THE 2003 ANNUAL REPORT OF THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM IN YOSEMITE NATIONAL PARK

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EXECUTIVE SUMMARY

Overview

Since 1989, The Institute for Bird Populations has been coordinating the Monitoring Avian Productivity and Survivorship (MAPS) program, a cooperative effort among public and private agencies and individual bird banders in North America to operate a continent-wide network of constant-effort mist-netting and banding stations. The purpose of MAPS is to provide annual indices of adult population size and post-fledging productivity, as well as estimates of adult survivorship and recruitment into the adult population, for various landbird species. Broad-scale data on productivity and survivorship are not obtained from any other avian monitoring program in North America and are needed to provide crucial information upon which to initiate research and management actions to reverse the recently documented declines in North American landbird populations. The system of national parks provides a group of ideal locations for this large-scale, long-term biomonitoring, because they contain large areas of breeding habitat for year-round resident and both short-distance and Neotropical migratory landbirds that are subject to varying local landscape-related and global climate-related effects.

A second objective of MAPS is to provide standardized population and demographic data for the landbirds found in local areas or on federally managed public lands, such as national parks, national forests, and military installations. In this light, the MAPS program has been operated in Yosemite National Park for the past 11 years (14 years at one station) with the hope that it will serve as an integral part of the park's Long-Term Ecological Monitoring (LTEM) program. It is expected that information from MAPS will be capable of aiding research and management efforts within the park to protect and enhance the park's avifauna and ecological integrity.

The goal of this report is to 1) summarize 11 years of MAPS data from four stations and six years of data from a fifth station along an elevation gradient in Yosemite National Park, 2) identify declining species in Yosemite National Park that are in need of management action, 3) identify the probable proximate, demographic causes (productivity or survival) for these population declines in Yosemite, and 4) suggest future analyses designed to confirm these causes and to identify and formulate management actions and conservation strategies to reverse these population declines that can be implemented at several spatial scales: in Yosemite National Park, in the greater Sierra Nevada ecosystem, and in montane western North America as a whole.

Adult Population Sizes and Productivity in 2003 and Comparison with Previous Years

A total of 1458 captures of 63 species was recorded during the summer of 2003 at Yosemite National Park. Adult population size for all species pooled for all five stations combined showed a fairly substantial but non-significant decrease of -11.0% between 2002 and 2003. Productivity (the proportion of young in the catch) in 2003 also decreased from that of 2002 by a significant absolute value of -0.266. These patterns tended to be park-wide for the more common species, although decreases in numbers young captured seemed to be species-wide as well as park-wide.

Populations of adult birds for all species pooled have generally increased in Yosemite National Park in even-numbered years and decreased in odd-numbered years, although some of the

changes were quite small (such as the 2.9% increase in 2002). For some of this time period, such as between 1996 and 2001, productivity for all species pooled showed the opposite pattern, increasing in odd-numbered years and decreasing in even-numbered years. This alternating cycle of population increases and decreases, with out-of-phase increases and decreases in productivity, has frequently been seen at many MAPS locations across the continent. It did not seem to occur at Yosemite in 1993-1996, however, and appears to have broken down again in Yosemite in 2002-2003, with productivity rising dramatically between 2001 and 2002 (for the second year in a row) and dropping dramatically between 2002-2003, despite a concurrent drop in population size. Perhaps a weak El Niño and the associated good productivity at Yosemite in 2002 has caused a shift in the alternating pattern.

We believe that the alternating out-of-phase pattern between increases and decreases in productivity and population size relates to density-dependent effects on productivity and recruitment along with lower productivity of first-time breeders. Populations that show this alternating two-year dynamic often also show a strong "productivity-population correlation," whereby changes in productivity in a given year are followed by corresponding changes in adult population size the following year. This dynamic appears to be less strongly manifest in regions that are characterized by high annual variation in weather and snowpack, such as Yosemite National Park, which shows only a weak productivity population correlation, than in regions where weather is more predictable year-round, including both Denali and Shenandoah national parks, which have shown stronger productivity-population correlations.

Population and Productivity Trends in Yosemite's Landbirds

Populations of adult birds of all species pooled at the four long-running MAPS stations in Yosemite National Park have shown a substantial and highly significant decrease of -2.7% per year over the 11 years, 1993-2003. This suggests that landbird populations at Yosemite have declined by 26% during the past 11 years, a truly substantial decline. Overall, 18 of 26 target species showed negative population trends during this 11-year period. Moreover, significant or near-significant 11-year declines were observed for eight species (Western Wood-Pewee, Dusky Flycatcher, Yellow Warbler, Hermit Warbler, Chipping Sparrow, Dark-eyed Junco, Black-headed Grosbeak, and Lazuli Bunting), whereas significant 11-year increases were observed in only two species (Mountain Chickadee and Yellow-rumped Warbler).

Comparison of 11-year (1993-2003) population trends from the four long-running Yosemite MAPS stations with long-term (1980-2002) BBS trends from the Sierra Nevada physiographic strata provides some interesting results. First, 13 of 18 target species having declining trends in Yosemite, and seven of the eight target species with significant or near-significant declining trends in Yosemite (all but Lazuli Bunting), also have declining trends overall in the Sierra. This suggests that the declines for these species in Yosemite are part of a Sierra-wide decline, and that conditions in Yosemite are not necessarily better for them than elsewhere in the Sierra. These species are in need of management action both in Yosemite and in the Sierra as a whole and should continue to be monitored closely in both Yosemite and the Sierra. Second, only two (Yellow-rumped Warbler and Song Sparrow) of the eight target species that are increasing at Yosemite MAPS stations are also increasing in the Sierra as a whole. This suggests that conditions for the other six species (Mountain Chickadee, Brown Creeper, American Robin, MacGillivray's Warbler, Western Tanager, and Cassin's Finch) may be better at Yosemite National Park than elsewhere in the Sierra. These species should also continue to be monitored in both Yosemite and the Sierra.

In contrast to the many species with significant or near-significant negative population trends as demonstrated by MAPS data, only one species, Lesser Goldfinch, showed a significant 11-year (1993- 2003) negative productivity trend, which was, however, highly significant. Six species, however, showed significant or near-significant increasing productivity trends. Despite the preponderance of significant positive over significant negative productivity trends, a total of only 13 of the 26 target species had positive productivity trends, and the productivity trend for all species pooled was only slightly positive, with an average absolute increase of +0.004 per year. A total of 13 of the 26 species had population and productivity trends in the same direction whereas 13 had them in opposite directions. Species that showed declines in both population and productivity trends included Western Wood-Pewee, Dusky Flycatcher, Cassin's Vireo, Golden-crowned Kinglet, Hermit Thrush, Chipping Sparrow, Dark-eyed Junco, Pine Siskin, and Lesser Goldfinch. Declines in these species might be expected to continue or even accelerate. On the other hand, increasing productivity for Red-breasted Sapsucker, Warbling Vireo, Nashville, Yellow, and Hermit warblers, Black-headed Grosbeak, Lazuli Bunting, and Purple Finch might eventually help to reverse the population declines of these species.

Demographics of Yosemite's Birds Along an Elevation Gradient

Total species richness of breeding species was highest at the lowest elevation station (Big Meadow), lowest at the highest elevation station (White Wolf), and clearly decreased with increasing elevation. Mean annual number of adults was highest at intermediate elevations (Crane Flat) and decreased progressively both at lower and higher elevations. Mean annual productivity for all species pooled was highest at still higher elevations (Gin Flat East) and, again, decreased progressively both at lower and higher elevations. Predictions from global climate models suggest that the Sierra is becoming increasingly arid and data from MAPS suggest that avian populations in the Sierra will be adversely affected by such climate change. These climate-caused changes could be further acerbated by concurrent land-use changes in the Sierra. This hypothesis underscores the importance of long-term avian demographic monitoring data in Yosemite National Park, where avian population and demographic changes are much less likely to be affected by land-use changes.

Survival Rates of Yosemite's Birds

We were able to obtain estimates of annual adult survival rates for 19 target species at Yosemite using 11 years of data from all five stations combined. As mentioned in previous reports, increased years of data have resulted in increased numbers of species for which survival estimates could be obtained. In addition, the mean precision of these survival rate estimates has increased substantially with each additional year of data, including 2003, when the mean precision CV(ϕ) for the 19 species was 21.2%. The mean survival rate for these 19 species was 0.463, while the mean recapture probability was 0.342 and the mean proportion of residents among newly captured adults was 0.576. $\Delta QAIC_C$ values continued to be relatively high (> 6.0) in all but one (Dark-eyed Junco) of these 19 species, suggesting that there is relatively little interannual variation in survival for most Yosemite species.

Causes of Population Change in Yosemite's Birds

Based on all demographic data, we made assessments as to whether Yosemite population declines and increases were driven by productivity on the breeding grounds, survival presumably during migration and/or on the winter grounds, both, or neither. Lower-than-expected productivity appears to be driving the population declines of five of the ten declining species, Western Wood-Pewee, Dusky Flycatcher, Warbling Vireo, Chipping Sparrow, and Lazuli Bunting, while low survivorship may also be driving or contributing to the declines of Red-breasted Sapsucker, Dusky Flycatcher, and Warbling Vireo. Similarly, it appears that higher than expected or increasing productivity may be driving the population changes of all three increasing species, Mountain Chickadee, Yellow-rumped Warbler, and MacGillivray's Warbler, with higher survival also contributing to the increase in MacGillivray's Warbler. Thus, overall, it appears that productivity at Yosemite may be driving or influencing the population dynamics of seven of the 13 species showing non-highly-fluctuating trends, whereas survival away from Yosemite is only driving or influencing trends in four species. This indicates that the population dynamics of most of Yosemite's breeding species are being affected by events in Yosemite National Park, and could be within the Park's ability to influence through management action.

Future Analyses

We cannot estimate first year survival with current MAPS analyses. This is because young birds typically disperse substantial distances from their natal site to their site of first breeding, resulting in very few or no recaptures of birds banded as juveniles. In future analyses we hope to be able to index first year survival by using data on species for which we can identify both one-year-old (second-year; SY) and older (after-second-year; ASY) birds in spring, by using CJS mark-recapture models to estimate annual recruitment of both SY and ASY birds. Then, by comparing spatial and temporal patterns of productivity and recruitment of SY and ASY birds, we will be able to make inferences regarding first year survival rates as well as amounts of immigration and emigration in the populations. Once these analyses have been performed, we will be able to examine patterns in adult and first year survival rates according to geographic location, climate, and habitat considerations, and to identify species (e.g., declining species at Yosemite that do not appear to show deficient productivity or adult survival: Yellow Warbler, Hermit Warbler, Dark-eyed Junco, and Black-headed Grosbeak) for which declines may be driven by low first year survival.

In three or four more years, when we will have accumulated 14 or 15 consecutive years of data from each of the four long-running stations, we hope to be able to estimate annual recruitment rates for both second-year and older birds, and to use these estimates to make inferences regarding first-year survival rates, as well as the amounts of immigration and emigration in the populations. Our aim is to be able to conduct some of these analyses at the spatial scale of the four individual stations. This may yield especially important results at Yosemite, where the stations span such a significant elevation range and the population dynamics appear to be influenced by elevation. Once these analyses have been completed we will be able not only to identify the effects of elevation on various demographic processes, but also to identify species that are declining based on poor productivity at each station (or within each of the parks elevation regimes), and make recommendations for management of these species accordingly.

Finally, by modeling spatial variation in vital rates as a function of spatial variation in population trends, we are beginning to gain insight as to the proximate demographic causes of population trends within a species at multiple spatial scales. We have also found that patterns of landscape structure detected within a two- to four-kilometer radius area of each station are good predictors not only of the numbers of birds of each species captured but, more importantly, of their productivity levels and population trends as well. Again, when we have accumulated 14-15 years of data, we plan to conduct similar analyses for the target species in the Sierra, by modeling productivity as a function of population trends and landscape characteristics that vary along a gradient from the pristine landscapes found in Yosemite National Park to the much more heavily managed landscapes on Sierran national forests where we also have MAPS stations.

Conclusions

Analyses of 11 years of MAPS data from four stations along an elevation gradient in Yosemite National Park, plus five years of data from a fifth station, have shown that bird populations in Yosemite have decreased substantially over the 11 years with many more species decreasing than increasing. We have also demonstrated how MAPS data can be used to measure and assess the effects of productivity and survivorship at different elevations as driving forces for the varying avian population trends documented in Yosemite National Park. Clearly, the indices and estimates of primary demographic parameters provided by the Yosemite MAPS Program are providing critical information that can be extremely useful for the management and conservation of landbirds in Yosemite and, in combination with similar data from other areas, throughout the Sierra Nevada and across the whole of North America.

The population dynamics of the breeding birds of Yosemite National Park are complex, as are the likely causes of the dynamics and, for those trends deemed problematic, their solutions. This complexity, in turn, underscores the importance of standardized, long-term data. Once 14 or 15 years of data have accumulated and the precision of our estimates improves further, time-dependence in survival estimates becomes more readily apparent, and long-term trends are more clearly established, we will be able to incorporate weather and climate data as well as landscape-level habitat data as additional co-variates in logistic regression analyses of productivity and in survivorship models. With these additional years of data we will be able to further our understanding of the population dynamics of Yosemite's birds and shed more light on the complex paths leading from stressors to population responses.

We conclude that the MAPS protocol is very well-suited to provide a critical component of the Park Service's Long-Term Ecological Monitoring program in Yosemite National Park. Based on the above information, we recommend that the operation of the five MAPS stations in Yosemite National Park be sustained into the future, and funding be sought for a comprehensive analysis of all Sierran MAPS data (including Yosemite's) that will be conducted after about 14 or 15 years of data have been accumulated.

INTRODUCTION

The National Park Service (NPS) has been charged with the responsibility of managing natural resources on lands under its jurisdiction in a manner that conserves them unimpaired for future generations. In order to carry out this charge, the NPS is implementing integrated long-term programs for inventorying and monitoring the natural resources in national parks and other NPS units. A pilot study to develop and evaluate field and analytical techniques to accomplish these objectives was first implemented in four national parks across the United States. The goals of this pilot program were to develop: (1) quantitative sampling and analytical methods that can provide relatively complete inventories and long-term trends for many components of biological diversity; and (2) effective means of monitoring the ecological processes driving the trends (Van Horn et al. 1992). An additional goal was that methods evaluated be useful in other national parks across the United States. This program is referred to as a Long-term Ecological Monitoring (LTEM) Program.

The development of an effective long-term ecological monitoring program in the national parks can be of even wider importance than aiding the NPS in managing its resources. Because lands managed by the NPS provide large areas of relatively pristine ecosystems, that promise to be maintained in a relatively undisturbed manner indefinitely into the future, studies conducted in national parks can provide invaluable information for monitoring natural ecological processes and for evaluating the effects of large-scale, even global, environmental changes. The national parks and other NPS units can also serve as critical control areas for monitoring the effects of relatively local land-use practices. Thus, long-term monitoring data from the national parks can provide information that is crucial for efforts to preserve natural resources and biodiversity at multiple spatial scales, ranging from the local scale to the continental or even global scale.

Landbirds

Landbirds, because of their high body temperature, rapid metabolism, and high ecological position on most food webs, may be 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. It is not surprising, therefore, that landbirds have been selected by the NPS to receive high priority for monitoring. Nor is it surprising that several large-scale monitoring programs that provide annual population estimates and long-term population trends for landbirds are already in place on this continent. They include the North American Breeding Bird Survey (BBS), the Breeding Bird Census, the Winter Bird Population Study, and the Christmas Bird Count.

Recent analyses of data from several of these programs, particularly the BBS, suggest that populations of many landbirds, including forest-, scrubland-, and grassland-inhabiting species, appear to be in serious decline (Peterjohn et al. 1995). Indeed, populations of most landbird species appear to be declining on a global basis. Nearctic-Neotropical migratory landbirds (species that breed in North America and winter in Central and South America and the West Indies; hereafter, Neotropical migratory birds) constitute one group for which pronounced population declines have been documented (Robbins et al.1989, Terborgh 1989). In response to these declines, the Neotropical Migratory Bird Conservation Program, “Partners in Flight - Aves de las Americas,” was initiated in 1991 (Finch and Stangel 1993). A major goal of Partners in Flight (PIF) is to reverse the declines in Neotropical migratory birds through a coordinated program of monitoring, research, management, education, and international cooperation. As one of the major cooperating agencies in PIF, the NPS has defined its role in the program to include the establishment of long-term monitoring programs at NPS units using protocols developed by the Monitoring Working Group of PIF. Clearly, the long-term ecological monitoring goals of the NPS and the monitoring and research goals of PIF share many common elements.

The goals of these programs differ, however, in at least one important respect. A major goal of PIF is to reverse population declines, especially in rare or uncommon (although not threatened or endangered) species, while a major objective of the NPS’s LTEM program is to understand the ecological processes driving population changes. This latter goal often necessitates concentrating on relatively common or even abundant species that are undergoing population changes, rather than rare or uncommon ones. Thus, appropriate target species might be expected to differ somewhat between PIF and LTEM efforts.

Primary Demographic Parameters

Existing population-trend data on Neotropical migrants, while suggesting severe and sometimes accelerating declines, provide no information on primary demographic parameters (productivity and survivorship) of these birds. Thus, population-trend data alone provide no means for determining at what point(s) in the life cycles problems are occurring, or to what extent the observed population trends are being driven by causal factors that affect birth rates, death rates, or both (DeSante 1995). In particular, large-scale North American avian monitoring programs that provide only population-trend data have been unable to determine to what extent forest fragmentation and deforestation on the temperate breeding grounds, versus that on the tropical wintering grounds, are causes for declining populations of Neotropical migrants. Without critical data on productivity and survivorship, it will be extremely difficult to identify effective management and conservation actions to reverse current population declines (DeSante 1992).

The ability to monitor primary demographic parameters of target species must also be an important component of any successful long-term inventory and monitoring program that aims to monitor the ecological processes leading from environmental stressors to population responses (DeSante and Rosenberg 1998). This is because environmental factors and management actions generally affect primary demographic parameters directly and these effects usually can be observed over a short time period (Temple and Wiens 1989). Because of the buffering effects of floater individuals and density-dependent responses of populations, there may be substantial timelags between changes in primary parameters and resulting changes in population size or density as measured by census or survey methods (DeSante and George 1994). Thus, a population could be in trouble long before this becomes evident from survey data. Moreover, because of the vagility of many animal species, especially birds, local variations in secondary parameters (e.g., population size or density) may be masked by recruitment from a wider region (George et al. 1992) or accentuated by lack of recruitment from a wider area (DeSante 1990). A successful monitoring program should be able to account for these factors.

Finally, a successful monitoring program should be able to detect significant differences in productivity as a function of such local variables as landscape-level habitat characteristics or degree of habitat disturbance. The detection of such differences can lead to immediate management implementation within a national park, especially for species where long-term demographic monitoring suggests that declines are related to local (e.g., productivity) rather than remote (e.g., overwintering survival in Neotropical migrants) factors.

MAPS

In 1989, The Institute for Bird Populations (IBP) established the Monitoring Avian Productivity and Survivorship (MAPS) program, a cooperative effort among public agencies, private organizations, and individual bird banders in North America to operate a continent-wide network of constant-effort mist-netting and banding stations providing long-term demographic data on landbirds (DeSante et al. 1995). The design of the MAPS program was patterned after the very successful British Constant Effort Sites (CES) Scheme that has been operated by the British Trust for Ornithology since 1981 (Peach et al. 1996). The MAPS program was endorsed in 1991 by both the Monitoring Working Group of PIF and the USDI Bird Banding Laboratory, and a four-year pilot project (1992-1995) was approved by the USDI Fish and Wildlife Service and National Biological Service (now the Biological Resources Division [BRD] of the U.S. Geological Survey [USGS]) to evaluate its utility and effectiveness for monitoring demographic parameters of landbirds. A peer review of the program and of the evaluation of the pilot project was completed by a panel assembled by USGS/BRD (Geissler 1996). The review concluded that: (1) MAPS is technically sound and is based on the best available biological and statistical methods; and (2) it complements other landbird monitoring programs such as the BBS by providing useful information on landbird demographics that is not available elsewhere.

Now in its 16th year (13th year of standardized protocol and extensive distribution of stations), the MAPS program has expanded greatly from 178 stations in 1992 to nearly 500 stations in 2003. The substantial growth of the Program since 1992 was caused by its endorsement by PIF and the subsequent involvement of various federal agencies in PIF, including the NPS, USDA Forest Service, US Fish and Wildlife Service, Department of Defense, Department of the Navy, and Texas Army National Guard. Within the past 11 years, for example, IBP has been contracted to operate five MAPS stations in Yosemite National Park, as well as six in Denali, five in Shenandoah, and two in Kings Canyon national parks, and six on Cape Cod National Seashore.

Goals and Objectives of MAPS

MAPS is organized to fulfill three tiers of goals and objectives: monitoring, research, and management.

I. The specific monitoring goals of MAPS are, for over 100 target species, including Neotropical-wintering migrants, temperate-wintering migrants, and permanent residents, to provide:

   (A) annual indices of adult population size and post-fledging productivity from data on the numbers and proportions of young and adult birds captured; and

(B) annual estimates of adult population size, adult survival rates, proportions of residents among newly captured adults, recruitment rates into the adult population, and population growth rates from modified Cormack-Jolly-Seber analyses of mark-recapture data on adult birds.

II. The specific research goals of MAPS are to identify and describe:

(A) temporal and spatial patterns in these demographic indices and estimates at a variety of spatial scales ranging from the local landscape to the entire continent; and

(B) relationships between these patterns and ecological characteristics of the target species, population trends of the target species, station-specific and landscape-level habitat characteristics, and spatially-explicit weather variables.

III. The specific management goals of MAPS are to use these patterns and relationships, at the appropriate spatial scales, to:

(A) identify thresholds and trigger points to notify appropriate agencies and organizations of the need for further research and/or management actions;

(B) determine the proximate demographic cause(s) of population change;

(C) suggest management actions and conservation strategies to reverse population declines and maintain stable or increasing populations; and

(D) evaluate the effectiveness of the management actions and conservation strategies actually implemented through an adaptive management framework.

The overall objectives of MAPS are to achieve the above-outlined goals by means of long-term monitoring at two major spatial scales. The first is a very large scale, effectively the entire North American continent divided into eight geographic regions. It is envisioned that the national parks, along with national forests, military installations, and other publicly owned lands, will provide a major subset of sites for this large-scale objective.

The second, smaller-scale but still long-term objective is to fulfill the above-outlined goals for specific geographic areas (perhaps based on BBS physiographic strata, such as the Sierra Nevada, Cascade Mountains, Central Valley, or California Foothills, or the newly described Bird Conservation Regions) or specific locations (such as individual national parks, national forests, or military installations). The objective for MAPS at these smaller scales is to aid research and management efforts within the areas, parks, forests, or installations to protect and enhance their avifauna and ecological integrity. The sampling strategy utilized at these smaller scales should be hypothesis-driven and should be integrated with other research and monitoring efforts.

Both long-term objectives are in agreement with goals laid out for the NPS's Long-Term Ecological Monitoring Program. Accordingly, the operation of MAPS stations at Yosemite

National Park has been included in the development of a LTEM Program for the Park. It is expected that information from the MAPS program will be capable of aiding research and management efforts within Yosemite National Park to protect and enhance the Park's avifauna and ecological integrity.

Recent Important Results from MAPS

Recent important results from MAPS reported in the peer-reviewed literature include the following. (1) Age ratios obtained during late summer, population-wide mist netting provided a good index to actual productivity in the Kirtland's Warbler (Bart et al. 1999). (2) Measures of productivity and survival derived from MAPS data were consistent with observed population changes at multiple spatial scales (DeSante et al. 1999). (3) Patterns of productivity from MAPS at two large spatial scales (eastern North America and the Sierra Nevada) not only agreed with those found by direct nest monitoring and those predicted from theoretical considerations, but were in general agreement with current life-history theory and were robust with respect to both time and space (DeSante 2000). (4) Modeling spatial variation in MAPS productivity indices and survival-rate estimates as a function of spatial variation in population trends provides a successful means for identifying the proximate demographic cause(s) of population change at multiple spatial scales (DeSante et al. 2001). (5) Productivity of landbirds breeding in Pacific Northwest national forests is affected by global climate cycles including the El Niño Southern Oscillation and the North Atlantic Oscillation in such a manner that productivity of Neotropical migratory species is determined more by late winter and early spring weather conditions on their wintering grounds than by late spring and summer weather conditions on their breeding grounds (Nott et al. 2002). These results indicate that MAPS is capable of achieving, and in some cases is already achieving, its objectives and goals.

The 2003 Report on the Yosemite MAPS Program

In this report we summarize results of the MAPS program at five stations in Yosemite National Park from 1993 (1998 at Gin Flat East Meadow and additionally from 1990 at the Hodgdon Meadow station) through 2003. We present annual changes in the numbers of adult and young birds and in productivity indices between 2002 and 2003, 11-year (6-year at Gin Flat East) mean indices of adult population size and productivity at each individual station and for all stations combined for each species and for all species pooled, and, for selected target species and all species pooled, temporal trends in adult population size at each station and for all stations combined and productivity trends at the park-wide scale. We model annual adult apparent survival rates for most of the target species. Finally, we model productivity and survivorship as a function of body mass, and consider all values, relationships, and trends in these vital rates in order to suggest demographic causes of the population trends observed in Yosemite's birds.

METHODS

Establishment and Operation of Stations

Five MAPS stations were re-established and operated in Yosemite National Park in 2003, at the same locations they were operated in previous years. The five stations, located along an elevation gradient from highest to lowest, were as follows: 1) White Wolf Meadow, set in a wet montane meadow with red fir/lodgepole pine forest at 2402 m elevation; 2) Gin Flat East Meadow, located in a wet montane meadow with mixed red fir and lodgepole pine at 2073 m elevation; 3) Crane Flat Meadow, located in a wet montane meadow with willow/aspen thickets and mixed coniferous forest at 1875 m elevation; 4) Hodgdon Meadow, located in a wet montane meadow with willow/dogwood thickets, mixed coniferous forest, and a patch of California Black Oak woodland at 1408 m elevation; and 5) Big Meadow, located in riparian willows and mixed coniferous forest in an open dry meadow at 1311 m elevation. The Hodgdon Meadow station was established and first operated in 1990, the Gin Flat East Meadow station in 1998, and the other three stations in 1993. See Table 1 for details of habitats and operation of each station in 2003.

Through the efforts of three intensively trained field biologist interns of The Institute for Bird Populations, Christina Rinas, Ramiro Aragon, and Matt Waltner-Toews, trained and supervised by IBP staff field biologist Kerry Wilcox, these five MAPS banding stations were operated during 2003 (and in all preceding years) in accordance with the highly standardized banding protocols developed for the MAPS Program throughout North America (DeSante et al. 2003a).

A total of ten net sites (14 at the Hodgdon Meadow station) were re-established at each of the stations in 2003 at the exact same locations where they were established and operated in each of the preceding years. One 12-m-long, 30-mm-mesh, nylon mist net was erected at each of the ten net sites at four of the stations on each day of operation. At Hodgdon Meadow, seven of the 14 net sites were operated on one day with the remaining seven net sites operated on a second day. Each of the stations was operated for six morning hours per day (beginning at about local sunrise) during one day (two days for Hodgdon Meadow) in each of eight consecutive 10-day periods between May 21 and August 8 or, for the two higher-elevation stations (White Wolf and Gin Flat East), for one day in each of seven consecutive 10-day periods between May 31 and August 8. Because of the heavy snowpack in 2003, the White Wolf station could not be operated until June 12. Otherwise, with very few exceptions, the operation of all stations occurred on schedule in 2003 during each of the ten-day periods. A brief overview of both the field and analytical techniques used in 2003 is presented here.

Data Collection

With few exceptions, all birds captured during the course of the study were identified to species, age, and sex and, if unbanded, were banded with USGS/BRD numbered aluminum bands. Birds were released immediately upon capture and before being banded if situations arose where bird safety would be comprised. Such situations involved exceptionally large numbers of birds being captured at once, or the sudden onset of adverse weather conditions such as high winds or rainfall. The following data were taken on all birds captured, including recaptures, according to MAPS guidelines using standardized codes and forms:

(1) capture code (newly banded, recaptured, band changed, unbanded);
(2) band number;
(3) species;
(4) age and how aged;
(5) sex (if possible) and how sexed (if applicable);
(6) extent of skull pneumaticization;
(7) breeding condition of adults (i.e., presence or absence of a cloacal protuberance or brood patch);
(8) extent of juvenal plumage in young birds;
(9) extent of body and flight-feather molt;
(10) extent of primary-feather wear;
(11) existence of molt limits and plumage characteristics
(12) fat class;
(13) wing chord and weight;
(14) date and time of capture (net-run time); and
(15) station and net site where captured.

