PART I

INTRODUCTION
Trends and traditions: Overview and synthesis

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Study of the factors that explain the distribution and abundance of animals has been a touchstone of population ecology for decades. Key to understanding changes in distribution and abundance is an appreciation of the relative degree of stability or variability of features of the environment that may force changes in bird populations or allow them to remain much the same for decades or even centuries. Human alterations of the landscape in the West have profoundly changed the distribution and abundance of many bird species, often negatively but sometimes positively. Yet at the same time many species maintain their traditions, occupying much the same geographical area or following ancestral migration pathways that appear to have been used for thousands of years. But no species is immune to change. As Arter et al. (this volume) note, avifaunal change has been continuous since the first bird took flight. That paper and other works have used the fossil and archaeological record to document extinctions and large distributional changes, some going back thousands of years and attributed to human exploitation, but more often ascribed to natural changes in climate and habitats.

Overall, however, the greatest and most rapid avifaunal changes in the West have been caused by industrial and agricultural development, resource extraction, and urbanization after European settlement of the region. Human influence on the environment varies widely across the West. For example, California and Alaska, the states with the highest and lowest population densities, respectively, were also the ones, as of the 1980s, with the highest (91%) and lowest (0.1%) percentages of losses of their historical wetlands (Dahl 1990). Although direct human alteration of landscapes has been the main driver of avifaunal change at the local and regional level over the last 250 years, today it is clear that the collective actions of humans across the globe have changed the Earth’s climate in ways that leave no place untouched. In their review of the published evidence of the effects of climate change on western landbirds already observed in western North America, Seavy et al. (this volume) describe how the climate of the region has already changed and how it is projected to change in the future. Although predictions of the future are risky, evidence from Seavy et al. and other papers they cite suggests there is a high likelihood that the avifaunal changes in western North America over the last 100 years will pale in comparison to those attributable to climate change in the next 100 years.

Environmental Setting

The studies in this volume address various aspects of the avifauna of western North America, ranging from Alaska to northwestern Mexico, and from the Rocky Mountains to the Pacific coast. Western North America is a remarkably diverse region topographically, climatologically, and biologically. Elevations range from the highest in North America at 6193 m above sea level at Denali in Alaska to the lowest at 86 m below sea level in the Badwater Basin of Death Valley in California. The coastal mountains of the Pacific Northwest receive the greatest average annual rainfall recorded in North America (wmo.asu.edu). Yet much of western North America is semi-arid or arid, including the Great Basin, Mojave, Sonoran, and Chihuahuan deserts, and the Arctic areas of Alaska and western Canada. Daily temperature extremes in the West range from a winter low in the Yukon Territory, Canada, of −63 °C to a summer high in Death Valley, California, of 56.7 °C—the highest temperature ever recorded on Earth. Year-to-year variation in precipitation in California is wider than anywhere else in the United States, annual totals routinely varying from 50% to >200% of long-term averages (Dettlinger and Cayan 2014). The region’s bird habitats are accordingly rich and varied. In addition, dominant ocean currents have a profound effect on marine and terrestrial birds and their habitats. Preeminent is the California Current, which brings cool nearshore waters south along the Pacific coast from southern British Columbia to southern Baja California. Annual productivity of the food web is stimulated by the seasonal wind-driven upwelling of nutrients from colder subsurface waters, making this region one of the most productive marine ecosystems in the world and supporting large populations


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of seabirds, marine mammals, and important fisheries. The timing and strength of coastal upwelling and productivity vary widely (e.g., King et al. 2011), being influenced by large-scale phenomena such as the El Niño–Southern Oscillation (Trenberth 1997), Pacific Decadal Oscillation (Mantru and Hare 2002), and the North Pacific Gyre Oscillation (Di Lorenzo et al. 2008). These phenomena influence the weather, climate, and ocean conditions strongly, on multiple scales, and seabirds’ responses to them vary as environmental conditions change over time (Schmidt et al. 2014). Landbirds may also respond to climate variation related to these phenomena (e.g., Purcell and Mori, \textit{this volume}).

