 1:**___________________ **Observer 2:**_____________________

Species Name:___________________ **Species Code:**__ __ __ __ **Quantity:**______ **Location Name:**_______________________

Coordinate Source (circle one): **Map/ GPD/ GPS Model:** ______________________

Easting:__ __ __ __ __ __ **Northing:**__ __ __ __ __ __ __ **GPS Error** (m):_______ **Datum:**_________

Transect and Point (if detected during point count):______________ **Nesting Stage** (check one): ___Unkn. ___Building ___ Eggs ___Nestlings ___Recent Fledglings

Description (include fieldmarks and/or vocalization description, and indicate sex and any nest sightings or behavior indicative of nesting):

Standard Operating Procedure (SOP) 10: Special Considerations for Devils Postpile National Monument

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

In addition to monitoring bird populations in the large wilderness national park units of SIEN (namely Sequoia & Kings Canyon and Yosemite National Parks), this program also monitors birds at a smaller NPS unit, Devils Postpile National Monument (DEPO). Working in this smaller, 'front-country' park differs in many respects from working in the large parks, but we have nevertheless tried to integrate it into the larger regional effort. This SOP describes the ways in which data collection, data analysis, and reporting differ from the methods described for the larger parks.

Before the Field Season

At least one month prior to the start of the field season, the Project Lead should coordinate with the superintendent or resource personnel at DEPO to make sure that local personnel are aware of the monitoring efforts and the likely survey dates. Campsites or other accommodations for the field crew also need to be arranged.

Data Collection

The entire point count grid at DEPO is to be surveyed annually by the SIEN bird monitoring crew, or other qualified personnel, spaced evenly across all park acreage.

The sampling design at DEPO differs substantially from that of the large parks. Rather than arraying points along transects that start from randomly selected points along trails, we overlaid DEPO with a systematic grid of points, 250 m apart. This grid-based approach yields 42 survey points.

Due to the relatively small number of points and easy access, the survey at DEPO should be completed easily by a 2-person crew during 3 mornings of surveying, or by a lone observer working for six mornings. Additional time will be needed for travel to DEPO, and reconnaissance. In the interest of conducting the survey at the height of the breeding season, when most species are singing most intensively, the survey at DEPO should be conducted between 1 June and 15 June. If logistically feasible, it would be beneficial to survey points at DEPO each year in approximately the same sequence, so that individual points will be surveyed around the same time of day each year.

Data collection at DEPO will follow the same methods described elsewhere in this protocol, except for differences related to the fact that points are arrayed in a systematic grid, rather than along discrete transects (see Figure 2 of the protocol narrative).

Points in the grids do not need to be surveyed in the same order in successive years, provided that all points are surveyed within the dates specified above. Surveyors should group points opportunistically to facilitate surveying as many points as possible per morning.

Point counts at DEPO are not grouped into discrete 14-point transects as they are in the large parks; rather, for the purpose of data management (but not for data analysis), we are considering the entire grid of survey points to be a single transect. For data collection at DEPO, simply enter 'DEPO' as the transect.

Note that individual points are sequentially numbered 01, 02, 03, etc. These numbers should be used wherever the data forms require the point to be indicated.

When conducting surveys in the smaller parks, complete the **Point Establishment Form** according to instructions provided in **SOP #8: *Establishing, Relocating, and Describing Survey Points***, except for the following fields:

Point Type: All points should be recorded as ‘Survey’ points.

Bearing to Point: Leave blank.

Change of Direction: Leave blank.

Reason: Leave blank.

Notes regarding travel between points: Be sure to indicate which point or other landmark you are approaching the survey point *from*.

Permanent Marker Information: Leave all associated fields blank.

Survey points at DEPO should *not* be marked with permanent markers.

At the end of each day’s work at the smaller parks, each observer should complete a **Transect Visit Log**. The data form should be completed according to the instructions in SOP #8**:** ***Establishing, Relocating, and Describing Survey Points***, with the following exceptions:

Observer2: Leave blank.

Transect Arm Code: Leave blank.

Data Analysis and Reporting

Data analysis for DEPO will not make use of *BirdTrend* software developed to accommodate the more complicated sample design implemented at the larger parks. Rather, data analysis should use the best available detectability estimation parameters (for initial years of the project, these will need to be obtained from pooling detections from all SIEN parks, as described in SOP #16**:** ***Data Analysis and Reporting***) to estimate an annual park-wide density for each species detected in the park. Simple linear regression should then be used to test for temporal trends in the biennial estimates for each species.

Linear regression may be performed using numerous widely available statistical software packages, as well as spreadsheet applications. Instructions for performing linear regression analysis in Microsoft Excel are provided below.

- Import annual density estimates (calculated in *Distance*) into an Excel spreadsheet, such that the years are listed in a single column, and the density estimates in another column.

- Click Tools > Data Analysis.

- In the window titled Data Analysis select Regression and click OK. A new window titled Regression should appear. This window has many options. Below is a brief explanation of each.

- Highlight the density estimates and put into "Input Y Range".

- Highlight the years and put into "Input X Range".

- Click Labels, if the variable names were included under the Input Range.

- "Constant is zero" should NOT be checked.

- Click "Confidence Level", if you want to change the level of confidence when creating intervals for the regression parameters.
-
- Select one of the following Output options:
    a. Click "Output Range" if you want the test results to be placed on the current sheet. Next, simply input the cell where you want the output to be placed.
    b. Click "New Worksheet Ply" if you want the test results to be placed on a new sheet. Next, type the name of the new sheet where you want the output to be placed.

- Click "Residuals" to output the residual values. The residual value is simply the difference between the observed value and the fitted value.

- Click "Standardized Residuals" to output the standardized residual values. Standardized residual values, unlike residual values, are invariant to the scale of measurement. Standardized residuals can be used to check for outliers in the data. If the standardized residual value is above 3 or below -3, the observation is a potential outlier.

- Click "Residual Plots" to return the residual scatterplot. The scatterplot allows a visual check of the regression assumptions. If the scatterplot has any significant pattern, the regression assumptions are being violated.

- Click "Line Fit Plots" to return a scatterplot of the data with the predicted values added to the plot.

- Normal Probability Plots are used to check the normality assumption of the error term (or residuals). Click "Normal Probability Plots" to output the normal probability plot.

- Click "OK". The test results and outputted scatterplots will be placed onto your spreadsheet.

Suggested table formats for reporting results from the smaller parks are provided in SOP #16: ***Data Analysis and Reporting***.

Standard Operating Procedure (SOP) 11: After the Field Season

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP identifies tasks that must be addressed before SIEN bird monitoring field crews complete the field season.

Clean, Inventory, and Store Field Gear

Each field team at each park is responsible for cleaning and properly storing all field gear checked out to them at the beginning of the field season.

- First aid kits should be inventoried, so that all used supplies can be replenished. First aid supplies should be checked to insure items with expiration dates will still be usable during the following field season. Items that are or will be out of date should be noted so that they can be replaced at the beginning of the next field season.
- Wash and dry all bear-resistant food canisters.
- Clean all water pump filters and store in sealed plastic container.
- Report needed repairs or replacement parts to the Project Lead and appropriately label any damaged equipment.

Data Management

- Ensure that all data are properly entered into the computer database.

Close-out

- Return keys, radios, or any other park property.

Field Season Reporting

The Field Lead should prepare a brief report (generally not more than three pages) that includes the following:

- Clear enumeration of which transects were completed during the season.
- Description of any logistic difficulties that arose, and explanation of how they were addressed.
- Clear documentation and explanation of any diversions from established protocols.
- Discussion of any interesting or potentially important observations about the parks' bird communities that may have been noted during the field season (e.g., apparent changes in phenology from previous years, or notable changes in apparent abundance of particular species).
- Suggestions for improving the training session or field season logistics in the future.
- An inventory of field equipment, noting any items needing repair or replacement.

Standard Operating Procedure (SOP) 12:
Workspace Setup and Project Records Management

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

A section of the networked file server at each host park will be reserved for this project, and access permissions will be established so that project staff members have access to needed files within this workspace. File structures, file-naming conventions, and records management will follow standard Network procedures.

This information is contained in SIEN's Data Management Plan (Cook and Lineback 2008) and will also be provided to protocol personnel by the SIEN Data Manager. The following portions of the Data Management Plan will be referred to for these SOP topics, as these pertain to all SIEN protocols:

- File Naming Conventions: Chapter 11 and Appendix 11-A
- File Directory Structure: Chapter 11 and Appendix 11-B
- Records Management: Chapter 11 (and see next section of this SOP)

Archival and Records Management

All project files should be reviewed, cleaned up and organized by the Project Lead and NPS Lead on a regular basis (e.g., annually in January). Decisions on what to retain and what to destroy should be made following guidelines stipulated in NPS Director's Order 19, which provides a schedule indicating the amount of time that the various kinds of records should be retained. Many of the files for this project may be scheduled for permanent retention, so it is important to isolate and protect them, rather than lose them in the midst of a large, disordered array of miscellaneous project files. Because this is a long-term monitoring project, good records management practices are critical for ensuring the continuity of project information. Files will be more useful to others if they are well organized, well named, and stored in a common format. In addition, it is important that files containing sensitive information be stored in a manner that will enable quick identification. Refer to **SOP #19: Sensitive Information Procedures** for more information.

To help ensure safe and organized electronic file management, SIEN has a hierarchical file directory structure for organizing project and protocol data, information, and products. Analog (non-digital) materials are to be handled according to current practices of the individual park collections (and see Cook and Lineback 2008, Chapter 11 for a summary of archiving guidance and procedures at the SIEN parks).

References

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR--2008/070. National Park Service, Fort Collins, Colorado. Available at: https://science1.nature.nps.gov/naturebib/biodiversity/2008-11-26/SIENDMP_CompletePlan_20081125.pdf (accessed 14 June 2010).

Standard Operating Procedure (SOP) 13:
Data Entry and Verification

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Figures

Page

Figure SOP 13 – 1. The Data Gateway form. .... SOP 13 – 6

Figure SOP 13 – 2. The Point Sampling form. .... SOP 13 – 7

Figure SOP 13 – 3. Main Data Entry form. .... SOP 13 – 8

Figure SOP 13 – 4. Point Count Data form. .... SOP 13 – 9

Figure SOP 13 – 5. Habitat Assessment form. .... SOP 13 – 10

Figure SOP 13 – 6. Rare Bird Observations form. .... SOP 13 – 11

Figure SOP 13 – 7. Task List browser. .... SOP 13 – 11

Figure SOP 13 – 8. Close-up view associated with the Task List browser. .... SOP 13 – 12

Figure SOP 13 – 9. Training Notes form. .... SOP 13 – 12

Figure SOP 13 – 10. Tool for managing lookup tables. .... SOP 13 – 13

Figure SOP 13 – 11. Species popup form. .... SOP 13 – 14

Figure SOP 13 – 12. Project crew list. .... SOP 13 – 14

Figure SOP 13 – 13. Contact information popup for editing information
associated with the project crew list. .... SOP 13 – 15

Figure SOP 13 – 14. Database backup prompt. .... SOP 13 – 15

Figure SOP 13 – 15. Prompt for specifying where to save the database backup. .... SOP 13 – 16

Figure SOP 13 – 16. Update Data Table Connections tool. .... SOP 13 – 16

Introduction
The SIEN bird monitoring program will make use of the customized relational database structure developed for the NCCN landbird monitoring program by John Boetsch, Data Manager at Olympic National Park. The design of this database is consistent with the Natural Resource Database Template (NRDT).

Data Entry
1. Data entry should occur as soon after data collection as possible.

2. The working database application will be found in the project workspace. For enhanced performance, it is recommended that users copy the front-end database onto their workstation hard drives and open it there. This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as an interface with data residing in the back-end working database.

3. Each data entry form is patterned after the layout of the field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged only to use the pre-built forms as a way of ensuring the maximum level of quality assurance.

4. As data are being entered, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should be done for each record prior to moving to the next form for data entry.

5. At regular intervals and at the completion of data entry the Project Lead should inspect the data that have been entered to check for completeness and perhaps catch avoidable errors (see *Data Verification*, below).

The goal of data entry is to transcribe field observations into a computer database with 100% accuracy, although errors are unavoidable. Subsequent data verification is conducted to ensure that raw data matches entered data. Following verification, data validation may result in changes *to the entered data.* Data entry is a separate operation from data validation and care must be taken to not impose validation (beyond that automatically imposed by programming rules in a database) during data entry.

Data Verification:
- Project leaders are responsible for specifying in the project protocol one or more of the data verification methods available and ensuring proper execution. At the discretion of the project leader, additional verification methods may be applied.
- Data verification should be carried out by staff familiar with data collection and entry.
- All records (100%) will be verified against original source data.
- A subset of randomly selected records (10%) will be reviewed after initial verification by the project leader. If errors are found, the entire data set will be verified again.

- A record of the verification process for each dataset, including number of iterations and results, will be prepared by the project leader as part of formal metadata generation (see SOP #14: ***Metadata Development*** for more details).
- Spatial data collected as part of the project will be viewed in a GIS and visually inspected for accuracy (e.g., points located outside park boundaries, upland locations occurring in water).

Data quality is appraised by applying verification and validation procedures as part of the quality control process. These procedures are more successful when preceded by effective quality assurance practices (i.e., planning). Data *verification* checks that the digitized data match the source data, while data *validation* checks that the data make sense. Although data entry and verification can be handled by personnel who are less familiar with the data, validation *requires in-depth knowledge about the data* (Validation is discussed in detail in SOP#15: ***Data Quality Review, Validation, and Certification***).

Database Instructions

These instructions are excerpted from the NCCN landbird monitoring protocol, and will likely need to be modified slightly for use at SIEN [this will be accomplished before such date the protocol is implemented].

Getting Started

The first action to be taken is to make sure the data entry workspace is set up properly on a networked drive. If you are unclear about where this should be, contact either the local park wildlife biologist or the Data Manager.

- Store the back-end database file on the server so that others can enter data into the same back end file. The back-end file has "_be_" as part of its name. Upon saving this back-end, the user may want to append the local park code to distinguish it from other back-end files associated with other crews (e.g., Landbirds_BDa03_be_2007_OLYM.mdb).
- The crew's copy of the front-end database may also be stored in the same folder.
- If it doesn't already exist, also create a folder in the same network folder named "backups" or "backup_copies" for storing daily backups of the back-end database file.

Prior to Using the Database

- Open the front-end database. The first thing it will do is to ask to update the links to the back-end database file. This will only need to be done once for each new issue of the front-end database.

Important Reminders for Daily Database Use

- A fresh copy of the front-end will need to be copied to your workstation every day. ***Do not open up and use the front-end on the network*** as this 'bloats' the database file and makes it run more slowly.
- Backups should be made consistently at some point every day that data entry occurs. Normally the front-end application will automatically prompt you to make a backup either upon initially opening or upon exiting the application. Backups can also be made

on demand by hitting the "Back up data" button on the main menu and storing the backup file in the "backups" folder.

- To save drive space and network resources, backup files should be compacted by right-clicking on the backup file in Windows Explorer and selecting the option: "Add to Zip file". Older files may be deleted at the discretion of the project crew lead.
- New issues of the front-end application may be released as needed through the course of the field season. If this happens, there should be no need to move or alter the back-end file. Instead, the front-end file may be deleted and replaced with the new version, which will be named in a manner reflecting the update (e.g., Landbirds_2007_v2.mdb).
- If the front-end database gets bigger and slower, compact it periodically by selecting Tools > Database Utilities > Compact and Repair Database.

Database Components

The working front-end application has the following functional components, which are accessed from the main application switchboard form that opens automatically when the application starts:

- Enter / edit data – Opens a form to confirm default settings (e.g., park, coordinate datum) prior to continuing to the project-specific data entry screens.
- Training notes – Opens a form for entering information about individual pre-season and refresher training sessions.
- Site task list – Keeps track of unfinished tasks associated with sample locations (e.g., forgotten equipment, unfinished data collection) that one field crew can use to communicate with a future field crew.
- Lookup tables – Opens a tool for managing the lookup values for the project data set (e.g., species list, list of project personnel, etc.).
- QA checks – Opens the data validation tool, which shows the results of pre-built queries that check for data integrity, missing data, and illogical values, and allows the user to fix these problems and document the fixes. See SOP #15: ***Data Quality Review and Certification***.
- View db window – Allows the user to view database objects (tables, queries and forms).
- Back up data – Creates a date-stamped copy of the back-end database file.
- Connect data tables – Verifies the connection to the back-end working database file, and provides the option to redirect or update that connection.

Entering Data

It is important to enter (and verify) transect data in the following order:

1. Point Establishment form – accessed by hitting the "Point setup" button in the Data Gateway form (**Figure SOP 13 – 1**).
2. Transect Visit Log and Point Count Conditions form (and the Point Revisit Form if applicable) – all of which can be entered in the unified form called "Data Entry Form".

3. Habitat data – which can be accessed by hitting the “Habitat data” button in the Data Entry form at any point after entering transect-visit-log data.
4. Point count data – which can be accessed by hitting the “Point count data” button in the Data Entry form at any point after entering transect-visit-log data.

When you select the “Enter / edit data” button, you will have a chance to change the default user name, park and declination. Make sure this information is correct each time you go to enter data.

Next you will see the Data Gateway, which is where you will see a list of transect, sample point and incidental (rare bird observations) sample locations that are already present in the back-end database. This list is automatically filtered by the selected park (upper left corner), and to show only transect origins. Filters can be changed at any time, and records can be sorted by double-clicking on the field label above each column.

