Headlines Scream
Raptors Increase 200% 1970-2017
What Do Hawk Counts Say?

This past year a number of very important articles have been published. One article on the changes in bird populations since 1970 by K. Rosenberg, and 10 other credited authors was published in the highly respected journal Science and is available on line at: https://www.birds.cornell.edu/home/bring-birds-back/. It documents an overall net decline of 29% in N. American birds - a net decline of 2.9 billion birds - with the largest losses in sparrows and grassland birds effecting both native and invasive species, with most of the losses occurring in the East. But it also described increases in breeding wetland birds (ducks & geese), woodpeckers and raptors, partially offsetting the losses in other species.

Most birders and raptor enthusiasts are concerned with population trends of birds and therefore it behooves us to pay close attention to this study. Every major news outlet and most magazines carried a story about this study. Unfortunately, most of these stories did not go much beyond the headline - 30% decline in N. Am. birds over the past 50 years. Few even mentioned the secondary findings: increases in breeding wetland birds (ducks & geese), woodpeckers and raptors, partially offsetting the loss in other species.

This was a major study – to my mind, of unprecedented scope. It gathered population data on ALL the birds in N. Am over the past 50 years! Where did they get the data? How did they analyze it? What about that increase in raptors? Exactly what species and what data was it based on?

But, an increase in raptors? Now that would be interesting to the readers of this journal. So I decided to look into it more closely. In the general press, there was abundant coverage of this article and its conclusions. The Cornell Lab published an article on the paper in Living Bird (available at https://www.allaboutbirds.org/news/vanishing-1-in-4-birds-gone). None of the articles described in detail the data and methods used to draw the conclusions, they just re-stated (and sometimes mis-stated) the conclusions in the published article. Even the original peer-reviewed article, published in Science, left me unsatisfied. It wasn't until I got to the Supplemental Material that my opinion of the study began to take shape.

The article is based on two data sets. One, dating from 1970 and including population data on 529 species, was based on published materials from 13 sources such as N. Am. Breeding Bird Surveys (BBS), Audubon Christmas Bird Counts (CBC), Partners in Flight (PIF) and Birds of N. Am (BNA). The other data set was based on NOAA-NEXTRAD data from 2007 to 2018. The radar was used essentially as a check on the accuracy of the data compiled from the main published sources. In both sources the data is complex. The bird population data is based on sources with different data collection methods and published in different forms and the published article did not describe how they managed to put this data together and come up with a simple number to summarize the overall change in population for each species or group of related species, but did give some indication of the sophisticated statistics used.

The Living Bird article has a summary graphic highlighting the species groups that showed increases: Waterfowl +50%, **Raptors +200%** and Turkeys +200% among others. The label for

the figure says "…..**Hawks and falcons** benefited greatly from focused conservation policy, such as Endangered Species legislation and the banning of harmful pesticides such as DDT….." **THAT +200%** is the big hook that convinced me to investigate further and discuss it in this forum. A +200% increase in raptors is no small deal even over 50 years, and certainly contrary to my observations across the same time period.

The Living Bird article and the paper itself, cited the +200% increase in raptors. The 'Change Since 1970' figure is directly from the Rosenberg article.

In Table S2 of the "Supplementary Materials" Rosenberg gives a more detailed look at the family groups:

Table S2 Family Common Name	Number species	Change Millions	Change %	% of species in Decline
New World Vultures	2	9.4	265%	0%
Osprey	1	0.4	304%	0%
Hawks	16	5.5	78.8%	19%
Falcons & Caracaras	6	0.03	0.5%	33%
Owls	11	1.7	15.9%	64%
Barn Owls	1	0.1	212%	0%

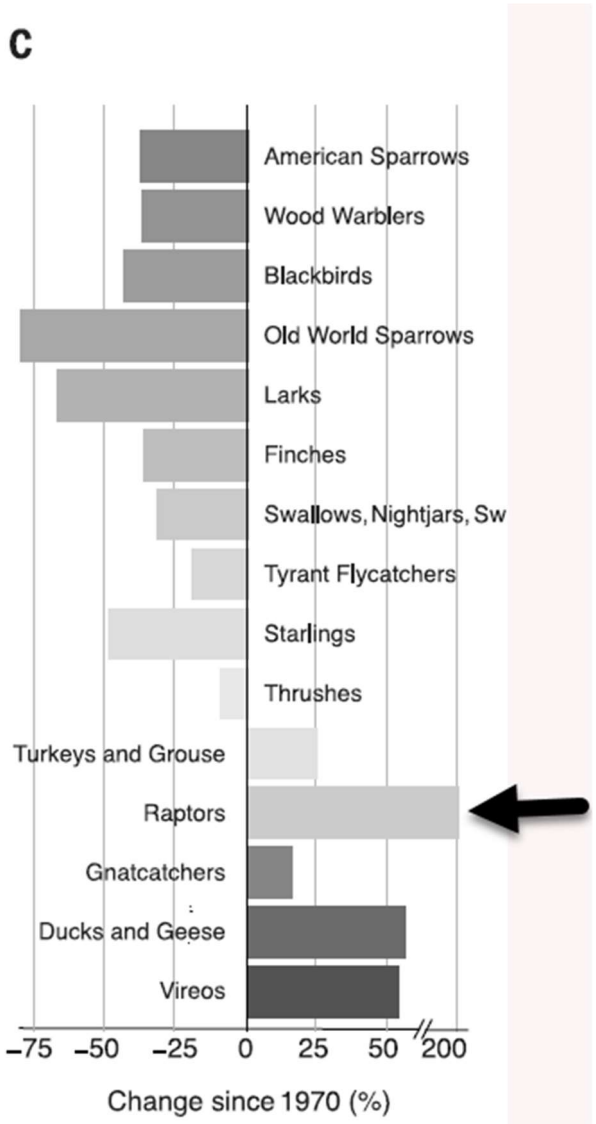


Table S2 shows percent change for six families ranging from 0.5% to 304%. Does the 200% increase in Raptors refer to all or several of these families, collectively? Using the numbers from Table S2, I calculated the original population for each family and added them as the highlighted numbers on Table 2.

Rosenberg Data - 48 Years 1970-2017 Family Com Name	Number species	Change Millions	Change %	% of species in Decline	1970 Population in Millions (calc-DP)	2017
New World Vultures	2	9.4	265.3%	0%	3.5	12.9
Osprey	1	0.4	304.4%	0%	0.13	0.53
Hawks	16	5.5	78.9%	19%	7.0	12.4
Falcons & Caracaras	6	0.03	0.5%	33%	6.0	6.03
Owls	11	1.7	15.9%	64%	10.7	12.4
Barn Owls	1	0.1	211.6%	0%	0.05	0.15

Table #2 – Taken from Rosenberg's Table S2 plus calculations for populations that I made from his data

I then looked at combinations of families and found the percent change. The resulting percent increase varied from 35% to 95%.

% Change Raptors 48 yrs- Rosenberg Data	
OS & Hawks & Falcons	+49%
OS & Hawks & Falc & Vult	+95%
OS & Hawks & Falc & Owls	+35%
OS & Hks & Fal & V & Owls	+65%

So I can find no basis in this table for the statement that Raptors have increased by 200% since 1970. (I have left out Rosenberg's 90% Credible Intervals because he did not appear to use them in his conclusions.) The closest we can come to the

Table #3 – Raptor percentage changes calculated from Rosenberg's data

+200% increase in raptors cited in the Rosenberg graphic and quoted in the Living Bird article, is to include the first four families, but omit the owls in the last two families. And we still only get a 95% increase…I'm stumped about where the 200% increase came from.

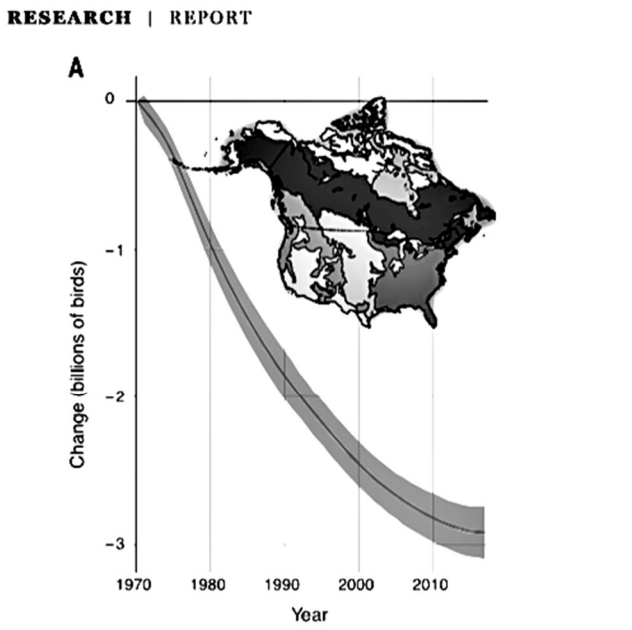


Fig. 1. Net population change in North American birds. (**A**) By integrating population size estimates and trajectories for 529 species (*18*), we show a net loss of 2.9 billion breeding birds across the continental avifauna since 1970. Gray shading represents the 95% credible interval (CI) around total estimated loss. Map shows color-coded breeding biomes based on Bird Conservation Regions and land cover classification (*18*).

Rosenberg also includes a graph for the population trend for all species, not just hawks. It was widely reproduced in news reports of Rosenberg's article. While there is no outward evidence, we have to assume that it is based on the calculated bird populations for the last 48 years. If that is so, it shows good news and bad news. The bad news is the loss of billions of individual birds over the time period. But the good news is that the decline is slowing! Just estimating approximately from the curve, a billion birds were lost in the first 10 years, but, as a rough estimate only 0.2 billion in the last 10 years. I found no mention of this very important change in trend in the article. Surely a marked decrease in the loss of birds is as important as the previous loss of birds. The origin of this curve is not obvious however. In my discussion of the OS below we will see that his trend for that species is based only on the first and last 3 years of the data. This approach ignores any patterns during the middle 42 years.

I wondered how I could compare the Rosenberg findings with hawk count data. Hawk count data are migration counts, whereas Rosenberg's numbers, which rely heavily on the BBS, are for breeding birds. While not all hawk species are migrants, we expect that the percent change we observe in hawk counts should be similar to the population changes calculated by Rosenberg. Hawk count data predominantly counts passage birds from a source region north of the count location, and not all the individuals in the source region will pass the same count location from year to year, or may even short-stop and not pass south of the latitude of the count location at all. In addition, the Rosenberg conclusions and data is for all of N. Am. and no hawk count location counts raptors from all of N. Am.

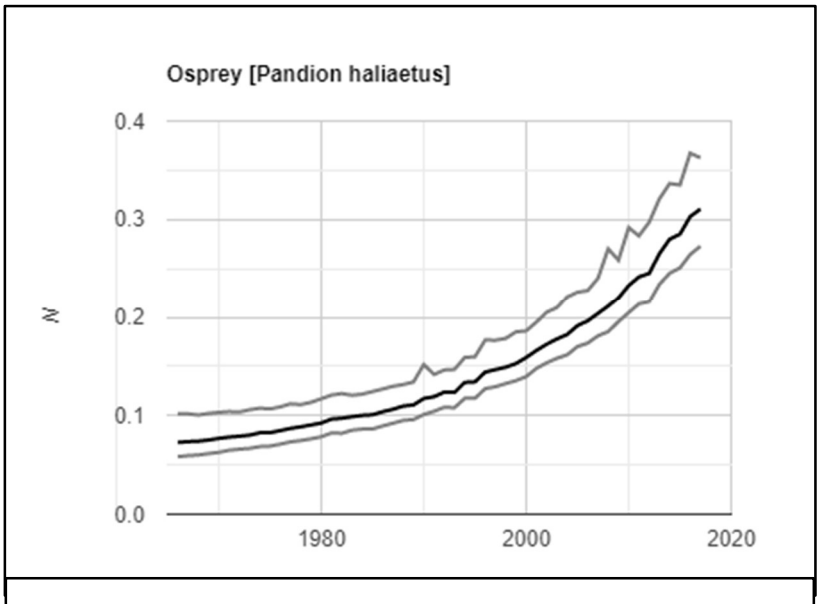
Because of space limitations in this publication we will only consider the trends in OS and Vultures seen at hawk watches. The hawk watch trends from selected watches for the other hawks and falcons is be available at:
http://www.battaly.com/nehw/reports/panko/raptors+200pc.pdf

Osprey Population Levels & Migration Counts:
Any birder in the Northeast will tell you that the OS population is increasing on the basis of breeding season observations. A local breeding bird atlas area here in Westchester County NY, that never had any breeding OS, now has two nests with a third nest just a half mile out of its borders. This in a densely populated suburban area that has an interstate, two NYS Parkways, numerous heavily traveled state roads, and no major water bodies It does have the cell towers that OS find so attractive. This area is not unique. It is happening all over NY and CT and, likely the whole Northeast. Yet hawk watches in the Northeast report a decrease in OS over the last

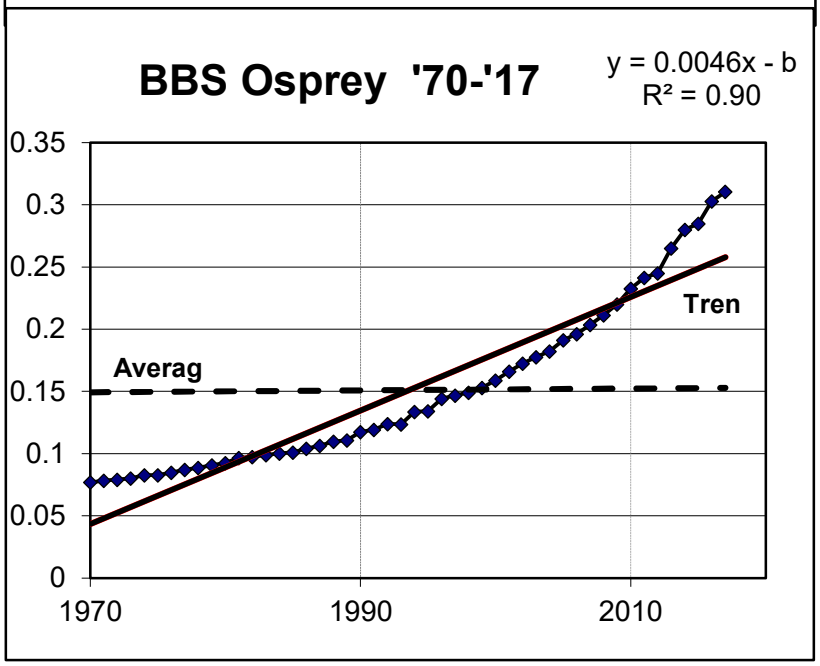
25 years. How these observations can be resolved with the pronounced and almost universal decline in OS counts at hawk watches is the outstanding puzzle of hawk watching, IMHO. (NEHW report pg 24, http://www.battaly.com/nehw/reports/NEHW2018.pdf).

