Trends in North American Vulture Populations

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ABSTRACT: In recent years, interactions between vultures and human activities have noticeably increased. These interactions include nuisance roosts, damage to homes and businesses, livestock depredation, and collisions with aircraft. One major factor contributing to the upsurge in vulture problems is higher numbers of these birds. Both turkey vultures and black vultures appear to be experiencing major population increases throughout much of their ranges in the United States. During 1990-2002, Christmas Bird Count (CBC) data revealed annual nationwide increases of 1.79% and 5.97% for turkey vultures and black vultures, respectively. Estimates from Breeding Bird Survey (BBS) data were 1.99% and 4.97% for the two species. Despite substantial differences in methodology associated with these two sets of data, they are consistent in charting overall increases in populations of both vulture species. Positive population trends are mostly confined to the eastern half of the country. The usefulness of survey data like the CBC and BBS is currently being seriously questioned, but for vultures I contend that the objections to the survey data are not critical. Nevertheless, suggestions for improved data collection procedures are offered.

KEY WORDS: black vulture, Breeding Bird Survey, *Cathartes aura*, Christmas Bird Count, *Coragyps atratus*, population, turkey vulture

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INTRODUCTION

For most North American bird species, there is no feasible means to estimate population size (Link and Sauer 1998). This fact can be very frustrating to wildlife management professionals and to the general public who often want to know, out of curiosity or for management reasons, how many birds of a given species inhabit a state or region. Despite the difficulty in determining how many birds are present in a population, it is possible to use counts of birds to construct an index to abundance that will enable managers to track changes in population over time and among geographic regions. To serve as the basis for such an index, counts must be performed under specific sets of rules or conditions by trained, competent observers (Link and Sauer 1998).

In North America, two such indices, the Christmas Bird Count (CBC) and the Breeding Bird Survey (BBS), are widely used to track the relative abundance of birds. The CBC, sponsored and organized by the National Audubon Society, was started in 1900. In the CBC, observers enumerate all birds encountered within a 24-km (15-mi) diameter circle during a 24-h period. The counts are held annually between 15 December and 5 January. In 2000, over 52,000 participants counted birds at 1,823 locations. The number of observers, the miles walked or driven, and the location of the count circles vary. Nevertheless, most CBC sites are used every year, so despite some turnover, overall coverage remains very similar from year to year (Butcher 1990).

The BBS is coordinated and organized by the U. S. Fish and Wildlife Service (FWS). It was initiated in 1966, and this survey differs markedly from the CBC (Robbins et al. 1986). Roadside survey routes are randomly distributed with each 1-degree block of latitude and longitude in the United States and southern Canada. Each survey route consists of 50 3-minute stops 0.8 km (0.5 mi) apart. The route is run once a year during the breeding season (late May - June) starting 30 min before sunrise. At each stop, the observer stands beside the vehicle and records all birds seen or heard within 400 m (0.25 mi). Approximately 2,900 routes are surveyed annually throughout the continental U. S. and Canada (Sauer et al. 2003).

Both the BBS and the CBC are useful for documenting population trends of black vultures (*Coragyps atratus*) and turkey vultures (*Cathartes aura*). Because the 2 indices are conducted at different times of the year, and therefore sample different segments of the populations, the indices have different uses. The BBS is useful for monitoring the status of the population and for documenting responses of the population to management practices. The BBS has less relevance, however, where management of wintering birds is the major concern. For example, although turkey vultures breed in Florida, the major problems associated with this species occur in the winter when thousands of migrants arrive and swell the population several times over. Under such conditions, the CBC is potentially a much more useful indicator of population status than is the BBS.

In this paper, I present data from the CBC and BBS to assess the population trends of both vulture species. I also examine recent information on requests for assistance regarding vulture management derived from the databases of the USDA Wildlife Services (WS) Program. I evaluate the problems of using indices such as the CBC and BBS as surrogate data for actual population counts, particularly as they apply to vultures.

