The Palo Alto Summer Bird Count, the First 40 Years

Part 1– Individual Species's Populations Trends

Introduction

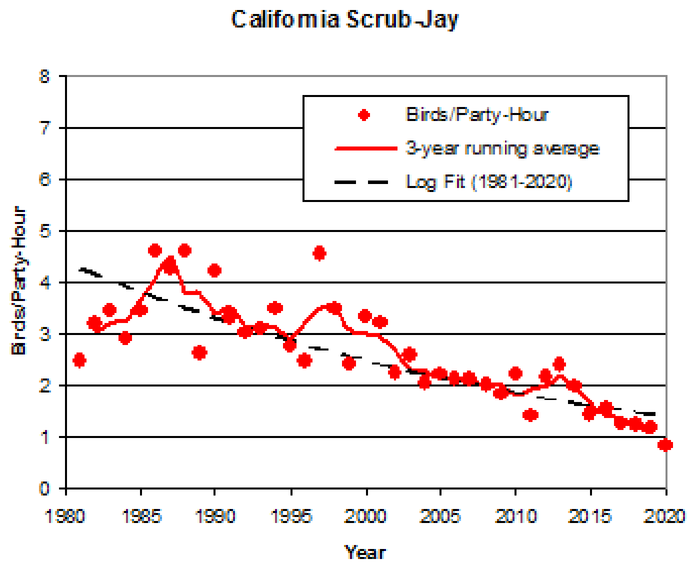
The first Palo Alto Summer Bird Count (SBC) was held on 31 May 1981. Since that initial count, most of the SBCs have been held during the first week in June. The discussion in Part 1, here, addresses the population trends over the first 40 years of some selected species. Part 2 will examine changes in the aggregate numbers of all species.

The Palo Alto SBC count circle is identical to the Palo Alto CBC circle. The protocols used for the summer count are also those used for the Christmas count. Trends for breeding birds in the count circle have been shown in the Santa Clara County Breeding Bird Atlas (Bousman 2007), but otherwise the count results have not been published.

Over the 40 years of the count, the average number of observed species has been about 149 ($\pm 1\sigma$ of 8.9). The average total birds counted has been 19,929 ($\pm 1\sigma$ of 4,305). The number of observers has been 71 ($\pm 1\sigma$ of 9.7) and the number of party-hours has been 172 ($\pm 1\sigma$ of 38). Over this time period, about 235 species have been recorded on the count.

The purpose of this count and the purpose of our local Christmas Bird Counts is to obtain some idea of how our local birds are doing. Forty years is almost two generations of human folk, but many more generations for the birds that are residents or summer residents in our count circle. The rarities that occasionally show up provide us all a kick (the adult Scissor-tailed Flycatcher in the frontispiece was found on the 29th count on 6 Jun 2009). But they are "eye candy." What is important are the population changes that have been recorded for our more common birds.

On the next page, I show the population trend for one of the selected resident species, the California Scrub-Jay.



California Scrub-Jay (decreasing population).

Yearly population change: -2.8% per year

Change over 40 years: -67%

Coefficient of determination, r^2: 0.68

P-value: 0.00000

Rank order: 13

Comments: Atlas shows Palo Alto and San Jose CBCs have similar declines; but Mt. Hamilton CBC is increasing.

I use this example to introduce the reader to the data and analyses that I have used. I show trend plots in the left column and provide some summary information in the right column.

The trend plot shows the number of birds recorded divided by the number of party-hours on the y-axis and the count year on the x-axis. These count data are shown as solid red circles. A 3-year running average is shown as a red line and this is a means of visualizing the data by reducing the higher frequencies in the variance.

The solid dashed black line is a log fit of the measured data. I use a log transform of the data, then fit the log-transformed data with a linear regression. I then back-transform the curve fit and plot it. This analysis is described in (Bousman 2007). There are other methods of fitting data, so there is some degree of arbitrariness in the method I've used. What is most important is that the calculated fit shown here should be roughly the same as what you would draw with a pencil to obtain a best fit to these data.

The summary information is shown to the right of the trend plot. Based on the log fit, I make an assessment of whether the population is stable (or uncertain), increasing, or decreasing. For the California Scrub-Jay, I consider the population to be decreasing. I show two measures of population change. The first is the yearly change, in this case -2.8% per year. The second measure is the change over the 40 years of the Summer Bird Count, in this case -67% over the 40 years.

I find it helpful to use the coefficient of determination of the linear regression fit, r^2, and also the P-value, a measure of significance. I have been warned that r^2 and the P-value are not appropriate measures to use with time series unless suitable autocorrelation tests have been performed. I have not done those tests, so these two values may not be trustworthy.

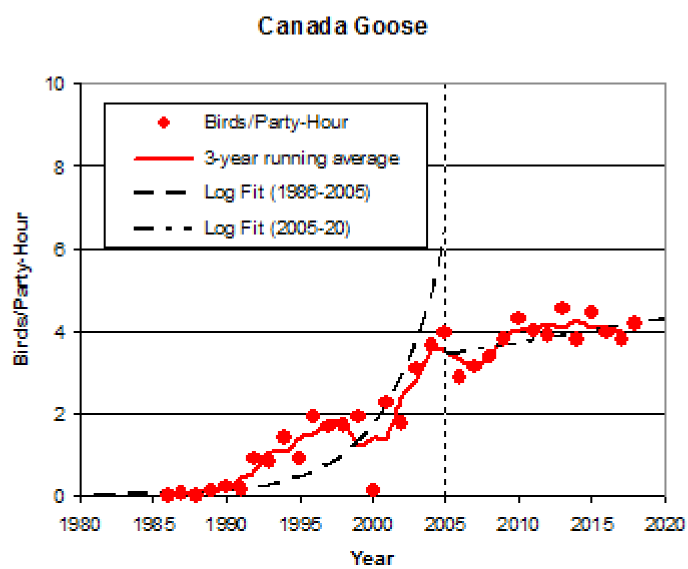
The rank order is based on using all of the data from the 40 years for all species. The order is most common in terms of birds/party-hour to the least common. But first I remove species groups (scaup spp. is an example) and also hybrid species. In the case if the California Scrub-Jay, it is the 13th most common species over the 40 year period, despite the decline shown in the figure. The rank-order distribution of all of the 235 species found during the 40 years is roughly logarithmic. Most of the trends that I have examined are of the more common birds. Birds encountered in only a few years will lack sufficient data to provide an estimate of a log fit (or any other fit). Roughly half of the 235 species may show suitable trends. The best criterion to see if a population trend can be estimated from the data is to calculate the fit and see if it makes sense.

In the 1990s, I reviewed the published literature on the use of Christmas Bird Count data. I wrote up two summaries from my review. Both are available as PDF files on the Santa Clara Valley Audubon Society website. The first of these files is named "Primer_2.pdf." It is a review of multiple approaches used in the past to analyze CBC data. The second of these files is named

"Primer_3.pdf." This file examines the acquisition of count data in Santa Clara County and appropriate analyses that have been used. The present analysis I have made in this study is dependent on these two primers and both may be of interest.

Below, the population trends of the selected species are shown in taxonomic order (as of July 2021). My selection of species is arbitrary to a degree. I have noticed changes for various species previously in the atlas and I have been curious if these changes have continued. I've also noticed changes in recent years for a number of birds and selected them for analysis. It would be nice to examine all species, but that takes time.

At the end of the presentation of the population trends I will add some of my additional comments (p. 16).



Canada Goose (increasing population).

Yearly population change: +30.1 per year over the first 20 years and +1.5% per year over the second 20 years

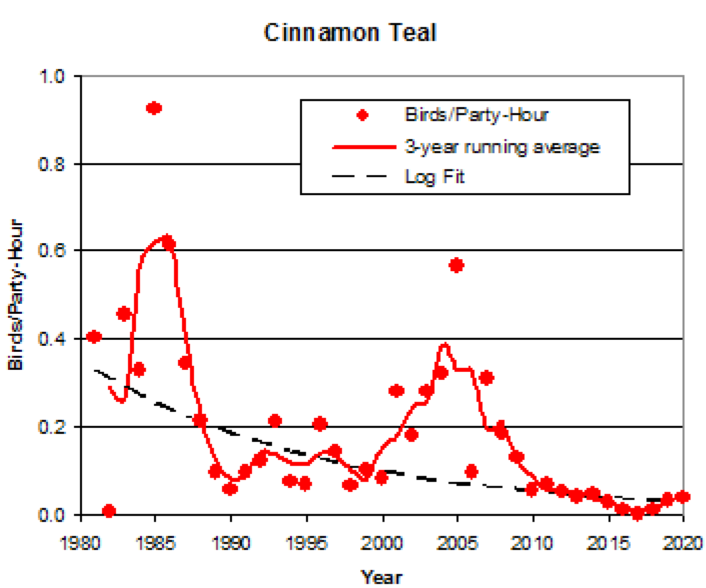
Change over first 20 years: 14,644%, over second 20 years; 25%

Coefficients of determination, r^2: 0.66 and 0.30

P-value: 0.00001 and 0.02878

Rank order: 14

Comments: I provide two fits



Cinnamon Teal (decreasing population).