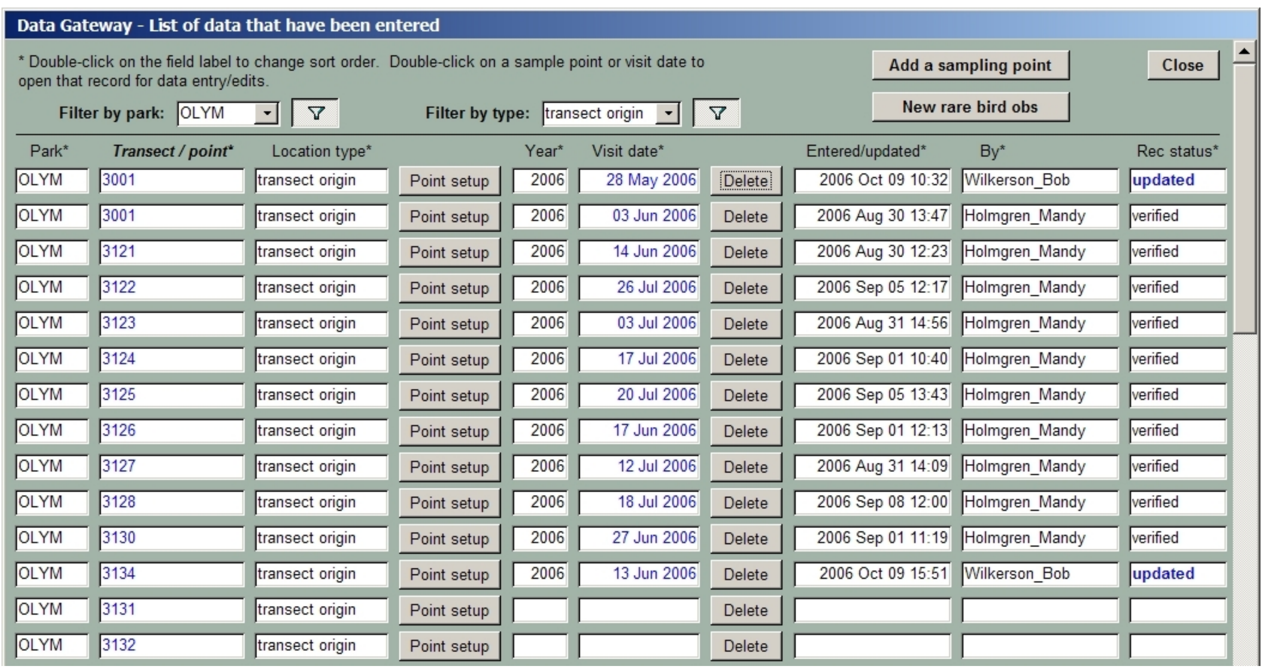


Figure SOP 13 – 1. The Data Gateway form.

Clicking the “Add a sampling point” button (upper right corner) will open the Point Sampling form (**Figure SOP 13 – 2**) to a blank record. To open an existing record for edits, or to complete data entry, click on the “Point setup” button associated with the desired record.

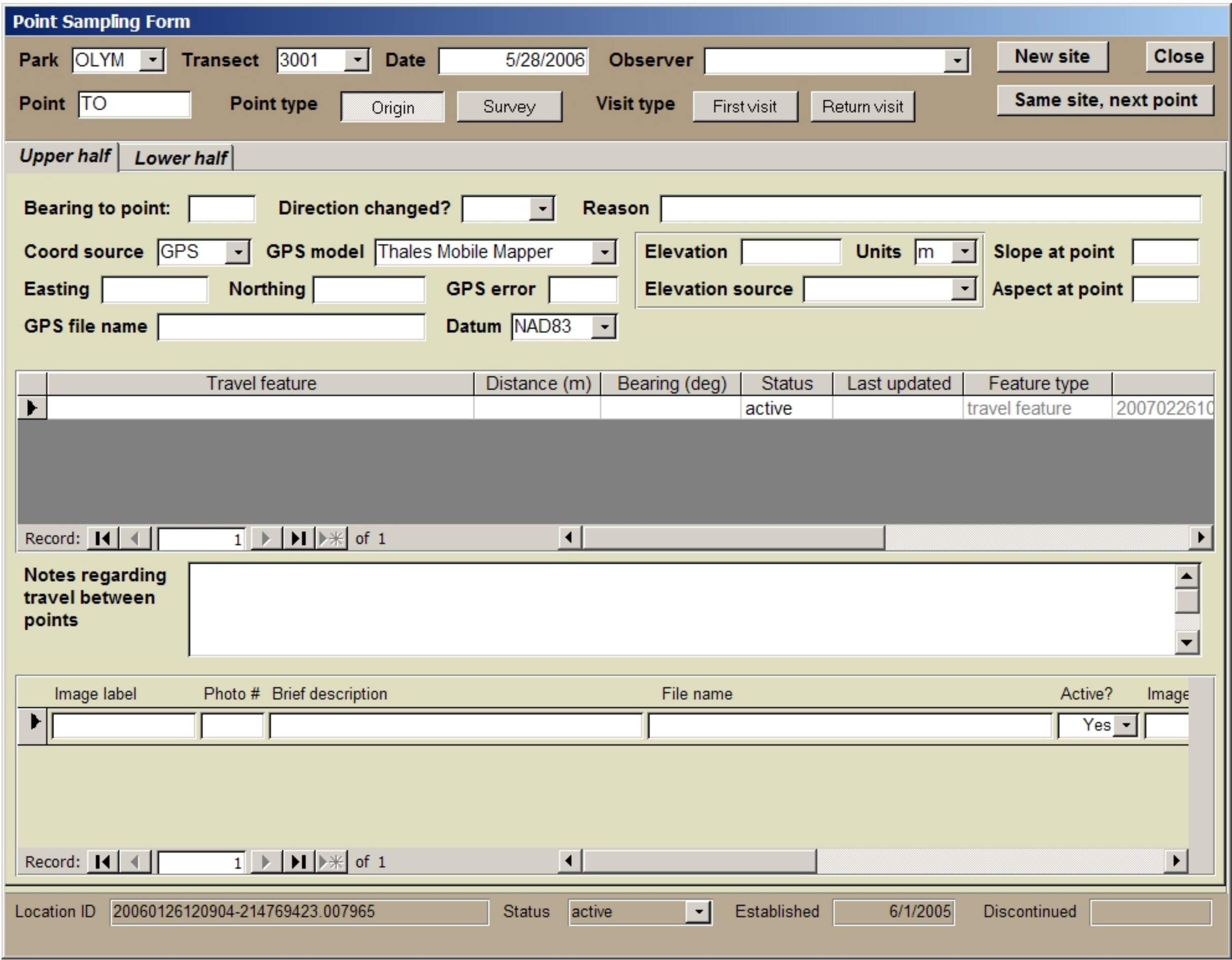


Figure SOP 13 – 2. The Point Sampling form.

In the Data Gateway form, double-click on the appropriate “Transect / point” cell, or on the “Visit date” cell to open the main data entry form (**Figure SOP 13 – 3**). This form has multiple tabs for entering the Transect Visit Log, the Plot Revisit Form, and the Point Count Conditions forms. It also has links for entering data from Point Count and Habitat Assessment forms associated with the transect visit.

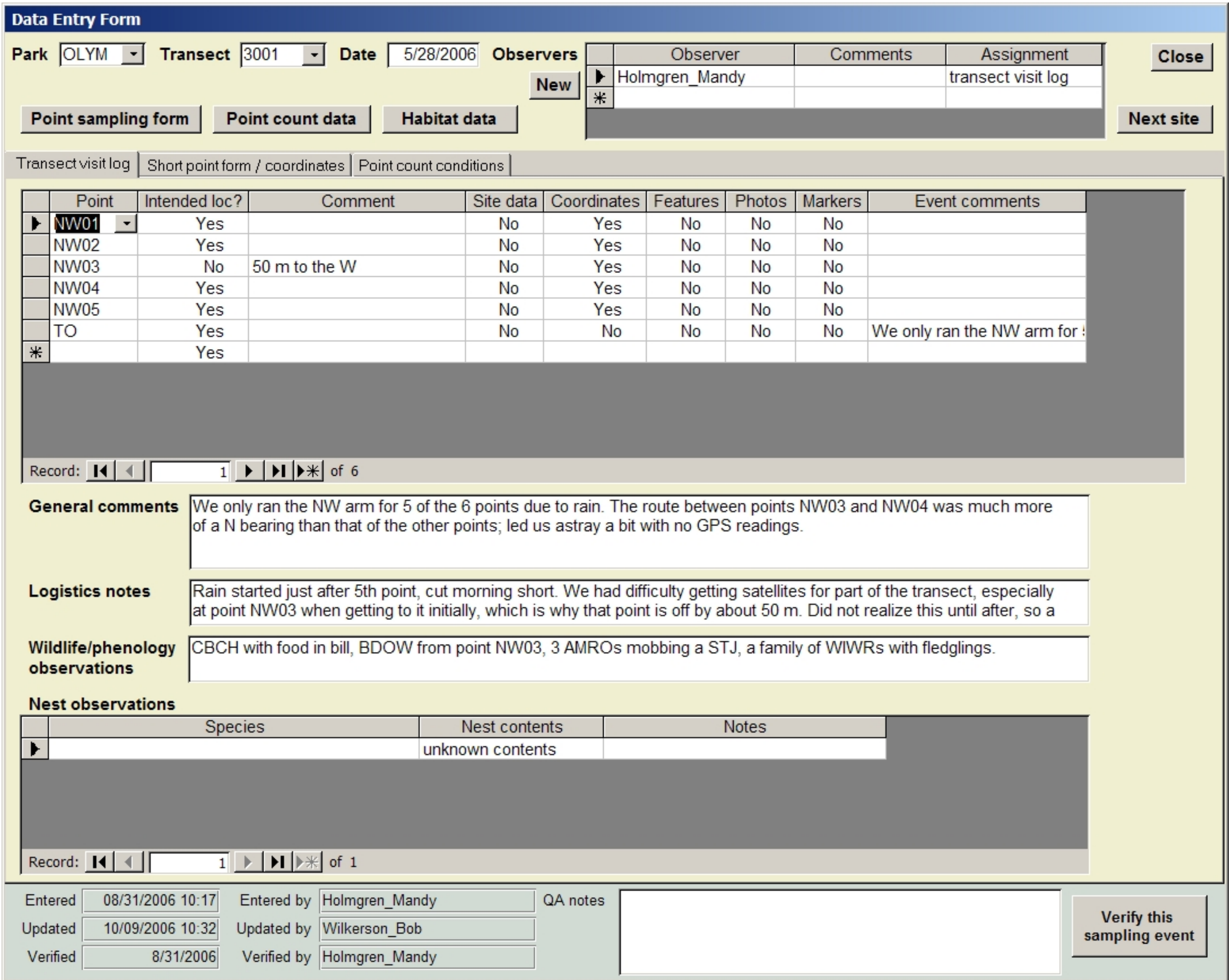


Figure SOP 13 – 3. Main Data Entry form.

Upon finishing data entry for each plot, the database entries should be compared against the original field forms. Most of the data entry screens – in particular the Data Entry Form, the Point Count Form, and the Rare Bird Observation Form – have fields for storing miscellaneous comments about each sampling event, quality assurance information about the event, and information on who created the sampling event record, who last updated it, etc. When all of the data for the sampling event have been entered, hit the button that says “Verify this sampling event” to indicate that the event record is complete and accurately reflects the field forms.

The following forms for point count data (**Figure SOP 13 – 4**) and habitat assessment (**Figure SOP 13 – 5**) can be accessed from the Data Entry Form using either the “Point count data” or “Habitat data” buttons at the top of the form.

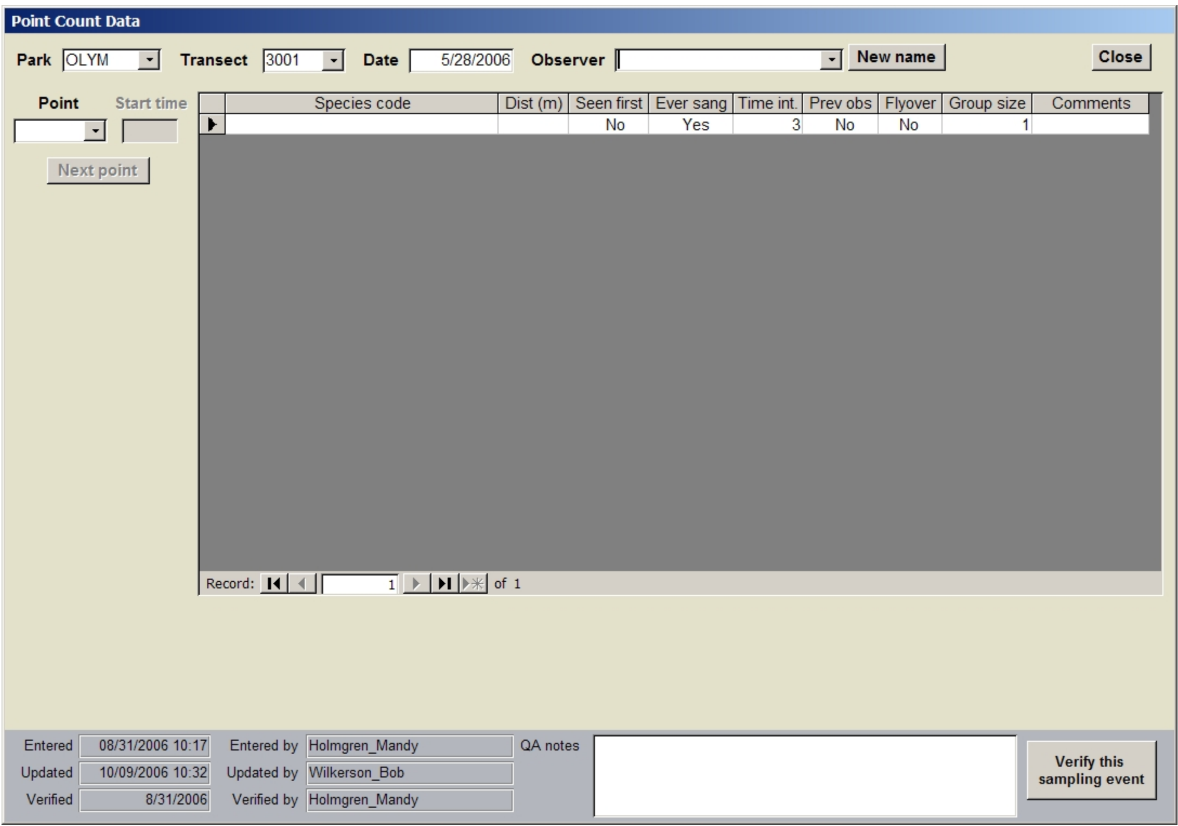


Figure SOP 13 – 4. Point Count Data form.

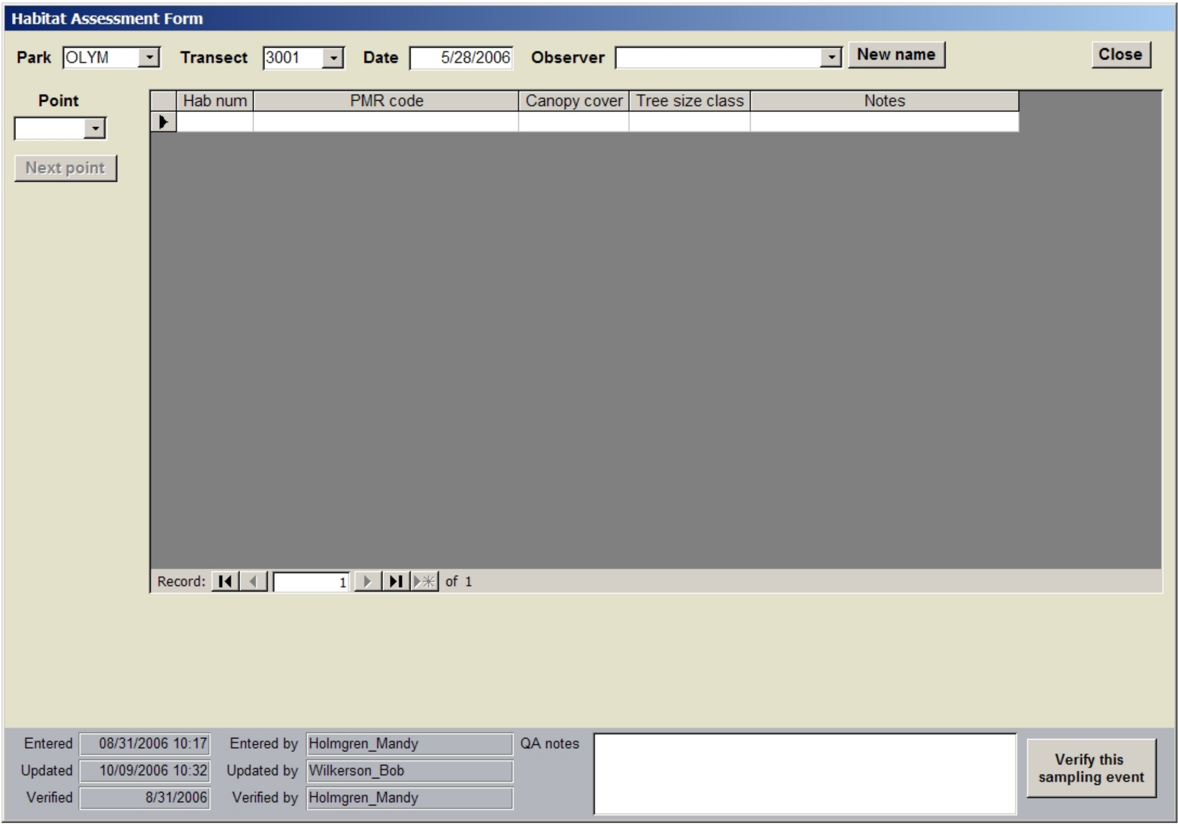


Figure SOP 13 – 5. Habitat Assessment form.

Rare bird observations can also be accessed from the Data Gateway form, either by changing the filter and opening by selecting the appropriate “Visit date” cell, or by adding a new record using the “New rare bird obs” button (**Figure SOP 13 – 6**). Relevant records may also be accessed directly for verification by double-clicking the appropriate row of the “Rec status” column in the Data Gateway form.