Effort data, the number and timing of net-hours on each day of operation, were collected in a standardized manner. In order to allow constant-effort comparisons of data to be made, the times of opening and closing the array of mist nets and of beginning each net check were recorded to the nearest ten minutes. The breeding status (confirmed breeder, likely breeder, non-breeder) of each species seen, heard, or captured at each MAPS station on each day of operation was recorded using techniques similar to those employed for breeding bird atlas projects.

For each of the five stations operated, simple habitat maps were prepared on which up to four major habitat types, as well as the locations of all structures, roads, trails, and streams, were identified and delineated; when suitable maps from previous years were available, these were updated. The pattern and extent of cover of each of four major vertical layers of vegetation (upperstory, midstory, understory, and ground cover), in each major habitat type, were classified into one of twelve pattern types and eleven cover categories according to guidelines spelled out in the MAPS Habitat Structure Assessment Protocol, developed by IBP Landscape Ecologist, Philip Nott (Nott et al. 2003).

Computer Data Entry and Verification

The computer entry of all banding data was completed by John W. Shipman of Zoological Data Processing, Socorro, NM. The critical data for each banding record (capture code, band number, species, age, sex, date, capture time, station, and net number) were proofed by hand against the raw data and any computer-entry errors were corrected. Computer entry of effort and vegetation data was completed by IBP biologists using specially designed data entry programs. All banding data were then run through a series of verification programs as follows:

(1) Clean-up programs to check the validity of all codes entered and the ranges of all numerical data;
(2) Cross-check programs to compare station, date, and net fields from the banding data with those from the summary of mist netting effort data;

(3) Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticization, breeding condition (extent of cloacal protuberance and brood patch), and extent of body and flight-feather molt, primary-feather wear, and juvenal plumage;
(4) Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species; and
(5) Verification programs to screen banding and recapture data from all years of operation for inconsistent species, age, or sex determinations for each band number.

Any discrepancies or suspicious data identified by any of these programs were examined manually and corrected if necessary. Wing chord, weight, station of capture, date, and any pertinent notes were used as supplementary information for the correct determination of species, age, and sex in all of these verification processes.

Data Analysis

To facilitate analyses, we first classified the landbird species captured in mist nets into five groups based upon their breeding or summer residency status. Each species was classified as one of the following: a regular breeder (B) if we had positive or probable evidence of breeding or summer residency within the boundaries of the MAPS station *during all years* that the station was operated; a usual breeder (U) if we had positive or probable evidence of breeding or summer residency within the boundaries of the MAPS station *during more than half but not all of the years* that the station was operated; an occasional breeder (O) if we had positive or probable evidence of breeding or summer residency within the boundaries of the MAPS station *during half or fewer of the years* that the station was operated; a transient (T) if the species was *never* a breeder or summer resident at the station, but the station was within the overall breeding range of the species; an altitudinal disperser (A) if the species breeds only at lower elevation than that of the station but disperses to higher elevations after breeding; and a migrant (M) if the station was not located within the overall breeding range of the species. Data for a given species from a given station were included in productivity analyses if the station was within the breeding range of the species; that is, data were included from stations where the species was a breeder (B, U, or O), transient (T), or altitudinal disperser (A), but not where the species was a migrant (M). Data for a given species from a given station were included in survivorship analyses only if the species was classified as a regular (B) or usual (U) breeder at the station.

A. Population-size and productivity analyses. The proofed, verified, and corrected banding data from 2003 were run through a series of analysis programs that calculated for each species and for all species combined at each station and for all stations pooled:

(1) the numbers of newly banded birds, recaptured birds, and birds released unbanded;
(2) the numbers and capture rates (per 600 net-hours) of first captures (in 2003) of individual adult and young birds; and
(3) the proportion of young in the catch.

Following the procedures pioneered by the British Trust for Ornithology (BTO) in their CES Scheme (Peach et al. 1996), the number of adult birds captured was used as an index of adult population size, and the proportion of young in the catch were used as indices of post-fledging productivity.

For all six stations we calculated changes between 2002 and 2003 in the numbers of adult and young birds captured and in the indices of post-fledging productivity. We determined the statistical significance of any changes that occurred according to methods developed by the BTO in their CES scheme (Peach et al. 1996). These year-to-year comparisons were made in a “constant-effort” manner by means of a specially designed analysis program that used actual net-run (capture) times and net-opening and -closing times on a net-by-net and period-by-period basis. We excluded captures that occurred in a given net in a given period in one year during the time when that net was not operated in that period in the other year. For species captured at several stations in Yosemite National Park, the significance of park-wide annual changes in the numbers of adult and young birds and in the indices post-fledging productivity was inferred statistically using confidence intervals derived from the standard errors of the mean percentage changes. The statistical significance of the overall change at a given station was inferred from a one-sided binomial test on the proportion of species at that station that increased (or decreased). Throughout this report, we use an alpha level of 0.05 for statistical significance and we use the term “near-significant” or “nearly significant” for differences for which $0.05 \leq P < 0.10$.

B. Analyses of trends in adult population size and productivity. We examined multi-year trends (five-year trends at Gin Flat East Meadow, 11-year trends at the other four stations and for all stations combined, and additional 13-year trends at Hodgdon Meadow) in indices of adult population size and 11-year trends in productivity indices for all stations combined for target species for which an average of at least six individual adult birds were captured per year at each station and at all five stations combined. For trends in adult population size, we first calculated adult population indices for each species for each of the 11 years based on an arbitrary starting index of 1.0 in the first year of station operation (1998 at Gin Flat East Meadow, 1993 at the other four stations and for all stations combined and, additionally, 1990 at Hodgdon Meadow). Constant-effort changes (as defined above) were used to calculate these “chain” indices in each subsequent year by multiplying the proportional change (percent change divided by 100) between the two years times the index of the previous year and adding that figure to the index of the previous year, or simply:

$$PSI_{i+1} = PSI_i + PSI_i * (d_i/100),$$

where PSI_i is the population size index for year I and d_i is the percentage change in constant-effort numbers from year I to year i+1. A regression analysis was then run to determine the slope (*PT*) of these indices over the ten or five year periods. Because the indices for adult population size are based on percentage changes, we further calculated the annual percent change (*APC*), defined as the average change per year over the 11-year period, to provide an estimate of the population trend for the species; *APC* was calculated as:

(actual year-one value of *PSI* / predicted year-one value of *PSI* based on the regression) * *PT*.

We present the *APC*, the standard error of the slope (*SE*), the correlation coefficient (*r*), and the significant of the correlation (*P*) to describe each trend. Species for which $r \geq 0.50$ are considered to have a substantially increasing trend, those for which $r \leq -0.5$ are considered to have a substantially decreasing trend, those for which $-0.5 < r > 0.5$ and $SE \leq X$ are considered to have a non-substantial trend, and those for which $-0.5 \leq r \geq 0.5$ and $SE > X$ are considered to have widely fluctuating values but no substantial trend; *X* varies by number of years, being 0.140 for five-year trends, 0.029 for 11-year trends, and 0.018 for 14-year trends.

Trends in Productivity, *PrT*, for all stations combined were calculated in an analogous manner by starting with actual productivity values in 1993 and calculating each successive year's value based on the actual constant-effort changes in productivity between each pair of consecutive years. For trends in productivity, the slope (*PrT*) and its standard error (*SE*) are presented, along with the correlation coefficient (*r*), and the significance of the correlation (*P*). Productivity trends are characterized in a manner analogous to that for population trends, except that 11-year productivity trends are considered to be highly fluctuating if the *SE* of the slope > 0.017.

C. Survivorship analyses – Modified Cormack-Jolly-Seber (CJS) mark-recapture analyses (Pollock et al.1990, Lebreton et al.1992) were conducted on select target species using 11 years (1993-2003) of capture histories of adult birds. Target species were those for which, on average, at least six individual adults per year were recorded from the six stations pooled at which the species was a regular (B) or usual (U) breeder. Using the computer program SURVIV (White 1983), we calculated, for each target species, maximum-likelihood estimates and standard errors (*SE*s) for adult survival probability (ϕ), adult recapture probability (*p*), and the proportion of residents among newly captured adults (τ) using a between- and within-year transient model (Pradel et al. 1997, Nott and DeSante 2002). The use of the transient model ($\phi p \tau$) accounts for the existence of transient adults (dispersing and floater individuals which are only captured once) in the sample of newly captured birds, and provides survival estimates that are unbiased with respect to these transient individuals (Pradel et al. 1997). Recapture probability is defined as the conditional probability of recapturing a bird in a subsequent year that was banded in a previous year, given that it survived and returned to the place it was originally banded.

The 11 years of data, 1993-2003, allowed us to consider all possible combinations of both time-constant and time-dependent models for each of the three parameters estimated from the transient model, for a total of eight models. We limited our consideration to models that produced estimates for both survival and recapture probability that were neither 0 nor 1. The goodness of fit of the models was tested by using a Pearson's goodness-of-fit test. Of those models that fit the data, the one that produced the lowest Akaike Information Criterion, correcting for dispersion of data and for use with smaller sample sizes relative to the number of parameters examined ($QAIC_C$), was chosen as the optimal model (Burnham et al. 1995). Models showing $QAIC_C$'s within 2.0 $QAIC_C$ units of each other were considered effectively equivalent (Anderson and Burnham 1999). The $QAIC_C$ was calculated by multiplying the log-likelihood for the given model by -2, adding two times the number of estimable parameters in the model, and providing corrections for overdispersed data and small sample sizes.

To assess the degree of annual variation in survival for each species, we calculated $\Delta QAIC_C$ as the difference between the completely time-constant model ($\phi p \tau$) and the model with time-dependent survival but time-constant capture probability and proportion of residents ($\phi_t p \tau$); thus, $\Delta QAIC_C$ was calculated as $QAIC_C(\phi_t p \tau)$-$QAIC_C(\phi p \tau)$, with lower (or more negative) $\Delta QAIC_C$ values indicating stronger interannual variation in survival.

D. Analyses of productivity and survival as a function of mean body mass. In birds, both productivity and survival vary with body mass: on average, the larger the bird the lower the annual productivity and the higher the annual survival. Thus, in order to assess whether or not annual productivity or survival in a given species is higher or lower than expected, body mass needs to be accounted for. We regressed both mean productivity indices and time-constant survival-rate estimates against body mass (log transformed to normalize the values) for all target species at the four long-running stations combined, and compared productivity indices and survival-rate estimates for individual species to the regression lines produced by these fits. We used the log of mean body mass values given by Dunning (1993). In this way we attempted to assess whether or not productivity and survival of a given species at Yosemite was as expected, lower than expected, or higher than expected based on its body mass.

RESULTS

A total of 2096.2 net-hours was accumulated at the five MAPS stations operated in Yosemite National Park in 2003 (Table 1). Data from 1895.7 of these net-hours could be compared directly to the previous year's data in a constant-effort manner.

Indices of Adult Population Size and Post-fledging Productivity

A. 2003 values. The 2003 capture summary of the numbers of newly-banded, unbanded, and recaptured birds in Yosemite National Park is presented for each species at each of the five stations individually and for all stations combined in Table 2. A total of 1458 captures of 63 species was recorded during the summer of 2003. Newly banded birds comprised 66.1% of the total captures. The greatest number of total captures (420) was recorded at the Hodgdon Meadow station and the smallest number of total captures (80) was recorded at the White Wolf station. The highest species richness also occurred at Hodgdon Meadow (50 species) and the lowest species richness also occurred at White Wolf (18 species).

The capture rates (per 600 net-hours) of individual adult and young birds and the proportion of young in the catch are presented for each species and for all species pooled at each station and all stations combined in Table 3. We present capture rates (captures per 600 net-hours) of adults and young in this table so that the data can be compared among stations which, because of the vagaries of weather and accidental net damage, can differ from one another in effort expended (see Table 1). These capture indices suggest that the total adult population size in 2003 was greatest at Crane Flat, followed in descending order by Hodgdon Meadow, Gin Flat East Meadow, Big Meadow, and White Wolf (Table 3). The capture rate of young of all species pooled at each station in 2003 was highest at Gin Flat East Meadow, followed by Crane Flat, Hodgdon Meadow, Big Meadow, and White Wolf (Table 3). The index of productivity at the five stations in 2003 (i.e., the proportion of young in the catch) was greatest at Gin Flat East Meadow (0.53), followed by Crane Flat (0.38), Hodgdon and Big meadows (each 0.35), and White Wolf (0.20).

Among individual species in 2003, Dark-eyed Junco was the most frequently captured, followed by Lincoln's Sparrow, MacGillivray's Warbler, Yellow-rumped Warbler, Orange-crowned Warbler, Song Sparrow, Warbling Vireo, Anna's Hummingbird, Golden-crowned Kinglet, Lazuli Bunting, Mountain Chickadee, Black-headed Grosbeak, Dusky Flycatcher, Hermit Warbler, and Brown Creeper (Table 2). Overall, the most abundant species at the five Yosemite National Park MAPS stations in 2003 (as determined by the number of adults captured per 600 net-hours), in decreasing order, were Dark-eyed Junco (22.0), MacGillivray's Warbler (13.7), Yellow-rumped Warbler (12.6), Lincoln's Sparrow (11.2), Warbling Vireo (9.4), Hermit Warbler (7.7), Mountain Chickadee (6.9), Dusky Flycatcher and Lazuli Bunting (6.3), and Song Sparrow (6.0). The following is a list of the common breeding species (captured at a rate of at least 6.0 adults per 600 net-hours), in decreasing order, at each station in 2003 (Table 3):

White Wolf
Dark-eyed Junco
American Robin
Yellow-rumped Warbler
Golden-crowned Kinglet

Hodgdon Meadow
MacGillivray's Warbler
Song Sparrow
Hermit Warbler
Warbling Vireo
Black-headed Grosbeak
Dark-eyed Junco
Lincoln's Sparrow
Purple Finch
Dusky Flycatcher
Orange-crowned Warbler
Western Tanager

Gin Flat East Meadow
Dark-eyed Junco
Yellow-rumped Warbler
Lincoln's Sparrow
Mountain Chickadee
Western Tanager
Red-breasted Sapsucker
American Robin
Pine Siskin
Western Wood-Pewee
Hammond's Flycatcher
MacGillivray's Warbler

Big Meadow
Lazuli Bunting
Spotted Towhee
Lesser Goldfinch
Purple Finch
Black-headed Grosbeak
Black Phoebe
Yellow Warbler

Crane Flat
Dark-eyed Junco
Yellow-rumped Warbler
Dusky Flycatcher
Lincoln's Sparrow
Warbling Vireo
Mountain Chickadee
MacGillivray's Warbler
Hermit Warbler
Chipping Sparrow
Lazuli Bunting
Orange-crowned Warbler

B. Comparisons between 2002 and 2003. Constant-effort comparisons between 2002 and 2003 were undertaken at all five Yosemite National Park MAPS stations for numbers of adult birds captured (adult population size; Table 4), numbers of young birds captured (Table 5), and proportion of young in the catch (productivity; Table 6).

Adult population size for all species pooled for all five stations combined showed a fairly substantial but non-significant decrease between 2002 and 2003, of -11.0% (Table 4). Twenty-four of 59 species showed decreases, a proportion not significantly greater than 0.50. The change in adult population size for all species pooled showed decreases at four of the five stations, by amounts ranging from -2.2% at White Wolf to -20.3% at Crane Flat, but increased at Big Meadow by +26.0%. The proportion of decreasing or increasing species was not significant at any station. Significant or near-significant decreases in the number of adults captured, for all stations combined, were recorded for Orange-crowned Warbler, Yellow-rumped Warbler, Lincoln's Sparrow, and Dark-eyed Junco (four of the most common species at Yosemite) whereas only one species, American Robin, showed such an increase.

The number of young birds captured of all species pooled at all five stations in Yosemite National Park combined showed a highly significant decrease, of -70.0% between 2002 and 2003 (Table 5). Decreases were recorded for 31 of 52 species, a proportion not significantly greater than 0.50. Decreases were recorded at all five stations, by consistent amounts ranging from -56.6% at Big Meadow to -74.3% at Crane Flat. Significant or near-significant proportions of decreasing species were recorded four of the five stations (all but Big Meadow). Ten species (Red-breasted Sapsucker, "Western" Flycatcher, Mountain Chickadee, Red-breasted Nuthatch, Orange-crowned, Nashville, Yellow-rumped, and Hermit warblers, Western Tanager, and Pine Siskin) showed significant decreases in number of young across all stations, whereas no species showed a significant or near-significant increase.

Productivity (the proportion of young in the catch) of all species pooled at all stations combined in 2003 (0.373) decreased from that in 2002 (0.638) by a significant absolute value of -0.266 (Table 6). Thirty-one of 51 species decreased, a proportion not non-significantly greater than 0.50. Productivity decreased at all five stations, ranging from -0.214 at Hodgdon Meadow to -0.276 at Crane Flat. No station showed a significant or near-significant proportion of increasing or decreasing species. Eight species (Red-breasted Sapsucker, Mountain Chickadee, Red-breasted Nuthatch, Hermit Thrush, Orange-crowned Warbler, Nashville Warbler, and Western Tanager) showed significant or near-significant decreases in productivity across stations, whereas only two species (Hammond's Flycatcher and Song Sparrow) showed such increases, and both were only near-significant (Table 6).

Thus, breeding populations decreased as compared with those of 2002 at all stations except Big Meadow, while productivity showed significant, park-wide decreases. These patterns tended to be park-wide for the more common species, although decreases in numbers young captured seemed to be species-wide as well as park-wide. Decrease in both population and productivity were greatest at the mid-elevation Crane Flat station, and became less severe at the lowest and highest-elevation stations. As in past years, we suspect that variations caused by local climate and snowpack, as influenced by station elevation, have been a factor in these results.

Mean Indices of Adult Population Size and Productivity

Table 7 presents mean annual numbers (per 600 net-hours) of individual adult and young birds captured, and proportions of young in the catch during a) the 11-year period (1993- 2003) for the White Wolf, Crane Flat, Hodgdon Meadow, and Big Meadow stations and for all stations combined, b) the six-year period (1998- 2003) for the Gin Flat East Meadow station, and c) the 14-year period (1990- 2003) for Hodgdon Meadow. The all-species-pooled values at the bottom of the table indicate that the highest breeding populations at Yosemite occurred at the mid-elevation Crane Flat Meadow station, followed in descending order by Hodgdon Meadow, Big Meadow, Gin Flat East Meadow, and White Wolf Meadow. The 11-year mean at Hodgdon Meadow was slightly higher than the 14-year mean there, indicating slightly lower-than-average adult population sizes there during 1990-1992. Numbers of young captured followed a different sequence, being highest at Gin Flat East Meadow, followed by Crane Flat, Hodgdon Meadow, Big Meadow, and White Wolf. Productivity was highest at Gin Flat East, followed by Crane Flat, White Wolf, Hodgdon Meadow, and Big Meadow. Productivity at Hodgdon Meadow (0.45) was similar during both the 11-year and the 14-year periods. Species richness of adults followed yet a different sequence, being highest at Big Meadow, the lowest elevation station, followed by Hodgdon Meadow, Gin Flat East Meadow, Crane Flat Meadow, and White Wolf.

Overall, total species richness was 74 species, while the 11-year mean number of adults captured per 600 net-hours was 229.6 and the mean productivity index was 0.48. These are high values when compared to other MAPS stations throughout western North America. The most abundant summer species in Yosemite over the 11 years (as determined by mist netting at meadow edge stations), having overall capture rates greater than 6.0 adults per 600 net-hours, were, in descending order: Dark-eyed Junco, MacGillivray's Warbler, Yellow-rumped Warbler, Lincoln's Sparrow, Warbling Vireo, Orange-crowned Warbler, Lazuli Bunting, Dusky Flycatcher, Hermit Warbler, Song Sparrow, Purple Finch, and Black-headed Grosbeak.

Multi-year Trends in Adult Population Size and Productivity
"Chain" indices of adult population size are presented for target species (those for which an average of at least six adult individuals per year were captured at stations where the species was a breeder or usual breeder) and for all species pooled at each of the five stations individually and for the four long-running stations combined in Figures 1-7. For White Wolf, Crane Flat, Hodgdon Meadow, Big Meadow, and all stations combined we show 11-year trends (1993-2003); for Gin Flat East Meadow we show six-year trends (1998- 2003); and for Hodgdon Meadow we also show 14-year trends (1990- 2003). We used annual percent change (*APC*) for each species as an estimate of the mean annual population trend for that species. These estimates of *APC*, along with the standard error of the slope (in parentheses), the correlation coefficient (r), and the significance of the correlation (P), are included for each target species and for all species pooled on each graph.

Eleven-year (1993- 2003) population trends for 26 target species and all species pooled at the four long-running stations combined (all but Gin Flat East) are shown in Figure 1. Populations of nine species (Western Wood-Pewee, Dusky Flycatcher, Nashville, Yellow, and Hermit warblers, Chipping Sparrow, Dark-eyed Junco, Black-headed Grosbeak, and Lazuli Bunting), as well as all species pooled, showed substantially declining trends ($r \leq -0.5$). The declines for Dusky Flycatcher, Black-headed Grosbeak, Lazuli Bunting, and all species pooled were highly significant; those for Western Wood-Pewee, Chipping Sparrow, and Dark-eyed Junco were significant; and those for Yellow Warbler and Hermit Warbler were nearly significant. Two other species (Red-breasted Sapsucker and Warbling Vireo) showed non-substantial, but probably real, population declines. In contrast, populations of only two species (Mountain Chickadee and Yellow-rumped Warbler) showed substantial increasing trends ($r \geq 0.5$), both of which were significant, while one other species (MacGillivray's Warbler) showed a non-substantial, but probably real, population increase. Altogether, populations of 12 species (Cassin's Vireo, Brown Creeper, Golden-crowned Kinglet, Hermit Thrush, American Robin, Western Tanager, Song Sparrow, Lincoln's Sparrow, Purple Finch, Cassin's Finch, Pine Siskin, and Lesser Goldfinch) showed wide interannual fluctuation (SE of the slope > 0.029) but no substantial linear trend (absolute $r < 0.5$). Overall, 8 of 10 significant or near-significant trends plus that of all species pooled were negative, and 18 of the 26 total species showed negative trends. The 11-year trend for all species pooled represented a highly significant ($P = 0.005$) decrease of -2.7% per year, suggesting that total populations of landbirds in Yosemite have been reduced by 26% over the 11-year period (1993-2003).

Eleven-year (White Wolf, Crane Flat, Hodgdon Meadow, and Big Meadow), six-year (Gin Flat East Meadow), as well as 14-year (Hodgdon Meadow) population trends for target species and all species pooled at each individual station are shown in Figures 2-7. At White Wolf (Fig. 2), the population of Dark-eyed Junco showed a non-substantial decrease over the 11-years, while trends for Yellow-rumped Warbler, Cassin's Finch, and all species pooled showed wide interannual fluctuation but no substantial linear trend. Overall, trends for two of the three target species and that of all species pooled were negative (all species pooled showed a decrease of -1.4% per year).

At Crane Flat (Fig. 3), 11-year population trends for Golden-crowned Kinglet, Hermit Warbler, and Dark-eyed Junco were substantially negative, with those for the kinglet and warbler being significantly negative and that for the junco being near-significantly negative, while populations of Warbling Vireo, MacGillivray's Warbler, and all species pooled showed non-substantial decreases. In contrast the population trend for Yellow-rumped Warbler was significantly positive. Population trends for the remaining two species, Dusky Flycatcher and Lincoln's Sparrow, showed wide interannual fluctuation but no substantial linear trend, although they both were negative. Overall, the trends for seven of the eight target species were negative, while all species pooled showed a decrease of -1.8% per year.

At Hodgdon Meadow (Fig. 4), 11-year population trends for Red-breasted Sapsucker, Dusky Flycatcher, and Lincoln's Sparrow were substantially negative with that for the flycatcher being highly significant, that for the sapsucker being significant, and that for the sparrow being near-significant. In addition, Warbling Vireo, Hermit Warbler, Purple Finch, and all species pooled showed non-substantial population decreases. In contrast, the population trend for Song Sparrow was substantially and significantly positive, while that for MacGillivray's Warbler was non-substantially positive. Populations of two species (Dark-eyed Junco and Black-headed Grosbeak) were highly fluctuating with no linear trend. Overall, trends for seven of the ten target species were negative while the trend for all species pooled indicated a decrease of -1.3% per year. Fourteen-year trends at Hodgdon Meadow (Fig. 5) were more positive (or less negative) than 11-year trends for eight of the ten species and all species pooled. Only Hermit Warbler and Purple Finch had more negative 14-year than 11-year trends. These patterns suggest that population sizes for most species at Hodgdon Meadow in 1990-1992 were lower than what would be expected from the subsequent 11-year trend.

At Big Meadow (Fig. 6), population trends for Chipping Sparrow, Black-headed Grosbeak, Lazuli Bunting, and all species pooled showed substantial and significant negative trends, with those for Black-headed Grosbeak, Lazuli Bunting and all species pooled being highly significant. In contrast, Purple Finch showed a substantial and near-significant positive trend. The remaining two species (Warbling Vireo and Lesser Goldfinch) showed fluctuating populations but no substantial linear trends. Overall, five of the six target species showed negative trends and the trend for all species pooled was a highly significant decrease of -5.9% per year.

In summary, among 27 station-species at the four long-running stations, 11-year population trends were negative for 21, positive for only six, and negative for all-species-pooled for each of the four stations.

Finally, at Gin Flat East Meadow (Fig. 7), trends are only available for the six years, 1998-2003. Here, substantial but non-significant increases were recorded over these six years for Western Tanager, Lincoln's Sparrow, and all species pooled, while a non-substantial increase was recorded for Dark-eyed Junco (*SE* of the slope < 0.97 for a six-year trend). The only negative trend recorded here was a non-substantial decrease for Yellow-rumped Warbler. Overall, trends for three of the four species and all species pooled were positive. Note, however, that these trends cannot be compared directly with the 11-year trends at the other stations.

"Chain" indices of productivity for each of the 11 years (1993- 2003) are shown in Figure 8 for the 26 target species and all species pooled at the four long-running stations combined (all but Gin Flat East). Only one species, Lesser Goldfinch, showed a substantially declining productivity trend ($r \leq -0.50$), which was highly significant. In contrast, six species (Red-breasted Sapsucker, Brown Creeper, American Robin, Yellow Warbler, Black-headed Grosbeak, and Lazuli Bunting) showed substantially increasing productivity trends ($r \geq 0.50$), which were highly significant for Red-breasted Sapsucker and Yellow Warbler, significant for Lazuli Bunting, and nearly significant for Brown Creeper, American Robin, and Black-headed Grosbeak. Six (Mountain Chickadee, Golden-crowned Kinglet, Yellow-rumped, Hermit, and MacGillivray's warblers, and Western Tanager) of the remaining 19 species showed fluctuating (absolute $r < 0.50$ and SE > 0.17) productivity trends with no substantial linear trend. Four species (Warbling Vireo, Nashville Warbler, Lincoln's Sparrow, and Purple Finch) and all species pooled had non-substantial positive productivity trends while nine species (Western Wood-Pewee, Dusky Flycatcher, Cassin's Vireo, Hermit Thrush, Chipping Sparrow, Song Sparrow, Dark-eyed Junco, Cassin's Finch, and Pine Siskin) non-substantial negative productivity trends (absolute $r < 0.50$ and SE $\leq$ 0.17). Overall, 13 of the 26 target species had positive productivity trends and 13 had negative productivity trends. The productivity trend for all species pooled was non-substantially positive ($r = +0.164$) with an average increase of only 0.004 per year.

Thus, in summary, populations of adults of all species pooled at the four long-running stations combined at Yosemite National Park have shown a substantial and highly significant 11-year decline of -2.7% per year (-26% during the 11-year period), whereas productivity of all species pooled has shown only a slight and non-significant 11-year increase of +0.004 per year (+0.045 for the 11-year period). Similarly, adult populations of 18 of 26 target species at the four long-running stations combined (and 21 of 27 target species at individual stations) have shown declining 11-year trends, while productivity trends at the four long-running stations combined showed an equal number (13 species) of increases and decreases.

To investigate the relationships among population trend, productivity, and elevation, we modeled, for all species pooled at each of the four long-running stations: (**A**) the annual percentage change in adult population size (*APC*), (**B**) the direction and strength of the correlation between adult population size and year (r), and (**C**) the mean productivity index as functions of elevation; and (**D**) *APC* and (**E**) r as functions of mean productivity. The five graphs in Figure 9 indicate that population trends for all species pooled (Figs. 9**A** and 9**B**) generally became increasingly negative as elevation decreased, from White Wolf to Big Meadow. Mean productivity generally showed the same relationship (Fig. 9**C**), which in turn resulted in population trends correlating positively with productivity (Figs. 9**D** and 9**E**). Although none of these correlations was significant (undoubtedly because of the small sample size of just four stations), these correlations suggest that the negative population trends at Yosemite, that became more negative at lower elevations, were likely driven by low productivity, which also became lower at lower elevations.