Yearly population change: -6.1% per year

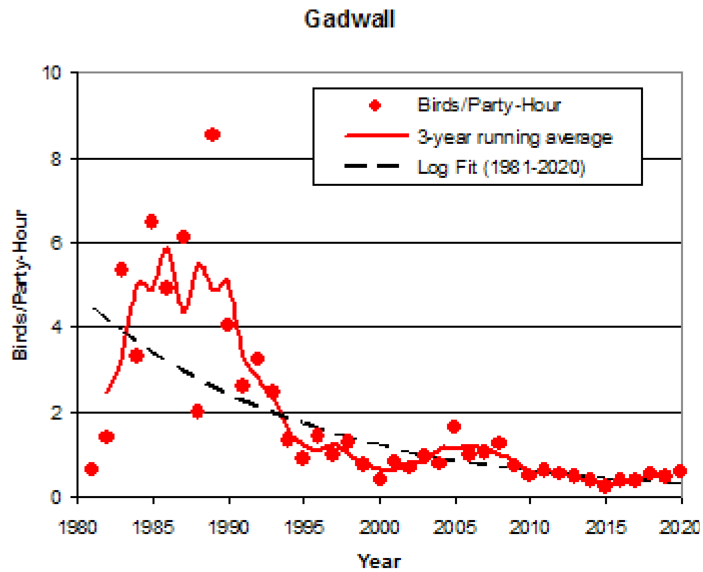
Change over 40 years: -91%

Coefficient of determination, r^2: 0.28

P-value: 0.00042

Rank order: 79

Comments: High variance in two periods.



Gadwall (decreasing population).

Yearly population change: -6.5% per year

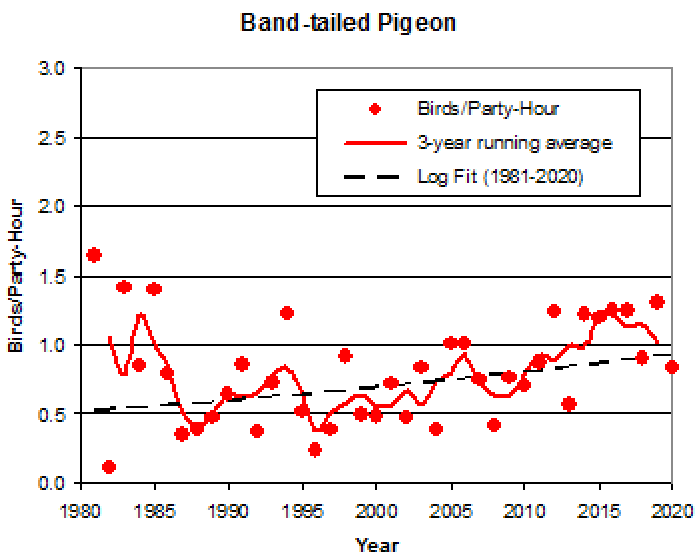
Change over 40 years: -93%

Coefficient of determination, r^2: 0.66

P-value: 0.00000

Rank order: 20

Comments: High variance in 1980s.



Band-tailed Pigeon (stable population).

Yearly population change: +1.5% per year

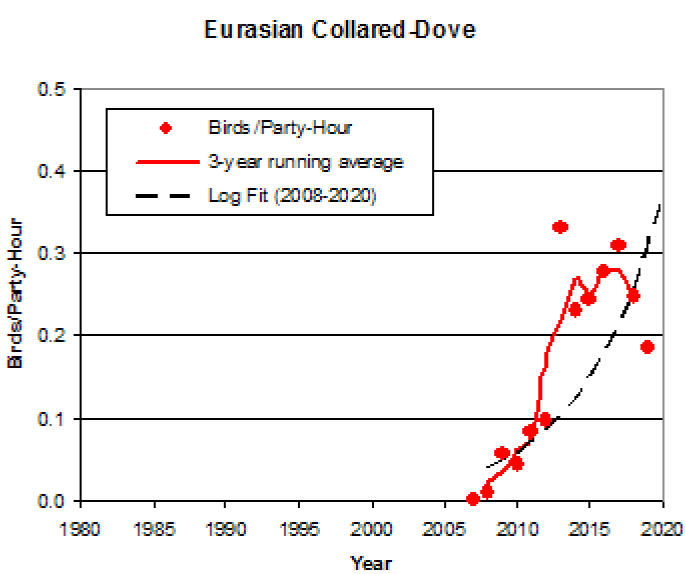
Change over 40 years: +79%

Coefficient of determination, r^2: 0.10

P-value: 0.05260

Rank order: 42

Comments: Slight population increase may not be significant.



Eurasian Collared-Dove (uncertain population).

Yearly population change: +27% per year

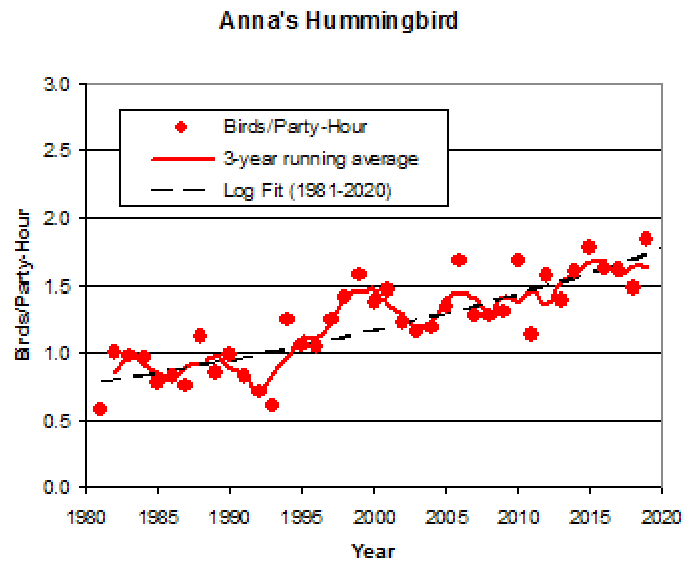
Change over 13 years: +1,673%

Coefficient of determination, r^2: 0.49

P-value: 0.00730

Rank order: 106

Comments: Probably too soon to tell if bird is increasing or in decline.



Anna's Hummingbird (increasing population).

Yearly population change: +2.1% per year

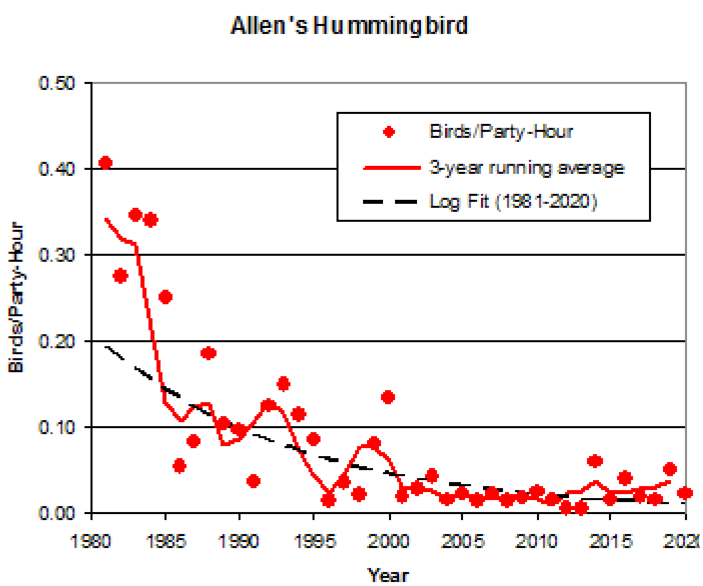
Change over 40 years: +125%

Coefficient of determination, r^2: 0.66

P-value: 0.00000

Rank order: 29

Comments: Similar increase shown in atlas for Palo Alto and San Jose CBCs through 2005.



Allen's Hummingbird (decreasing population).

Yearly population change: -7.2% per year

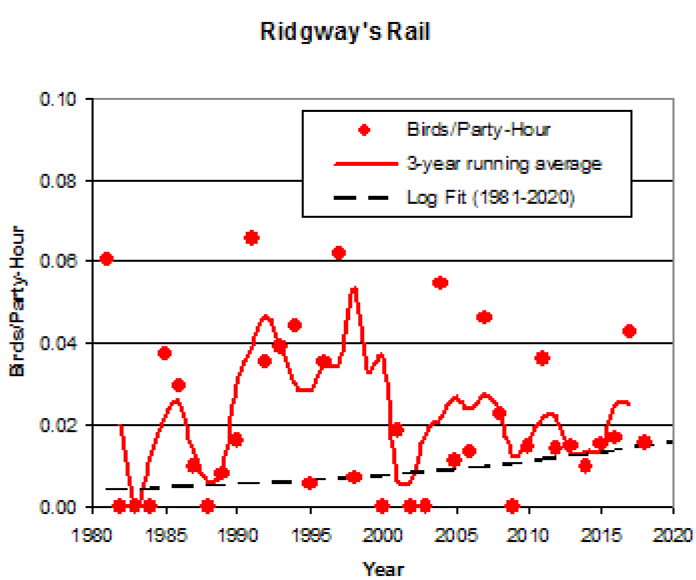
Change over 40 years: -95%

Coefficient of determination, r^2: 0.58

P-value: 0.00000

Rank order: 105

Comments: Possibly stable in Region 7, now rarely found elsewhere within the circle.