Rosenberg, et al Results

Two factors make OS an interesting example to examine. 1) This taxonomic family consists of only one species. 2) For Rosenberg's list of sources, only the BBS has information on hawk populations.



The BBS provides a graph of its OS data. The Y-axis is labeled N, the letter often used to represent a species population. When the data base is queried, this is labeled as RA, and not N. So the dark line may not be a direct plot of their data but a number statistically calculated from their data. The grey lines are a representation of the uncertainty they see in the accuracy of their data.



Rosenberg states that he usually averaged the first three years and last three years and used the averages to calculate the percent change in population. Using the first graph I estimated the values for 1970 and 2017 and got a value of 303.9% for the change over the 48 years which is very close to Rosenberg's value of 304.4%. Elsewhere in this article I used the values at the ends of the Trend Line to calculate the percent change. If we use an exponential fit to this data (R^2 = 0.98), which is better than the linear fit (R^2=0.90), we get a percent change of 370%.

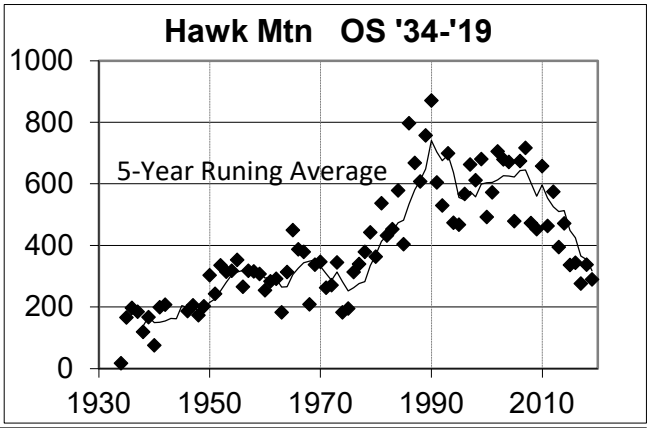
I do not know enough about the BBS data to speculate what bias, if any, the BBS counts are subject to, but two factors may be significant. OS may breed more commonly along roads, making them more noticeable on BBS routes. OS nests and their presence are easily detected compared to other raptors.

For the remaining analysis I will be assuming that Rosenberg's numbers are a direct and simple calculation from the BBS numbers. It gets a little more complicated to verify this in his other groups, as they involve more than one species.

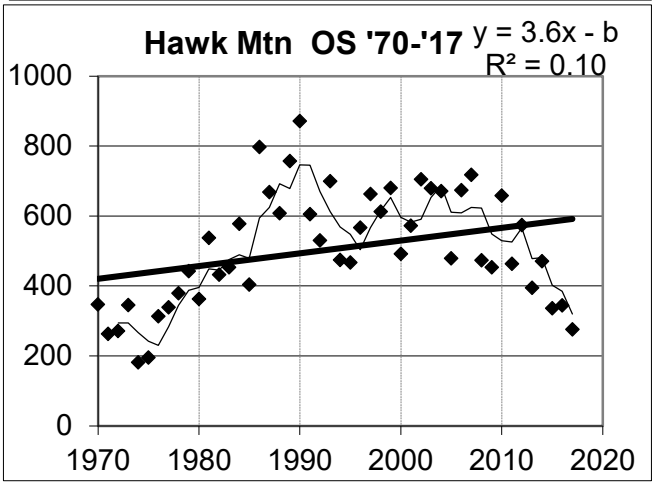
Hawk Watch Data

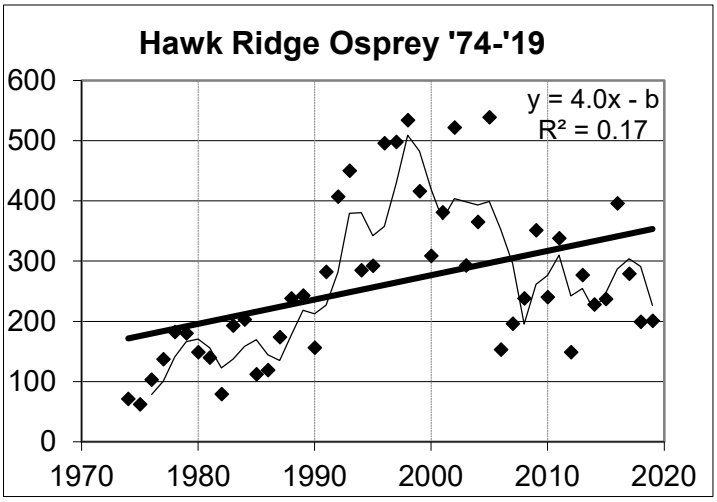
To examine the OS trends in hawk watch data, I looked at several representative sites across the continent, and then looked at the NEHW compilation of northeastern sites.

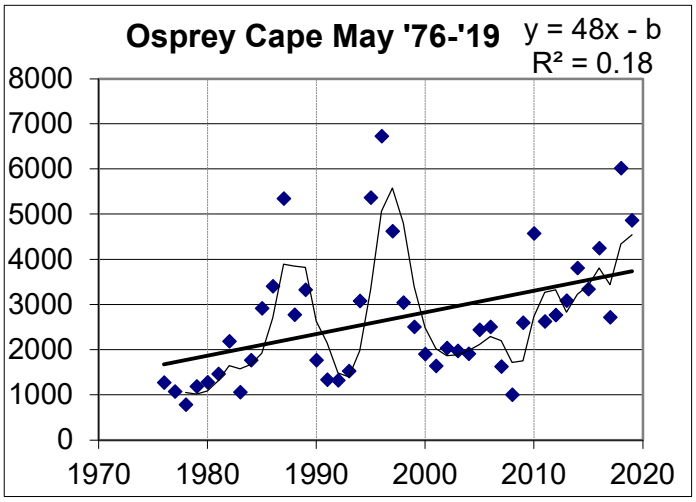
Hawk Mountain shows an interesting pattern: This begins 35 years earlier than that considered by Rosenberg. After WWII and until the mid '70's the OS count looks relatively constant. Silent Spring was published in 1962 and DDT outlawed in the US in 1972. And we see a rapid rise in population after 1976, peaking in 1990. Then a period of constant counts from 1990 to 2010. And an apparent decline since 2010. It presents a much more complex picture of OS numbers in the northeast than Rosenberg's over-simplified +304.4% does for the period 1970-2017.



If we average the years around 1970 and 2017, as with the BBS data, we get a percent change of 0% and if we plot a trend line we get a slight but insignificant increase. This increase, from the trend line, though insignificant, is +40% which demonstrates the difference between averaging the end years or using the linear regression. But the data from Hawk Mtn only reflects the OS population of the northeast, and likely only the inland portion of that population, and Rosenberg's conclusions are for all of N.Am but only the years 1970-2017.



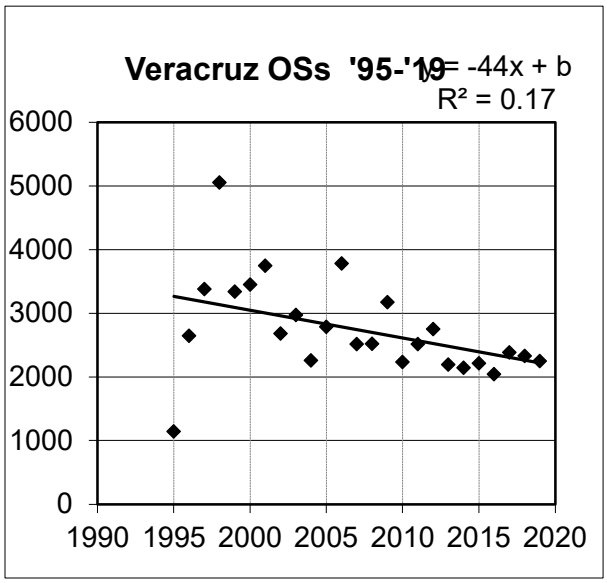




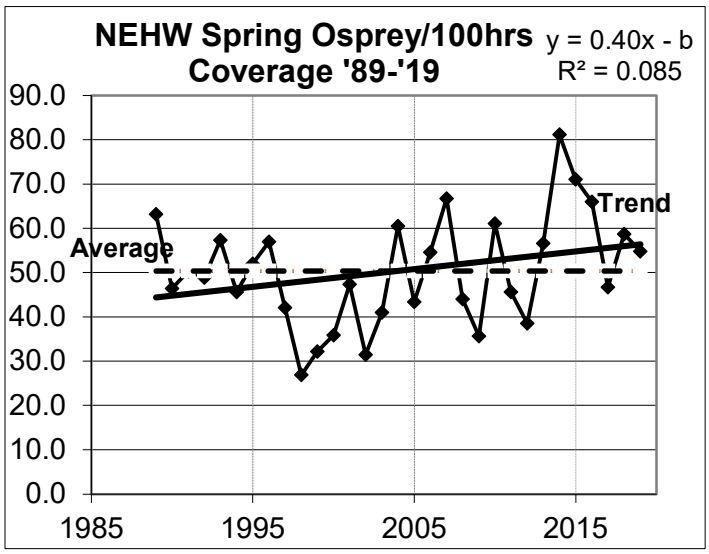
Hawk Ridge in Duluth MN also measures a northern, inland population, and its graph is remarkably similar to Hawk Mtn's. From the 70's we first see a rise, then a steady portion in the 90's, to a decline down to the current levels. This is for a period of 46 years, overlapping with 44 years of the time period used by Rosenberg. If we use the linear trend line to get a percent value for the overall period, it is 100%, not close to his 300%.

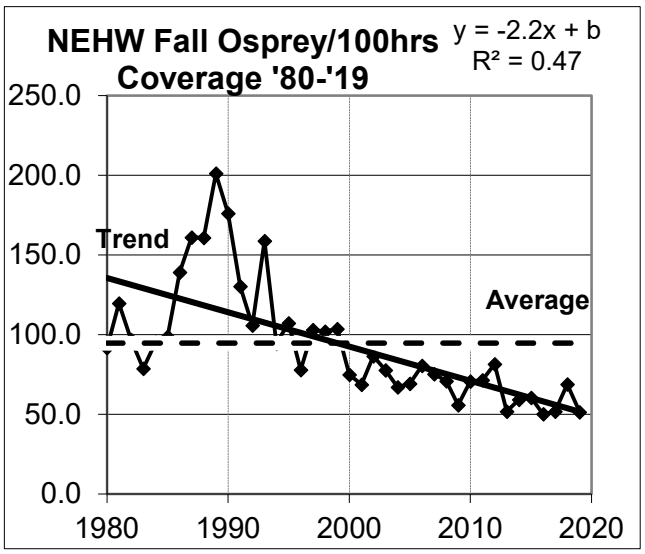
For a look at the coastal population we can look at **Cape May**. Its count starts in September and therefore may miss some early migrating adults. This graph shows a great deal of variation, possibly because weather sometimes brings otherwise uncounted offshore migrants in close enough to be counted at Cape May. It does not show the trends evident in the Hawk Mtn data. It does show an increase of +124% from 1976 to 2017, and a significantly strong increase from 2010 to 2019.

The OS counted at Cape May and Hawk Mtn are likely breeders from the northeast. If we look at Veracruz perhaps we will see a wider picture of the N.Am. continent.



The **Veracruz** data, like Cape May, is a reasonable sample – averaging over 2000 OS per year and it likely represents a breeding population from a broad inland portion of N.Am. It suffers from only having counts for 25 years. The wide variation in the counts from 1995 to 1998, makes it impossible to reasonably calculate a percent change using start and stop years. But it is obvious that the trend is down over the last 20 years. A regression line through the data shows a decrease of about 30% over 25 years.





The graphs above are from Trudy Battaly's compilation of all of the hawk watches of the northeast as given in this issue. In order to compensate for new hawk watches and ones that change their coverage significantly, the total hawks are divided by total hours of watching and multiplied by 100. They are somewhat contradictory. The numbers of OS coming north in spring are not changing significantly over the last 31 years, while the fall OS going south through our area seem to be decreasing significantly over the last 40 years. There could be a number of reasons for this; 1) The OS may use different routes coming north in the spring than going south in the fall, which we know to be true, 2) there could be a decline in breeding success resulting in a decline in the fall migrating population, while over-wintering success is increasing, keeping the breeding (spring) population constant. Whatever the causes for these curves, neither serve to confirm Rosenberg's thesis that their population is increasing by 300%.

Summarizing for Osprey:

We have a rather complex picture from the different data available:

Rosenberg – 1970-2017 - +304.4% - likely based mostly on BBS (inland & roadside) data

BBS - 1970-2017 - +300% - mostly inland and roadside data, continent wide

Hawk Mtn - 1970-2017 - +40% - mostly inland and northeastern population
Hawk Ridge- 1974-2019 - +100% - mostly inland and northcentral population
Cape May - 1974-2019 - +120% - coastal and northeastern population
Veracruz - 1995-2019- -30% - mostly inland and central population

NEHW – Spring – 1989-2019 – possibly a slight increase – statistically insignificant.
NEHW – Fall – 1980–2019 – significant decrease of 60% over the last 40 years

My calculations of the change in the number of hawks at particular watches are done differently from Rosenberg's. I mostly used a regression line for the period and site in question and used the difference in the beginning and ending of the line rather than comparing the average the first three years to that of the last three years.

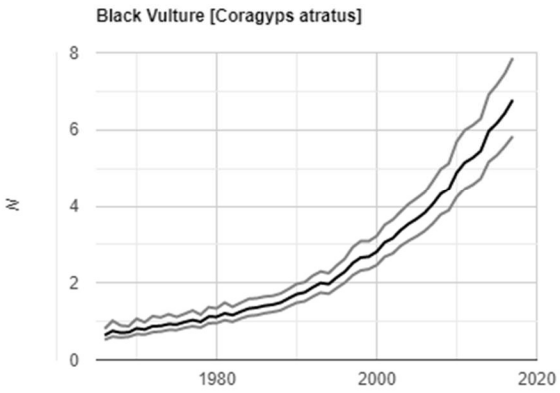
Considering all the data, I would lean toward the hawk watches and estimate an increase in OS population through the '90s followed by a steady period and a decrease in the 2000's, resulting in an overall net increase of about 50% since the '70's.