Estimates of Adult Survivorship

Using 11 years of data (1993- 2003), estimates of adult survival and recapture probability were obtained for 19 of the 26 target species breeding in Yosemite National Park (Tables 8-9). The remaining seven species (Cassin's Vireo, Hermit Thrush, Nashville Warbler, Western Tanager, Cassin's Finch, Pine Siskin, and Lesser Goldfinch) had too few between-year recaptures for mark-recapture models to provide estimates of between-year survival.

Because of the existence of floaters, failed breeders, and dispersing adults in bird populations, the transient model, which permits estimation of the proportion of residents in the population and allows survival estimates to be based on the resident population, will always produce less biased survivorship estimates than non-transient models. Thus, we only present results of the transient model. Table 8 indicates that the fully time-constant model ($\phi p \tau$) was selected over all time-dependent models for 16 of the 19 species by having an Akaike Information Criterion ($QAIC_C$) value that was at least 2.0 $QAIC_C$ units lower than that for any other model. For Warbling Vireo, a model detecting time-dependence in proportion of residents was the selected model; for Dark-eyed Junco, models detecting time-dependence in both survival and recapture probability were equivalent to the time-constant model, and for Black-headed Grosbeak the model detecting time-dependence in proportion of residents was equivalent to the time-constant model. The relatively high positive $\Delta QAIC_C$ values for 18 of the 19 species suggest that relatively little interannual variation in survival exists for those species; indeed, the mean $\Delta QAIC_C$ was +10.6. Only for Dark-eyed Junco did the $\Delta QAIC_C$ (-0.8) indicate substantial time-dependence in survival.

In Table 9, we present the maximum-likelihood time-constant estimates of annual adult survival, recapture probability, and proportion of residents, as well as the maximum-likelihood estimates for these parameters from the selected or equivalent time-dependent models identified in Table 8. Estimates of annual adult survival rate for the 19 species, using the time-constant model, ranged from a low of 0.150 for Purple Finch (which suggests a lack of site fidelity in this species, which may be typical of Cardueline finches) to a high of 0.634 for Western Wood-Pewee, with a mean of 0.463. Recapture probability varied from a low of 0.129 for Hermit Warbler (reflecting the inherent difficulty of capturing this species that typically forages above net-level) to a high of 0.652 for MacGillivray's Warbler, with a mean of 0.342. Proportion of residents varied from a low of 0.143 for Golden-crowned Kinglet to a high of 1.000 for Red-breasted Sapsucker, Mountain Chickadee, American Robin, and Chipping Sparrow and averaged 0.576.

For Dark-eyed Junco, survival was relatively high (> 0.6) during the winters of 1995-1996 and 2002-2003, and relatively low (< 0.4) during the winters of 1994-1995, 1997-1998, 1998-1999, and 2000-2001. We suspect that this reflects the weather and food availability along the Pacific slope of California, where this species winters. Recapture probability for Dark-eyed Junco was relatively high (> 0.6) in 1994, 1996, 1997, and 2003 and relatively low (<0.35) in 1995 and 2001. Proportion of residents for Warbling Vireo was relatively high (> 0.7) in 1994 and 1998 and relatively low (< 0.2) in 1996 and 1999-2003; whereas for Black-headed Grosbeak it was relatively high in 1993, 1995, and 1997 and relatively low in 1996 and 199-2003. The low proportion of residents for both species in 1996 and 1999-2003 is of interest. However, we have no explanation for the causes of time dependence in recapture probability or proportion of residents at this time.

Productivity-Population Correlations

To see if productivity in a given year has had a direct effect on breeding population size the following year, we regressed the proportional change in the number of adults between year i+2 and year i+1 on the absolute change in productivity between year i+1 and year i for the 26 species and all species pooled from the four long-running stations in Yosemite National Park over the 11 years 1993- 2003 (Fig. 10). The slopes and r-values in Figure 10, hereafter termed "productivity-population correlations", are used as indicators of the strength of this relationship. Although the productivity-population correlation was positive for 14 of 26 species and all species pooled, there were only three significant or near-significant correlations (Golden-crowned Kinglet, $r = 0.675$, $P < 0.046$; Nashville Warbler, $r = -0.620$, $P = 0.075$, and Hermit Warbler, $r = -0.594$, $P = 0.092$), of which two were positive and one was negative. These results weakly support the concept that changes in productivity one year tend to correspond to changes in population size the next year, at least for some species, but suggest that other factors besides productivity must be involved to bring about the observed annual changes in population size.

Productivity and Survival as a Function of Body Mass

It has previously been shown that both productivity and survival in birds vary with body mass: on average, the larger the bird the lower the productivity and the higher the survival. Thus, in order to assess whether or not productivity or survival in a given species is higher or lower than expected, body mass needs to be accounted for. Figure 11 shows mean productivity indices and time-constant annual adult survival rate estimates recorded at Yosemite National Park as a function of mean body mass (log transformed) for 18 target species for which survival could be estimated using data from all five stations combined (Purple Finch was not included as its very low survival estimate likely reflects the typically low site-fidelity that is characteristic of Cardueline finches). The purpose of this analysis was to determine which species at Yosemite showed higher or lower productivity or survival than might be expected given their body mass. Two regression lines are presented on each graph, one (solid) for the 18 target species using data from Yosemite National Park, and one (dashed) using data from 210 (productivity) and 89 (survival) species for which these parameters could be estimated from MAPS data collected from stations distributed across the entire North American continent. For both productivity and survival, the regression lines based on data from the 18 species at Yosemite were similar to those based on data from North America as a whole, although productivity of smaller species and, perhaps, survival of larger species each tended to be higher at Yosemite than in North America as a whole over this period.

Ten of the 18 species shown in Figure 11 (species alpha codes in bold uppercase letters) showed population declines, of which the declines for eight species were substantial (r of the population trend ≤ -0.50; Figure 1). Five of these ten species, Western Wood-Pewee (WEWP), Dusky Flycatcher (DUFL), Warbling Vireo (WAVI), Chipping Sparrow (CHSP), and Lazuli Bunting (LAZB), each showed lower-than-expected productivity, at least as compared to the relationship between productivity and body mass at Yosemite. Warbling Vireo and, perhaps, Dusky Flycatcher also showed lower-than-expected adult survival, while adult survival for Chipping Sparrow was as expected and that for Western Wood-Pewee and Lazuli Bunting was higher than expected. In contrast, Red-breasted Sapsucker (RBSA) had slightly lower than expected adult survival and as-expected (or slightly higher-than-expected) productivity. No deficient vital rate could be detected for the remaining four species. Two of them, Hermit Warbler (HEWA) and Dark-eyed Junco (DEJU), had higher-than-expected productivity; the warbler also had higher-than-expected survival whereas the junco had as-expected survival. Yellow Warbler (YWAR) had as-expected productivity and higher-than-expected survival, and for the remaining species, Black-headed Grosbeak (BHGR), both productivity and survival were as-expected.

Three of the 18 species (shown in Figure 11 in regular uppercase letters) showed population increases, of which the increases for two species were substantial (*r* of the population trend $\geq$ 0.50; Figure 1). All three of these species, Mountain Chickadee (MOCH), Yellow-rumped Warbler (YRWA), and MacGillivray's Warbler (MGWA), showed relatively high productivity (at least compared to North America as a whole). MacGillivray's Warbler also showed higher-than-expected adult survival, while the Yellow-rumped Warbler showed close-to-expected survival and the chickadee showed lower-than-expected survival. Thus, it appears that productivity, more often than survival, accounts for the population decreases and increases in Yosemite birds.

The remaining five species (shown in Figure 11 in regular lowercase letters) had widely fluctuating population trends over the 11 years at Yosemite (see Fig. 1). Several of these species showed as-expected or counterbalanced productivity indices and survival estimates (e.g., Golden-crowned Kinglet [gcki] and American Robin [amro]), although productivity of Brown Creeper (brcr), Song Sparrow (sosp), and Lincoln's Sparrow (lisp) were higher than expected without correspondingly low survival. Interestingly, populations of Brown Creeper and Song Sparrow both tended to increase, which is consistent with what would be expected from their vital rates, although the population of Lincoln's Sparrow tended to decrease.

Causes of Population Declines and Increases Based on Demographic Data

Based on all of the above demographic data, we made assessments as to whether Yosemite population declines or increases were driven by productivity on the breeding grounds, survival presumably during migration and/or on the winter grounds, both, or neither (Table 10). Assessments for each species were based on a synthesis of productivity indices, productivity trends, survival estimates, $\Delta QAIC_C$ values, and productivity and survival values relative to Yosemite-wide and continent-wide relationships for productivity and survivorship as a function of body mass. As an example, for Dusky Flycatcher, a highly significantly decreasing species (Fig. 1) that also decreased at both stations at which it was a target species, Crane Flat (Fig. 3) and Hodgdon Meadow (Figs. 4 and 5), productivity was low (0.13; based on the 11-year mean for all stations pooled from Table 7), the productivity trend was slightly negative (-0.003; Fig. 8), the productivity-population correlation was positive (Fig. 10), survival was slightly low (0.409, Table 9), $\Delta QAIC_C$ was high (+10.0; Table 8), and productivity was much lower than expected while survival was about as-expected or perhaps slightly low relative to body mass (Fig. 11). In this case, most or all evidence suggests that dramatically low productivity has been driving the significant population decrease for Dusky Flycatcher, although possibly low adult survival may also have contributed to the decline. As another example, consider Yellow-rumped Warbler, a significantly increasing species at Yosemite (Fig. 1) that increased at both of the stations at which it was a target species, White Wolf and Crane Flat). Productivity for Yellow-rumped Warbler was high (0.46; based on the 11-year mean for all stations pooled from Table 7), the productivity trend was slightly negative (-0.010; Fig. 8) but fluctuating, the productivity-population correlation was positive (Fig. 10), survival was slightly low (0.405; Table 9), $\Delta QAIC_C$ was high (+8.3; Table 8), and productivity was higher than expected while survival was about as expected or slightly low relative to body mass (Fig. 11). Here, most or all evidence suggests that high productivity rather than high survival has been driving the population increase for Yellow-rumped Warbler at Yosemite.

Using this approach, we suggest that lower-than-expected productivity may be driving the population declines of five of the ten declining species, Western Wood-Pewee, Dusky Flycatcher, Warbling Vireo, Chipping Sparrow, and Lazuli Bunting. Productivity for the last species, Lazuli Bunting, is increasing so we might expect to see populations for this species rebounding in the future. For both Warbling Vireo and Dusky Flycatcher, low survivorship may also be contributing to the declines of these species. Low adult survival also appears to be contributing to the decline of a sixth species, Red-breasted Sapsucker. For the remaining four declining species both productivity and survivorship were as expected or higher than expected. We can only surmise that other factors not currently measured by MAPS (e.g., low intrinsic recruitment due to habitat degradation outside the Park or low first year survival rates) are causing the population declines.

It also appears that higher than expected productivity may be driving the population increases for Mountain Chickadee, Yellow-rumped Warbler, and MacGillivray's Warbler, although higher-than-expected adult survival may also be contributing to the increase for MacGillivray's Warbler. Thus, overall, it appears that productivity at Yosemite is driving the population dynamics of five of the ten declining species and two of the three increasing species, whereas survival away from Yosemite appears only to be driving three of the declining species and one of the increasing species.

DISCUSSION AND CONCLUSIONS

Annual Changes in Adult Population Size and Productivity

Previous reports and Fig. 1 of this report have documented that populations of adult birds in Yosemite National Park, for all species pooled, generally increased in even-numbered years (such as 2000 and 2002) and decreased in odd-numbered years (such as 1999 and 2001), although some of the changes were quite small (such as the 2.9% increase in 2002). Previous reports and Fig. 8 of this report have documented that for some of this time period, such as between 1996 and 2001, productivity for all species pooled showed the opposite pattern, increasing in odd-numbered years (such as 1999 and 2001) and decreasing in even-numbered years (such as 1998 and 2000). This alternating cycle of population increases and decreases, with out-of-phase increases and decreases in productivity, has frequently been seen at many MAPS locations across the continent, including Yosemite between 1996 and 2001, but not during 1993-1996. This alternating cycle appears to have broken down again in 2002-2003, with productivity rising dramatically between 2001 and 2002 (for the second year in a row) and dropping dramatically between 2002-2003, despite a concurrent drop in population size.

We believe that the alternating out-of-phase pattern between increases and decreases in productivity and population size relates to density-dependent effects on productivity and recruitment along with lower productivity of first-time breeders. This model suggests that populations that have shown an increase in a given year, typically show reduced productivity that year, apparently due to stronger intra- and, possibly, inter-specific competition and a greater proportion of inexperienced first-time breeders. This poor productivity then results in decreased recruitment and fewer breeding birds the following year, which in turn have higher productivity due to weaker competition and a higher proportion of experienced (two-year-old or older) breeders. Populations that show this alternating two-year dynamic often also show a strong "productivity-population correlation," whereby changes in productivity in a given year are followed by corresponding changes in adult population size the following year.

The productivity-population correlation was positive at Yosemite for 14 of 26 species and for all species pooled, and two of the three significant or near-significant correlations were positive, thus generally supporting the idea that changes in productivity one year bring do about corresponding changes in population size the next year, at least for certain species. However, the productivity-population correlations at Yosemite were weaker than those at other national parks, including both Denali and Shenandoah. Indeed, this dynamic appears to be less strongly manifest in regions, such as Yosemite, that are characterized by high annual variation in weather and snowpack, than in regions where weather is more predictable year-round. It is possible that the relatively unstable (El Niño dominated) weather in Yosemite in the early to mid 1990's gave way to more consistent (La Niña dominated) weather late in the 1990's through 2001, but returned to El Niño dominated weather in 2002 which, for reasons we do not yet understand, was associated with excellent productivity. Perhaps the brief El Niño and associated good productivity of 2002 at Yosemite simply caused a shift in the alternating pattern. La Niña conditions are now predicted again for the next few years so we might expect to see the alternating pattern return again (but be out of phase with that of 1996-2001), in which case populations should be low and productivity high in 2004.

Population and Productivity Trends of Yosemite's Birds
Based on data from the four long-running stations presented in this report, populations of adult birds of all species pooled in Yosemite National Park have shown a substantial and highly significant decrease of -2.7% per year over the 11 years 1993- 2003. While this may not seem to be large annual declines, it suggests that Yosemite's landbird populations have declined by 26% during the past 11 years, a truly substantial decrease. Overall, 18 of 26 target species showed negative population trends during this 11-year period. Moreover, significant or near-significant 11-year declines were observed for eight species, whereas significant 11-year increases were observed in only two species.

The 11-year (1993-2003) trend in adult population size for all species pooled at Hodgdon Meadow (-1.3% per year, $r = -0.437$) contrasted with the 14-year trend there (+0.4% per year, $r = +0.137$). The difference was that populations during the three years, 1990-1992, tended to be lower than expected based on the subsequent 11-year mean. This suggests that populations in Yosemite National Park may be undergoing small and perhaps cyclical increases and decreases over decade-long periods and, in the long run, be relatively stable. However, four species that showed pronounced 11-year decreases at Hodgdon Meadow and over all four long-running Yosemite stations combined (Red-breasted Sapsucker, Dusky Flycatcher, Hermit Warbler, and Purple Finch), also showed pronounced 14-year decreases at Hodgdon Meadow. Indeed, the 14-year decreases at Hodgdon Meadow were highly significant for two of these species (Red-breasted Sapsucker and Dusky Flycatcher). These decreases, thus, do not appear to be part of a short-term cycle and are cause both for concern and for management action. The same may be true for Western Wood-Pewee, Chipping Sparrow, Dark-eyed Junco, Black-headed Grosbeak, and Lazuli Bunting, all of which showed significant declines in Yosemite, although the junco and the grosbeak showed 14-year increases at Hodgdon Meadow, suggesting that these populations may indeed be cyclical.

Comparison of 11-year (1993-2003) population trends from the four long-running Yosemite MAPS stations with long-term (1980-2002; 2003 data are not yet available) BBS trends from the Sierra Nevada physiographic strata (see http://www.mbr-pwrc.usgs.gov/bbs/trend/tf02.html) provides some interesting results. First, 13 of 18 target species having declining trends in Yosemite, and 7 of the 8 target species with significant or near-significant declining trends in Yosemite, also have declining trends overall in the Sierra ($P = 0.48$ and $P = 0.35$, respectively; one-sided binomial tests). This suggests that the declines for most of these species in Yosemite are part of a Sierra-wide decline and that conditions in Yosemite National Park are not necessarily better for them than elsewhere in the Sierra. Populations of all of these 13 species (Western Wood-Pewee, Dusky Flycatcher, Warbling Vireo, Golden-crowned Kinglet, Nashville, Yellow, and Hermit warblers, Chipping and Lincoln's sparrows, Dark-eyed Junco, Black-headed Grosbeak, Purple Finch, and Pine Siskin) are in need of management action both in Yosemite and in the Sierra as a whole, and should be closely monitored in Yosemite as well as in the Sierra as a whole.

The one species with a significant decline in Yosemite that appears to be increasing elsewhere in the Sierra is Lazuli Bunting. Lesser Goldfinch is another species with a negative population trend in Yosemite (which, however, is highly fluctuating) that also appears to be increasing overall in the Sierra. Interestingly, most Lazuli Buntings and Lesser Goldfinches are captured at the Big Meadow station which is surrounded by habitat that is recovering from the devastating Arch Rock fire that occurred in the late summer of 1990. Both of these species are known to colonize recently burned areas. It is likely, therefore, that populations of both of these species were very high when the Big Meadow station was first established in 1993, are subsequently have been returning to more normal levels. Two other species with negative, but highly fluctuating, population trends in Yosemite and positive long-term trends elsewhere in the Sierra are Cassin's Vireo and Hermit Thrush. The overall Sierra trend for Cassin's Vireo has been becoming less positive in more recent years, while the Sierra trend for Hermit Thrush has actually become substantially negative in recent years. Both of these species need to be closely monitored as well. The final species with a negative Yosemite trend and a positive long-term BBS trend is Red-breasted Sapsucker for which the sierra trend has been becoming more positive in recent years just as the Yosemite trend has become less negative in recent years. This species thus seems to be beginning to recover from earlier lower population levels and should continue to be monitored.

In sharp contrast, however, only two (Yellow-rumped Warbler and Song Sparrow) of the eight target species that are increasing at Yosemite MAPS stations are also increasing in the Sierra as a whole ($P = 0.48$; one-sided binomial tests). This suggests that conditions for the other six species (Mountain Chickadee, Brown Creeper, American Robin, MacGillivray's Warbler, Western Tanager, and Cassin's Finch) are better in Yosemite National Park than elsewhere in the Sierra. These species should also continue to be monitored in both Yosemite and the Sierra.

In contrast to the many species with significant or near-significant negative population trends as demonstrated by MAPS data, only one species, Lesser Goldfinch, showed a significant 11-year (1993- 2003) negative productivity trend, which was, however, highly significant. Six species, however, Red-breasted Sapsucker, Brown Creeper, American Robin, Yellow Warbler, Black-headed Grosbeak, and Lazuli Bunting, showed significant or nearly increasing productivity trends. The productivity trend for all species pooled was slightly positive, with an average absolute increase of +0.004 per year. Despite the preponderance of significant positive over significant negative trends, a total of only 13 of the 26 target species had positive productivity trends. A total of 13 of the 26 species had population and productivity trends in the same direction whereas 13 had them in opposite directions. Species that showed declines in both population and productivity trends included Western Wood-Pewee, Dusky Flycatcher, Cassin's Vireo, Golden-crowned Kinglet, Hermit Thrush, Chipping Sparrow, Dark-eyed Junco, Pine Siskin, and Lesser Goldfinch. Declines in these species might be expected to continue or even accelerate. On the other hand, increasing productivity for Red-breasted Sapsucker, Warbling Vireo, Nashville, Yellow, and Hermit warblers, Black-headed Grosbeak, Lazuli Bunting, and Purple Finch might help to reverse the population declines of these species.

Demographics of Yosemite's Birds Along an Elevation Gradient

Eleven years (1993- 2003) of data from four MAPS stations (and six years from a fifth) along an elevation gradient on the west slope of the Sierra Nevada in Yosemite National Park have shown that species richness (number of species), total adult population size, productivity, and adult population trend each varied with elevation in a unique way. Total species richness of breeding species was highest at the lowest elevation (Big Meadow – 60 species), lowest at the highest elevation (White Wolf Meadow – 34 species), and clearly decreased with increasing elevation. In marked contrast to total species richness, mean annual number of adults of all species pooled (essentially an index of total bird density) was highest at intermediate elevations (Crane Flat) and decreased progressively both at lower (Hodgdon and Big Meadows) and higher (Gin Flat East and White Wolf) elevations.

In further contrast, mean annual productivity for all species pooled was highest at still higher elevations (Gin Flat East) and, again, decreased progressively both at lower (Crane Flat, Hodgdon Meadow, and Big Meadow) and higher (White Wolf) elevations. Excluding Gin Flat East, which has only been operated for five years, productivity showed a positive correlation with elevation. Station-specific 11-year population trends for all species pooled also correlated positively with elevation; e.g., the trend was slightly and non-significantly negative at White Wolf but highly significantly negative at Big Meadow. Although none of these correlations were significant (due to the small number of stations), they suggest that the increasingly negative population trends at lower elevation stations may have been driven by the increasingly lower productivity at those same stations, especially in drought years with meager snowpacks. Predictions from global climate models and recent weather data suggest that the Sierra is becoming increasingly arid and that this drying tendency may be accelerating. Data from MAPS suggest that, in general, avian populations in the Sierra will be adversely affected by such climate change. This hypothesis underscores the importance of long-term avian demographic monitoring data in Yosemite National Park, where avian population and demographic changes are affected heavily by concurrent land-use changes.

Survival Rates of Yosemite's Birds

It is important to note that productivity alone is not necessarily the driving force for long-term population trends, even when annual changes in productivity can be shown to drive annual changes in population size. Rather, it is the overall relation between average productivity and average mortality that determines overall population trends. Indeed, an alternating cycle of out-of-phase changes in productivity and population size, such as that described earlier, could occur in species variously showing increasing, stable, or decreasing population trends. In order to fully investigate the effects of productivity on long-term population trends and determine the causes of population change, we must also consider annual adult survival rates.

We were able to obtain estimates of annual adult survival for 19 target species at Yosemite using 11 years of data from all five stations combined. As mentioned in previous reports, increased years of data have resulted in increased numbers of species for which survival estimates could be obtained. In addition, the mean precision of these survival rate estimates has increased substantially with each additional year of data. For example, the mean CV(ϕ) for 16 species whose adult survival rates could be estimated from seven (1993-1999), nine (1993-2001), and ten (1993- 2002) years of data decreased from 23.9% for seven years of data, to 16.7% for nine years of data, and to 15.4% for 11 (1993-2003) years of data. Similarly, the mean CV(ϕ) for the 19 species using 1993-2003 data (21.2%) continues to show improvement over the mean CV for the same 19 species using 1993-2002 data (21.6%). These results continue to suggest that maximum precision may not be obtained until 12 or more years of data are available, a result in agreement with predictions by Rosenberg (1996) and Rosenberg et al. (1999). $\Delta QAIC_C$ values were relatively high (> 6.0) in all but one (Dark-eyed Junco) of these 19 species, suggesting that there is relatively little interannual variation in survival for most Yosemite species.

Causes of Population Changes in Yosemite's Birds

Based on all demographic data, we made assessments as to whether population declines or increases in Yosemite were driven by productivity on the breeding grounds, survival presumably during migration and/or on the winter grounds, both, or neither. Lower-than-expected productivity appears to be driving the population declines of five of the ten declining species, Western Wood-Pewee, Dusky Flycatcher, Warbling Vireo, Chipping Sparrow, and Lazuli Bunting, while low survivorship may also be driving or contributing to the declines of Red-breasted Sapsucker, Dusky Flycatcher, and Warbling Vireo. Similarly, it appears that higher than expected or increasing productivity may be driving the population changes of all three increasing species, Mountain Chickadee, Yellow-rumped Warbler, and MacGillivray's Warbler, with higher survival also contributing to the increase in MacGillivray's Warbler. Thus, overall, it appears that productivity at Yosemite is driving or influencing the population dynamics of seven of the 13 species showing substantial trends, whereas survival away from Yosemite is only driving or influencing trends in four species. This indicates that the population dynamics of most of Yosemite's breeding species are being affected by events in Yosemite National Park, and could be within the Park's ability to influence through management action.

Future Analyses

We cannot estimate first year survival with current MAPS analyses. This is because young birds typically disperse substantial distances from their natal site to their site of first breeding, resulting in very few or no recaptures of birds banded as juveniles. In future analyses we hope to be able to index first year survival by using data on species for which we can identify both one-year-old (second-year; SY) and older (after-second-year; ASY) birds in spring, by using CJS mark-recapture models to estimate annual recruitment of both SY and ASY birds. Then, by comparing spatial and temporal patterns of productivity and recruitment of SY and ASY birds, we will be able to make inferences regarding first year survival rates as well as amounts of immigration and emigration in the populations. Once these analyses have been performed, we will be able to examine patterns in adult and first year survival rates according to geographic location, climate, and habitat considerations, and to identify species (e.g., declining species at Yosemite that do not show deficient productivity or adult survival: Yellow Warbler, Hermit Warbler, Dark-eyed Junco, and Black-headed Grosbeak) for which declines may be driven by low first year survival.

In three or four more years, when we will have 14-15 consecutive years of data from each of the four long-running stations, we hope to perform many of these park-wide analyses at the spatial scale of the four individual stations. This may yield especially important results at Yosemite, where the stations span such a significant elevation range and the population dynamics appear to be influenced by elevation. Once these analyses have been completed we will be able not only to identify the effects of elevation on various demographic processes, but also identify species that are declining based on poor productivity at each station (or within each of the parks elevation regimes), and make recommendations for management of these species accordingly.

We have recently initiated two additional broad-scale analyses to help us further understand the population dynamics of landbirds and potential management actions to assist bird populations. First, by modeling spatial variation in vital rates as a function of spatial variation in population trends we are beginning to determine the proximate demographic causes of population trends within a species on multiple spatial scales (DeSante et al. 2001). Among Gray Catbird populations on a continental scale, for example, we found that adult survival-rate estimates varied appropriately between areas of increasing vs. decreasing population trends while productivity indices were independent of area, suggesting that low survivorship was driving population trends in this species at that scale. At a smaller spatial scale, we modeled productivity indices and time-constant annual adult survival-rate estimates with MAPS data from DoD installations for target species for which trends in adult captures were substantially negative on installations in one subregion and positive on installations in another subregion. We found that differences in productivity were evident in and correctly predicted differences in population trends for all five target species, while difference in survival were evident in only two species but also correctly predicted population trends for both (DeSante et al. 2001). Analyses of spatial variation in productivity and survival as a function of spatial variation in population trends, therefore, appear to be very effective in understanding causes of population declines. We hope to undertake such analyses (e.g., between Sierra stations within and outside of Yosemite) sometime in the future, when we will have accumulated 14 or 15 years of data.

Second, we have found that patterns of landscape structure detected within a two- to four-kilometer radius area of each station are good predictors not only of the numbers of birds of each species captured but, more importantly, of their productivity levels as well (Nott 2000). For four forest interior species in the eastern U.S., for example, this study revealed the existence of threshold values of woodland/forest patch size above which productivity levels were high and below which productivity dropped off rapidly. As another example, for Wilson's Warblers in Pacific Northwest national forests, we found that the amount of deciduous forest cover in otherwise coniferous forest matrices within two km of the stations correlated positively and highly significantly with breeding population size, but non-significantly with productivity, indicating that increasing the deciduous component of these forests can increase adult population size without compromising productivity. These types of analyses provide extremely powerful tools to identify and formulate management actions aimed at reversing declining populations and maintaining stable or increasing populations of landbirds, because they can address the particular vital rate responsible for the decline. We plan to conduct similar analyses for the target species in the Sierra, by modeling productivity as a function of various landscape characteristics that vary along a gradient from the pristine landscapes found in Yosemite National Park to the much more heavily managed landscapes on Sierran national forests where we also have MAPS stations. We plan to conduct such analyses after we have accumulated 14 or 15 years of data.