Ridgway's Rail (stable or uncertain population).

Yearly population change: +3.7% per year

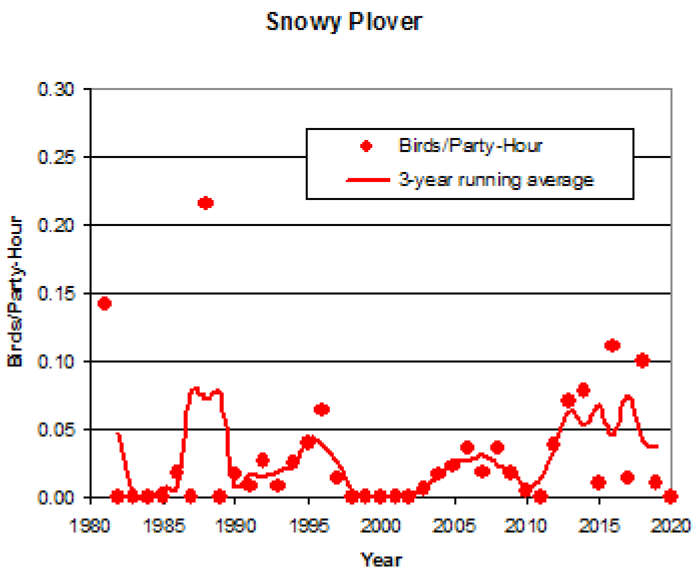
Change over 40 years: +312%

Coefficient of determination, r^2: 0.04

P-value: 0.23379

Rank order: 133

Comments: Eight years with none seen or heard, requires use of alternative analyses.



Snowy Plover (stable or uncertain population).

Yearly population change per year: not calculated

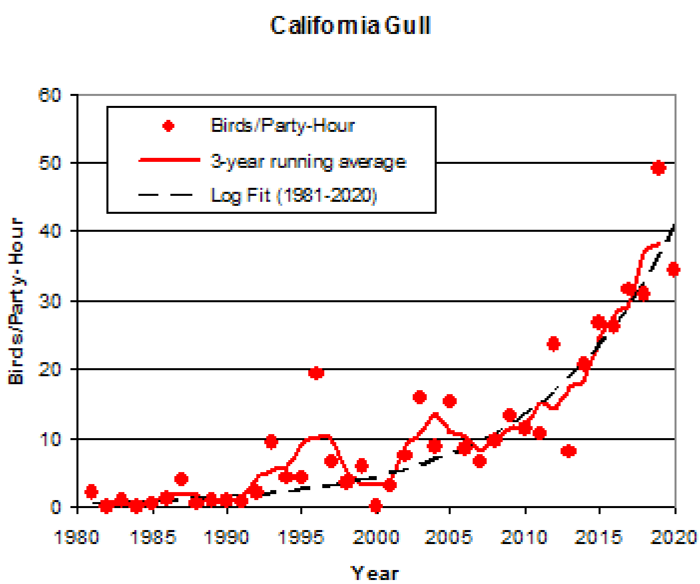
Change over 40 years: not calculated

Coefficient of determination, r^2: not calculated

P-value: not calculated

Rank order: 126

Comments: Too rare in count circle for these analyses.



California Gull (increasing population).

Yearly population change: +12% per year

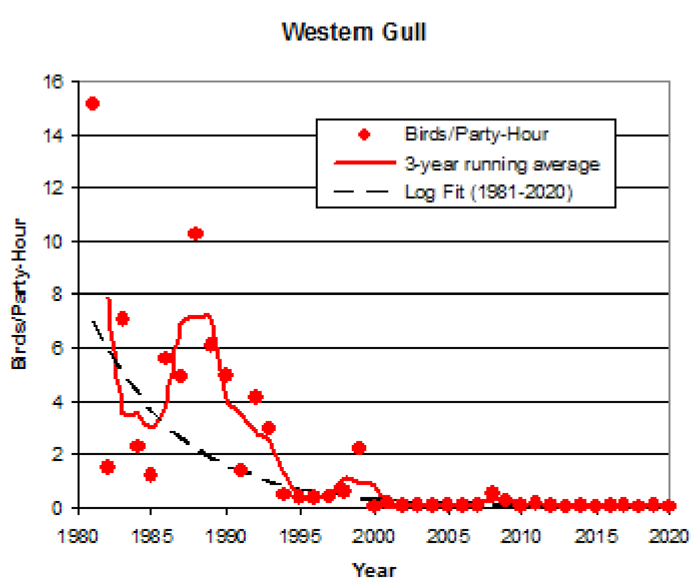
Change over 40 years: +7,632%

Coefficient of determination, r^2: 0.65

P-value: 0.00000

Rank order: 1

Comments: Increase documented in San Francisco Bay (Burns et al. 2018).



Western Gull (decreasing population).

Yearly population change: -15.2% per year

Change over 40 years: -99.8%

Coefficient of determination, r^2: 0.74

P-value: 0.00000

Rank order: 25

Comments: Substantial variance in earlier years, then extinction. Affected by the closing of the Palo Alto dump.

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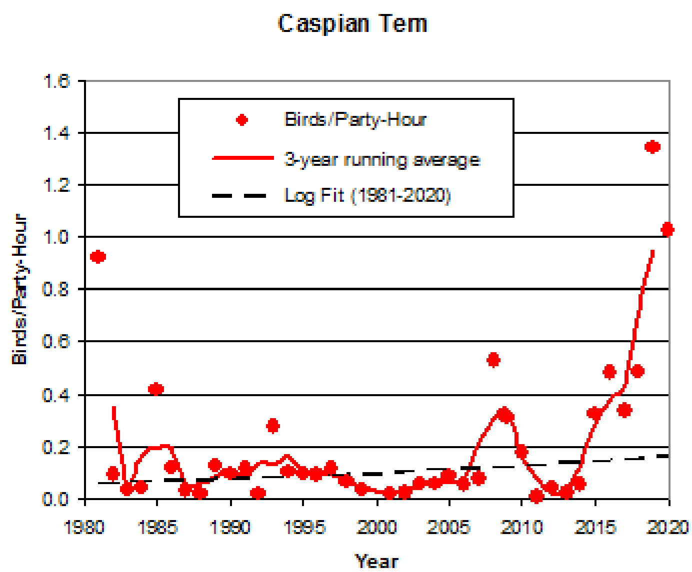


Caspian Tern (stable or uncertain population).

Yearly population change: +2.7% per year

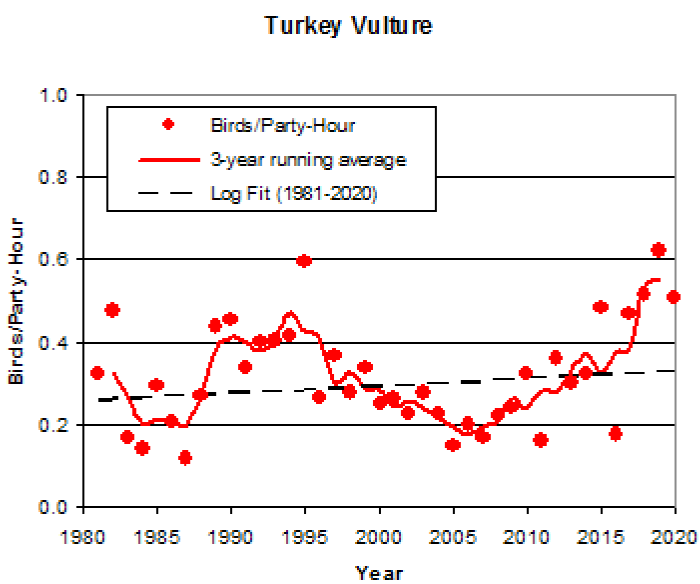
Change over 40 years: +179%

Coefficient of determination, r^2: 0.06

P-value: 0.13826

Rank order: 73

Comments: Too much variance. In recent years the refuge added new islands in ponds in San Mateo County that are now being used for nesting.



Turkey Vulture (stable or uncertain population).

