

**Monitoring Avian Productivity and
Survivorship (MAPS) in Mount Revelstoke, Banff, Waterton Lakes
and Jasper National Parks (1993-2006)**



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Executive Summary

Overview

Canada's mountain national parks have a long history of bird study, from the early work by Banfield and Soper through the wildlife surveys included in the ecological land classifications for each of the parks, to a range of more recent work.

The objective of this report is to detect and compare trends in populations, productivity and survival of target species at four sites in the mountain national parks. The four MAPS banding stations were operated from 1993-2006 in accordance with the standardized banding protocols developed for the Monitoring Avian Productivity and Survivorship (MAPS) program throughout North America. Skunk Cabbage station operated in Mount Revelstoke National Park, British Columbia, from 1993-2002. Ranger Creek station was initiated in Banff National Park, Alberta, in 1999. Wishbone station was initiated in Waterton Lakes National Park, Alberta, in 2002. Pyramid Lake station was initiated in Jasper National Park, Alberta, in 2004. The latter three stations are still operating.

Trends in adult population size

Populations of adult birds of 14 species pooled at the four MAPS stations in the western Canadian national parks showed an increase of +0.2% per year over the 14 years, suggesting a total increase of +2.8% from 1993-2006. While adult populations of 10 of 14 target species showed declining trends, this was offset by significant increases in four other species. Declines were shown by: Ruby-crowned Kinglet, Veery, Yellow Warbler, Yellow-rumped Warbler, Northern Waterthrush, Common Yellowthroat, Wilson's Warbler, Fox Sparrow, Lincoln's Sparrow, and Dark-eyed Junco. Increases were shown by: "Traill's" Flycatcher, Warbling Vireo, American Robin, and Cedar Waxwing.

Population trends of the same 14 target species pooled, taken from Breeding Bird Survey (BBS) routes in Alberta and British Columbia (see Table 9; data from <http://www.mbr-pwrc.usgs.gov/bbs/bbs.html>), reflects that most of the trends were similar, although there were a few significant differences. Six of the 10 species showing declining populations at the MAPS stations also showed decline on the BBS routes, while trends for the other four species were equivocal, with opposite trends in the two provinces. Only one of the four species ("Traill's" Flycatcher) showing increasing populations at the MAPS stations also showed an increase on the BBS routes, one species (American Robin) had an opposite trend, and two species (Warbling Vireo and Cedar Waxwing) showed significantly higher increases at MAPS stations compared to declines or equivocal trends on BBS routes.

Trends in productivity

In contrast to population trends, trends of productivity of target species showed a highly significant ($P = 0.012$) increase of +0.038 when all stations were pooled. More species (nine) showed positive or stable trends than showed negative (five) trends. Productivity trends at Wishbone reflect that in the first year of operation of the station (2002) there were significant spring snowstorms that caused lots of mortality and virtually no productivity. Because 2002 was set as the base year for the indices, almost any amount of productivity would show an increase.

Survivorship

The estimated survival rate for adults for all three stations pooled (1993-2006) appears to be relatively good compared with values for the Northwestern MAPS Region as a whole (1992-2003). The mean survival for the 15 species pooled for all three stations (0.492) for which this comparison could be made

was 3.2% lower than that of the Northwest Region (0.524). Three species showed substantially higher (>10%) values for the mountain parks stations than in the Northwest Region (Wilson's Warbler, Lincoln's Sparrow and Black-capped Chickadee), while seven species (Warbling Vireo, Swainson's Thrush, Yellow Warbler, Yellow-rumped Warbler, Northern Waterthrush, Common Yellowthroat and Song Sparrow) showed substantially lower survival.

Assessment of trends

Based on all demographic data available, we made assessments as to whether population declines or increases were driven by productivity on the breeding grounds or adult survival presumably during migration or on the winter grounds, both or neither (Table 12). Assessments were based on a synthesis of population trends and significance, productivity trends and indices, and survival probability, relative to those in the Northwest Region of MAPS as a whole. Pyramid Lake was not included in this assessment because the three years of operations do not allow survival probabilities to be generated.

For most substantially decreasing species at the individual stations and at the three stations pooled, the population trend was slightly lower than that for the Northwest Region, productivity was generally lower but showing an increasing trend, and survival rate was lower for one species (Common Yellowthroat), equivalent for one species (Veery) and higher for two species (MacGillivray's Warbler and Least Flycatcher). This evidence suggests that lower-than-expected productivity may be the driving factor of the decline, but that this could improve over time if the positive trend continues. The only significantly declining species (Veery at Wishbone station) had decreasing productivity and equivalent survival, suggesting again that productivity is driving the decline.

For all three stations pooled, higher-than-expected productivity may also be driving the population trend for two ("Traill's" Flycatcher and Warbling Vireo) of the three significantly increasing species. Trend for the third species, Cedar Waxwing, is more difficult to assess because data was unavailable from the Northwest Region, but is possibly related to high numbers of adults being captured during irruptive years.

The analyses that we performed for all stations pooled should be interpreted with some caution, as the stations are quite separated spatially and were operated over different time periods. As trends for Wishbone and Pyramid Lake stations are based on only five and three years of data, respectively, they should be interpreted cautiously. As the stations gather more years of data, future estimates will be more robust.

Because the adult population levels are fairly stable it would appear that habitat at all of the stations is of good quality, as should be expected in national parks. The general increase in productivity would suggest that the habitat quality is improving because the adults that are present on the stations can produce more young per adult.

The data collected contributes to the assessment of native biodiversity for the terrestrial ecosystem indicator of the long-term monitoring program in the mountain national parks.

Acknowledgements

All data presented in this report were collected by station operators and their dedicated volunteers. Data management assistance was provided by The Institute for Bird Populations. Justin McKeown helped compile data tables. Station operators include:

- Skunk Cabbage station: Janice Jarvis, Elaine O’Neill, John Woods
- Ranger Creek station: Cyndi Smith, Ken Symington, Greg Meyer, Peter Duck
- Wishbone station: Cyndi Smith
- Pyramid Lake station: Brenda Dobson, Mike Wesbrook

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The Wishbone MAPS station is funded by Parks Canada, Waterton Lakes National Park.

The Pyramid Lake station thanks the Friends of Jasper National Park for funding, and Parks Canada for logistical support. Stefan Jungkind has been a dedicated lead bander and trainer over the past three years and they thank him for his efforts.

1.0 Introduction

1.1 Monitoring Landbirds in the Mountain National Parks

While songbirds are a small component of the overall biodiversity of Canada's national parks, they are the most diverse group of land vertebrates (Kehler and Samson 2005), and widely recognized as a potentially valuable indicator group (Moses et al. 2001). There are several advantages to using songbirds in ecosystem monitoring, including: 1) there is a high level of knowledge about their ecology, 2) they are affected by processes at a range of scales from local to continental and even global, 3) many species exhibit niche specialization that can make them sensitive to environmental change, 4) field methods for monitoring songbirds are well developed, and 5) there is strong public interest in birds. Monitoring the response of songbirds over time has the potential to track and better understand environmental change related to climate change, invasive species, altered disturbance regimes, and habitat fragmentation or degradation within or outside the parks, including at stopover or wintering sites for migrants (Kehler and Samson 2005).

Canada's mountain national parks have a long history of bird study, from the early work by Banfield (1953, 1954) and Soper (1968) through the wildlife surveys included in the ecological land classifications for each of the parks (Holroyd and Van Tighem 1983, Van Tighem and Gyug 1983, Wallis et al. 2002), to a range of more recent work (e.g., Chruszcz and Breniser 2003).

The objective of this report is to detect and compare trends in populations, productivity and survival of target species at four sites in Mount Revelstoke, Banff, Waterton Lakes and Jasper national parks. These sites are constant effort mist netting stations that are part of the Monitoring Avian Productivity and Survivorship (MAPS) program. The data contributes to the assessment of native biodiversity for the terrestrial ecosystem indicator of the long-term monitoring program in the mountain national parks.

1.2 Monitoring Avian Productivity and Survivorship (MAPS)

The MAPS program was established in 1989 by The Institute for Bird Populations (IBP), Point Reyes, California (DeSante and Nott 2001). Its goal is to provide long-term demographic data on landbirds as an aid in identifying the causal factors driving population trends documented by other avian monitoring programs such as the North American Breeding Bird Survey and Christmas Bird Counts. It is 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 stations during the breeding season.

The MAPS Program is a recommended survey in the Canadian Landbird Monitoring Strategy of the Canadian Wildlife Service (Anon. 1994).

1.3 Goals and Objectives of MAPS

The objective of MAPS is to provide long-term population and demographic information on target passerine species at various spatial scales by providing:

- annual indices and longer-term trends in adult population size and post-fledging productivity from analyses of numbers and proportions of adult and young birds captured during the breeding season; and
- annual estimates and longer-term trends of adult survivorship, adult population size, and recruitment into the adult population from analyses of mark-recapture data on adult birds gathered at these same stations.

These indices and estimates can be used to aid in:

- identifying the proximate causes of population changes in the target species;
- identifying conservation and management actions to reverse the population trends of declining species; and
- evaluating the effectiveness of the conservation and management actions implemented.

MAPS data has contributed to publications on survival rate estimates (DeSante et al. 1995), proximate demographic causes of population change (DeSante et al. 2001), and the influence of climate change on avian productivity in the Pacific Northwest (Nott et al. 2002).

The MAPS program divides the continent into eight major regions based on biogeographical and meteorological considerations. The stations in the Canadian mountain national parks fall into the Northwest Region (Fig. 1). For this region the IBP designated the following neotropical migrants, based on expert opinion, as being most common (i.e. providing enough data to allow statistical inferences to be made) or of most importance to monitor:

- Dusky Flycatcher
- Western Flycatcher complex
- Swainson's Thrush
- American Robin
- Warbling Vireo
- Orange-crowned Warbler
- Yellow Warbler
- MacGillivray's Warbler
- Wilson's Warbler
- Song Sparrow
- Lincoln's Sparrow
- "Oregon" Dark-eyed Junco

All of these species have been captured at the four mountain national parks MAPS stations and are included in analyses in this report. For a complete list of species captured at the four stations, and their scientific names, see Appendix A.

2.0 Methods

2.1 Establishment and Operation of Stations

Four MAPS banding stations were operated during the 14 years (1993-2006) in accordance with the standardised banding protocols developed for the MAPS Program throughout North America (DeSante et al. 2005). These stations (Table 1, Fig. 1) included:

- Skunk Cabbage (SKUN), located in Mount Revelstoke National Park in British Columbia, was set in a riparian shrubland with surrounding forest (Fig. 2) at 610 m elevation; operated from 1993-2002.
- Ranger Creek (RANG), located in Banff National Park in Alberta, is set in a mixed shrubland and grassland (Fig. 3) at 1,400 m elevation; operated from 1999-2006 and is ongoing.
- Wishbone (WISH), located in Waterton Lakes National Park in Alberta, is set in a wet cottonwood forest with a seasonally flooded shrub component (Fig. 4) at 1,300 m elevation; operated from 2002-2006 and is ongoing.

- Pyramid Lake (JNP), located in Jasper National Park in Alberta, is set in a wetland-meadow complex including an aspen stand (Fig. 5) at 1,000 m elevation; operated from 2004-2006 and is ongoing.

Ten net sites were established at each of the stations in their first year of operation and were operated at the exact same locations in subsequent years with the following exceptions:

- 1) At Ranger Creek the original 10 nets were operated in the first four years (1999-2002). One net site could not be operated in 2003 and it and another site were replaced by two new sites in 2004 and those 10 net sites were operated through 2006.
- 2) At Wishbone and Pyramid Lake two of the original net sites were dropped in the second season and replaced by two new sites.

One 12-m-long, 30-mm-mesh, nylon mist net was erected at each of the net sites on each day of operation. With few exceptions, each of the stations was operated for six morning hours per day (beginning at about local sunrise) during one day in each of seven consecutive 10-day periods between May 31 and August 8 or, for the highest-elevation station (Ranger Creek), for one day in each of six periods between June 10 and August 8. The Pyramid Lake station only operated five periods in their first year (2004). The Skunk Cabbage station operated an additional two 10-day periods in the years 1993-1996, operating up to August 28, as was MAPS protocol for those years. The data from these additional later periods are not included in any analyses. To facilitate constant-effort comparison of data, nets are opened, checked, and closed in a similar manner on all days of operation. This protocol was adjusted as required to minimise stress to captured birds.

2.2 Data Collection

With few exceptions, all birds captured at MAPS stations were identified to species, age, and sex. Unbanded birds were banded with USGS/BRD numbered aluminum bands. Birds were released immediately upon capture and before being banded or processed if situations arose where bird safety was compromised. Such situations could involve exceptionally large numbers of birds being captured at once, or the sudden onset of adverse weather conditions such as high winds or rainfall. As applicable to species/sex/age and condition on the captured birds, the following data were collected from all birds, including recaptures, according to MAPS guidelines, using standardized codes and forms (DeSante et al. 2005):

- capture code (newly banded, recaptured, band changed, unbanded)
- band number
- species
- age and how aged
- sex (if possible) and how sexed (if applicable)
- extent of skull pneumaticisation
- breeding condition of adults (i.e., extent of cloacal protuberance or brood patch)
- extent of juvenal plumage in young birds
- extent of body and flight-feather moult
- extent of primary-feather wear
- presence of moult limits and plumage characteristics
- wing chord
- fat class and body mass
- date and time of capture (net-run time)
- station and net site where captured

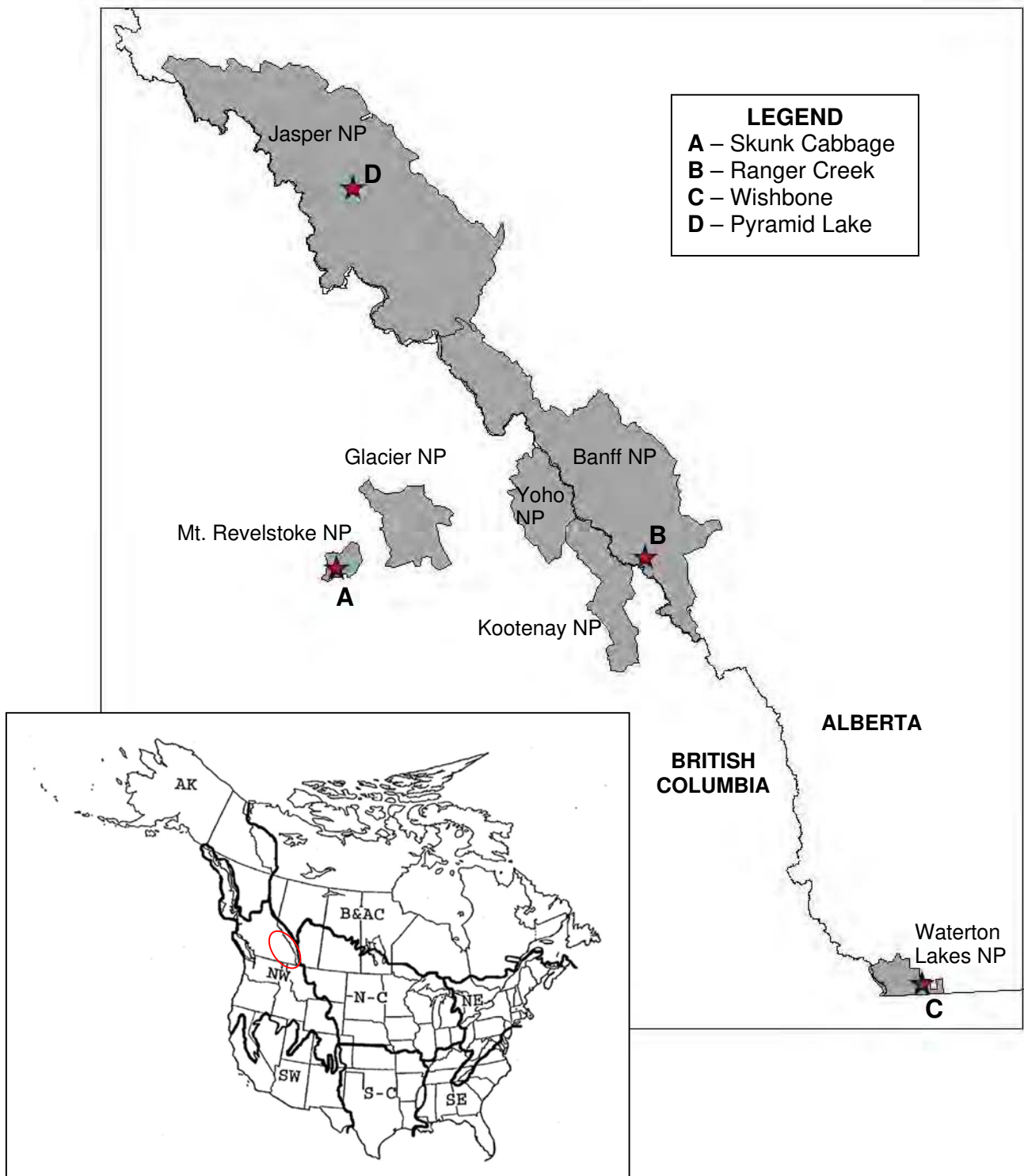


Figure 1. Location of MAPS stations (red stars) in Canadian mountain national parks (NP), 1992-2006, in the context of the eight MAPS regions in the continental USA and Canada (red oval).

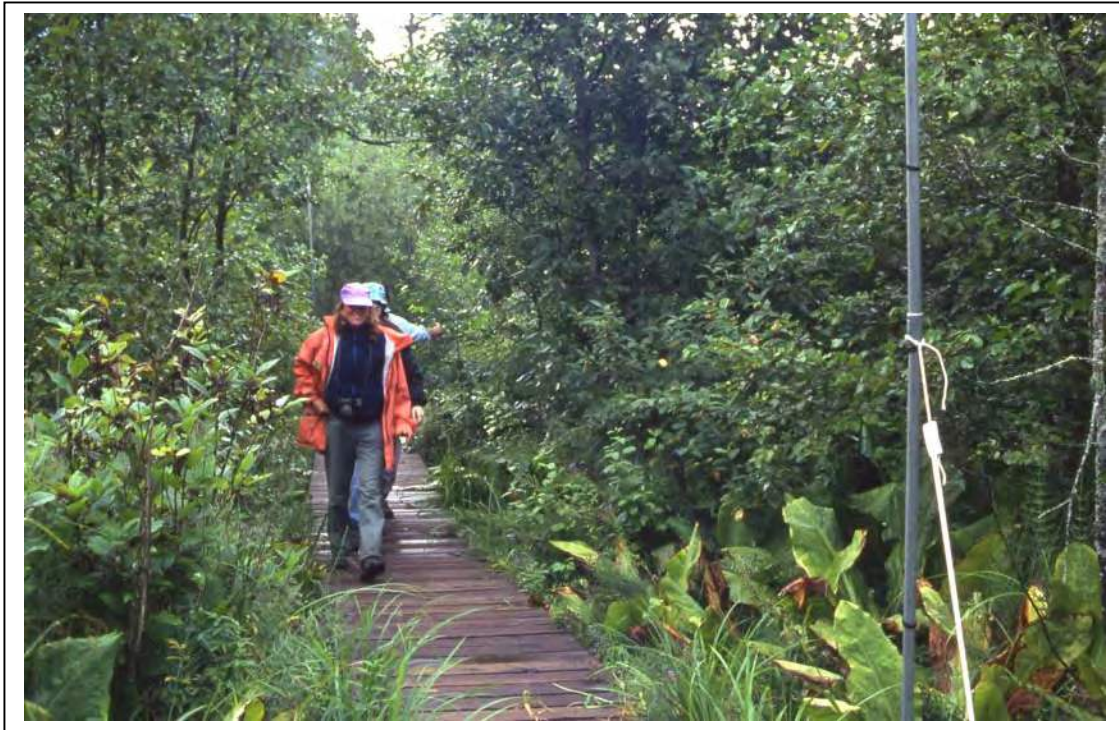


Figure 2. Typical habitat at Skunk Cabbage MAPS Station in Mount Revelstoke National Park, BC. Photo: Cyndi M. Smith.