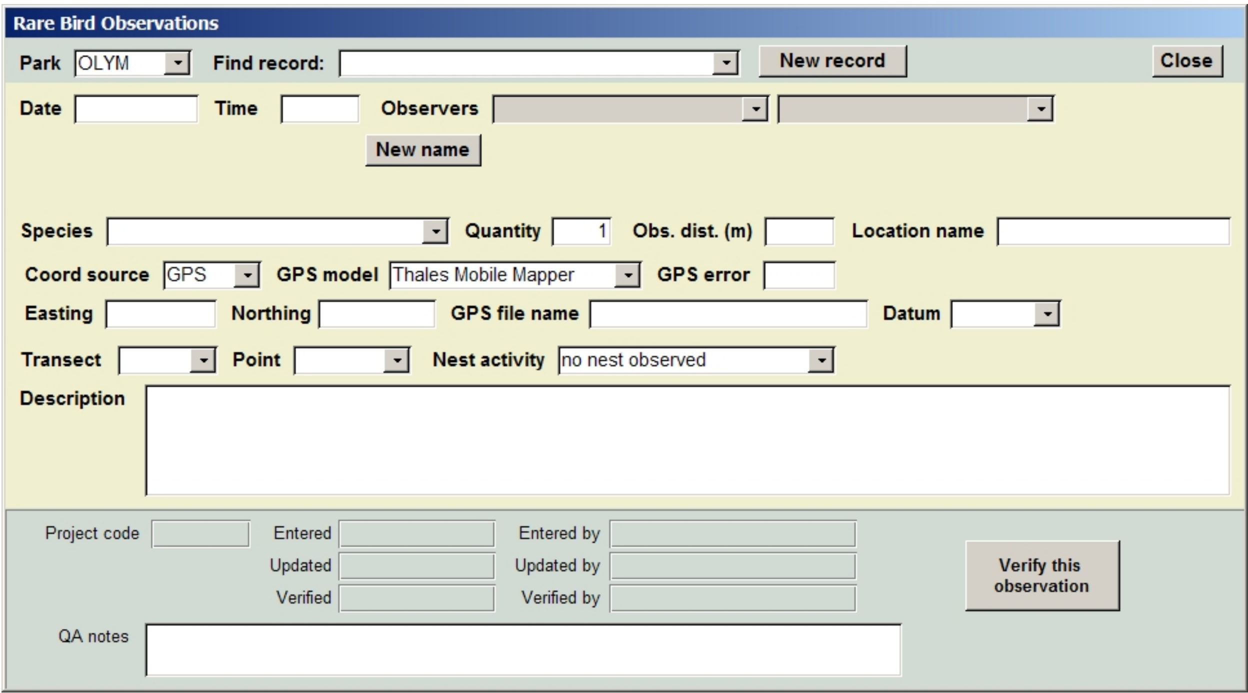


Figure SOP 13 – 6. Rare Bird Observations form.

Task List and Training Notes

The task list browser (**Figure SOP 13 – 7**) functions in much the same way as the Data Gateway form, and can be sorted or filtered by park or location type. Hit the “Closeup” button to view or edit information for that record.

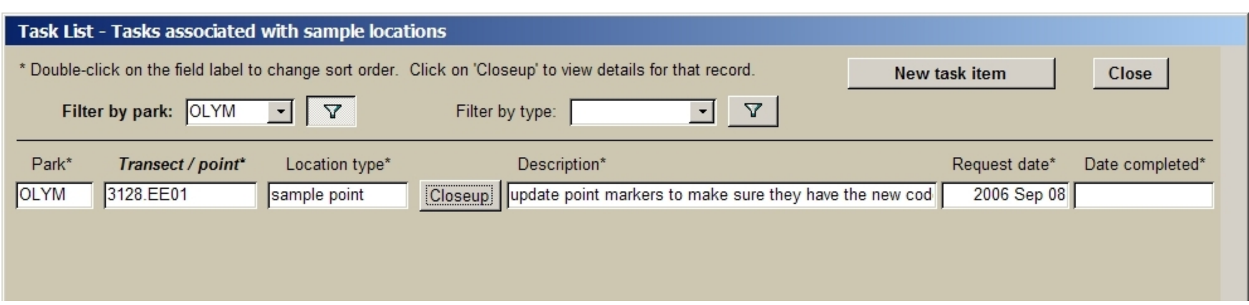


Figure SOP 13 – 7. Task List browser.

A sample close-up view for entering/editing location task items is provided in **Figure SOP 13 – 8**.

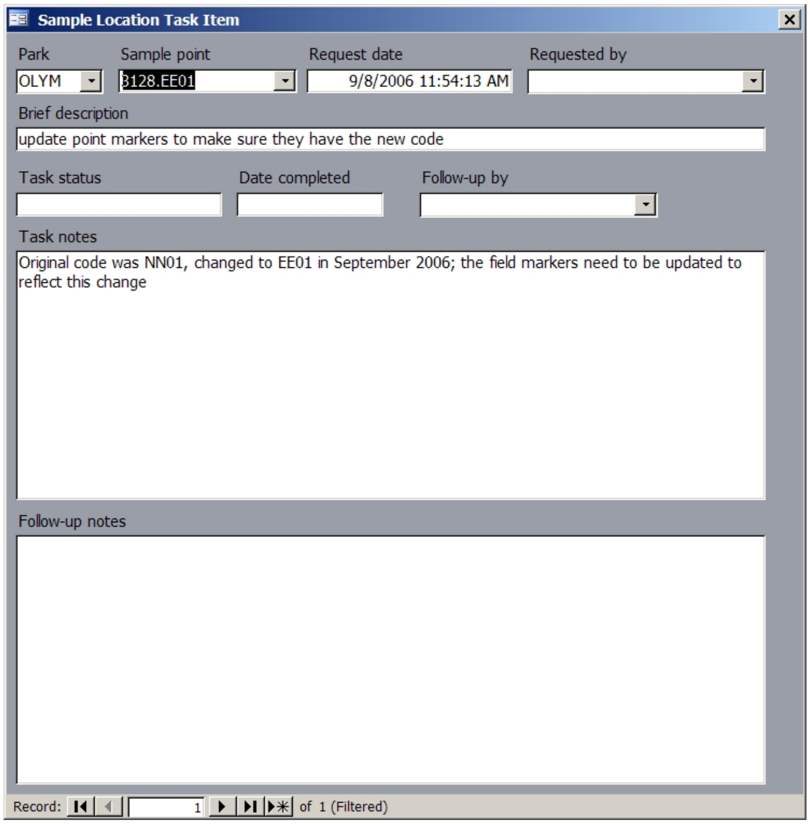


Figure SOP 13 – 8. Close-up view associated with the Task List browser.

The database also includes a separate for entering and storing training notes (**Figure SOP 13 – 9**).

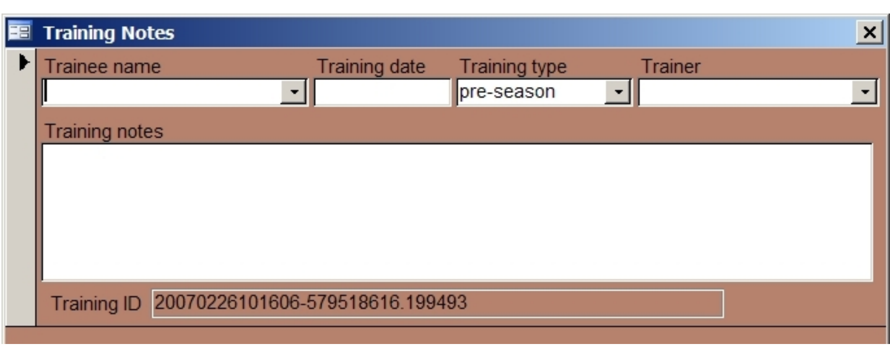
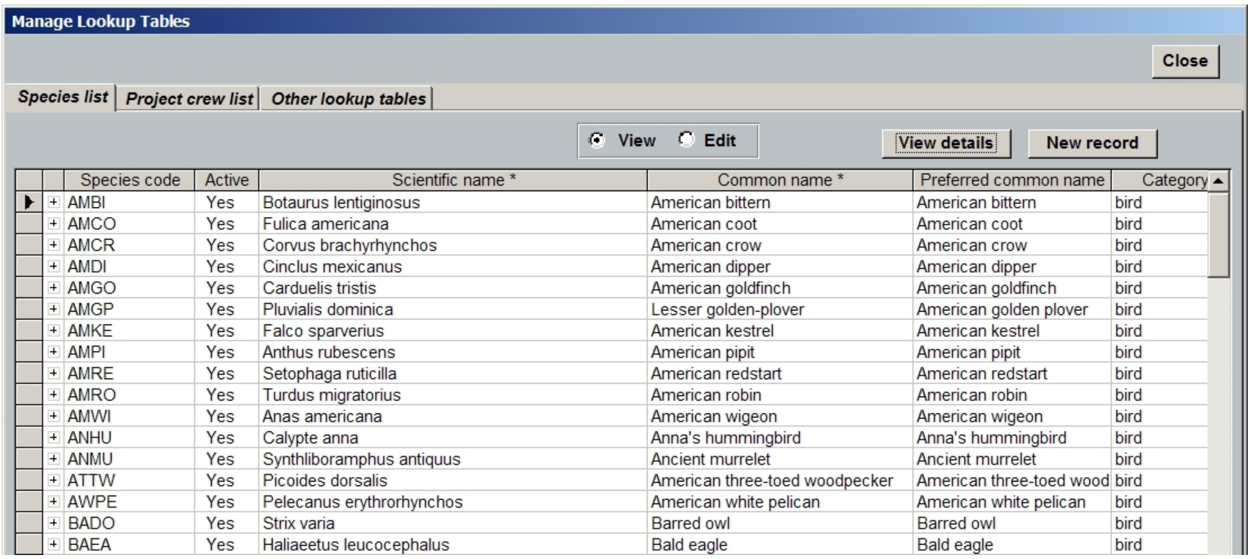


Figure SOP 13 – 9. Training Notes form.

Manage Lookups

From the main menu, hit 'Lookup tables' to open the lookup tool (**Figure SOP 13 – 10**). This tool has 3 tabs – one for the project species list, another for the project contacts list, and a third for viewing the contents of all other lookup tables. The first tab is the project species list. Minor edits may be made by putting the form into Edit mode. By selecting a record and clicking "View details", or by double-clicking on any record selector (the gray box to the left of each record), the species popup form will open. To add a new record hit 'New record'.



Species code	Active	Scientific name *	Common name *	Preferred common name	Category
AMBI	Yes	Botaurus lentiginosus	American bittern	American bittern	bird
AMCO	Yes	Fulica americana	American coot	American coot	bird
AMCR	Yes	Corvus brachyrhynchos	American crow	American crow	bird
AMDI	Yes	Cinclus mexicanus	American dipper	American dipper	bird
AMGO	Yes	Carduelis tristis	American goldfinch	American goldfinch	bird
AMGP	Yes	Pluvialis dominica	Lesser golden-plover	American golden plover	bird
AMKE	Yes	Falco sparverius	American kestrel	American kestrel	bird
AMPI	Yes	Anthus rubescens	American pipit	American pipit	bird
AMRE	Yes	Setophaga ruticilla	American redstart	American redstart	bird
AMRO	Yes	Turdus migratorius	American robin	American robin	bird
AMWI	Yes	Anas americana	American wigeon	American wigeon	bird
ANHU	Yes	Calypte anna	Anna's hummingbird	Anna's hummingbird	bird
ANMU	Yes	Synthliboramphus antiquus	Ancient murrelet	Ancient murrelet	bird
ATTW	Yes	Picoides dorsalis	American three-toed woodpecker	American three-toed wood	bird
AWPE	Yes	Pelecanus erythrorhynchos	American white pelican	American white pelican	bird
BADO	Yes	Strix varia	Barred owl	Barred owl	bird
BAEA	Yes	Haliaeetus leucocephalus	Bald eagle	Bald eagle	bird

Figure SOP 13 – 10. Tool for managing lookup tables.

The species popup form (**Figure SOP 13 – 11**) can be used for adding or editing species records. Required fields are shown in bold, and items with an asterisk next to the name are not to be edited except by the Data Manager (these come from either ITIS or the NPSpecies application). The Integrated Taxonomic Information System (ITIS) website may be accessed by clicking on the button labeled 'ITIS website', or by clicking on either the Taxonomic Serial Number (TSN) or scientific name if either of these fields is already populated. All new records – except for unknown taxa or temporary names – should have TSN entered if it exists on the ITIS website.

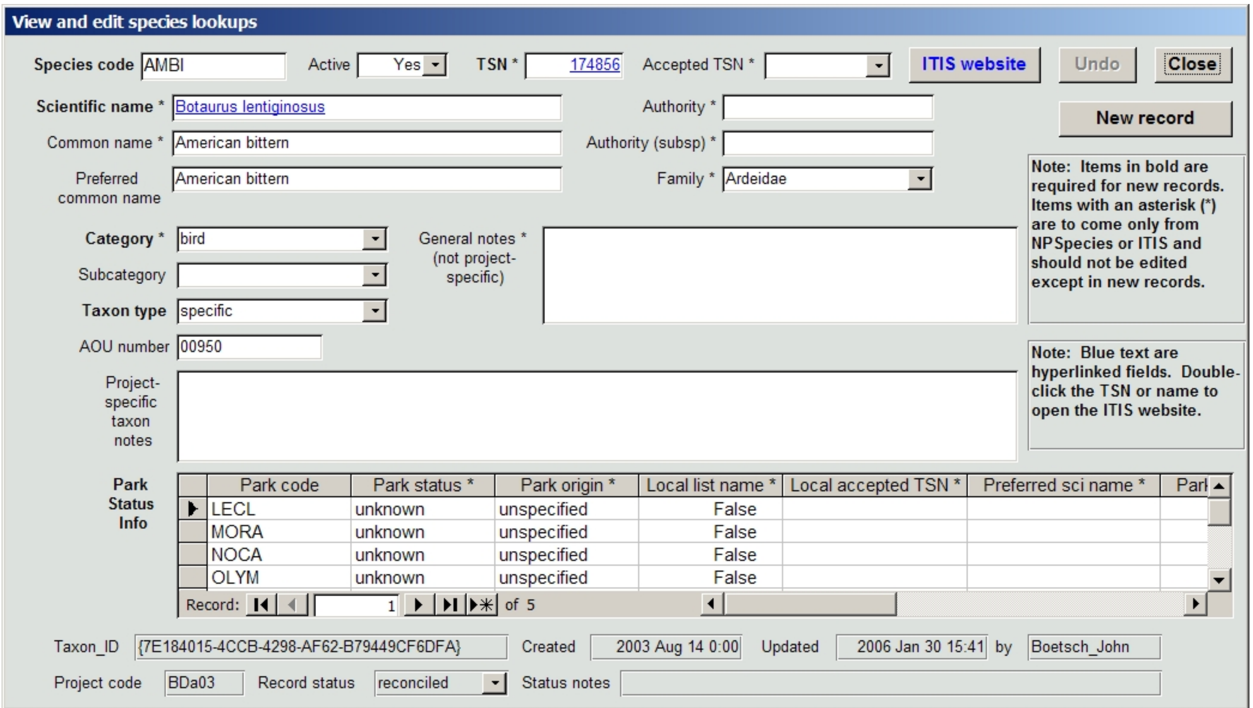
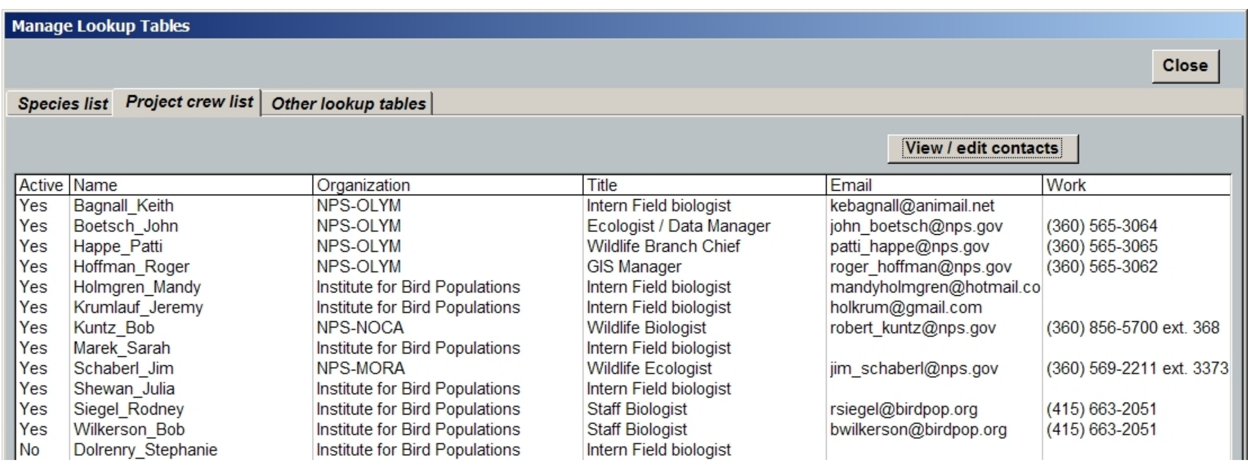


Figure SOP 13 – 11. Species popup form.

The second tab of the lookups module is a list of contacts for the project (**Figure SOP 13 – 12**).



Active	Name	Organization	Title	Email	Work
Yes	Bagnall_Keith	NPS-OLYM	Intern Field biologist	kebagnall@animail.net	
Yes	Boetsch_John	NPS-OLYM	Ecologist / Data Manager	john_boetsch@nps.gov	(360) 565-3064
Yes	Happe_Patti	NPS-OLYM	Wildlife Branch Chief	patti_happe@nps.gov	(360) 565-3065
Yes	Hoffman_Roger	NPS-OLYM	GIS Manager	roger_hoffman@nps.gov	(360) 565-3062
Yes	Holmgren_Mandy	Institute for Bird Populations	Intern Field biologist	mandyholmgren@hotmail.co	
Yes	Krumlauf_Jeremy	Institute for Bird Populations	Intern Field biologist	holkrum@gmail.com	
Yes	Kuntz_Bob	NPS-NOCA	Wildlife Biologist	robert_kuntz@nps.gov	(360) 856-5700 ext. 368
Yes	Marek_Sarah	Institute for Bird Populations	Intern Field biologist		
Yes	Schaberl_Jim	NPS-MORA	Wildlife Ecologist	jim_schaberl@nps.gov	(360) 569-2211 ext. 3373
Yes	Shewan_Julia	Institute for Bird Populations	Intern Field biologist		
Yes	Siegel_Rodney	Institute for Bird Populations	Staff Biologist	rsiegel@birdpop.org	(415) 663-2051
Yes	Wilkerson_Bob	Institute for Bird Populations	Staff Biologist	bwilkerson@birdpop.org	(415) 663-2051
No	Dolrenry_Stephanie	Institute for Bird Populations	Intern Field biologist		

Figure SOP 13 – 12. Project crew list.