Yearly population change: +0.6% per year

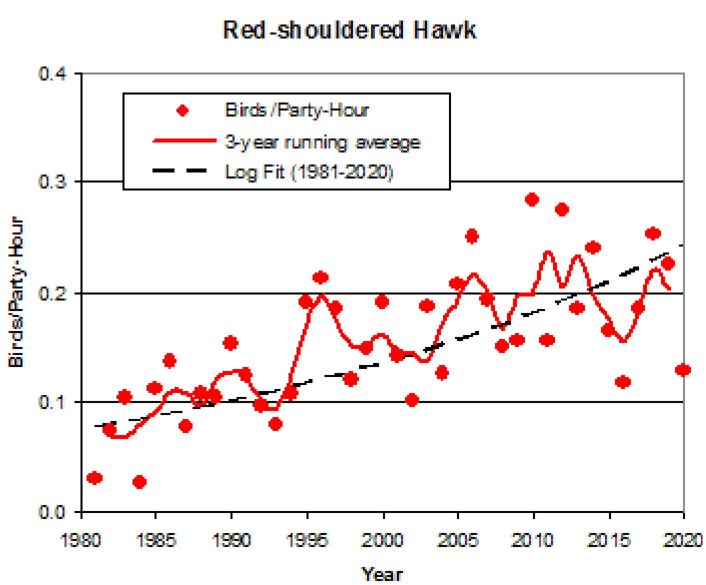
Change over 40 years: +127%

Coefficient of determination, r^2: 0.03

P-value: 0.28696

Rank order: 58

Comments: Apparent oscillations in data.



Red-shouldered Hawk (increasing population).

Yearly population change: +2.9% per year

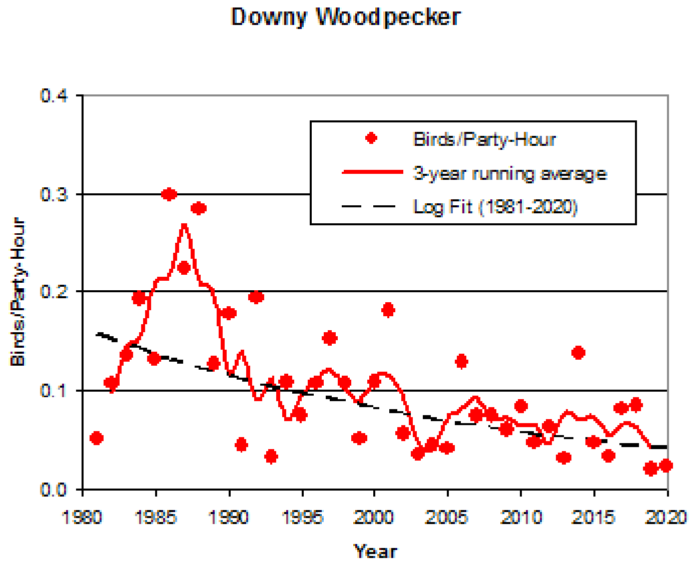
Change over 40 years: +210%

Coefficient of determination, r^2: 0.44

P-value: 0.00000

Rank order: 81

Comments: None.



Downy Woodpecker (decreasing population).

Yearly population change: -3.4% per year

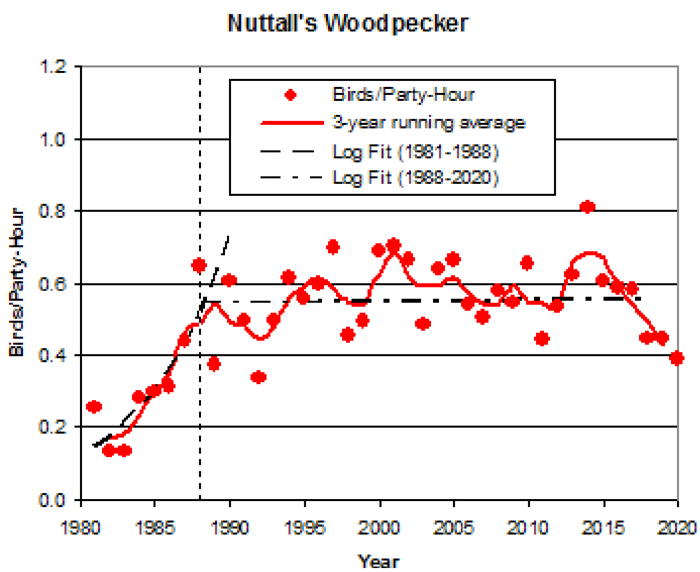
Change over 40 years: -74%

Coefficient of determination, r^2: 0.34

P-value: 0.00009

Rank order: 13

Comments: None.



Nuttall's Woodpecker (increasing population).

Yearly population change: +20% per year over first 8 years and +0.1% per year over remaining years

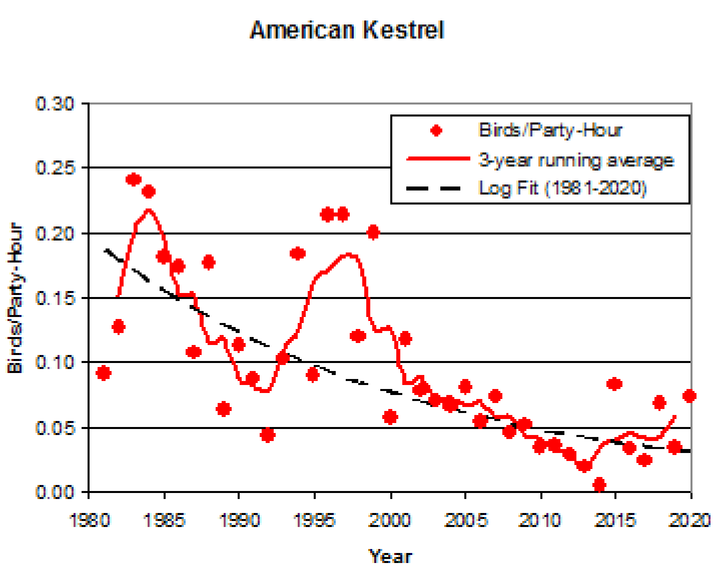
Change over 40 years: +251% and 2%

Coefficient of determination, r^2: 0.68 and 0.00

P-value: 0.00000 and 0.87604

Rank order: 47

Comments: Trend is stable or uncertain after 1988.



American Kestrel (decreasing population).

Yearly population change: -4.5% per year

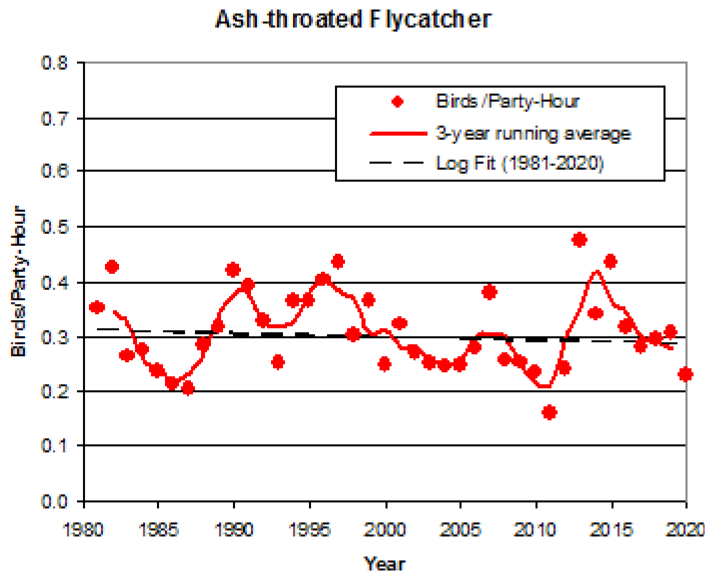
Change over 40 years: -84%

Coefficient of determination, r^2: 0.47

P-value: 0.00000

Rank order: 13

Comments: None.



Ash-throated Flycatcher (stable).

Yearly population change: -0.2% per year

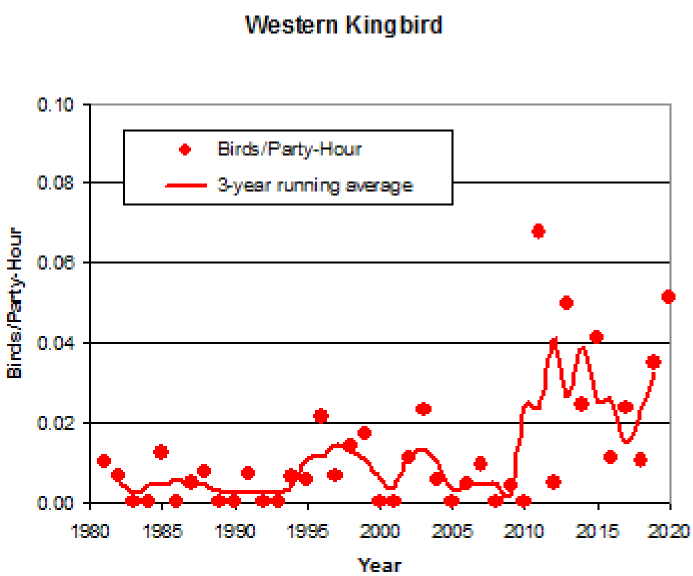
Change over 40 years: -7.7%

Coefficient of determination, r^2: 0.01

P-value: 0.54271

Rank order: 61

Comments: None.