Figure 3. Typical habitat at Ranger Creek MAPS Station in Banff National Park, AB. Photo: Cyndi M. Smith.



Figure 4. Typical habitat at Wishbone MAPS Station in Waterton Lakes National Park, AB. Photo: Cyndi Smith.

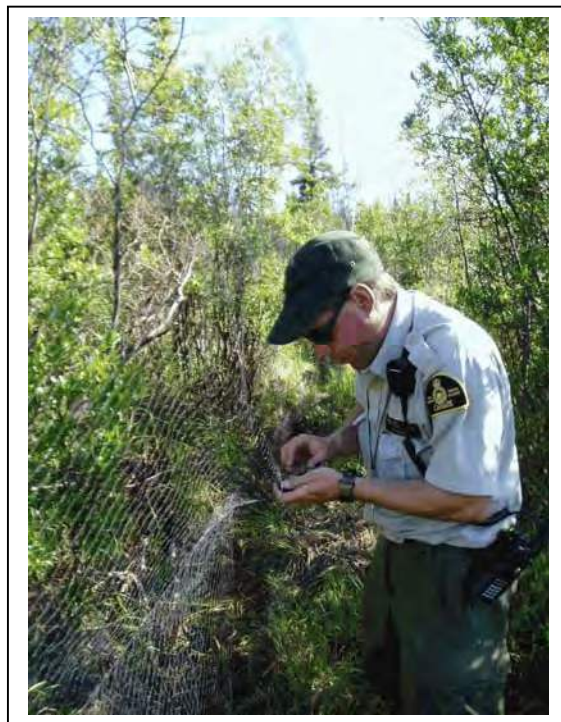


Figure 5. Typical habitat at Pyramid Lake MAPS Station in Jasper National Park, AB. Photo: Brenda Shepherd.

Effort data (i.e., the number and timing of net hours on each day of operation) were also collected in a standardised manner. In order to allow constant effort comparisons of data, 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 (summer residency) 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 four stations, simple habitat maps were prepared in at least one of the years of operation (indicating extent and location of major habitats, as well as structures, roads, trails, and streams) and were checked and updated where necessary. 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 in the MAPS Habitat Structure Assessment Protocol (Nott et al. 2003).

2.3 Data Entry and Verification

The computer entry of all banding data was either completed by the station operator using the computer program MAPSPROG (Froehlich et al. 2006) or 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, breeding status, and vegetation data was completed by the operator using MAPSPROG (Froehlich et al. 2006) or IBP biologists using custom data entry programs. All banding data were then run through a series of verification programs as follows:

- Clean-up programs to check the validity of all codes entered and the ranges of all numerical data.
- Cross-check programs to compare station, date, and net fields from the banding data with those from the summary of mist netting effort data.
- Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticisation, breeding condition (extent of cloacal protuberance and brood patch), and extent of body and flight-feather moult, primary-feather wear, and juvenal plumage.
- Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species.
- 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 are used as supplementary information for the correct determination of species, age, and sex in all of these verification processes.

2.4 Data Analysis

All species encountered at the station were classified into six 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.
- a migrant (M) if the station was not located within the overall breeding range of the species. This category includes extralimital breeders, i.e., the species bred at the station but the station was outside the normal breeding range for the species.

Since banding allowed unique identification of individuals, the total number of individual birds captured of each species could be calculated on a yearly basis. For species with a B, U, and O residency status at a particular station, we calculated an index of birds per 600 net-hours. For each species with a B or U status at a particular station, we used the data in population and productivity trends and survivorship analyses. By using data only from stations that lie within the breeding range of the species, the capture rates can be compared among stations even when they operate for differing lengths of time because of elevation, safety issues or the vagaries of weather.

Throughout this report we define "target species" for trend and survivorship analyses as those for which an average of 2.5 individual adult birds were captured per year. For the three long-running stations combined, a total of 21 species met this requirement and were termed target species. For survivorship analyses, an additional requirement for including a target species in the analysis was that at least two returns were recorded.

2.4.1 Adult population indices and productivity analyses

The proofed, verified, and corrected banding data from all 14 years were run through a series of analysis programs that calculated for each species:

- the mean numbers and capture rates (per 600 net-hours) of first captures (in a given year) of individual adult and young birds.
- the mean reproductive index. Following the procedures pioneered by the British Trust for Ornithology (BTO) in their CES Scheme (Peach et al. 1996), we used the number of adult birds captured as an index of adult population size. For each species each year, we calculated a yearly reproductive index as the number of young divided by the number of adults. Years for which the reproductive index was undefined for a species, i.e., no adults of that species were captured in that year, are not included in the mean reproductive index for that species.

If a station was operated for multiple days within a single period (usually because weather precluded finishing a period on the scheduled day) only data from the first day were included in the means and in trend analyses.

2.4.2 Analyses of trends in adult population size and productivity

For each target species and for all species pooled we examined multi-year trends (10-year trends at Skunk Cabbage, eight-year trends at Ranger Creek, five-year trends at Wishbone, three-year trends at Pyramid Lake, and 14-year trends at the four stations combined) in adult (after hatch year) population size and productivity (reproductive index). Year-to-year comparisons were made in a "constant effort" manner by means of an analysis program (DeSante and Kaschube 2006) that used actual net run (capture) times and

net opening and closing times on a net-by-net and period-by-period basis. We only included captures for net/time period combinations that were consistently sampled across the years the station operated. For trends in population size, we first calculated adult population indices for each species for each of the years based on an arbitrary starting index of 1.0 in the first year of station operation (1993 for all stations pooled or the first year of station operation for the individual station analyses). The constant effort changes were used to calculate "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:

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

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. 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, 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 .

Trends for species in which the number of adult individuals were zero in one or more years cannot be graphed using the "chained" indices method and are not included in this report. However, to accommodate species not found at the Skunk Cabbage station, trends for 10 species begin in 1999 when the Ranger Creek station began operations.

We present the APC , the standard error of the slope (SE), the correlation coefficient (r), and the significance of the correlation (P) to describe each trend. The values used to define a "substantially" changing species is dependent on the number of years included in the trend. For trends greater than 10 years, species for which $r > 0.3$ are considered to have a substantially increasing trend, those for which $r < -0.3$ are considered to have a substantially decreasing trend, those for which absolute $r < 0.3$ and $SE < 0.029$ are considered to have a non-substantial and non-fluctuating trend, and those for which absolute $r < 0.3$ and $SE > 0.029$ are considered to have non-substantial, widely fluctuating trends. For trends of 6-10 years the threshold is increased to $r = 0.5$ and a $SE = 0.055$ and for five or fewer years the threshold is increased to $r = 0.7$ and a SE of 0.07, to reflect the greater uncertainty with shorter trend periods.

Trends in productivity, PrT , for all stations combined, were calculated in an analogous manner by starting with actual productivity values (i.e., the number of hatch year birds captured per adult of the same species) in the first year of operation 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 of the regression line (PrT) and its standard error (SE) are presented, along with the correlation coefficient (r), and the significance of the correlation (P), are shown on each figure. Productivity trends are characterized in a manner analogous to that for population trends, except that, for non-substantial trends, we do not attempt to distinguish between those that are widely fluctuating and those that are non-fluctuating. Trends in productivity are only presented for those species for which a trend in adults was calculated.

2.4.3 Survivorship analyses

Modified Cormack Jolly Seber (CJS) mark recapture analyses (Pollock et al. 1990; Lebreton et al.1992) were conducted on the target species for station specific analyses for Skunk Cabbage, Ranger Creek, and Wishbone and for those three stations pooled. For the station-specific analyses capture histories of adult birds included 10 years (1993-2002) of data at Skunk Cabbage, eight years (1999-2006) at Ranger Creek,

and five years at Wishbone. For the three longer running stations combined, the capture histories of adult birds included a total of 14 years (1993-2006) of data. Using the computer program TMSURVIV (White 1983; Hines et al. 2003), we calculated, for each target species, maximum likelihood estimates and standard errors (*SEs*) 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; Hines et al. 2003). 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). Four years of data are required to apply the transient model, so a non-transient model was applied to the data from the three years (2004-2006) at the Pyramid Lake station. 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. Although 14 years of data would allow 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 time-constant models that produced estimates for both survival and recapture probability that were neither 0 nor 1 and for which the proportion of residents was not 0.

3.0 Results

3.1 Indices of Adult Population Size and Post-fledging Productivity

The capture summary of the numbers of newly banded, unbanded and recaptured adult birds of each species is presented for Skunk Cabbage (Table 2), Ranger Creek (Table 3), Wishbone (Table 4) and Pyramid Lake (Table 5). A total of 4864 captures of 77 species were recorded from all stations and years combined. Newly banded birds comprised 62% of the total captures. The highest species richness among stations occurred at Ranger Creek (58) and the lowest species richness occurred at Pyramid Lake (38).

In Table 6 we compare the capture summaries of Ranger Creek, Wishbone and Pyramid Lake for the three years that they operated at the same time (2004-2006). Newly banded birds comprised 66% of the total captures. The greatest number of total captures (580) was recorded at Pyramid Lake, followed by Ranger Creek (444) and Wishbone (419). Species richness was the same for Ranger Creek and Pyramid Lake (37) followed closely by Wishbone (36) during 2004-2006, although over its period of operation (1999-2006) Ranger Creek has recorded 58 species.

3.2 Mean Indices of Adult Population Size and Post-fledging Productivity

Mean annual numbers (per 600 net-hours) of individual adult and young birds and the reproductive index, at the four individual stations and the three longer-running stations (Skunk Cabbage, Ranger Creek, and Wishbone) for each species and for all species pooled, are presented in Table 7, for all years in which each station operated.

The all-species-pooled values at the bottom of the table indicate that the highest capture rates occurred at Pyramid Lake (243.6 adults/600 net-hours), followed in descending order by Ranger Creek (216.3), Skunk Cabbage (193.6) and Wishbone (128.1). The capture rate of young of all species pooled at each station was also highest at Pyramid Lake (95.8 young/600 net-hours), followed in descending order by Ranger Creek (69.2), Skunk Cabbage (48.2) and Wishbone (22.3). Reproductive index (the number of young per adult) was correspondingly greatest at Pyramid Lake (0.38), followed in descending order by Ranger Creek (0.35), Skunk Cabbage (0.24) and Wishbone (0.17).

Species richness of adults followed a different sequence, being highest at Ranger Creek (46), followed by

Skunk Cabbage (40), Wishbone (34) and Pyramid Lake (32). Species richness of young birds was quite different, being highest at Skunk Cabbage (33), followed by Ranger Creek (30), Pyramid Lake (28) and Wishbone (18).

The most abundant species at the three MAPS stations pooled (Skunk Cabbage, Ranger Creek and Wishbone), with overall capture rates greater than 6.0 adults/600 net-hours were, in descending order, MacGillivray's Warbler, Yellow Warbler, Song Sparrow, Common Yellowthroat, Cedar Waxwing, "Traill's" Flycatcher¹, Swainson's Thrush and Veery. Overall, total species richness for the three stations was 62 species, while the mean number of adults captured was 185.4 per 600 net-hours, and the mean reproductive index was 0.27 young per adult over the entire period.

3.3 Multi-year Trends in Adult Population Size

Chain indices of adult population size are presented for target species and all species pooled for all four stations combined (Fig. 6), and for each individual station (Figs. 7-10) (see also Table 8). For Skunk Cabbage we show 10-year trends, 1993-2002 (Fig. 7); for Ranger Creek we show eight-year trends, 1999-2006 (Fig. 8); for Wishbone we show five-year trends, 2002-2006 (Fig. 9); and for Pyramid Lake we show the three-year trend (Fig. 10). The annual percentage change (*APC*) in the index of adult population size was used as the measure of the mean annual population trend. These estimates of *APC*, 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.

Fourteen-year (1993-2006) population trends for 14 species and all species pooled at the four stations combined are shown in Figure 6. Common Yellowthroat was the only substantially declining species ($r < -0.3$ for those with 14-year trends and $r < -0.5$ for those with eight-year trends) but the trend was not significant. Substantially increasing trends ($r > 0.3$ or 0.5 , depending) were highly significant for Cedar Waxwing, and significant for "Traill's" Flycatcher and Warbling Vireo. Populations of Ruby-crowned Kinglet, Veery, Yellow Warbler, Yellow-rumped Warbler, Fox Sparrow and Dark-eyed Junco showed non-substantial (absolute $r < 0.3$ for those with 14-year trends and absolute $r < 0.5$ for those with eight-year trends) but substantially fluctuating trends (SE of the slope ≥ 0.021 for those with 14-year trends and ≥ 0.055 for those with eight-year trends). American Robin, Northern Waterthrush and Lincoln's Sparrow showed non-substantial and not substantially fluctuating trends. Overall, 10 of the 14 species showed negative trends and four showed positive trends. The 14-year trend of all species pooled represented a non-substantial ($r = 0.046$), not significant ($P = 0.876$) increase of +0.2% per year, suggesting that total populations of land birds at the four sites may have increased by 2.8% over the period.

At Skunk Cabbage (Fig. 7), only one of 11 species (MacGillivray's Warbler) showed a substantial decline ($r \leq -0.3$ for the 14-year trend), but it was not significant. Substantial increases in Warbling Vireo populations were highly significant, Veery was nearly significant, while "Traill's" Flycatcher was not significant. Populations of the remaining seven species (Red-eyed Vireo, Swainson's Thrush, Cedar Waxwing, Yellow Warbler, American Redstart, Common Yellowthroat, and Song Sparrow) showed non-substantial and substantially fluctuating trends. Overall, five of the 11 species showed negative trends, five species showed positive trends, and one trend was flat. The 14-year trend of all species pooled represented a nearly substantial ($r = 0.299$), but not significant ($P = 0.401$) increase of +1.9% per year, suggesting that total populations of land birds at Skunk Cabbage may have increased by 27% over the period.

¹ The term "Traill's" Flycatcher is used when Alder and Willow flycatchers can not be distinguished in the hand.

At Ranger Creek (Fig. 8), two of 11 species (Warbling Vireo and Common Yellowthroat) showed substantial declines ($r < -0.5$ for the eight-year trend), but neither were significant. Substantial increases ($r > 0.5$) in Lincoln's Sparrow were not significant. Populations of Ruby-crowned Kinglet, Yellow Warbler, Yellow-rumped Warbler, Fox Sparrow and Dark-eyed Junco showed non-substantial and substantially fluctuating trends. "Traill's" Flycatcher, Northern Waterthrush and Wilson's Warbler showed non-substantial and not substantially fluctuating trends. Overall, seven of the 11 species showed negative trends while four of the 11 species showed positive trends. The eight-year trend of all species pooled represented a non-substantial, not significant ($P = 0.867$) decrease of -0.7% per year, suggesting that total populations of land birds at Ranger Creek may have decreased by 6% over the period.

At Wishbone (Fig. 9), Veery populations showed a substantial decline ($r < -0.70$ for the five-year trend) which was significant, while Least Flycatcher and House Wren showed substantial, but not significant declines. Red-naped Sapsucker populations showed a substantial increase ($r > 0.70$) which was significant, while Cedar Waxwing populations showed a substantial but not significant increase. Populations of Black-capped Chickadee, American Robin, Gray Catbird, and Northern Waterthrush trends were non-substantial and substantially fluctuating, while Yellow Warbler populations were non-substantial and not substantially fluctuating. The 5-year trend of all species pooled represented a substantial ($r = -0.849$), not significant ($P = 0.069$) decrease of -5.4% per year, suggesting that total populations of land birds at Wishbone may have decreased by 27% over the period. **As these trends are based on only five years of data, they should be interpreted cautiously.**

At Pyramid Lake (Fig. 10), four of the 12 species (Black-capped Chickadee, Orange-crowned Warbler, Chipping Sparrow, and Dark-eyed Junco) showed substantial declines ($r < -0.70$ for three-year trends), but none were significant. Substantial increases in Least Flycatcher populations were significant, while Ruby-crowned Kinglet, Swainson's Thrush, Common Yellowthroat, and Lincoln's Sparrow populations showed a substantial ($r > 0.70$) but not significant increase. Populations of Dusky Flycatcher, Tennessee Warbler and Wilson's Warbler showed non-substantial but substantially fluctuating trends. The three-year trend of all species pooled represented a substantial, but not significant ($P = 0.407$) increase of 8.6% per year, suggesting that total populations of land birds at Pyramid Lake may have increased by 26% over the period. **As these trends are based on only three years of data, they should be interpreted cautiously.**

The longest-running station, Skunk Cabbage, showed an increase of +1.9% per year over their 10 years of operation, suggesting a total increase of +19% from 1993-2002. Ranger Creek showed a decrease of -0.7% over their eight years of operation, suggesting a total decrease of -5.6% from 1999-2006. Wishbone showed a substantial decrease of -5.4% over their five years of operation, suggesting a total decrease of -27% from 2002-2006. Pyramid lake showed a substantial increase of +8.6% over their three years of operation, suggesting a total increase of +25.8% from 2004-2006.

Population trends for Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake, and for all stations pooled, are compared with short-term (1993-2005) trends for the Breeding Bird Survey routes for Alberta and British Columbia (Table 9).

3.4 Multi-year Trends in Productivity

Chain indices of productivity are shown for all stations combined (Fig. 11) for target species and all species pooled, and for each individual station (Figs. 12-15) (see also Table 10).

Fourteen-year (1993-2006) productivity trends for 14 species and all species pooled at the four stations combined are shown in Figure 11. Substantially declining trends ($r \leq -0.3$ for those with 14-year trends and $r \leq -0.5$ for those with eight-year trends) were only significant for Veery. Substantially increasing trends ($r \geq 0.3$) were highly significant for Common Yellowthroat. Yellow-rumped Warbler populations

had a nearly substantial and nearly significant increase. Populations of Alder Flycatcher, Warbling Vireo, Ruby-crowned Kinglet, American Robin, Yellow Warbler, Northern Waterthrush, Wilson's Warbler, Fox Sparrow, Lincoln's Sparrow, and Dark-eyed Junco showed non-substantial (absolute $r < 0.3$ for 14-year trends and absolute $r < 0.5$ for eight-year trends) and substantially fluctuating (SE of the slope ≥ 0.021) trends, while Cedar Waxwing was not substantially fluctuating. Overall, five of the 14 species showed negative trends, eight showed positive trends, and one trend was flat. The productivity trend for all species pooled indicated an average annual increase of 0.038 ($SE = 0.013$) per year.

Fourteen-year (1993-2006) productivity trends for 11 species and all species pooled for Skunk Cabbage are shown in Figure 12. Non-significant substantially declining trends were found for "Traill's" Flycatcher and Warbling Vireo, while non-significant substantially increasing trends were found for MacGillivray's Warbler and Common Yellowthroat. Swainson's Thrush, Yellow Warbler and Song Sparrow showed non-substantial and substantially fluctuating trends, while Red-eyed Vireo, Veery, Cedar Waxwing and American Redstart were not substantially fluctuating. Overall, four of the 11 species showed negative trends and seven showed positive trends. The productivity trend for all species pooled indicated an average annual increase of 0.014 ($SE = 0.021$) per year.

Eight-year (1999-2006) productivity trends for 11 species and all species pooled for Ranger Creek are shown in Figure 13. Trends for Common Yellowthroat were substantially and significantly increasing, while those for Yellow-rumped Warbler were nearly significant, and trends for Warbling Vireo were increasing but not significantly. Trends for Yellow Warbler were decreasing but not significantly. Non-substantial, fluctuating trends were shown for "Traill's" Flycatcher, Ruby-crowned Kinglet, Wilson's Warbler, Fox Sparrow, Lincoln's Sparrow and Dark-eyed Junco. Northern Waterthrush had a non-substantial and non-fluctuating trend. Overall, four of the 11 species showed negative trends, while seven showed positive trends. The productivity trend for all species pooled indicated an average annual increase of 0.030 ($SE = 0.054$) per year.