METHODS

Sources of data on vulture population trends were online databases maintained by the US Fish and Wildlife Service (BBS) and the National Audubon Society (CBC). The address for BBS data is http://www.mbr-pwrc.usgs.gov/bbs/trend/tf02.html, and the CBC can be

accessed at http://www.audubon.org/bird/cbc/hr/index.html. Within each database, appropriate queries can yield information for selected species over a specified time interval at a given geographic scale. I chose the 13-yr time period 1990-2002 for analysis. This seemed like a sufficient number of years for population trends to be revealed and it is recent enough to reflect current conditions. In addition, choosing this recent time frame probably avoided any lingering impacts of DDT and its derivative DDE which adversely affected vulture populations in the past (Kirk and Mossman 1998, Buckley 1999, Kiff 2000).

For CBC data, I applied linear regression analysis to estimate population trends. For the most part, population trend estimates and associated p values and variances for BBS data were obtained directly from the BBS web page. When I used 3-yr mean BBS values, I obtained regression equations and p values using Microsoft Excel® spreadsheet software.

The Management Information System (MIS) of the USDA Wildlife Services Program collects information from each state on requests for assistance with regard to wildlife conflicts. These data are compiled in a series of tables, and since FY1996 the tables are accessible online at http://www.aphis.usda.gov/ws/pubs.html. I extracted information from the tables to document recent trends in vulture conflicts as reported to the WS state offices throughout the country.

I examined vulture populations on 3 geographic scales: nationally, by FWS region, and state by state. The FWS regions (Figure 1) are relevant because the FWS is responsible for managing migratory birds and permits for lethal control of nuisance vultures are issued by the FWS regional offices. For state trends, I focused on the east and southeast US where the majority of the vulture conflicts occur.

RESULTS

Trends in Vulture Conflicts

Numbers of vulture incidents reported to USDA WS personnel increased throughout the study period (Figure 2). There were increases in virtually all resource categories, although not all increased at the same rate. For a given year, the reported incidents represent a fraction of the actual vulture-related problems as individuals often do not report problems to Wildlife Services personnel after initially obtaining assistance (B. Constantin, USDA Wildlife Services, Gainesville, FL, pers. commun.). Depredation permits issued by the FWS region 4 office in Atlanta, GA for lethal control of vultures increased from 2 in 1993 to over 100 in 2003 (Figure 3).

Vulture Population Trends – CBC

Across the US, CBC observations of black vultures since 1990 increased annually at a rate of 5.97% and observations of turkey vultures increased annually at a rate of 1.79% (Figure 4). Increases were not uniform, however. For example, black vulture numbers were highest and population trends steepest in the south and southeast compared to states in the northern portion of the species' winter range (Figure 4). In Virginia,

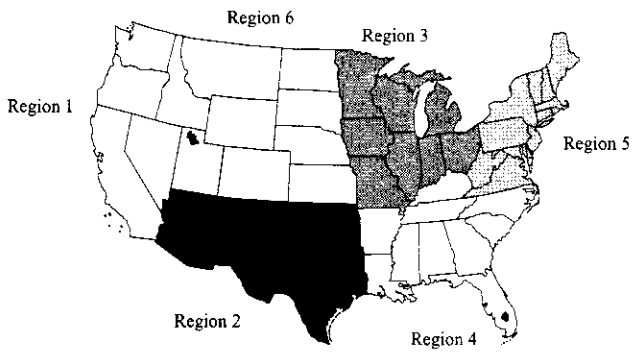

Figure 1. U.S. Fish and Wildlife Service administrative regions.