Western Kingbird (stable or uncertain).

Yearly population change: not calculated

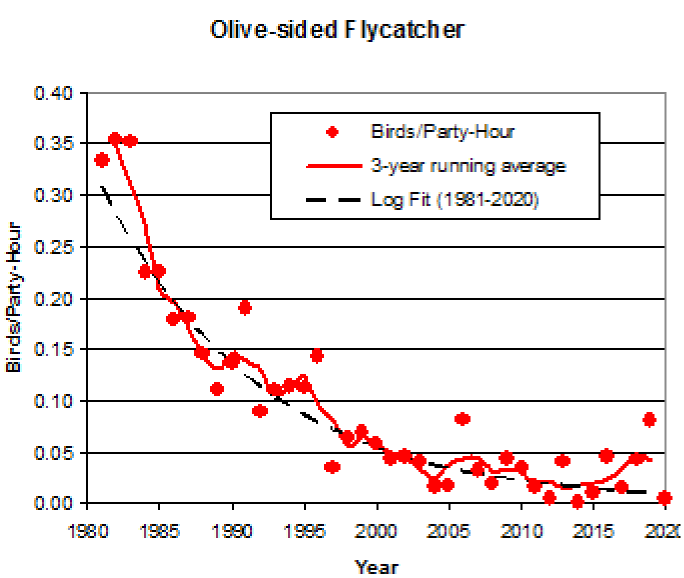
Change over 40 years: not calculated

Coefficient of determination, r^2: not calculated

P-value: not calculated

Rank order: 144

Comments: May be increasing in last decade, but uncertain.



Olive-sided Flycatcher (decreasing population).

Yearly population change: -8.7% per year

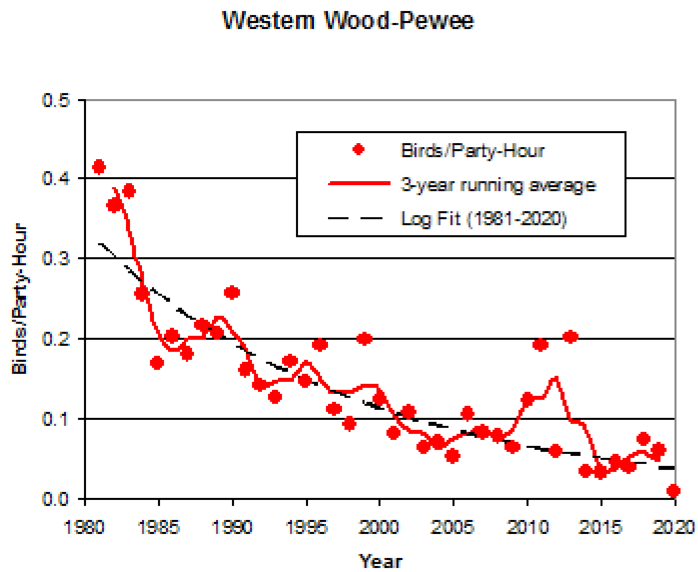
Change over 40 years: -97%

Coefficient of determination, r^2: 0.60

P-value: 0.00000

Rank order: 99

Comments: Some continue in Region 7.



Western Wood-Pewee (decreasing population).

Yearly population change: -5.3% per year

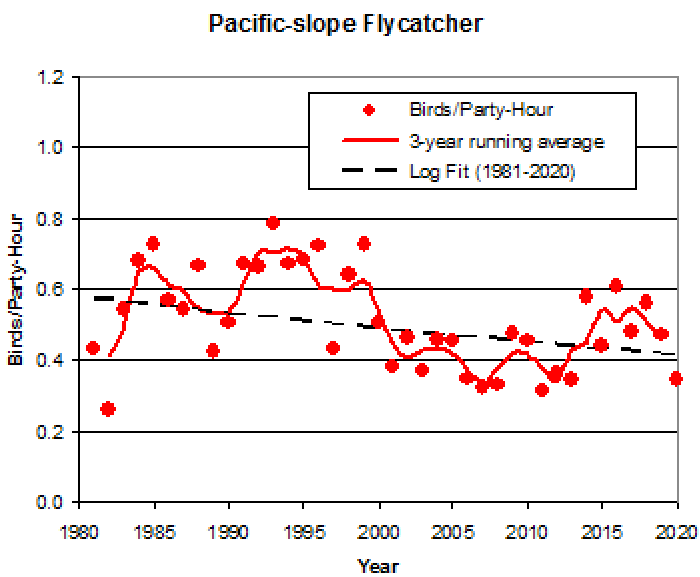
Change over 40 years: -88%

Coefficient of determination, r^2: 0.64

P-value: 0.00000

Rank order: 86

Comments: Some remain in Region 7.



Pacific-slope Flycatcher (decreasing).

Yearly population change: -0.8%

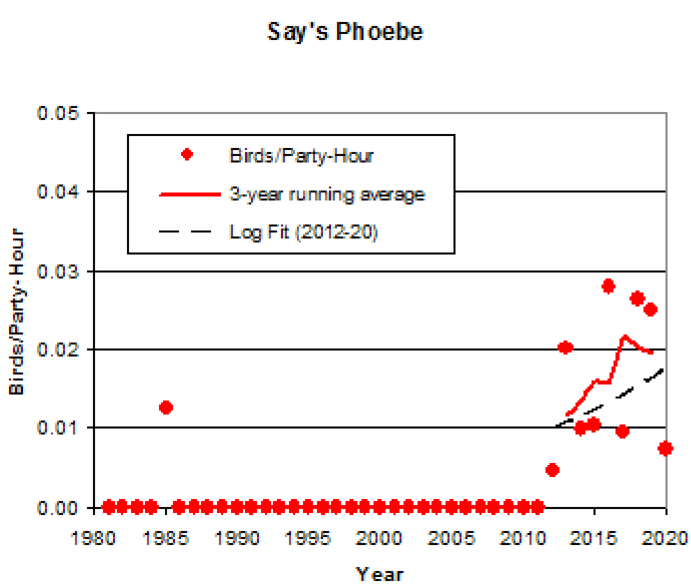
Change over 40 years: -28%

Coefficient of determination, r^2: 0.12

P-value: 0.02767

Rank order: 48

Comments: None.



Say's Phoebe (uncertain population).

Yearly population change: +7.3% per year

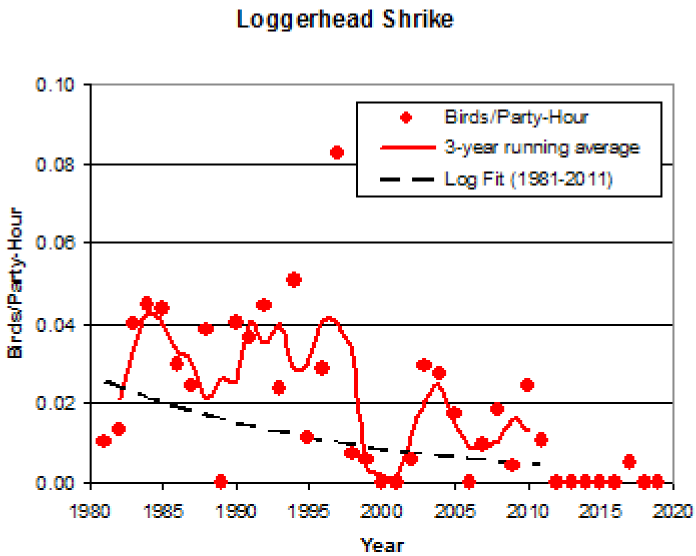
Change over 9 years: +76%

Coefficient of determination, r^2: 0.09

P-value: 0.42435

Rank order: 99

Comments: Recent increase, lacks data to show significance.



Loggerhead Shrike (decreasing or extinct).

Yearly population change: -5.7% per year

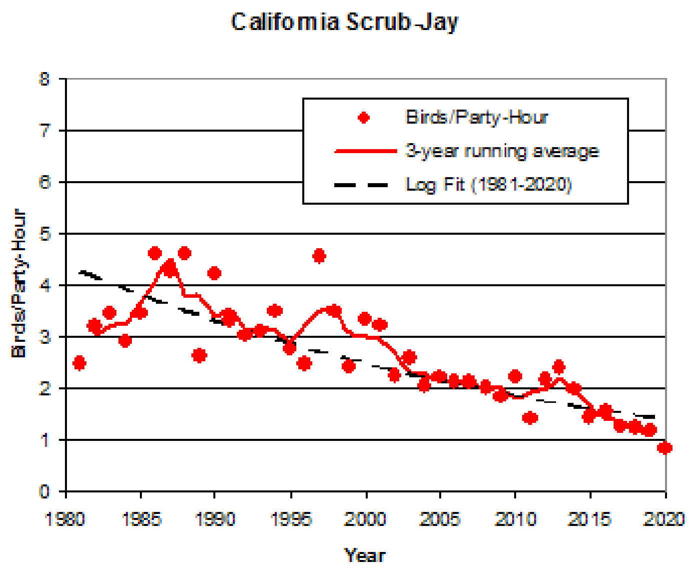
Change over 40 years: -83%

Coefficient of determination, r^2: 0.08

P-value: 0.12834

Rank order: 141

Comments: High variance, uncertain, but likely extinct.