Five-year (2002-2006) productivity trends for 10 species and all species pooled for Wishbone are shown in Figure 14. There were no substantially decreasing trends, but Black-capped Chickadee populations showed a substantially increasing though not significant trend. Populations of Red-naped Sapsucker, House Wren, Gray Catbird and Yellow Warbler showed non substantial but substantially fluctuating trends. Populations of Least Flycatcher, Veery, American Robin, Cedar Waxwing, and Northern Waterthrush showed non substantial and not substantially fluctuating trends. Overall, three of the 10 species showed negative trends, four showed positive trends and three showed no trend. The productivity trend for all species pooled indicated an average annual increase of 0.042 ($SE = 0.010$) per year.

Three-year (2004-2006) productivity trends for 12 species and all species pooled for Pyramid lake are shown in Figure 15. Substantially decreasing, but not significant, trends were recorded for Least Flycatcher and Swainson's Thrush. Substantially increasing, but not significant, trends were recorded for Dusky Flycatcher, Black-capped Chickadee, Ruby-crowned Kinglet, Common Yellowthroat, and Dark-eyed Junco. Tennessee Warbler, Orange-crowned Warbler, Wilson's Warbler and Lincoln's Sparrow showed non-substantial but substantially fluctuating trends, while the Chipping Sparrow trend was non substantial and non-fluctuating. Overall, four of the 12 species showed a negative trend, seven showed a positive trend, and one trend was flat. The productivity trend for all species pooled indicated an average annual increase of 0.056 ($SE = 0.194$) per year.

3.5 Estimates of Adult Survivorship

We were able to obtain estimates of adult survival and recapture probabilities (Table 11) using transient models for seven species at Skunk Cabbage, eight species at Ranger Creek, four species at Wishbone, and 15 species at these three stations pooled. We were not able to estimate adult survival rates at Pyramid

Lake because only three years of data were available, and four years of data are required for the survival analysis using the transient model. We present time-constant estimates of annual adult survival, recapture probability, and proportion of residents. Table 11 also includes survival rates for the same species in the Northwest Region of MAPS as a whole.

Estimates of annual adult survival rate for all three stations pooled ranged from a low of 0.304 for Yellow-rumped Warbler to a high of 0.689 for Wilson's Warbler, with a mean of 0.492. Recapture probability varied from a low of 0.092 for Lincoln's Sparrow to a high of 0.731 for Common Yellowthroat, with a mean of 0.461. Proportion of residents varied from a low of 0.095 for "Traill's" Flycatcher to a high of 1.0 for Song Sparrow, and averaged 0.456.

At Skunk Cabbage estimates of annual adult survival rate ranged from a low of 0.315 for Common Yellowthroat to a high of 0.737 for Veery, with a mean of 0.516. Recapture probability varied from a low of 0.215 for Red-eyed Vireo to a high of 0.790 for Common Yellowthroat, with a mean of 0.492. Proportion of residents varied from a low of 0.284 for MacGillivray's Warbler to a high of 1.0 for Song Sparrow, and averaged 0.641.

At Ranger Creek estimates of annual adult survival rate ranged from a low of 0.252 for Yellow Warbler to a high of 0.734 for Lincoln's Sparrow, with a mean of 0.502. Recapture probability varied from a low of 0.105 for Lincoln's Sparrow to a high of 0.604, with a mean of 0.388. Proportion of residents varied from a low of 0.135 for Common Yellowthroat to a high of 0.746 for Yellow Warbler, and averaged 0.357.

At Wishbone estimates of annual adult survival ranged from a low of 0.548 for Veery to a high of 0.717 for Least Flycatcher, with a mean of 0.650. Recapture probability varied from a low of 0.093 for Gray Catbird to a high of 0.727 for Veery, with a mean of 0.362. Proportion of residents varied from a low of 0.390 for Veery to a high of 1.0 for Gray Catbird, and averaged 0.595.

4.0 Discussion and Conclusions

4.1 Population and Productivity Trends

Populations of adult birds of 14 species pooled at the four MAPS stations in the western Canadian national parks showed an increase of +0.2% per year over the 14 years, suggesting a total increase of +2.8% from 1993-2006. While adult populations of 10 of 14 target species showed declining trends, this was offset by significant increases in four other species. Declines were shown by: Ruby-crowned Kinglet, Veery, Yellow Warbler, Yellow-rumped Warbler, Northern Waterthrush, Common Yellowthroat, Wilson's Warbler, Fox Sparrow, Lincoln's Sparrow, and Dark-eyed Junco. Increases were shown by: "Traill's" Flycatcher, Warbling Vireo, American Robin, and Cedar Waxwing.

Population trends of the same 14 target species pooled, taken from Breeding Bird Survey (BBS) routes in Alberta and British Columbia (see Table 9; data from <http://www.mbr-pwrc.usgs.gov/bbs/bbs.html>), reflects that most of the trends were similar, although there were a few significant differences. Six of the 10 species showing declining populations at the MAPS stations also showed decline on the BBS routes, while trends for the other four species were equivocal, with opposite trends in the two provinces. Only one of the four species ("Traill's" Flycatcher) showing increasing populations at the MAPS stations also showed an increase on the BBS routes, one species (American Robin) had an opposite trend, and two species (Warbling Vireo and Cedar Waxwing) showed significantly higher increases compared to declines, or equivocal trends. Cedar Waxwing is an irruptive species, so data from a few irruptive winters could have resulted in the increasing trend.

Substantial declines for Common Yellowthroat at Ranger Creek may reflect a change in habitat, where a beaver dam was flooded out, and then abandoned in 2005. Substantial declines for three species (Least Flycatcher, House Wren and Veery) at Wishbone station and four species (Black-capped Chickadee, Orange-crowned Warbler, Chipping Sparrow and Dark-eyed Junco) at Pyramid Lake station should be interpreted cautiously, as these stations have only been operated for five and three years, respectively.

In contrast to population trends, trends of productivity of target species showed a highly significant ($P = 0.012$) increase of +0.038 when all stations were pooled. More species (nine) showed positive or stable trends than showed negative (five) trends. Productivity trends at Wishbone reflect that in the first year of operation of the station (2002) there were significant spring snowstorms that caused considerable mortality and virtually no productivity. Because 2002 was set as the base year for the indices, almost any amount of productivity would show an increase.

4.2 Survival Rates

The estimated survival rate for adults for all three stations pooled (1993-2006) appears to be relatively good compared with values for the Northwestern MAPS Region as a whole (1992-2003; see <http://www.birdpop.org/nbii/surv/default.asp>). The mean survival for the 15 species pooled for all three stations (0.492) for which this comparison could be made was 3.2% lower than that of the Northwest Region (0.524). Three species showed substantially higher (>10%) values for the mountain parks stations than in the Northwest Region (Wilson's Warbler, Lincoln's Sparrow and Black-capped Chickadee), while seven species (Warbling Vireo, Swainson's Thrush, Yellow Warbler, Yellow-rumped Warbler, Northern Waterthrush, Common Yellowthroat and Song Sparrow) showed substantially lower survival.

4.3 Causes of Population Changes

Based on all demographic data available, we made assessments as to whether population declines or increases were driven by productivity on the breeding grounds or adult survival presumably during migration and/or on the winter grounds, both or neither (Table 12). Assessments were based on a synthesis of population trends and significance, productivity trends and indices, and survival probability, relative to those in the Northwest Region of MAPS as a whole. Pyramid Lake was not included in this assessment because the three years of operations did not allow survival probabilities to be generated.

For most substantially decreasing species at the individual stations and at the three stations pooled, the population trend was slightly lower than that for the Northwest Region, productivity was generally lower but showing an increasing trend, and survival rate was lower for one species (Common Yellowthroat), equivalent for one species (Veery) and higher for two species (MacGillivray's Warbler and Least Flycatcher). This evidence suggests that lower-than-expected productivity may be the driving factor of the decline, but that this could improve over time if the positive trend continues. The only significantly declining species (Veery at Wishbone station) had decreasing productivity and equivalent survival, suggesting again that productivity is driving the decline.

For all three stations pooled, higher-than-expected productivity may also be driving the population trend for two ("Traill's" Flycatcher and Warbling Vireo) of the three significantly increasing species. Trend for the third species, Cedar Waxwing, is more difficult to assess because data was unavailable from the Northwest Region, but is likely related to high numbers of adults being captured during irruptive years.

4.4 Conclusions

The analyses that we performed for all stations pooled should be interpreted with some caution, as the stations are quite separated spatially and were operated over different time periods. As the Wishbone and Pyramid Lake stations gather more years of data, future estimates will be more robust.

Because the adult population levels are fairly stable it would appear that habitat at all of the stations is of good quality, as should be expected in national parks. The general increase in productivity would suggest that the habitat quality is improving because the adults that are present on the stations can produce more young per adult.

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Table 1. Summary of the MAPS program in Canadian mountain national parks, 1993-2006.

Name	Code	Major Habitat Type	Latitude- Longitude	Elev. (m)	Total Net Hours	Inclusive Dates	Years of Operation
Skunk Cabbage	SKUN	Riparian shrubland with surrounding forest	51° 05' 00"N, -117° 55' 30"W	610	4962	May 31 – Aug 8	1993-2002
Ranger Creek	RANG	Mixed shrubland and grassland, with beaver-flooded willow thickets; some conifers and deciduous	51° 12' 10"N, -115° 45' 00"W	1,400	2808	10 June – Aug 8	1999-2006
Wishbone	WISH	Wet cottonwood forest with seasonally flooded shrubland	49° 06' 12"N, -113° 49' 25"W	1,300	2046	May 31 – Aug 8	2002-2006
Pyramid Lake	JNP-1	Wetland-meadow complex including an aspen stand	52° 00' 55"N, -118° 05' 28"W	1,000	1356	May 31 – Aug 8	2004-2006

Table 2. Capture summary of adult birds for **Skunk Cabbage** MAPS station by year, and all years combined, for individual species and all species pooled, 1993-2002. N = newly banded. U = unbanded. R = recaptured.

Species	1993			1994			1995			1996			1997			1998			1999			2000			2001			2002			Combined								
	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U						
Merlin																																							
Red-naped Sapsucker	1			1												1			1												1			4	0	1			
Downy Woodpecker																1																		1	0	0			
Rufous Hummingbird																6						16						8	17		1	15	34	0	29				
Western Wood Peewee	1																		1						1						1	3	0	1					
Alder Flycatcher																									1			3			2	6	0	0					
Willow Flycatcher																												5	5	0	0								
Hammond's Flycatcher	1						2												1			1			2						5	2	0						
Dusky Flycatcher																			1												1	0	0						
"Traill's" Flycatcher	9	10	1	5	1		3	7		10	8	1	3	1		2	1		9	6					1						4	45	35	2					
Unid. Empidonax Flycatcher				1																		1												0	0	2			
Cassin's Vireo	1						1			1															1						4	0	0						
Warbling Vireo	8	1		5	2		6	2		6	1		3			4			8	3		7	5		5	2		10	6		62	22	0						
Red-eyed Vireo	7	4		5	6		3			7	1		5	1		8	5		8	6		2	6		3	10		1	3		49	42	0						
Stellar's Jay													1						3			1									5	0	0						
Black-capped Chickadee	5	1					7			1	4		3	1		2	1								1						2	19	9	0					
Chestnut-backed Chickadee	3																														3	0	0						
Red-breasted Nuthatch										1																		1	2	0	0								
Brown Creeper							1																								1	1	0	0					
Winter Wren																2	1								1	1					3	1	1						
Golden-crowned Kinglet							2	2																							2	2	0						
Veery	1	1		6	1		2	3		7	8		3	3		3	10		5	7		12	9		4	13		5	5		48	60	0						
Swainson's Thrush	8			17	1		9	2		9			7	1		6			10	2		8	2		5	1		8			87	9	0						
American Robin				1			1						1			2			3	1		3			1	5	1	4	1		20	3	1						
Varied Thrush																1			2			1			2			1	7	0	0								
Gray Catbird										1	1		1						1			1									4	1	0						
Cedar Waxwing	7			25			5	1		12	7	1	7	5		12	4		11	3		30	8	1	8	2		16	3	1	133	33	3						
Tennessee Warbler	4	1																										1	5	1	0								
Orange-crowned Warbler	2									1																					3	0	0						
Nashville Warbler	5		1																												5	0	1						
Yellow Warbler	10	5		6	5		7	4		4	7		7	10		4	5	1	13	21		8	7					6	8	8	67	78	1						

Table 2 (con't). Capture summary of adult birds for **Skunk Cabbage** MAPS station by year, and all years combined, for individual species and all species pooled, 1993-2002. N = newly banded. U = unbanded. R = recaptured.

	1993			1994			1995			1996			1997			1998			1999			2000			2001			2002			Combined						
Species	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U				
Magnolia Warbler	5			2	2		1									3	1	1							2	4								13	7	1	
Audubon's Warbler																									3				1		1			4	1	0	
Townsend's Warbler	5												1																		2			8	0	0	
Blackpoll Warbler																			1												2			3	0	0	
American Redstart	12	2	1	6	1		9	8		8	9	1	4	1		13	15		6	4		4						7	6		2	5		71	51	2	
Northern Waterthrush	5	2					4			2	2		4			5	1		5			2	2		1			1						29	7	0	
MacGillivray's Warbler	39	25		15	19		13	13		13	13		9	20	1	17	14		29	37	1	14	24		10	23		10	5	2	169	193	4				
Common Yellowthroat	12	8	2	12	15		5	13		8	11	1	7	8	1	14	28		12	28		14	22	1	6	13		6	10		96	156	5				
Wilson's Warbler	3			2						2			2						5									8	1	1	8			1	30	1	2
Chestnut-sided Warbler																1																		1	0	0	
Western Tanager										1									1			2												4	0	0	
Clay-coloured Sparrow				1																														1	0	0	
Fox Sparrow				1																														1	0	0	
Song Sparrow	14	10		19	19		11	31		10	20		9	12		18	19	1	11	18	1	19	31	1	10	21	1	12	25	3	133	206	7				
Lincoln's Sparrow							1	1																										1	1	0	
Oregon Junco							1			1																								2	0	0	
Black-headed Grosbeak							1						2	3					2			3			2	1	1	3						13	4	1	
Brown-headed Cowbird																									1									1	0	0	
Pine Siskin	9			6			1			1			5	1		3			3			2			2			1						33	1	0	
ALL SPECIES POOLED	177	70	6	137	72	0	94	87	0	106	91	4	83	67	8	125	105	3	168	136	3	144	123	13	103	102	4	115	73	23	1252	926	64				
Total number of captures		253			209			181			201			158			233			307			280			209			211			2242					
Number of species	25	12	5	19	11	0	22	12	0	21	13	4	19	13	3	24	13	3	25	12	3	23	17	5	21	14	4	25	11	6	48	25	18				
Total number of species		26			19			22			21			20			24			26			27			24			28			51					

Table 3. Capture summary of adult birds for **Ranger Creek** MAPS station by year, and all years combined, for individual species and all species pooled, 1999-2006. N = newly banded. U = unbanded. R = recaptured.

Species	1999			2000			2001			2002			2003			2004			2005			2006			Combined		
	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U
Sharp-shinned Hawk							1			1															2	0	0
American Three-toed Woodpecker										1															1	0	0
Wilson's Snipe	1						1																		2	0	0
Calliope Hummingbird			3							2				1		1			1						0	0	8
Rufous Hummingbird						4			3							1									0	0	8
Red-naped Sapsucker													1					1							2	0	0
Olive-sided Flycatcher																					1				1	0	0
Willow Flycatcher				5	1					15	1		6	2		9	2		10	5		3	3		48	14	0
Least Flycatcher	3	1		3	2	1	4	1								4	1		3	3		2			19	8	1
Hammond's Flycatcher	1																								1	0	0
“Traill’s” Flycatcher	15	7			2		9	12		4			2												24	27	0
Blue-headed Vireo																		1			1				2	0	0
Warbling Vireo	4	3		3	1		5	3		1			3			4			3	2		1			24	9	0
Northern Rough-winged Swallow	2																								2	0	0
Black-capped Chickadee	1						1	1								2			1	1		1	1		6	3	0
Mountain Chickadee	1						1						1			1									4	0	0
Boreal Chickadee	1									6			3	1											10	1	0
Red-breasted Nuthatch	1						3						2			1									7	0	0
Brown Creeper										1															1	0	0
Golden-crowned Kinglet	1			1			1																		3	0	0
Ruby-crowned Kinglet	6			5	1		8	3		3			1			3	3		4	1		9			39	8	0
Swainson's Thrush	3	1					1			6	1					3	1		5			7	3		25	6	0
American Robin	14	3		4	3	1	6			3			5			6	6		1	1		2	1		41	14	1
Varied Thrush	1																								1	0	0
Cedar Waxwing				3	1		2			1			2			4	1		1			7	5		20	7	0
Tennessee Warbler	2	1					1			1												1			5	1	0
Orange-crowned Warbler	6	2		2	1		4	3		1	4					2	1		3	2		1	2		19	15	0
Nashville Warbler	1																								1	0	0
Yellow Warbler	14	11		15	18		13	14		6	11		1	1		6	2		5	8		4	5		64	70	0
Magnolia Warbler				2																					2	0	0
Yellow-rumped Warbler				2			3			1			6			2			1	1		1	1		16	2	0
Audubon's Warbler	11	3		8	3		3	1		1			5			7	7		1	1					1	35	16

Table 3 (con't). Capture summary of adult birds for **Ranger Creek** MAPS station by year, and all years combined, for individual species and all species pooled, 1999-2006. N = newly banded. U = unbanded. R = recaptured.

Species	1999			2000			2001			2002			2003			2004			2005			2006			Combined		
	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U
Townsend's Warbler	1						3			1					3	1					5			13	1	0	
Blackpoll Warbler	3	1		1						1			1						1					7	1	0	
American Redstart	7	1		3						1			1		5						2			18	2	0	
Norther Waterthrush	8	7		3	2		7	8		4	10		1	4	4	1		5	3		4	1		36	36	0	
MacGillivray's Warbler	4	1		1	1		2	1					1											8	3	0	
Common Yellowthroat	16	7		6	4		4			6	4		3		13	11	1	4	3	1		1		52	30	2	
Wilson's Warbler	22	7		8	5		19	10		9	4		6	5	1	6	4		12	6	2	7	2		89	43	3
Myrtle Warbler	3	2		2	1		1								2	1								8	4	0	
Chipping Sparrow	4	1		6	3		5	1					1	1	6			2			4			28	6	0	
Clay-coloured Sparrow										1					1						1			3	0	0	
Savannah Sparrow															1						1			2	0	0	
Fox Sparrow	3	2		7	10		6	5		3	12		5	4	1	7	9		5	8		2	1		38	51	1
Lincoln's Sparrow	7	9		2	4		4	3		3			3	8	4	11		5	4		6	7		34	46	0	
White-throated Sparrow										1														1	0	0	
White-crowned Sparrow										1														1	0	0	
Mountain White-crowned Sparrow																					2	1		2	1	0	
Gambel's White-crowned Sparrow	3	3																						3	3	0	
Dark-eyed Junco				4						2	1													6	1	0	
Oregon Junco	4						4						1		8	1		2	3		3	1		22	5	0	
Red-winged Blackbird							2						4	1	4			2		1				12	1	1	
Brown-headed Cowbird	2	1		3			2			2					4						1			14	1	0	
Pine Grosbeak	1																							1	0	0	
Red Crossbill							4																	4	0	0	
White-winged Crossbill							6																	6	0	0	
Pine Siskin	5			10	1		27	1					4		1			5						52	2	0	
ALL SPECIES POOLED	182	74	3	109	64	6	163	67	5	82	53	0	66	30	3	123	63	3	83	52	5	79	35	1	887	438	26
Total number of captures		259			179			235			135			99		189			140			115			1351		
Number of species	36	21	1	25	19	3	33	15	2	27	11	0	23	11	3	29	17	3	24	16	4	26	14	1	56	33	9
Total number of species		37			27			35			29			26		31			25			28			58		

Table 4. Capture summary of adult birds for **Wishbone** MAPS station by year, and all years combined, for individual species and all species pooled, 2002-2006. N = newly banded. U = unbanded. R = recaptured.