The West’s varied habitats support a diverse avifauna both overall and at the regional level. California, for example, ranks among the top four states in the nation in terms of the number of regularly occurring species of birds (Stein et al. 2000, Stein 2002); for number of subspecies of birds, it probably ranks at the very top (P. Unitt pers. comm.). Other areas stand out as well: Alaska hosts a unique and rich avifauna by virtue of its extensive boreal forest, wetlands, productive marine waters, and Arctic tundra combined with its shared biogeography with Asia. Northwestern Canada shares many of the avifaunal characteristics of Alaska but has a higher proportion of species with ranges extending from eastern North America. And the Southwest encompasses most of North America’s deserts, home to many species restricted to those habitats.

\section*{Historical Studies}

Initial limited study of the rich avifauna of the West in the 1800s was followed by a golden era of exploration during the first four decades of the 20th century. During this period, the status, habitat needs, and distribution of the region’s avifauna were documented by various naturalists, most notably under the direction, inspiration, and guidance of Joseph Grinnell and Annie Alexander at the Museum of Vertebrate Zoology (MVZ), University of California, Berkeley (Grinnell 1940, Stein 2001, Sunderland et al. 2012). Much of the data collected through the MVZ came from field work organized to document the diversity, distribution, and geographic variation of the vertebrate fauna in poorly known areas of the West, particularly in areas in danger of rapid change caused by human encroachment, but also in protected parks.

This work resulted in avifaunal summaries for particular bird groups (Grinnell et al. 1918), for portions or all of California (e.g., Grinnell and Storer 1924, Grinnell and Miller 1944), and for other states and provinces (e.g., Swarth 1922, Linsdale 1936) and the Baja California Peninsula (Grinnell 1928). Field workers from other institutions were also active and published comparable avifaunal summaries for other states, provinces, or larger geographic regions (e.g., Taverner 1928, Munro and Cowan 1947, Gabrielson and Lincoln 1959). The use of all available information to document population trends and distributional changes was a cornerstone of many of these publications. All of this work formed the foundation for many subsequent investigations of the distribution and abundance of birds in the West through the present day.

After the Grinnell–Alexander era and continuing to the present, came a progressive shift from descriptive ornithology to a quantitative and hypothesis-driven approach, though the naturalistic style has been maintained to some degree by various “old-school” and, increasingly, amateur ornithologists (Shuford 2005). Although some (e.g., Cicero and Johnson 1996) have bemoaned the decline in scientific standards in more recent compilations of avifaunal data, there are many achievements of excellence (e.g., Kessel and Gibson 1978, Campbell et al. 1990, Marshall et al. 2003, Sinclair et al. 2003). Understanding of the patterns of distribution and drivers of population change was significantly advanced during the later decades of the 20th century by studies linked to management of waterfowl populations, environmental assessments for resource development, expanded research by universities, museums, and nonprofit organizations, and concerns for declining populations of landbirds migrating to the neotropics, seabirds, shorebirds, waterbirds, and other groups (e.g., Carter et al. 1992, Hagan and Johnston 1992, Nichols et al. 1995, Noon and McKelvey 1996, Brown et al. 2001, Kushlan et al. 2002, Rich et al. 2004). Another important trend was the establishment of programs that incorporate citizen scientists as the backbone of gathering quantitative information on the distribution, abundance, and trends of birds in western North America and beyond. Prominent examples include the Christmas Bird Count, Breeding Bird Survey, Monitoring Avian Productivity and Survivorship program, the regional reports of \textit{North American Birds} and its predecessors, eBird, various local long-term monitoring projects, and numerous breeding bird atlases, which individually and collectively have been essential to analyses of trends in western bird populations, as presented in many papers in the current volume.

\section*{Volume Themes}

The papers in this volume emphasize the overarching themes of the effects of extensive habitat loss
and degradation on the avifauna of the West in the 19th and 20th centuries and the responses of birds to environmental change and variation. The messages from these papers, however, are quite varied. Several portray rays of hope, documenting reversals of trends in the loss of some important habitats, the recovery of some avian populations in response to management, and resiliency in other species as they adapt to novel habitats. Others express increasing concern for the potential future effects of a rapidly changing climate. Most emphasize the importance of long-term monitoring of the population trends, distribution, and ecological attributes of the region's birdlife.