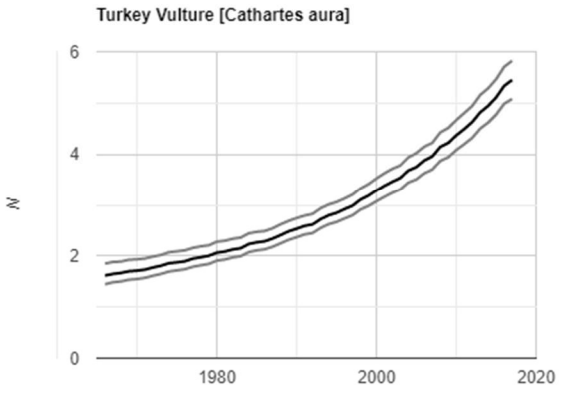
Vultures

Rosenberg, et al Results

Rosenberg groups BVs and TVs together and reports a +265.3% increase over the 48 years from 1970 and implying a current populations of about 12.4 million. Throughout the report Rosenberg gives numbers that imply much greater accuracy than I think they deserve. His own Credible Intervals for vultures indicate the value 264.3 is good only within a 30% range with 90% confidence. So 265.3% might better be stated as somewhere between 235% and 295%. Thus, the value of 265.3% implies knowledge of its precision to a much greater extent than he actually claims. I will write it as 260%. A similar argument applies to the values cited above and below.

The BBS graphs for the Vultures are given below.





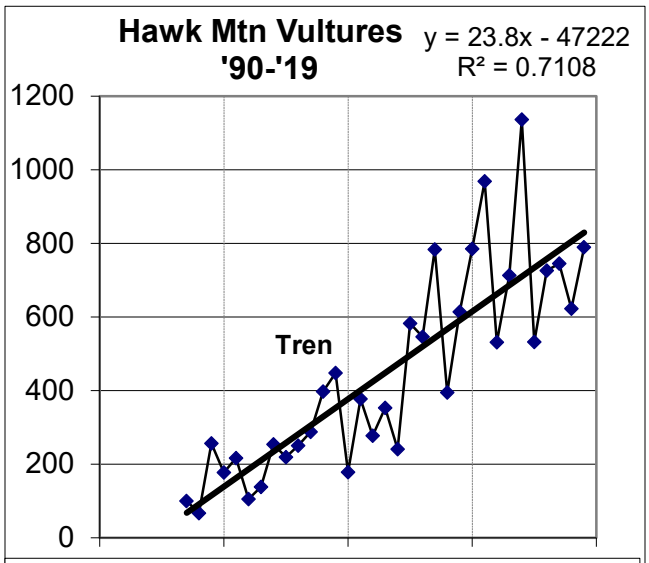
These graphs are labeled N along the Y-axis, with no units of measure. N is normally used to indicate population but I do not know if the numbers are actual estimates of numbers of vultures in millions or are actually different units of measure. Therefore, I can't combine them to get a BBS estimate for the percent change of vultures during this period. Also, being 1966-2017, the BBS period is a little longer than Rosenberg's. But from the graphs we can estimate a change in TVs of 230%, and a change of BVs of 1000% over the period. Rosenberg, presumably using this same BBS data, reported a change of their sum to be 265.3% for the period 1970-2017 and a change of 9.4 million in population. Reading these graphs, and assuming the y-axis is

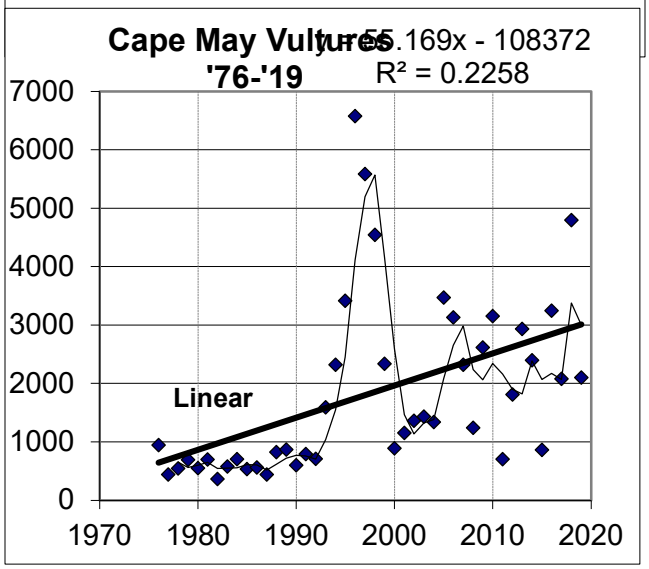
millions, I get a change of 420% and 9.9 million over the slightly longer 1966-2017 year period. The 9.9 million is very reasonable, compared to Rosenberg's 9.4 million for a slightly shorter time period, but I am unable to explain why I get a percent change for the combined species of 420% compared to Rosenberg's 265.3% for the slightly shorter time period. It should also be noted that this BBS data puts the total number of BVs at 6.7 million and the TVs at 5.4 million. 20% more BVs than TVs? Certainly not in the Northeast in 2017, but they are a more southerly species than the TVs so this may be accurate.

Hawk Watch Data

How well do the hawk counts reflect the change in population of vultures over the years? First, we'll look at the premier, longest hawk watch – Hawk Mtn.

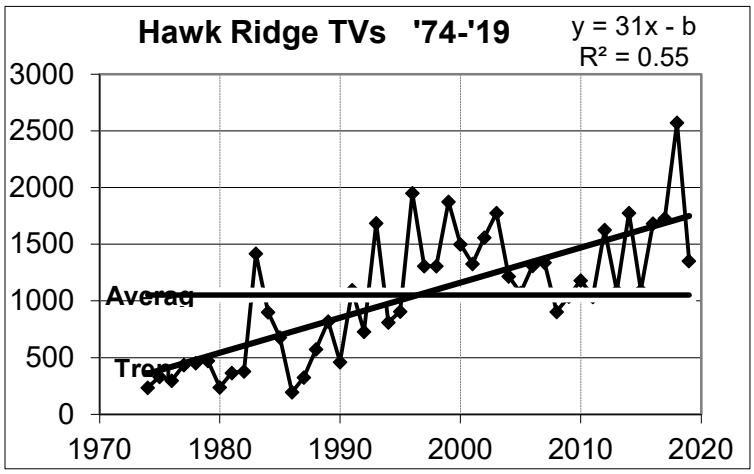
Unfortunately data from **Hawk Mtn** for all the years of Rosenberg's study is not available. Hawk Mtn recorded some Vultures in the early years but seemed not to count them from the mid 60's to mid 80's, so the picture from Hawk Mtn is not as good for the Vultures as it was for the Osprey.



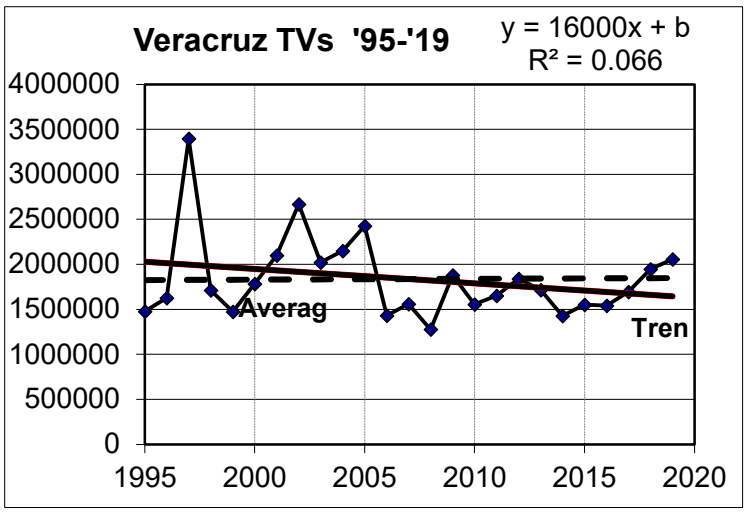


The trend at Hawk Mtn is stark and huge. I would tend to believe it is mostly due to a slow start up in counting vultures in the 80's & 90's except the trend is exactly similar and continues through to 2019. This gives an increase of 900% for Vultures counted at Hawk Mtn from 1987 to 2019. But this is certainly an exaggeration as they counted as many as 200-300 some years back in the '50's. But there is no way to include this data and estimate the change observed since 1970, since the Vultures were, in fact, not counted. But whatever numbers did pass would reduce the 900% change considerably. So I will put the value in parentheses, and consider it not (900%) but a large positive value at any rate.

There is no reason to expect **Cape May** would be a good reflection of the Vulture population of the northeast and, indeed, its data looks very problematical. I see a steady period from '76 to '92. Then a huge positive excursion from '95 to ''98. And then a relatively steady period with a great deal of variation from 1999 to 2019. The trend line shows an overall increase over the period of 350% but I would be hesitant to say any more than it shows a large increase. I think the number of Vultures counted at Cape May are strongly influenced by weather conditions. So much so that the uncertainty in any trend it shows is very large.

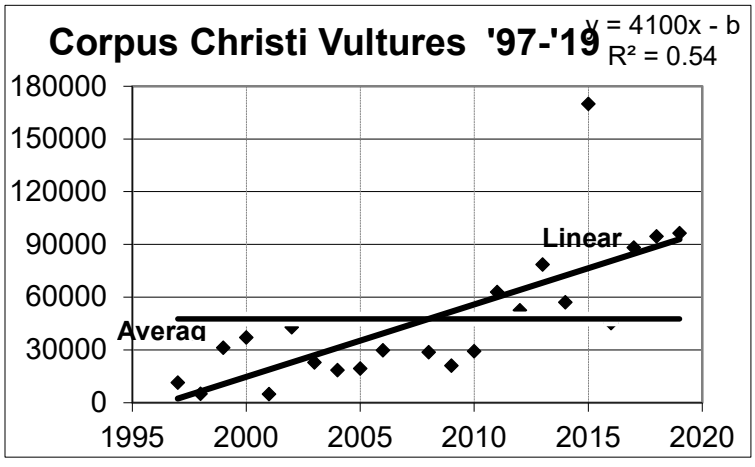


Hawk Ridge MN, only counted 2 BV over its 46 years. So the graph given is only for TVs. The regression line shows a change of 270% over that time period. This is rather close to Rosenberg's 260%, especially considering that no BVs were included. It certainly looks like the northern population of TVs is increasing rapidly and Rosenberg's estimate looks good.

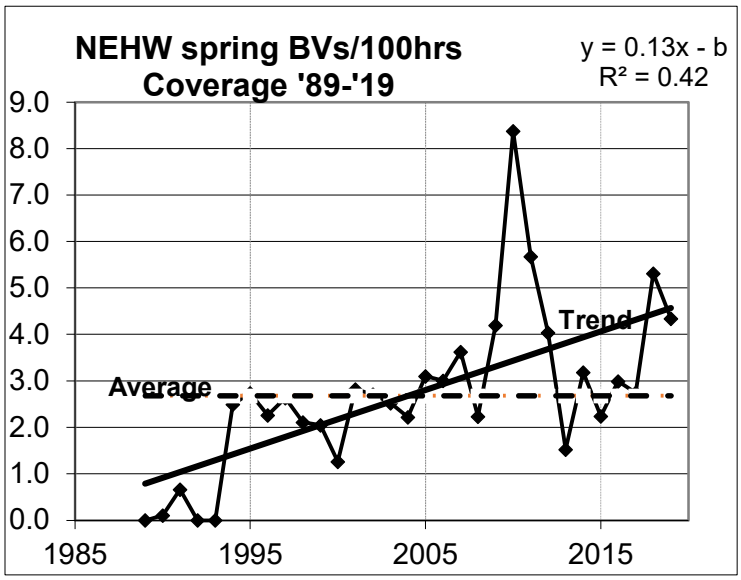


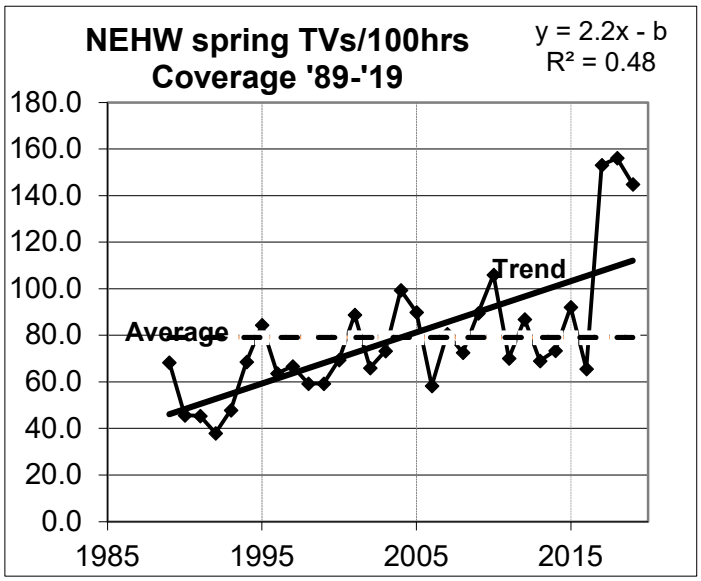
We also have the data from **Veracruz**. There are some factors to be aware of when interpreting this data. 1) Veracruz probably counts birds from the widest portion of N.Am. compared to any other hawk watch. 2) But it does not count migrants from all of N.Am. Some TVs & other hawk species stop migrating before getting to Veracruz, and some take routes that do not pass Veracruz. 3) The data from Veracruz extends from 1992-2019 but much of the data from 1994 is missing. So I've taken the data from the two Veracruz sites from 1995-2019, a total of 25 years. Rosenberg's data represents the years 1970-2017 or 48 years. Surprise! Veracruz's count of TVs shows a very small decline over the 25 years. Possibly the proportion of TVs short-stopping and overwintering north of Veracruz is increasing because of climate change. BVs are not counted at Veracruz because they are generally local and not migrant.