	2002			2003			2004			2005			2006			Combined		
Species	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U
Sharp-shinned Hawk													1			1		
Rufous Hummingbird												1						1
Calliope Hummingbird															1			1
Red-naped Sapsucker	3			3			3	1		5	2		2	2		16	5	
Downy Woodpecker	1			1			2						2			6		
Hairy Woodpecker													2	2		2	2	
“Traill’s” Flycatcher	3			2	1											5	1	
Alder Flycatcher							2			3	2		2			7	2	
Least Flycatcher	6	1		6	1		6	3		6	1		3	2		27	8	
Dusky Flycatcher	1			1						1						3		
Pacific Slope Flycatcher							1									1		
Cassin's Vireo	1			1												2		
Warbling Vireo	1			1						2						4		
Black-capped Chickadee	7	3		7	2	1	7	3		12	2		13	3	1	46	13	2
Red-breasted Nuthatch	2			2			2									6		
House Wren	6	3		6	3		6	5	2	6			8	6		32	17	2
Veery	7	3		7	3		3	9		3			2	1		22	16	
Swainson's Thrush	5	1		5	1		1	1		3						14	3	
American Robin	3	2		3	2		3	3		2	2		3			14	9	
Gray Catbird	4		1	4	1		12	9	1		1		6	1		26	12	2
Cedar Waxwing	6			6			4			12	1		12	4	1	40	5	1
Tennessee Warbler													1			1		
Yellow Warbler	31	10	1	31	10	1	19	20		22	15	1	22	9		125	64	3
American Redstart	1				1		1						1			3	1	
Northern Waterthrush	3	4			3	4	2			2			3	2		10	9	4
MacGillivray's Warbler													1			1		
Common Yellowthroat										2			2	4		4	4	
Yellow-breasted Chat										1						1		
Wilson's Warbler	1			1												2		
Tree Swallow							3	2								3	2	
Clay-colored Sparrow							1			2			6			9		
Savannah Sparrow	5			5			1			2					1	13		1

Table 4 (con't). Capture summary of adult birds for **Wishbone** MAPS station by year, and all years combined, for individual species and all species pooled, 2002-2006. N = newly banded. U = unbanded. R = recaptured.

	2002			2003			2004			2005			2006			Combined		
Species	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U	N	R	U
Song Sparrow										3	2		1	4		4	6	
Lincoln's Sparrow	1			1			3			3						8		
Mountain White-crowned Sparrow										1			1			2		
Oregon Junco										1						1		
Black-headed Grosbeak	5			5						3				1		13	1	
Brown-headed Cowbird	1			1			1	2					1			4	2	
American Goldfinch	3			3			5			3						14		
ALL SPECIES POOLED	107	27	2	102	28	6	88	58	3	100	28	2	95	41	4	492	182	17
Total number of captures		136			136			149			130			140			691	
Number of species	24	8	2	22	11	3	22	11	2	23	9	2	22	13	4	37	19	9
Total number of species		24			24			22			25			25			39	

Table 5. Capture summary of adult birds for **Pyramid Lake** MAPS station by year, and all years combined, for individual species and all species pooled, 2004-2006. N = newly banded. U = unbanded. R = recaptured.

Species	2004			2005			2006			Combined		
	N	R	U	N	R	U	N	R	U	N	R	U
Sharp-shinned Hawk	1									1	0	0
Calliope Hummingbird			5		1			1	0	0	0	7
Rufous Hummingbird			1		3			1	0	0	0	5
Western Wood Peewee	1									1	0	0
Alder Flycatcher	1		4			4				9	0	0
Least Flycatcher	5	3	11	4	1	11	4			27	11	1
Dusky Flycatcher	3	1	5	5		2	2			10	8	0
Cassin's Vireo	2						1			3	0	0
Warbling Vireo	1		7	3		1				9	3	0
Black-capped Chickadee	7	1	1	3		1	2			9	6	0
Boreal Chickadee			1							1	0	0
Red-breasted Nuthatch	1									1	0	0
Ruby-crowned Kinglet	2		3			5	1			10	1	0
Swainson's Thrush	7	2	9	2	1	15	12	1		31	16	2
American Robin			1		1	5				6	0	1
Cedar Waxwing			25	4	1	10				35	4	1
Tennessee Warbler	3	1	10			9	1			22	2	0
Orange-crowned Warbler	6	1	15	10	3	9	2	1		30	13	4
Yellow Warbler						1	1			1	1	0
Blackpoll Warbler						1				1	0	0
American Redstart			2			5				7	0	0
Northern Waterthrush			1							1	0	0
MacGillivray's Warbler	2		3	1						5	1	0
Common Yellowthroat	5	1	5	4		5	4			15	9	0
Wilson's Warbler	21	10	1	14	18	2	18	13	1	53	41	4
Myrtle Warbler			1			1				2	0	0
Chipping Sparrow	7		4	1		3				14	1	0
Clay-coloured Sparrow	1					2	1			3	1	0
Fox Sparrow	2	2	1	1					1	3	3	1
Song Sparrow	1					2	2			3	2	0
Lincoln's Sparrow	15	4	1	10	11	1	16	13	1	41	28	3
Swamp Sparrow						2	1			2	1	0

Table 5 (con't). Capture summary of adult birds for **Pyramid Lake** MAPS station by year, and all years combined, for individual species and all species pooled, 2004-2006. N = newly banded. U = unbanded. R = recaptured.

	2004			2005			2006			Combined		
Species	N	R	U	N	R	U	N	R	U	N	R	U
White-throated Sparrow	4	2		8	5		4	1	1	16	8	1
Oregon Junco	3	1	1	2	1		3			8	2	1
Slate-coloured Junco				2	1					2	1	0
Purple Finch							1			1	0	0
Pine Siskin	1			2						3	0	0
ALL SPECIES POOLED	102	29	9	147	74	14	137	60	8	386	163	31
Total number of captures		140			235			205			580	
Number of species	24	12	5	25	16	9	26	15	8	35	22	12
Total number of species		26			27			29			38	

Table 6. Capture summary of adult birds for **Ranger Creek, Wishbone and Pyramid Lake** MAPS stations for individual species and all species pooled, 2004-2006. N = newly banded. U = unbanded. R = recaptured.

Species	2004			2005			2006			Combined		
	N	R	U	N	R	U	N	R	U	N	R	U
Sharp-shinned Hawk	0	0	0	1	0	0	1	0	0	2	0	0
Rufous Hummingbird	0	0	1	0	0	1	0	0	5	0	0	7
Calliope Hummingbird	0	0	2	0	0	1	0	0	7	0	0	10
Red-naped Sapsucker	1	0	0	10	5	0	0	0	0	11	5	0
Downy Woodpecker	0	0	0	4	0	0	0	0	0	4	0	0
Hairy Woodpecker	0	0	0	2	2	0	0	0	0	2	2	0
Olive-sided Flycatcher	1	0	0	0	0	0	0	0	0	1	0	0
Western Wood Peewee	0	0	0	0	0	0	1	0	0	1	0	0
Alder Flycatcher	0	0	0	7	2	0	9	0	0	16	2	0
Willow Flycatcher	22	10	0	0	0	0	0	0	0	22	10	0
Least Flycatcher	9	4	0	15	6	0	27	11	1	51	21	1
Dusky Flycatcher	0	0	0	1	0	0	10	8	0	11	8	0
Pacific Slope Flycatcher	0	0	0	1	0	0	0	0	0	1	0	0
Cassin's Vireo	0	0	0	0	0	0	3	0	0	3	0	0
Blue-headed Vireo	2	0	0	0	0	0	0	0	0	2	0	0
Warbling Vireo	8	2	0	2	0	0	9	3	0	19	5	0
Black-capped Chickadee	4	2	0	32	8	1	9	6	0	45	16	1
Mountain Chickadee	1	0	0	0	0	0	0	0	0	1	0	0
Boreal Chickadee	0	0	0	0	0	0	1	0	0	1	0	0
Red-breasted Nuthatch	1	0	0	2	0	0	1	0	0	4	0	0
Ruby-crowned Kinglet	16	4	0	0	0	0	10	1	0	26	5	0
House Wren	0	0	0	20	11	2	0	0	0	20	11	2
Veery	0	0	0	8	10	0	0	0	0	8	10	0
Swainson's Thrush	15	4	0	4	1	0	31	16	2	50	21	2
American Robin	9	8	0	8	5	0	6	0	1	23	13	1
Gray Catbird	0	0	0	18	11	1	0	0	0	18	11	1
Cedar Waxwing	12	6	0	28	5	1	35	4	1	75	15	2
Tennessee Warbler	1	0	0	1	0	0	22	2	0	24	2	0
Orange-crowned Warbler	6	5	0	0	0	0	30	13	4	36	18	4
Yellow Warbler	15	15	0	63	44	1	1	1	0	79	60	1
Yellow-rumped Warbler	4	2	0	0	0	0	0	0	0	4	2	0
Audubon's Warbler	8	8	1	0	0	0	0	0	0	8	8	1

Table 6 (con't). Capture summary of adult birds for **Ranger Creek, Wishbone** and **Pyramid Lake** MAPS stations for individual species and all species pooled, 2004-2006. N = newly banded. U = unbanded. R = recaptured.

Species	2004			2005			2006			Combined		
	N	R	U	N	R	U	N	R	U	N	R	U
Townsend's Warbler	8	1	0	0	0	0	0	0	0	8	1	0
Blackpoll Warbler	1	0	0	0	0	0	1	0	0	2	0	0
American Redstart	7	0	0	2	0	0	7	0	0	16	0	0
Northern Waterthrush	13	5	0	7	2	0	1	0	0	21	7	0
MacGillivray's Warbler	0	0	0	1	0	0	5	1	0	6	1	0
Common Yellowthroat	17	15	2	4	4	0	15	9	0	36	28	2
Yellow-breasted Chat	0	0	0	1	0	0	0	0	0	1	0	0
Wilson's Warbler	25	12	2	0	0	0	53	41	4	78	53	6
Myrtle Warbler	2	1	0	0	0	0	2	0	0	4	1	0
Tree Swallow	0	0	0	3	2	0	0	0	0	3	2	0
Chipping Sparrow	12	0	0	0	0	0	14	1	0	26	1	0
Clay-coloured Sparrow	2	0	0	9	0	0	3	1	0	14	1	0
Savannah Sparrow	2	0	0	3	0	1	0	0	0	5	0	1
Fox Sparrow	14	18	0	0	0	0	3	3	1	17	21	1
Song Sparrow	0	0	0	4	6	0	3	2	0	7	8	0
Lincoln's Sparrow	15	22	0	6	0	0	41	28	3	62	50	3
Swamp Sparrow	0	0	0	0	0	0	2	1	0	2	1	0
White-throated Sparrow	0	0	0	0	0	0	16	8	1	16	8	1
Mountain White-crowned Sparrow	2	1	0	2	0	0	0	0	0	4	1	0
Oregon Junco	13	5	0	1	0	0	8	2	1	22	7	1
Slate-coloured Junco	0	0	0	0	0	0	2	1	0	2	1	0
Black-headed Grosbeak	0	0	0	3	1	0	0	0	0	3	1	0
Red-winged Blackbird	6	0	1	0	0	0	0	0	0	6	0	1
Brown-headed Cowbird	5	0	0	2	2	0	0	0	0	7	2	0
Purple Finch	0	0	0	0	0	0	1	0	0	1	0	0
Pine Siskin	6	0	0	0	0	0	3	0	0	9	0	0
American Goldfinch	0	0	0	8	0	0	0	0	0	8	0	0
ALL SPECIES POOLED	285	150	9	283	127	9	386	163	31	954	440	49
Total number of captures	444			419			580			1443		
Number of species	35	21	6	34	18	8	35	22	12	57	39	20
Total number of species	37			36			37			59		

Table 7. Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at **Skunk Cabbage, Ranger Creek, Wishbone** and **Pyramid Lake** MAPS stations, and for the three longer running stations pooled, averaged over the 14 years, 1993-2006. Data for each species are included only from stations that lie within the breeding range of the species.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, and Wishbone pooled 1993-2006 ²		
	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹
Sharp-shinned Hawk				0.4	0.0	0.00	0.3	0.0	0.00	0.7	0.0	0.00	0.2	0.0	0.00
Wilson's Snipe				0.4	0.0	0.00							0.1	0.0	0.00
Red-naped Sapsucker	0.6	0.4	0.50	0.5	0.2	0.50	4.4	0.9	0.20				1.3	0.5	0.33
Downy Woodpecker	0.1	0.0	0.00				1.2	0.3	0.33				0.3	0.1	0.25
Hairy Woodpecker							0.6	0.0	0.00				0.1	0.0	0.00
Amer. 3-toed Woodp.				0.2	0.0	0.00							0.0	0.0	0.00
Northern Flicker	0.0	0.1	ud. ³	0.0	0.2	ud. ³							0.0	0.1	ud. ³
Olive-sided Flycatcher				0.3	0.0	0.00							0.1	0.0	0.00
Western Wood Pewee	0.4	0.0	0.00				0.3	0.0	0.00	0.7	0.0	0.00	0.3	0.0	0.00
“Traill’s” Flycatcher	8.0	0.4	0.07	19.1	3.2	0.24	3.2	0.0	0.00	4.8	0.6	0.11	9.4	1.0	0.13
Least Flycatcher	0.0	0.2	ud.	4.9	1.7	0.32	9.4	0.3	0.03	17.7	1.9	0.12	3.0	0.5	0.17
Hammond's Flycatcher	0.9	0.6	0.40	0.2	0.0	0.00							0.6	0.4	0.30
Dusky Flycatcher	0.1	0.1	0.00				0.9	0.3	0.00	7.9	1.2	0.16	0.2	0.1	0.00
Western Flycatcher							0.0	0.3	ud. ³				0.0	0.1	ud.
Cassin's Vireo	0.4	0.0	0.00				0.3	0.0	0.00	2.1	1.3	0.75	0.3	0.0	0.00
Warbling Vireo	7.9	0.9	0.18	5.8	0.8	0.38	0.9	0.0	0.00	5.9	2.8	0.21	5.4	0.7	0.33
Red-eyed Vireo	8.8	0.3	0.05										5.0	0.2	0.05
Steller's Jay	0.7	0.7	0.78										0.3	0.3	0.78
Tree Swallow							1.2	0.0	0.00				0.2	0.0	0.00
N. Rough-winged Sw.				0.4	0.0	0.00							0.1	0.0	0.00
Black-capped Chickadee	3.4	1.5	0.40	2.1	0.6	0.00	5.8	7.3	1.47	8.0	13.2	2.29	3.9	2.6	0.56
Mountain Chickadee				0.9	0.0	0.00				0.0	0.6	ud. ³	0.2	0.0	0.00

Table 7 (con't). Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at **Skunk Cabbage**, **Ranger Creek**, **Wishbone** and **Pyramid Lake** MAPS stations, and for the three longer running stations pooled, averaged over the 14 years, 1993-2006. Data for each species are included only from stations that lie within the breeding range of the species.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, and Wishbone pooled 1993-2006 ²		
	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹
Chestnut-backed Chick.	0.5	0.1	0.00										0.3	0.1	0.00
Boreal Chickadee				2.2	0.2	0.00				0.6	0.6	1.00	0.4	0.1	0.00
Red-breasted Nuthatch	0.3	0.0	0.00	1.5	0.2	0.00	0.9	0.3	0.50	0.7	0.0	0.00	0.7	0.1	0.08
Brown Creeper				0.2	1.1	0.00							0.0	0.3	ud.
House Wren							9.1	1.4	0.27				1.7	0.3	0.27
Winter Wren	0.4	0.0	0.00										0.3	0.0	0.00
Golden-crowned Kinglet	0.3	0.6	0.00	0.6	2.5	3.67							0.4	0.9	3.75
Ruby-crowned Kinglet				9.2	3.2	0.52				6.2	1.7	0.29	2.3	0.8	0.52
Veery	9.9	1.0	0.12				7.7	0.6	0.06				6.4	0.8	0.11
Swainson's Thrush	11.3	1.9	0.17	6.3	4.5	1.11	2.6	0.3	0.17	20.3	4.2	0.22	8.2	2.4	0.33
Hermit Thrush				0.0	0.5	ud.							0.0	0.1	ud.
American Robin	3.0	1.9	0.63	9.6	2.1	0.23	5.0	0.3	0.07	3.6	0.7	0.00	4.7	1.5	0.34
Varied Thrush	0.9	1.8	2.00	0.2	0.0	0.00							0.4	0.9	1.93
Gray Catbird	0.6	0.0	0.00				7.0	0.6	0.08				1.7	0.1	0.05
Cedar Waxwing	19.5	0.7	0.04	4.6	0.0	0.00	10.4	0.0	0.00	19.6	0.0	0.00	13.6	0.5	0.03
Tennessee Warbler	0.3	0.1	0.00	1.1	0.0	0.00				13.3	2.3	0.14	0.4	0.1	0.00
Orange-crowned War.	0.1	0.3	0.00	5.3	0.0	0.00				20.0	5.4	0.26	1.4	0.2	0.00
Nashville Warbler	0.8	0.0	0.00										0.6	0.0	0.00
Yellow Warbler	11.2	4.7	0.43	16.0	5.0	0.19	31.0	7.2	0.24	0.6	1.1	0.00	16.2	5.4	0.41
Magnolia Warbler	2.0	0.4	0.10	0.4	0.0	0.00							1.4	0.2	0.10
Yellow-rumped Warbler	0.7	0.1	0.00	14.1	13.7	1.43				1.2	0.6	0.50	3.9	3.6	1.39

Table 7 (con't). Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at **Skunk Cabbage**, **Ranger Creek**, **Wishbone** and **Pyramid Lake** MAPS stations, and for the three longer running stations pooled, averaged over the 14 years, 1993-2006. Data for each species are included only from stations that lie within the breeding range of the species.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, and Wishbone pooled 1993-2006 ²		
	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹	Ad.	Yg.	Repr. Ind. ¹
Townsend's Warbler	0.6	0.1	0.17	3.0	1.1	0.15				0.0	0.6	ud.	1.0	0.3	0.15
Blackpoll Warbler				1.5	0.0	0.00				0.6	0.0	0.00	0.4	0.0	0.00
American Redstart	10.0	1.9	0.18	4.1	0.2	0.06	0.9	0.0	0.00	4.2	1.2	0.35	7.2	1.3	0.13
Northern Waterthrush	3.7	1.3	0.44	10.7	1.4	0.15	4.1	0.0	0.00	0.6	6.4	9.00	5.5	1.0	0.17
MacGillivray's Warbler	29.3	5.3	0.21	1.7	0.0	0.00	0.6	0.0	0.00	3.1	1.2	0.17	17.2	2.8	0.17
Common Yellowthroat	19.1	2.8	0.12	12.2	1.1	0.20	1.2	0.0	0.00	9.9	7.6	0.72	14.2	2.0	0.13
Wilson's Warbler	3.9	0.3	0.17	22.7	4.7	0.26	0.3	0.3	0.00	38.0	9.7	0.27	7.3	1.4	0.29
Western Tanager	0.6	0.0	0.00										0.3	0.0	0.00
Chipping Sparrow				6.4	1.6	0.31				9.2	0.0	0.00	1.7	0.4	0.31
Clay-coloured Sparrow	0.2	0.0	0.00	0.7	0.3	0.33	2.6	0.9	0.05	1.9	0.0	0.00	0.8	0.2	0.06
Savannah Sparrow				0.5	0.0	0.00	2.3	0.3	0.06				0.6	0.1	0.05
Fox Sparrow	0.0	0.3	ud.	10.6	4.9	0.40	0.3	0.0	0.00	3.9	0.7	0.11	2.7	1.5	0.39
Song Sparrow	26.2	15.2	0.57				1.7	0.0	0.00	1.9	3.0	1.00	15.2	9.1	0.48
Lincoln's Sparrow	0.1	0.0	0.00	8.4	3.7	0.49	3.3	0.6	0.19	27.7	20.3	0.82	2.7	1.0	0.36
White-crowned Sparrow				1.3	0.2	0.00	0.6	0.0	0.00	0.0	0.6	ud.	0.4	0.1	0.00
Dark-eyed Junco	0.0	0.4	und.	6.9	4.8	0.93	0.0	0.3	und.	6.3	3.8	0.64	1.7	1.6	1.01
Black-headed Grosbeak	1.9	0.6	0.22				2.9	0.0	0.00				1.4	0.2	0.14
Red-winged Blackbird				2.8	0.0	0.00	1.8	0.0	0.00				0.7	0.0	0.00
Brown-headed Cowbird	0.2	0.0	0.00	3.0	1.9	0.54				0.0	0.7	ud.	1.1	0.5	0.55
Pine Grosbeak				0.2	0.0	0.00							0.1	0.0	0.00
Purple Finch										0.6	1.7	1.00			

Table 7 (con't). Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at **Skunk Cabbage**, **Ranger Creek**, **Wishbone** and **Pyramid Lake** MAPS stations, and for the three longer running stations pooled, averaged over the 14 years, 1993-2006. Data for each species are included only from stations that lie within the breeding range of the species.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, and Wishbone pooled 1993-2006 ²		
	Ad.	Yg.	Repr Ind. ¹	Ad.	Yg.	Repr Ind. ¹	Ad.	Yg.	Repr Ind. ¹	Ad.	Yg.	Repr Ind. ¹	Ad.	Yg.	Repr Ind. ¹
Red Crossbill				0.8	0.0	0.00							0.2	0.0	0.00
White-winged Crossbill				1.3	0.2	0.17							0.3	0.1	0.17
Pine Siskin	4.5	0.7	0.25	11.2	3.3	0.11				1.9	0.0	0.00	5.8	1.3	0.18
American Goldfinch							3.5	0.0	0.00				0.7	0.0	0.00
ALL SPECIES POOLED	193.6	48.2	0.24	216.3	69.2	0.35	128.1	22.3	0.17	243.6	95.8	0.38	185.4	49.8	0.27
Number of Species	40	33		46	30		34	18		32	28		62	49	
Total Number of Species		44			48			36			36			66	

¹ Years for which the reproductive index was undefined (no adult birds were captured in the year) are not included in the mean reproductive index. Ud = undefined.

