POPULATION TRENDS AMONG LANDBIRDS OF THE KLAMATH-SISKIYOU ECOREGION: AN ANALYSIS OF BREEDING BIRD SURVEY DATA

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Abstract

The Klamath-Siskiyou Ecoregion of northern California and southern Oregon is an area of great conservation interest due to its diverse ecological communities and extensive wildlands. This paper examines the status of the region's bird populations, using data summaries from the Breeding Bird Survey (BBS), the most comprehensive database on long-term population trends for North American birds. The "Southern Pacific Rainforests" unit of the BBS includes much of the Klamath-Siskiyou, providing analytical summaries of population trends for landbird species of the region. Birds exhibiting a variety of habitat preferences, nesting strategies, and migration patterns were compared. The results indicate that native landbirds of the Klamath-Siskiyou have undergone broad declines over the past 35 years: 34% of species have experienced statistically significant declines, while only 13% have exhibited significant population increases over this time span. Population declines were particularly dramatic among neotropical migrants, with 39% of species showing significant declines and only 6% showing significant increases. Permanent resident species, in contrast, showed declines and increases in roughly equal numbers: 25% significantly decreased and 20% significantly increased. The only group of birds showing broad increases over the past 35 years was introduced species: four of the five introduced species increased, three of them significantly.

Introduction

Dramatic population declines among numerous species of breeding birds have been documented in the United States in recent decades (see reviews in Terborgh 1989; Hagen and Johnston 1992; Martin and Finch 1995). These declines extend across diverse geographical and ecological categories, including birds of grasslands (Askins 1999; Peterjohn and Sauer 1999), eastern deciduous forests (Askins et al. 1990; Holmes and Sherry 2001), and western coniferous forests (Marshall 1988; DeSante and George 1994).

This paper examines the status of landbird species that breed in the Klamath-Siskiyou Ecoregion of southern Oregon and northern California. This area, dominated by a series of rugged mountain ranges, is delineated by its distinct geology of ancient metamorphosed sedimentary rocks with granitic and ultramafic intrusions (Diller 1902). These substrates produce varied soil types, many with unusual mineral compositions, supporting a great diversity of plant communities and numerous endemic plant species (DellaSala et al. 1999).

The region extends from the area of Roseburg, Oregon, south to the Yolla Bolly Mountains in the vicinity of Covelo, California, and from the Pacific coast east to the western foothills of the Cascades. The Klamath-Siskiyou Region turns inland just south of the Klamath River mouth, and thus does not include the broad coastal plain of Humboldt County, California. Detailed delineation of the area and maps can be found in Trail et al. (1997), Strittholt and DellaSala (2001), and Siskiyou Project (2004).

The Klamath-Siskiyou is an area of great conservation interest, due to its high plant diversity, exceptional array of ecological communities, and extensive roadless and wilderness areas (DellaSala et al. 1999; Strittholt and DellaSala 2001). The region's avifauna includes 392 species, with 190 confirmed breeders (Trail et al. 1997). The Klamath-Siskiyou is notable for the number of bird species that reach a range limit in the region, emphasizing its importance as an ecological crossroads (Trail et al. 1997).

Little published information is available on the status of breeding bird populations in the Klamath-Siskiyou. The region is home to 16 landbirds that have been placed on the "Watch List" of the Partners in Flight conservation effort, identifying them as species of special conservation significance (Partners in Flight 2004). Ten of these birds are listed as "Threatened and Declining" species, including Band-tailed Pigeon, Rufous Hummingbird, Olive-sided Flycatcher, Oak Titmouse, and Wrentit. The remaining six birds are listed as "Range Restricted" species, including Allen's Hummingbird, White-headed Woodpecker, and Hermit Warbler.

In this paper, I present an assessment of bird population trends among breeding landbirds of the Klamath-Siskiyou based on Breeding Bird Survey (BBS) data. The Breeding Bird Survey is an annual bird survey effort conducted across the United States and Canada and administered by the U.S. Geological Survey (USGS). Counts are carried out along roadside transects, or "routes," which are 24 miles (39.4 km) long and consist of 50 evenly spaced, 3-minute point counts. All birds seen or heard within ?-mile (400 m) of the point are recorded. Each route is surveyed one morning per year during the early breeding season, usually in early June. Surveys begin 30 minutes before sunrise.

The same routes are surveyed annually, ideally by the same observer. The BBS was initiated in the eastern U.S. in 1966 and implemented nationwide in 1968. Data from over 4000 survey routes are now maintained in the BBS database. The USGS maintains excellent analytical summaries of these data, which are available on the Internet (Sauer et al. 2003a).

There are a number of well-known limitations of BBS methodology (Robbins et al. 1986; Link and Sauer 1997; Sauer et al. 2003b). Rare bird species, including many predators and habitat specialists, are not adequately sampled by a general survey methodology such as the BBS. The fact that all counts are done from roadsides introduces a bias in overall habitat representation, and may result in inflated population estimates for bird species that favor disturbed and edge habitats. Bird species with low detectibility (e.g., relatively non-vocal species) are likely to be under-counted. Common and highly vocal species may also be under-recorded, due to observer efforts to avoid double-counting.

Breeding Bird Survey data also have a number of unique strengths. Data covering a long time span are critical to any analysis of long-term population change. Many BBS routes have been run continuously for over 30 years, a record unmatched by any other North American breeding bird survey effort. Other BBS strengths are the consistent methodology, repeated routes, and high standards of data management and analysis.

In balance, the BBS has proven to be an invaluable source of information on population trends for many relatively common, easily detected species, which include many songbirds of great conservation interest. BBS data were essential for developing priorities and planning objectives in the nationwide Partners in Flight (PIF) bird conservation effort (Carter et al. 2000). The California and Oregon/Washington Partners in Flight programs have used BBS data to prepare detailed bird conservation plans for major habitats in their areas (California PIF 2004; Oregon/Washington PIF 2004).

