

Impacts of the Conservation Reserve Enhancement Program on the Regional Trends in Bird and Eastern Cottontail Populations^a

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Abstract: Grassland bird populations have decreased significantly across North America in recent decades. It is considered that the new grasslands created under the Conservation Reserve Program (CRP) have benefited grassland birds, although most species continue to decline. An enhanced version of CRP, the Conservation Reserve Enhancement Program (CREP) was introduced in southern Pennsylvania in 2000. In order that effects of the program on populations of grassland and other birds could be assessed, a monitoring program was established in 2001. Of 62 common bird species reported during the monitoring surveys, 12 showed significant population increases while 20 showed significant decreases. The larger number of decreasing species is mainly attributable to the emergence of West Nile Virus, which caused significant, but temporary, declines for at least 10 bird species. Populations of several grassland species fared better in areas where a higher percentage of farmland was enrolled in CREP. The strongest positive effects of CREP on grassland bird populations were noted for American kestrel, eastern kingbird, grasshopper sparrow, song sparrow and eastern meadowlark. Across a suite of grassland species, there was an average annual population increase of 15% in areas where more than 3% of farmland was enrolled in CREP by 1 June 2004. This contrasted with average decreases of more than 7% in areas with no CREP. We found no evidence of any effect of CREP enrollment on eastern cottontail populations. These responses are early indicators that CREP has benefited some grassland bird species in southern Pennsylvania, but we caution that the program is still in its infancy and that responses for some species may show a considerable time-lag due to the small and fragmented nature of grassland bird communities in the region.

OBJECTIVES

1. To monitor trends in agricultural habitats in 20 southeastern Pennsylvania counties enrolled in CREP.
2. To monitor trends in breeding bird and eastern cottontail populations on agricultural lands in the 20 CREP counties.
3. To determine the impact of establishing undisturbed grassland habitats on the regional abundance and population trends of grassland nesting birds and eastern cottontails.

INTRODUCTION

Grassland bird populations have been in steady decline across North America for the past four decades or more (Vickery 2001; Sauer et al. 2005). The declines are of such magnitude that they have been predicted to become a "prominent wildlife conservation crises of the 21st Century" (Brennan and Kuvlesky 2005). The causes of these declines are many and varied. Loss of grassland extent and habitat fragmentation have undoubtedly been major contributory factors, but changes in grassland management, such as increased frequency of/earlier mowing, and replacement of native grassland with

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monocultures, often of non-native species, may also be important. This intensification of grassland and other agricultural management is acknowledged to have had adverse environmental impacts. To negate some of these impacts, the Conservation Reserve Program (CRP) was introduced in the 1985 Food Security Act, with key aims of curtailing excess agricultural production and reducing soil erosion (Isaacs and Howell 1988). The CRP requires that farmers take erodible land out of arable production and sow grass, for contract periods of 10-15 years, in return for a rental income. The CRP resulted in the creation of millions of acres of grasslands across agricultural areas of the United States. Numerous studies have shown that the new habitat created by CRP has benefited grassland bird species (e.g. Johnson and Igle 1995, Ryan et al. 1998, Swanson et al. 1999), but most grassland bird species have continued to decline since the introduction of CRP (Norment 2001), suggesting that it has not been sufficient to compensate for continuing population losses across the farmed landscape.

Due to unfavorable local economic conditions, CRP enrollment was low in the northeast United States. In order that the program was more suitable for those areas, a subsidiary program, the Conservation Reserve Enhancement Program (CREP) was authorized in the 1996 Farm Bill.

In April 2000, the Governor of Pennsylvania and U.S. Secretary of Agriculture approved a \$210M conservation initiative for 20 counties within the Lower Susquehanna Basin in southern Pennsylvania. The Lower Susquehanna Basin CREP has a goal of converting 100,000 acres of cropland and marginal pasture to conservation cover for 10-15 years. The program's goals are to improve water quality, reduce soil erosion, increase farm income, and improve wildlife habitat. The most widespread management practice in CREP is reseeded former arable land with grasses, which, it is hoped will help to reverse the rapid and sustained declines of grassland birds noted in Pennsylvania over the last 40 years. The State must provide 20% of the costs and is also responsible for monitoring the effectiveness of the habitat improvements on water quality and targeted wildlife populations.

To monitor the effects of CREP on grassland and other farmland birds in the Lower Susquehanna Basin CREP, a monitoring program was established in 2001. Although CREP was expanded to 23 counties in the Upper Susquehanna Basin in 2003 and 16 counties in the Ohio River Basin in 2004, there are, as yet, no specific programs to monitor the effects of CREP on bird populations in those areas.

This project was a continuation of 01004Af "Effects of Local and Landscape Features on Avian Use and Productivity in Conservation Reserve Program (CREP) fields. Previous research has shown that CREP fields in southern Pennsylvania support primarily generalist species, such as red-winged blackbirds and song sparrows, and edge species, such as indigo buntings and common yellowthroats, with lower numbers of grassland specialists such as grasshopper sparrows and eastern meadowlarks (Wentworth and Brittingham 2005). Species diversity, abundance and nesting success was higher in CREP fields than from paired hayfields. It is not clear whether the positive field-scale effects demonstrated by that study are sufficient to elicit a population level response. The aims of this paper are to examine population trends of bird species within the 20 county study area, for the period 2001 to 2005, to evaluate whether CREP has resulted in large-scale responses by grassland bird populations.

METHODS

Bird Surveys

The survey protocol is based on The Breeding Bird Survey (BBS) with slight modifications (Sauer & Droege 1990). Birds were surveyed at 5-minute point counts (BBS is 3-minute) at up to 50 stops along a survey route. The counts are approximately 0.5 miles apart and all birds seen or heard within an 820ft (250m) radius of each survey point are counted. The survey routes were selected randomly within areas dominated by farmland, according to land cover data, and were not selected to coincide with CREP agreements (Figure 1). Survey routes are generally along township roads; major highways, where traffic noise could reduce bird detectability, are avoided. A team of 12 highly skilled birdwatchers, who were employed by the Pennsylvania Game Commission (PGC), carried out bird surveys on 89 routes, twice per season, once in May and once in June. In 2004 and 2005 only the June surveys were conducted.

Eastern cottontails *Sylvilagus floridanus* were also counted on each survey. Cottontail counts included all individuals seen while driving the survey routes, including animals seen on the bird point counts and those seen while driving between points.

Spatial Data Analysis Using GIS

Spatial analysis was carried out using ArcView GIS (Ormsby et al. 2004). The sampling unit in this analysis is the survey route (Figure 1). The routes averaged 33.4-point counts (range 20-50), or 16.2 miles in length. This analysis is concerned with landscape-scale population changes - our definition of landscape is the area within 790ft (500m) of each survey route. Some survey routes were almost contiguous, and hence the landscapes overlapped and could not, therefore, be considered independent samples (see end of Appendix 2). In these cases, data from the two contiguous landscapes were combined, reducing the sample size to 84 landscapes. The landscapes averaged 2,276 acres (range 1,275-4,847). Land cover data (Myers and Bishop 1999) were used to calculate the area of each land use within each landscape. The area of farmed land was the sum of the grassland and arable



Figure 1. Map of the 20 county study area - shaded white, and sampling areas (landscapes) - shaded black, land use types. Although the land use within the landscapes varied, overall, there was little difference in land use of the study areas between counties (Figure 2). A high percentage of the landscapes was farmed (average 74.5%, range 45-93%), a smaller proportion forested (mean 18%, range 2-43%) and only a small area urban/developed (mean 1.14%, range 0.02-5.1%), and other habitats (mean=5.2%, range 0.7-11.8%).

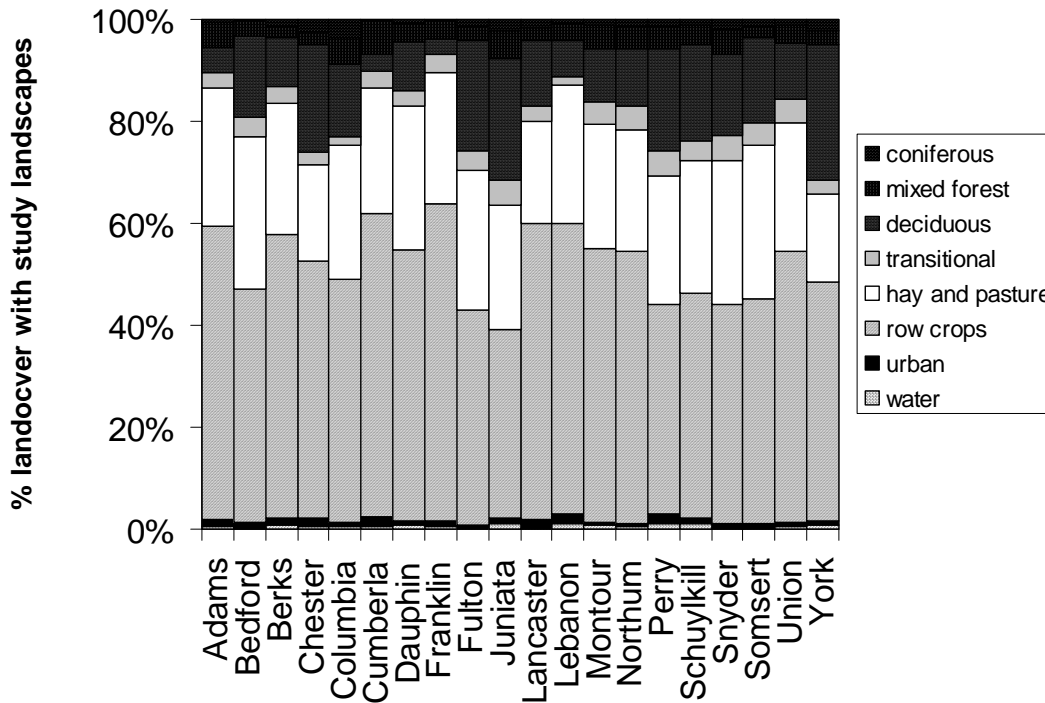


Figure 2. Land cover types within the 84 study landscapes, by county.

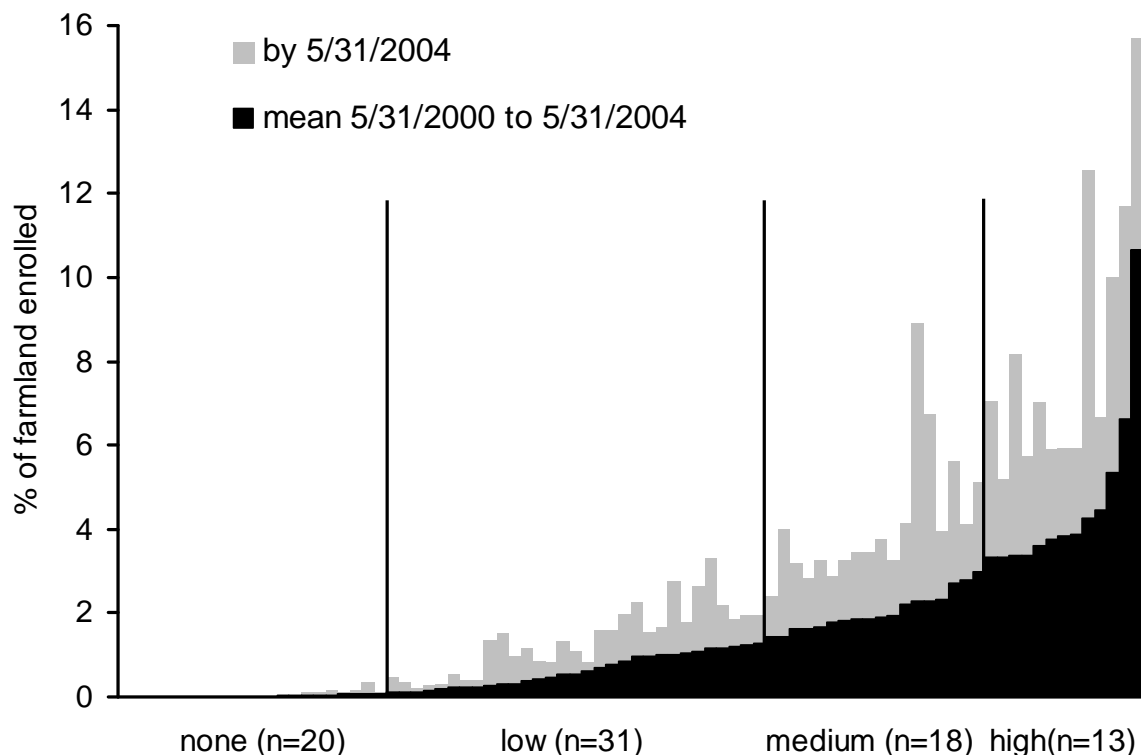
Digitized maps of CREP agreements were supplied by the Natural Resources Conservation Service (NRCS). The following CREP practices were selected for the analysis: CP01 - introduced grasses and legumes (cool season grasses), CP02 - native grasses (warm season grasses), CP10 (vegetative cover - grass already established) and CP21 - filter strips (grasses).

Enumerating CREP Enrollment Rates

CREP was considered to be available as a habitat for grassland birds after one full growing season. This is a liberal assessment of grassland bird habitat created by CREP, because some CREP fields may not be suitable for some grassland bird species until after more than one growing season. To assess the extent of CREP enrollment with which to compare bird populations we used annual growing seasons of 1 June to 31 May, hence, by the 2005 bird surveys, only CREP fields sown before 31 May 2004 was considered to be available for birds. The summed CREP area for each landscape was then calculated as a percentage of the total farmland within each landscape.

Because sign up was continuous through the five-year study period, there are many ways in which the amount of CREP in each of the 84 landscapes could be measured. To categorize landscapes into areas with no CREP, low enrollment, medium enrollment and high enrollment, we calculated the mean of the percentage of farmland within each landscape that was enrolled by 31 May of each year 2000 to 2004. This is a better measure of CREP availability to birds than the total enrolled by the end of the period, as in some landscapes most of the enrollment was towards the end of the period, in which case bird populations had less time to respond to the new habitat.

The landscapes were ranked according to the mean % of farmland enrolled, and then categorized based on split-points where a step change in enrollment could be seen (Figure 3). The four resulting categories of CREP enrollment are shown in Table 1.



landscapes in CREP enrollment categories

Figure 3. Percentage of farmland enrolled in CREP by 1st June 2004 for each of the 84 landscapes of southern Pennsylvania, with split-points between the four categories of enrollment.

Table 1. CREP enrollment categories as devised for analysis of bird population changes in 20 counties of southern Pennsylvania between 2001 and 2005.

CREP enrollment category	Number of landscapes	Split-points (ranges) for landscapes in each categories	Mean % enrolled by 31 May 2004
None (and negligible)	20	0 - 0.07	0.05
Low	31	0.1 - 1.27	1.42
Medium	19	1.42 - 2.97	4.01
High	14	3.31 - 10.67	8.27

* Mean of % of farmland enrolled at 31 May 2000, 2001, 2002, 2003 and 2004. The percentage of farmland enrolled in CREP within the 84 landscapes was not correlated to the % of existing grassland, or the % of farmland overall in each landscape (Figure 4). We conclude that using other potential measures of CREP extent, such as % increase in grassland

as a result of enrollment, or % of total landscape enrolled, would not produce different results from our "% of farmland enrolled" parameter. It is important to note that most existing grassland in the area does not provide good habitat for grassland nesting birds because it is mown during the bird nesting season. Farmland is the principle land use in almost all of the 84 landscapes, with between 20 and 40% of that farmland in some type of grassland (Figure 4).

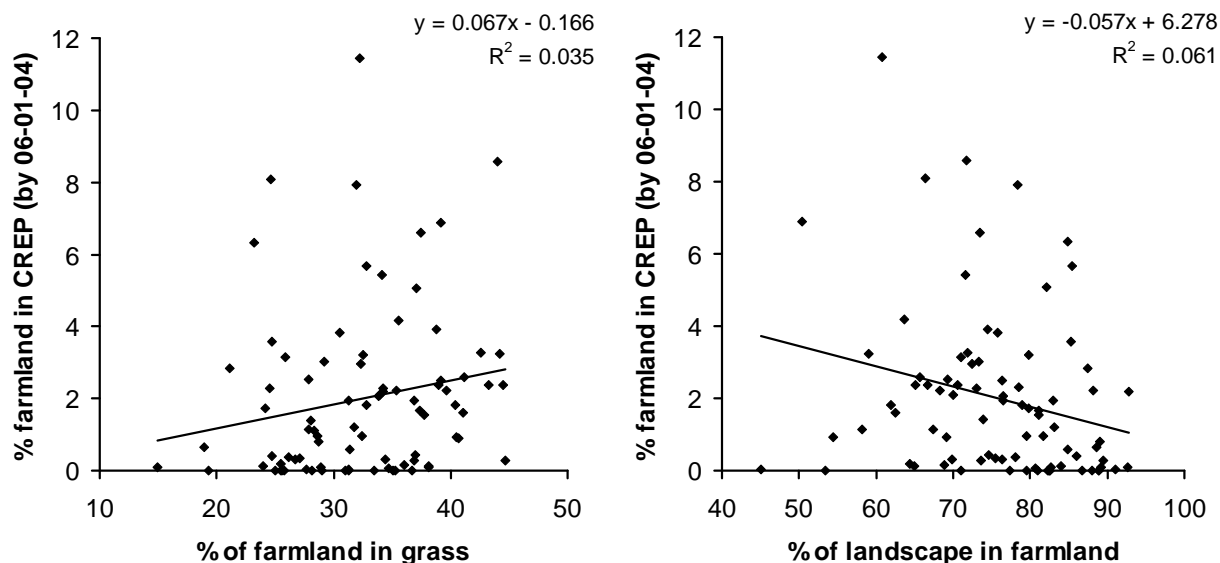


Figure 4. Percentage of farmland enrolled in CREP by 1st June 2004 for each of the 84 landscapes of southern Pennsylvania, plotted against % of farmland previously in grassland (left) and % of the total landscape in farmed (right).

Analysis of Bird and Cottontail Population Trends

Of the 84 survey routes, data were received for four or more years for 67. Separate analysis were carried out based on all available data, and only data from the June bird surveys for the 67 routes with at least four years of data. The latter ensures greater comparability between years, but the lower sample sizes may reduce the power to detect significant population changes.

Population trends for the years 2001 to 2005 were estimated using program TRIM (TRENds and Indices for Monitoring data). TRIM is statistical software to analyze time-series of counts with missing observations, using Poisson regression (Pannekoek and van Strien 2001). TRIM is useful for modeling bird count data because the Poisson error distribution copes well with large numbers of zero counts. The effects of CREP on population changes at the landscape scale was carried out by including the percentage of farmland enrolled in CREP as a covariate. Landscapes were categorized as high CREP, medium CREP, low CREP and none/negligible (Table 1). Wald-tests (Pannekoek and van Strien 2001) were used to test for the significance of CREP enrollment on population trends, henceforth called the CREP effect.

Analysis was restricted to species for which TRIM was able to calculate population indices for each of the 4 CREP covariate categories, the 62 most common and widespread bird species in the 20 county study area, as well as eastern cottontail. Of these species, some were scarce, localized or found

mainly in large aggregations, and hence the results should therefore be treated with caution for Canada goose, turkey vulture, yellow-billed cuckoo, purple martin and bobolink.

Note that for this analysis we combined the counts for two chickadee species: black-capped and Carolina. The study area includes the southern edge of the black-capped chickadee's range and the northern edge of the Carolina chickadee's, but the two species' distribution overlap and there is a zone in which hybridization occurs (Curry 2005) making specific identification unreliable. Combining the data for these two species also has the advantage that it increases sample sizes and therefore the ability to detect significant population changes.

The population trend for all sites between 2001 and 2005 was estimated from the modeled slope parameter. The direction and significance of the trend is classified according to the overall slope as well as its 95% confidence interval (= slope +/- 1.96 times the standard error of the slope).

- Strong increase - increase significantly more than 5% per year (5% would mean a doubling in abundance within 15 years).
Criterion: lower limit of confidence interval > 1.05.
- Moderate increase - significant increase, but not significantly more than 5% per year.
Criterion: $1.00 < \text{lower limit of confidence interval} < 1.05$.
- Stable - no significant increase or decline, and it is certain that trends are less than 5% per year.
Criterion: confidence interval encloses 1.00 but lower limit > 0.95 and upper limit < 1.05.
- Uncertain - no significant increase or decline, but not certain if trends are less than 5% per year.
Criterion: confidence interval encloses 1.00 but lower limit < 0.95 or upper limit > 1.05.
- Moderate decline - significant decline, but not significantly more than 5% per year.
Criterion: $0.95 < \text{upper limit of confidence interval} < 1.00$.
- Steep decline - decline significantly more than 5% per year (5% would mean a halving in abundance within 15 years).
Criterion: upper limit of confidence interval < 0.95.

Because of the small sample sizes for many species, analysis at the species guild level would be more informative for evaluating the overall patterns of population trends with respect to CREP enrollment. Canonical Correspondence Analysis was used to devise habitat species guilds based on their habitat associations within the study area (see below). The results for the grassland species guild could then be compared with those for other species to evaluate whether the population changes are likely to be attributable to CREP, or whether other extrinsic factors have influenced bird populations.

Population trends and the effects of CREP enrollment rates for species guilds were estimated by averaging the indices across guilds. This average can be considered to be an indicator index for a group of birds that share similar habitat requirements (Gregory et al. 2005). The geometric mean was used as the average measure of population change. Note that this is not weighted by population size, therefore the relative population change of a

scarce species has the same effect on the index as that for a common species. The variance for each index (\bar{I}) was calculated as follows:

$$\text{var}(\bar{I}) \approx \left(\frac{\bar{I}}{T}\right)^2 \sum_t \left(\frac{\text{var}(I_t)}{I_t^2}\right)$$

where there are T indices to be averaged and the index for each species is denoted I_t . Standard errors (SE) and 95% confidence intervals ($1.96 * \text{SE}$) could then be calculated (Gregory et al 2005).

Canonical Correspondence Analysis to Derive Species Guilds

Point level bird data and habitat data from the first survey year (2001) was used to derive species guilds. Program Canoco (ter Braak and Šmilaur 2002) was used to produce an ordination plot using Canonical Correspondence Analysis (CCA). This technique can be used to derive linear relationships between a suite of species counts and a suite of environmental variables. These relationships are then plotted on a bi-plot, to show which species are most closely related to which environmental gradients. In this study, the environmental gradients were the percentage cover of eight major land use types, as estimated by the bird surveyors: human, arable, pasture, hay, fallow, herb, shrub and woodland. Those species, which lie closest to the "hay" gradient in the bi-plot, would be considered grassland species.

RESULTS

Results: CREP enrollment within the study areas

By the 2005 bird-breeding season we estimate that 2.4% of farmland was enrolled in CREP and available to birds within our study areas (Figure 5), a percentage that grew steadily each year. Of that available CREP, 85% was cool-season grassland (CP1), 10% was warm-season grassland (CP2), 3.5% existing grassland (CP10) and 1.7% filter-strips (CP21). Note that existing grassland CRP contracts were enrolled as CP10 in some counties and CP1 in others. Hence, a portion of the CP1 grassland was existing grassland, although mowing regimes changed when the contracts were rolled over into CREP.

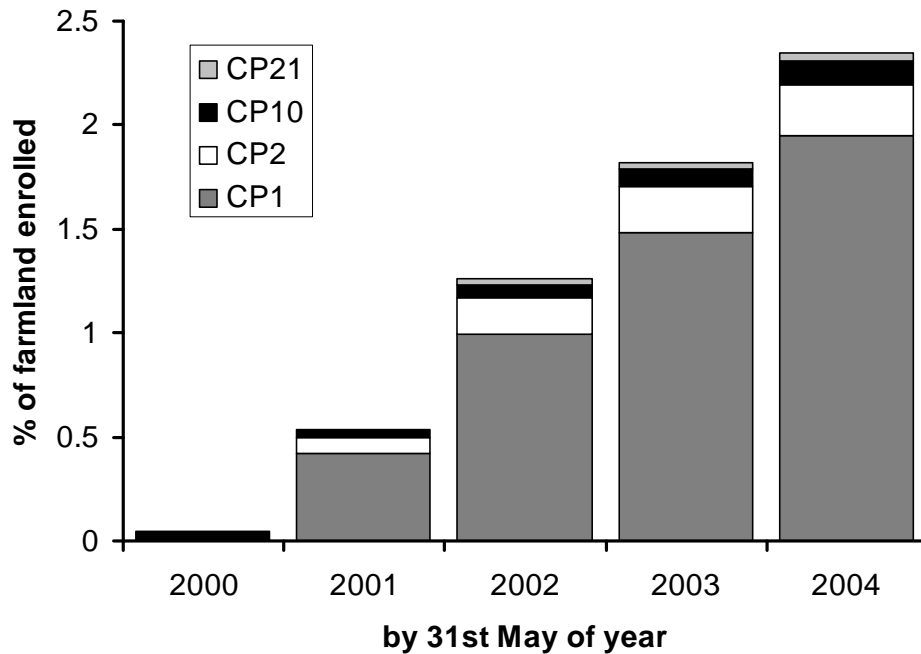
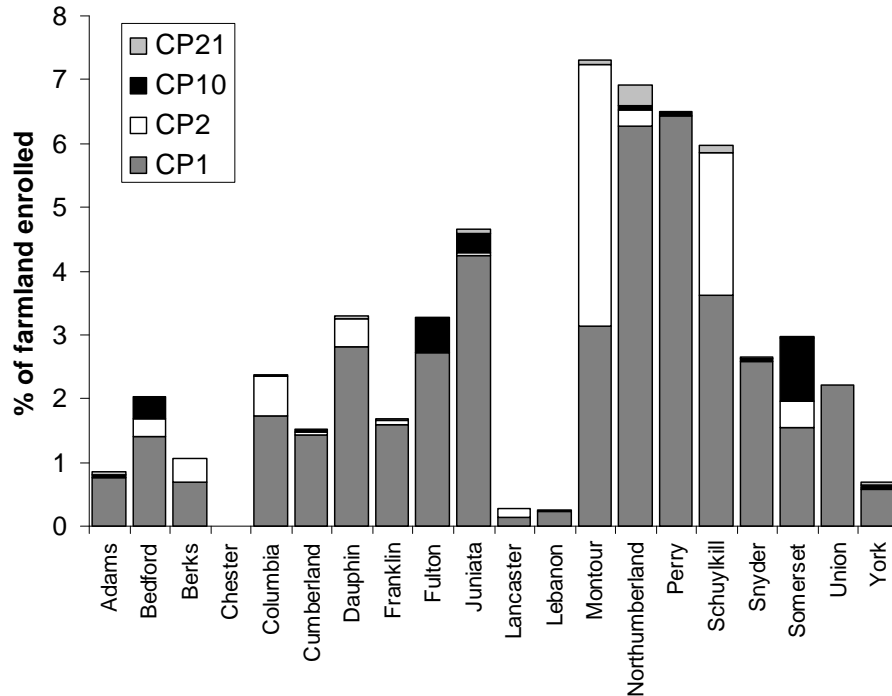


Figure 5. Cumulative CREP enrollment, as a % of farmland, by 31st May of each year, summed across 84 landscapes in southern Pennsylvania.

CREP enrollment varied widely between landscapes and counties. Enrollment rates within our study landscapes ranged from none in the three landscapes in Chester County to an average of 7.5% in the two landscapes in Montour county (Figure 6) by 31st May 2004. Generally, enrollment was highest in counties in central Pennsylvania and lowest in the southeast of the state. The great majority of enrollment was in CP1 with substantial CP2 enrollment only in Montour, Columbia and Schuylkill counties. Rollover contracts from CRP (CP10) were modest in total extent, with the highest rates in the western counties of Bedford, Fulton and Somerset. Existing grassland in many other counties was enrolled as CP1, hence the extent of CP10 cannot be assumed to reflect the extent of rollover from CRP to CREP. Enrollment in CP21 amounted to a negligible percentage of total farmland in all counties, the highest rate (0.3% of farmland) being in landscapes in Northumberland County.

Figure 6. CREP enrollment, as a % of farmland, by 31st May 2004, by county and practice. Note that these data relate to the CREP within the 84 study landscapes only, not the whole program. Note that rollover from CRP was enrolled as CP1 in some counties and CP10 in others.



The rates of CREP enrollment within the landscapes generally reflected the actual enrollment rates for each county (Figure 7). Note though, that enrollment rates within the study landscapes were generally slightly higher than the average across each of the twenty counties, which we speculate may be because fields that are enrolled in CREP are more likely to be roadside fields that are closer to the road-based survey routes. In general though, we can be confident that CREP enrollment within our 84 landscapes was representative of the whole of the twenty counties.

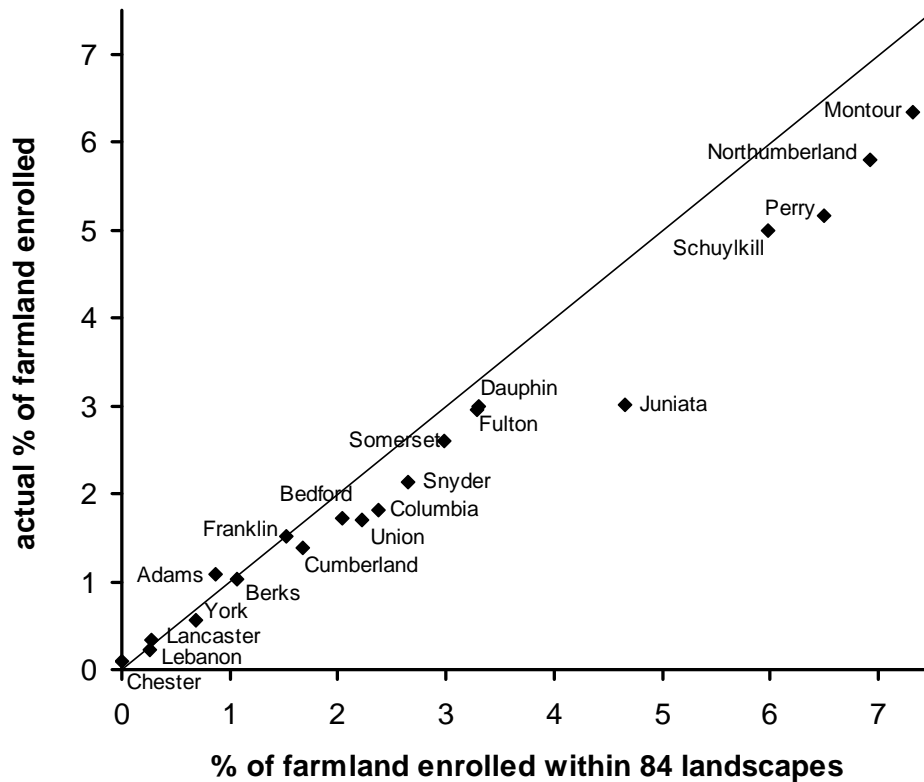


Figure 7. CREP enrollment, as a % of farmland, by 31st May 2004 for the 84 landscapes plotted against actual enrollment within each of the 20 counties of southern Pennsylvania.

Categorizing Bird Species into Habitat Guilds

The Canonical Correspondence Analysis (CCA) proved to be a successful method of assigning the 62 commonest species into habitat guilds. The CCA bi-plot (Figure 8) shows that habitat gradients followed a logical successional pattern, moving anti-clockwise from human habitats, through arable, pasture, fallow, hay, herbaceous, scrub and forest. A grassland bird species guild was therefore defined by what bird species were most associated with grasslands within our study areas, and comprised 12 species (Figure 8).

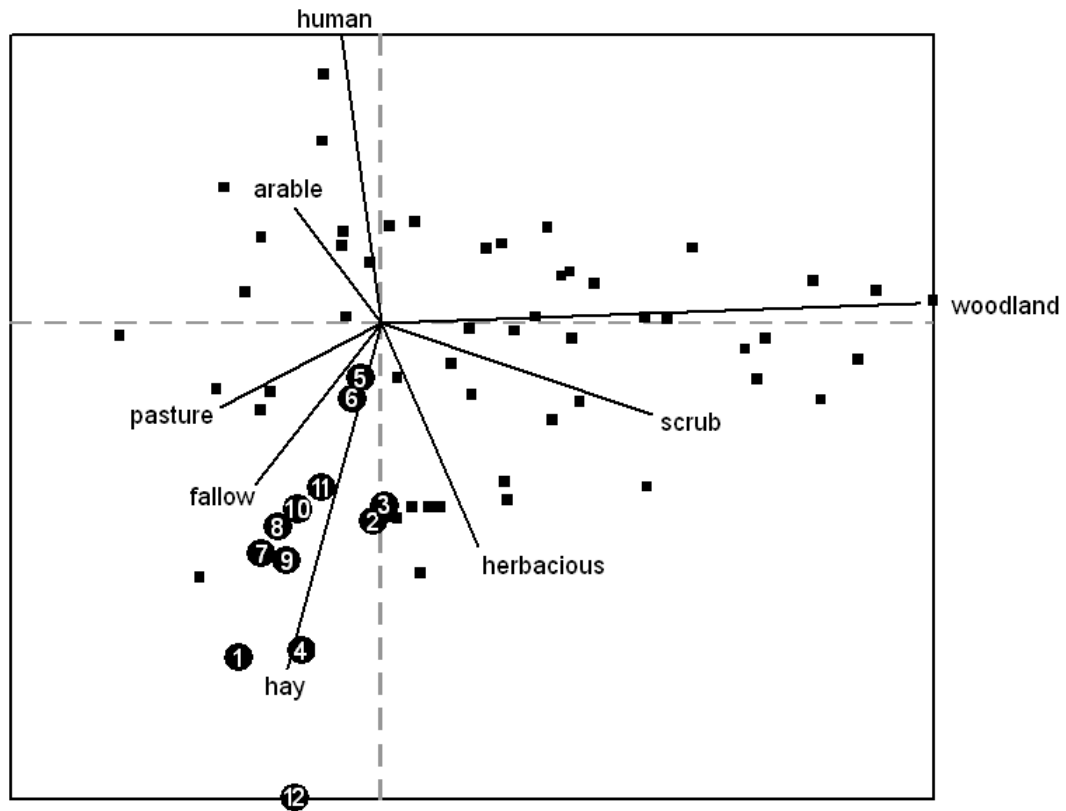


Figure 8. CCA bi-plot showing relationships between birds (each dot is one species) and main habitats gradients (lines) for 2001 count data. The proximity of a species to a habitat gradient shows the strength of affinity for, or specialization in that habitat. Generalist species cluster towards the center of the plot, specialists are found towards the edges. The 12 species in the grassland species guild are highlighted with large circles, numbers relate to the species (listed below).

1. Canada goose
2. American kestrel
3. red-tailed hawk
4. eastern kingbird
5. tree swallow
6. eastern bluebird
7. vesper sparrow
8. Savannah sparrow
9. grasshopper sparrow
10. eastern meadowlark
11. red-winged blackbird
12. bobolink

This species guild does not include some species typically thought of as grassland species, notably the horned lark, which is predominantly a bird of arable areas in Pennsylvania, but includes other species not normally considered grassland specialists. Of these additions, that of Canada goose may be questionable, most of the birds detected on CREP routes were flocks of non-breeding birds grazing or resting in open fields. The inclusion of

eastern kingbird highlights the importance of grasslands as a foraging habitat for this insectivorous species.

Bird Population Trends 2001-2005

Bird population trends were estimated for 62 species. Of these, 12 showed significant population increases between 2001 and 2005, while 20 showed significant declines (Table 2), the remaining 30 species were either stable or showed indistinct population trends. Detailed results for each species can be found in Appendix 1.

Table 2. Species showing significant population changes in farmland areas of 20 counties of southern Pennsylvania between 2001 and 2005

Increasing population trends			Decreasing population trends		
Species	Mean annual change		Species	Mean annual change	
turkey vulture	+10.8	**	ring-necked pheasant	-11.0	*
red-tailed hawk	+14.4	*	American kestrel	-14.8	**
yellow-billed cuckoo	+14.3	*	Killdeer	-5.5	**
red-bellied woodpecker	+6.2	**	eastern phoebe	-8.3	**
northern flicker	+14.3	*	blue jay	-8.1	**
horned lark	+6.9	*	American crow	-11.8	**
tree swallow	+10.8	*	fish crow	-13.3	**
chickadees	+10.1	**	tufted titmouse	-12.8	**
American robin	+2.7	*	white-breasted nuthatch	-14.5	*
brown thrasher	+15.7	*	eastern bluebird	-11.3	**
yellow warbler	+8.0	**	northern mockingbird	-3.7	**
eastern meadowlark	+8.5	**	Eurasian starling	-4.3	*
			cedar waxwing	-10.8	**
			Ovenbird	-9.4	**
			common yellowthroat	-5.1	*
			field sparrow	-6.7	**
			grasshopper sparrow	-9.6	**
			indigo bunting	-5.6	**
			house finch	-8.9	*
			American goldfinch	-9.6	**

* significant at $p < 0.05$

** significant at $p < 0.01$

Effect of CREP Enrollment on Bird Population Trends

Populations of nine of the 62 species showed a positive correlation with the rate of CREP enrollment while one showed a significant negative correlation (Table 3). Four of the 12 species in the grassland species guild showed a positive effect, compared with five of the 51 species in other species guilds. Of these, the positive CREP effect for song sparrows is expected - this was found to be one of the most common species in CREP fields during 2002-2004 (Wentworth and Brittingham 2005).

Table 3. Bird species showing a significant apparent effect of the rate of CREP enrollment ("CREP effect") on their population trends 20 counties of southern Pennsylvania between 2001 and 2005. P values are the results of Wald-tests of the significance of the CREP covariate on population trends.

Species	Habitat guild	CREP effect	P
American kestrel	Grassland	Positive	0.0499
rock pigeon	Arable	Positive	0.0497
eastern kingbird	Grassland	Positive	0.0121
American crow	Forest	Positive	0.0005
house wren	Scrub	Positive	0.0037
gray catbird	Scrub	Positive	0.0008
grasshopper sparrow	Grassland	Positive	0.0285
song sparrow	Scrub	Positive	0.0032
eastern meadowlark	Grassland	Positive	0.0296
brown-headed cowbird	Forest	Negative	0.0436

Because of small samples sizes for some species, and the confounding effect of the West Nile Virus emergence on population trends (see below), analysis at the species guild level may be more informative than at the single species level. The CREP effect for the grassland species guild is significantly positive, with a significant mean increase of 15.9% per year for these species in High CREP enrollment areas, contrasting markedly with an average 7.4% per annum decline in landscapes with no CREP (Figure 9). The CREP effect across all other species was not significant, with no differences in population trends between areas with no CREP and the three rates of enrollment (Figure 9).

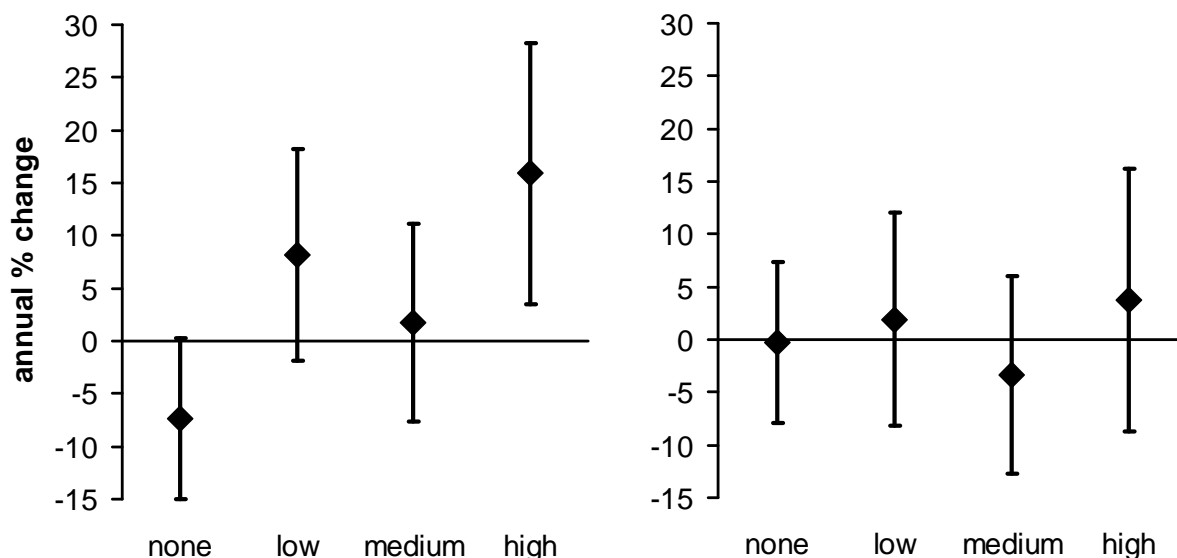


Figure 9. Annual population changes between 2001 and 2005 for the grassland species guild (left) and all others species (right) in landscapes with four levels of CREP enrollment by 1st June 2004. None is <0.1% of farmland, low is 0.1-1.25%, medium is 1.25-3%, high is >3%. Error bars are 95% confidence intervals.

Some species found to be common in CREP fields (Wentworth and Brittingham 2005) did not show a significant effect of CREP on population's levels, notably field sparrow (Figure A1.47.2) and red-winged blackbird (Figure A1.55.2). We suggest that this may be because these species are

found in a wide variety of habitats, and the numbers found in CREP fields are small relative to the total regional population size.

Population Trends and Effects of CREP Enrollment on Eastern Cottontail Populations

Cottontail populations showed fluctuations through the 5-year period, probably associated with severity of winter weather. The winter of 2002/2003 was particularly cold, with average temperatures for January to March 2003 4 degrees Fahrenheit below normal (source: National Weather Service Forecast Office <http://www.erh.noaa.gov/ctp/climate.php>). Overall though, the linear population trend for 2001 to 2005 was one of moderate increase (Figure A1.63.2).

There was no evidence that eastern cottontail population trends differed between landscapes with different rates of enrollment (Figure A1.63.2).

Implications of West Nile Virus

Examination of the population trend graphs in Appendix 1 shows that ten species showed sharp population decreases between 2002 and 2004, which would be consistent with a strong effect of West Nile Virus mortality on bird population levels. Those species were (with year of notable effect):

1. eastern phoebe in 2003 (Figure A1.17.1)
2. blue jay in 2004 (Figure A1.21.1)
3. American crow in 2004 (Figure A1.22.1)
4. fish crow in 2004 (Figure A1.23.1)
5. tufted titmouse in 2004 (Figure A1.29.1)
6. white-breasted nuthatch in 2003 (Figure A1.30.1)
7. Carolina wren in 2003 (Figure A1.31.1)
8. eastern bluebird in 2003 and 2004 (Figure A1.34.1)
9. ovenbird in 2004 (Figure A1.43.1)
10. American goldfinch in 2004 (Figure A1.61.1)

American kestrel (Figure A1.6.1), chickadees (Figure A1.28.1) and house finch (Figure A1.60.1) population trends may also show an effect of West Nile Virus on population levels but the sharp decrease noted for the other ten species were not as marked for these.

All of the ten species listed above showed significant linear population decreases through 2001 to 2005 as a result of the decreases in 2002 to 2004, with the exception of Carolina wren, which showed a modest overall increase through the period (Table 2).

This apparent effect of West Nile Virus emergence on bird populations within the study area provides an unexpected confounding factor when population trends with respect to CREP enrollment are evaluated. Unfortunately, the emergence and prevalence of West Nile Virus was not uniform across the study area, and indeed was most marked in the southeast of Pennsylvania, in the same counties where CREP enrollment was low (Figure 10). This confounding of high West Nile Virus prevalence with low CREP enrollment might explain some of the surprising apparent associations between CREP enrollment and bird population changes (Table 3).

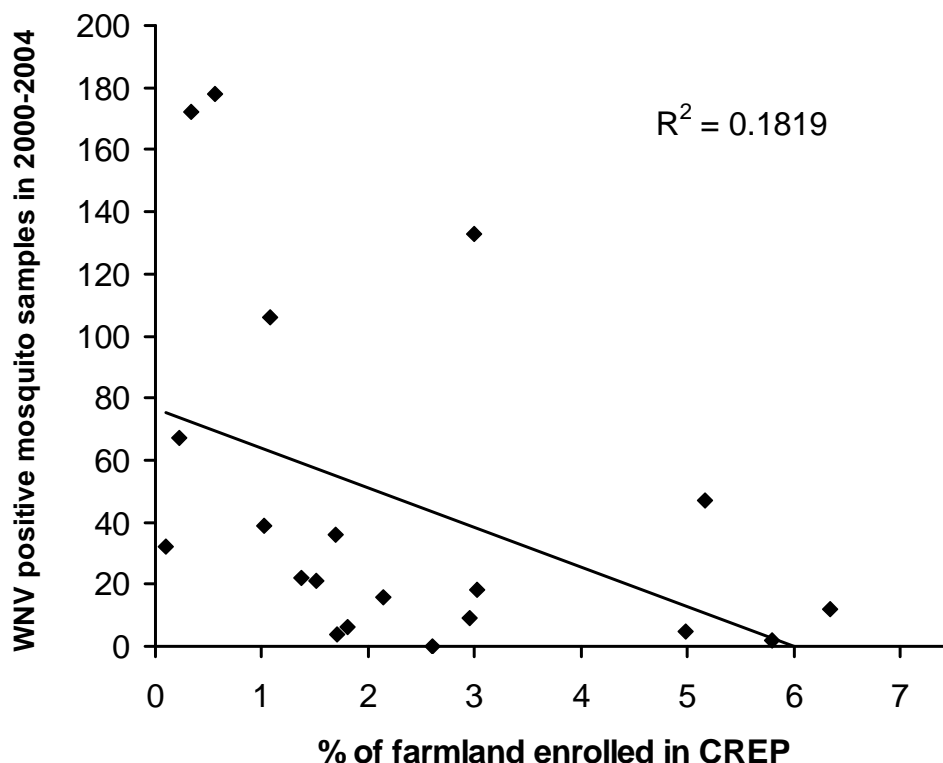


Figure 10. West Nile virus prevalence, as measured by the number of positive mosquito samples per county during 2000-2004, plotted against CREP enrollment rate for each county. Source of mosquito sample data: Pennsylvania's West Nile Virus Surveillance Program (<http://www.westnile.state.pa.us/index.html>). Total number of mosquito samples tested positive for West Nile Virus during the year 2000 to 2004.