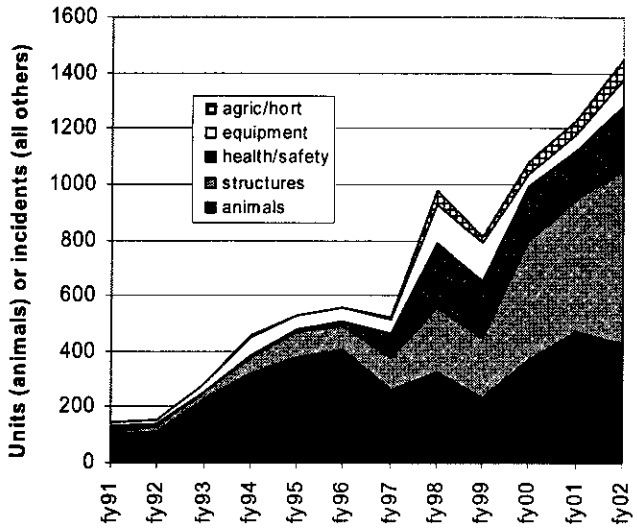

Figure 2. Vulture-related damage incidents reported to USDA Wildlife Services personnel, 1990 - 2002.

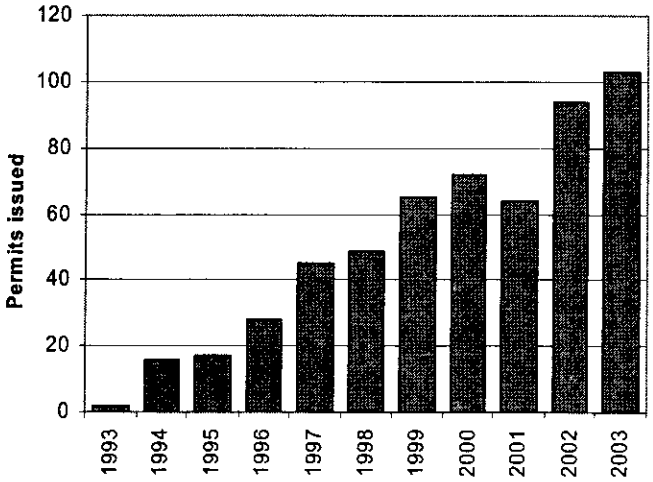

Figure 3. Number of vulture depredation permits issued by the U.S. Fish and Wildlife Service Region 4 office.

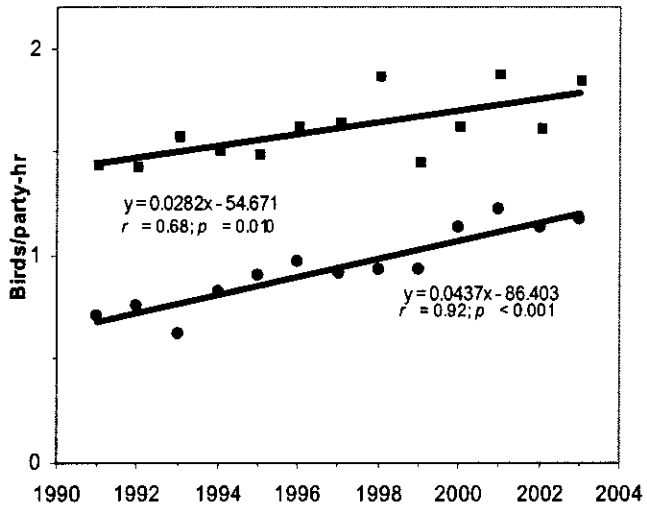

Figure 4. Across the U.S., CBC data indicate increasing trends in turkey vulture (squares) and black vulture (circles) populations.

observations of both turkey vultures (11.84%/year) and black vultures (17.93%/year) exhibited strong upward trends across the 23 CBC sites counted annually during 1990-2002 (Figure 5). Across the 37 Florida CBC sites that were used each year, turkey vultures exhibited no trend, whereas observations of black vultures increased 25.73% annually (Figure 5).

Consistently, turkey vultures are more numerous than black vultures, but the gap between the species is narrowing. In 1990, there were roughly 5 black vultures observed for every 10 turkey vultures in the CBC (Figure 6). By 2002, the ratio was 7 black vultures for every 10 turkey vultures.