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.

³ The reproductive index is undefined at this station because no young individual of the species was ever captured in the same year as an adult individual of the species.

Table 8. Population trend for target species and for all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake** and **all stations pooled**, over the 14 years 1993-2006. The index of population size was arbitrarily defined as 1.0 in 1993 (1999 for select species - see text). 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 correlation coefficient (r), the annual percentage change in the index of adult population size (APC), and the standard error (SE) of the slope are presented. Target species were not the same for each station. Significance: ** $P < 0.01$; * $0.01 \leq P < 0.05$.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake pooled 1993-2006		
	r^1	APC	SE	r^2	APC	SE	r^3	APC	SE	r^3	APC	SE	r	APC	SE
Red-naped Sapsucker							0.894*	14.5	0.058						
“Traill’s” Flycatcher	0.500	27.1	0.123	0.098	1.2	0.045							0.595*	11.2	0.044
Least Flycatcher							-0.849	-15.1	0.056	0.999*	24.8	0.014			
Dusky Flycatcher										-0.114	-3.5	0.618			
Warbling Vireo	0.830**	300.6	0.157	-0.525	-7.3	0.058							0.612*	47.0	0.659
Red-eyed Vireo	-0.229	-2.7	0.043												
Black-capped Chickadee							0.033	0.8	0.255	-0.803	-27.5	0.260			
House Wren							-0.822	-14.2	0.060						
Ruby-crowned Kinglet				-0.066	-1.3	0.075				0.866	200.0	0.866	-0.037	-0.8	0.079
Veery	0.620*	20.8	0.344				-0.941*	-17.1	0.042				-0.077	-1.0	0.253
Swainson's Thrush	0.010	0.1	0.080							0.971	93.4	0.289			
American Robin							-0.486	-5.6	0.069				0.020	0.3	0.041
Gray Catbird							0.241	17.3	0.808						
Cedar Waxwing	0.255	6.4	0.178				0.849	55.1	0.198				0.672**	66.4	0.336
Tennessee Warbler										0.554	5.7	0.139			
Orange-crowned Warbler										-0.714	-16.4	0.280			
Yellow Warbler	0.0	0.0	0.045	0.456	15.5	0.103	-0.503	-5.0	0.053				-0.085	-0.7	0.025
Yellow-rumped Warbler				-0.438	-6.5	0.059							-0.097	-1.6	0.079
American Redstart	-0.053	-0.8	0.102												
Northern Waterthrush				-0.254	-3.1	0.041	0.104	1.9	0.138				-0.646	-6.8	0.028

Table 8 (con't). Population trend for target species and for all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake and all stations pooled**, over the 14 years 1993-2006. The index of population size was arbitrarily defined as 1.0 in the initial year of station operation. 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 correlation coefficient (r), the annual percentage change in the index of adult population size (APC), and the standard error (SE) of the slope are presented. Target species were not the same for each station. Significance: ** $P < 0.01$; * $0.01 \leq P < 0.05$.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake pooled 1993-2006		
	r^1	APC	SE	r^2	APC	SE	r^3	APC	SE	r^3	APC	SE	r	APC	SE
MacGillivray's Warbler	-0.318	-2.9	0.026												
Common Yellowthroat	-0.045	-0.4	0.036	-0.584	-9.9	0.041				0.997	28.6	0.036	-0.305	-2.3	0.022
Wilson's Warbler				0.084	1.4	0.049				-0.530	-5.4	0.121	-0.573	-6.4	0.033
Chipping Sparrow										-0.866	-27.0	0.206			
Fox Sparrow				-0.026	-0.4	0.134							-0.061	-0.8	0.119
Song Sparrow	-0.211	-1.2	0.029												
Lincoln's Sparrow				0.629	23.6	0.062				0.810	25.1	0.236	-0.487	-5.7	0.034
Dark-eyed Junco				-0.368	-5.2	0.058				-0.866	-8.0	0.072	-0.159	-2.2	0.56
ALL SPECIES POOLED	0.299	1.9	0.025	-0.071	-0.7	0.036	-0.849	-5.4	0.022	0.803	8.6	0.102	0.046	0.2	0.014

¹ A threshold of $r > 0.30$ was used for defining a “substantially” changing trend.

² A threshold of $r > 0.50$ was used for defining a “substantially” changing trend.

³ A threshold of $r > 0.70$ was used for defining a “substantially” changing trend.

Table 9. Population trend for target species at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake** and **all stations pooled**, over the 14 years 1993-2006, compared to population trends from Breeding Bird Survey routes, 1993-2005. Significance: ** $P < 0.01$; * $0.01 \leq P < 0.05$.

Species	Skunk Cabbage	Ranger Creek	Wishbone	Pyramid Lake	Pooled	Alberta BBS	British Columbia BBS
Red-naped Sapsucker			14.5 (0.041)*			4.89 (0.356)	-4.42 (0.001)**
“Traill’s” Flycatcher	27.1 (0.141)	1.2 (0.818)			11.2 (0.025)*	0.95 (0.878)	0.52 (0.631)
Least Flycatcher			-15.1 (0.069)	24.8 (0.025)*		-6.73 (0.00)	-2.67 (0.101)
Dusky Flycatcher				-3.5 (0.927)		0.72 (0.789)	-3.24 (0.003)**
Black-capped Chickadee			0.8 (0.958)	-27.5 (0.407)		-2.19 (0.409)	-0.81 (0.428)
House Wren			-14.2 (0.088)			-2.64 (0.049)*	-6.41 (0.020)*
Ruby-crowned Kinglet		-1.3 (0.876)		200.0 (0.333)	-0.8 (0.929)	-0.96 (0.539)	2.18 (0.073)
Warbling Vireo	300.6 (0.003)**	-7.3 (0.182)			47.0 (0.020)*	-1.79 (0.0615)	1.71 (0.012)*
Red-eyed Vireo	-2.7 (0.524)					4.53 (0.001)**	-2.88 (0.062)
Veery	20.8 (0.056)		-17.1 (0.017)*		-1.0 (0.792)	11.55 (0.001)**	-3.47 (0.073)
Swainson's Thrush	0.1 (0.983)			93.4 (0.154)		3.08 (0.006)**	-1.45 (0.002)**
American Robin			-5.6 (0.407)		0.3 (0.962)	-0.19 (0.749)	-0.57 (0.085)
Gray Catbird			17.3 (0.696)			4.00 (0.269)	12.44 (0.001)**
Cedar Waxwing	6.4 (0.477)		55.1 (0.069)		66.4 (0.009)**	-13.48 (0.144)	-4.87 (0.013)*
Tennessee Warbler				5.7 (0.626)		-4.91 (0.330)	11.17 (0.034)*
Orange-crowned Warbler				-16.4 (0.494)		1.50 (0.555)	-3.17 (0.001)**
Yellow Warbler	0.0 (1.000)	15.5 (0.256)	-5.0 (0.388)		-0.7 (0.773)	-1.52 (0.083)	-1.13 (0.193)
Yellow-rumped Warbler		-6.5 (0.277)			-1.6 (0.818)	0.13 (0.935)	-1.08 (0.093)
American Redstart	-0.8 (0.885)					-8.30 (0.358)	0.48 (0.675)
Northern Waterthrush		-3.1 (0.544)	1.9 (0.867)		-6.8 (0.083)	0.36 (0.904)	-0.07 (0.939)
MacGillivray's Warbler	-2.9 (0.371)					-6.80 (0.136)	-1.43 (0.179)
Common Yellowthroat	-0.4 (0.902)	-9.9 (0.129)		28.6 (0.052)	-2.3 (0.290)	-6.72 (0.00)	-1.41 (0.134)
Wilson's Warbler		1.4 (0.842)		-5.4 (0.644)	-6.4 (0.138)	1.44 (0.573)	-5.08 (0.004)**
Chipping Sparrow				-27.0 (0.333)		3.86 (0.014)*	-2.62 (0.001)**
Fox Sparrow		-0.4 (0.949)			-0.8 (0.887)	2.81 (0.462)	-1.71 (0.232)
Song Sparrow	-1.2 (0.559)					-2.52 (0.013)*	1.10 (0.161)
Lincoln's Sparrow		23.6 (0.095)		25.1 (0.399)	-5.7 (0.221)	-4.03 (0.014)*	-4.88 (0.008)**
Dark-eyed Junco		-5.2 (0.370)		-8.0 (0.333)	-2.2 (0.707)	-1.94 (0.168)	-4.40 (0.00)

Table 10. Trend in productivity for target species and for all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake** and **all stations pooled**, over the 14 years 1993-2006. The productivity index was defined as the actual productivity value in the initial year of station operation. Indices for subsequent years were determined from constant-effort between-year changes in reproductive index from stations where the species was a regular or usual breeder and summer resident. The correlation coefficient (r), the measure of the productivity trend (PrT), and the standard error (SE) of the slope are presented. Target species were not the same for each station. Significance of r : ** $P < 0.01$; * $0.01 \leq P < 0.05$.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake pooled 1993-2006		
	r^1	PrT	SE	r^2	PrT	SE	r^3	PrT	SE	r^3	PrT	SE	r	PrT	SE
Red-naped Sapsucker							0.354	0.100	0.153						
“Traill’s” Flycatcher	-0.348	-0.034	0.032	-0.144	-0.023	0.066									
Alder Flycatcher													0.296	0.022	0.021
Least Flycatcher							0.0	0.0	0.027	-0.991	0.163	0.022			
Dusky Flycatcher										0.866	0.095	0.055			
Warbling Vireo	-0.336	-0.035	0.035	0.577	0.250	0.144							0.075	0.007	0.027
Red-eyed Vireo	0.081	0.003	0.013												
Black-capped Chickadee							0.778	0.710	0.331	0.882	2.184	1.164			
House Wren							0.606	0.167	0.126						
Ruby-crowned Kinglet				-0.115	-0.030	0.105				0.945	0.625	0.217	0.153	0.036	0.095
Veery	-0.244	-0.014	0.019				-0.426	-0.025	0.031				-0.541*	-0.023	0.010
Swainson's Thrush	0.151	0.013	0.030							-0.990	-0.178	0.026			
American Robin							0.354	0.033	0.051				-0.221	-0.024	0.043
Gray Catbird							-0.364	-0.050	0.074						
Cedar Waxwing	0.010	0.0	0.012				0	0	0				-0.150	-0.003	0.006
Tennessee Warbler										0.157	0.021	0.132			
Orange-crowned Warbler										0.410	0.055	0.122			
Yellow Warbler	0.214	0.036	0.058	-0.589	-0.104	0.058	-0.434	-0.068	0.081				-0.121	-0.015	0.035
Yellow-rumped Warbler				0.690	0.631	0.270							0.689	0.374	0.161
American Redstart	-0.241	-0.013	0.019												
Northern Waterthrush				0.350	0.022	0.024	0	0	0				0.479	0.065	0.049

Table 10 (con't). Trend in productivity for target species and for all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake** and **all stations pooled**, over the 14 years 1993-2006. The productivity index was defined as the actual productivity value in the initial year of station operation. Indices for subsequent years were determined from constant-effort between-year changes in reproductive index from stations where the species was a regular or usual breeder and summer resident. The correlation coefficient (r), the measure of the productivity trend (PrT), and the standard error (SE) of the slope are presented. Target species were not the same for each station. Significance of r : ** $P < 0.01$; * $0.01 \leq P < 0.05$.

Species	Skunk Cabbage 1993-2002			Ranger Creek 1999-2006			Wishbone 2002-2006			Pyramid Lake 2004-2006			Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake pooled 1993-2006		
	r^1	PrT	SE	r^1	PrT	SE	r^1	PrT	SE	r^1	PrT	SE	r^1	PrT	SE
MacGillivray's Warbler	0.559	0.028	0.015												
Common Yellowthroat	0.408	0.033	0.026	0.746*	0.134	0.049				0.855	0.975	0.592	0.677**	0.077	0.024
Wilson's Warbler				0.299	0.046	0.061				-0.286	-0.060	0.199	0.0	0.001	0.065
Fox Sparrow				-0.169	-0.026	0.063							-0.081	-0.012	0.060
Song Sparrow	0.075	0.015	0.070												
Lincoln's Sparrow				0.074	0.020	0.110				-0.248	-0.242	0.945	0.466	0.145	0.113
Dark-eyed Junco				0.100	0.051	0.204				0.866	0.042	0.024	0.099	0.050	0.205
ALL SPECIES POOLED	0.222	0.014	0.021	0.218	0.030	0.054	0.925	0.042	0.010	0.274	0.056	0.822	0.652	0.038	0.013

¹ Threshold of $r = 0.30$ for defining “substantially” changing trends.

² Threshold of $r = 0.50$ for defining “substantially” changing trends.

³ Threshold of $r = 0.70$ for defining “substantially” changing trends.

Table 11. Estimates of adult annual survival and recapture probabilities and proportion of residents among newly captured adults using a time-constant transient survival model for select species¹ breeding at **Skunk Cabbage**, **Ranger Creek** and **Wishbone** MAPS stations obtained from 14 years (1993-2006)² of mark-recapture data, and survival probability of some of the same species for MAPS stations in the Northwest Region of the MAPS network.

Species	Num. sta. ³	Num. ind. ⁴	Num. caps. ⁵	Num. ret. ⁶	Survival probability ⁷	Surv. C.V. ⁸	Recapture probability ⁹	Proportion of residents ¹⁰	Survival probability ¹¹	Surv. C.V. ¹²
<u>SKUNK CABBAGE</u>										
Warbling Vireo *	1	49	69	5	0.556 (0.215)	38.7	0.369 (0.243)	0.293 (0.239)	0.489 (0.015)	3.1
Red-eyed Vireo	1	47	87	12	0.680 (0.119)	17.6	0.215 (0.096)	0.639 (0.326)	0.646 (0.089)	13.8
Veery	1	48	108	19	0.737 (0.093)	12.6	0.349 (0.100)	0.525 (0.206)	0.570 (0.049)	8.7
Yellow Warbler	1	62	137	14	0.381 (0.100)	26.2	0.494 (0.179)	0.784 (0.378)	0.561 (0.011)	2.0
MacGillivray's Warbler	1	153	336	44	0.548 (0.059)	10.7	0.554 (0.088)	0.284 (0.089)	0.485 (0.010)	2.0
Common Yellowthroat	1	98	249	31	0.315 (0.061)	19.4	0.790 (0.126)	0.959 (0.300)	0.501 (0.018)	3.6
Song Sparrow †	1	129	320	47	0.392 (0.058)	14.7	0.676 (0.102)	1.000 (0.245)	0.477 (0.009)	1.8
<u>RANGER CREEK</u>										
"Traill's" Flycatcher	1	73	113	13	0.645 (0.110)	17.1	0.477 (0.146)	0.153 (0.083)	0.527 (0.027) ¹³	5.1 ¹³
Yellow Warbler	1	65	134	10	0.252 (0.101)	40.2	0.604 (0.267)	0.746 (0.436)	0.561 (0.011)	2.0
Yellow-rumped Warbler *	1	60	81	5	0.304 (0.176)	57.8	0.371 (0.299)	0.444 (0.384)	0.482 (0.025)	5.2
Northern Waterthrush	1	38	72	10	0.451 (0.123)	27.2	0.578 (0.207)	0.540 (0.307)	0.621 (0.083)	13.4
Common Yellowthroat *	1	53	82	3	0.427 (0.248)	58.1	0.296 (0.279)	0.135 (0.159)	0.501 (0.018)	3.6
Wilson's Warbler	1	92	133	10	0.689 (0.134)	19.5	0.290 (0.130)	0.185 (0.105)	0.428 (0.015)	3.5
Lincoln's Sparrow *	1	34	79	3	0.734 (0.253)	34.5	0.105 (0.100)	0.337 (0.390)	0.433 (0.014)	3.3
Dark-eyed Junco *	1	28	34	3	0.514 (0.309)	60.2	0.385 (0.337)	0.315 (0.357)	0.453 (0.011)	2.4
<u>WISHBONE</u>										
Least Flycatcher *	1	29	41	3	0.717(0.386)	53.8	0.131 (0.162)	0.558 (0.629)	0.587 (0.168)	28.6
Veery	1	19	40	7	0.548 (0.162)	29.5	0.727 (0.228)	0.390 (0.281)	0.570 (0.049)	8.7
Gray Catbird *†	1	22	32	2	0.700 (0.633)	90.4	0.093 (0.172)	1.000 (1.715)	0.556 (0.035)	6.4
Yellow Warbler	1	86	142	20	0.635 (0.129)	20.3	0.496 (0.144)	0.434 (0.163)	0.561 (0.011)	2.0

Table 11 (con't). Estimates of adult annual survival and recapture probabilities and proportion of residents among newly captured adults using a time-constant transient survival model for select species¹ breeding at **Skunk Cabbage**, **Ranger Creek** and **Wishbone** MAPS stations obtained from 14 years (1993-2006)² of mark-recapture data, and survival probability of some of the same species for MAPS stations in the Northwest Region of the MAPS network.