Faced with the difficulty of reconciling the hawk watch data, I looked at another southern hawk watch – Corpus Christi. At Corpus Christi they do count migrating BVs and average about 430/year while they average 47,000 TVs/year. Birds of the World says that BVs do not migrate but may withdraw from northern and higher elevation breeding locations. This would explain the low numbers counted at Corpus Christi and make the hawk count data for this species entirely unreliable. Thus the BBS data would be the only good source of population data.

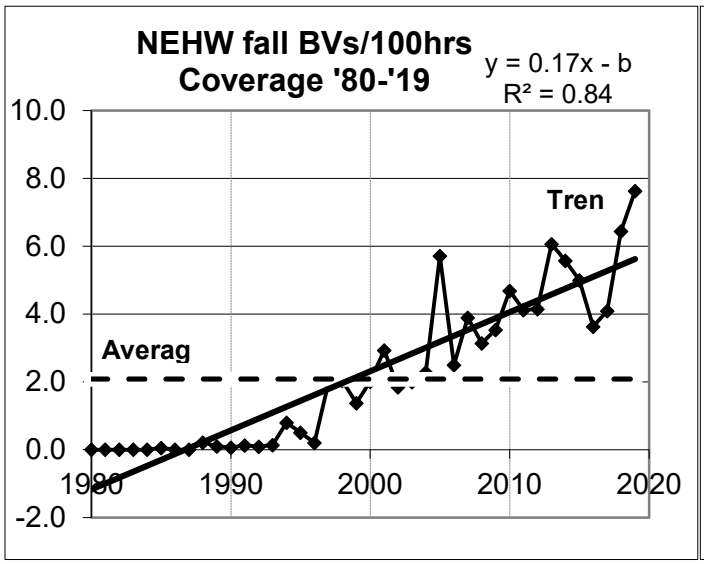


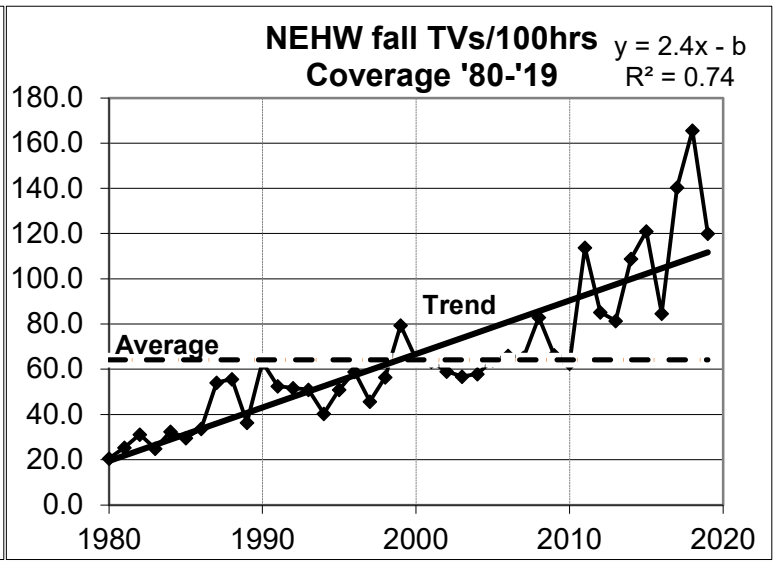
Again when looking at hawk watch data I used the trend line to estimate the population trends. For Corpus Christi we get a 5700% increase in both vultures but 99% of this is due to TVs. Perhaps in the early years of the watch ('97 & 98) the vultures were not counted or were not migrating past Corpus Christi for some reason, but these years lead to the totally unrealistic estimate of an increase of 5700% for TVs in the years 1997-2019.





Above are the graphs of the NEHW spring data for BVs and TVs. Both show increases over the last 31 years that are significant. But if you notice the average numbers of both you'll see that the numbers of BVs are less than 5% of the TVs, making their contribution to the sum of vultures insignificant. But adding them in does increase the statistical significance slightly. When they are added there seems to be an increase of about 140% in the last 31 years.





Above is the fall data from all the northeast hawk watches for both BVs and TVs. Both show statistically significant increases **and**, unusual with hawk watch data, both the fall and spring show the same trend of approximately the same magnitude. As with the spring data the number of BVs is insignificant compared to the TVs, but again, when the two are added there is a slight increase in statistical significance. The increase in the sum is about 474% over 40 years. Rosenberg found an increase of only 260% over a slightly longer period of 44 years. But the NEHW and Rosenberg's results are consistent if we assume most of the increase in vultures is in the northern portion of their range due to climate warming, with little or no loss in the southern portion of their range.

Summarizing for Vultures:

Rosenberg: 1970-2017 – 48 years - sum of TVs & BVs: 265.3% & increase of 9.4 million

BBS: 1966 – 2017 – 52 years - TVs only; +230% & increase of 3.7 million to 5.4 million total in 2017
BBS: 1966- 2017 – 52 years - BVs only; +1000% increase of 6.1 million to 6.7 million total in 2017
BBS: 1966-2017 – 52 years – TVs +BVs - +420% increase of 9.8 million to 12 million total in 2017

If the axis of the BBS data is really only hundreds of thousands instead of millions, all BV population numbers are multiplied by 1/10. The percentages remain the same and the combined total is 6.1 million and the percent change comes out to 240%....much closer to Rosenberg's 265.3%. I have emailed the BBS to clarify this, but I have not yet succeeded in reaching them.

Hawk watch vulture numbers
Mostly TVs because of the tendency of BVs not to migrate long distances
Hawk Mtn –1990-2019 – 30 years – TVs + BVs - + 900% but likely a distorted overestimate
Cape May – 1976-2019 – 44 years – TVs + BVs - +350% but counts at Cape May are very variable – weather effects?
Hawk Ridge – 1974-2019 – 46 years – TVs - +270% consistent with Rosenberg's conclusions
Veracruz – 1995-2019 – 25 years – TVs – perhaps a slight decline, but no statistically significant trend. This is very different from all other estimates. Perhaps increased over-wintering north of Veracruz is the factor reducing its count.
Corpus Christi – 1997-2019 – 23 years – TVs + BVs - +5700% but numbers for initial years are likely too low for unknown reasons giving a totally unrealistic percent change

NEHW – spring – 1989-2019 – increase in both BVs & TVs with their sum increasing 140% in 31 years.
NEHW – fall – 1980-2019 - increase in both BVs & TVs with their sum increasing 470% in 40 years.

Thus the hawk watches considered here do not do much to confirm or contradict Rosenberg's conclusions. Many do not count BVs because they do not migrate long distances and the values for TVs for other watches are suspect for one reason or another. However, the hawk watches that count Vultures from the northern portion of their range are in reasonable agreement with the trends noted by Rosenberg.

Summary

My experience watching birds over the same period as the Rosenberg study confirms his overall conclusion of a marked decrease in bird populations over the last 50+ years. If I were guessing, I would even guess that his 30% decrease is an underestimate.

But I find his calculation of a 200% increase in raptors hard to believe and when I tried to substantiate it using his own data, I was unable to. In this section we looked at two taxonomic groups that accounts for most of his increase in raptors – the OS and the Vultures. I found that the BBS data that he used for the OS did yield a 300% increase if you used just the years at the beginning and end of the period to characterize the change over the period. When I surveyed the hawk watch count data a much more complex history of the OS emerged with periods of steady population, growing population and decreasing population that was not evident in the BBS data and shows a population decline in the recent 20 years while still having a population 50% to 100% above 1970's, and a steady or declining population at Veracruz since the mid-'90's. Our own NEHW data disagreed, showing a steady OS population in spring since the 90's and a declining population in the fall since the 80's.

The other taxonomic group that showed a large increase in Rosenberg's study, that would account for the +200% increase in raptors, were the Vultures. Using the same BBS data that he used I was unable to obtain the same increase he did, and in fact, got a larger one. Using count data from a number of hawk watches was difficult for a number of reasons. First of all BVs are not true obligate migrants so their population is not reflected in hawk watch migration counts but they do seem to be increasing in the north. The much more common, breeding and migrating, TVs do seem to be increasing in hawk watch counts but it is hard to pin down a rate to compare with Rosenberg's +260% rate. Again the NEHW data tends to be more consistent and shows a 140% increase in spring over the much shorter time period of 1989-2019, and the fall shows much larger increase of +420% over the years 1980-2019.

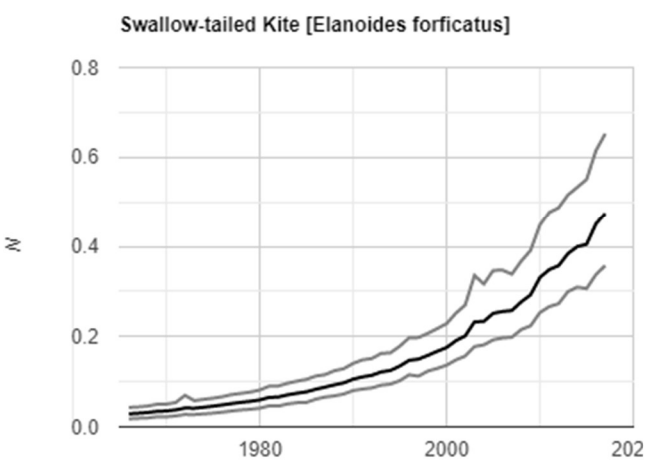
In summary I found no justification for Rosenberg's +200% increase in raptors. His OS increase rests on BBS data, but seems to be inconsistent with hawk watch counts. I could not justify his BV + TV rate of change with BBS data or hawk count data but both show an overall population increase since 1970. If there has been an increase in raptors since 1970, it would be mainly driven by these two groups of raptors. Check out the web for my investigation for the hawks and falcons at http://www.battaly.com/nehw/reports/panko/raptors+200pc.pdf
But the amount of change that they show over the period is much smaller and couldn't account for the +200% overall increase in raptors.

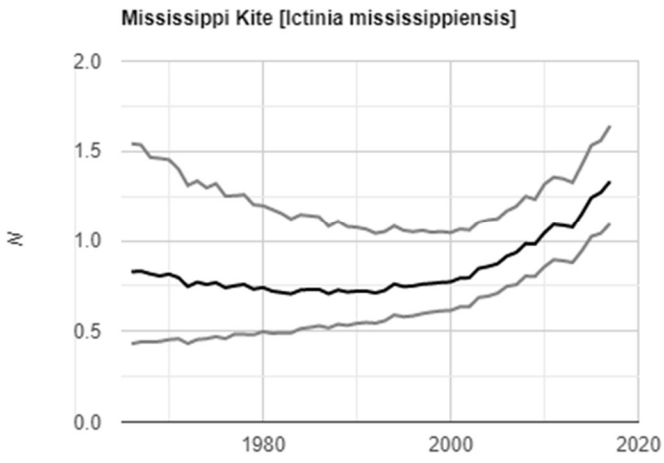
ONLINE CONTINUATION OF RAPTORS +200%

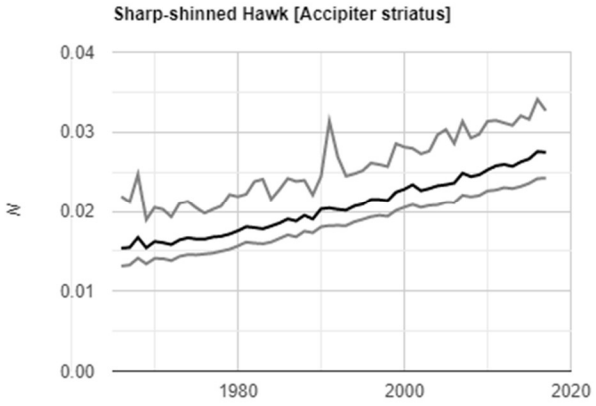
Total Hawks (TH*)

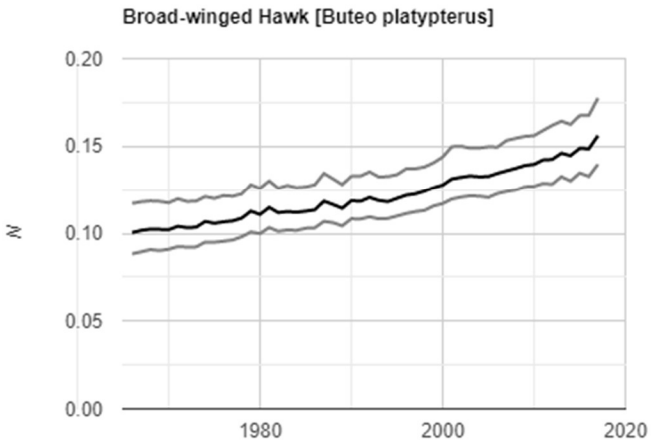
Rosenberg gives his results for the taxonomic group Accipitridae and includes 16 hawk species. Presumably Swallow-tailed, and Mississippi Kite, Bald Eagle, Northern Harrier, Sharp-shinned, Cooper's, Goshawk, Harris's, Red-shouldered, Broad-winged, Swainson's, Red-tailed, Ferruginous, Golden Eagle, that BBS gives good data for plus another 2 (perhaps White-tailed and Snail Kite &/or Rough-legged Hawk?). This degree of lumping makes it a nightmare to evaluate his conclusions and for him to do the original work We (and he) must consider northern, southern, eastern, western, migrant & non-migrant species. Rosenberg calculates a 78.9% population increase in this group of species with 3 of them in decline.