California Scrub-Jay (decreasing population).

Yearly population change: -2.8% per year

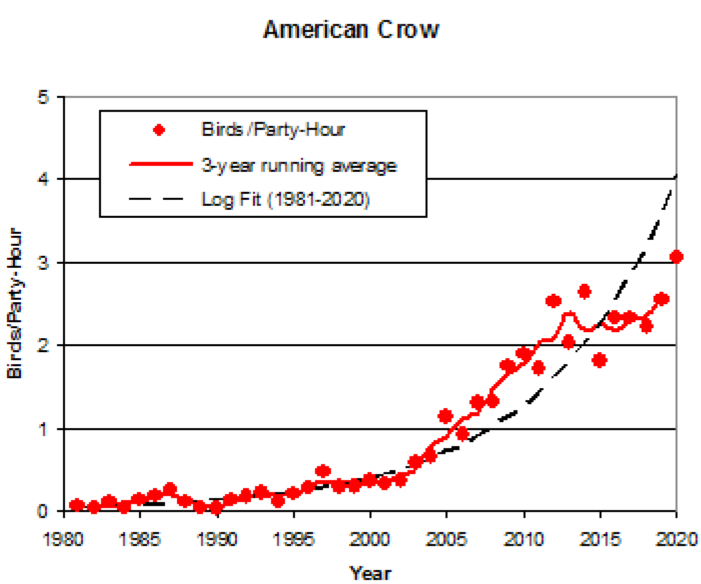
Change over 40 years: -67%

Coefficient of determination, r^2: 0.68

P-value: 0.00000

Rank order: 13

Comments: Atlas shows Palo Alto and San Jose CBCs have similar declines; but Mt. Hamilton CBC is increasing.



American Crow (increasing population).

Yearly population change: +12% per year

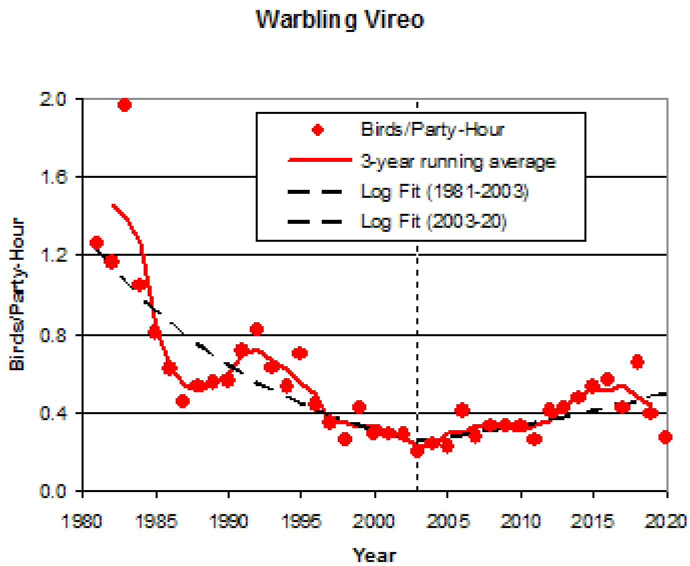
Change over 9 years: +9056%

Coefficient of determination, r^2: 0.88

P-value: 0.00000

Rank order: 33

Comments: Increase appears to be slowing about 2013, but wait and see.



Warbling Vireo (decreasing, then increasing).

Yearly population change: -6.9 per year over the first 23 years and +4.0% per year over the last 18 years

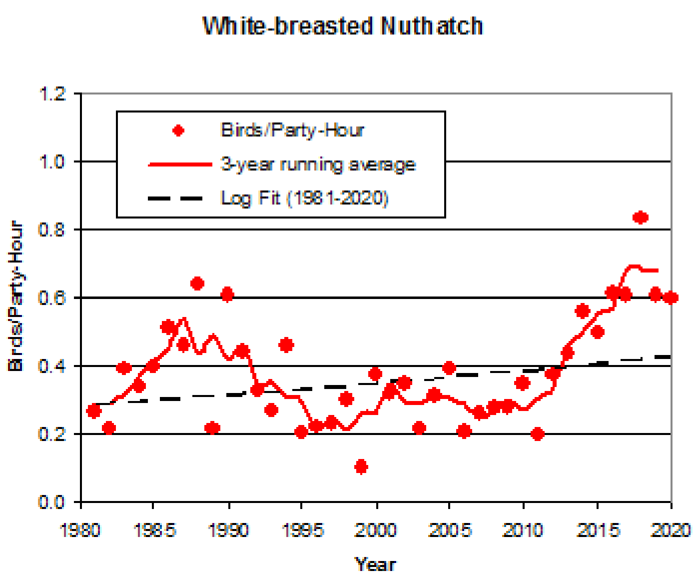
Change over first 23 years: -79%, over last 18 years; 96%

Coefficients of determination, r^2: 0.76 and 0.42

P-value: 0.00000 and 0.00374

Rank order: 47

Comments: Vulnerable to dangers on migration and in winter elsewhere as well as summer residency.



White-breasted Nuthatch (stable or uncertain population).

Yearly population change: +1.0% per year

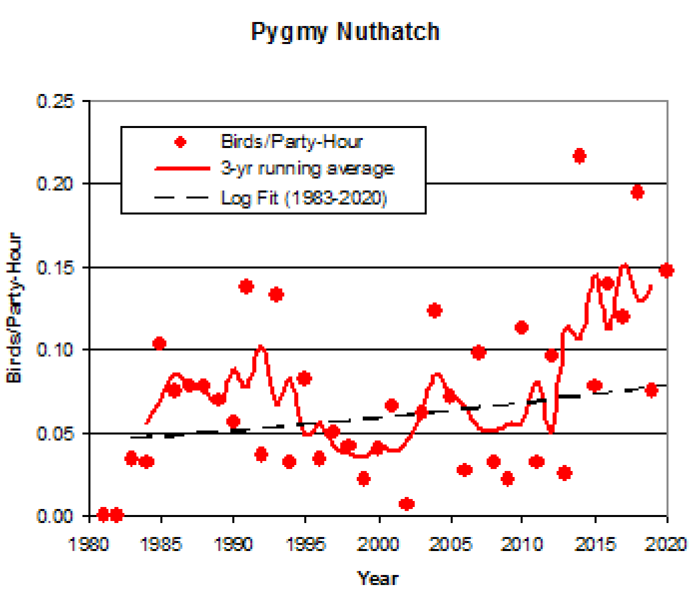
Change over 40 years: +49%

Coefficient of determination, r^2: 0.08

P-value: 0.08397

Rank order: 53

Comments: None.



Pygmy Nuthatch (stable or uncertain population).

Yearly population change: +1.5% per year

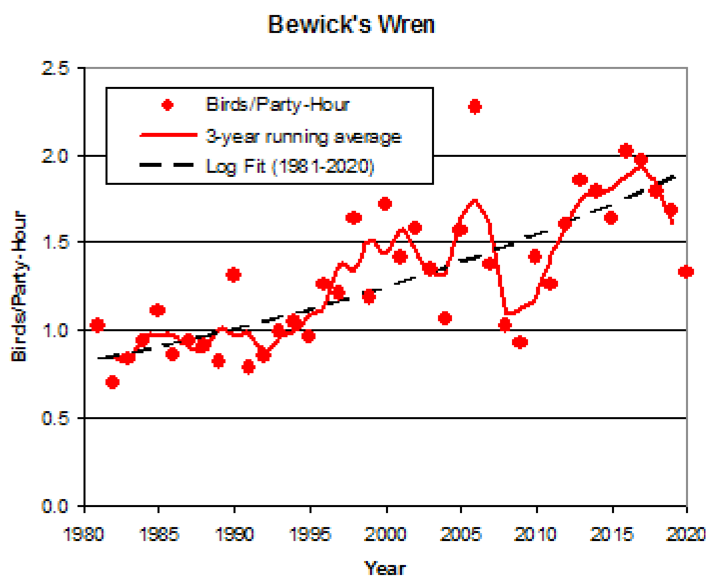
Change over 9 years: +72%

Coefficient of determination, r^2: 0.05

P-value: 0.18232

Rank order: 103

Comments: Moving into flatlands in recent years, but too much variance to be certain of trend.



Bewick's Wren (increasing population).