Species	Num. sta. ³	Num. ind. ⁴	Num. caps. ⁵	Num. ret. ⁶	Survival probability ⁷	Surv. C.V. ⁸	Recapture probability ⁹	Proportion of residents ¹⁰	Survival probability ¹¹	Surv. C.V. ¹²
<u>ALL 3 STATIONS</u>										
“Traill’s” Flycatcher	3	129	212	22	0.577 (0.080)	13.8	0.636 (0.120)	0.095 (0.049)	0.527 (0.027) ¹³	5.1 ¹³
Least Flycatcher *	2	49	68	5	0.515 (0.222)	43.1	0.259 (0.203)	0.434 (0.366)	0.587 (0.168)	28.6
Warbling Vireo	3	76	104	7	0.383 (0.153)	39.9	0.370 (0.239)	0.466 (0.358)	0.489 (0.015)	3.1
Red-eyed Vireo	1	47	87	12	0.604 (0.097)	16.1	0.233 (0.101)	0.694 (0.354)	0.646 (0.089)	13.8
Black-capped Chickadee	3	43	58	9	0.577 (0.149)	25.9	0.383 (0.183)	0.547 (0.332)	0.480 (0.030)	6.3
Veery	2	67	148	26	0.624 (0.073)	11.7	0.465 (0.100)	0.499 (0.174)	0.570 (0.049)	8.7
Swainson's Thrush	3	105	120	7	0.351 (0.164)	46.8	0.620 (0.292)	0.229 (0.172)	0.593 (0.007)	1.1
Yellow Warbler	3	213	413	44	0.404 (0.060)	14.9	0.512 (0.103)	0.654 (0.176)	0.561 (0.011)	2.0
Yellow-rumped Warbler *	1	60	81	5	0.304(0.176)	57.8	0.371 (0.299)	0.444 (0.384)	0.482 (0.025)	5.2
Northern Waterthrush	3	73	119	14	0.391 (0.104)	26.6	0.650 (0.188)	0.456 (0.216)	0.621 (0.083)	13.4
MacGillivray's Warbler	1	153	336	44	0.519 (0.053)	10.3	0.587 (0.086)	0.286 (0.090)	0.485 (0.010)	2.0
Common Yellowthroat	2	151	331	34	0.314 (0.057)	18.1	0.731 (0.124)	0.596 (0.187)	0.501 (0.018)	3.6
Wilson's Warbler	1	92	133	10	0.689 (0.134)	19.5	0.290 (0.130)	0.185 (0.105)	0.428 (0.015)	3.5
Song Sparrow †	2	133	330	49	0.383 (0.054)	14.0	0.713 (0.095)	1.000 (0.238)	0.477 (0.009)	1.8
Lincoln's Sparrow *	2	45	91	3	0.744 (0.266)	35.7	0.092 (0.092)	0.253 (0.296)	0.433 (0.014)	3.3

¹ Species included were those for which an average of 2.5 individual adult birds were captured per year and least two returns were recorded at all three stations combined (or at each station for station-specific analyses) and for which both survival and recapture probability were neither 0 nor 1.

² Estimates for the Skunk Cabbage station alone were calculated using data from 10 years (1993-2002); for the Ranger Creek station alone were calculated using data from eight years (1999-2006); and for the Wishbone station alone were calculated using data from five years (2002-2006). Estimates for all three stations pooled were calculated using data from 14 years (1993-2006).

³ Number of stations where the species was a regular or usual breeder and at which adults of the species were captured.

⁴ Number of adult individuals captured at stations where the species was a regular or usual breeder (i.e., number of capture histories).

⁵ Total number of captures of adult birds of the species at stations where the species was a regular or usual breeder.

⁶ 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.

⁷ Survival probability (ϕ) presented as the maximum likelihood estimate (standard error of the estimate).

Table 11 (con't). Estimates of adult annual survival and recapture probabilities and proportion of residents among newly captured adults using a time-constant transient survival model for select species¹ breeding at **Skunk Cabbage**, **Ranger Creek** and **Wishbone** MAPS stations obtained from 14 years (1993-2006)² of mark-recapture data, and survival probability of some of the same species for MAPS stations in the Northwest Region of the MAPS network.

⁸ The coefficient of variation for survival probability, $CV(\varphi)$.

⁹ Recapture probability (p) presented as the maximum likelihood estimate (standard error of the estimate).

¹⁰ The proportion of residents among newly captured adults (τ) presented as the maximum likelihood estimate (standard error of the estimate).

¹¹ Survival probability for the Northwest Region of MAPS (standard error of the estimate).

¹² The coefficient of variation for survival probability $CV(\varphi)$ in the Northwest Region of MAPS.

¹³ Only Willow Flycatcher reported for the Northwest Region.

* The estimate for survival probability should be viewed with caution because it is based on fewer than five between-year recaptures or the estimate is very imprecise ($SE(\varphi) \geq 0.200$ or $CV(\varphi) \geq 50.0\%$)

† The estimate for survival probability, recapture probability, or both may be biased low because the estimate for τ was 1.00.

Table 12. Assessment of vital rates for target species showing substantially decreasing or substantially increasing population trends at **Skunk Cabbage** (1993-2002), **Ranger Creek** (1999-2006) and **Wishbone** (2002-2006) MAPS stations, and at these three stations **pooled**.

Species	Population trend and its significance ¹	Population trend ²	Productivity ³	Survival Probability ⁴
SKUNK CABBAGE				
A. Decreasing Species				
MacGillivray's Warbler	-2.9	slightly lower	increasing, low	slightly high
B. Increasing Species				
"Traill's" Flycatcher	+27.1	much higher	decreasing, equivalent	unavailable
Warbling Vireo	+300.6**	much higher	decreasing, equivalent	slightly high
Veery	+20.8	much higher	decreasing, unavailable	high
RANGER CREEK				
A. Decreasing Species				
Warbling Vireo	-7.3	slightly lower	increasing, high	unavailable
Common Yellowthroat	-9.9	slightly lower	increasing, low	slightly low
B. Increasing Species				
Lincoln's Sparrow	+23.6	slightly lower	increasing, equivalent	high
WISHBONE				
A. Decreasing Species				
Least Flycatcher	-15.1	slightly lower	stable, unavailable	high
House Wren	-14.2	lower	increasing, unavailable	unavailable
Veery	-17.1*	much lower	decreasing, unavailable	equivalent
B. Increasing Species				
Red-naped Sapsucker	+14.5*	higher	increasing, unavailable	unavailable
Cedar Waxwing	+55.1	much higher	stable, stable	unavailable
ALL STATIONS POOLED				
A. Decreasing Species				
Common Yellowthroat	-2.3	equivalent	increasing, low	low
B. Increasing Species				
"Traill's" Flycatcher	+11.2*	much higher	increasing, high	equivalent
Warbling Vireo	+47.0*	much higher	increasing, high	slightly low
Cedar Waxwing	+66.4**	much higher	decreasing, unavailable	unavailable

Table 12 (con't). Assessment of vital rates for target species showing substantially decreasing or substantially increasing population trends at **Skunk Cabbage** (1993-2002), **Ranger Creek** (1999-2006) and **Wishbone** (2002-2006) MAPS stations, and at these three stations **pooled**.

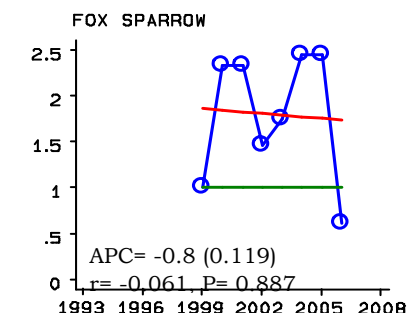
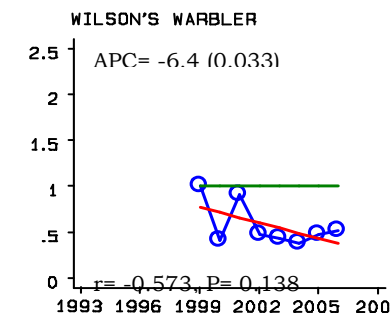
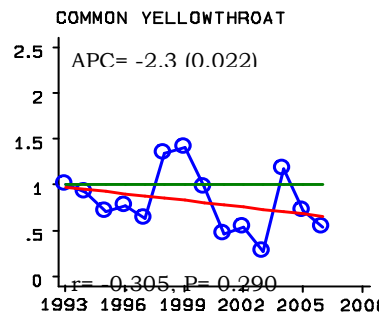
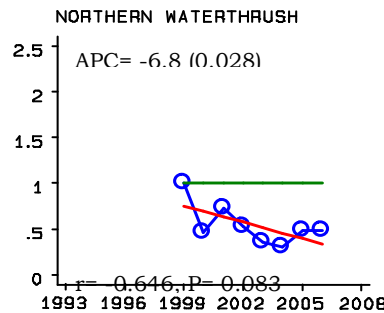
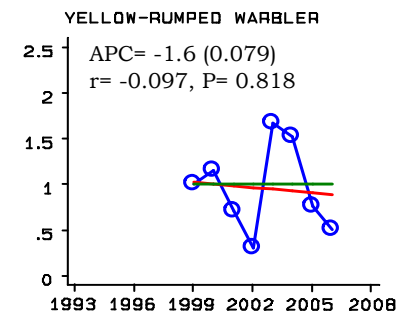
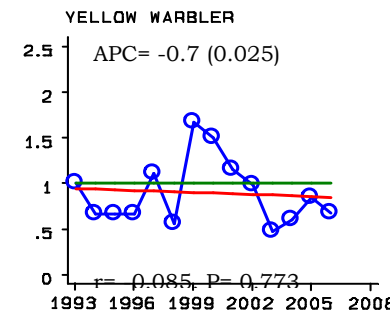
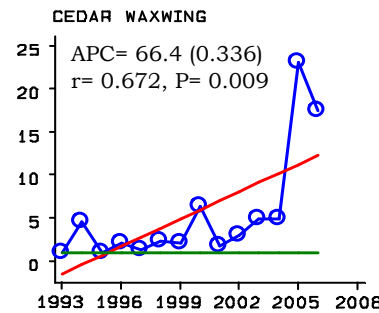
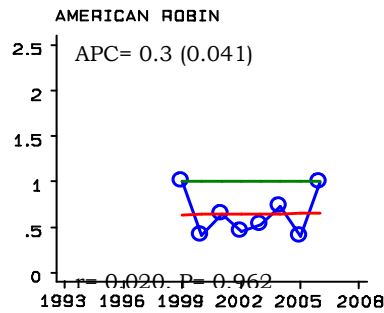
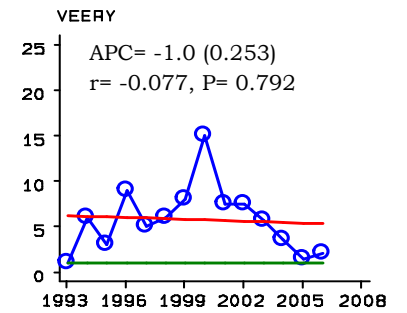
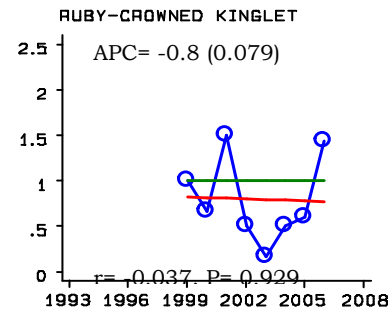
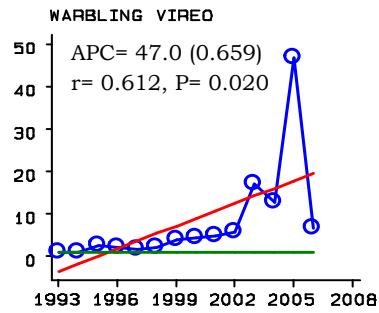
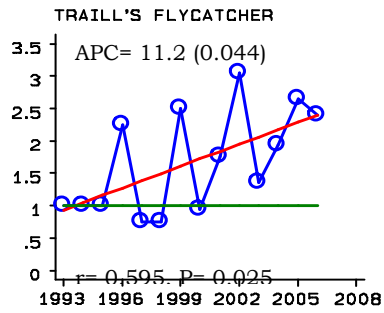
¹ Significance of the trends in adult population levels (Annual Percent Change value from Figures 3, 4 and 5 for Skunk Cabbage, Ranger Creek and Wishbone, respectively, and Figure 2 for all stations pooled). ** $P < 0.01$; * $0.01 \leq P < 0.05$.

² Population trend from previous column is compared to the population trend from Breeding Bird Survey routes (Table 9).

³ Productivity assessment is based on the productivity trend (PrT value from Figures 8, 9 and 10 for Skunk Cabbage, Ranger Creek and Wishbone, respectively, and Figure 7 for all stations pooled), and on the reproductive index (R.I. value from Table 7 for all stations and the Northwest Region of MAPS), respectively.

⁴ Survival assessment is based on comparison with survival in the Northwest Region of MAPS.

Index of adult population size



Year

Figure 6. Population trends for 14 species and all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake pooled** over the 14 years 1993-2006. The index of population size was arbitrarily defined as 1.0 in 1993 (green line) (1999 for select species - see text). 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.

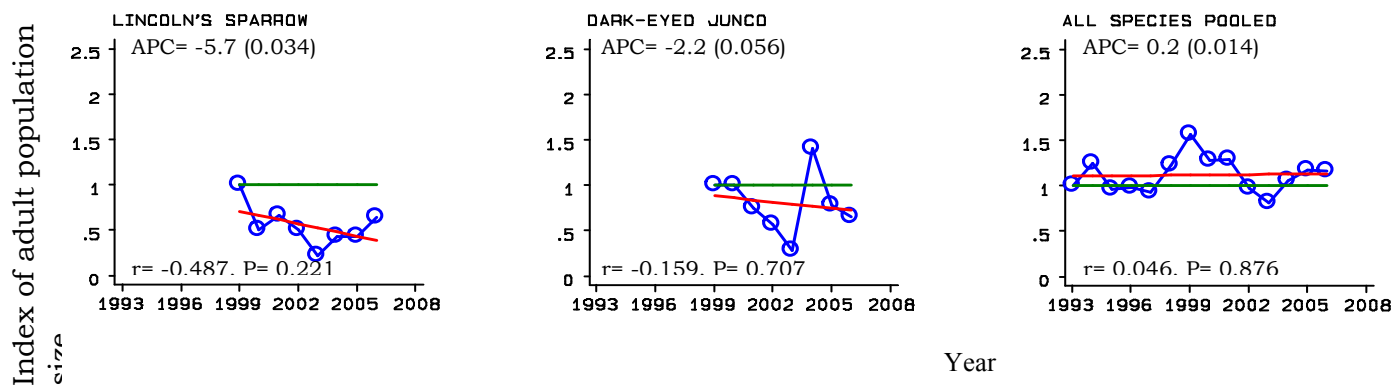
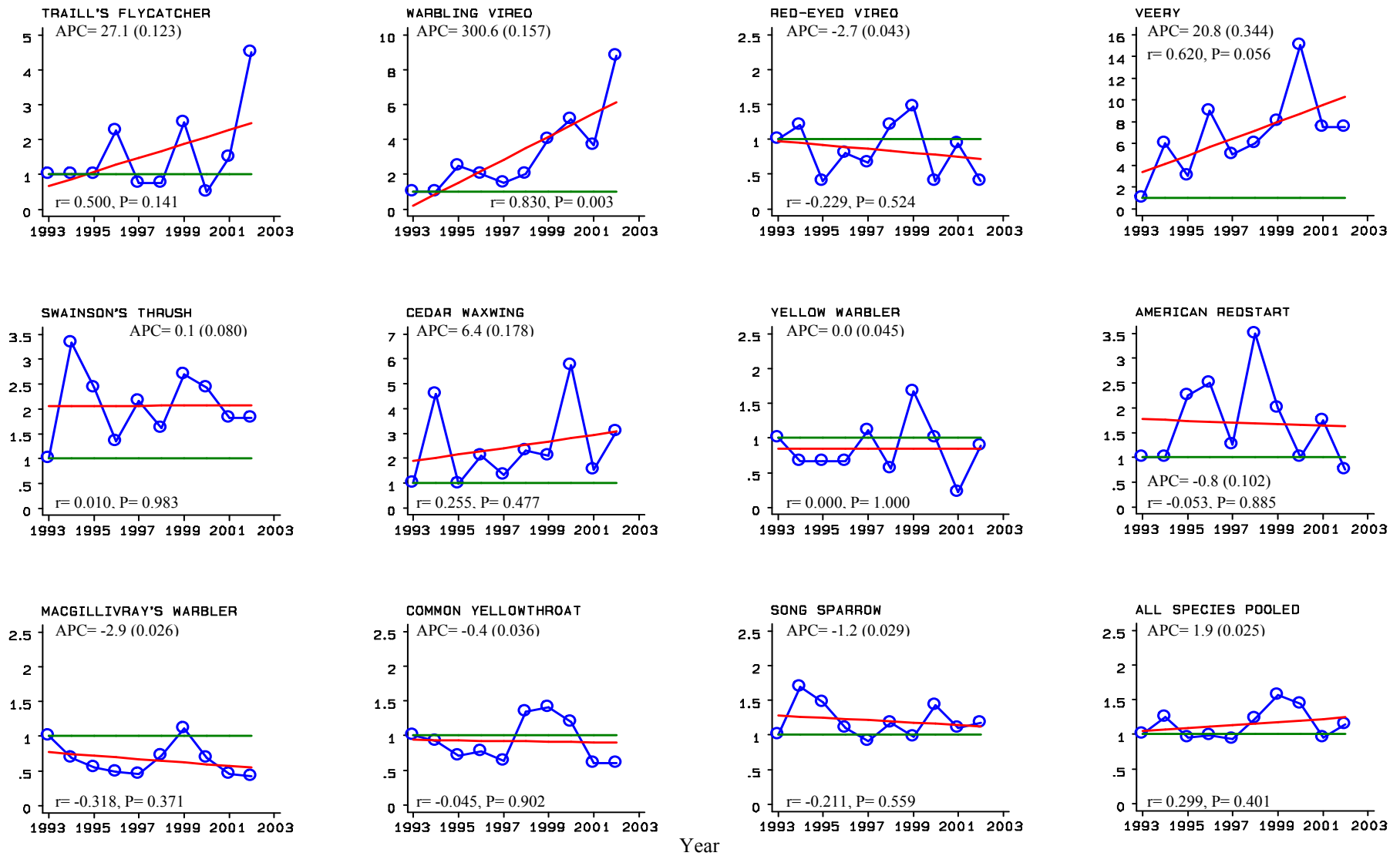


Figure 6 (con't). Population trends for 14 species and all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone** and **Pyramid Lake pooled** over the 14 years 1993-2006. The index of population size was arbitrarily defined as 1.0 in 1993 (green line) (1999 for select species - see text). Indices 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.

Index of adult population size



Year

Figure 7. Population trends for 11 species and all species pooled at the **Skunk Cabbage** MAPS station over the ten years 1993-2002. The index of population size was arbitrarily defined as 1.0 in 1993 (green line). 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 (APC) in the index of adult population size was used as the measure of the population trend, 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.

