Summary of Breeding Bird Trends in the Chippewa and Superior National Forests of Minnesota - 1995-2013

Report to Chippewa National Forest and Superior National Forest, October 2013

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SUMMARY

- A total of 326 existing forest stands were surveyed for breeding birds including 133 and 193 stands (953 survey points) in the Chippewa and Superior National Forests (NFs), respectively in 2013.
- Trends in relative abundance were calculated for a total 73 bird species, including 63 species in the Chippewa NF and 63 in the Superior NF for 19 years from 1995 to 2013. All trends are reported as significant when $P < 0.05$.
- The Chippewa NF had 20 species that increased, three species that significantly decreased, and 40 species that were relatively stable from 1995 to 2013. Hence, > 95 % of the species (60/63 species) with adequate trend information are estimated to be stable or increasing over the past 19 years in the Chippewa NF.
- The Superior NF had 22 species that increased, six that decreased, and 35 species that were relatively stable from 1995 to 2013. Hence, > 90 % of the species (57/63 species) with adequate trend information are estimated to be stable or increasing over the past 19 years in the Superior NF.
- Thirteen species increased in both the Chippewa and Superior NFs, including Black-and-White Warbler, Black-capped Chickadee, Black-throated Green Warbler, Blue Jay, Cedar Waxwing, Nashville Warbler, Northern Parula, Ovenbird, Pileated Woodpecker, Pine Warbler, Red-breasted Nuthatch, White-throated Sparrow, and Yellow-bellied Sapsucker.
- The Connecticut Warbler was the only species with a declining trend in both the Chippewa and Superior NFs.
- All of the guild analyses showed signficant increases during the 1995-2013 period except for non-significant trends for bird species associated with early-successional forests in the Chippewa NF. The guild trends are primarily influenced by the large number of species that have positive trends relative to the number of negative trends.
- The overall trend information indicates that most breeding bird species within these NFs that we are capable of monitoring and detecting trends are either increasing or stable in populations, while a few species such as the Connecticut Warbler, Song Sparrow, and Yellow-bellied Flycatcher continue to have trends that remain a concern.
- This the second year that trend calculations have been presented without results from the Chequamegon NF included. In addition, it is the first year that a regional trend for the combined Chippewa and Superior NFs has been calculated. A broader regional analysis of trends that includes the Chequamegon and Nicolet NF's of northern Wisconsin will be available soon in a USFS General Technical Report (Niemi et al. 2013).

INTRODUCTION

The breeding bird communities of the western Great Lakes region have among the richest diversity of breeding bird species in North America (Green 1995, Howe et al. 1997, Rich et al. 2004). The importance of this diversity and past concerns with potential declines of some species has led to a strong interest in monitoring forest bird populations in the region. The relatively heavily forested landscapes of northern Minnesota and Wisconsin are considered to be population 'sources' for many forest bird species and may be supplementing population 'sinks' in the agricultural landscapes of the lower Midwest (Robinson et al. 1995, Temple and Flaspohler 1998). Analysis of population trends is used as an 'early-warning system' of potential problems in a species population and serves as a measure of the ecological condition of the environment (Niemi and McDonald 2004a).

Recently, a draft of a general technical report on a summary of the twenty-plus year data that have been gathered in the Chequamegon, Chippewa, Nicolet, and Superior NFs from the late 1980s through 2011 has been completed (Niemi et al. 2013). This report has gone through several iterations of peer-review and is currently in press. It summarizes a substantial amount of information that has been gathered on population trends, habitat relationships, bird community assemblages, factors potentially affecting population trends, management recommendations for bird species of concern, and a brief review of potential invasive species affecting bird species.

Large-scale population monitoring programs such as the U.S. Geological Survey's Breeding Bird Survey (BBS) provide important information on trends at a continental scale. However, limited coverage in some areas can make it difficult to use BBS data to characterize population trends at smaller geographic scales (Peterjohn et al. 1995). Continental trends also have the potential to mask regional population trends (Holmes and Sherry 1988), thus there is a need for regional monitoring programs that can provide more localized information (Howe et al. 1997). In response to the need for regional population data, a long-term forest breeding bird monitoring program was established in 1991 in the Chippewa and Superior NFs. The Forest Service is mandated to monitor certain management indicator species (Manley et al. 1993), and our monitoring program expands beyond indicator species to include all forest songbird species that we can adequately sample. Although recent changes to the USFS Planning Rule are in the process of being implemented (USDA Forest Service 2012), we are confident that this program is an effective way of monitoring the characteristics and conditions of an important component of the ecological communities present in these NFs. Currently, more than 300 stands (> 900 points) within the two NFs are surveyed during the breeding season (June 1 to July 10).

The primary objective of this report is to update U.S. Forest Service personnel on results of the forest bird monitoring program. Here we focus on relative abundance trends of individual species during the period from 1995-2013 (19 years) and summarize the most important recent results.

DESIGN AND METHODS

Sample Design

Bird monitoring programs within NFs in northern Minnesota and Wisconsin were designed 1) to establish a baseline inventory of local breeding bird assemblages, 2) to monitor population changes of forest bird species over time, and 3) to identify bird-habitat associations, particularly those relevant to forest management activities. Originally, the monitoring program was designed for the Chequamegon NF (WI), Chippewa NF (MN), and Superior NF (MN). After the 2010 field season, the Chequamegon NF was unable to continue to fund the program. Results from the Chequamegon NF 1995-2010 and the Chippewa and Superior NFs 1995-2011 were included in the general technical report (Niemi et al. 2013)

Verner (1985) in a classic paper on bird counting techniques concluded that greater care in planning and executing counts of birds should include prior consultation with biometricians, training of personnel, and testing the bird identification skills and sensory capabilities (e.g., hearing) of field observers. Our design in the Chippewa and Superior NFs adhered to these recommendations, and has been peer-reviewed as part of national breeding bird monitoring meetings (Hanowski et al. 1995, 2002a, and 2005a) and in several peer-reviewed publications (e.g., Niemi et al. 2004, Etterson et al. 2009, and Lapin et al. 2013).

We distributed sampling locations across the forest mosaic in a stratified random manner in consultation with a professional statistician (R. Regal, University of Minnesota-Duluth). For each NF, stands ≥ 16 ha were grouped from their respective compartment inventories into strata defined by dominant tree species (i.e., forest cover type) and stocking density. Because the Superior NF was large, we randomly selected three of the six districts to sample (Tofte, Kawishiwi, and LaCroix). We also excluded the Boundary Waters Canoe Area Wilderness because there is no timber management and logistically the area is difficult to

access. For each NF, stands were randomly selected from each stratum so the final proportion of stands was equal to the proportion of forested land area of each cover type and stocking density for each of the NFs (Hanowski and Niemi 1995a). A total of 135 and 169 stands were originally selected in the Chippewa, and Superior NFs, respectively (Figure 1). A total of 13 habitat types were sampled in the Chippewa NF and 12 in the Superior NF (Niemi et al. 2013). Due to potential interest in logging lowland-conifer forests, twenty-five stands primarily composed of black spruce were added to the Superior NF in 2008.

Breeding Bird Counts

In 1991 we established three point locations within each stand using the guidance for point counts available at the time (Reynolds et al. 1980, Ralph and Scott 1981). Point count locations were initially located a minimum of 220 m apart and at least 100 m from the edge of the forest stand using a combination of forest inventory maps and pacing (Hanowski et al. 1990, 1996; Blake et al. 1992). Sample points were subsequently recorded using a recreation-grade GPS when the technology became available. Point counts were designed to be 10 minutes in length, conducted by trained observers (see observer training below), and completed between 0.5 hours before to 4 hours after sunrise on days with low wind (< 15 km/hr) and light or no precipitation. All counts were conducted between early to mid-June in the Superior NF, and late June to early July in the Chippewa NF. Prior to 1995, only birds recorded up to 100 m from the sample point were recorded. In 1995 we changed the protocol to include unlimited distance sampling, but continued to estimate distances within 50 m, 100 m, and beyond 100 m following a series of coordination workshops (Howe et al. 1997b). The number of individuals observed for each species was recorded at 0-3, 3-5, and 5-10-minute intervals. In 2010 we began to gather data at one-minute intervals after the first two minutes of sampling to gain a better understanding of bird detectability (Etterson et al. 2009). Bird counters were randomly assigned to forest stands so each counter sampled approximately the same number of stands of each forest cover type. Weather data (cloud cover, temperature, and wind speed) and time of day were recorded before each count.

Observer Training

Testing and training of counters has been an important component of the monitoring program. Prior to the field season, tapes or compact disks of 120+ bird songs were provided to all potential counters. Each counter was tested on their ability to pass an identification test of 75 bird songs. Songs on the tape were grouped by habitat (e.g., upland deciduous, lowland coniferous) to simulate field cues that would aid in song identification. A standard for number of correct responses was established by giving the test to observers who had four to five years of field experience. Based on their results, the standard for passing was set at 85% correct responses. In late May of each monitoring year observer field training was conducted over a three or four day period in either the Superior NF or in the vicinity of Duluth, Minnesota, USA. Observers conducted simultaneous practice counts at several points used in the monitoring program. Data were compiled for each observer and compared with experienced observers. In addition to field training and testing, all observers were required to have a hearing test to ensure their hearing was within normal ranges, as established by audiologists, for all frequencies (125 to 8,000 hertz).

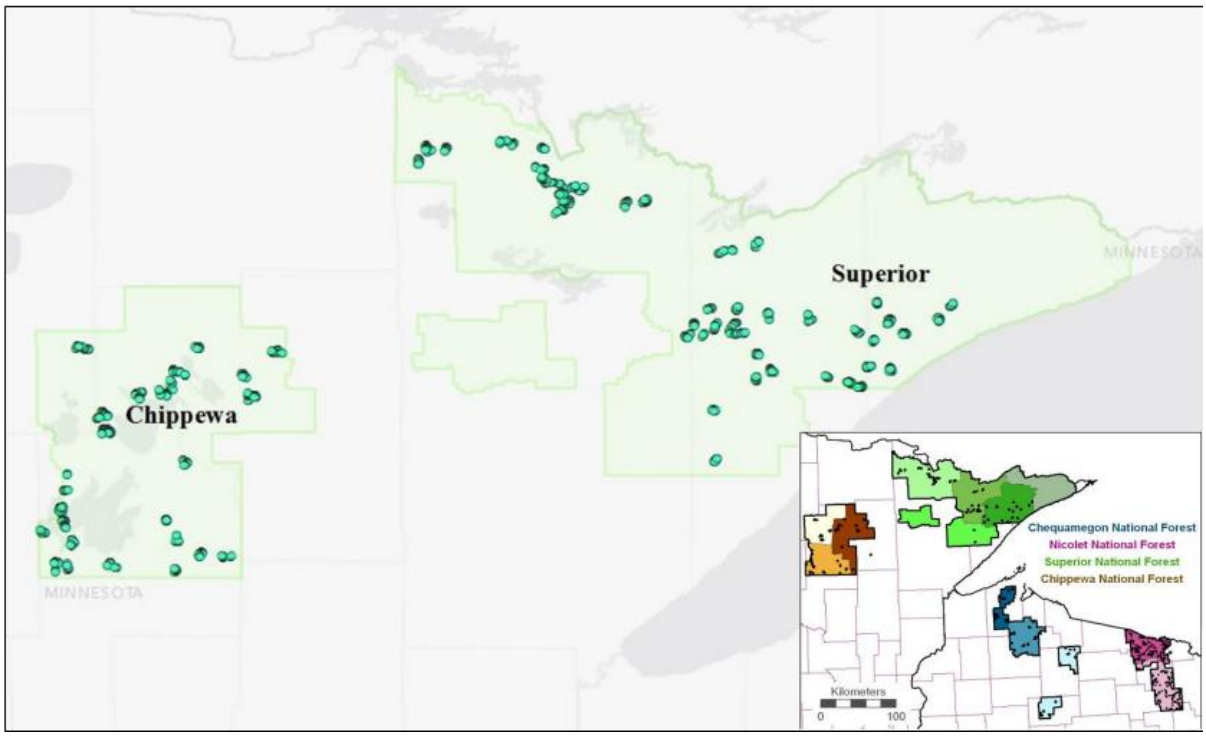

Figure 1. General locations of forest breeding bird point counts in northern Minnesota's Chippewa and Superior National Forests. Inset shows the regional scope of National Forests included in Niemi et al. 2013.

Analysis

Population/abundance estimates

Bird population estimates are defined here as the annual mean number of observations of a species in a 10-minute point count for each NF and for the NFs combined. Stand-level abundance estimates for species trend analyses in the Chippewa and Superior NFs were calculated by summing the numbers of individuals across the two furthest points per stand. The middle point in each stand was excluded because an unlimited radius count from the center of the middle point sometimes overlapped areas counted on the other points. In addition, Hanowski et al. (1995) analyzed these data and determined that two points per stand were nearly equivalent in power to detect change as the use of three points per stand. The mid-point of the stand has been recorded regardless because 1) it may be used as a test point for habitat prediction modeling, 2) little time is saved by skipping the point, 3) occupancy models require a minimum of three replications in a stand (MacKenzie et al. 2006), and 4) data collected annually from the point still can be used to estimate population change. During training sessions there was an emphasis to use best judgment to avoid double counting of individual birds while sampling within a stand. Because of the change to unlimited distances, all of the trend analyses (below) were based on unlimited distance counts and were restricted to the period from 1995-2013.

We used the following criteria to help ensure that our trend analyses provided reliable population information. Stands were included in the analysis only if they had been sampled during at least six years. Data were included for a species if it was observed at a minimum of five stands per NF and during at least three years at each stand. For species that were observed at a minimum of five stands in each of the NFs, we pooled results and carried out an additional, regional, analysis.

The implicit assumption underlying the use of point count data to estimate species-level relative abundance was that the bird species monitored have equivalent detectability within the surveys. Detectability analysis attempts to correct for species-level biases in detectability, and has been applied to bird point count data recently (MacKenzie et al. 2006). We applied detectability analysis to explore how our counts compared with detectability-adjusted counts for sixteen species with varying detectability using the methods of Etterson et al. (2009). Results for sixteen species that spanned the range for low-detectable species (e.g., Golden-crowned Kinglet) to highly detectable species (e.g., Ovenbird) showed that trends calculated from detectability-adjusted counts were similar to trends calculated from counts of individuals, but the most appropriate method was not apparent for cases where the two methods yielded conflicting trends. For instance, differences between methods were greatest for species with relatively small sample sizes (e.g., Brown Creeper). The primary conclusion from these detectability comparisons was that large within-year sample sizes from the same points, standardization of data gathering, and a relatively long time series resulted in trends that were similar regardless of whether counts or detectability-adjusted counts were used. Using counts unadjusted for detectability has also been supported in a critical review by Johnson (2007). For these reasons, and for the sake of simplicity, we report results using indices estimated from annual counts and have assumed that detection probabilities are constant among habitat types.

Population trajectories

A population trajectory is defined as the relative change in size of a population across years. Because we do not detect every individual bird present in our study areas, we cannot know true population size. Instead, we must assume that our sample design gives a representative index of population size for each year. We used locally weighted (LOESS) regression to smooth the time series of species relative abundance for each stand (James et al.1996). In LOESS-regression, fitted values (points along the curve) for years are calculated by giving a small amount of weight to neighboring years, for example, a year with high raw abundance for a species would tend to bring up the fitted values for the year before and the year after. We then computed the arithmetic mean and 95% confidence intervals using the fitted values from the within-stand regressions for each species in each year. The mean fitted value represents the annual index of population size and the respective confidence intervals represent the uncertainty in the estimated index. The time series of the fitted mean population index and confidence intervals graphically define a species' population trajectory.

Population trend

A population trend defines the direction and magnitude of population change over a given time period (Link and Sauer 1997). Non-linear trends notwithstanding, we view a significant trend as a unidirectional change, therefore linear methods can be used to detect a trend without asserting that the population trajectory is linear (Urquhart and Kincaid 1999). Population trends were assessed using simple linear regression applied to an annual index of population size for a study area (described above) and time. We used the slope coefficient to characterize direction and magnitude of the trend. To facilitate comparison, slopes were converted to units of percent annual change by dividing annual population indexes by the predicted value of the index at the midpoint of the entire survey period (1995 to 2013) prior to regressing the index with time (Bart et al. 2003). We assessed the significance of the regressions using a bootstrap procedure (Manly 1991) in which trends were computed for 500 bootstrap resamples of the stands used to calculate the annual population index. For each bootstrap resample, trend was calculated using the same steps as for the original trend. For each original trend, an exact p-value was calculated as the percentile at which zero occurred in the distribution of 500 bootstrapped slopes. For example, $p = 0.01$ would be equivalent to 99% of bootstrapped slopes being greater than zero, which would give us a high degree of confidence that the true population slope was different from zero. Future analyses of trends will explore the recent approach by Sauer and Link (2011) using a hierarchical modeling approach for trend detection in the BBS.

Guild analyses

Each species was categorized within three different guild types: migration, nesting, and habitat preference (Appendix E). Information for categorizing species was obtained primarily from Ehrlich et al. (1988),

Freemark and Collins (1992). Given that some species use different migration strategies, nesting substrates, and vegetation types in different portions of their geographic range, we further modified guild assignments based on personal experience with forest birds within the western Great Lakes region. All individuals of a species that were assigned to each guild were included in the same analysis described above for individual species.

Species guilds are not mutually exclusive, so the species pool in a migration guild, for example, can include many of the same species that were assigned to a nesting guild (Sauer et al. 1996). Directional trends in abundant species (e.g., Ovenbird or Red-eyed Vireo) can strongly influence the trend of the guilds in which it is a member. Given these limitations, we believe it is important to examine common patterns of change among species within a guild. If all or many species within a guild show similar trends in relative abundance, then a more thorough examination of potential stressors affecting this portion of their life histories may reveal causes of observed trends. For instance, a severe drought in the late 1980s was correlated with a decline in the population levels of many breeding bird species found in the habitat guild of aspen forests of northern Wisconsin (Blake et al. 1992).

RESULTS AND DISCUSSION

Over the course of 19 field seasons we have detected nearly 300,000 individual birds of 163 species on approximately 17,000 ten-minute point counts (over 2,800 hours of sampling) in the Chippewa and Superior NFs. In 2013, we sampled 133 stands in the Chippewa NF and 193 in the Superior NF. Seventy-three species were tested for trends in at least one national forest, including 63 in the Chippewa NF and 63 in the Superior NF (Table 1). As monitoring has proceeded through the years, new species have met our criteria for inclusion in trend analyses on each national forest. The number of tested species has increased steadily from 36 in 2000, when the criteria were first applied, to 73 in 2013. For the first time, a regional trend was calculated for 42 species between the Chippewa and Superior NFs.

Overview of Population Trends

Thirty species (41%) increased in at least one national forest and eight (11%) species decreased in at least one national forest (Table 1). Therefore, 35 species (48%) had stable or non-significant population trends among those in which we could detect a trend. There were no conflicting trends between the Chippewa and Superior NFs in 2013. Twenty species increased in the Chippewa NF and 22 species increased in the Superior NF. Of these, thirteen species increased in both NFs. These included the Pileated Woodpecker, Blue Jay, Black-capped Chickadee, Northern Parula, Cedar Waxwing, Ovenbird, Yellow-bellied Sapsucker, Red-breasted Nuthatch, Black-and-White Warbler, Nashville Warbler, Black-throated Green Warbler, Pine Warbler, and White-throated Sparrow (Tables 2 and 3). In contrast, three species decreased in the Chippewa NF and six species decreased in the Superior NF (Table 4). One species, the Connecticut Warbler, decreased in both NFs.

Appendix A includes trend graphs of individual species trajectories within the Chippewa and Superior NFs. Appendix B is a complete statistical summary of the trend analysis including species, its four alphabet code, its trend within each NF, a regional trend (if possible), the significance of the trend, the explained variation of the trend, and the number of stands in which the species was detected sufficiently to include in the trend calculation. The combination of the p-value and the explained variation indicate the strength of the trend for each species within each NF. Appendix C describes the common name, scientific name, four-letter code used in field identification, and a summary of the three major guilds included here: migration strategy, nest site, and vegetation type primarily used by the species. Appendices D and E identify the number individuals observed for species not included in the trend calculations for each NF from 1995 to 2013, respectively.

Chippewa National Forest

Of the 63 species tested in the Chippewa NF, 20 species (32 %) increased significantly (Table 2) and three (5%) declined (Table 4). Compared with trends from 1995-2012 when five species had significantly declined; the Golden-winged Warbler (p= 0.21) and Yellow-rumped Warbler (p= 0.64) no longer had a significant declining trend (Appendix A). The number of Golden-winged Warblers detected on the Chippewa NF has more than doubled each year since 2011, slowing the previously declining trend. In 2013, counts for the Yellow-rumped Warbler were at their highest level within each NF and region-wide. The other three species were consistent with declining trends through 2012 and included the Connecticut Warbler, Song Sparrow, and Yellow-throated Vireo.

The Connecticut Warbler has shown one of the most consistent declines for any species in the monitoring project and is discussed in detail by Niemi et al. (2013). The Yellow-throated Vireo is an uncommon species in the Chippewa NF; however, 35 forest stands were included in the analysis of its trend, potentially indicating a spatially and temporally patchy distribution in the forest (Appendix A). Its declining trend has been steady from 2001 to 2013, yet raw counts are at their highest level in six years. A declining pattern since the early 2000's is also evident for Song Sparrow, which coincides with detected declines on the Breeding Bird Survey routes within these National Forests (Niemi et al. 2013) as well as across the boreal-hardwood transition and entire eastern United States (Sauer et al. 2012).

Superior National Forest

Of the 63 species tested in the Superior NF, 22 species (35%) were increasing (Table 2) and six (10%) were decreasing (Table 4). Compared with the results through 2012, the Broad-winged Hawk, Common Loon, Connecticut Warbler, Evening Grosbeak, Swainson's Thrush, and Yellow-bellied Flycatcher continued to show declining trends through 2013. There were no new species with declining trends and both the Magnolia Warbler (p= 0.26) and Ruffed Grouse (p= 0.50) no longer had significantly declining trends. The declining trends in the Connecticut Warbler and Swainson's Thrush are discussed in some detail in Niemi et al. (2013). These species as well as the Yellow-bellied Flycatcher are primarily found in conifer, and especially lowland-conifer forests on the Superior NF. Twenty-five stands in lowland conifer forests were added to the Superior NF in 2008 and have been consistently sampled for six years, making 2013 the initial year of potential inclusion in trend analysis. However, due to the relatively low abundance of these species and the criteria used for inclusion in analysis, a large increase in the number of stands used to detect their trends was not noticed in 2013. Thus, these lowland conifer stands will become more important for detecting the trends of lowland-conifer dependent species over a longer time frame.

The Evening Grosbeak has been declining over a large area of the northern U.S. and Canada. Potential reasons include disease transmitted at bird feeders, reduced food supplies due to logging of hardwood forests in Canada (is primary breeding area), and changes in its breeding and wintering distribution due to shifting climatic conditions (Niemi 2012). More localized population trends have been shown to track spruce budworm outbreaks (Gillihan and Byers 2001). The most recent widespread outbreak occurred just before monitoring began (Niemi et al. 2013), potentially augmenting populations and forming the starting point for a decline in this species. We believe the declining trends of the Common Loon and Broad-winged Hawk should be viewed with caution unless substantiated with other data, as the point count methodology is not the best survey technique for these species.

Pooled National Forests

We calculated a regional trend between the Chippewa and Superior NFs for 42 species in 2013. Twenty-four species (57%) were increasing (Table 2) and 3 (7%) were decreasing (Table 4). There were no contradictory trends between the forests. The Connecticut Warbler, Song Sparrow, and Yellow-bellied Flycatcher all showed highly significant region-wide declines. The latter two species also showed declining

region wide trends across the four NFs included in Niemi et al. (2013) (Chippewa, Superior, Chequamegon and Nicolet), while the Connecticut Warbler was not common enough to warrant analysis across these Western Great Lakes NFs. The Song Sparrow showed similar declines in results from local Breeding Bird Survey routes while the Yellow-bellied Flycatcher had an increasing trend (Niemi et al. 2013). These results are indicative of the differences between these the two monitoring projects, especially in sample size and the habitat context of on versus off-road counts. The agreement of results for Song Sparrows might relate to this species' use of open and shrubby habitats often characteristic of roadsides in northern Minnesota and hence surveyed by the BBS. Conversely, the Yellow-bellied Flycatcher, along with many other forest-species, is probably best monitored through off-road, habitat-specific counts (Hanowski and Niemi 1995b). Contrary results between this program and the BBS point to the importance of monitoring bird populations at different landscape scales (Niemi et al. 2013).

Management Activities on Study Areas

Of the survey sites in the two national forests, 16.1% have been at least partially harvested since the beginning of monitoring, which is about 1.1% a year. Over the first ten years of monitoring an average of 1.4% of sampled sites were harvested each year, whereas in the most recent nine years of monitoring 0.8% of sampled sites were harvested per year. The overall harvest rate is comparable to the 4.8% change from mature forest to early-successional types on federally managed forest lands in northeastern Minnesota between 1990 and 1995 (i.e. ~1% annual change; Wolter and White 2002). Additionally, the trend towards lower harvest levels in recent years is compatible with NF-wide trends (Niemi et al. 2013). Thus, it appears that management activities on our sample sites have continued to be representative of these two national forests.

Guild Analyses

At both the NF-level and regional scale, nearly all migratory, nesting, and habitat association guilds showed significant increases from 1995-2013 (Table 5). The only exception was species associated with early-successional forests in the Chippewa NF which showed a stable trend. This parallels the reduction in logging that has occurred in these two NFs over the past 10 years as documented in Niemi et al. (2013). Among the guilds included in the analysis, one would expect that breeding bird species associated with early-successional forests would be those most affected by a reduction in logging activity. Still, these species, both individually and as a guild, are generally showing stable or increasing trends.

There were no guilds that significantly decreased. A continued noteworthy pattern; however, are the trends among the migratory guilds. Permanent residents continue to show the greatest overall percentage increase over the past 19 years with an increase of 2.8% per year within both the Chippewa and Superior NFs (Table 5). Both short-distance migrants and long-distance migrants have also had increasing trends but not as high as the permanent residents (Table 5). Note that a 2.8% per year increase over a 19-year period represents a more than 50% increase in the number of permanent resident individuals within these two NFs in 2013 compared with 1995.

The possible hypotheses why permanent residents may be increasing at a greater rate than the short and long distance migrants include the following. (1) Over-winter survival has increased for permanent residents because the climate is warming and winters are less severe in terms of temperature. (2) Nest success has increased due to increased access to snags and cavities present from decreased logging and changing silvicultural practices. (3) Winter feeding of birds has been increasing over the past 19 years and supplemental food aids in over-winter survival. (4) Climatic warming results in earlier emergence of food (insects, berries, buds, etc.) and, hence, the earlier nesting species such as permanent residents would gain the greatest benefit from this shift in phenology. These hypotheses are not mutually exclusive, but some of the data presented in the recent general technical report on climate patterns over the period 1995-2011 suggests some support for hypotheses 1 and 4 (Niemi et al. 2013).

CONCLUSIONS

There are several possible hypotheses on why so many species seem to be stable or increasing in relative abundance over the past 19 years. First, and most apparent, logging activity has steadily decreased in both the Chippewa and Superior NFs over the past ten years; primarily due to the economic downturn of the recent recession and other factors that have contributed to reduced demand for lumber, paper, and other forest products. This has led to several potentially important changes to the age structure of forests. Over the period 1977-2012, northeastern Minnesota has seen an increase in the proportion of forest that is greater than 60 years old and a concurrent decrease in mid-successional forests of 41-60 years old (MFRC 2013). Therefore, the amount of forest in early successional age-classes has either remained stable or increased slightly. Because the majority of breeding bird species in these forests relates to either early or late successional forests, it is logical that nearly all species would also be stable or increasing. Older forests, especially those with diverse structural elements, support a much broader range of species including early successional species (Schieck and Song 2006). Aspen forests provide an excellent example of how this structural diversity develops; stands >60 years old have 2-3 times higher natural mortality than those that are 41-60 years old (MFRC 2013), thus providing a variety of habitat elements from snags that increase nest-cavities to tree-fall gaps that create shrubby growth utilized by many species.

There is evidence that silvicultural practices have also changed over the last 20 years. Although about 70% of harvesting is completed through clear-cutting, this has steadily decreased from 1991-2008 with selection harvesting, thinning, and patch clear-cuts being utilized more often (D'Amato et al. 2009). Over the same period, there has been a nearly two-fold increase in the number of clear-cuts (44% in 1991 to 80% in 2008) that incorporate leave trees (D'Amato et al. 2008). With logging being the most significant disturbance on these NFs, changes in practice have a variety of effects on both local and regional populations of birds. This is especially true if modifications (e.g. leaving standing timber and snags in clear-cuts) mimic disturbance features that these species evolved to utilize. Changing age-class structure and silvicultural practices might better represent the natural fire disturbance regime that once dominated these forests (Heinselman 1973; Niemi et al. 1998) and to which most of these bird species certainly respond.

Despite increasing mature forest cover, several of the species that are decreasing breed primarily in mid-to-late-successional forests including the Broad-winged Hawk, Connecticut Warbler, Evening Grosbeak, Swainson's Thrush, and Yellow-bellied Flycatcher. For each, there are potential reasons for these trends. First, these species, with the exception of the Broad-winged Hawk, have mostly boreal distributions and are at or near the edge of their breeding range in these NF's. This is where we might expect initial declines to be most evident, especially if changing climatological factors are influencing these species' populations. The Connecticut Warbler, Swainson's Thrush, and Yellow-bellied Flycatcher are all highly associated with lowland coniferous forests. These species also share similar food types and foraging-space in dense, shrubby growth near the ground (Pitocchelli et al. 1997; Evans Mack and Yong 2000; Gross and Lowther 2001). There is some evidence that drought conditions and lower food supplies over the past ten years may have affected reproduction for these species that rely on an insectivorous diet to feed their young (Niemi et al. 2013). The declining trend of the Broad-winged Hawk (5 stands – the minimum for inclusion) is based on relatively sparse data and is contrary to recent analyses that show a stable trend in migration numbers past Hawk Ridge Bird Observatory (*R. Regal unpublished data*). Though difficult to characterize, the decline in Evening Grosbeak is relatively clear throughout North America (Sauer et al. 2012).

Among the major conclusions of the 20-year summary of the national forest bird monitoring program (Niemi et al. 2013) is our inability to definitively pinpoint specific causes for increases or decreases of specific species. Because these species range over relatively wide areas these populations are subject to many potential factors that can affect their population. These factors include climate, weather, diseases, landscape and habitat change due to both natural and anthropogenic disturbances (e.g., forest fire, logging, wind, exurban development and insect defoliation). Hazards of migration and over-wintering conditions can also influence population levels. We plan to explore two analyses that may shed light on how these

factors might be affecting species' populations; an analysis of the important factors influencing trend numbers and a re-examination of the trend analysis with a Bayesian hierarchical framework.

Nevertheless, given the number of species that we are able to monitor, if there is an influence of a large-scale forest management activity, then it is likely that such a signal would be detected by these data. In fact, the clearest signal we may have is reflected in the large number of species that are increasing or are stable; largely due to the reduction in logging activity in these forests, associated changes in age-class structure across the landscape, as well as the annual changes in ambient weather conditions (e.g., drought and mild winters).

The overall message in this report is positive regarding breeding forest birds in the Chippewa and Superior NFs. Although there is evidence of positive trends in forest-cover across the region (+5.5% in last 35 years; MFRC 2013), from a historical perspective, most of these forest-associated breeding species likely have much lower populations today than in the past due to habitat loss. For example, Minnesota has lost almost half of its forest area from 31 million acres in the mid-1800's to less than 17 million acres today. These rates of forest loss are conservative relative to other U.S. states and in over-wintering habitats of Mexico and in Central and South America. Maintaining adequate forested habitat across these species' ranges and identifying the factors influencing their populations will be major challenges for many generations to come.

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Table 1. Trends for two National Forests (NF) and pooled NF's based on linear regression of loess-smoothed annual index of abundance (See Methods) (1995- 2013). I= significantly increasing, D= significantly decreasing. *$P \leq 0.05$, ** $P \leq 0.01$. See Appendix A for species graphs and Appendix B for test statistics and sample sizes.

	Chippewa NF	Superior NF	Regional
Alder Flycatcher	ns	ns	ns
American Crow	ns	ns	ns

American Goldfinch	I**	ns	I**
American Redstart	ns	ns	ns
American Robin	ns	I**	I**
Black-and-white Warbler	I**	I**	I**
Blackburnian Warbler	ns	ns	ns
Black-billed Cuckoo	-	ns	-
Black-capped Chickadee	I**	I**	I**
Black-throated Blue Warbler	-	ns	-
Black-throated Green Warbler	I**	I**	I**
Blue Jay	I**	I**	I**
Blue-headed Vireo	ns	ns	ns
Broad-winged Hawk	-	D**	-
Brown Creeper	ns	ns	ns
Brown-headed Cowbird	ns	-	-
Canada Warbler	I*	ns	I*
Cape May Warbler	-	I**	-
Cedar Waxwing	I*	I**	I**
Chestnut-sided Warbler	ns	ns	ns
Chipping Sparrow	ns	ns	I*
Common Loon	ns	D*	-
Common Raven	ns	ns	ns
Common Yellowthroat	ns	ns	ns
Connecticut Warbler	D**	D**	D**
Downy Woodpecker	ns	ns	ns
Eastern Wood-Pewee	ns	ns	ns

Evening Grosbeak	-	D**	-
Golden-crowned Kinglet	ns	I**	I**
Golden-winged Warbler	ns	ns	ns
Gray Catbird	ns	-	-
Gray Jay	ns	I*	I**
Great Crested Flycatcher	ns	-	-
Hairy Woodpecker	ns	ns	ns
Hermit Thrush	I**	ns	I**
Indigo Bunting	ns	-	-
Least Flycatcher	ns	ns	ns
Magnolia Warbler	ns	ns	ns
Mourning Dove	I**	-	-
Mourning Warbler	ns	ns	ns
Nashville Warbler	I**	I**	I**
Northern Flicker (Yellow-shafted)	ns	I*	I**
Northern Parula	I*	I**	I**
Northern Waterthrush	ns	I*	ns
Olive-sided Flycatcher	ns	ns	ns
Ovenbird	I**	I**	I**
Palm Warbler (Western)	ns	-	-
Pileated Woodpecker	I**	I**	I**
Pine Warbler	I**	I**	I**
Purple Finch	ns	I*	ns
Red-breasted Nuthatch	I**	I**	I**
Red-eyed Vireo	I**	ns	I*

Red-winged Blackbird	ns	ns	ns
Rose-breasted Grosbeak	ns	ns	ns
Ruby-crowned Kinglet	-	I**	-
Ruby-throated Hummingbird	ns	-	-
Ruffed Grouse	-	ns	-
Scarlet Tanager	ns	ns	ns
Song Sparrow	D**	ns	D**
Swainson's Thrush	-	D**	-
Swamp Sparrow	ns	ns	ns
Tennessee Warbler	-	ns	-
Veery	I**	ns	I*
White-breasted Nuthatch	ns	-	-
White-throated Sparrow	I**	I**	I**
Wilson's Snipe	-	ns	-
Winter Wren	ns	ns	ns
Wood Thrush	I**	ns	ns
Yellow Warbler	ns	-	-
Yellow-bellied Flycatcher	ns	D**	D**
Yellow-bellied Sapsucker	I**	I**	I**
Yellow-rumped Warbler (Myrtle)	ns	I**	I**
Yellow-throated Vireo	D**	-	-

Table 2. Species with significantly increasing trends ($P \leq 0.05$) for two national forests and region-wide (1995-2013), based on regression of loess-smoothed annual index of abundance. $^{**}P \leq 0.01$. Species graphs can be found in Appendix A.

Chippewa NF	Superior NF	Regional
American Goldfinch**	American Robin**	American Goldfinch**
Black-and-white Warbler**	Black-and-white Warbler**	American Robin**
Black-capped Chickadee**	Black-capped Chickadee**	Black-and-white Warbler**
Black-throated Green Warbler**	Black-throated Green Warbler**	Black-capped Chickadee**
Blue Jay**	Blue Jay**	Black-throated Green Warbler**
Canada Warbler	Cape May Warbler**	Blue Jay**
Cedar Waxwing	Cedar Waxwing**	Canada Warbler
Hermit Thrush**	Golden-crowned Kinglet**	Cedar Waxwing**
Mourning Dove	Gray Jay	Chipping Sparrow
Nashville Warbler**	Nashville Warbler**	Golden-crowned Kinglet**
Northern Parula	Northern Flicker (Yellow-shafted)	Gray Jay**
Ovenbird**	Northern Parula**	Hermit Thrush**
Pileated Woodpecker**	Northern Waterthrush	Nashville Warbler**
Pine Warbler**	Ovenbird**	Northern Flicker (Yellow-shafted)**
Red-breasted Nuthatch**	Pileated Woodpecker**	Northern Parula**
Red-eyed Vireo**	Pine Warbler**	Ovenbird**
Veery**	Purple Finch	Pileated Woodpecker**
White-throated Sparrow**	Red-breasted Nuthatch**	Pine Warbler**
Wood Thrush**	Ruby-crowned Kinglet**	Red-breasted Nuthatch**
Yellow-bellied Sapsucker**	White-throated Sparrow**	Red-eyed Vireo
	Yellow-bellied Sapsucker**	Veery
	Yellow-rumped Warbler (Myrtle)**	White-throated Sparrow**
		Yellow-bellied Sapsucker**
		Yellow-rumped Warbler (Myrtle)**

Table 3. Summary of species with increasing trends ($P \leq 0.05$) on two national forests (1995-2013). Individual species graphs can be found in Appendix A.

Increased in one NF	**Increased in both NFs**
American Goldfinch	Black-and-white Warbler
American Robin	Black-capped Chickadee
Canada Warbler	Black-throated Green Warbler
Cape May Warbler	Blue Jay
Golden-crowned Kinglet	Cedar Waxwing
Gray Jay	Nashville Warbler
Hermit Thrush	Northern Parula
Mourning Dove	Ovenbird
Northern Flicker (Yellow-shafted)	Pileated Woodpecker
Northern Waterthrush	Pine Warbler
Purple Finch	Red-breasted Nuthatch
Red-eyed Vireo	White-throated Sparrow
Ruby-crowned Kinglet	Yellow-bellied Sapsucker
Veery	
Wood Thrush	
Yellow-rumped Warbler (Myrtle)	

Table 4. Species with significantly decreasing trends ($P < 0.05$) for two national forests (1995-2013), based on regression of loess-smoothed annual index of abundance. $^{**}P < 0.01$. Species graphs can be found in Appendix A.

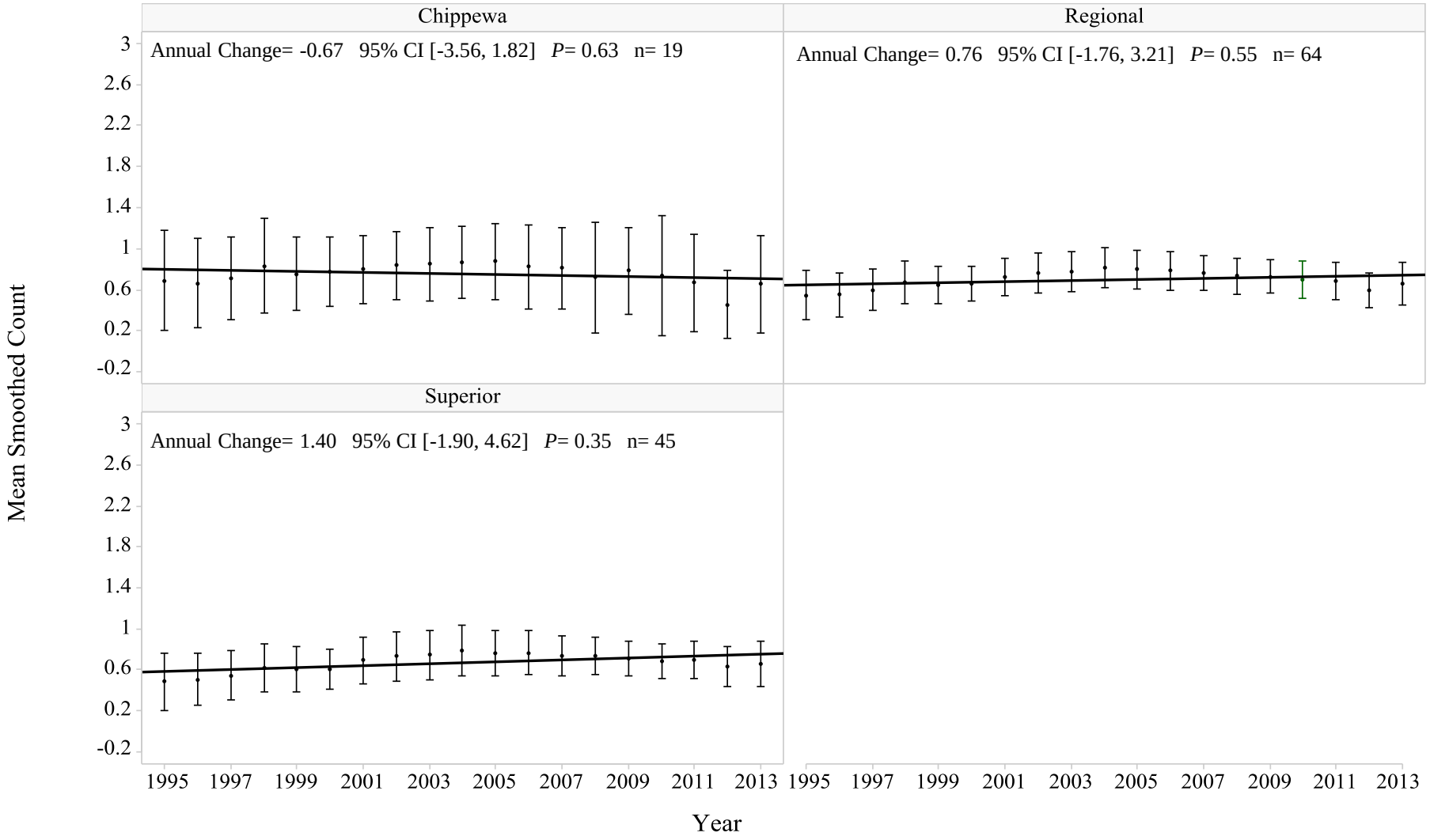
Chippewa NF	Superior NF	Regional
Connecticut Warbler**	Broad-winged Hawk**	Connecticut Warbler**
Song Sparrow**	Common Loon	Song Sparrow**
Yellow-throated Vireo**	Connecticut Warbler**	Yellow-bellied Flycatcher**
	Evening Grosbeak**	
	Swainson's Thrush**	
	Yellow-bellied Flycatcher**	

Table 5. Test statistics and sample sizes for guild trend analyses on two National Forests and a combined regional analysis (1995-2013). All species combined within each guild category and analyzed as a group, regardless of whether a species meets criteria for individual species analyses. Trend= percent annual change in population trend. N= number of stands analyzed. See appendix A for trend graphs.