Because of the pronounced elevation factor at Yosemite, and the complex effects of weather on population size and productivity, we will need to incorporate elevation-specific habitat analyses and account for weather on an annual basis. For example, as discussed in last year's report (DeSante et al. 2003b), elevation effects on adult population size also reflect the effects of dry years (greater population sizes at higher elevations due to lack of snow pack and warmer temperatures) vs. wet years (greater population sizes at lower elevations due to higher food productivity and cooler temperatures). Thus, landscape-level analyses at Yosemite will necessarily involve interactions between elevation and weather as well as habitat characteristics. It is the complexity of these interactions that create the need for long-term (14-15 years) data.

Conclusions

Analyses of 11 years of MAPS data from four stations along an elevation gradient in Yosemite National Park, plus six years of data from a fifth station, have shown that bird populations in Yosemite have decreased over the 11 years with substantially more species decreasing than increasing. These data have also shown that species richness, total bird density, productivity, and population trends all vary with elevation in generally different ways. We have also demonstrated how MAPS data can be used to measure and assess the effects of productivity and survivorship as driving forces for the varying avian population trends documented in Yosemite National Park, both overall and at the individual species level. In future analyses, we hope to include estimates of first-year recruitment and indices of first-year survival in order to more fully understand what parameters are most affecting population changes in each target species.

This report demonstrates that the indices and estimates of primary demographic parameters provided by the Yosemite MAPS Program are providing critical information that will be extremely useful for the management and conservation of landbirds in Yosemite and, in combination with similar data from other areas, throughout the Sierra Nevada and across the whole of North America. The results highlighted above have also revealed that the population dynamics of the breeding birds of Yosemite National Park are complex, as are the likely causes of the dynamics and, for those trends deemed problematic, their solutions. This complexity, in turn, underscores the importance of standardized, long-term data. Once about 14 or 15 years of data have accumulated and the precision of our estimates improves further, time-dependence in estimates is more readily apparent, and long-term trends are more clearly established, we will be able to incorporate weather and climate data as well as landscape-level habitat data as additional co-variates in logistic regression analyses of productivity and in survivorship models. We are confident that, with these additional years of data, we will be able to further our understanding of the population dynamics of Yosemite's birds and shed more light on the complex paths leading from stressors to population responses.

Results from the first 11 years of the MAPS Program in Yosemite National Park (14 years at the Hodgdon Meadow station), as documented in this report, indicate that meaningful station-specific indices of adult population size and post-fledging productivity, reasonably precise park-wide estimates of annual survival rates of adults, and important information on annual changes, longer-term trends, and elevation differences in these indices and estimates are being obtained for at least 26 target species. We conclude that the MAPS protocol is very well-suited to provide a critical component of the Park Service's Long-Term Ecological Monitoring program in Yosemite National Park. Based on the above information, we recommended that the operation of the five MAPS stations currently active in Yosemite National Park be sustained indefinitely into the future, and a comprehensive analysis of all Sierran MAPS data (including Yosemite's) be conducted after about 14 or 15 years of data have been accumulated, that is, depending on the availability of additional funding for these analyses, after the 2006 or 2007 field season.

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Table 1. Summary of the 2003 MAPS program in Yosemite National Park.

Station						2003 operation		
Name	Code	No.	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	Total number of net-hours[1]	No. of periods	Inclusive dates
White Wolf	WHWO	11904	Wet montane meadow, red fir/ lodgepole pine forest	37˚52'10"N,-119˚39'10"W	2402	305.7 (249.0)	7	6/12 - 8/06
Gin Flat East Meadow	GFEM	11980	Wet montane meadow, mixed fir forest	37˚46'00"N,-119˚45'30"W	2073	370.5 (333.8)	7	6/08 - 8/05
Crane Flat	CRFL	11907	Wet montane meadow, willow/ aspen thickets, mixed coniferous forest	37˚45'20"N,-119˚48'10"W	1875	454.5 (436.5)	8	5/26 - 8/04
Hodgdon Meadow	HODG	11107	Wet montane meadow, willow/ dogwood thickets, mixed oak and coniferous forest	37˚47'50"N,-119˚52'00"W	1408	560.3 (523.7)	8	5/27 - 8/01
Big Meadow	BIME	11905	Riparian willows, mixed coniferous forest, open dry meadow	37˚42'20"N,-119˚45'10"W	1311	405.2 (353.2)	8	5/25 - 7/30
ALL STATIONS COMBINED						2096.2 (1895.7)	8	5/25 - 8/06

[1] Total net-hours in 2003. Net-hours in 2003 that could be compared in a constant-effort manner to 2002 are shown in parentheses.

Table 2. Capture summary for the five individual MAPS stations operated in Yosemite National Park and all five stations combined in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Anna's Hummingbird					5			3			22			21			51	
Calliope Hummingbird		1						1			2						4	
Rufous Hummingbird					1			2			1						4	
Allen's Hummingbird					5			2			2			1			10	
Unidentified Selasphorus					8			2			2			1			13	
Acorn Woodpecker													1			1		
Williamson's Sapsucker	2															2		
Red-breasted Sapsucker	1			6		1	1		3	3		4	2	1		13	1	8
Downy Woodpecker										1			4		1	5		1
Hairy Woodpecker				1			1		2	1			2		1	5		3
White-headed Woodpecker				2			1			2			3			8		
Northern Flicker				1						1			3		1	5		1
Olive-sided Flycatcher										2						2		
Western Wood-Pewee	1		1	4						2			2		2	9		3
"Traill's" Flycatcher													1			1		
Hammond's Flycatcher				16			4		1	1						21		1
Gray Flycatcher											1						1	
Dusky Flycatcher				1			10		8	8		4				19		12
"Western" Flycatcher				1			2			5		1				8		1
Unidentified Empidonax Flycatcher					5						1						6	
Black Phoebe										1			9			10		
Cassin's Vireo				1			1			7						9		
Warbling Vireo	2		1	1			12		13	21		9	3		1	39		24
Steller's Jay								1		1		1	1			2	1	1
Mountain Chickadee	1		1	13		3	12	1	2	1						27	1	6
Chestnut-backed Chickadee										2						2		
Bushtit										1			4			5		
Red-breasted Nuthatch				7			3			1						11		
White-breasted Nuthatch				1									4			5		

Table 2. (cont.) Capture summary for the five individual MAPS stations operated in Yosemite National Park and all five stations combined in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Brown Creeper	2			7		2	11			5		1	2			27		3
House Wren				4			7		2	2		1	2			15		3
Golden-crowned Kinglet	4			38			5	1	2	1						48	1	2
Western Bluebird													1			1		
Townsend's Solitaire				1												1		
Hermit Thrush	2			1			3			3						9		
American Robin	6		4	6			4	1		3	1				1	19	2	5
Wrentit													4		1	4		1
Orange-crowned Warbler	3			5			17	1	2	20		4	17	4		62	5	6
Nashville Warbler				3			9	1	1	4		1	5			21	1	2
Yellow Warbler							1			3		4	7		5	11		9
Yellow-rumped Warbler	5		3	38		1	25		5	7			3			78		9
Townsend's Warbler				13	1		2			1						16	1	
Hermit Warbler	1			1			8		2	17	1	1				27	1	3
MacGillivray's Warbler				6			19		14	33	4	36	4		2	62	4	52
Wilson's Warbler										1			1			2		
Unidentified Warbler											1						1	
Western Tanager				10		1	2			7			2			21		1
Green-tailed Towhee				1				1					1			2	1	
Spotted Towhee										5	1	1	10		3	15	1	4
Chipping Sparrow	3						7		5	2						12		5
Fox Sparrow							2									2		
Song Sparrow				1			5			30	2	24		1	2	36	3	26
Lincoln's Sparrow	2			25	3	24	25	2	36	9	1	7				61	6	67
Dark-eyed Junco	14	1	14	25	1	11	38	4	40	12	5	13				89	11	78
Unidentified Sparrow					4			2									6	
Black-headed Grosbeak							1			10	1	3	15	1	1	26	2	4
Lazuli Bunting				1			7		1				26		2	34		3
Red-winged Blackbird										1	1					1	1	

Table 2. (cont.) Capture summary for the five individual MAPS stations operated in Yosemite National Park and all five stations combined in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Brewer's Blackbird										2	1		3			5	1	
Brown-headed Cowbird												1						1
Pine Grosbeak	1															1		
Purple Finch										8	2		9			17	2	
Cassin's Finch	2		2	2			1					1				5		3
House Finch										1						1		
Unidentified Carpodacus Finch														1			1	
Pine Siskin				8						2						10		
Lesser Goldfinch				2									10		1	12		1
Evening Grosbeak													2			2		
Unidentified Bird											1			1			2	
ALL SPECIES POOLED	52	2	26	253	33	43	246	25	139	250	53	117	163	32	24	964	145	349
Total Number of Captures		80			329			410			420			219			1458	
Number of Species	17	2	7	34	6	7	31	13	17	43	16	19	32	6	14	57	24	33
Total Number of Species		18			37			37			50			36			63	

Table 3. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations operated in Yosemite National Park and all five stations combined in 2003.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Acorn Woodpecker													1.5	0.0	0.00	0.3	0.0	0.00
Williamson's Sapsucker	3.9	0.0	0.00													0.6	0.0	0.00
Red-breasted Sapsucker	2.0	0.0	0.00	11.3	0.0	0.00	1.3	1.3	0.50	4.3	1.1	0.20	3.0	0.0	0.00	4.3	0.6	0.12
Downy Woodpecker										0.0	1.1	1.00	4.4	1.5	0.25	0.9	0.6	0.40
Hairy Woodpecker				1.6	0.0	0.00	4.0	0.0	0.00	1.1	0.0	0.00	0.0	1.5	1.00	1.4	0.3	0.17
White-headed Woodpecker				3.2	0.0	0.00	1.3	0.0	0.00	2.1	0.0	0.00	4.4	0.0	0.00	2.3	0.0	0.00
Northern Flicker				1.6	0.0	0.00				1.1	0.0	0.00	5.9	0.0	0.00	1.7	0.0	0.00
Olive-sided Flycatcher										2.1	0.0	0.00				0.6	0.0	0.00
Western Wood-Pewee	2.0	0.0	0.00	6.5	0.0	0.00				1.1	1.1	0.50	4.4	0.0	0.00	2.6	0.3	0.10
"Traill's" Flycatcher													1.5	0.0	0.00	0.3	0.0	0.00
Hammond's Flycatcher				6.5	19.4	0.75	5.3	1.3	0.20	0.0	1.1	1.00				2.3	4.0	0.64
Dusky Flycatcher				1.6	0.0	0.00	18.5	0.0	0.00	7.5	2.1	0.22				6.3	0.6	0.08
"Western" Flycatcher				1.6	0.0	0.00	2.6	0.0	0.00	4.3	2.1	0.33				2.0	0.6	0.22
Black Phoebe										1.1	0.0	0.00	8.9	4.4	0.33	2.0	0.9	0.30
Cassin's Vireo				1.6	0.0	0.00	1.3	0.0	0.00	4.3	3.2	0.43				1.7	0.9	0.33
Warbling Vireo	3.9	0.0	0.00	1.6	0.0	0.00	17.2	4.0	0.19	17.1	5.4	0.24	3.0	1.5	0.33	9.4	2.6	0.21
Steller's Jay										1.1	1.1	0.50	1.5	0.0	0.00	0.6	0.3	0.33
Mountain Chickadee	3.9	0.0	0.00	14.6	9.7	0.40	15.8	0.0	0.00	1.1	0.0	0.00				6.9	1.7	0.20
Chestnut-backed Chickadee										1.1	1.1	0.50				0.3	0.3	0.50
Bushtit										0.0	0.0	0.00	1.5	3.0	0.67	0.3	0.6	0.67
Red-breasted Nuthatch				3.2	8.1	0.71	0.0	4.0	1.00	1.1	0.0	0.00				0.9	2.3	0.73
White-breasted Nuthatch				1.6	0.0	0.00							5.9	0.0	0.00	1.4	0.0	0.00
Brown Creeper	2.0	2.0	0.50	4.9	6.5	0.57	5.3	9.2	0.64	2.1	4.3	0.67	1.5	1.5	0.50	3.1	4.9	0.61
House Wren				0.0	6.5	1.00	2.6	6.6	0.71	0.0	2.1	1.00	1.5	1.5	0.50	0.9	3.4	0.80
Golden-crowned Kinglet	7.9	0.0	0.00	4.9	56.7	0.92	5.3	2.6	0.33	1.1	0.0	0.00				3.4	10.6	0.75
Western Bluebird													1.5	0.0	0.00	0.3	0.0	0.00

Table 3. (cont.) Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations operated in Yosemite National Park and all five stations combined in 2003.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Townsend's Solitaire				0.0	1.6	1.00										0.0	0.3	1.00
Hermit Thrush	3.9	0.0	0.00	1.6	0.0	0.00	4.0	0.0	0.00	2.1	1.1	0.33				2.3	0.3	0.11
American Robin	13.7	0.0	0.00	8.1	1.6	0.17	5.3	0.0	0.00	2.1	1.1	0.33	1.5	0.0	0.00	5.4	0.6	0.09
Wrentit													4.4	3.0	0.40	0.9	0.6	0.40
Orange-crowned Warbler	0.0	5.9	1.00	0.0	8.1	1.00	6.6	15.8	0.71	6.4	17.1	0.73	3.0	22.2	0.88	3.7	14.6	0.80
Nashville Warbler				0.0	4.9	1.00	4.0	7.9	0.67	3.2	1.1	0.25	4.4	3.0	0.40	2.6	3.4	0.57
Yellow Warbler							0.0	1.3	1.00	2.1	2.1	0.50	8.9	5.9	0.40	2.3	2.0	0.47
Yellow-rumped Warbler	9.8	3.9	0.29	24.3	37.2	0.61	22.4	13.2	0.37	4.3	3.2	0.43	4.4	0.0	0.00	12.6	10.9	0.46
Hermit Warbler	2.0	0.0	0.00	1.6	0.0	0.00	10.6	1.3	0.11	18.2	1.1	0.06				7.7	0.6	0.07
MacGillivray's Warbler				6.5	3.2	0.33	15.8	14.5	0.48	31.1	21.4	0.41	4.4	1.5	0.25	13.7	9.7	0.42
Wilson's Warbler										0.0	1.1	1.00	0.0	1.5	1.00	0.0	0.6	1.00
Western Tanager				13.0	3.2	0.20	1.3	1.3	0.50	6.4	1.1	0.14	3.0	0.0	0.00	4.9	1.1	0.19
Green-tailed Towhee				1.6	0.0	0.00							1.5	0.0	0.00	0.6	0.0	0.00
Spotted Towhee										4.3	1.1	0.20	14.8	1.5	0.09	4.0	0.6	0.13
Chipping Sparrow	5.9	0.0	0.00				9.2	1.3	0.13	2.1	0.0	0.00				3.4	0.3	0.08
Fox Sparrow							2.6	0.0	0.00							0.6	0.0	0.00
Song Sparrow				0.0	1.6	1.00	0.0	5.3	1.00	21.4	21.4	0.50	1.5	0.0	0.00	6.0	7.2	0.54
Lincoln's Sparrow	0.0	3.9	1.00	24.3	19.4	0.44	18.5	23.8	0.56	10.7	3.2	0.23				11.2	10.0	0.47
Dark-eyed Junco	33.4	9.8	0.23	29.2	22.7	0.44	40.9	25.1	0.38	11.8	9.6	0.45				22.0	13.5	0.38
Black-headed Grosbeak							0.0	1.3	1.00	12.9	0.0	0.00	10.4	11.8	0.53	5.4	2.6	0.32
Lazuli Bunting				1.6	0.0	0.00	9.2	0.0	0.00				20.7	19.3	0.48	6.3	3.7	0.37
Red-winged Blackbird										1.1	0.0	0.00				0.3	0.0	0.00
Brewer's Blackbird										2.1	0.0	0.00	4.4	0.0	0.00	1.4	0.0	0.00
Brown-headed Cowbird										1.1	0.0	0.00				0.3	0.0	0.00
Pine Grosbeak	2.0	0.0	0.00													0.3	0.0	0.00
Purple Finch										9.6	1.1	0.10	11.8	1.5	0.11	4.9	0.6	0.11

Table 3. (cont.) Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations operated in Yosemite National Park and all five stations combined in 2003.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Cassin's Finch	5.9	0.0	0.00	1.6	1.6	0.50	1.3	0.0	0.00	1.1	0.0	0.00				1.7	0.3	0.14
House Finch										0.0	1.1	1.00				0.0	0.3	1.00
Pine Siskin				8.1	4.9	0.38				2.1	0.0	0.00				2.0	0.9	0.30
Lesser Goldfinch				3.2	0.0	0.00							14.8	0.0	0.00	3.4	0.0	0.00
Evening Grosbeak													1.5	1.5	0.50	0.3	0.3	0.50
ALL SPECIES POOLED	102.1	25.5	0.20	191.1	217.0	0.53	232.3	141.3	0.38	209.9	113.5	0.35	165.9	87.4	0.35	186.9	119.9	0.39
Number of Species	15	5		28	18		26	19		38	28		32	18		54	42	
Total Number of Species		17			33			30			43			34			57	

Table 4. Percentage changes between 2002 and 2003 in the numbers of individual ADULT birds captured at five constant-effort MAPS stations in Yosemite National Park.

						All five stations combined				
							Number of adults			
Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	2002	2003	Percent change	SE[2]
Williamson's Sapsucker	++++[3]					1	0	2	++++[3]	
Red-breasted Sapsucker	++++	16.7	-50.0	-69.2	0.0	5	23	15	-34.8	27.1
Downy Woodpecker					++++[3]	1	0	3	++++	
Hairy Woodpecker		++++[3]	200.0	++++[3]		3	1	5	400.0	300.0
White-headed Woodpecker		100.0	0.0	++++	++++	4	2	8	300.0	294.4
Northern Flicker		++++	-100.0	0.0	100.0	4	4	6	50.0	61.2
Olive-sided Flycatcher		-100.0		++++		2	2	2	0.0	200.0
Western Wood-Pewee	++++	++++		-50.0	++++	4	2	7	250.0	408.2
"Traill's" Flycatcher				-100.0	-50.0	2	4	1	-75.0	25.0
Hammond's Flycatcher		++++	-20.0	-100.0		3	7	8	14.3	86.0
Dusky Flycatcher	-100.0	-66.7	55.6	16.7		4	19	22	15.8	27.4
"Western" Flycatcher	-100.0	++++	-50.0	++++		4	5	7	40.0	130.5
Black Phoebe				++++	400.0	2	1	6	500.0	200.0
Cassin's Vireo		0.0	++++[3]	-40.0		3	6	5	-16.7	31.5
Warbling Vireo	++++	-50.0	0.0	-20.0	-33.3	5	38	34	-10.5	9.6
Steller's Jay	-100.0			0.0	++++	3	2	2	0.0	86.6
Mountain Chickadee	-71.4	166.7	500.0	0.0		4	13	23	76.9	121.6
Chestnut-backed Chickadee				-50.0		1	2	1	-50.0	
Bushtit				-100.0	-80.0	2	7	1	-85.7	8.2
Red-breasted Nuthatch		++++		++++		2	0	3	++++	
White-breasted Nuthatch		++++			++++	2	0	5	++++	
Brown Creeper	++++	50.0	++++	100.0		4	3	9	200.0	172.1
Bewick's Wren					-100.0	1	2	0	-100.0	
House Wren			100.0		-50.0	2	3	3	0.0	66.7
Winter Wren					-100.0	1	1	0	-100.0	
American Dipper					-100.0	1	1	0	-100.0	
Golden-crowned Kinglet	++++	-40.0	-66.7	-80.0		4	19	11	-42.1	30.1

Table 4. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual ADULT birds captured at five constant-effort MAPS stations in Yosemite National Park.

							All five stations combined				
							Number of adults				
Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	2002	2003	Percent change	SE[2]	
Western Bluebird					++++	1	0	1	++++		
Townsend's Solitaire				-100.0		1	2	0	-100.0		
Hermit Thrush	++++	++++	200.0	++++		4	1	7	600.0	541.6	
American Robin	66.7	66.7	33.3	0.0	0.0	5	11	16	45.5	11.8	**
Wrentit					50.0	1	2	3	50.0		
Orange-crowned Warbler		-100.0	-66.7	-33.3	-60.0	4	27	11	-59.3	8.4	***
Nashville Warbler		-100.0	++++	0.0	-40.0	4	9	8	-11.1	33.9	
Yellow Warbler				-33.3	150.0	2	5	7	40.0	88.0	
Yellow-rumped Warbler	-66.7	-53.1	-56.4	-55.6	50.0	5	94	43	-54.3	3.2	***
Black-throated Gray Warb.						0	0	0			
Hermit Warbler	0.0	-66.7	-52.9	142.9		4	28	27	-3.6	55.2	
MacGillivray's Warbler		-20.0	-7.7	-34.1	++++	4	59	46	-22.0	11.9	
Wilson's Warbler			-100.0		-100.0	2	3	0	-100.0	88.9	
Western Tanager	-100.0	-46.2	-83.3	0.0	++++	5	26	16	-38.5	18.2	
Green-tailed Towhee		-50.0			++++	2	2	2	0.0	100.0	
Spotted Towhee				++++	28.6	2	7	13	85.7	114.3	
Chipping Sparrow	++++	-100.0	40.0	0.0	-100.0	5	10	12	20.0	46.6	
Fox Sparrow		-100.0	++++			2	2	2	0.0	200.0	
Song Sparrow				-20.8	-50.0	2	26	20	-23.1	4.1	
Lincoln's Sparrow	-100.0	-16.7	-6.7	-37.5		4	51	39	-23.5	8.8	*
Dark-eyed Junco	-6.7	-26.3	-11.4	-31.3	-100.0	5	86	70	-18.6	5.3	**
Black-headed Grosbeak			-100.0	200.0	100.0	3	7	16	128.6	64.8	
Lazuli Bunting		++++	133.3		0.0	3	14	19	35.7	43.8	
Red-winged Blackbird				-80.0		1	5	1	-80.0		
Brewer's Blackbird				-33.3	50.0	2	5	5	0.0	40.0	
Brown-headed Cowbird		-100.0		++++		2	1	1	0.0	200.0	
Pine Grosbeak	0.0					1	1	1	0.0		

Table 4. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual ADULT birds captured at five constant-effort MAPS stations in Yosemite National Park.

Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	All five stations combined: n[1]	Number of adults: 2002	Number of adults: 2003	Percent change	SE[2]
Purple Finch	-100.0	-100.0	-100.0	350.0	500.0	5	7	15	114.3	128.4
Cassin's Finch	++++	-66.7	-50.0	0.0		4	6	6	0.0	72.0
House Finch						0	0	0		
Pine Siskin		300.0	-100.0	-33.3		3	13	6	-53.8	51.7
Lesser Goldfinch		++++	-100.0		800.0	3	2	10	400.0	396.9
Lawrence's Goldfinch		-100.0			-100.0	2	10	0	-100.0	88.9
Evening Grosbeak					++++	1	0	1	++++	
ALL SPECIES POOLED	-2.2	-17.4	-20.3	-12.9	26.0	5	689	613	-11.0	5.9
No. species that increased[4]	10(9)	16(10)	12(4)	14(9)	20(10)				26(6)	
No. species that decreased[5]	9(6)	19(8)	18(6)	20(4)	14(7)				24(6)	
No. species remained same	2	1	2	8	3				9	
Total Number of Species	21	36	32	42	37				59	
Proportion of increasing (decreasing) species	(0.429)	(0.528)	(0.563)	(0.476)	0.541				(0.407)	
Sig. of increase (decrease)[6]	(0.808)	(0.434)	(0.298)	(0.678)	0.371				(0.941)	

[1] Number of stations at which at least one adult bird was captured in either year.
[2] Standard error of the % change in the number of adult birds captured.
[3] Increase indeterminate (infinite) because no adult was captured during 2002.
[4] No. of species for which adults were captured in 2003 but not in 2002 are in parentheses.
[5] No. of species for which adults were captured in 2002 but not in 2003 are in parentheses.
[6] Statistical significance of the one-sided binomial test that the proportion of increasing (decreasing) species is not greater than 0.50.
*** $P < 0.01$; ** $0.01 < P < 0.05$; * $0.05 < P < 0.10$.

Table 5. Percentage changes between 2002 and 2003 in the numbers of individual YOUNG birds captured at five constant-effort MAPS stations in Yosemite National Park.

						All five stations combined					
						Number of young					
Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	2002	2003	Percent change	SE[2]	
Williamson's Sapsucker		-100.0				1	1	0	-100.0		
Red-breasted Sapsucker		-100.0	-50.0	-87.5	-100.0	4	17	2	-88.2	6.8	***
Downy Woodpecker					++++[3]	1	0	1	++++[3]		
Hairy Woodpecker				-100.0	++++	2	1	1	0.0	200.0	
White-headed Woodpecker		-100.0				1	1	0	-100.0		
Northern Flicker			-100.0	-100.0		2	2	0	-100.0	88.9	
Olive-sided Flycatcher						0	0	0			
Western Wood-Pewee		-100.0		++++[3]	-100.0	3	2	1	-50.0	75.0	
"Traill's" Flycatcher						0	0	0			
Hammond's Flycatcher		++++[3]	++++[3]	++++		3	0	13	++++		
Dusky Flycatcher			-100.0	++++	-100.0	3	4	1	-75.0	39.0	
"Western" Flycatcher	-100.0	-100.0	-100.0	-77.8		4	12	2	-83.3	5.6	***
Black Phoebe				-100.0	++++	2	1	3	200.0	600.0	
Cassin's Vireo				100.0		1	1	2	100.0		
Warbling Vireo			++++	-25.0	++++	3	4	7	75.0	156.1	
Steller's Jay		-100.0		++++		2	1	1	0.0	200.0	
Mountain Chickadee	-100.0	-71.4	-100.0			3	21	4	-81.0	9.8	**
Chestnut-backed Chickadee				++++		1	0	1	++++		
Bushtit				-100.0	-100.0	2	15	0	-100.0	88.9	
Red-breasted Nuthatch	-100.0	-75.0	-66.7	-100.0		4	29	7	-75.9	3.1	***
White-breasted Nuthatch				-100.0		1	1	0	-100.0		
Brown Creeper	-50.0	100.0	400.0	-42.9	++++	5	12	15	25.0	60.5	
Bewick's Wren					-100.0	1	2	0	-100.0		
House Wren		50.0	-16.7	100.0	-66.7	4	12	11	-8.3	23.3	
Winter Wren	-100.0					1	1	0	-100.0		
American Dipper						0	0	0			
Golden-crowned Kinglet	-100.0	271.4	-90.5	-100.0		4	44	28	-36.4	67.3	

Table 5. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual YOUNG birds captured at five constant-effort MAPS stations in Yosemite National Park.

							All five stations combined				
							Number of young				
Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	2002	2003	Percent change	SE[2]	
Western Bluebird						0	0	0			
Townsend's Solitaire		++++				1	0	1	++++		
Hermit Thrush			-100.0	++++		2	1	1	0.0	200.0	
American Robin		-100.0		-100.0		2	5	0	-100.0	88.9	
Wrentit					100.0	1	1	2	100.0		
Orange-crowned Warbler	++++[3]	-82.8	-92.5	-86.9	-78.9	5	352	45	-87.2	3.1	***
Nashville Warbler	-100.0	-90.9	-88.7	-93.8	-50.0	5	107	12	-88.8	2.0	***
Yellow Warbler			++++	0.0	100.0	3	3	6	100.0	57.7	
Yellow-rumped Warbler	-80.0	-90.5	-55.0	-40.0		4	276	37	-86.6	4.8	***
Black-throated Gray Warb.		-100.0	-100.0	-100.0		3	4	0	-100.0	88.9	
Hermit Warbler	-100.0	-100.0	-98.0	-88.9		4	70	2	-97.1	1.5	***
MacGillivray's Warbler	-100.0	-50.0	42.9	33.3	-50.0	5	27	32	18.5	14.9	
Wilson's Warbler			-100.0		-100.0	2	5	0	-100.0	88.9	
Western Tanager		-91.7	0.0	-83.3		3	19	3	-84.2	7.9	***
Green-tailed Towhee						0	0	0			
Spotted Towhee					-100.0	1	4	0	-100.0		
Chipping Sparrow			++++			1	0	1	++++		
Fox Sparrow						0	0	0			
Song Sparrow		++++	++++	38.5	-100.0	4	14	23	64.3	45.9	
Lincoln's Sparrow	100.0	300.0	63.6	-75.0		4	27	35	29.6	66.0	
Dark-eyed Junco	-20.0	16.7	-44.8	-18.2	-100.0	5	58	43	-25.9	14.6	
Black-headed Grosbeak		-100.0	-50.0	-100.0	100.0	4	6	5	-16.7	51.9	
Lazuli Bunting					14.3	1	7	8	14.3		
Red-winged Blackbird				-100.0		1	1	0	-100.0		
Brewer's Blackbird						0	0	0			
Brown-headed Cowbird						0	0	0			
Pine Grosbeak						0	0	0			

Table 5. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual YOUNG birds captured at five constant-effort MAPS stations in Yosemite National Park.

Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	All five stations combined: Number of young 2002	All five stations combined: Number of young 2003	All five stations combined: Percent change	All five stations combined: SE[2]	
Purple Finch			-100.0	0.0	++++	3	2	2	0.0	86.6	
Cassin's Finch		-50.0	-100.0			2	3	1	-66.7	22.2	
House Finch				++++		1	0	1	++++		
Pine Siskin		-91.2	-100.0	-100.0		3	37	3	-91.9	1.0	***
Lesser Goldfinch		-100.0				1	1	0	-100.0		
Lawrence's Goldfinch		-100.0				1	1	0	-100.0		
Evening Grosbeak					++++	1	0	1	++++		
ALL SPECIES POOLED	-70.3	-72.9	-74.3	-64.1	-56.6	5	1215	364	-70.0	2.7	***
No. species that increased4	2(1)	8(3)	8(5)	11(7)	11(7)				17(7)		
No. species that decreased5	11(8)	21(12)	20(10)	23(12)	13(9)				31(14)		
No. species remained same	0	0	1	2	0				4		
Total Number of Species	13	29	29	36	24				52		
Proportion of increasing (decreasing) species	(0.846)	(0.724)	(0.690)	(0.639)	(0.542)				(0.596)		
Sig. of increase (decrease)[6]	(0.011) **	(0.012) **	(0.031) **	(0.066) *	(0.419)				(0.106)		

[1] Number of stations at which at least one young bird was captured in either year.
[2] Standard error of the % change in the number of young birds captured.
[3] Increase indeterminate (infinite) because no young bird was captured during 2002.
[4] No. of species for which young birds were captured in 2003 but not in 2002 are in parentheses.
[5] No. of species for which young birds were captured in 2002 but not in 2003 are in parentheses.
[6] Statistical significance of the one-sided binomial test that the proportion of increasing (decreasing) species is not greater than 0.50.
*** $P < 0.01$; ** $0.01 < P < 0.05$; * $0.05 < P < 0.10$.

Table 6. Percentage changes between 2002 and 2003 in the PROPORTION OF YOUNG in the catch at five constant-effort MAPS stations in Yosemite National Park.

							All five stations combined				
							Proportion young				
Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	2002	2003	Absol. change	SE[2]	
Williamson's Sapsucker	+-+-+[3]	+-+-+[3]				2	1.000	0.000	-1.000	0.000	
Red-breasted Sapsucker	+-+-+	-0.455	0.000	-0.181	-0.500	5	0.425	0.118	-0.307	0.086	**
Downy Woodpecker					+-+-+[3]	1	------[4]	0.250	+-+-+[3]		
Hairy Woodpecker		+-+-+	0.000	-1.000	+-+-+	4	0.500	0.167	-0.333	0.451	
White-headed Woodpecker		-0.500	0.000	+-+-+[3]	+-+-+	4	0.333	0.000	-0.333	0.181	
Northern Flicker		+-+-+	+-+-+[3]	-0.500	0.000	4	0.333	0.000	-0.333	0.157	
Olive-sided Flycatcher		+-+-+		+-+-+		2	0.000	0.000	0.000	0.000	
Western Wood-Pewee	+-+-+	-1.000		0.500	-1.000	4	0.500	0.125	-0.375	0.376	
"Traill's" Flycatcher				+-+-+	0.000	2	0.000	0.000	0.000	0.000	
Hammond's Flycatcher		+-+-+	0.200	1.000		3	0.000	0.619	0.619	0.159	*
Dusky Flycatcher	+-+-+	0.000	-0.250	0.125	+-+-+	5	0.174	0.044	-0.130	0.094	
"Western" Flycatcher	+-+-+	-1.000	-0.200	-0.667		4	0.706	0.222	-0.484	0.273	
Black Phoebe				-1.000	0.375	2	0.500	0.333	-0.167	0.505	
Cassin's Vireo		0.000	+-+-+	0.233		3	0.143	0.286	0.143	0.127	
Warbling Vireo	+-+-+	0.000	0.188	-0.009	0.333	5	0.095	0.171	0.075	0.060	
Steller's Jay	+-+-+	+-+-+		0.500	+-+-+	4	0.333	0.333	0.000	0.363	
Mountain Chickadee	-0.417	-0.490	-0.500	0.000		4	0.618	0.148	-0.470	0.191	*
Chestnut-backed Chickadee				0.500		1	0.000	0.500	0.500		
Bushtit				+-+-+	-0.615	2	0.682	0.000	-0.682	0.079	
Red-breasted Nuthatch	+-+-+	-0.286	0.000	-1.000		4	1.000	0.700	-0.300	0.107	*
White-breasted Nuthatch		+-+-+		+-+-+	+-+-+	3	1.000	0.000	-1.000	0.000	
Brown Creeper	-0.500	0.071	-0.375	-0.208	+-+-+	5	0.800	0.625	-0.175	0.110	
Bewick's Wren					+-+-+	1	0.500	------[4]	+-+-+		
House Wren		0.000	-0.143	0.000	-0.100	4	0.800	0.786	-0.014	0.127	
Winter Wren	+-+-+				+-+-+	2	0.500	------	+-+-+		
American Dipper					+-+-+	1	0.000	------	+-+-+		
Golden-crowned Kinglet	-1.000	0.313	-0.300	-0.706		4	0.698	0.718	0.020	0.186	

Table 6. (cont.) Percentage changes between 2002 and 2003 in the PROPORTION OF YOUNG in the catch at five constant-effort MAPS stations in Yosemite National Park.

							All five stations combined				
							Proportion young				
Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	2002	2003	Absol. change	SE[2]	
Western Bluebird					+-+-+	1	------	0.000	+-+-+		
Townsend's Solitaire		+-+-+		+-+-+		2	0.000	1.000	1.000	0.000	
Hermit Thrush	+-+-+	+-+-+	-0.500	+-+-+		4	0.500	0.125	-0.375	0.108	**
American Robin	0.000	-0.400	0.000	-0.750	0.000	5	0.313	0.000	-0.313	0.158	
Wrentit					0.067	1	0.333	0.400	0.067		
Orange-crowned Warbler	+-+-+	0.033	-0.208	-0.169	-0.062	5	0.929	0.804	-0.125	0.044	**
Nashville Warbler	+-+-+	0.029	-0.250	-0.592	-0.044	5	0.922	0.600	-0.322	0.148	*
Yellow Warbler			+-+-+	0.083	-0.056	3	0.375	0.462	0.087	0.126	
Yellow-rumped Warbler	-0.121	-0.278	0.007	0.072	0.000	5	0.746	0.463	-0.283	0.163	
Black-throated Gray Warb.		+-+-+	+-+-+	+-+-+		3	1.000	------	+-+-+		***
Hermit Warbler	-0.833	-0.667	-0.635	-0.507		4	0.714	0.069	-0.645	0.043	***
MacGillivray's Warbler	+-+-+	-0.086	0.105	0.158	-0.750	5	0.314	0.410	0.096	0.047	
Wilson's Warbler			+-+-+		+-+-+	2	0.625	------	+-+-+		
Western Tanager	+-+-+	-0.355	0.357	-0.357	+-+-+	5	0.422	0.158	-0.264	0.081	**
Green-tailed Towhee		0.000			+-+-+	2	0.000	0.000	0.000	0.000	
Spotted Towhee				+-+-+	-0.364	2	0.364	0.000	-0.364		
Chipping Sparrow	+-+-+	+-+-+	0.125	0.000	+-+-+	5	0.000	0.077	0.077	0.041	
Fox Sparrow		+-+-+	+-+-+			2	0.000	0.000	0.000	0.000	
Song Sparrow		+-+-+	+-+-+	0.135	-0.333	4	0.350	0.535	0.185	0.072	*
Lincoln's Sparrow	0.667	0.302	0.139	-0.198		4	0.346	0.473	0.127	0.104	
Dark-eyed Junco	-0.028	0.113	-0.113	0.043	+-+-+	5	0.403	0.381	-0.022	0.060	
Black-headed Grosbeak		+-+-+	0.333	-0.200	0.000	4	0.462	0.238	-0.223	0.242	
Lazuli Bunting		+-+-+	0.000		0.032	3	0.333	0.296	-0.037	0.166	
Red-winged Blackbird				-0.167		1	0.167	0.000	-0.167		
Brewer's Blackbird				0.000	0.000	2	0.000	0.000	0.000	0.000	
Brown-headed Cowbird		+-+-+		+-+-+		2	0.000	0.000	0.000	0.000	
Pine Grosbeak	0.000					1	0.000	0.000	0.000		

Table 6. (cont.) Percentage changes between 2002 and 2003 in the PROPORTION OF YOUNG in the catch at five constant-effort MAPS stations in Yosemite National Park.

Species	White Wolf	Gin Flat E. Mead.	Crane Flat	Hodgdon Meadow	Big Meadow	n[1]	All five stations combined: Proportion young 2002	Proportion young 2003	Absol. change	SE[2]	
Purple Finch	+-+-+	+-+-+	+-+-+	-0.233	0.143	5	0.222	0.118	-0.105	0.077	
Cassin's Finch	+-+-+	0.100	-0.333	0.000		4	0.333	0.143	-0.191	0.154	
House Finch				+-+-+		1	------	1.000	+-+-+		
Pine Siskin		-0.543	+-+-+	-0.400		3	0.740	0.333	-0.407	0.287	
Lesser Goldfinch		-1.000	+-+-+		0.000	3	0.333	0.000	-0.333	0.333	
Lawrence's Goldfinch		+-+-+			+-+-+	2	0.091	------	+-+-+		
Evening Grosbeak					+-+-+	1	------	0.500	+-+-+		
ALL SPECIES POOLED	-0.249	-0.247	-0.276	-0.214	-0.255	5	0.638	0.373	-0.266	0.068	**
No. species that increased	1	7	8	11	5				12		
No. species that decreased	6	13	12	19	10				31		
No. species remained same	2	5	6	5	7				8		
Total Number of Species[5]	9	25	26	35	22				51		
Proportion of increasing (decreasing) species	(0.667)	(0.520)	(0.462)	(0.543)	(0.455)				(0.608)		
Sig. of increase (decrease)[6]	(0.254)	(0.500)	(0.721)	(0.368)	(0.738)				(0.080) *		

[1] Number of stations at which at least one aged bird was captured in either year.
[2] Standard error of the change in the proportion of young.
[3] The change in the proportion of young is undefined at this station because no aged individual of the species was captured in one of the two years.
[4] Proportion of young not given because no aged individual of the species was captured in the year shown.
[5] Species for which the change in the proportion of young is undefined are not included.
[6] Statistical significance of the one-sided binomial test that the proportion of increasing (decreasing) species is not greater than 0.50.
*** $P < 0.01$; ** $0.01 \leq P < 0.05$; * $0.05 \leq P < 0.10$

Table 7. Mean numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations operated in Yosemite National Park averaged over the 11 years, 1993-2003 (1998-2003 for Gin Flat East Meadow) and for Hodgdon Meadow alone averaged over 14 years, 1990-2003. Data for each species are included only from stations that lie within the breeding range of the species.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow (1993-2003)			Big Meadow			All stations pooled (1993-2003)[2]			Hodgdon Meadow (1990-2003)		
Species	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]
Sharp-shinned Hawk				0.2	0.0	0.00										*0.0*	*0.0*	*0.00*			
Belted Kingfisher													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
Acorn Woodpecker													1.0	0.0	0.00	0.2	0.0	0.00			
Williamson's Sapsucker	5.4	0.8	0.08	0.0	0.3	1.00										0.9	0.2	0.18			
Red-breasted Sapsucker	0.6	0.6	0.50	5.8	3.8	0.38	2.0	0.5	0.14	6.3	3.2	0.29	1.4	0.4	0.14	3.3	1.6	0.28	6.3	3.0	0.28
Downy Woodpecker										0.5	0.2	0.33	2.1	0.8	0.31	0.6	0.2	0.32	0.5	0.2	0.37
Hairy Woodpecker	0.1	0.0	0.00	0.5	0.0	0.00	0.8	0.1	0.17	0.2	0.8	0.83	2.4	1.0	0.39	0.9	0.5	0.40	0.3	0.7	0.76
White-headed Woodpecker				1.3	0.5	0.25	0.7	0.0	0.00	0.7	0.1	0.17	0.8	0.0	0.00	0.6	0.1	0.17	0.7	0.1	0.13
Northern Flicker	0.2	0.2	0.50	0.3	0.0	0.00	0.3	0.1	0.25	0.9	0.4	0.20	2.3	0.1	0.05	0.9	0.2	0.14	0.8	0.3	0.16
Olive-sided Flycatcher				0.5	0.0	0.00				0.6	0.0	0.00	0.2	0.0	0.00	0.3	0.0	0.00	0.7	0.0	0.00
Western Wood-Pewee	1.5	0.3	0.22	1.3	0.5	0.50				3.5	0.8	0.17	6.0	0.9	0.17	2.9	0.5	0.17	3.6	0.7	0.16
"Traill's" Flycatcher							0.5	0.1	0.25	1.9	0.6	0.28	1.0	0.0	0.00	1.0	0.2	0.15	1.9	0.6	0.28
Hammond's Flycatcher	0.0	2.3	1.00	1.8	11.4	0.86	3.3	1.6	0.32	1.9	0.8	0.33	0.2	0.1	0.33	1.5	2.0	0.45	2.1	0.7	0.28
Dusky Flycatcher	1.8	0.3	0.16	3.4	1.5	0.37	18.4	2.5	0.11	15.8	2.2	0.11	1.4	0.1	0.13	10.1	1.4	0.13	17.5	3.0	0.13
"Western" Flycatcher	0.2	0.2	0.50	0.3	0.8	0.67	2.8	1.5	0.38	4.0	2.8	0.32	0.5	0.4	0.42	2.1	1.3	0.36	3.7	2.5	0.31
Black Phoebe							0.0	0.1	1.00	0.3	0.8	0.72	5.9	7.0	0.50	1.3	1.8	0.53	0.2	0.6	0.72
Western Kingbird													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
Cassin's Vireo	0.0	0.4	1.00	0.5	0.3	0.33	1.3	0.1	0.06	5.1	3.2	0.38	1.2	0.1	0.07	2.3	1.2	0.34	5.2	3.2	0.38
Warbling Vireo	3.0	0.3	0.15	1.6	0.3	0.25	16.6	1.1	0.06	24.8	11.5	0.29	9.0	1.2	0.11	14.1	4.2	0.22	24.2	11.2	0.29
Steller's Jay	0.2	0.0	0.00	0.3	0.3	0.50				1.2	0.2	0.13	0.3	0.1	0.33	0.5	0.1	0.17	1.1	0.2	0.13
Tree Swallow													0.0	0.1	1.00	0.0	0.0	1.00			
N. Rough-winged Swallow													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
Mountain Chickadee	5.6	2.9	0.39	10.5	9.6	0.43	5.5	3.9	0.41	1.0	0.3	0.17	0.3	0.0	0.00	3.5	2.2	0.39	1.4	0.5	0.19
Chestnut-backed Chick.	0.0	0.1	1.00				0.0	0.1	1.00	0.8	0.4	0.21				0.2	0.2	0.38	0.6	0.3	0.31
Oak Titmouse													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
Bushtit										0.9	2.1	0.70	1.9	4.9	0.72	0.6	1.6	0.71	0.7	1.7	0.70
Red-breasted Nuthatch	0.3	1.3	0.73	1.8	12.0	0.85	4.8	4.3	0.53	0.8	1.1	0.44				1.5	2.6	0.65	0.7	1.1	0.51
White-breasted Nuthatch				0.3	0.0	0.00				0.0	0.1	1.00	0.9	0.1	0.25	0.2	0.1	0.40	0.0	0.1	1.00
Brown Creeper	3.7	5.5	0.46	3.2	3.5	0.44	3.8	6.4	0.58	0.7	2.5	0.73	2.2	2.0	0.37	2.4	3.8	0.58	1.1	2.4	0.66

Table 7. (cont.) Mean numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations operated in Yosemite National Park averaged over the 11 years, 1993-2003 (1998-2003 for Gin Flat East Meadow) and for Hodgdon Meadow alone averaged over 14 years, 1990-2003. Data for each species are included only from stations that lie within the breeding range of the species.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow (1993-2003)			Big Meadow			All stations pooled (1993-2003)[2]			Hodgdon Meadow (1990-2003)		
Species	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]
Bewick's Wren													1.5	0.9	0.43	0.3	0.2	0.43			
House Wren	0.4	3.1	0.93	0.5	3.6	0.91	2.7	9.7	0.85	0.3	3.6	0.90	5.3	7.3	0.55	2.0	5.8	0.75	0.7	3.5	0.84
Winter Wren	0.0	0.2	1.00				0.2	0.7	0.70	0.2	0.8	0.86	0.3	0.1	0.25	0.2	0.5	0.82	0.2	0.7	0.85
American Dipper													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
Golden-crowned Kinglet	1.9	8.4	0.81	5.0	27.1	0.69	16.7	22.9	0.47	1.7	2.3	0.47				4.9	9.8	0.59	1.5	2.0	0.49
Ruby-crowned Kinglet	0.9	0.0	0.00													0.2	0.0	0.00			
Western Bluebird													2.4	0.8	0.25	0.5	0.2	0.25			
Townsend's Solitaire				0.0	0.3	1.00				0.2	0.4	0.80				0.0	0.1	0.83	0.1	0.3	0.83
Swainson's Thrush										0.4	0.0	0.00				0.1	0.0	0.00	0.4	0.0	0.00
Hermit Thrush	1.9	0.2	0.06	0.5	0.0	0.00	4.2	0.6	0.14	1.5	0.7	0.26	0.1	0.0	0.00	1.8	0.4	0.20	1.7	0.7	0.27
American Robin	6.8	1.0	0.16	5.8	1.9	0.22	2.9	0.0	0.00	3.2	0.9	0.20	4.2	0.4	0.08	4.2	0.7	0.14	3.2	0.7	0.18
Wrentit													1.3	0.9	0.38	0.2	0.2	0.38			
Orange-crowned Warbler	2.2	18.8	0.93	1.8	19.7	0.88	15.8	72.5	0.80	18.3	79.6	0.77	8.4	45.4	0.82	11.6	55.9	0.81	15.8	76.3	0.80
Nashville Warbler	1.2	23.0	0.95	0.5	22.1	0.96	4.5	27.8	0.84	6.1	12.8	0.54	3.1	6.8	0.67	3.8	17.3	0.77	6.0	12.2	0.56
Yellow Warbler							1.5	0.3	0.19	5.1	1.8	0.29	7.1	5.2	0.43	3.4	1.7	0.34	5.3	2.4	0.31
Yellow-rumped Warbler	25.4	26.3	0.40	35.2	113.6	0.64	30.6	19.3	0.34	4.8	2.6	0.31	1.6	0.0	0.00	15.5	19.7	0.46	4.7	2.3	0.28
Black-thrtd. Gray Warbler	0.0	0.2	1.00	0.0	0.8	1.00	0.0	0.9	1.00	0.1	2.0	0.97	0.0	0.7	1.00	0.0	1.1	0.99	0.3	2.2	0.90
Hermit Warbler	2.4	11.0	0.67	2.4	9.8	0.64	22.8	17.9	0.36	9.8	9.8	0.41	0.1	0.0	0.00	8.7	9.6	0.47	10.2	8.3	0.36
MacGillivray's Warbler	0.0	0.8	1.00	6.5	3.8	0.26	13.8	9.9	0.34	32.6	19.3	0.35	8.2	9.6	0.52	15.7	10.9	0.37	30.4	18.6	0.36
Wilson's Warbler	0.0	0.8	1.00	0.3	1.3	0.75	1.8	3.7	0.48	3.6	1.0	0.28	1.2	0.8	0.42	1.9	1.5	0.47	3.5	1.4	0.31
Western Tanager	0.6	0.5	0.56	12.0	6.4	0.27	3.2	0.2	0.06	5.2	3.2	0.29	3.4	0.0	0.00	4.3	1.7	0.25	4.9	3.1	0.30
Green-tailed Towhee				0.8	0.0	0.00				0.0	0.1	1.00	0.1	0.1	0.50	0.1	0.1	0.50	0.0	0.1	1.00
Spotted Towhee										0.4	0.3	0.73	7.0	1.2	0.10	1.5	0.3	0.21	0.3	0.3	0.80
Chipping Sparrow	1.0	0.0	0.00	0.8	0.3	0.25	5.7	0.6	0.09	3.8	0.9	0.14	10.4	3.4	0.32	5.1	1.2	0.21	3.6	0.8	0.13
Sage Sparrow													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
Fox Sparrow				1.4	0.0	0.00	0.4	0.1	0.25	0.1	0.0	0.00	0.1	0.1	0.50	0.2	0.0	0.13	0.1	0.0	0.00
Song Sparrow	0.4	0.0	0.00	0.0	1.7	1.00	2.3	2.6	0.50	21.5	22.7	0.49	6.3	4.1	0.31	8.7	8.8	0.48	18.4	19.2	0.48
Lincoln's Sparrow	4.3	1.9	0.27	22.2	11.9	0.35	26.6	26.5	0.49	18.2	11.2	0.37	1.1	1.9	0.67	14.6	11.3	0.43	15.8	9.6	0.36
Dark-eyed Junco	36.6	27.8	0.38	31.5	28.4	0.45	55.3	57.9	0.48	16.1	20.9	0.50	3.9	2.3	0.40	26.7	27.2	0.47	14.1	18.7	0.53

Table 7. (cont.) Mean numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations operated in Yosemite National Park averaged over the 11 years, 1993-2003 (1998-2003 for Gin Flat East Meadow) and for Hodgdon Meadow alone averaged over 14 years, 1990-2003. Data for each species are included only from stations that lie within the breeding range of the species.

	White Wolf			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow (1993-2003)			Big Meadow			All stations pooled (1993-2003)[2]			Hodgdon Meadow (1990-2003)		
Species	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]
Black-headed Grosbeak	0.3	0.1	0.33	0.5	0.5	0.67	0.6	0.4	0.28	12.1	2.0	0.16	12.2	3.9	0.24	6.9	1.6	0.21	10.7	1.8	0.16
Lazuli Bunting	0.0	0.4	1.00	0.3	0.0	0.00	7.9	0.8	0.09	0.7	0.2	0.42	37.8	17.0	0.31	10.4	4.1	0.27	0.7	0.1	0.21
Red-winged Blackbird										3.2	0.2	0.03				1.0	0.0	0.03	2.6	0.1	0.03
Brewer's Blackbird	0.8	0.2	0.11	0.0	0.2	1.00				0.8	0.0	0.00	3.3	0.2	0.03	1.1	0.1	0.13	0.7	0.0	0.00
Brown-headed Cowbird				0.3	0.0	0.00	0.1	0.0	0.00	0.3	0.0	0.00	0.7	0.2	0.10	0.3	0.0	0.04	0.3	0.0	0.00
Bullock's Oriole													2.3	0.1	0.06	0.5	0.0	0.06			
Pine Grosbeak	4.9	0.0	0.00													0.8	0.0	0.00			
Purple Finch	0.5	0.3	0.50	1.3	0.0	0.00	7.4	2.6	0.25	11.8	2.9	0.20	10.1	6.1	0.23	7.7	2.8	0.24	14.9	5.7	0.23
Cassin's Finch	14.0	0.8	0.03	2.4	0.8	0.18	2.4	0.3	0.17	1.8	0.3	0.04	0.9	0.1	0.13	3.7	0.4	0.09	1.9	0.3	0.05
House Finch							0.1	0.0	0.00	0.0	0.2	1.00				0.0	0.1	0.67	0.0	0.1	1.00
Red Crossbill	0.1	0.0	0.00							0.7	0.2	0.20	0.2	0.0	0.00	0.3	0.0	0.08	0.5	0.1	0.20
Pine Siskin	6.9	0.9	0.18	7.0	18.6	0.51	5.1	0.3	0.05	2.2	0.8	0.13	0.7	0.3	0.31	3.8	2.2	0.28	2.4	0.6	0.12
Lesser Goldfinch				1.6	2.9	0.61	0.6	0.4	0.25	0.6	0.3	0.35	13.1	7.3	0.29	3.3	2.0	0.34	0.6	0.3	0.40
Lawrence's Goldfinch				0.3	0.3	0.50							2.5	0.1	0.20	0.5	0.1	0.22	0.1	0.0	0.00
Evening Grosbeak	0.4	0.0	0.00							0.1	0.0	0.00	1.7	0.4	0.21	0.5	0.1	0.21	0.1	0.0	0.00
House Sparrow													0.1	0.0	0.00	*0.0*	*0.0*	*0.00*			
ALL SPECIES POOLED	136.3	141.9	0.46	174.7	320.6	0.61	296.4	301.4	0.48	259.1	238.0	0.45	204.4	147.2	0.42	229.6	226.0	0.48	250.0	225.5	0.45
Number of Species	34	34		41	35		39	38		53	50		61	46		70	55		54	50	
Total Number of Species		42			46			42			56			63			74			57	

[1] Years for which the proportion of young was undefined (no aged birds were captured in the year) are not included in the mean proportion of young.
[2] For numbers presented in italics, the mean number of adults or young is greater than 0.1 at one or more stations, but over the entire location the mean number is less than 0.05. The species is counted in the number of species over all stations pooled.

Table 8. Summary statistics for survival analyses with temporally variable survival and recapture probabilities and proportion of residents in transient models using 11 years (1993-2003) of mark-recapture data from the five currently operating MAPS stations at Yosemite National Park. $QAIC_C$[1] and (GOF)[2] are presented for all models.

	Transient Models								
Species	$\phi p \tau$[3]	$\phi_t p \tau$[4]	$\phi p_t \tau$[5]	$\phi p \tau_t$[6]	$\phi_t p_t \tau$[7]	$\phi_t p \tau_t$[8]	$\phi p_t \tau_t$[9]	$\phi_t p_t \tau_t$[10]	$\Delta QAIC_C$
Red-breasted Sapsucker	60.0* (1.000)	78.8 (1.000)	74.5 (1.000)	73.6 (1.000)	87.7 (1.000)	96.4 (1.000)	90.9 (1.000)	108.9 (1.000)	18.8
Western Wood-Pewee	69.2* (1.000)	83.2 (1.000)	81.4 (1.000)	75.5 (1.000)	99.9 (1.000)	111.7 (1.000)	96.4 (1.000)	118.7 (1.000)	14.0
Dusky Flycatcher	121.5* (1.000)	131.5 (1.000)	131.5 (1.000)	126.4 (1.000)	141.8 (1.000)	139.8 (1.000)	137.3 (1.000)	148.6 (1.000)	10.0
Warbling Vireo	116.2 (1.000)	132.3 (1.000)	126.5 (1.000)	113.8* (1.000)	137.2 (1.000)	126.2 (1.000)	125.4 (1.000)	134.0 (1.000)	16.1
Mountain Chickadee	39.4* (1.000)	46.2 (1.000)	48.5 (1.000)	54.0 (1.000)	67.7 (1.000)	71.5 (1.000)	72.4 (1.000)	94.4 (1.000)	6.9
Brown Creeper	45.9* (1.000)	56.0 (1.000)	57.2 (1.000)	58.5 (1.000)	78.3 (1.000)	80.1 (1.000)	81.0 (1.000)	107.6 (1.000)	10.1
Golden-crowned Kinglet	37.8* (1.000)	50.6 (1.000)	49.8 (1.000)	51.9 (1.000)	65.9 (1.000)	64.4 (1.000)	64.8 (1.000)	85.2 (1.000)	12.8
American Robin	96.3* (1.000)	108.8 (1.000)	110.8 (1.000)	107.2 (1.000)	124.8 (1.000)	126.3 (1.000)	127.6 (1.000)	141.6 (1.000)	12.5
Yellow Warbler	93.5* (1.000)	106.2 (1.000)	104.5 (1.000)	104.1 (1.000)	117.7 (1.000)	119.3 (1.000)	118.4 (1.000)	130.6 (1.000)	12.7
Yellow-rumped Warbler	100.3* (1.000)	108.6 (1.000)	111.3 (1.000)	110.9 (1.000)	118.7 (1.000)	119.9 (1.000)	122.5 (1.000)	131.9 (1.000)	8.3

Table 8. (cont.) Summary statistics for survival analyses with temporally variable survival and recapture probabilities and proportion of residents in transient models using 11 years (1993-2003) of mark-recapture data from the five currently operating MAPS stations at Yosemite National Park. $QAIC_C$[1] and (GOF)[2] are presented for all models.