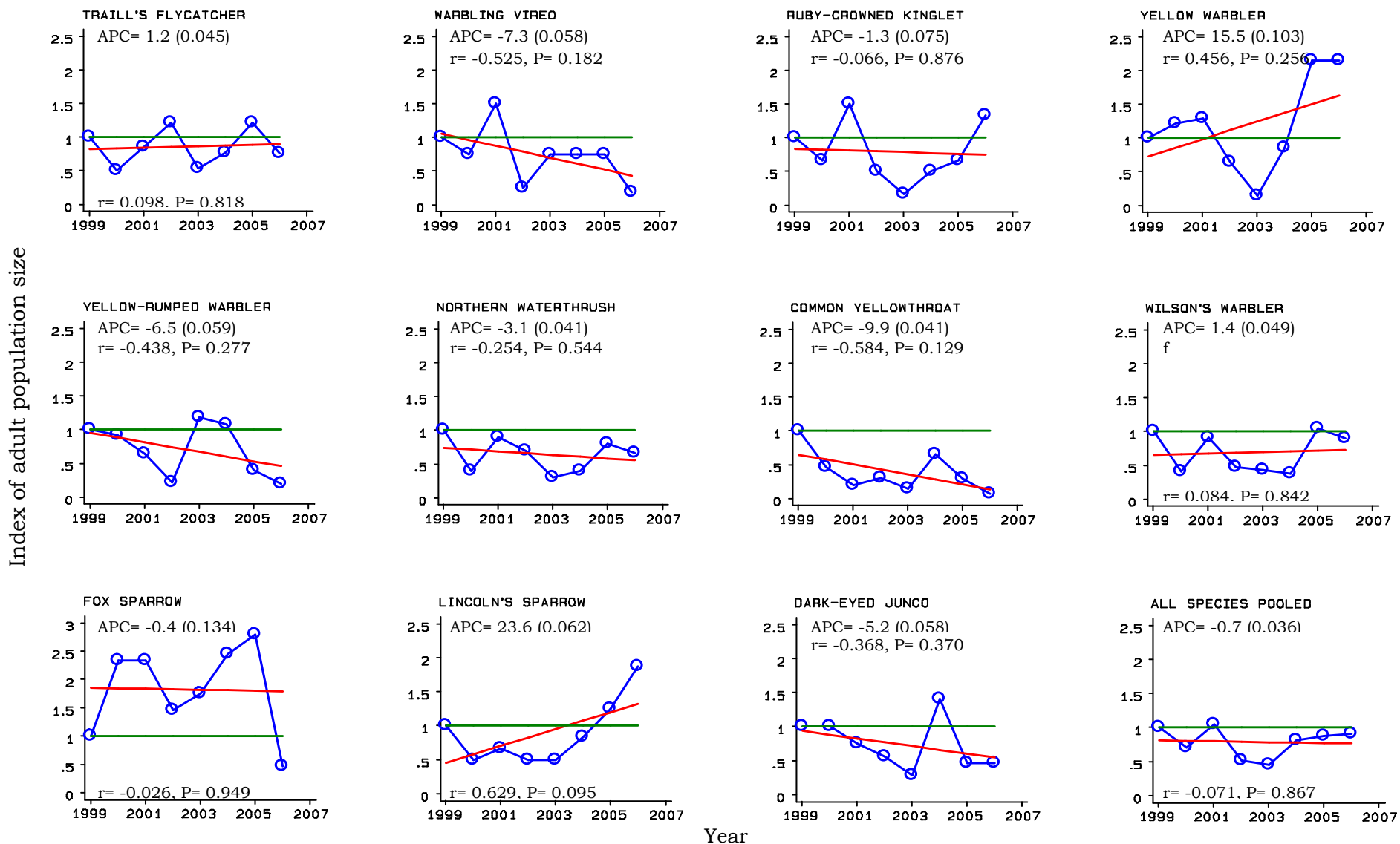


Figure 8. Population trends for 11 species and all species pooled at the **Ranger Creek** MAPS station over the eight years 1999-2006. The index of population size was arbitrarily defined as 1.0 in 1999 (green line). Indices for subsequent years were determined from constant-effort between-year changes 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 (APC) in the index of adult population size was used as the measure of the population trend, 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.

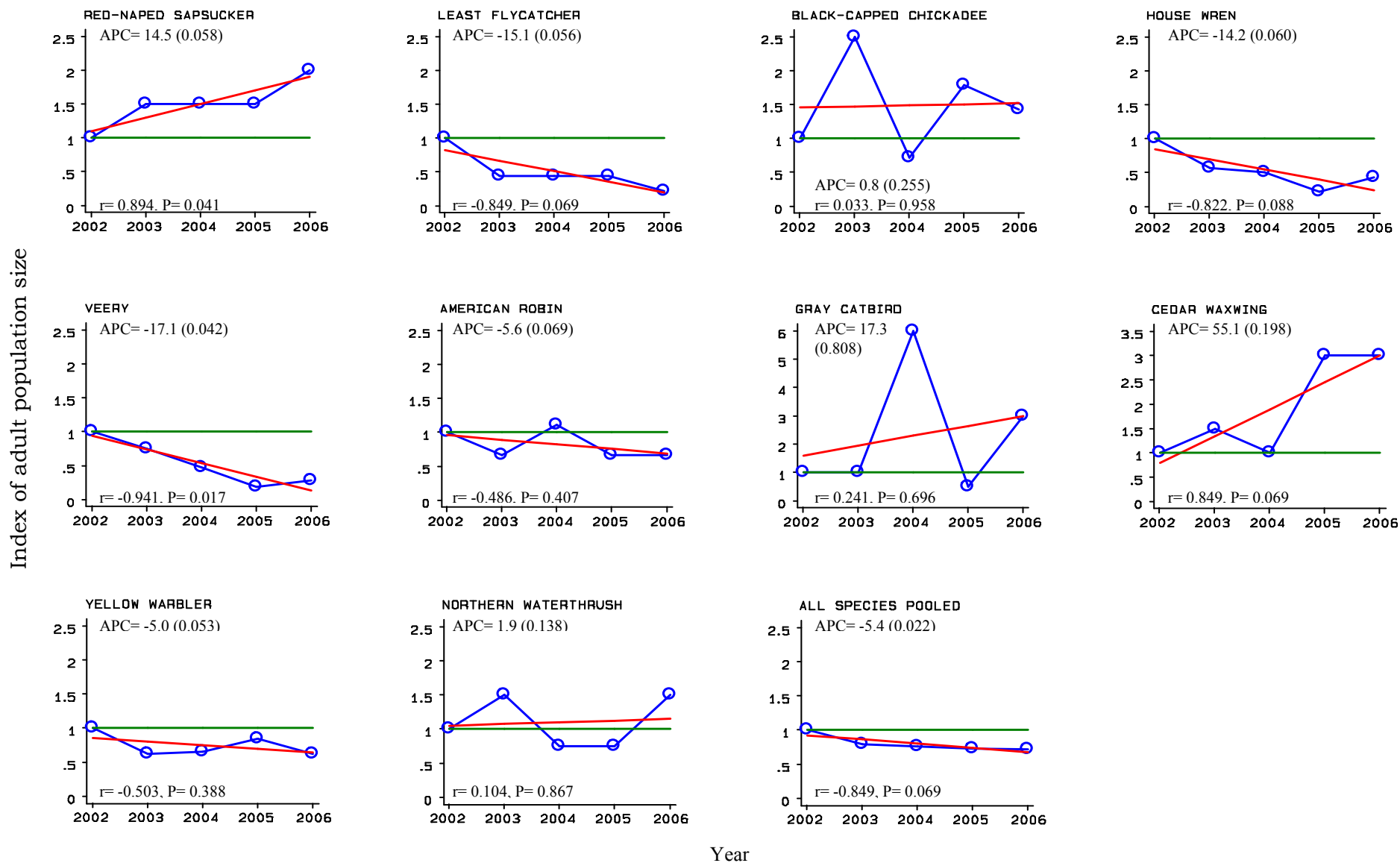


Figure 9. Population trends for ten species and all species pooled at the **Wishbone** MAPS station over the five years 2002-2006. The index of population size was arbitrarily defined as 1.0 in 2002 (green line). Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change (APC) in the index of adult population size was used as the measure of the population trend, 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.

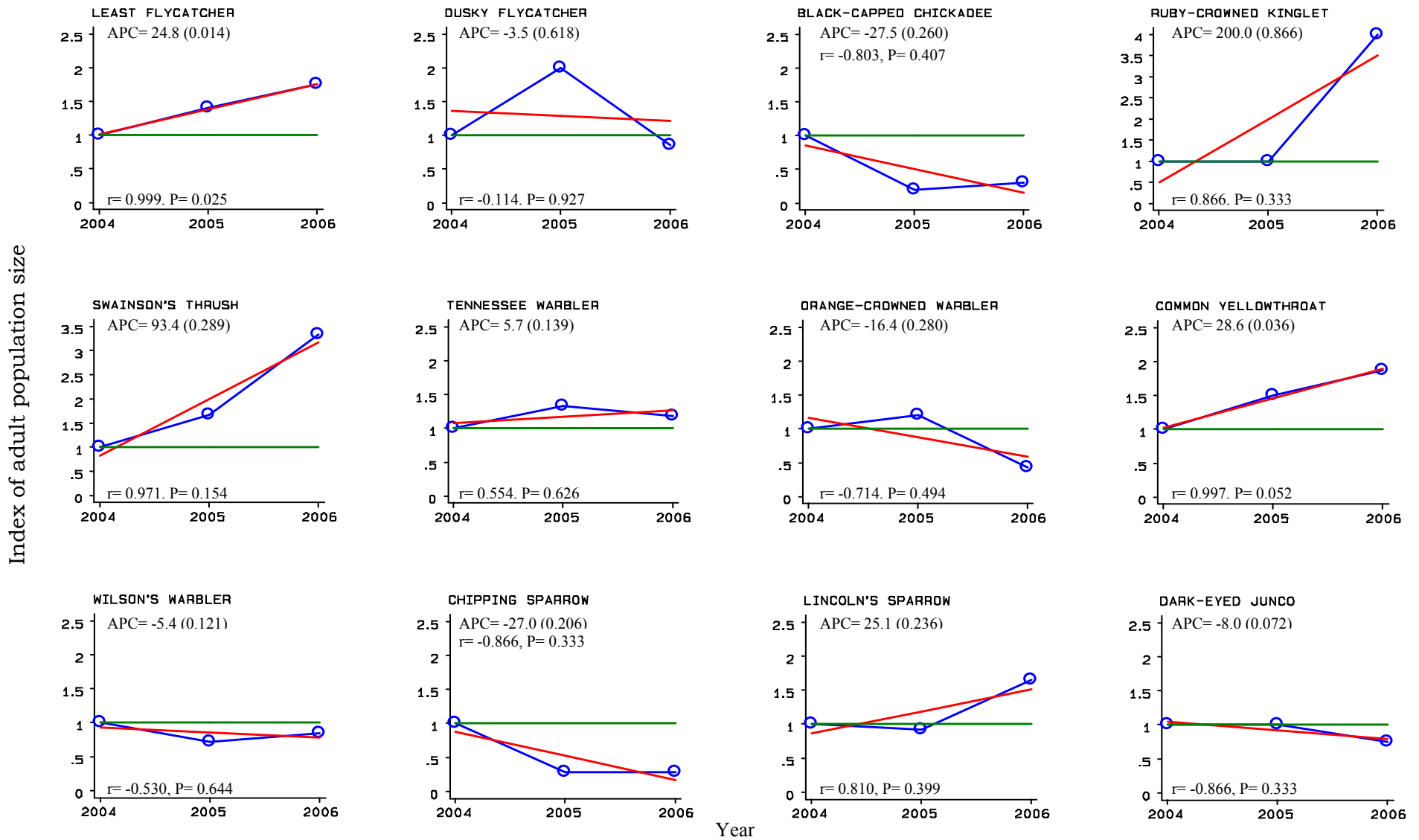


Figure 10. Population trends for 12 species and all species pooled at the **Pyramid Lake** MAPS station over the three years 2004-2006. The index of population size was arbitrarily defined as 1.0 in 2004 (green line). Indices for subsequent years were determined from constant-effort between-year changes 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 (APC) in the index of adult population size was used as the measure of the population trend, 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.

Index of adult population size

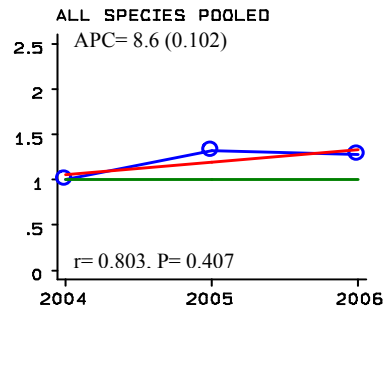


Figure 10 (con't). Population trends for 12 species and all species pooled at the **Pyramid Lake** MAPS station over the three years 2004-2006. The index of population size was arbitrarily defined as 1.0 in 2004. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change (APC) in the index of adult population size was used as the measure of the population trend, 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.

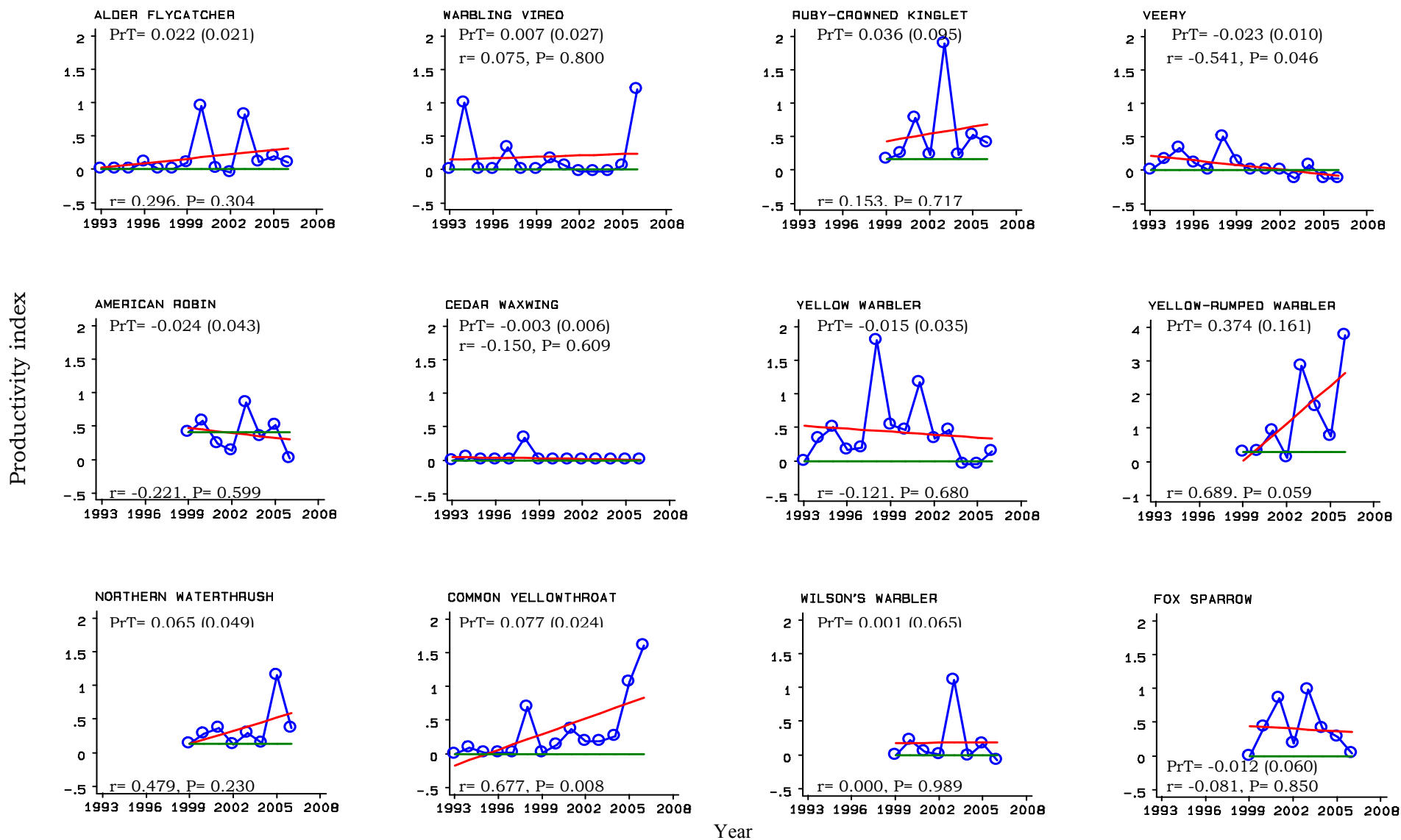


Figure 11. Trend in productivity for 14 species and all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake** MAPS stations **pooled** over the 14 years 1993-2006. The productivity index was defined as the actual productivity value in 1993 (green line) (1999 for selected species - see text). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

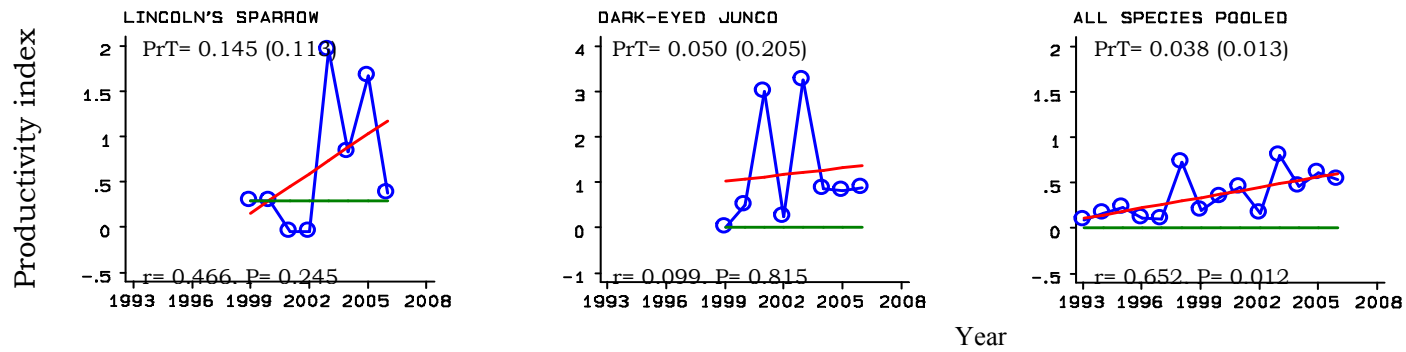


Figure 11 (con't). Trend in productivity for 14 species and all species pooled at **Skunk Cabbage, Ranger Creek, Wishbone and Pyramid Lake** MAPS stations **pooled** over the 14 years 1993-2006. The productivity index was defined as the actual productivity value in 1993 (green line) (1999 for selected species - see text). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

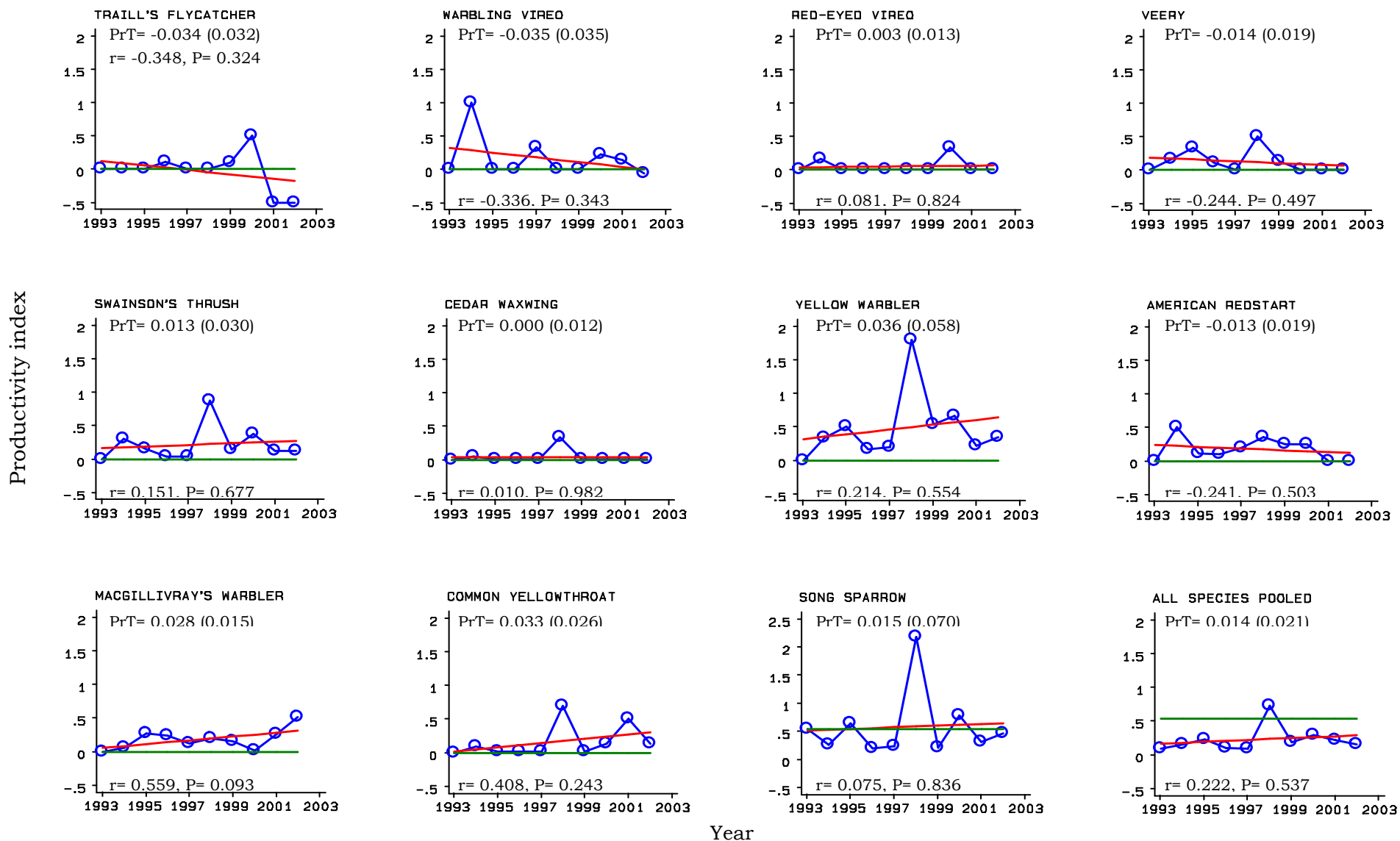


Figure 12. Trend in productivity for 11 species and all species pooled at the **Skunk Cabbage** MAPS station over the 10 years 1993-2002. The productivity index was defined as the actual productivity value in 1993 (green line). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