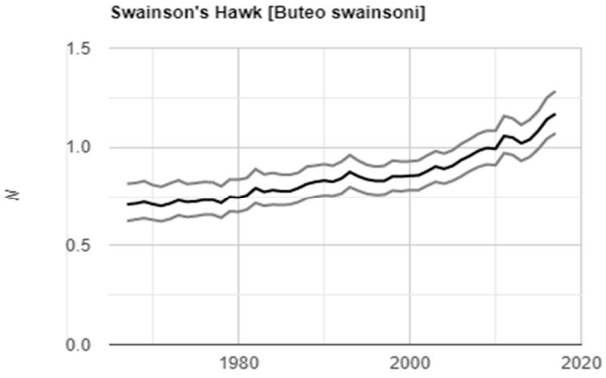
All we can do is look at some of the more numerous species and see how their numbers have changed.
BBS – SK. MK, SS, BW, SW, RT

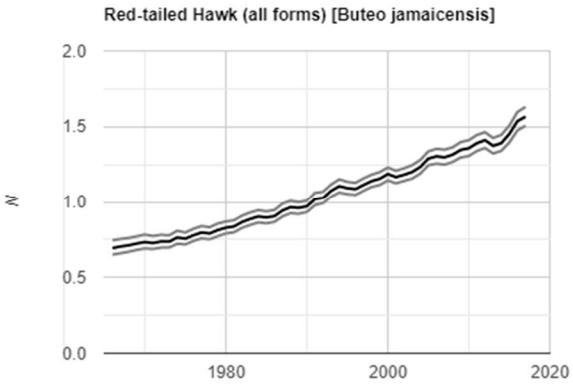




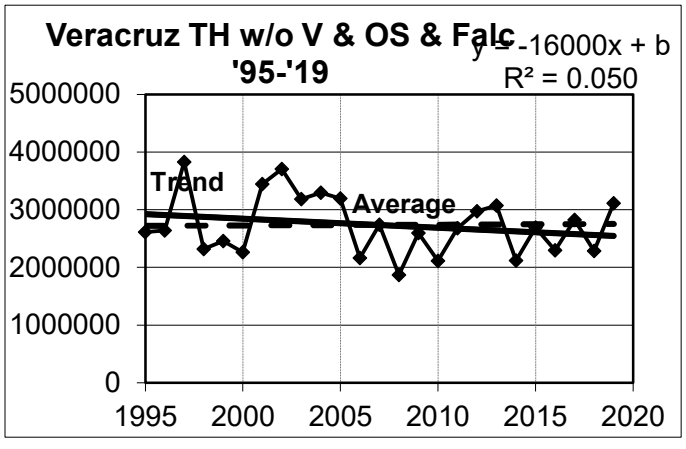


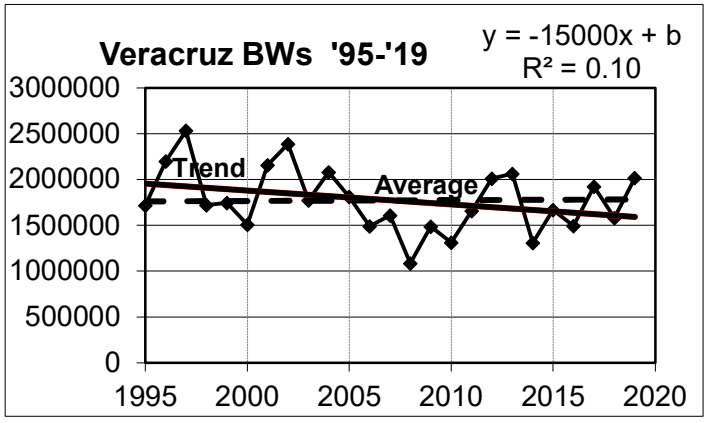






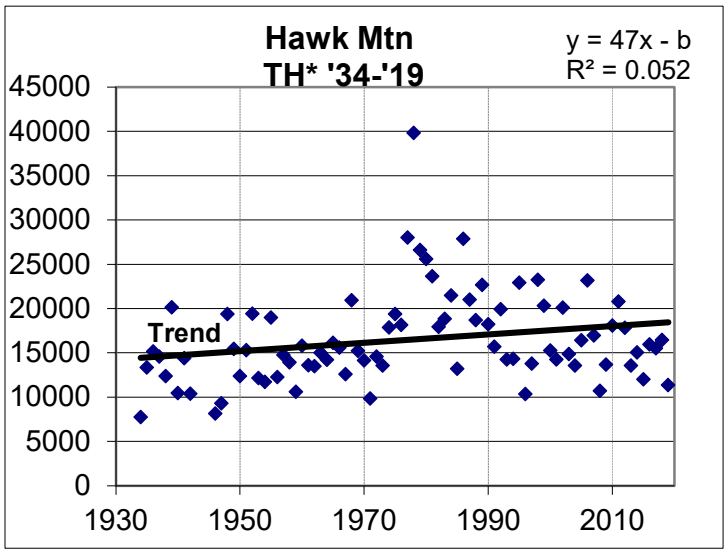
Out of the 16 species in Rosenberg's TH* category I picked 6 of the what I considered the most numerous and the BBS graphs of these are given above. They all show increases from 1966 to 2017. The wide range on the values of the Y-axis, for example .20 for BWs and 2.0 for RTs increases my skepticism that N is a value for the hawk population in N.Am. The population increase shown for SSs is also surprising, as is the 50% increase in BW numbers. But I can't say much more without knowing more about how the value for N is calculated and what is happening with the other 10 species. The doubling of the population of RTs is also notable. Using the data given there is 16 SK, 8 MK, 6.3 BW, 43 SW, 59 RT hawks for every SS in N. Am. These ratios do not seem at all correct to me, and Rosenberg's calculations are based on this BBS data. This argument however, is entirely based on their estimate of SSs being correct and the vertical axis being the population in the same units between species..

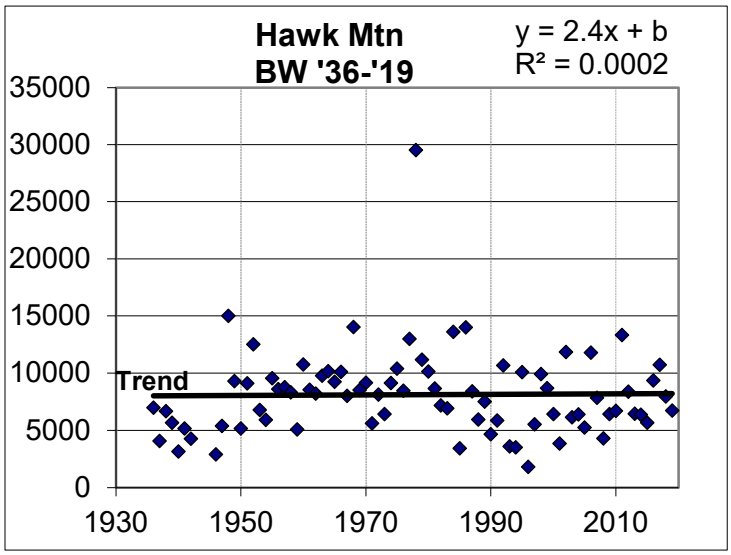




Veracruz as shown above for 1995-2019 shows no change in TH* and it counts more than 2.5 million migrant hawks a year! But the trend is dominated by the 1.8 million BWs in counts in an average year (also shown) but also includes 200,000 MK, and 260,000 SW. All other species are relatively insignificant compared to these three in determining the trend.

Hawk Mtn which counts many fewer hawks, but with a different species composition also has the BW as its most numerous species. And neither TH* or BWs shows any trend over time.





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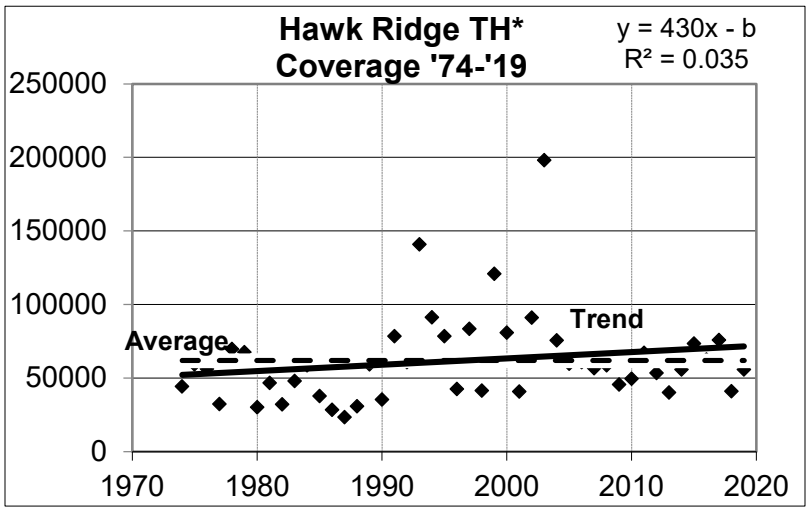
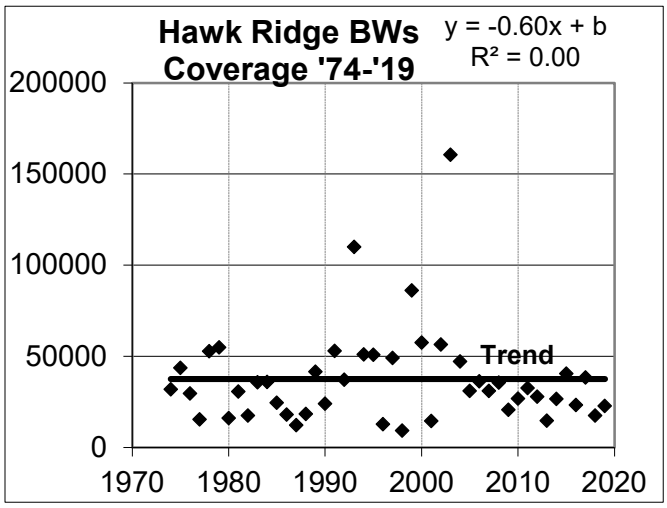
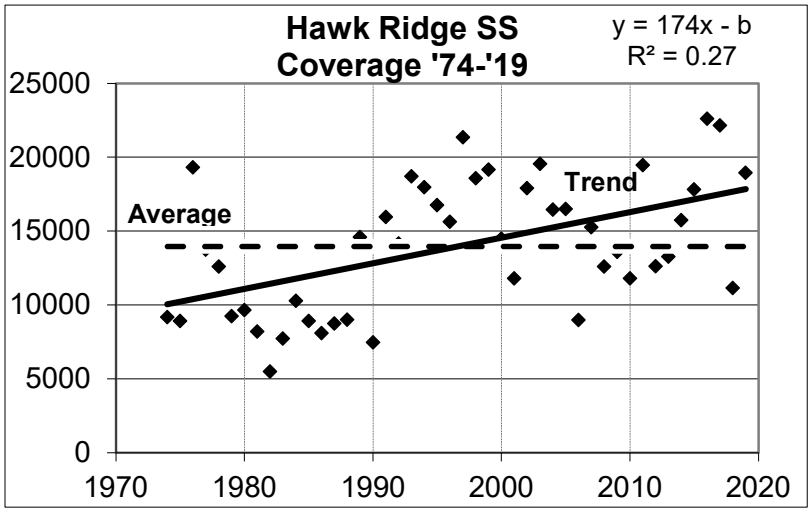
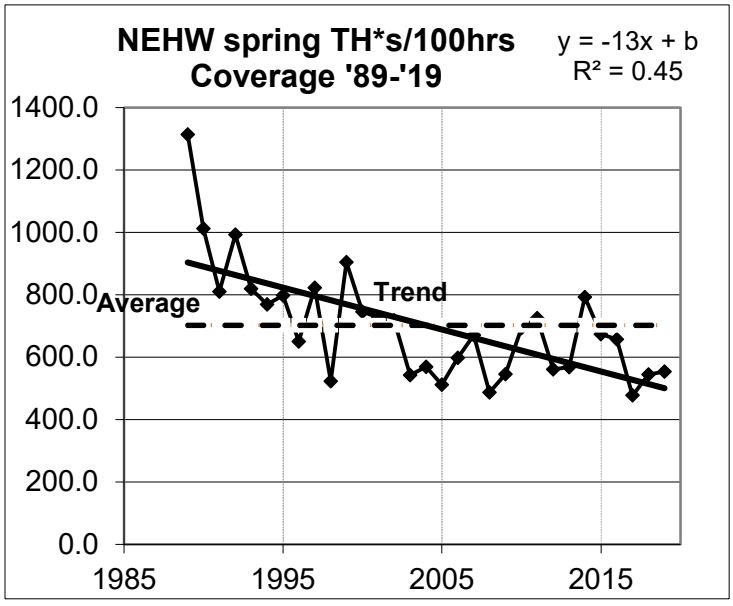
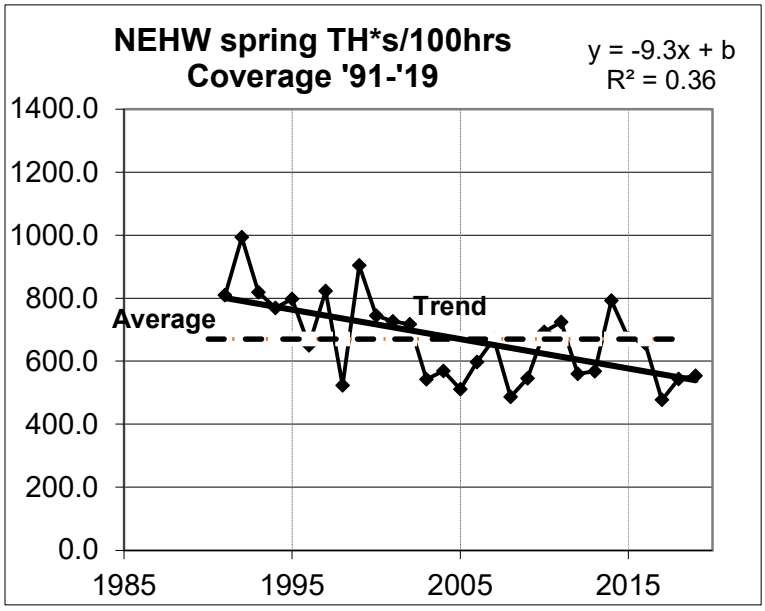






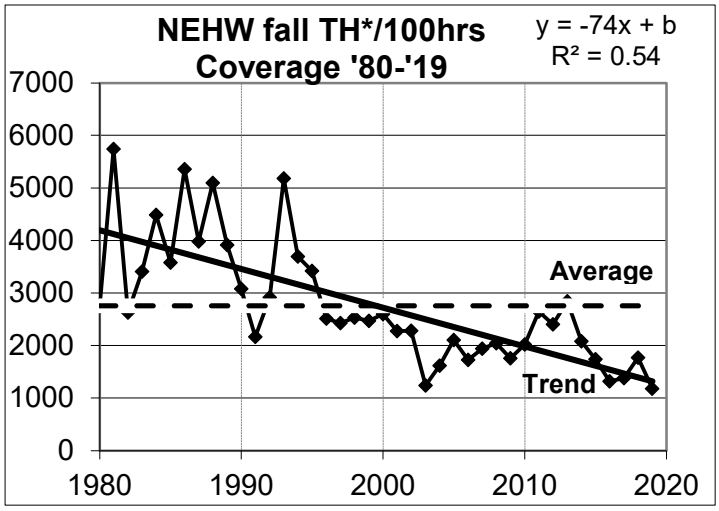
The Hawk Ridge data is very interesting. The BWs are the most common species in their count and SS is second. Over 42 years, TH* show no trend, BWs show no trend, and SSs show a slight increase. It is good to see an increasing trend for SS on a migration count.