DISCUSSION

Although many studies have shown that grassland birds utilize CRP, often at higher species diversity and abundances than in agricultural grasslands (Best et al. 1998; Ryan et al. 1998; Weber et al. 2002), few studies have been able to demonstrate that this has produced a positive effect at the population scale (Murphy et al. 2003). We believe ours is the first study to examine the effects of CREP on bird population responses at a large-scale. That we are able to show significant population increase for several species in landscapes with the most CREP is a very significant finding, especially given that the program is still in its infancy. Many of the CREP fields in the study area had been sown for only one or two years by the end of our 5-year study, and hence the findings must be treated with some caution. It could be that we have significantly under-estimated the value of CREP for grassland birds, given that we have such a short time period with which to demonstrate population level responses. We recommend that monitoring continues, such that effects over a long time period can be assessed.

We note that the monitoring protocol might not be adequate to detect population changes or effects of CREP enrollment for certain species. Notable among these are game birds, both wild turkey and ring-necked pheasant

have been found to nest in CREP fields in southern PA (Wentworth and Brittingham 2005) but these species are most vocal during late winter and early spring and less detectable during late spring when the bird surveys were carried out. Less vocal species would be easily missed by the roadside surveys, especially in fields of standing-vegetation, such as CREP, it is therefore possible that we are unable to detect significant effects of CREP enrollment on populations of these two species. Tall standing-vegetation in CREP fields may also reduce the detection of eastern cottontails by the bird surveyors, although it should be noted Fristky (2006) found no relationship between eastern cottontail abundance and CREP enrollment.

The most important finding of our study is that a guild of grassland bird species increased by an average of 15.9% per year in landscapes with high CREP enrollment (>3% of farmland within 4 years of the program's inception). This suite of grassland bird species declined by an average 7.4% per year in areas with no CREP, this continuation of the long-term downward trend in the absence of CREP explains why overall, populations of several grassland bird species continue to decline in southern Pennsylvania. Our results suggest that the effects of CREP enrollment on grassland bird populations are most obvious where a larger percentage of farmland is enrolled.

Note that annual population changes are estimated from linear trends, but some of the trends shown were clearly not linear. Some of the population changes may be largely driven by short-term effects of abiotic factors, such as cold winters, which cause increased mortality of resident species, or cool wet springs and summers which can depress nesting success. Additionally, the emergence of West Nile Virus appears to have caused large declines in some of these species during the study period. The apparent positive effects of CREP for rock pigeon, American crow, house wren and gray catbird are not expected, we suggest that these may be spurious, possibly relating to the effects of West Nile Virus emergence. The apparent negative effect of CREP on brown-headed cowbird numbers is somewhat surprising, but it is interesting to note that this species was most strongly associated with forests in our study, not grasslands.

The species for which the CREP bird monitoring data suggest an effect of West Nile Virus are similar to those for which effects were detected as national and regional scale (LaDeau et al. 2007), with the notable exception of house wren and American robin, which were not obviously affected by West Nile Virus in southern Pennsylvania. However, it could be that effects of West Nile Virus on populations of some species were masked by other factors, for example, strong increases in populations that did not have high West Nile Virus prevalence.

We suggest that the apparent CREP effects for American crow, house wren and gray catbird may in fact all be due to the confounded West Nile Virus effect. The positive CREP effects for grassland species such as grasshopper sparrow, eastern meadowlark, eastern kingbird and song sparrow would not be attributable to West Nile Virus, because the population trends for those species show no indication of a West Nile Virus effect.

The combined effects of the complications associated with the emergence of West Nile Virus and the sparseness of data for some species (not helped by the omission of data from several survey routes in 2004 and 2005) may have reduced our power to detect significant effects of CREP enrollment on bird populations. Given this, and the relatively short time since the

introduction of the program, we believe this study to be a conservative estimate of the positive effects of CREP enrollment on bird populations.

We conclude that there is sufficient evidence to show that some grassland bird populations have already benefited from the creation of grassland fields through the CREP in southern Pennsylvania. Although there is, as yet, no evidence of a reversal of long-term declines, localized stabilization and increases of populations of some species against a backdrop of continuing declines elsewhere provides evidence of benefits of CREP for grassland bird species. However, longer term monitoring will be needed to see whether these responses elicit a reversal of the long-term decrease in population levels of these species at a larger scale.

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Appendix 1. Results by species

A1.1 Canada Goose *Branta canadensis*

Population trend **uncertain**
Effect of CREP enrollment on population trend is **not significant**

mean annual change +3.9% (se = 5.8)
Wald-test for CREP effect = 5.85, p = 0.1191

Fig. A1.1.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

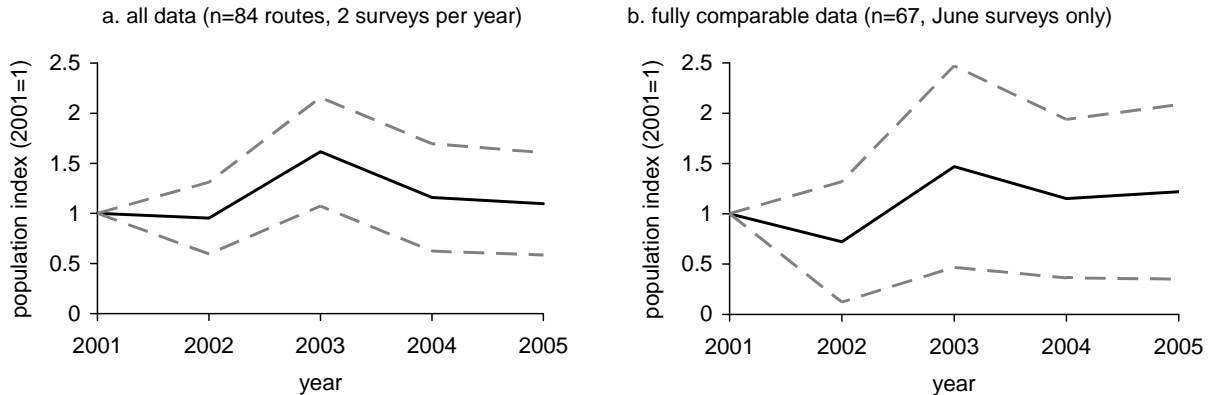


Fig. A1.1.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

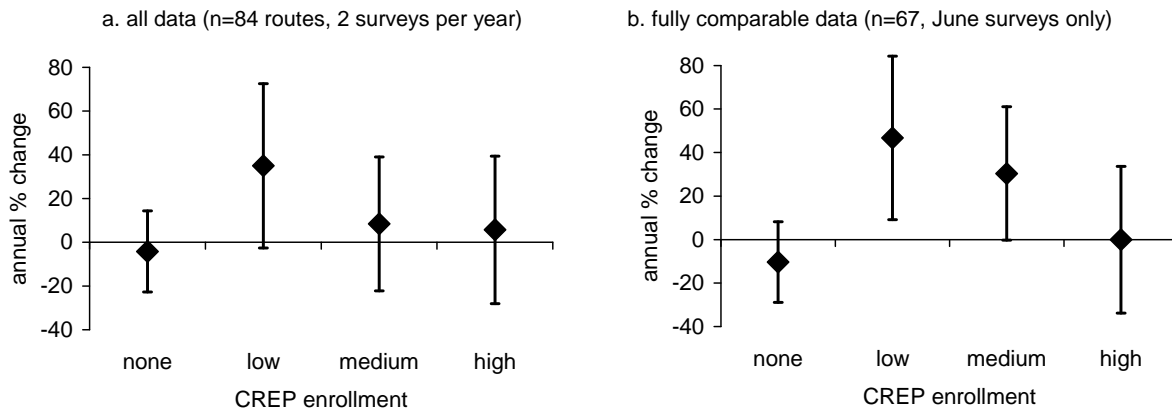
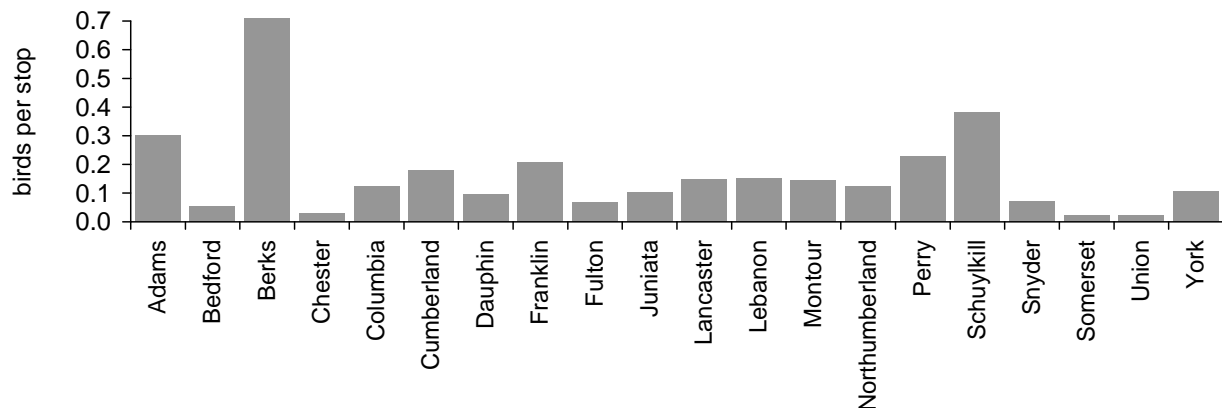


Fig. A1.1.3 Mean count per stop by county for all years



A1.2 Mallard *Anas platyrhynchos*

Population trend **uncertain**
Effect of CREP enrollment on population trend is not **significant**

mean annual change +0.7% (se = 5.5)
Wald-test for CREP effect = 7.79, p = 0.0507

Fig. A1.2.1. Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

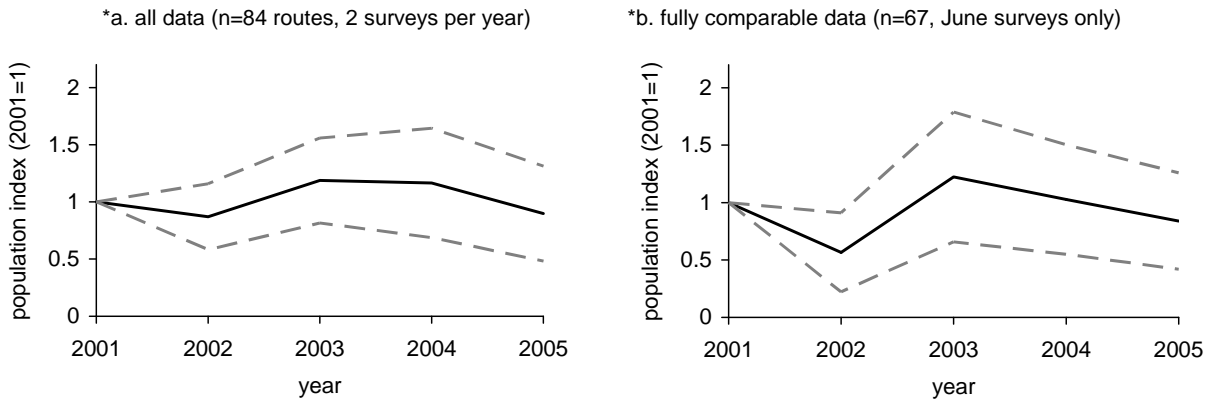


Fig. A1.2.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

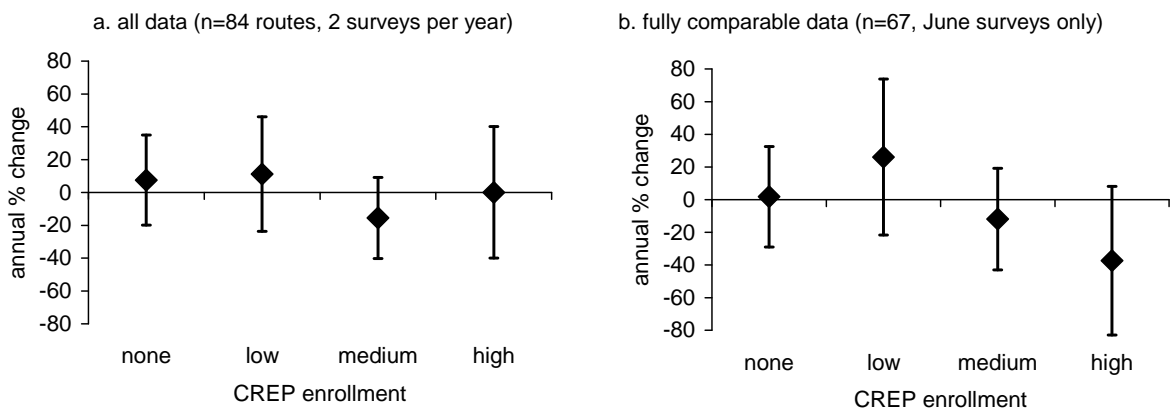
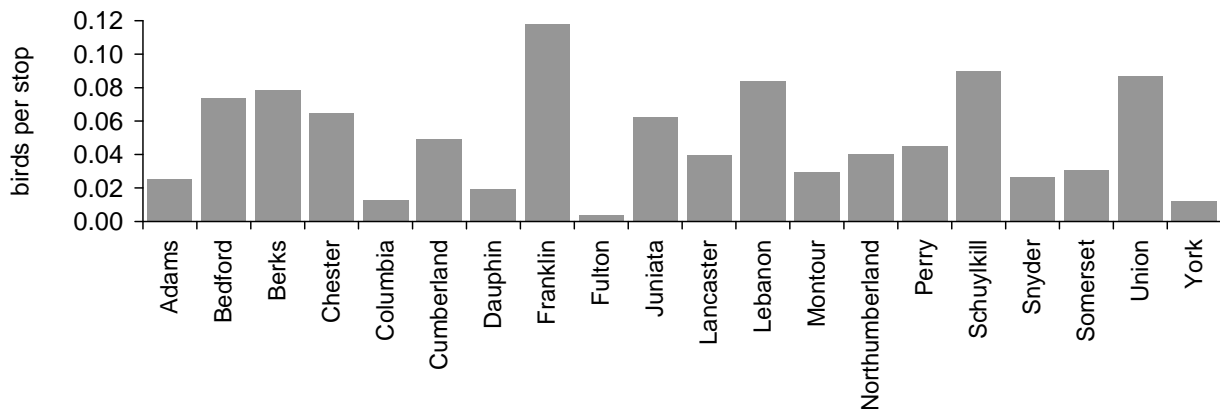


Fig. A1.2.3 Mean count per stop by county for all years



A1.3 Ring-necked Pheasant *Phasianus colchicus*

Moderate decline ($p < 0.05$)
Effect of CREP enrollment on population trend is **not significant**

mean annual change -11.0% (se = 4.3)
Wald-test for CREP effect = 0.93, $p = 0.8171$

Fig. A1.3.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

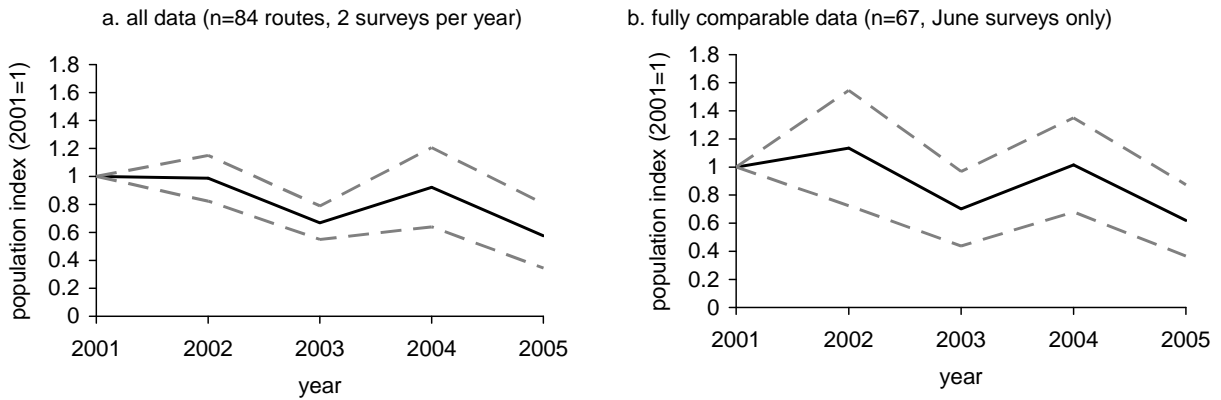


Fig. A1.3.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

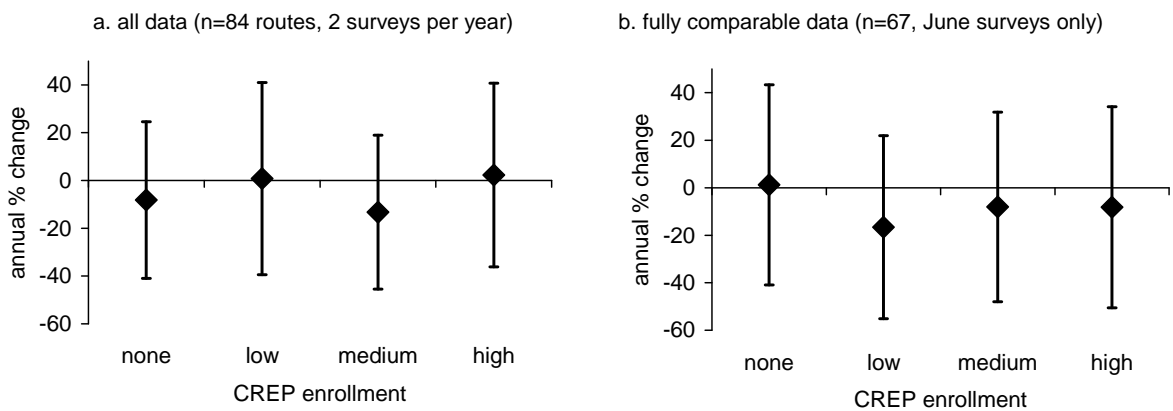
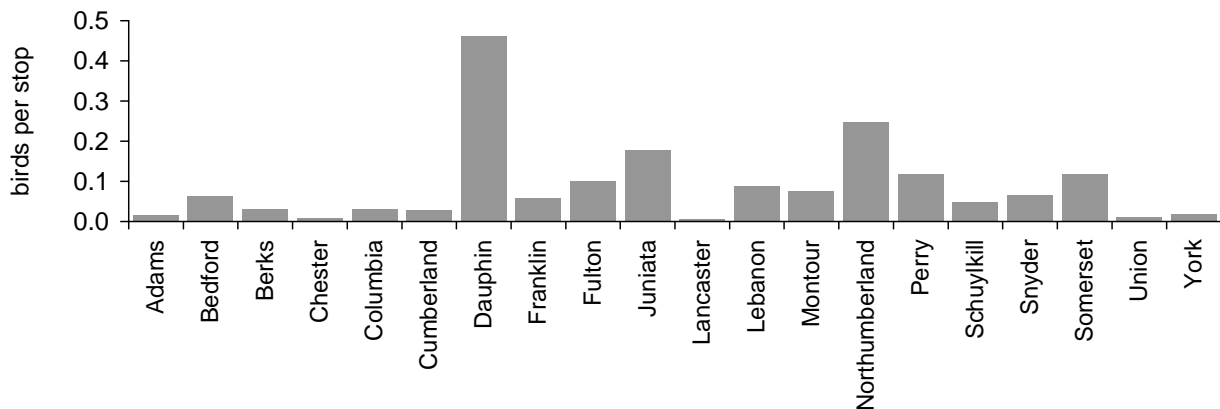


Fig A1.3.3 Mean count per stop by county for all years



A1.4 Turkey Vulture *Cathartes aura*

Moderate increase ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +10.8% (se = 3.4)

Wald-test for CREP effect = 7.62, $p = 0.0545$

Fig. A1.4.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

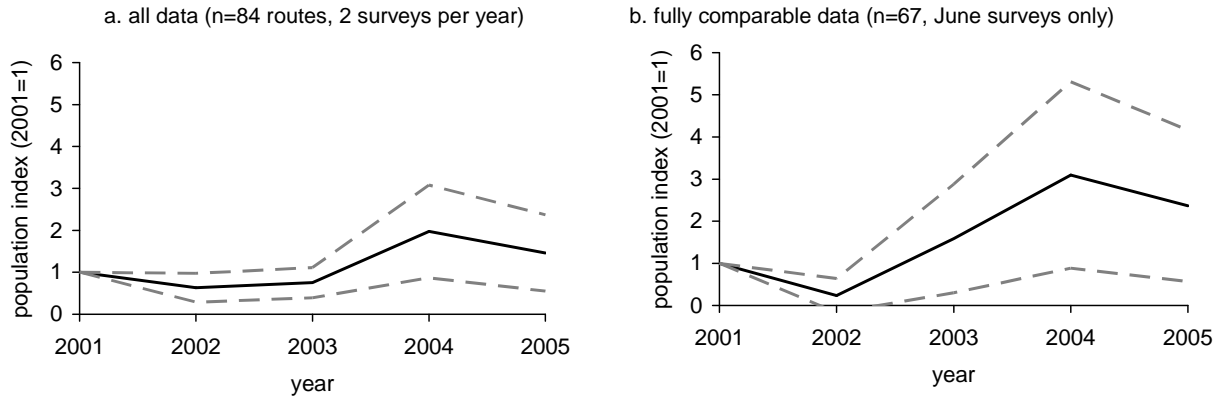


Fig. A1.4.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

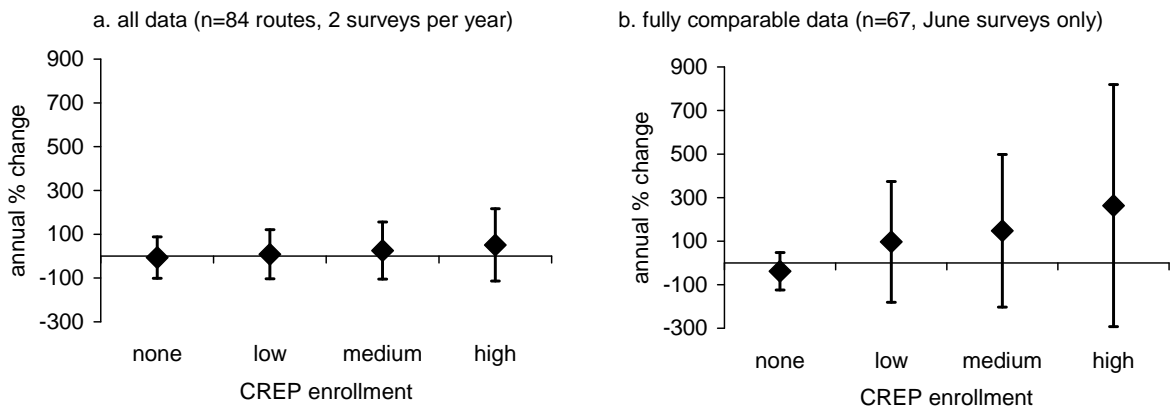
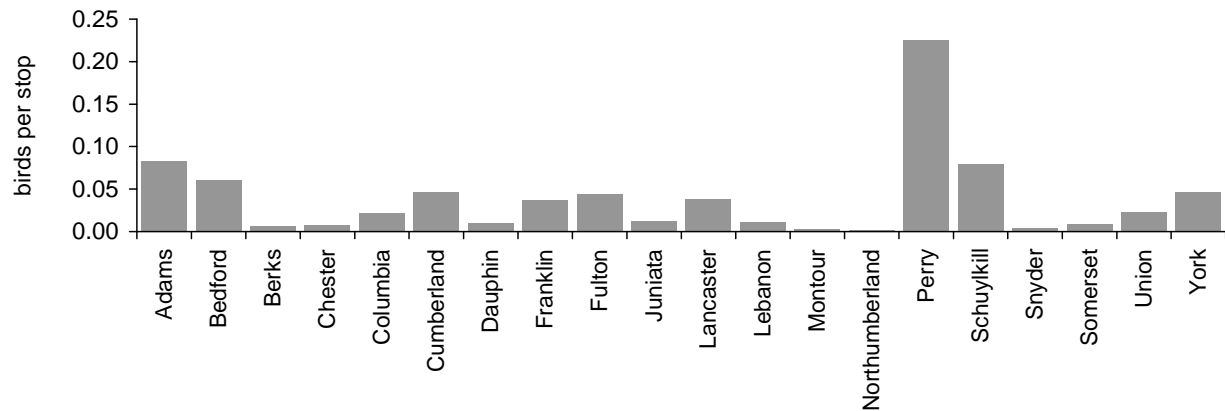


Fig. A1.4.3 Mean count per stop by county for all years



A1.5 Red-tailed Hawk *Buteo jamaicensis*

Moderate increase ($p < 0.05$)
Effect of CREP enrollment on population trend is **not significant**

mean annual change +14.4% (se = 5.9)
Wald-test for CREP effect = 5.50, $p = 0.1389$

Fig. A1.5.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

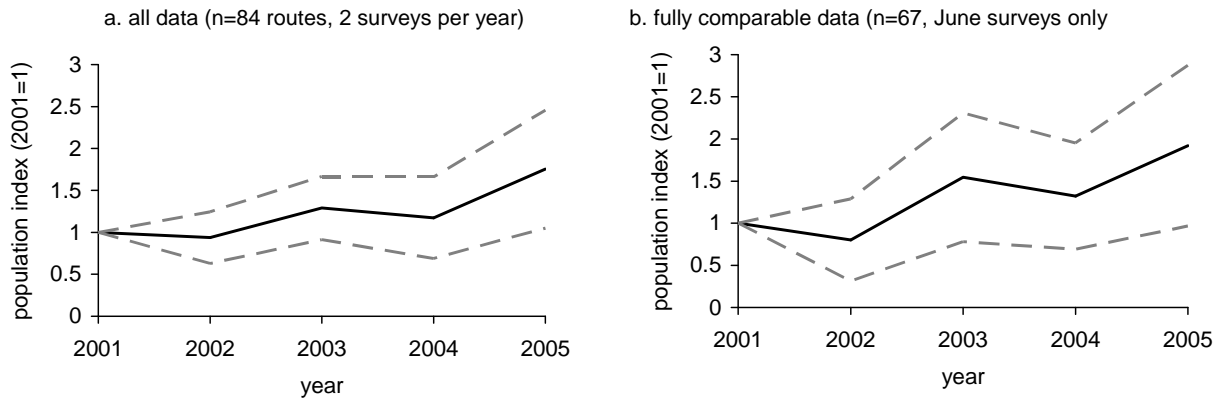


Fig. A1.5.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

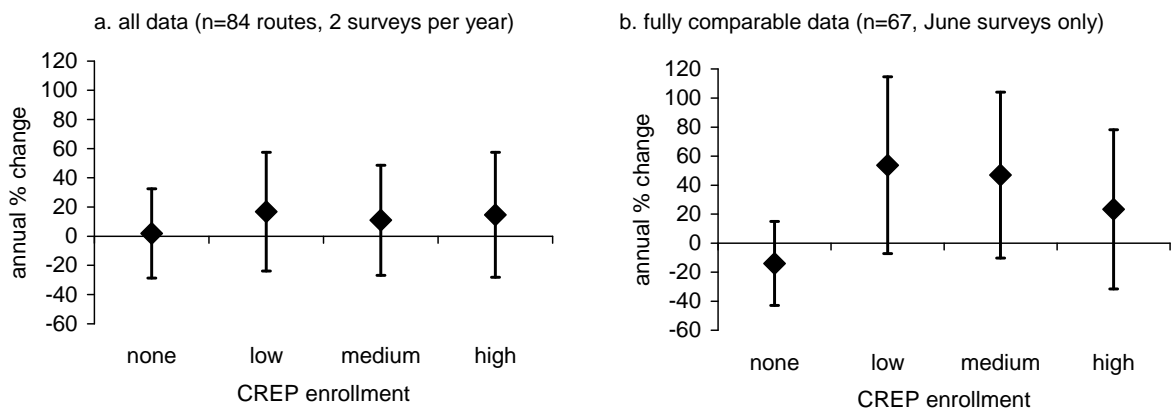
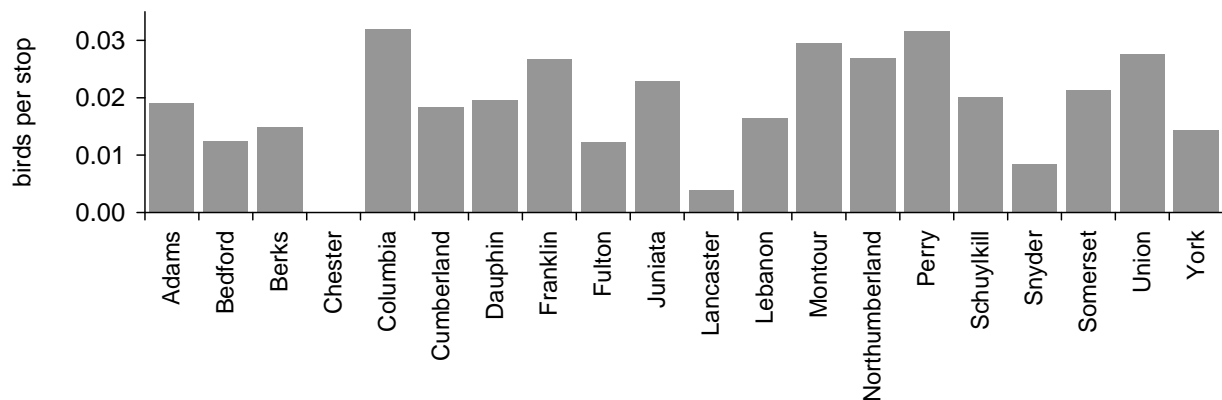


Fig. A1.5.3 Mean count per stop by county for all years



A1.6 American Kestrel *Falco sparverius*

Steep decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -14.8% (se = 4.7)

Wald-test for CREP effect = 7.82, $p = 0.0499$

Fig. A1.6.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

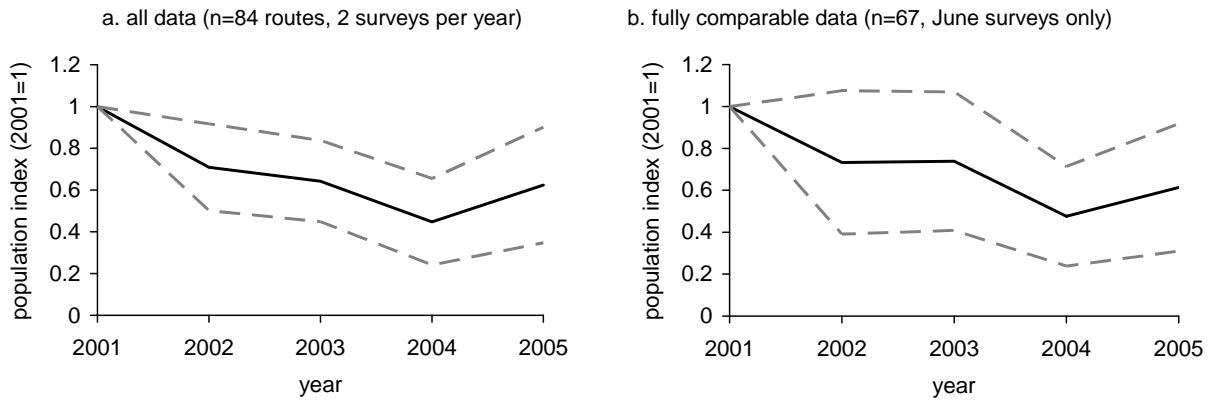


Fig. A.1.6.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

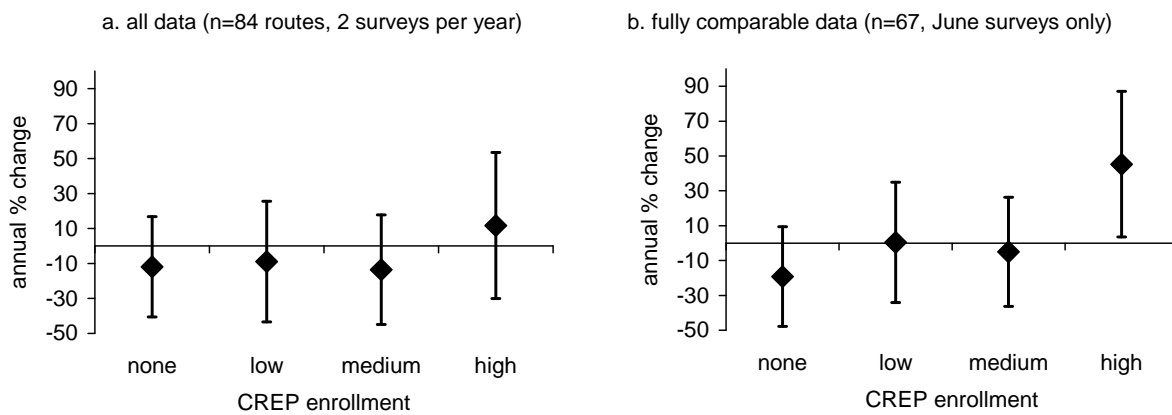
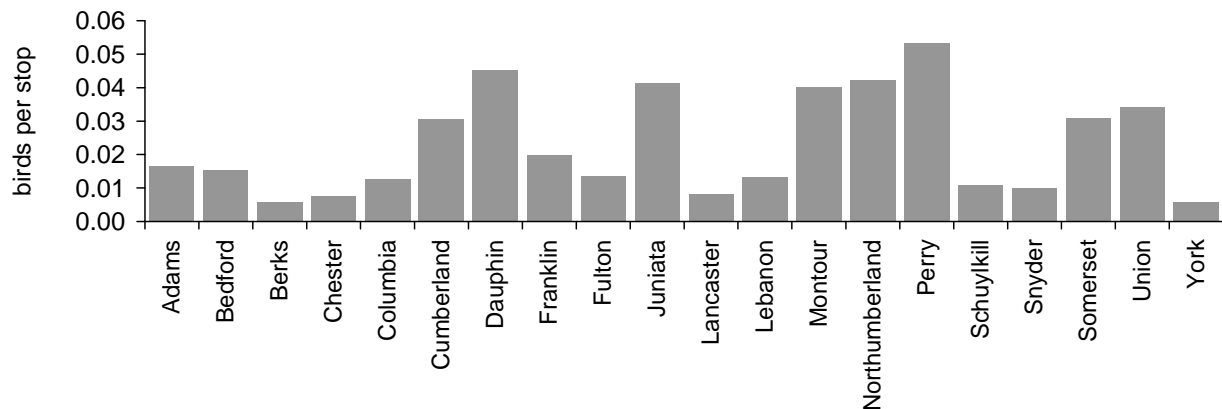


Fig. A1.6.3 Mean count per stop by county for all years



A1.7 Killdeer *Charadrius vociferus*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **significant but undetermined**

mean annual change -5.5% (se = 2.6)

Wald-test for CREP effect = 7.21, $p = 0.0654$

Fig. A1.7.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

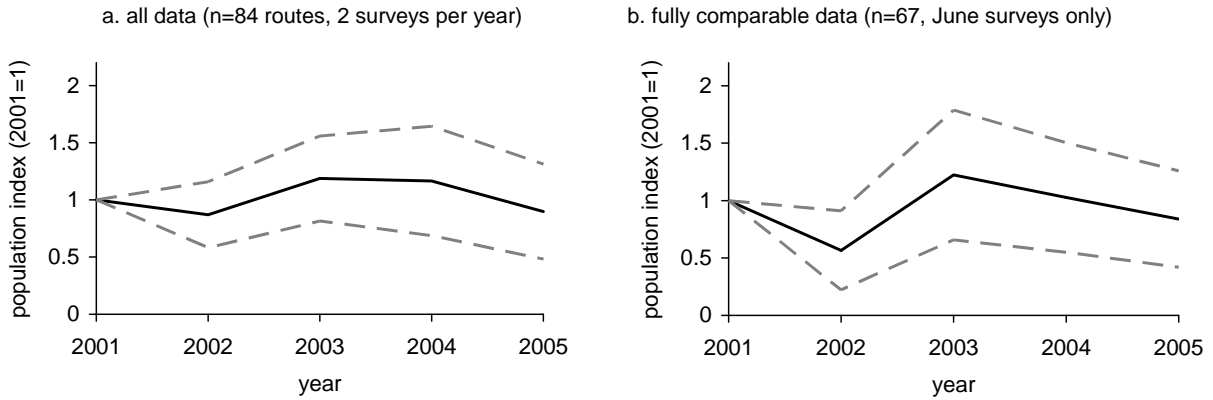


Fig. A1.7.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

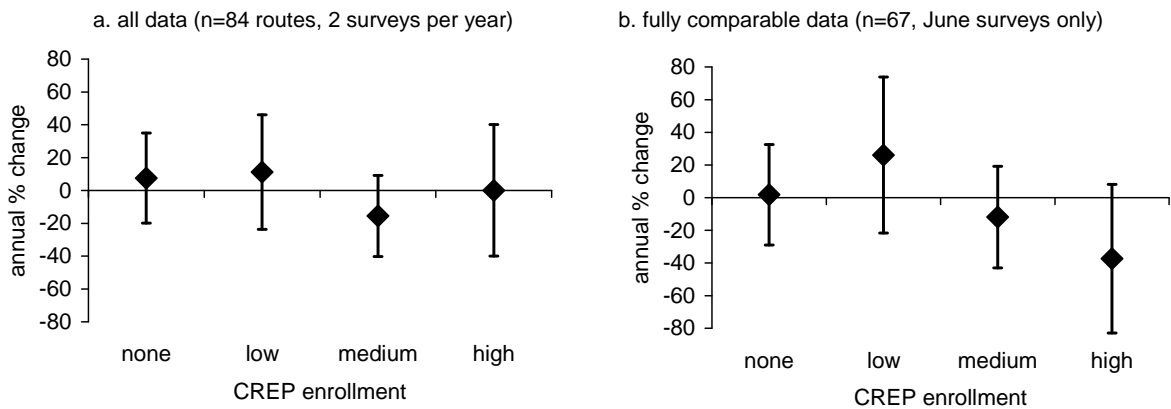
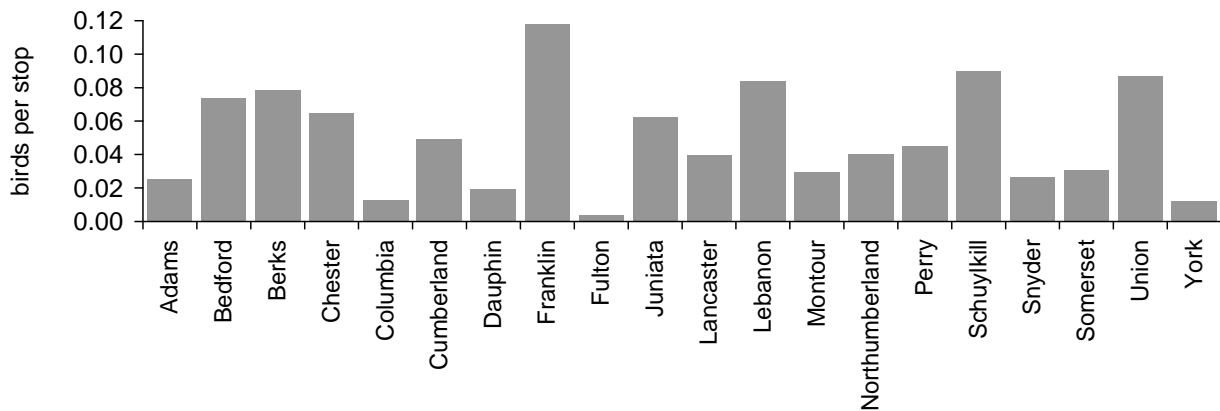


Fig. A1.7.3 Mean count per stop by county for all years



A1.8 Rock Pigeon *Columba livia*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -5.1% (se = 2.6)

Wald-test for CREP effect = 7.83, p = 0.0497

Fig. A1.8.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

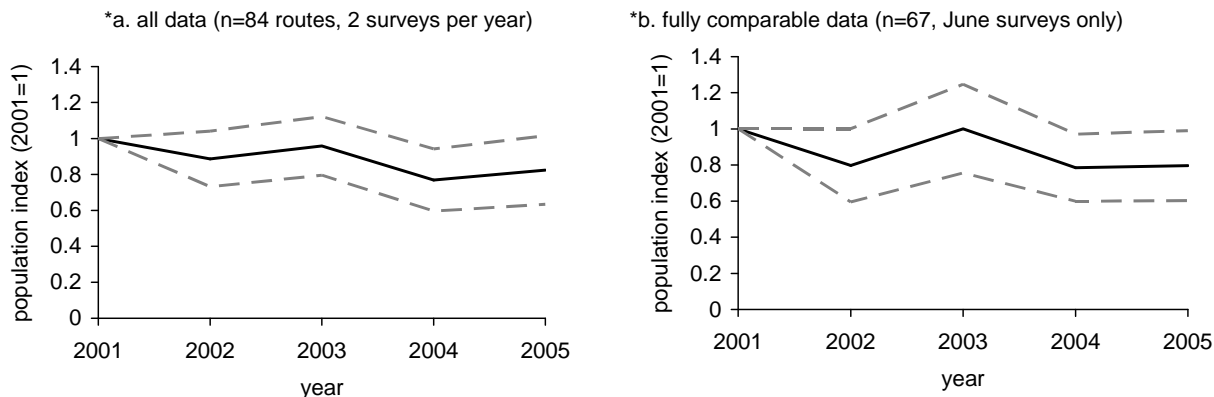


Fig. A1.8.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

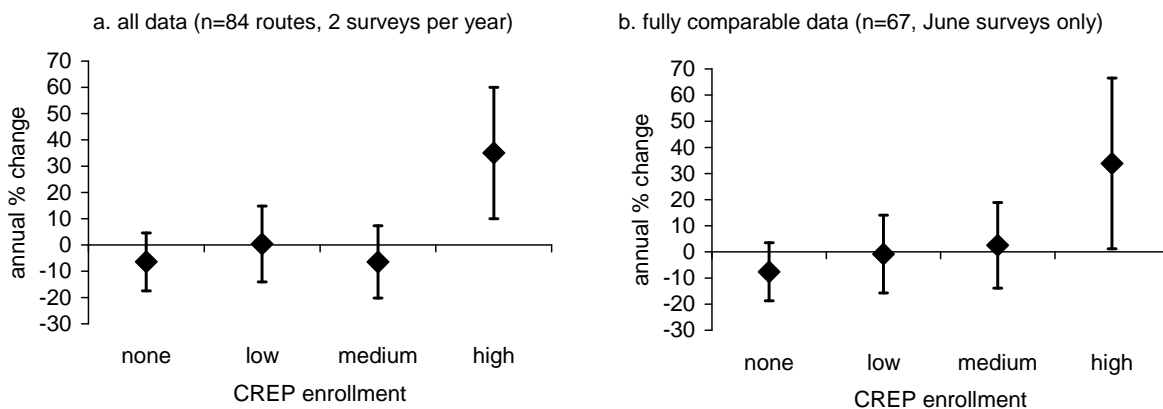
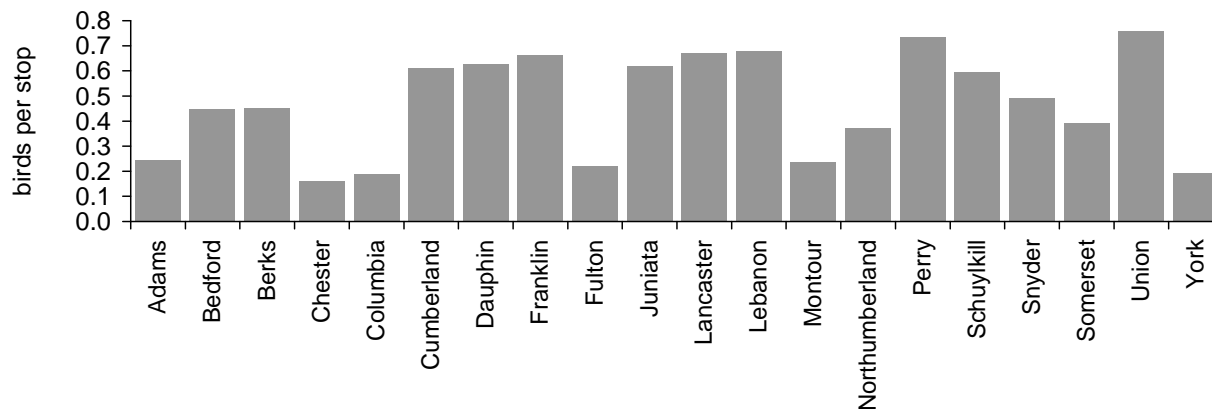