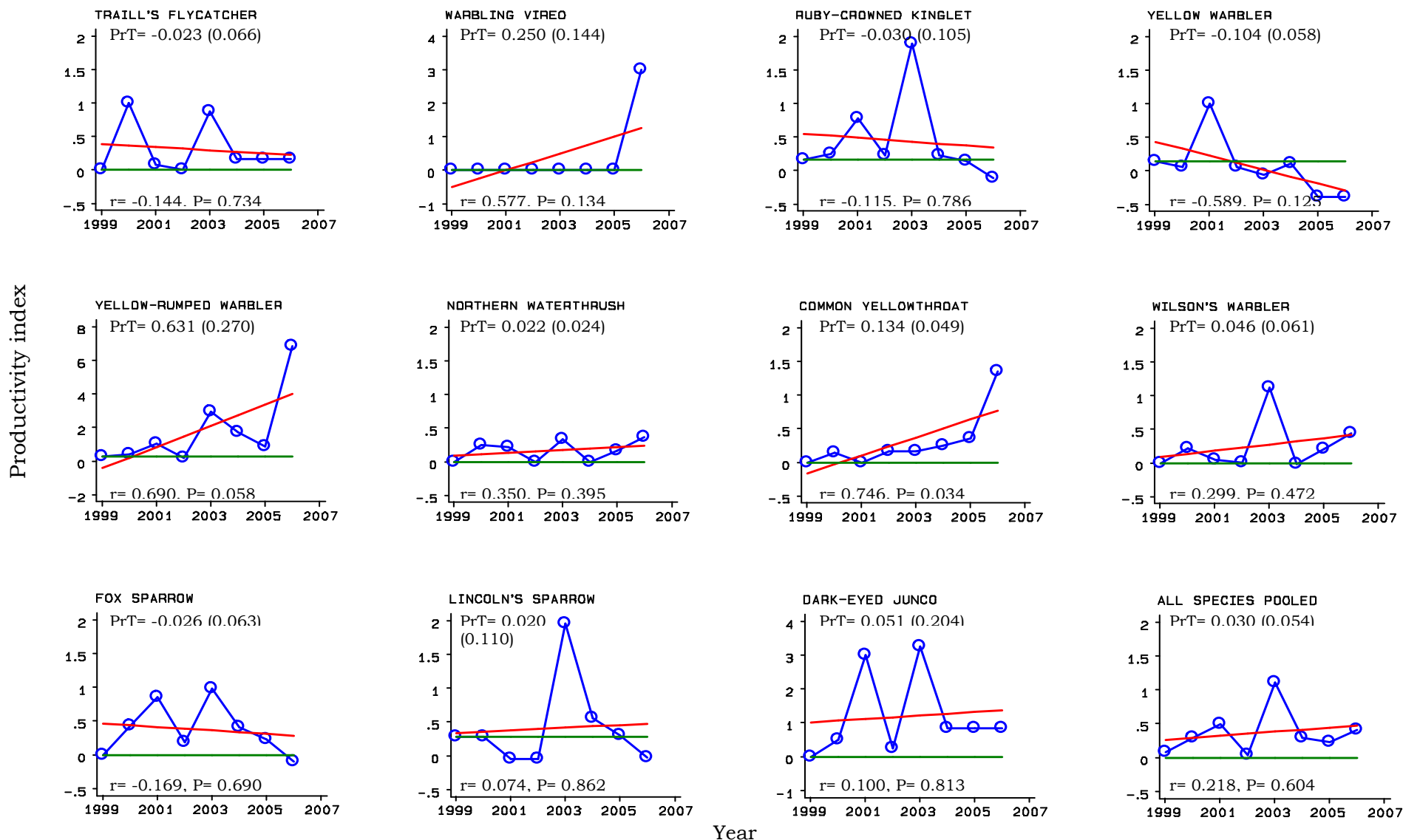


Figure 13. Trend in productivity for 11 species and all species pooled at the **Ranger Creek** MAPS station over the eight years 1999-2006. The productivity index was defined as the actual productivity value in 1999 (green line). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

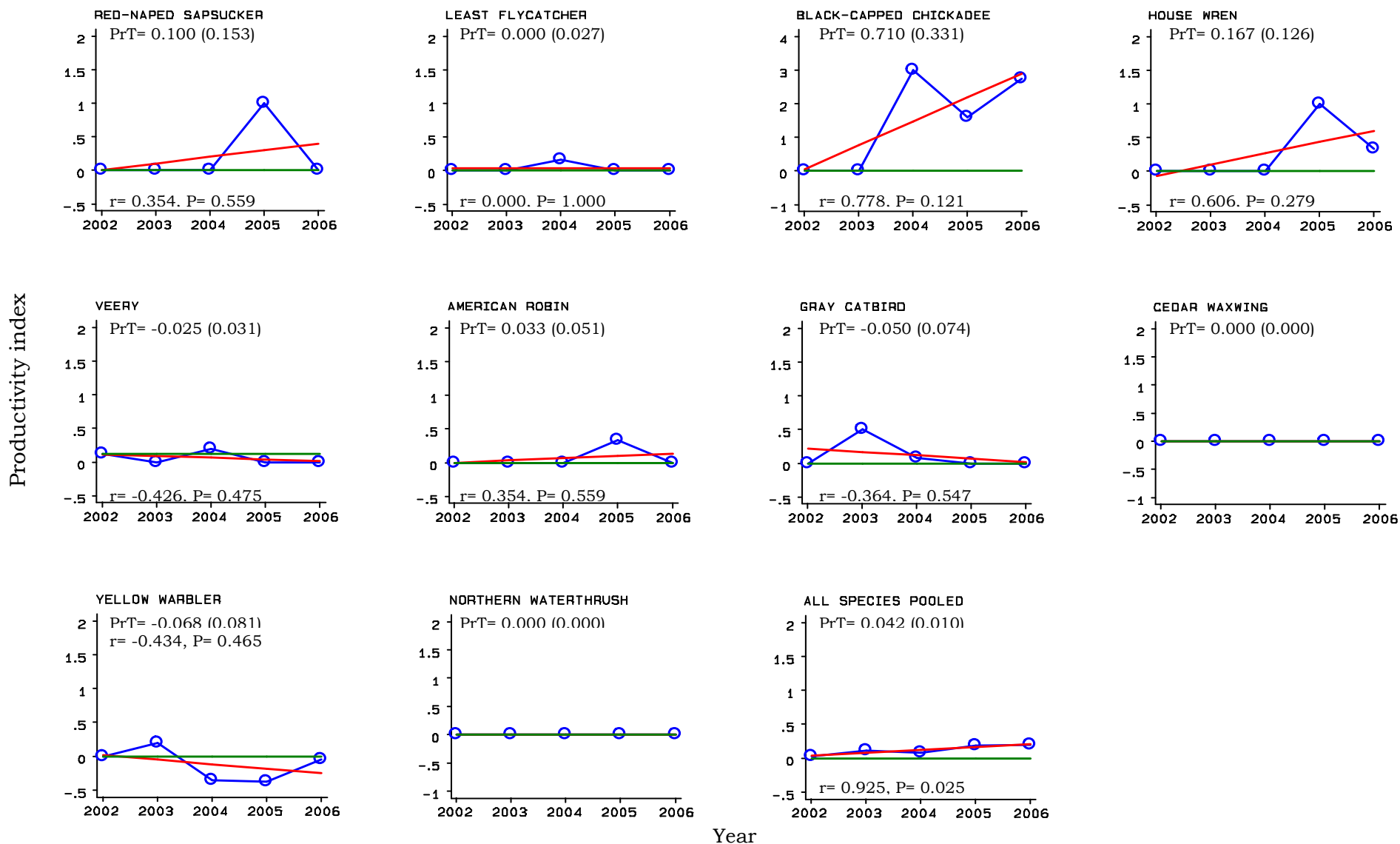


Figure 14. Trend in productivity for ten species and all species pooled at the **Wishbone** MAPS station over the five years 2002-2006. The productivity index was defined as the actual productivity value in 2002 (green line). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

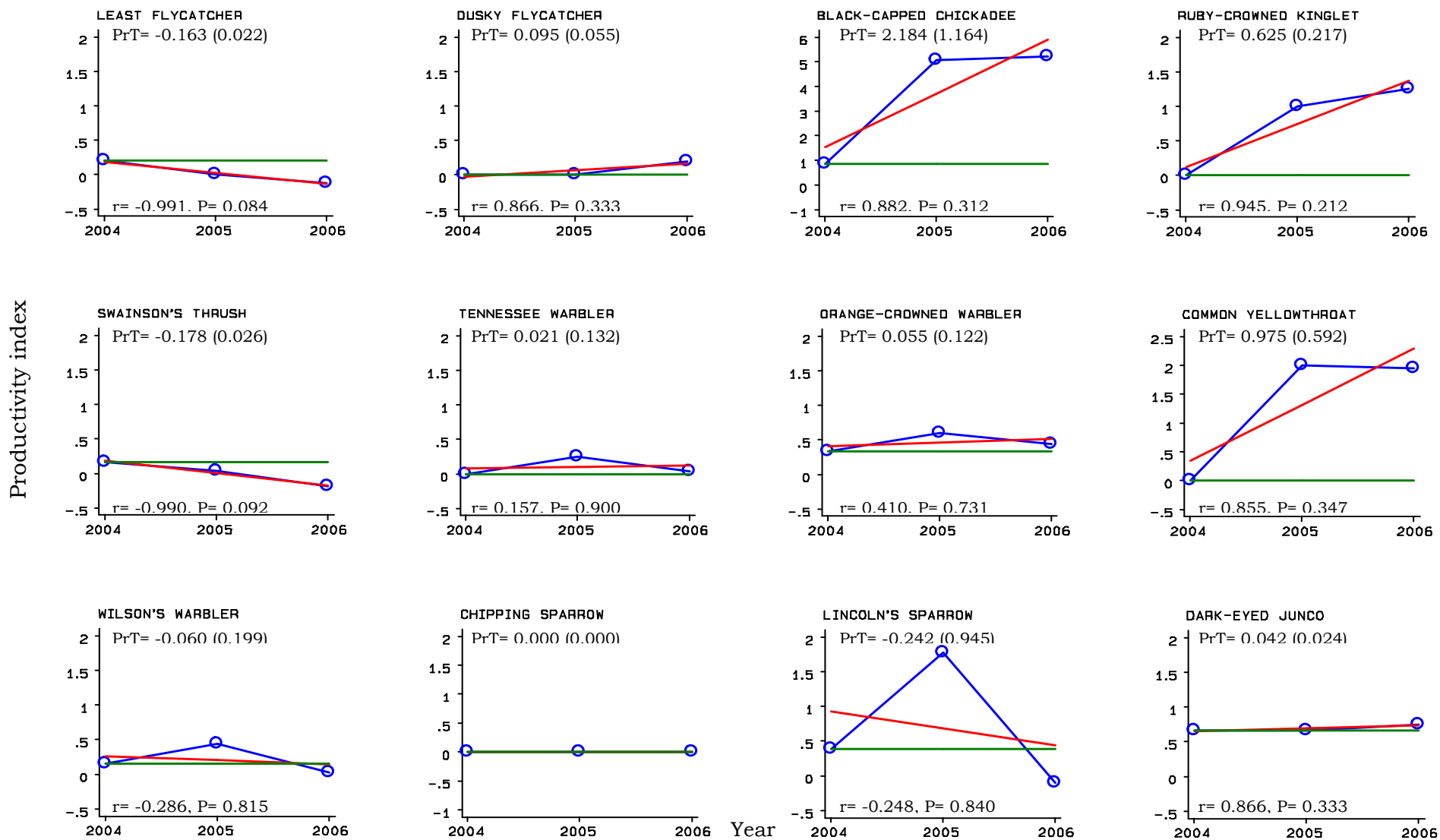


Figure 15. Trend in productivity for 12 species and all species pooled at the **Pyramid Lake** MAPS station over the three years 2004-2006. The productivity index was defined as the actual productivity value in 2004 (green line). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

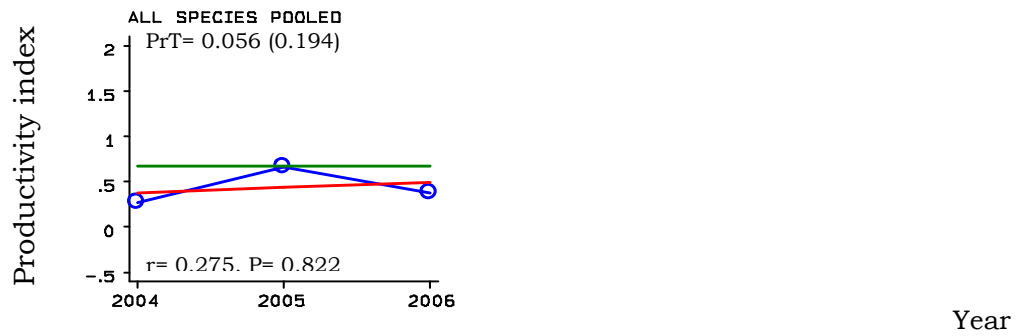


Figure 15 (con't). Trend in productivity for 12 species and all species pooled at the **Pyramid Lake** MAPS station over the three years 2004-2006. The productivity index was defined as the actual productivity value in 2004 (green line). Indices for subsequent years were determined from constant-effort between-year changes in reproductive index 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.

APPENDIX A:

Alphabetical list of common and scientific names of birds captured at the four MAPS stations

Alder Flycatcher (*Empidonax alnorum*)
American Goldfinch (*Carduelis tristis*)
American Redstart (*Setophaga ruticilla*)
American Robin (*Turdus migratorius*)
American Three-toed Woodpecker (*Picoides dorsalis*)
“Audubon’s” Yellow-rumped Warbler (*Dendroica coronata auduboni*)
Black-capped Chickadee (*Poecile atricapilla*)
Black-headed Grosbeak (*Pheucticus malanocephalus*)
Blackpoll Warbler (*Dendroica striata*)
Blue-headed Vireo (*Vireo solitarius*)
Boreal Chickadee (*Poecile hudsonica*)
Brown Creeper (*Certhia americana*)
Brown-headed Cowbird (*Molothrus ater*)
Calliope Hummingbird (*Stellula calliope*)
Cassin’s Vireo (*Vireo cassinii*)
Cedar Waxwing (*Bornbycilla cedrorum*)
Chestnut-backed Chickadee (*Poecile rufescens*)
Chestnut-sided Warbler (*Dendroica pensylvanica*)
Chipping Sparrow (*Spizella passerina*)
Clay-coloured Sparrow (*Spizella pallida*)
Common Yellowthroat (*Geothlypis trichas*)
Downy Woodpecker (*Picoides pubescens*)
Dusky Flycatcher (*Empidonax oberholseri*)
Fox Sparrow (*Passerella iliaca*)
“Gambel’s” White-crowned Sparrow (*Zonotrichia leucophrys gambelii*)
Golden-crowned Kinglet (*Regulus satrapa*)
Gray Catbird (*Dumetella carolinensis*)
Hairy Woodpecker (*Picoides villosus*)
Hammond’s Flycatcher (*Empidonax hammondi*)
House Wren (*Troglodytes aedon*)
Least Flycatcher (*Empidonax minimus*)
Lincoln’s Sparrow (*Melospiza lincolni*)
MacGillivray’s Warbler (*Oporornis tolmei*)
Magnolia Warbler (*Dendroica magnolia*)
Merlin (*Falco columbarius*)
Mountain Chickadee (*Poecile gambeli*)
“Mountain” White-crowned Sparrow (*Zonotrichia leucophrys oriantha*)
“Myrtle” Warbler (*Dendroica coronata coronata*)
Northern Waterthrush (*Seiurus noveboracensis*)
Olive-sided Flycatcher (*Contopus cooperi*)
Orange-crowned Warbler (*Vermivora celata*)
“Oregon” Dark-eyed Junco (*Junco hyemalis oregonus*)
Pacific Slope Flycatcher (*Empidonax difficilis*)
Pine Grosbeak (*Pinicola enucleator*)
Purple Finch (*Carpodacus purpureus*)
Red Crossbill (*Loxia curvirostra*)
Red-breasted Nuthatch (*Sitta canadensis*)
Red-eyed Vireo (*Vireo olivaceus*)
Red-naped Sapsucker (*Sphyrapicus nuchalis*)

Red-winged Blackbird (*Agelaius phoeniceus*)
Ruby-crowned Kinglet (*Regulus calendula*)
Rufous Hummingbird (*Selasphorus rufus*)
Savannah Sparrow (*Passerculus sandwichensis*)
Sharp-shinned Hawk (*Accipiter striatus*)
“Slate-coloured” Dark-eyed Junco (*Junco hyemalis hyemalis*)
Song Sparrow (*Melospiza melodia*)
Stellar’s Jay (*Cyanocitta stelleri*)
Swamp Sparrow (*Melospiza georgiana*)
Swainson’s Thrush (*Catharus ustulatus*)
Tennessee Warbler (*Vermivora peregrina*)
Townsend’s Warbler (*Dendroica townsendi*)
“Traill’s” Flycatcher: includes Alder (*Empidonax alnorum*) and Willow (*E. traillii*) flycatchers
Tree Swallow (*Tachycineta bicolor*)
Varied Thrush (*Ixoreus naevius*)
Veery (*Catharus fuscescens*)
Warbling Vireo (*Vireo gilvus*)
Western Flycatcher complex (*Empidonax difficilis/occidentalis*)
Western Tanager (*Piranga ludoviciana*)
Western Wood Pewee (*Contopus sordidulus*)
White-throated Sparrow (*Zonotrichia albicollis*)
Willow Flycatcher (*Empidonax traillii*)
Wilson’s Snipe (*Gallinago delicata*)
Wilson’s Warbler (*Wilsonia pusilla*)
Winter Wren (*Troglodytes troglodytes*)
Yellow Warbler (*Dendroica petechia*)
Yellow-breasted Chat (*Icteria virens*)
Yellow-rumped Warbler (*Dendroica coronata*)