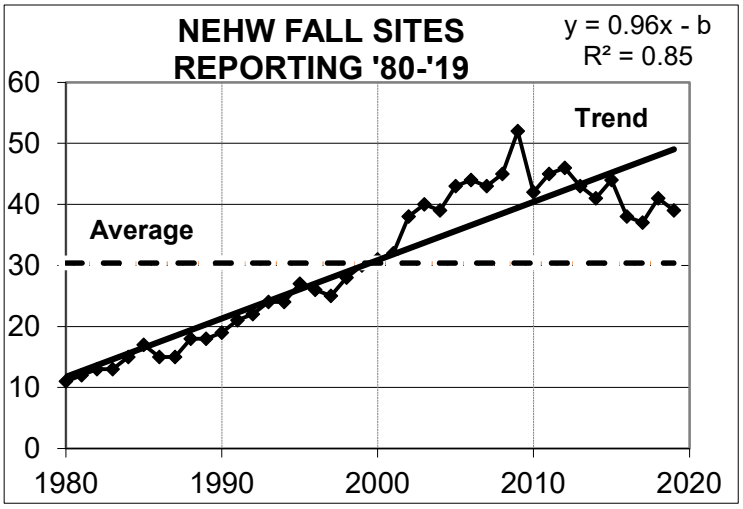




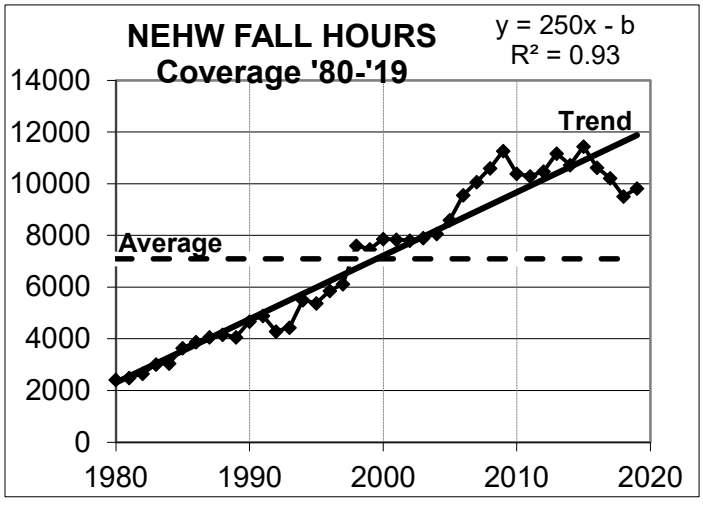
If we look at the northeastern states & how the TH* have changed, we have the graph on the above left. Which shows a distinct decline over a period of 31 years (somewhat shorter than Rosenberg's 48 years). How much of that decline is due to the two first years? I replotted the same data but without the first 2 years and got the graph on the right. I was surprised to see how little difference it made. The first showed a decline of 13 hawks/100hours/year over the last

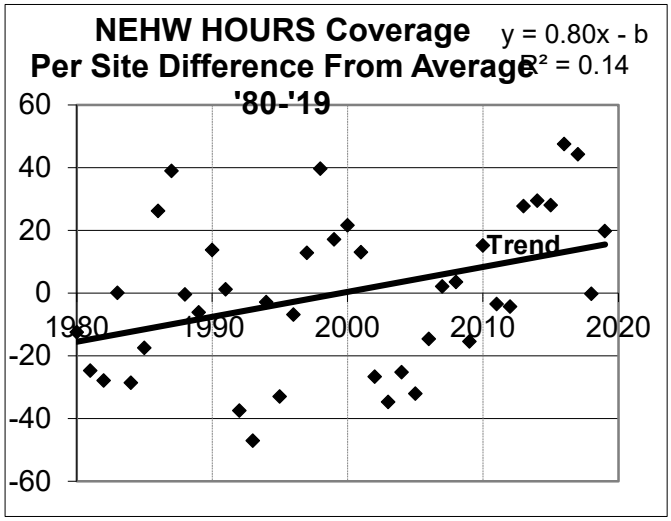
31 years, and the second a decline of 9.3 hawks/100hours/year over 29 years….still a definite decline. The overall average declined from 702 to 670 hawks/100hours.





For the fall migration numbers from all of the watches in the northeast, we see a strong decline since 1980. This is mostly due to a decline in BW & SS numbers. But BW travel in concentrated groups and large numbers are only seen at a few of our hawk watches in any given year. This means that these TH numbers are dependent on just a few hours on a few different days in a small number of hawk watches. The number of hawk watches, the hours each one logs in, and the locations of the watches varies from year to year. We attempt to compensate for this by not using the number of BWs, but adding up the number of BWs and dividing by the hundreds of hours logged by all the watches and all these things change from year to year. The graph on the left above gives TH*/100hrs for each year since 1980. But the TH* numbers are dominated by BW numbers. Were the chances that a large group of BWs would be detected the same from year to year. One thing that would depend on is the number of hawk watch sites, has that number remained constant from 1980? The answer is contained in the graph on the right. The number of sites and hence the chance of detecting a group of BWs steadily increased from 1980 to 2009 and slowly declined since then. Other things being equal this should give an increasing number for TH* up to 2009 and a nearly steady number since then. But this is not at all what we observe….the TH*/100 hours is decreasing. So the increasing number of sites is not driving the number of TH*/100 hours, there is a trend to the TH* numbers and that is a decrease.





But the number of watch sites is not all there is to it…..how has the hours of coverage changed over the years? The graph on the left gives the answer….the hours logged has changed in the

same way the number of site have…increased up to 2009 and then remained constant. So, this also does not account for the observed decrease in TH*. AND there is yet another complication. When we divide through by the number of hours this assumes that all hours at any hawk watch is equally likely to produce hawks, and in this case BWs. All hawk watch hours are not created equal. 10 hours at a watch in mid-Sept are much more likely to produce a large number of hawks as opposed to 10 hours in late October. The second graph on the right above is an attempt to quantify this. Some hawk watches cover just a few days in mid-Sept in an attempt to see a large flock of BWs. Other watches start in early Sept and go through Nov. and will count a fewer number of hawks per hour but of a wider variety of species. This second graphs plots the total number of hours of coverage in a year by the number of sites. Then subtracts the average of this over the years from the value for each year to get "Hour Coverage per site difference from the Average". If there were only a few sites in a given year and they covered Sept through Nov then that year would give a high value on this chart. The average is the 0 line. And if there were many sites that only covered a few days in Sept, then they could cover the same number of hours but would produce a low value on this chart. And years with low values would be more likely to produce high TH*/100hour values. Luckily for us there is almost no trend in these values over the years. There is seemingly a great deal of year to year variation on this chart but very little in the way of a trend. And small differences are also exaggerated in this plot. A value of 40 for a particular year means about 40 hours per site more of coverage than a year with a value of zero. And 40 hours of coverage likely only represents 8 days of 5 hour coverage per day. Most important however is that the average is not showing a trend and although there is a great deal of variation from year to year, the amount of variation does not seem to be changing over the years. Therefore the changing amount of coverage per watch site per year does not account for the overall decrease in TH* from 1980-2019 either.

Summarizing for TH*:

Rosenberg TH* 1970-2017 – 48 yrs - +78.9% increase in 16 species with 3 species declining.

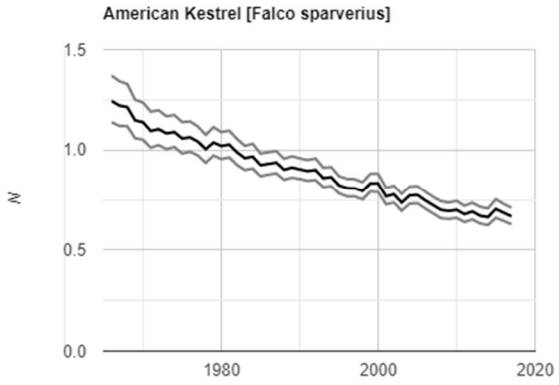
BBS – I am not confident that I can accurately calculate population trends for each species because I am not sure how the N values on the Y-axis compare between species. But Rosenberg did this, and I assume he did it well. And got the 78.9% increase although the implied accuracy of this number is to much.

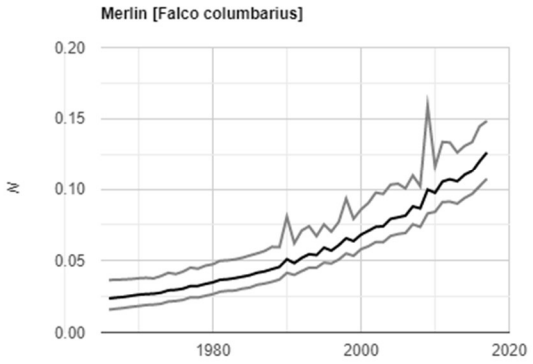
Hawk Mtn TH* 1934-2019 - 88 yrs - +30% increase in 11 species with 7 sp declining
Hawk Mtn TH* 1970-2019 - 50 yrs - +17% increase in 11 species + with 7 sp declining
Hawk Ridge TH* 1974-2019 – 47 yrs - +37% increase in 14 species with 6 species declining
Veracruz TH* 1995-2019 – 25 yrs - ~ 0% change in in 15 species with 2 species declining and a number of addition species in very small numbers

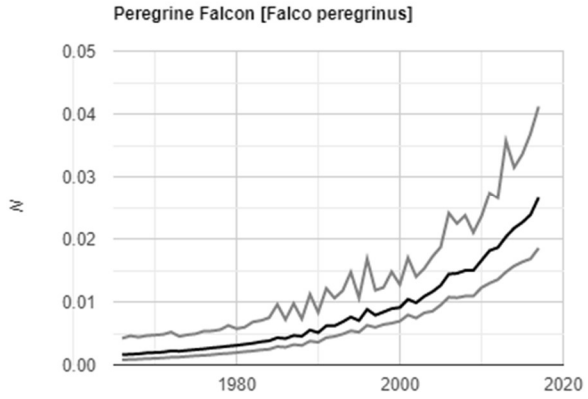
NEHW TH* Spring-1989-2019 – 32 yrs – a -44% decline in 12 species with 10 species declining
NEHW TH* Fall-1980-2019 – 40 yrs – a -68% decline in 12 species with 10 species declining

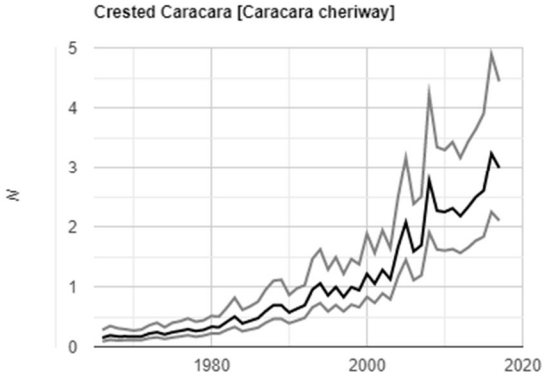
Rosenberg calculated a 78.9% increase in TH* with only 3 hawk species declining probably from BBS data on the basis of what we saw with the OS and Vultures. The data from hawk watches do not confirm this. Hawk Mtn shows an increase about only 20% as large as Rosenberg's and Hawk Ridge shows about half as large. Veracruz, on a shorter time scale, shows no trend. Northeastern watches in spring show a decline of 44% in 32 years, and in fall and even larger decline of 68% in 40 years. While Rosenberg notes a stronger decline in the east as observed in these watches, the mid-western watches do not show an increase half as large as Rosenberg's. My best guess is that the BBS data that Rosenberg's numbers are based on are biased by detectability issues and give an overestimate of the changes over the 48 years. Their data do not seem to detect BWs & SSs very well, and the hawk watches show a decline in these species. But much more work is would have to be done to justify this opinion.

Falcons:



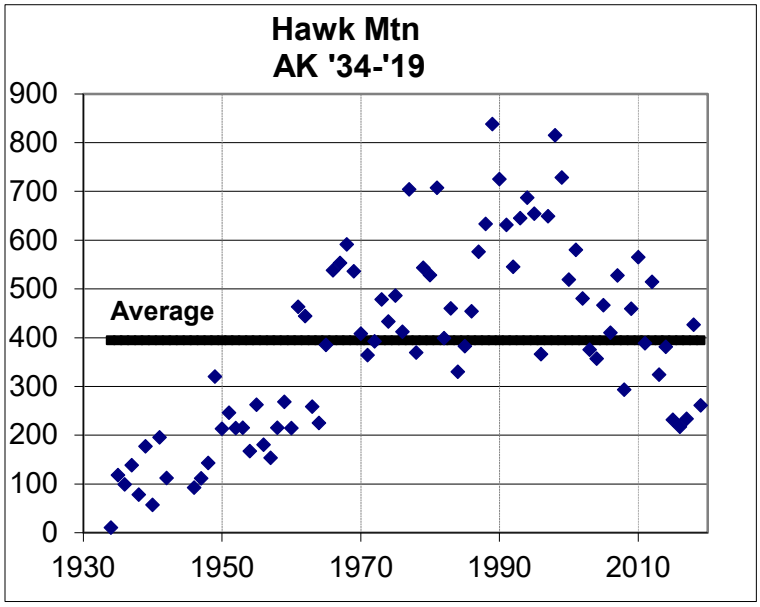


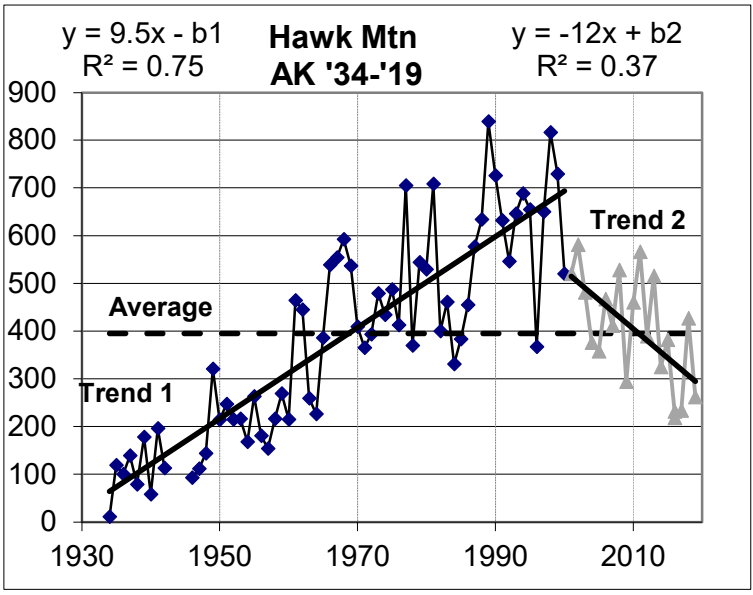




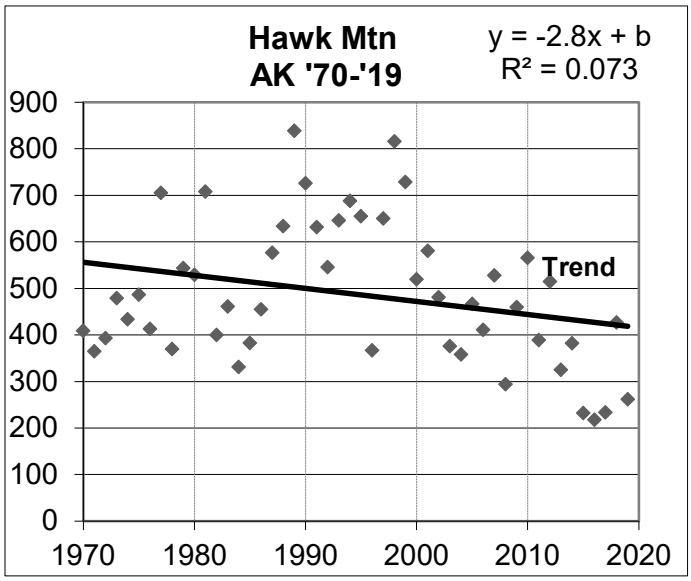
Above are all of the species Rosenberg includes in the Falcon category. Three of the four show increasing trends, and just the AKs are declining. Rosenberg includes 6 species with 4 increasing population and 2 decreasing. The two extra species, that BBS gives no data for are likely Gyrfalcon and Aplomado Falcon.