Yearly population change: +2.1 per year

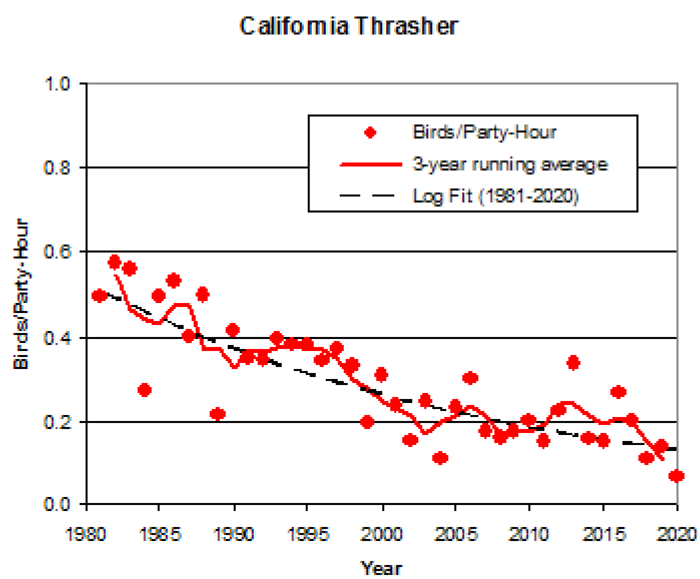
Change over 40 years: +129%,

Coefficient of determination, r^2: 0.57

P-value: 0.00000

Rank order: 27

Comments: None.



California Thrasher (decreasing population).

Yearly population change: -3.4% per year

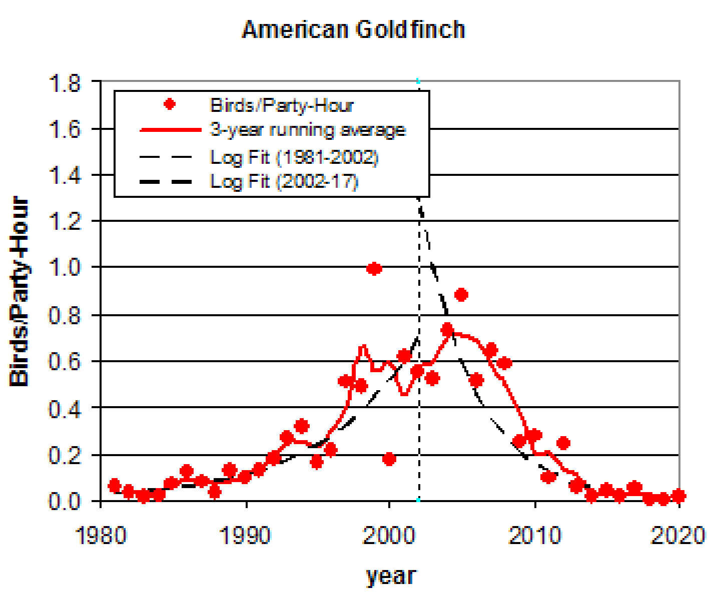
Change over 40 years: -47%

Coefficient of determination, r^2: 0.64

P-value: 0.00000

Rank order: 67

Comments: None.



American Goldfinch (increasing, then decreasing).

Yearly population change: +17% per year over the first 22 years and -23% per year over the last 16 years

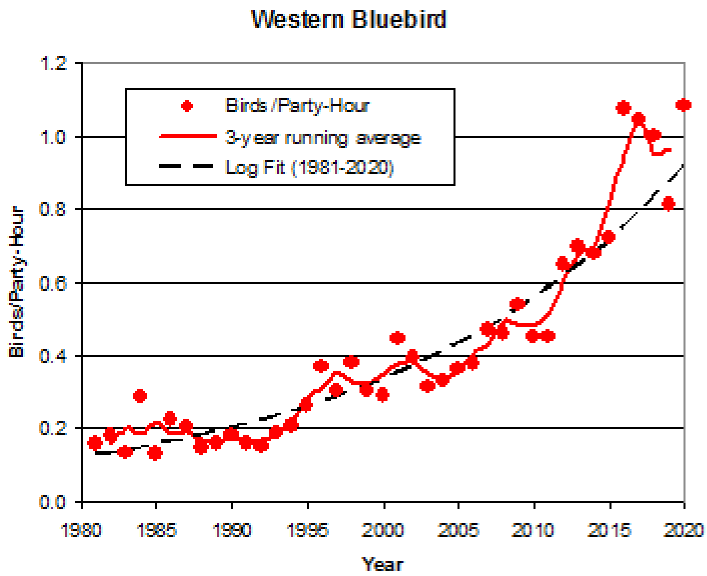
Change over first 22 years: +2827%, over last 16 years; 100% (essentially extinct)

Coefficients of determination, r^2: 0.76 and 0.77

P-value: 0.00000 and 0.00001

Rank order: 69

Comments: Palo Alto CBC data are different.



Western Bluebird (increasing population).

Yearly population change: +5.1 per year

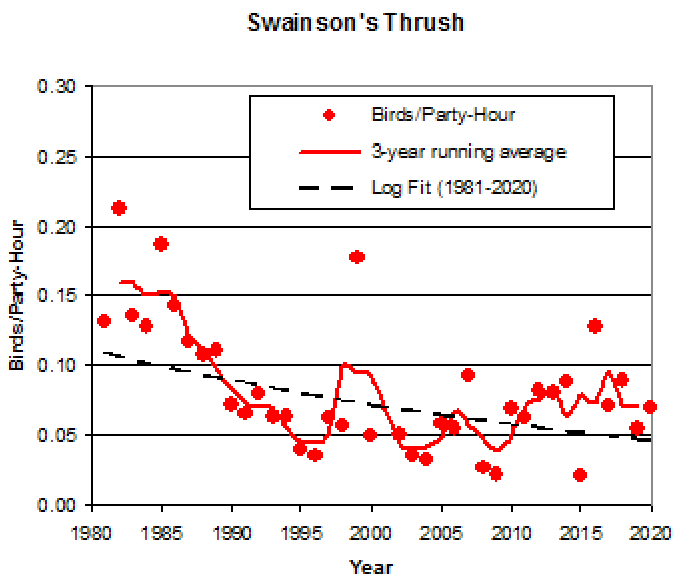
Change over 40 years: +605%,

Coefficient of determination, r^2: 0.87

P-value: 0.00000

Rank order: 49

Comments: None.



Swainson's Thrush (decreasing population).

Yearly population change: -2.2% per year

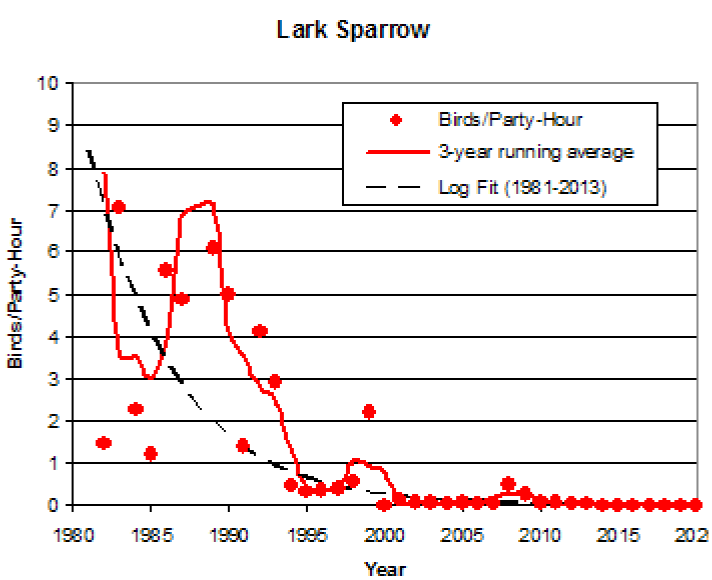
Change over 40 years: -57%

Coefficient of determination, r^2: 0.21

P-value: 0.00000

Rank order: 104

Comments: Possibly stable in Region 7 in last decade.



Lark Sparrow (decreasing, now extinct).

Yearly population change: +17% per year

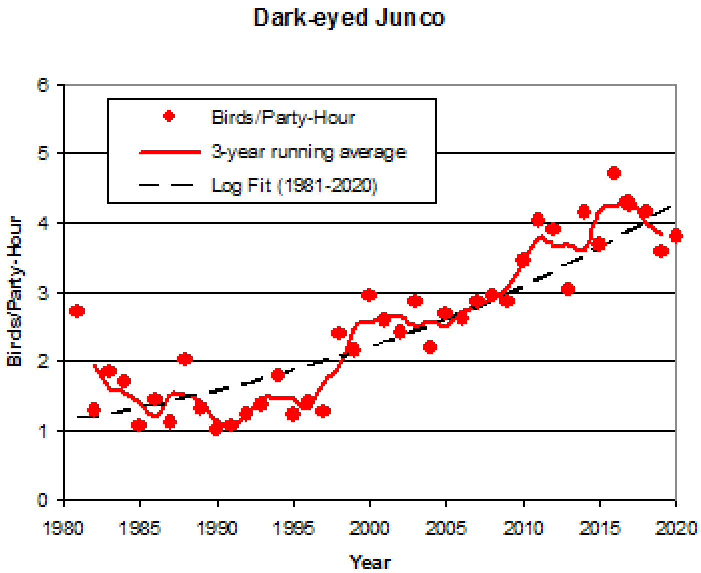
Change over 33 years: -100% (extinct)

Coefficient of determination, r^2: 0.69

P-value: 0.00000

Rank order: 69

Comments:



Dark-eyed Junco (increasing population).