Although there is considerable overlap in the topics covered by the 25 papers in the volume, we have grouped them broadly into four sections: Changes in Distribution, Population Trends and Changing Demographics, Response to Changes in Climate and the Environment, and Looking Back–Looking Forward. The geographical representation of the papers varies widely. Ten represent studies that focused on regions or sites in California, one on California and the Baja California Peninsula (and the adjacent ocean), five on Alaska, five on the West (or western United States) as a whole, and one each on the Intermountain West and Southwest, southern Great Plains, and Colorado. One paper (Winker this volume)—a review of the importance of systematics, genetics, and taxonomy for tracking avifaunal change—is not geographically focused. Papers also vary considerably in the bird species or groups covered: seven focus on one or two species in their area of interest, six on landbirds, five on all birds, two each on waterfowl and shorebirds, one each on waterbirds and introduced birds, and the aforementioned review by Winker that applies to all bird groups. All papers attempt to explain the patterns of avifaunal change they document.

Habitat Change

Various studies attribute changes in bird abundance or distribution to changes in the extent or availability of winter waterfowl habitat to the north. Although populations of most waterfowl species increased or were stable over this period, overall the number of waterfowl wintering in the Central Valley did not increase. Rather, the areas of concentration of wintering waterfowl within the Central Valley shifted north as many species responded to changes in the distribution of habitats.

Pandolfino and Handel (this volume) analyze data from 17 Christmas Bird Count circles in the Central Valley that were surveyed regularly between the winters of 1978–79 and 2013–14. Of the 112 taxonomic units (species or species groups) that were relatively abundant and widespread in the region during winter, trends were positive for 52 (46%), not significantly different from zero for 40 (36%), and negative for 20 (18%). Habitats in the Central Valley for which the proportions of increasing taxa were highest were riparian forest, wetlands (including flooded agricultural fields), and open water. But among taxa associated with grasslands and other open habitats, more decreased than increased. Trends suggest that recent efforts to preserve and restore wetlands and riparian habitats, and to flood more rice after harvest, are benefiting birds, whereas loss of grasslands appears to be reducing bird numbers in that habitat. The authors conclude, however, that dynamics are complex and the factors contributing to population changes of birds in some habitat types are as diverse as the species in them.

Page and Stenzel (this volume) compare trends of waterbirds at Bolinas Lagoon on the central California coast in two periods, 1972–1993 and 1998–2015, the latter of which coincided with a great increase in rice fields flooded after harvest inland in the Sacramento Valley. Among the 22 taxa using the estuary that also commonly use flooded rice fields, trends of 12 (54%) were consistent with a distributional shift to newly created inland habitat. However, dispersal of waterbirds away from Bolinas Lagoon might also have been prompted by restoration of former tidal wetlands around nearby San Francisco and Tomales bays and by an increasing risk of predation by the increasing number of falcons.

A theme of several papers is the influence of urbanization on the distribution and abundance of birds. In a comprehensive review of bird introductions in western North America, Garrett (this volume) found a continuing trend toward establishment of bird species imported for aviculture and the pet trade in urban regions and other highly altered landscapes. Unitt and Hargrove (this volume) report that of 44 species that have clearly expanded downslope or southward in southern California, 10
have adapted to urbanization to a substantial degree. In an analysis of population trends of species wintering in the Central Valley based on Christmas Bird Count data, Pandolfino and Handel (this volume) found that numbers of species that adapt well to areas of human habitation are stable or increasing. Burns et al. (this volume) document the establishment and proliferation of California Gulls (Larus californicus) breeding around San Francisco Bay and link the expansion of the population to the availability of suitable nesting sites close to anthropogenic food subsidies at landfills.

Some studies attribute changes in abundance and distribution to changes in the quality of habitat. Swem and Matz (this volume) document the recovery and then stabilization of a population of the Arctic Peregrine Falcon (Falco peregrinus tundrius) in northern Alaska that benefited from increased habitat quality in winter and migration after restrictions on pesticide use in Canada and the United States. Wiggins (this volume) credits changes in the distribution of the two species of ravens on the southern Great Plains to changes in habitat quality. A contraction of the range of the Chihuahuan Raven (Corvus cryptoleucus) may reflect changes in land use, a decline in prairie dog abundance, fire suppression, and a decline in the number of suitable nest sites (windmills). By contrast, causes of the expansion of the range of the Common Raven (Corvus corax), though less certain, may reflect changes related to the long-term decline in the region’s human population, leading to an increase in nest sites in abandoned homes, as well as to a decline in persecution.