By selecting a contact record and hitting the “View / edit” button, or by double-clicking on a contact record, the contact information popup is opened in edit mode (**Figure SOP 13 – 13**). Once edits are accepted with the “Done” button, the user may either page through the records using the record navigator at the bottom of the form, or may search for a particular name in the drop-down pick list.

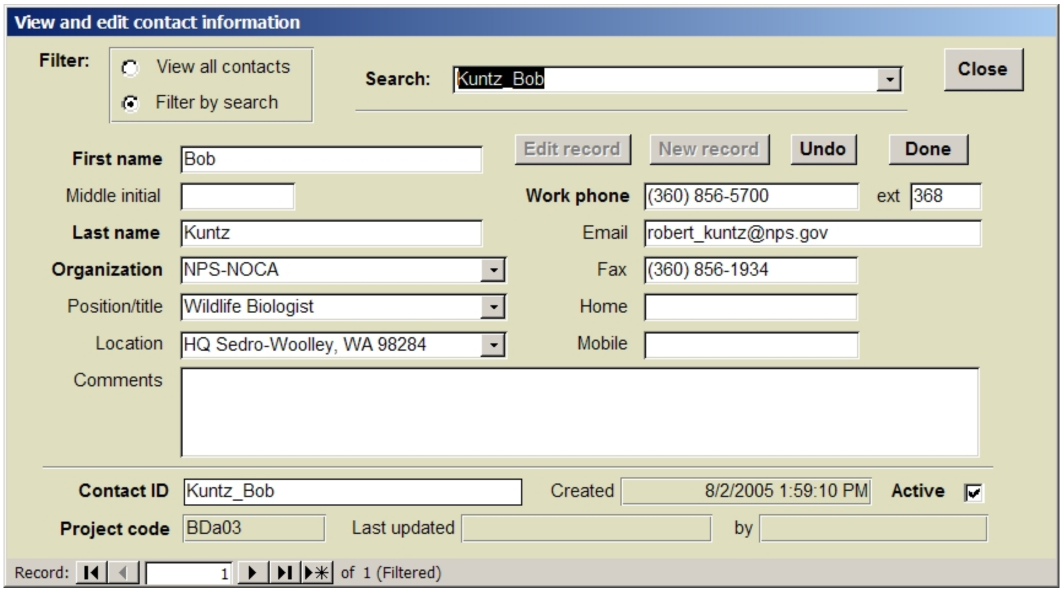


Figure SOP 13 – 13. Contact information popup for editing information associated with the project crew list.

Database Backups

It is recommended that data backups be made on a regular basis – perhaps every day that new data are entered – to save time in case of mistakes or database file corruption. Depending on application defaults, you will be prompted upon opening or closing the application as to whether or not you want to make a backup (**Figure SOP 13 – 14**). If you choose not to make a backup at this time, you may make one at any point by hitting the "Back up data" button on the main menu.

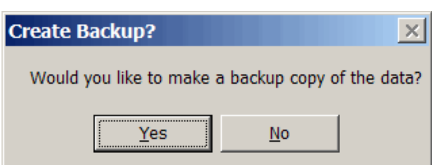


Figure SOP 13 – 14. Database backup prompt.

If you respond 'Yes' to the backup prompt, a window will open to allow you to indicate where to save the file (**Figure SOP 13 – 15**). The default path is the same as the back-end database file, and the default name is that for the back-end file with a date stamp appended to the end. It is recommended that backups be made in a subfolder exclusively for backups in order to clearly separate the working back-end database file from the backups. These periodic backup files should be compressed to save drive space, and may be deleted once enough subsequent backups are made. All such backups should be deleted after the data have passed the quality review and been certified.

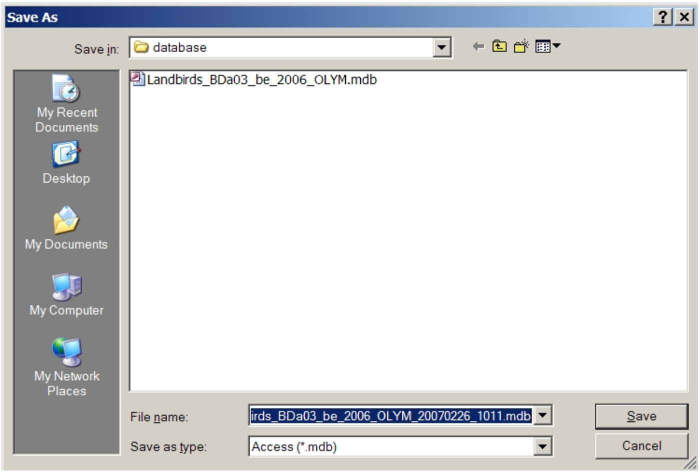


Figure SOP 13 – 15. Prompt for specifying where to save the database backup.

Link Back-end Data File

When first installing the front-end application, the user will need to establish the table links to the back-end database. Users may also need to refresh the links if the back end path changes or if a user wants to connect to a different back-end data file. Table links can be updated using the Data Table Connections tool (**Figure SOP 13 – 16**), available by hitting the 'Connect data tables' button on the main menu. Browse to the desired back-end file and then hit 'Update links' to refresh the connection.

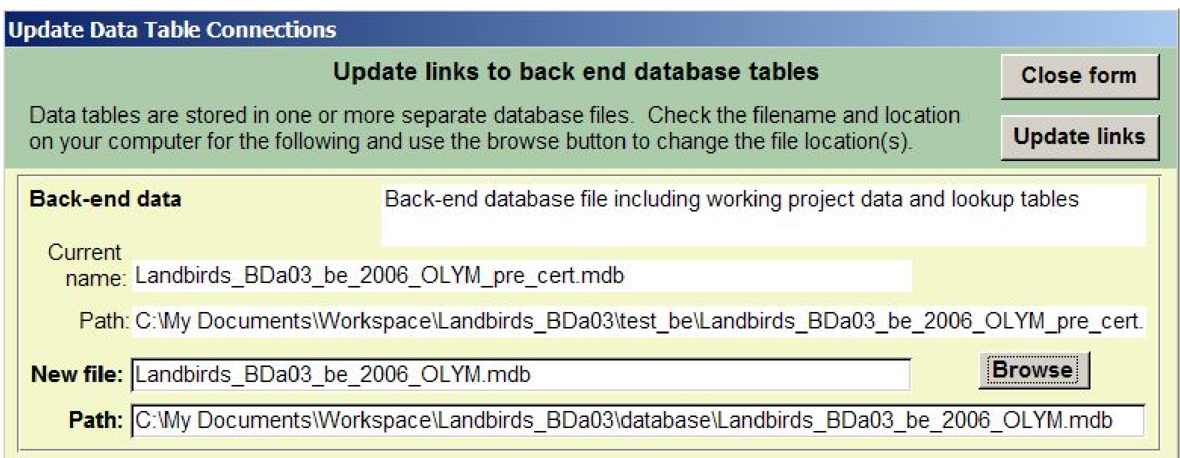


Figure SOP 13 – 16. Update Data Table Connections tool.

Standard Operating Procedure (SOP) 14: Metadata Development

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction
Documenting data is a time-consuming task for NPS staff and cooperators. Thorough documentation, however, is essential for preserving the integrity and longevity of data and the products of its analysis. It is therefore an essential component of sound data management.

Data documentation is a critical step toward ensuring that data sets are usable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, condition and other characteristics of a given data set. Additionally, metadata provide the means to catalog and search among data sets, thus making them available to a broad range of potential data users. Metadata for this project will conform to Federal Geographic Data Committee (FGDC) guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed, and synthesized.

Updated metadata is a required deliverable that should accompany each season's certified data. For long-term projects such as this one, metadata creation is most time consuming the first time it is developed—after which most information remains static from one year to the next. Metadata records in subsequent years then only need to be updated to reflect changes in contact information and taxonomic conventions, to include recent publications, to update data disposition and quality descriptions, and to describe any changes in collection methods, analysis approaches or quality assurance for the project.

Content Standards
Network metadata content standards will adhere to those set by FGDC and NPS policy (Cook and Lineback 2008). The required content consists of seven sections (Sections 1-7), all of which contain elements required for spatial data. The NPS Metadata Profile adds another section (Section 0). The Biological and ESRI Profiles are added as elements to Sections 1-7. A summary of these sections is provided below.

> ***Section 0, NPS Information –*** purpose of the metadata, relevant park unit(s), and data steward.
>
> ***Section 1, Identification Information –*** who produced the data set, when and why it was produced, and where it is from. Constraints on access (e.g., for sensitive data) and use are also recorded in this section. Also includes the geographic extent, bounding altitudes, taxonomy, and analytical tools used in processing (for biological data).
>
> ***Section 2, Data Quality –*** the accuracy of attributes and geographic positions and the procedures used to ascertain accuracy. This section also documents the completeness and lineage of the data set. Lineage includes source(s) of the data and processing steps, and methodologies used (for biological data).
>
> ***Section 3, Spatial Data Organization –*** methods of spatial reference. Mandatory for spatial data.

Section 4, Spatial Reference Information – coordinate system definitions. Mandatory for spatial data.

Section 5, Entity and Attribute Information – attribute names, definitions, codes and their meanings and other information essential to a basic understanding of the data.

Section 6, Distribution Information – methods and contacts used for obtaining data. Also documents information critical for using biological data formatted in ASCII.

Section 7, Metadata Reference Information – includes who created the metadata, when it was created, the profile used, and the frequency of update

Metadata that are *fully compliant* with FGDC and NPS standards have entries in Section 0 and all element fields in Sections 1-7 where the *Optionality* field contains the term 'mandatory' or 'mandatory if applicable'. A mandatory element is one which must be populated for every data set. A mandatory if applicable element is one which must be populated if the data set exhibits the characteristic being documented by the metadata element. For example, the element defining the vertical coordinate system would be mandatory if a data set contains elevation data.

Metadata that are *minimally compliant* with FGDC and NPS standards have entries in Section 0 and all 'mandatory' and 'mandatory if applicable' element fields in Sections 1, 6, and 7, and Section 2 for biological data. These include the fields used by the NPS Data Store. Data sets documented to this extent can be distributed via the Data Store's online upload utility. See Appendix 8B for guidance on creating metadata for the NPS Data Store.

Network Standards

Different types of data and information require different kinds and levels of documentation. Standards for documentation of SIEN data sets are as follows:

1. ***Spatial Data*** will contain, at a minimum, all of Section 0 and the required elements of Sections 1-7.

2. ***Non-Spatial Data*** will include, at a minimum, all elements of Section 0, the required elements of Sections 1, 6, and 7, and Section 2 for biological data. The minimum requirements for non-spatial data therefore meet the requirements for minimum compliance with the FGDC and NPS standards.

3. ***Relational Databases*** will be documented according to the standards outlined above. Complete documentation will also include entity relationship diagrams, business rules, and programming code.

Complete metadata information should be delivered to the Data Manager according to guidelines for spatial and biological data within Appendix 8 of SIEN's ***Data Management Plan*** (Cook and Lineback 2008) and that of SOP #17**: *Product Delivery Specifications***. Where possible, metadata documents should be created with the following tools to ensure standardization and the ability to upload to the NPS Data Store (see SIEN Data Management Plan, Chapter 8, for specific guidance):

ESRI's ArcCatalog© is a multifunction application for managing spatial data and for editing FGDC compliant metadata.

NPS Metadata Tools and Editor (SIEN Data Management Plan, Appendix 8D) is a custom software application for authoring and editing NPS metadata. It extends the basic functionality of ArcCatalog for managing spatial metadata and provides a stand-alone tool for creating and manipulating non-spatial metadata outside of ArcCatalog.

NPS Database Metadata Extractor is an add-in for MS Access 2000-2003. The extractor automatically harvests entity (table) and attribute (field) metadata from MS Access databases, including domains. It further allows the user to edit and review the harvested metadata and make batch edits and to export metadata to a FGDC-compliant XML file.

Metadata Parser (mp) is a program developed by the USGS that comes bundled with both ArcCatalog and the NPS Metadata Tools and Editor. It is used to validate metadata records and to generate compliant output files for posting to clearinghouses. The parser generates a textual report indicating errors in the metadata, primarily in the structure, but also in the values of some of the scalar elements where values are restricted by the standard.

The "Metadata in Plain Language" questionnaire (SIEN Data Management Plan, Appendix 8E)(Cook and Lineback 2008) is a user-friendly information sheet (MS Word© document) that can be used to elicit metadata needed to complete all FGDC required elements for data sets not formatted for geographic information systems (e.g., shapefiles, coverages, and geotiffs). It currently does not include questions specific to the Biological Data Profile nor the NPS Profile and therefore, does not alone, meet the content standards specified by the NPS Metadata Profile. Additional information must be obtained to comply with these specifications.

Other tools may be used as long as the metadata produced meet the appropriate requirements for content, format and organization. Completion will occur after the dataset is certified by the Network Data Manager or project leader. The Network Data Manager or project leader ensures that updated metadata are uploaded to the NPS Data Store.

The Project Lead should update the metadata interview content as changes to the protocol are made, and each year as additional data are accumulated.

Identifying Sensitive Information

Part of metadata development includes determining whether or not the data include any sensitive information, which is partly defined as the specific locations of rare, threatened or endangered species. Prior to completing the metadata interview form, the Project Lead should identify any sensitive information in the data. The findings should be documented and communicated to the Data Manager.

- See **SOP #19 Sensitive Information** and refer to Sierra Nevada Network FOIA and Sensitive Data Guidelines (see SIEN Data Management Plan, Appendix 9B)(Cook and Lineback 2008).

References Cited

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR--2008/070. National Park Service, Fort Collins, Colorado. Available at: https://science1.nature.nps.gov/naturebib/biodiversity/2008-11-26/SIENDMP_CompletePlan_20081125.pdf (accessed 14 June 2010).

Standard Operating Procedure (SOP) 15:
Data Quality Review, Validation, and Certification

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Figures

Page

Figure SOP 15 – 1. General course of data and associated Quality Assurance/Quality Control procedures. ... SOP 15.4

Figure SOP 15 – 2. First page of the quality review form. ... SOP 15.9

Figure SOP 15 – 3. Second page of the quality review form. ... SOP 15.9

Figure SOP 15 – 4. A quality review query in edit mode. ... SOP 15.10

Figure SOP 15 – 5. A quality review query in design view. ... SOP 15.10

Figure SOP 15 – 6. Sample summary report for a query. ... SOP 15.12

Tables

Page

Table SOP 15 – 1. Automated data validation queries in Bird Monitoring database. ... SOP 15.5

Introduction

This document describes the procedures for validation and certification of data in the working project database. SIEN's Data Management Plan (Cook and Lineback 2008) and accompanying Appendix 3A are to be followed when additional details or clarification are necessary.

After the season's field data have been entered, verified, and processed (see SOP # 13: ***Data Entry and Verification***), they need to be reviewed and certified by the Project Lead for quality, completeness, and logical consistency. While data *verification* is the process of ensuring that accurate transcription of the raw data was accomplished, data *validation* is the process of checking data for completeness, structural integrity, and logical consistency. *Validation* is the process of reviewing computerized data for range and logic errors and may accompany data verification *only* if the operator has comprehensive knowledge of the data and subject. More often, validation is a separate operation carried out *after* verification by a project specialist who can identify generic and specific errors in particular data types. It is essential that we validate all data as truthful and do not misrepresent the circumstances and limitations of collection.

The working database application facilitates this process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values. The user may then fix problems and document each fix.

Once the data have been through the validation process and metadata have been developed for them, they are to be certified according to Network guidelines for data certification and provided to the Network Data Manager.

Details on these steps are provided below.

The following figure (Figure SOP 15 – 1), depicts the validation and certification steps described in this SOP (please note: the first four steps in this figure are described in detail in SOP #13: Data Entry and Verification)

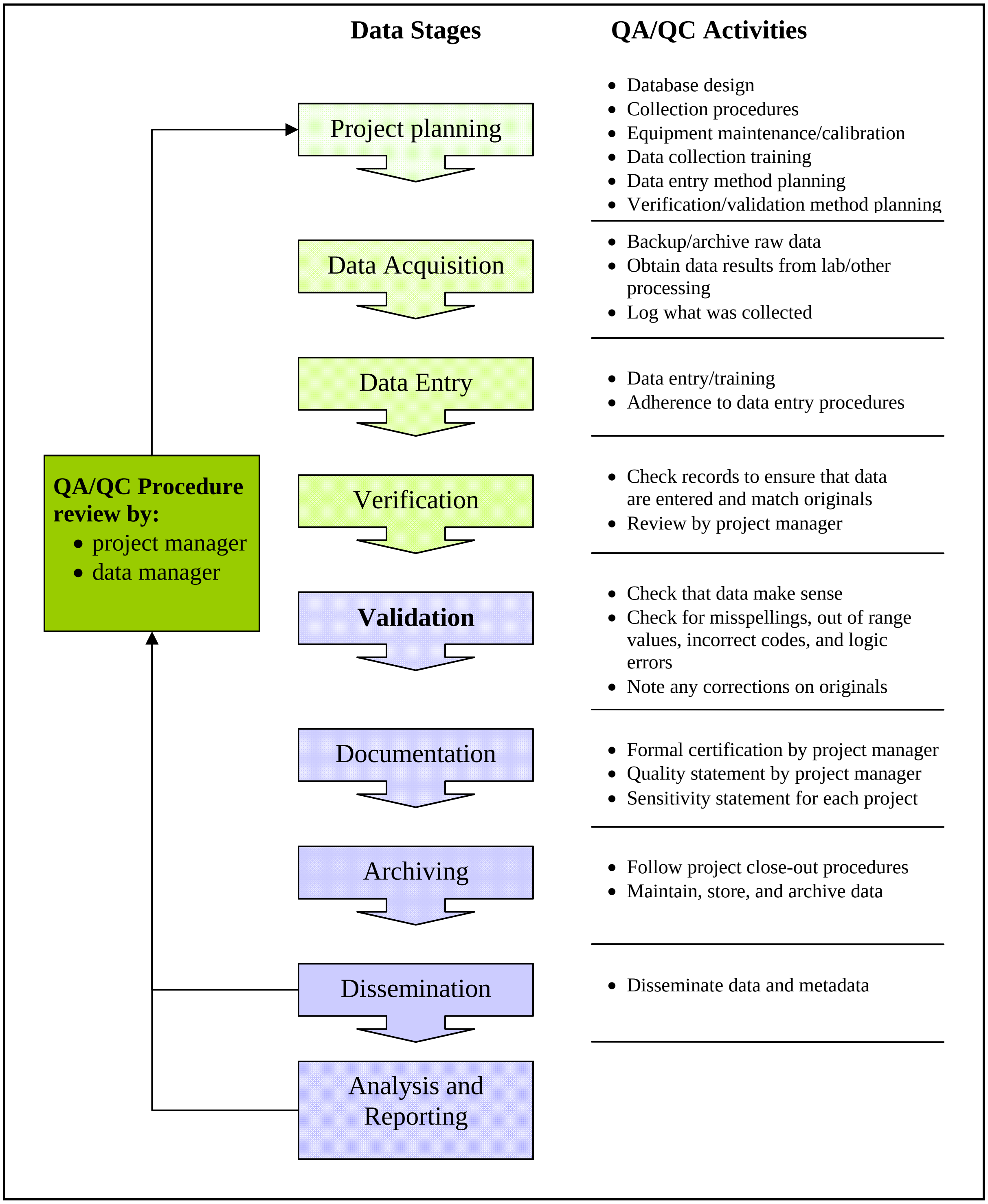


Figure SOP 15 – 1. General course of data and associated Quality Assurance/Quality Control procedures. This SOP provides details for data validation and documentation (i.e., certification steps)(Cook and Lineback 2008).