Yearly population change: +3.4% per year

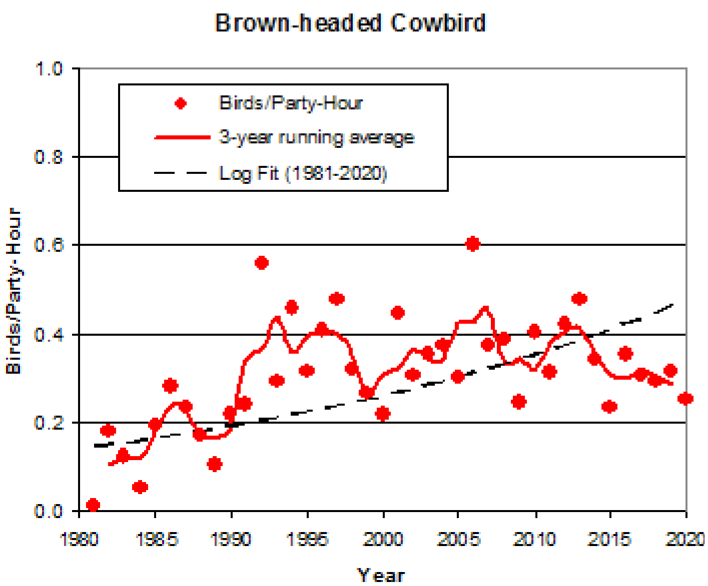
Change over 34 years: +371%

Coefficient of determination, r^2: 0.34

P-value: 0.00031

Rank order: 122

Comments: None.



Brown-headed Cowbird (increasing population).

Yearly population change: -3.1% per year

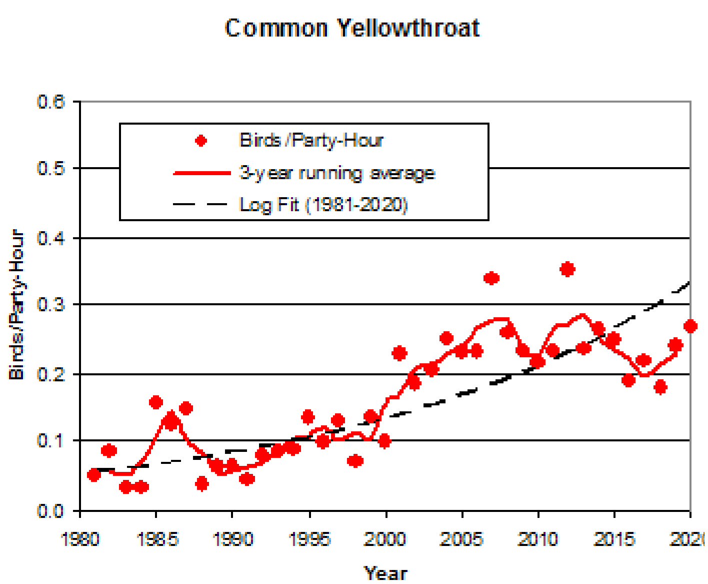
Change over 40 years: +329%

Coefficient of determination, r^2: 0.26

P-value: 0.00082

Rank order: 59

Comments: None.



Common Yellowthroat (increasing population).

Yearly population change: +4.7% per year

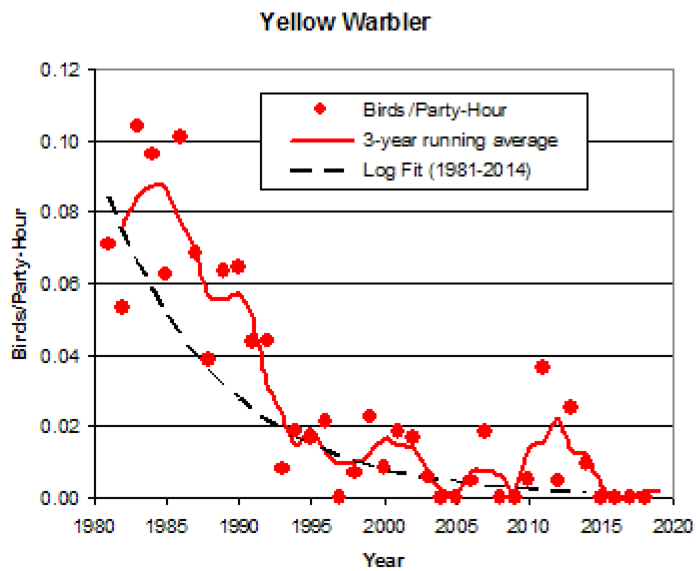
Change over 40 years: +595%

Coefficient of determination, r^2: 0.64

P-value: 0.00000

Rank order: 48

Comments:



Yellow Warbler (decreasing population, extinct).

Yearly population change: -12% per year

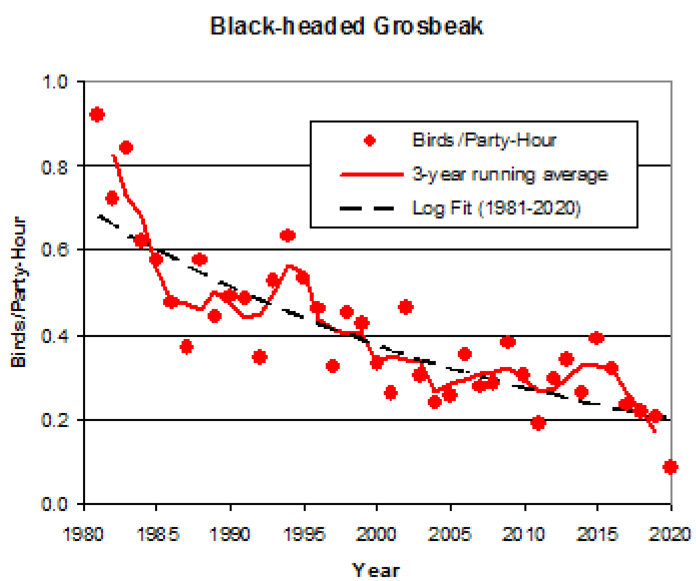
Change over 34 years: -98%,

Coefficient of determination, r^2: 0.34

P-value: 0.00031

Rank order: 132

Comments: Riparian obligate.



Black-headed Grosbeak (decreasing population).

Yearly population change: -3.1% per year

Change over 40 years: -31%

Coefficient of determination, r^2: 0.67

P-value: 0.00000

Rank order: 54

Comments: None.

Some General Comments.

I've included a sample of 40 population trends of some of the more common species that have been recorded on the Palo Alto Summer Bird Count over the last 40 years. There is great deal of variety in these trends, some birds increasing, some stable, some decreasing, and some where there is inadequate data. I found this surprising, but I had forgotten that I had put together a qualitative summary of avifaunal changes in an Appendix of the Santa Clara County Breeding Bird Atlas (Bousman 2007).

More surprising for me was the number of species that have disappeared in the last 40 years: Western Gull, Loggerhead Shrike, Lark Sparrow, and Yellow Warbler.

The Palo Alto count circle is very small compared to all of these species's breeding ranges. Does that mean that the increases and decreases I've shown in my sample here is just a result of too little data?

I've selected one method of analysis to provide a visual estimate of population trends. What we can judge with our eyeballs may be more trustworthy than my analytical approach (it is not original with me). A logarithmic function seems natural to me. But polynomial fits are useful in many areas of mathematics, and could be a better approach. Ecologists are fond of logistic functions, and they can provide a fit that is similar to a sigmoid curve (maybe this fit would be better for Canada Goose, Nuttall's Woodpecker, or American Crow). Does the arbitrary nature of my simple mathematics set me up for unexpected errors?

It would be wonderful to understand the variation we see in the trends I've shown. The possible reasons for these changes may be extraordinarily large in many cases, I believe. It seems likely that in many of these cases there may be multiple interacting causes as well, that is, there is not a singular cause, the famed "silver bullet."

In a larger sense, is there any metric that can tell us about the overall health of our local bird populations? I will address that problem in Part 2.

Bill Bousman
Menlo Park
7 May 2022

References

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Burns, C. E., J. T. Ackerman, N. B. Washburn, J. Bluso-Demers, C. Robinson-Nilsen, and C. Strong. 2018. California Gull population growth and ecological impacts in the San Francisco Bay estuary, 1980–2016, *in* Trends and traditions: Avifaunal change in western North America (W. D. Shuford, R. E. Gill Jr., and C. M. Handel, eds.), pp. 180–189. Studies of Western Birds 3. Western Field Ornithologists, Camarillo, CA; doi 10.21199/SWB3.9.