Vulture Population Trends – BBS

Since 1967, BBS data reflect an estimated average annual increase in black vulture observations of 2.99% (p = 0.00085) while turkey vultures increased annually by 1.37% (p = 0.00007) (Figure 7). For the more recent 1990-2002 period, nationwide trends indicate an annual increase of 4.97% (p = 0.00006) for black vultures and 1.99% (p = 0.00021) for turkey vultures. Among US Fish and Wildlife Service regions, black vultures showed strong increases in the BBS wherever sufficient observations were available (regions 2, 4, and 5; Figure 8) while turkey vultures displayed the strongest trends in the northeastern part of the country (regions 3 and 5; Table 1).

At the state level, statistically significant positive trend estimates with low variances occurred in the BBS for black vultures in Florida, Texas, Tennessee, and Louisiana (Table 2). Arkansas, Maryland, Virginia, North Carolina, and South Carolina also displayed strong positive trends, but the estimates were accompanied with high variances. Several states displayed strong, statistically significant positive trends in turkey vulture observations (Table 3). The turkey vulture is widespread throughout the country, but statistically significant trends occurred predominantly in eastern and southern states only.

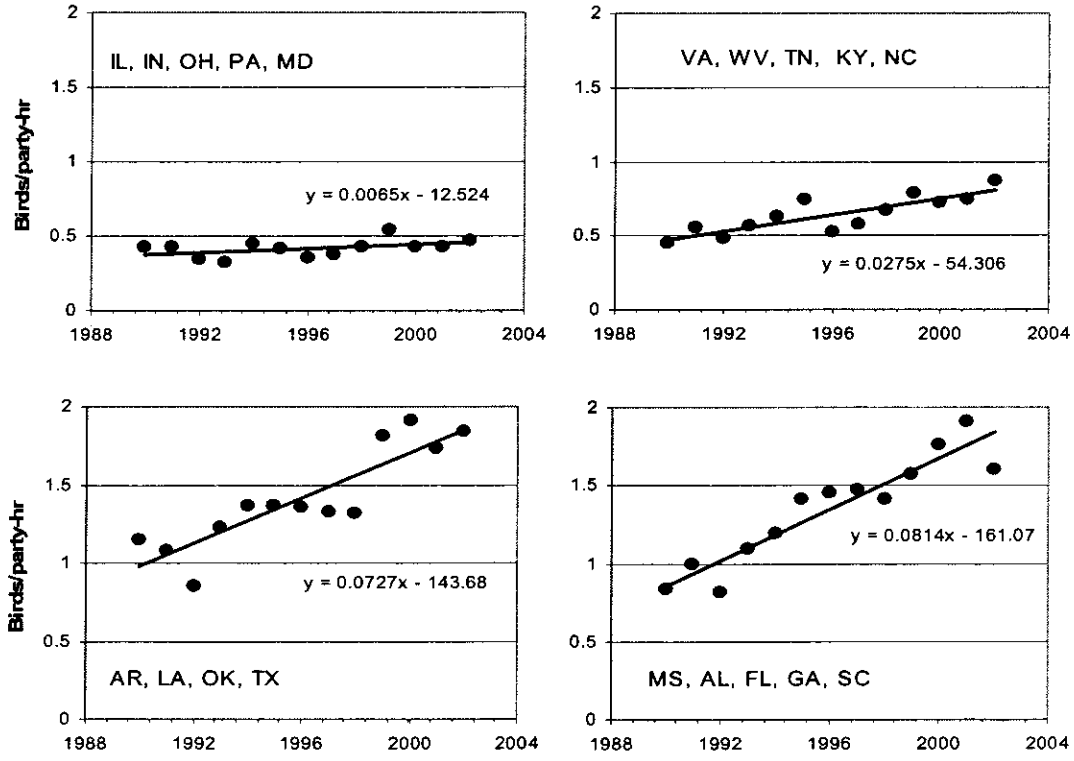

Figure 5. Regional trends in black vulture populations, according to CBC data, 1990 - 2002.