Data Quality Review

Table SOP 15 – 1 shows the automated validation checks that are performed on the data prior to certification. The table is excerpted from the NCCN landbird monitoring protocol; queries will need to be modified slightly once the database has been revised for local use in the SIEN. These queries are designed to return records that need to be fixed, so ideally – once all data checks have been run and any errors have been fixed – none of the queries will return records. However, not all errors and inconsistencies can be fixed, in which case a description of the resulting errors and why edits were not made is then documented and included in the metadata and certification report.

The queries are named and numbered hierarchically so that high-order data–for example from tables on the parent side of a parent-child relationship–should be fixed before low-order data (e.g., individual species observations). The rationale for this is that one change in a high-order table affects many downstream records, and so proceeding in this fashion is the most efficient way to isolate and treat errors.

Table SOP 15 – 1. Automated data validation queries in Bird Monitoring database.

Query_name	Returns records meeting the following criteria
qa_1a_Strata_missing_critical_info	Missing park code, project code, stratification date, stratum name, stratum definition
qa_1b_Strata_illogical_dates	Stratum record updated date prior to created date
qa_2a_Sites_missing_critical_info	Missing site code, park code, or stratum ID
qa_2b_Sites_park_inconsistencies	Park code inconsistent with strata table
qa_2c_Sites_duplicates_on_code_and_park	Duplicate records on site code and park code
qa_2d_Sites_missing_evaluation_codes	Established or rejected sites without evaluation codes
qa_2e_Sites_site_status_inconsistencies	Missing site status, ‘retired’ sites without discontinued dates, discontinued dates on status other than ‘retired’, or discontinued dates without establishment dates
qa_2f_Sites_illogical_dates	Discontinued date prior to establishment date, or updated date prior to created date
qa_2g_Sites_missing_panel_type	Active sites without a panel type
qa_2h_Sites_missing_site_name	Missing site name (no remedy required)
qa_3a_Locations_missing_critical_info	Missing site ID (except where loc_type = 'incidental'), location code, location type, or park code
qa_3b_Locations_park_inconsistencies	Park code inconsistent with sites table
qa_3c_Locations_duplicates_on_site_and_loc_code	Duplicate records on site ID and loc code
qa_3d_Locations_duplicates_on_site_and_loc_name	Duplicate records on site ID and loc name
qa_3e_Locations_duplicates_on_loc_name_and_park	Duplicate records on loc name and park code
qa_3f_Locations_missing_sampling_events	Location type <> 'origin' and missing an event; or event is null and features, markers or images were entered
qa_3g_Locations_missing_establishment_dates	Locations with sampling events or field coordinates or discontinued dates, but without with location establishment dates

Table SOP 15 – 2. Automated data validation queries in Bird Monitoring database (continued).

Query_name	Returns records meeting the following criteria
qa_3h_Locations_loc_status_inconsistencies	Missing loc status; sampled locations with loc status = 'rejected' or 'proposed'; locs with establishment dates or field coords and loc_status = 'proposed'; 'retired' locs without discontinued dates; discontinued dates on status other than 'retired'
qa_3i_Locations_unclassified_new_points	Newly sampled locations with an undetermined location type (location_type = 'new')
qa_3j_Locations_loc_type_and_loc_code_inconsistent	Locations where loc code = 'TO' and loc type <> 'origin' or vice versa, or where loc code = 'rare' and loc type <> 'incidental' or vice versa
qa_3k_Location_illogical_dates	Discontinued date prior to establishment date, or updated date prior to created date
qa_3l_Locations_without_coordinates	Locations without coordinates
qa_3m_Locations_without_field_coords	Locations that have sampling events but no field coordinates (no remedy required)
qa_3n_Locations_with_more_than_one_coord	Locations with more than one coordinate record - verify that these are intended
qa_3o_Locations_missing_travel_info	Sampled locations missing azimuth to point, travel notes, or reason for azimuth direction changes where direction changed = 'yes'
qa_3p_Locations_missing_env_values	Missing elevation, slope or aspect values
qa_3q_Locations_elev_source_inconsistencies	Sampled locations where elevation source = 'GIS theme'
qa_3r_Locations_missing_elev_metadata	Missing elevation units or elevation source where elevations are present
qa_3s_Locations_elev_unit_inconsistencies	Elevation units = 'm' but elevation source = 'GIS theme'; units = 'm' but elevation values over 4419
qa_3t_Locations_without_markers	Locations that have sampling events but no markers
qa_3u_Locations_no_best_coord_assigned	For GIS specialist - locations without best coordinates
qa_4a_Coordinates_missing_critical_values	Records missing location ID or coord creation date
qa_4b_Coordinates_incomplete_field_UTMs	A portion of the field coordinate pair is missing, or the field datum is missing
qa_4c_Coordinates_missing_field_UTMs	Field UTMs are missing, but where there is either a coordinate collection date, a coordinate label, a field error, field offsets, field sources, GPS file or model type, or a source map scale filled in
qa_4d_Coordinates_missing_field_coord_date	Field coordinates without a coordinate collection date
qa_4e_Coordinates_inconsistent_field_source_info	Field coordinate source = 'map', however there is a GPS file name, a field horizontal error, or GPS model filled in to suggest that the source is GPS
qa_4f_Coordinates_final_UTM_inconsistencies	Final UTM coordinates are incomplete; or they are present and the coordinate type or datum is missing; or coord type or an estimated error value is present and the coordinates are missing
qa_4g_Coordinates_public_UTM_inconsistencies	Public UTM coordinates are incomplete; or they are

Table SOP 15 – 2. Automated data validation queries in Bird Monitoring database (continued).

Query_name	Returns records meeting the following criteria
	present and the public coord type is missing; or public coord type or public coord scale is present and the public coordinates are missing
qa_4h_Coordinates_illogical_dates	Coordinates with updated dates before creation dates
qa_4i_Coordinates_target_coord_inconsistencies	Target UTM coordinates are incomplete; or they are present and the target datum is missing
qa_4j_Coordinates_without_final_or_public_coords	For GIS specialist - records missing final UTMs and/or public coordinates
qa_5a_Sample_period_errors	Missing start or end dates; start date/time after end date/time; or updated dates prior to created dates
qa_6a_Events_missing_critical_info	Missing location ID, project code, or start date
qa_6b_Events_duplicates_on_location	Duplicate records on location ID - also shows how many records exist in related tables
qa_6c_Events_missing_start_times	Start times missing where location type is missing or <> 'origin'
qa_6d_Events_without_observers	Events without associated observers
qa_6e_Events_without_point_count_data	Events without associated point count data where location type <> 'incidental'
qa_6f_Events_without_habitat_data	Events without associated habitat data where location type <> 'incidental'
qa_6g_Events_missing_obs_records	Events at incidental sampling locations without associated rare bird or nesting observations
qa_6h_Events_inconsistent_coord_info	Events at locations where coordinates_updated = True but missing associated coordinate records, or having associated coordinates where coordinates _updated = False, or where coord_date is different from the date of the event
qa_6i_Events_inconsistent_feature_info	Events at locations where features_updated = True but missing associated feature records, or having associated features where features_updated = False
qa_6j_Events_inconsistent_marker_info	Events at locations where markers_updated = True but missing associated marker records, or having associated markers where markers_updated = False, or where marker_installed is different from the date of the event
qa_6k_Events_inconsistent_image_info	Events at locations where photos_taken = True but missing associated image records, or having associated images where photos_taken = False, or where image_date is different from the date of the event
qa_6l_Events_missing_conditions	Point count events with missing environmental conditions - noise level, wind_cond, precip_cond, cloud_cover, temperature
qa_6m_Events_illogical_dates	Events with start date/times occurring after end date/times; or records that have update or verified dates prior to the record creation date
qa_7a_Observers_missing_critical_info	Missing event ID or contact ID

Table SOP 15 – 2. Automated data validation queries in Bird Monitoring database (continued).

Query_name	Returns records meeting the following criteria
qa_7b_Observers_missing_role	Observer role is missing (no remedy required)
qa_7c_Markers_missing_critical_info	Missing marker code, location ID, marker type, marker status, or marker updated values
qa_7d_Markers_missing_measurements	Missing marker height, substrate, or having only partial offset information (distance without azimuth or vice versa)
qa_7e_Markers_status_inconsistencies	Marker status = 'removed' but no removal date, or with a removal date and status <> 'removed'
qa_7f_Markers_illogical_dates	Marker updated or marker removed date before marker installed date
qa_7i_Features_missing_measurements	Missing distance or azimuth values
qa_7j_Features_missing_critical_info	Location ID, feature type, or feature status is missing
qa_8a_Habitat_missing_critical_info	Missing event ID or habitat num
qa_8b_Habitat_missing_values	Missing PMR code, canopy cover, or tree size class
qa_8c_Nesting_obs_missing_values	Missing event ID, taxon ID, or nest activity
qa_8d_Point_counts_missing_critical_info	Missing event ID, taxon ID, time interval, or group size
qa_8e_Point_counts_missing_values	Missing observation distance, seen first, ever sang, prev observed, or flyover
qa_8f_Rare_bird_obs_missing_critical_info	Missing event ID or taxon ID
qa_8g_Rare_bird_obs_missing_values	Missing observation distance, group size, or nest activity

In addition to these automated checks, the person performing the quality review should remain vigilant for errors or omissions that may not be caught by automated queries. Another task that cannot be automated is the process of making sure that all data for the current season are in fact entered into the database. This will often involve manual comparisons between field forms or other lists of the sites visited and the results of queries showing the sites for which data exist.

Using the Database Quality Review Tools

Open the working copy of the database application and hit the button labeled “QA Checks”. This will open the quality review form. Upon opening, the quality review form automatically runs the validation queries and stores the results in a table built into the front-end database (tbl_QA_Results). Each time the queries results are refreshed, or the quality review form is re-opened, the number of records returned and the run times are rewritten so that the most recent result set is always available; any remedy description and the user name for the person making the edits is retained between runs of the queries. These results form the basis of documentation in the certification report output as shown below.

The first page of the quality review form (Figure SOP 15 – 2) has a results summary showing each query sorted by name, number of records returned by the query, most recent run time, and description. There is also a button for refreshing results, which may need to be done periodically as changes in one part of the data structure may change the number of records returned by other queries.

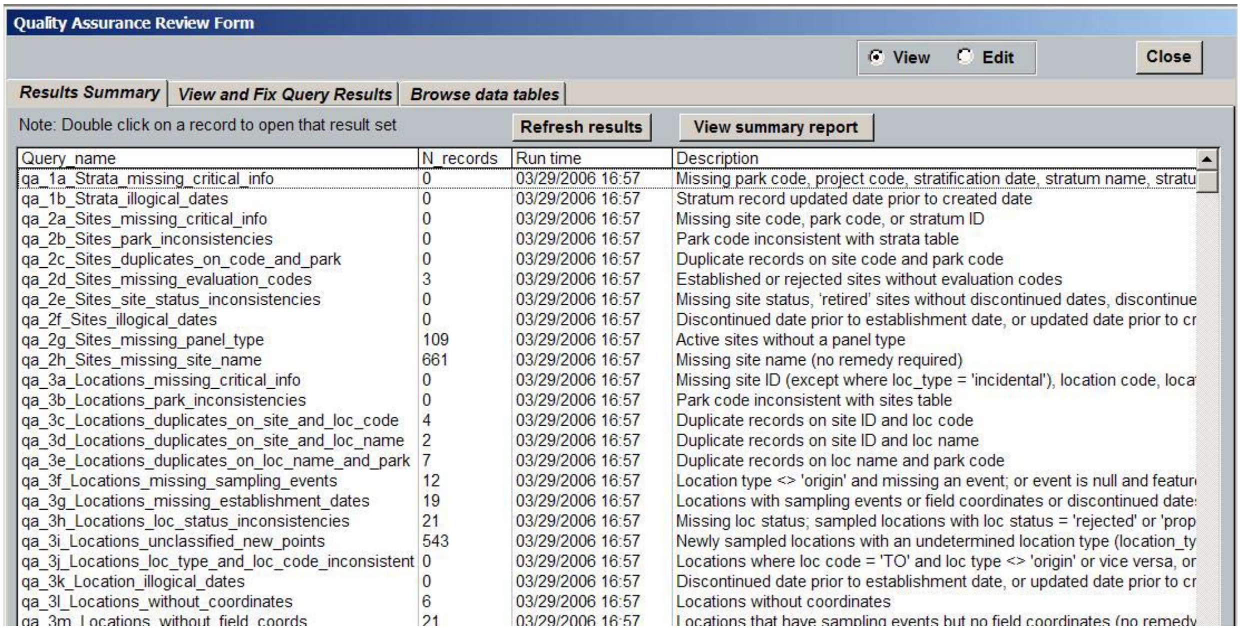


Figure SOP 15 – 2. First page of the quality review form.

Double-clicking a particular query name, opens the second page (Figure SOP 15 – 3), which shows the results from that query.

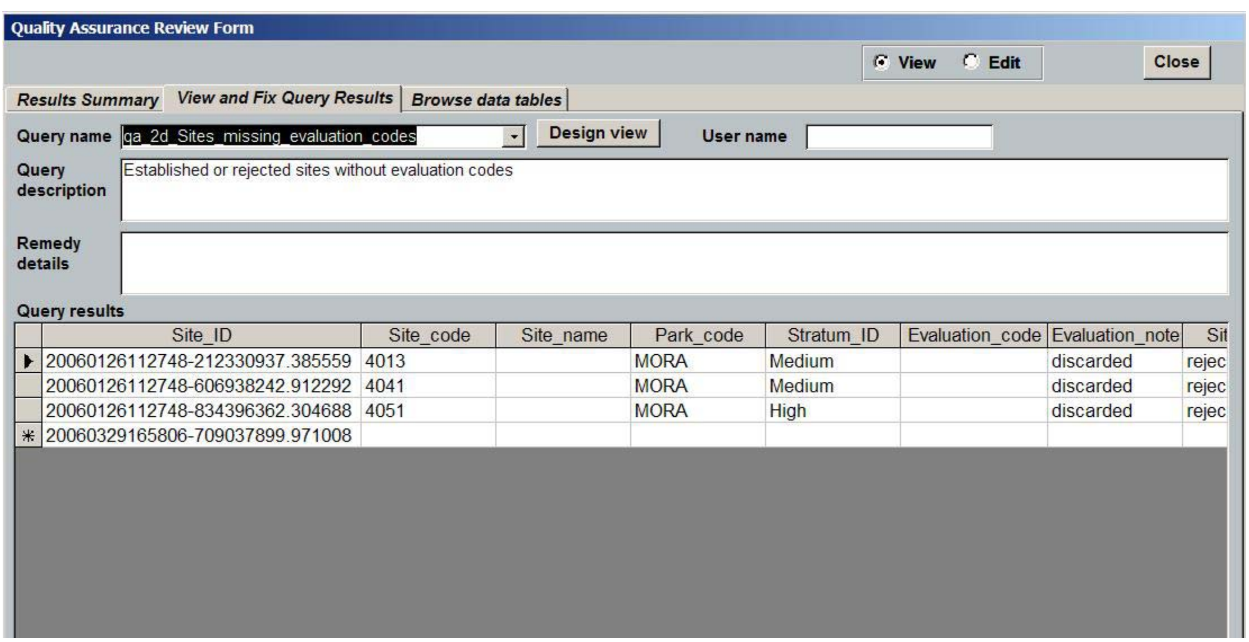


Figure SOP 15 – 3. Second page of the quality review form.

In the upper-right is a switch that allows the user to put the form in either view mode (default) or edit mode (Figure SOP 15 – 4). Upon changing to edit mode, the form changes color to provide a visual reminder that edits are possible. At this point the query results may be modified and the remedy details may be entered in the appropriate place. If certain records in a query result set are not to be fixed for whatever reason, this is also the place to document that. The user name is automatically filled in (if it was blank) once the user types in the remedy details.