	Transient Models								
Species	$\phi p \tau$ [3]	$\phi_t p \tau$ [4]	$\phi p_t \tau$ [5]	$\phi p \tau_t$ [6]	$\phi_t p_t \tau$ [7]	$\phi_t p \tau_t$ [8]	$\phi p_t \tau_t$ [9]	$\phi_t p_t \tau_t$ [10]	$\Delta QAIC_C$
Hermit Warbler	88.7* (1.000)	102.5 (1.000)	99.5 (1.000)	94.4 (1.000)	106.7 (1.000)	110.3 (1.000)	101.2 (1.000)	114.7 (1.000)	13.8
MacGillivray's Warbler	155.6* (1.000)	166.3 (1.000)	168.5 (1.000)	168.9 (1.000)	179.0 (1.000)	179.5 (1.000)	182.6 (1.000)	194.3 (1.000)	10.7
Chipping Sparrow	76.1* (1.000)	88.2 (1.000)	89.6 (1.000)	93.7 (1.000)	98.3 (1.000)	109.0 (1.000)	108.8 (1.000)	120.5 (1.000)	12.1
Song Sparrow	143.3* (0.999)	153.3 (0.999)	150.9 (1.000)	154.7 (0.999)	156.4 (1.000)	165.3 (1.000)	166.4 (0.999)	169.9 (1.000)	10.0
Lincoln's Sparrow	177.6* (0.985)	184.1 (0.993)	180.7 (0.999)	186.0 (0.994)	187.9 (1.000)	198.9 (0.988)	192.8 (0.999)	203.2 (0.999)	6.5
Dark-eyed Junco	211.1* (0.919)	210.3* (0.989)	211.2* (0.987)	220.8 (0.926)	220.9 (0.988)	224.9 (0.978)	224.5 (0.979)	233.0 (0.981)	-0.8
Black-headed Grosbeak	109.5* (1.000)	118.1 (1.000)	118.7 (1.000)	110.2* (1.000)	130.9 (1.000)	125.6 (1.000)	123.8 (1.000)	134.2 (1.000)	8.6
Lazuli Bunting	104.3* (1.000)	114.4 (1.000)	111.5 (1.000)	115.0 (1.000)	123.0 (1.000)	129.4 (1.000)	124.9 (1.000)	136.8 (1.000)	10.1
Purple Finch	37.3* (1.000)	45.6 (1.000)	44.1 (1.000)	48.7 (1.000)	61.5 (1.000)	65.9 (1.000)	63.6 (1.000)	80.5 (1.000)	8.3

1 Akaike Information Criterion ($QAIC_C$) given as -2(log-likelihood) + 2(number of estimable parameters) with corrections for small sample sizes and overdispersion of data.

Table 8. (cont.) Summary statistics for survival analyses with temporally variable survival and recapture probabilities and proportion of residents in transient models using 11 years (1993-2003) of mark-recapture data from the five currently operating MAPS stations at Yosemite National Park. $QAIC_C$[1] and (GOF)[2] are presented for all models.

[2] Goodness-of-fit is a measure of how well the actual distribution of data fits the theoretical distribution calculated using the estimates provided by the model. The larger the value provided by the GOF test the better the model describes the data.

[3] $\phi p \tau$ Model: Transient model with temporally-constant survival probability, recapture probability, and proportion of residents (invariable from year to year).

[4] $\phi_t p \tau$ Model: Transient model with temporally-variable survival probability; and temporally-constant recapture probability and proportion of residents.

[5] $\phi p_t \tau$ Model: Transient model with temporally-variable recapture probability; and temporally-constant survival probability and proportion of residents.

[6] $\phi p \tau_t$ Model: Transient model with temporally-variable proportion of residents; and temporally-constant survival and recapture probabilities.

[7] $\phi_t p_t \tau$ Model: Transient model with temporally-variable survival and recapture probabilities; and temporally-constant proportion of residents.

[8] $\phi_t p \tau_t$ Model: Transient model with temporally-variable survival probability and proportion of residents; and temporally-constant recapture probability.

[9] $\phi p_t \tau_t$ Model: Transient model with temporally-variable recapture probability and proportion of residents; and temporally-constant survival probability.

[10] $\phi_t p_t \tau_t$ Model: Transient model with temporally-variable survival probability, recapture probability, and proportion of residents.

[11] $\Delta QAIC_C$ is defined as the difference in $\Delta QAIC_C$ between the $\phi p \tau$ model and the $\phi_t p \tau$ model.

* The chosen models are the model with the lowest $QAIC_C$ and the models with $QAIC_C$s within 2.0 units of the model with the lowest $QAIC_C$.

Table 9. Estimates of adult survival and recapture probabilities and proportion of residents using both temporally variable and time-constant models for 19 species breeding at the five currently operating MAPS stations in Yosemite National Park obtained from 11 years (1993-2003) of mark-recapture data.

Species	Num. sta2.[1]	Num. ind.[2]	Num. caps.[3]	Num. ret.[4]	Model[5]	$QAIC_C$[6]	Survival probability[7]	Surv. C.V.[8]	Recapture probability[9]	Proportion of residents[10]
Red-breasted Sapsucker	3	98	132	14	$\phi p \tau$	60.0	0.465 (0.121)	26.1	0.211 (0.120)	1.000 (0.597)
Western Wood-Pewee	4	92	125	12	$\phi p \tau$	69.2	0.634 (0.113)	17.9	0.135 (0.074)	0.659 (0.370)
Dusky Flycatcher	4	292	473	56	$\phi p \tau$	121.5	0.409 (0.051)	12.6	0.480 (0.087)	0.556 (0.134)
Warbling Vireo	5	462	667	52	$\phi p \tau$	116.2*	0.363 (0.053)	14.7	0.434 (0.092)	0.422 (0.109)
					$\phi p \tau_t$	113.8	0.354 (0.052)	14.7	0.450 (0.092)	a0.537 (0.249)
										b0.777 (0.328)
										c0.546 (0.278)
										d0.168 (0.169)
										e0.574 (0.266)
										f0.884 (0.348)
										g0.141 (0.141)
										h0.000 (0.860)
										i0.194 (0.194)
										j0.000 (1.109)
Mountain Chickadee	5	126	150	9	$\phi p \tau$	39.4	0.277 (0.138)	49.8	0.241 (0.210)	1.000 (0.906)
Brown Creeper	5	80	102	8	$\phi p \tau$	45.9	0.436 (0.144)	33.0	0.307 (0.184)	0.443 (0.298)
Golden-crowned Kinglet	4	174	209	7	$\phi p \tau$	37.8	0.269 (0.127)	47.3	0.481 (0.291)	0.143 (0.105)
American Robin	5	137	181	21	$\phi p \tau$	96.3	0.618 (0.090)	14.6	0.130 (0.061)	1.000 (0.476)
Yellow Warbler	3	97	192	27	$\phi p \tau$	93.5	0.633 (0.072)	11.4	0.435 (0.095)	0.253 (0.100)
Yellow-rumped Warbler	4	546	643	40	$\phi p \tau$	100.3	0.405 (0.072)	17.7	0.262 (0.086)	0.460 (0.163)
Hermit Warbler	4	297	332	19	$\phi p \tau$	88.7	0.596 (0.093)	15.7	0.129 (0.066)	0.402 (0.212)

Table 9. (cont.) Estimates of adult survival and recapture probabilities and proportion of residents using both temporally variable and time-constant models for 19 species breeding at the five currently operating MAPS stations in Yosemite National Park obtained from 11 years (1993-2003) of mark-recapture data.

Species	Num. sta2.[1]	Num. ind.[2]	Num. caps.[3]	Num. ret.[4]	Model[5]	$QAIC_C$[6]	Survival probability[7]	Surv. C.V.[8]	Recapture probability[9]	Proportion of residents[10]
MacGillivray's Warbler	4	445	978	136	$\phi p \tau$	155.6	0.518 (0.034)	6.6	0.652 (0.052)	0.361 (0.059)
Chipping Sparrow	4	154	222	22	$\phi p \tau$	76.1	0.457 (0.083)	18.2	0.191 (0.083)	1.000 (0.459)
Song Sparrow	3	245	508	74	$\phi p \tau$	143.3	0.427 (0.047)	11.0	0.490 (0.076)	0.923 (0.186)
Lincoln's Sparrow	5	415	1058	126	$\phi p \tau$	177.6	0.485 (0.035)	7.2	0.580 (0.056)	0.465 (0.079)
Dark-eyed Junco	5	794	1465	196	$\phi p \tau$	211.1	0.460 (0.029)	6.3	0.502 (0.045)	0.590 (0.074)
					$\phi_t p \tau$	210.3	a0.446 (0.110)	24.7	0.489 (0.046)	0.598 (0.076)
							b0.315 (0.070)	22.2		
							c0.692 (0.118)	17.1		
							d0.548 (0.094)	17.2		
							e0.369 (0.081)	22.0		
							f0.374 (0.079)	21.1		
							g0.546 (0.101)	18.5		
							h0.325 (0.063)	19.4		
							i0.521 (0.095)	18.2		
							j0.646 (0.113)	17.5		
					$\phi p_t \tau$	211.2	0.451 (0.030)	6.7	a0.631 (0.129)	0.592 (0.074)
									b0.307 (0.086)	
									c0.615 (0.113)	
									d0.601 (0.104)	
									e0.478 (0.105)	
									f0.474 (0.098)	
									g0.578 (0.108)	
									h0.325 (0.077)	
									i0.460 (0.097)	
									j0.700 (0.128)	

Table 9. (cont.) Estimates of adult survival and recapture probabilities and proportion of residents using both temporally variable and time-constant models for 19 species breeding at the five currently operating MAPS stations in Yosemite National Park obtained from 11 years (1993-2003) of mark-recapture data.

Species	Num. sta2.[1]	Num. ind.[2]	Num. caps.[3]	Num. ret.[4]	Model[5]	$QAIC_C$[6]	Survival probability[7]	Surv. C.V.[8]	Recapture probability[9]	Proportion of residents[10]
Black-headed Grosbeak	3	207	262	31	$\phi p \tau$	109.5	0.572 (0.070)	12.3	0.298 (0.083)	0.404 (0.134)
					$\phi p \tau_t$	110.2	0.562 (0.069)	12.2	0.309 (0.084)	a0.754 (0.335)
										b0.563 (0.296)
										c0.765 (0.361)
										d0.000 (0.643)
										e0.706 (0.408)
										f0.197 (0.198)
										g0.000 (1.273)
										h0.197 (0.198)
										i0.000 (1.566)
										j0.000 (0.000)
Lazuli Bunting	2	330	406	25	$\phi p \tau$	104.3	0.631 (0.073)	11.6	0.174 (0.059)	0.242 (0.091)
Purple Finch	4	271	295	10	$\phi p \tau$	37.3	0.150 (0.102)	68.0	0.359 (0.329)	0.619 (0.634)

[1] Number of super-stations where the species was a regular or usual breeder at which adults of the species were captured.
[2] Number of adult individuals captured at stations where the species was a regular or usual breeder (i.e., number of capture histories).
[3] Total number of captures of adult birds of the species at stations where the species was a regular or usual breeder.
[4] Total number of returns. A return is the first recapture in a given year of a bird originally banded at the same station in a previous year.
[5] Models included are those chosen by $QAIC_C$ (those models marked with * in Table 8) plus the $\phi p \tau$ model in all cases. See Table 8 for definitions of the models.
[6] Akaike Information Criterion ($QAIC_C$) given as -2(log-likelihood) + 2(number of estimable parameters) with corrections for small sample size and over dispersion of data.
[7] Survival probability presented as the maximum likelihood estimate (standard error of the estimate).

a The survival probability between the years 1993-1994 in a temporally variable model.
b The survival probability between the years 1994-1995 in a temporally variable model.
c The survival probability between the years 1995-1996 in a temporally variable model.
d The survival probability between the years 1996-1997 in a temporally variable model.
e The survival probability between the years 1997-1998 in a temporally variable model.
f The survival probability between the years 1998-1999 in a temporally variable model.

Table 9. (cont.) Estimates of adult survival and recapture probabilities and proportion of residents using both temporally variable and time-constant models for 19 species breeding at the five currently operating MAPS stations in Yosemite National Park obtained from 11 years (1993-2003) of mark-recapture data.

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[7] (cont.) Survival probability presented as the maximum likelihood estimate (standard error of the estimate).
- g The survival probability between the years 1999-2000 in a temporally variable model.
- h The survival probability between the years 2000-2001 in a temporally variable model.
- i The survival probability between the years 2001-2002 in a temporally variable model.
- j The survival probability between the years 2002-2003 in a temporally variable model.

[8] The coefficient of variation for survival probability.

[9] Recapture probability presented as the maximum likelihood estimate (standard error of the estimate).
- a The recapture probability in 1994 in a temporally variable model.
- b The recapture probability in 1995 in a temporally variable model.
- c The recapture probability in 1996 in a temporally variable model.
- d The recapture probability in 1997 in a temporally variable model.
- e The recapture probability in 1998 in a temporally variable model.
- f The recapture probability in 1999 in a temporally variable model.
- g The recapture probability in 2000 in a temporally variable model.
- h The recapture probability in 2001 in a temporally variable model.
- i The recapture probability in 2002 in a temporally variable model.
- j The recapture probability in 2003 in a temporally variable model.

[10] The proportion of residents among newly captured adults presented as the maximum likelihood estimate (standard error of the estimate).
- a The proportion of residents in the adult population in 1993 in a temporally variable model.
- b The proportion of residents in the adult population in 1994 in a temporally variable model.
- c The proportion of residents in the adult population in 1995 in a temporally variable model.
- d The proportion of residents in the adult population in 1996 in a temporally variable model.
- e The proportion of residents in the adult population in 1997 in a temporally variable model.
- f The proportion of residents in the adult population in 1998 in a temporally variable model.
- g The proportion of residents in the adult population in 1999 in a temporally variable model.
- h The proportion of residents in the adult population in 2000 in a temporally variable model.
- i The proportion of residents in the adult population in 2001 in a temporally variable model.
- j The proportion of residents in the adult population in 2002 in a temporally variable model.

* Time-constant model was not marked by $QAIC_C$, but is shown for comparison with other species.

Table 10. Assessment of vital rates for 13 target species showing decreasing or increasing 11-year (1993-2003) population trends at the four long-running stations in Yosemite National Park.

Species	Trend and its significance[1]	Productivity	Survival Probability
A. Decreasing Species			
Red-breasted Sapsucker	- 4.3	as expected, increasing	slightly low
Western Wood-Pewee	- 6.1 **	low	high
Dusky Flycatcher	- 5.9 ***	low	slightly low
Warbling Vireo	- 1.3	low	low
Yellow Warbler	- 4.0 *	as expected, increasing	high
Hermit Warbler	- 4.2 *	high	high
Chipping Sparrow	- 6.2 **	low	as expected
Dark-eyed Junco	- 3.0 **	high	as expected
Black-headed Grosbeak	- 5.9 ***	as expected, increasing	as expected
Lazuli Bunting	- 8.0 ***	low, increasing	high
B. Increasing Species			
Mountain Chickadee	14.4 **	slightly high, increasing	low
Yellow-rumped Warbler	17.2 **	high	slightly low
MacGillivray's Warbler	1.5	slightly high	high

[1] Significance of the declines in adult population levels. *** $P < 0.01$; ** $0.01 \leq P < 0.05$; * $0.05 \leq P < 0.10$.

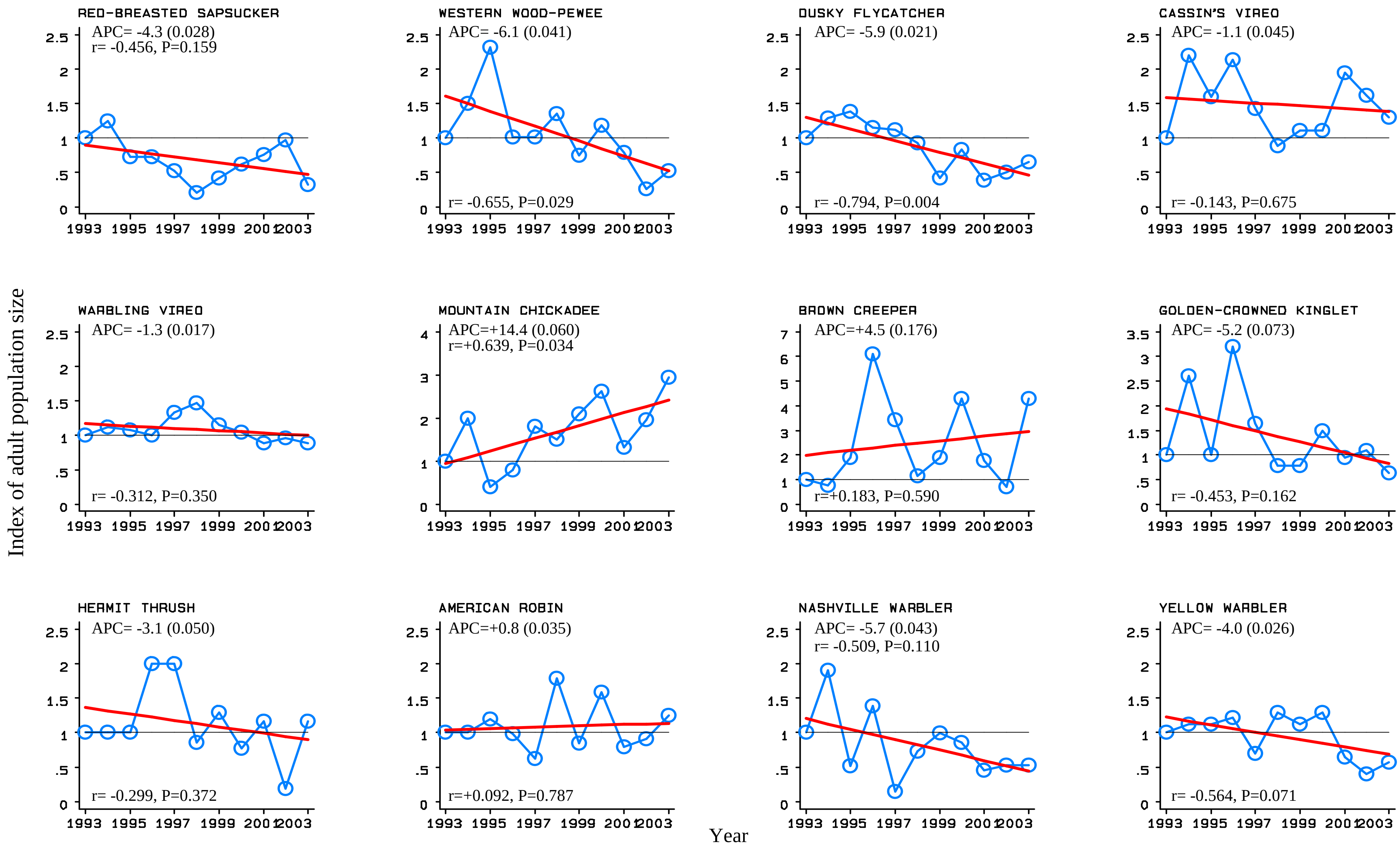


Figure 1. Population trends for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

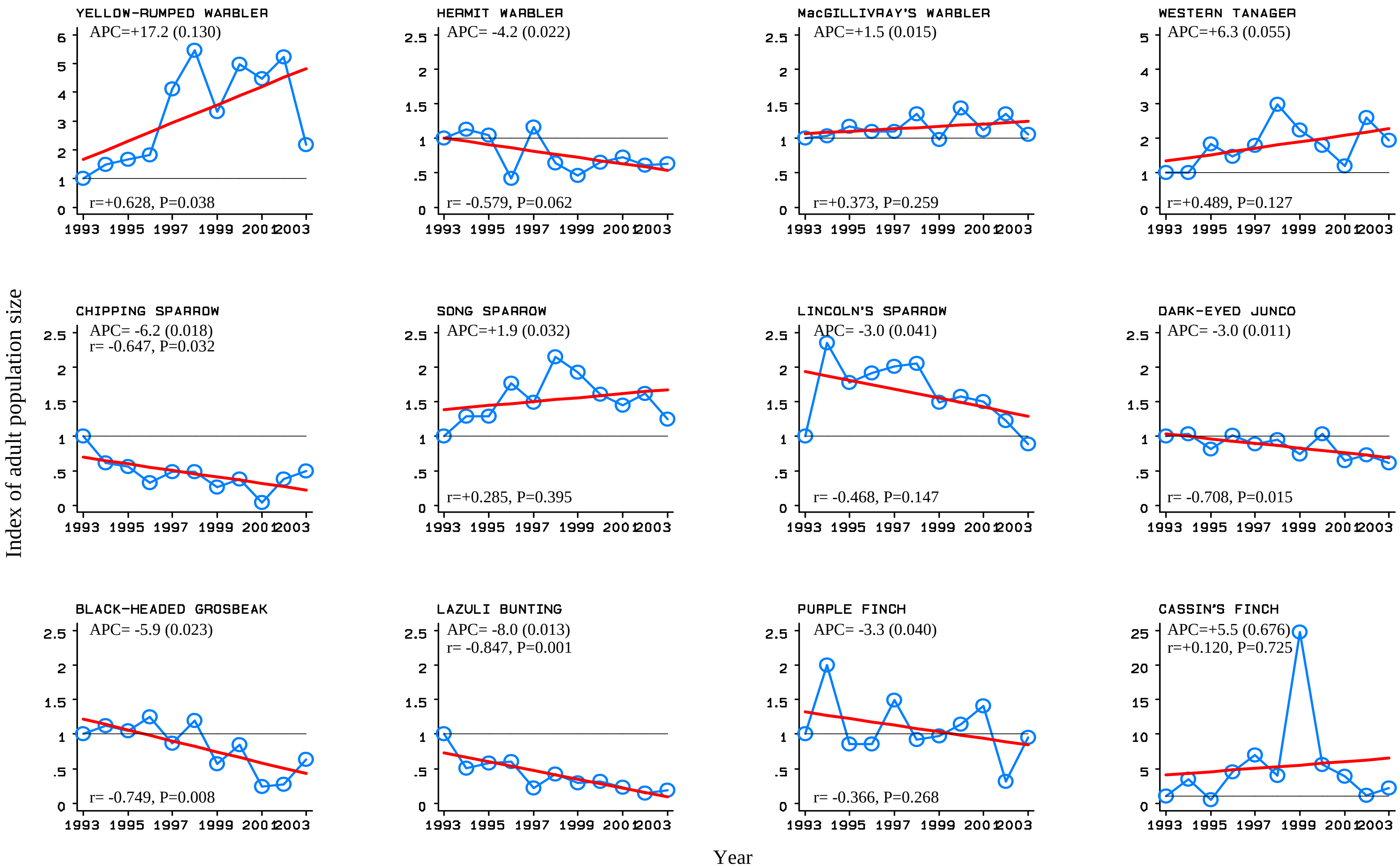


Figure 1. (cont.) Population trends for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

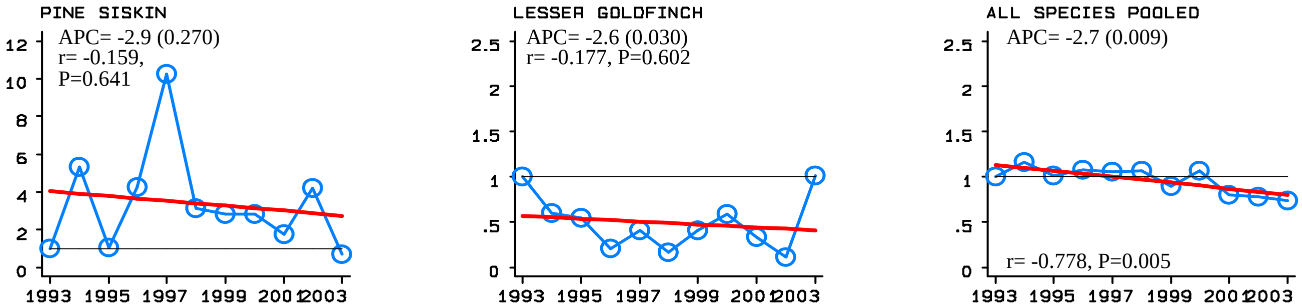


Figure 1. (cont.) Population trends for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

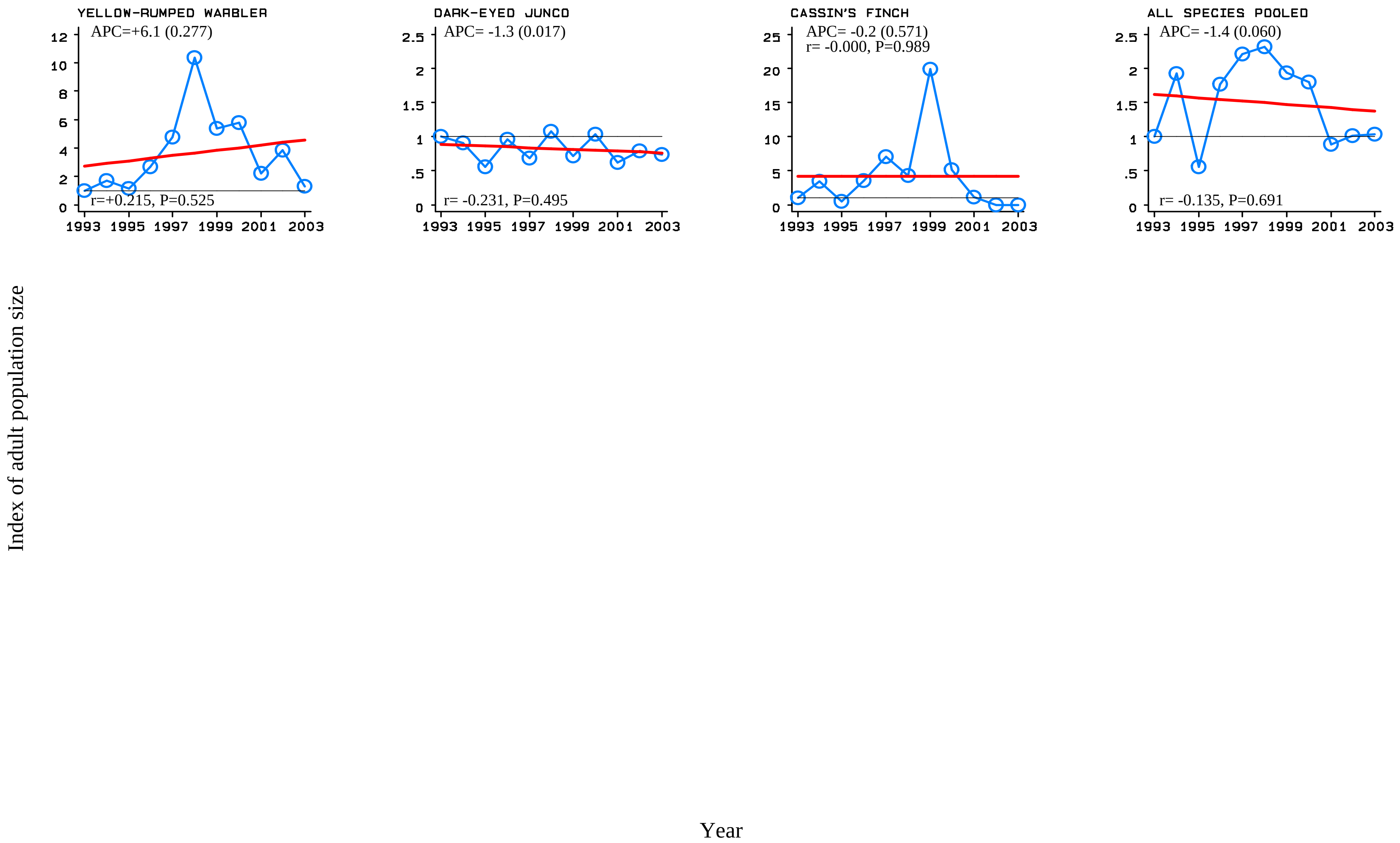


Figure 2. Population trends for three species and all species pooled at the White Wolf MAPS station in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