Fig. A1.8.3 Mean count per stop by county for all years



A1.9 Mourning Dove *Zenaida macroura*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +7.1% (se = 1.3)

Wald-test for CREP effect = 3.39, p = 0.3354

Fig. A1.9.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

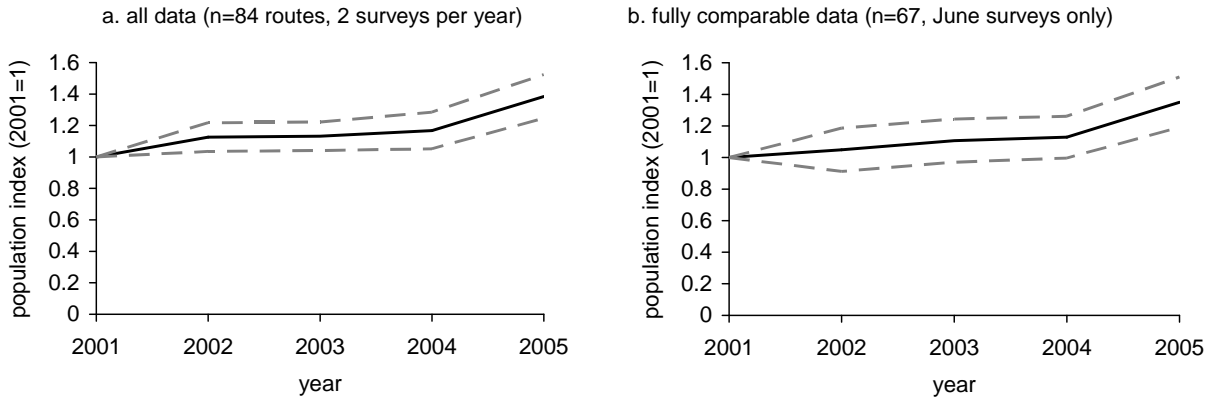


Fig. A1.9.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

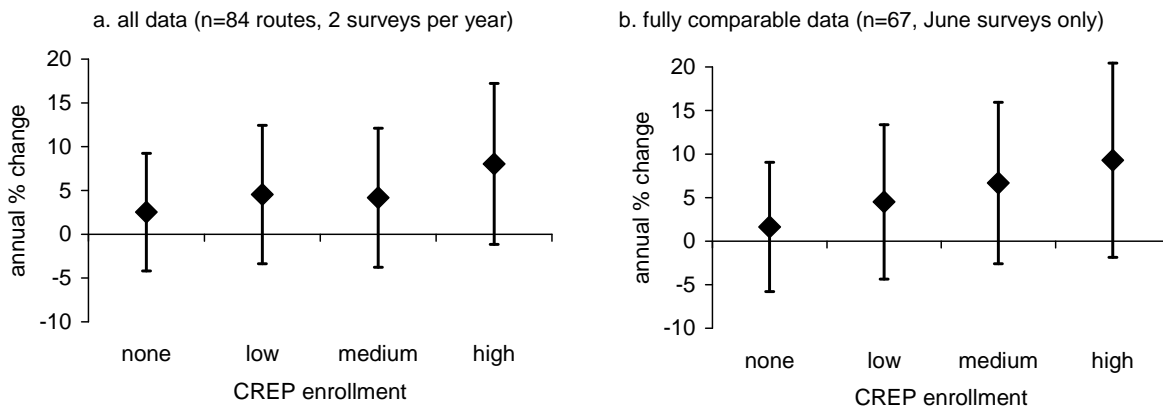
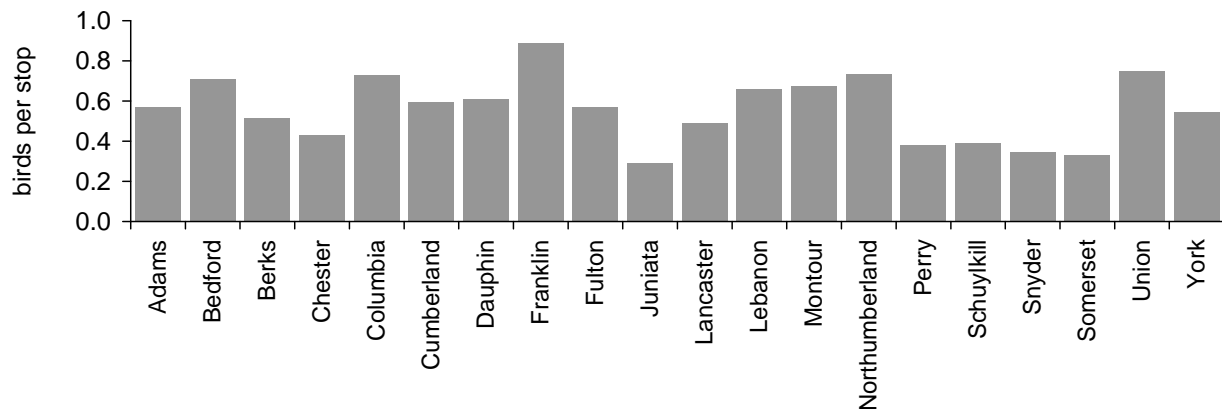


Fig. A1.9.3 Mean count per stop by county for all years



A.1.10 Yellow-billed Cuckoo *Coccyzus americanus*

Moderate increase ($p < 0.05$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +14.3% (se = 6.4)

Wald-test for CREP effect = 4.94, $p = 0.1764$

Fig. A1.10.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

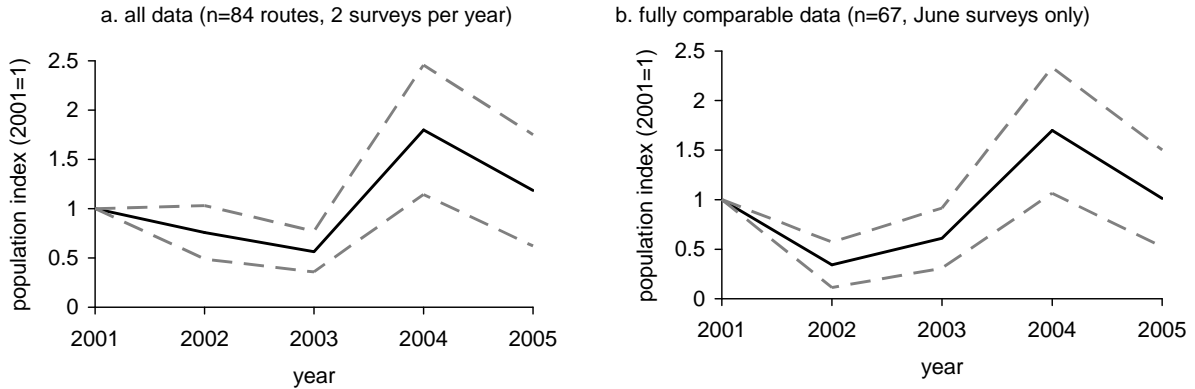


Fig. A1.10.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

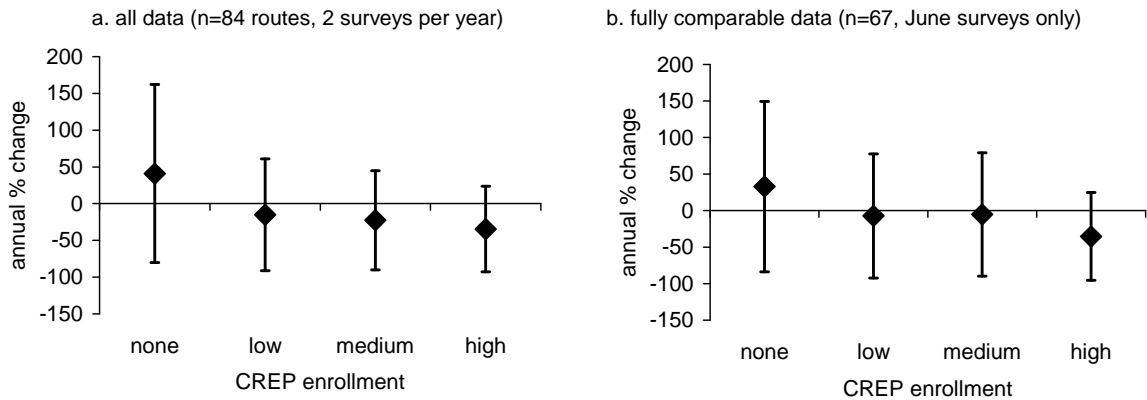
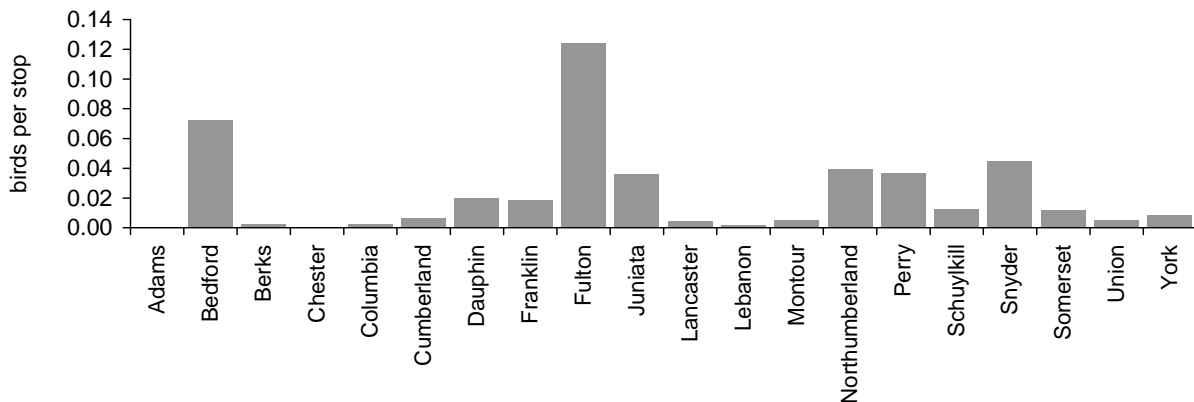


Fig. A1.10.3 Mean count per stop by county for all years



A1.11 Chimney Swift *Chaetura pelagica*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +3.3% (se = 3.8)

Wald-test for CREP effect = 1.18, p = 0.7588

Fig. A1.11.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

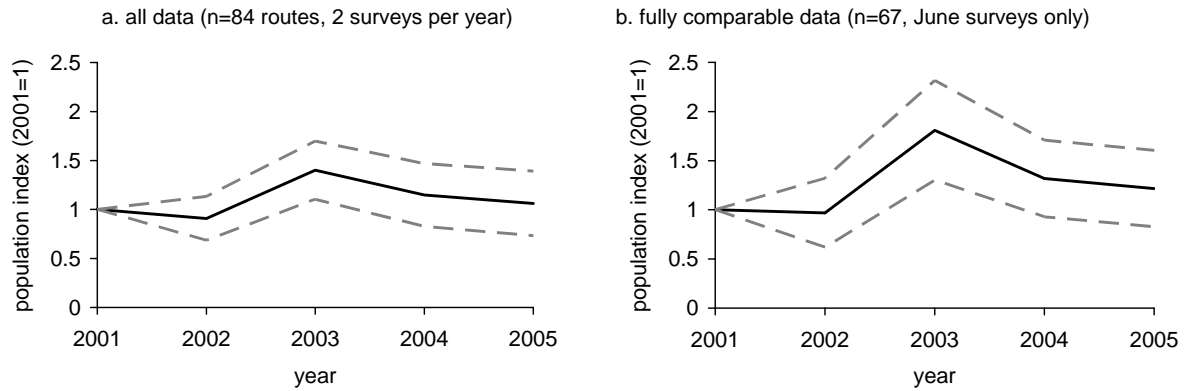


Fig. A1.11.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

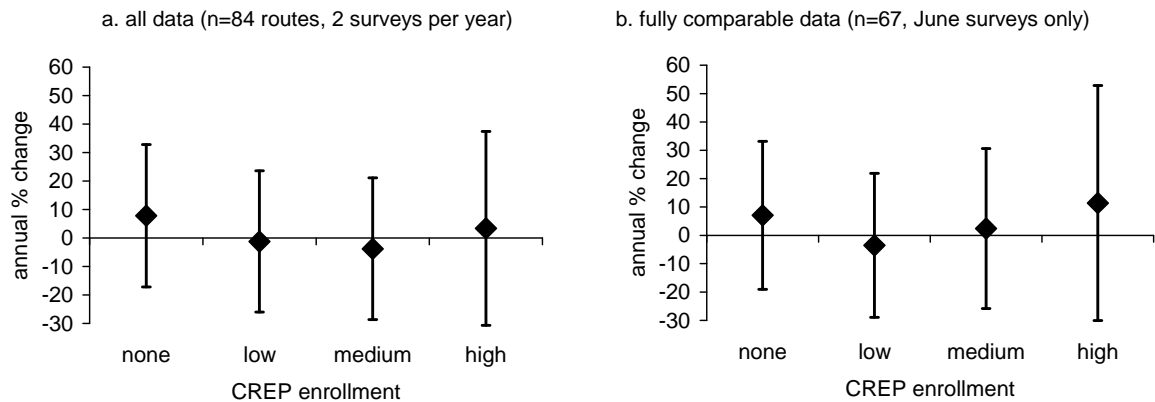
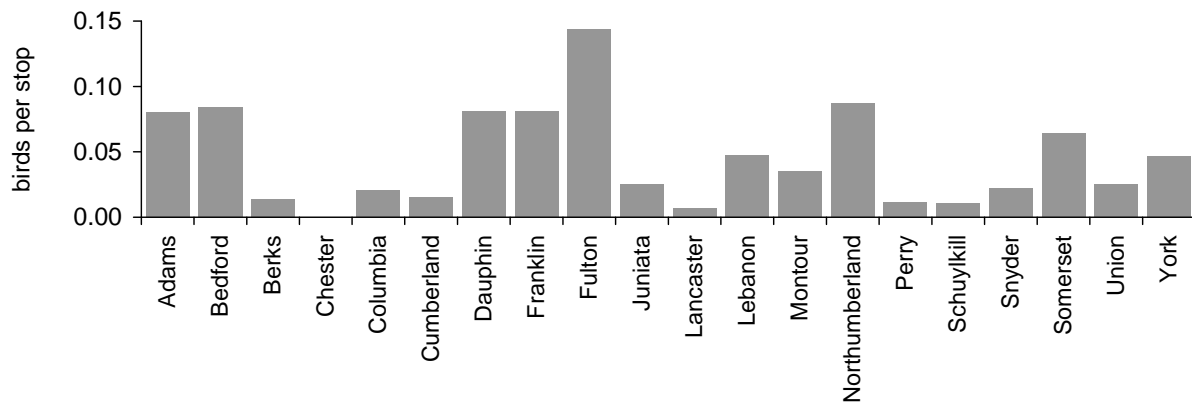


Fig. A1.11.3 Mean count per stop by county for all years



A1.12 Red-bellied Woodpecker *Melanerpes carolinus*

Moderate increase ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +6.2% (se = 2.2)

Wald-test for CREP effect = 6.62, $p = 0.0852$

Fig A1.12.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

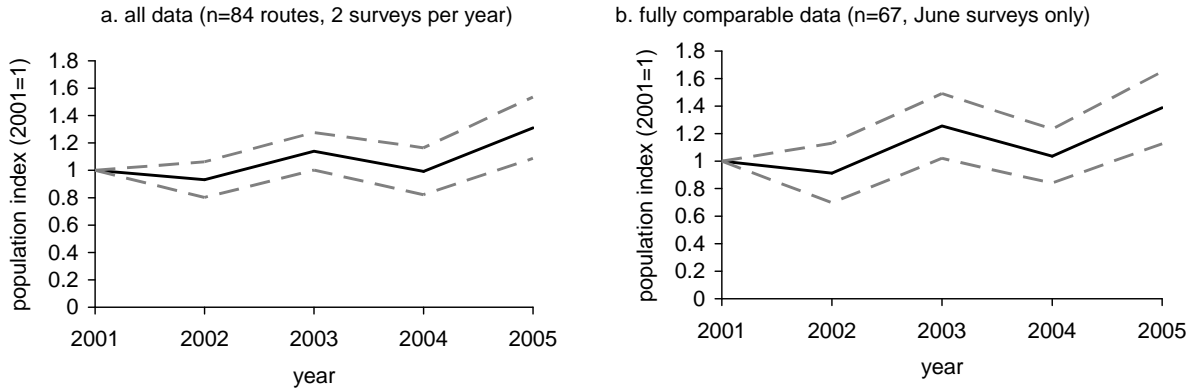


Fig. A1.12.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

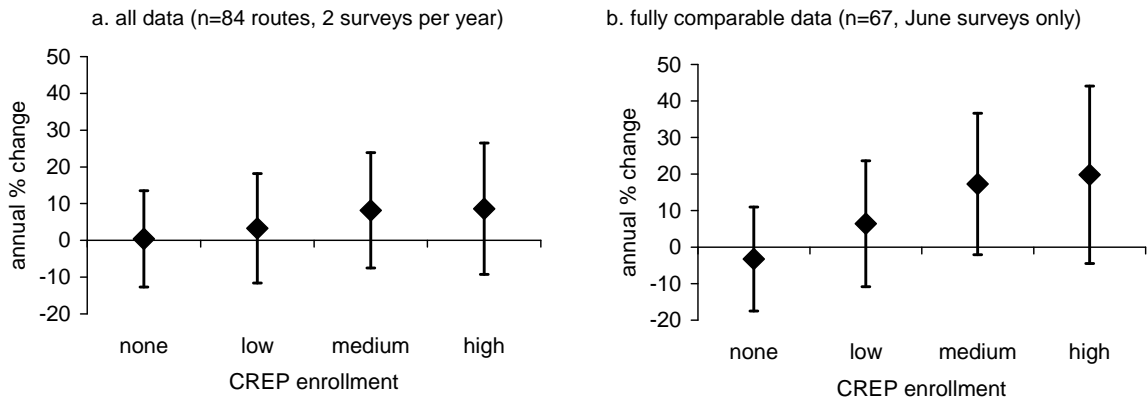
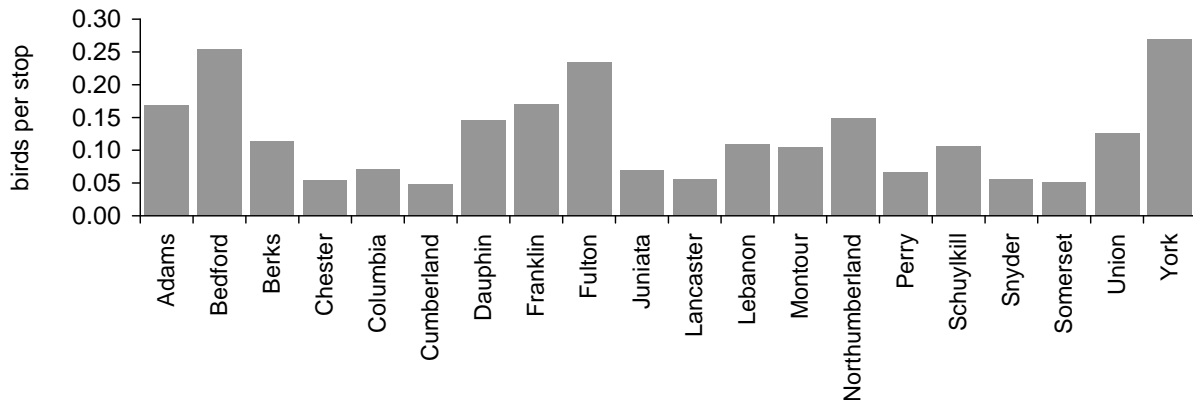


Fig. A1.12.3 Mean count per stop by county for all years



A1.13 Downy Woodpecker *Picoides pubescens*

Population trend **stable**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +2.6% (se = 3.8)

Wald-test for CREP effect = 6.71, p = 0.0819

Fig. A1.13.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

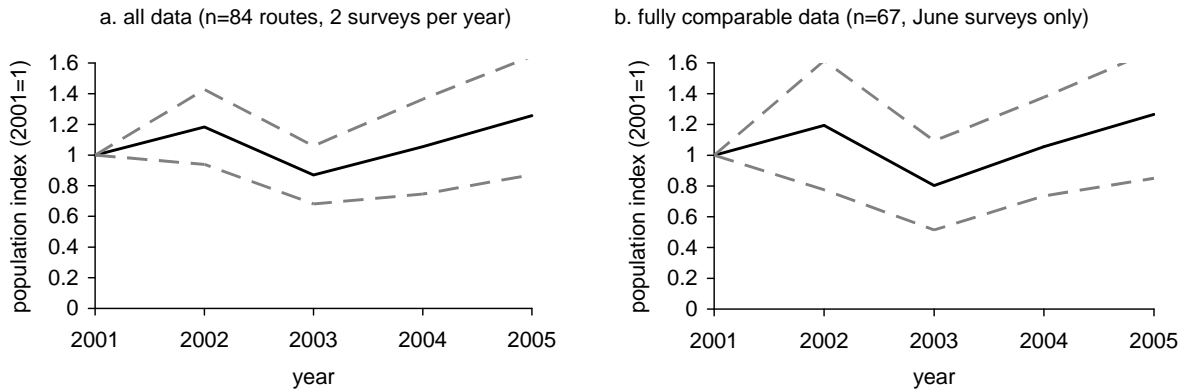


Fig. A1.13.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

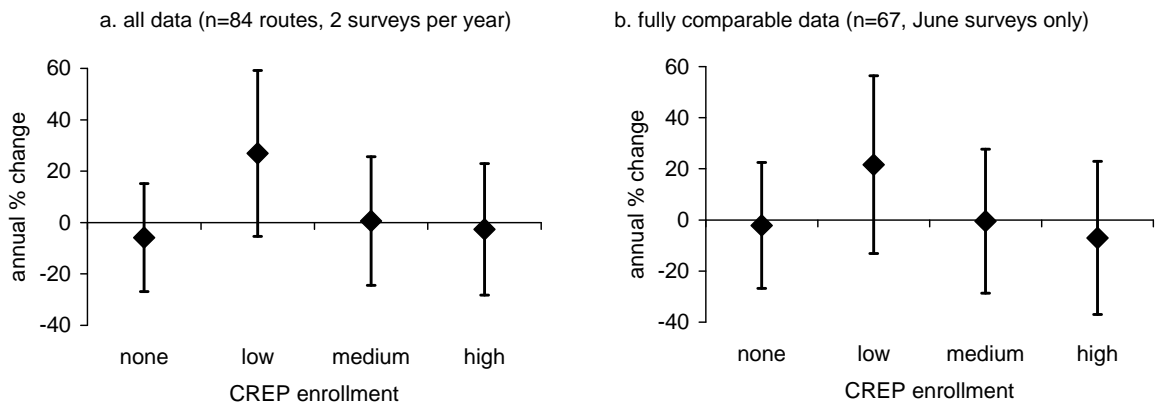
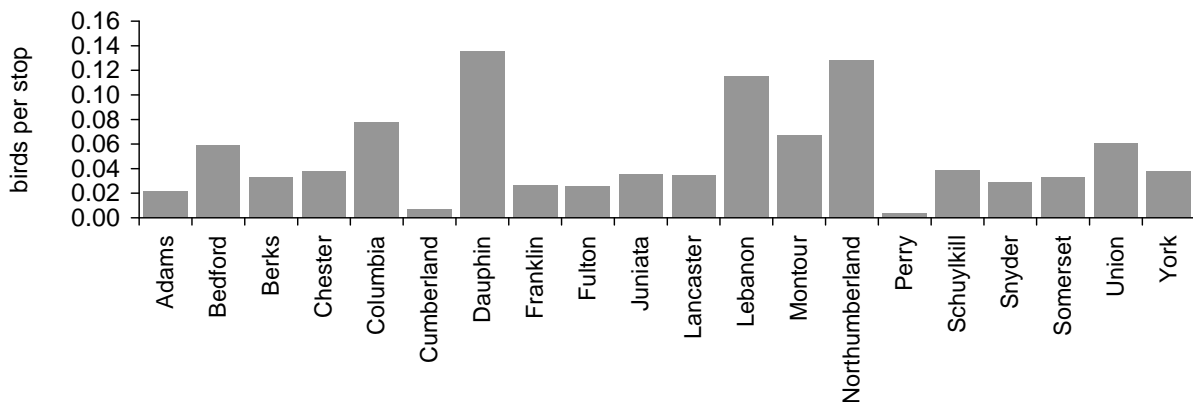


Fig. A1.13.3 Mean count per stop by county for all years



A1.14 Northern Flicker *Colaptes auratus*

Moderate increase ($p < 0.05$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +14.3% (se = 6.4)

Wald-test for CREP effect = 4.94, $p = 0.1764$

Fig. A1.14.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

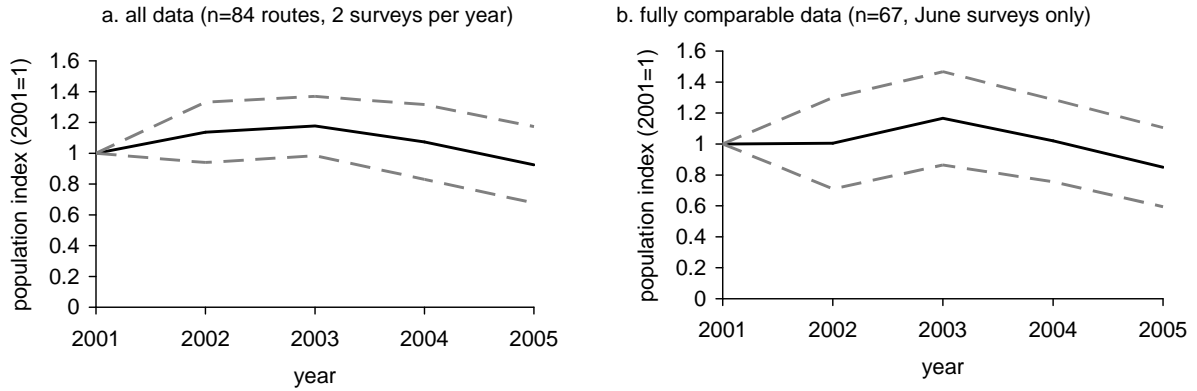


Fig. A1.14.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

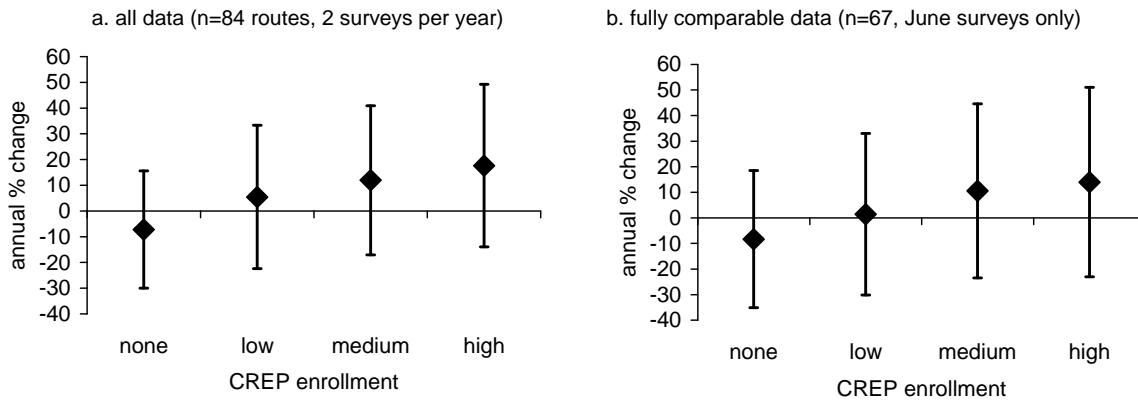
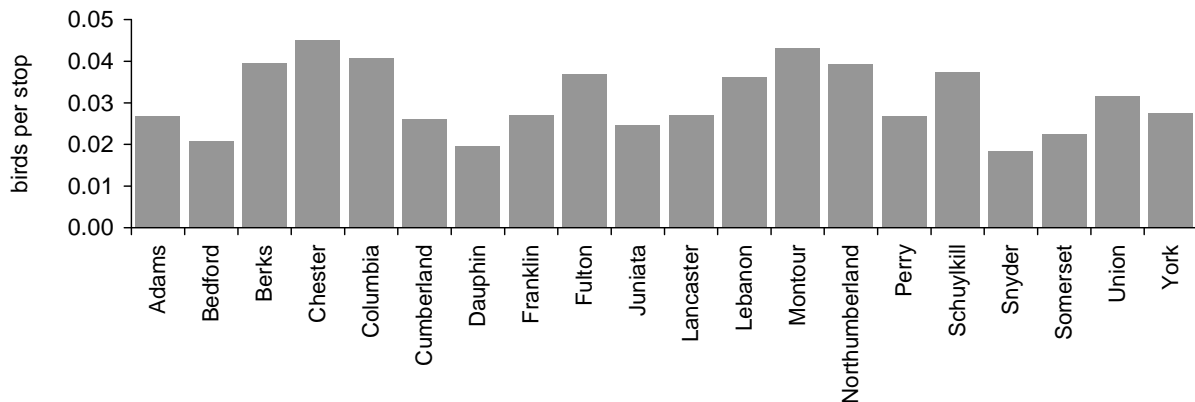


Fig. A1.14.3 Mean count per stop by county for all years



A1.15 Eastern Wood-Pewee *Contopus virens*

Population trend **uncertain**
Effect of CREP enrollment on population trend is not **significant**

mean annual change -5.3% (se = 3.0)
Wald-test for CREP effect = 7.65, p = 0.0537

Fig. A1.15.1

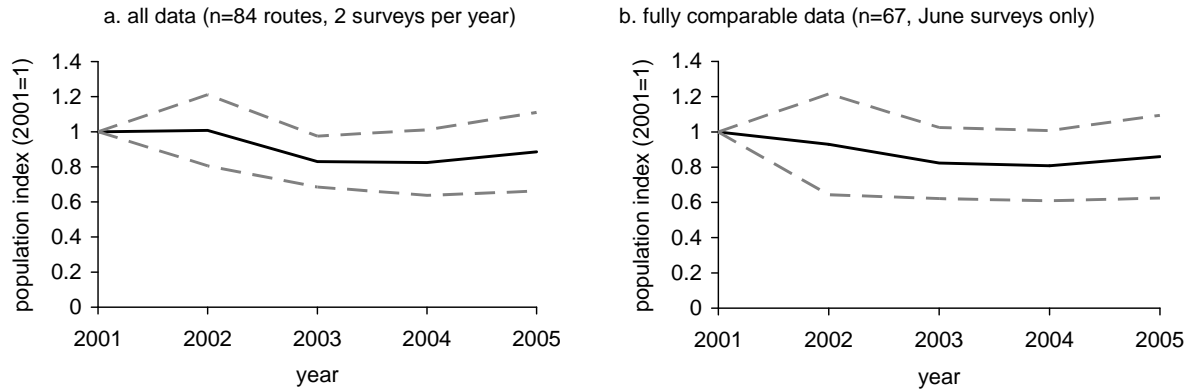


Fig. A1.15.2 Annual population change (95% confidence limits) by CREP enrollment rate
(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

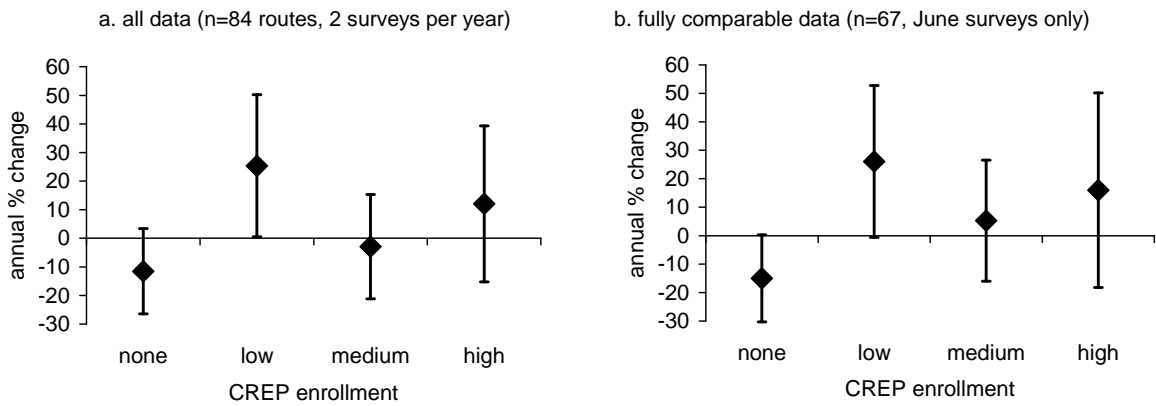
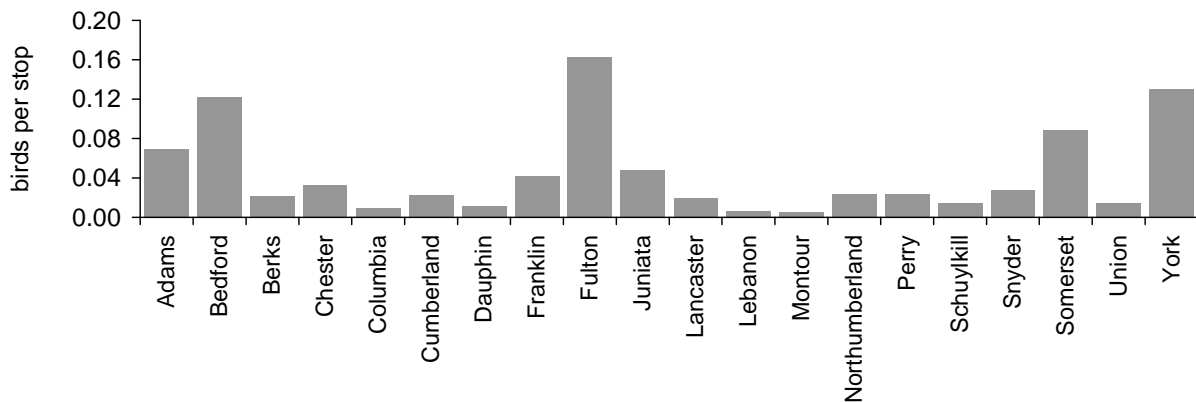


Fig. A1.15.3 Mean count per stop by county for all years



A1.16 Willow Flycatcher *idonax traillii*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +2.7% (se = 4.0)

Wald-test for CREP effect = 2.4, p = 0.4932

Fig. A1.16.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

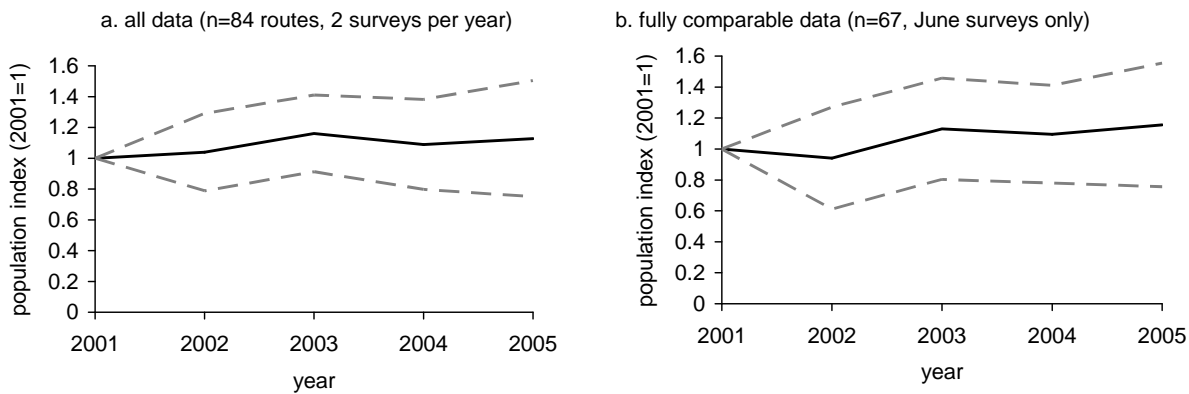


Fig. A1.16.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

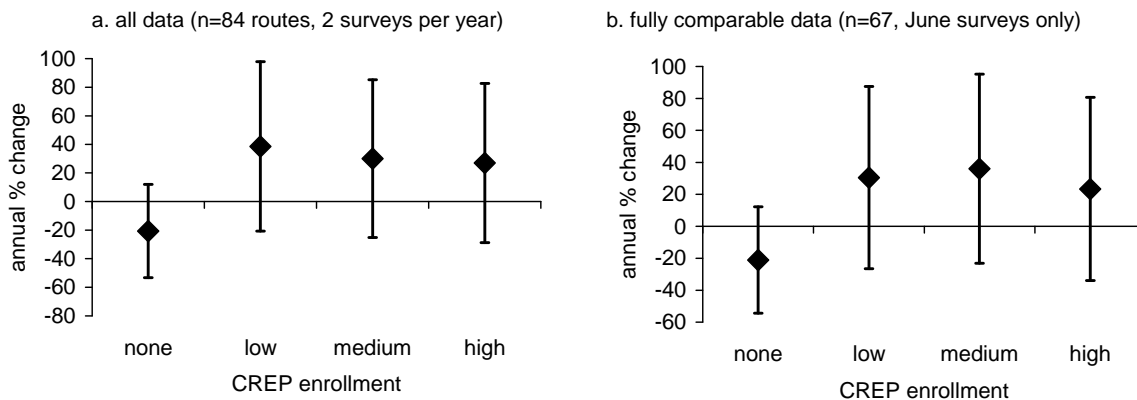
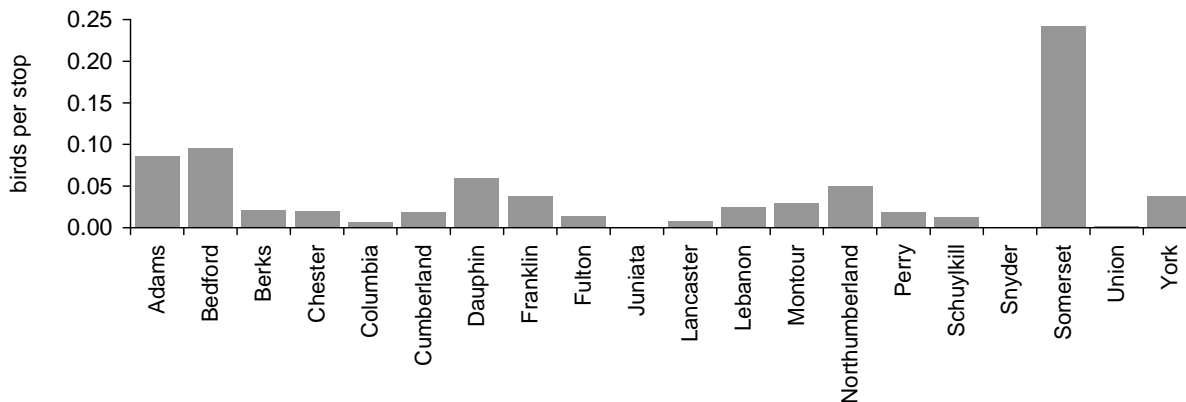


Fig. A1.16.3 Mean count per stop by county for all years



A1.17 Eastern Phoebe *Sayornis phoebe*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change -8.3% (se = 3.2)

Wald-test for CREP effect = 6.7, $p = 0.0781$

Fig. A1.17.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

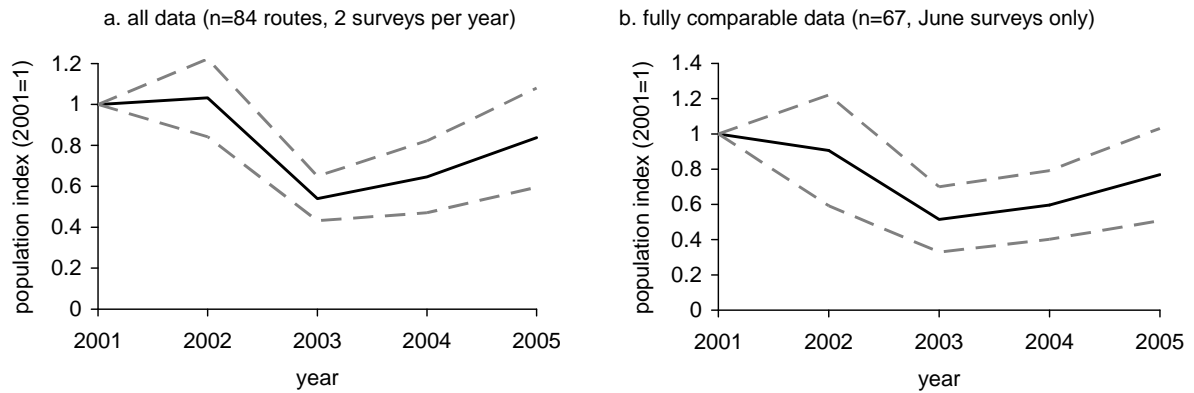


Fig. A1.17.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

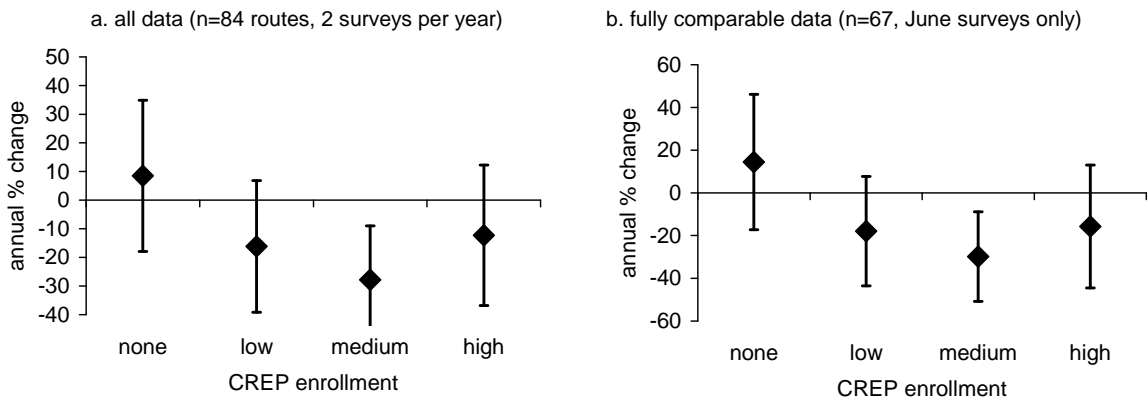
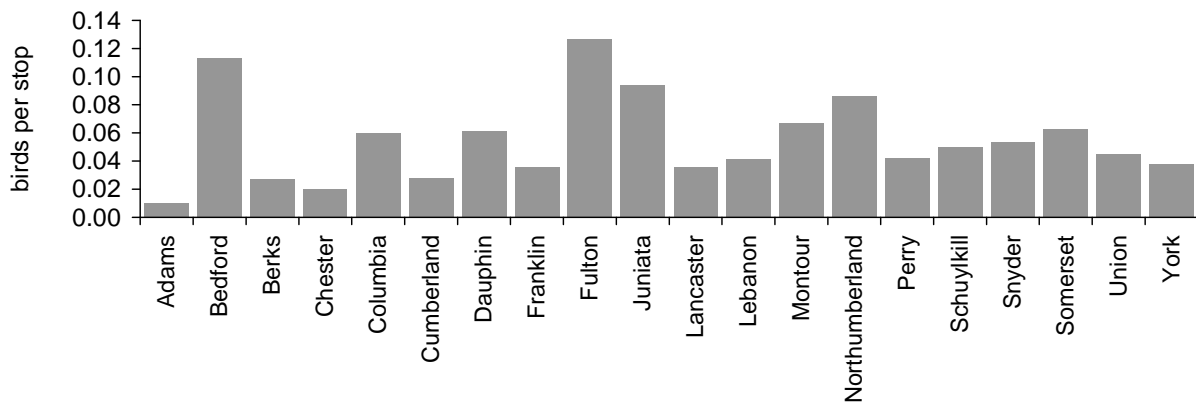


Fig. A1.17.3 Mean count per stop by county for all years



A1.18 Great Crested Flycatcher *Myiarchus crinitus*

Population trend **uncertain**

Effect of CREP enrollment on population trend is not **significant**

mean annual change -5.3% (se = 3.3)

Wald-test for CREP effect = 3.2, $p = 0.3623$

Fig. A1.18.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

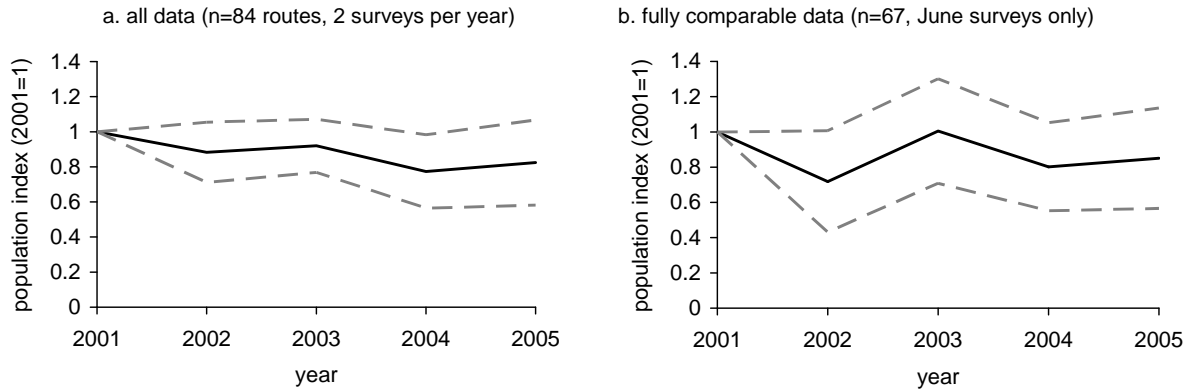


Fig. A1.18.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

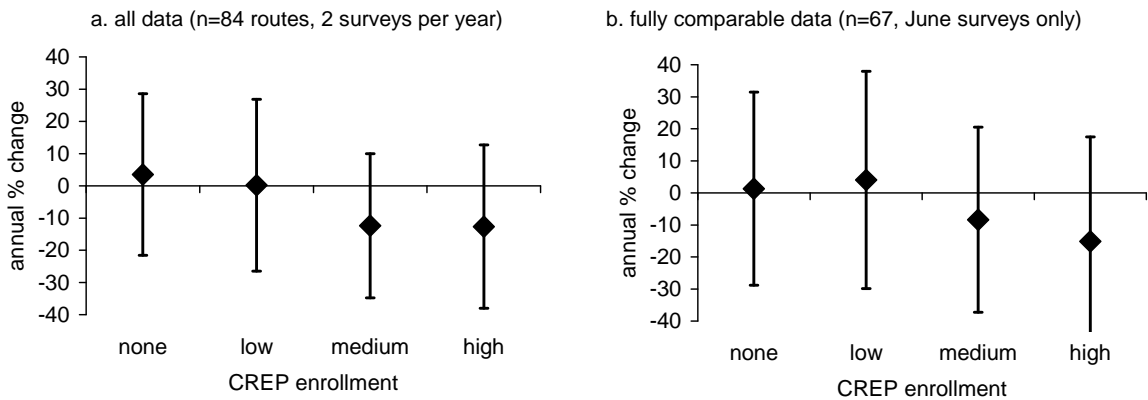
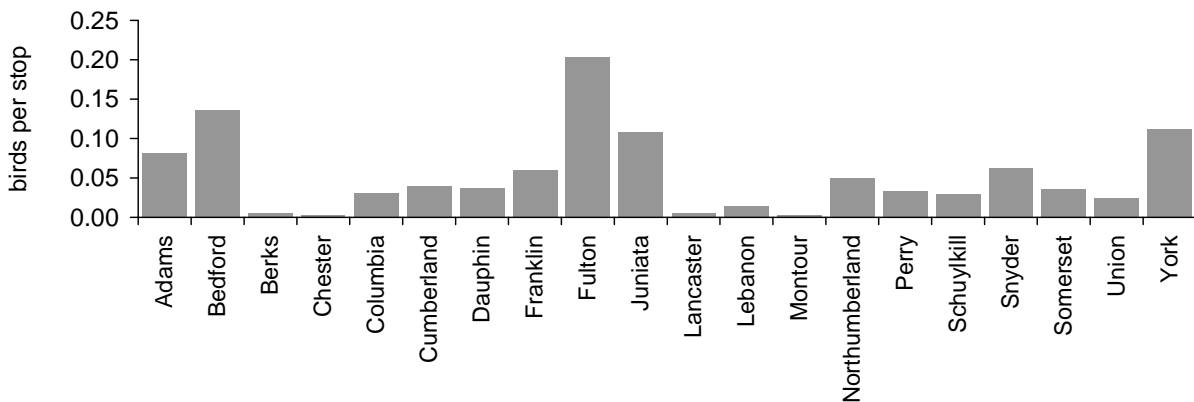


Fig. A1.18.3 Mean count per stop by county for all years



A1.19 Eastern Kingbird *Tyrannus tyrannus*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -1.1% (se = 3.2)

Wald-test for CREP effect = 10.94, p = 0.0121

Fig. A1.19.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

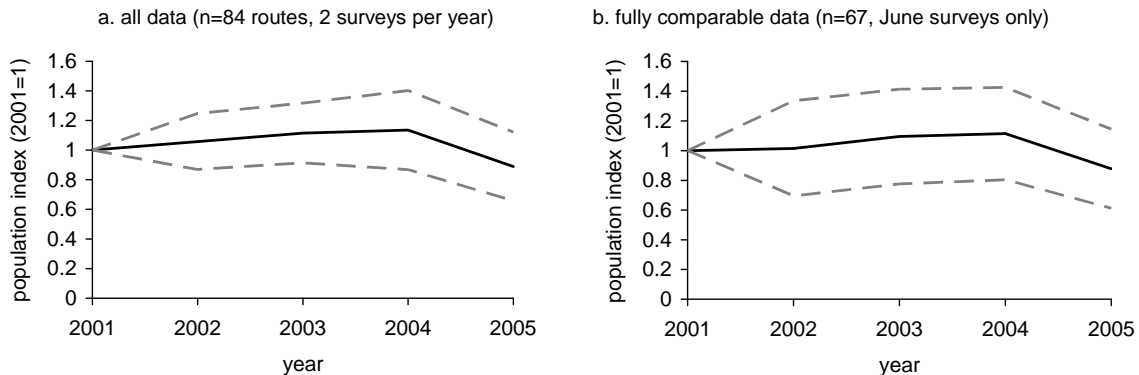


Fig. A1.19.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

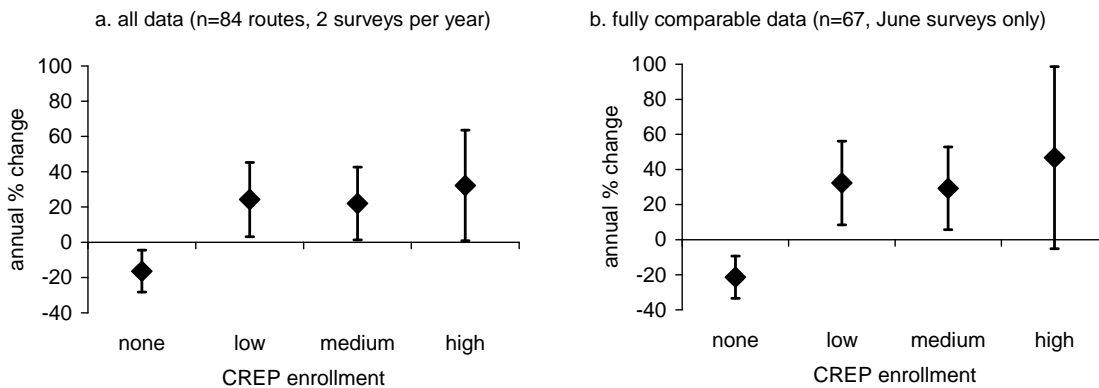
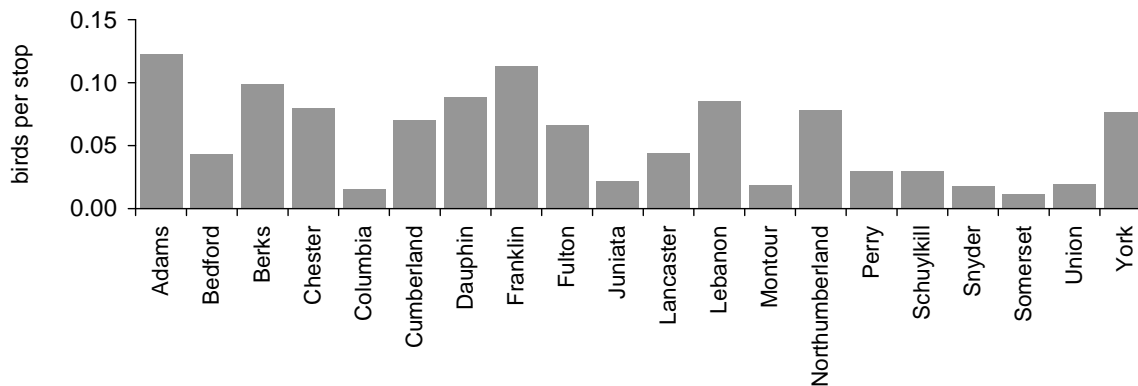


Fig. A1.19.3 Mean count per stop by county for all years



A1.20 Red-eyed Vireo *Vireo olivaceus*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +4.0% (se = 2.8)

Wald-test for CREP effect = 5.63, p = 0.1311

Fig. A1.20.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

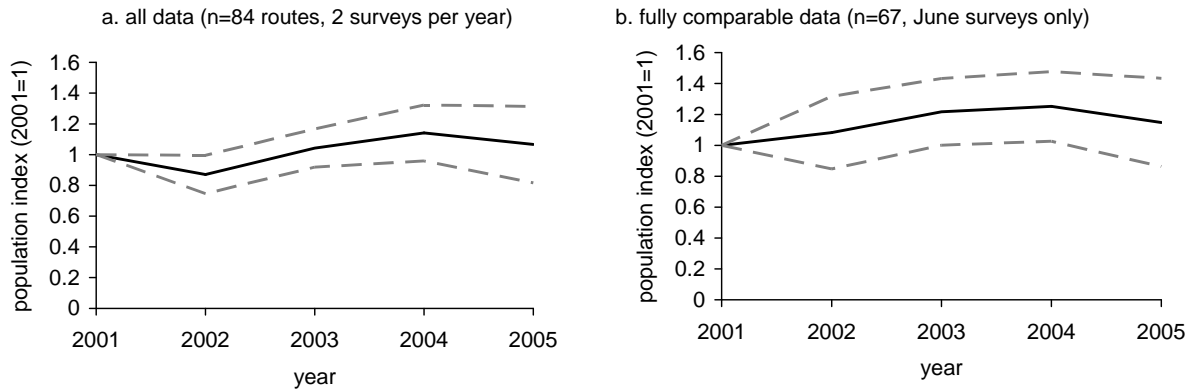


Fig. A1.20.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

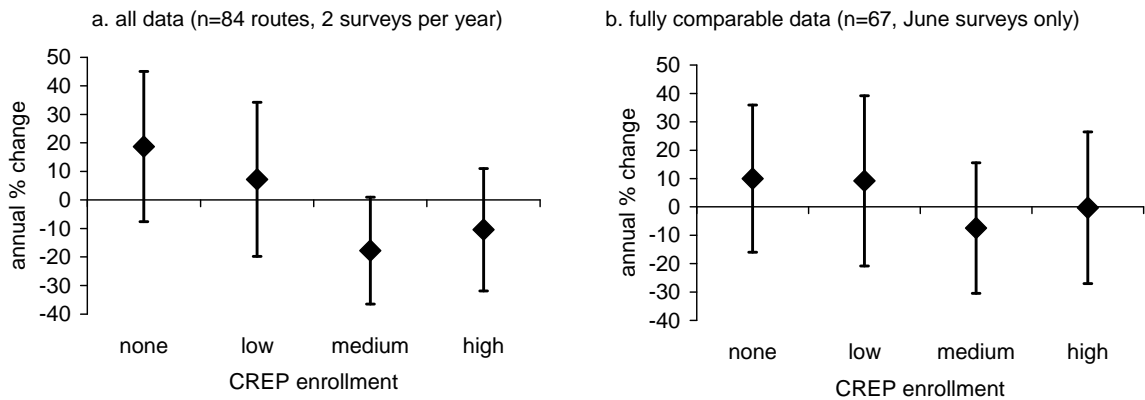
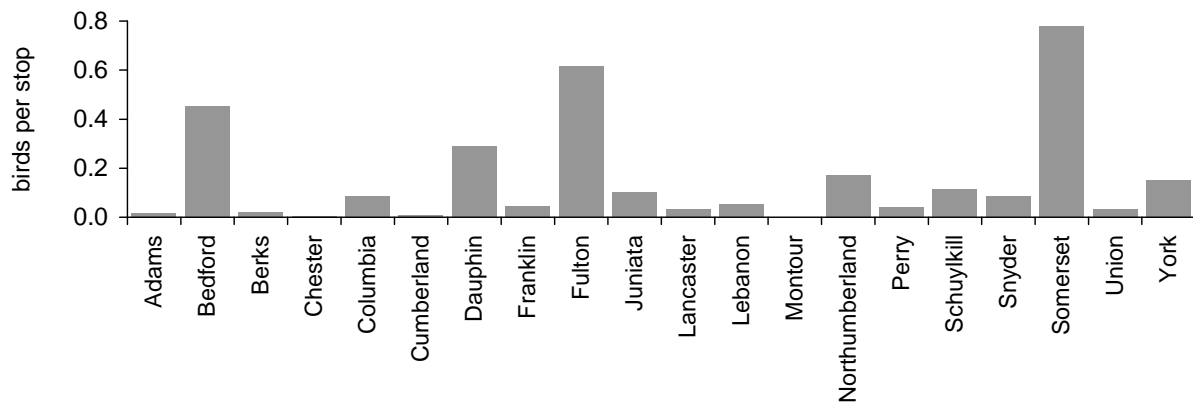


Fig. A1.20.3 Mean count per stop by county for all years



A1.21 Blue Jay *Cyanocitta cristata*

Moderate decrease ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change -8.1% (se = 2.1)

Wald-test for CREP effect = 4.39, $p = 0.22$

Fig. A1.21.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

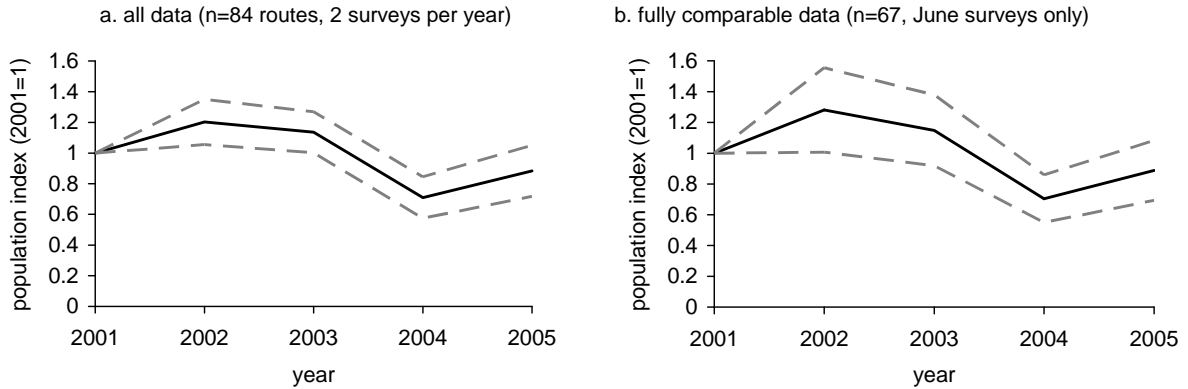


Fig. A1.21.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

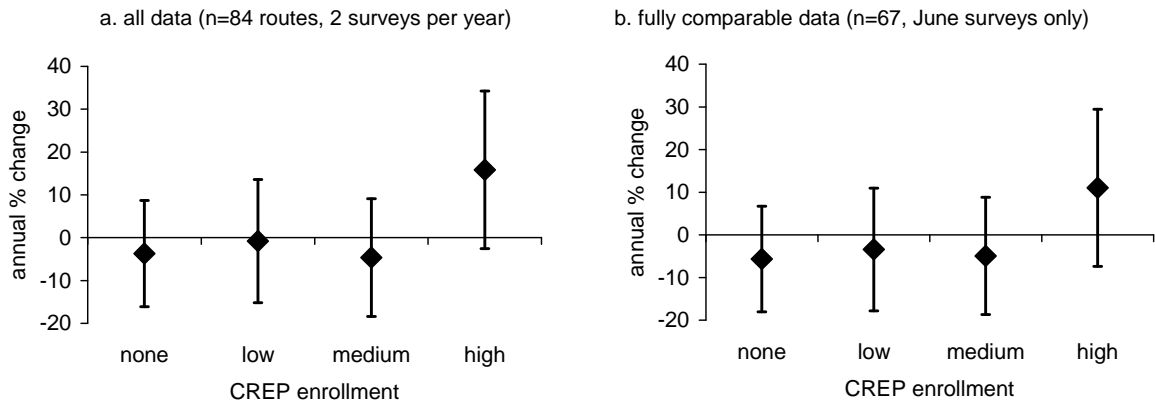
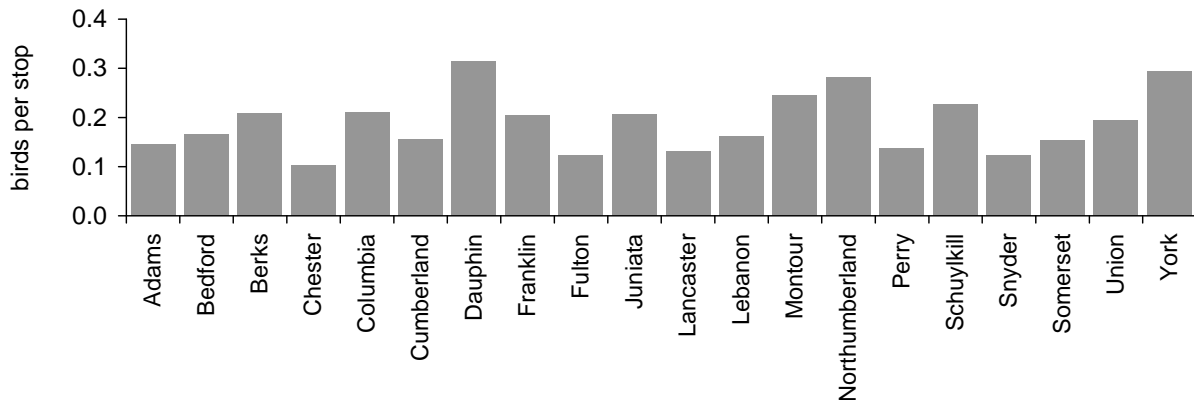


Fig. A1.21.3 Mean count per stop by county for all years



A1.22 American Crow *Corvus brachyrhychos*

Steep decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -11.8% (se = 1.6)

Wald-test for CREP effect = 17.65, $p = 0.0005$

Fig. A1.22.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

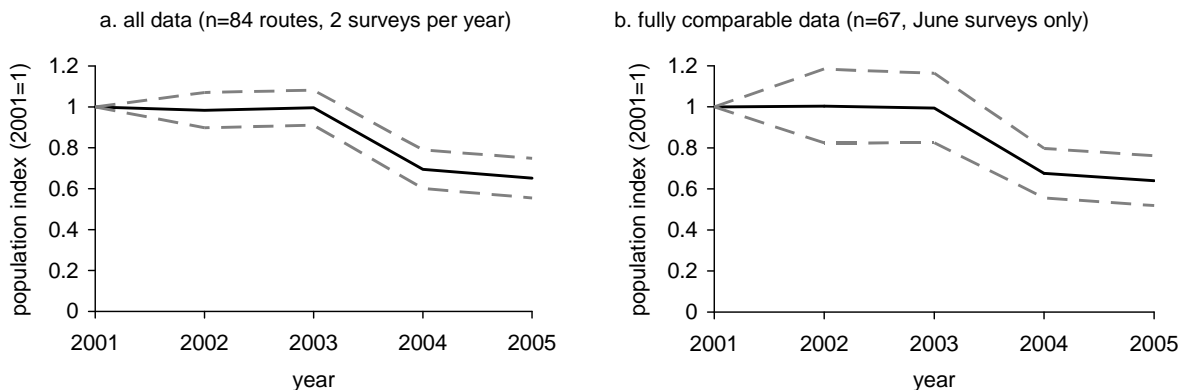


Fig A1.22.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

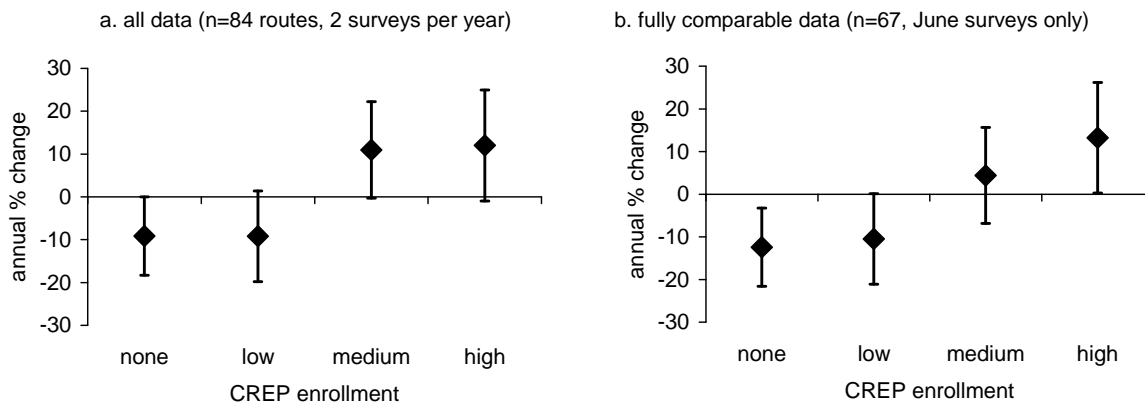
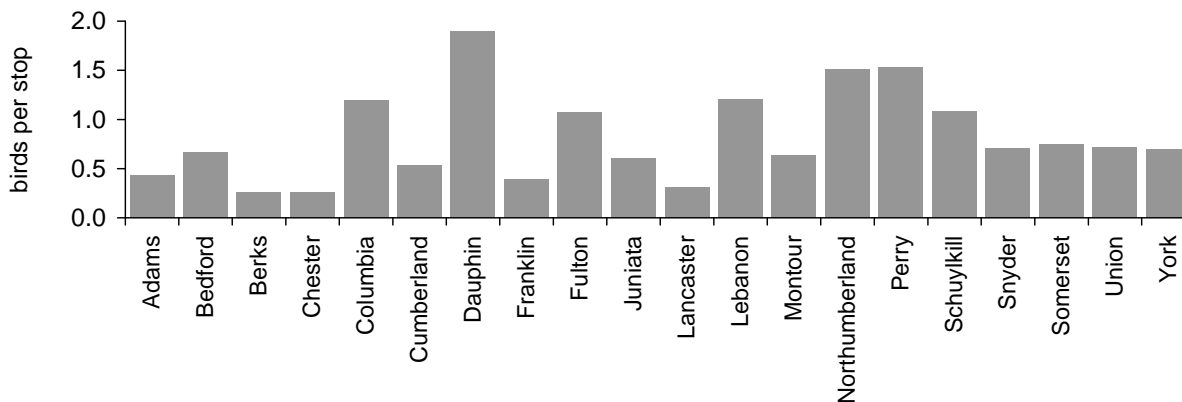


Fig A1.22.3 Mean count per stop by county for all years



A1.23 Fish Crow *Corvus ossifragus*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is not significant

mean annual change -13.3% (se = 4.4)

Wald-test for CREP effect = 2.73, $p = 0.436$

Fig. A1.23.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

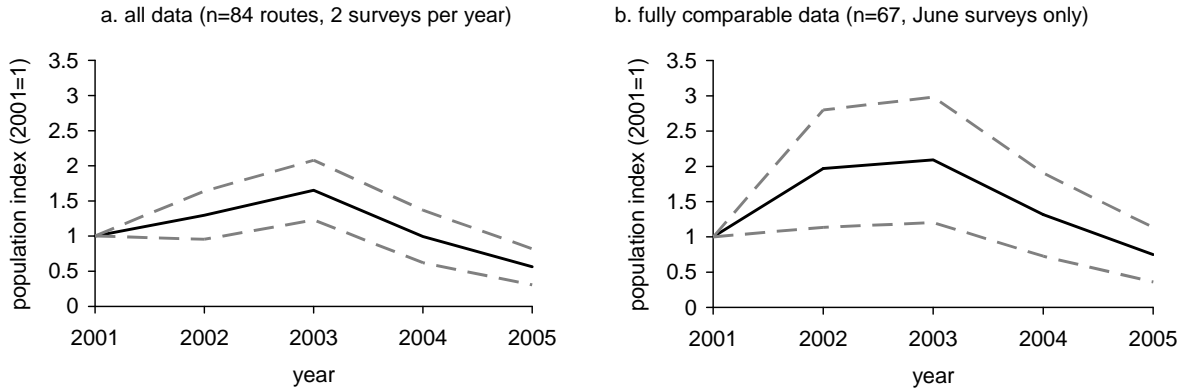


Fig A1.23.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

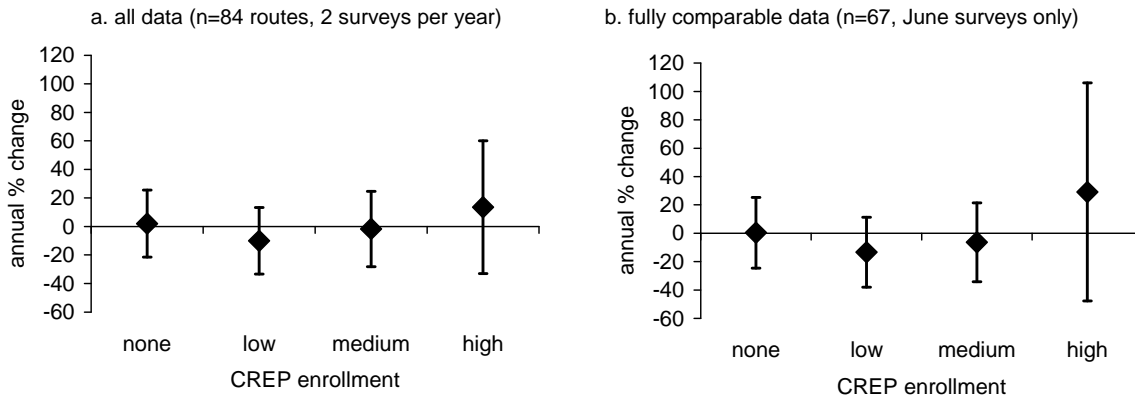
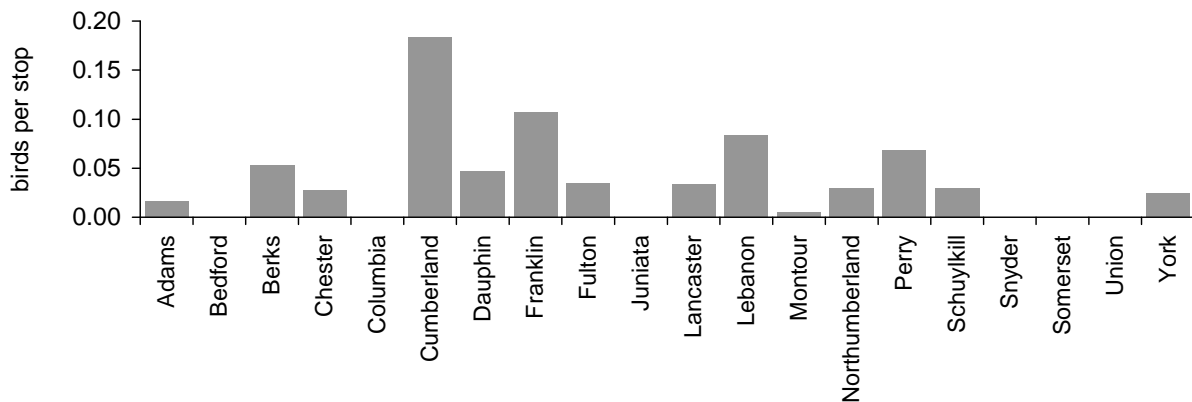


Fig. A1.23.3 Mean count per stop by county for all years



A1.24 Horned Lark *Eremophila alpestris*

Moderate increase ($p < 0.05$)

Effect of CREP enrollment on population trend is not significant

mean annual change +6.9% (se = 3.5)

Wald-test for CREP effect = 1.62, $p = 0.6557$

Fig. A1.24.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

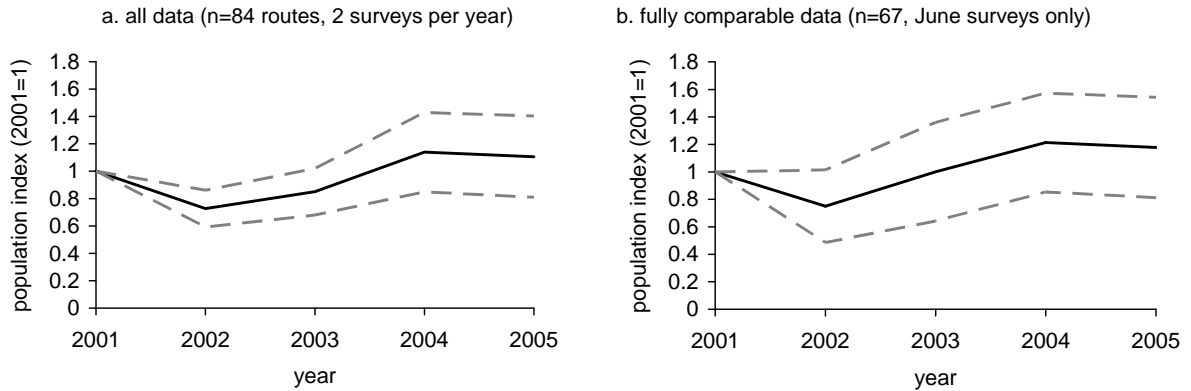


Fig. A1.24.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

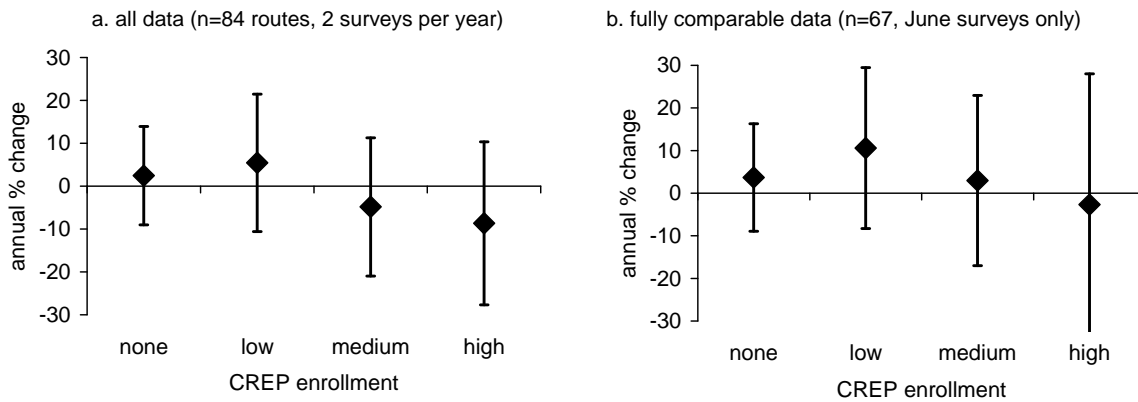
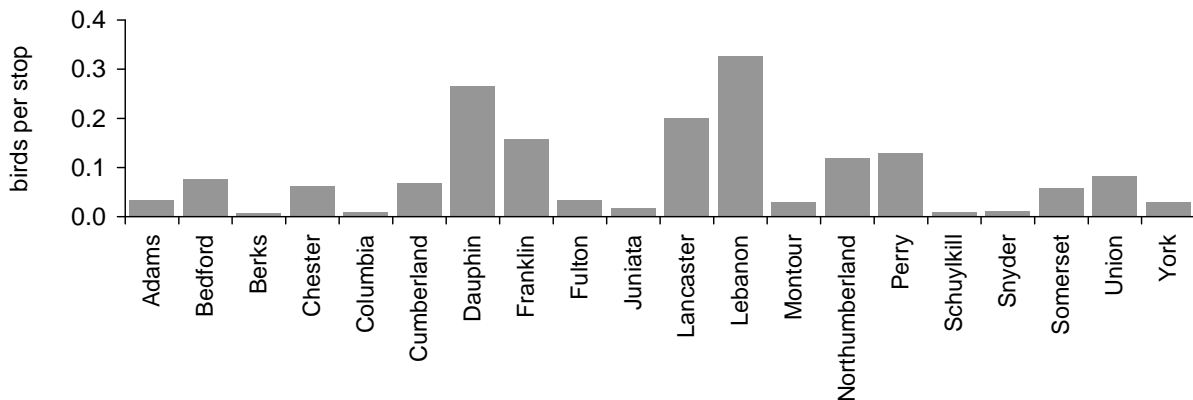


Fig. A1.24.3 Mean count per stop by county for all years



A1.25 Purple Martin *Progne subis*

Population trend **uncertain**
Effect of CREP enrollment on population trend is **not significant**

mean annual change +1.6% (se = 5.7)
Wald-test for CREP effect = 2.95, p = 0.3999

Fig. A1.25.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

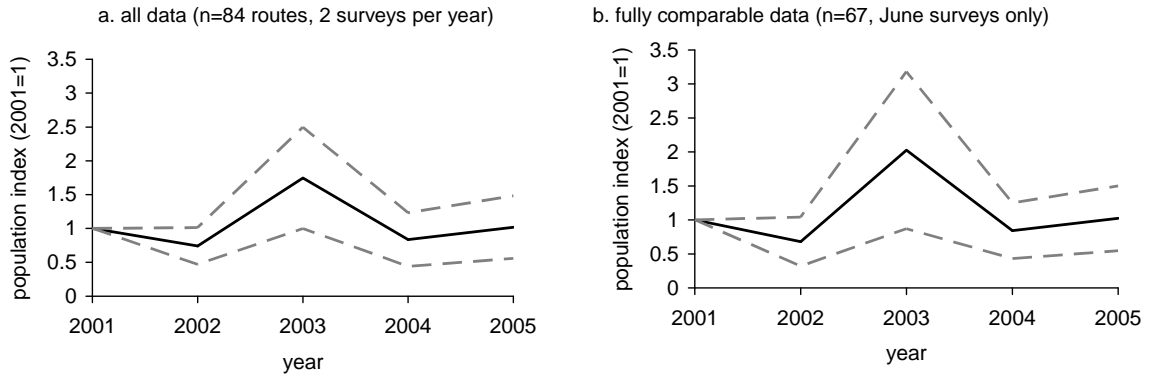


Fig. A1.25.2 Annual population change (95% confidence limits) by CREP enrollment rate
(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

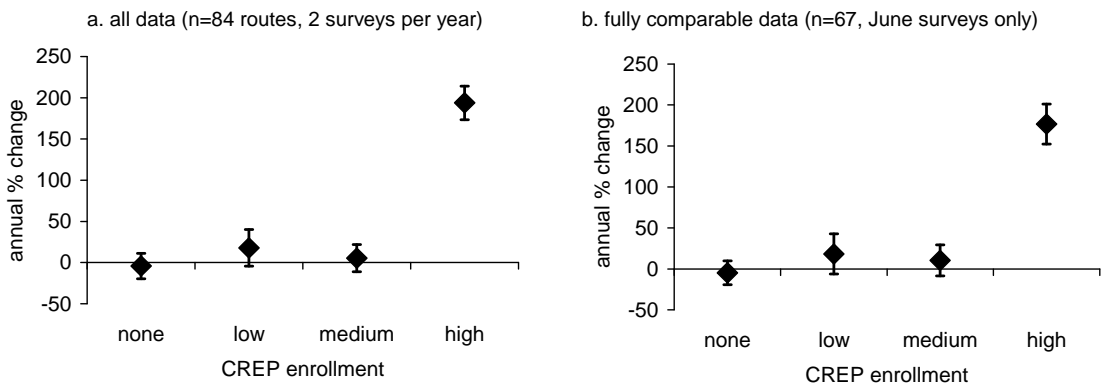
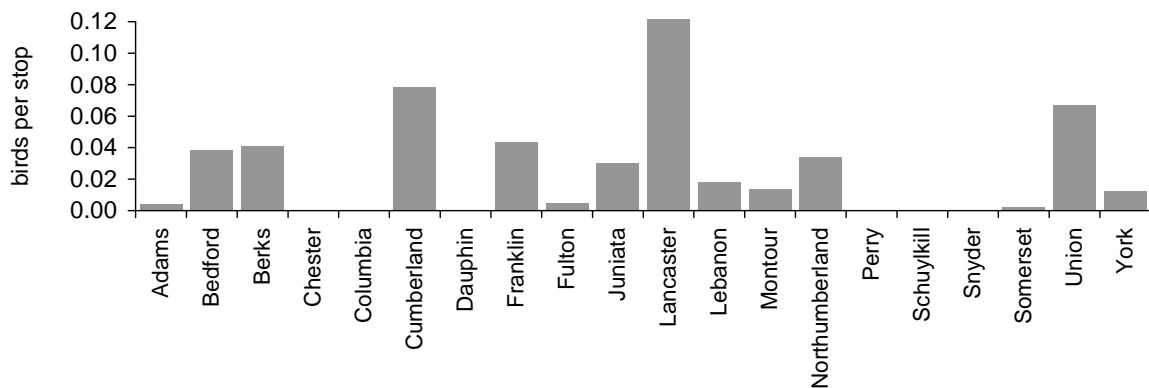


Fig. A1.25.3 Mean count per stop by county for all years



A1.26 Tree Swallow *Tachycineta bicolor*

Moderate increase ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +10.8% (se = 3.4)

Wald-test for CREP effect = 7.62, $p = 0.0545$

Fig. A1.26.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

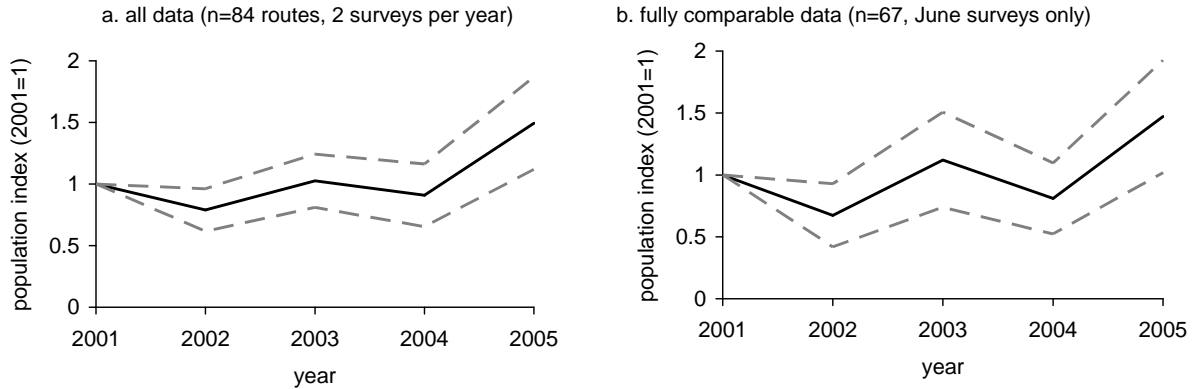


Fig. A1.26.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

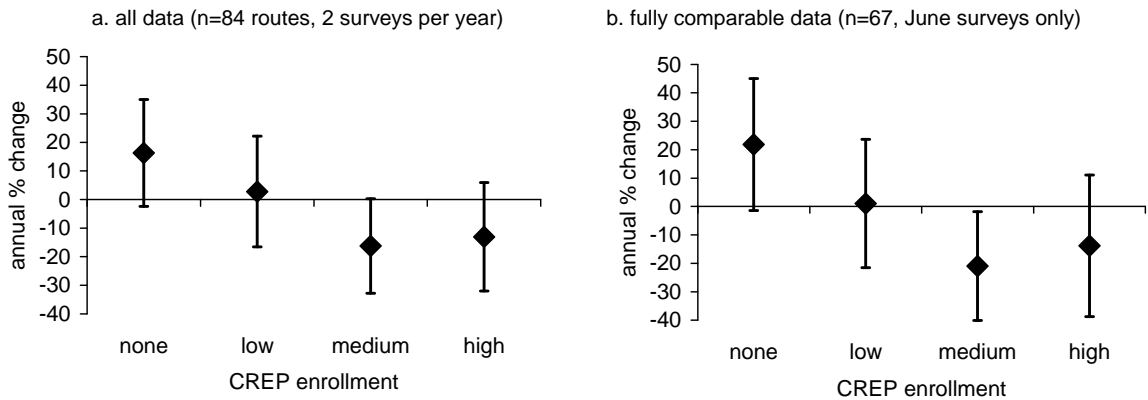
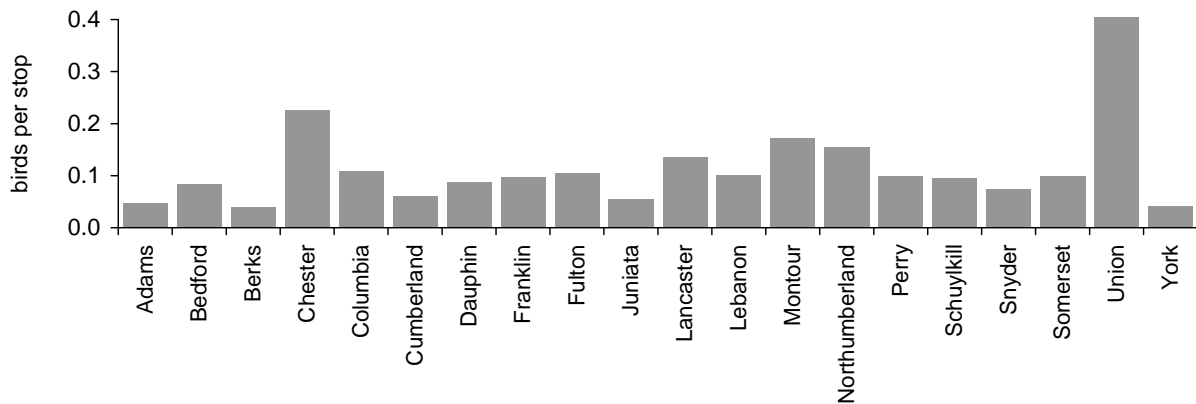


Fig. A1.26.3 Mean count per stop by county for all years



A1.27 Barn Swallow *Hirundo rustica*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +3.4% (se = 1.8)

Wald-test for CREP effect = 4.83, p = 0.1848

Fig. A1.27.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

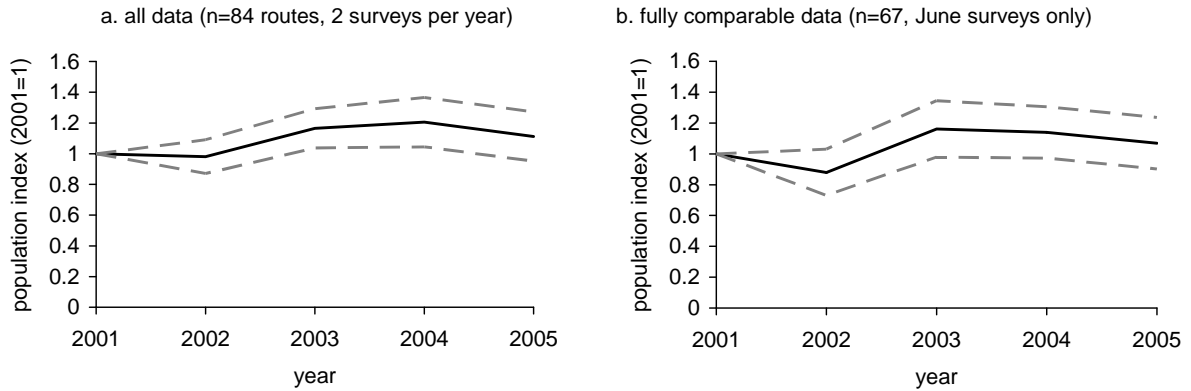


Fig. A1.27.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

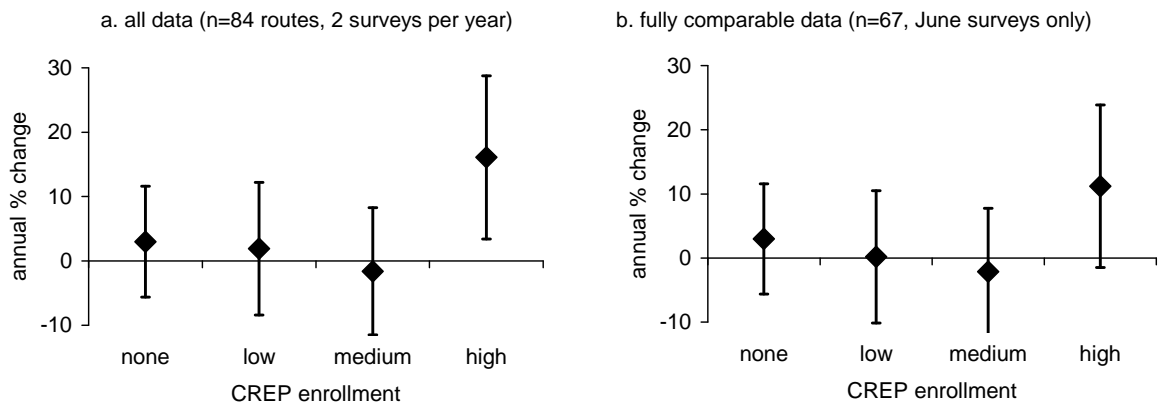
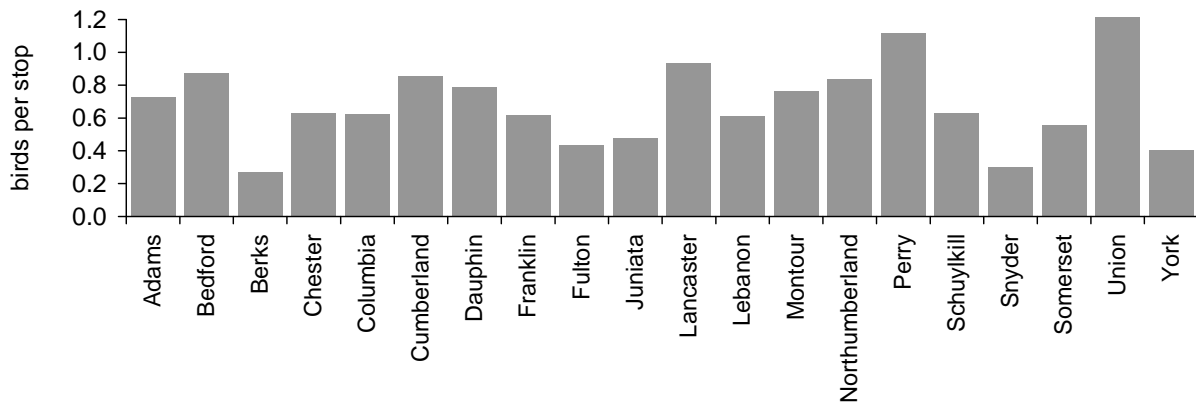


Fig. A1.27.3 Mean count per stop by county for all years



A1.28 Black-capped / Carolina Chickadee *Poecile atricapilla* / *carolinensis*

Moderate increase (p<0.01)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +10.1% (se = 3.9)

Wald-test for CREP effect = 4.62, p = 0.2016

Fig. A1.28.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

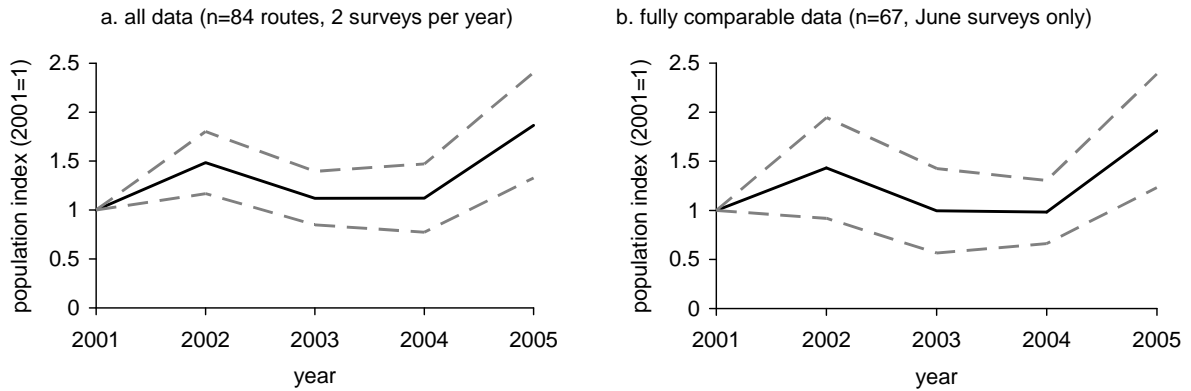


Fig. A1.28.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

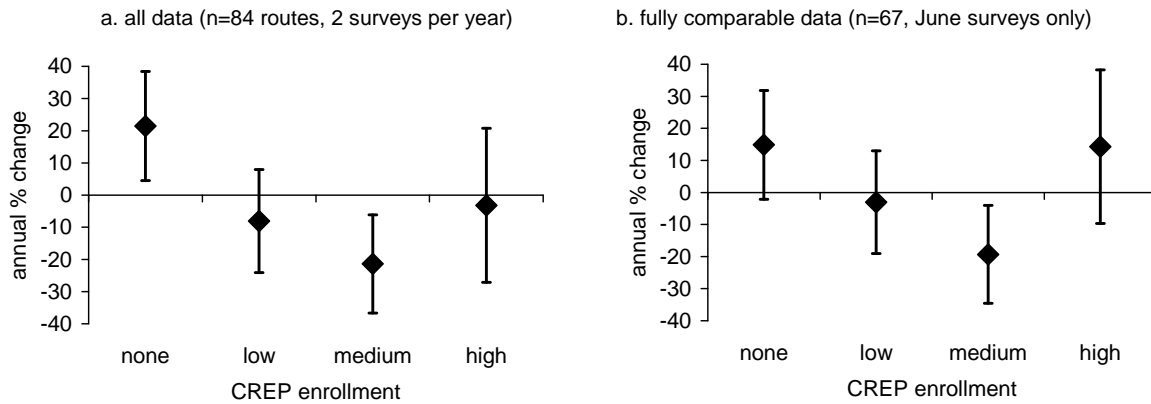
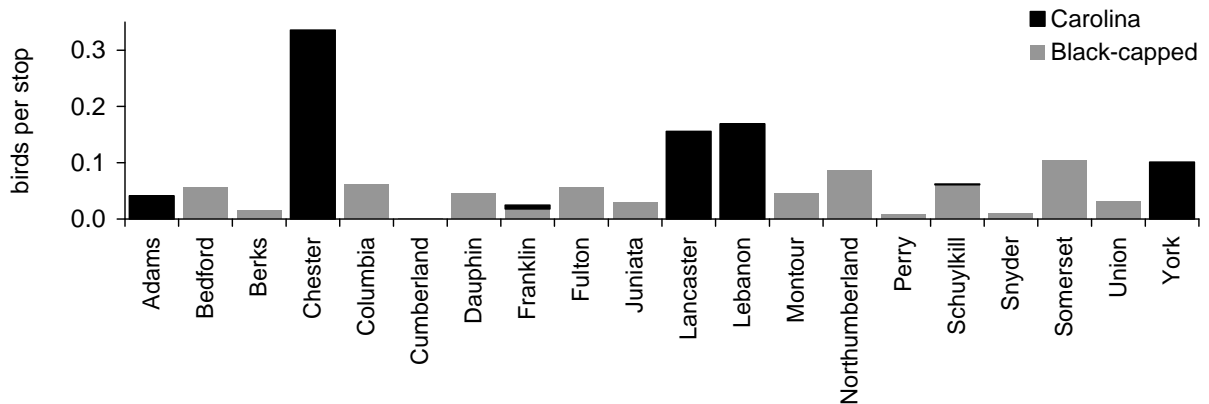


Fig. A1.28.3 Mean count per stop by county for all years



A1.29 Tufted Titmouse *Baeolophus bicolor*

Steep decline ($p < 0.01$)

Effect of CREP enrollment on population trend is not significant

mean annual change -12.8% (se = 2.5)

Wald-test for CREP effect = 2.2, $p = 0.5163$

Fig. A1.29.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

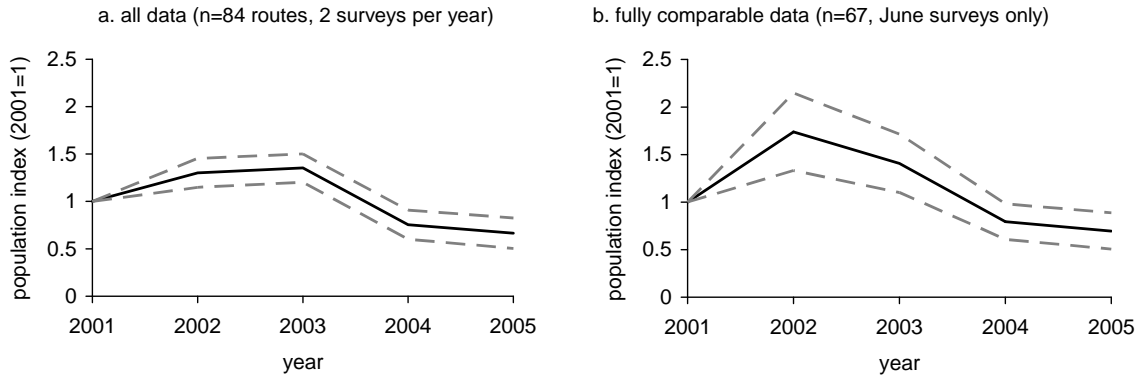


Fig. A1.29.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

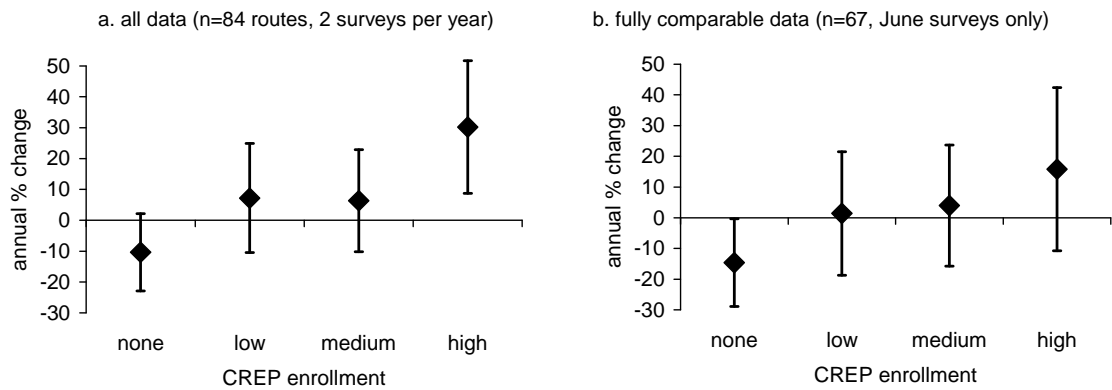
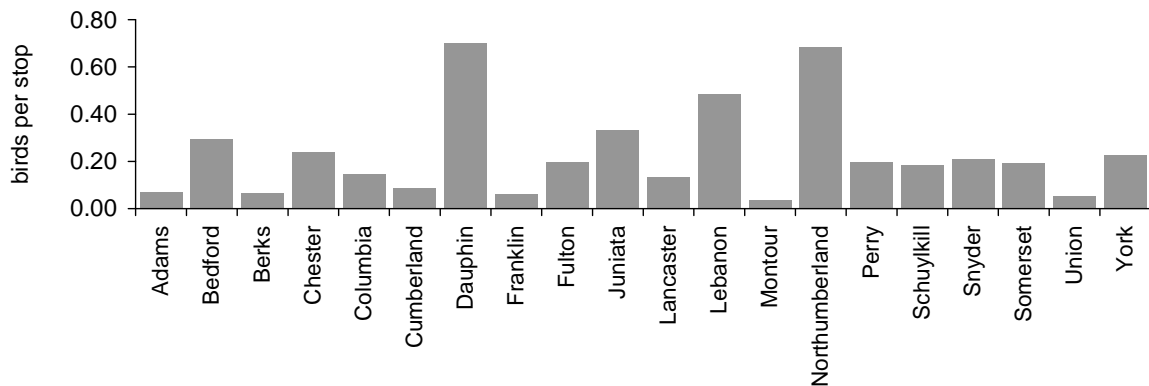


Fig. A1.29.3 Mean count per stop by county for all years



A1.30 White-breasted Nuthatch *Sitta carolinensis*

Steep decline ($p < 0.05$)
Effect of CREP enrollment on population trend is **not significant**

mean annual change -14.5% (se = 4.1)
Wald-test for CREP effect = 4.6, $p = 0.2033$

Fig. A1.30.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

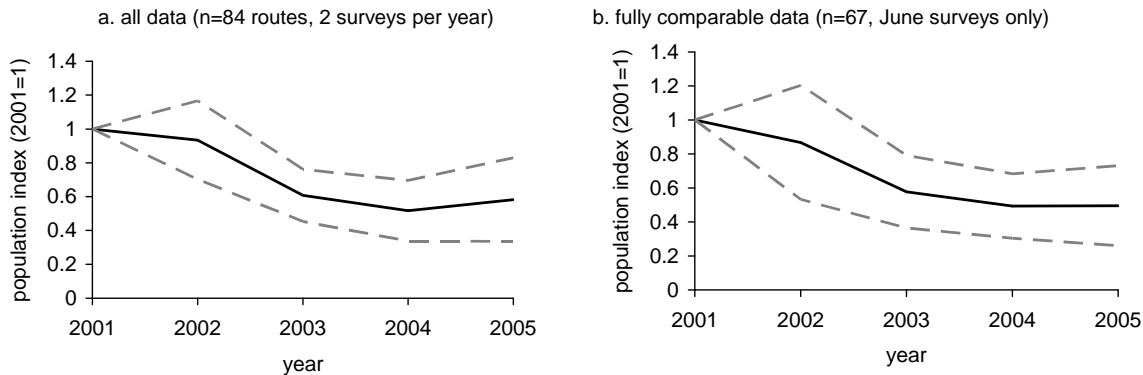


Fig. A1.30.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

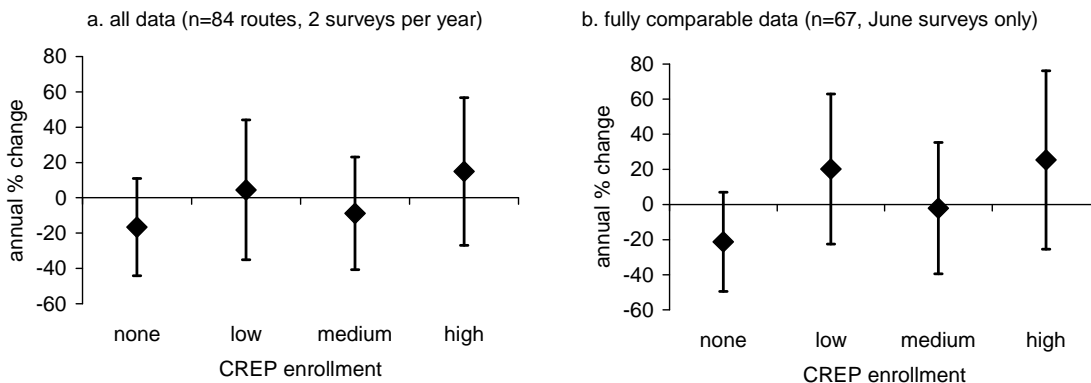
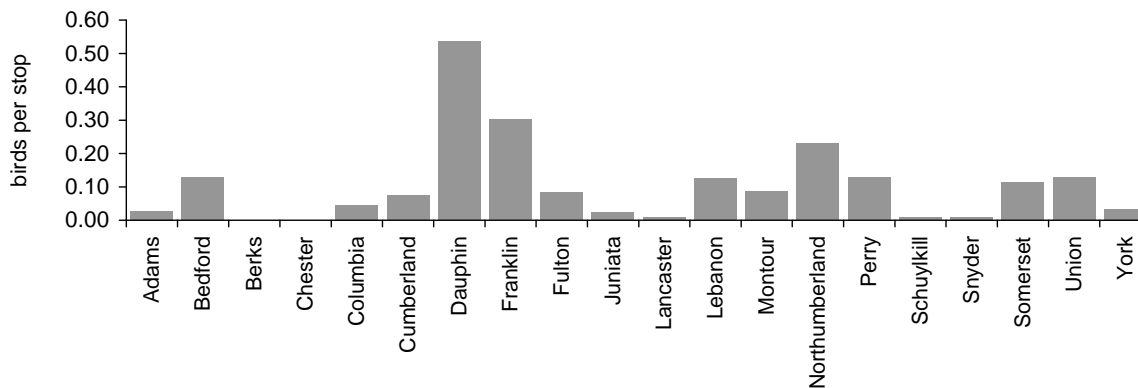


Fig. A1.30.3 Mean count per stop by county for all years



A1.31 Carolina Wren *Thryothorus ludovicianus*

Moderate increase ($p < 0.05$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +5.7% (se = 2.9)

Wald-test for CREP effect = 7.50, $p = 0.0729$

Fig. A1.31.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

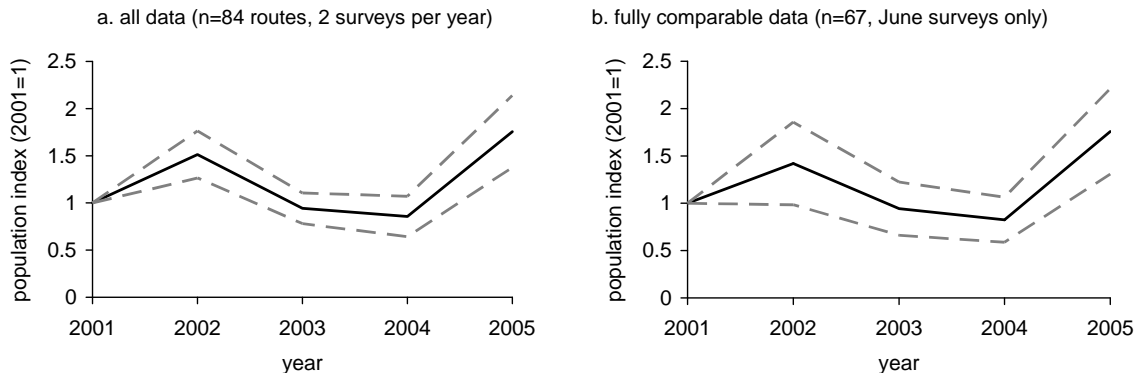


Fig. A1.31.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

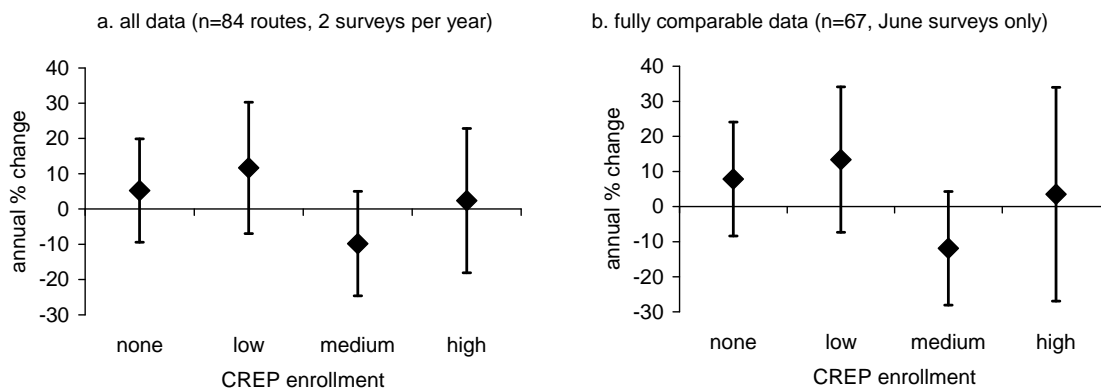
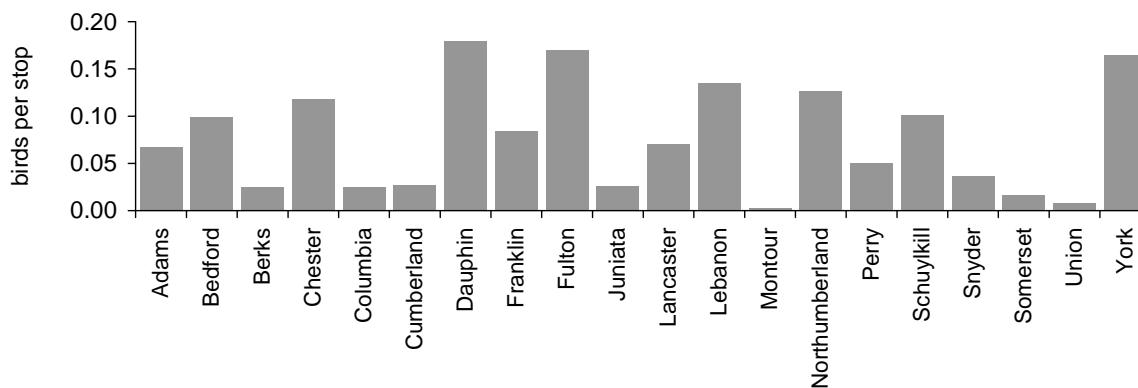


Fig. A1.31.3 Mean count per stop by county for all years



A1.32 House Wren *Troglodytes aedon*

Population trend **stable**

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -0.5% (se = 1.8)

Wald-test for CREP effect = 13.27, p = 0.0037

Fig. A1.32.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

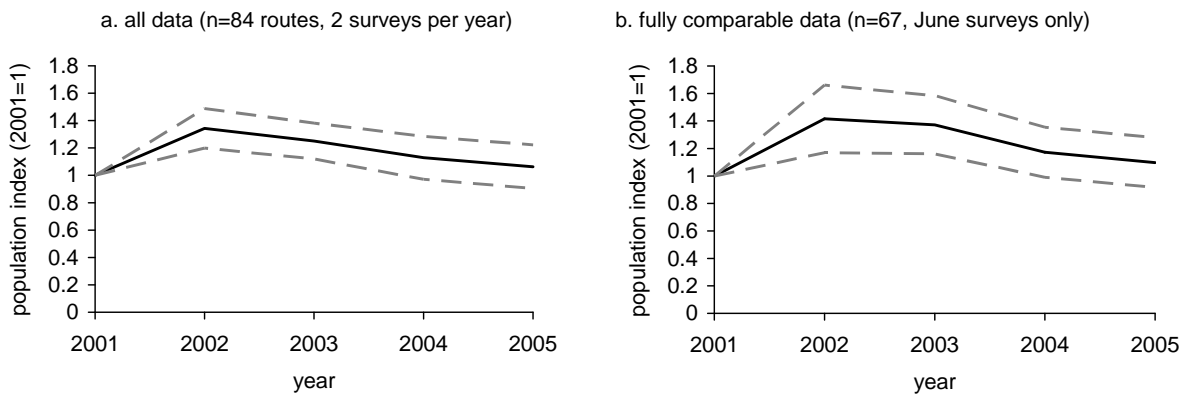


Fig. A1.32.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

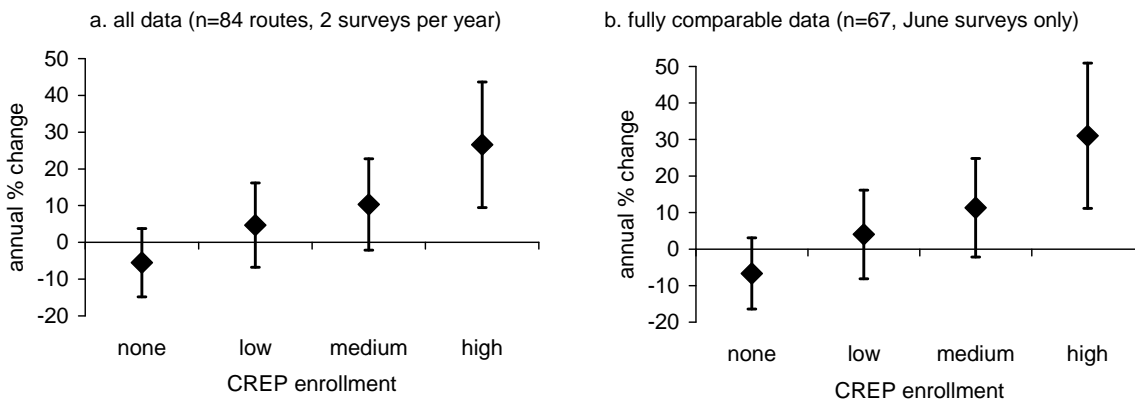
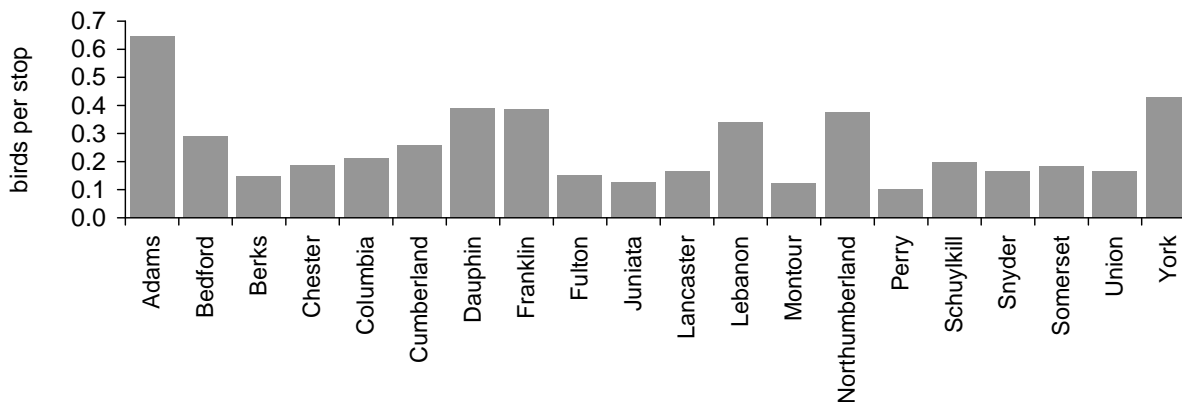


Fig. A1.32.3 Mean count per stop by county for all years



A1.33 Blue-gray Gnatcatcher *Poliioptila caerulea*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change +4.1% (se = 5.4)

Wald-test for CREP effect = 0.31, p = 0.9509

Fig. A1.33.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

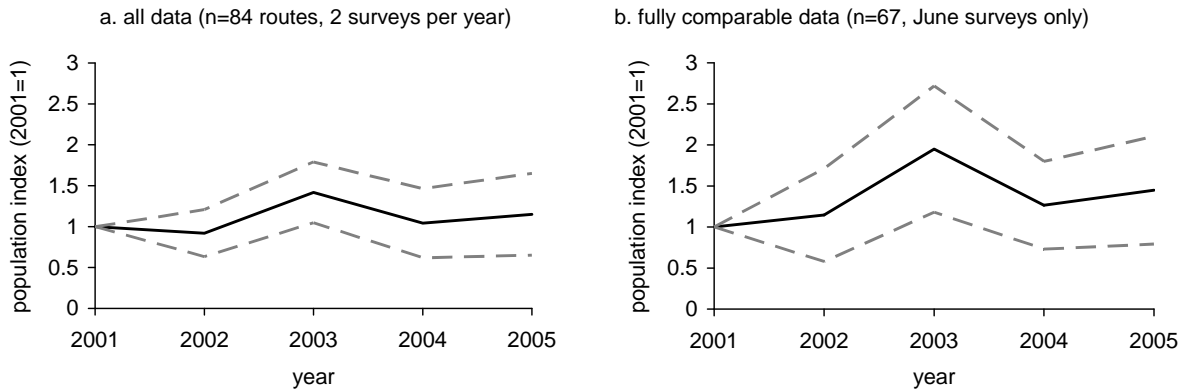


Fig. A1.33.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

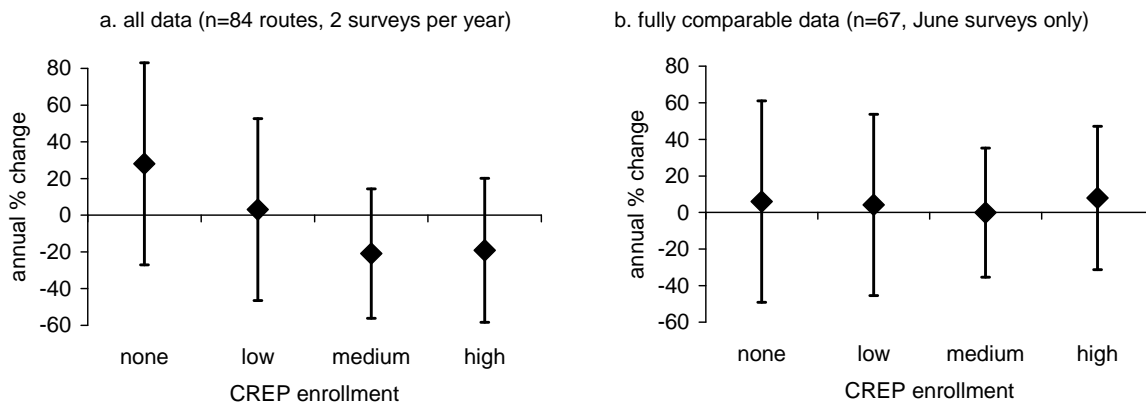
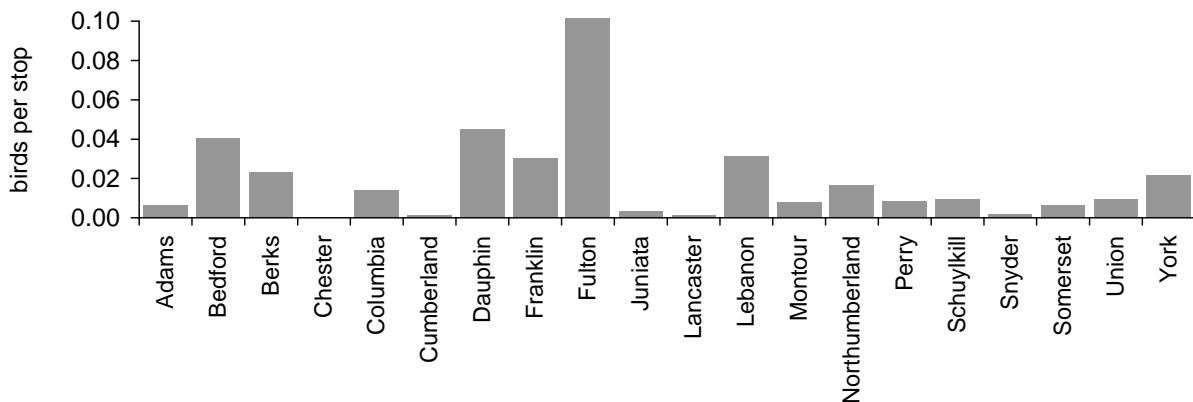


Fig. A1.33.3 Mean count per stop by county for all years



A1.34 Eastern Bluebird *Sialia sialis*

Steep decline ($p < 0.01$)

Effect of CREP enrollment on population trend **significant but undetermined**

mean annual change -11.3% (se = 2.5)

Wald-test for CREP effect = 8.6, $p = 0.0351$

Fig. A1.34.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

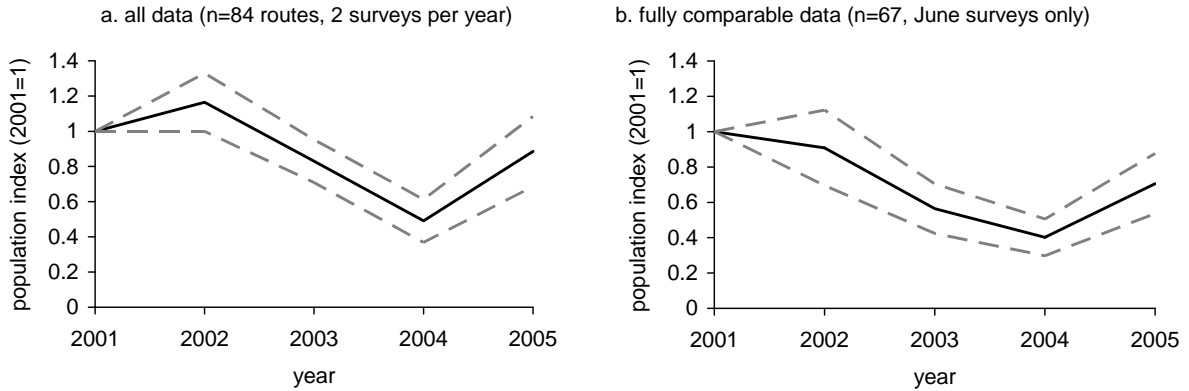


Fig. A1.34.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

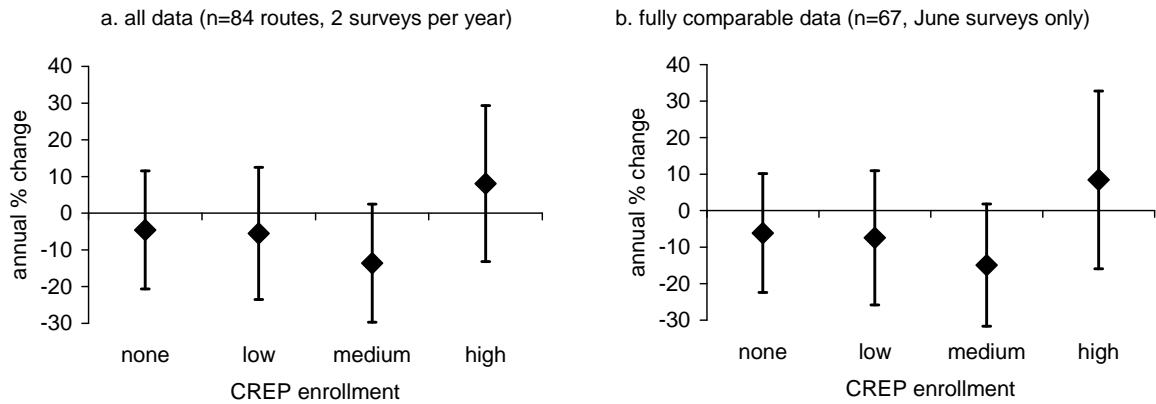
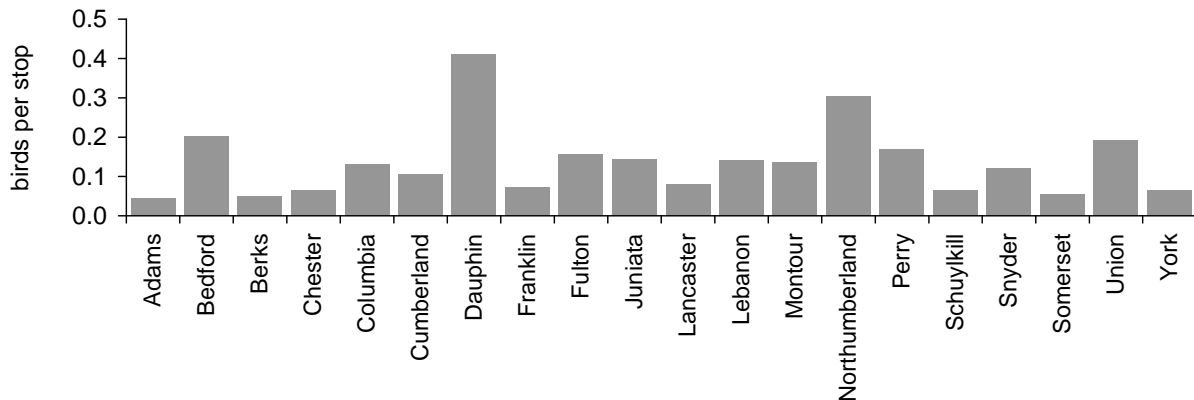


Fig. A1.34.3 Mean count per stop by county for all years



A1.35 Wood Thrush *Hylocichla mustelina*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change -2.6% (se = 1.9)

Wald-test for CREP effect = 5.22, p = 0.1563

Fig. A1.35.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

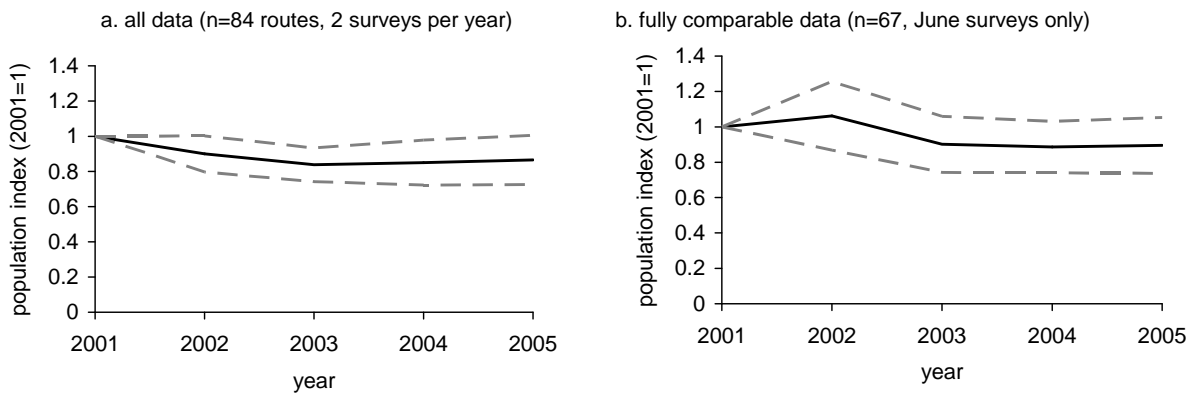


Fig. A1.35.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

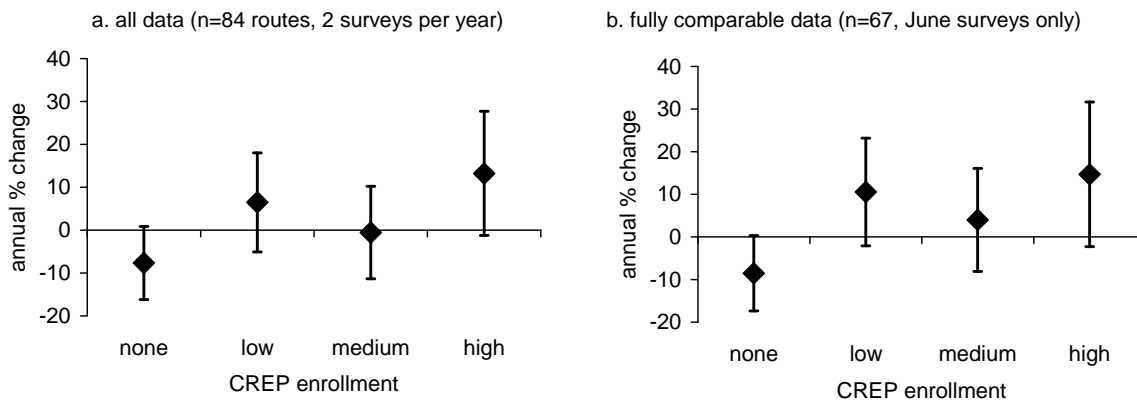
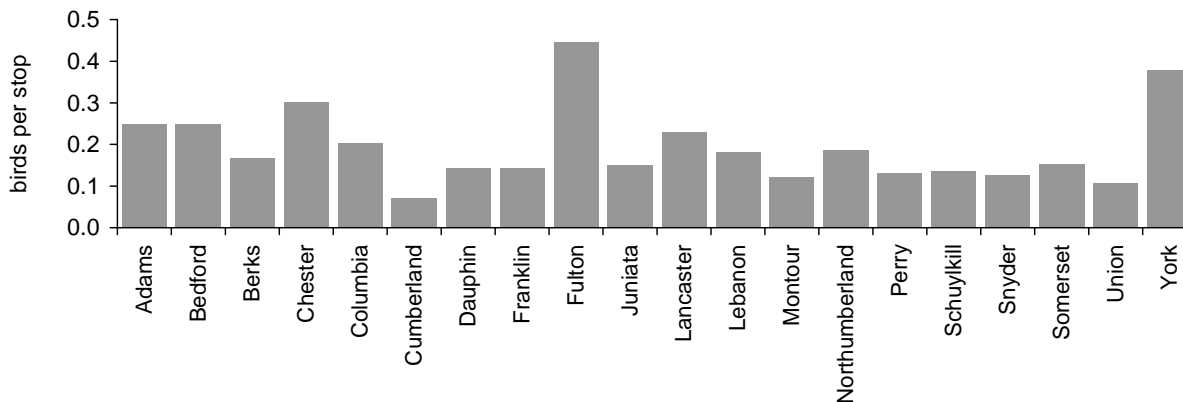


Fig. A1.35.3 Mean count per stop by county for all years



A1.36 American Robin *Turdus migratorius*

Moderate increase ($p < 0.05$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +2.7% (se = 1.1)

Wald-test for CREP effect = 4.58, $p = 0.2056$

Fig. A1.36.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

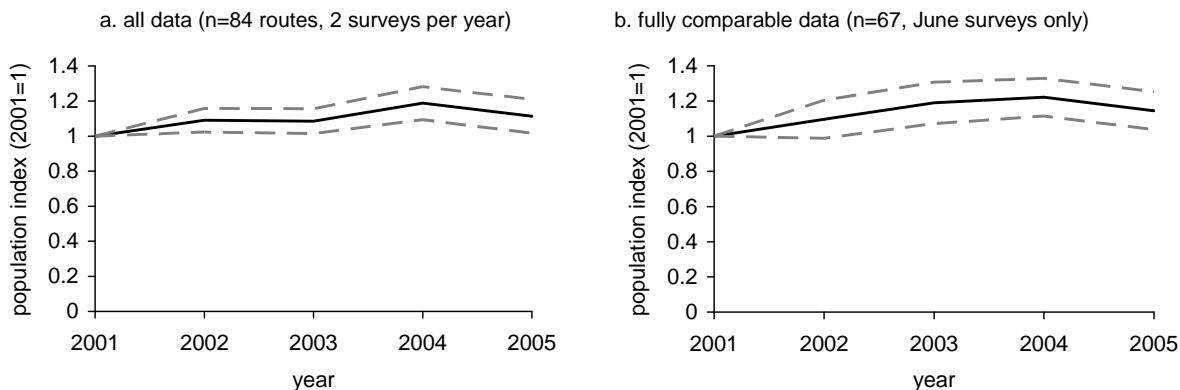


Fig. A1.36.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

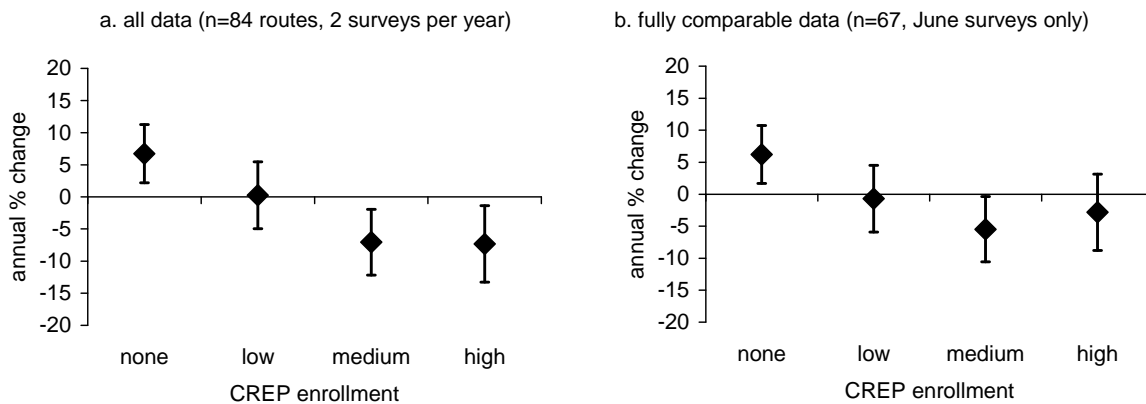
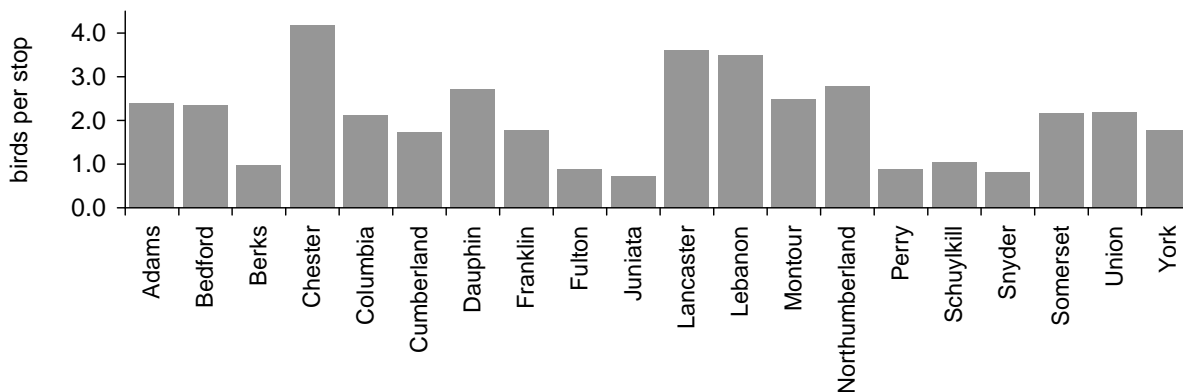


Fig. A1.36.3 Mean count per stop by county for all years



A1.37 Gray Catbird *Dumetella carolinensis*

Population stable ($p < 0.05$)

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -1.9% (se = 1.5)

Wald-test for CREP effect = 16.66, $p = 0.0008$

Fig. A1.37.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

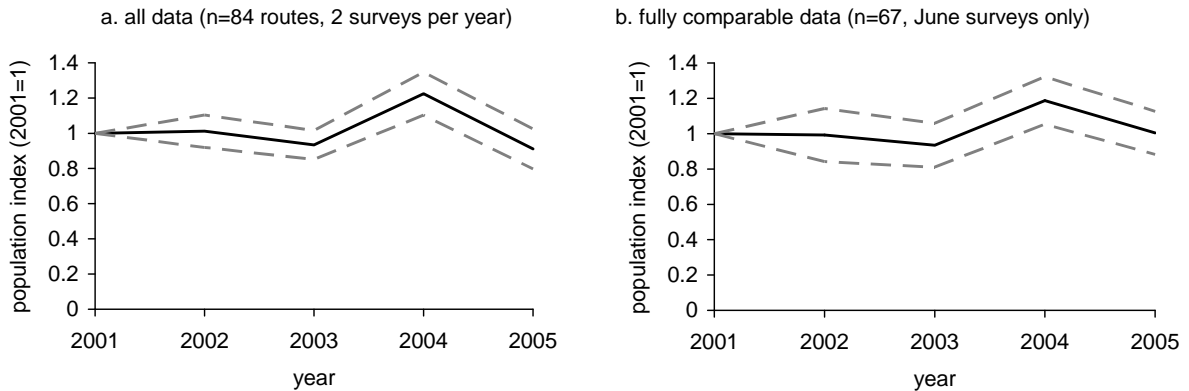


Fig. A1.37.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

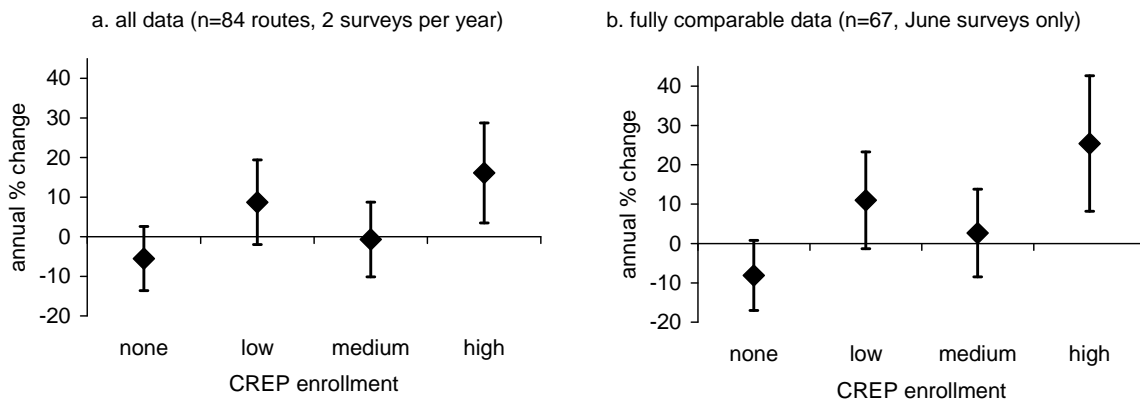
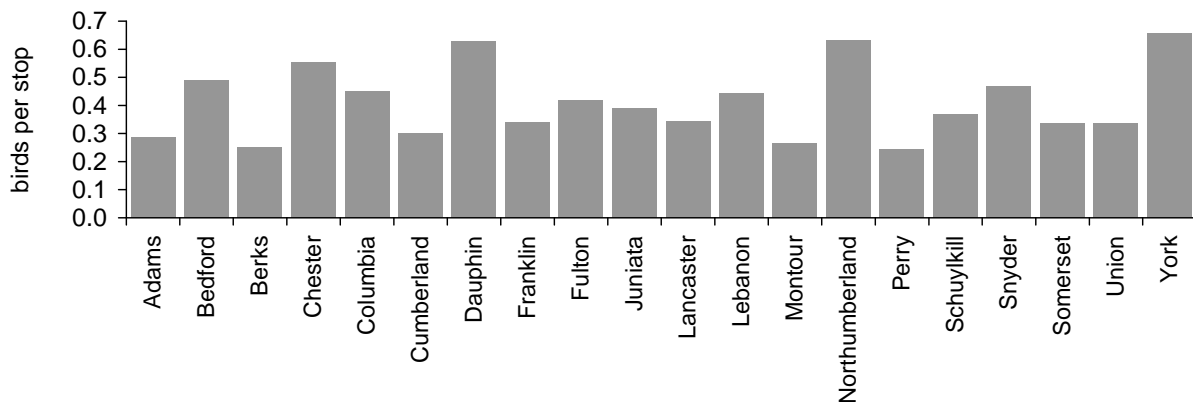


Fig. A1.37.3 Mean count per stop by county for all years



A1.38 Northern Mockingbird *Mimus polyglottos*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is not significant

mean annual change -3.7% (se = 1.5)

Wald-test for CREP effect = 4.96, $p = 0.1750$

Fig. A1.38.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

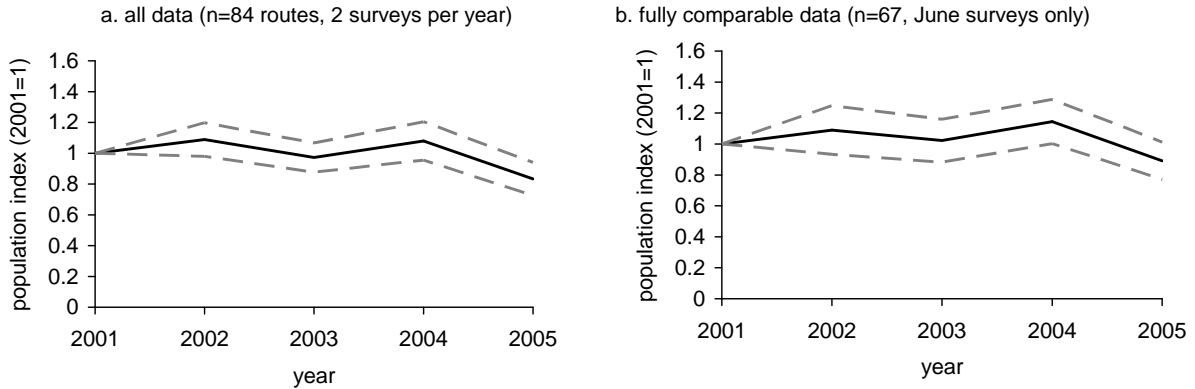


Fig. A1.38.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

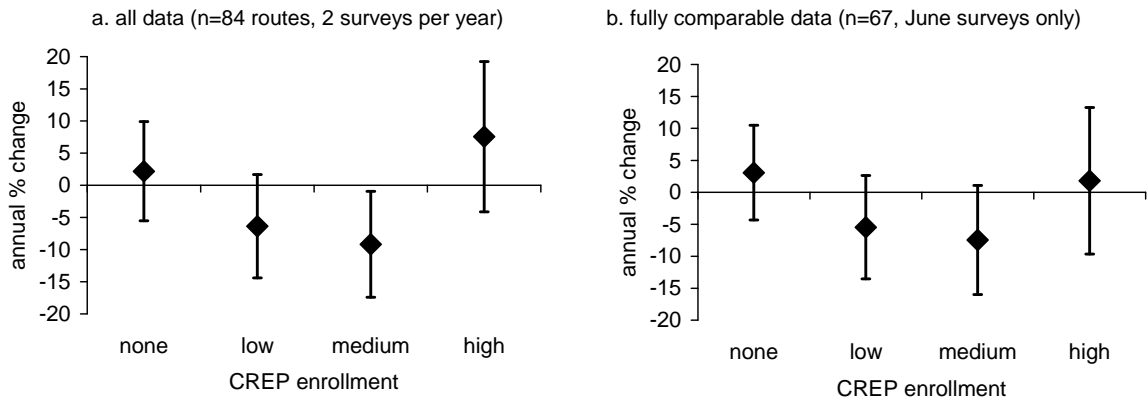
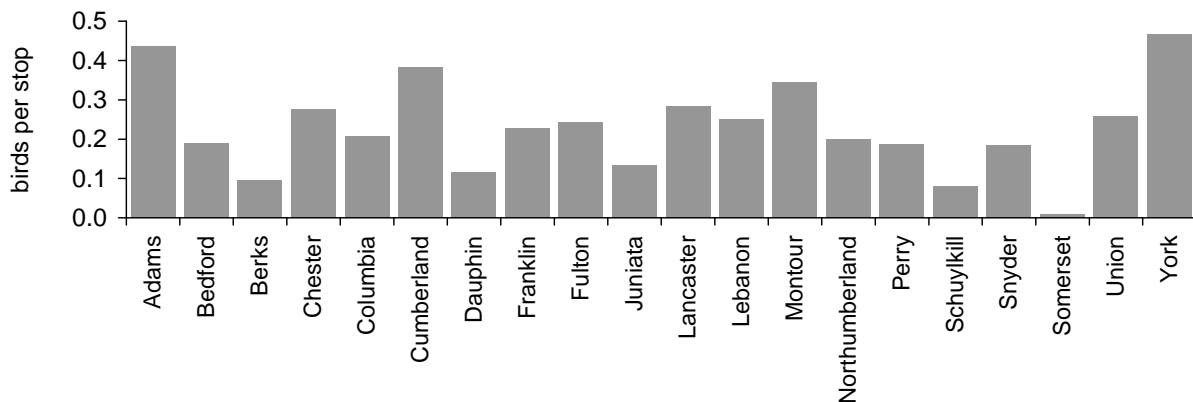


Fig. A1.38.3 Mean count per stop by county for all years



A1.39.1 Brown Thrasher *Toxostoma rufum*

Strong increase (p<0.01)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +15.7% (se = 4.1)
Wald-test for CREP effect = 4.76, p = 0.19
Cov1 4.76 3 0.1900

Fig. A1.39.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

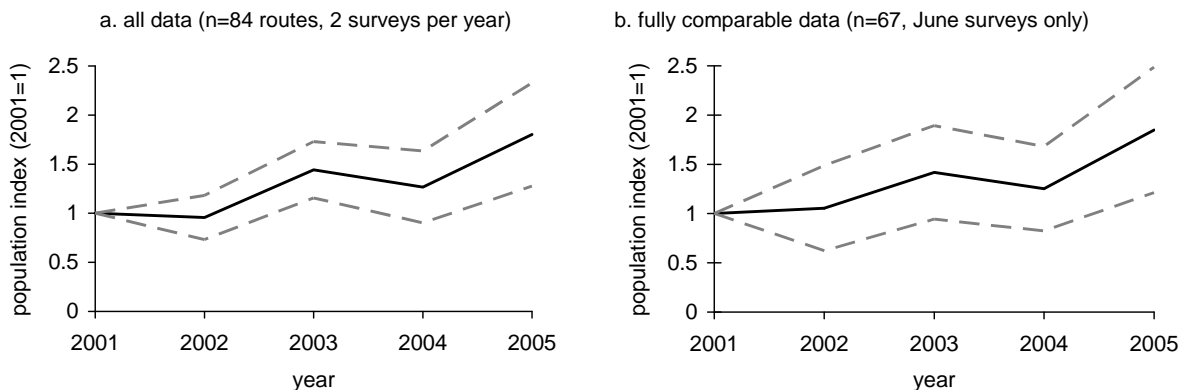


Fig. A1.39.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

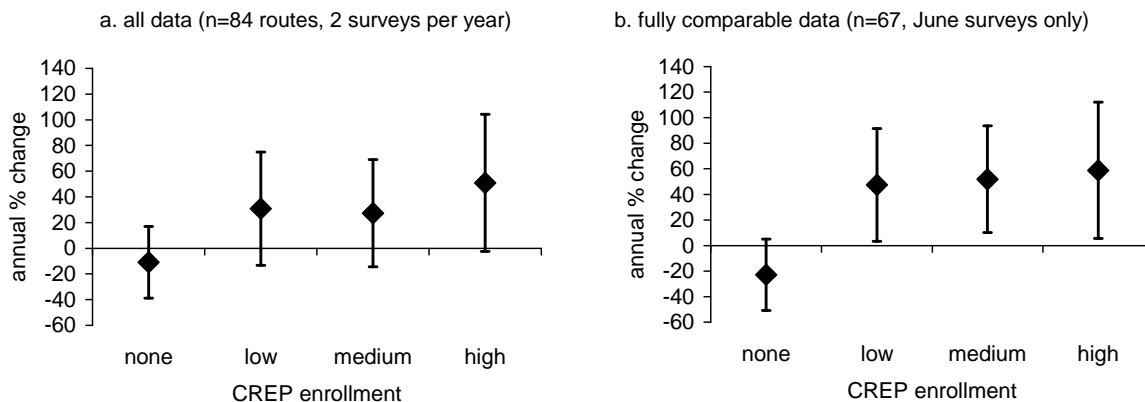
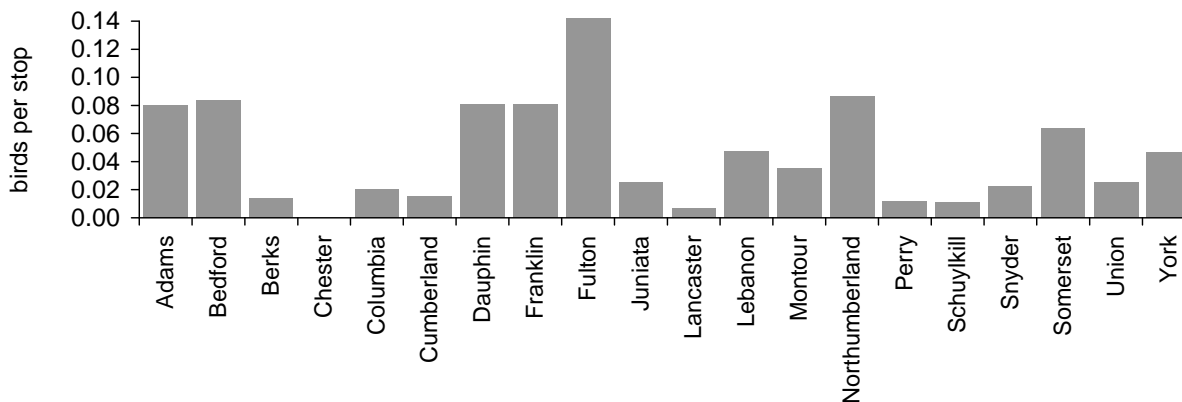


Fig. A1.39.3 Mean count per stop by county for all years



A1.40 Eurasian Starling *Sturnus vulgaris*

Moderate decline ($p < 0.05$)

Effect of CREP enrollment on population trend is not significant

mean annual change -4.3% (se = 1.9)

Wald-test for CREP effect = 5.08, $p = 0.1661$

Fig. A1.40.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

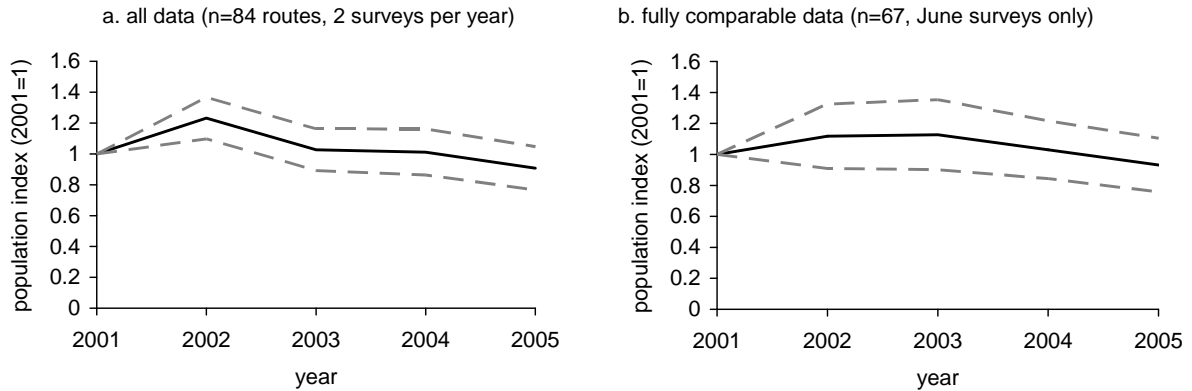


Fig. A1.40.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

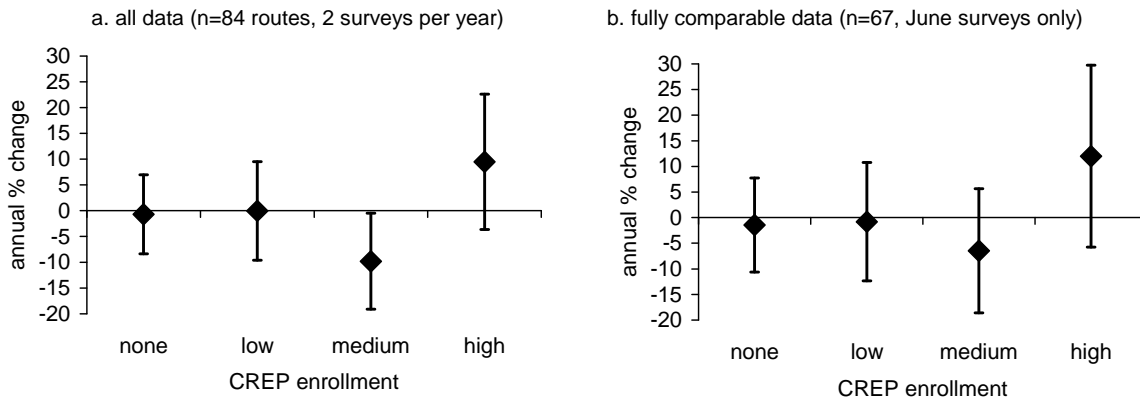
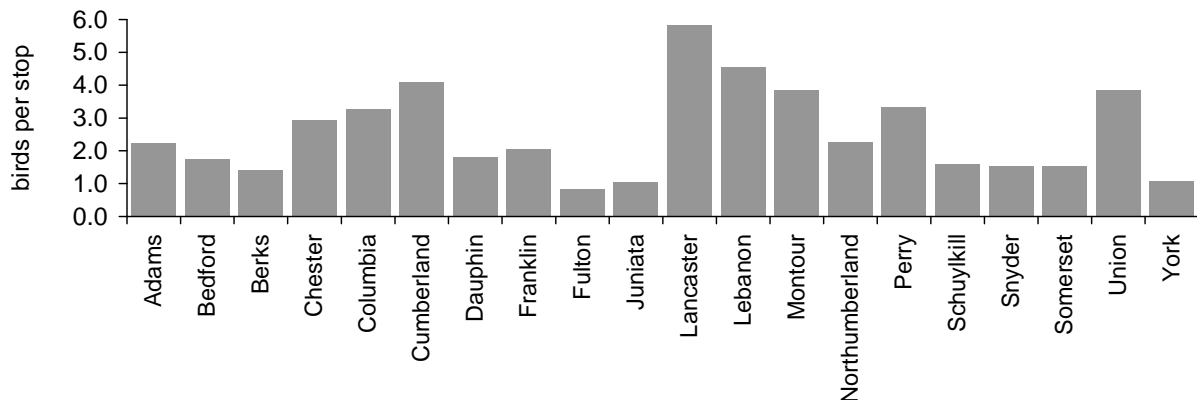


Fig. A1.40.3 Mean count per stop by county for all years



A1.41.1 Cedar Waxwing *Bombycilla cedrorum*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change -10.8% (se = 4.7)

Wald-test for CREP effect = 0.83, $p = 0.84$

Fig. A1.41.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

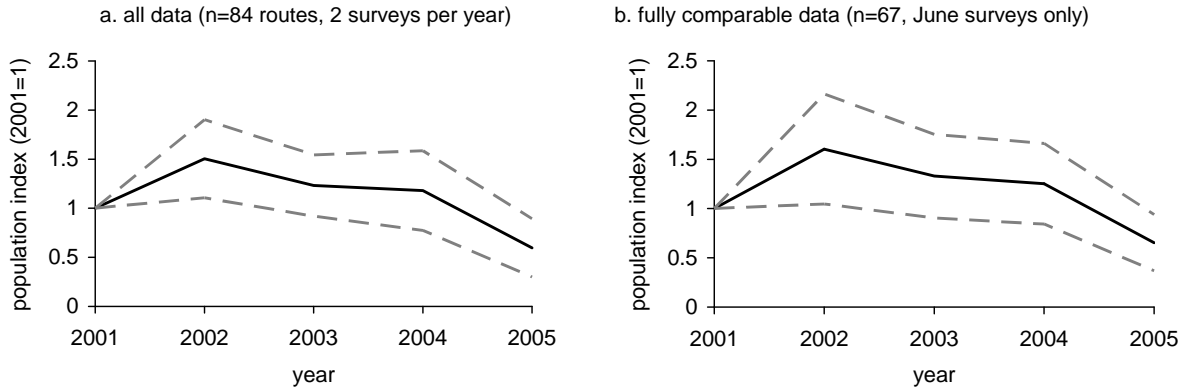


Fig. A1.41.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

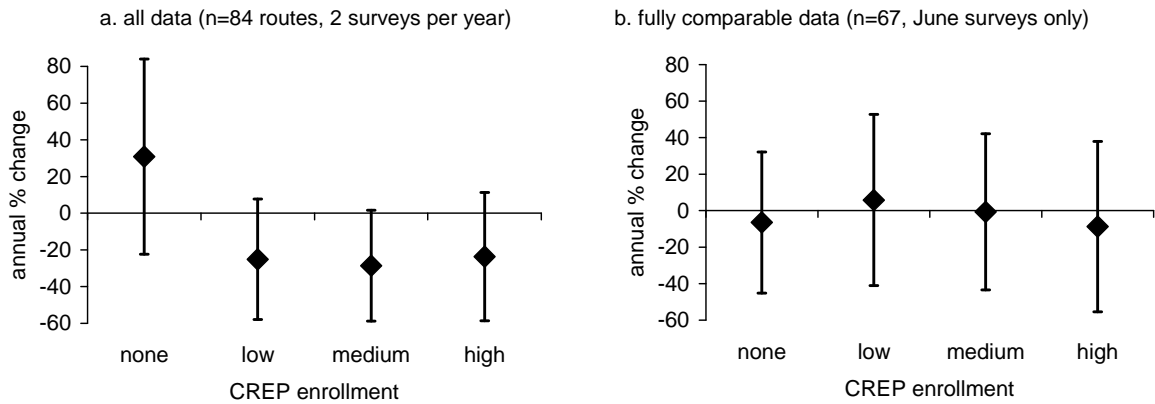
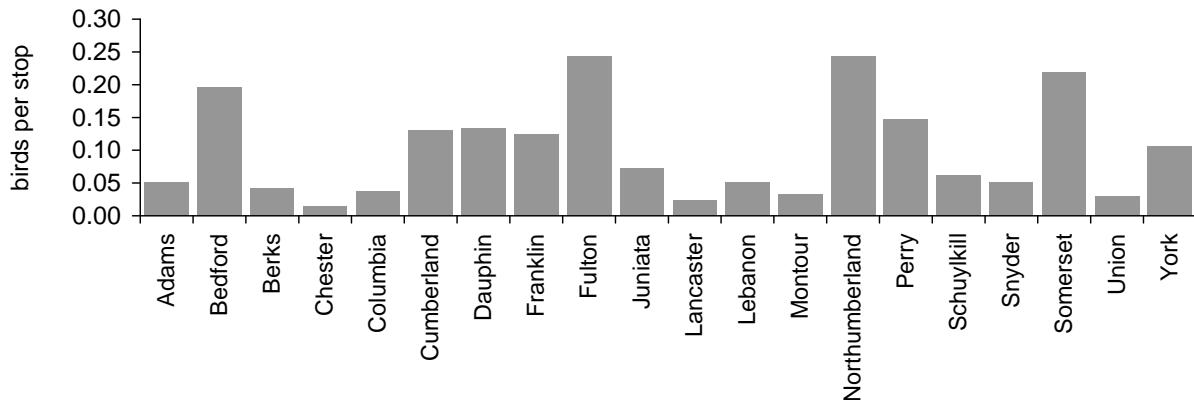


Fig. A1.41.3 Mean count per stop by county for all years



A1.42 Yellow Warbler *Dendroica petechia*

Moderate increase ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +8.0% (se = 2.7)

Wald-test for CREP effect = 7.00, $p = 0.0718$

Fig. A1.42.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

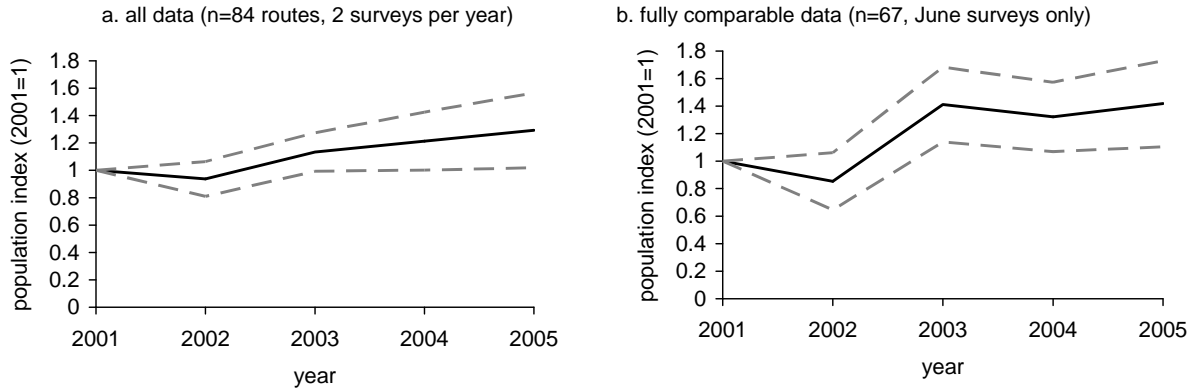


Fig. A1.42.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

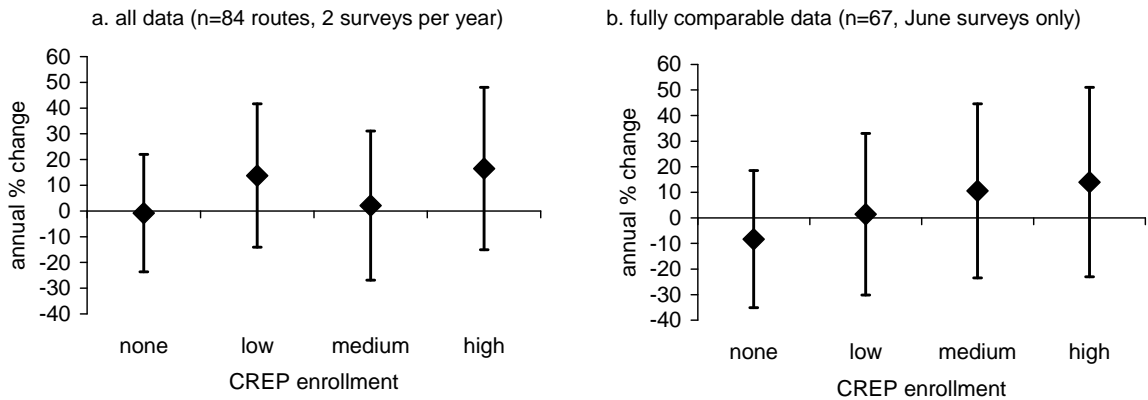
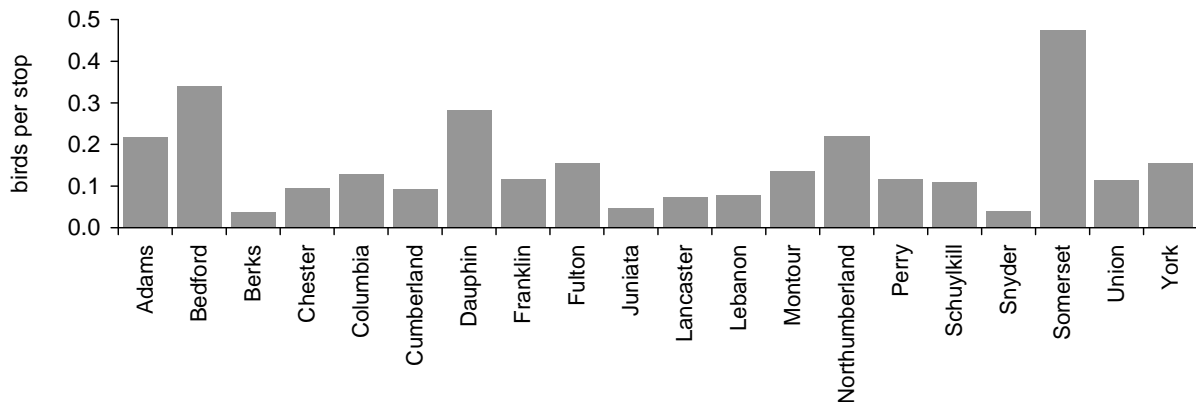


Fig. A1.42.3 Mean count per stop by county for all years



A1.43 Ovenbird *Seiurus aurocapillus*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is not significant

mean annual change -9.4% (se = 3.6)

Wald-test for CREP effect = 5.49, $p = 0.1392$

Fig. A1.43.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

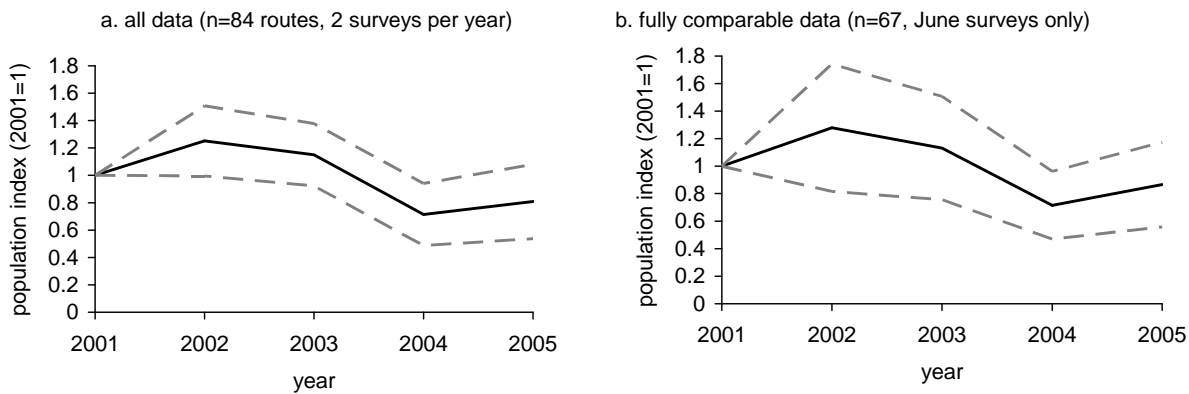


Fig. A1.43.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

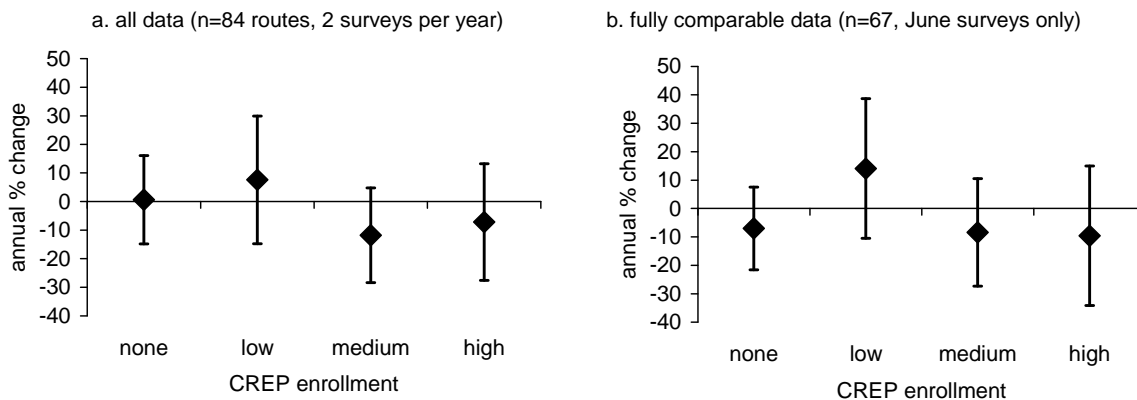
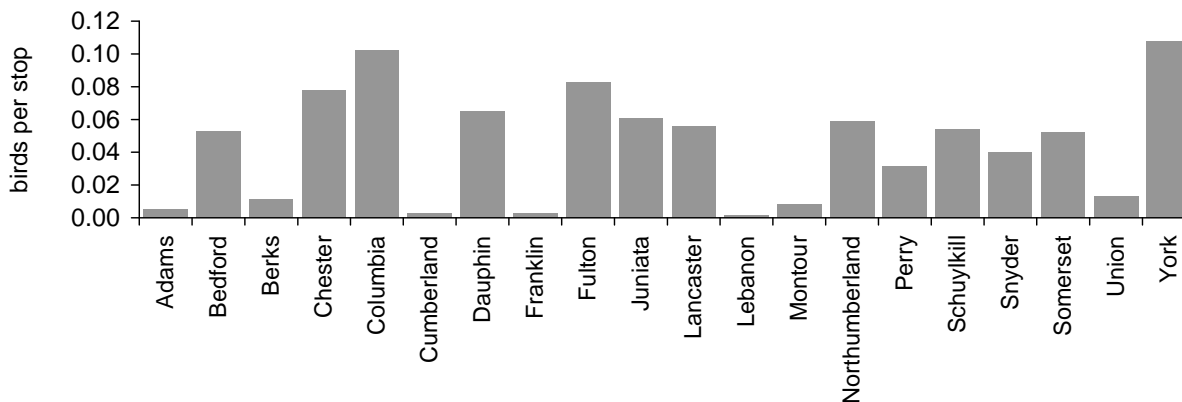


Fig. A1.43.3 Mean count per stop by county for all years



A1.44 Common Yellowthroat *Geothlypis trichas*

Moderate decline ($p < 0.05$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change -5.1% (se = 1.8)

Wald-test for CREP effect = 5.07, $p = 0.1667$

Fig. A1.44.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

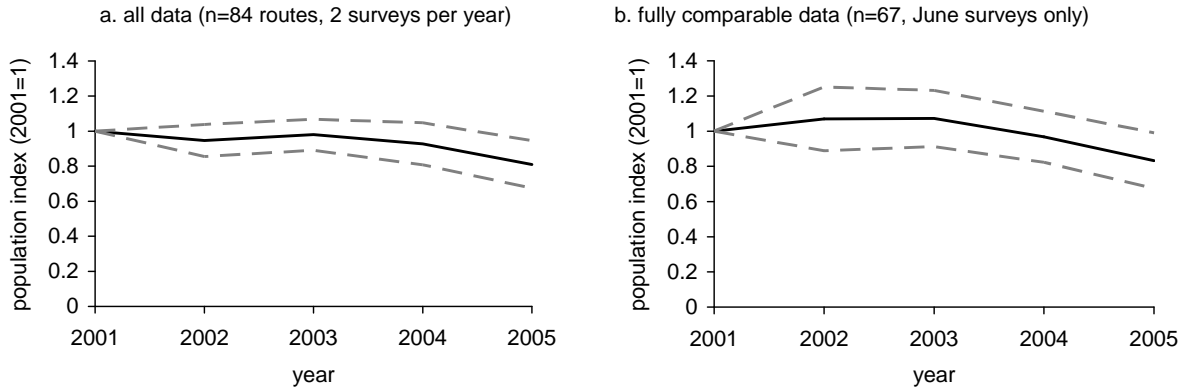


Fig. A1.44.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

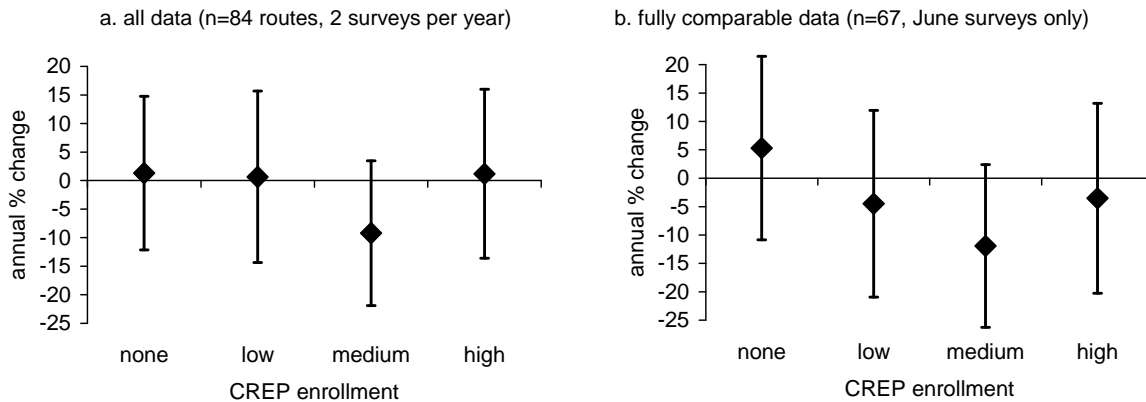
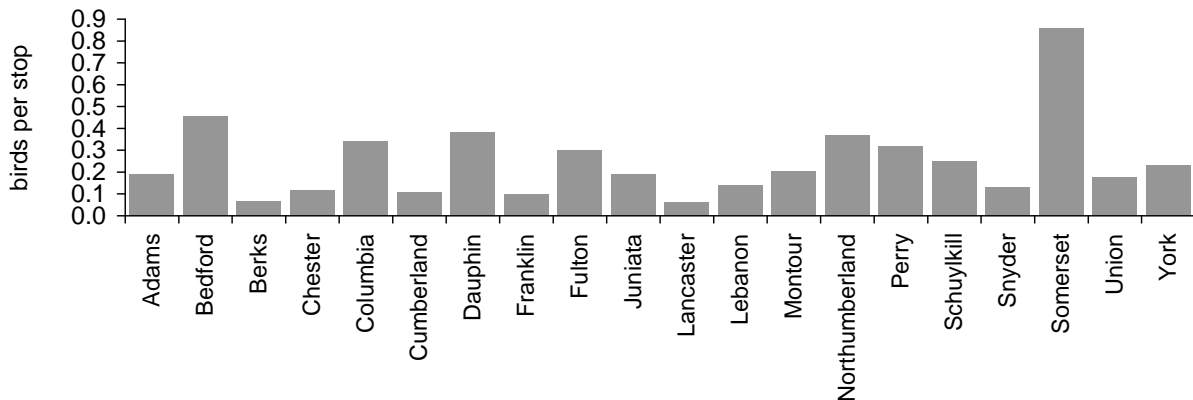


Fig. A1.44.3 Mean count per stop by county for all years



A1.45 Scarlet Tanager *Piranga olivacea*

Moderate increase ($p < 0.05$)

Effect of CREP enrollment on population trend is **significant but undetermined**

mean annual change +10.0% (se = 4.3)

Wald-test for CREP effect = 1.48, $p = 0.6876$

Fig. A1.45.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

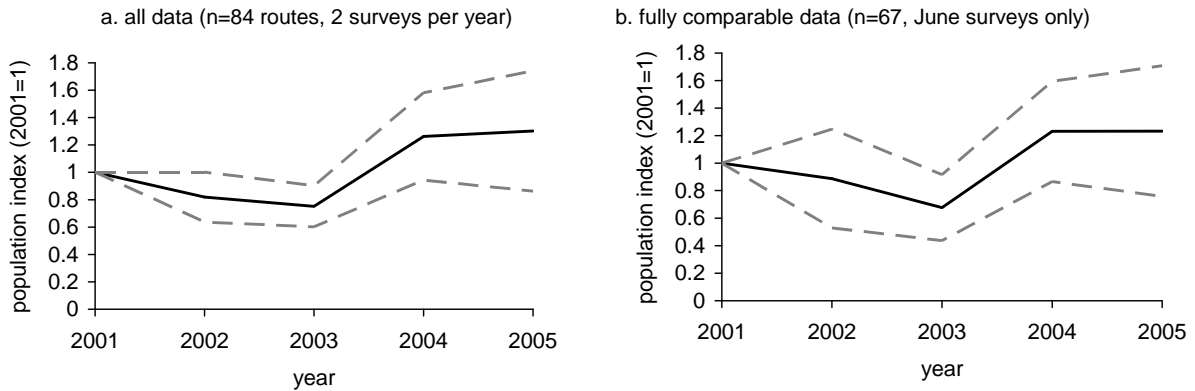


Fig. A1.45.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

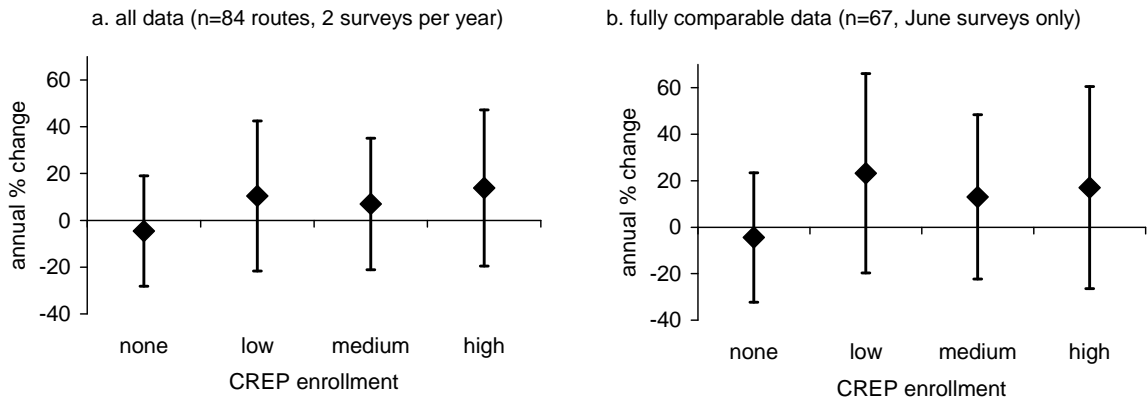
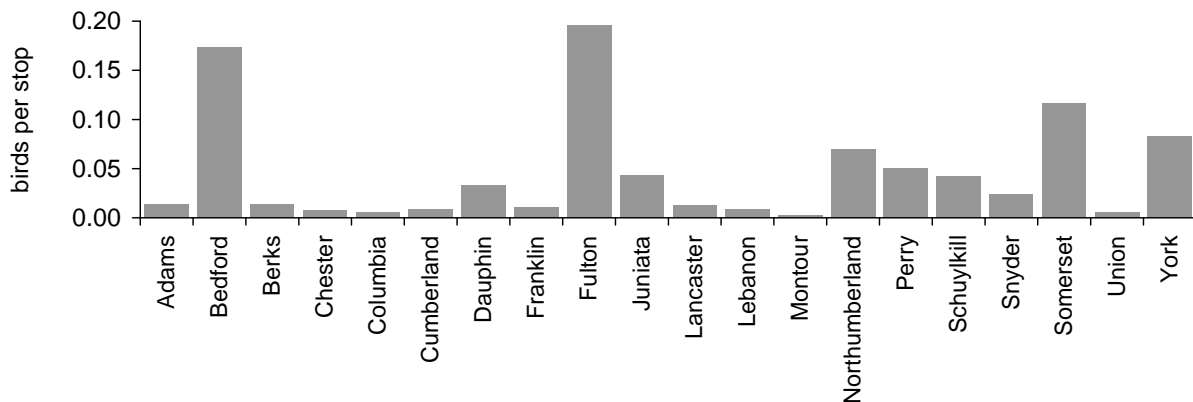


Fig. A1.45.3 Mean count per stop by county for all years



A1.46 Chipping Sparrow *Spizella passerina*

Population stable ($p < 0.05$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change -1.3% (se = 1.4)

Wald-test for CREP effect = 7.71, $p = 0.0524$

Fig. A1.46.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

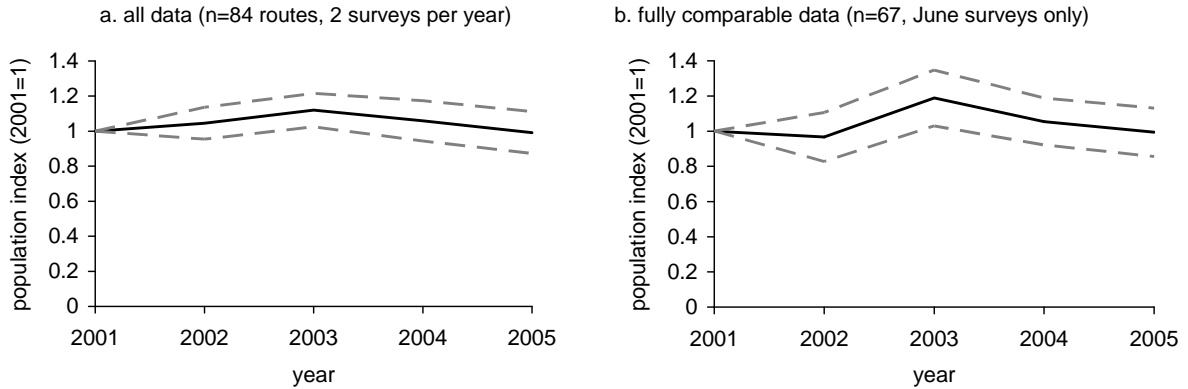


Fig. A1.46.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

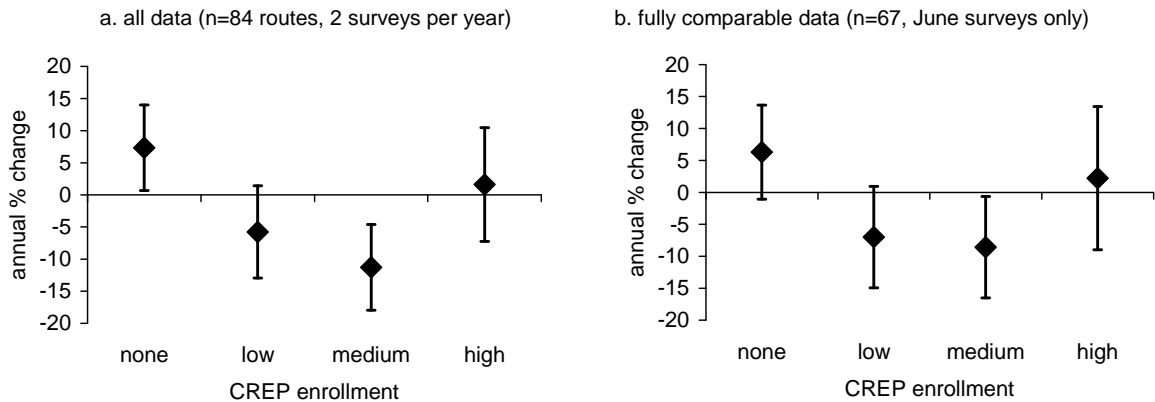
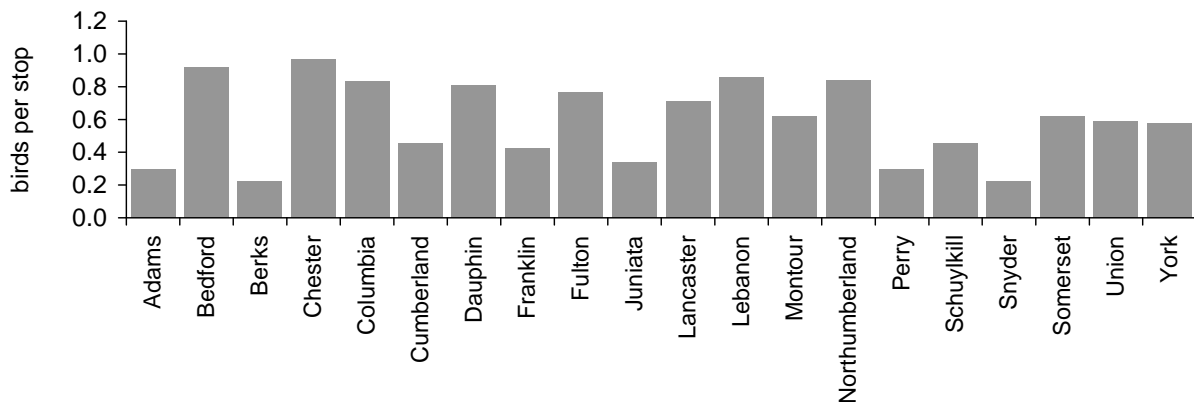


Fig. A1.46.3 Mean count per stop by county for all years



A1.47 Field Sparrow *Spizella pusilla*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is not significant

mean annual change -6.7% (se = 1.9)

Wald-test for CREP effect = 6.93, $p = 0.0743$

Fig. A1.47.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

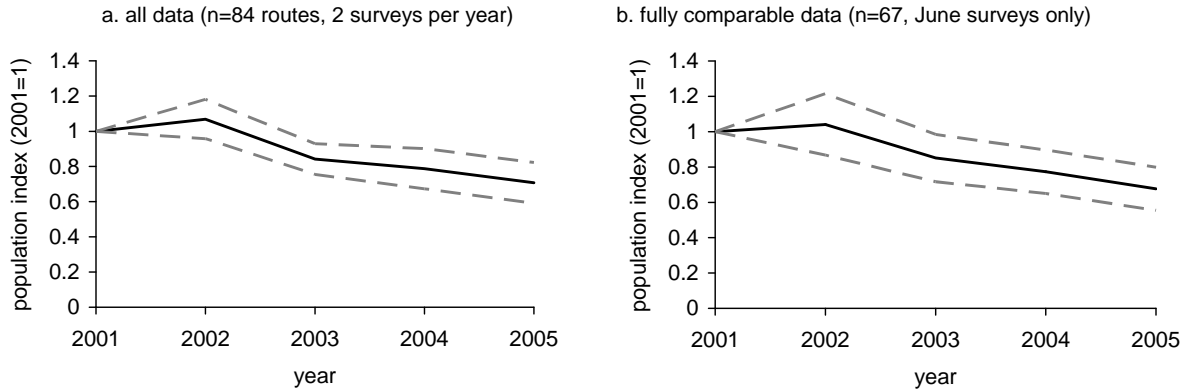


Fig. A1.47.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

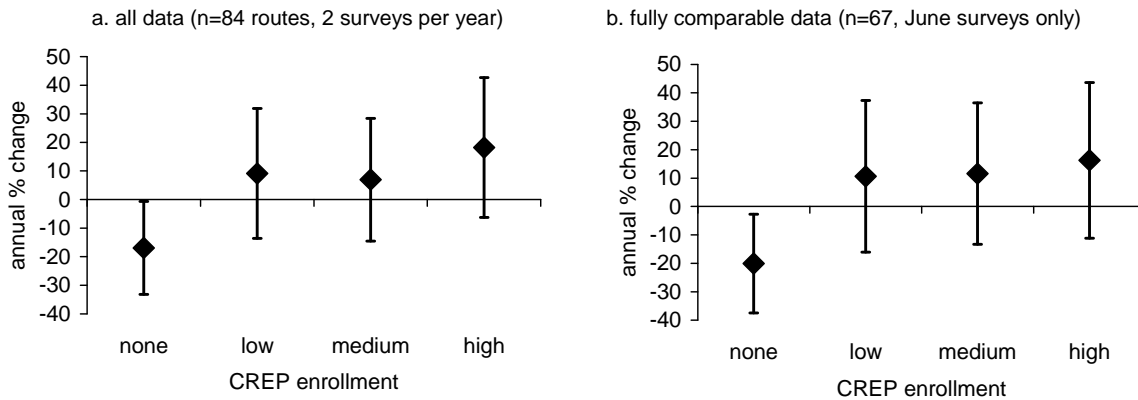
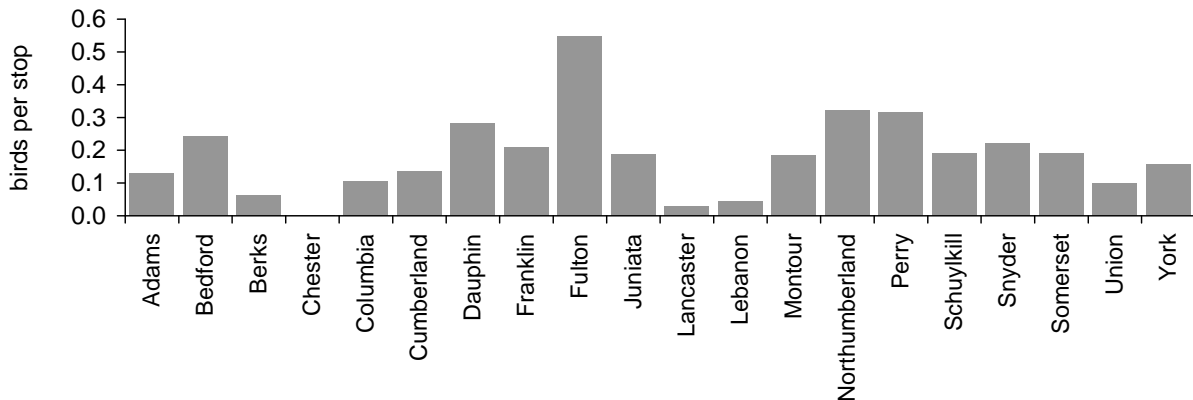


Fig. A1.47.3 Mean count per stop by county for all years



A1.48 Vesper Sparrow *Poocetes gramineus*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change -4.4% (se = 3.0)

Wald-test for CREP effect = 2.68, p = 0.4443

Fig. A1.48.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

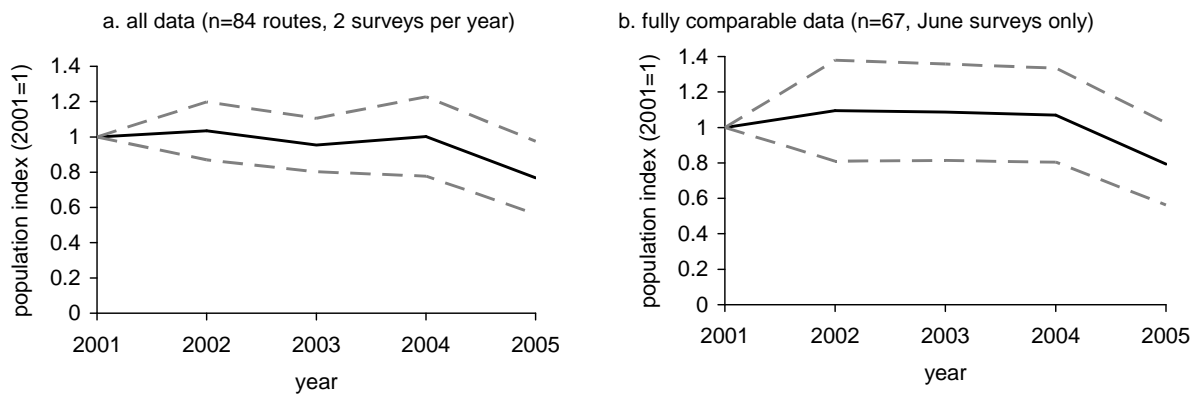


Fig. A1.48.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

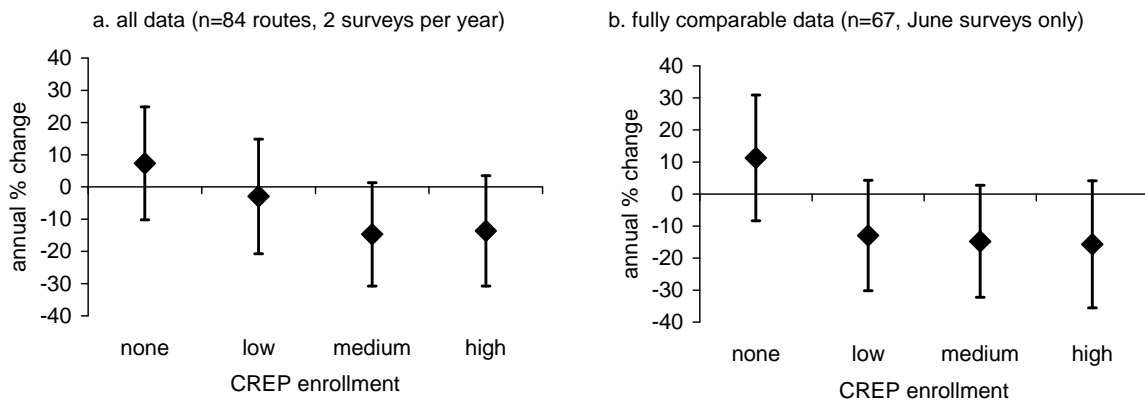
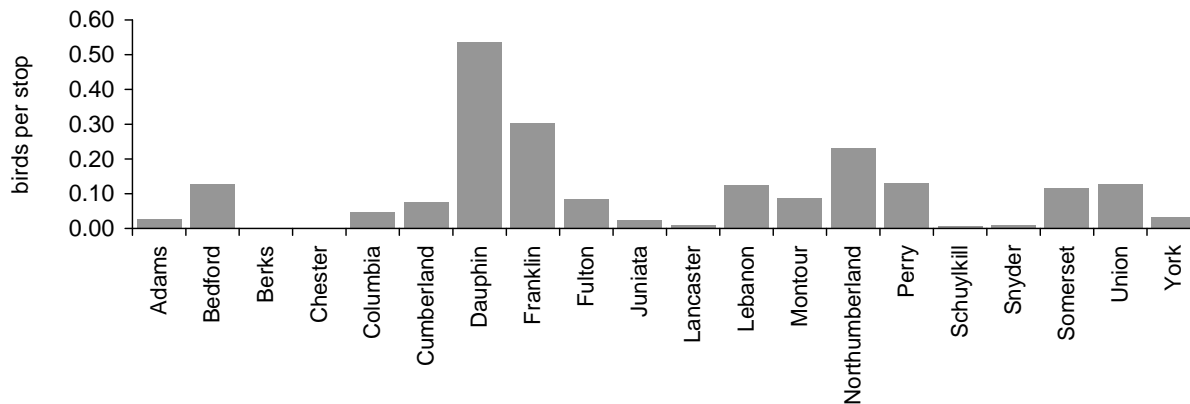


Fig. A1.48.3 Mean count per stop by county for all years



A1.49 Savannah Sparrow *Passerculus sandwichensis*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **significant but undetermined**

mean annual change -2.6% (se = 3.4)

Wald-test for CREP effect = 9.46, p = 0.0238

Fig. A1.49.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

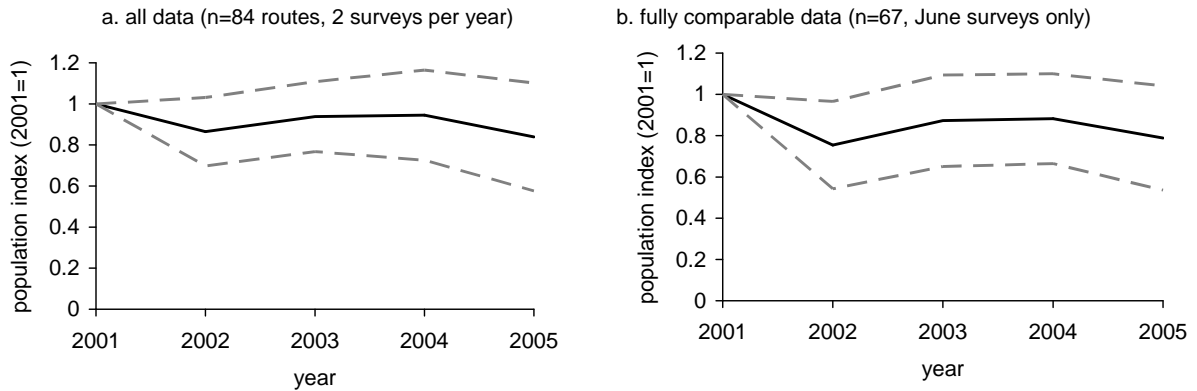


Fig. A1.49.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

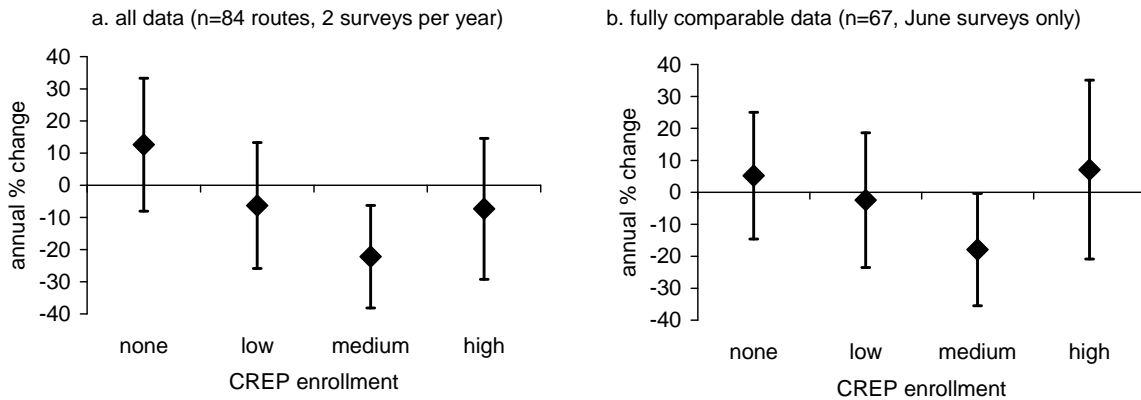
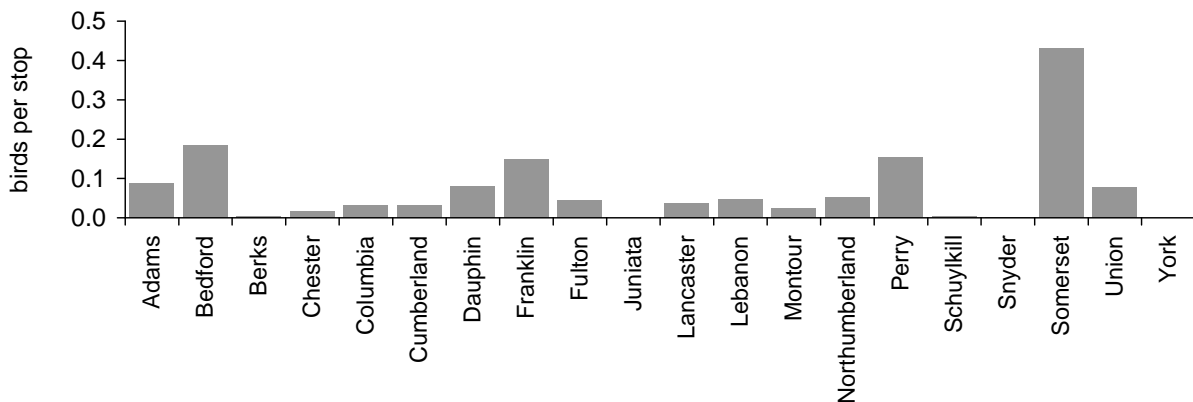


Fig. A1.49.3 Mean count per stop by county for all years



A1.50 Grasshopper Sparrow *Ammodramus savannarum*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -9.6% (se = 2.5)

Wald-test for CREP effect = 9.06, $p = 0.0285$

Fig. A1.50.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

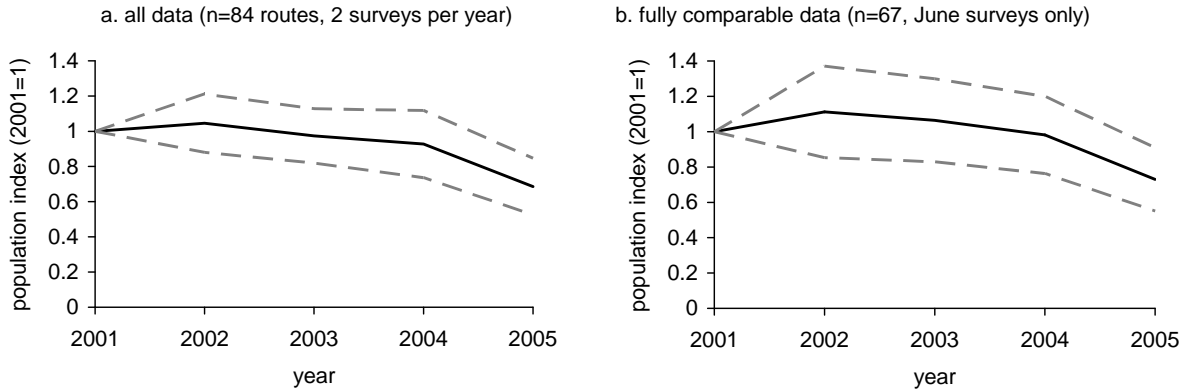


Fig. A1.50.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

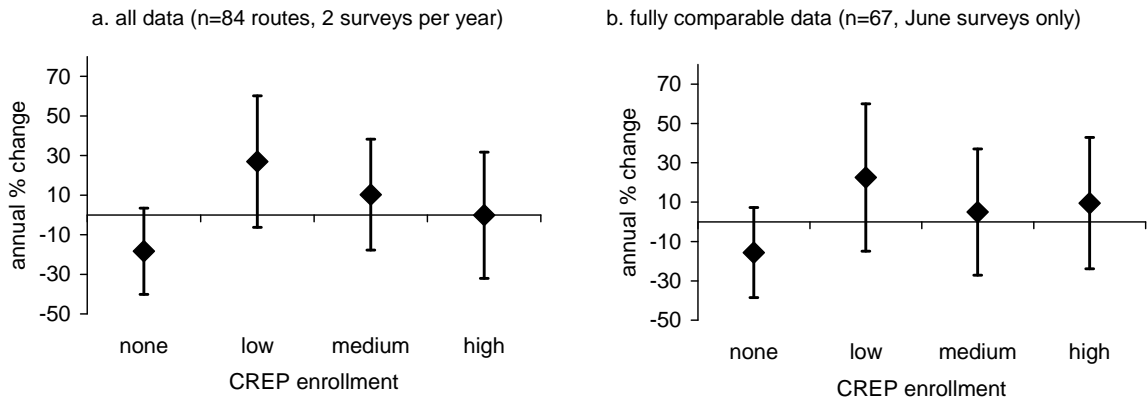
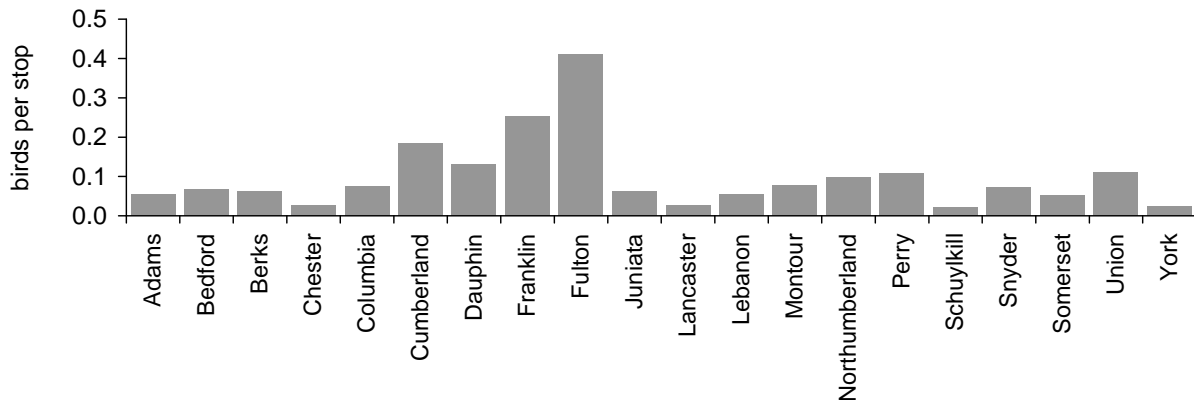


Fig. A1.50.3 Mean count per stop by county for all years



A1.51 Song Sparrow *Melospiza melodia*

Population stable

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change -1.1% (se = 1.2)

Wald-test for CREP effect = 13.8, p = 0.0032

Fig. A1.51.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

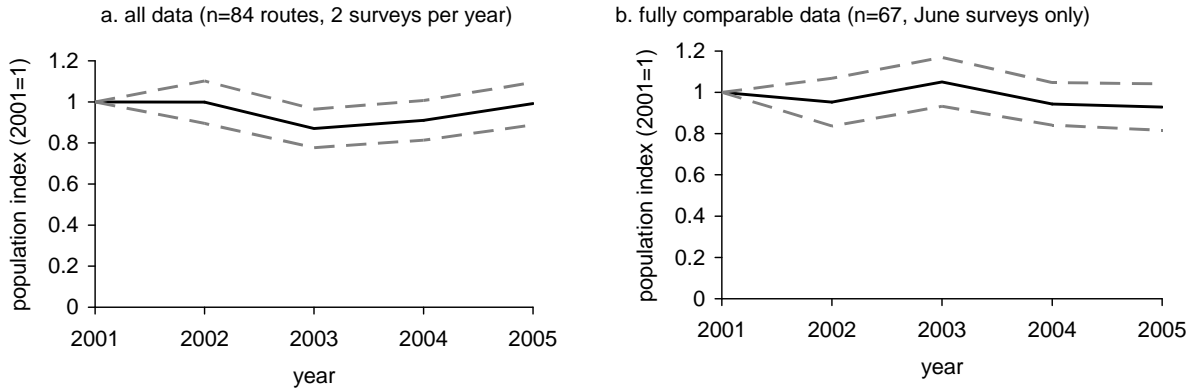


Fig. A1.51.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

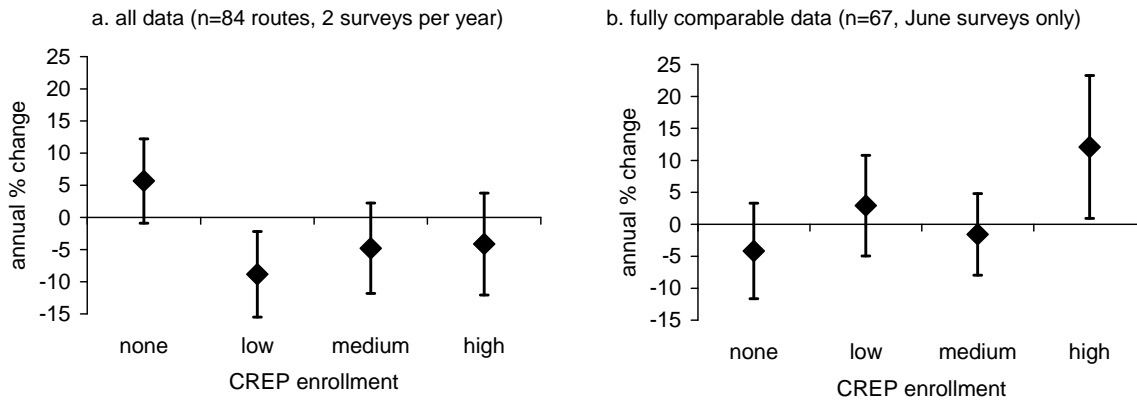
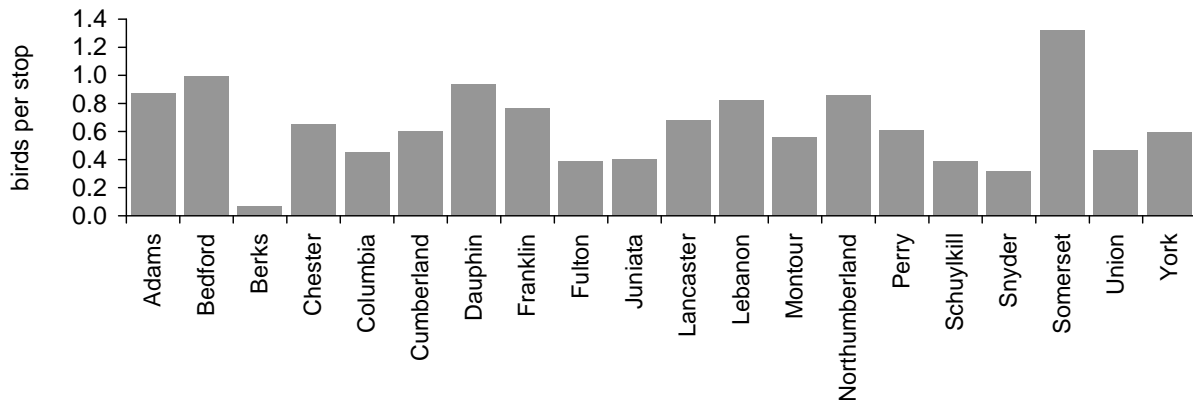


Fig. A1.51.3 Mean count per stop by county for all years



A1.52 Northern Cardinal *Cardinalis cardinalis*

Population trend **stable**

Effect of CREP enrollment on population trend is **significant but undetermined**

mean annual change +0.8% (se = 1.0)

Wald-test for CREP effect = 10.03, p = 0.0183

Fig. A1.52.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

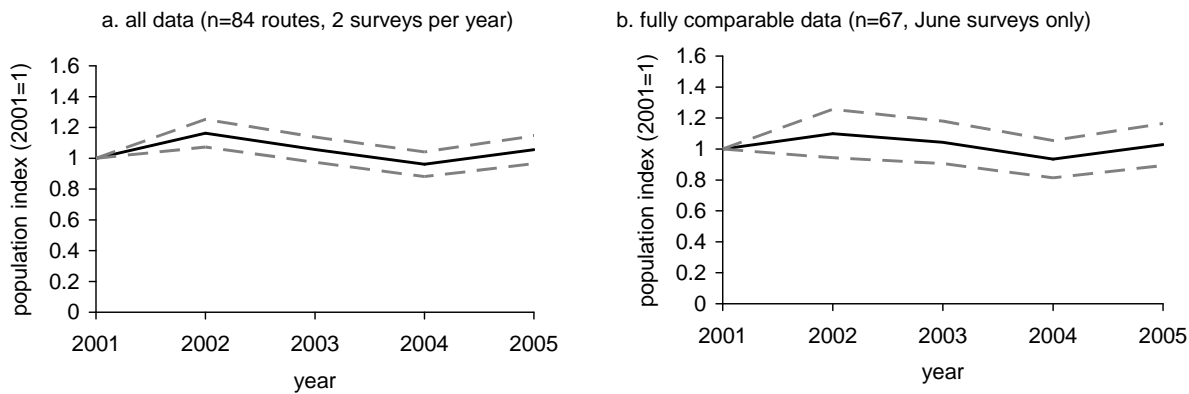


Fig. A1.52.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

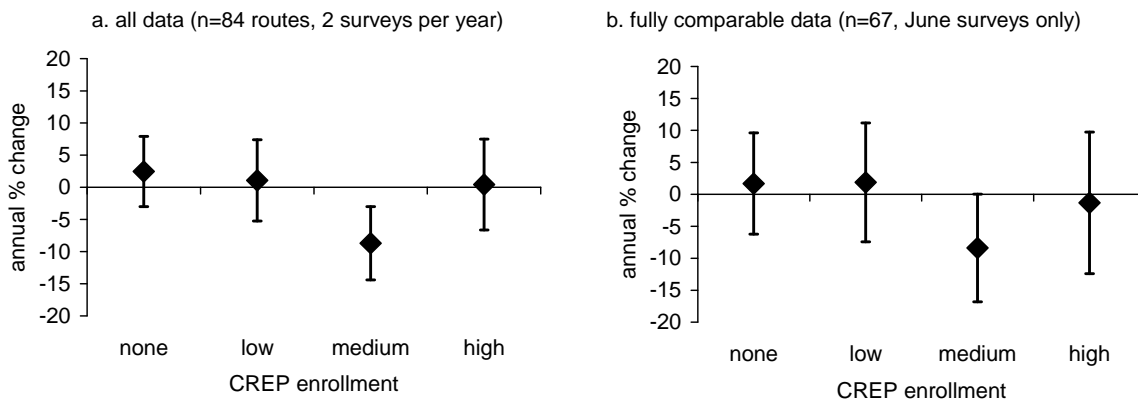
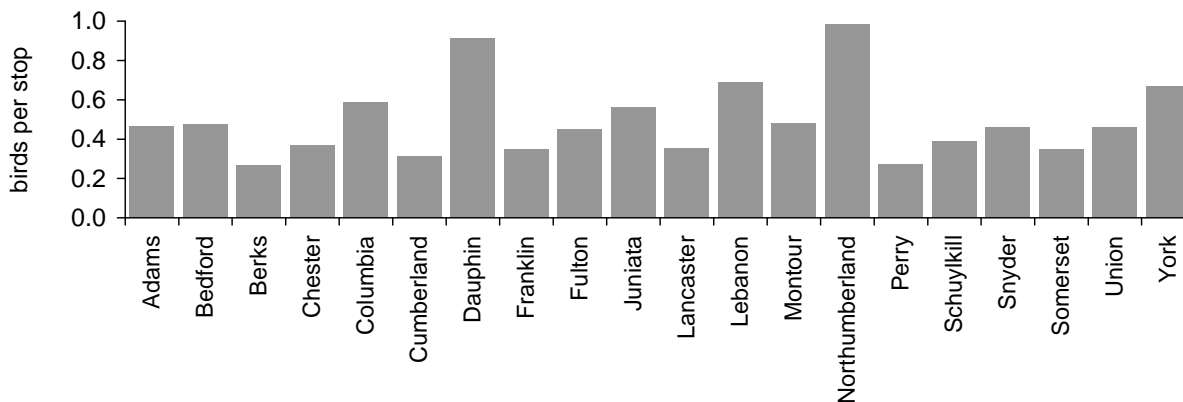


Fig. A1.52.3 Mean count per stop by county for all years



A1.53 Indigo Bunting *Passerina cyanea*

Moderate decline ($p < 0.01$)

Effect of CREP enrollment on population trend is not significant

mean annual change -5.6% (se = 1.7)

Wald-test for CREP effect = 5.45, $p = 0.1418$

Fig. A1.53.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

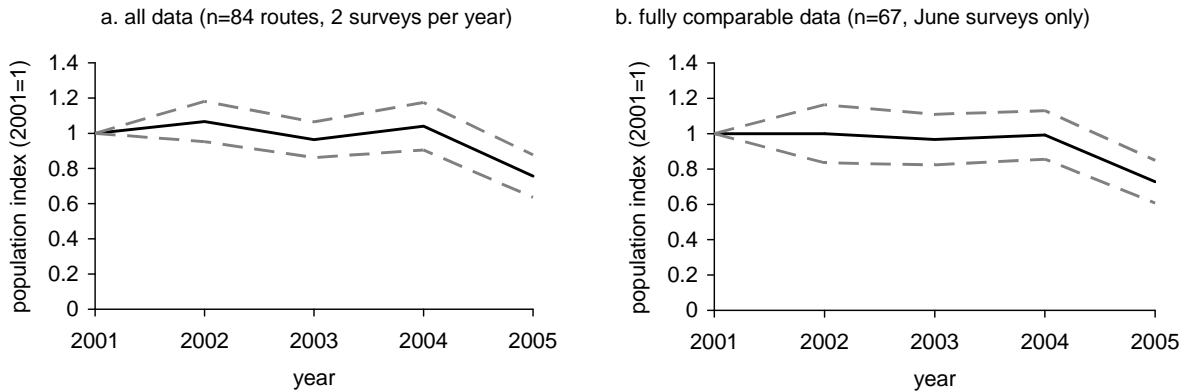


Fig. A1.53.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

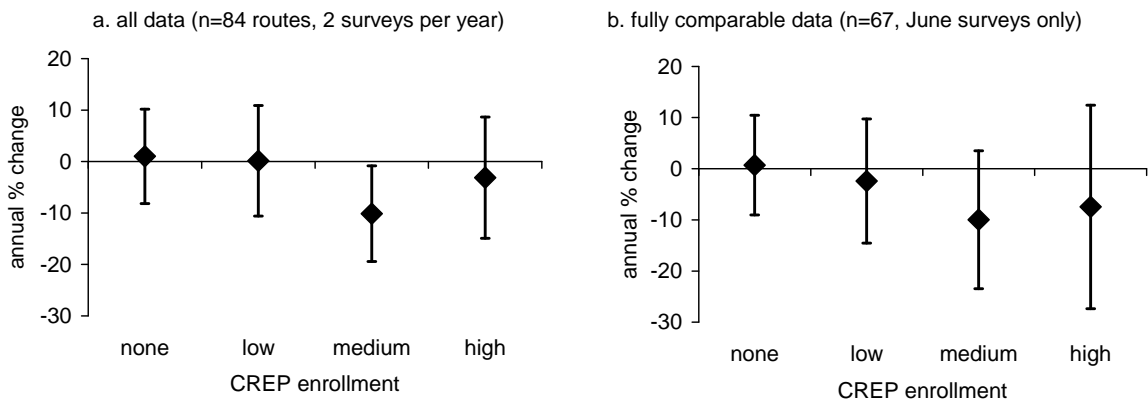
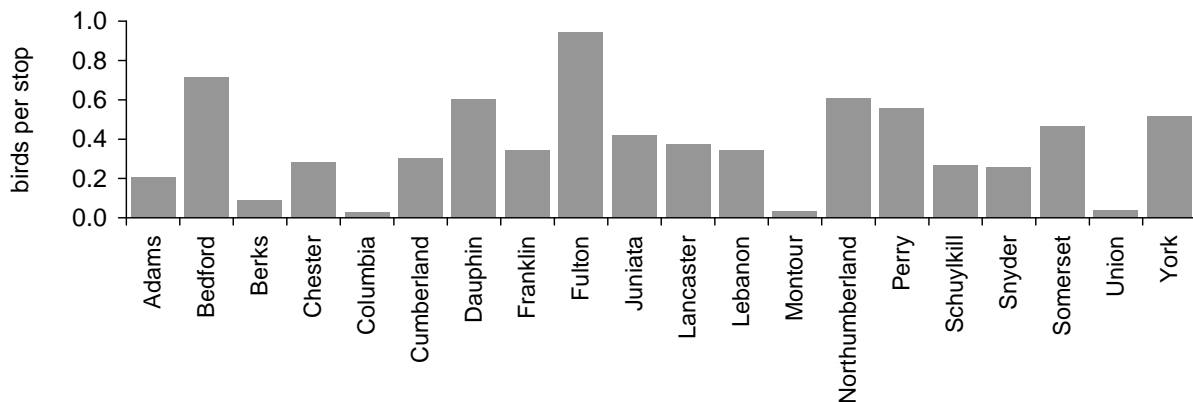


Fig. A1.53.3 Mean count per stop by county for all years



A1.54 Bobolink *Dolichonyx oryzivorus*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **not significant**

mean annual change -0.6% (se = 9.1)

Wald-test for CREP effect = 7.53, p = 0.0569

Fig. A1.54.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

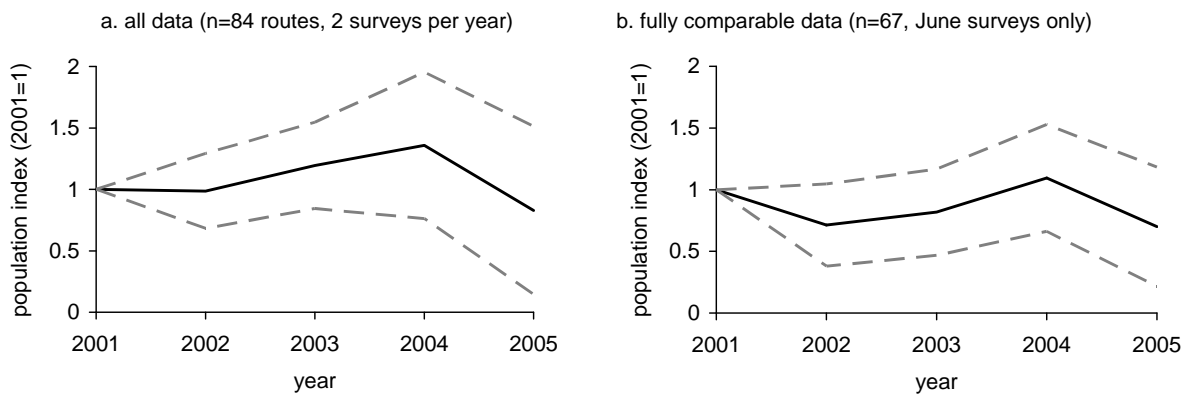


Fig. A1.54.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

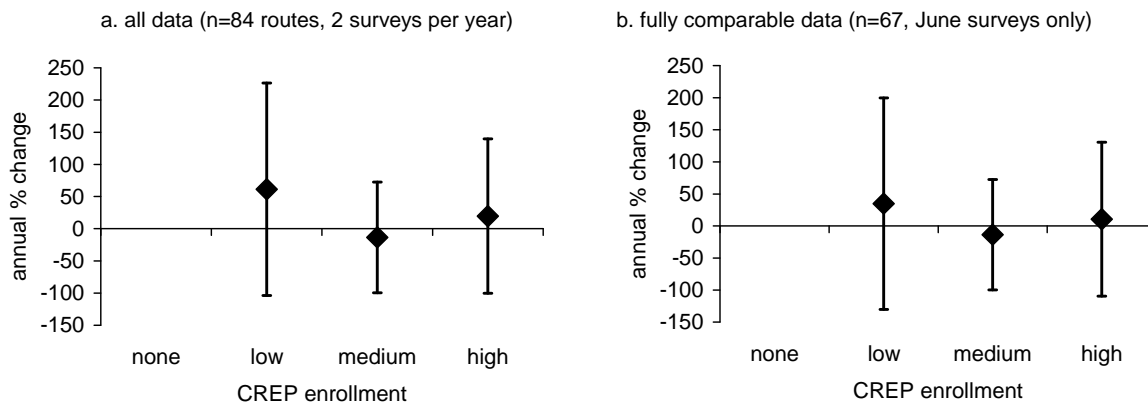
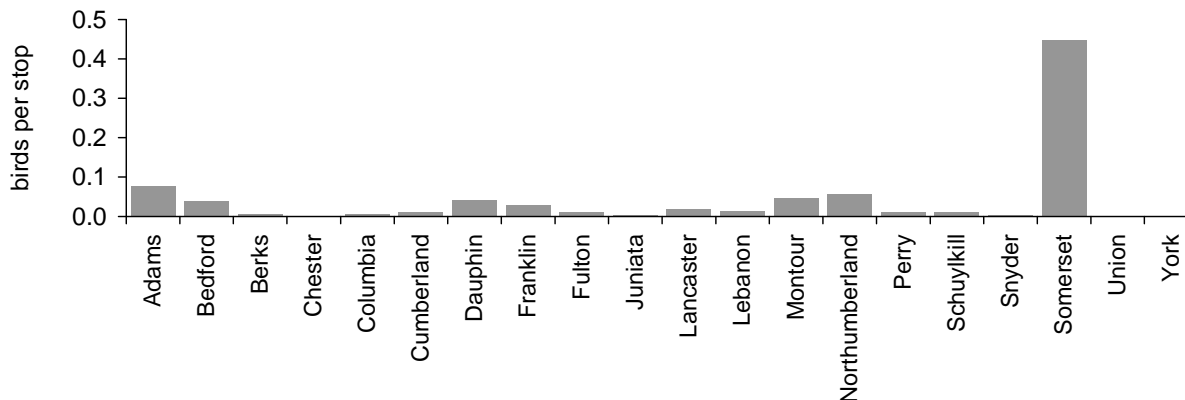


Fig. A1.54.3 Mean count per stop by county for all years



A1.55 Red-winged Blackbird *Agelaius phoeniceus*

Population stable

Effect of CREP enrollment on population trend is **not significant**

mean annual change +0.3% (se = 1.3)

Wald-test for CREP effect = 2.60, p = 0.4576

Fig. A1.55.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

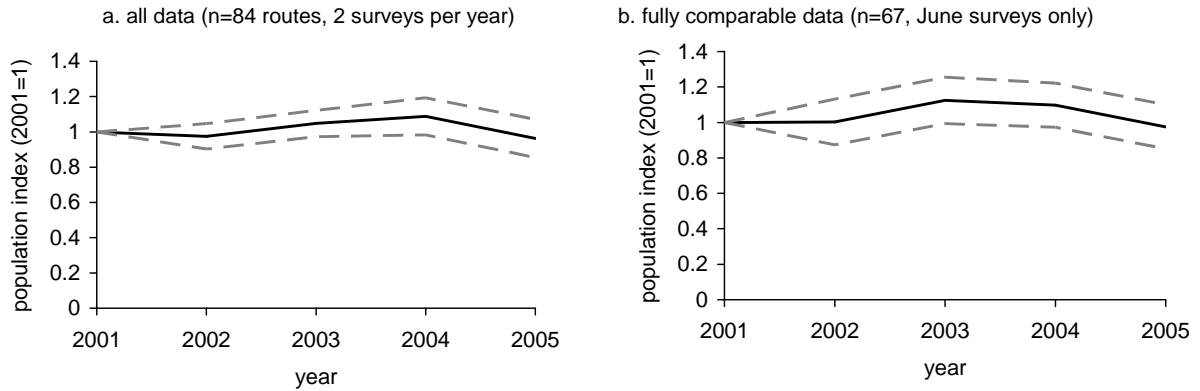


Fig. A1.55.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

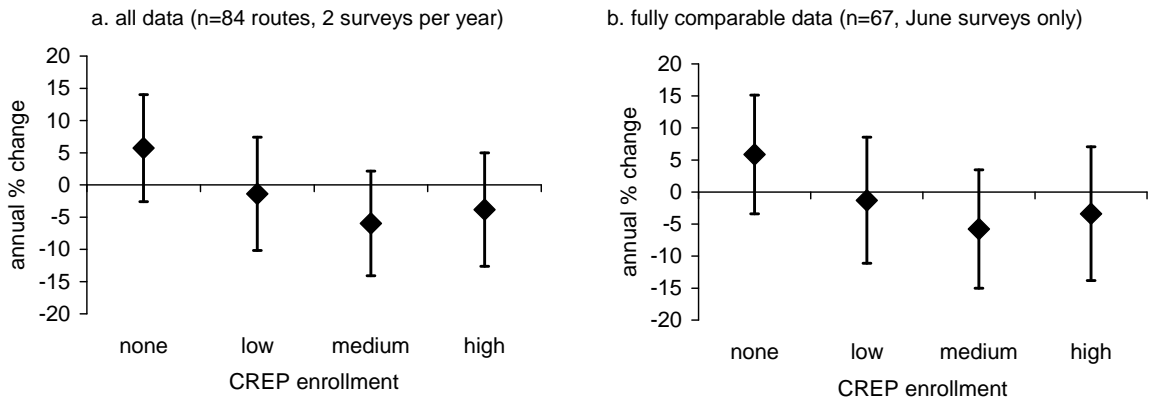
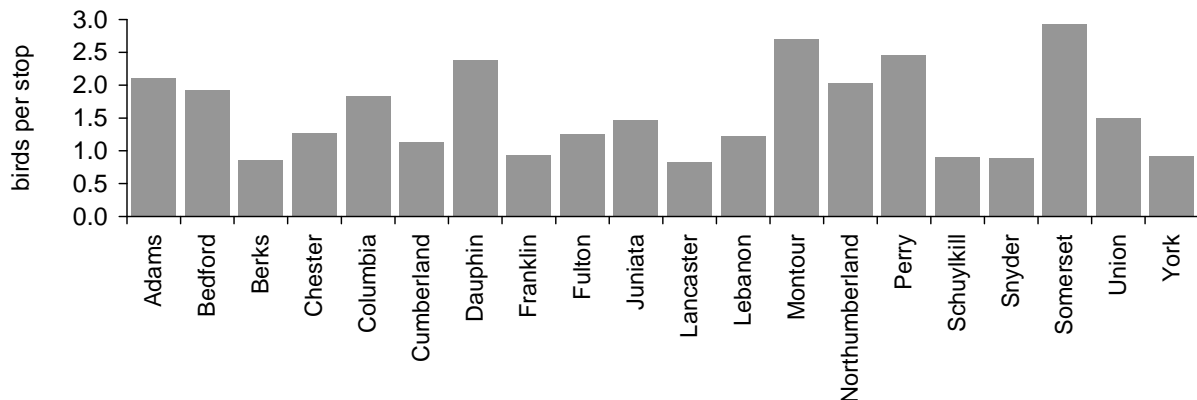