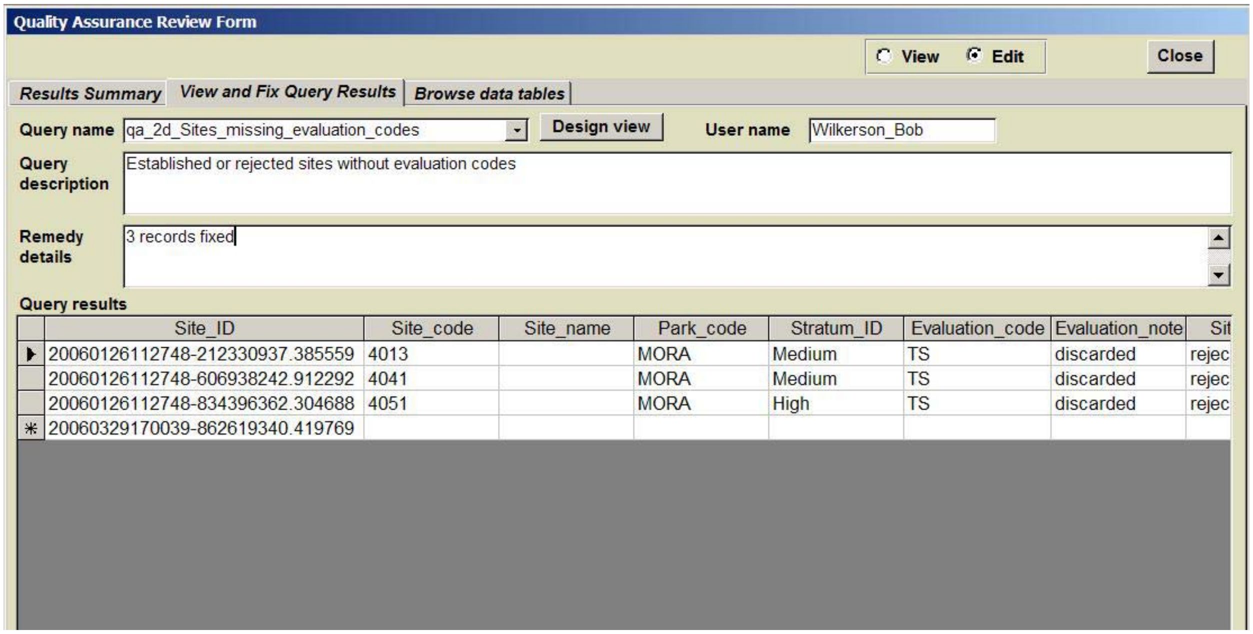


Figure SOP 15 – 4. A quality review query in edit mode.

On this page is also a button labeled “Design view”, which will open the currently selected query in the design interface in Access (Figure SOP 15 – 5). In this manner, the user can verify that the query is in fact filtering records appropriately. Note: Any desired changes to query structure or names should be discussed with the Data Manager <u>prior</u> to making these changes.

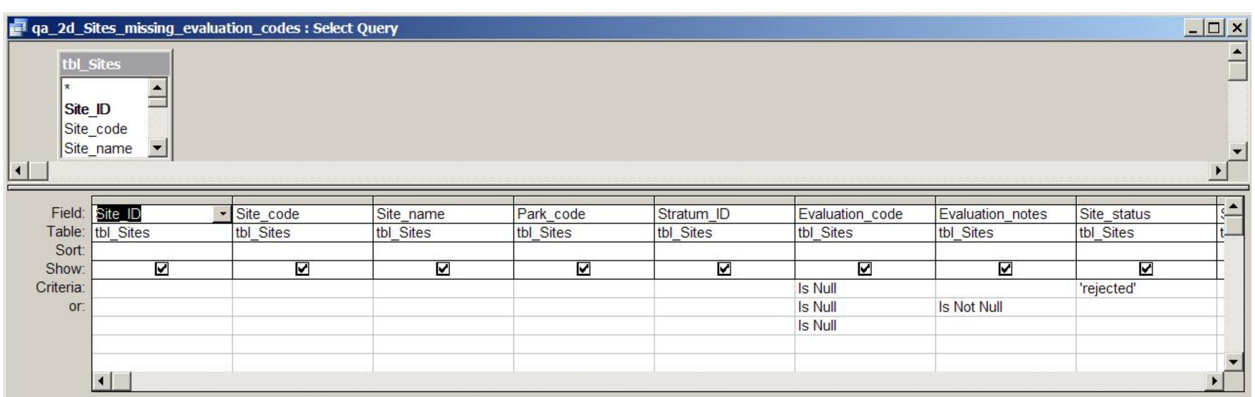


Figure SOP 15 – 5. A quality review query in design view.

Certain queries, due to their structural complexity, cannot be edited directly. Other queries may not contain all of the fields the user may want to see in order to make the best decision about whether and how to edit a given record. In such cases, the user may opt to view and/or edit data directly in the data tables. To facilitate this process, the “Browse Data Tables” page on the form can be used to open the table directly for viewing and editing as needed.

As with all edits performed during the quality review, these types of direct edits in the data tables should be made with extreme care as the validation checks that are built into the front-end data entry forms are not present in the tables themselves. It is possible, therefore, to make edits to the tables that may result in a loss of data integrity and quality. While the automated queries are intended to check for these, it is not possible to check for every possible error combination. Whenever making quality review edits – whether through a query or directly in a table – the user should remember to update the Updated_date and Updated_by fields to the current date and the current user name.

Generating Output for the Certification Report

The first page of the quality review form has a button labeled “View summary report”. This button opens the formatted information for each query, the last run time, the number of records returned at last run time, a description and any remedy details that were typed in by the user (Figure SOP 15 – 6). This report can be exported from the database and included as an attachment to the certification report by either hitting File > Export on the Access menu, or by right clicking on the report object and selecting Export. Select ‘Rich Text Format (*.rtf)’ to retain formatting to facilitate importing it into the certification report in Word.

tbl_QA_Results

Quality Assurance and Data Validation Results **Run time** 03/29/2006 17:02 **QA by**

Query name	Records	Query description	Remedy details
qa_1a_Strata_missing_critical_info	0	Missing park code, project code, stratification date, stratum name, stratum definition	
qa_1b_Strata_illogical_dates	0	Stratum record updated date prior to created date	
qa_2a_Sites_missing_critical_info	0	Missing site code, park code, or stratum ID	
qa_2b_Sites_park_inconsistencies	0	Park code inconsistent with strata table	
qa_2c_Sites_duplicates_on_code_and_park	0	Duplicate records on site code and park code	
qa_2e_Sites_site_status_inconsistencies	0	Missing site status, 'retired' sites without discontinued dates, discontinued dates on status other than 'retired', or discontinued dates without establishment dates	
qa_2f_Sites_illogical_dates	0	Discontinued date prior to establishment date, or updated date prior to created date	
qa_2g_Sites_missing_panel_type	109	Active sites without a panel type	
qa_2h_Sites_missing_site_name	661	Missing site name (no remedy required)	
qa_3a_Locations_missing_critical_info	0	Missing site ID (except where loc_type = 'incidental'), location code, location type, or park code	
qa_3b_Locations_park_inconsistencies	0	Park code inconsistent with sites table	
qa_3c_Locations_duplicates_on_site_and_lo	4	Duplicate records on site ID and loc code	
qa_3d_Locations_duplicates_on_site_and_lo	2	Duplicate records on site ID and loc name	
qa_3e_Locations_duplicates_on_loc_name_	7	Duplicate records on loc name and park code	
qa_3f_Locations_missing_sampling_events	12	Location type <> 'origin' and missing an event; or event is null and features, markers or images were entered	
qa_3g_Locations_missing_establishment_da	19	Locations with sampling events or field coordinates or discontinued dates, but without with location establishment dates	
qa_3h_Locations_loc_status_inconsistencies	21	Missing loc status; sampled locations with loc status = 'rejected' or 'proposed'; locs with establishment dates or field coords and loc_status = 'proposed'; 'retired' locs without discontinued dates; discontinued dates on status other than 'retired'	
qa_3i_Locations_unclassified_new_points	543	Newly sampled locations with an undetermined location type (location_type = 'new')	
qa_3j_Locations_loc_type_and_loc_code_in	0	Locations where loc code = 'TO' and loc type <> 'origin' or vice versa, or where loc code = 'rare' and loc type <> 'incidental' or vice versa	
qa_3k_Location_illogical_dates	0	Discontinued date prior to establishment date, or updated date prior to created date	

Wednesday, March 29, 2006 Page 1 of 4

Page: 1

Figure SOP 15 – 6. Sample summary report for a query.

Completing Data Certification

Data certification is a benchmark in the project information management process that indicates that: (1) the data are complete for the period of record, (2) they have undergone and passed the quality assurance checks, and (3) that they are appropriately documented and in a condition for archiving, posting, and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies which may or may not have been detected during quality assurance reviews.

References

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR--2008/070. National Park Service, Fort Collins, Colorado. Available at: https://science1.nature.nps.gov/naturebib/biodiversity/2008-11-26/SIENDMP_CompletePlan_20081125.pdf (accessed 14 June 2010).

Standard Operating Procedure (SOP) 16:
Data Analysis and Reporting

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Tables

Page

Table SOP 16 – 1. Observers who conducted point counts in SIEN parks in Year X. .... SOP 16.6

Table SOP 16 – 2. SIEN bird monitoring transects that were surveyed in Year X. .... SOP 16.7

Table SOP 16 – 3. Summary history of SIEN bird monitoring transects completed through Year X. .... SOP 16.8

Table SOP 16 – 4. All species recorded in the three large parks during the Year X field season, including species detected during point counts, and species recorded on ‘rare bird’ detection forms. .... SOP 16.9

Table SOP 16 – 5. Number of transects with detections and number of individual detections for each species detected during point counts in the large parks in Year X. .... SOP 16.9

Table SOP 16 – 6. Survey history of each transect surveyed in Year X. .... SOP 16.10

Table SOP 16 – 7. Number of individuals detected and number of points with detections for each species detected during point counts at Devils Postpile National Monument in Year X. .... SOP 16.10

Table SOP 16 – 8. Annual density estimates for American Robin. .... SOP 16.12

Table SOP 16 – 9. Summary trend results for each species with a calculable density trend in the large parks. .... SOP 16.13

Table SOP 16 – 10. Density adjustment parameters obtained through modeling of species-specific detectability. .... SOP 16.14

Table SOP 16 – 11. Detailed trend results for American Robin. .... SOP 16.16

Introduction
This Standard Operating Procedure describes methods for analyzing data associated with the SIEN bird monitoring program, and provides guidelines and templates for the annual and 4-year reports. Items 2-4, below, apply only to data analysis in conjunction with 4-year reports.

Review, Conformance and Communication
The National Park Service requires QA/QC review and approval prior to communicating or disseminating data and information. Documentation of the QA/QC standards used in producing the information and that substantiate the quality of the information must be formally certified and distributed with the related data and information.

Querying Data from the Database
Our custom-designed MS Access database includes features that allow the analyst to query the database to produce most of the data summary tables that should be included in the annual report, and allow for an easy transition between the database and the properly formatted summary tables described below.

However, detectability modeling, point-specific density estimation, and temporal trend assessment require exporting data to other software applications for manipulation and analysis. Guidelines for performing these operations are provided below in sections 2-4.

Computing and Selecting Detectability Parameters
At the end of every 4-year interval, we will conduct a complete analysis of factors influencing the detectability of birds and will develop detectability models to be used in estimating density of birds from raw counts. The data analyst should use the most recently available version of the free software program *Distance* (Thomas et al. 2005), available at http://www.ruwpa.st-and.ac.uk/distance/, to model detectability and estimate density of SIEN birds. This SOP provides some guidelines for analyzing the SIEN bird data in *Distance*, but explaining in detail how to use the software or providing a primer on analytical techniques associated with distance sampling is beyond its scope. *Distance* includes a user-friendly interface and a user's manual that explains how to use the software. The user's manual assumes that the user is already familiar with distance sampling concepts and statistics. Data analysts seeking help with the analytical aspects of distance sampling should consult Buckland et al. (2001) and, for a discussion of more advanced topics, Buckland et al. (2004).

Numerous factors may influence detectability, including species, habitat, observer, year, and perhaps other variables. Some of these factors are likely to vary over time or space, and therefore must be accounted for before: (1) density estimates can be made, and (2) trends in density can be assessed.

Data analysis should identify and correct for any substantial sources of variation in detectability, to the extent sample sizes allow. For common species, the analyst will model detection probabilities based on species detections amassed during the 4-year analysis period. For rarer species, it may be necessary to derive detection models using more extensive data sets that contain all SIEN bird inventory and monitoring data gathered to date. As of spring 2006 this amounts to approximately 25,000 bird detections with distance estimates. By having all data at his or her disposal, the analyst retains flexibility to test effects of variables such as habitat, year, and observer on detection probability where sample sizes allow, and develop the best possible detectability functions for rarer species.

To import the inventory and monitoring data into *Distance* for detectability modeling, first create a text file that contains all detection records for all species of interest (if desired, records for additional species may be left in the file, as they will do no harm). At a minimum, the file should contain fields indicating the habitat group (open- or closed-canopy), survey point, species (4-letter codes will be easiest to use) and detection distance. Other fields may be added if the analyst is interested in exploring additional possible covariates of detectability. The records in the text file must be sorted in the correct order: habitat group (and/or grouping defined by other variables that may affect detectability, such as observer or year), survey point, and species.

Follow general instructions provided in the *Distance* User's Manual to create a project and import data. Although step-by-step instructions are beyond the scope of this SOP, suggestions below should help in successfully navigating through portions of the user interface that may be confusing.

- In the New Project Setup Wizard, at "Step 3: Survey Methods", choose "Point transect" as the Type of Survey.

- At Step 5, it is not necessary to select any multiplier options if the project will be used only for modeling detectability (that is, if it will not be used for calculating density estimates, which may be treated as a separate step from detectability estimation).

- In Import Data Wizard, at "Step 5: Data File Structure", select the habitat group field as the Region, the point identifier field as the Point Transect (note that in Distance terminology, each of the sampling points is a "Point Transect"), and detection distance and species as Observation fields.

Once data have been successfully imported, use the Analysis tab to construct and test detectability models. For each species with adequate data, specify the model definitions three ways: (1) once with the data filter set to include only detections at points in relatively closed-canopy habitats, (2) once with the data filter set to include only detection at relatively open-canopy habitats, and (3) once with all detections of the species included. Then use criteria including Akaike Information Criterion, model fit statistics, and biological 'reasonableness' of the models to determine whether a better model was fit by separating or combining the two groups of habitats. The same general approach may be used to assess other potential sources of variation in detectability, including observer and year. Other sources may be important as well; there is no substitute for thorough data exploration.

Alternately, the multiple covariates distance sampling (MCDS) engine in the *Distance* software may be used to model potential sources of variation in detectability as covariates of the scale parameter of the key function. Using this method, the covariates are assumed to influence the scale of the detection function, but not its shape; that is, the covariates affect the rate at which detectability decreases with distance, but not the overall shape of the detection curve.

Once the analyst is satisfied that the best possible models of detectability for each species have been developed, he or she should record the essential parameters of the selected model(s) for each species—truncation point (*w*), detection probability estimate (*P*), standard error of the detection probability estimate (*se* of *P*), and degrees of freedom of the detection probability estimate (*df* of *P*). All of these values should be reported in the 4-year report.

Estimating Density

Once the detectability model parameters have been derived, they should be used to estimate density of each species at each point, for all years under consideration.

To estimate point-specific densities for a particular year in *Distance*, begin by querying the SIEN bird monitoring database to create a text file containing all of the point count detections for the year of interest. At a minimum, the text file will need to contain fields indicating the park, the habitat group (open-canopy or closed-canopy), the survey point, the species (4-letter codes will be most convenient), and the estimated distance from the observer. If other variables such as observer or year have also been found to affect detectability, they need be included as well.

A few things to keep in mind when creating the text file:

- Detections classified in the database as ‘flyovers’ should be omitted from the text file.

- There must be at least one record for every point that was surveyed in the year of interest. For points where no birds were detected, there should be a single record with species = ‘None’. Failure to account for points with no detections will cause an upward bias in the results.

- Distance will not perform the calculations correctly if the records are not sorted properly. For the density estimations, the records must be sorted by point, such that all the records for each species at each point are grouped together in the database.

Import the text file into *Distance*. At Step 5 of the New Project Setup Wizard be sure to check the box indicating “Add Multipliers for: Other”. When running the calculations for each species and each set of habitats, use the Data tab to enter the appropriate multiplier (detection probability) estimate, standard error, and degrees of freedom values from the modeling efforts in Section 2 above. Use the Data Filter to specify not only the species, but also the truncation point, which should be the distance used for generating the models (see section 2, above). Remember to change the multiplier and truncation values each time analysis is conducted on a new species. If two separate models (one for closed-canopy points and one for open-canopy points) are to be used for a given species, also use the Data Filter to specify the set of habitats for which the program should produce density estimates.

When defining models, select the uniform key function with no series expansions—this way the program will simply use the parameter values you have specified, without constructing new models. Specifying Sample under “Level of Resolution of Estimates” in the Model Definition

Properties box will instruct the program to return a density estimate of the species indicated in the Data Filter at each survey point.

Assessing Temporal Trends in Density Estimates

Temporal trends in density estimates of bird species can be assessed using the custom-made software program *BirdTrend*, developed for the NCCN landbird monitoring program by TerraStat Consulting Group for use with the free software package R. The software will need to be modified slightly for use in the SIEN, to accommodate the different numbers of parks, panels, transects per panel, and points per transect.

In addition to assessing temporal trends, *BirdTrend* also calculates park-and year-specific density estimates for each species. Detailed instructions for importing and analyzing data are provided in the User's Manual for *BirdTrend*, which can be found in the NCCN Landbird Monitoring Protocol. Note that the *Distance* output tables must be reformatted according to the specifications in the *BirdTrend* User's Manual before they can be imported into *BirdTrend*.

Reporting Annual and 4-year Results

Several standard summary tables should be included in the annual report. The recommended structures for standard tables and figures to include in the annual report are presented in the following pages, with fabricated data included for illustrative purposes.

Observers who Conducted Point Counts in the Current Year

Table SOP 16 – 1 of the annual report should provide the names and roles of all observers who conducted point counts during the current year. A sample table is provided below.

Table SOP 16 – 1. Observers who conducted point counts in SIEN parks in Year X.

Observer	Role
Stephanie Dolrenry	Technician
Bob Wilkerson	Field Lead

Transects That Were Completed in the Current Year

Table SOP 16 – 2 of the annual report should list each transect that was supposed to have been sampled during the current year, and the number of points along each transect actually sampled. An abbreviated version of the table is provided below.

Table SOP 16 – 2. SIEN bird monitoring transects that were surveyed in Year X.

Park	Panel	Elevation	Transect	No. of points completed
SEKI	1	Low	5001	18
SEKI	1	Medium	5015	14
SEKI	2	High	5017	14
YOSE	1	Low	6017	14
YOSE	1	Low	6020	14
YOSE	2	Medium	6032	15

Summary History of Transects Completed up Through the Current Year

Table SOP 16 – 3 of the annual report should indicate how many transects were surveyed in each elevation zone of each park, during the current year and in all previous years. A sample table is provided below.

Table SOP 16 – 3. Summary history of SIEN bird monitoring transects completed through Year X.