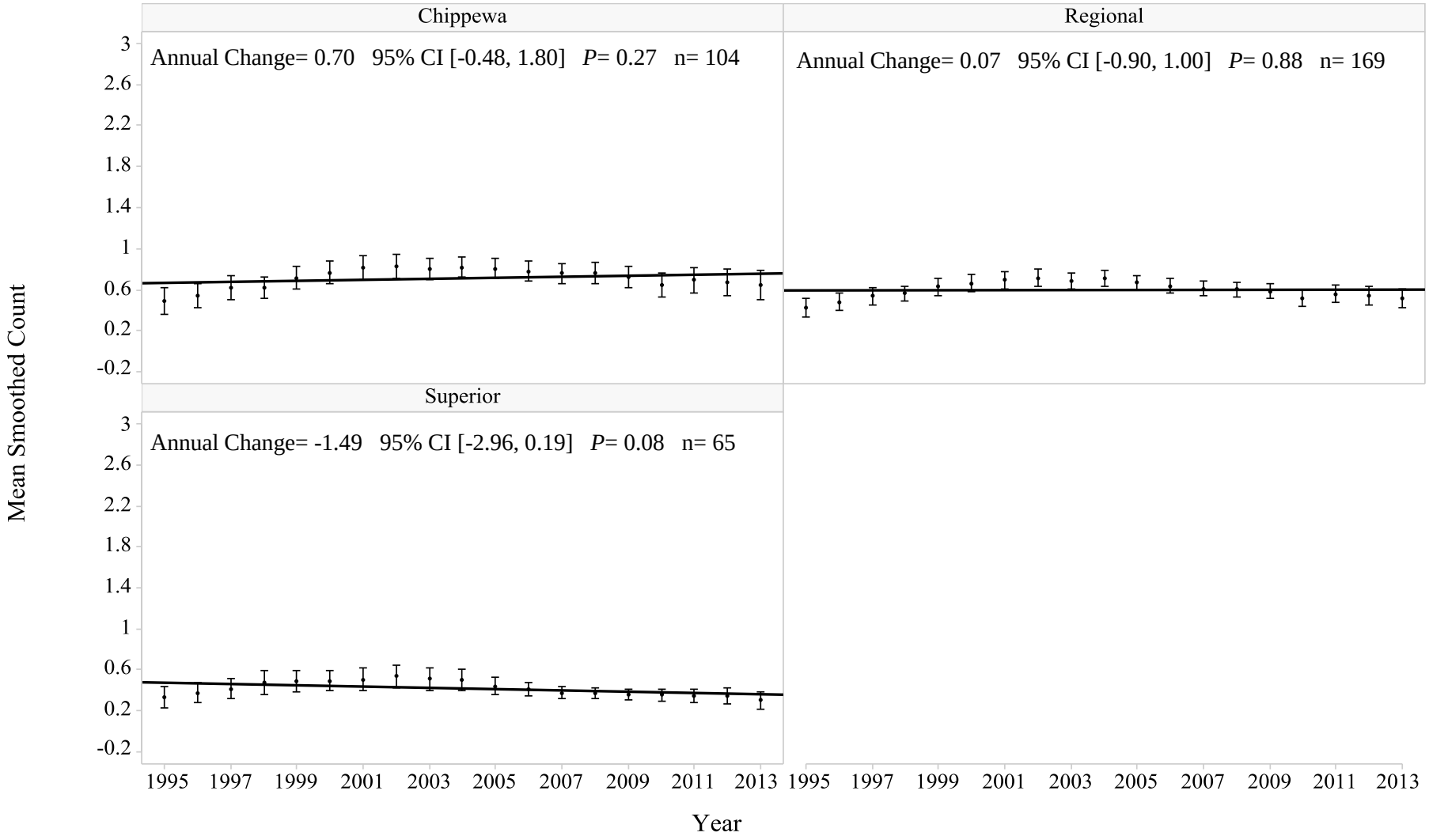
	Chippewa NF				**Superior NF**				**Regional**			
Guild Category	Trend	*P*	R^2	N	Trend	*P*	R^2	N	Trend	*P*	R^2	N
Short distance migrants	0.67	<0.01	0.13	125	1.75	<0.01	0.78	146	1.28	<0.01	0.50	271
Long distance migrants	1.22	<0.01	0.36	125	0.71	<0.01	0.21	146	0.94	<0.01	0.28	271
Permanent residents	2.55	<0.01	0.63	125	3.05	<0.01	0.87	146	2.83	<0.01	0.78	271
Ground nesting	1.53	<0.01	0.65	125	0.96	<0.01	0.40	146	1.20	<0.01	0.54	271
Shrub/Sub-canopy nesting	0.52	0.04	0.04	125	0.60	0.02	0.10	146	0.55	<0.01	0.06	271
Canopy nesting	1.07	<0.01	0.34	125	2.34	<0.01	0.99	146	1.69	<0.01	0.80	271
Cavity nesting	2.67	<0.01	0.58	125	2.80	<0.01	0.59	145	2.73	<0.01	0.58	270
Coniferous forest	1.84	<0.01	0.67	122	2.04	<0.01	0.95	146	1.95	<0.01	0.87	268
Lowland coniferous	1.49	<0.01	0.71	118	1.46	<0.01	0.78	146	1.50	<0.01	0.89	264
Deciduous forest	1.28	<0.01	0.29	125	0.72	<0.01	0.16	146	1.00	<0.01	0.22	271
Early-succession	0.63	0.14	0.07	124	0.87	0.04	0.19	146	0.78	0.01	0.14	270
Mixed forest	2.20	<0.01	0.85	125	1.58	<0.01	0.87	146	1.86	<0.01	0.87	271

Appendix A. Species and guild population trend graphs of mean smoothed count index 1995-2013.