Climate Change and Climate Variability

Directional responses to climate change. Despite a large and rapidly expanding literature on the projected effects of climate change, Seavy et al. (this volume) found surprisingly few published papers that have evaluated effects already observed on landbirds in western North America. This and other assessments show that shifts of birds’ distributions have so far not been consistent with the expectation that a warming climate will cause species to shift upward in elevation and/or northward in latitude. Erickson et al. (this volume) evaluate directional changes in the distribution of 672 taxonomic units (species, subspecies, and groups of subspecies of birds) in California and the Baja California Peninsula over the last 100 years. Of the 263 species they judged to have undergone real changes, 194 changed latitudinally. Although in aggregate the latitudinal range changes were toward the north, as predicted with a warming climate, the proportion with a northward change varied considerably among residents (50%), migratory breeders (64%), and species wintering or occurring in other seasonal roles (89%). Unitt and Hargrove (this volume) examine the factors that might explain range changes in southern California that appear contrary to predictions based on climate warming. They conclude that habitat modifications have been a leading force driving southward and downslope range expansions of birds in this region.

Winker and Gibson (this volume) predict that climatic warming in Beringia, at the nexus of Asia (eastern Siberia) and North America (Alaska and northwestern Canada), will enable some species of migratory birds—those at their range edges that probably are limited by time to complete reproduction and molt—to substantially expand their ranges in this region, on a primarily east–west axis. Taylor et al. (this volume) used a data set on nest density and probability of breeding spanning six decades to examine the effect of climate-induced changes in environmental conditions (warmer and longer summers, drying landscape, changing vegetation) on populations of shorebirds at Utqiagvik (formerly Barrow), Alaska. They found some evidence that shorebird species characteristic of the Low Arctic may be expanding their ranges farther north as the climate warms and that the increase of tundra shrubs may be reducing habitat suitability for some species. Thus changes in northern limits of birds’ distributions are likely to be influenced not only by amelioration of climate at current range limits but also by differential effects on key habitats used for nesting and foraging. Such changes in distribution and abundance, however, are likely to be nonlinear as northern habitats continue to change over time (Thompson et al. 2016).

Four of the volume’s papers evaluate whether birds’ phenology on northern breeding grounds has changed in response to climate warming over a long term. In a study spanning four decades on the Yukon–Kuskokwim Delta in western Alaska, Ely et al. (this volume) found that the dates of first arrival of all shorebirds in spring varied significantly from year to year by more than two weeks. Yet there was no long-term trend in arrival times over the length of the study. Temperatures along the terminal portions of the spring migration route were significantly correlated with conditions on the breeding grounds and the timing of shorebirds’ arrival there, suggesting that shorebirds may use environmental cues during spring migration to regulate their pace of movement. In a 30-year study of three goose and one eider species also in the Yukon–Kuskokwim Delta, Fischer et al. (this volume) found that the timing of nest initiation and hatching of all species varied from year to year by up to three weeks. But
Despite annual variation in spring conditions, there was no evidence that the birds’ breeding chronology advanced significantly, as might be expected with the warming climate. In a 30-year study of a population of Arctic Peregrine Falcons in northern Alaska recovering and then stabilizing following restrictions on the use of DDT and related compounds, Swem and Matz (this volume) found hatching dates got later over time, counter to expectations with a warming climate. By contrast, Taylor et al. (this volume), comparing data from the early 1960s and 2000s, found evidence that Dunlin (Calidris alpina arctica) breeding on the North Slope of Alaska now molt over a longer period of time, apparently in response to longer and warmer summers associated with long-term climate warming in that region.

The limited evidence for phenological changes in these studies is consistent with the results of a review of the literature on the effects of climate change on landbirds in western North America by Seavy et al. (this volume), who found consistent patterns of phenological change of migration or reproduction in fewer than 10 of the region’s species. This may in part reflect the paucity of long-term studies, given that variability in environmental conditions may mask trends in phenology unless they are measured over several decades or longer. Or, like these northern breeders, various other species may maintain a high degree of plasticity in responding to climatic variability, making them resilient, at least in the medium term, to the effects of progressive climate change.