		Number of Transects Completed							
Park	**Elevation class**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
SEKI	Low	2	2	2	2	2	2	2	2
SEKI	Medium	18	18	16	18	18	18	18	17
SEKI	High	10	9	10	10	10	10	10	10
SEKI	ALL	30	29	28	30	30	30	30	29
YOSE	Low	10	10	10	10	10	10	10	10
YOSE	Medium	10	10	9	10	10	10	10	10
YOSE	High	10	8	10	10	10	10	10	10
YOSE	ALL	30	28	29	30	30	30	30	30
ALL	Low	12	12	12	12	12	12	12	12
ALL	Medium	28	28	25	28	28	28	28	27
ALL	High	20	17	20	20	20	20	20	20
ALL	ALL	60	57	57	60	60	60	60	59

All Species Recorded in the Large Parks during the Field Season

Table SOP 16 – 4 in the Annual Report should list all species detected during point counts, and/or recorded on 'rare bird' detection forms in the large parks during the current year. In the abbreviated sample table below, asterisks indicate species that were recorded only on 'rare bird' detection forms. The real table will likely contain well over 100 records.

Table SOP 16 – 4. All species recorded in the three large parks during the Year X field season, including species detected during point counts, and species recorded on 'rare bird' detection forms. Asterisks indicate species that were recorded only on 'rare bird' detection forms.

Common Name	Latin Name	Notable
Pileated Woodpecker	*Dryocopus pileatus*	
Olive-sided Flycatcher	*Contopus borealis*	
Western Wood-Pewee	*Contopus sordidulus*	
Willow Flycatcher*	*Empidonax trailii*	X
Hammond's Flycatcher	*Empidonax hammondii*	
Pacific-slope Flycatcher	*Empidonax difficilis*	

Number of Individuals of Each Species Detected during Point Counts in the Large Parks and the Number of Transects on which Each Species was Detected

Table SOP 16 – 5 in the Annual Report should indicate the number of individuals of each species detected during point counts in the large parks and the number of transects on which each species was detected. An abbreviated sample table is provided below. The real table will likely have 80 or more records. Totals include all point counts, not just the point counts that contribute to park-specific and network density estimates.

Table SOP 16 – 5. Number of transects with detections and number of individual detections for each species detected during point counts in the large parks in Year X.

	Number of Transects with Detections			Number of Individuals Detected[a]		
Species	**SEKI**	**YOSE**	**ALL**	**SEKI**	**YOSE**	**ALL**
Red-tailed Hawk	0	1	1	0	1	1
Mountain Chickadee	16	19	35	36	43	79
Wilson's Warbler	3	2	5	3	3	6
Dark-eyed Junco	26	27	53	70	77	147

The report should also include one or more additional tables and/or bar graphs indicating the numbers of each species detected on the annual panel of transects only.

Transect Survey History at the Large Parks through the Current Year

Appendix 1 of the Annual Report should provide a more detailed (compared to item 5b, above) survey history of each transect surveyed to date. An abbreviated sample table (**Table SOP 16 –**

6) is provided below. The real table should include a record for each transect that has ever been surveyed.

Table SOP 16 – 6. Survey history of each transect surveyed in Year X.

Park	Panel Membership	Elevation Class	Transect	Number of Points Completed					
				2008	2009	20010	2011	2012	2013
SEKI	Ann1	Low	5001	14	14	14	14	14	14
SEKI	Ann1	Medium	5015	14	14	14	0	14	14
SEKI	Alt2	High	5017	18	0	0	0	18	0
SEKI	Alt3	High	5018	0	14	0	0	0	16
YOSE	Ann1	Low	6017	14	14	14	14	14	14
YOSE	Ann1	Low	6020	14	14	14	14	13	14
YOSE	Alt2	Medium	6032	14	14	14	14	14	14
YOSE	Alt3	High	6045	0	14	0	0	0	14

Reporting Results for DEPO

For DEPO, the report should:

- list any points that were not surveyed, and explain why they were missed.
- provide the number of individuals detected and the number of points with detections for each species detected during point counts at DEPO in the current year. A sample table structure (**Table SOP 16 – 7**) is provided below.

Table SOP 16 – 7. Number of individuals detected and number of points with detections for each species detected during point counts at Devils Postpile National Monument in Year X.

Species[a]	Number of points with detections	Number of individuals detected
Golden-crowned Kinglet	8	12
Dark-eyed Junco	41	53

[a]Includes all species detected during point counts at DEPO in the specified year.

Maps to Include in the Annual Reports

The annual report should include maps indicating the general location of each transect that was surveyed in each large park during the current year.

Other Components of Annual Reports

In addition to the tables and figures described above, annual reports should include:

- A brief narrative section describing any logistic problems that were encountered, and providing suggestions for preventing or coping with similar problems in the future.

- A "methods" section detailing data collection procedures and analytical techniques; this may change little from year to year, but should still be included as part of each year's report. The section should highlight any changes from previous methods.
- A "results" section that describes the content of the tables and figures.
- Graphs showing trends in the raw counts of at least the most common species detected on the annual panel. These graphical presentations of trends in raw data will not be analyzed quantitatively because they represent interim data that has not accounted for annual differences in avian detectability (to be analyzed at the end of each 4-year interval).
- A brief "discussion" section that highlights and interprets any notable findings, such as detections of unexpected species, factors such as unusual weather patterns that might have affected results, or unexpectedly large changes in raw detection counts obtained from the annual panel.
- An "acknowledgements" section thanking individuals who contributed to the field season or report.

Standard Report Format: Annual reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Annual reports will use the Natural Resource Report template; trend analysis and other peer-reviewed technical reports will use the Natural Resource Technical Report template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

In addition to the material recommended for the annual reports, the 4-year reports should also include the following tables.

Estimated Annual Density of Each Species in Each Large Park and in All Three Parks Combined

The 4-year reports should provide a table (**Table SOP 16 – 8**) of the estimated density (bird/ha) of each species at each large park during (and at all three parks combined) during each year, leading up to and including the present year. Note that the *BirdTrendAnnualDensity* module of *BirdTrend* can perform these calculations, taking into account the appropriate weighting of each transect.

Table SOP 16 – 8. Annual density estimates for American Robin.

Park	Year	Mean Density (birds/ha)	Mean Density SE
SEKI	2008	0.40	0.010
SEKI	2009	0.47	0.015
SEKI	2010	0.51	0.012
SEKI	2011	0.42	0.014
SEKI	2012	0.44	0.010
YOSE	2008	0.55	0.010
YOSE	2009	0.38	0.015
YOSE	2010	0.50	0.012
YOSE	2011	0.51	0.014
YOSE	2012	0.39	0.010
Combined	2008	0.48	0.010
Combined	2009	0.53	0.015
Combined	2010	0.55	0.012
Combined	2011	0.47	0.014
Combined	2012	0.42	0.010

Summary Trend Results for Species with Adequate Data for Density Estimation and Trend Assessment

The 4-year report should summarize trend results from *BirdTrend* for species with adequate data for density estimation and trend assessment. An abbreviated sample table (**Table SOP 16 – 9**) is provided below. Note that *BirdTrend* produces this summary table.

Table SOP 16 – 9. Summary trend results for each species with a calculable density trend in the large parks.

Species	Years	Park	No. Non-zero Transects	Mean of Slope	Variance of Slope	df	t-stat	2-tailed p-value
AMRO	2008–2015	SEKI	72	0.022	0.00035	38.26	1.1976	0.238
	2008–2015	YOSE	72	0.018	0.000157	45.54	1.4181	0.163
	2008–2015	Combined	204	0.030	0.000133	146.83	2.3328	0.210
WIWA	2008–2015	SEKI	60	0.098	0.00038	47.62	5.0157	0
	2008–2015	YOSE	60	0.088	0.000317	50.77	4.9443	0
	2008–2015	Combined	204	0.090	0.000128	150.7	7.9335	0

Detectability Parameters used for Calculating Density Estimates

The 4-year report should discuss results of detectability modeling and should provide the detectability parameters used for calculating density estimates. The table structure (see **Table SOP 16 – 10**) may change somewhat if analysts decide to use covariates other than habitat (such as observer, year, etc.). Note that these are fabricated values, and that the real table will include many more species.

Table SOP 16 – 10. Density adjustment parameters obtained through modeling of species-specific detectability.

	Density Adjustment Parameters Obtained Through Detectability Modeling									
	Relatively Closed-canopy Habitats					Relatively Open-canopy Habitats				
			Detection Probability					Detection Probability		
Species Name	No. of Detections	Sample Width (m)	*P*	SE	df	No. of Detections	Sample Width (m)	*P*	SE	df
Western Wood-Pewee	64	90	0.707	0.323	220	62	94	0.780	0.090	70
Hammond’s Flycatcher	120	72	0.665	0.240	150	67	79	0.680	0.069	95
Pacific-slope Flycatcher	350	72	0.600	0.268	94	70	79	0.654	0.069	100
Mountain Chickadee	805	85	0.504	0.066	400	805	85	0.504	0.066	400

Detailed Species-specific Trend Results

The 4-year report should provide a table (e.g. see sample

Table SOP 16 – 11) with detailed trend results for each species for which density estimates have been calculated. Note that this table will be produced by *BirdTrend*.

Table SOP 16 – 11. Detailed trend results for American Robin.

SPECIES: AMRO
YEARS: 2007–2016

Park	Variance Group	Panel(s)	Elevation Class	# Non-Zero Sites	Mean Slope	Variance of Slope	Variance of Mean Slope	df	t-stat	2-tailed p-value
SEKI	1	Ann1	Low	4	0.0337	0.000715	-	-	-	-
	2	Ann1	Mid	4	-0.0341	0.000612	-	-	-	-
	3	Ann1	High	4	0.0091	0.001378	-	-	-	-
	4	Alt2,Alt3,Alt4, Alt5	Low	20	0.0302	0.030507	-	-	-	-
	5	Alt2,Alt3,Alt4, Alt5	Mid	20	0.0276	0.01932	-	-	-	-
	6	Alt2,Alt3,Alt4, Alt5	High	20	0.0084	0.015879	-	-	-	-
	Combined Panels		Low	24	0.0308	-	0.001064	-	-	-
			Mid	24	0.0173	-	0.000675	-	-	-
			High	24	0.0086	-	0.000561	-	-	-
				-	-	-	-	-	-	-
	Grand Mean		All	72	0.0224	-	0.00035	38.26	1.1976	0.2384
YOSE	1	Ann1	Low	4	0.0302	0.000486	-	-	-	-
	2	Ann1	Mid	4	0.0029	0.003128	-	-	-	-
	3	Ann1	High	4	4.00E-04	0.000745	-	-	-	-
	4	Alt2,Alt3,Alt4, Alt5	Low	20	0.0467	0.010676	-	-	-	-
	5	Alt2,Alt3,Alt4, Alt5	Mid	20	-0.0039	0.013248	-	-	-	-
	6	Alt2,Alt3,Alt4, Alt5	High	20	0.0216	0.007386	-	-	-	-
	Combined Panels		Low	24	0.044	-	0.000374	-	-	-
			Mid	24	-0.0028	-	0.000482	-	-	-
			High	24	0.0181	-	0.000262	-	-	-
	Grand Mean		All	72	0.0178	-	0.000157	45.54	1.4181	0.163
Combined				204	0.0269	-	0.000133	146.83	2.3328	0.021

Density Reporting and Trend Assessment for DEPO

For DEPO, the 4-year report should provide annual density estimates for each species with adequate data for density estimation. It should also present simple linear regression analysis of parkwide density over time (See SOP #10**: Special Considerations for DEPO** for more detailed instructions).

Analyzing Trends in Bird Species Distributions: Specific questions regarding distributional change are much harder to anticipate than those regarding population trend (has the population increased or decreased?). For distribution, there are many different kinds of questions that may be asked—has a particular species shifted its upper elevation boundary? Its lower elevation boundary? Has it disappeared from particular habitats or regions of the park?

Since it is reasonable to expect temporal (annual or greater) variation in distributions, it will likely take many years to detect a trend. That is, initially we will likely be describing the temporal variation associated with distribution patterns.

The following types of analyses of bird distributions may be pursued, depending on the primary questions of interest and the opportunities to form partnerships with others to do larger regional-scale analyses of bird distributions:

- Within Sequoia and Kings Canyon and Yosemite, determine the centers of abundance for a subset of species that have large enough population sizes to be recorded at numerous sample points and transects. For a particular species, its center of abundance would be the elevation at which half of the recorded individuals are found at lower elevations and half at higher elevations. These could be determined annually and plotted on graphs (by year and elevation). Eventually (after several panel rotations), there would be enough points to do a trend analysis to determine if centers of abundance are shifting.
- Seek regional partnerships where there are opportunities to combine our data with other similar data collected across California and the Pacific Northwest to assess regional scale changes in bird distributions through tracking centers of abundance latitudinally (as in National Audubon Society 2009).
- Periodically (every 2-3 panel rotations or 8-12 years) explore the use of niche and occupancy modeling in combination with local weather/climate data to assess whether birds are moving spatially to track their defined climatic niche – employ methods developed by Tingley et al. 2009, or work with University of California research scientists who are using these methods with similar data sets.
- Seek expertise in other spatial analysis techniques (such as geostatistical-temporal modeling) and for those species that are sufficiently abundant, identify whether or not the spatial patterns in mean densities are changing over time.

Additional Components of the 4-year Report

In addition to the extra analyses and tables described above, the 4-year report should also assess spatial patterns in the density estimates, identify any possible distributional changes within parks, and perhaps try to place network results within the larger context of bird population changes throughout the Sierra Nevada, as measured by regional efforts such as the BBS or MAPS. The report should also evaluate operational aspects of the monitoring program, such as whether any transects need to be eliminated or moved due to access problems, whether the sampling period remains appropriate (the optimal sampling season could conceivably change over time in response to climate change), etc.

References

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2004. Advanced distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford.

National Audubon Society. 2009. Birds and climate change – ecological disruption in motion. A briefing for policymakers and concerned citizens. National Audubon Society, Inc., New York, NY 10014. Accessed February 26, 2010 at: http://birdsandclimate.audubon.org/.

Thomas, L., J. L. Laake, S. Strindberg, F. F. C. Marques, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. L. Hedley, and J. H. Pollard. 2002. Distance 4.0 Release 2. Research Unit for Wildlife Populations Assessment, University of St. Andrews, UK. http://www.ruwpa.st-and.ac.uk/distance/

Tingley, M. W., W. B. Monahan, S. R. Beisinger, and C. Moritz. 2009. Birds track their Grinnellian niche through a century of climate change. Proceedings of the National Academy of Sciences (USA) 106, suppl. 2:19637-19643.

Standard Operating Procedure (SOP) 17:
Project Delivery Specifications

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This document provides details on the process of submitting completed data sets, reports and other project deliverables. Prior to submitting digital products, files should be named according to the naming conventions appropriate to each product type (see below for general naming conventions).

All digital file submissions that are sent by email should be accompanied by the following information about the products:

- Submission date
- Name of the person submitting the product(s)
- Name and file format of each product
- Indication of whether or not each product contains sensitive information (see **SOP #19: Sensitive Information Procedures** for more detail).

Much useful information is currently detailed in SIEN's ***Data Management Plan*** (Cook and Lineback 2008), especially chapters 3, 6, and 10 and their associated appendices. We also have excerpted and slightly modified the information that follows in this SOP from the North Coast and Cascades Network Landbird Monitoring Protocol (Siegel et al. 2007).

Table SOP 17 – 1. Product delivery schedule and specifications.

Deliverable Product	Primary Responsibility	Target Date	Instructions
Field season report	Project Lead	September 15 of the same year	Upload digital file in MS Word format to the SIEN file directory[1].
Raw GPS data files	Field Crew Lead	September 15 of the same year	Zip and send all digital files to the Data Technician.
Processed GPS data files	GIS Specialist	September 15 of the same year	Zip and upload raw and processed files to the SIEN file directory.
Certified working database	Project Lead	November 30 of the same year	Refer to the following section on delivering certified data and related materials.
Certified geospatial data	Project Lead with GIS Specialist		
Data certification report	Project Lead		
Metadata interview form	Project Lead and Data Tech		
Full metadata (parsed XML)	Data Manager and Data Technician	March 15 of the following year	Upload the parsed XML record to the NPS IRMA[2], and store on the SIEN file directory.
Annual I&M report	Project Lead and NPS Lead	April 30 of the following year	Refer to the following section on reports and publications.
4-year analysis report	Project Lead, NPS Lead	Every 4 years by April 30	
Other publications	NPS Lead, Project Lead	as completed	
Field data forms	NPS Lead and Project Lead	Every 4 years by April 30	Scan original, marked-up field forms as PDF files and upload these to the SIEN file directory. Originals go to the Park Curator for archival.
Other records	NPS Lead and Project Lead	review for retention every January	Organize and send analog files to Park Curator for archival. Digital files that are slated for permanent retention should be uploaded to the SIEN file directory. Retain or dispose of records following NPS Director's Order #19[3].

[1] The SIEN file directory is a hierarchical digital filing system stored on the SIEN file servers (Cook and Lineback 008).

[2] NPS Integration of Resources Management Applications (IRMA) is a clearinghouse for natural resource reports, data and metadata (http://science.nature.nps.gov/im/datamgmt/IRMA.cfm).

[3] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm.

Specific Instructions for Delivering Certified Data and Related Materials

Data certification is a benchmark in the project information management process that indicates that: 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks; and 3) that they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. For more information refer to **SOP #15: Data Quality Review and Certification**.

The following deliverables should be delivered as a package:

- *Certified working database:* Database in MS Access format containing data for the current season that has been through the quality assurance checks documented in **SOP #15: Data Quality Review and Certification**.
- *Certified geospatial data:* GIS themes in ESRI coverage or shapefile format.
- *Data certification report:* A brief questionnaire in MS Word that describes the certified data product(s) being submitted. A template form is available in the SIEN Data Management Plan (Cook and Lineback 2008, Appendix 3-A)
- *Metadata:* The metadata interview form is an MS Word questionnaire that greatly facilitates metadata creation. It is available on the SIEN network file directory. For more details, refer to **SOP #14: Metadata Development**.