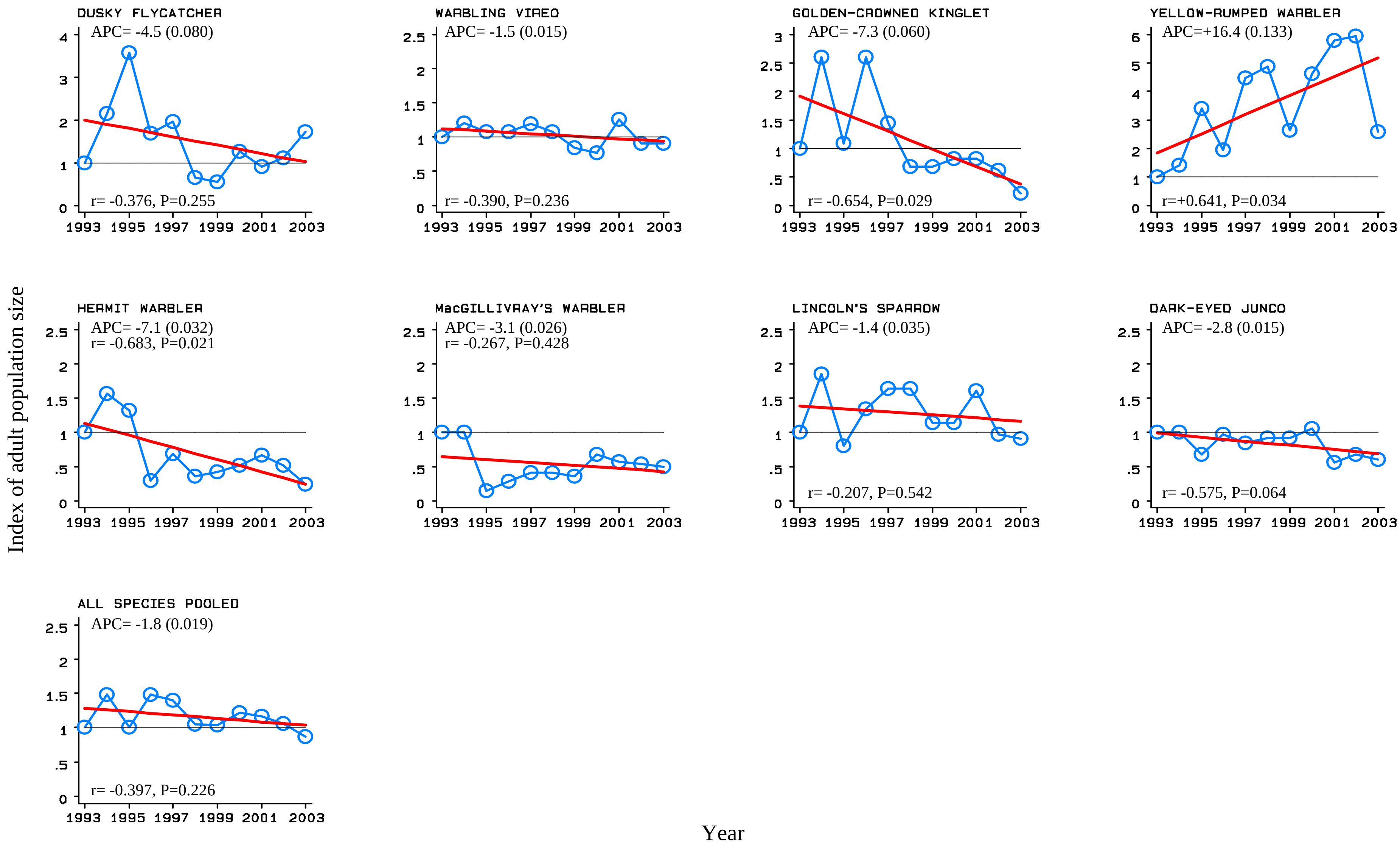


Figure 3. Population trends for eight species and all species pooled at the Crane Flat MAPS station in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

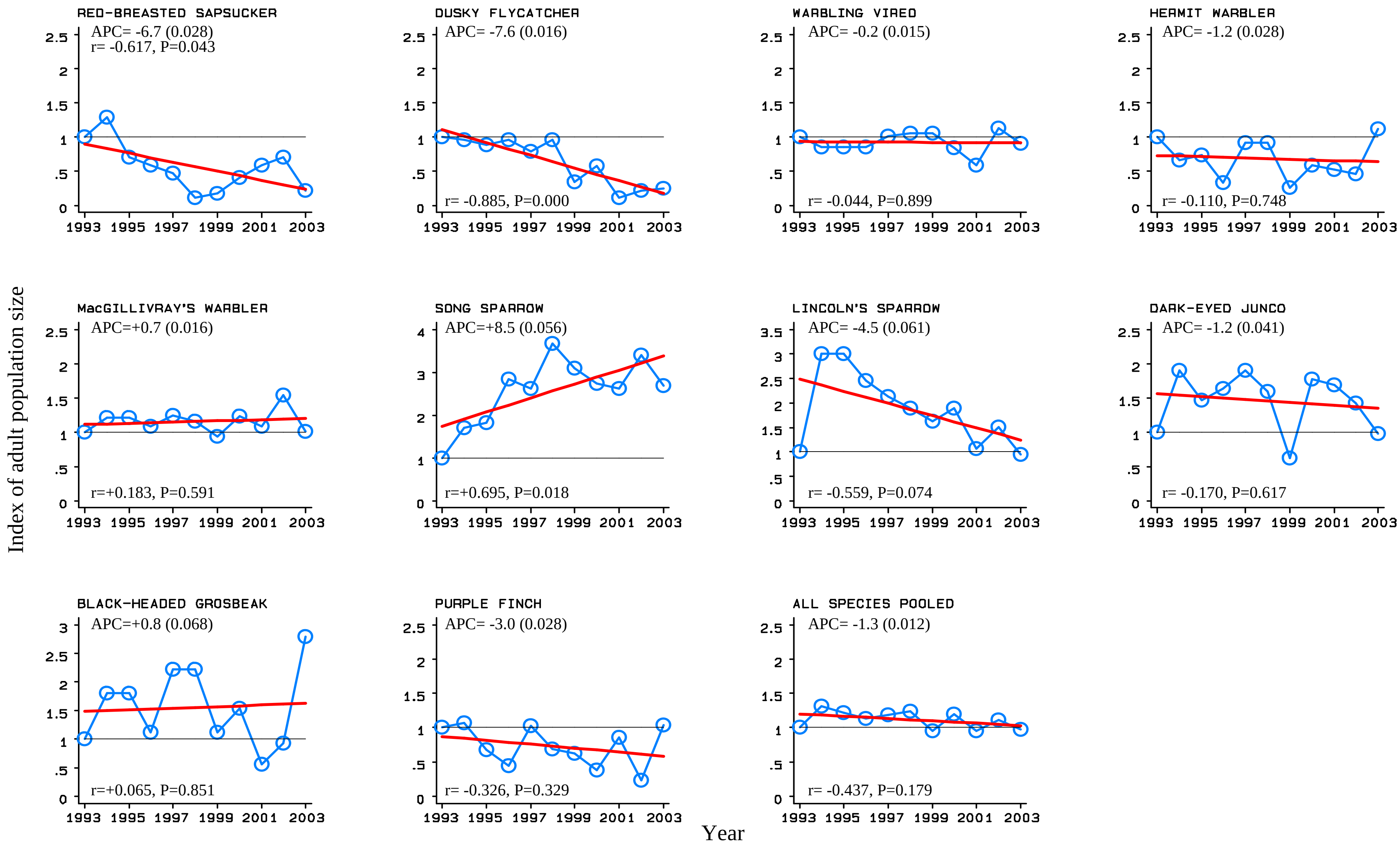


Figure 4. Population trends for ten species and all species pooled at the Hodgdon Meadow MAPS station in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

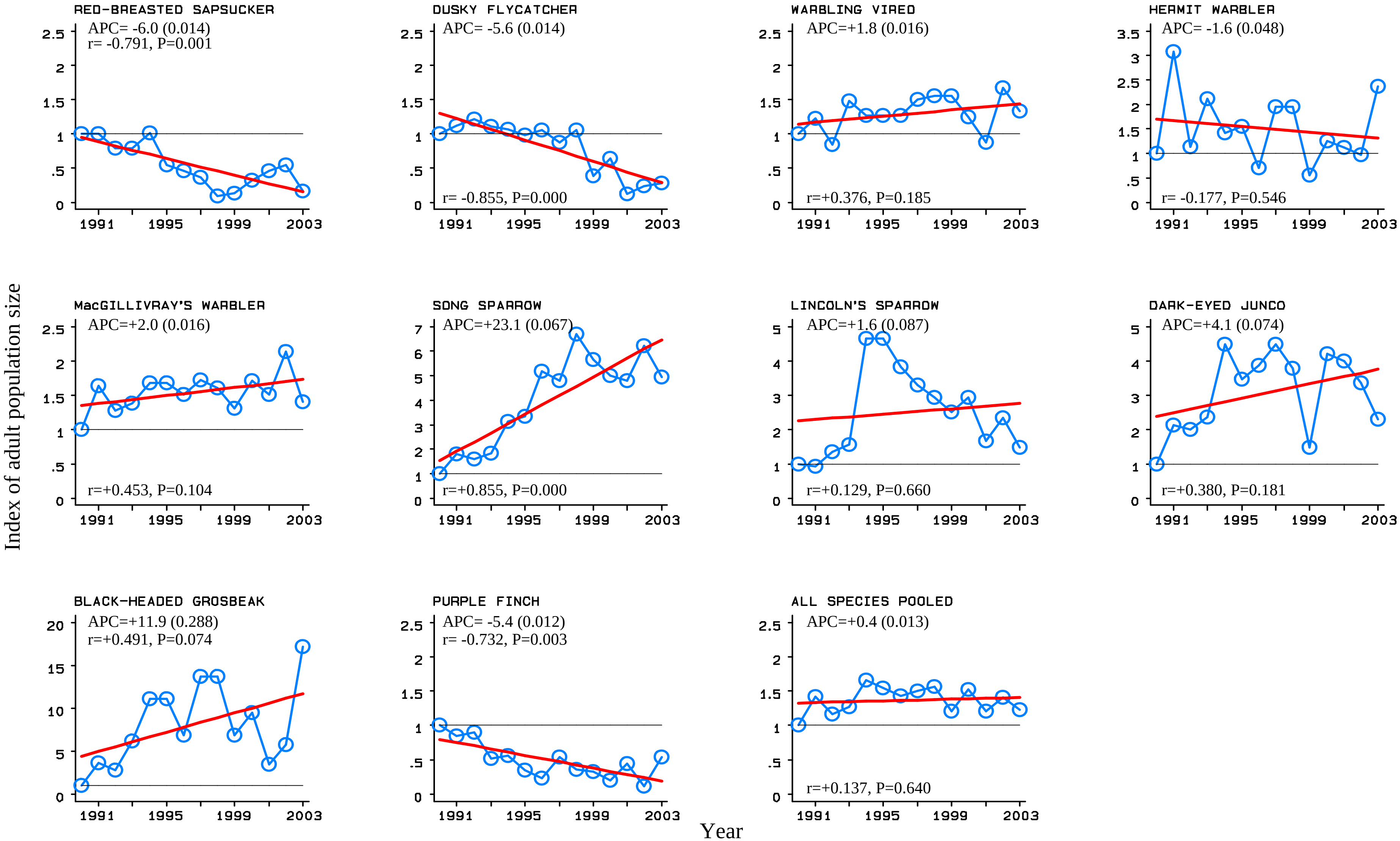


Figure 5. Population trends for ten species and all species pooled at the Hodgdon Meadow MAPS station in Yosemite National Park over the 14 years 1990-2003. The index of population size was arbitrarily defined as 1.0 in 1990. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

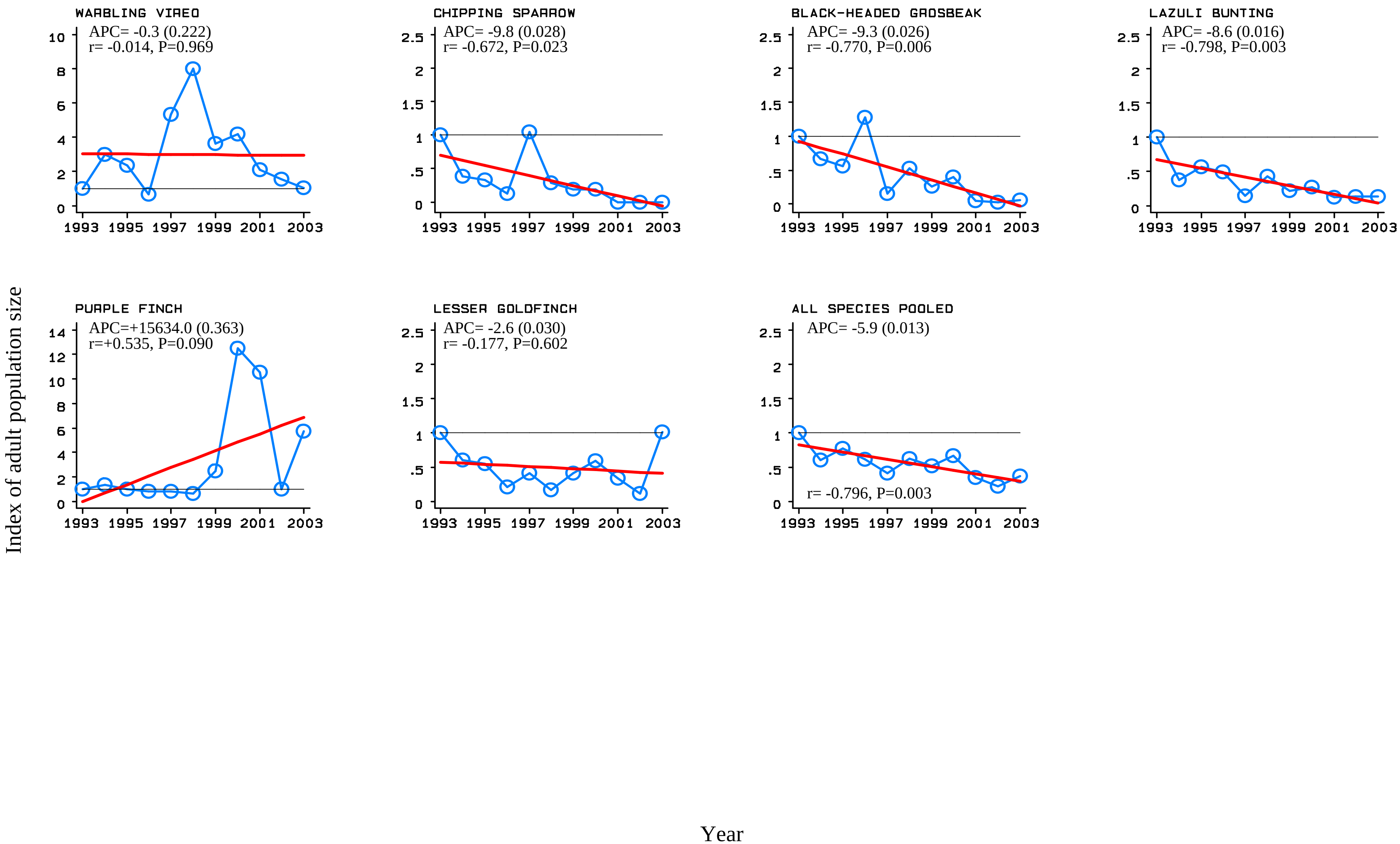


Figure 6. Population trends for six species and all species pooled at the Big Meadow MAPS station in Yosemite National Park over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

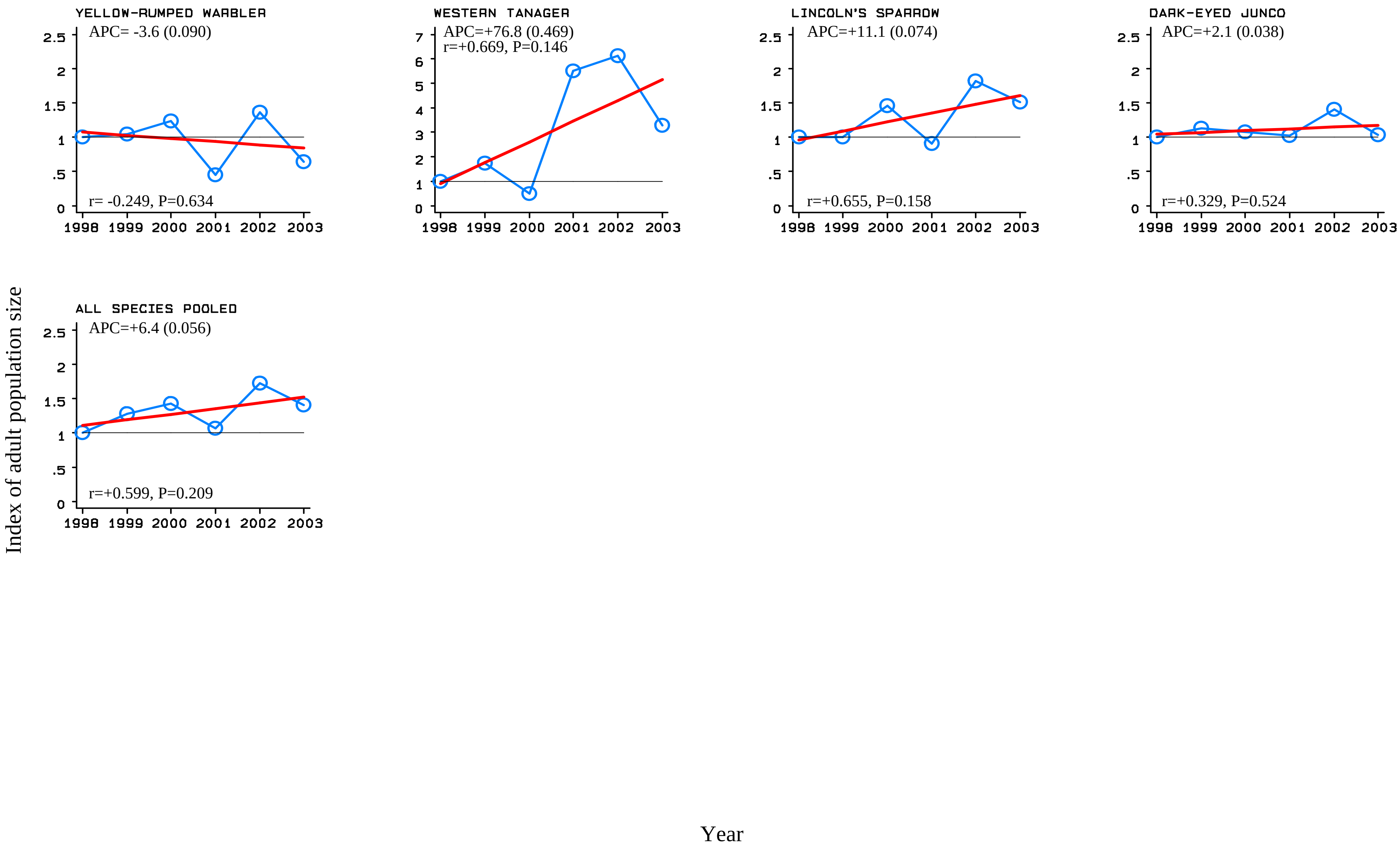


Figure 7. Population trends for four species and all species pooled at the Gin Flat East Meadow MAPS station in Yosemite National Park over the six years 1998-2003. The index of population size was arbitrarily defined as 1.0 in 1998. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

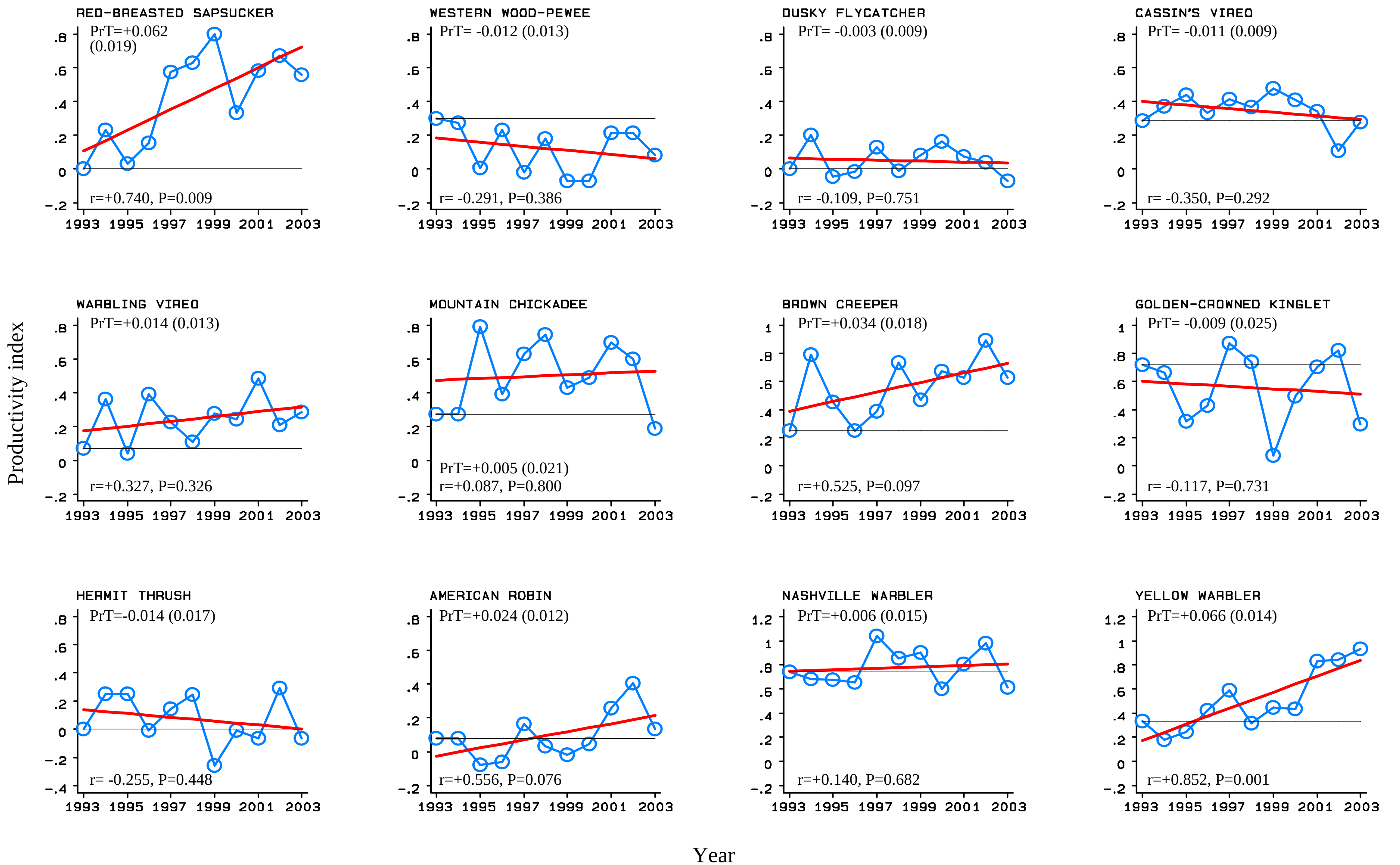


Figure 8. Trend in productivity for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the 11 years 1993-2003. The productivity index was defined as the actual productivity value in 1993. Indices for subsequent years were determined from constant-effort between-year changes in proportion of young in the catch from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line for annual change in the index of productivity was used as the measure of the productivity trend (PrT), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

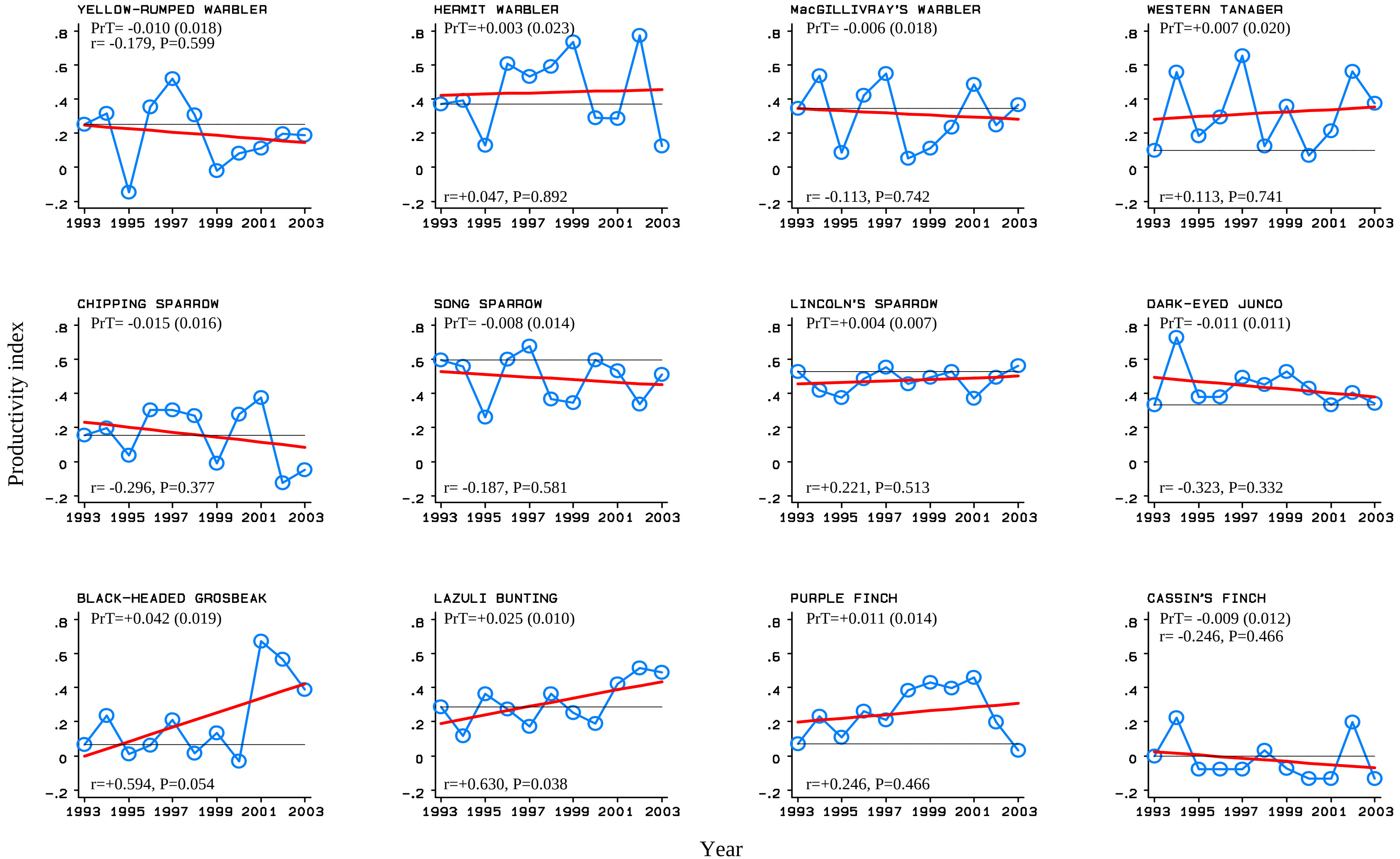
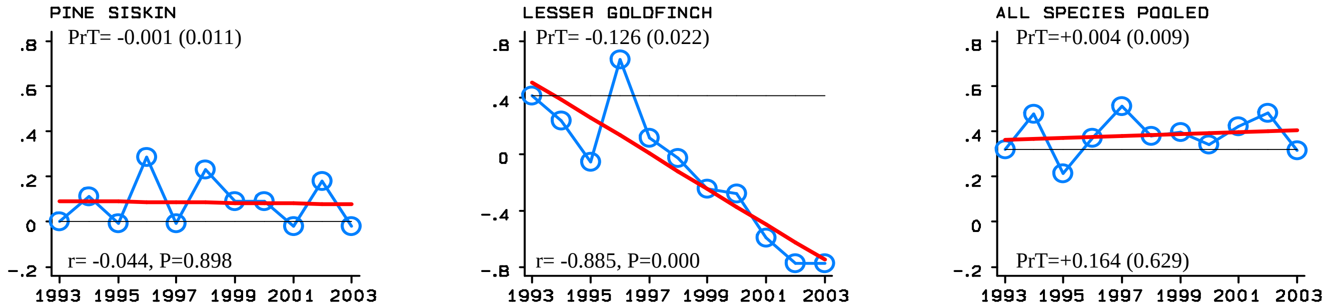


Figure 8. (cont.) Trend in productivity for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the 11 years 1993-2003. The productivity index was defined as the actual productivity value in 1993. Indices for subsequent years were determined from constant-effort between-year changes in proportion of young in the catch from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line for annual change in the index of productivity was used as the measure of the productivity trend (PrT), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.