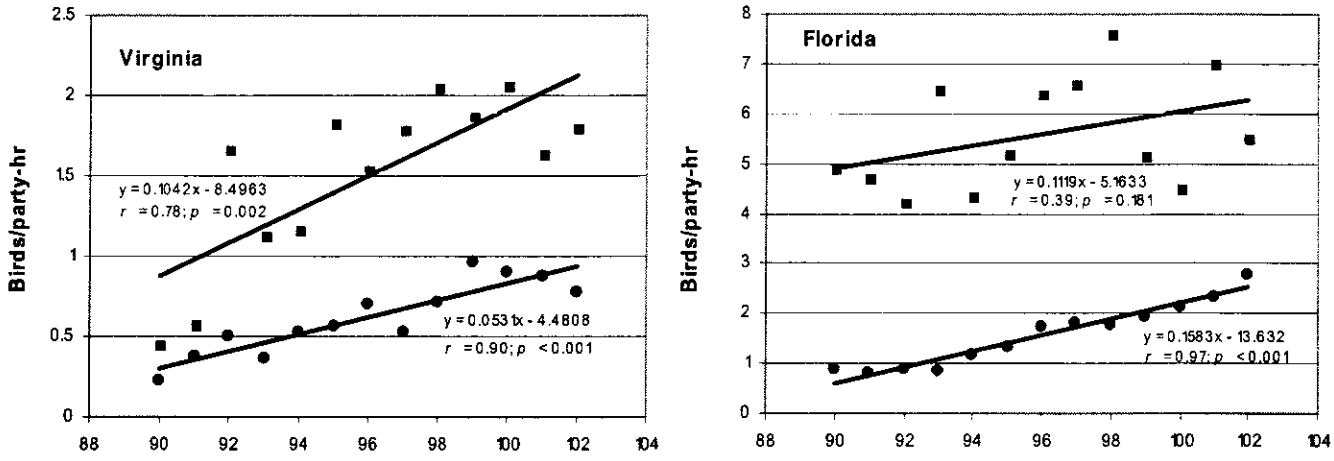

Figure 6. Turkey vulture (squares) and black vulture (circles) population trends from CBC sites that were used each year during 1990 - 2002 in Virginia (23 sites) and Florida (37 sites).

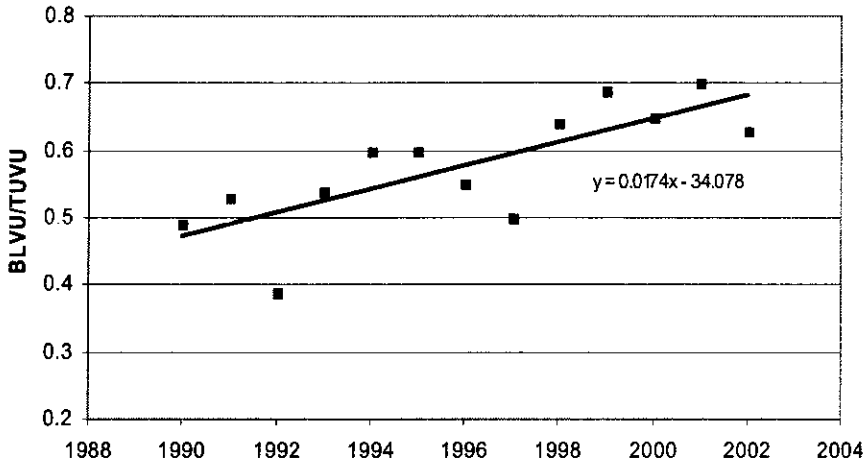

Figure 7. Ratio of black vultures to turkey vultures recorded by CBC observers across the U.S, 1990 - 2002.