Fig. A1.55.3 Mean count per stop by county for all years



A1.56 Eastern Meadowlark *Sturnella magna*

Moderate increase ($p < 0.01$)

Effect of CREP enrollment on population trend is **significantly positive**

mean annual change +8.5% (se = 3.0)

Wald-test for CREP effect = 8.98, $p = 0.0296$

Fig. A1.56.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

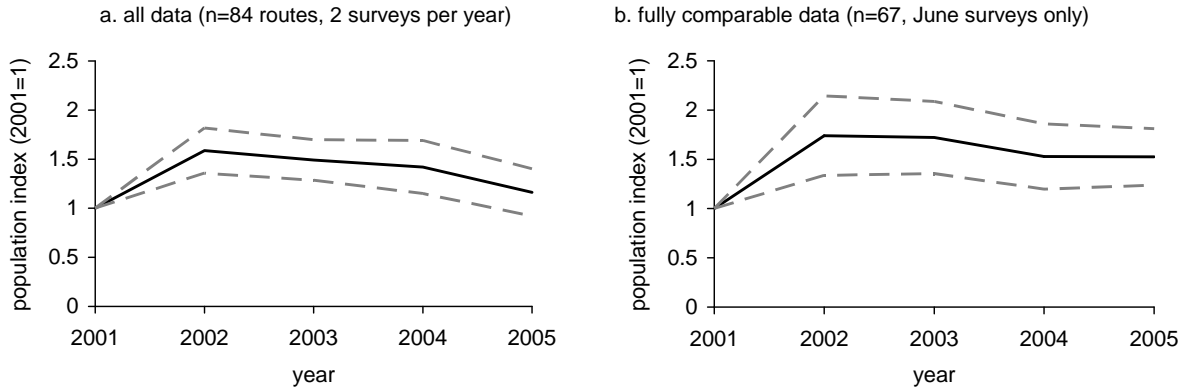


Fig. A1.56.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

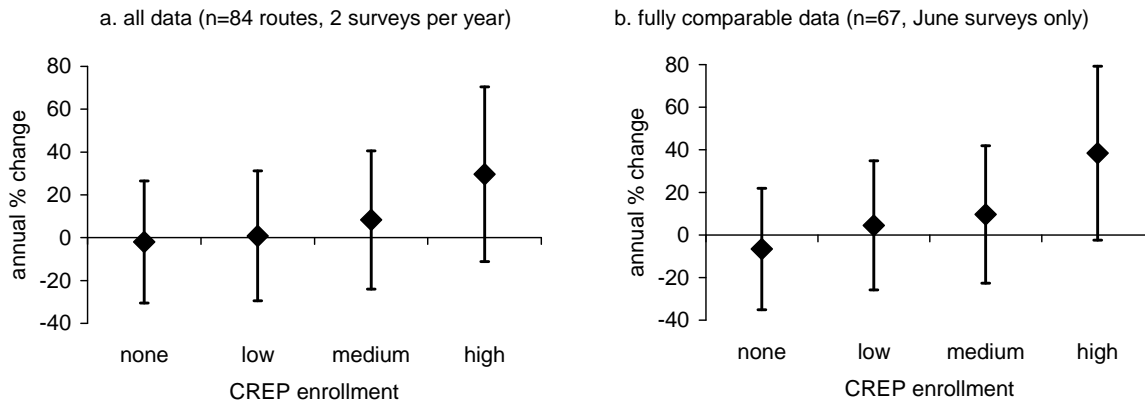
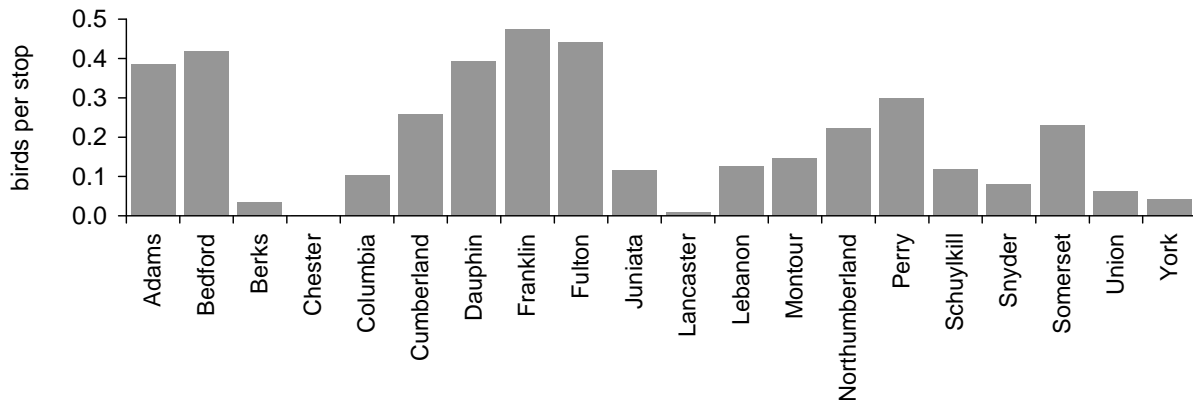


Fig. A1.56.3 Mean count per stop by county for all years



A1.57 Common Grackle *Quiscalus quiscula*

Population trend **stable**

Effect of CREP enrollment on population trend is **not significant**

mean annual change -1.4% (se = 1.4)

Wald-test for CREP effect = 3.02, p = 0.3879

Fig. A1.57.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

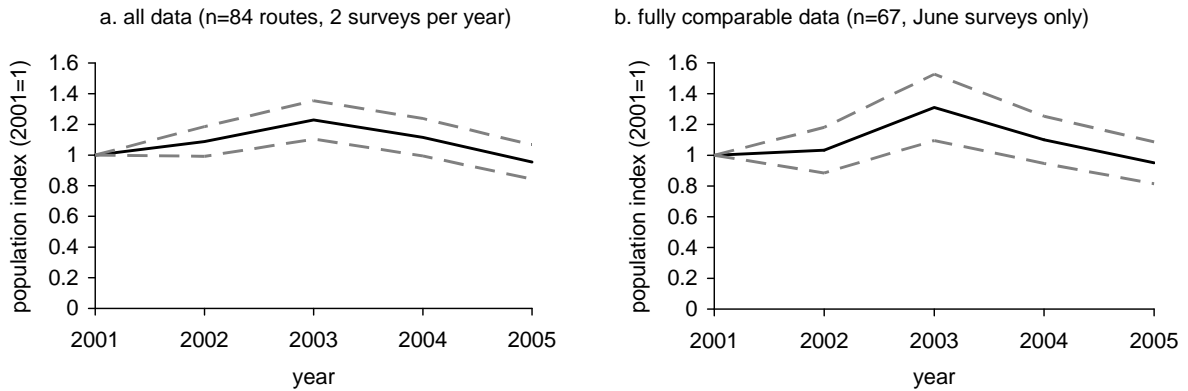


Fig. A1.57.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

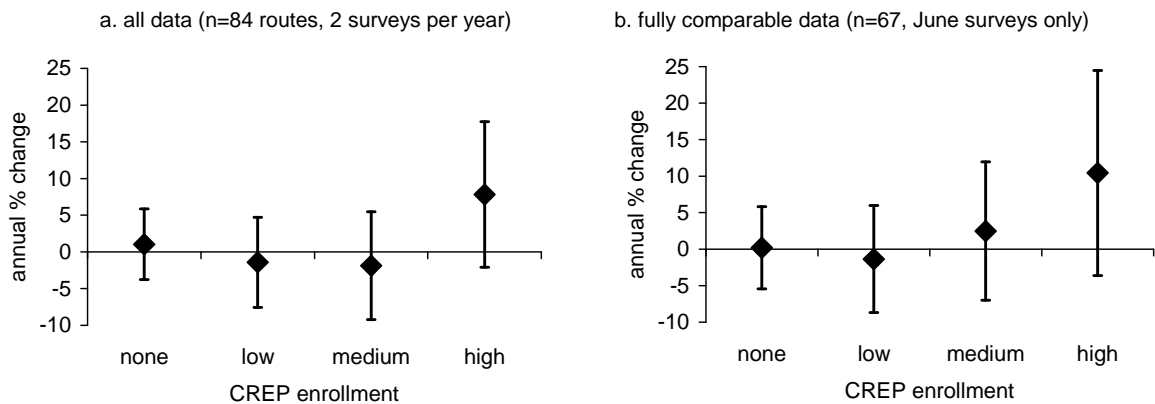
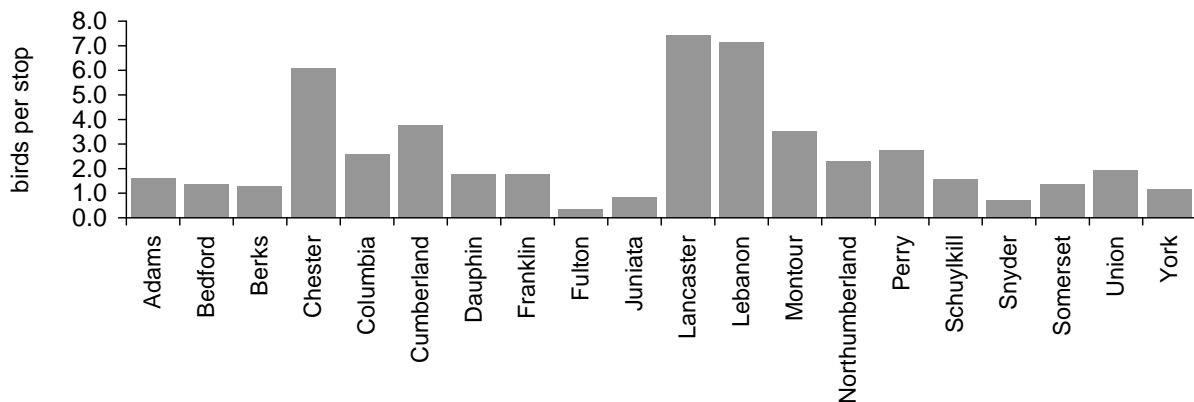


Fig. A1.57.3 Mean count per stop by county for all years



A1.58 Brown-headed Cowbird *Molothrus ater*

Population trend **uncertain**

Effect of CREP enrollment on population trend is **significantly negative**

mean annual change +1.8% (se = 3.0)

Wald-test for CREP effect = 8.12, p = 0.0436

Fig. A1.58.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

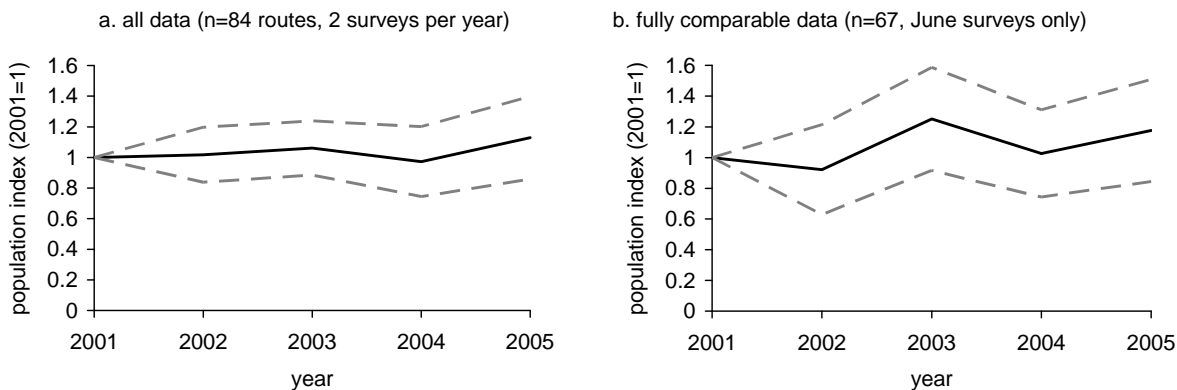


Fig. A1.58.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

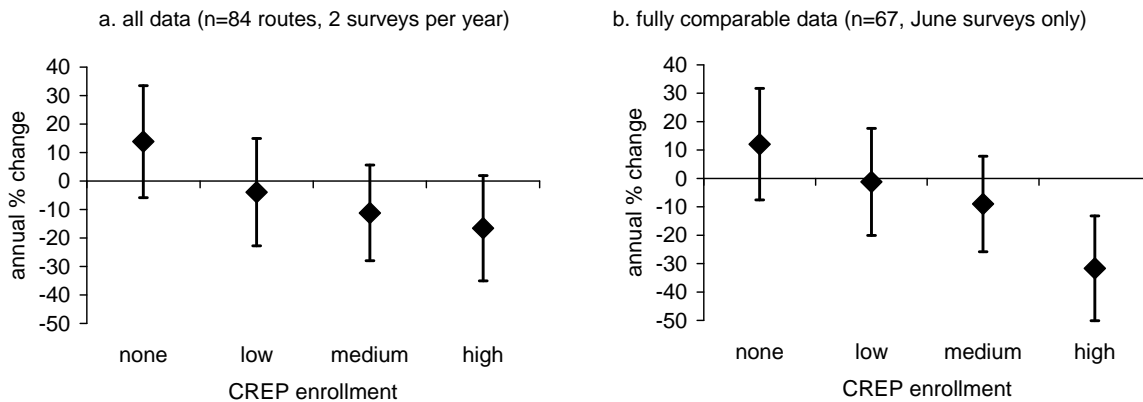
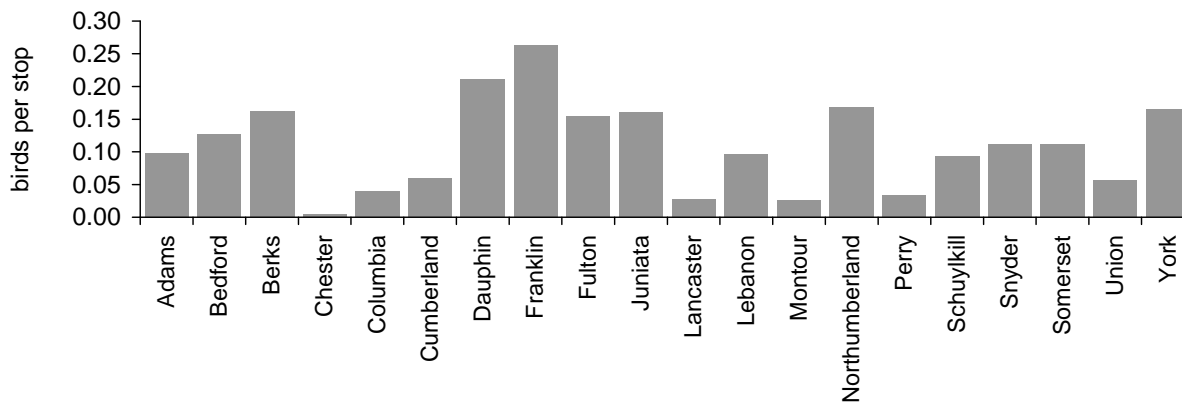


Fig. A1.58.3 Mean count per stop by county for all years



A1.59 Baltimore Oriole *Icterus galbula*

Moderate increase ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change +10.9% (se = 3.9)

Wald-test for CREP effect = 1.64, $p = 0.6502$

Fig. A1.59.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

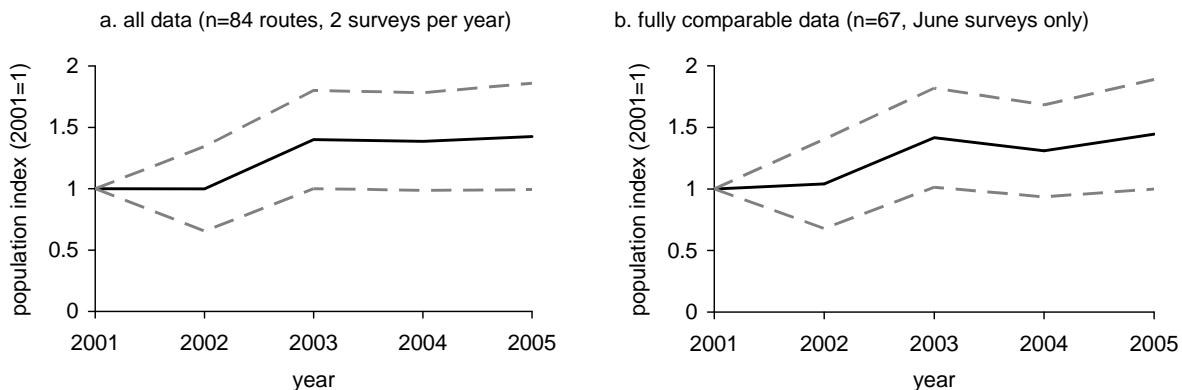


Fig. A1.59.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

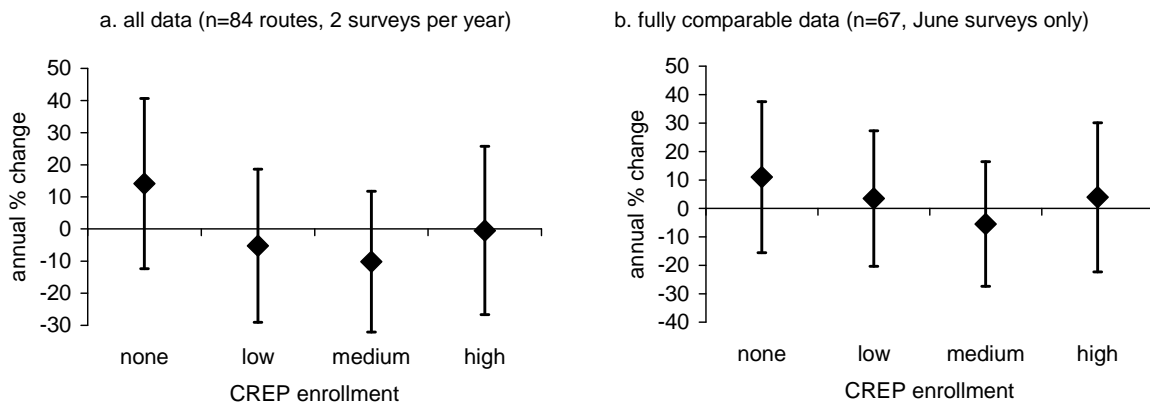
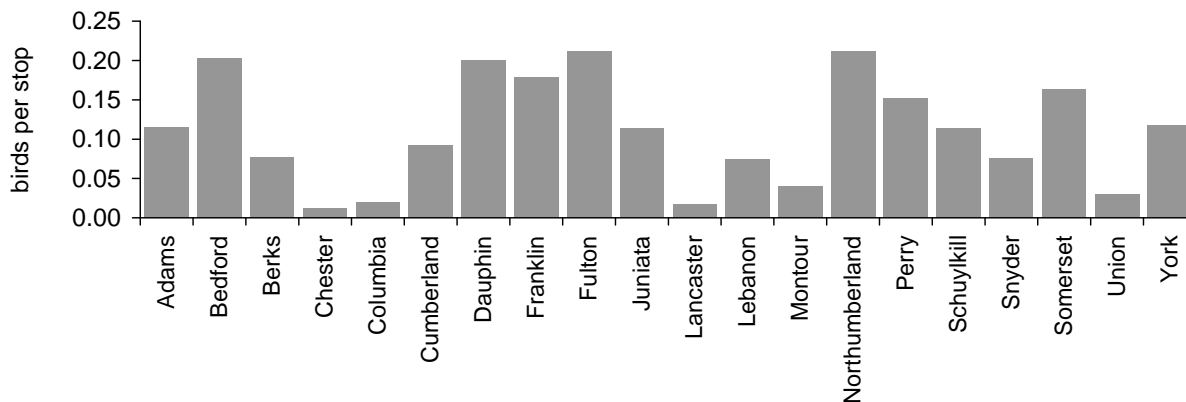


Fig. A1.59.3 Mean count per stop by county for all years



A1.60 House Finch

Steep decline ($p < 0.05$)

Effect of CREP enrollment on population trend is not **significant**

mean annual change -8.9% (se = 2.0)

Wald-test for CREP effect = 1.76, $p = 0.6232$

Fig. A1.60.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

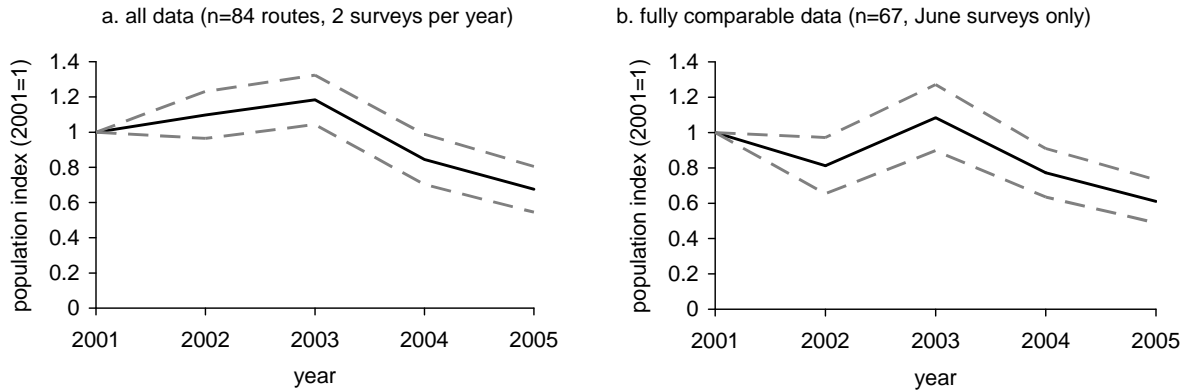


Fig. A1.60.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

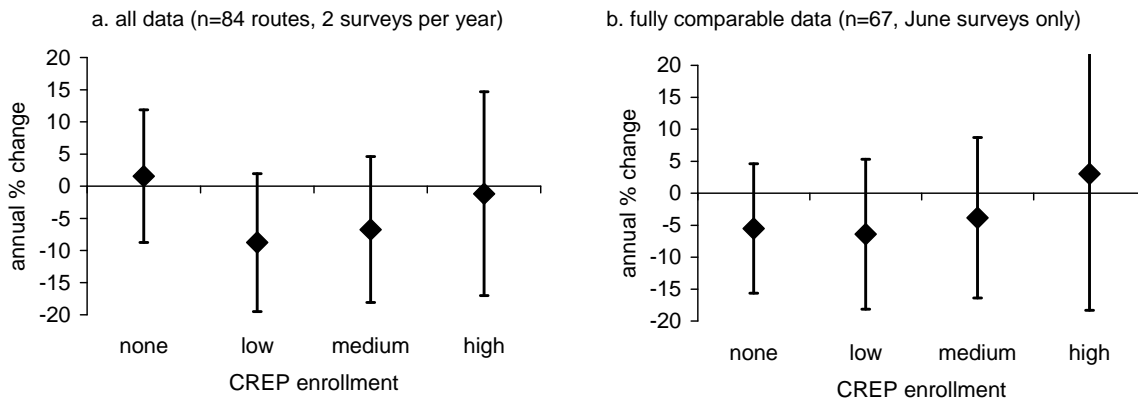
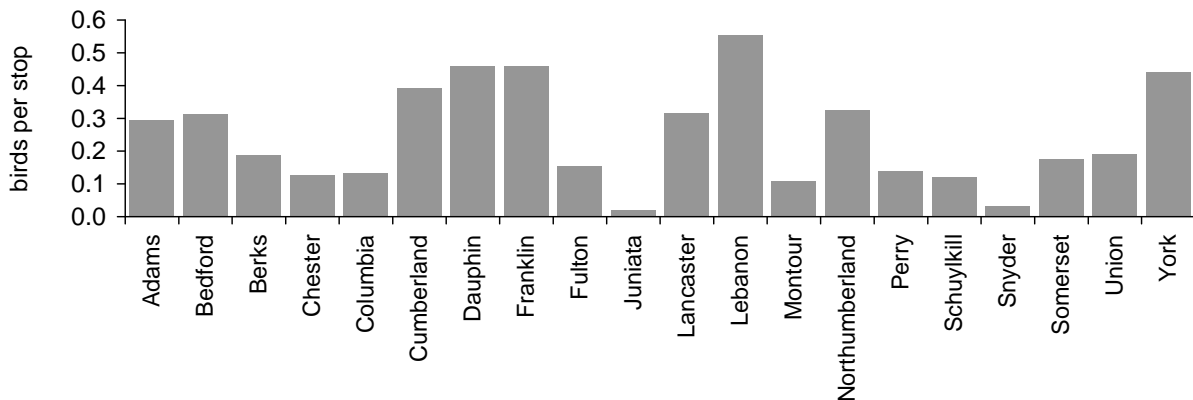


Fig. A1.60.3 Mean count per stop by county for all years



A1.61 American Goldfinch *Carduelis tristis*

Steep decline ($p < 0.01$)

Effect of CREP enrollment on population trend is **not significant**

mean annual change -9.6% (se = 1.6)

Wald-test for CREP effect = 5.41, $p = 0.1442$

Fig. A1.61.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

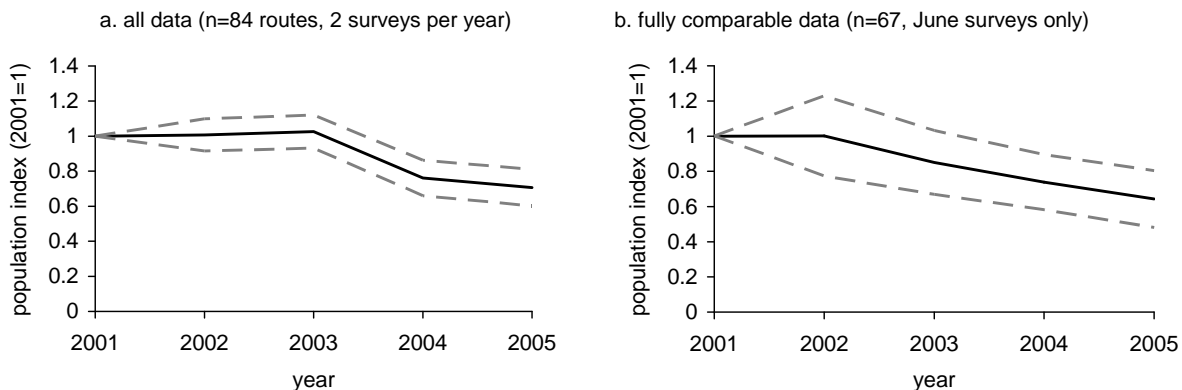


Fig. A1.61.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

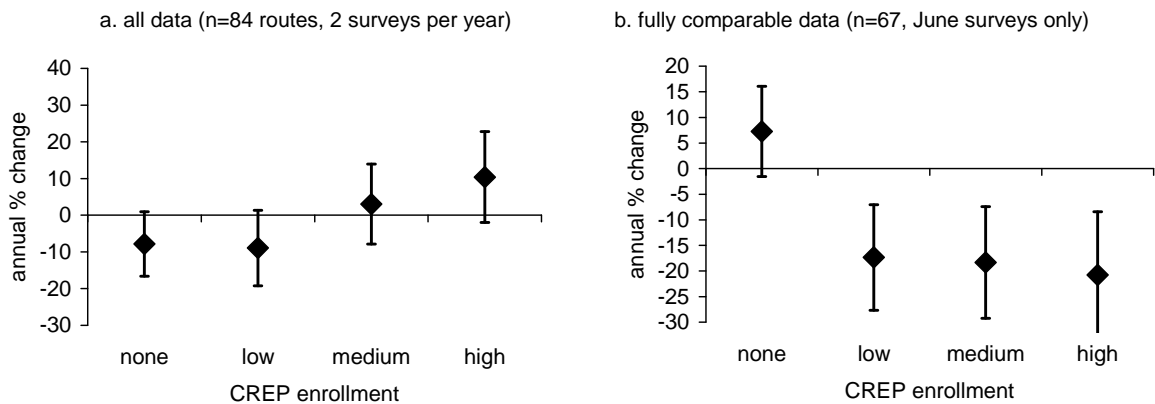
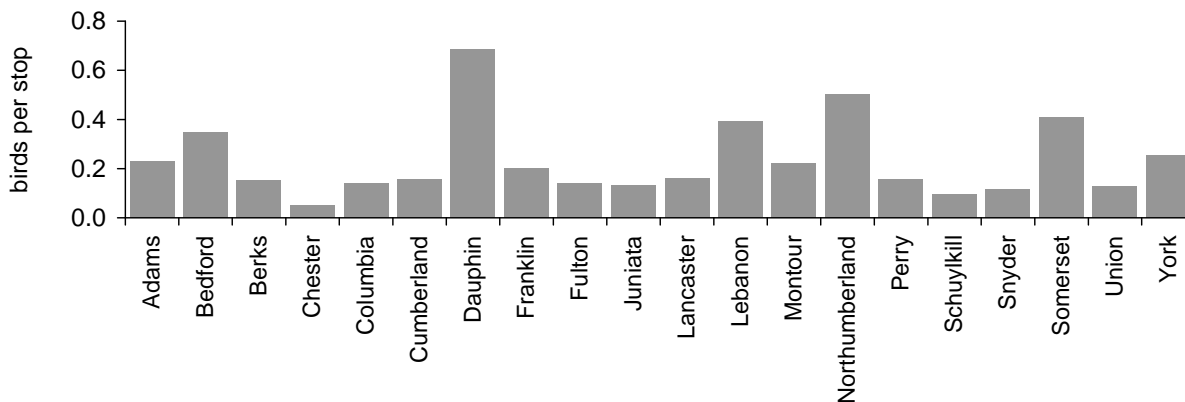


Fig. A1.61.3 Mean count per stop by county for all years



A1.62 House Sparrow *Passer domesticus*

Population trend **stable**

Effect of CREP enrollment on population trend is not **significant**

mean annual change -0.6% (se = 1.4)

Wald-test for CREP effect = 8.0, p = 0.0461

Fig. A1.62.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

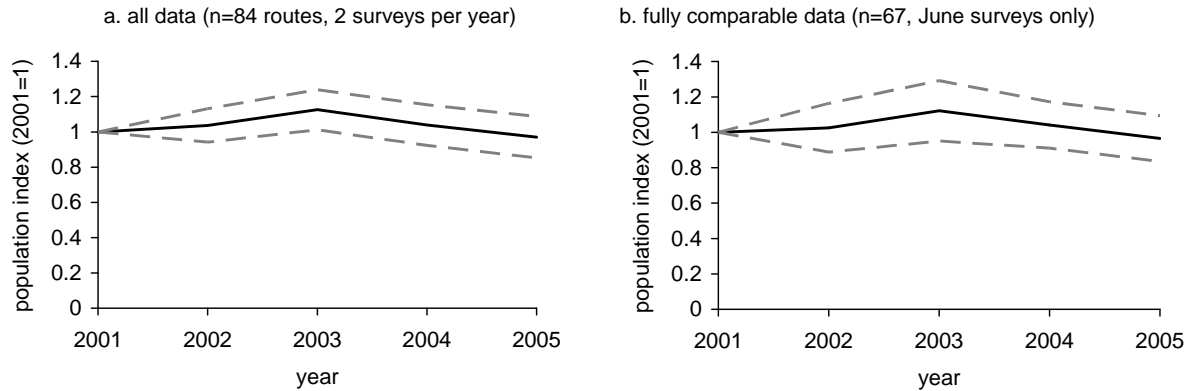


Fig. A1.62.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

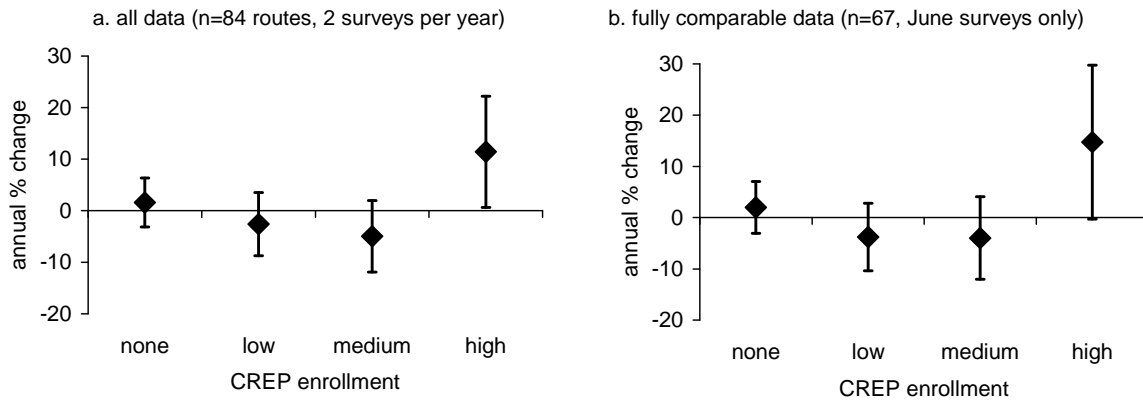
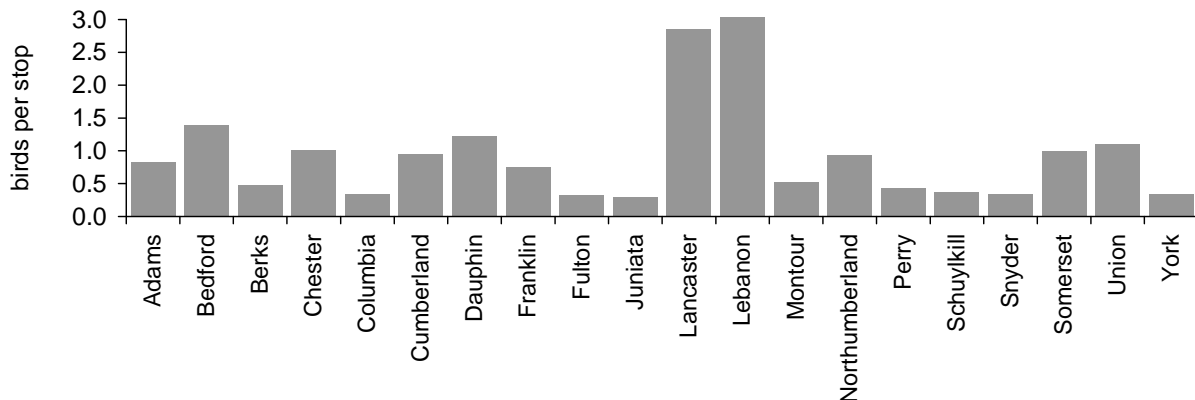


Fig. A1.62.3 Mean count per stop by county for all years



Cottontail Rabbit *Sylvilagus floridanus*

Moderate increase ($p < 0.05$)
Effect of CREP enrollment on population trend is **not significant**

mean annual change +6.3% (se = 3.2)
Wald-test for CREP effect = 0.94, $p = 0.8160$

Fig. A1.63.1 Population trend between 2001 and 2005 (dotted line = 95% confidence limits)

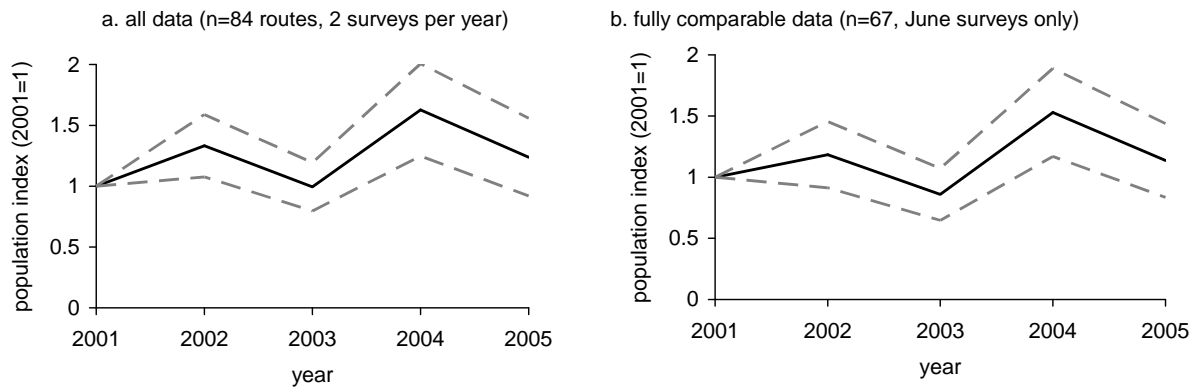


Fig. A1.63.2 Annual population change (95% confidence limits) by CREP enrollment rate

(rate is the mean % of farmland in CREP 2001-2005: none=0, low<0.5, medium=0.5-2.3, high>2.3)

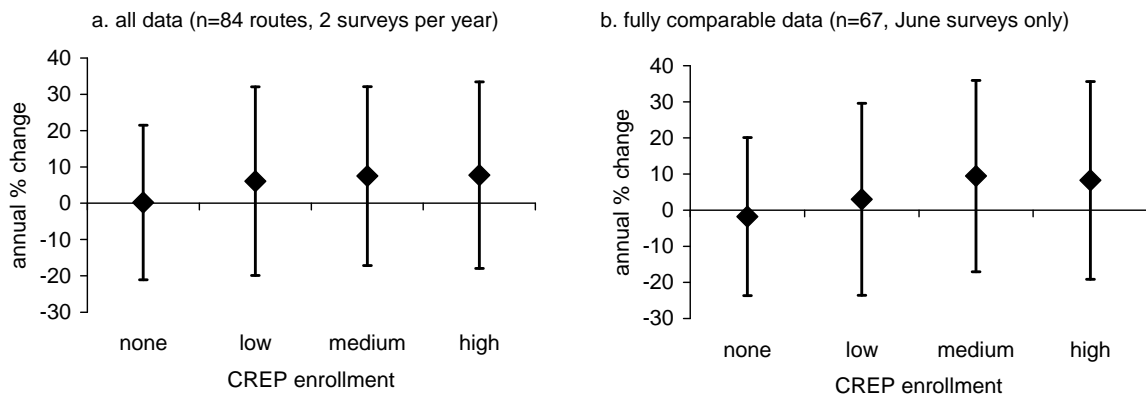
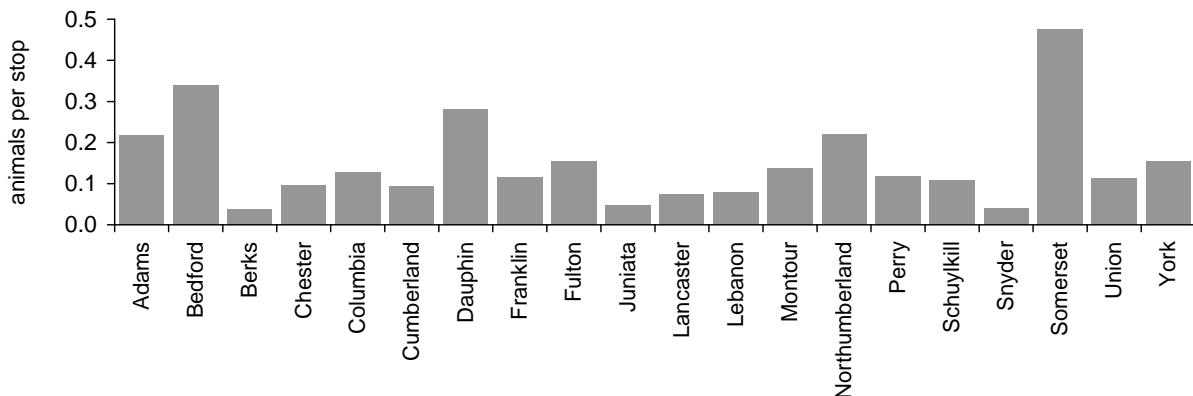


Fig. A1.63.3 Mean count per stop by county for all years



Appendix 2. List of survey routes, number of stops, and observer.

County	Route	Number of stops	Observer
Adams	ADA1	47	Pete Robinson
	ADA2	34	Pete Robinson
	ADA3	32	Pete Robinson
Bedford	BED1	50	Bob Mulvihill
	BED2	44	Bob Mulvihill
	BED3	50	Bob Mulvihill
	BED4	50	Bob Mulvihill
Berks	BER1	24	Patti Barber
	BER2	28	Patti Barber
	BER3	28	Patti Barber
	BER4	22	Patti Barber
	BER5	28	Patti Barber
	BER6	27	Patti Barber
Chester	CHE1	22	Anne Bodling
	CHE2	22	Anne Bodling
	CHE3	23	Anne Bodling
Columbia	COL1	27	Wayne Laubscher
	COL2	22	Wayne Laubscher
	COL3	21	Wayne Laubscher
	COL4	29	Wayne Laubscher
Cumberland	CUM1	39	Don Orris/ Deb Siefkin
	CUM2	40	Don Orris/ Deb Siefkin
	CUM3	31	Don Orris/ Deb Siefkin
	CUM4	48	Don Orris/ Deb Siefkin
	CUM5	40	Don Orris/ Deb Siefkin
Dauphin	DAU1	40	Deuane Hoffman
	DAU2	32	Deuane Hoffman
	DAU3	31	Deuane Hoffman
Franklin	FRA1	44	Dan Snell
	FRA2	30	Dan Snell
	FRA3	36	Dan Snell
	FRA4	36	Dan Snell

Appendix 2 (cont.). List of routes, number of stops, and observer.

County	Route	Number of	Observer
Franklin	FRA5	31	Dan Snell
	FRA6	42	Dan Snell
	FRA7	39	Dan Snell
	FRA8	42	Dan Snell
	FRA9	34	Dan Snell
Fulton	FUL1	25	Dan Snell
	FUL2	28	Dan Snell
	FUL3	30	Bob Mulvihill
	FUL4	27	Dan Snell
Juniata	JUN1	38	Hunter Hart
	JUN2	43	Hunter Hart
	JUN3	37	Hunter Hart
	JUN4	44	Hunter Hart
	JUN5	24	Hunter Hart
	JUN6	42	Hunter Hart
Lancaster	LAN1	43	Anne Bodling
	LAN2	38	Anne Bodling
	LAN3	35	Anne Bodling
	LAN4	50	Anne Bodling
	LAN5	34	Anne Bodling
	LAN6	28	Anne Bodling
	LAN7	36	Anne Bodling
Lebanon	LEB1	27	Anne Bodling
	LEB2	28	Anne Bodling
	LEB3	28	Deuane Hoffman
	LEB4	30	Deuane Hoffman
Montour	MON1	22	Wayne Laubscher
	MON2	25	Wayne Laubscher
Northumberland	NOR1	21	Deuane Hoffman
	NOR2	22	Deuane Hoffman
	NOR3	26	Deuane Hoffman
	NOR4	23	Deuane Hoffman
	NOR5	20	Wayne Laubscher
	NOR6	21	Wayne Laubscher
	NOR7	24	Deuane Hoffman

Appendix 2 (cont.). List of routes, number of stops, and observer.

County	Route	Number of stops	Observer
Perry	PER1	39	Don Orris
	PER2	41	Don Orris
Schuykill	SCH1	24	Patti Barber/ Dave Krue/ Mike Ward
	SCH2	29	Patti Barber/ Dave Krue/ Mike Ward
	SCH3	46	Patti Barber/ Dave Krue/ Mike Ward
	SCH4	0	Patti Barber/ Dave Krue/ Mike Ward
Somerset	SOM1	50	Bob Mulvihill
	SOM2	50	Bob Mulvihill
	SOM3	36	Bob Mulvihill
Snyder	SNY1	35	George Boone
	SNY2	48	George Boone
	SNY3	40	George Boone
	SNY4	30	George Boone
	SNY5	37	George Boone
Union	UNI1	23	Wayne Laubscher
	UNI2	39	Wayne Laubscher
	UNI3	32	Wayne Laubscher
York	YOR1	47	Pete Robinson
	YOR2	38	Pete Robinson
	YOR3	38	Pete Robinson
	YOR4	44	Pete Robinson
	YOR5	31	Pete Robinson
	YOR6	22	Pete Robinson

Data for the following pairs of pairs of routes were combined due to their near contiguous coverage:

DAU1 and DAU2
 JUN3 and JUN5
 NOR1 and NOR2
 SNY2 and SNY4
 SNY3 and SNY5