Productivity index

Year

Figure 8. (cont.) Trend in productivity for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the 11 years 1993-2003. The productivity index was defined as the actual productivity value in 1993. Indices for subsequent years were determined from constant-effort between-year changes in proportion of young in the catch from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line for annual change in the index of productivity was used as the measure of the productivity trend (PrT), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

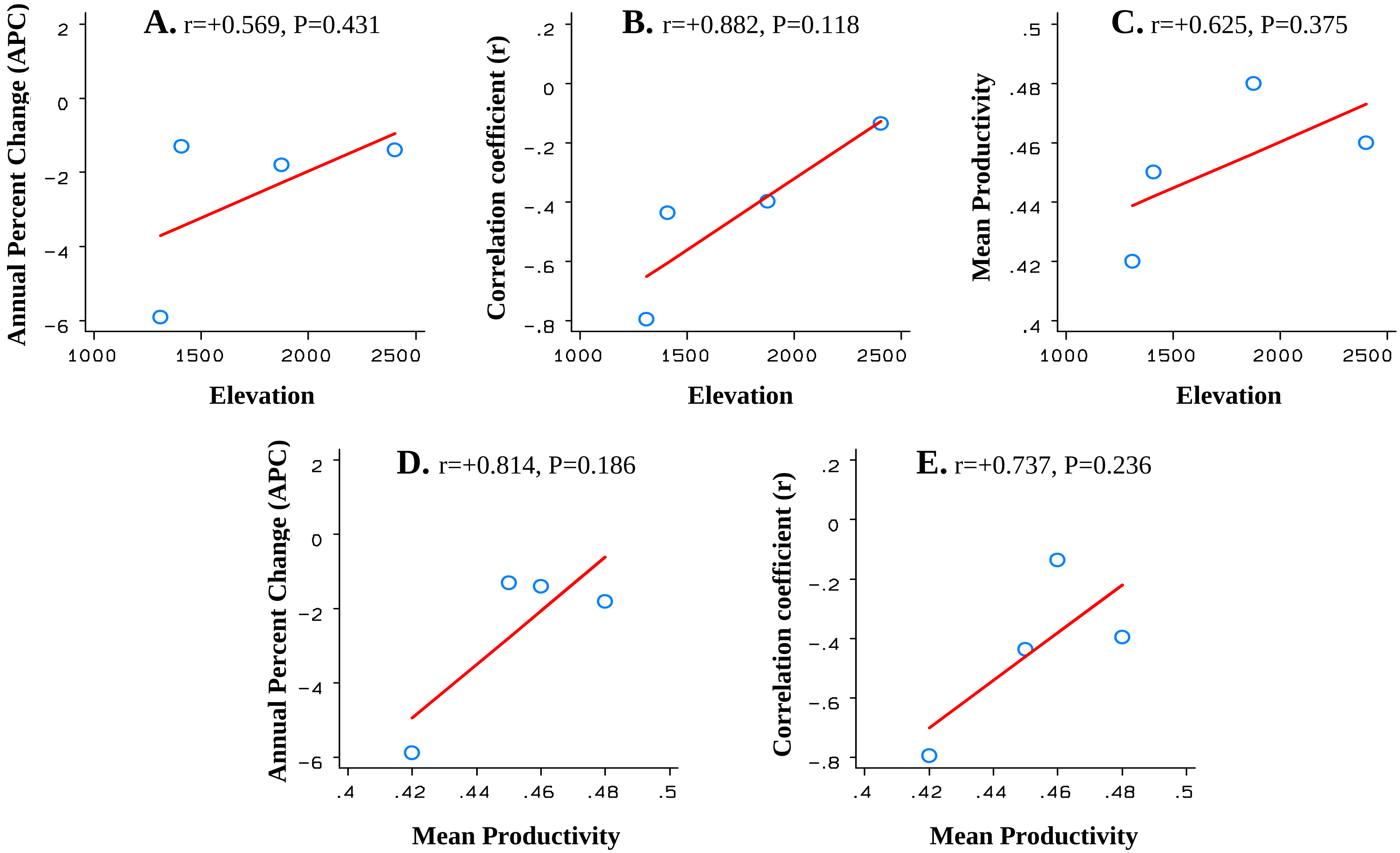


Figure 9. Five correlations of population indices for all species pooled at the four long running MAPS stations at Yosemite National Park over the 11 years 1993-2003. The correlations are: A. the annual percent change (APC) in adult population index against elevation, B. the correlation coefficient of adult population size against elevation, C. the mean productivity over all years against elevation, D. the annual percent change (APC) in adult population index against the mean productivity over all years, E. the correlation coefficient of adult population size against the mean productivity over all years. The correlation coefficient (*r*) and significance of the correlation coefficient (*P*) are shown on each graph.

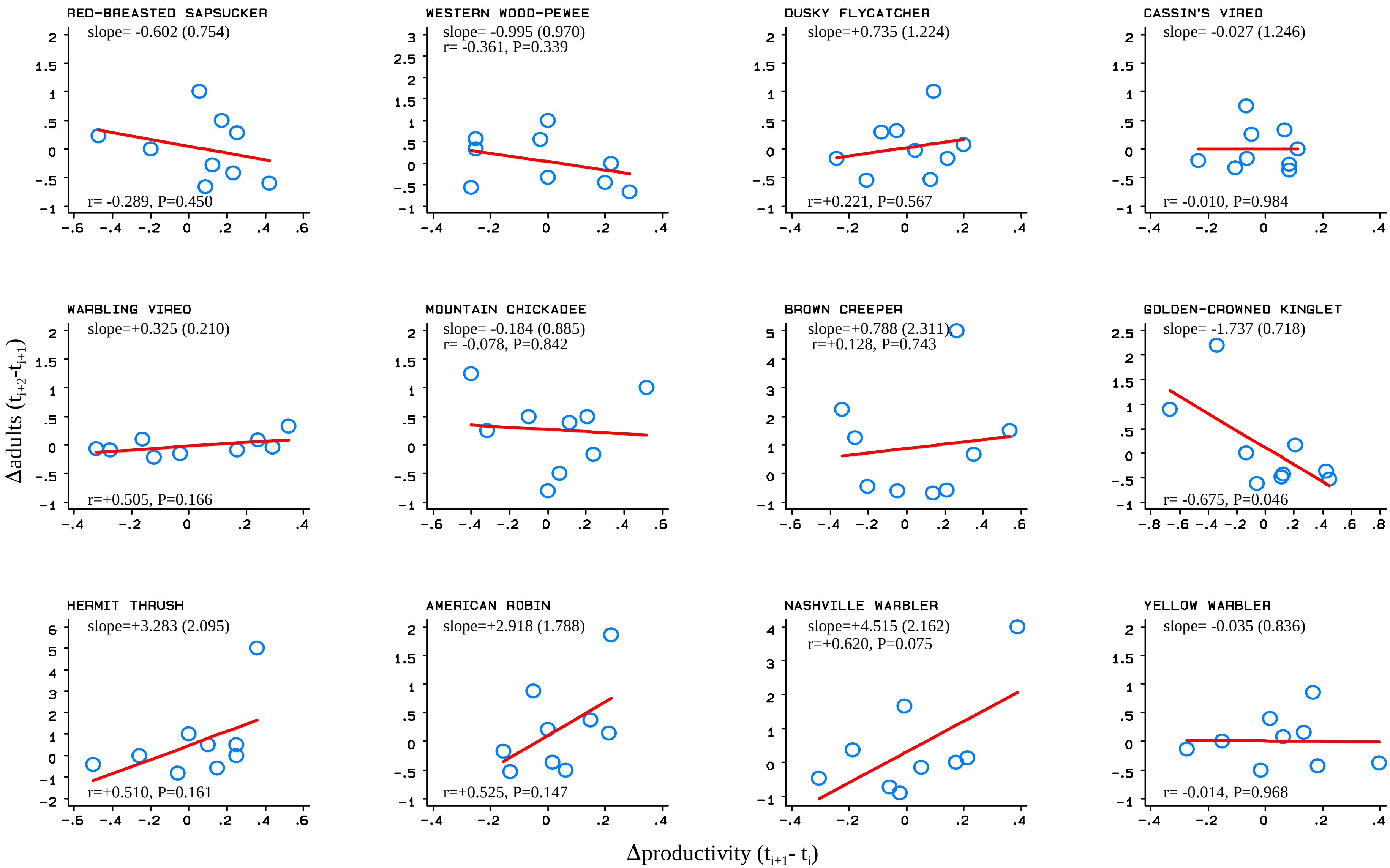


Figure 10. The regression of the proportional change in the number of adults between year i+2 and year i+1 on the absolute change in productivity between year i+1 and year i ("productivity/population correlation") for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the years 1993-2003. The constant-effort between-year changes were obtained from data pooled from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line, the standard error of the slope (in parentheses), the correlation coefficient (r), and significance of the correlation coefficient (P) are presented on each graph.

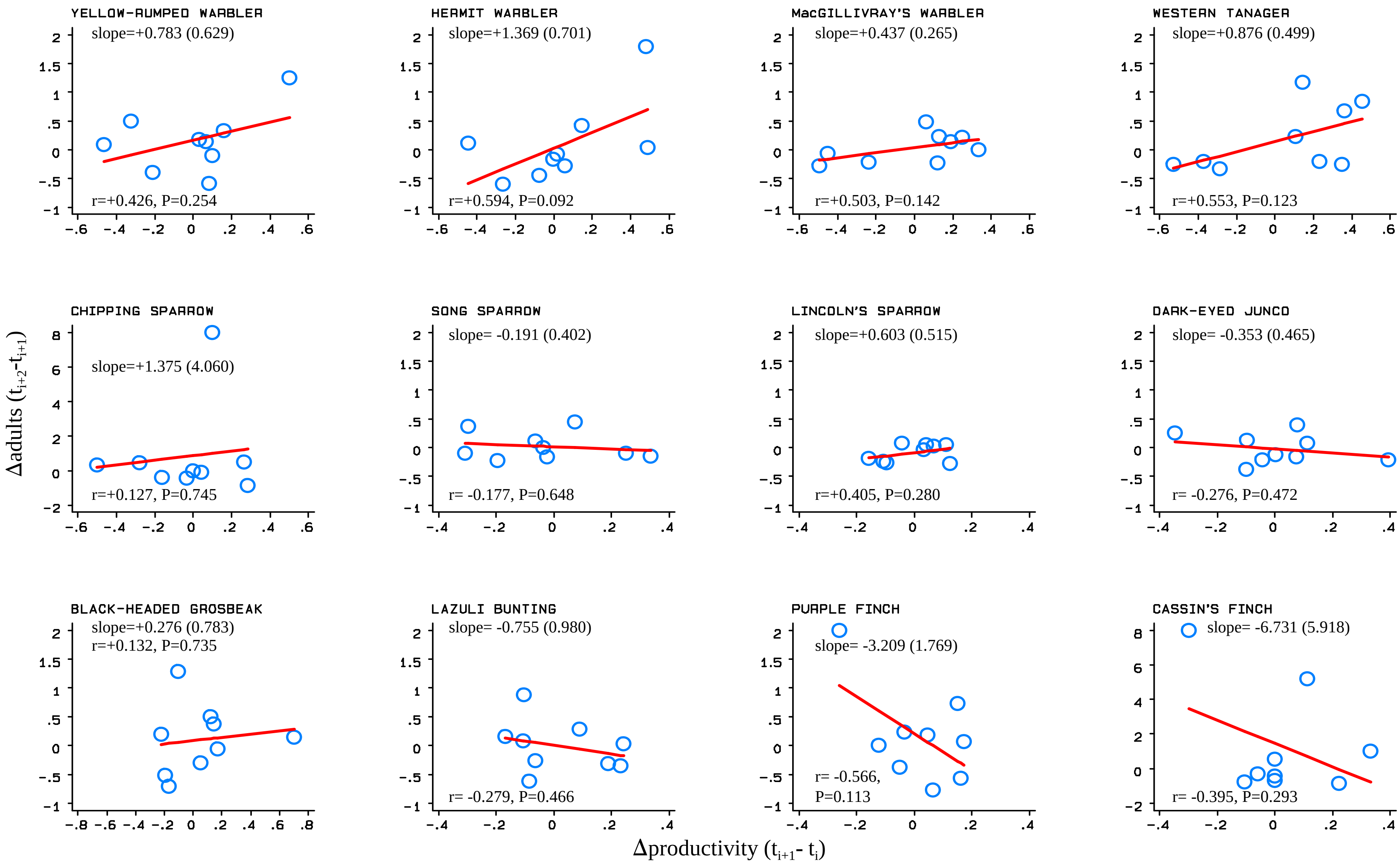


Figure 10. (cont.) The regression of the proportional change in the number of adults between year i+2 and year i+1 on the absolute change in productivity between year i+1 and year i ("productivity/population correlation") for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the years 1993-2003. The constant-effort between-year changes were obtained from data pooled from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line, the standard error of the slope (in parentheses), the correlation coefficient (r), and significance of the correlation coefficient (P) are presented on each graph.

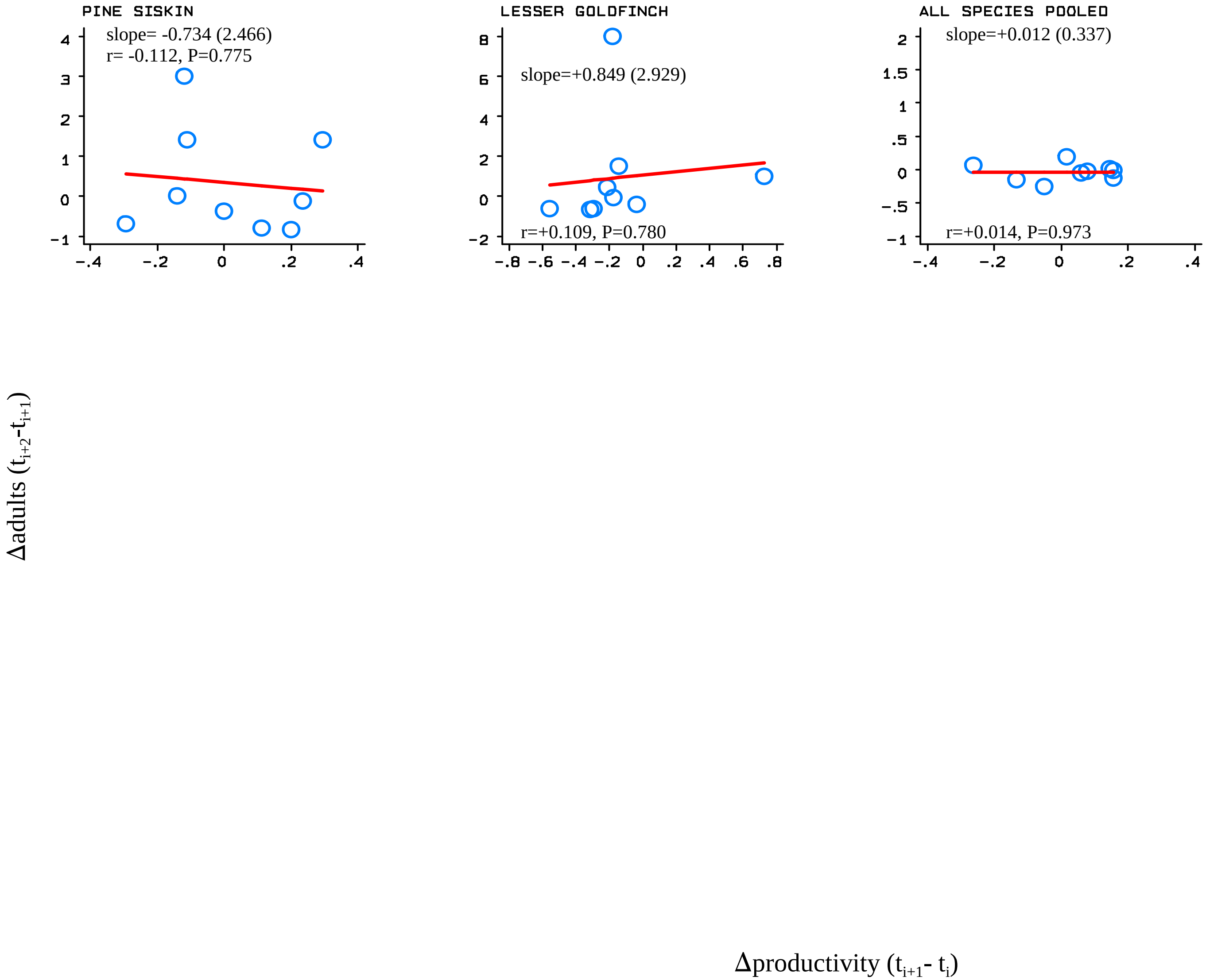


Figure 10. (cont.) The regression of the proportional change in the number of adults between year i+2 and year i+1 on the absolute change in productivity between year i+1 and year i ("productivity/population correlation") for 26 species and all species pooled at the **four long running** MAPS stations in Yosemite National Park over the years 1993-2003. The constant-effort between-year changes were obtained from data pooled from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line, the standard error of the slope (in parentheses), the correlation coefficient (r), and significance of the correlation coefficient (P) are presented on each graph.

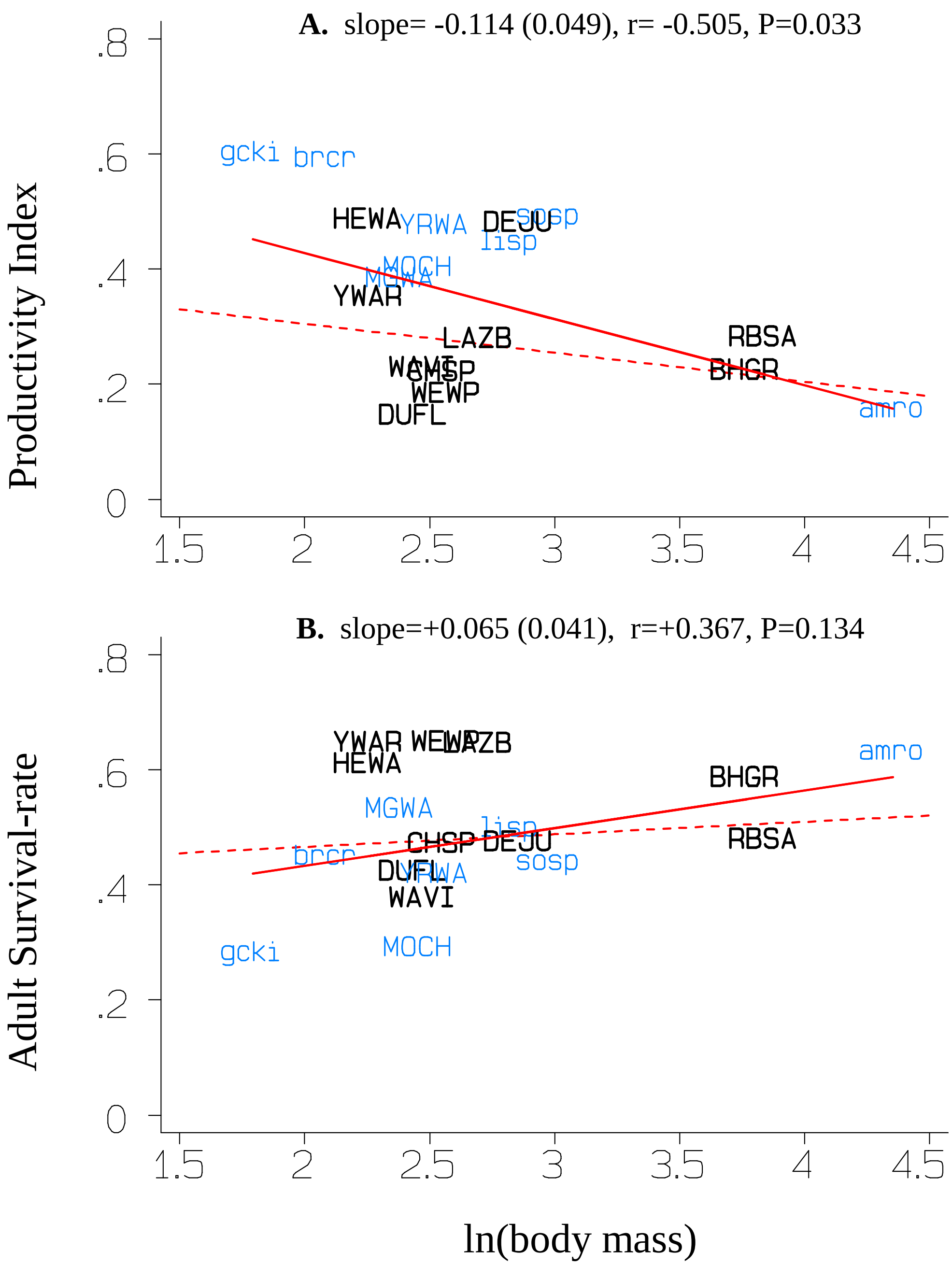


Figure 11. Regressions of mean productivity index (**A**) and time-constant annual adult survival rate (**B**) from data pooled from the five currently operating MAPS stations in Yosemite National Park on the natural log of body mass for 18 target species for the 11 years 1993-2003. Four-letter codes (see Appendix) in bold upper-case letters represent species that had decreasing population trends; those in non-bold upper-case letters had increasing population trends; and those in lower-case letters had highly fluctuating data without any substantial linear trend [SE(slope) > 0.29]. Regression lines are presented for the 18 target species in Yosemite National Park (solid line) and the for all species throughout all of North America (dashed line; see text). The slope, the r-value, and P-value are presented for the regression for the 18 target species in Yosemite.

Appendix. Numerical listing (in AOU checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 14 years, 1990-2003, of the MAPS Program on the six stations ever operated in Yosemite National Park.

NUMB	SPEC	SPECIES NAME
01300	TUVU	Turkey Vulture
01630	MALL	Mallard
01980	COME	Common Merganser
02020	OSPR	Osprey
02170	NOHA	Northern Harrier
02200	SSHA	Sharp-shinned Hawk
02210	COHA	Cooper's Hawk
02240	NOGO	Northern Goshawk
02380	RSHA	Red-shouldered Hawk
02460	RTHA	Red-tailed Hawk
02510	GOEA	Golden Eagle
02630	AMKE	American Kestrel
03000	BLUG	Blue Grouse
03040	WITU	Wild Turkey
03100	MOUQ	Mountain Quail
03130	CAQU	California Quail
03370	VIRA	Virginia Rail
05440	BTPI	Band-tailed Pigeon
05570	MODO	Mourning Dove
06670	WESO	Western Screech-Owl
06800	GHOW	Great Horned Owl
06830	NOPO	Northern Pygmy-Owl
06940	SPOW	Spotted Owl
06970	GGOW	Great Gray Owl
07040	NSWO	Northern Saw-whet Owl
07330	BLSW	Black Swift
07410	VASW	Vaux's Swift
07530	WTSW	White-throated Swift
08670	ANHU	Anna's Hummingbird
08690	CAHU	Calliope Hummingbird
08720	BTAH	Broad-tailed Hummingbird
08730	RUHU	Rufous Hummingbird
08740	ALHU	Allen's Hummingbird
08774	USHU	Unidentified Selasphorus Hummingbird
08775	UNHU	Unidentified Hummingbird
09110	BEKI	Belted Kingfisher
09390	LEWO	Lewis's Woodpecker
09430	ACWO	Acorn Woodpecker
09570	WISA	Williamson's Sapsucker
09600	RBSA	Red-breasted Sapsucker

Appendix. (cont.) Numerical listing (in AOU checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 14 years, 1990-2003, of the MAPS Program on the six stations ever operated in Yosemite National Park.

NUMB	SPEC	SPECIES NAME
09640	NUWO	Nuttall's Woodpecker
09650	DOWO	Downy Woodpecker
09660	HAWO	Hairy Woodpecker
09690	WHWO	White-headed Woodpecker
09710	BBWO	Black-backed Woodpecker
09800	RSFL	Red-shafted Flicker
09860	PIWO	Pileated Woodpecker
09915	UNWO	Unidentified Woodpecker
11340	OSFL	Olive-sided Flycatcher
11380	WEWP	Western Wood-Pewee
11475	TRFL	"Traill's" Flycatcher
11475	WIFL	Willow Flycatcher
11510	HAFL	Hammond's Flycatcher
11515	HDFL	Hammond's/Dusky Flycatcher
11520	GRFL	Gray Flycatcher
11530	DUFL	Dusky Flycatcher
11555	PSFL	Pacific-slope Flycatcher
11555	WEFL	"Western" Flycatcher
11595	UEFL	Unidentified Empidonax Flycatcher
11600	BLPH	Black Phoebe
11740	ATFL	Ash-throated Flycatcher
12020	WEKI	Western Kingbird
12085	UNFL	Unidentified Flycatcher
12710	CAVI	Cassin's Vireo
12740	HUVI	Hutton's Vireo
12760	WAVI	Warbling Vireo
12790	REVI	Red-eyed Vireo
12920	STJA	Steller's Jay
13110	WESJ	Western Scrub-Jay
13150	CLNU	Clark's Nutcracker
13190	AMCR	American Crow
13300	CORA	Common Raven
13410	TRES	Tree Swallow
13440	VGSW	Violet-green Swallow
13490	NRWS	Northern Rough-winged Swallow
13540	BARS	Barn Swallow
13555	UNSW	Unidentified Swallow
13580	MOCH	Mountain Chickadee
13600	CBCH	Chestnut-backed Chickadee
13640	OATI	Oak Titmouse

Appendix. (cont.) Numerical listing (in AOU checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 14 years, 1990-2003, of the MAPS Program on the six stations ever operated in Yosemite National Park.

NUMB	SPEC	SPECIES NAME
13680	BUSH	Bushtit
13690	RBNU	Red-breasted Nuthatch
13700	WBNU	White-breasted Nuthatch
13710	PYNU	Pygmy Nuthatch
13730	BRCR	Brown Creeper
14040	BEWR	Bewick's Wren
14070	HOWR	House Wren
14110	WIWR	Winter Wren
14205	UNWR	Unidentified Wren
14210	AMDI	American Dipper
14240	GCKI	Golden-crowned Kinglet
14250	RCKI	Ruby-crowned Kinglet
14570	WEBL	Western Bluebird
14590	TOSO	Townsend's Solitaire
14810	SWTH	Swainson's Thrush
14820	HETH	Hermit Thrush
15000	AMRO	American Robin
15110	WREN	Wrentit
15370	EUST	European Starling
15550	CEDW	Cedar Waxwing
15660	OCWA	Orange-crowned Warbler
15670	NAWA	Nashville Warbler
15750	YWAR	Yellow Warbler
15800	AUWA	Audubon's Warbler
15810	BTYW	Black-throated Gray Warbler
15840	TOWA	Townsend's Warbler
15850	HEWA	Hermit Warbler
16040	AMRE	American Redstart
16090	NOWA	Northern Waterthrush
16140	MGWA	MacGillivray's Warbler
16150	COYE	Common Yellowthroat
16280	HOWA	Hooded Warbler
16290	WIWA	Wilson's Warbler
16460	YBCH	Yellow-breasted Chat
16495	UNWA	Unidentified Warbler
16840	WETA	Western Tanager
17790	GTTO	Green-tailed Towhee
17810	SPTO	Spotted Towhee
18020	CHSP	Chipping Sparrow
18110	SAGS	Sage Sparrow

Appendix. (cont.) Numerical listing (in AOU checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 14 years, 1990-2003, of the MAPS Program on the six stations ever operated in Yosemite National Park.

NUMB	SPEC	SPECIES NAME
18130	SAVS	Savannah Sparrow
18220	FOSP	Fox Sparrow
18230	SOSP	Song Sparrow
18240	LISP	Lincoln's Sparrow
18290	MWCS	Mountain White-crowned Sparrow
18320	ORJU	Oregon Junco
18335	UNSP	Unidentified Sparrow
18600	RBGR	Rose-breasted Grosbeak
18610	BHGR	Black-headed Grosbeak
18660	LAZB	Lazuli Bunting
18670	INBU	Indigo Bunting
18730	RWBL	Red-winged Blackbird
18810	WEME	Western Meadowlark
18820	YHBL	Yellow-headed Blackbird
18860	BRBL	Brewer's Blackbird
18960	BHCO	Brown-headed Cowbird
19105	BUOR	Bullock's Oriole
19330	PIGR	Pine Grosbeak
19350	PUFI	Purple Finch
19360	CAFI	Cassin's Finch
19370	HOFI	House Finch
19375	UCFI	Unidentified Carpodacus Finch
19380	RECR	Red Crossbill
19430	PISI	Pine Siskin
19490	LEGO	Lesser Goldfinch
19500	LAGO	Lawrence's Goldfinch
19510	AMGO	American Goldfinch
19580	EVGR	Evening Grosbeak
19920	HOSP	House Sparrow
20085	UNBI	Unidentified Bird