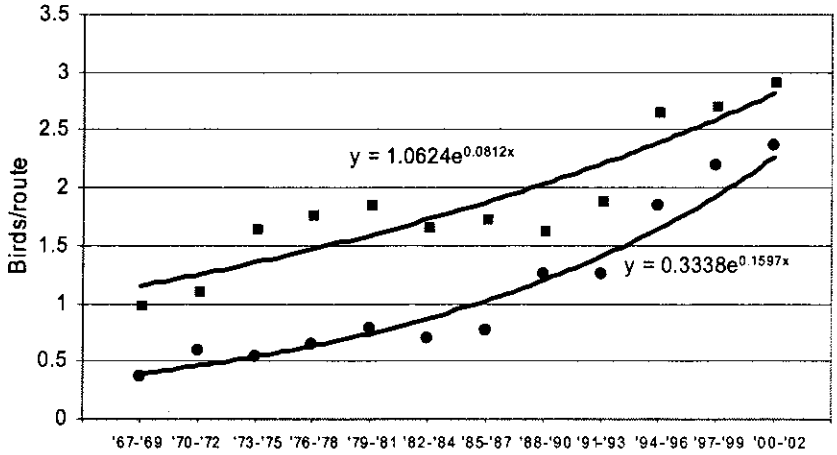

Figure 8. Turkey vulture (squares) and black vulture (circles) population trends according to BBS results, 1967 - 2002. Data plotted are 3-year mean values for the U.S.

Table 1. Population trends (percent annual increase) among US Fish and Wildlife Service regions for black and turkey vultures estimated from Breeding Bird Survey data, 1990 - 2002.

Region	Black vulture		Turkey vulture	
	Trend (%/yr)	*P*	Trend (%/year)	*P*
1	Insufficient data		1.62	0.193
2	5.90	<0.001	0.62	0.484
3	Insufficient data		5.77	<0.001
4	4.40	0.005	2.04	0.074
5	18.62	0.005	3.75	<0.001
6	Insufficient data		6.75	0.064

Table 2. Estimated population trends for black vultures in various states according to Breeding Bird Survey data, 1990 - 2002. Trends with *P* > 0.10 are not included.

State	Trend (%/year)	*P*	Variance	Birds/ route
Arkansas	18.76	0.01095	38.93	0.46
Florida	6.71	0.00162	4.18	7.89
Louisiana	5.40	0.03324	5.87	3.39
Maryland	14.83	0.02129	37.60	0.93
North Carolina	17.65	0.06226	79.40	0.72
South Carolina	16.27	0.05699	57.19	3.60
Tennessee	18.79	0.00004	10.35	1.11
Texas	5.83	0.00126	3.07	4.23
Virginia	14.24	0.08849	65.73	0.89

Table 3. Estimated turkey vultures population trends in various states according to Breeding Bird Survey data, 1990 - 2002. Only trends with *P* < 0.10 are included.

State	Trend (%/year)	*P*	Variance	Birds/ route
Arkansas	4.84	0.05077	5.55	3.46
Illinois	13.98	0.02325	35.22	1.38
Louisiana	7.78	0.00088	4.59	3.07
Missouri	8.28	0.00164	6.09	3.47
N. Carolina	11.16	0.00003	6.05	3.78
Ohio	3.31	0.05686	2.91	4.92
Oklahoma	4.24	0.04906	4.41	4.81
Pennsylvania	5.38	0.00934	4.09	1.52
S. Carolina	15.98	0.00305	23.92	3.70
Tennessee	8.18	0.00413	7.04	3.20
Virginia	4.53	0.01809	3.46	4.08
West Virginia	11.98	0.00023	8.64	3.11

As with the CBC data, the relative abundances of black and turkey vultures in the BBS have changed over time. Formerly, approximately 3 black vultures were observed for every 10 turkey vultures, but now the ratio is approximately 8 black vultures per 10 turkey vultures (Figure 9).

DISCUSSION

The usefulness of indices to population status, such as the CBC and the BBS, has been in doubt for years (Burnham 1981). Raw counts of birds, even when corrected for level of effort, could constitute dubious data upon which to base management decisions (Thompson 2002). The principal issue with regard to the usefulness of indices is detectability. Not every bird is detected during a given survey. The proportion of the actual population present that is detected is usually not known. The proportion detected is affected by a host of factors that encompass characteristics of the environment, the birds, and the observers (Rosenstock et al. 2002). Therefore it cannot be assumed that the proportion detected remains constant across time or space (Anderson 2001). But without this assumption, it is difficult, maybe impossible, to understand what the actual counts mean.

If detectability varies, then a given number of birds counted at one time and place does not represent the same proportion of the population as does the same number of birds recorded at another time and place.