Methods

This paper is based on BBS data summaries and trend analyses prepared by USGS statisticians and available to the public at the BBS website (Sauer et al. 2003a). Two methods of statistical analysis of population trends are provided by USGS: a linear route-regression approach based on estimating equations (Link and Sauer 1994) and a curve-fitting route-regression approach based on locally-weighted least squares (LOESS) (James et al. 1996). Comparative analyses indicate that these two methods produce similar results, but that Estimating Equations are generally more precise (Peterjohn et al. 1997). This paper relies on trend estimates supplied by USGS using Estimating Equations (see USGS 2004a for detailed discussion of the route-regression methodology).

USGS analyzes BBS data geographically by state and by region. Regional analyses are stratified by physiographic regions based on Aldrich's (1963) map of life areas of North America. Much of the Klamath-Siskiyou Ecoregion falls within the "Southern Pacific Rainforests" physiographic region as defined by the BBS. This extends from the Monterey Bay area of central California north to the Canadian border, and encompasses the coastal mountains and interior valleys west of the Sacramento Valley in California and Cascade Mountains in Oregon and Washington. One major part of the Klamath-Siskiyou Ecoregion that is outside the Southern Pacific Rainforests is the Trinity/Marble Mountains, which are included in the BBS's "Sierra-Nevada" physiographic region. Maps of the BBS physiographic regions can be found in Robbins et al. (1986) and on the Web (USGS 2004b).

The Southern Pacific Rainforests region is a far larger area than the Klamath-Siskiyou. Despite this, the bird species present in the Southern Pacific Rainforests data correspond well to the Klamath-Siskiyou avifauna (Trail et al. 1997), with the exception of some Klamath-Siskiyou birds of higher-elevation and dry forest habitats, such as Cassin's Finch and Green-tailed Towhee. Overall, the South Pacific Rainforests BBS region provides a better match for the Klamath-Siskiyou avifauna than do other partially overlapping BBS regions, such as the Sierra-Nevada, or the Oregon or California state data. All these include many species not found in the Klamath-Siskiyou.

Recently, Sauer et al. (2003b) evaluated BBS data for use with a newer system of geographic stratification developed for migratory bird conservation planning by Partners in Flight "Bird Conservation Regions." This analysis demonstrated that either system of stratification provides comparable results, indicating that BBS data are not highly sensitive to the particular stratification scheme used. Further comparisons of bird population trends in various geographical regions of western North America are presented in the Results section.

This paper examines BBS regional population trend data from 1968-2002 for breeding landbirds of the Klamath-Siskiyou (BBS routes in the western U.S. were first surveyed in 1968). This is based on USGS data summaries and trend analyses for the Southern Pacific Rainforests region (USGS 2004c). Following USGS recommendations, only birds encountered on at least 15 routes are included in the analyses summarized here. Inferences on population trends for less frequently detected species cannot be made from BBS data.

I eliminated from this analysis those birds on the Southern Pacific Rainforests regional list that rarely or never breed in the Klamath-Siskiyou: Purple Martin, Red-eyed Vireo, Ruby-crowned Kinglet, and Townsend's Warbler (Trail et al. 1997). I also did not include data for waterbirds and shorebirds, which the BBS survey methodology samples poorly. This eliminated Double-crested Cormorant, Great Blue Heron, Green Heron, Canada Goose, Wood Duck, Mallard, Common Merganser, Western Gull, Glaucous-winged Gull, Killdeer, and Spotted Sandpiper.

This process produced a list of 100 breeding landbird species of the Klamath-Siskiyou for which adequate BBS data were available for analysis (Appendix I). Ninety-five of these species are native to the region. The remaining five are non-native (Ring-necked Pheasant, Wild Turkey, Rock Pigeon, European Starling, and House Sparrow). The analyses summarized below are concerned almost exclusively with the native bird species.

I subdivided the BBS data in several ways for analysis, using both "species groups" as defined by USGS and other groupings developed specifically for the Klamath-Siskiyou. For each grouping, the proportion of species with increasing and decreasing trends was compared. The different groups to which each species was assigned for analysis are indicated in Appendix I.

One major category of interest in bird conservation is Residency Status: permanent resident, short-distance migrant, or neotropical migrant. I compared population trends among these three groups. I also examined the Nest Site category: open-cup nesting vs. cavity-nesting. There has been considerable concern about the status of cavity-nesting birds in our region, both due to forestry practices that have reduced the availability of snags upon which many species depend (Bull 1986), and to nest-site competition with the introduced European Starling.

I also present a comparison of early-seral and late-seral breeding birds. With the loss of most late-seral forests in the Pacific Northwest due to logging, there is concern for the viability of old-growth-associated species, and it is of interest to examine this habitat variable with the BBS data. I limited the comparison to birds of early seral and scrub habitats (including chaparral) vs. those of late seral habitats. Thus, grassland species (e.g., Western Meadowlark. Savannah Sparrow) and the broad group of "woodland" species as defined by BBS were not considered in this comparison. "Woodland" species were excluded because the range of habitat types lumped together in this designation was so broad as to obscure underlying patterns (for example, the BBS "woodland" group includes both the conifer-dependent Steller's Jay and the oak-dependent Western Scrub-Jay, and both the riparian Warbling Vireo and the upland Hutton's Vireo).