These BBS graphs show for the period 1966-2017 that AKs declined 47%, ML increased 464%, PF increased 1400%, and Caracara increased 1600%. Rosenberg had to take this data, account for the different number of individuals in each population, and calculate an overall amount of change in the population. He got +0.5%.for all 6 species with 2 species declining. I an unable to check this without a reliable method of estimating the populations. So let's look at the hawk watch data and see what it says. Of course, we do not get any idea about the population trends of Caracara, Aplomado Falcon, and Gyrfalcon populations from hawk watch data.



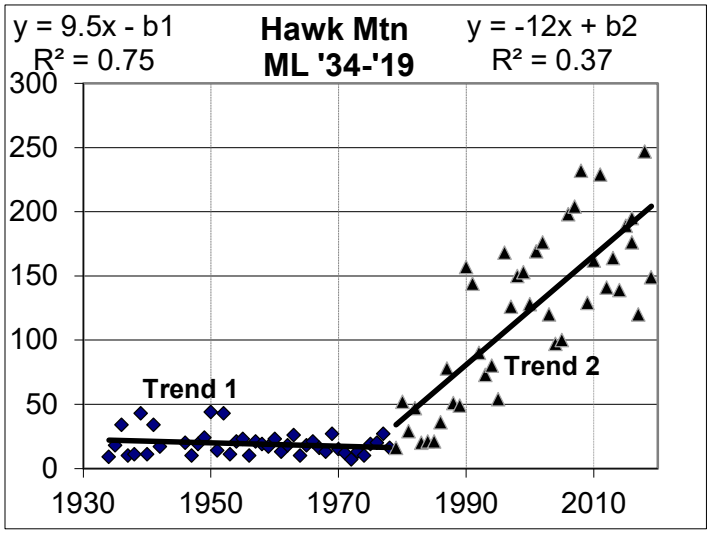


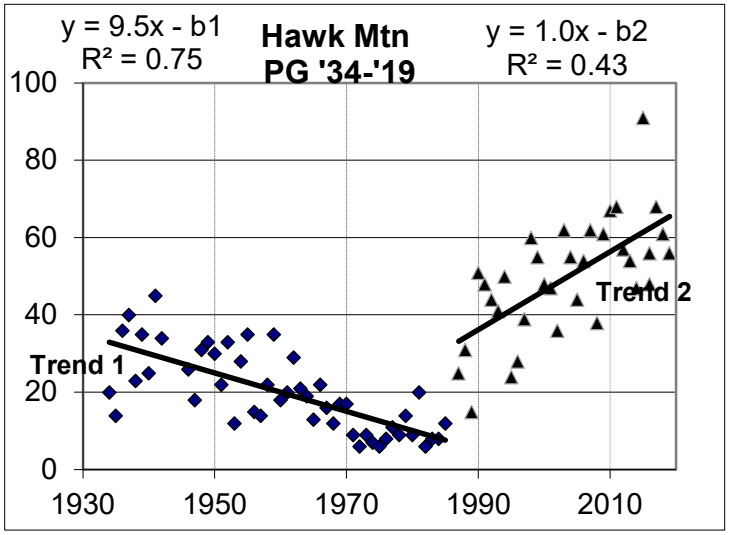
The data from Hawk Mtn for AKs is plotted above for the years 1934-2019. If you look at the data points I think you'll agree that there seems to be two distinct phases. I've plotted one possibility on the right above. The rising period 1934-200. And a falling period 200-2019. Now doing this is a very radical thing to do, but justified, in my opinion, in this case. Normally, all the collected data should be plotted with one trend line. Although it is a radical procedure I've done it very conservatively. Choosing the starting and ending points is somwhat arbitrary, and the slopes of the curves are very dependent on how it is done. Had I fitted a trend line from '34 to '99 and from '99-2019 the regression lines would have much stronger slopes and statistical significance would be higher. To get an estimate of the change over the same period as Rosenberg we get the following:



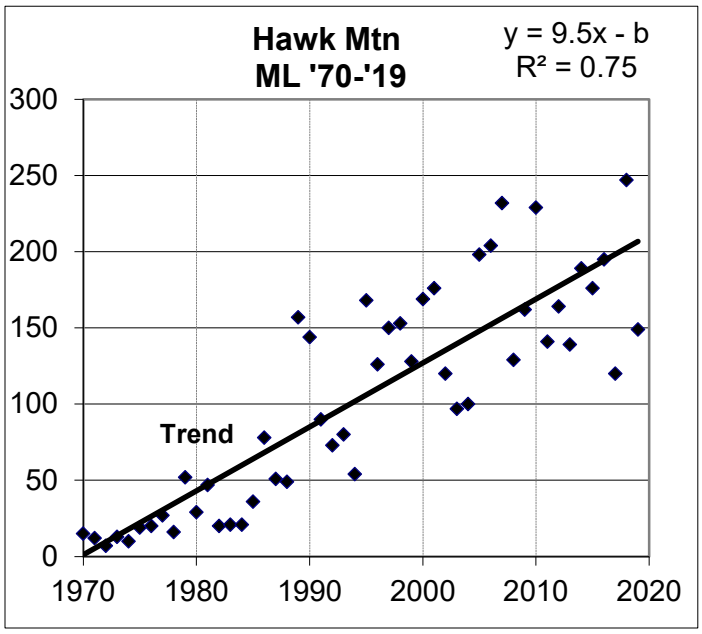
Essentially if we choose only the data from 1970 to 2019, there is no trend to the numbers from Hawk Mtn, what we really know from the graphs above there was a steep increase from '34 to '20 and a strong decrease from '20 to '19. This shows one weakeness of Rosenberg's approach and decision to lump several species together and to report only the percent change over a fixed time period.

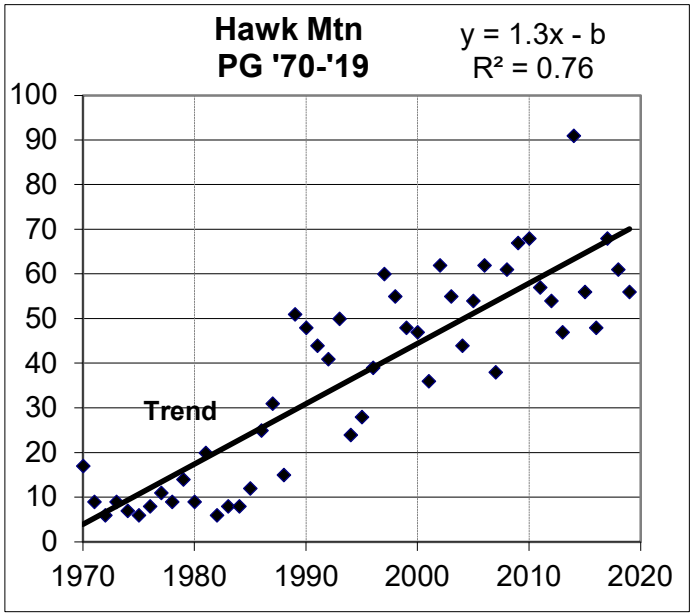
Interestingly enough, counts from Hawk Mtn also show two separate trends for MLs and PGs as well – see below.

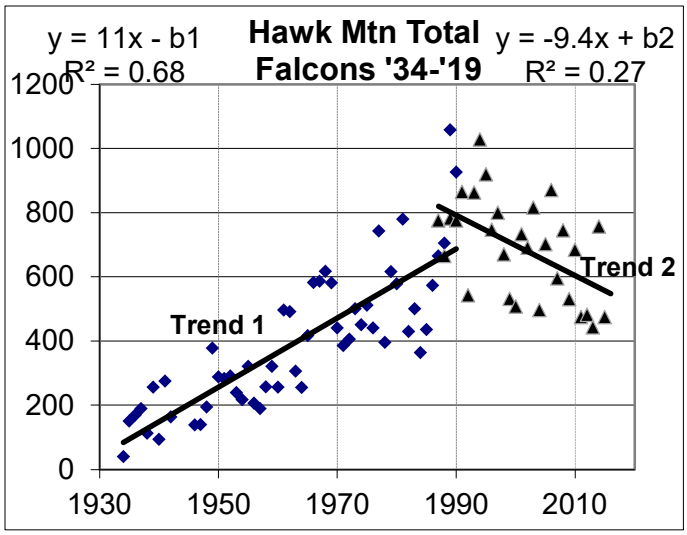


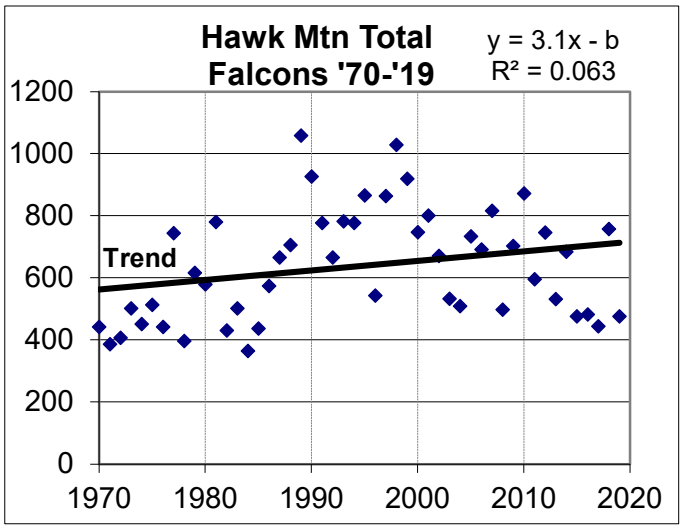


And for 1970-2019:





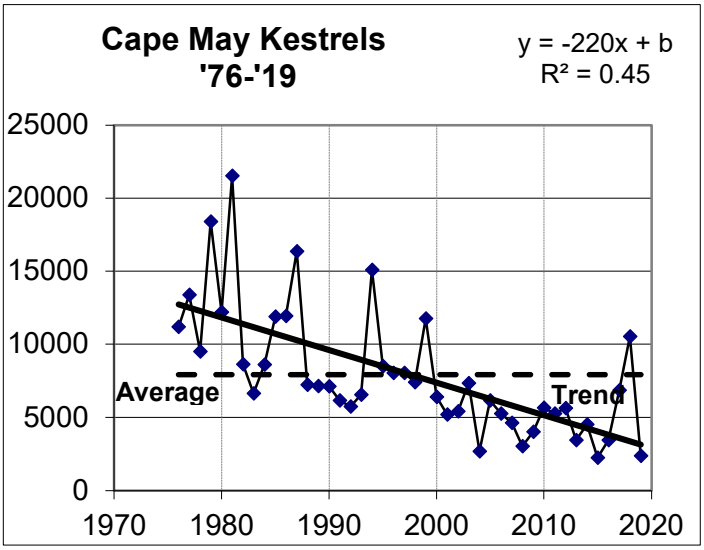


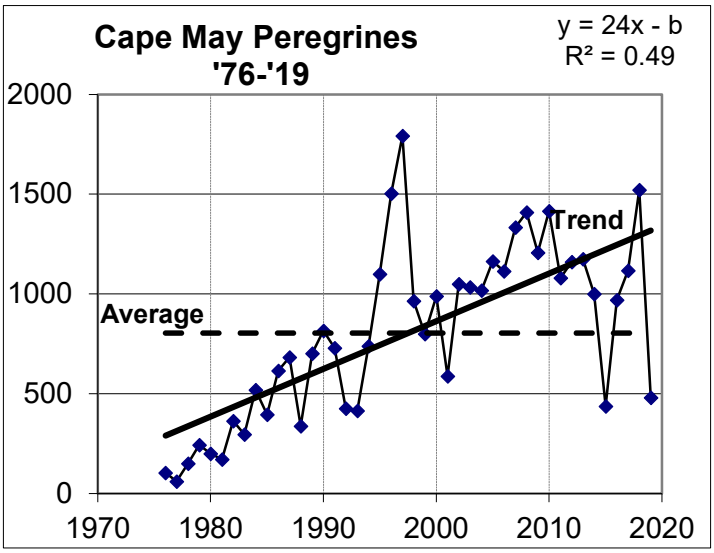


If we plot the combined falcon data for ’34-’19 we get the curve on the left. And just as we might expect because the numbers of Kestrels are dominant we get 2 curves again one increasing

and one decreasing. Lumping the data and restricting the years to ’70-’19 we get no trend. The sum of the increasing MLs & PGs is enough to flatten out the curve, and appears to be normal scatter with a positive pulse in the middle years.

