



BIRD MONITORING

IMPORTANCE — Sierra Nevada Network (SIEN) parks -- Yosemite (YOSE), Sequoia and Kings Canyon (SEKI), and Devils Postpile (DEPO) -- provide over 1,600,000 acres of habitat for over 200 species of birds, including many neotropical migrants. Birds are particularly good indicators of change in terrestrial ecosystems because their ecology (including diverse habitat needs, trophic position, rapid metabolism, and presence in all the parks' terrestrial habitats) integrates the effects of numerous stressors. SIEN bird populations are affected by various stressors, both large-scale stressors such as climate change and air pollution, and more localized effects such as altered fire regimes and non-native species invasions. Park birds also rely on migration stopover sites and wintering grounds outside the parks, many of which are being rapidly altered by development, logging, agriculture and water diversions. The parks serve as important 'reference sites' for assessing the effects of climate change and land use changes on bird populations throughout the Sierra Nevada, as national parks are among the few sites in the United States where population trends due to large-scale regional or global change patterns are relatively unconfounded by local changes in land use. Birds contribute substantially to animal diversity, representing more than 60 percent of the total number of vertebrate species in SIEN parks, and are a major focus of interest to park visitors and the general public.



Golden-crowned Kinglet. (G. Lindquist)



Yellow Warbler. (G. Lindquist)



Band-tailed Pigeon. (G. Lindquist)

EXISTING AND PLANNED MONITORING

Monitoring avian productivity and survivorship (MAPS) is currently done in Yosemite, Kings Canyon, and Devils Postpile with a combination of temporary project funds and base-funded NPS staff time. Yosemite has the longest operating MAPS stations (1990-2010), followed by Kings Canyon (1991-93, 2001-2010), and Devils Postpile (2002-2010). SIEN staff worked with park staff and The Institute for Bird Populations (IBP) to develop a protocol to monitor birds across park landscapes using point counts (Siegel et al. 2010a). The resulting protocol (to be implemented in 2011) will provide information about changes in abundance and distribution of birds across park landscapes. The MAPS program uses mist-netting, detailed data collection on captured birds, and mark-recapture statistics to estimate

adult population sizes, adult survivorship, post-fledging productivity, and recruitment into the adult population for a subset of the most abundant species at selected reference sites. These two approaches are complementary, and an ideal bird monitoring program incorporates both point counts to obtain relative abundance of many species across a large spatial area and banding stations to reveal the demographic drivers of population changes observed over the broader landscape. The park MAPS stations are currently reliant on temporary funds that park staff have obtained from year-to-year. Securing long-term funds is a priority as these are valuable long-term datasets to the parks, and the information they provide would also help the network interpret changes in distribution and abundance of birds that are monitored through point counts.



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TRENDS IN BIRD POPULATIONS

Recent analyses of Yosemite MAPS data showed that 14 of 25 (65%) frequently captured species had negative population trends (substantial declines occurred for 10 of these species, $r \leq -0.30$), one species showed a flat trend, and 10 species showed positive trends (5 of these were substantial) (Siegel et al. 2010b, Stock et al. 2010). The overall number of adult birds (all species pooled) has decreased at a rate of 0.6% per year, suggesting that the population of sampled birds at Yosemite's MAPS stations has declined by 9.7% from 1993 to 2009. The species showing substantial decreasing population trends are: Golden-crowned Kinglet, Hermit Warbler, Lazuli Bunting, Western Wood-pewee, Dusky Flycatcher, Warbling Vireo, Yellow Warbler, Dark-eyed Junco, Purple Finch, and Hermit Thrush. Those with substantially increasing population trends include: Mountain Chickadee, MacGillivray's Warbler, Western Tanager, Song Sparrow, and Yellow-rumped Warbler. Comparison of long-term population trends in SIEN parks with MAPS and Breeding Bird Survey data from throughout the Sierra suggests that population trends of most declining species in the parks are part of larger Sierra Nevada-wide declines (DeSante et al. 2005, Siegel and Kaschube 2007). Trend analyses for Devils Postpile's MAPS dataset can be done in 2012, when 10 years of data are available.

BIRDS AND CLIMATE CHANGE

As the Sierra Nevada's climate changes, increased temperature, decreased snowpack, altered fire regimes, and plant community shifts will likely alter the ranges of Sierra bird species and restructure bird assemblages. Of particular concern in the Sierra Nevada in the context of climate change are bird species that are restricted to high-elevation habitats, and species that may be especially sensitive to habitat changes



Hermit Warbler banded at Yosemite MAPS station. (NPS photo)



Wildlife Biologist Sarah Stock monitoring birds in Yosemite National Park. (NPS photo)

resulting from altered fire frequency, severity, and season. Mountain-dwelling birds have already responded to climate change in many parts of the world by shifting their ranges upslope, and evidence is mounting that similar changes are already occurring in SIEN parks.

MAPS monitoring at Yosemite and Kings Canyon indicates bird populations in the parks are quite sensitive to weather variation and broad-scale climate phenomena. A recent analysis of MAPS results from Kings Canyon indicates that La Niña conditions (atmospheric circulation patterns in the tropical Pacific that tend to yield mild winters and earlier springs in the Sierra Nevada), which are expected to become more pronounced in the coming decades, appear to be associated with suppressed songbird productivity (Siegel et al. 2009). Data from Yosemite MAPS stations, which are arrayed along an elevational gradient, suggest that several species, particularly *Empidonax* flycatchers, may be shifting their distribution upslope. These indications are consistent with other data from Yosemite and elsewhere in the Sierra showing that the distributions of many bird species have changed during the past century, as spatial patterns in precipitation and temperature throughout the region have shifted (Tingley et al. 2009). More recently, researchers at The Institute for Bird Populations used data from park-wide bird surveys to produce detailed profiles of elevation ranges for 75 bird species at YOSE and SEKI (Siegel et al. in review). These profiles of elevation range will serve as a benchmark for monitoring future range shifts within the parks.



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DISCUSSION

The SIEN's recently developed protocol for monitoring bird populations with point counts (Siegel et al. 2010a) will provide more spatially extensive data on a greater number of species, and will reveal any population changes and distribution shifts that may be related to climate change. Together, the existing MAPS stations and the spatially extensive point count monitoring program can provide land managers with unprecedented information about how bird populations are changing across diverse park habitats, and indicate which demographic processes (productivity, survival, etc.) are driving those changes.

Bird monitoring in parks provides rich information for understanding avian ecology, guiding science-based management of park habitats, and interpreting birds to public audiences. The Yosemite MAPS stations detected serious declines in Willow Flycatcher over the past two decades that triggered an intensive research project to better understand the status of this species and the reasons for its decline in Yosemite (Siegel et al. 2008). All SIEN parks have successfully included interpretation of birds to public audiences as part of their mist-netting and banding projects, which occur during peak tourist season. Bird monitoring can



Sacha Heath, Point Reyes Bird Observatory Biologist, demonstrates bird-banding to Devils Postpile visitors. (NPS photo)

also provide critical information to managers about which species are declining and which demographic processes are driving those declines, and whether they are more likely tied to conditions on breeding grounds in the parks or distant wintering grounds and migration corridors. Further research or adaptive management can then be initiated to identify causes of declines and potential for mitigation with management actions and educational efforts.

WHERE MONITORED

Yosemite, Sequoia, and Kings Canyon National Parks and Devils Postpile National Monument

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