I developed the late-seral list used here based on the Northwest Forest Plan's list of old-growth-associated bird species (Thomas et al. 1993), with modifications indicated by subsequent research and my own experience of bird habitat relations in the Klamath-Siskiyou. Some species on the Northwest Forest Plan's list (e.g., Northern Flicker, White-breasted Nuthatch) were omitted as not truly representative of late-seral habitats in the Klamath-Siskiyou (Marshall et al. 2003). Others not on the Plan's list (e.g., Swainson's Thrush, Pine Siskin) were added to more accurately reflect the late-seral avifauna (Marshall et al. 2003).

Results

Non-native Species

Among the five non-native landbirds in the Klamath-Siskiyou, three increased significantly from 1968-2002: Wild Turkey, Rock Pigeon, and House Sparrow. European Starling numbers also increased, but this trend did not reach the level of statistical significance. The remaining non-native species, Ring-necked Pheasant, declined significantly during this period. The analyses that follow consider only the 95 species of native landbirds with BBS data suitable for analysis (Appendix I).

Overall Trends in Native Landbirds

Between 1968-2002, statistically significant population declines outnumbered significant increases by well over two to one among Klamath-Siskiyou native landbirds (34% significant declines vs. only 13% significant increases). Overall, including both statistically significant and non-significant trends, nearly two-thirds (64%) of species showed population declines in the BBS data. Direction and significance of population trends for all species are shown in Appendix I. Figure 1 shows examples of population trend data for a significantly declining species, the Bushtit, and a significantly increasing species, the Common Raven. Note the magnitude of these trends, with Bushtit declining from mean counts of around eight to far less than one, and Common Raven increasing from mean counts of around two to over eight. Exact values for the magnitude of trends of each species, with graphs, are available at USGS (2004c).

How robust are these results? One way to assess that is to see if the species' trends hold true across adjacent and overlapping regions. In Table 1, I list the 10 most sharply declining and the 10 most sharply increasing native landbirds (among species with statistically significant trends) of the Southern Pacific Rainforests (SPRF). The species are listed in order of trend strength (strongest trends at the top). The population trends of these species in the SPRF are compared with their trends in five related geographic regions. These regions are the states of California and Oregon; the BBS physiographic regions "Sierra Nevada" (the Sierra Nevada Mountains and the Marble Mountains portion of the Klamath-Siskiyou) and "Cascades" (the Cascade Mountains of Oregon and Washington, including the northeast corner of the Klamath-Siskiyou); and the "Western U.S." region of the BBS (including the states from the Rocky Mountains to the Pacific coast).

Species with declining trends exhibited considerable consistency across these regions. Nine of the top ten declining species in the Southern Pacific Rainforests also showed significant declines in the most inclusive region, the Western U.S. In nine of 48 possible comparisons across regions, these species exhibited increases rather than declines, but in no case were these increasing trends significant. Two birds, Chipping Sparrow and Olive-sided Flycatcher, exhibited significantly declining trends in all regions.

The species with significantly increasing trends in the Southern Pacific Rainforests appeared to be less consistent across the other five regions. These species switched to negative trends in 14 of 47 comparisons, and in two additional cases exhibited neither a positive nor negative trend. Only half showed significantly increasing trends in the most inclusive region, the Western U.S. Four species switched to show significant negative trends in one or more regions (Red-breasted Nuthatch, Red-winged Blackbird, Steller's Jay, and Black-headed Grosbeak). One species, Osprey, showed significantly increasing trends in all regions.

Trends in Relation to Residency Status

Population trends varied markedly in relation to residency status (Table 2). Permanent residents that showed statistically significant trends increased and decreased in similar proportions. However, short-distance migrants (i.e., those that migrate mostly

within North America north of Mexico) showed more than twice as many significant declines as significant increases. This difference was further magnified among the neotropical migrants, in which six times more species showed significant declines than increases, and almost 80% showed some degree of population decline. The only two neotropical migrants with significant increases in the Southern Pacific Rainforests from 1968-2002 were Common Yellowthroat and Black-headed Grosbeak.

Trends in Relation to Nest Type

The overall population trends of cup and cavity nesting birds in the BBS data for the Southern Pacific Rainforests are the same: 65% of both groups showed declines (Table 3). Open-cup nesting birds showed somewhat more significant declines than did cavity-nesting birds. Within the group of cavity-nesting species, I further compared those species that excavated their own nest cavities ("excavators") with those that depend on natural cavities or those excavated by other species ("non-excavators"). Although the number of species is not large, it is striking that 38% of non-excavators declined significantly, whereas not a single "excavator" species (woodpeckers and Red-breasted Nuthatch) showed a significant decline.

Trends in Relation to Habitat

The results of the comparison between early seral vs. late seral birds (Table 4) do not support the hypothesis of disproportionate declines among late-seral species. Significant declines were documented in 40% of early seral and scrub birds, compared to 32% of late seral birds. Equal proportions of early and late seral species showed significant increases.

Discussion

It is important to recognize that each bird species has a unique set of habitat relations, and is subject to a unique suite of factors influencing productivity, mortality, and thus population trends. Generalizations across species inevitably obscure these individual differences. Nevertheless, such generalizations may enable us to recognize common factors that would otherwise remain undetected.

Non-Native Species

While a detailed consideration of non-native species population dynamics is beyond the scope of this paper, it is worth noting that non-native species were the only category of birds identified in this analysis that showed a net increase from 1968-2002. Non-native birds have apparently not reached equilibrium in the Klamath-Siskiyou, and their effects on native birds may increase in coming years.

Comparisons Across Regions

Table 1 reveals considerable consistency in population trends across an array of geographical regions. In only 5% of cases (5 of 95 possible comparisons) did a species exhibit different significant trends in different regions. All five of these cases involved a species with a statistically significant increase in the Southern Pacific Rainforests showing a statistically significant decline elsewhere. In general, increasing trends in the Southern Pacific Rainforest data appeared to be less consistent across regions than declining trends. This difference may be due to the fact that the increasing trends in the BBS data, even when statistically significant, were generally not as steep as the declining trends, and were thus more prone to reversal by inter-year variability.