There have been suggestions for dealing with the detectability issue (Nichols et al. 2000, Bart and Earnst 2002, Rosenstock et al. 2002). Adoption of such methods will no doubt improve collection of data in future studies, but it is difficult to see how these suggestions will resolve apparent shortcomings of existing databases such as the BBS and CBC. Perhaps the best that can be done with existing BBS and CBC index data is to focus on "patterns of population change" rather than "magnitudes of calculated trends and variances" (Droege 1990, p. 3).

Do concerns about detectability apply to the 2 species of vulture? Factors that affect detectability fall into 3 categories:

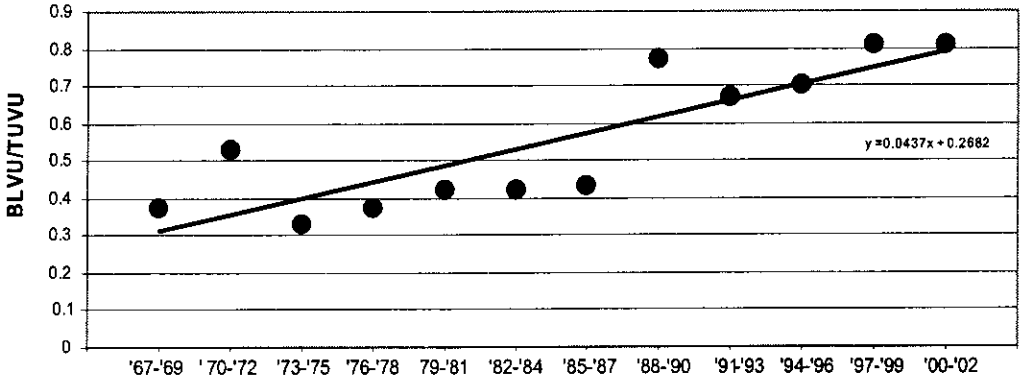

Figure 9. Ratio of black vultures to turkey vultures recorded by BBS observers across the U.S., 1967 - 2002. Data plotted are 3-year means.

1) Observers vary in ability, training, motivation, etc. However, even the most inexperienced bird observer is unlikely to misidentify a vulture. Variation in observer competence is likely not an important factor in counting vultures.

2) Attributes of the bird could affect detectability. Vultures are large and they often perch conspicuously on telephone poles, transmission line towers, and snags. They are not secretive, their vocalizations are not used for identification, and they are not easily confused with other species.

3) Environmental factors could have important effects, however. Vultures are less likely to be in the air during rainy weather than when the weather is clear and sunny (Kirk and Mossman 1998). Vultures are generally more readily noticed when they are in the air than when they are perched. Thus, conspicuousness increases throughout the day, as vultures are more likely to be seen flying in the afternoon than in the morning (Bunn et al. 1995). Because each BBS route is supposed to be completed by 10:00 AM, fewer birds will be detected than if the surveys were conducted later in the day. This will be particularly true in rainy weather.

Overall, then, it seems as though weather and time of day have the potential to affect detectability of vultures. Counts conducted early in the morning should yield fewer detections than those conducted later, and routes surveyed in clear weather should yield more vulture observations than those conducted during inclement weather. These 2 predictions can be tested with existing BBS information.

At this time, it seems overly conservative to discount the wealth of information on vultures contained in the BBS and CBC databases just because of concerns relating to variation in detectability due to weather and time of day. Regardless of the measure employed, the available information points to steadily increasing numbers of black and turkey vultures. Whereas the question of detectability and its effects on index counts are important to avian ecologists and wildlife managers, the problems do not seem as acute for vultures as for most other species. I contend that in the absence of a viable alternative, the BBS and CBC databases can be used efficiently and appropriately to document changes in vulture populations over time and among areas.

In the future, vulture surveys using BBS-type methods should be conducted later in the day to optimize the number of observations, and if possible, such surveys should be restricted to days without precipitation. The same suggestions hold for other species with similar daily activity patterns.

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