Numerical responses to climate variability. One of two papers by Purcell and Mori (this volume) models the importance of weather and climate on annual variability in the abundance of 35 bird species of oak woodlands in the Sierra Nevada foothills. Many more species responded to cold than to hot temperatures, and, because minimum temperatures are increasing faster than maximum temperatures, the authors suggest that species sensitive to cold may benefit from climate warming. The number of species that increased in abundance with increasing precipitation was roughly equal to the number that decreased. El Niño is predicted to increase in frequency and severity with climate change, but the effects of these events may vary with elevation. Purcell and Mori found that many more species responded positively than responded negatively to warm, wet El Niño conditions at their low-elevation study site. But at higher elevations in the Sierra Nevada, where precipitation is dominated by snow, the effect of El Niño on breeding birds has generally been negative (references in Purcell and Mori, this volume).

The influence of precipitation on abundance is more apparent for populations of waterbirds. Stenzel and Page (this volume) investigated the relationship between levels of annual precipitation and patterns of abundance for 42 taxa of waterbirds in a coastal estuary in central California. They found a significant relationship between abundance and the current winter’s rainfall for 19 taxa, and between abundance and annual rainfall during the previous 1–4 years for 28 taxa; in both cases, negative associations outweighed positive ones.

Assessment of changes in the sizes of populations of the Ring-billed (Larus delawarensis) and California gulls in the West between surveys in the late 1970s and early 1980s and those from 2009 to 2011 were made difficult by drought during the latter period, which reduced the number or size of active colonies as dropping water levels eliminated many nesting islands (Doster and Shuford this volume).

The three studies of responses of birds to fire found, like many previous studies, that the effects vary by species, length of time since fire, and severity of the burn (Hargrove and Unitt, Raphael et al., and Yanco and Linkhart, this volume). Hargrove and Unitt sampled the abundance of birds in spring/summer and winter, primarily in chaparral with isolated stands of oak woodland and coniferous forest, for five years after very large fires in southern California. The authors characterize species as “fire followers” (positive response to fire), “fire resilient” (indifferent to fire or increased sharply after an initial negative response), or “fire sensitive” (negative response to fire). Variation in numbers of many species, particularly granivorous winter visitors, paralleled variation in annual rainfall, highlighting the interactions between fire and climatic variation.

Yanco and Linkhart’s 6-year study focuses on the post-fire response of Flammulated Owls (Psiloscops flammeolus) that recolonized pine forest during the decade after the largest fire in Colorado’s history. Breeding males established home ranges in habitats containing less area burned at high severity and more area burned at low severity or remaining unburned than was available, and the size of a home range was positively correlated with the proportion of area burned at high severity. By contrast, the level of the fire’s severity did not appear to be an important factor in the owls’ selection of habitats at the finer scales used for foraging and day roosting.

The study by Raphael et al., spanning almost half a century, found that changing vegetation structure with forest succession after fire, and the birds’ habitat associations for foraging and nesting, explain most of the observed trends in the avian community. Some changes, however, may have been associated with a
warmer and drier period during the last five years of the study. With a warming climate and current fuel loading across the West, fires are growing larger and more severe. Under that scenario, these studies collectively suggest that species that are rare, patchily distributed, and dependent on later stages of succession, or are highly adapted to ecosystems dependent on fire of low or mixed severity, are most at risk.

Drivers of Change

Many of the papers in the volume assess trends in abundance, seek confirmation of trends based on monitoring programs conducted at other scales, and attempt to explain trends by associations with comparable changes in habitat. Three papers use varying approaches to examine the demographic drivers of population trends or to infer the season during which resources might be limiting. DeSante et al. (*this volume*) estimate population trends in western North America for 86 landbird species from 15 years of capture-recapture data from the Monitoring Avian Productivity and Survivorship program. They link trends to a species’ status with respect to migration, finding the magnitude and frequency of declines greater among species wintering in the North Temperate Zone than among those wintering in the neotropics or among resident species. On the basis of further analyses, the authors make inferences regarding the proximate demographic drivers of population change in four selected species. They hypothesized that changes in abundance are driven primarily by survival of adults in one species, survival and productivity of adults in another, and survival of first-year birds in two species.