Residency Status

Neotropical migrants are the group of species identified in this analysis as suffering the greatest proportion of significant declines. This result is in line with other studies of North American bird population trends (Robbins et al. 1989; Terborgh 1989; Martin and Finch 1995). Neotropical migrants face many hazards during their long migrations, including loss of stopover habitats (Simons et al. 2000) and collisions with obstacles such as towers (Morris et al. 2003) and buildings (Evans Ogden 1996). They are also vulnerable to destruction of their wintering habitats in the tropics (Terborgh 1989). In the light of the increased mortality risks faced by neotropical migrants, habitat management actions that increase productivity on the breeding grounds would be of great benefit to the long-term persistence of these species.

Nest Site Status

Cavity-nesting bird species that do not excavate their own cavities may also be particularly subject to population declines. In this analysis, 38% of these species declined significantly, as compared to not a single significant decline among cavity-nesters that excavate. Non-excavating cavity nesters often depend on nest sites in snags, and this result suggests that the availability and especially the persistence of snags may be a critical limiting factor for some bird species in our region. Snag management is of particular importance in logged and burned landscapes, where snag dispersion and size distribution, as well as overall density, can have great impacts on cavity-nesting birds (Saab et al. 2002).

Habitat Preferences in Relation to Seral Stage

The analysis of population trends in relation to seral stage does not support the hypothesis that late-seral-associated birds are at disproportionate risk of population decline. However, this result must be interpreted with caution. One problem is that some late-seral birds of great conservation interest in the Klamath-Siskiyou occur at low density and are not adequately sampled by the BBS methodology. Examples include Marbled Murrelet, Northern Goshawk, Spotted Owl, and White-headed Woodpecker. An even more fundamental issue is that BBS routes are not designed to reflect overall habitat availability. For example, if BBS routes in late-seral forest were established in areas with relatively low intensities of logging (e.g., national parks), BBS data might show late-seral bird populations as stable, even if there was a large loss in late-seral habitat regionally.

In the light of other evidence that the amount of late-seral forests has declined drastically in the Klamath-Siskiyou (Noss et

al. 1999), it is important to recognize that late-seral bird populations may have declined more severely in the region than is suggested by the BBS data. Information on BBS route distribution in relation to land ownership or management status (e.g., Forest Service, National Park Service, private industrial timberland) is needed to resolve these questions.

Conservation Priorities and Future Research Needs

A central objective of the U.S. Fish and Wildlife Service Migratory Bird Program Strategic Plan is to "keep common birds common;" that is, to identify and effectively address threats to common birds before they cause significant population declines (USFWS 2004). The actions needed to rescue a species that has declined to endangered status are far more difficult, expensive, and uncertain than are those needed to stabilize a species just beginning to decline.

It is noteworthy that many species that have shown significant declines in the BBS data for the Southern Pacific Rainforests are still generally considered to be common birds. Examples include American Kestrel, Rufous Hummingbird, Western Wood-Pewee, Barn Swallow, Bushtit, Chipping Sparrow, Song Sparrow, Dark-eyed Junco, and American Goldfinch. All of these birds have adapted well to human-modified environments, and their familiarity may obscure reductions in their numbers. Some are neotropical migrants whose declines could be linked to habitat destruction or other factors on the wintering grounds. Others, however, are permanent residents that lack obvious risk factors for population decline.

These results reported here confirm that complacency about the population status of common birds is not appropriate, and that these species deserve more study and monitoring. If such adaptable species are showing broad declines, human modifications of the environment may be having even more widespread negative effects than we realize. For example, it has been suggested that Chipping Sparrow and Bushtit declines in Oregon may be linked to fire suppression that has allowed conifer invasion of oak woodland habitats (Hagar and Stern 2001). This same process could be involved in other species' declines identified in the BBS data, including Oak Titmouse and American Goldfinch. There is an urgent need for research on this and similar issues relating to the effects of habitat modification on bird populations.

This study is a first attempt to examine population trends among landbirds of the Klamath-Siskiyou. I hope that it will stimulate more detailed analysis of BBS data from this region. Despite the limitations of these data, they offer important insights into bird population trends. The broad scope of declines documented here, involving some of our most familiar and adaptable birds, is reason for great concern.

However, BBS data alone are not enough. They must be supplemented with additional sources of information on bird populations in the Klamath-Siskiyou. Much further research is needed on bird population dynamics and habitat relations in order to allow private landowners and public land managers to make the decisions needed to preserve healthy bird populations in the Klamath-Siskiyou. Specifically, there is a great need for a comprehensive regional monitoring and research program to provide the following:

- Increased monitoring of habitats and species not adequately covered by BBS (e.g., riparian habitats, for which the Oregon/Washington PIF has a special species monitoring plan).
- Better understanding of the habitat relationships of at-risk species to integrate bird conservation and management (e.g., in fuels reduction and fire management plans).
- More complete data on demography, including nest searching to verify where birds breed successfully (indexes of abundance and density may be misleading) and studies of survivorship vs. productivity (needed to distinguish breeding season vs. wintering ground effects).

Fortunately, many of these studies are under way, and are being coordinated by the Klamath Demographic Monitoring Network (Ralph 2001). This network, anchored by the Klamath Bird Observatory, the Humboldt Bay Bird Observatory, and the Redwood Sciences Laboratory of the U.S. Forest Service, extends along the coast from Mendocino County, California north to Coos County, Oregon, and inland from Crater Lake south through the Klamath Basin, the Modoc Plateau, and the upper Sacramento River drainage. It includes data from over 45 constant-effort mist-netting stations and more than 7000 breeding-season point counts. Further development of this network, and analyses of the data it is generating, will be critical to preserving the long-term health of bird populations in the Klamath-Siskiyou Ecoregion.