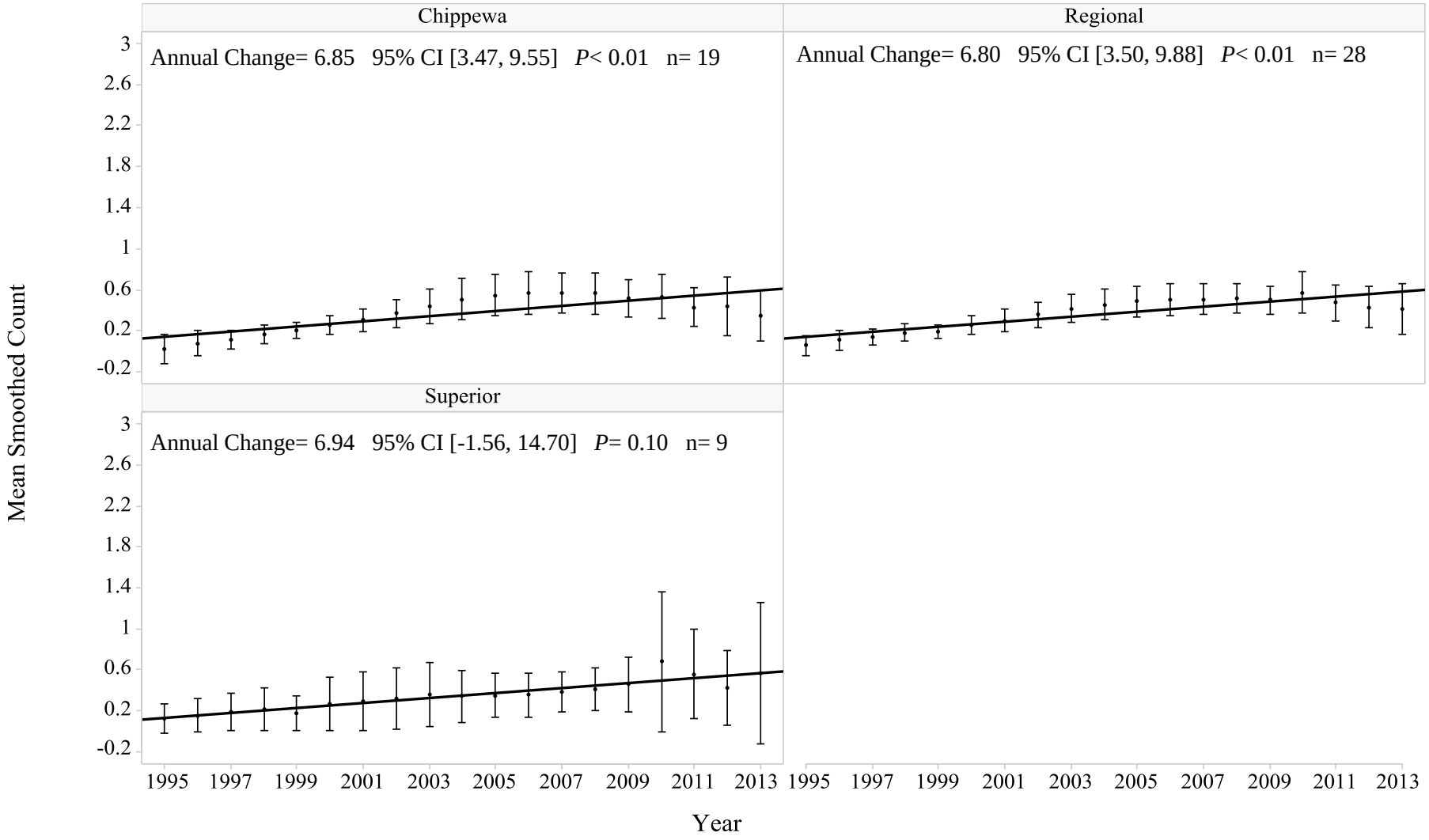
Alder Flycatcher



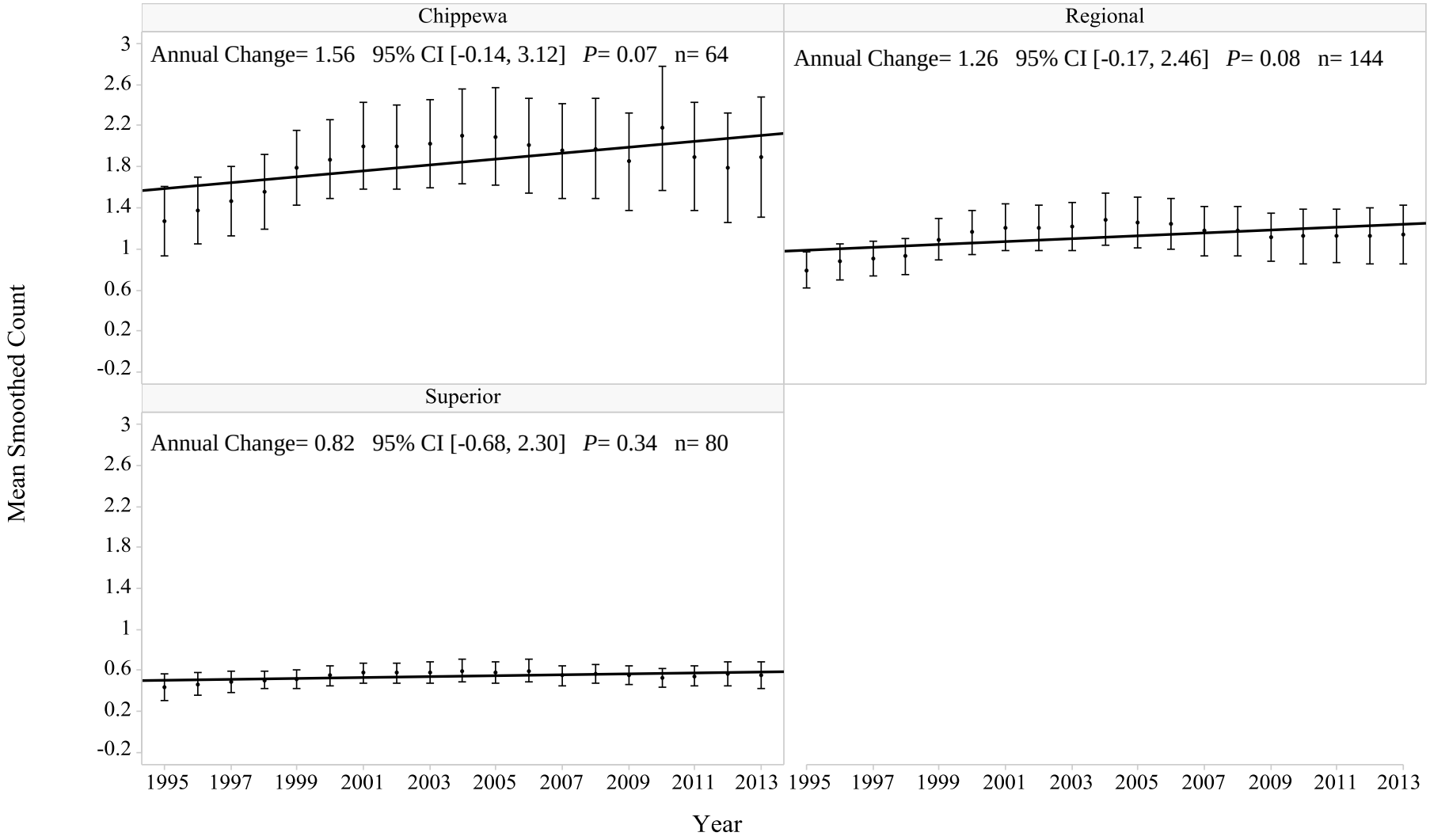
American Crow



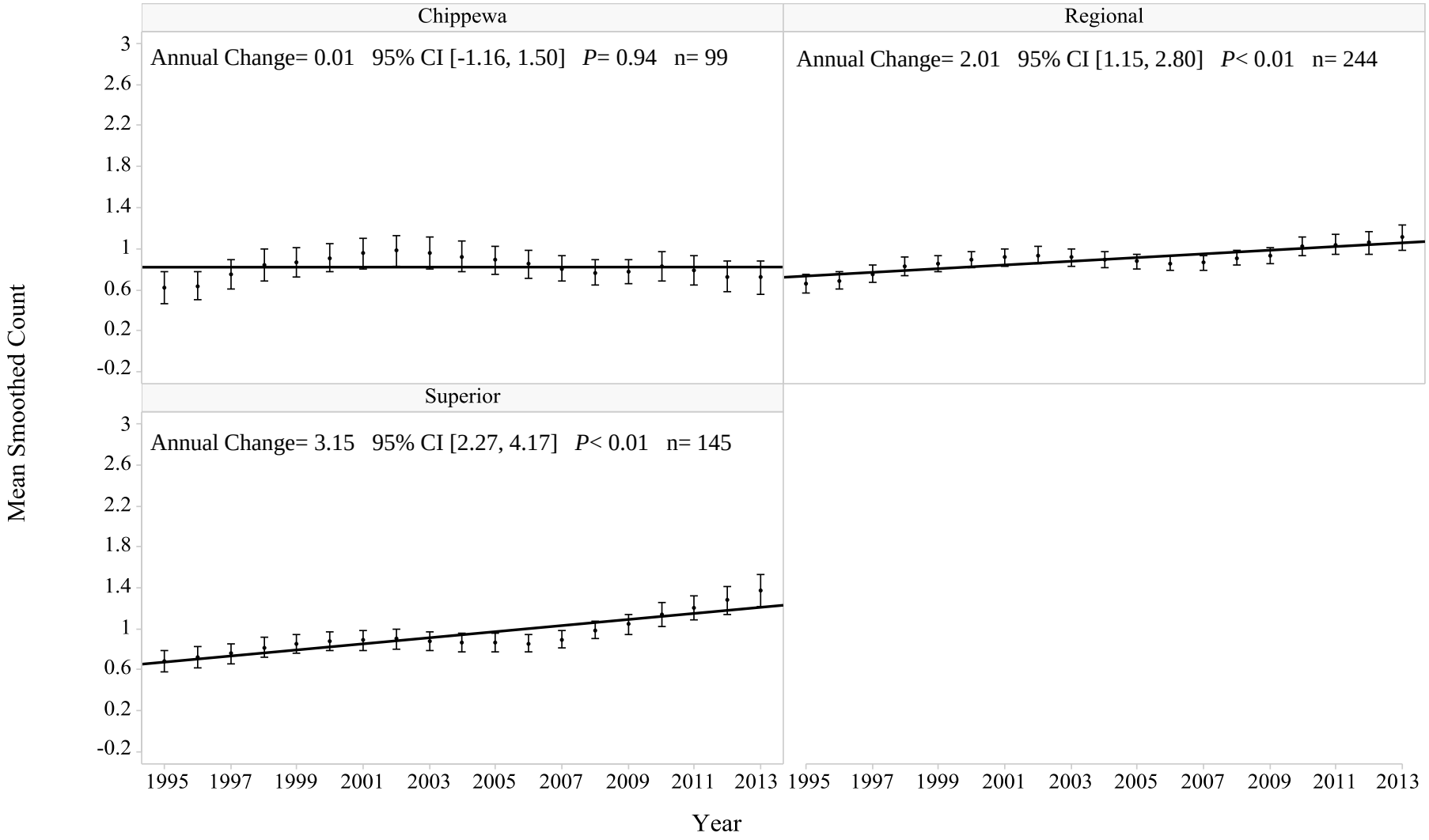
American Goldfinch



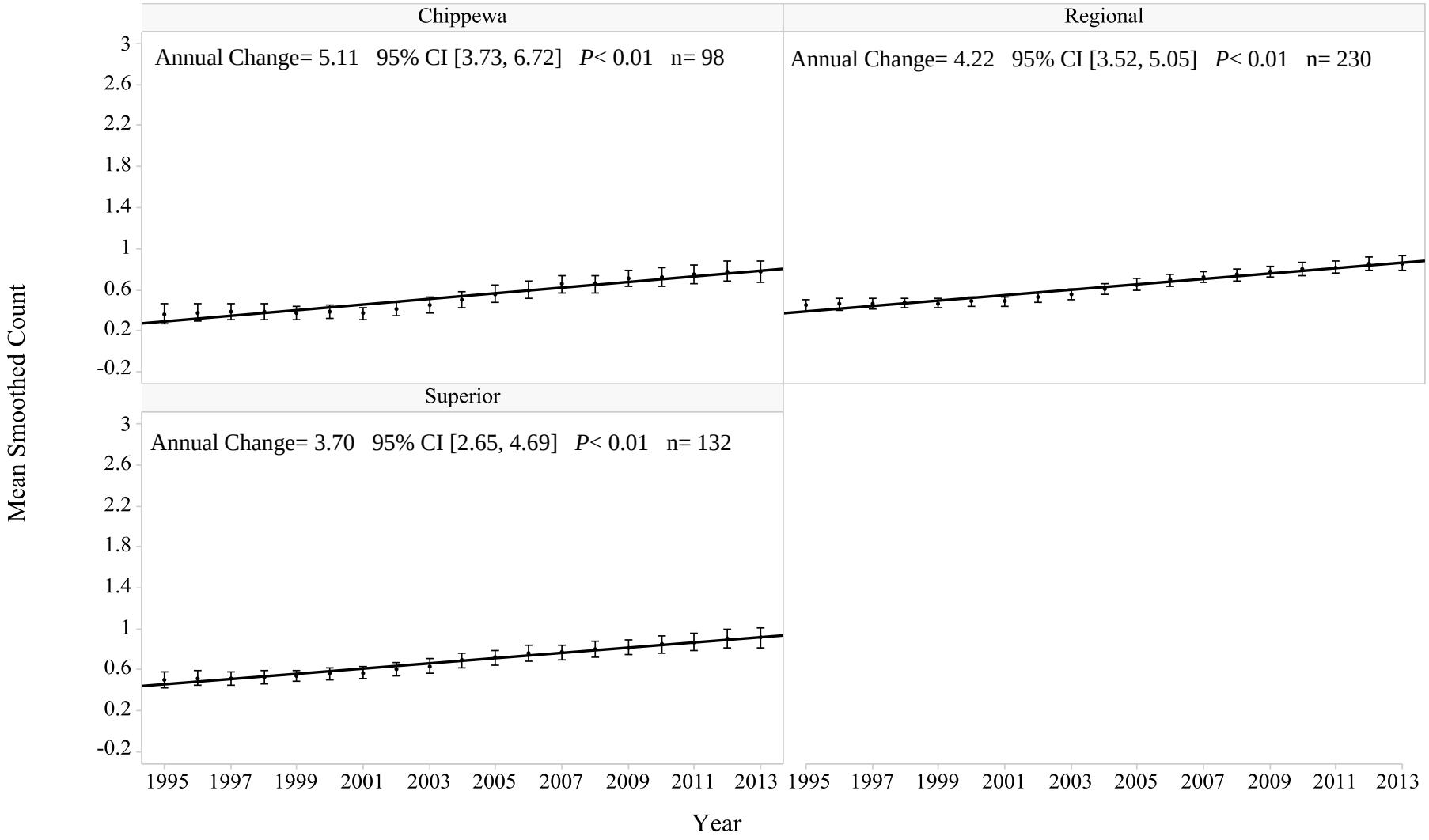
American Redstart



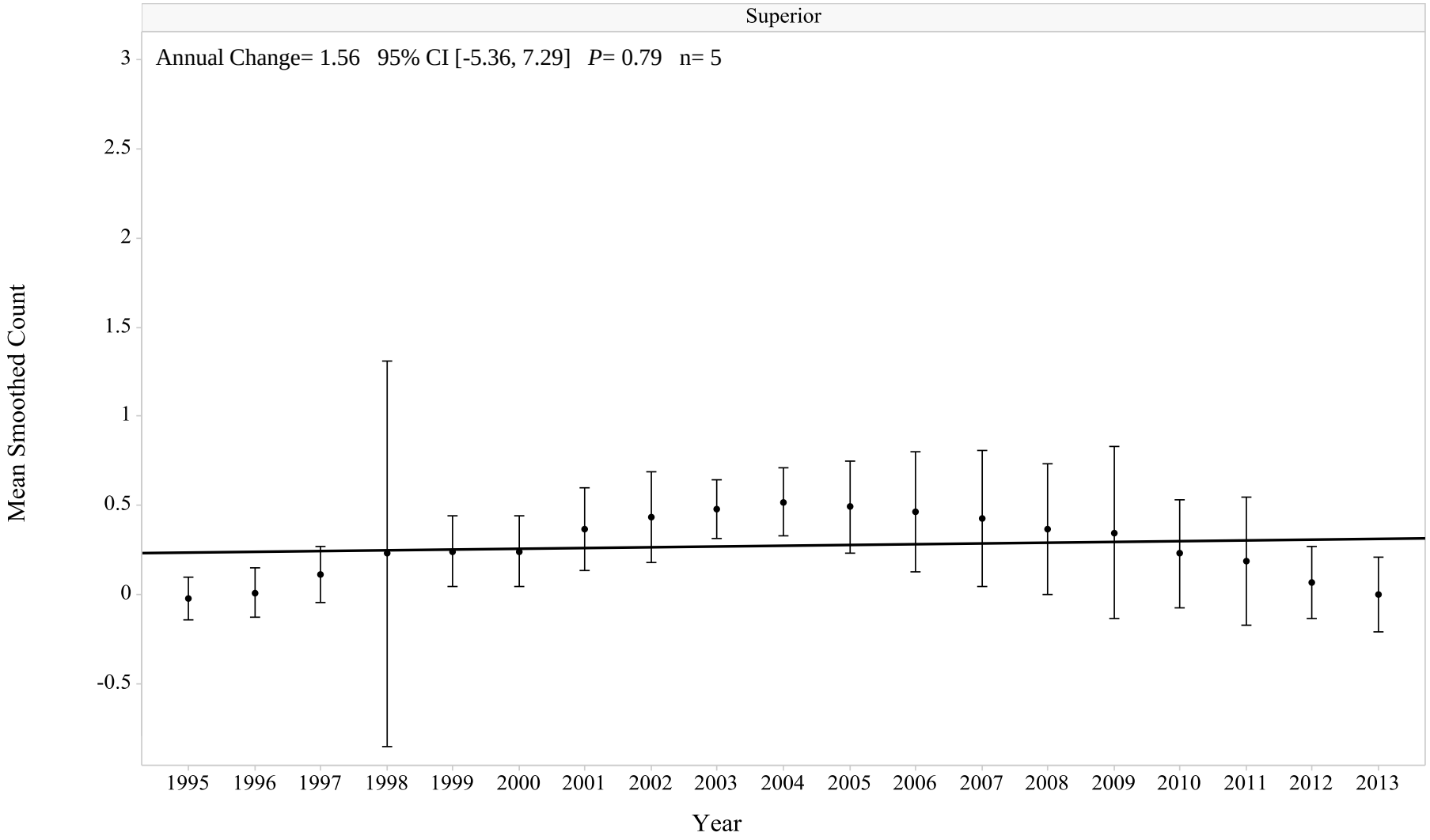
American Robin



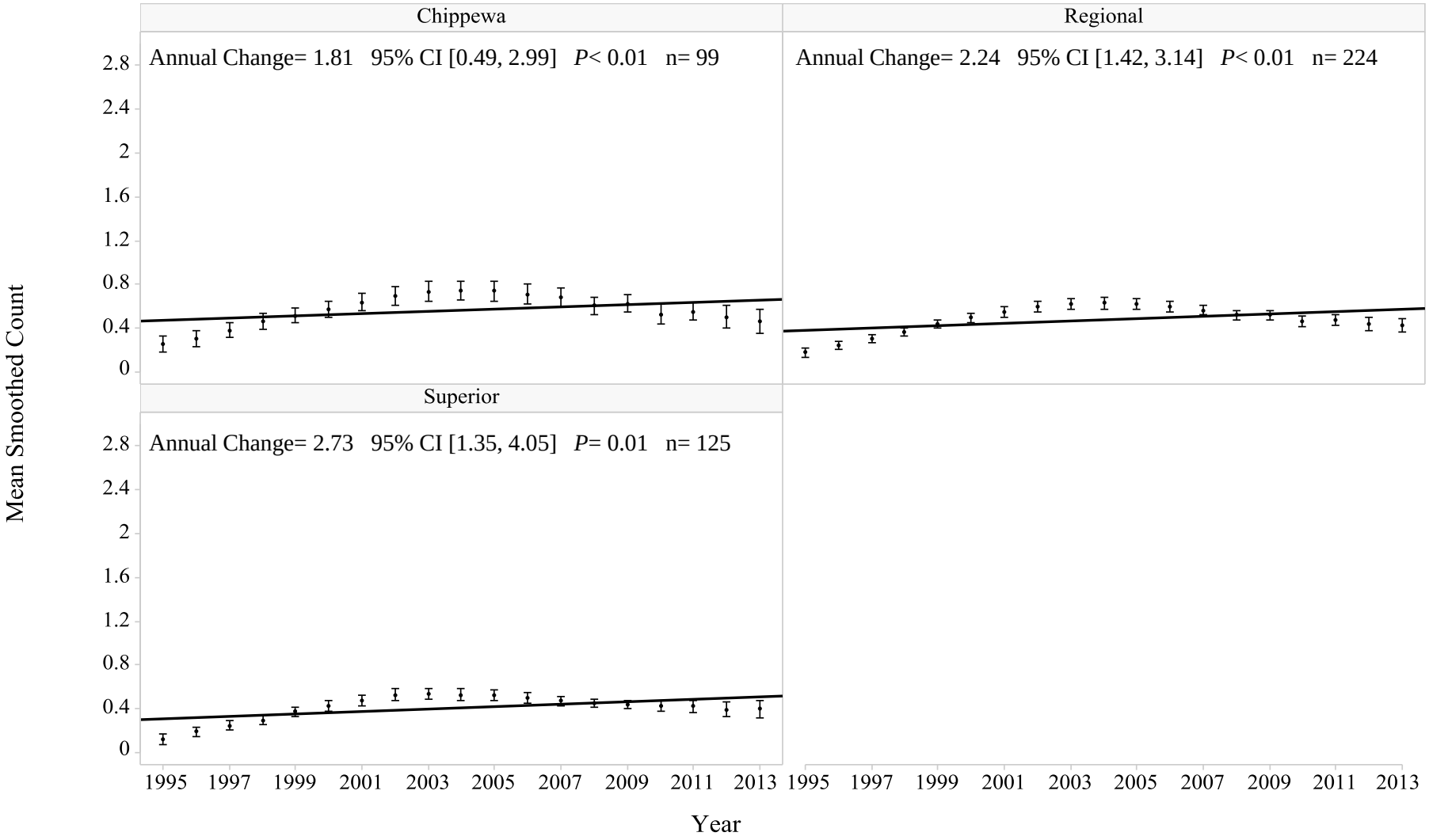
Black-and-white Warbler



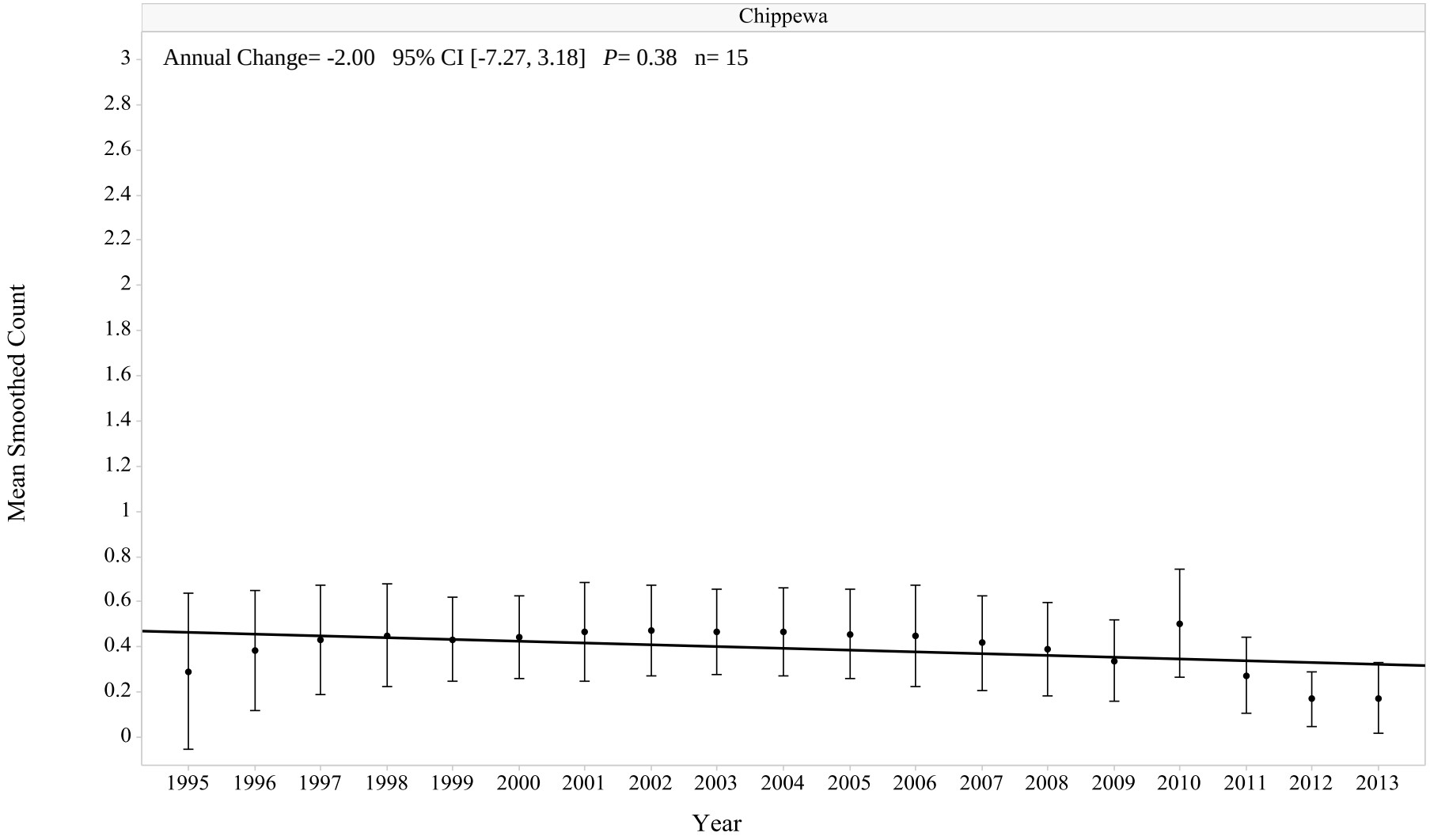
Black-billed Cuckoo



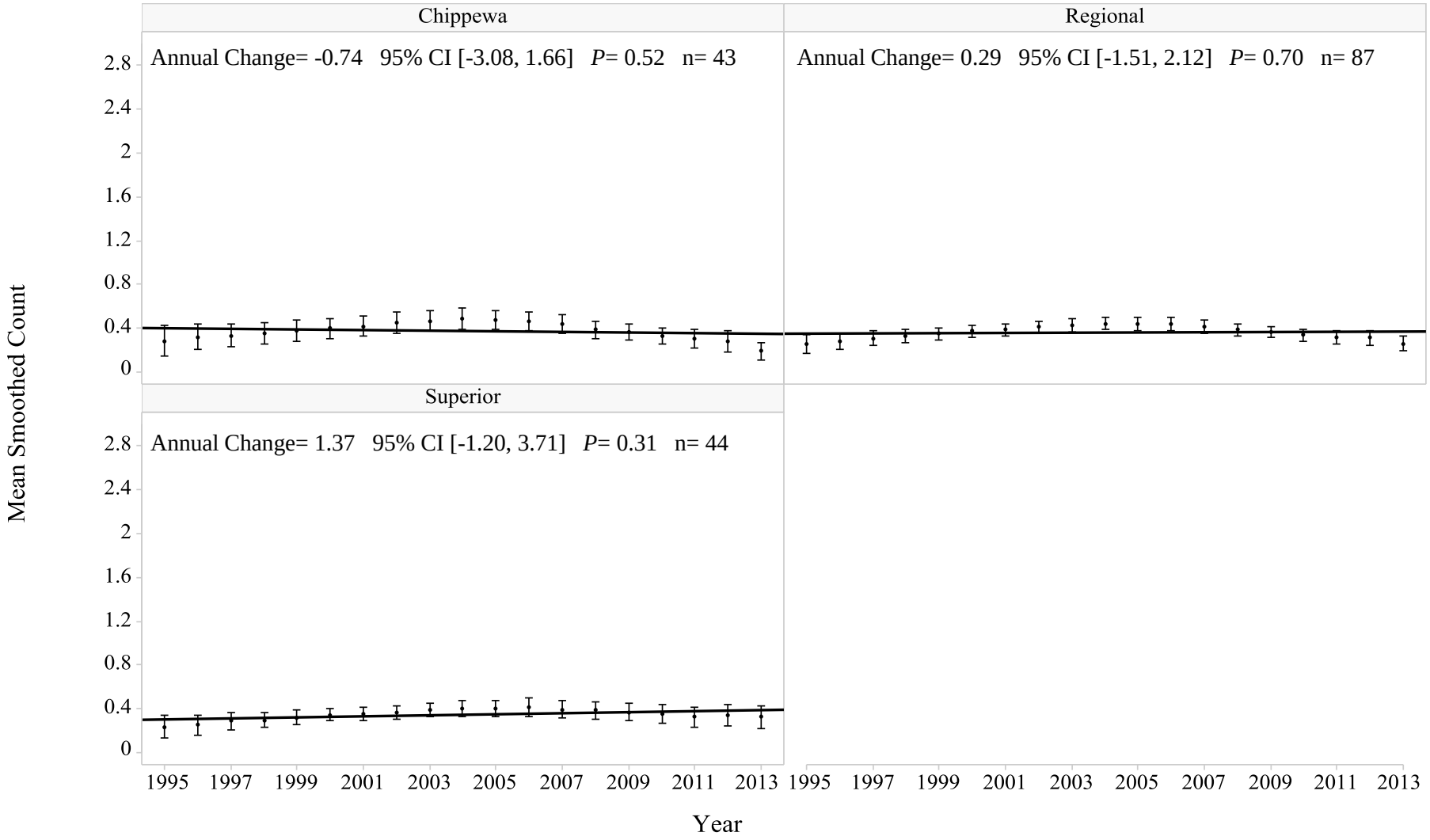
Black-capped Chickadee



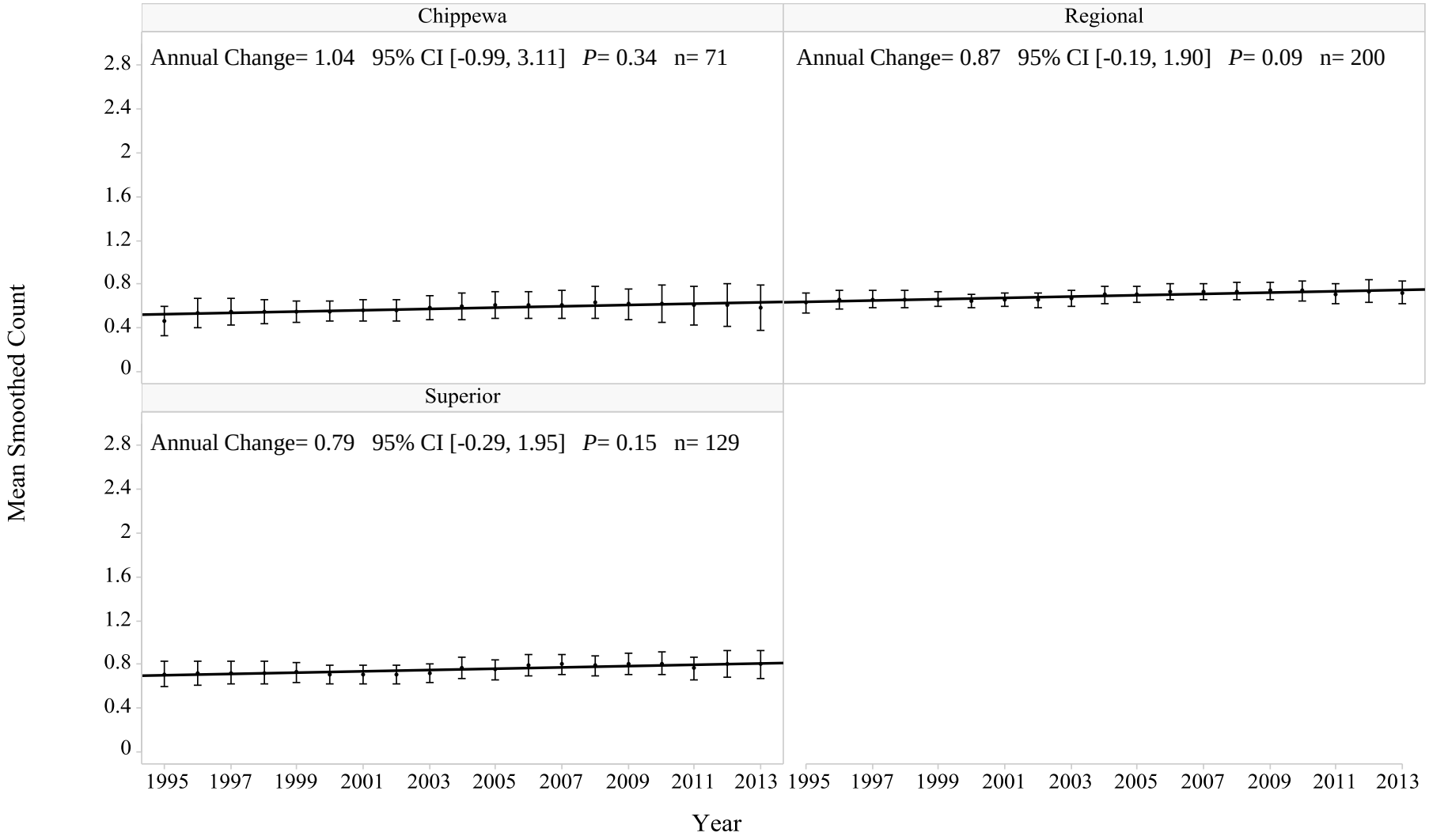
Brown-headed Cowbird



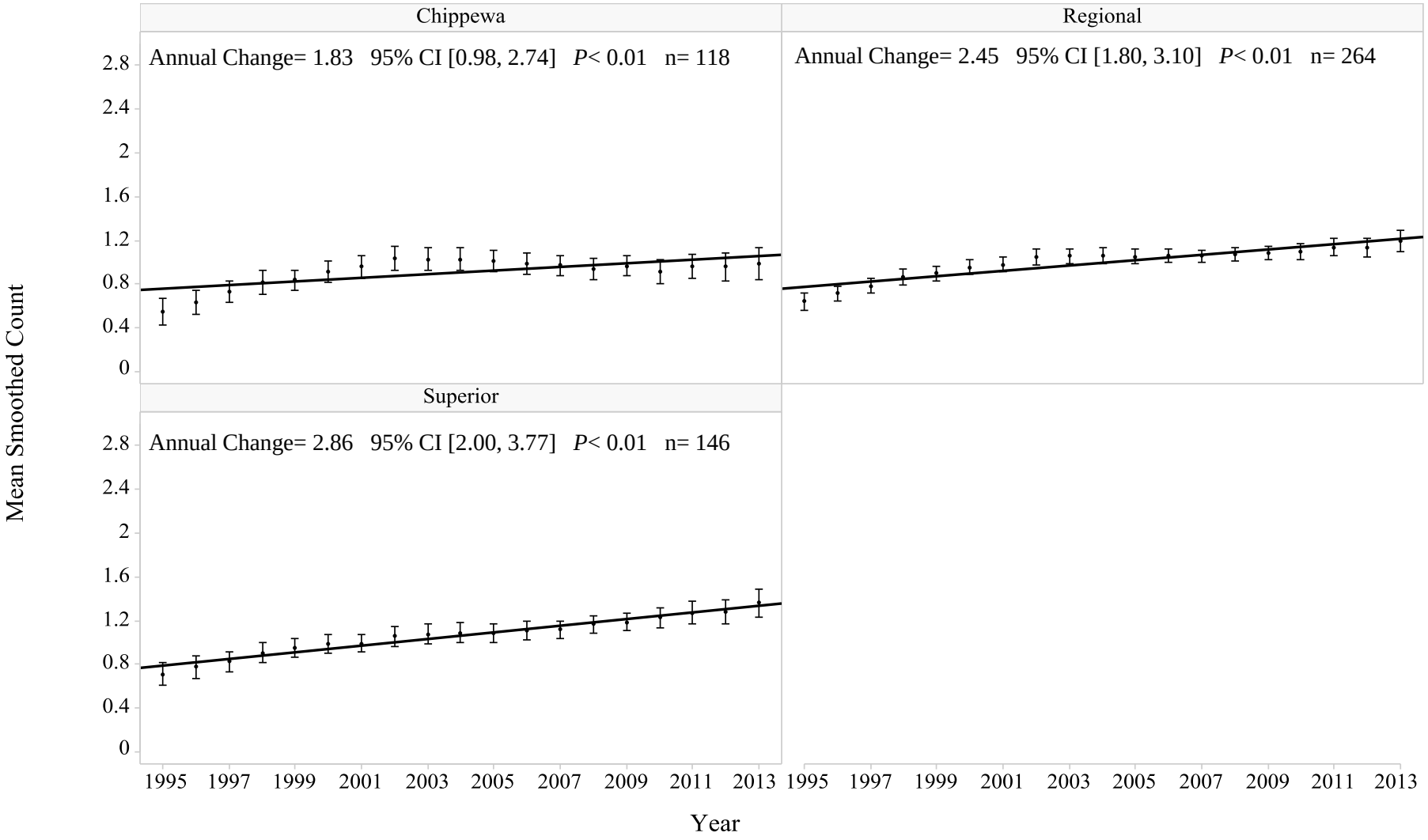
Blue-headed Vireo



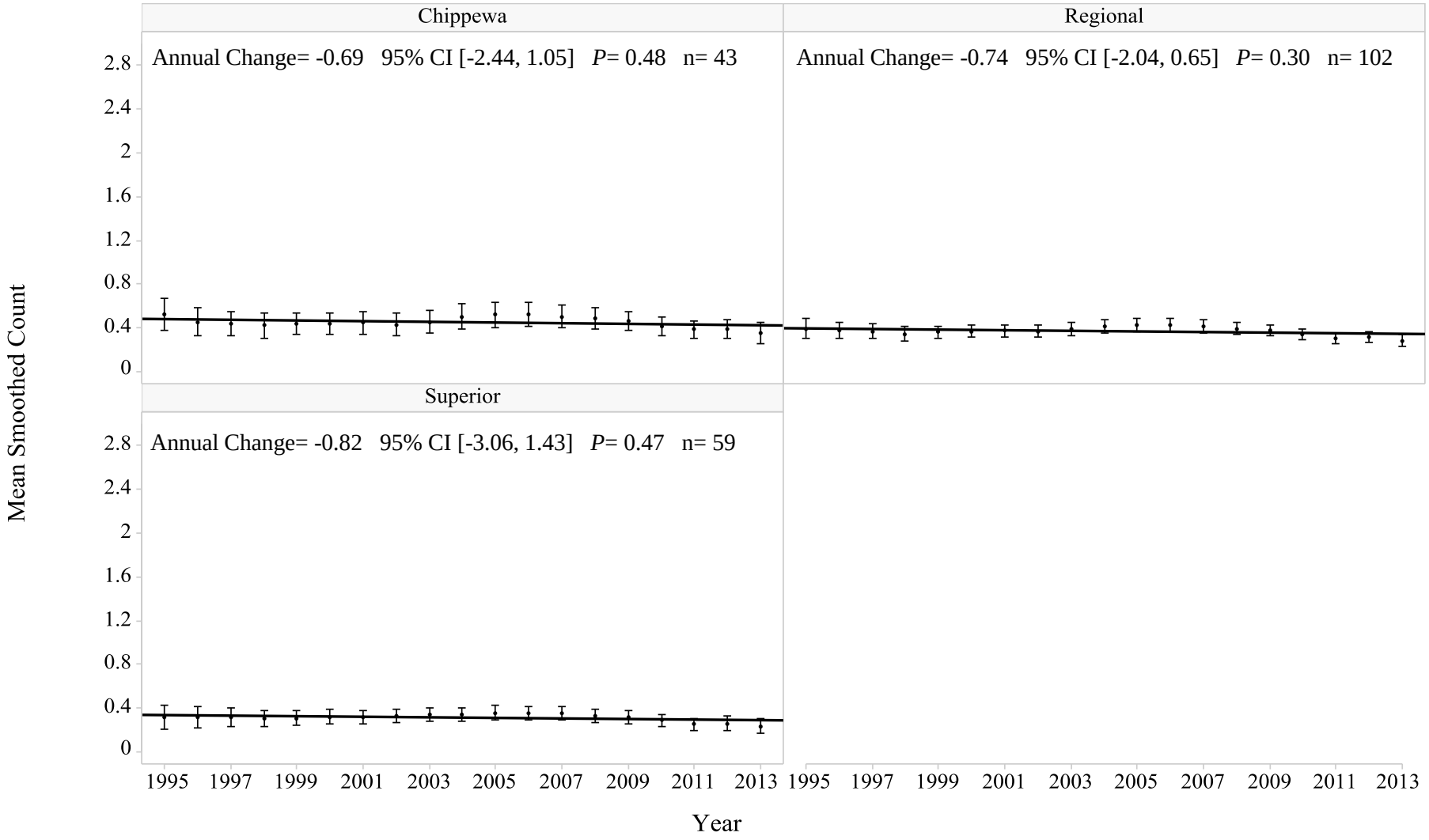
Blackburnian Warbler



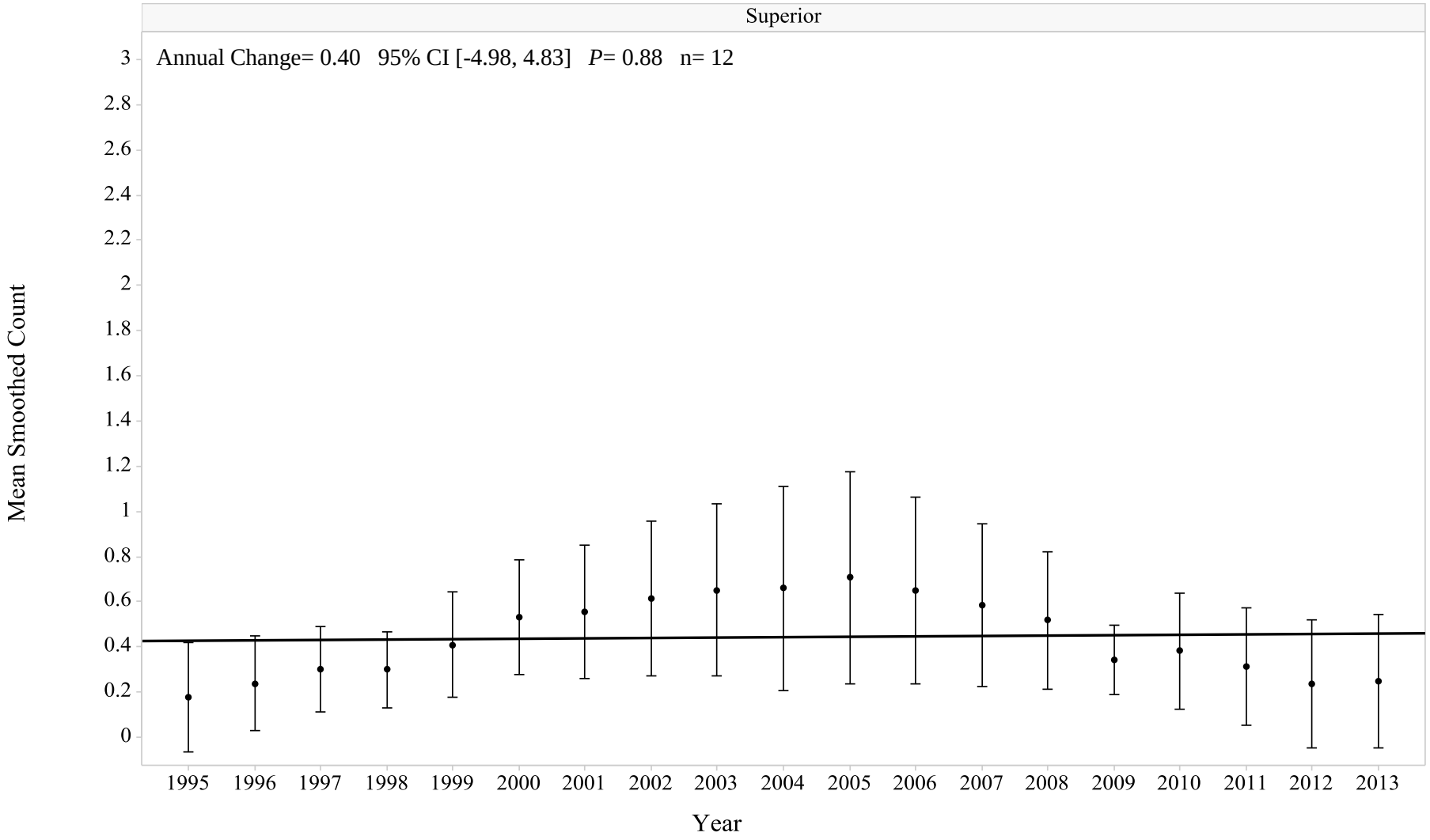
Blue Jay


Chippewa
Annual Change= 1.83 95% CI [0.98, 2.74] P< 0.01 n= 118
Regional
Annual Change= 2.45 95% CI [1.80, 3.10] P< 0.01 n= 264
Superior
Annual Change= 2.86 95% CI [2.00, 3.77] P< 0.01 n= 146
Mean Smoothed Count
0
0.4
0.8
1.2
1.6
2
2.4
2.8
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
Year

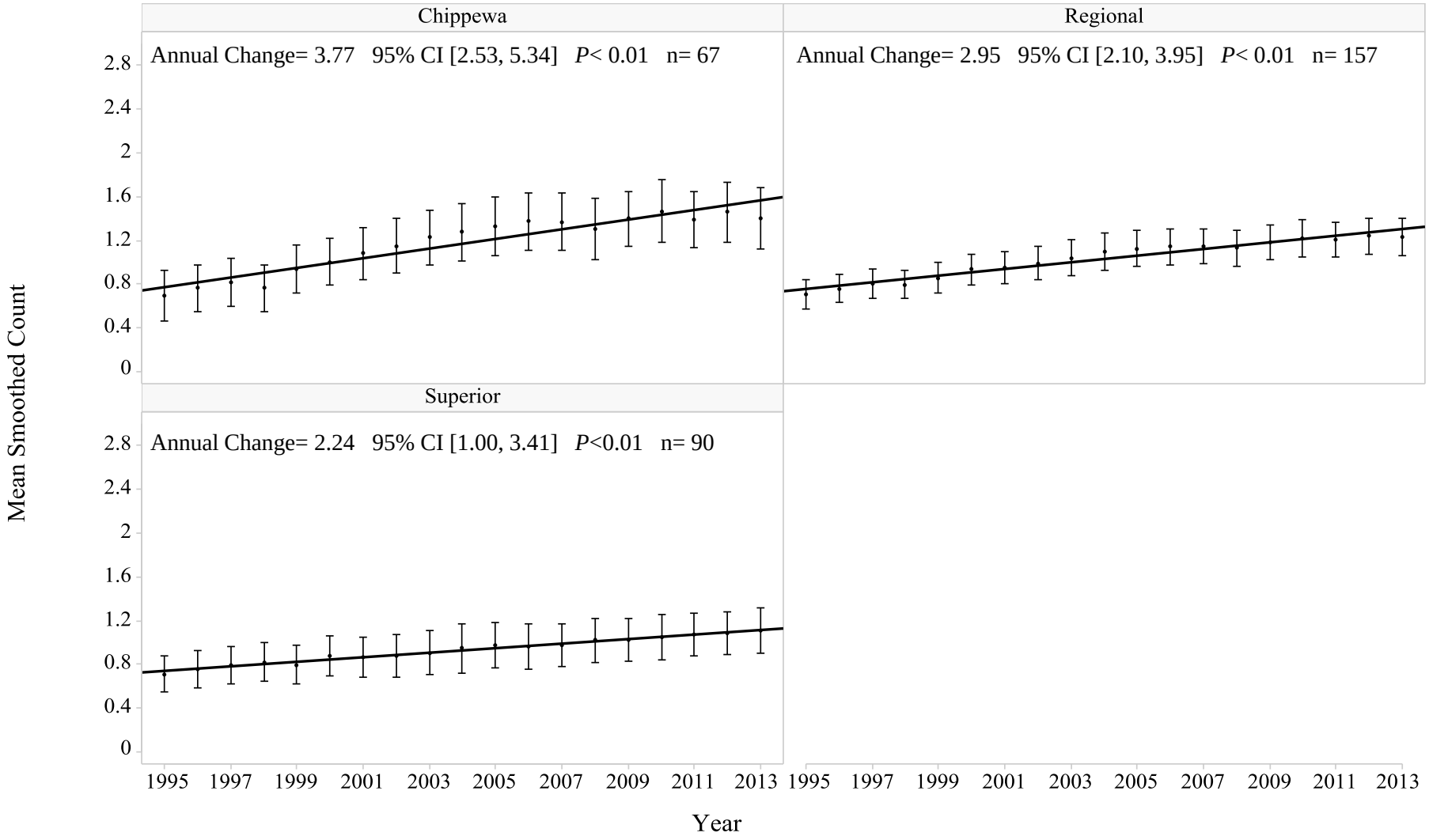
Brown Creeper



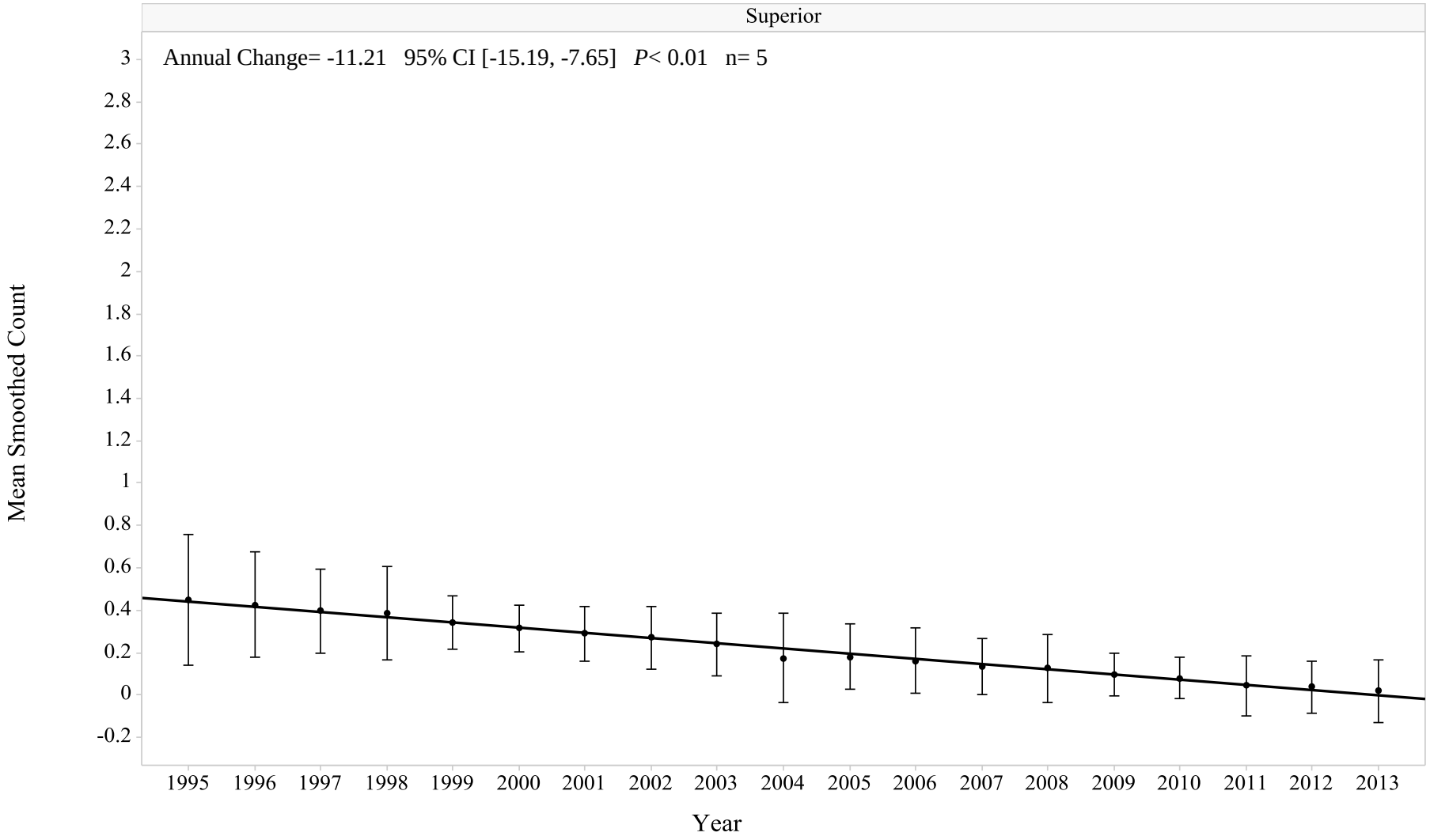
Black-throated Blue Warbler



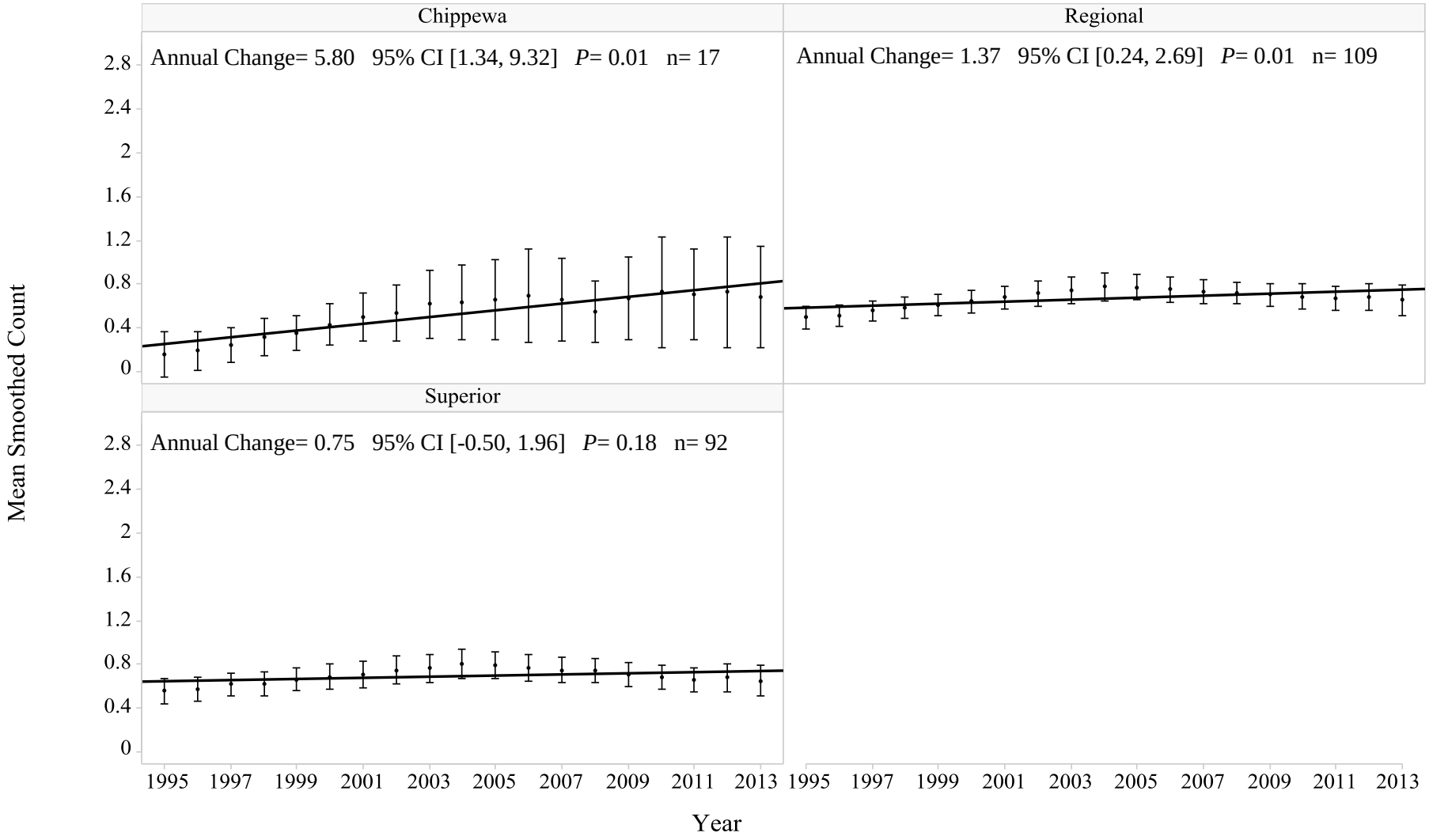
Black-throated Green Warbler



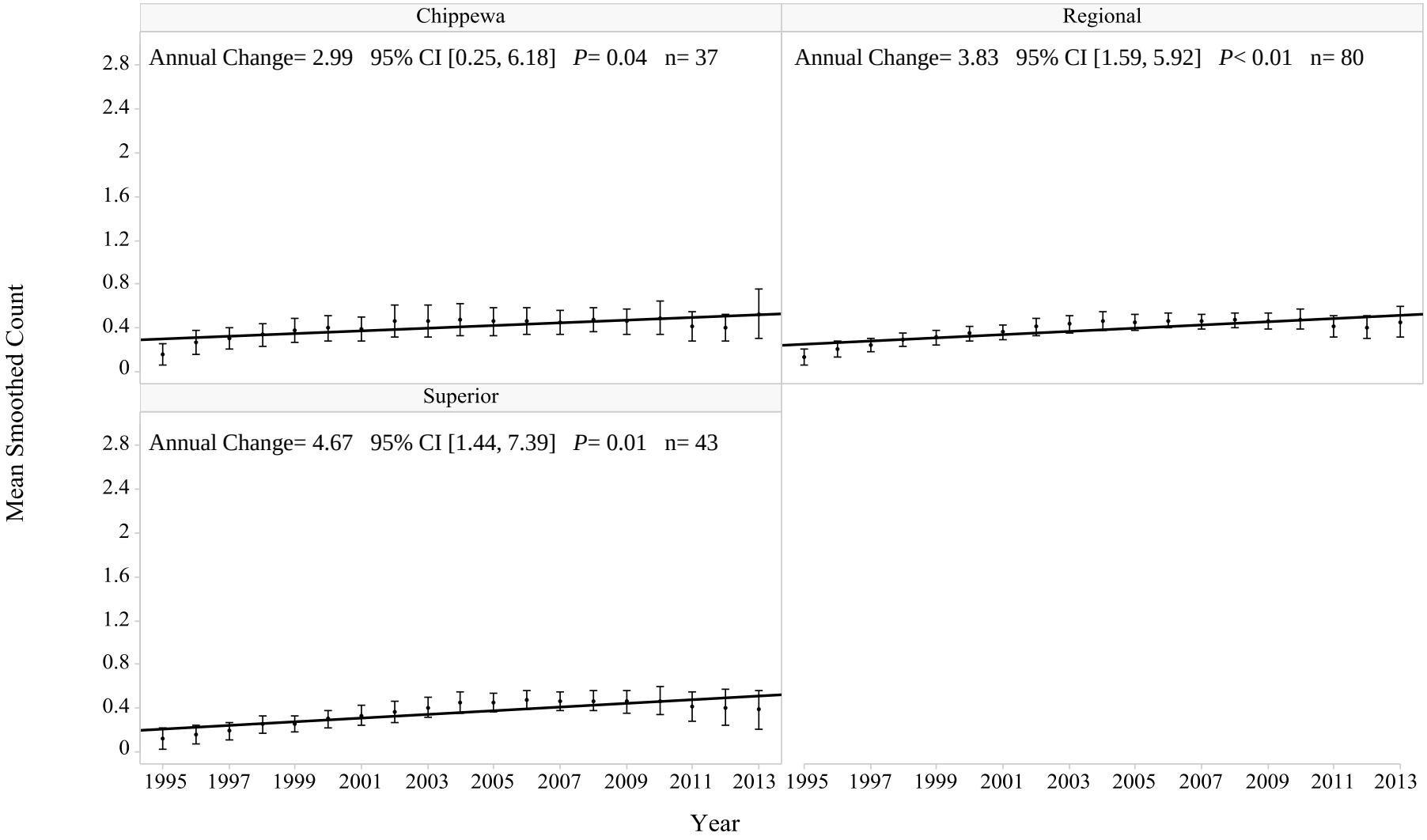
Broad-winged Hawk



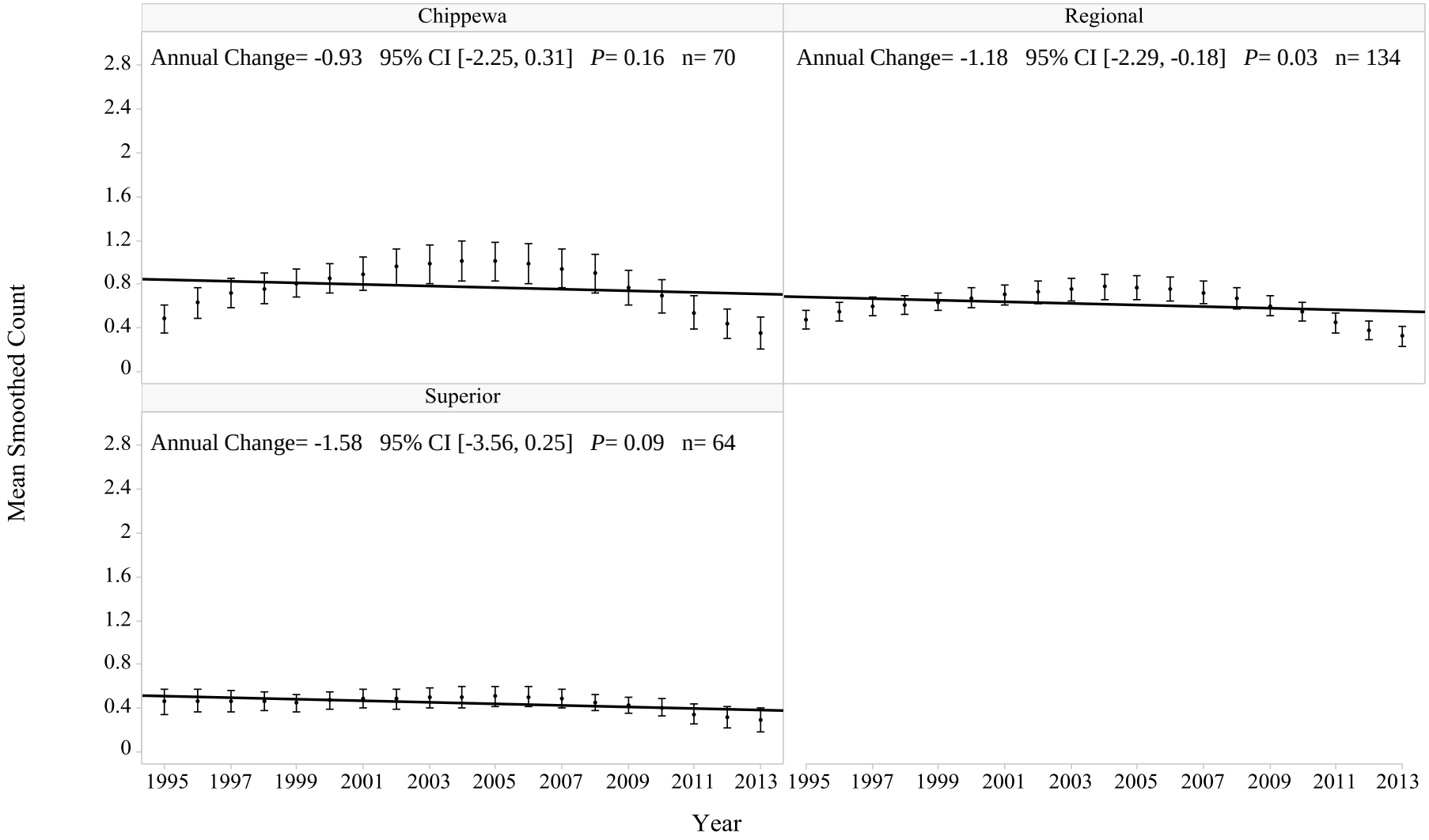
Canada Warbler



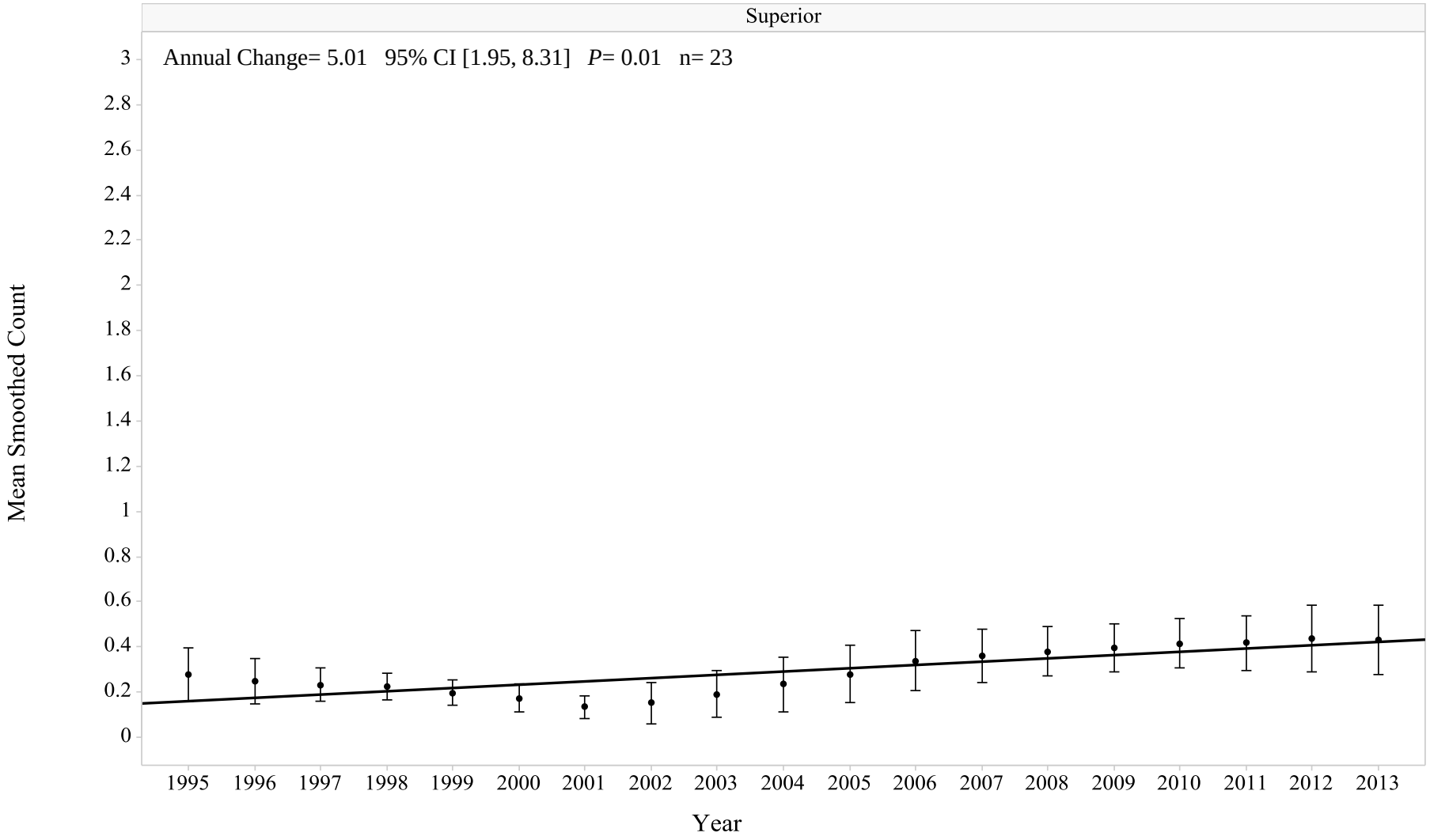
Cedar Waxwing



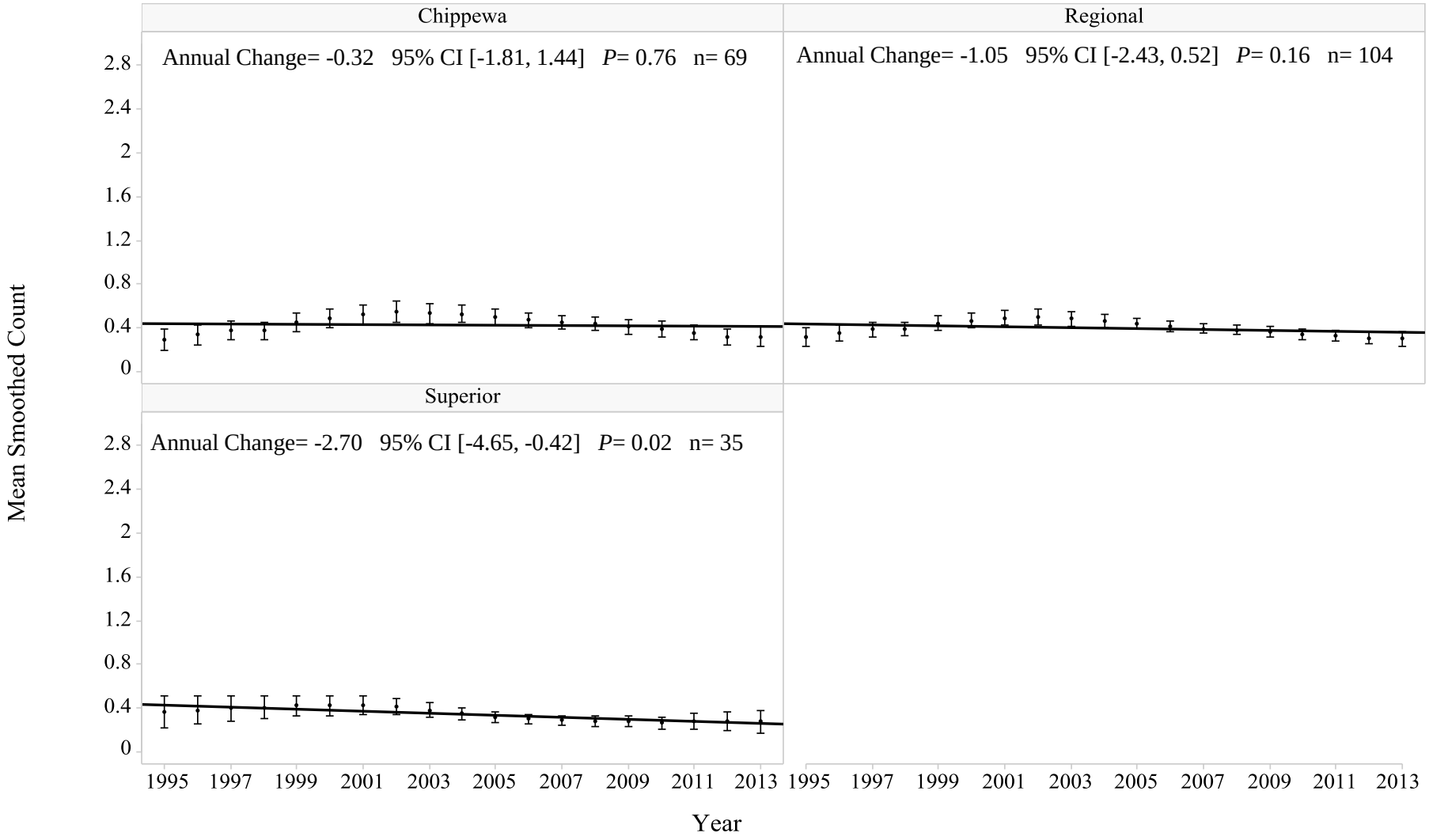
Chipping Sparrow



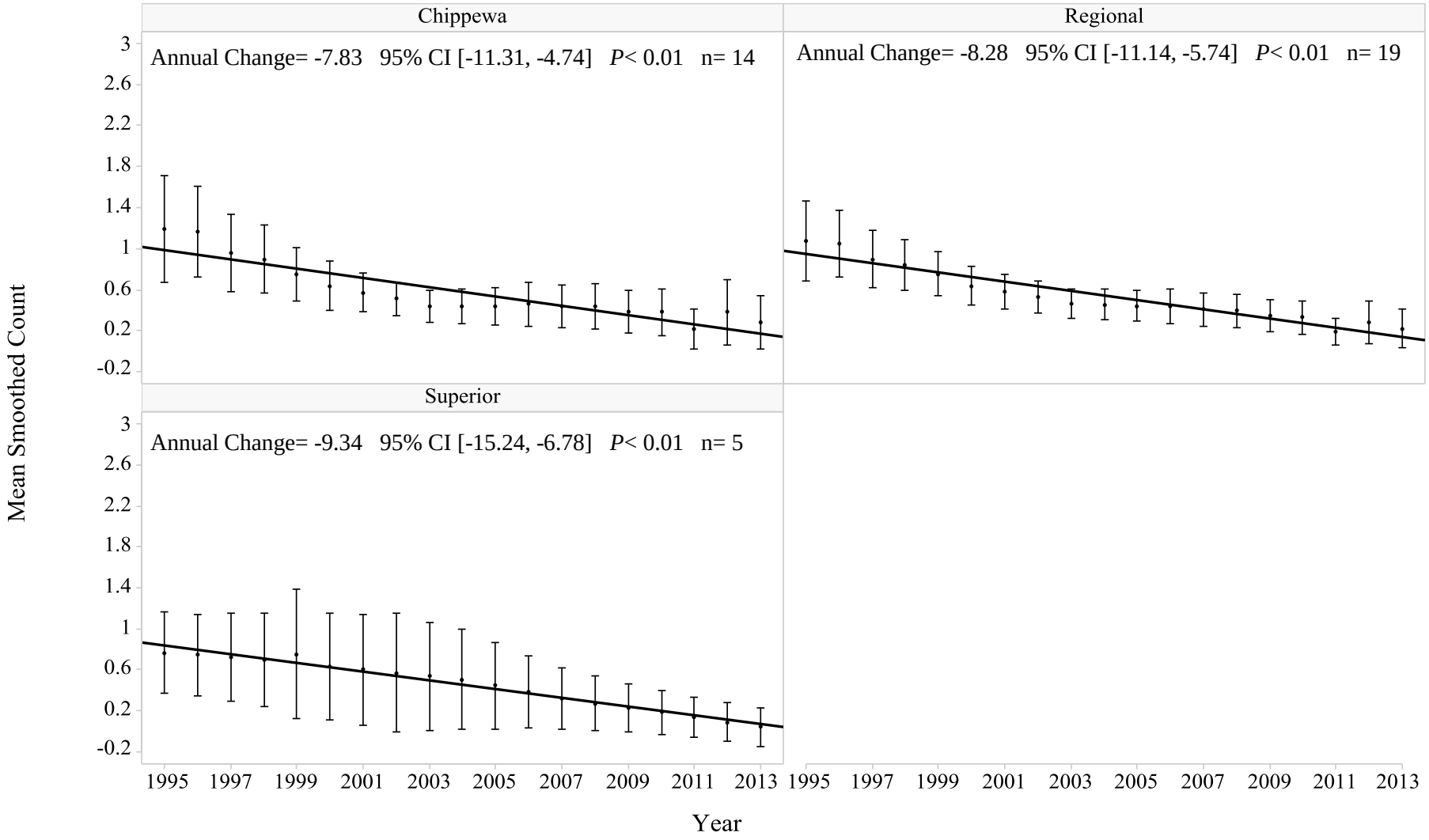
Cape May Warbler



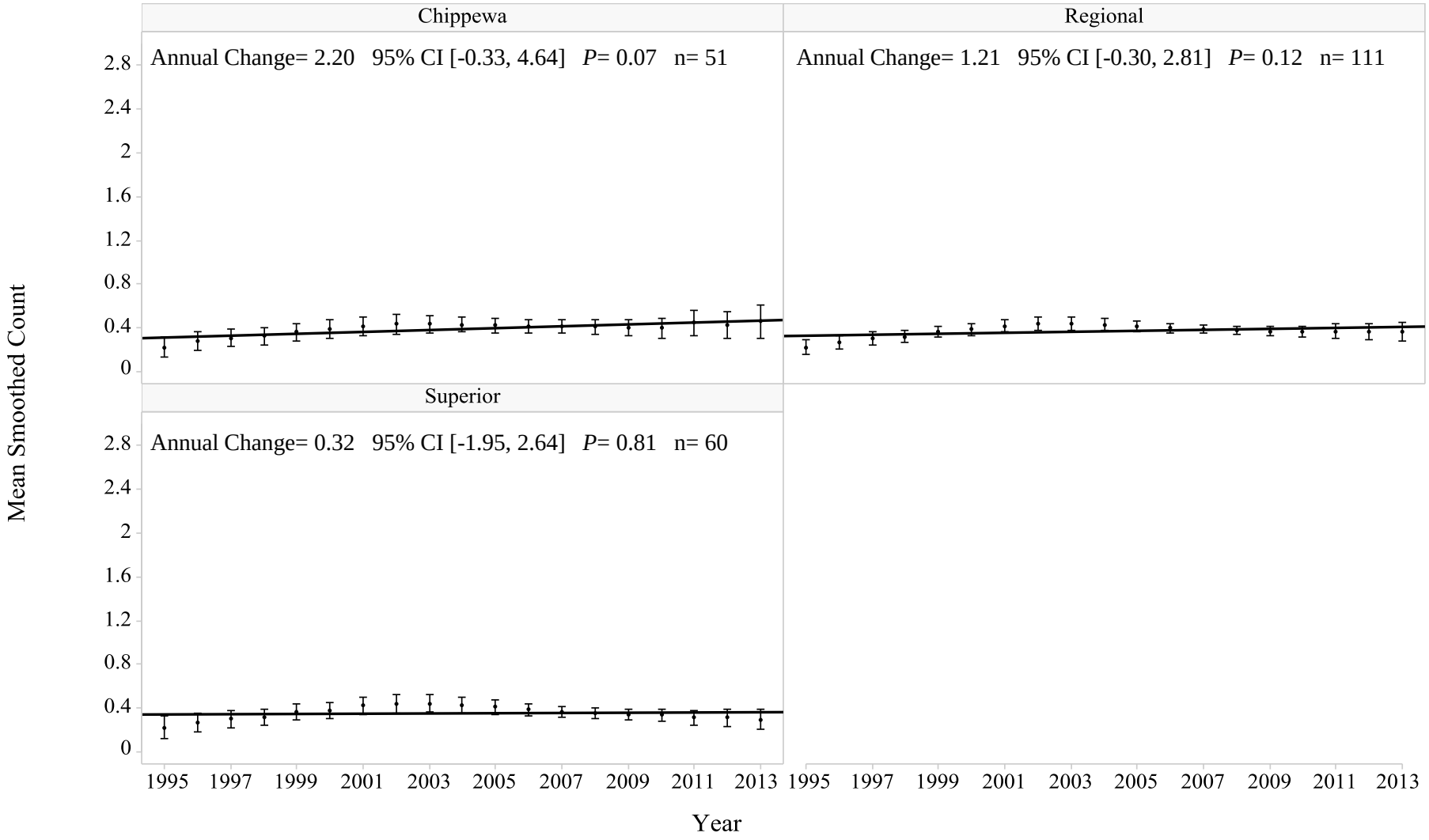
Common Loon


Chippewa
Annual Change= -0.32 95% CI [-1.81, 1.44] P= 0.76 n= 69
Regional
Annual Change= -1.05 95% CI [-2.43, 0.52] P= 0.16 n= 104
Superior
Annual Change= -2.70 95% CI [-4.65, -0.42] P= 0.02 n= 35
Mean Smoothed Count
0
0.4
0.8
1.2
1.6
2
2.4
2.8
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Year