Moulton et al. (*this volume*) assess trends in abundance and productivity within the western population of the American White Pelican (*Pelecanus erythrorhynchos*) on the basis of counts of adults and young at 18 breeding colonies. Their results suggest that the pelican’s population dynamics in this region are influenced by long-term trends in abundance and production, as well as short-term, density-dependent processes that influence annual rates of change in the abundance of breeding birds, perhaps in response to resource abundance or availability at the population scale outside of the breeding season.

Swem and Matz (*this volume*) examine the demographics of a recovering population of the Arctic Peregrine Falcon in northern Alaska, which increased at a rate of 8% per year from 1981 to 1994 and then stabilized. Although productivity declined throughout the study period, the rate of decline in the recovery (1981–1994) and post-recovery (≥1995) periods did not differ. The number of young that pairs produced was negatively related to year, location, and hatching date, and positively to the frequency of territory occupation. The authors hypothesize that the decline in productivity in this recovering population could have resulted, at least in part, from a subtle form of density dependence, in which an ever larger proportion of pairs was relegated to less optimal territories as the population increased. These studies collectively demonstrate the importance of understanding the underlying demographic drivers of changes in abundance and the potential importance of density dependence. Competition can become an important driving force as the availability of suitable habitat or other key resources decreases.

Managing Conflicts

Two studies conclude that management for threatened or endangered species or habitats at risk can have negative effects on other species. Burns et al. (*this volume*) report that the colonization and exponential increase of the population of California Gulls breeding in the San Francisco Bay estuary had negative effects on shorebirds and terns nesting nearby. The large gull population poses substantial challenges for meeting the South Bay Salt Pond Restoration Project’s goals of restoring extensive areas of former salt ponds to salt marsh for the endangered Ridgway’s Rail (*Rallus obsoletus obsoletus*) and salt-marsh harvest mouse (*Reithrodonomys raviventris*) while maintaining or increasing populations of other breeding waterbirds and shorebirds. As saltmarsh restoration reduces the extent of former salt ponds it will increase the likelihood of gull predation on other breeding birds concentrated in this smaller footprint (Burns et al. and Doster and Shuford, *this volume*).

Similarly, although managing piñon–juniper woodlands in the Intermountain West to benefit the Greater Sage-Grouse (*Centrocercus urophasianus*) is clearly warranted, the effects of removing trees to create or protect shrublands have not been adequately assessed for its negative effect on the more rapidly declining Pinyon Jay (*Gymnorhinus cyanocephalus*; Boone and Ammon, *this volume*). Such studies highlight the need to examine the potentially complex effects of management on all species within an avian community to minimize unintended consequences.

LOOKING FORWARD

Our ability to assess changes in the abundance and distribution of birds is constantly advancing because of new technologies, improvements in analytical techniques, and lessons learned from prior work. Yet there is always room for improvement in monitoring populations, identifying drivers of avifaunal change,
and linking knowledge gained with policy and management for successful conservation of declining bird populations and their habitats. A compelling theme of an earlier symposium on avifaunal change (Jehl and Johnson 1994) was the need for scientifically sound baseline data, at biologically meaningful scales, to provide robust evidence of change in avian populations (Johnson and Jehl 1994, Scott 1994). Many studies in the current volume excelled in achieving this goal, but many others, as in the earlier volume, demonstrated that limitations in baseline data hinder the detection of change, particularly when populations fluctuate greatly in response to wide annual variation in climate.

Although general environmental monitoring is often criticized as being unscientific, too expensive, and wasteful, there are numerous examples of highly successful long-term monitoring programs that have provided important scientific advances and crucial information for environmental policy (Parr et al. 2003, Lovett et al. 2007, Hughes et al. 2017). Prolonged observation is crucial for establishing the range of natural variation in populations, identifying temporal trends, and witnessing rare and unexpected events. This is particularly the case when processes change slowly or when environmental conditions are highly variable from year to year.