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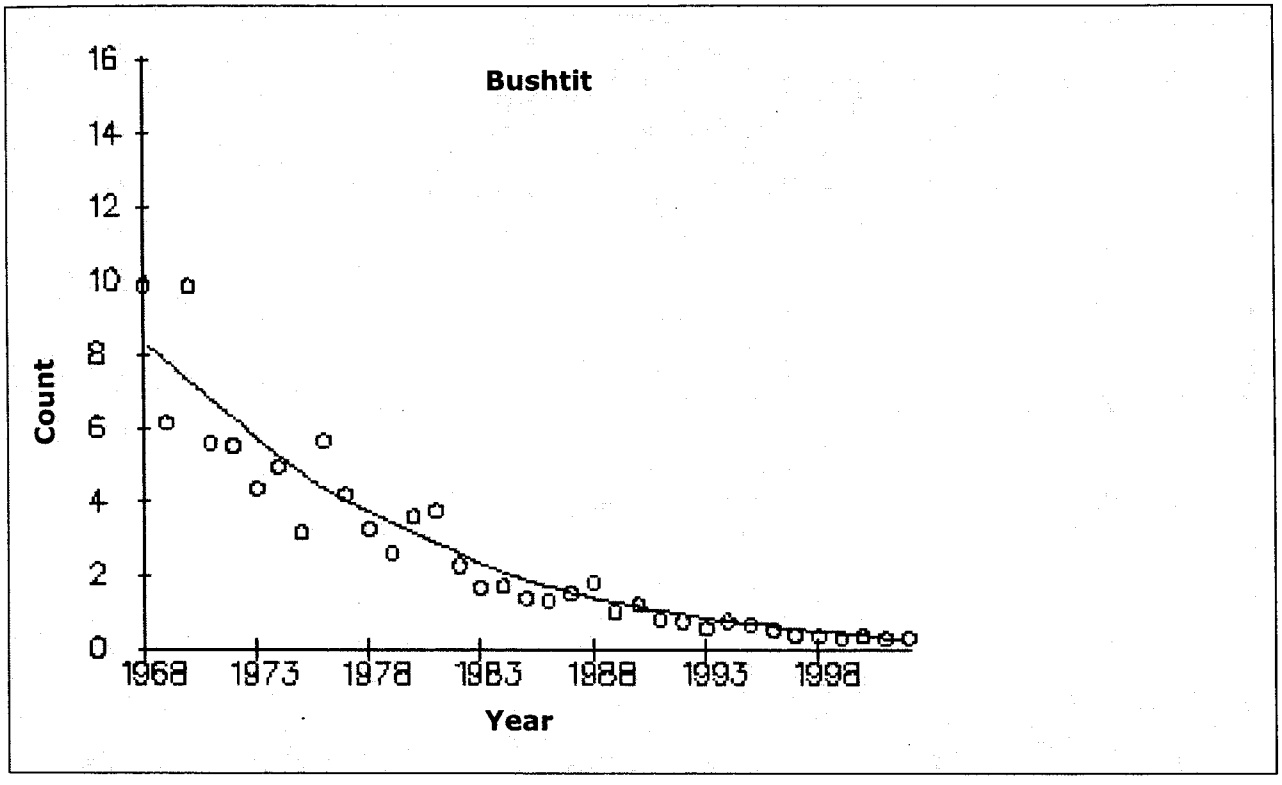
USGS. 2004c. BBS Bird population data summaries for the Southern Pacific Rainforests, 1968-2002, can be found at: http://www.mbr-pwrc.usgs.gov/cgi-bin/atlasr02.pl?S93.

Figure 1. Examples of population trend data for a sharply declining species, the Bushtit (upper graph) and a sharply increasing species, the Common Raven (lower graph). The Y-axis shows the average number of birds per count for the South Pacific Rainforest region for a given year. Both trends are highly significant ($P \leq 0.01$). Data from USGS.