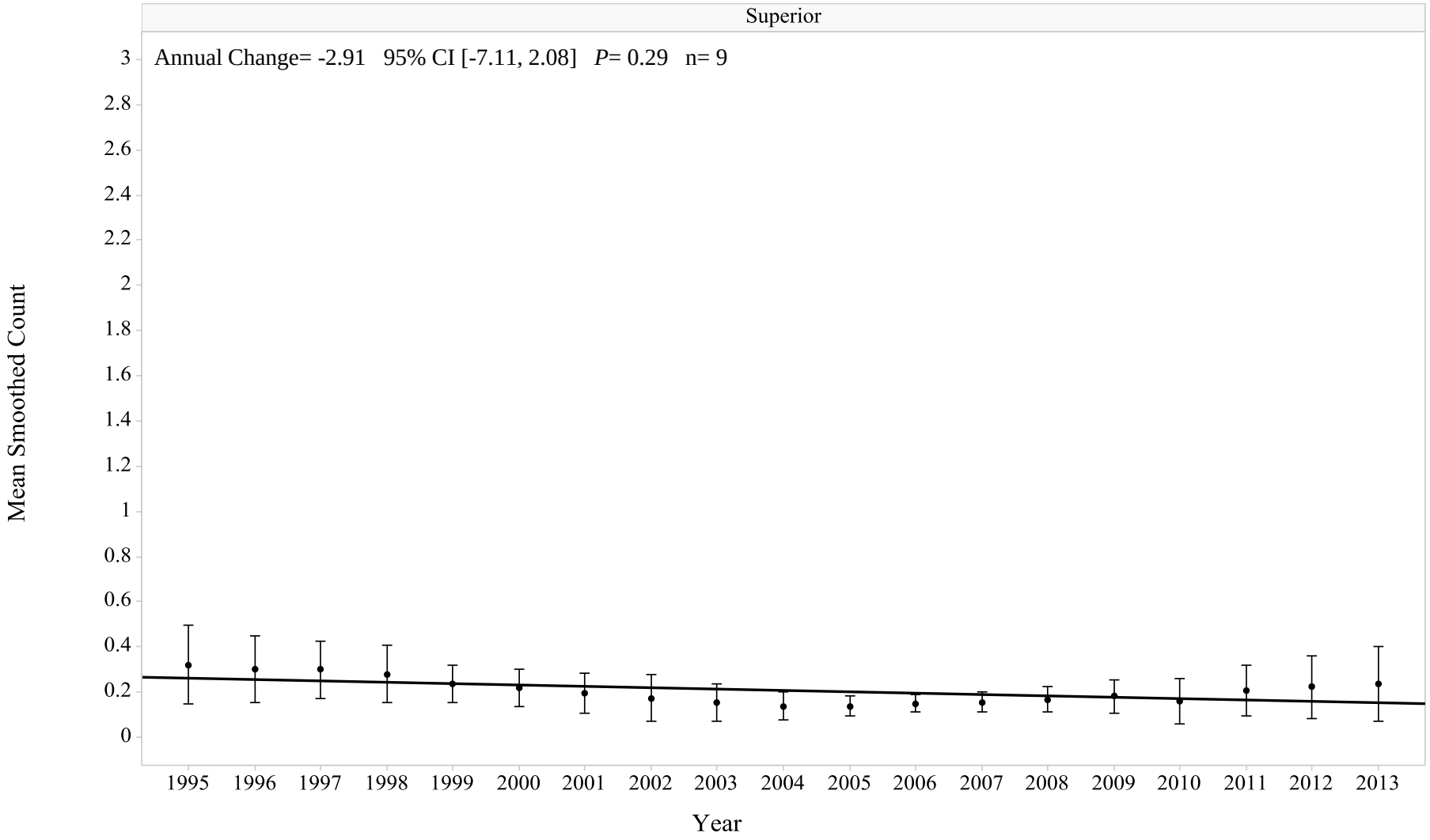
Connecticut Warbler



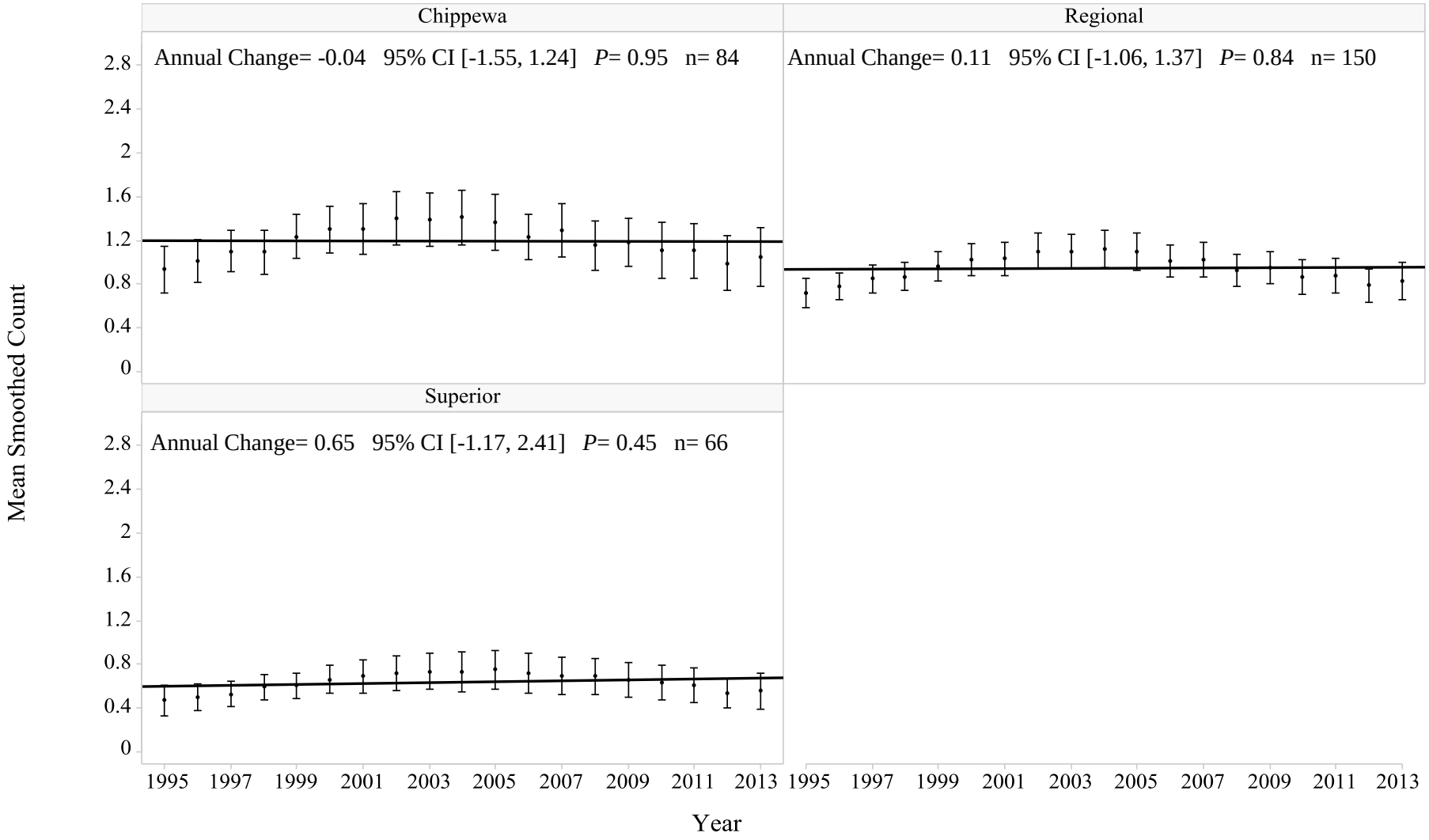
Common Raven



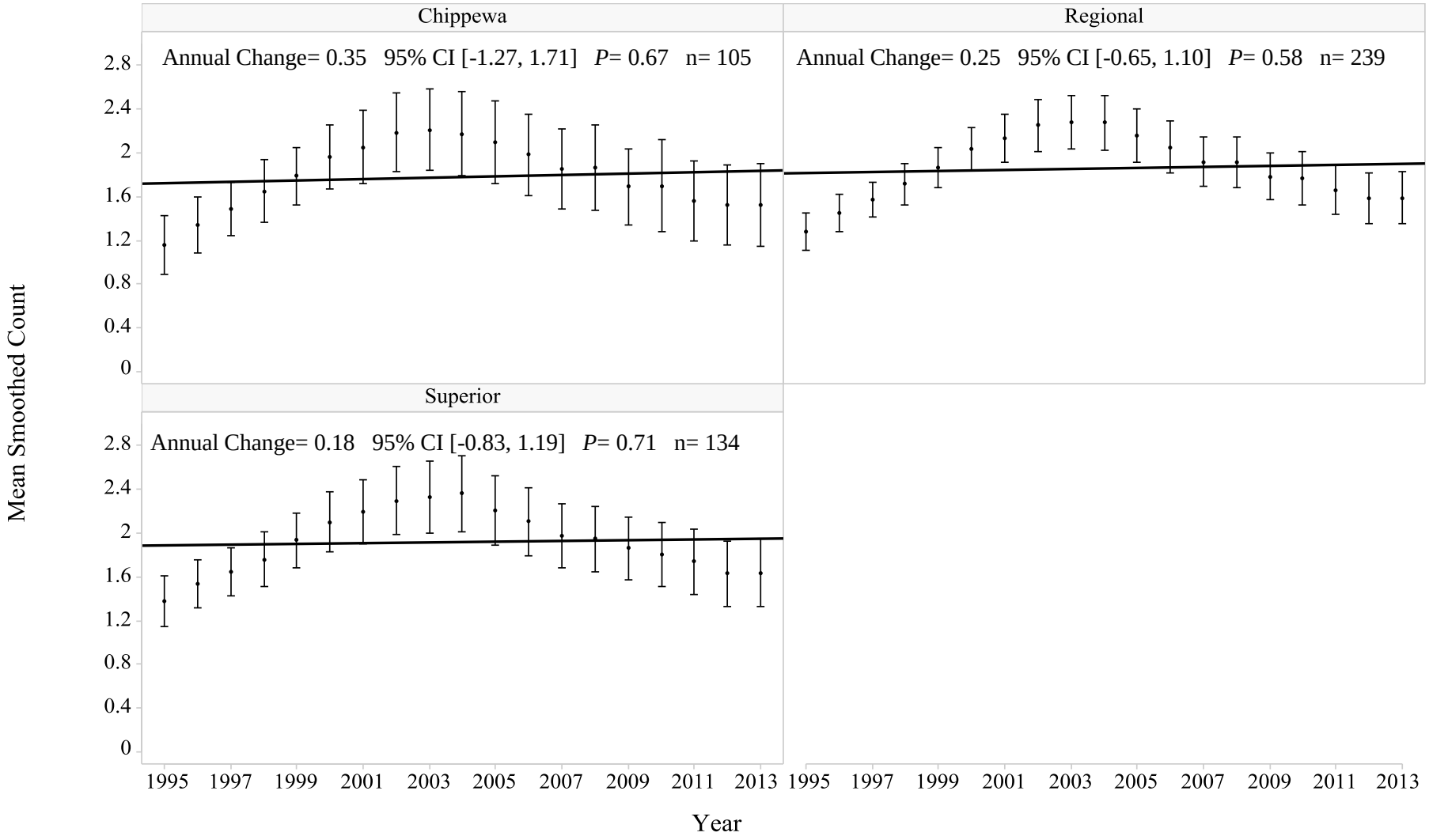
Wilson's Snipe



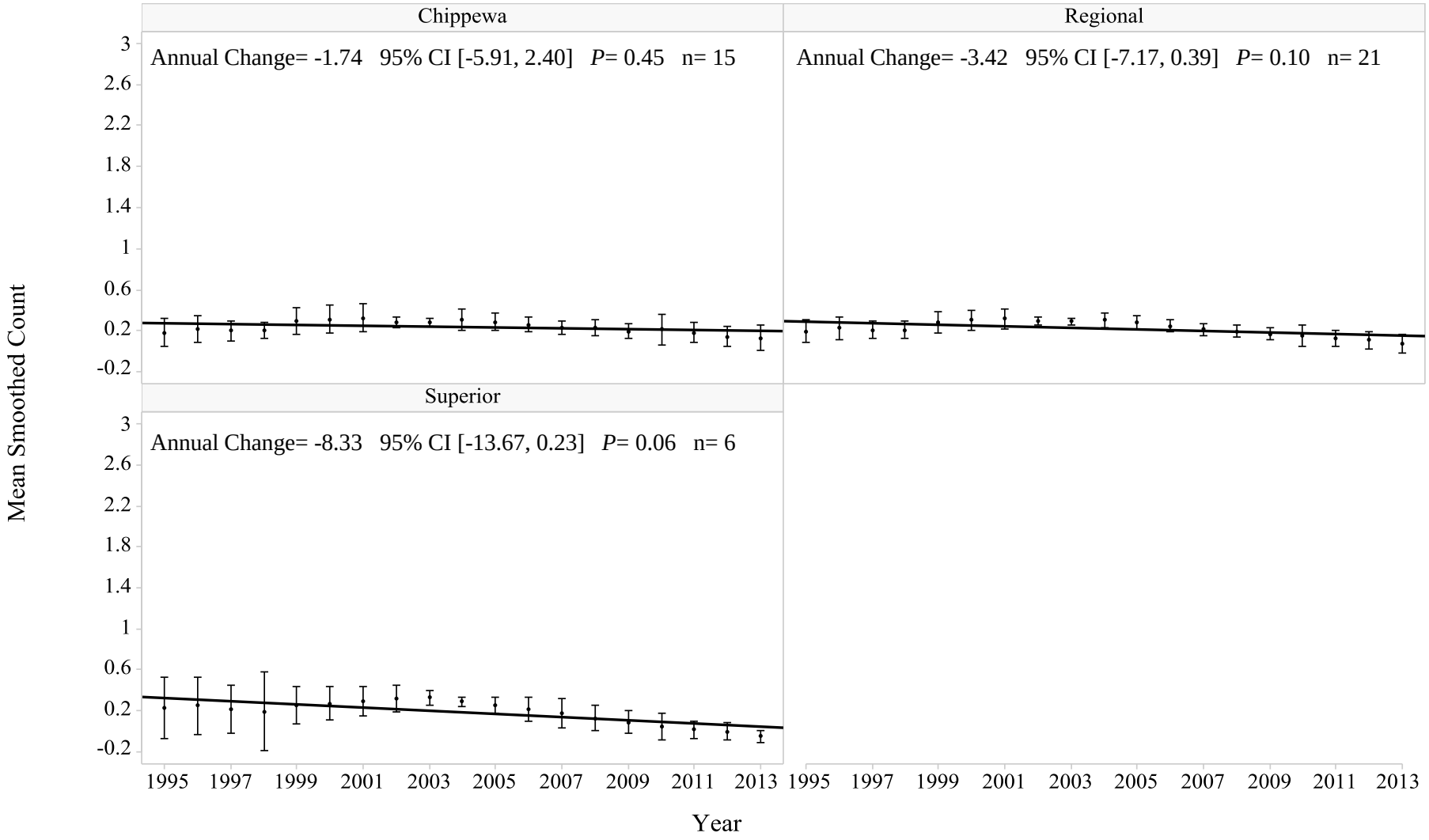
Common Yellowthroat



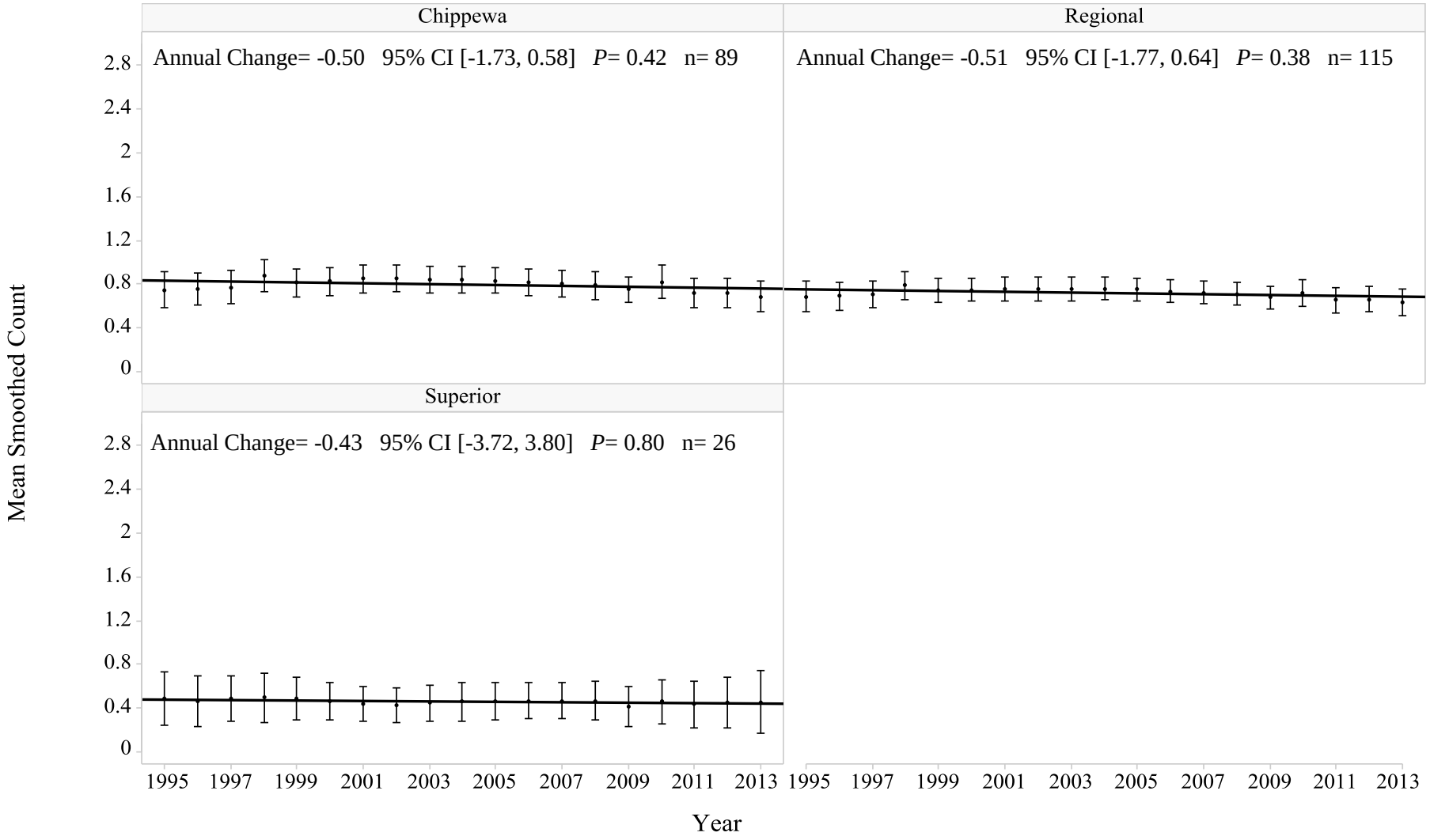
Chestnut-sided Warbler



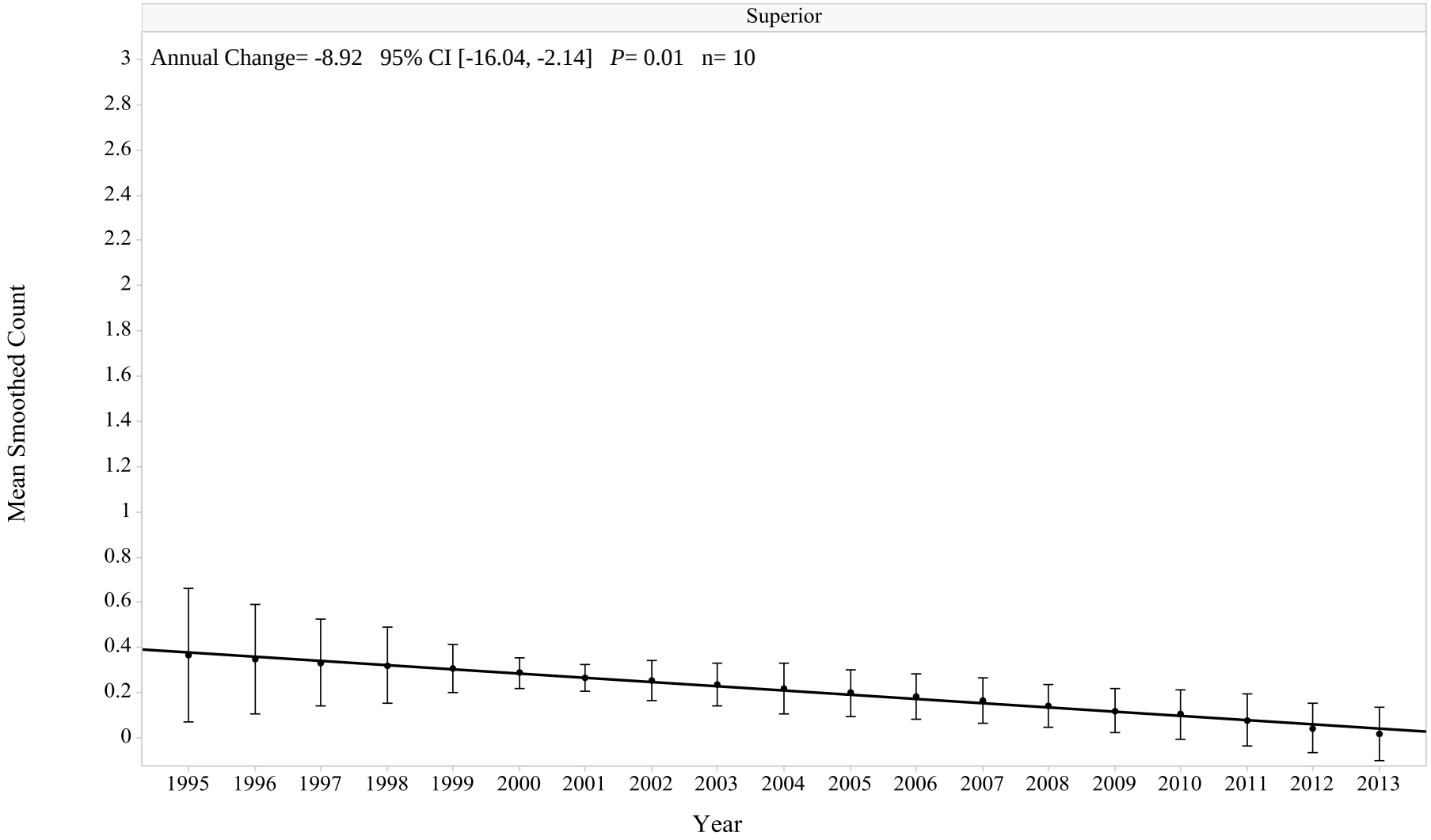
Downy Woodpecker



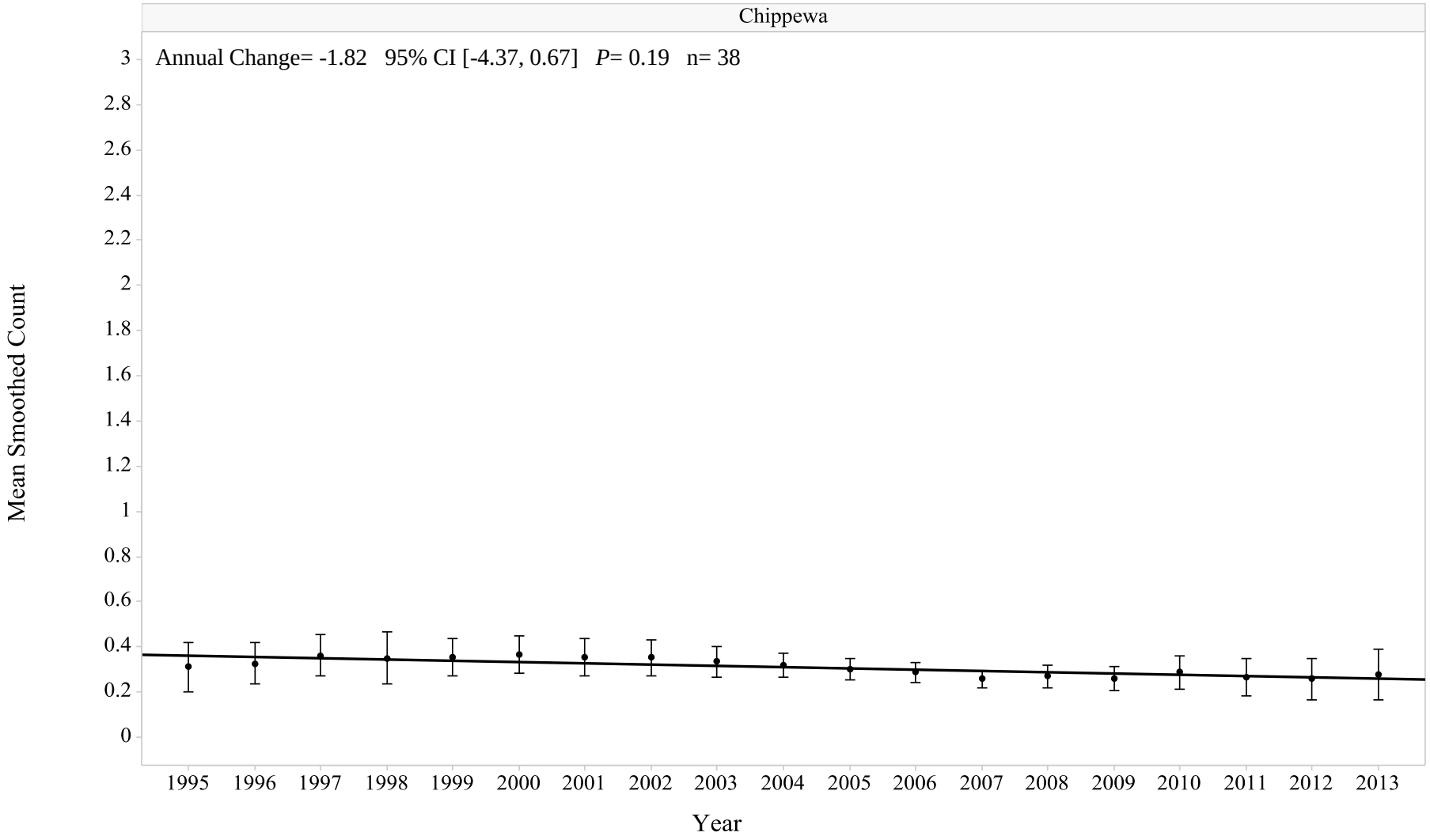
Eastern Wood-Pewee



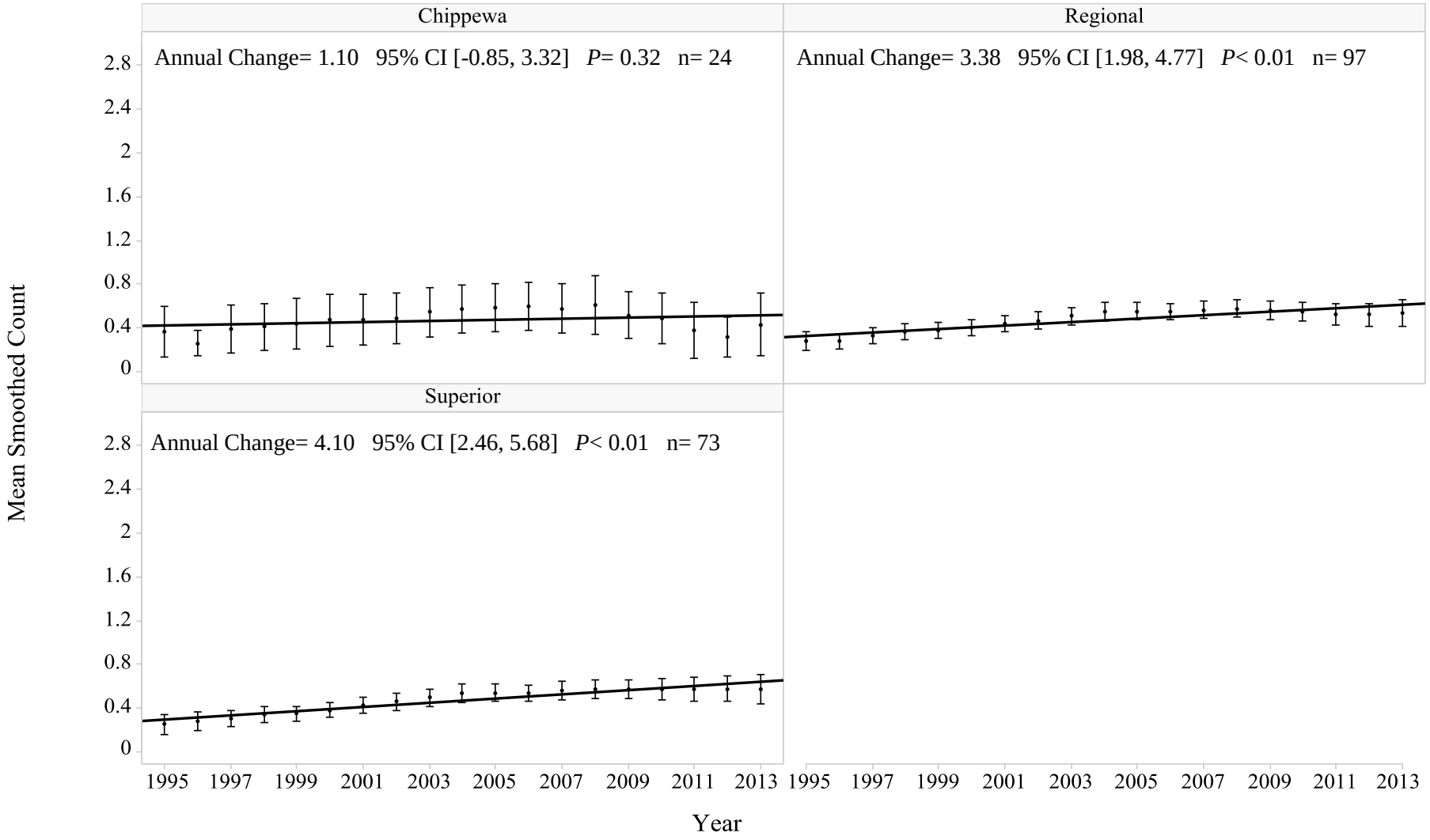
Evening Grosbeak



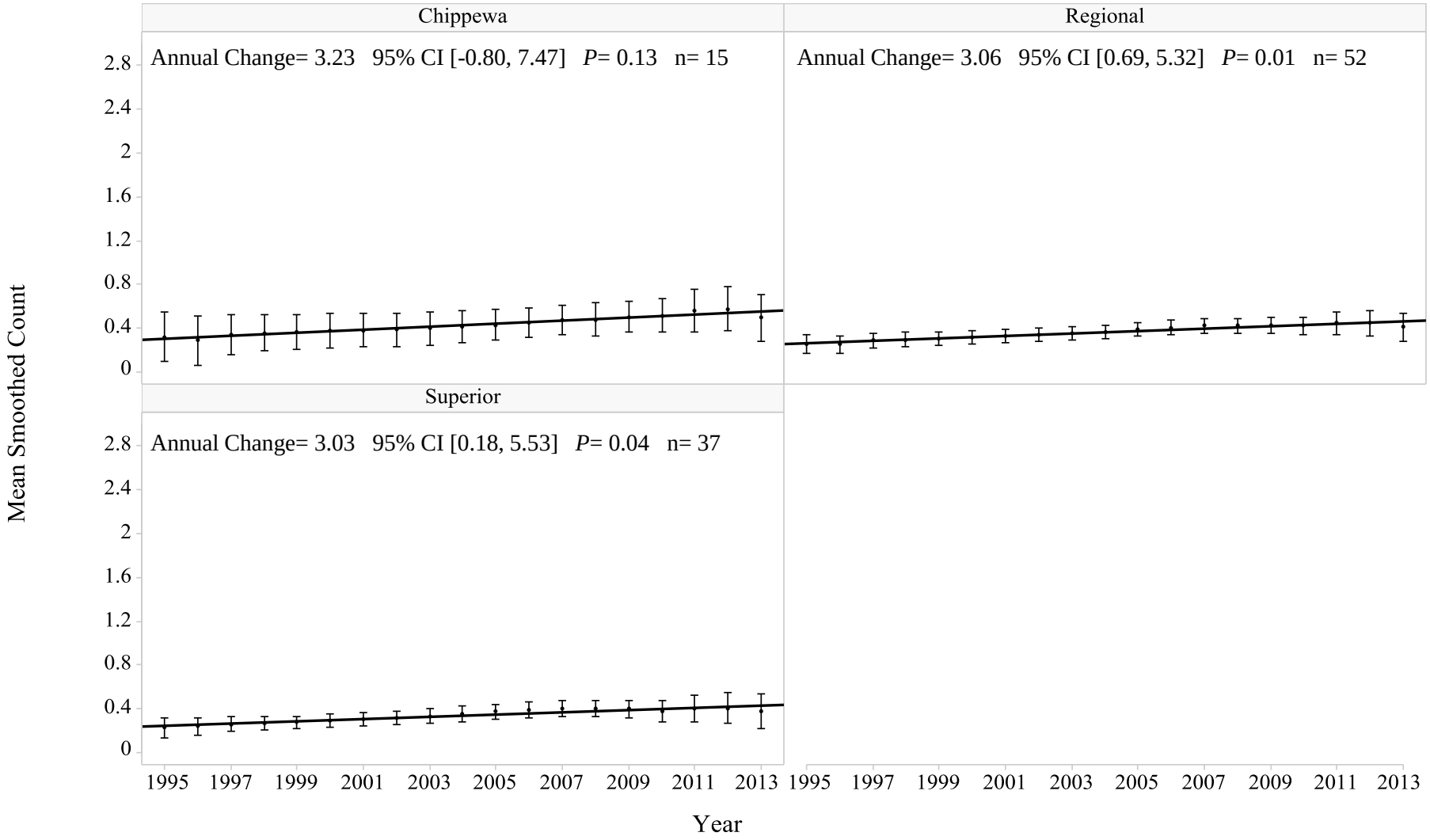
Great Crested Flycatcher



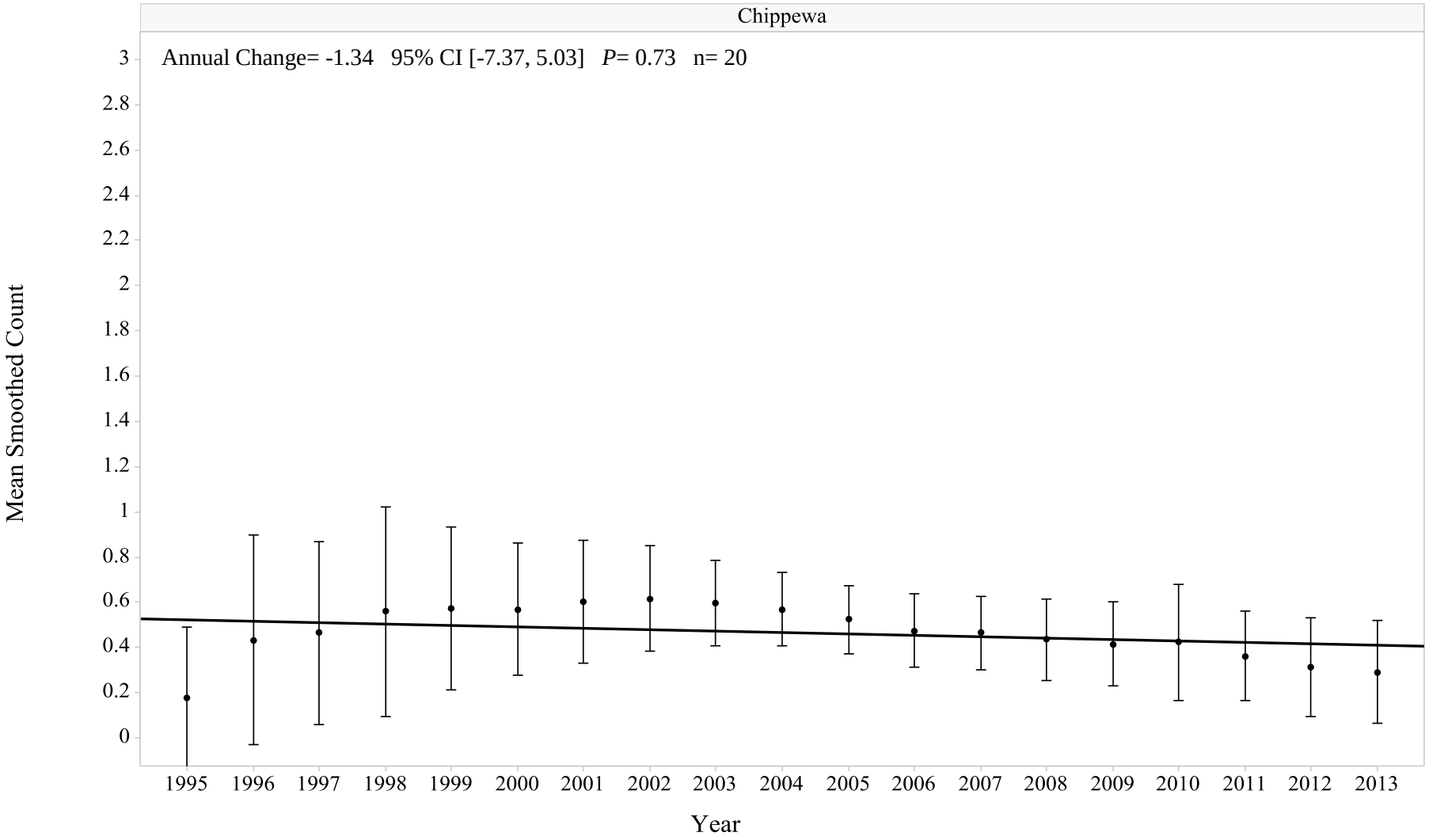
Golden-crowned Kinglet



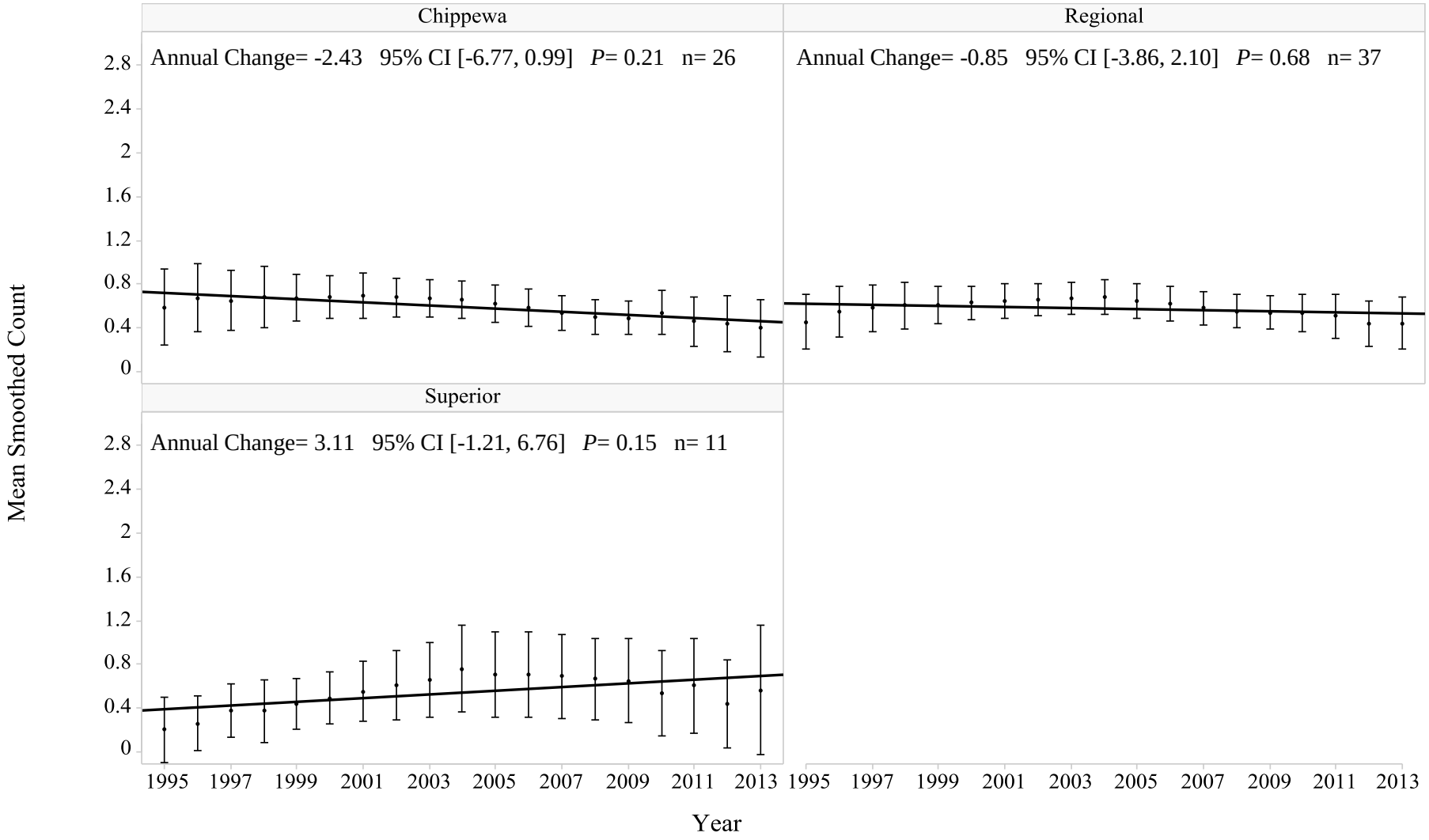
Gray Jay


Chippewa
Annual Change= 3.23 95% CI [-0.80, 7.47] P= 0.13 n= 15
Regional
Annual Change= 3.06 95% CI [0.69, 5.32] P= 0.01 n= 52
Superior
Annual Change= 3.03 95% CI [0.18, 5.53] P= 0.04 n= 37
Mean Smoothed Count
0
0.4
0.8
1.2
1.6
2
2.4
2.8
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Year

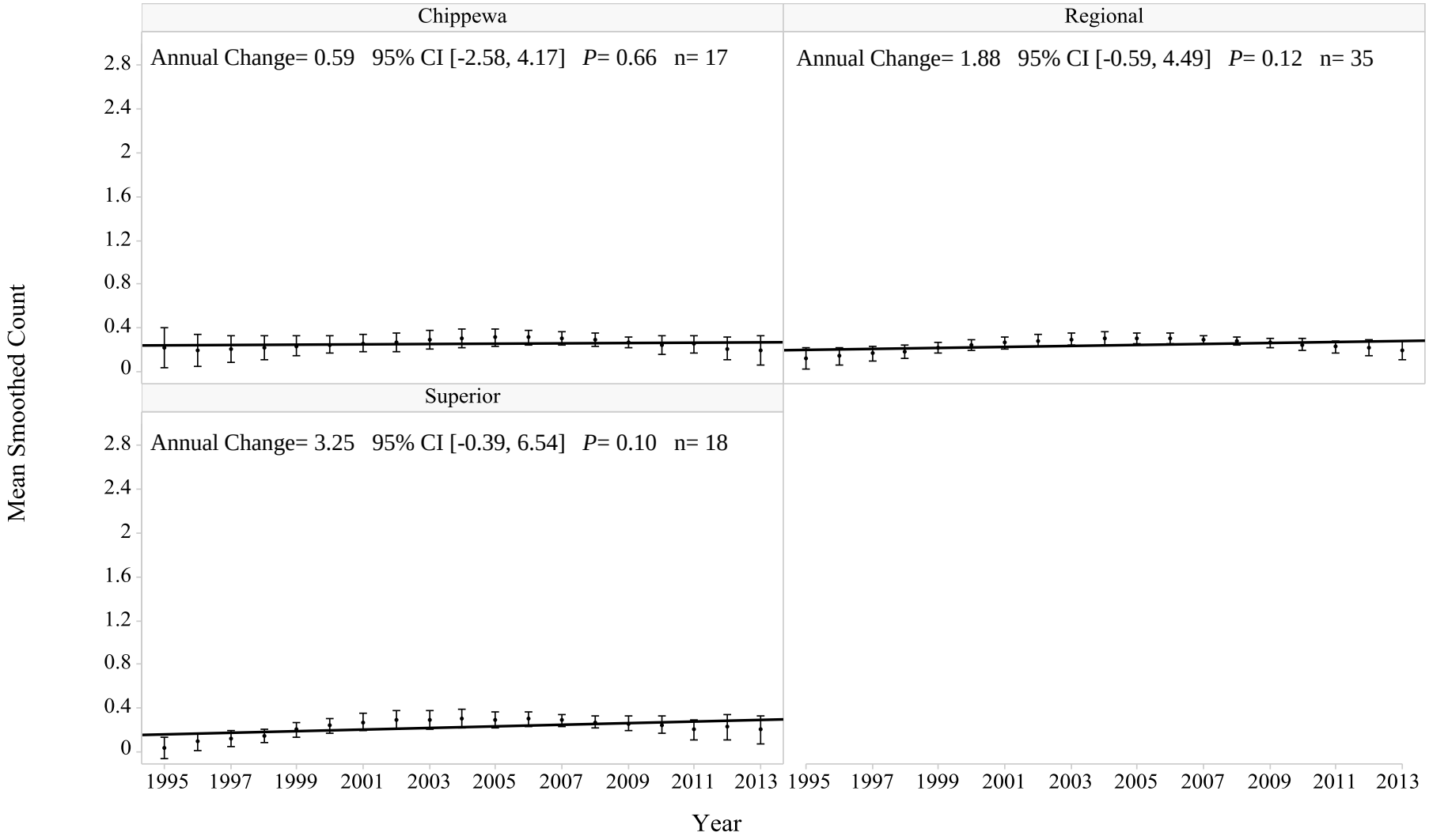
Gray Catbird



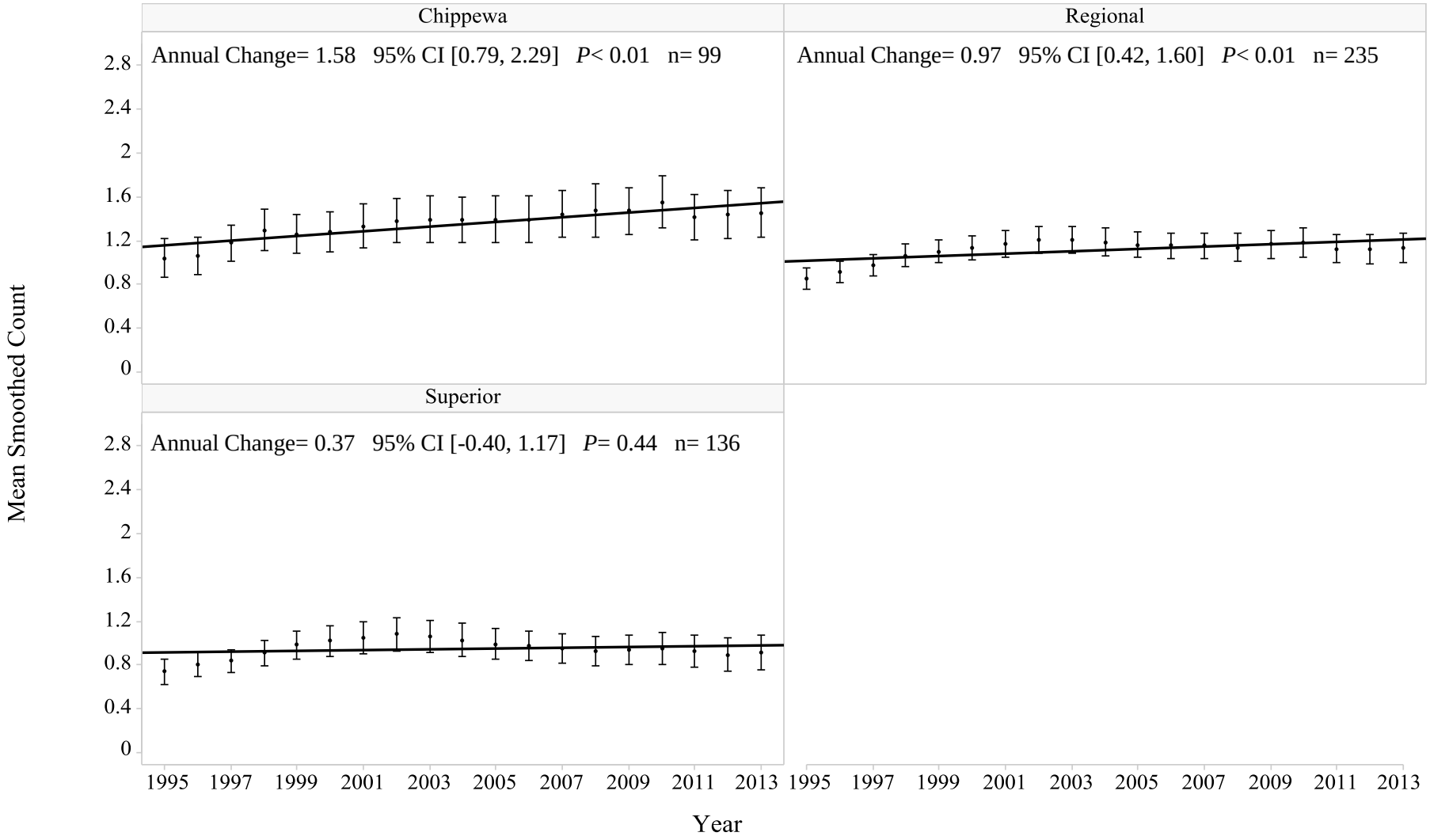
Golden-winged Warbler



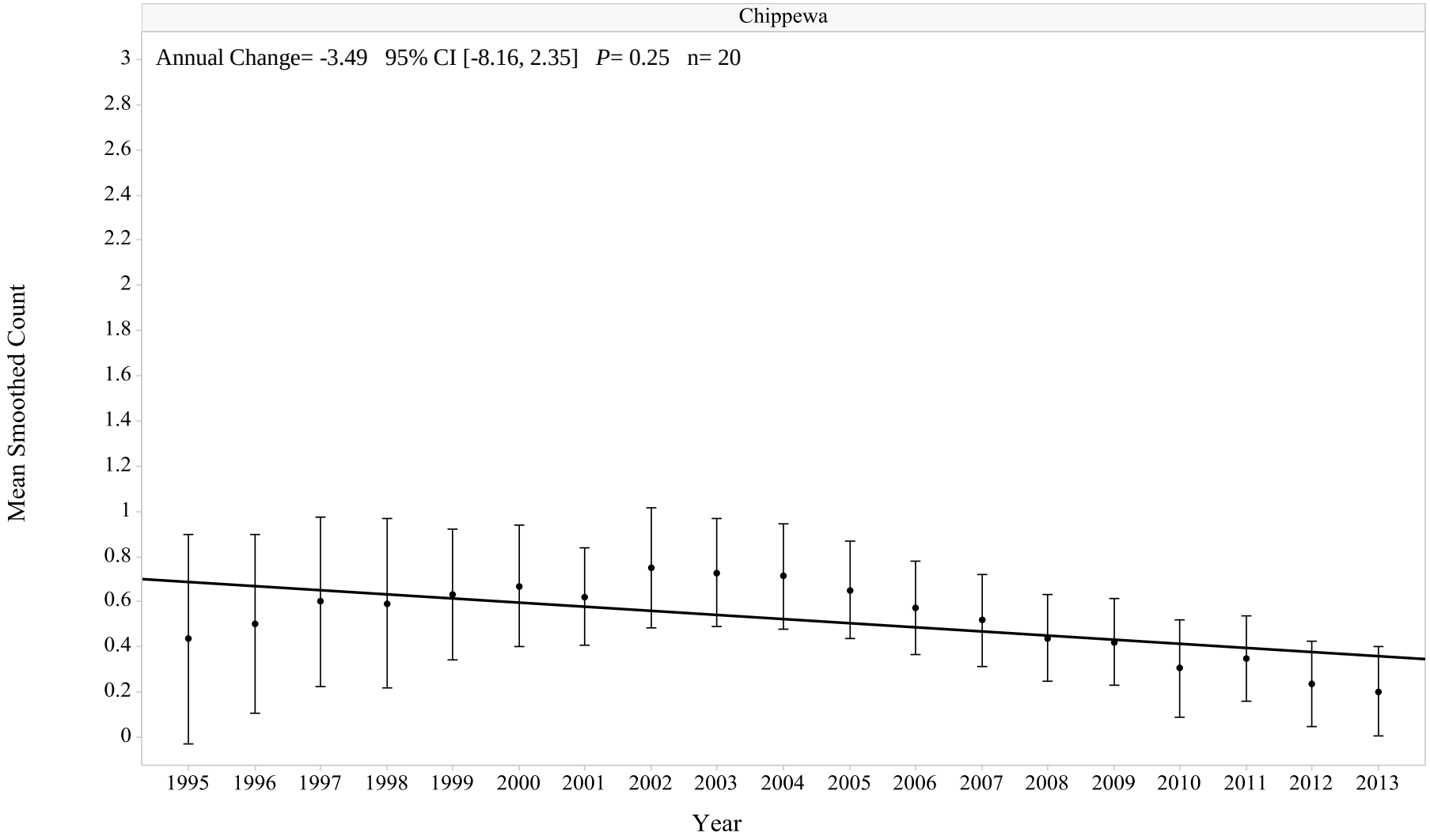
Hairy Woodpecker



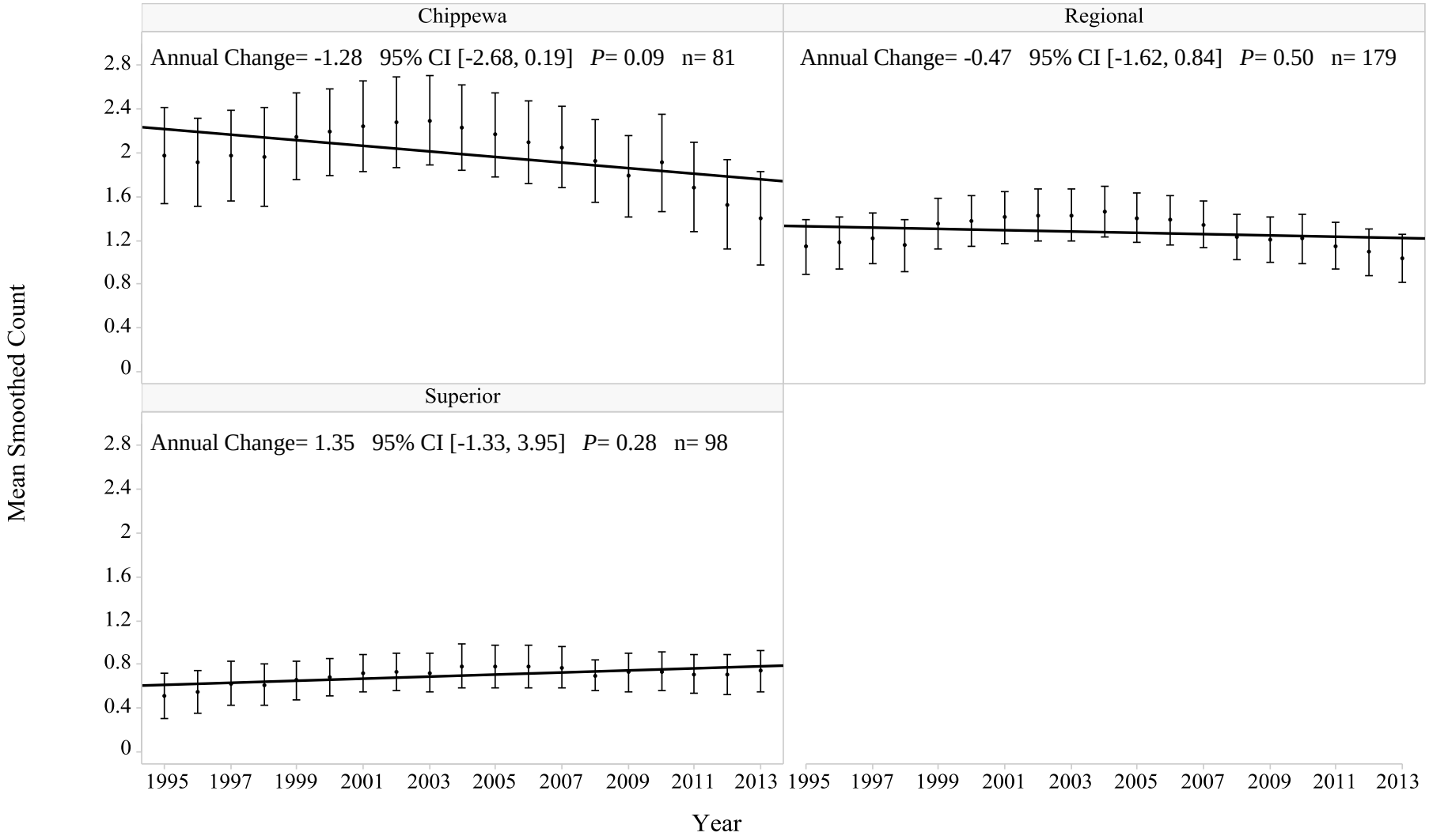
Hermit Thrush



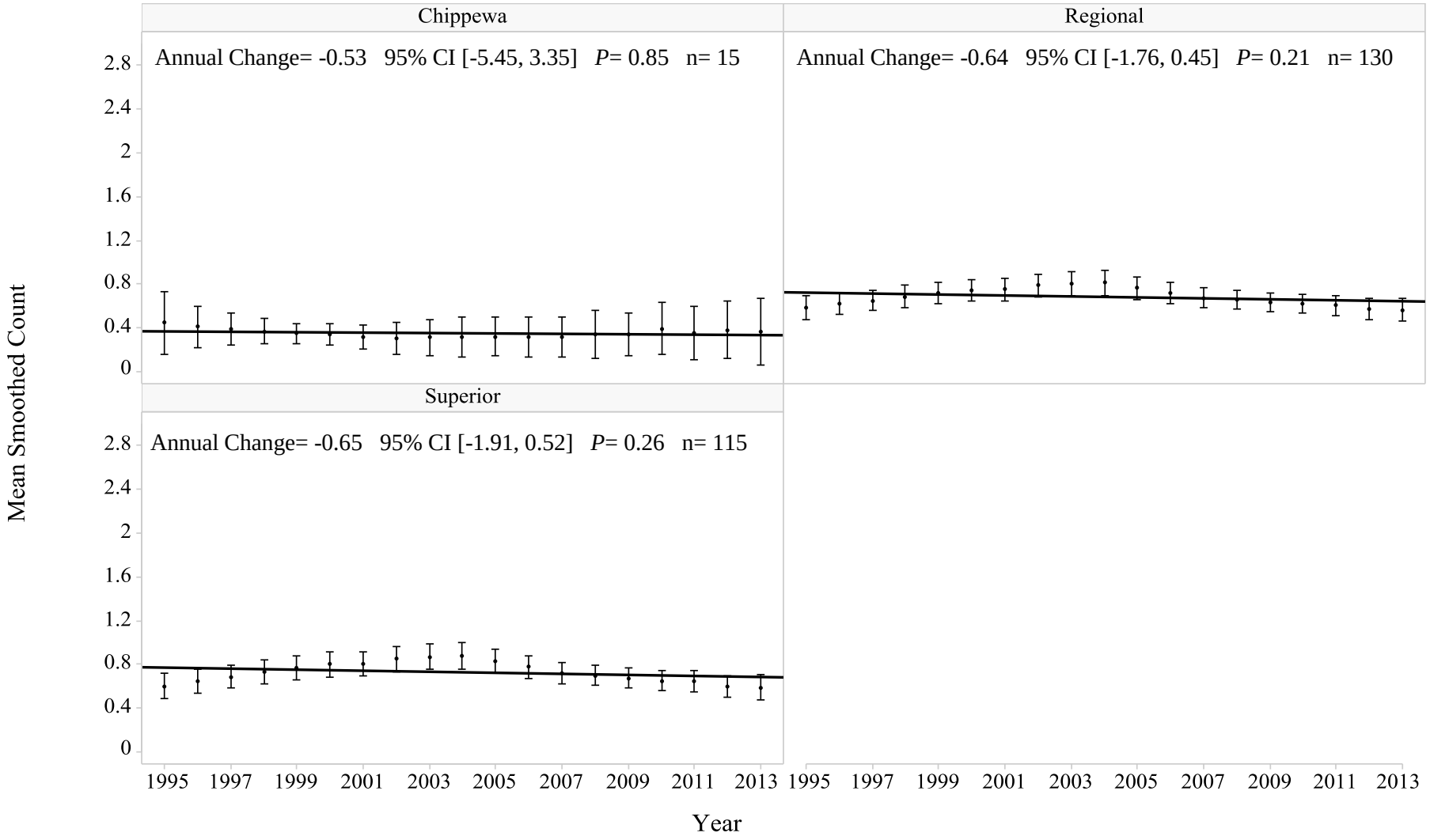
Indigo Bunting



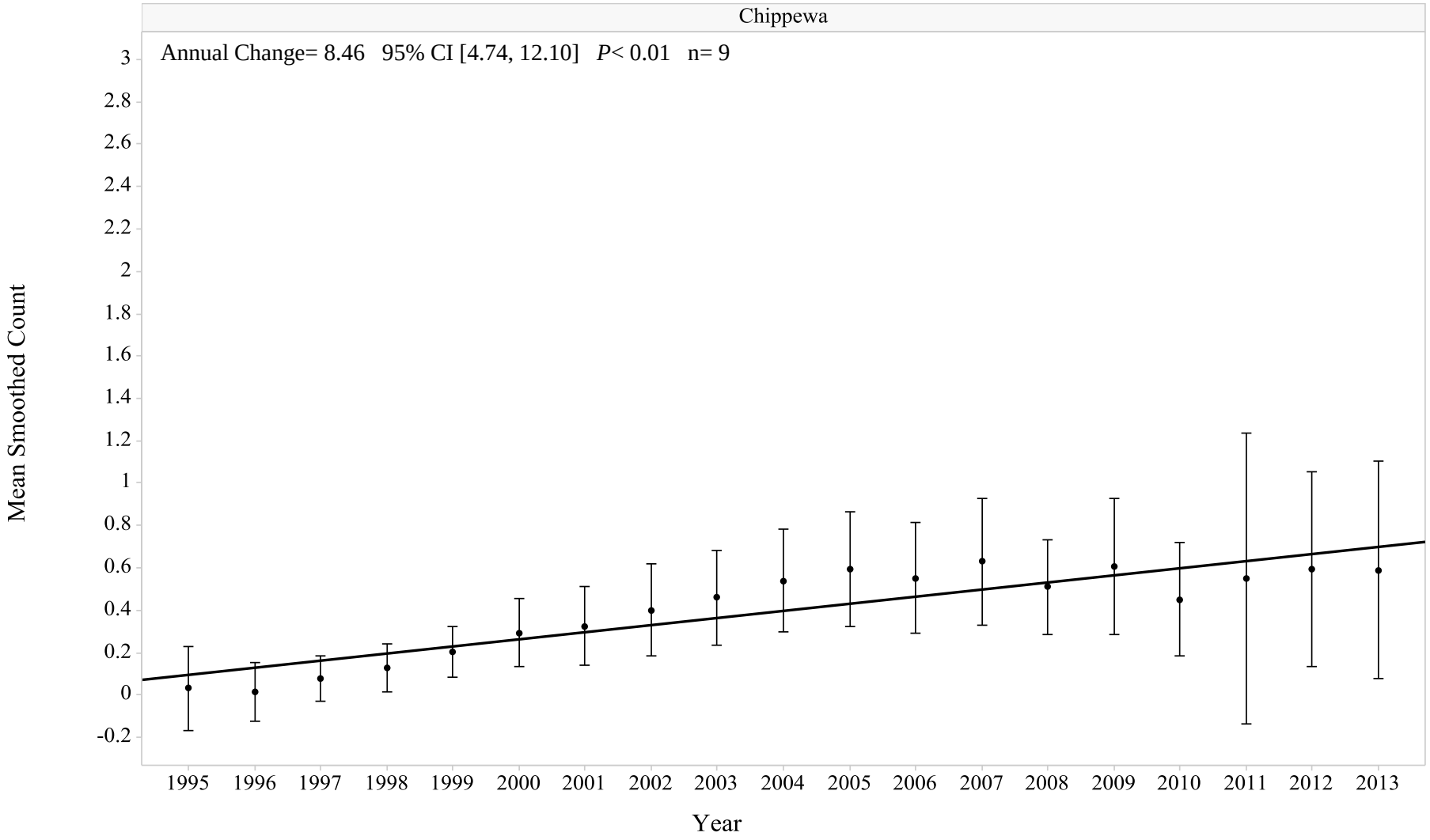
Least Flycatcher



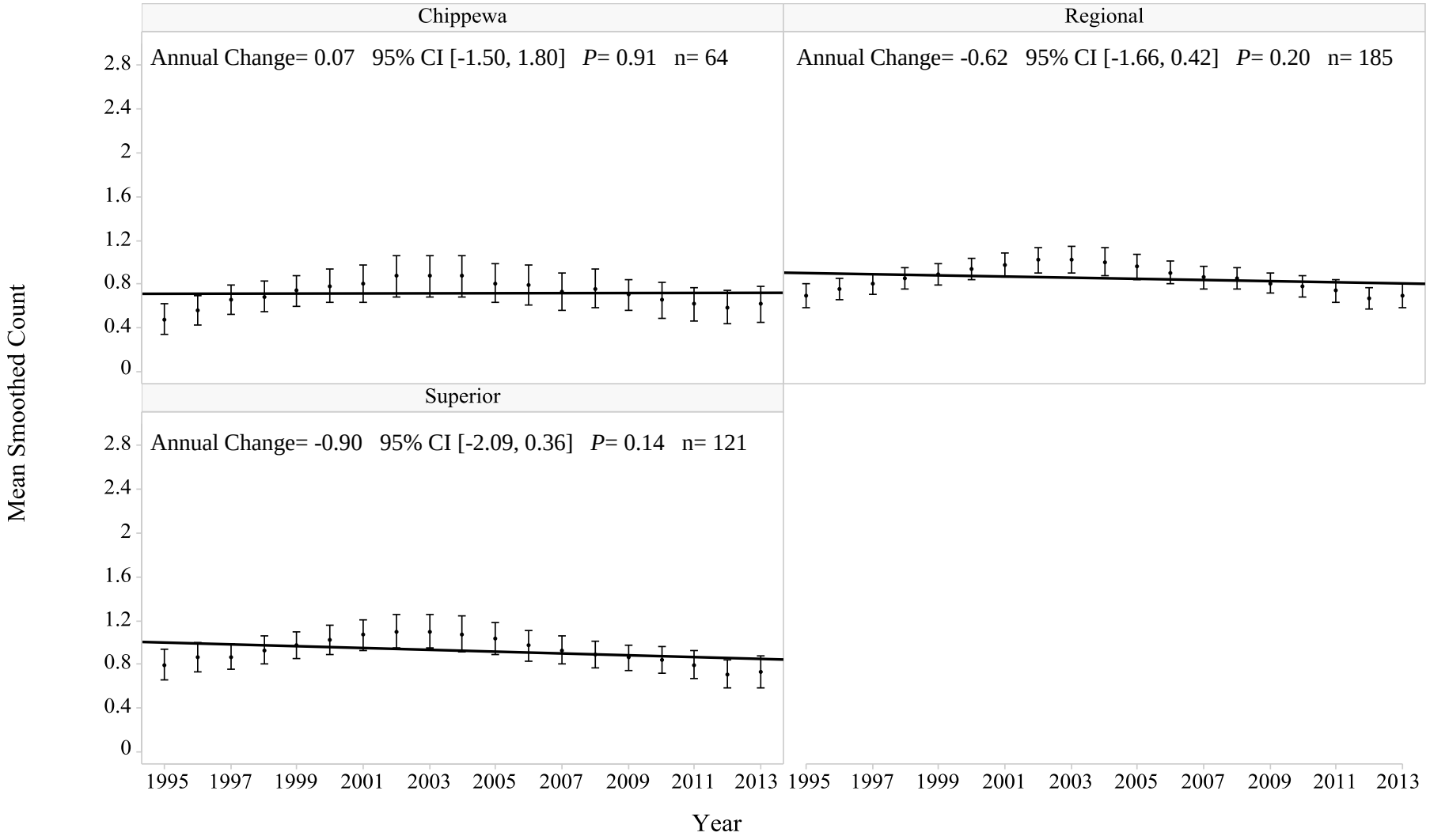
Magnolia Warbler



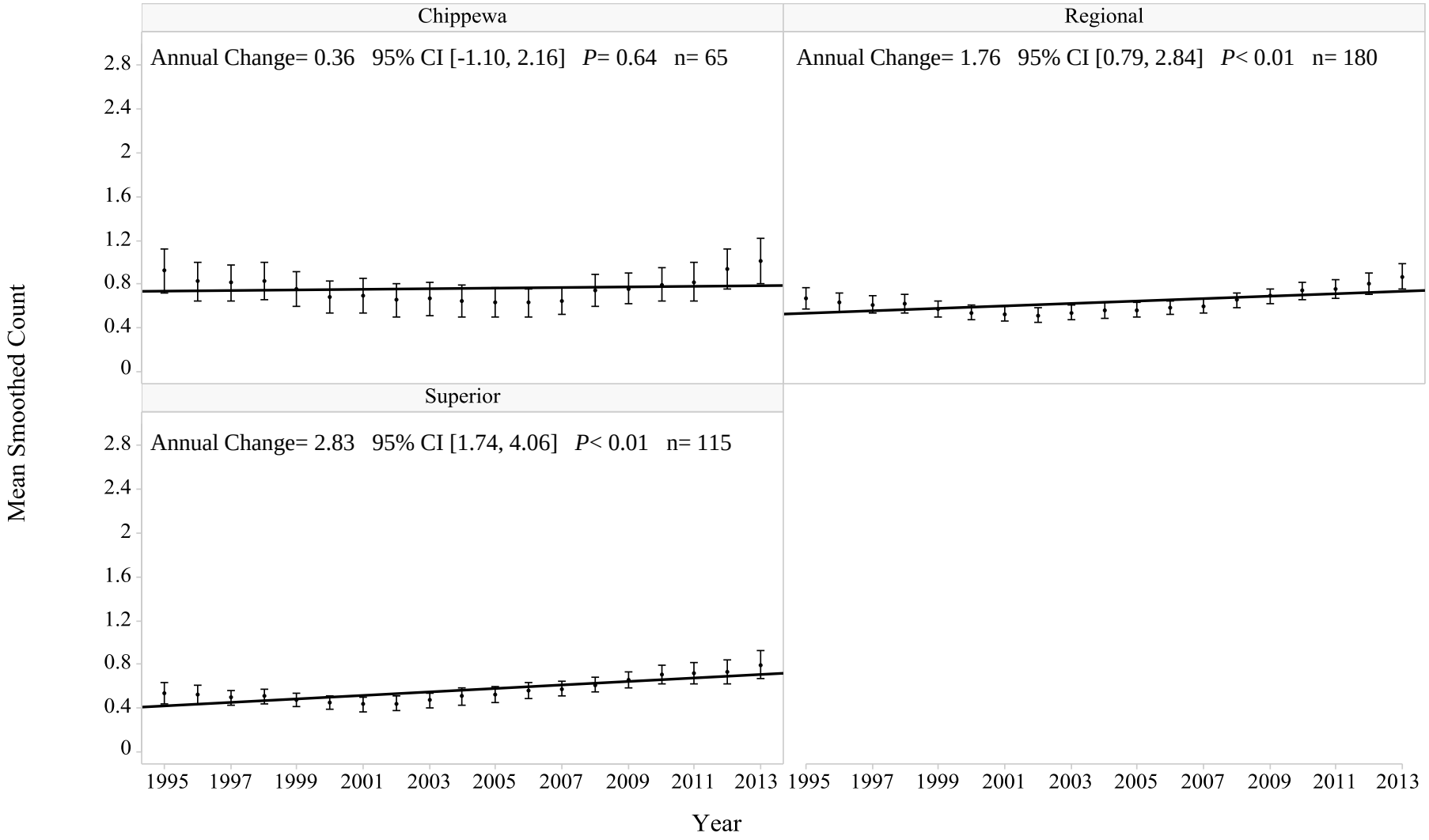
Mourning Dove



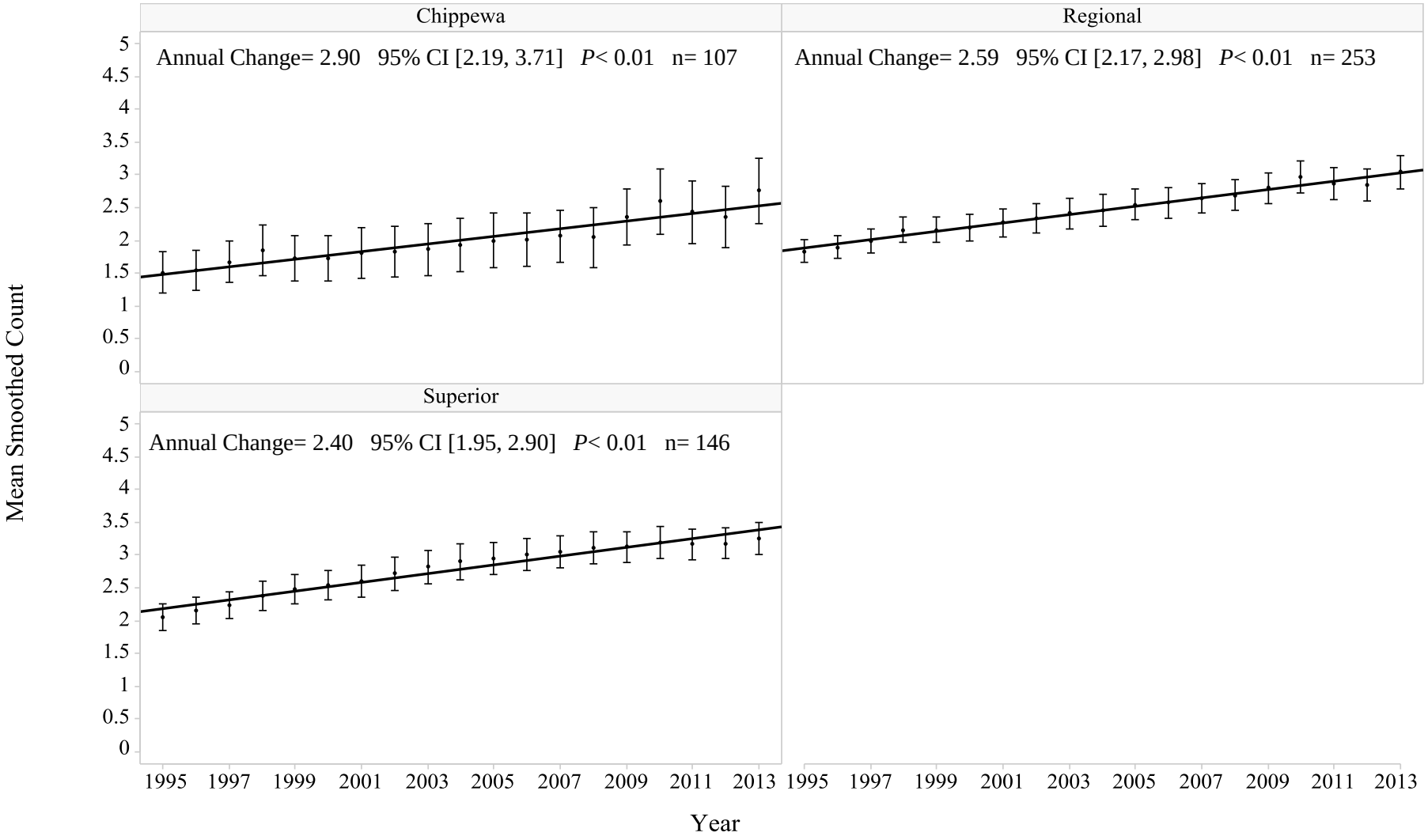
Mourning Warbler



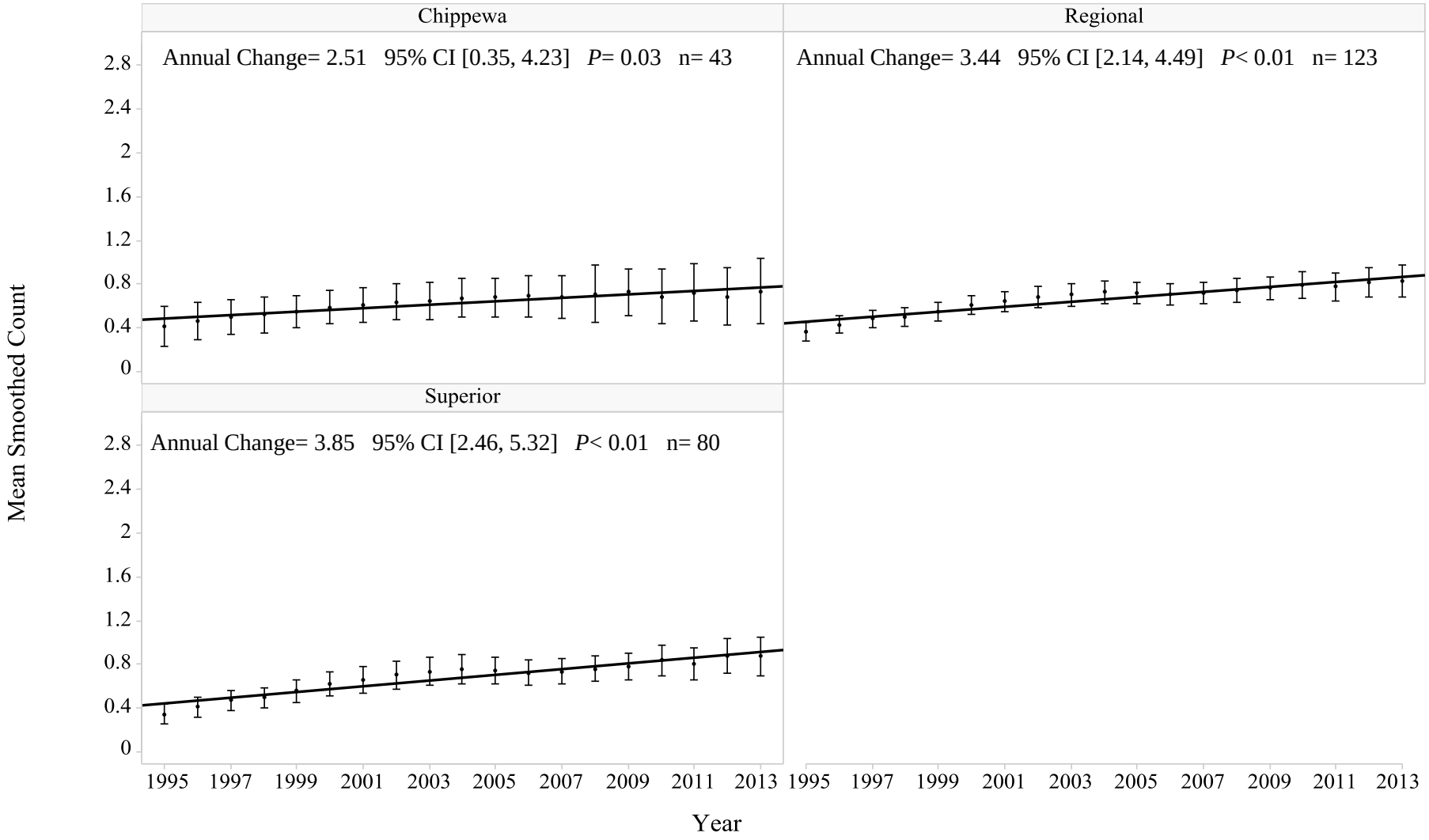
Yellow-rumped Warbler (Myrtle)



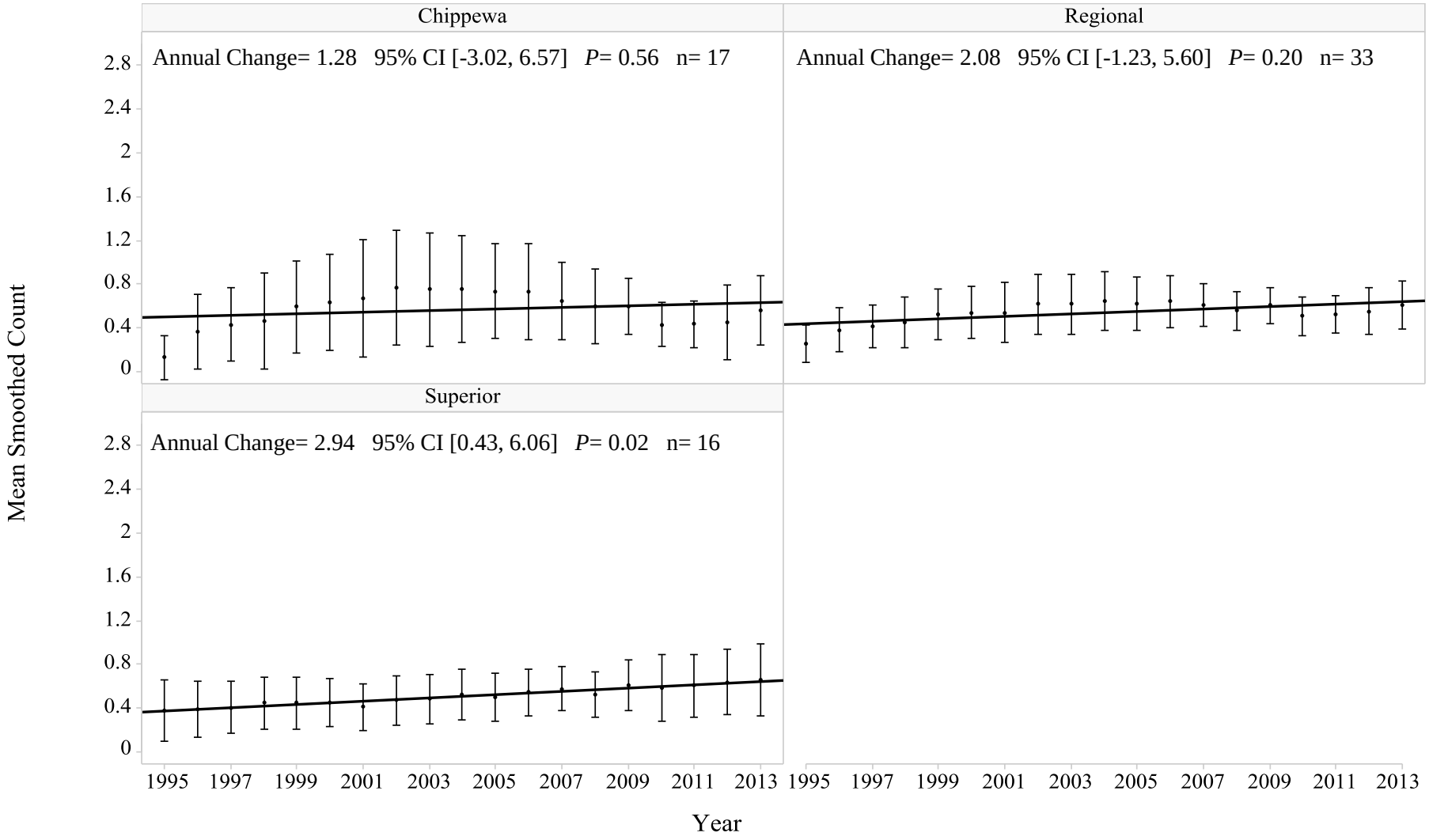
Nashville Warbler



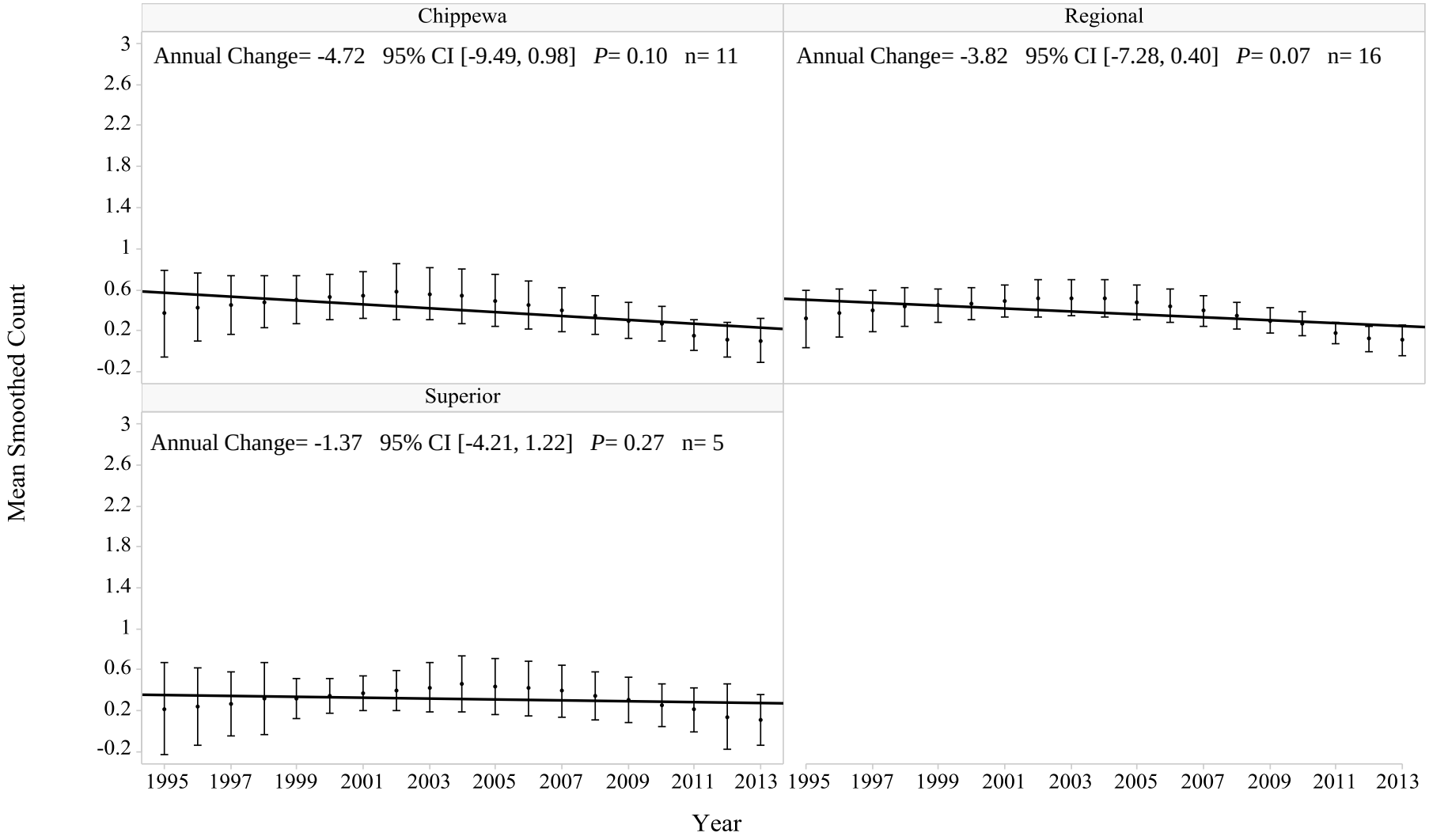
Northern Parula



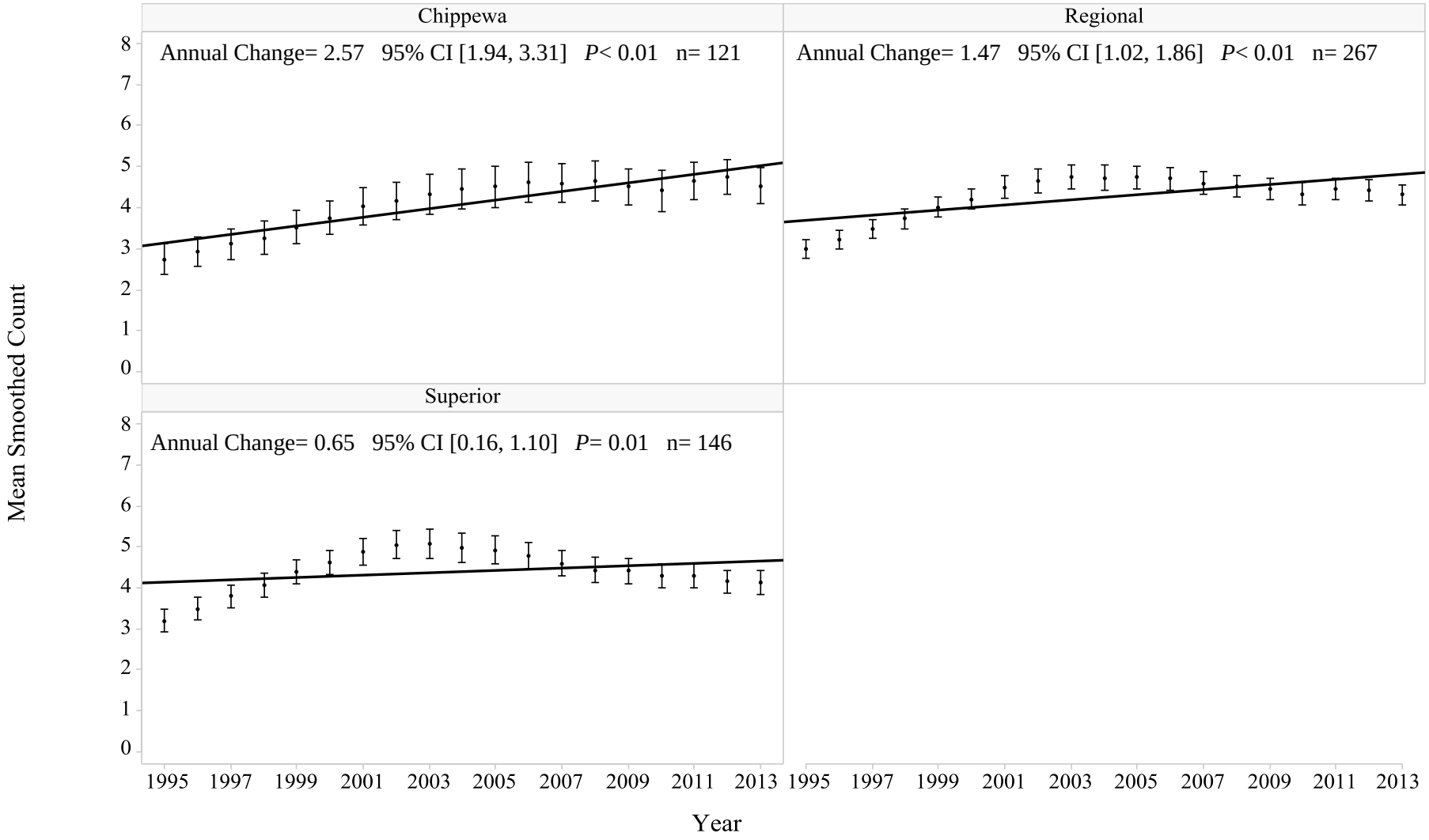
Northern Waterthrush



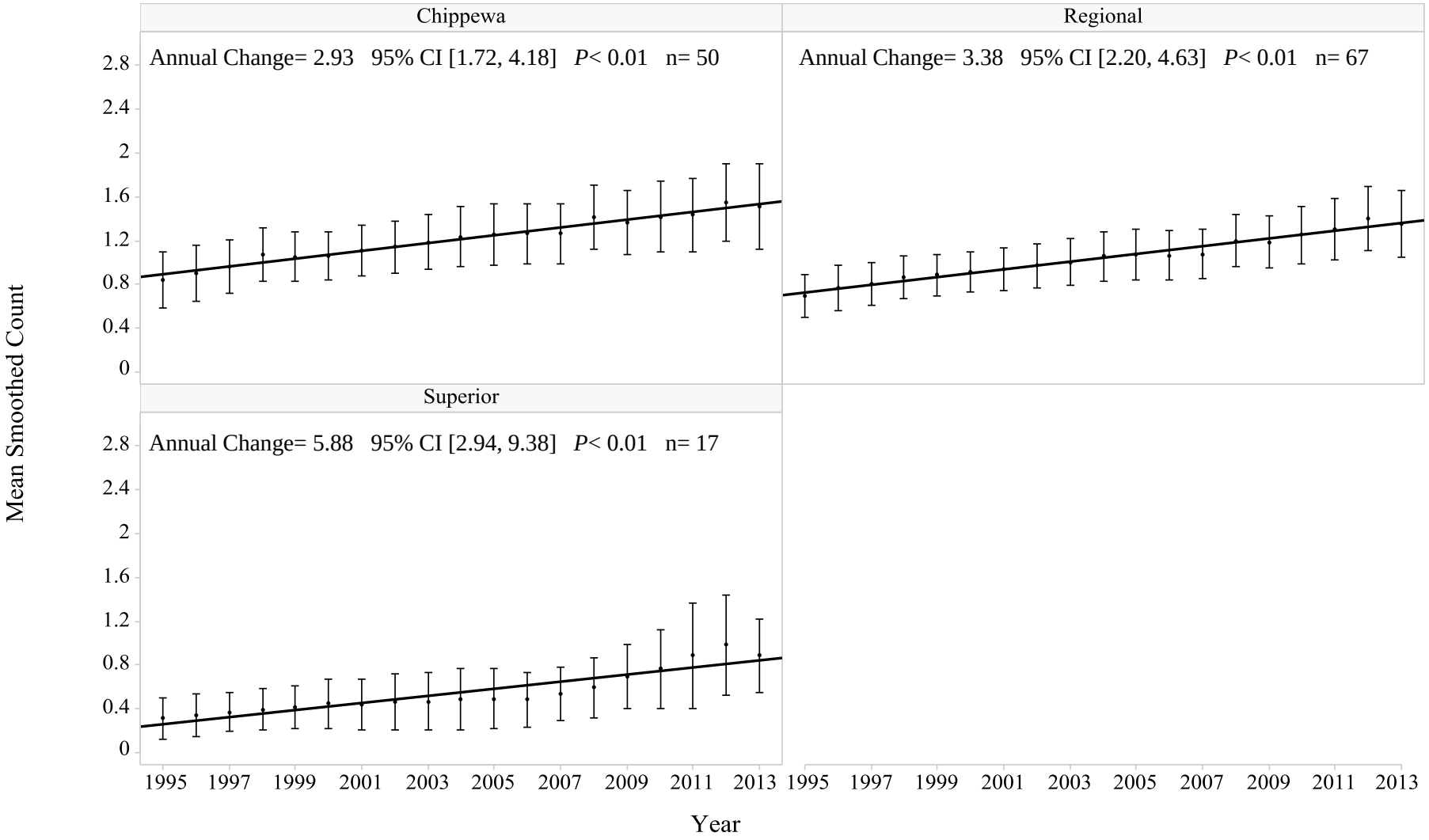
Olive-sided Flycatcher



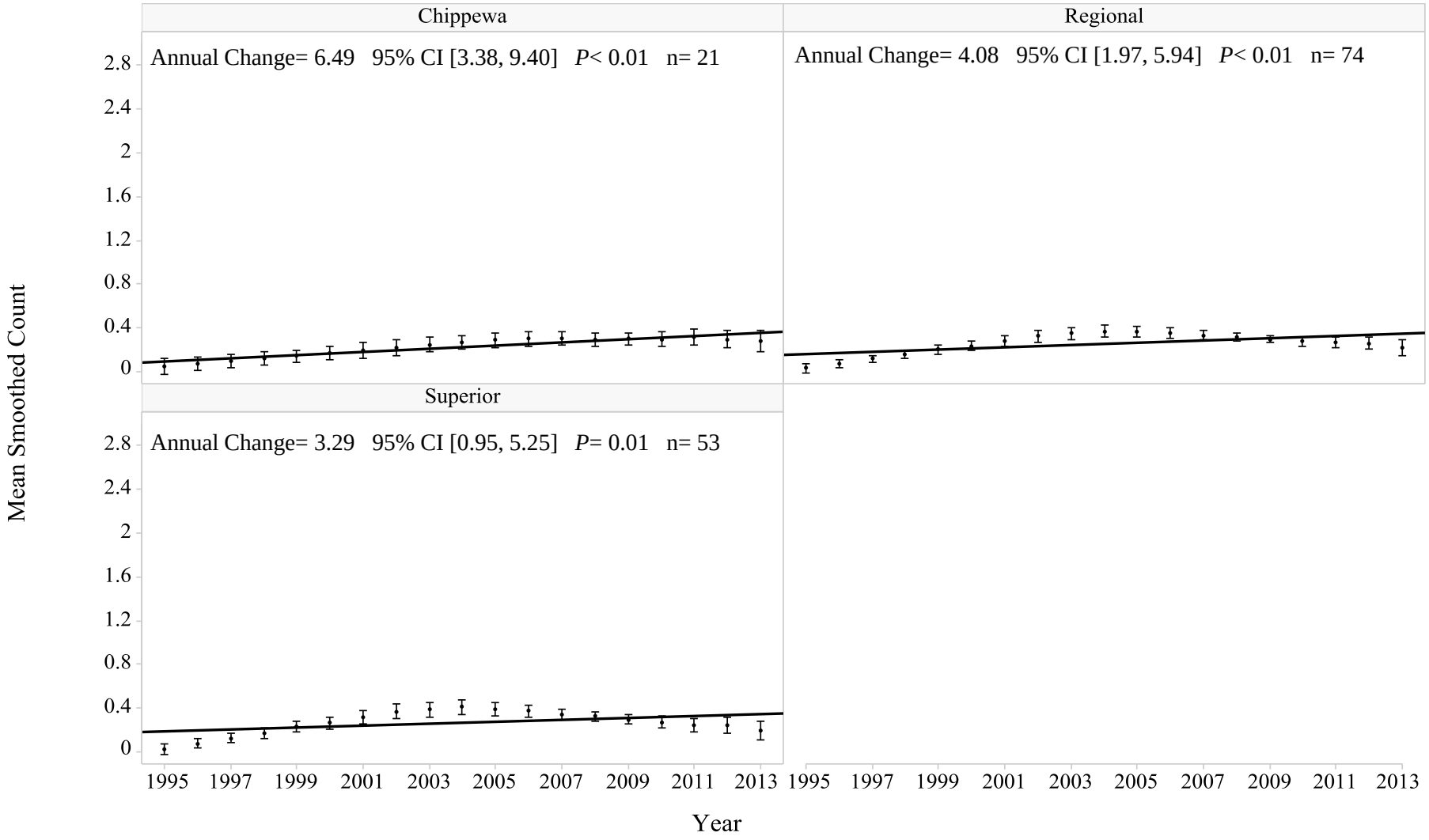
Ovenbird


Chippewa
Annual Change= 2.57 95% CI [1.94, 3.31] P< 0.01 n= 121
Regional
Annual Change= 1.47 95% CI [1.02, 1.86] P< 0.01 n= 267
Superior
Annual Change= 0.65 95% CI [0.16, 1.10] P= 0.01 n= 146
Mean Smoothed Count
0
1
2
3
4
5
6
7
8
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Year

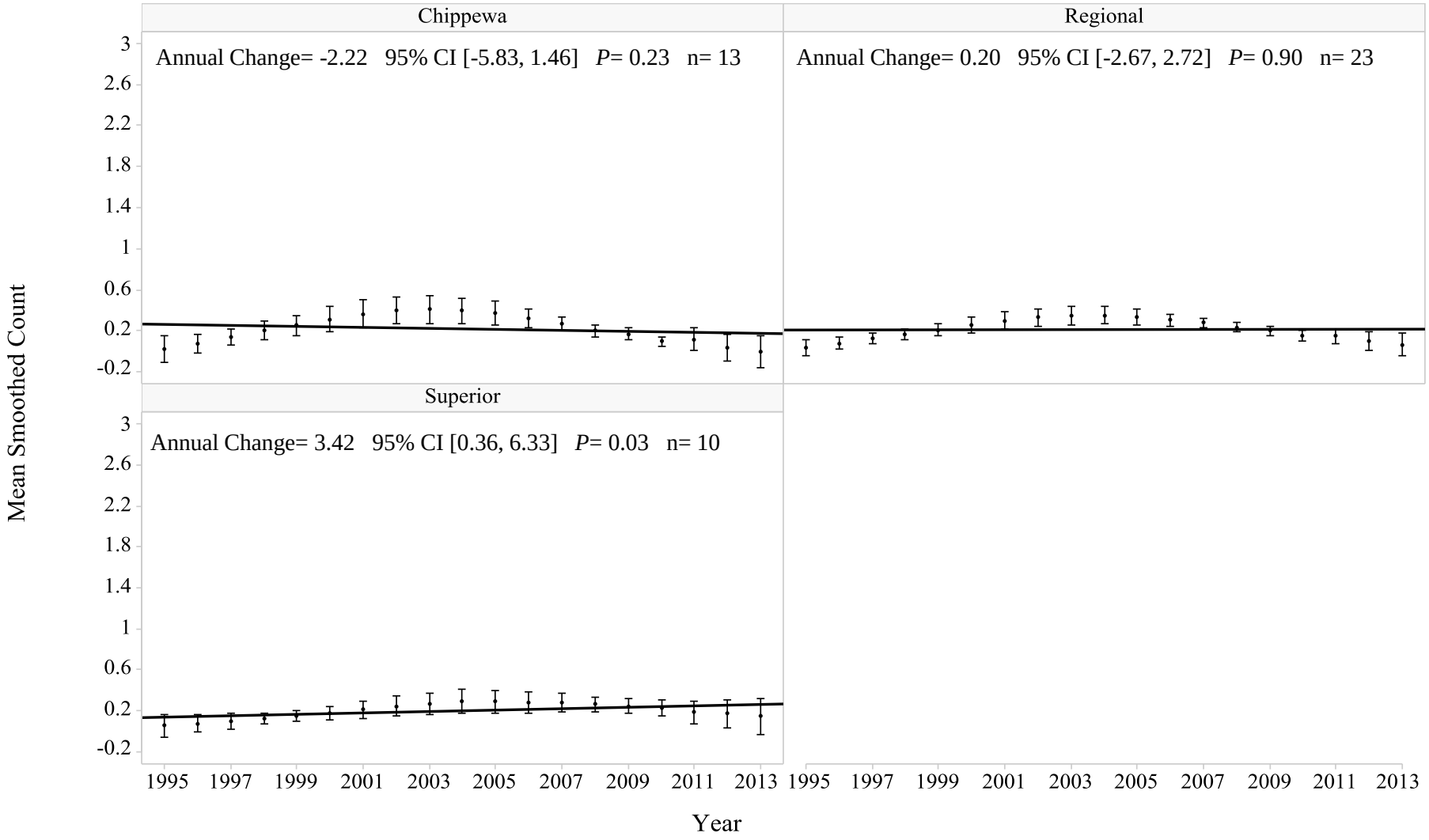
Pine Warbler



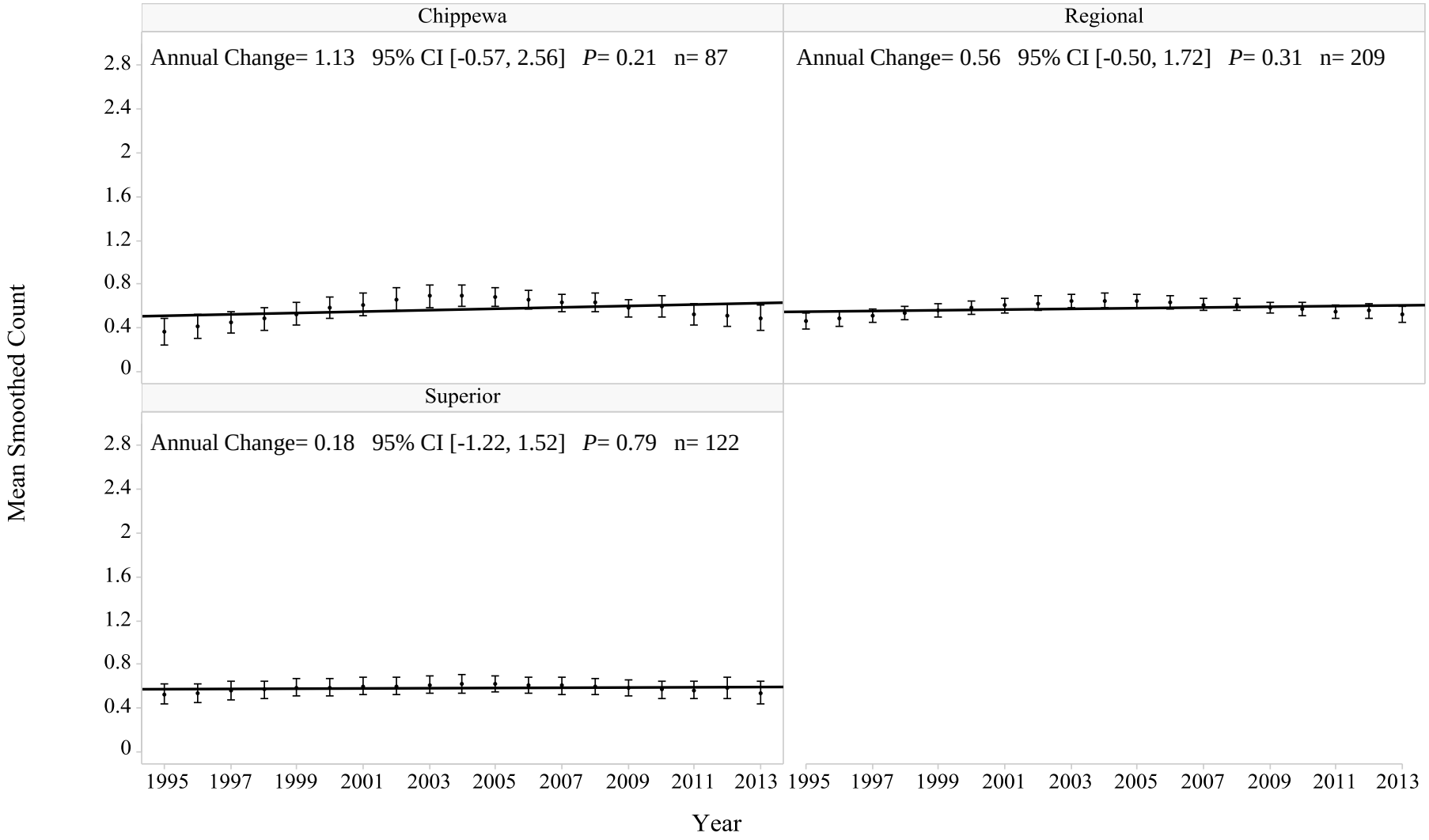
Pileated Woodpecker



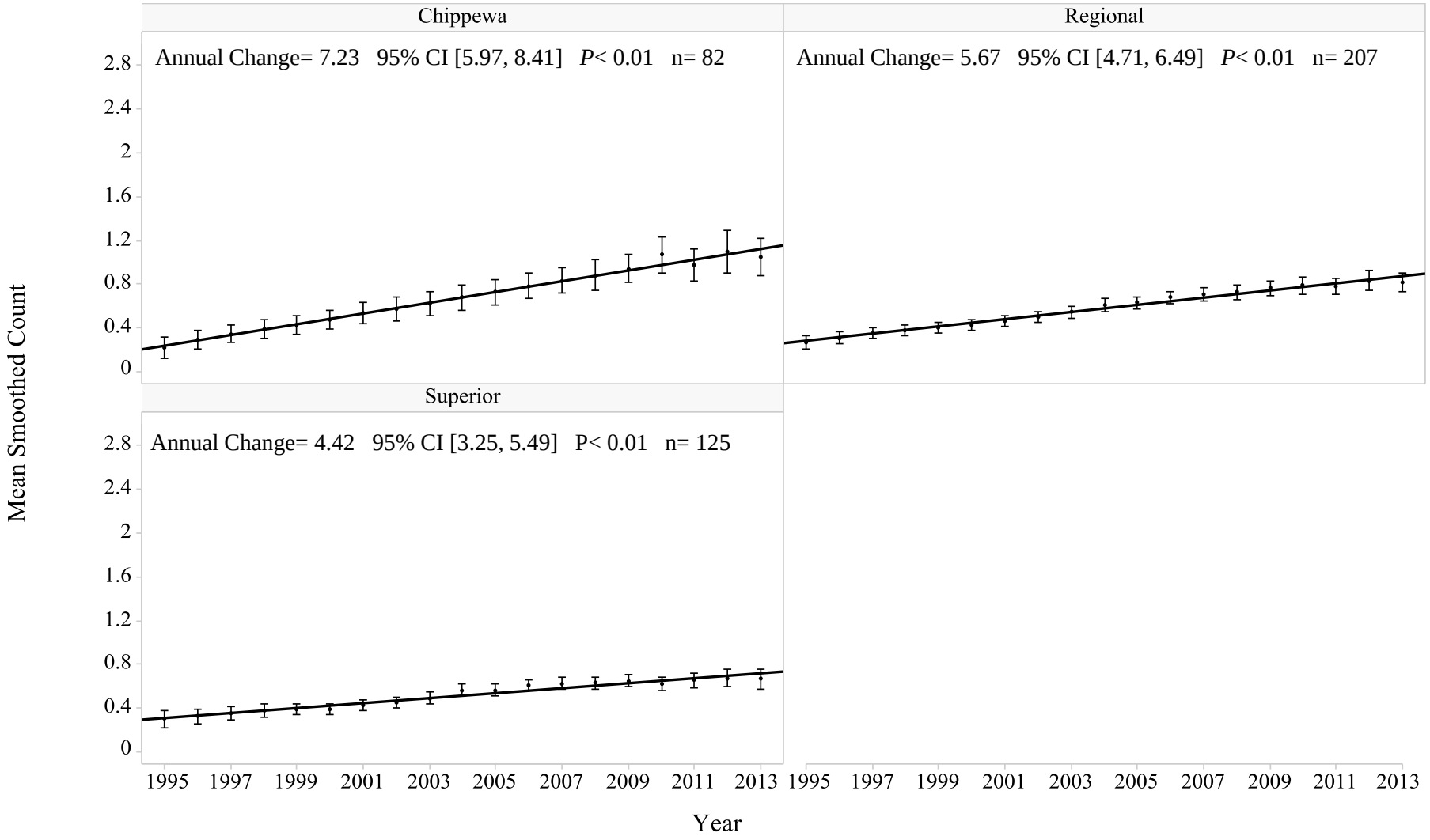
Purple Finch



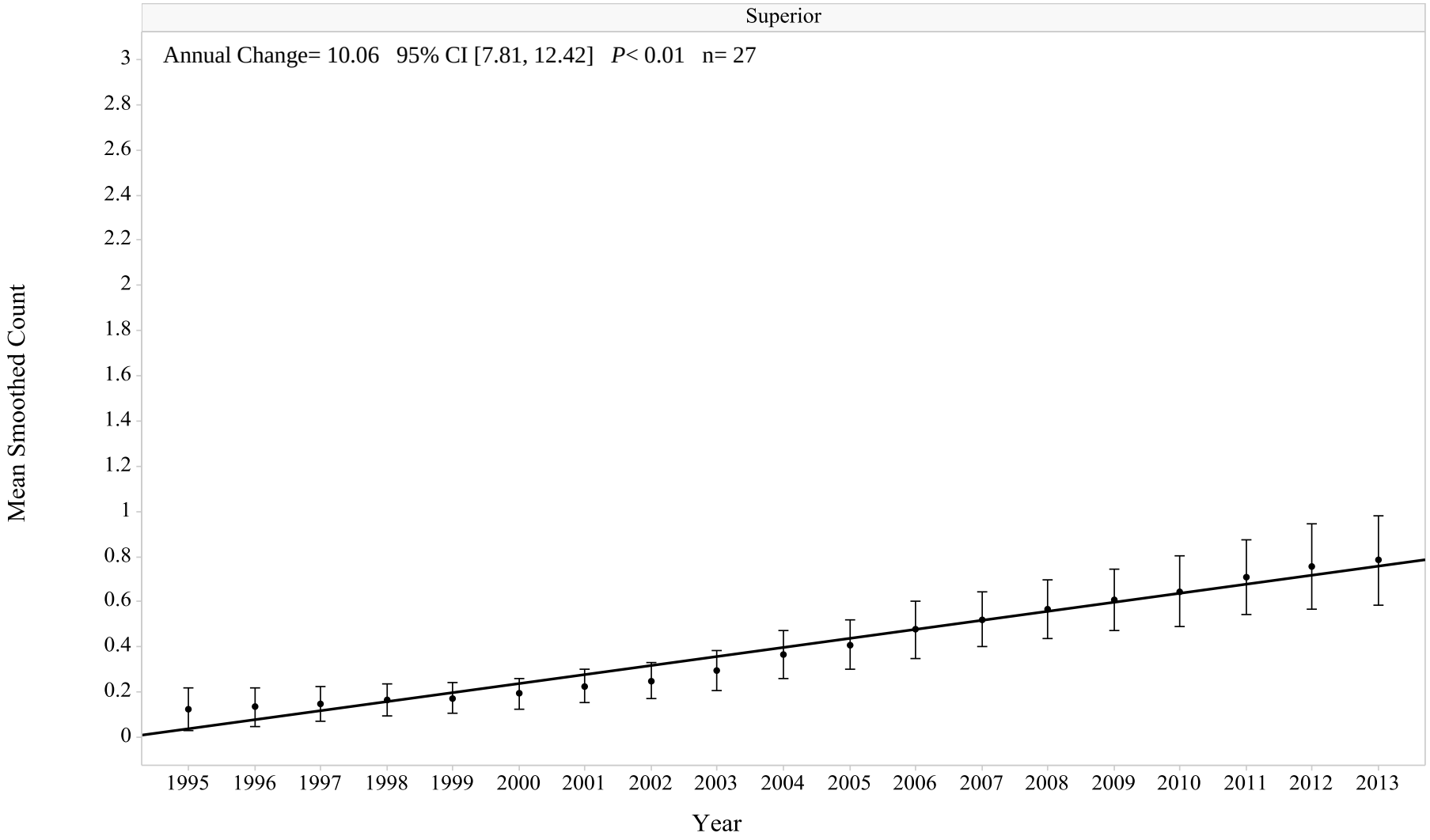
Rose-breasted Grosbeak



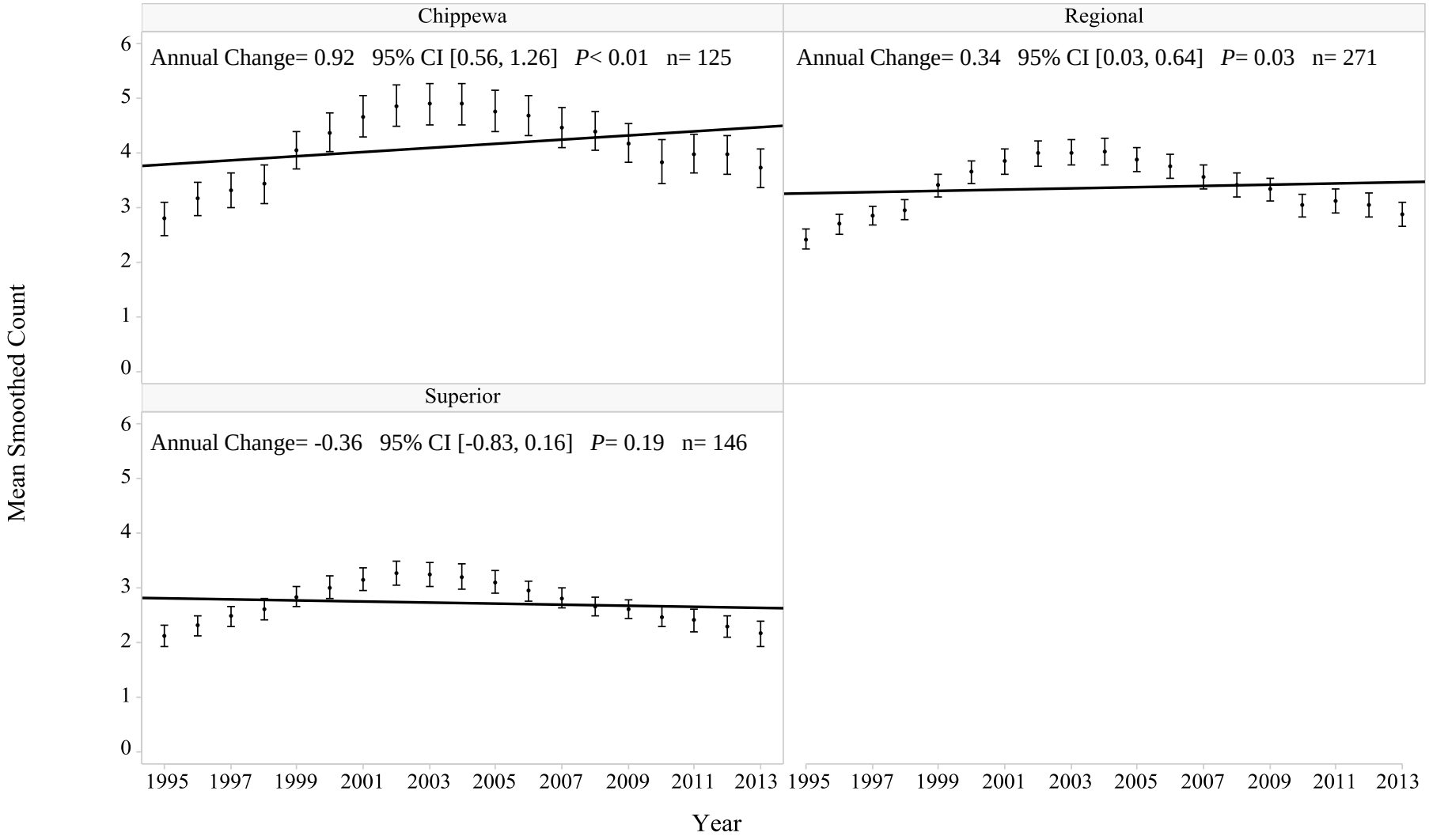
Red-breasted Nuthatch



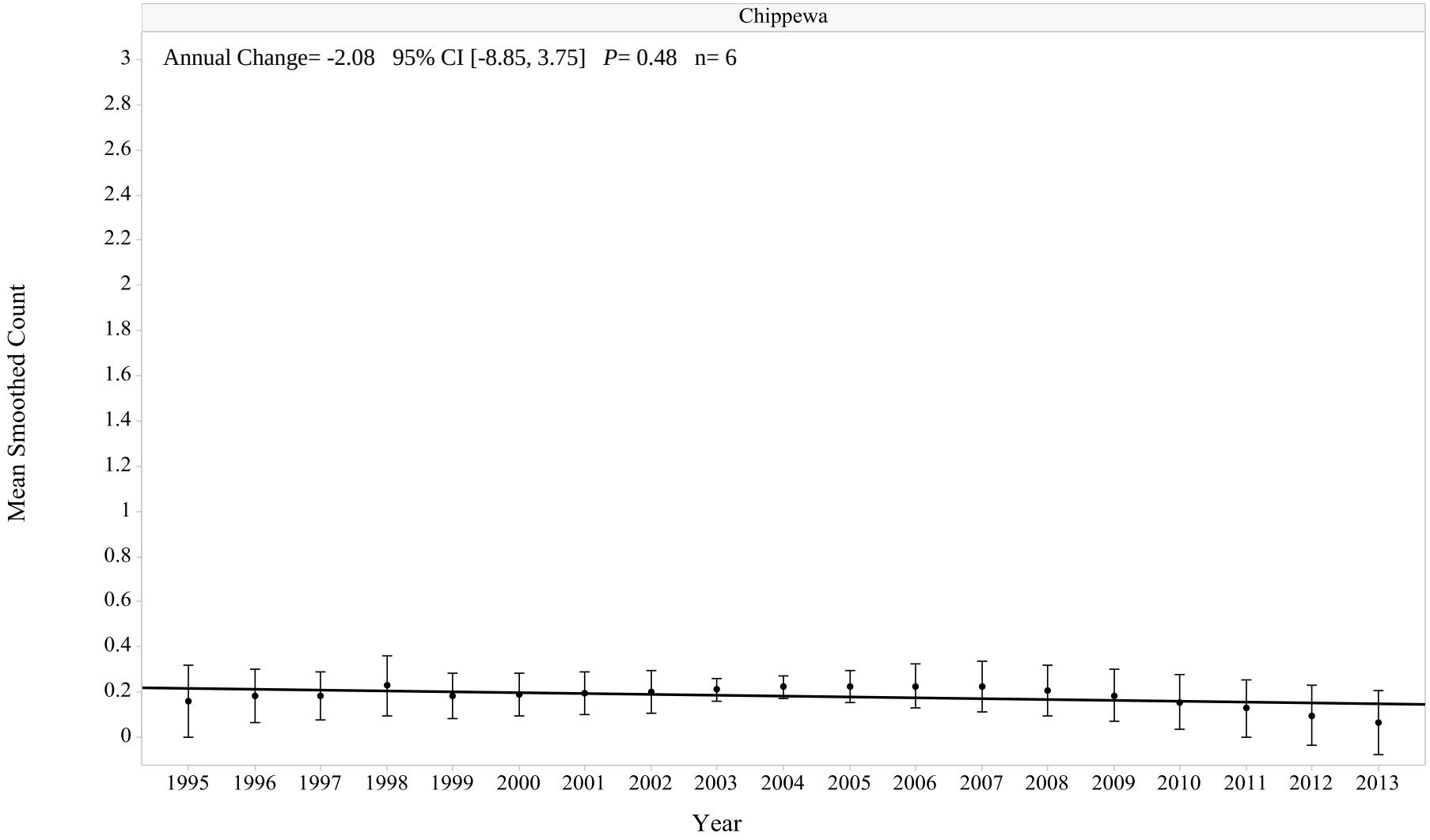
Ruby-crowned Kinglet



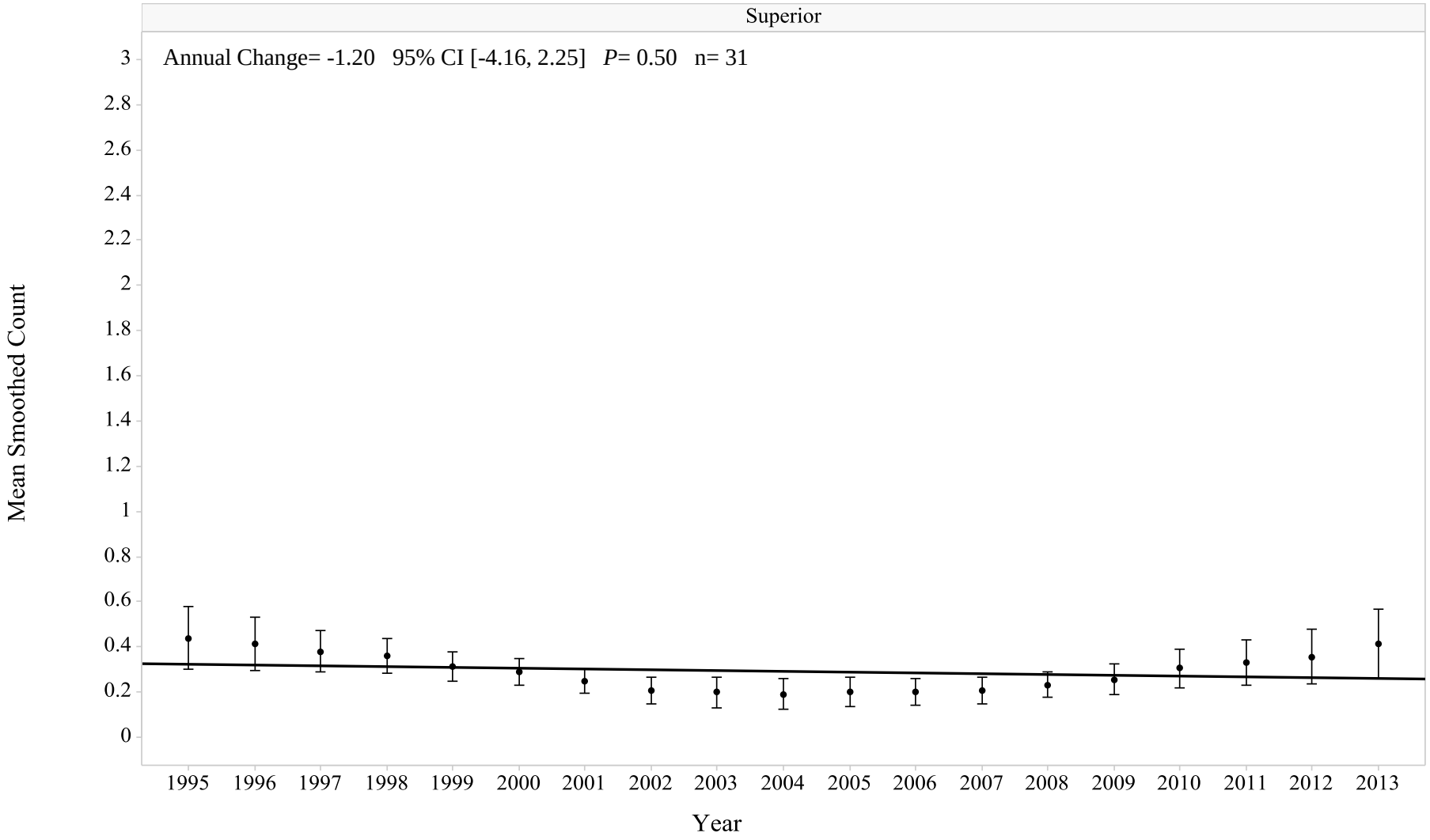
Red-eyed Vireo



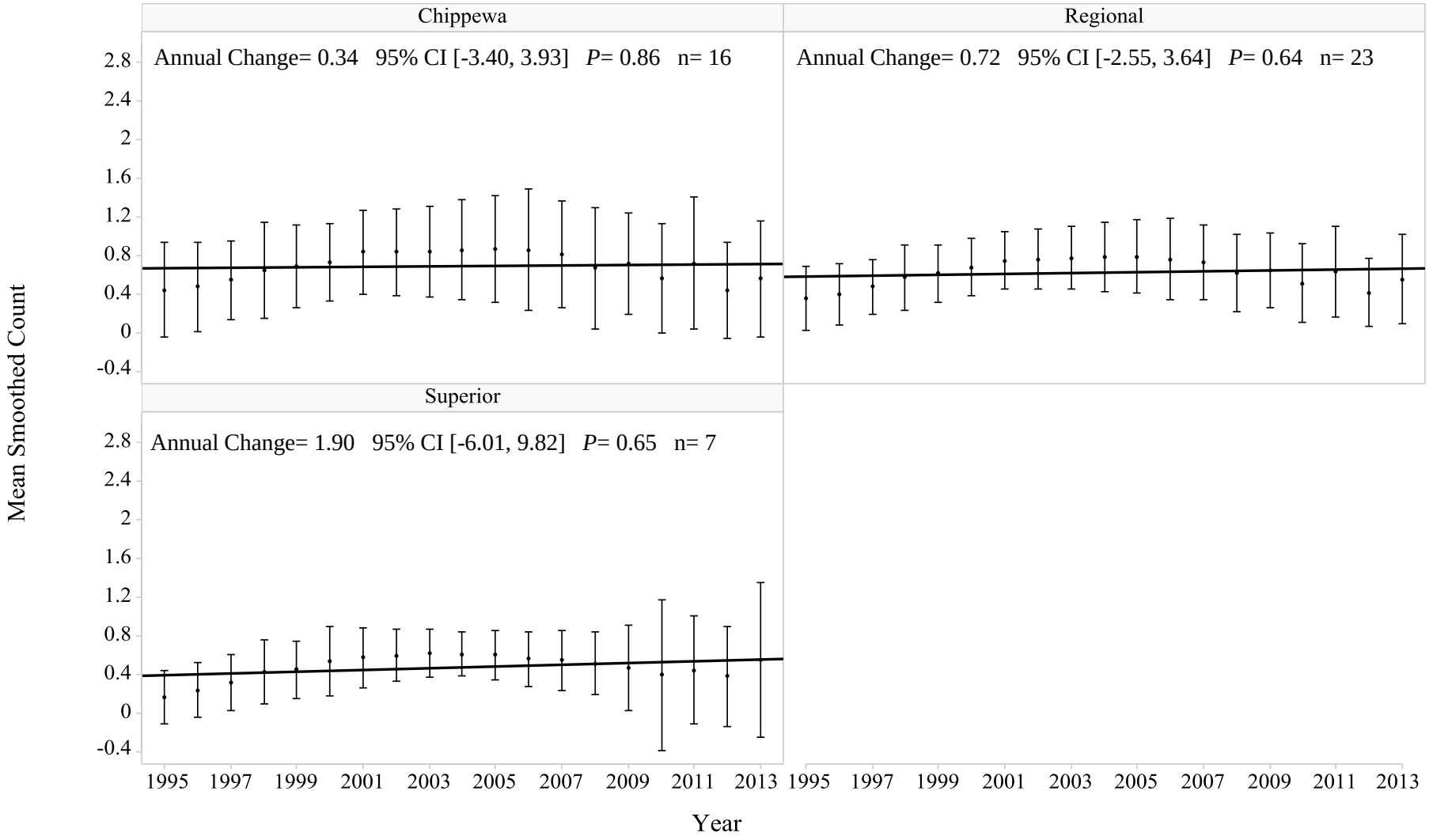
Ruby-throated Hummingbird



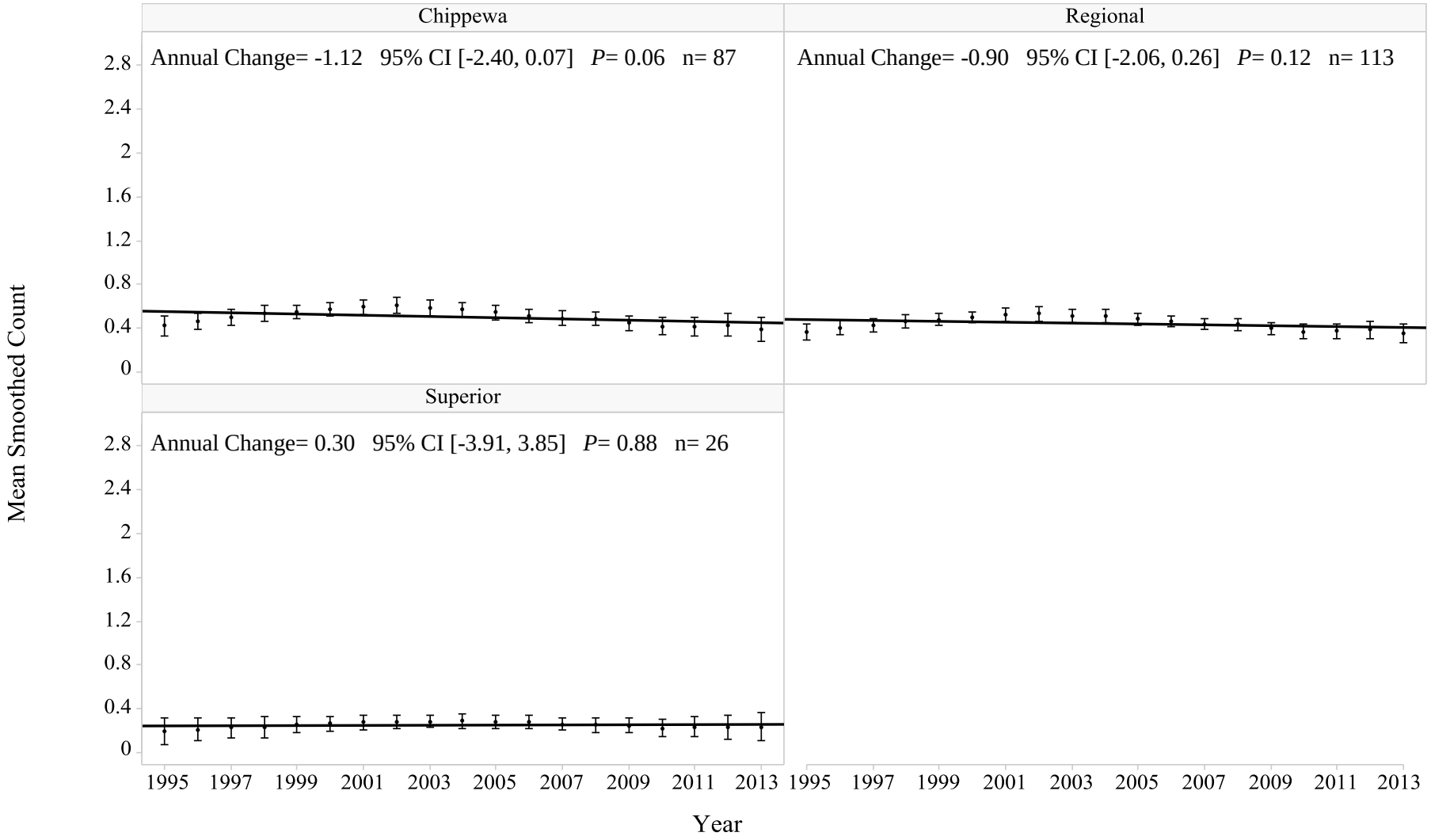
Ruffed Grouse



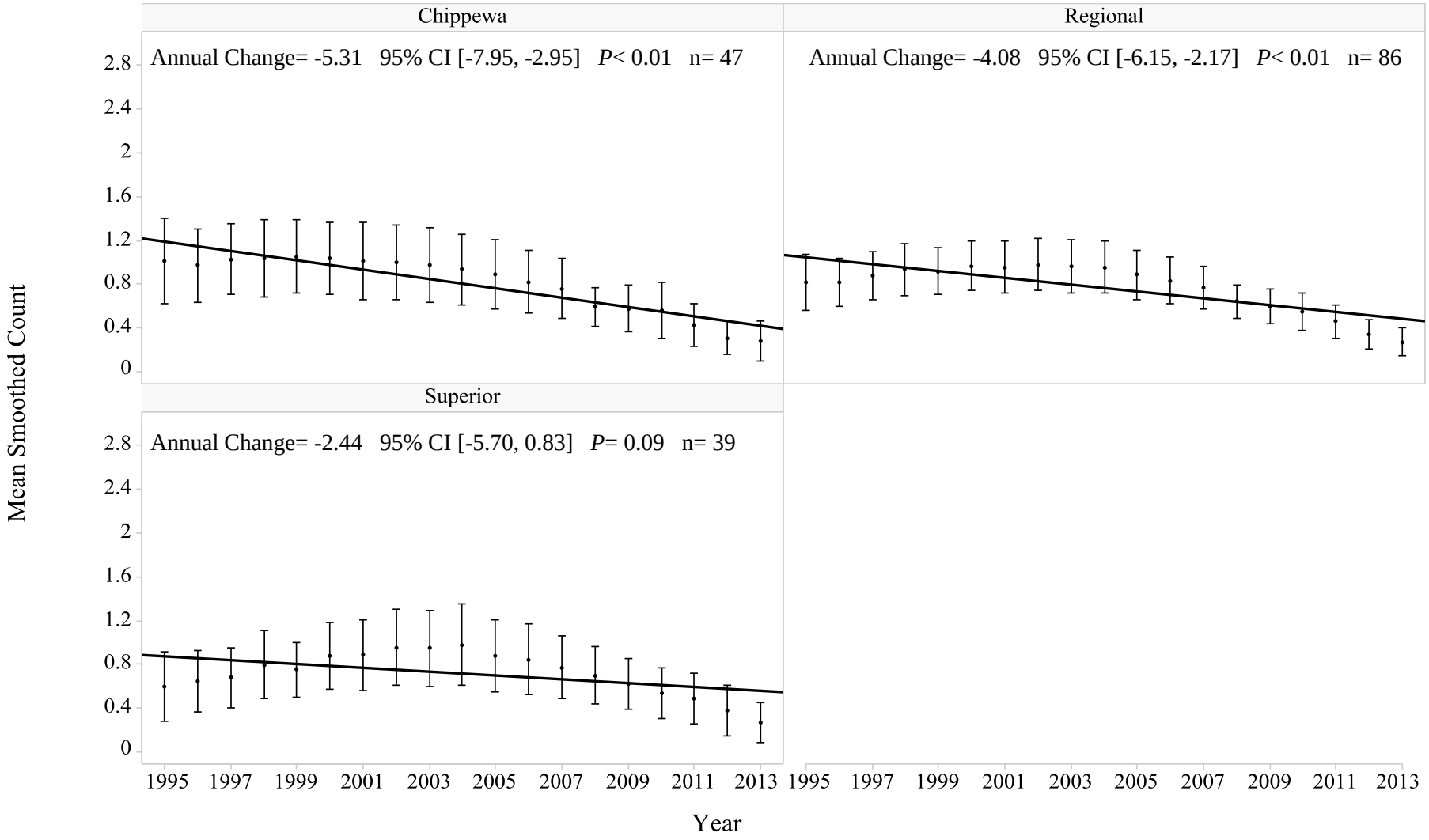
Red-winged Blackbird



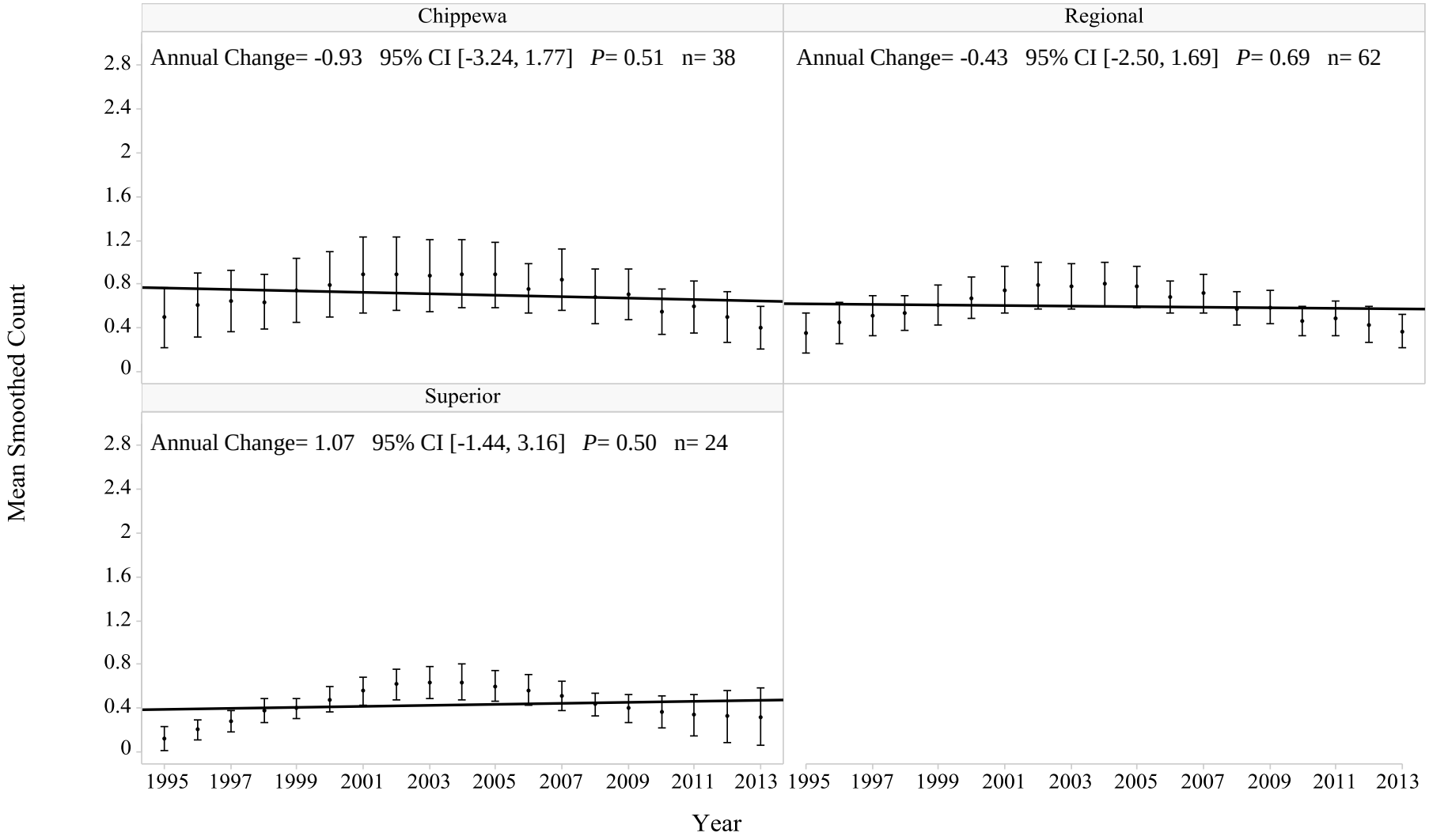
Scarlet Tanager



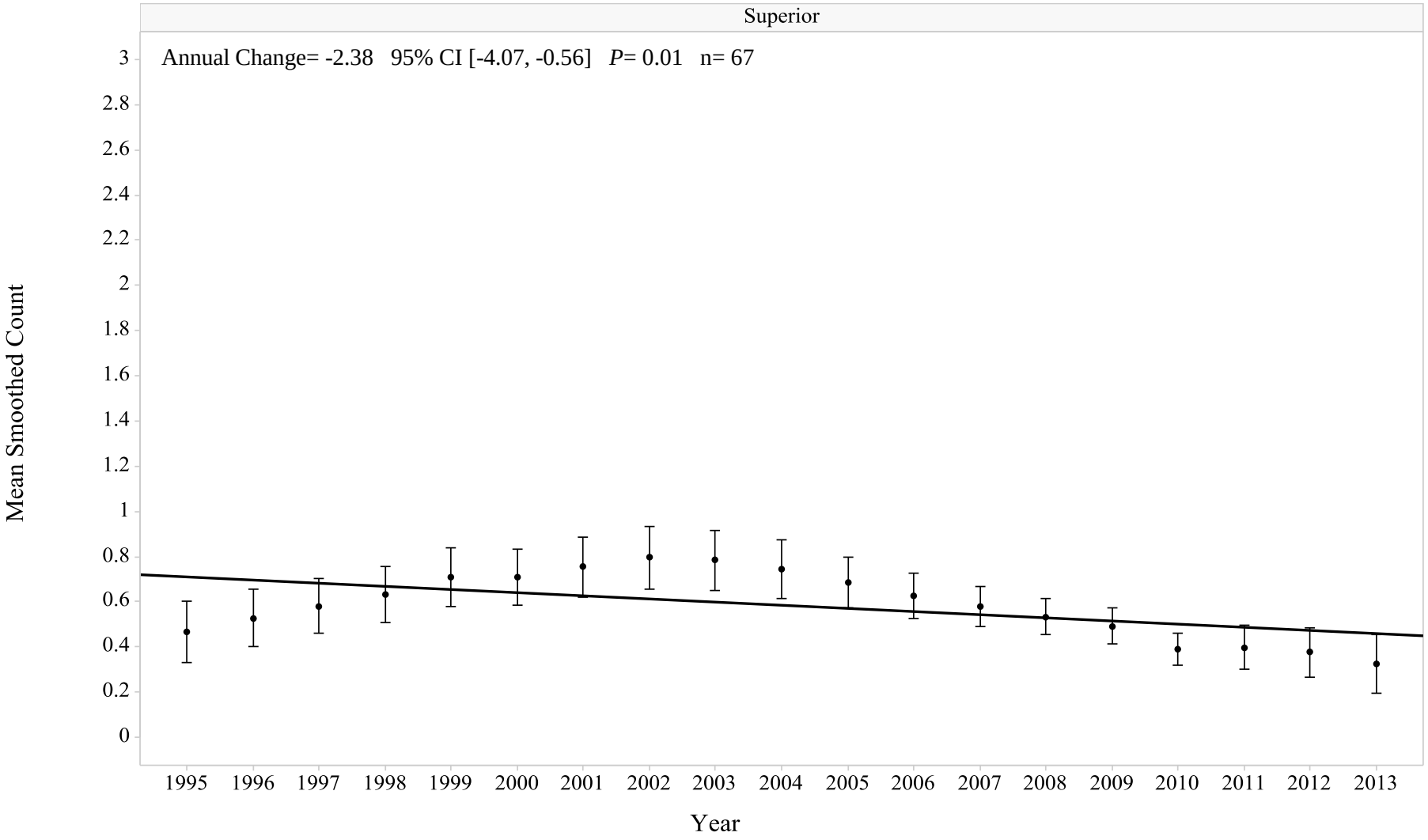
Song Sparrow



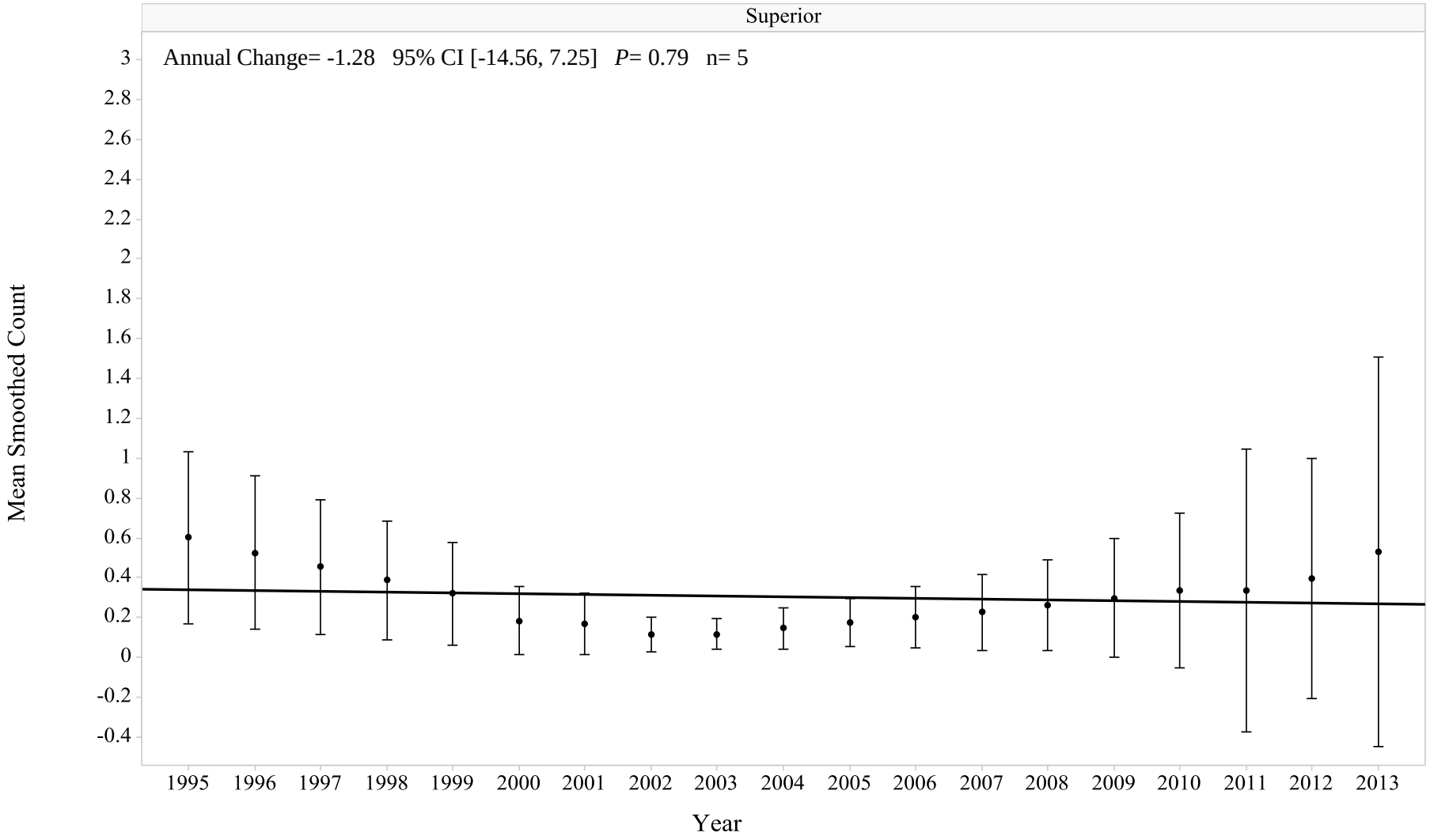
Swamp Sparrow



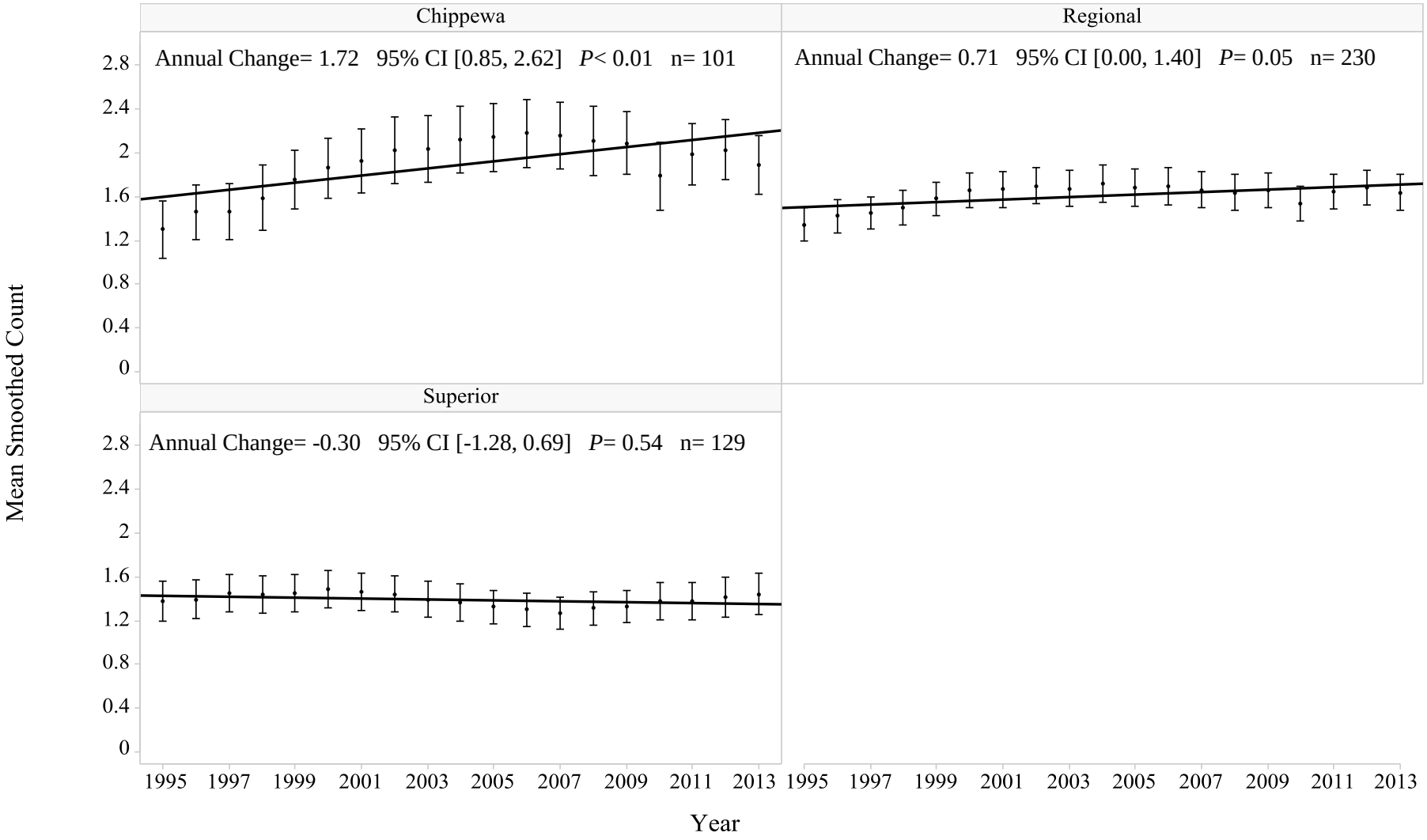
Swainson's Thrush



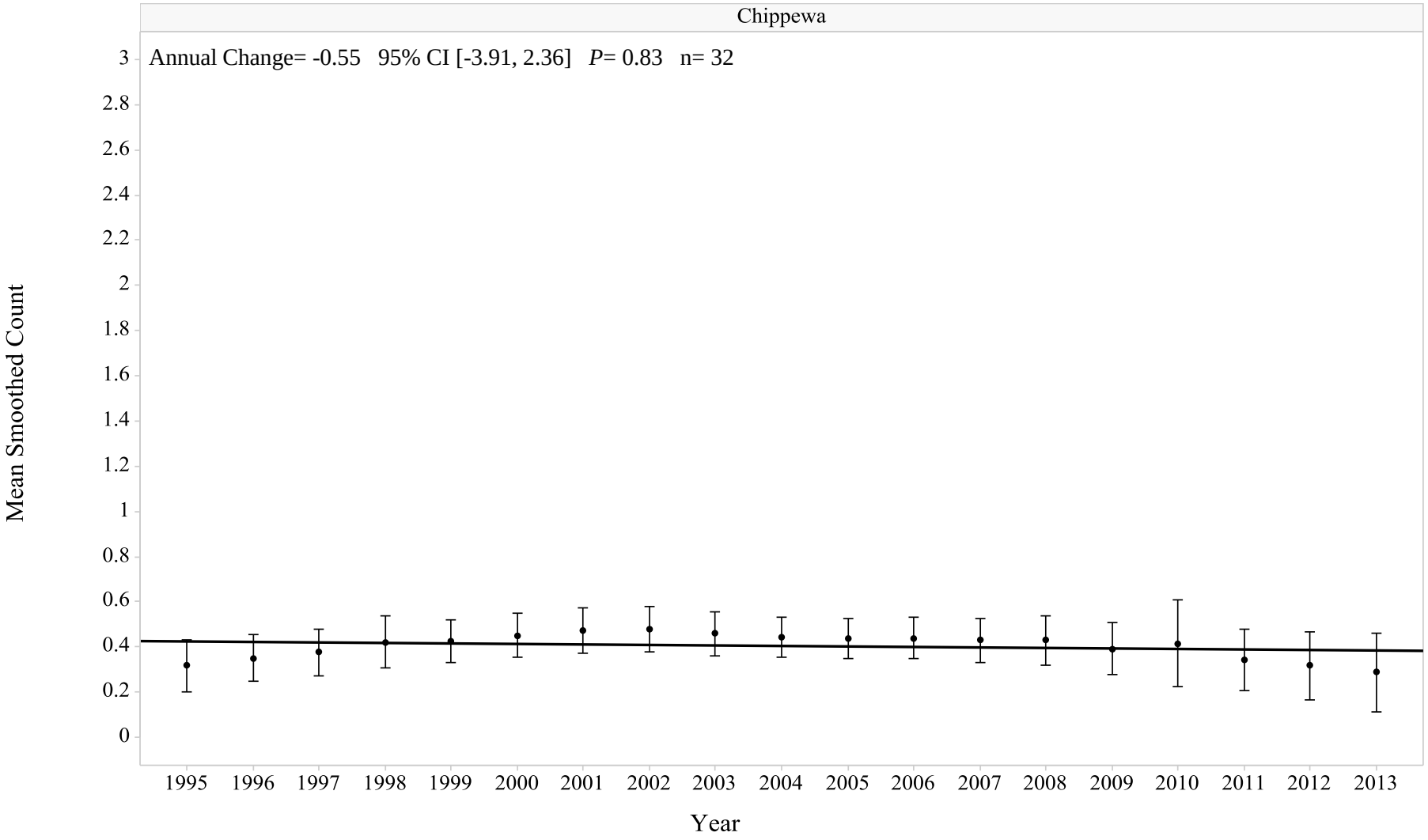
Tennessee Warbler



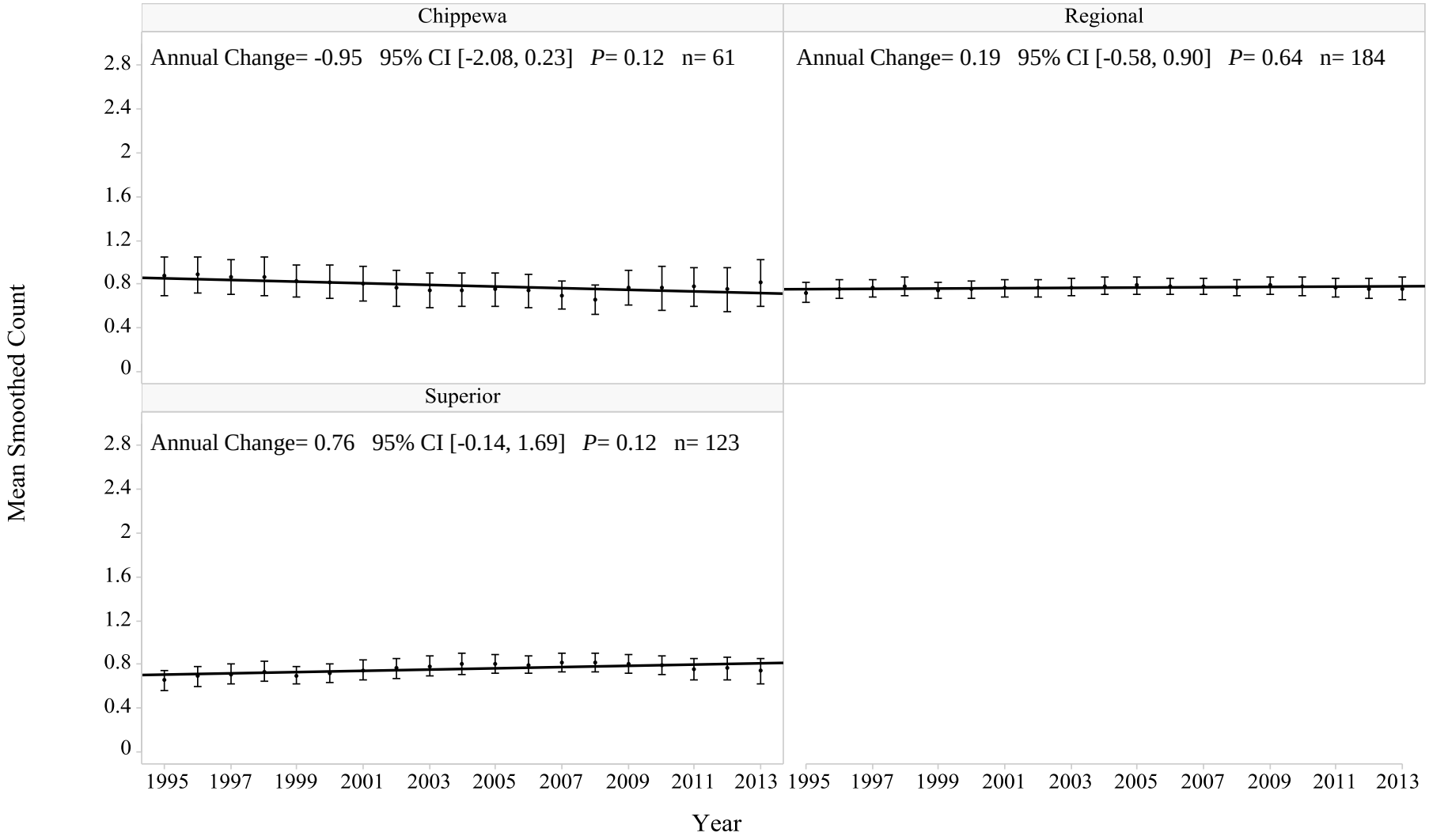
Veery


Chippewa
Annual Change= 1.72 95% CI [0.85, 2.62] P< 0.01 n= 101
Regional
Annual Change= 0.71 95% CI [0.00, 1.40] P= 0.05 n= 230
Superior
Annual Change= -0.30 95% CI [-1.28, 0.69] P= 0.54 n= 129
Mean Smoothed Count
0
0.4
0.8
1.2
1.6
2
2.4
2.8
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Year

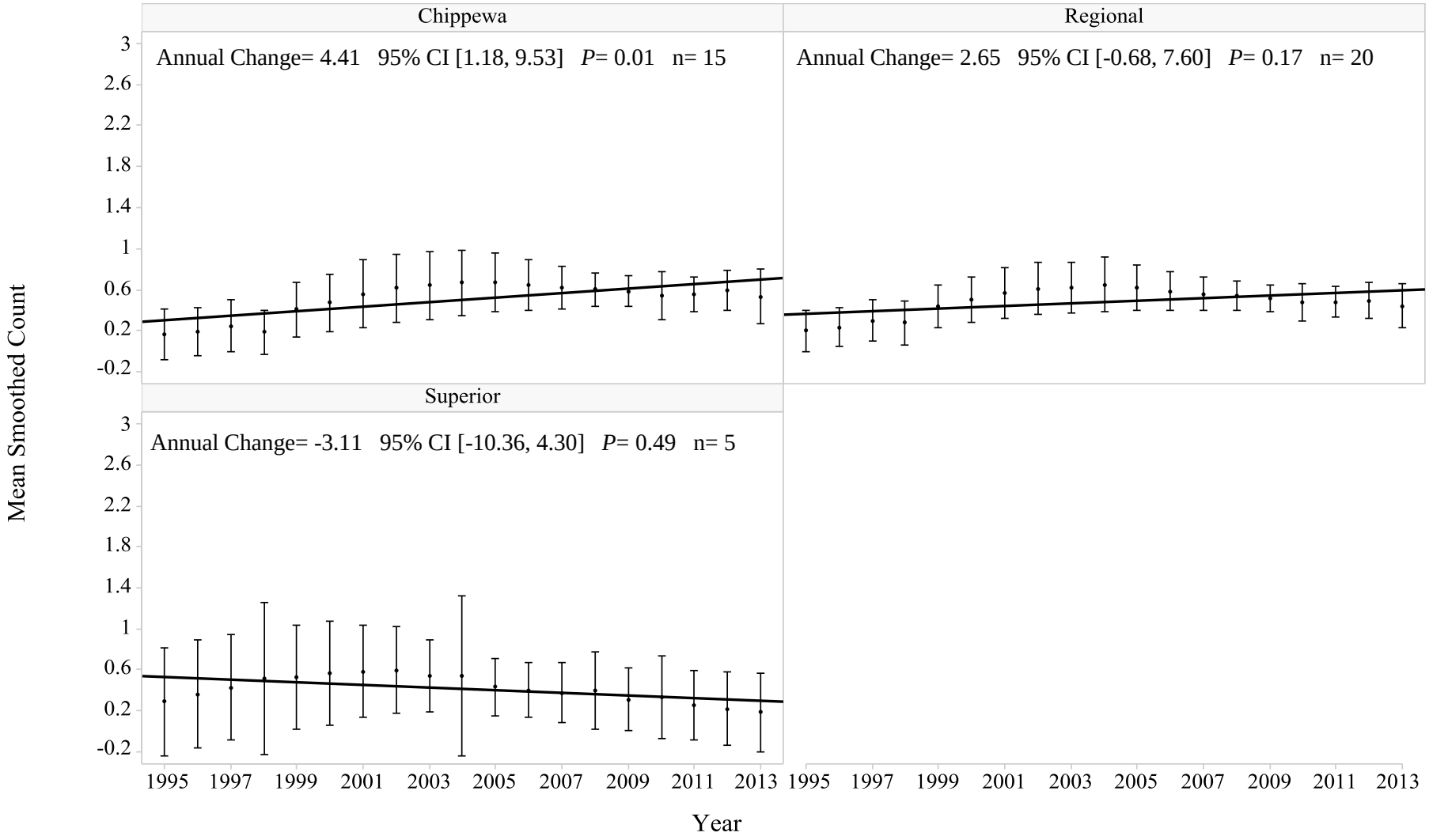
White-breasted Nuthatch



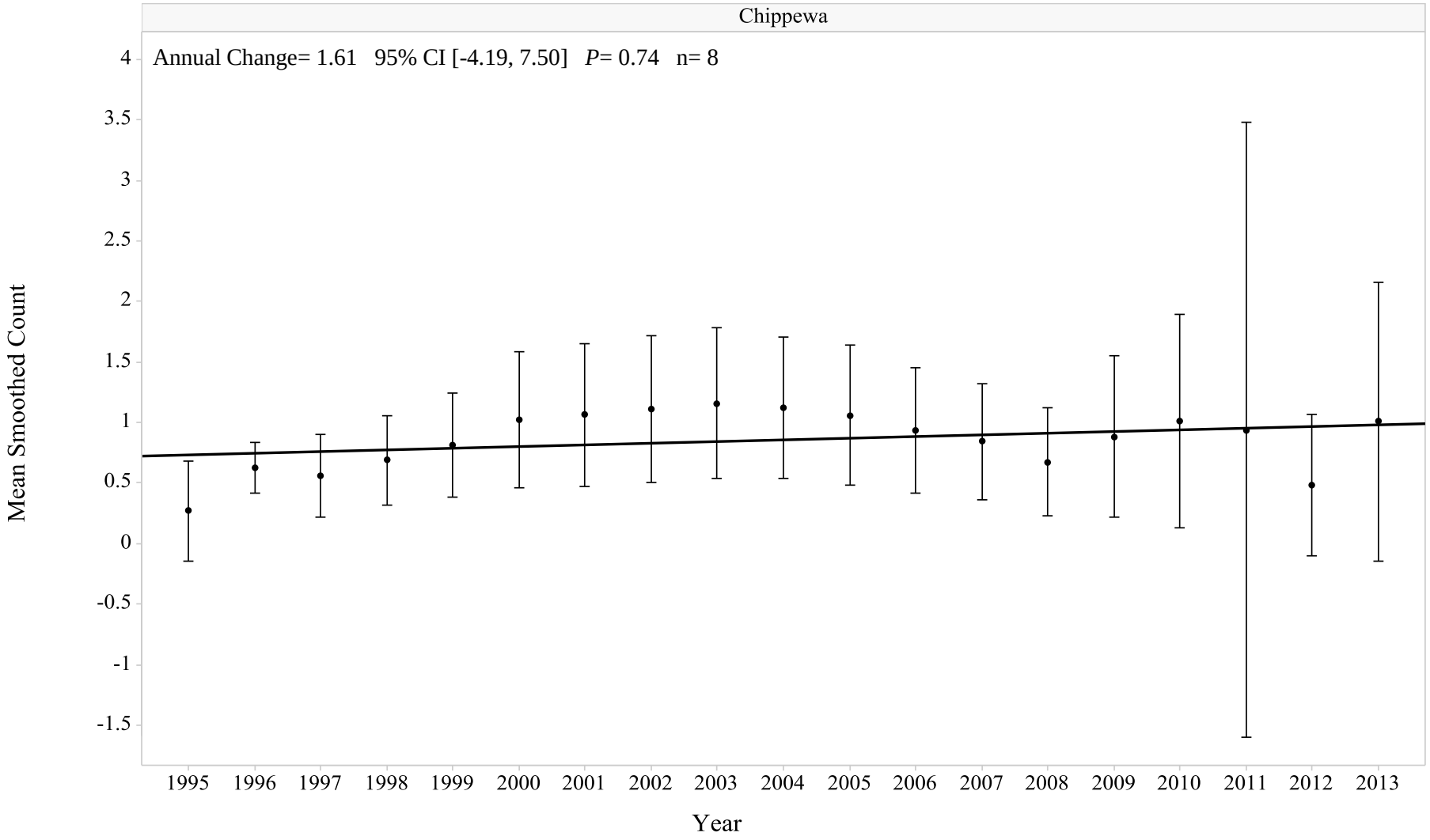
Winter Wren


Chippewa
Annual Change= -0.95 95% CI [-2.08, 0.23] P= 0.12 n= 61
Regional
Annual Change= 0.19 95% CI [-0.58, 0.90] P= 0.64 n= 184
Superior
Annual Change= 0.76 95% CI [-0.14, 1.69] P= 0.12 n= 123
Mean Smoothed Count
0
0.4
0.8
1.2
1.6
2
2.4
2.8
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Year

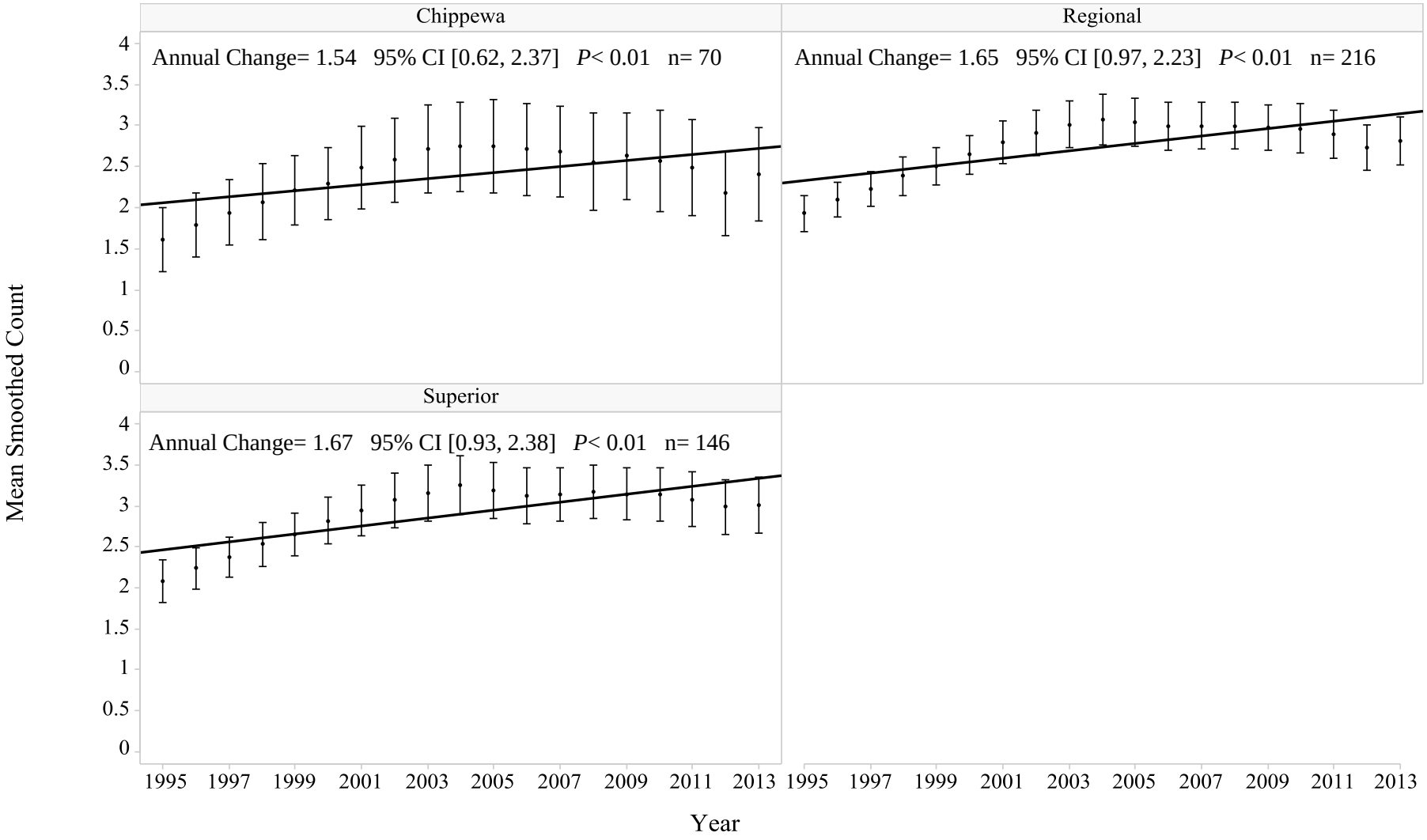
Wood Thrush


Chippewa
Annual Change= 4.41 95% CI [1.18, 9.53] P= 0.01 n= 15
Regional
Annual Change= 2.65 95% CI [-0.68, 7.60] P= 0.17 n= 20
Superior
Annual Change= -3.11 95% CI [-10.36, 4.30] P= 0.49 n= 5
Mean Smoothed Count
3
2.6
2.2
1.8
1.4
1
0.6
0.2
-0.2
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
Year

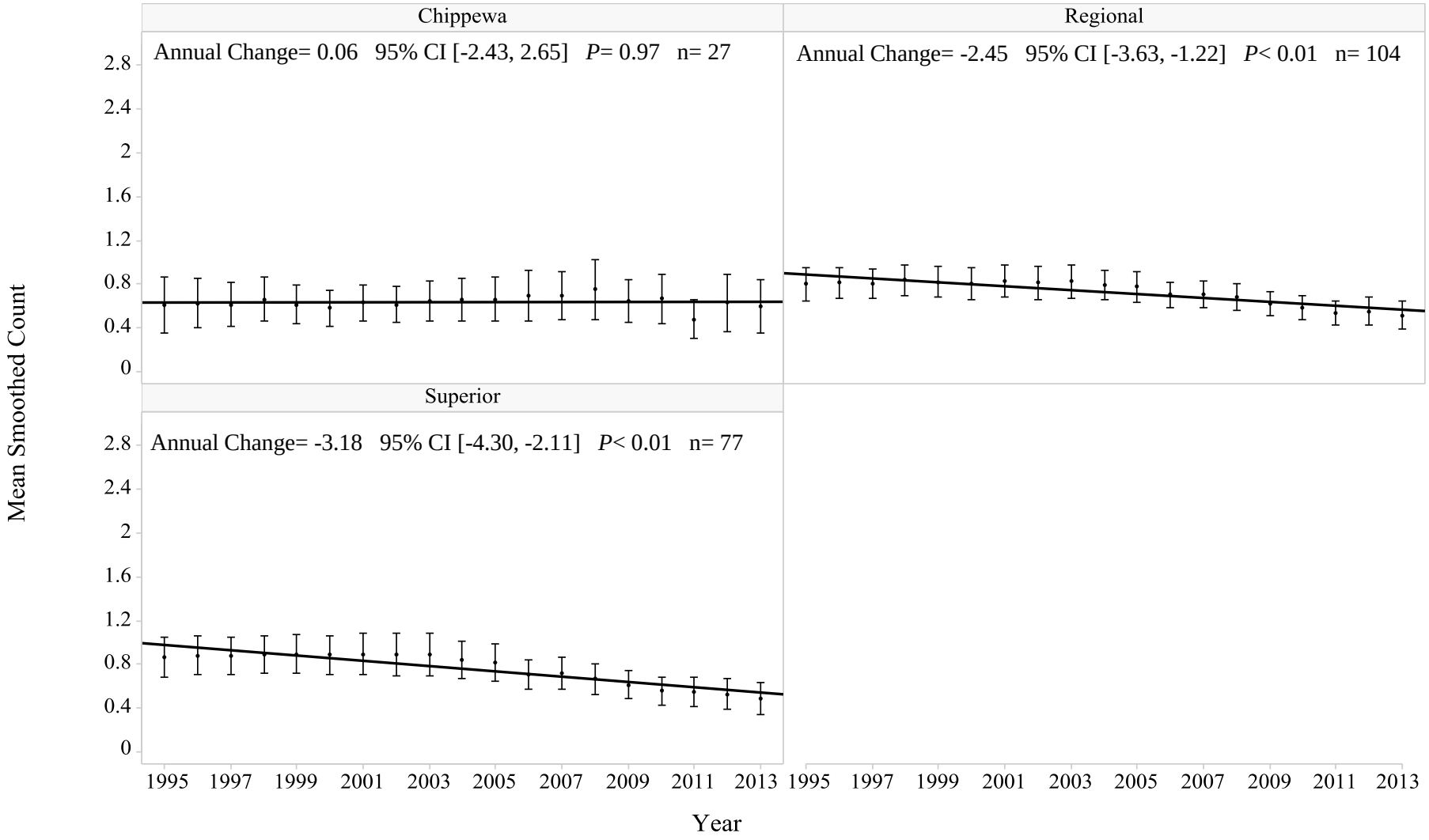
Palm Warbler (Western)