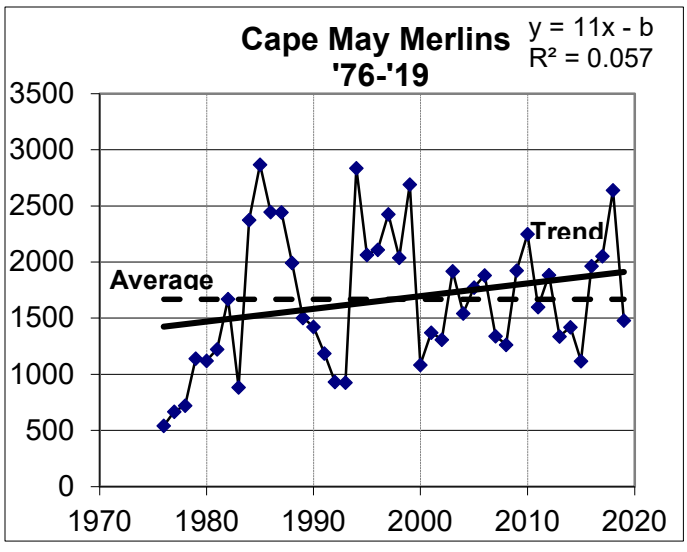
But for east coast falcons there is one preeminent watch site – Cape May….

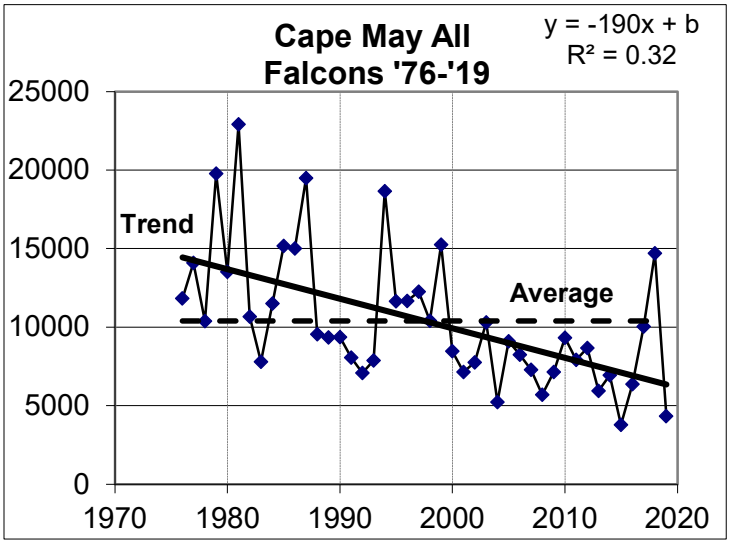




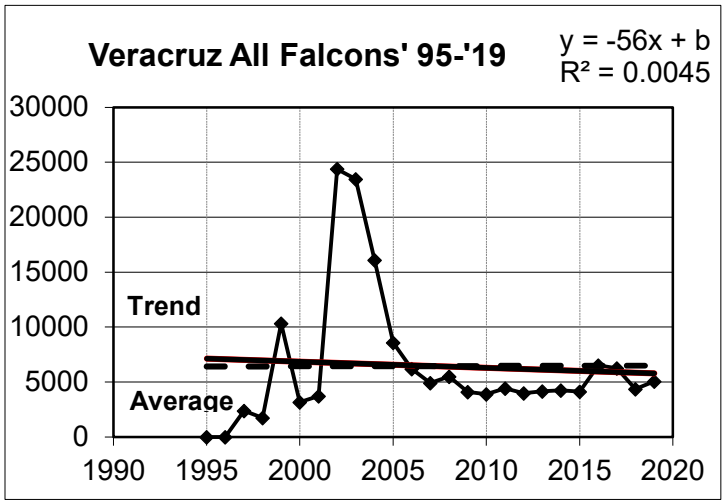
The number of Kestrels counted at Cape May is very different from Hawk Mtn. We don’t see the peak around 1990, but a significant long-term decline with a lot of variation. Particularly worrying here is the steady decline of all the peak years. But the leveling off of all the lowest years may presage an end to the decline.

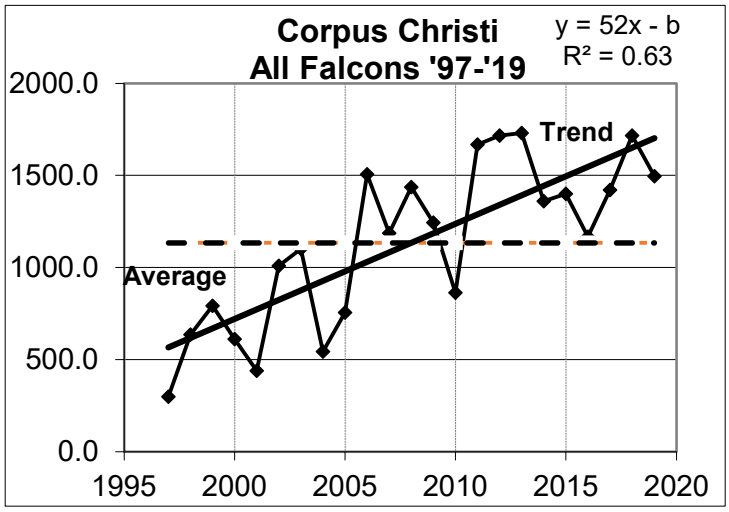
Cape May Peregrines are doing well. And they likely include the recovering inland population in New England as well as Tundra breeders.



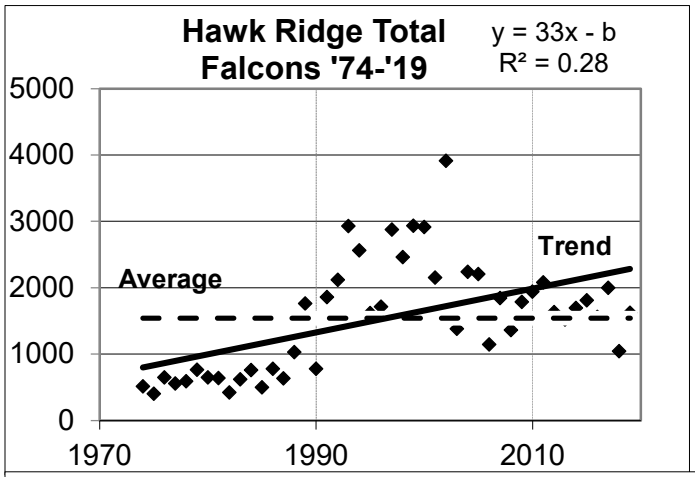


At Cape May there is no significant trend in Merlin numbers – left above. And, as with Hawk Mtn, at Cape May the decline in Kestrels dominates the total Falcon change with minor moderation due to the increasing Peregrines.

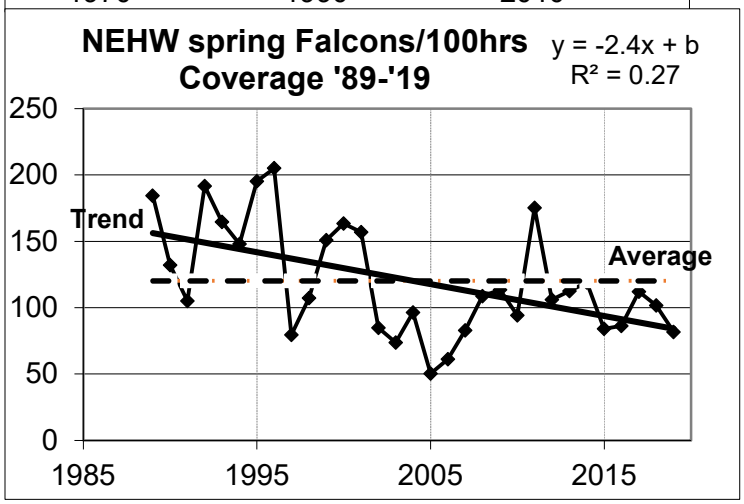


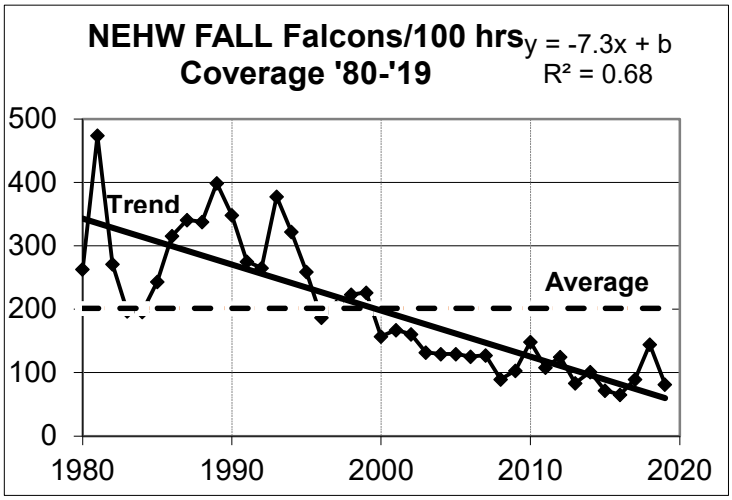


Both are most southern watches show very different patterns. They are different from each other and different from other watches we have considered. A huge pulse of AKs in 2002 & 2203 & somewhat lesser in 2004 is not evident in other watches which show a broader pulse somewhat earlier. This pulse of AKs was also accompanied by large (but smaller) increase in Merlins and Peregrines as well. I suspect weather during the migration season over the Gulf, and it deserves investigation. Corpus Christi is totally different. A strong and consistent increase over the 23 years is remarkable. It is due mostly to AKs, but the MLs showed an even faster and more consistent increase with PGs not far behind.



Finally we have Hawk Ridge, ideally suited to count Falcons breeding in the northern forests and tundra. Its counts show a strong steady increase in MLs & PGs but its falcon total is dominated by AKs. And these show the now familiar pulse. At Hawk Ridge it occurred between 1993 and 2002.





The spring and fall numbers for all the NE hawk watches is more of the same old, same old. The numbers are dominated by AKs which show a pulse in the late '90' and early 2000's and then decrease. The much smaller numbers of MLs show no change and PGs show a distinct increase not nearly enough to balance the decline of the AKs.

Summarizing for Falcons:

Rosenberg 1970-2017 had a 0.5% increase in Falcons (including Caracaras) in 6 species with a decline in 2 species, one of which is likely Kestrels.

BBS 1966-2017, which is likely the main basis of Rosenberg's conclusions show very large increases in 3 of the 4 species with only the Kestrels declining. Without a good idea of the actual breeding population of Caracaras however we cannot calculate an overall percentage change. But it seems unlikely that there would be only the small positive increase Rosenberg got.

Hawk Mtn 1934-2019 shows a strong increase in Kestrels '34-'00, and strong decrease after 2000. It shows a totally different patterns for Merlins with a steady low level of hawks until 1977 and then a marked increase. Peregrines showed pattern very similar to Merlins. The short term pattern of total Falcons over a 50 year period, similar to Rosenberg ('70-19), is a 25% increase overall, including a recent decrease and a large positive pulse between 1989 & 2001.

Hawk Ridge shows a huge increase of 200% in total Falcons from '74-'19. This is due to a strong increase in numbers of Merlins and Peregrines and a much smaller increase in AKs as well. The AKs at Hawk ridge show the '89-'01 pulse and are mostly steady, with just a slight decline, thereafter.

Cape May 1976-2019 shows an all Falcon decline of 56% for the period due entirely to the decline In Kestrels as the numbers of MLs are steady and PGs are increasing. Cape May does not show the positive pulse of falcons of the '90's and early 2000's as shown by Hawk Mtn and Hawk Ridge.

Veracruz shows no trend over the limited period of '95-'19.

Corpus Christi shows a steady and totally anomalous increase of +200% of all Falcons without Caracaras over the very short period of '97-'19. This increase is mostly the result of increasing AKs, but its counts of MLs and PGs also show the same strong increase. One possible explanation might be increased overwintering with climate change but this is just speculation at this point.

The NEHW Spring 1989-2019 all falcon counts show a decline of 84%, with no pulse. Again the decline is due to the decline of AKs, the MLs were steady and the smaller number of PGs showed an increase.

The NEHW Fall 1980-2019 all falcon counts show a smaller decline of 59%, with a distinctive pulse, '89-'93 in AKs . Again the decline is due to the decline of AKs, the MLs were steady and the smaller number of PGs showed an increase.

The picture presented by the hawk watches for falcons over the period '70-'19 is an initial increase and then a decline in AK numbers. A mostly steady or small increase in MLs and a distinct increase in PGs. For the most part the decline in AKs dominates and there seems to be an overall decline in total Falcon numbers.

Conclusions:

Rosenberg's study may be a ground breaking survey of all the birds of N.Am. but it's lumping of species and trends likely based on only two points at the beginning and end of the '70-'17 period is an oversimplification that has serious disadvantages. In particular the headline, stated by

Rosenberg, “raptors increase by 200%” is a very misleading statement that only serves to hamper the public’s understanding of raptors and their conservation. The report seems to invite, and certainly received, widespread, oversimplified headline reporting in much of the popular and even the more specialized publications. But the overall finding of a decline of 29% in total bird numbers since 1970 deserves our attention. The summary of changes in bird numbers by breeding biome is commendable.

As far as the headline of a 200% increase in hawks, the picture is much more subtle and disturbing. The Vultures seem to be doing well, and contribute a major element to the overall increase in hawk numbers even though most people, including birders, do not include them in the “hawk group”. The Osprey numbers present a real puzzle as breeding surveys show a distinct increase, but fall counts in the northeast and in Veracruz show a distinct decrease. The lumping of Buteos and Accipitors in TH*, I find uncomfortable. The net increase of almost 80% calculated by Rosenberg seems unlikely because the most numerous species, BWs & SSs, seem to be decreasing. A big missing piece in this puzzle is the population of the far west which I have not attempted to evaluate and herein may lie the lack of correspondence between hawk watch data and Rosenberg’s conclusion. The situation with the total falcons is confusing. The BBS data seems to show an increase except for AKs and the populations of AKs do not seem to dominate the Falcon category when Caracaras are included. But Rosenberg calculated no change for this group, while eastern hawk watches show a strong decline but do not included Caracaras.