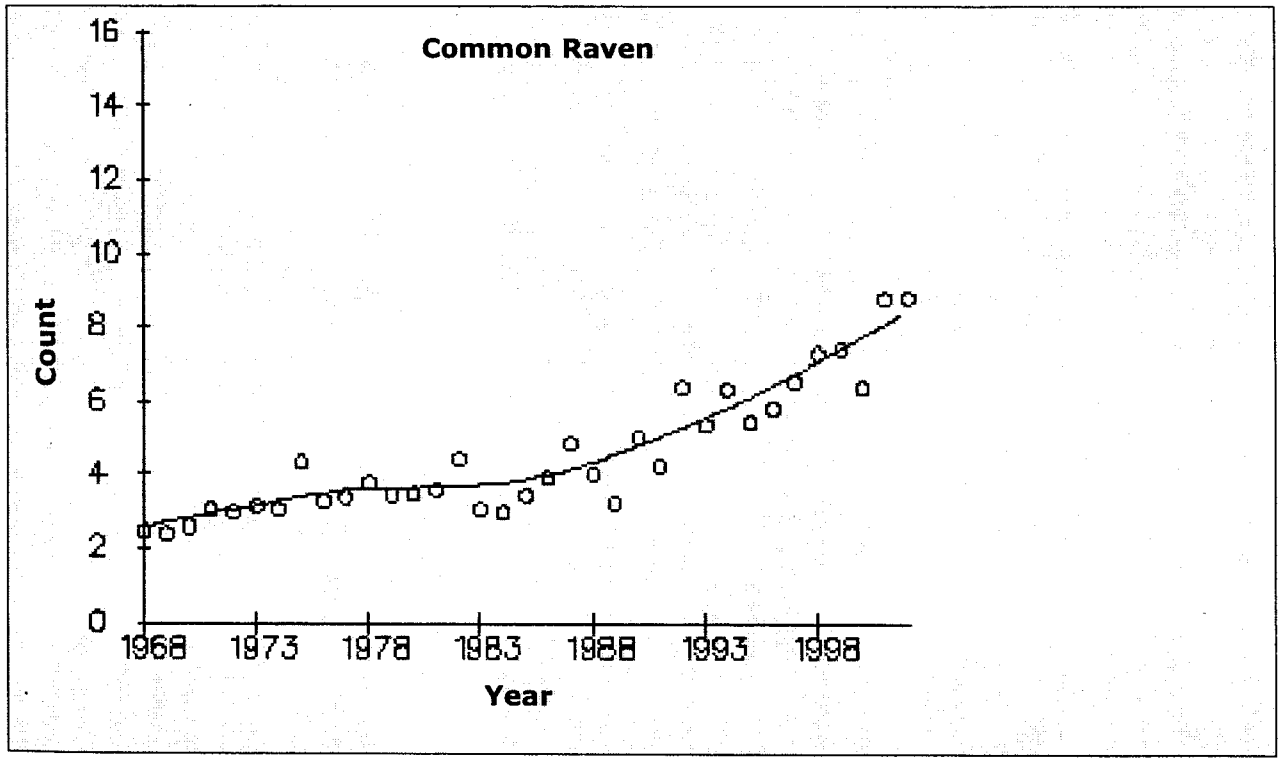


Table 1. Population trends for sharply declining and increasing native landbirds in the Southern Pacific Rainforests (SPRF) compared with other BBS regions. The upper box lists the 10 native landbirds with the steepest population declines in the SPRF from 1968-2002. The lower box lists the 10 native landbirds with the steepest population increases in the SPRF over this period. See text for description of regions.
Key: - - (significantly declining); - (non-significant declining trend); + + (significantly increasing); + (non-significant increasing trend); na (sufficient data not available for analysis); 0 (no trend in data). Statistical significance level for population trends defined as $P < 0.10$, following USGS 2004a.

Declining Species	So. Pacific Rainforest	CA	Sierra Nevada	OR	Cascades	Western US
Bushtit	- -	- -	-	-	- -	- -
Common Nighthawk	- -	+	+	-	+	- -
Chipping Sparrow	- -	- -	- -	- -	- -	- -
Blue Grouse	- -	+	+	-	-	- -
Pine Siskin	- -	- -	-	-	-	- -
Western Meadowlark	- -	- -	+	-	- -	- -
American Kestrel	- -	- -	+	- -	+	- -
Lark Sparrow	- -	-	na	- -	na	-
Golden-cr. Kinglet	- -	- -	-	- -	+	- -
Olive-sided Flycatcher	- -	- -	- -	- -	- -	- -

Increasing Species	So. Pacific Rainforest	CA	Sierra Nevada	OR	Cascades	Western US
Northern Pygmy-Owl	+ +	+ +	+	+	-	+
Osprey	+ +	+ +	+ +	+ +	+ +	+ +
Common Yellowthroat	+ +	+ +	na	+	+ +	+ +
Black Phoebe	+ +	+ +	+	+	na	+ +
Common Raven	+ +	+ +	+	0	+ +	+ +
Red-breasted Nuthatch	+ +	-	- -	- -	-	+ +
Red-winged Blackbird	+ +	+	+	-	-	- -
Steller's Jay	+ +	+	- -	-	-	+
Black-headed Grosbeak	+ +	0	- -	+	+ +	+
California Towhee	+ +	-	+	+	na	-

Table 2. Population trends in relation to residency status among native landbirds of the BBS Southern Pacific Rainforests region. N = the number of species in each category. Species list with residency status in Appendix I. Data from USGS 2004c.

	All Species			Species With Signif. Trends	
Trends		Decreasing	Increasing		
Decreasing Increasing					
Permanent Residents	(N = 20)	11 (55%)	9 (45%)	5 (25%)	4
(20%)					
Short-Distance Migrants	(N = 32)	17 (53%)	15 (47%)	11 (34%)	5
(16%)					
Neotropical Migrants	(N = 33)	26 (79%)	7 (21%)	13 (39%)	2
(6%)					

Table 3. Population trends in relation to nest type among native landbirds of the BBS Southern Pacific Rainforests region. N = the number of species in each category. Species list with nest type status in Appendix I. Data from USGS 2004c.

	All Species			Species With Signif. Trends	
	Decreasing	Increasing		Decreasing	Increasing
Open-cup Nesting	(N = 52)	34 (65%)	18 (35%)	18 (35%)	7 (13%)
Cavity-Nesting	(N = 20)	13 (65%)	7 (35%)	5 (25%)	2 (10%)
Excavator	(N = 7)	5 (71%)	2 (29%)	0 (0%)	1 (14%)
Non-Excavator	(N = 13)	8 (62%)	5 (38%)	5 (38%)	2 (13%)

Table 4. Population trends in relation to early vs. late seral habitat preferences among native landbirds of the BBS Southern Pacific Rainforests region. N = the number of species in each category. Species list with seral habitat preferences in Appendix I. Data from USGS 2004c.

	All Species			Species With Signif. Trends	
	Decreasing	Increasing		Decreasing	Increasing
Early Seral/Scrub	(N = 25)	19 (76%)	6 (24%)	10 (40%)	4 (16%)
Late Seral	(N = 19)	11 (58%)	8 (42%)	6 (32%)	3 (16%)

APPENDIX I. Species included in this analysis of landbird population trends for the Klamath-Siskiyou Ecoregion (total = 100 species). All data are taken from summaries for the Southern Pacific Rainforest physiographic province in the BBS data (USGS 2004c). Following each species is a notation indicating population trend and significance. + + means a significant increasing trend; + means non-significant increasing trend; - - means significant declining trend; and – means non-significant declining trend. Statistical significance level defined as $P < 0.10$, following USGS (2004a). The five non-native bird species included in the analysis are noted with an asterisk before the species name.

Species were included in different analytical categories, as follows (see text for definitions):
Residency: PR = permanent resident; SD = short-distance resident; NM = neotropical migrant
Habitat: ES = early seral/scrub; LS = late seral
Nesting: OC = open cup nesting; CV = cavity-nesting; (e) = excavator; (ne) = non-excavator

	Trend 1968-2002	Residency	Habitat	Nesting
BIRDS OF PREY				
Turkey Vulture (*Cathartes aura*)	+	SD		
Osprey (*Pandion haliaetus*)	+ +	SD		
Red-tailed Hawk (*Buteo jamaicensis*)	+			
American Kestrel (*Falco sparverius*)	- -	SD		CV (ne)
Northern Pygmy-Owl (*Glaucidium gnoma*)	+ +		LS	CV (ne)
GAMEBIRDS				
Blue Grouse (*Dendropagus obscurus*)	- -	PR		
*Ring-necked Pheasant (*Phasianus colchicus*)	- -			
*Wild Turkey (*Meleagris gallopavo*)	+ +			
California Quail (*Callipepla californica*)	-	PR	ES	
Mountain Quail (*Oreortyx pictus*)	+	PR	ES	
PIGEONS & DOVES				
*Rock Pigeon (*Columba livia*)	+ +			
Band-tailed Pigeon (*Columba fasciata*)	-	NM		
Mourning Dove (*Zenaida macroura*)	- -	SD		
NIGHTJARS				
Common Nighthawk (*Chordeiles minor*)	- -	NM	ES	
SWIFT & HUMMINGBIRDS				
Vaux's Swift (*Chaetura vauxi*)	- -	NM	LS	CV (ne)
Anna's Hummingbird (*Calypte anna*)	+	PR		
Allen's Hummingbird (*Selasphorus sasin*)	-	NM		
Rufous Hummingbird (*Selasphorus rufus*)	- -	NM		
KINGFISHER				
Belted Kingfisher (*Ceryle halcyon*)	- -			
WOODPECKERS				
Acorn Woodpecker (*Melanerpes formicivorus*)	-	PR		CV (e)
Red-breasted Sapsucker (*Sphyrapicus ruber*)	+		LS	CV (e)
Downy Woodpecker (*Picoides pubescens*)	-	PR		CV (e)
Hairy Woodpecker (*Picoides villosus*)	-	PR	LS	CV (e)
Northern Flicker (*Colaptes auratus*)	-			CV (e)
Pileated Woodpecker (*Dendrocopus pileatus*)	-	PR	LS	CV (e)

	Trend 1968-2002	Residency	Habitat	Nesting
FLYCATCHERS				
Olive-sided Flycatcher (*Contopus borealis*)	- -	NM		OC
Western Wood-Pewee (*Contopus sordidulus*)	- -	NM		OC
Black Phoebe (*Sayornis nigricans*)	+ +	PR		OC
Willow Flycatcher (*Empidonax traillii*)	- -		ES	OC
Hammond's Flycatcher (*Empidonax hammondii*)	+	NM	LS	OC
Dusky Flycatcher (*Empidonax oberholseri*)	-	NM		OC
Pacific-slope Flycatcher (*Empidonax difficilis*)	- -		LS	OC
Ash-throated Flycatcher (*Myiarchus cinerascens*)	-	NM		CV (ne)
Western Kingbird (*Tyrannus verticalis*)	-	NM		OC
VIREOS				
Cassin's Vireo (*Vireo cassinii*)	-			OC
Warbling Vireo (*Vireo gilvus*)	+	NM		OC
Hutton's Vireo (*Vireo huttoni*)	-	PR		OC
JAYS AND CROWS				
Steller's Jay (*Cyanocitta stelleri*)	+ +	PR		OC
Western Scrub-Jay (*Aphelocoma californica*)	+	PR		OC
American Crow (*Corvus brachyrhynchos*)	+	SD		
Common Raven (*Corvus corax*)	+ +	PR		
SWALLOWS				
Tree Swallow (*Tachycineta bicolor*)	-	SD		CV (ne)
Violet-green Swallow (*Tachycineta thalassina*)	+	NM		CV (ne)
No. Rough-winged Swallow (*Stelgidopteryx serripennis*)	-	NM		
Cliff Swallow (*Petrochelidon pyrrhonota*)	- -	NM		
Barn Swallow (*Hirundo rustica*)	- -	NM		OC
CHICKADEES & ALLIES				
Black-capped Chickadee (*Poecile atricapilla*)	+	PR		CV (ne)
Chestnut-backed Chickadee (*Poecile rufescens*)	- -	PR	LS	CV (ne)
Oak Titmouse (*Baeolophus inornatus*)	- -	PR		CV (ne)
Bushtit (*Psaltiparus minimus*)	- -	PR	ES	
NUTHATCHES & CREEPER				
Red-breasted Nuthatch (*Sitta canadensis*)	+ +	SD	LS	CV (e)
White-breasted Nuthatch (*Sitta carolinensis*)	+	PR		CV (ne)
Brown Creeper (*Certhia americana*)	-	SD	LS	
WRENS & WRENTIT				
Marsh Wren (*Cistothorus palustris*)	+	SD		
Bewick's Wren (*Thryomanes bewickii*)	+	SD	ES	CV (ne)
House Wren (*Troglodytes aedon*)	-	NM	ES	CV (ne)
Winter Wren (*Troglodytes troglodytes*)	+ +	SD	LS	
Wrentit (*Chamaea fasciata*)	-	PR	ES	OC
STARLING & WAXWING				
*European Starling (*Sturnus vulgaris*)	+			
Cedar Waxwing (*Bombycilla cedrorum*)	+	SD		OC