After the quality review is completed, the Project Lead should package the certification materials for delivery as follows:

1. Open the certified back-end database file and compact it (in Microsoft Access, Tools > Database Utilities > Compact and Repair Database). This will make the file size much smaller. Back-end files are typically indicated with the letters "_be" in the name (e.g., Birds_ be_2011.mdb).
2. Rename the certified back-end file with the project name, the year or span of years for the data being certified, and the word "certified". For example: Birds_2011_certified.mdb.
3. Create a compressed file (using WinZip® or similar software) and add the back-end database file to that file. Note: The front-end application does not contain project data and as such should not be included in the delivery file.
4. Add the completed metadata interview and data certification forms to the compressed file. Both files should be named in a manner consistent with the naming conventions described elsewhere in this document.
5. Add any geospatial data files that aren't already in the possession of the Data/GIS Technician. Geospatial data files should be developed and named according to the SIEN file naming conventions (Appendix 11-A, Cook and Lineback 2008).
6. Upload the compressed file containing all certification materials to the new submissions folder of the SIEN directory structure. If the Project Lead does not have intranet access to the SIEN directory structure, then certification materials should be delivered as follows:

   a. If the compressed file is under 5 mb in size, it may be delivered directly to the NPS Lead and Data Manager by email.
   b. If the compressed file is larger than 5 mb, it should be copied to a CD or DVD and delivered in this manner. Under no circumstances should products containing sensitive information be posted to an FTP site or other unsecured web portal (refer to **SOP #19: Sensitive Information Procedures** for more information).

7. Notify the Data Manager and NPS Lead by email that the certification materials have been uploaded or otherwise sent.

Upon receiving the certification materials, the Data Manager will:

1. Review them for completeness and work with the Project Lead if there are any questions.
2. Notify the Data Technician if any geospatial data are submitted. The Data Technician will then review the data, and update any project GIS data sets and metadata accordingly.
3. Store the certified products together in the SIEN directory structure.
4. Upload the certified data to the master project database.
5. Notify the Project Lead that the year's data have been uploaded and processed successfully. The Project Lead may then proceed with data summarization, analysis and reporting.
6. Develop, parse and post the XML metadata record to the NPS IRMA.
7. After a holding period of 2 years, the Data Manager will upload the certified data to the NPS IRMA. This holding period is to protect professional authorship priority and to provide sufficient time to catch any undetected quality assurance problems.

Specific Instructions for Reports and Publications

Annual reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Annual reports will use the Natural Resource Report template, and trend analysis and other peer-reviewed technical reports will use the Natural Resource Technical Report template. Instructions for acquiring a series number and other information about NPS publication standards can be found at: http://www.nature.nps.gov/publications/NRPM/index.cfm. In general, the procedures for reports and publications are as follows:

1. The document should be formatted using the NPS Natural Resource Publications template. Formatting according to NPS standards is easiest when using the template from the very beginning, as opposed to reformatting an existing document.
2. The document should be peer reviewed at the appropriate level. For example, I&M Annual Reports should be reviewed by other members of the appropriate project work group. The Network Program Manager will also review all annual reports for completeness and compliance with I&M standards and expectations.
3. Upon completing the peer review, acquire a publication series number from the NPS Technical Information Center or the appropriate local or regional key official (currently the Regional I&M Coordinator).

4. Upload the file in PDF and MS Word formats to the SIEN directory structure.
5. Send a printout to each Park Curator.
6. The Data Manager or a designee will create a bibliographic record and upload the PDF document to IRMA according to document sensitivity.

References

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR--2008/070. National Park Service, Fort Collins, Colorado. Available at: https://science1.nature.nps.gov/naturebib/biodiversity/2008-11-26/SIENDMP_CompletePlan_20081125.pdf (accessed 14 June 2010).

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007c. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

Standard Operating Procedure (SOP) 18: Revising the Protocol

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This document explains how to make and track changes to the SIEN Bird Monitoring Protocol and its associated SOPs via the Revision History Log at the beginning of each of these documents. This SOP was adapted from the North Coast and Cascades Network (Siegel et al. 2007) and Klamath Network Landbird Monitoring Protocols (Stephens et al. 2010).

While this monitoring plan has been developed using current standardized methodology, all monitoring programs need to be flexible to adapt to changes. As new technologies, methods, and equipment become available, this protocol will be updated as appropriate, by balancing current best practices against the continuity of protocol information. Project staff should refer to this SOP whenever edits are necessary and should be familiar with the protocol versioning system in order to identify and use the most current versions of the protocol documents. All changes will be made in a timely manner with the appropriate level of review.

All edits require review for clarity and technical soundness. Small changes to existing documents (e.g., formatting, simple clarification of existing content, small changes in the task schedule or project budget, or general updates to information management handling SOPs) may be reviewed in-house by project cooperators and SIEN staff. However, major changes to data collection or analysis techniques, sampling design, or response design will trigger an outside review. The Project Lead should coordinate with the SIEN Program Manager to determine if outside review is needed.

Revision Procedures

The following procedures will ensure that both minor and major revisions to this document will align with the monitoring plan.

1. Discuss proposed changes with other project staff prior to making modifications. It is important to consult with the Data Manager prior to making changes because certain types of changes may jeopardize dataset integrity unless they are planned and executed with dataset integrity in mind. Also, because certain changes may require altering the database structure or functionality, advance notice of changes is important to minimize disruptions to project operations. Consensus should be reached on who will be making the changes and in what timeframe.
2. Make the agreed-upon changes in the current, primary version of the appropriate protocol document. Also note that a change in one document may necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly, renumbering an SOP may mean changing document references in several other documents. Also, the project task list and other appendices may need to be updated to reflect changes in timing or responsibilities for the various project tasks.
3. Document all edits in the Revision History Log embedded in the protocol narrative and each SOP. Log changes only in the document being edited (i.e., if there is a change to an SOP, log those changes only in that document). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, the change and the paragraph(s) and page(s) where changes are made, and briefly the reason for making the changes.

4. Circulate the changed document for internal review among project staff and cooperators. Minor changes and clarifications will be reviewed in-house. When significant changes in methodology are suggested, revisions will first undergo internal review by the project staff. Additional external review including, but not limited, to National Park Service staff with appropriate avian research and statistical expertise will be required.
5. Upon ratification and finalizing changes:
    a. Ensure that the version date (last saved date field code in the document header) and file name (field code in the document footer) are updated properly throughout the document.
    b. Make a copy of each changed file to the protocol archive folder (i.e., a subfolder under the Protocol folder in the project workspace).
    c. The copied files should be renamed by appending the revision date in YYYYMMDD format. In this manner, the revision date becomes the version number and this copy becomes the "versioned" copy to be archived and distributed.
    d. The current, primary version of the document (i.e., not the versioned document just copied and renamed) does not have a date stamp associated with it.
    e. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup. Inform the Data Manager so the new version number(s) can be incorporated into the project metadata.
6. As appropriate, create PDF files of the versioned documents to post to the Internet and share with others. These PDF files should have the same name and be made from the versioned copy of the file.
7. Send a digital copy of the revised monitoring plan to the Network Program Manager and Network Data Manager. The revised monitoring plan will be forwarded to all individuals who had been using a previous version of the affected document. Ensure that surveyors in the field have a hardcopy of the new version.
8. The Network Data Manager will place a copy of the revised protocol in the proper folder on the Sierra Nevada Network shared drive. In addition, the Network Data Manager will archive the previous version in the Sierra Nevada Network archive drive.
9. The Network Data Manager will post the revised version and update the associated records in the proper I&M databases associated with IRMA, the SIEN Intranet and Internet web sites, and the Protocol database.

Example of Document Revision

SOP_2_Safety.doc is revised on October 31, 2011 and circulated for review.

Changes are accepted by the group and changes are finalized on December 6, 2011.

The revised SOP is:

1. Copied into the Archive folder.
2. That versioned copy is renamed SOP_2_Safety_20111206.doc.
3. Both the current, primary version and the versioned copy are set to read-only.

4. A PDF of the document is created from the versioned copy and named SOP_2_Safety_20111206.pdf.
5. Both the PDF and the versioned document are uploaded to the SIEN shared directory.
6. The PDF is sent to any cooperators and updated on any other websites, or in appropriate on-line databases.

References

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007c. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

Stephens, J. L., S. R. Mohren, J. D. Alexander, D. A. Sarr, and K. M. Irvine. 2010. Klamath Network: Draft landbird monitoring protocol. Natural Resource Report NPS/KLMN/NRR – 2010/XXX. National Park Service, Fort Collins, Colorado.

Standard Operating Procedure (SOP) 19: Sensitive Information

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Introduction

This SOP addresses the handling of sensitive information and was excerpted from the North Coast and Cascades Network Landbird Monitoring Protocol (Siegel et al. 2007).

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy can be found in the NPS Management Policies (National Park Service 2006), and in Director's Order #66.

These guidelines apply to all SIEN staff, cooperators, contractors, and other partners who are likely to obtain or have access to information about protected NPS resources. The NPS Lead has primary responsibility for ensuring adequate protection of sensitive information related to this project (see Cook and Lineback 2008 and Boetsch et al. 2005 for additional information about sensitive information policy guidance and applications to the Inventory & Monitoring Program).

The following are highlights of our strategy for protecting this information:

- *Protected resources*, in the context of the SIEN Inventory and Monitoring Program, include species that have State- or Federally-listed status, and other species deemed rare or sensitive by local park taxa experts.
- *Sensitive information* is defined as information about protected resources which may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.
- In general, if information is withheld from one requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
- To share information as broadly as legally possible, and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
    - Random coordinate offsets of up to 2 km for data collection locations, and
    - Removal of data fields from the released copy that are likely to contain sensitive information.

What Kinds of Information Can and Cannot Be Shared?

Do Not Share

Project staff and cooperators should not share any information outside NPS that reveals details about the "nature or specific location" of protected resources, unless a confidentiality agreement is in place. Specifically, the following information should be omitted from shared copies of all data, presentations, reports, or other published forms of information.

- *Exact coordinates:* Instead, public coordinates are to be generated that include a random offset azimuth and distance. These offset coordinates can be shared freely.
- *Other descriptive location data:* Examples may include travel descriptions, location descriptions, or other fields that contain information which may reveal the specific location of the protected resource(s).
- *Protected resource observations at disclosed locations:* If specific location information has already been made publicly available, the occurrence of protected resources at that location cannot be shared outside NPS without a confidentiality agreement. For example, if the exact coordinates for a monitoring station location are posted to a website or put into a publication, then at a later point in time a spotted owl nest is observed at that monitoring station, that nest cannot be mentioned or referred to in any report, presentation, data set, or publication that will be shared outside NPS.

Do Share
All other information about the protected resource(s) may be freely shared, so long as the information does not reveal details about the "nature or specific location" of the protected resource(s) that aren't already readily available to the general public in some form (e.g., other published material). Species tallies and other types of data presentations that do not disclose the precise locations of protected resources may be shared, unless by indicating the presence of the species the specific location is also revealed (i.e., in the case of a small park).

Details for Specific Products
Whenever products such as databases and reports are being generated, handled and stored, they should be created explicitly for one of the following purposes:

1. *Public or general-use* – Intended for general distribution, sharing with cooperators, or posting to public websites. They may be derived from products that contain sensitive information so long as the sensitive information is either removed or otherwise rendered in a manner consistent with other guidance in this document.
2. *Internal NPS use* – These are products that contain sensitive information and should be stored and distributed only in a manner that ensures their continued protection. These products should clearly indicate that they are solely for internal NPS use by containing the phrase: "Internal NPS Use Only – Not For Release." These products can only be shared within NPS or in cases where a confidentiality agreement is in place. They do not need to be revised in a way that conceals the location of protected resources.

Data Sets
To create a copy of a data set that will be posted or shared outside NPS:

1. Make sure the public offset coordinates have been populated for each sample or observation location in tbl_Locations.
2. Remove tbl_Coordinates and tbl_GPS_Info.
3. Delete the following database objects to ensure consistent omission of fields that may contain specific, identifying information about locations of protected resources

a. tbl_Sites.Site_notes
b. tbl_Locations.Travel_notes
c. tbl_Locations.Elevation, Elev_units, Elev_source
d. tbl_Locations.Location_desc
e. e. tbl_Locations.Location_notes
f. tbl_Features
g. tbl_Markers

The local, master copy of the database contains the exact coordinates and all data fields. The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Maps and Other GIS Output

General use maps and other geographic representations of observation data that will be released or shared outside NPS should be rendered using offset coordinates, and should only be rendered at a scale that does not reveal their exact position (e.g., 1:100,000 maximum scale).
If a large-scale, close-up map is to be created using exact coordinates (e.g., for field crew navigation, etc.), the map should be clearly marked with the following phrase: “Internal NPS Use Only – Not For Release.”

The Data Manager and/or Data Technician can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Presentations and Reports

Public or general-use reports and presentations should adhere to the following guidelines:

- Do not list exact coordinates or specific location information in any text, figure, table, or graphic in the report or presentation. If a list of coordinates is necessary, use only offset coordinates and clearly indicate that coordinates have been purposely offset to protect the resource(s) as required by law and NPS policy.
- Use only general use maps as specified in the section on maps and other GIS output.

If a report is intended for internal use only, these restrictions do not apply. However, each page of the report should be clearly marked with the following phrase: “Internal NPS Use Only – Not For Release.”

Voucher Specimens

Specimens of protected taxa should only be collected as allowed by law. Labels for specimens should be clearly labeled as containing sensitive information by containing the following phrase: “Internal NPS Use Only – Not For Release.” These specimens should be stored separately from other specimens to prevent unintended access by visitors. As with any sensitive information, a confidentiality agreement should be in place prior to sending these specimens to another non-NPS cooperator or collection.

Procedures for Coordinate Offsets

1. Process GPS data, upload into the database, and finalize coordinate data records. Update tbl_Coordinates. Is_best as appropriate, especially where there is more than one set of coordinates per sample location.
2. Set the minimum and maximum offset distances (project-specific, typically up to 2 km).
3. Apply a random offset and random azimuth to each unique set of coordinates.
4. Coordinates may then be either rounded or truncated so the UTM values end in zeros to give a visual cue that the values are not actual coordinates.
5. Do not apply independent offsets to clustered or otherwise linked sample locations (e.g., multiple sample points along a transect). Instead, either apply a single offset to the cluster so they all remain clustered after the offset is applied, or apply an offset to only one of the points in the cluster (e.g., the transect origin) and store the result in the public coordinates for each point in that cluster.
6. These “public” coordinates are then the only ones to be shared outside NPS – including all published maps, reports, publications, presentations, and distribution copies of the data set – in the absence of a confidentiality agreement.

The following components can be used to create individual offsets rounded to the nearest 100 meters in MS Excel:

- Angle = rand() * 359
- Distance = ((Max_offset – Min_offset) * rand() + Min_offset)
- Public_UTME = Round(UTME_final + (Distance * cos(Angle – 90)), -2)
- Public_UTMN = Round(UTMN_final + (Distance * sin(Angle + 90)), -2)

Sharing Sensitive Information

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Integration of Resource Management Applications (IRMA) or another publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses – these may not contain sensitive information.

Responding to Data Requests

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full data set that includes sensitive information) may only be shared after a confidentiality agreement is established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. All data requests will be tracked by the project manager and data manager and a project tracking database will be developed to assist with tracking of data requests for all monitoring projects.

Once a confidentiality agreement is in place, products containing sensitive information may be shared following these guidelines:

- Always clearly indicate in accompanying correspondence that the products contain sensitive information, and specify which products contain sensitive information.
- Indicate in all correspondence that products containing sensitive information should be stored and maintained separately from non-sensitive information, and protected from accidental release or re-distribution.
- Indicate that NPS retains all distribution rights; copies of the data should not be redistributed by anyone but NPS.
- Include the following standard disclaimer in a text file with all digital media upon distribution: “The following files contain protected information. This information was provided by the National Park Service under a confidentiality agreement. It is not to be published, handled, re-distributed or used in a manner inconsistent with that agreement.” The text file should also specify the file(s) containing sensitive information.
- If the products are being sent on physical media (e.g., CD or DVD), the media should be marked in such a way that clearly indicates that media contains sensitive information provided by the National Park Service.

Confidentiality Agreements

Confidentiality agreements may be created between NPS and another organization or individual to ensure that protected information is not inadvertently released. When contracts or other agreements with a non-federal partner do not include a specific provision to prevent the release of protected information, the written document must include the following standard Confidentiality Agreement:

> **Confidentiality Agreement** - I agree to keep confidential any protected information that I may develop or otherwise acquire as part of my work with the National Park Service. I understand that with regard to protected information, I am an agent of the National Park Service and must not release that information. I also understand that by law I may not share protected information with anyone through any means except as specifically authorized by the National Park Service. I understand that protected information concerns the nature and specific location of endangered, threatened, rare, commercially valuable, mineral, paleontological, or cultural patrimony resources such as threatened or endangered species, rare features, archeological sites, museum collections, caves, fossil sites, gemstones, and sacred ceremonial sites. Lastly, I understand that protected information must not be inadvertently disclosed through any means including websites, maps, scientific articles, presentation, and speeches.

Note: Certain states, including the State of Washington, have sunshine laws that do not have exemptions for sensitive information. NPS should not create confidentiality agreements or share sensitive information with these states without first seeking the advice of an NPS solicitor.

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

References

Boetsch, John R., B. Christoe, R. Holmes. 2009. Data management plan for the North Coast and Cascades Network Inventory and Monitoring Program (2005). Natural Resource Report NPS/NCCN/NRR—2009/078. National Park Service, Fort Collins, Colorado. Online. (http://science.nature.nps.gov/im/units/nccn/dm_docs/NCCN_DMP_Sep2005.pdf). Accessed 4 February 2010.

Cook, R. R. and P. Lineback. 2008. Sierra Nevada Network data management plan. Natural Resource Report NPS/NRPC/NRR--2008/070. National Park Service, Fort Collins, Colorado. Available at: https://science1.nature.nps.gov/naturebib/biodiversity/2008-11-26/SIENDMP_CompletePlan_20081125.pdf (accessed 14 June 2010).

National Park Service. 2006. Management Policies. Available at: http://www.nps.gov/policy/mp2006.pdf (accessed 23 June 2010).

Siegel, R. B., R. L. Wilkerson, K. J. Jenkins, R. C. Kuntz II, J. R. Boetsch, J. P. Schaberl, and P. J. Happe. 2007c. Landbird monitoring protocol for national parks in the North Coast and Cascades Network. U.S. Geological Survey Techniques and Methods 2-A6. U.S. Geological Survey, Reston, Virginia. Available at http://geopubs.wr.usgs.gov/docs/wrgis/tm.html (accessed 10 June 2010).

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.

NPS 963/105361, August 2010

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov