

**PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
RESEARCH DIVISION
PROJECT ANNUAL JOB REPORT**

PROJECT CODE NO.: 06010

TITLE: Conservation Reserve Enhancement Program (CREP) Monitoring

JOB CODE NO.: 01004

TITLE: Impacts of the Conservation Reserve Enhancement Program on the Regional Trends in Bird Populations and Eastern Cottontail Populations.

PERIOD COVERED: 1 July 2004 to 30 June 2005

COOPERATING AGENCIES: The Pennsylvania State University, School of Forest Resources

WORK LOCATION: Southcentral and southeast Pennsylvania

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DATE: 7 July 2005

Abstract: Bird and eastern cottontail populations have been surveyed annually since 2001 along 90 survey routes in the 20 counties of the Chesapeake Watershed CREP region. The aims of the survey are to establish whether or not CREP has benefited cottontail and grassland bird populations within the region. Here we document how the survey data are gathered, what the sample sizes are for each species, and trial some analyses with which we hope to demonstrate how CREP has affected populations. It is shown that the survey is generating very large sample sizes of many grassland bird species, which should allow population changes to be detected for all but the scarcest grassland species within the region. Comparison of population trends for the years 2001 to 2004 in trial analyses of data from five counties in central PA indicates that farmland bird populations have fared better in areas where there is more CREP. Species that may have benefited include those for which CREP may provide a new foraging habitat, in addition to those that nest within CREP fields. A more thorough analysis of data for all 20 counties for the period 2001 to 2005 will allow us to say with more confidence whether these patterns are attributable to the introduction of CREP.

OBJECTIVES

1. To monitor trends in agricultural habitats in 20 southeastern Pennsylvania counties enrolled in CREP.

2. To monitor trends in breeding bird populations and eastern cottontail rabbit 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 cottontail rabbits.

4. To provide recommendations on future habitat management programs to restore farmland wildlife populations.

INTRODUCTION

In April 2000, the Governor of Pennsylvania and U.S. Secretary of Agriculture approved a \$210M conservation initiative for 20 counties. The Pennsylvania Conservation Reserve Enhancement Program (CREP) has a goal of converting 100,000 acres of cropland and marginal pasture to conservation cover for 10-15 years. The program is entirely voluntary, and its goals are to improve water quality, reduce soil erosion, increase farm income, and improve wildlife habitat in 20 counties in the Chesapeake Bay watershed. The most widespread management practice in CREP is reseeding 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 Chesapeake Watershed counties, a monitoring program was initiated in 2001. CREP was expanded to 23 "Northern Tier" counties of Pennsylvania 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 in these areas.

The aims of this interim report are to provide some early pointers as to potential effects/benefits of CREP within the 20 county region, and to highlight the direction of future research. Of particular interest are questions such as:

1. Is there any evidence that CREP has benefited grassland/farmland bird populations?
2. Does landscape context (e.g. amount and fragmentation of farmland) influence the benefits of CREP for birds?
3. Are CREP fields the appropriate size and spatial configuration to maximize their usefulness to grassland birds?
4. Could population demographics (e.g. dispersal distances, historical range size, density thresholds) inhibit the rate of spread of grassland birds into newly created grasslands?

This report includes summary statistics of data for the whole of the 20 county region and some trial analyses based on 5 counties in central PA: Columbia, Montour, Northumberland, Snyder, and Union.

METHODS

Bird Survey Protocol

The survey protocol is based on The Breeding Bird Survey (Sauer & Droege 1990), with 5-minute point counts at up to 50 stops along a survey route. The stops are approximately 0.5 miles apart and all birds seen or heard are counted within a 250m radius of each survey point. 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. 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 PA Game Commission (PGC), carry out bird surveys on 90 routes (Appendix 1). In addition to birds, the observers count the number of eastern cottontails *Sylvilagus floridanus* along the surveys routes. The percentage of each major habitat type (Anderson Land Classification) within 250 m of each survey point, is estimated by the surveyors annually. In 2003, all points along survey routes were geo-referenced using GPS units. All routes will be run annually from 2001 thru 2015. However, due to budget cuts, routes will not be run in 2006. Most of the survey data for 2001, 2003, and 2004 has now been entered into an Access Relational Database.

In this report, 2001 is the baseline year, as this is the first year of the bird surveys. However, many CREP agreements were signed after 2001. Results included here do not therefore necessarily reflect changes that have occurred after 3 years of CREP agreements.

Trial Analyses for 5 Counties; Data Manipulation and Analysis

Several data layers are used to complete the analysis. The projection for each data layers was defined in ArcCatalog using the *NAD_1983_UTM_18N* projection. The steps used to manipulate these into the correct format were as follows:

Birds Survey Routes.--A total of 16 birds survey routes are included in this analysis. Each route had between 25 and 50 stops. In 2004, the locations of the stops were recorded by the surveyors using Global Positioning System units. The routes are labeled with the first three letters of the county and then the route number within that county; for example, the 4 routes in Columbia County are labeled COL2, COL2, COL3, and COL4.

CREP Agreement Boundaries.--Shapefiles of all CREP agreements were supplied by the Pennsylvania Department for the Conservation of Natural Resources (DCNR). The following CREP practices were selected for the analysis: CP01 - introduced grasses and legumes (cool season grasses), CP02 - native grasses (warm season grasses), and CP21 - filter strips (grasses). Areas of each polygon were then calculated using ArcMap GIS.

Land Cover.--Joe Bishop, PSU, supplied a raster layer of land cover for Pennsylvania used for PA GAP analysis (Myers & Bishop 1999). In order that the area of each land cover type could be calculated, the raster file was re-projected in *UTM18* and then converted to a shapefile using the *Conversion* tool in ArcCatalog. Land cover types 4 (Hay), 5 (Row Crops), and 6 (Row Crops) were then selected to represent farmland.

Creating Buffers.--Buffers in increments of 250 meters up to 2 km were created around each point along the 16 sixteen routes. These buffers were then used to define the "landscape" for each survey route.

Unfortunately, as some routes were in close proximity, the buffers overlapped and hence the routes could not be considered independent samples. To overcome this, the data for some routes were combined, first using a 1-km buffer and then a 2-km buffer, as follows:

Route	1-km buffer	2-km buffer
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COL1	COL1	COL1
COL2	COL2	COL2
COL3	COL3	} COL3
COL4	COL4	
MON1	MON1	} NOR1
MON2	MON2	
NOR5	NOR5	
NOR6	NOR6	
SNY1	SNY1	SNY1
SNY2	} SNY2	= SNY2
SNY4		
SNY3	} SNY3	= SNY3
SNY5		
UNI1	} UNI1	} UNI1
UNI2		
UNI3	UNI3	

The original 16 routes were therefore reduced to 13 independent routes when a 1-km buffer around the survey points was applied, and only 8 routes when a 2-km buffer was applied.

Trial Analyses for 5 Counties: Analysis of Bird Count Data

We entered bird count data for each route, year and survey (May or June), the mean number of birds per stop was then calculated for each species. We calculated the mean (geometric) percent annual population change between 2001 and 2004 using linear regression (note that computerized 2002 data are not yet available).

The mean bird population change was then regressed against the percentage of farmland in CREP for each route (or group of routes) for the 1 km buffer. This then allowed an assessment of whether bird populations fared better in landscapes with more CREP agreements when compared with those containing few CREP agreements. A significant positive relationship indicates that CREP may have benefited the bird populations in that area. This analysis was carried out only for farmland and grassland species where the mean number of birds per stop was >0.1, along with a number of species that are not likely to be directly affected by CREP in the landscape, such as woodland obligates. Several grassland species were excluded from the analysis because sample sizes were considered too small to produce representative population trends for the study area, including bobolink, savannah sparrow and Vesper sparrow. The sample totaled 27 bird species, along with eastern cottontails. The bird species included 8 species that are likely to, or have been observed to nest in CREP fields (Kevin Wentworth pers. comm.), 12 that could benefit from CREP as a foraging habitat (including aerial insectivores), and 7 species that are unlikely to use CREP.

RESULTS

Data Overview

Well over 100,000 birds have been recorded on the CREP routes in each year since 2001. As the sample includes all habitats within agricultural areas, it is perhaps not surprising that the most numerous species are habitat generalists, often associated with human areas as well as farmland and woodland. The 10 most numerous species in 2001, the baseline year for the CREP surveys, are listed in Table 1, ranked from the most widespread downwards. Of these 10, only the red-winged blackbird, which was the fourth most widespread, could be considered a true farmland bird species.

The second most widespread farmland obligate was the eastern meadowlark, which was located at almost 10% of all stops in 2001 (Table 2). The latter species, along with ring-necked pheasant, bobolink, and Vesper, grasshopper, and savannah sparrows are the widespread grassland species for which it is hoped CREP will help to stabilize or help recover dwindling populations. Some other grassland species that CREP may benefit, including northern bobwhite and Henslow's sparrow, are now too scarce in this region to be detected in any numbers on CREP routes - only single figures of each species have been found in any given year. In addition to these grassland specialists, CREP may benefit a wide range of species by increasing foraging habitat, and food resources. These species include aerial feeders, such as the barn swallow, and ground foragers such as eastern bluebird.

Trial Analysis for 5 Central Counties

The Landscape and Survey Routes.--A map of farmland land cover and the locations of CREP agreements in central Pennsylvania indicates that agriculture is the dominant land use within the 5 county area, and that CREP agreements are very unevenly distributed, with none in Snyder County and most in Montour and Columbia Counties (Figure 1). The survey routes are evenly distributed within the farmland areas (Figure 2). Note that additional routes were surveyed in southern Northumberland County but because GPS locations of the stops are not yet available, these were excluded from the analysis. The advantages of using a 1-km buffer around the stops as our definition of "landscape" as opposed to the 2-km buffer are evident from Figure 2. The overlapping 2-km buffer reduces the number of independent routes to just 8, while with a 1-km buffer there are 13 independent routes. This larger sample size allows greater statistical power to detect differences in bird population trends between low CREP uptake and high CREP uptake areas.

Amount of CREP in the Landscape.--When the 2-km buffer is applied, it can be seen that of the 8 routes, only 3 have substantial amounts of CREP within the "landscape" (Figure 3). There is approximately an even split of CP01 (introduced legumes and grasses) and CP02 (native grasses) with very little CP21 (grass strips).

The cumulative percentage of the landscape in CREP agreements within each of the 8 250 m buffers was calculated to see whether there was any difference in the amount of CREP within 1 km as opposed to the 2-km buffer. While the amount of CREP was relatively low within 250 m of the stops, there is no reason to suggest that amount within 1 km is significantly different from that within 2 km (Figure 4). As the 1-km and 2-km buffers show similar metrics, the 1 km is suggested to be a better metric with which to define the landscape around each survey route, because this allows for a larger sample size of independent routes.

A better measure of CREP may be as a percentage of farmland rather than as a percentage of the landscape, because there is some variation between the routes in the extent of non-farmland land uses such as forest and urban (Figure 5). The percentage of CREP within the farmland was therefore calculated for the 13 independent routes within the 1-km buffer (Figure 6). There was a great deal of variation with no or very little CREP around 4 of the routes, up to 4% at 5 routes, and 4% to 7% at the remaining 4. This variance in CREP extent will be very useful when ascertaining whether bird populations have fared better in areas where there is more CREP.

Bird Population Changes in Relation to CREP Extent.--The percentage annual population change regressed against percentage of farmland in CREP provides an indication of whether birds in areas with more CREP have fared better. It was found that 7 bird species, along with eastern cottontails, fared significantly better in those areas with more CREP (Table 3). Three of these bird species are known to nest in CREP fields and the remaining 5 could potentially benefit from increased foraging opportunities. There were no significantly negative relationships, indicating that for these 28 species, CREP has not been a detrimental addition to the landscape.

Of the 28 species in Table 3, those are known to, or are likely to, nest within CREP fields have generally fared better in areas where there is more CREP. Notable exceptions are grasshopper sparrow, for which there was virtually no effect, and killdeer for which there was a non-significant negative effect. Although the latter species does nest in grassland, it requires short grass and favors patches of bare ground, which may be absent in CREP fields. There is a chance, therefore, that this species could be negatively affected by the introduction of CREP.

Those species for which CREP could provide a new and valuable foraging resource also fared better where there is more CREP, while in contrast, there were no relationships between the amount of CREP and population changes of woodland obligates. This provides a useful check on the results for farmland obligates, because it suggests that the positive results shown are not likely to happen by chance, or due to other, unknown environmental factors.

All of these relationships are tentative, because the sample sizes are small (13). A similar analysis based on all 90 CREP routes and over a longer period of time is likely to provide much more conclusive results. The relationships between bird population changes and extent of CREP are shown in Figures 7a - 7h.

To the right of the point where the regression line crosses the x-axis indicates what percentage of CREP in the landscape is likely to be sufficient to increase populations of that species. This varies between 0.5% for some species to 5% for northern mockingbird.

DISCUSSION

The preliminary analyses presented in this report suggest that when evaluating bird populations at the landscape scale, a buffer of 1 km around survey routes may be sufficient, as this maximizes sample size when compared with a larger buffer of 2 km. The GIS analysis has provided a model with which to apply the analysis to all 20 counties and 90 survey routes. This analysis will be completed once the 2005 bird survey data are available, providing 5 years of monitoring data with which to estimate trends. Population trends will be estimated using Generalized Linear Models.

The relationship between bird population trends in 2001-2004 and the extent of CREP in the landscape shows some promising early indications that populations of several species have benefited from the introduction of CREP. This analysis will be extended to cover the whole of the data set. Relationships between population trends and other landscape metrics such as land cover fragmentation and CREP patch size will then add further light on any relationships that are detected. Data from the first Pennsylvania Breeding Bird Atlas (Brauning 1992) will be used to test whether populations are limited by a lack of local populations to colonize CREP fields.

Analysis in the final report will use two methods of calculating the extent of CREP: percentage of farmland (as in this preliminary analysis) and absolute extent. It could be that the effects of CREP in mixed farmland/forested areas are quite different from those in areas dominated by farmland. Use of the land cover data collected by the surveyors should also shed light on some of the potentially complex interactions in different parts of the 20 county region.

LITERATURE CITED

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ACKNOWLEDGMENTS

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Table 1. The ten most widespread bird species on all 90 CREP routes in 2001.

Species	Number of individuals counted	% of all birds	% of stops noted at
1 American robin	11,606	9.9	56.7
2 Common grackle	12,974	11.6	41.3
3 European starling	13,468	12.0	38.1
4 Red-winged blackbird	8,505	7.6	37.6
5 Song sparrow	3,836	3.4	36.6
6 American crow	4,603	4.1	33.7
7 Mourning dove	3,735	3.3	30.3
8 Chipping sparrow	3,174	2.8	29.7
9 Northern cardinal	2,715	2.4	29.0
10 House sparrow	5,576	5.0	24.4

Table 2. Numbers of widespread farmland birds recorded on all 90 CREP routes in 2001.

Species	Number of individuals counted	% of all birds	% of stops noted at
Barn swallow	1,369	1.2	18.7
Field sparrow	1,125	1.0	12.8
American goldfinch	1,502	1.3	12.7
Killdeer	1,132	1.0	11.8
Eastern meadowlark	908	0.8	9.2
Rock pigeon	3,042	2.7	8.1
Eastern bluebird	795	0.7	8.1
Brown-headed cowbird	710	0.6	7.5
Vesper sparrow	636	0.6	6.6
Ring-necked pheasant	560	0.5	6.6
Grasshopper sparrow	602	0.6	6.2
Savannah sparrow	537	0.5	6.8
Horned lark	615	0.5	4.3
Bobolink	269	0.2	2.1

Table 3. Relationship between bird and cottontail population changes (2001 to 2004), and the extent of CREP within the landscape for 13 survey routes.

Species	Mean birds/ stop	Slope %CREP vs. population change	R ²	p (blank = not significant)
Potential CREP nesters				
Ring-necked pheasant <i>Phasianus colchicus</i>	0.123	0.398	0.297	
Killdeer <i>Charadrius vociferous</i>	0.250	-0.364	0.042	
Vesper sparrow <i>Pooecetes gramineus</i>	0.118	0.144	0.010	
Grasshopper sparrow <i>Ammodramus savabbarum</i>	0.112	0.095	0.002	
Song sparrow <i>Melospiza melodia</i>	0.467	2.775	0.329	0.045
Red-winged blackbird <i>Agelaius phoeniceus</i>	1.852	6.111	0.396	0.009
Eastern meadowlark <i>Sturnella magna</i>	0.141	1.222	0.514	0.004
Eastern cottontail <i>Sylvilagus floridanus</i>	0.111	1.016	0.302	0.03
Potential CREP foragers				
Barn swallow <i>Hirundo rustica</i>	0.786	6.693	0.599	0.008
American crow <i>Corvus brachyrhynchos</i>	0.873	0.626	0.006	
Eastern bluebird <i>Sialia sialis</i>	0.173	1.680	0.406	0.007
Northern mockingbird <i>Mimus polyglottos</i>	0.292	1.734	0.300	0.04
European starling <i>Sturnus vulgaris</i>	3.100	-2.596	0.009	
Common yellowthroat <i>Geothlypis trichas</i>	0.249	0.997	0.278	
Chipping sparrow <i>Spizella passerina</i>	0.612	2.559	0.141	
Field sparrow <i>Spizella pusilla</i>	0.177	0.014	0.009	
Common grackle <i>Quiscalus quiscula</i>	2.108	12.128	0.269	0.04
Brown-headed cowbird <i>Molothrus ater</i>	0.111	0.449	0.081	
American goldfinch <i>Carduelis tristis</i>	0.188	0.783	0.111	
House sparrow <i>Passer domesticus</i>	0.599	1.194	0.032	
No CREP use				
Downy woodpecker <i>Picoides pubescens</i>	0.223	-0.569	0.130	
Northern flicker <i>Colaptes auratus</i>	0.131	0.004	0.005	
Tufted titmouse <i>Baeolophus bicolor</i>	0.179	0.560	0.113	
House wren <i>Troglodytes aedon</i>	0.201	0.532	0.038	
Wood thrush <i>Hylocichla mustelina</i>	0.166	-0.190	0.018	
American robin <i>Turdus migratorius</i>	2.055	0.420	0.002	
Gray catbird <i>Dumetella carolinensis</i>	0.379	0.897	0.025	
Northern cardinal <i>Cardinalis cardinalis</i>	0.554	0.022	0.006	

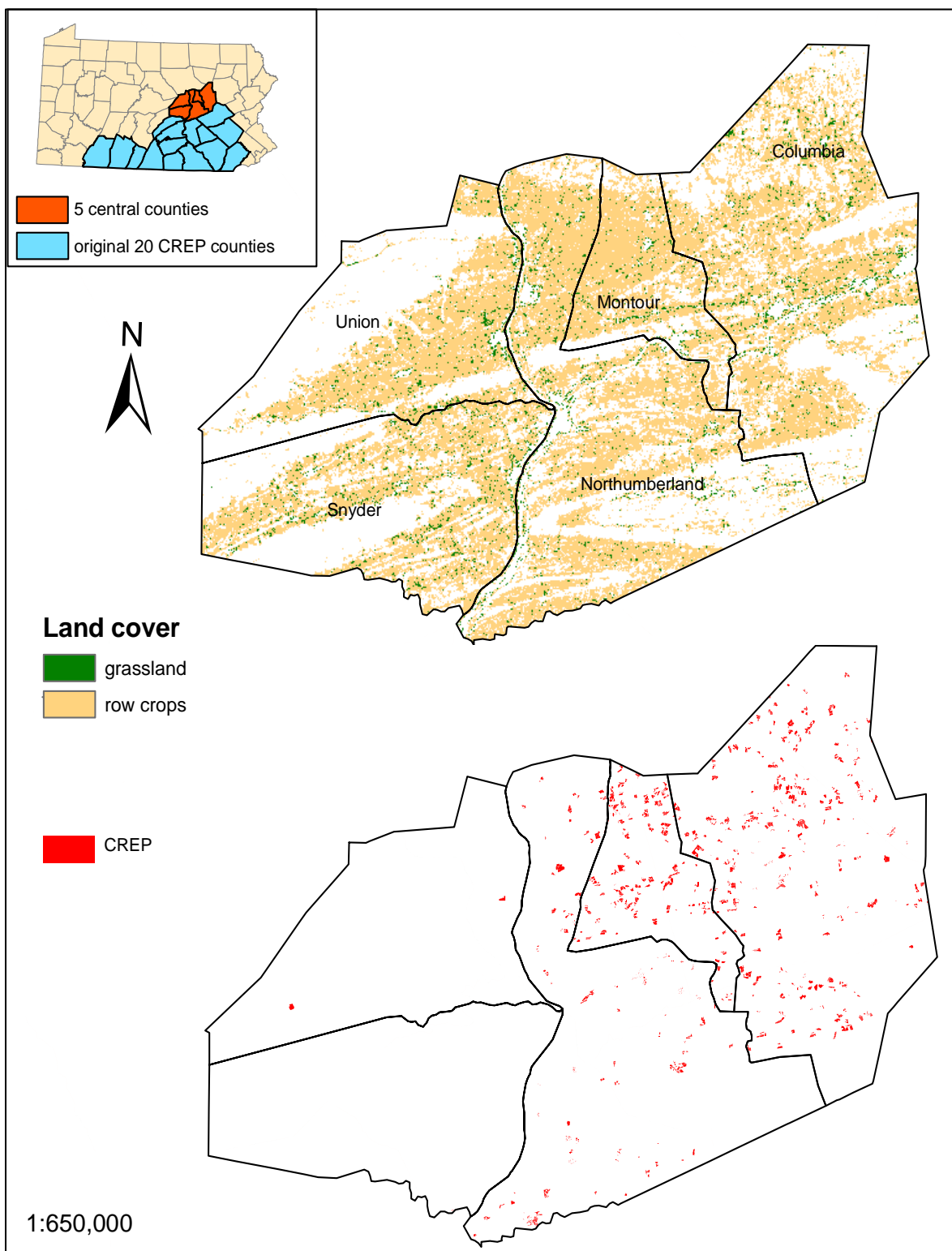


Figure 1. Location of the study area (top left), the extent of farmland (top) and distribution of CREP agreements (bottom). Map produced in ArcMap.

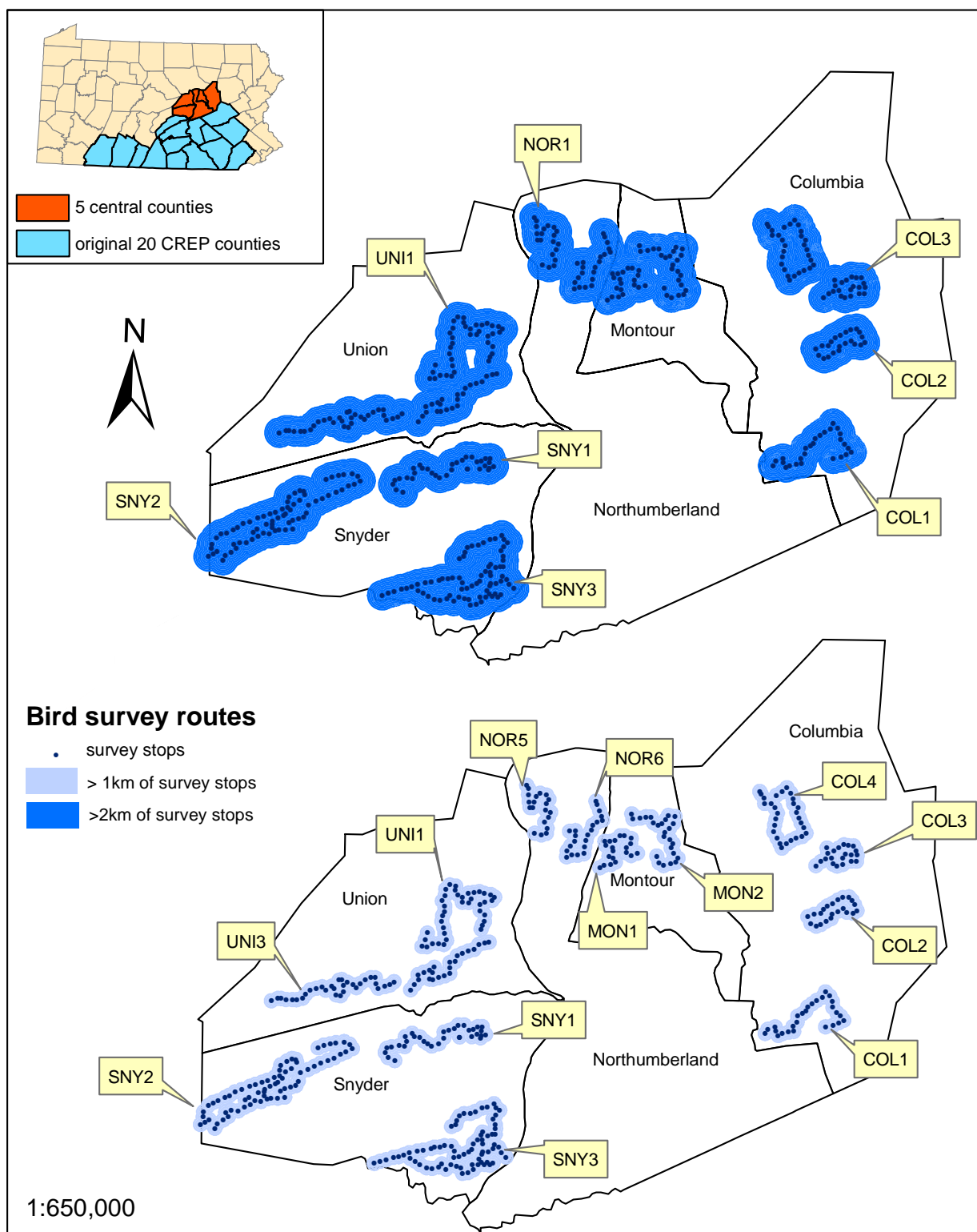


Figure 2. Location of the study area (top left), the survey routes and "landscape" buffers of 2 km (top) and 1 km (bottom). Map produced in ArcMap.

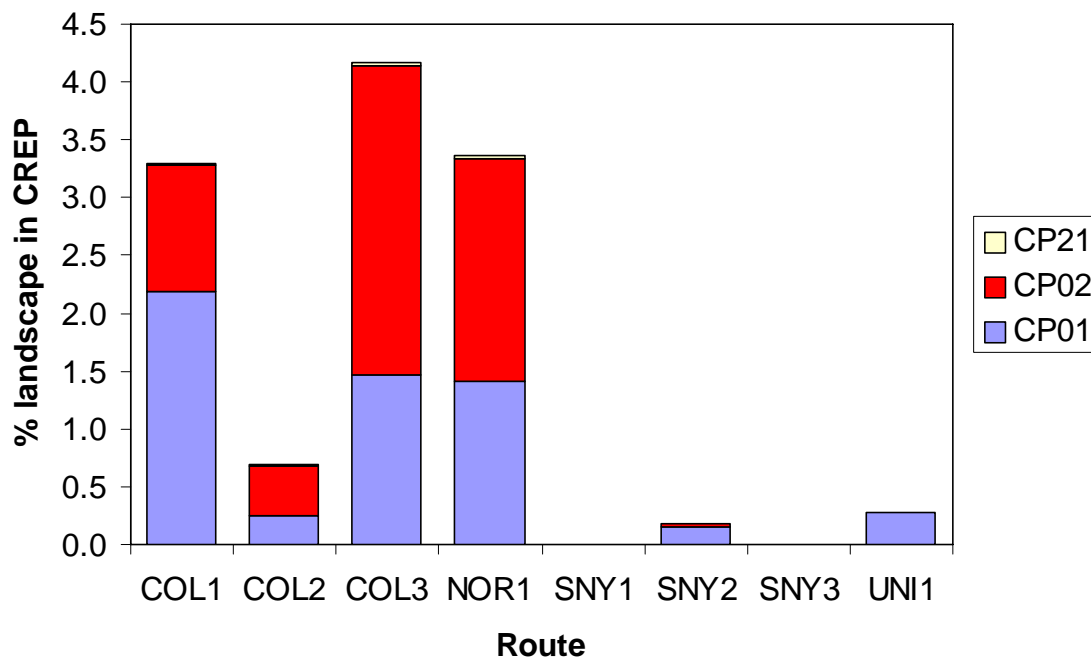


Figure 3. Percentage of the landscape in CREP within 2 km of the eight survey routes (2 km buffer definition of independent routes).

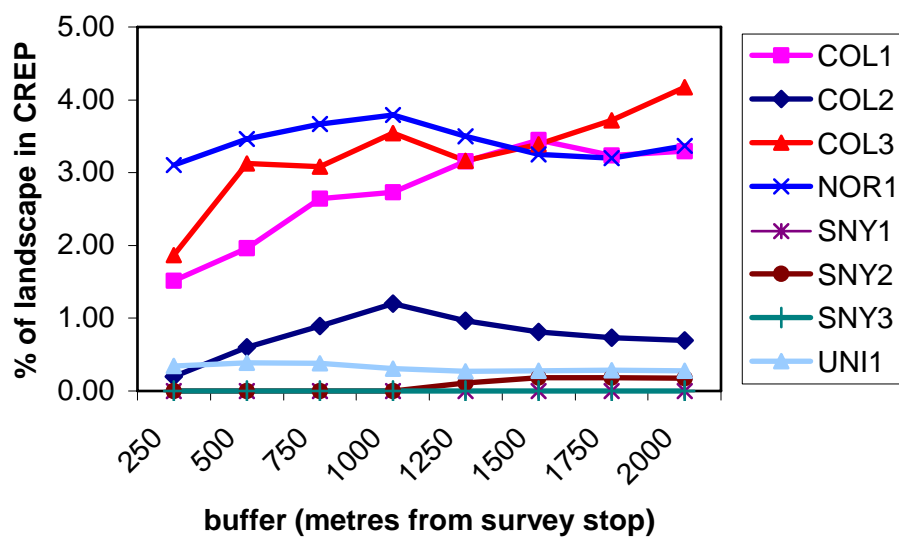


Figure 4. Cumulative percentage of the landscape in CREP within the eight buffers of the survey stops.

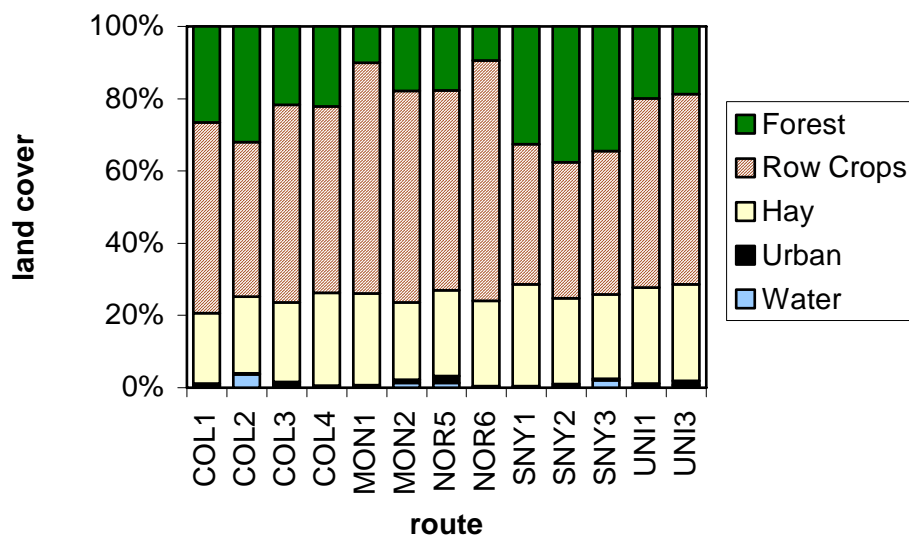


Figure 5. Land cover types within the 1 km buffer of the 13 survey routes

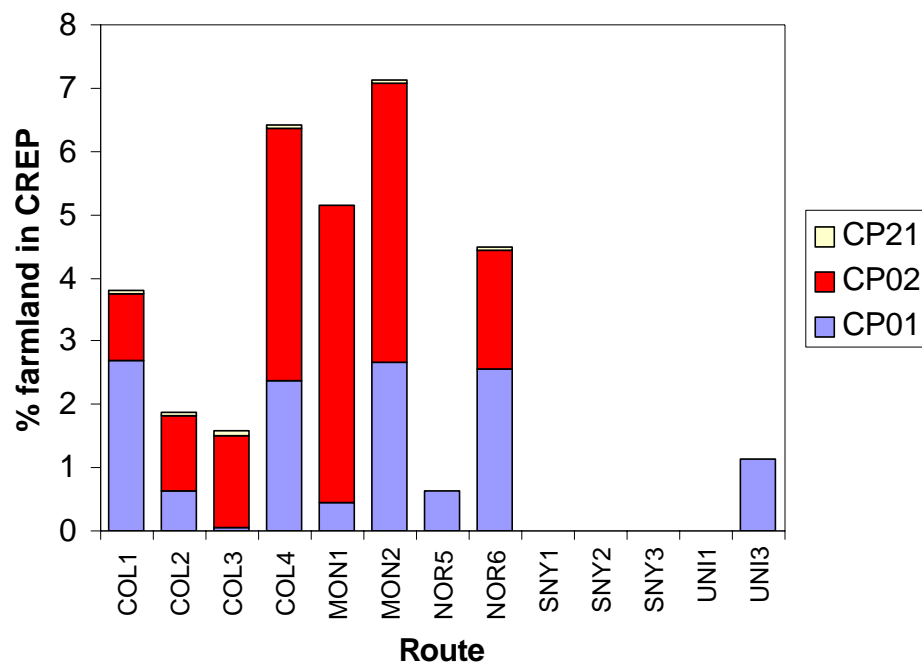
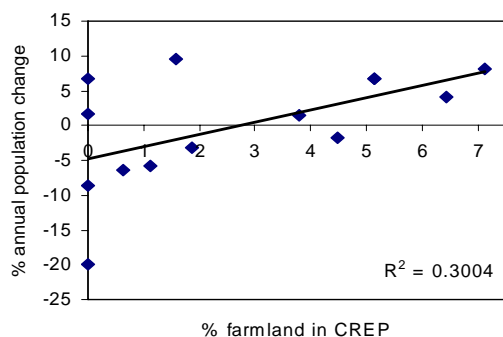
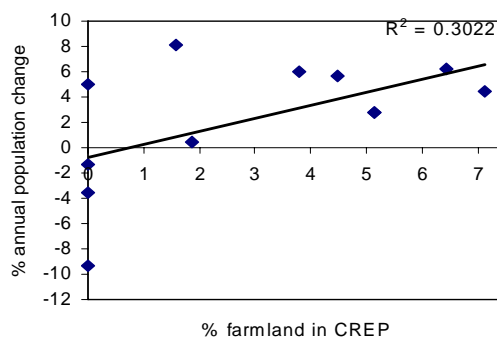


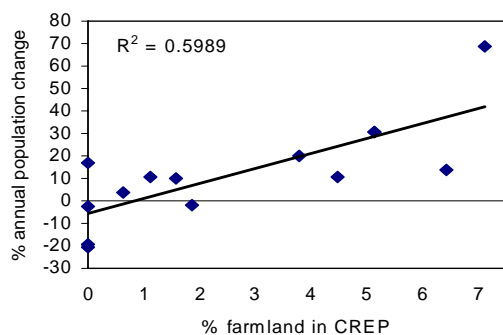
Figure 6. Percentage of farmland in CREP agreements within 1km of the 13 survey routes (1 km buffer definition of routes)



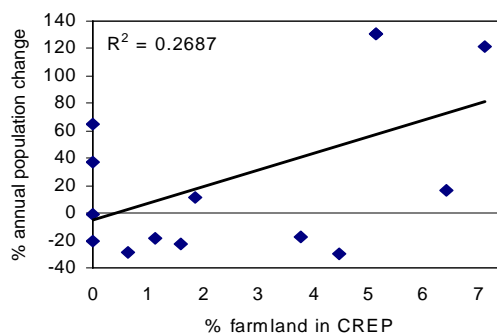
7a. Barn Swallow



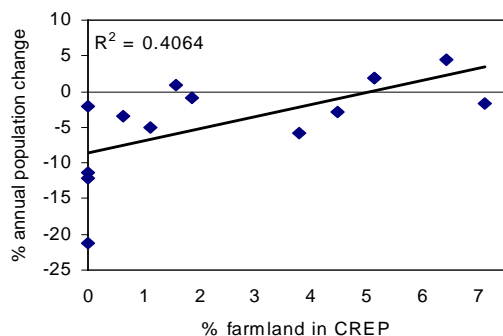
7b. Common Grackle



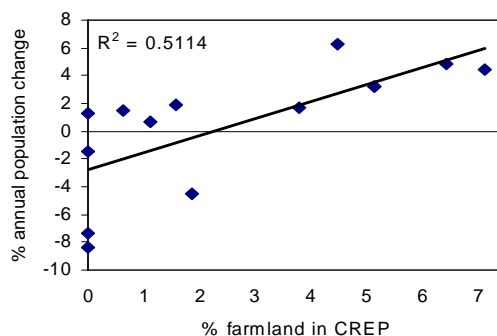
7c. Eastern Meadowlark



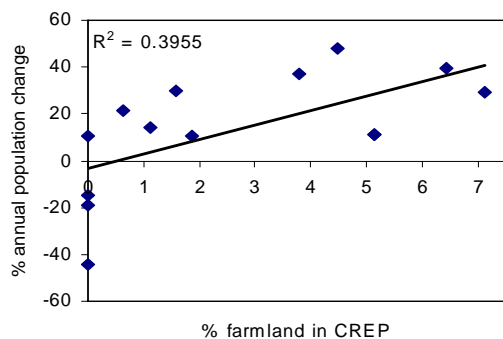
7d. Eastern Bluebird



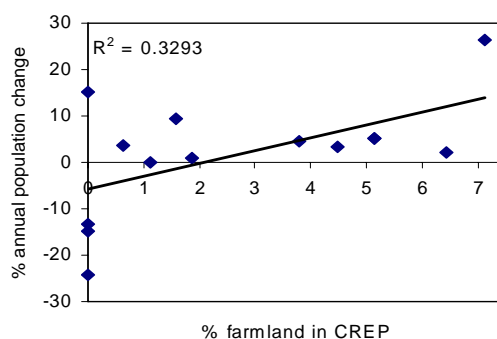
7e. Northern Mockingbird



7f. Eastern Cottontail



7g. Red-winged Blackbird



7h. Song Sparrow

Figure 7. Significant relationships between percentage of farmland in CREP and annual population changes between 2001 and 2004

Appendix 1. List of routes, number of stops, and observer, 2004.

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
	CUM2	40	Don Orris
	CUM3	31	Don Orris
	CUM4	48	Don Orris
	CUM5	40	Don Orris
Dauphin	DAU1	40	Duane Hoffman
	DAU2	32	Duane Hoffman
	DAU3	31	Duane Hoffman
Franklin	FRA1	44	Dan Snell
	FRA2	30	Dan Snell
	FRA3	36	Dan Snell
	FRA4	36	Dan Snell

Appendix 1 (cont.). List of routes, number of stops, and observer, 2004.

County	Route	Number of stops	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	Duane Hoffman
	LEB4	30	Duane Hoffman
Montour	MON1	22	Wayne Laubscher
	MON2	25	Wayne Laubscher
Northumberland	NOR1	21	Duane Hoffman
	NOR2	22	Duane Hoffman
	NOR3	26	Duane Hoffman
	NOR4	23	Duane Hoffman
	NOR5	20	Wayne Laubscher
	NOR6	21	Wayne Laubscher
	NOR7	24	Duane Hoffman

Appendix 1 (cont.). List of routes, number of stops, and observer, 2004.

County	Route	Number of stops	Observer
Perry	PER1	39	Don Orris
	PER2	41	Don Orris
Schuykill	SCH1	24	Mike Ward
	SCH2	29	Mike Ward
	SCH3	46	Mike Ward
	SCH4	0	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