	Trend 1968-2002	Residency	Habitat	Nesting
THRUSHES & KINGLET				
Western Bluebird (*Sialia mexicanus*)	- -	SD		CV (ne)
Swainson's Thrush (*Catharus ustulatus*)	- -	NM	LS	OC
Hermit Thrush (*Catharus guttata*)	-	SD	LS	OC
American Robin (*Turdus migratorius*)	+	SD		OC
Varied Thrush (*Ixoreus naevius*)	+	SD	LS	OC
Golden-crowned Kinglet (*Regulus satrapa*)	- -	SD	LS	OC
WARBLERS & TANAGER				
Orange-crowned Warbler (*Vermivora celata*)	- -	NM	ES	OC
Nashville Warbler (*Vermivora ruficapilla*)	-	NM	ES	OC
Yellow Warbler (*Dendroica petechia*)	-	NM	ES	OC
Yellow-rumped Warbler (*Dendroica coronata*)	-		LS	OC
Black-thr. Gray Warbler (*Dendroica nigrescens*)	-	NM		OC
Hermit Warbler (*Dendroica occidentalis*)	+	NM	LS	OC
MacGillivray's Warbler (*Oporornis tolmiei*)	- -	NM	ES	OC
Common Yellowthroat (*Geothlypis trichas*)	+ +	NM	ES	OC
Wilson's Warbler (*Wilsonia pusilla*)	-	NM		OC
Yellow-breasted Chat (*Icteria virens*)	-	NM	ES	OC
Western Tanager (*Piranga ludoviciana*)	+	NM		OC
SPARROWS & ALLIES				
Spotted Towhee (*Pipilo maculatus*)	+ +	SD	ES	OC
California Towhee (*Pipilo californica*)	+ +	PR	ES	OC
Chipping Sparrow (*Spizella passerina*)	- -	NM	ES	OC
Lark Sparrow (*Chondestes grammacus*)	- -	NM	ES	OC
Savannah Sparrow (*Passerculus sandvicensis*)	+	SD		OC
Song Sparrow (*Melospiza melodia*)	- -	SD	ES	OC
White-crowned Sparrow (*Zonotrichia leucophrys*)	- -	SD	ES	OC
Dark-eyed Junco (*Junco hyemalis*)	- -			OC
GROSBEAK & BUNTING				
Black-headed Grosbeak (*Pheucticus ludovicianus*)	+ +	NM		OC
Lazuli Bunting (*Passerina amoena*)	-	NM	ES	OC
BLACKBIRDS & ALLIES				
Red-winged Blackbird (*Agelaius phoeniceus*)	+ +	SD	ES	OC
Western Meadowlark (*Sturnella neglecta*)	- -	SD		OC
Brewer's Blackbird (*Euphagus cyanocephalus*)	-	SD	ES	OC
Brown-headed Cowbird (*Molothrus ater*)	- -	SD		
Bullock's Oriole (*Icterus bullockii*)	- -	NM		
FINCHES & HOUSE SPARROW				
Purple Finch (*Carpodacus purpureus*)	- -	SD		OC
House Finch (*Carpodacus mexicanus*)	-	SD		OC
Red Crossbill (*Loxia curvirostra*)	+	SD	LS	OC

	Trend 1968-2002	Residency	Habitat	Nesting
Pine Siskin (*Carduelis pinus*)	- -	SD	LS	OC
Lesser Goldfinch (*Carduelis psaltria*)	-	SD	ES	OC
American Goldfinch (*Carduelis tristis*)	- -	SD	ES	OC
Evening Grosbeak (*Coccothraustes vespertinus*)	+	SD		OC
*House Sparrow (*Passer domesticus*)	+ +			

Chi-square goodness-of-fit tests were carried out to compare the results for both all species and for those with significance population changes only. The null hypothesis was that each residency category would show population increases in 50% of species and decreases in 50%. For all species, the chi-square was 11.26 ($p < 0.005$), and for species with significant changes only, the chi-square was 10.43 ($p < 0.01$). Thus, these results cannot be dismissed as random variations. It is clear that the neotropical migrant category contributes more than expected to the observed declines and less than expected to the observed increases.

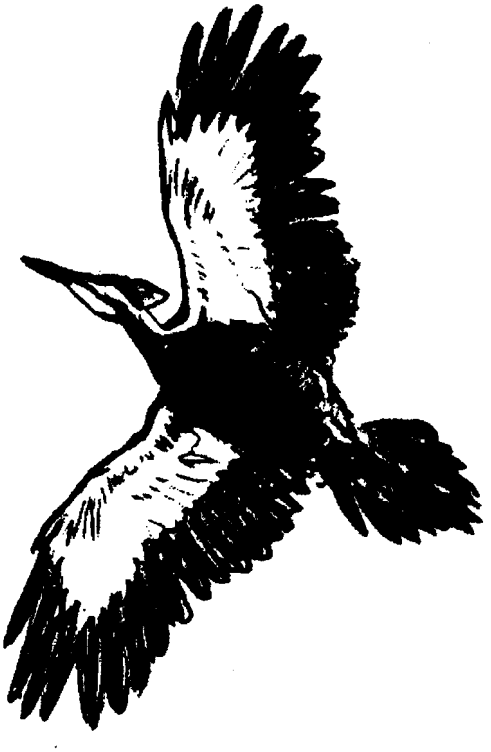


Illustration by Bob Cremins