In the current volume over half of the papers are based on long-term studies (>30 years), with some conducted annually for decades and others of equal or greater duration with data collected intermittently. Other papers relied on compilation of anecdotal observations made over even longer time spans. It is likely that some of these studies were not planned to be long term when initiated but evolved to be so because of researchers’ dedication and their realization over time of the increasing value of the results. The quality of long-term studies can be improved if they are thought out well in advance and, of course, if adequate funding can be obtained (Lovett et al. 2007, Hughes et al. 2017). Still, we applaud the efforts of those researchers who have persisted in collecting long-term data despite logistical and fiscal constraints, and for organizations and federal agencies that have adopted some of these efforts and kept them going (e.g., Christmas Bird Count, Breeding Bird Survey).

Monitoring to assess population trends is essential but not sufficient for ensuring sustainable populations of birds. For effective conservation, it is crucial to understand the ultimate causes of well-documented changes in distribution and abundance and then implement management at the appropriate geographic scale (Johnson and Jehl 1994, Scott 1994). Integrating data on populations trends with demographic modeling, ancillary data on ecological requirements and potential threats, and targeted research on populations at risk may allow the causes of declines to be identified and addressed (e.g., Greenwood 2003, Schaub and Abadi 2011, Eglington and Pearce-Higgins 2012, Pool et al. 2014). Most papers in this volume examine the potential causes of changes in distribution and abundance, often concluding that the dynamics are complicated and explanations are elusive. Although the factors influencing change are varied, the most important ones are habitat loss and modification, management and regulation, human exploitation, and natural climatic variation, factors similar to those invoked during the earlier symposium on avifaunal change in this region (Jehl and Johnson 1994). Our current studies, however, provide much more compelling evidence of the complex effects of climatic factors on the distribution and abundance of birds. Winker (this volume) concludes we still have much work to do in fully describing extant avian diversity so that we know which populations we should be tracking when monitoring change. He also recommended including a specimen component in our monitoring programs to enable future retrospective studies, which are proving invaluable for understanding recent historical changes in birds and our shared environments.

When studying population change it is important to be mindful of the trap of “shifting baseline syndrome,” which could hinder the establishment of suitable (i.e., more ambitious) conservation/restoration targets (Pauly 1995, Soga and Gaston 2018). This arises when each generation of scientists accepts as baseline the population sizes and species composition that existed at the beginning of their careers and uses this baseline as the benchmark for evaluating changes (Pauly 1995). With further declines and each new generation accepting a new and lower baseline, the result is a gradual shift of the baseline and hence an inappropriate reference point for evaluating losses or identifying conservation targets. This syndrome applies to policy makers and the general public as well. The perceived causes of this syndrome are various, including lack of data on the natural environment, loss of individual interactions with nature, and lack of personal knowledge of basic natural history (Soga and Gaston 2018). Other causes may include lack of familiarity with the historical literature and lack of familiarity with the data inherent in scientific collections.

In a similar vein, there is increasing concern about the demise of natural history training and research in universities at a time when it is crucial to understand the basic biology and ecological
interactions of organisms to aid in their conservation (Noss 1996, Wilcove and Eisner 2000, Beehler 2010, Sunderland et al. 2012, Bijlsma et al. 2014, Tewksbury et al. 2014). This shift in emphasis coincides with the boom in theoretical and experimental biology and ecological modeling, but scientists without an intimate knowledge of nature will have difficulty interpreting results realistically (Noss 1996) and even framing questions properly. Reemphasizing natural history does not mean turning back the clock but rather adopting new technologies and integrating them with other disciplines to make the most out of field observations (Sunderland et al. 2012, Tewksbury et al. 2014). The research in the papers in this volume has a strong foundation in natural history and field observation and amply demonstrates the value of long-term field studies for conservation. We hope the publication of these works will inspire additional long- and short-term research, based on natural history, that will help identify patterns and causes of avifaunal change in the West. We also hope this collection of papers will encourage others to analyze long-term data sets available on other species or geographic regions not treated here.

ACKNOWLEDGMENTS
We thank Daniel D. Gibson, Ken Able, John Pearce, and Philip Unit for their constructive comments. Any use of trade, firm, or product names is for descriptive purposes and does not imply endorsement by the U.S. government.

LITERATURE CITED