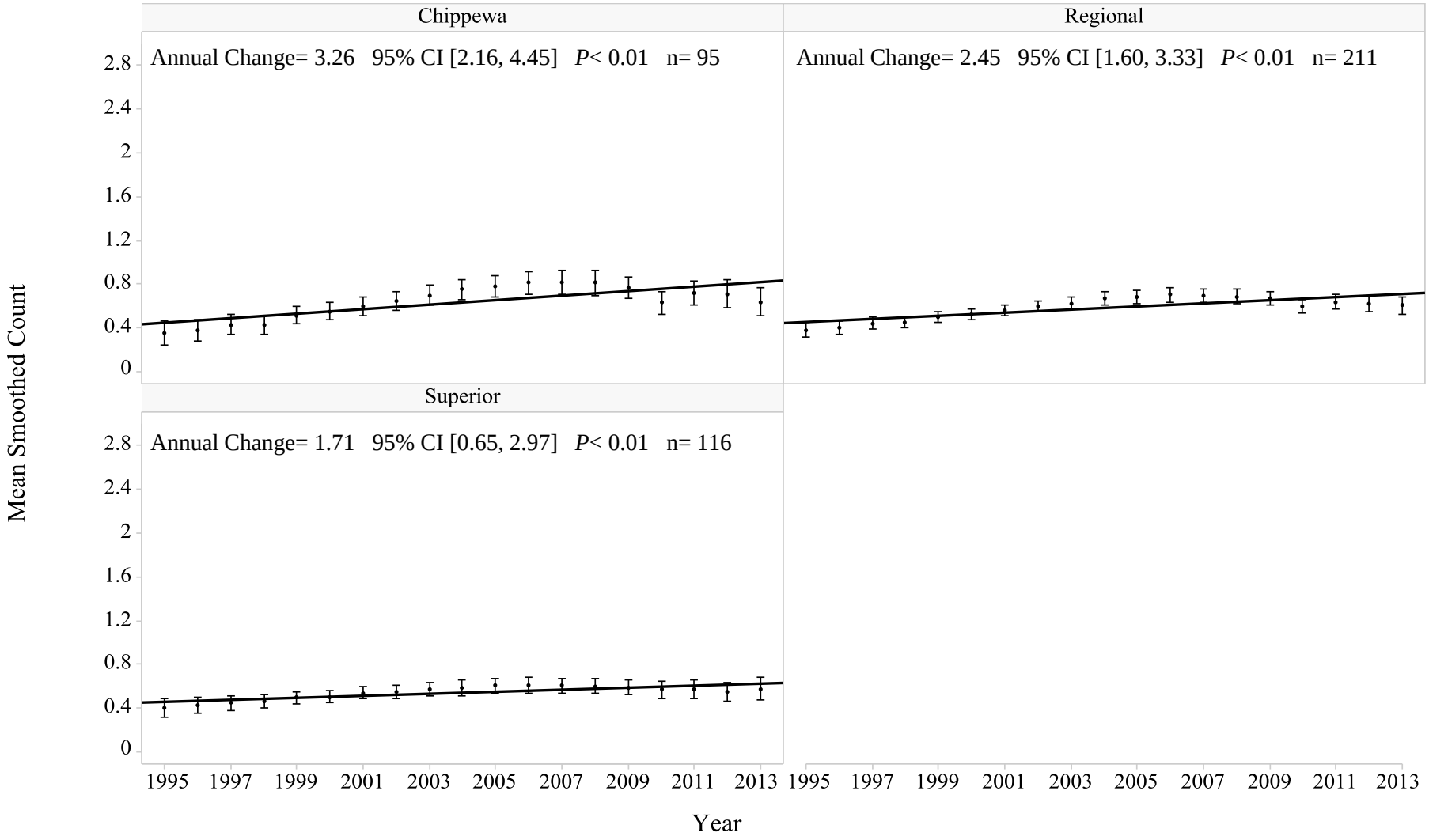
White-throated Sparrow



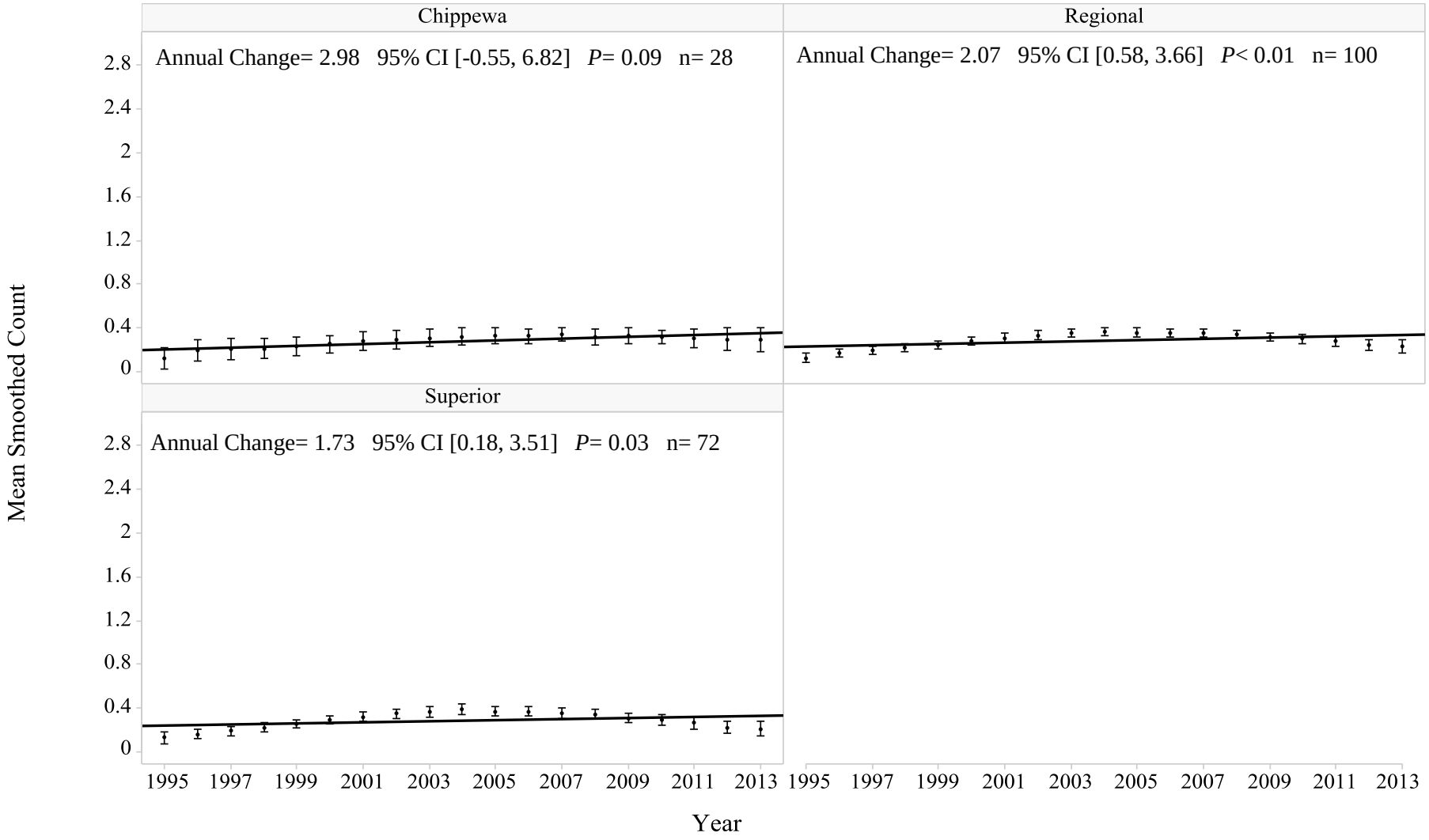
Yellow-bellied Flycatcher



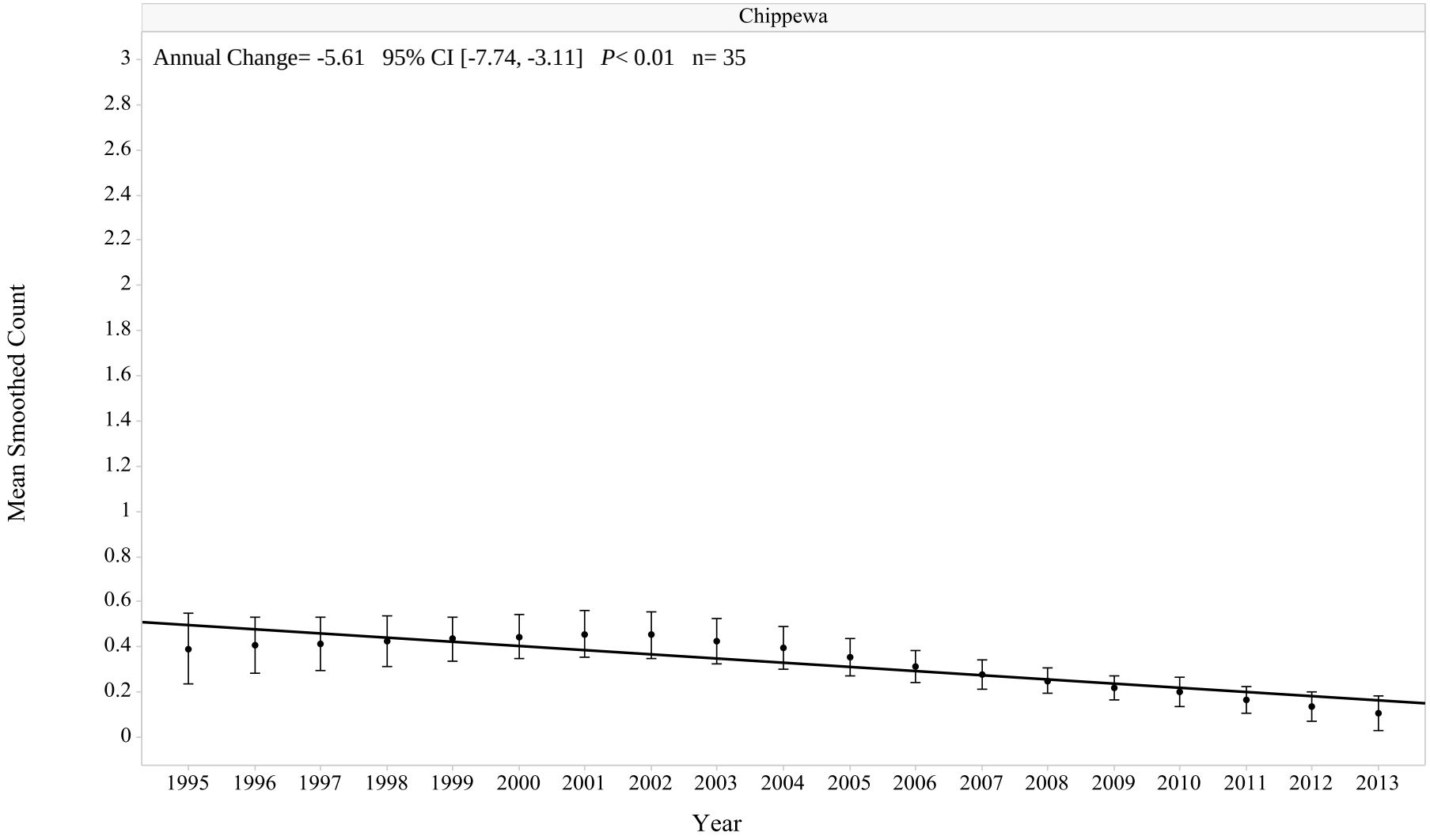
Yellow-bellied Sapsucker



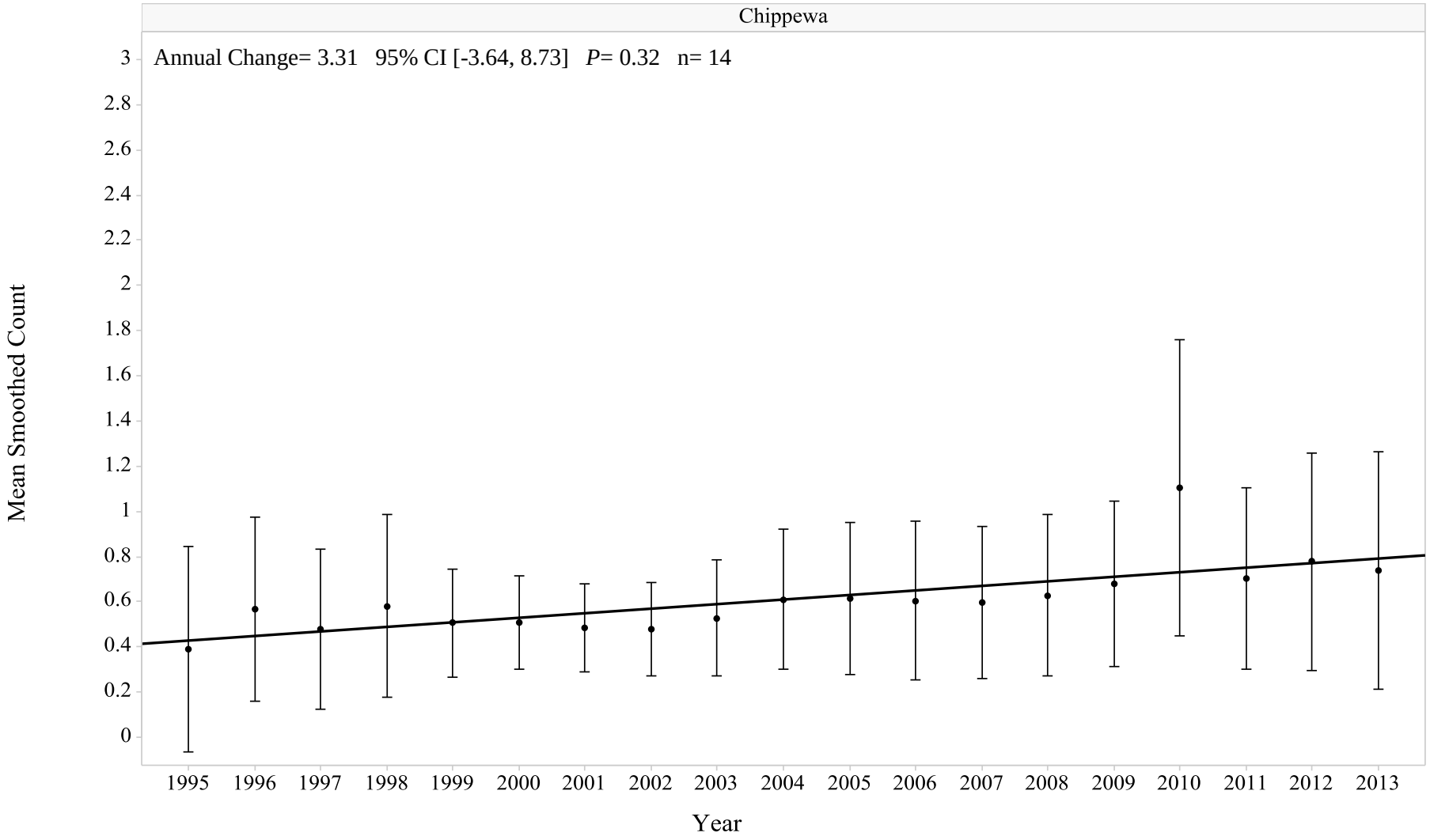
Northern Flicker (Yellow-shafted)



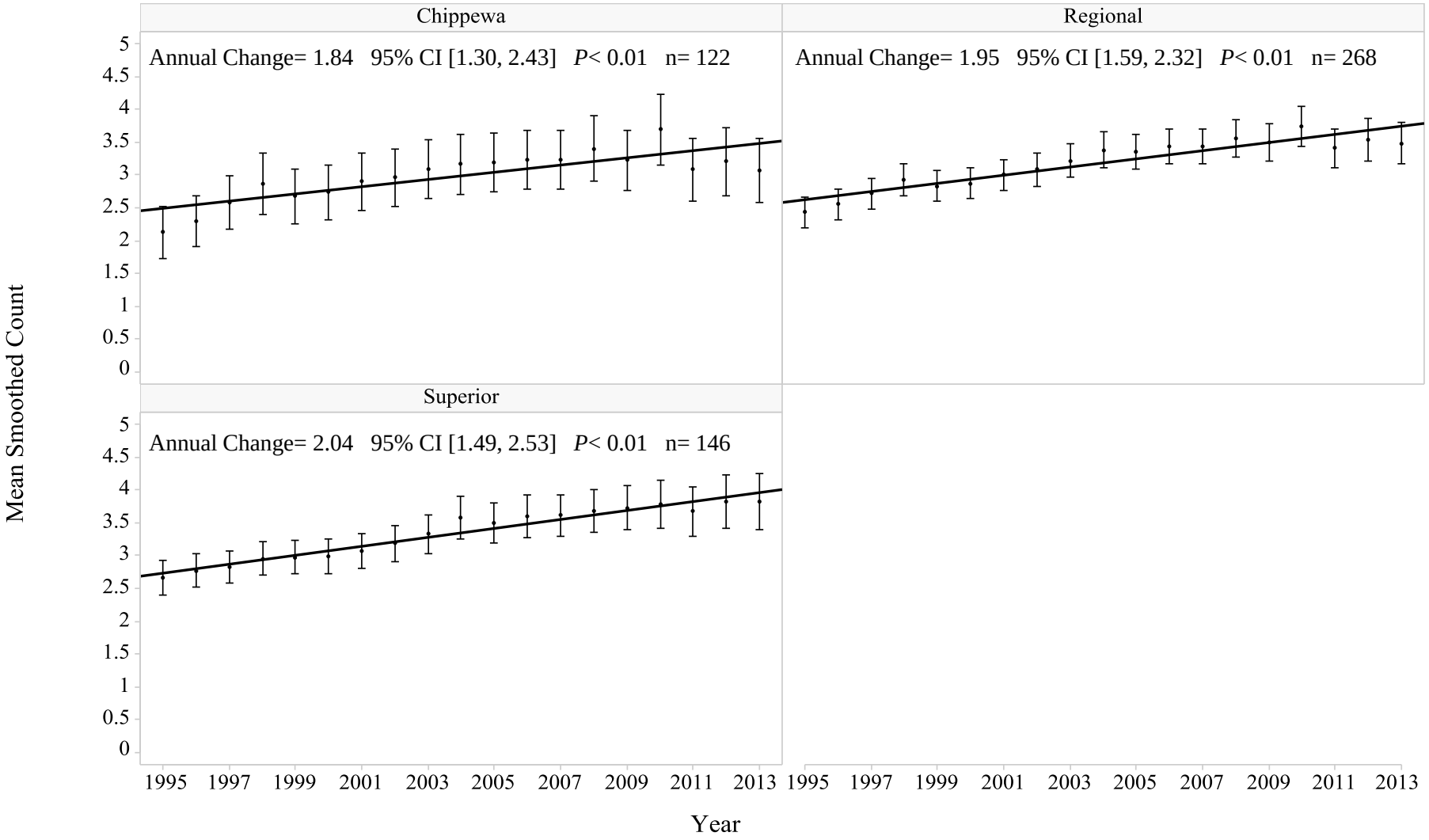
Yellow-throated Vireo



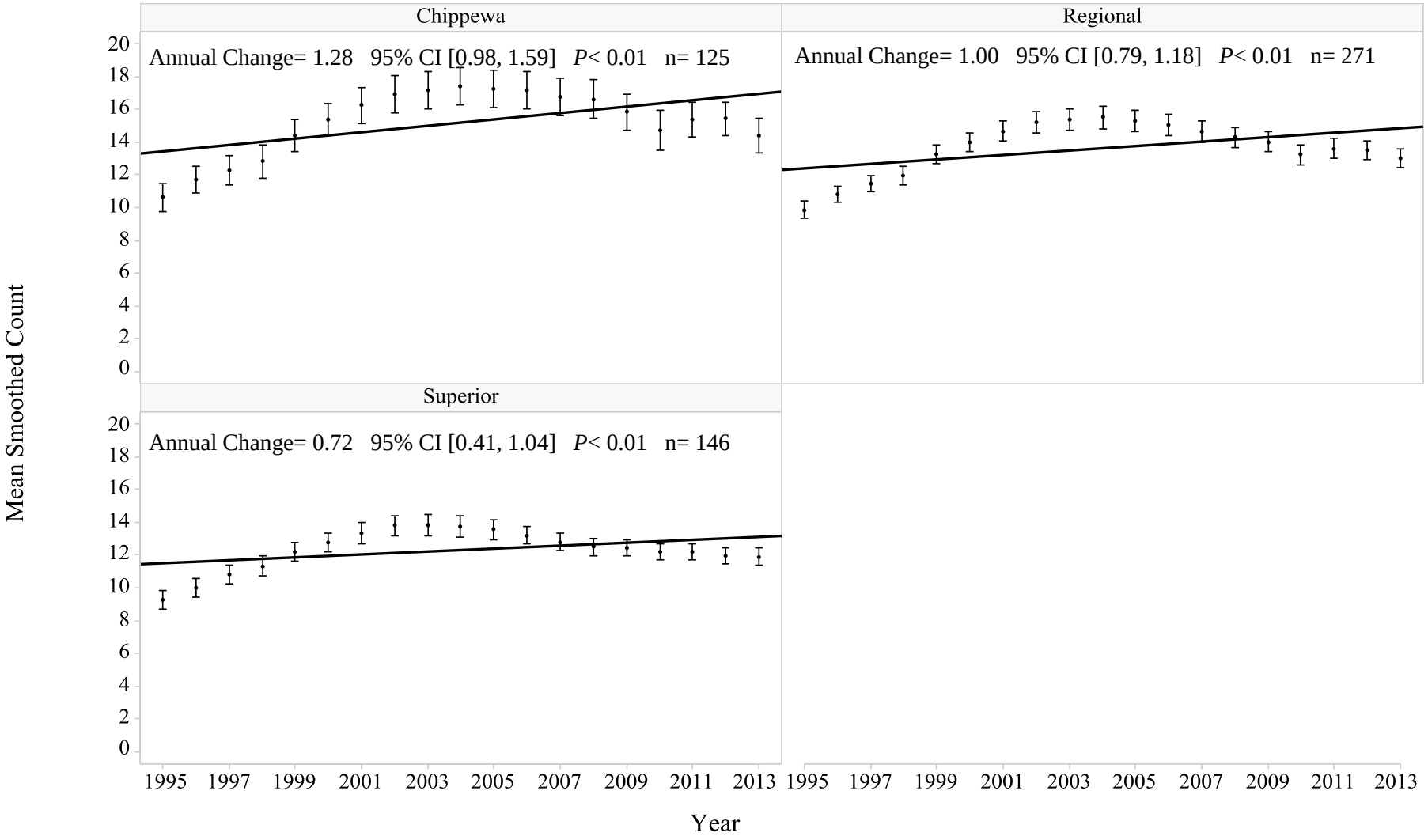
Yellow Warbler



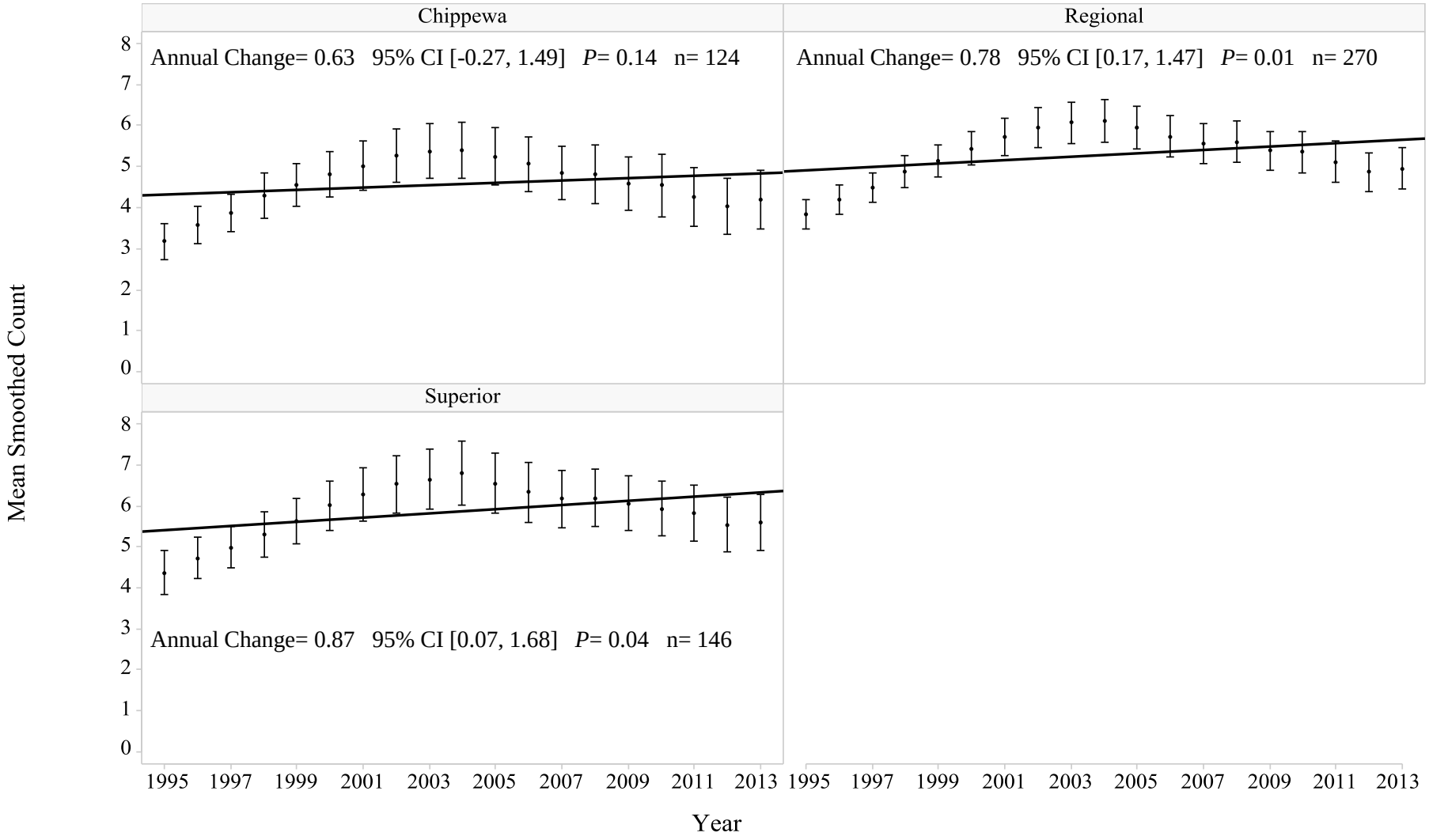
Coniferous Forest Habitat



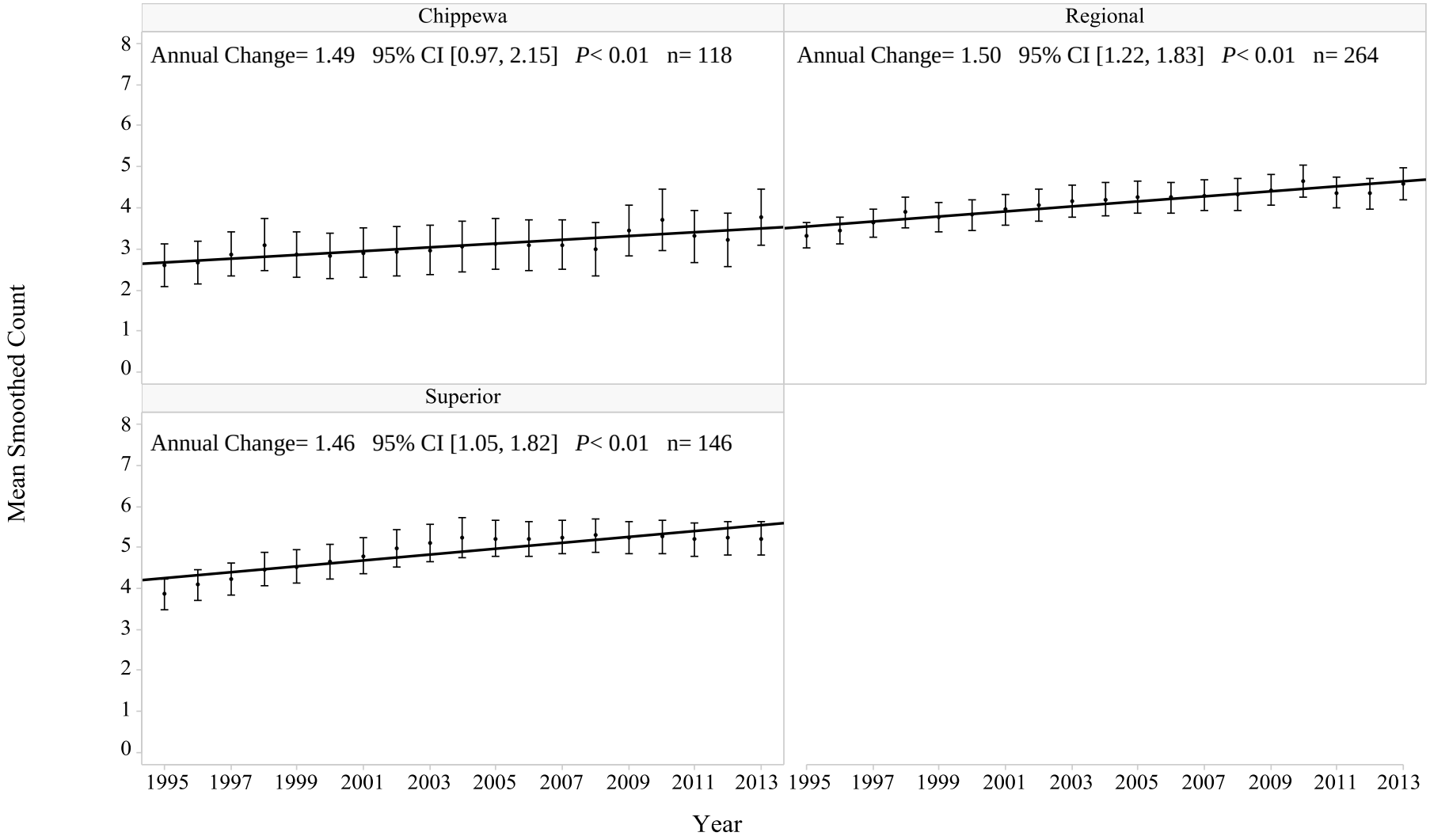
Deciduous Forest Habitat



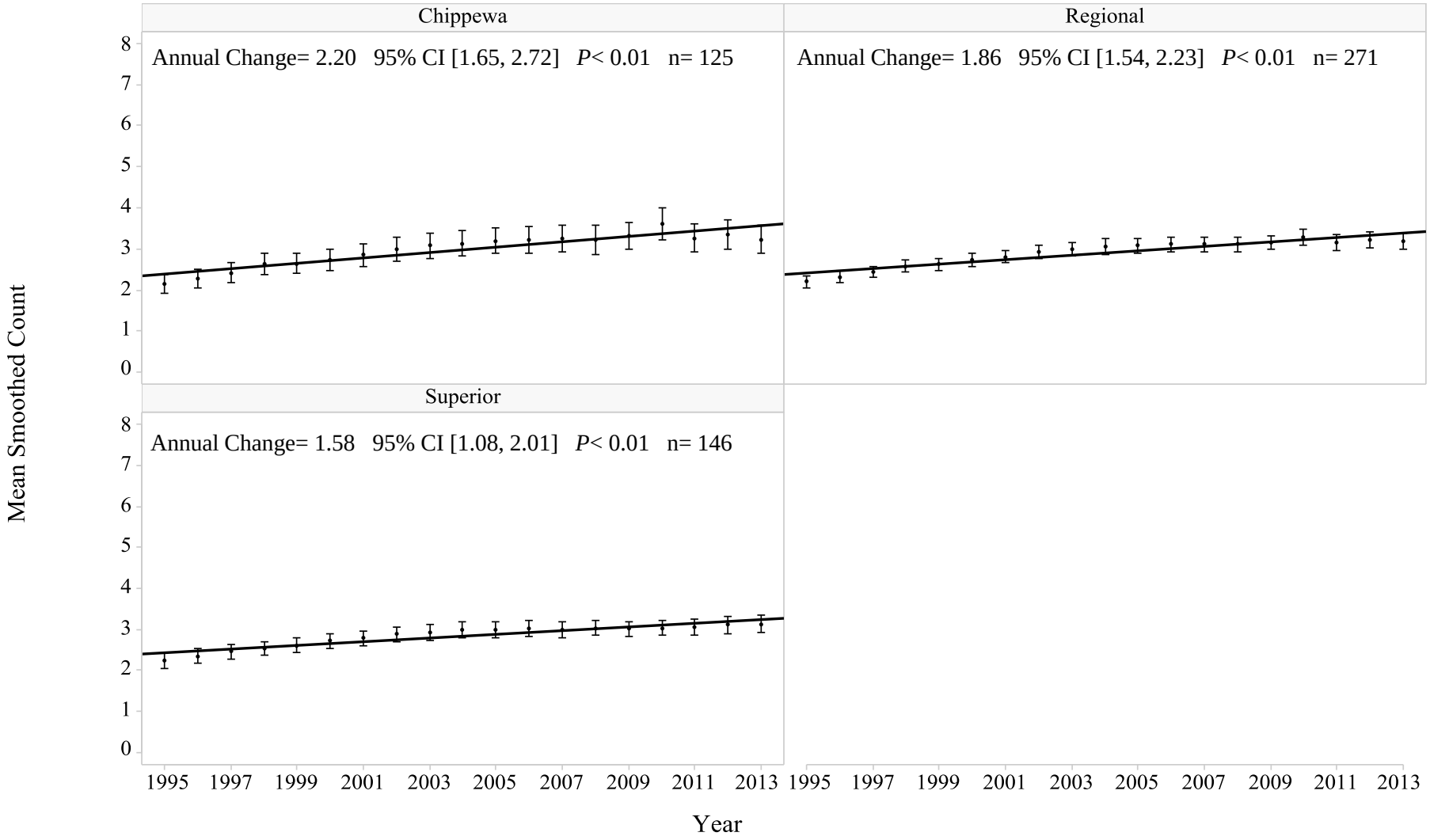
Early-successional Forest Habitat



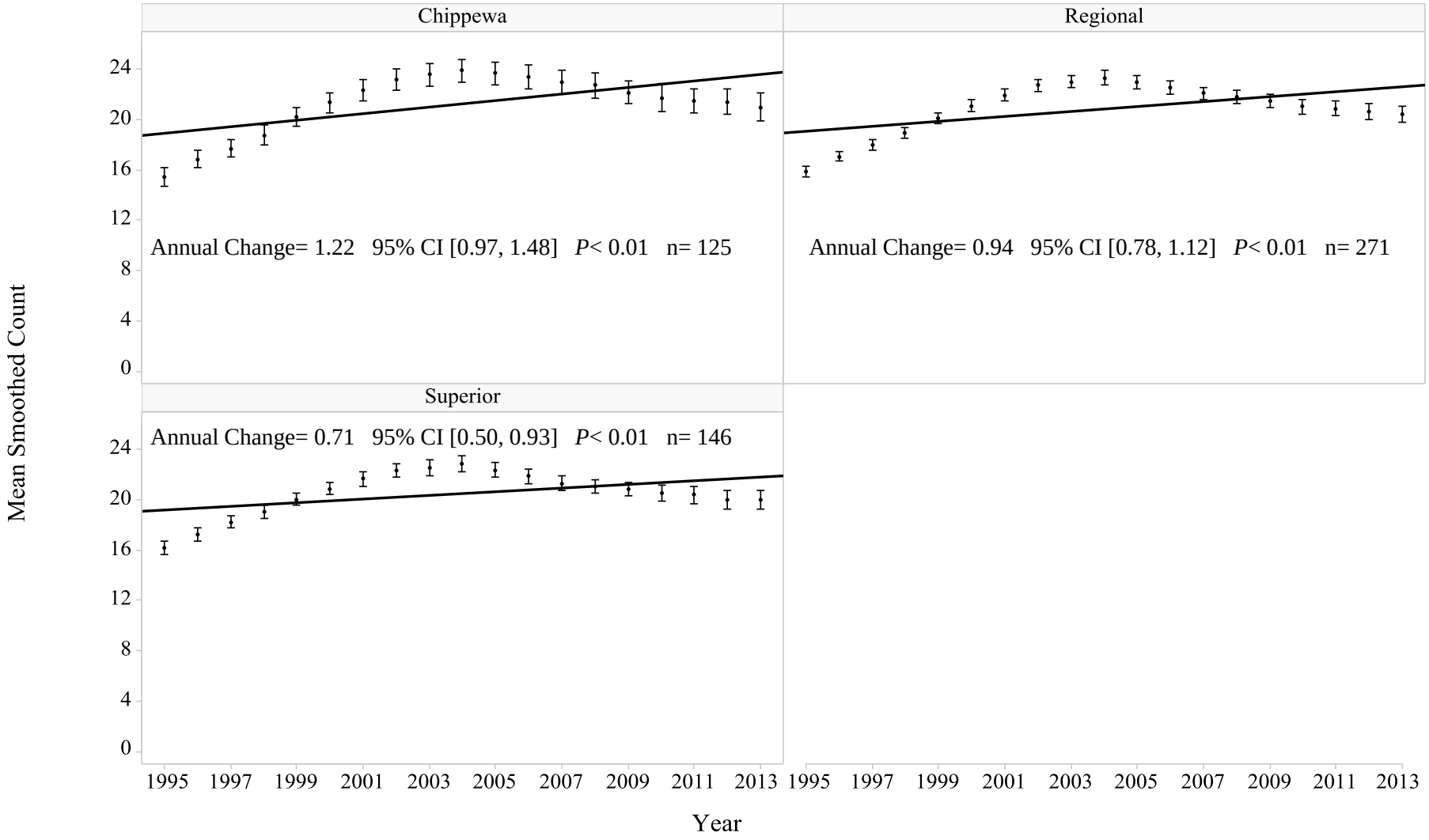
Lowland Coniferous Forest Habitat



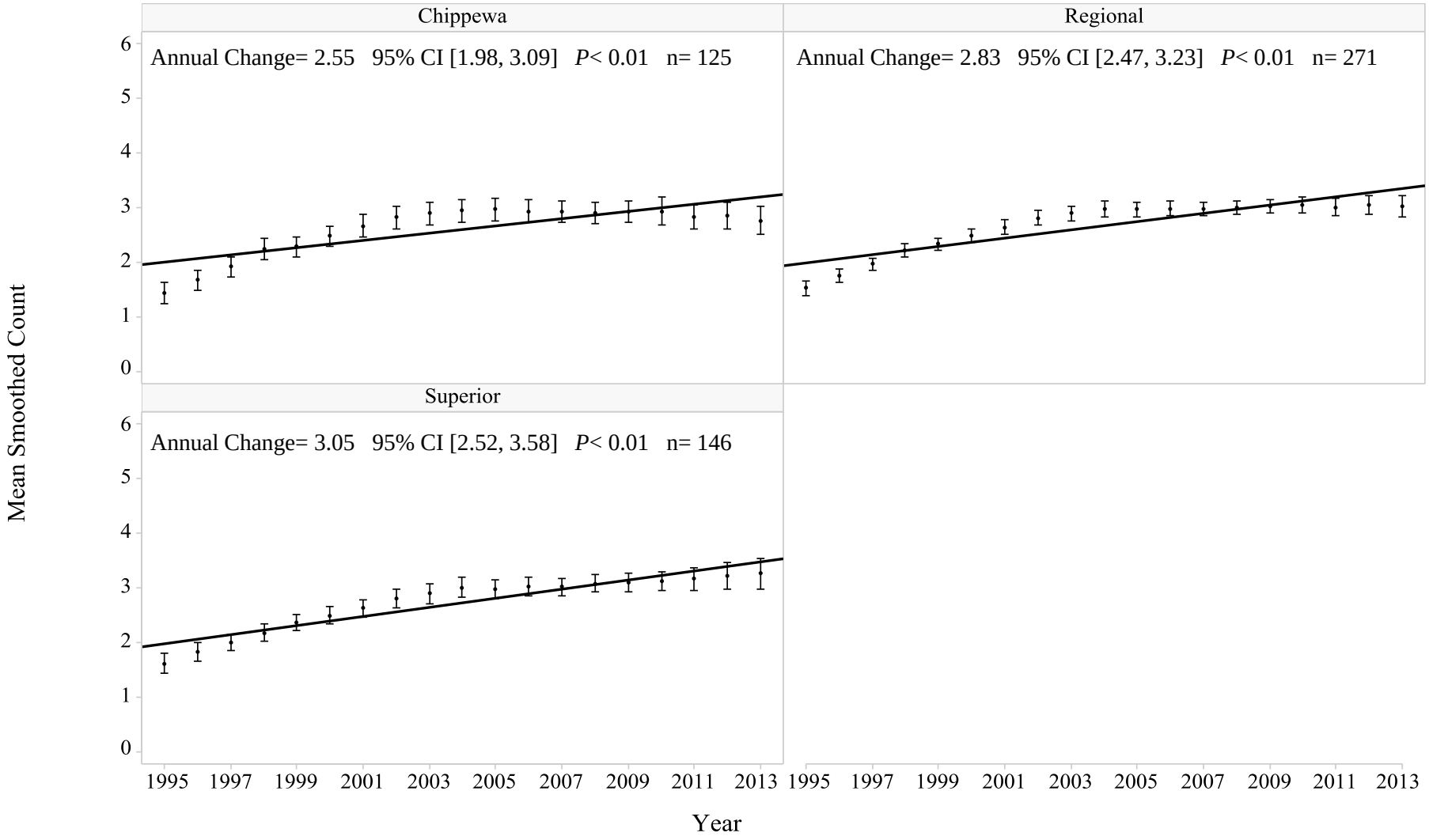
Mixed Forest Habitat



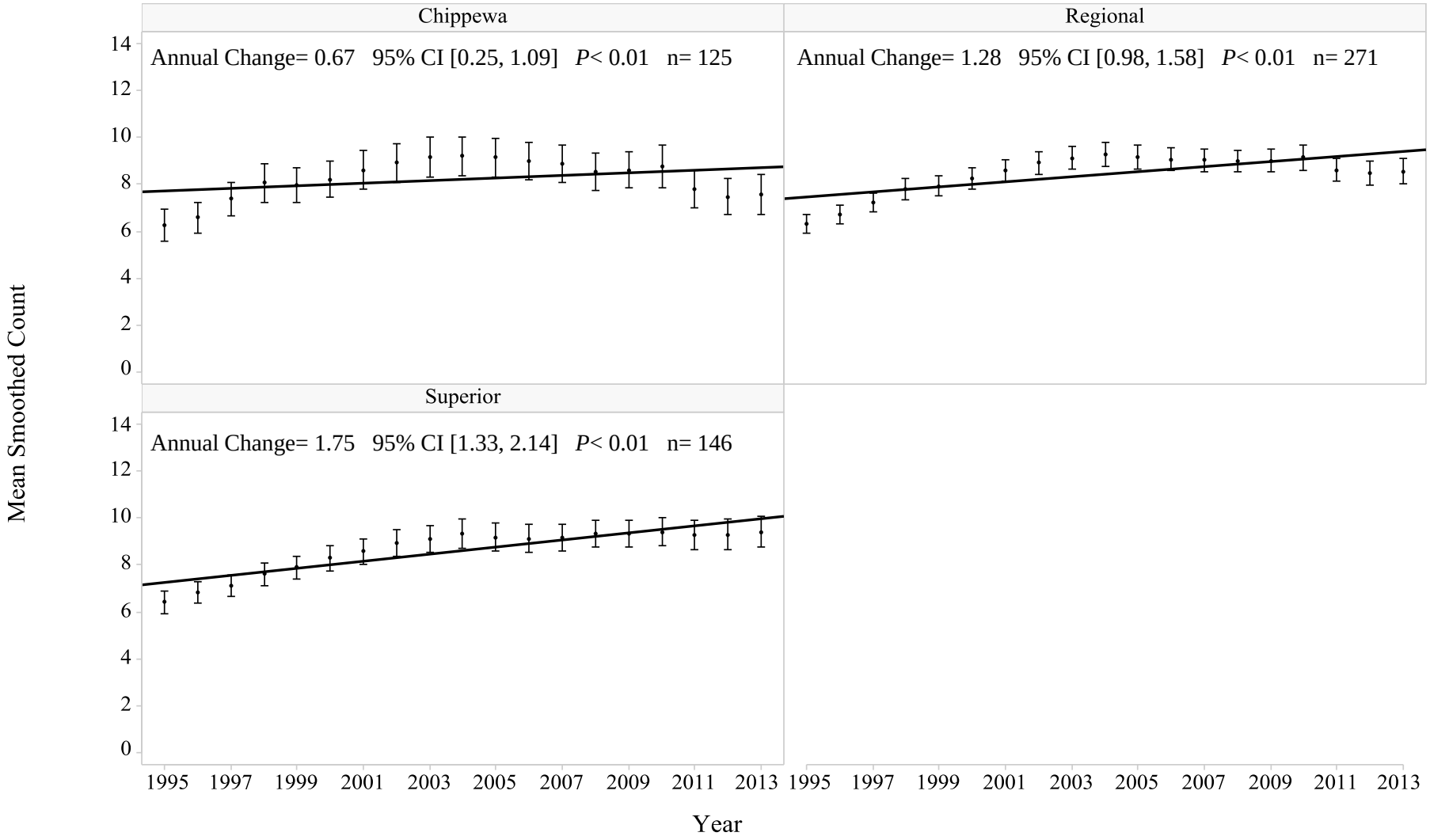
Long Distance Migrants



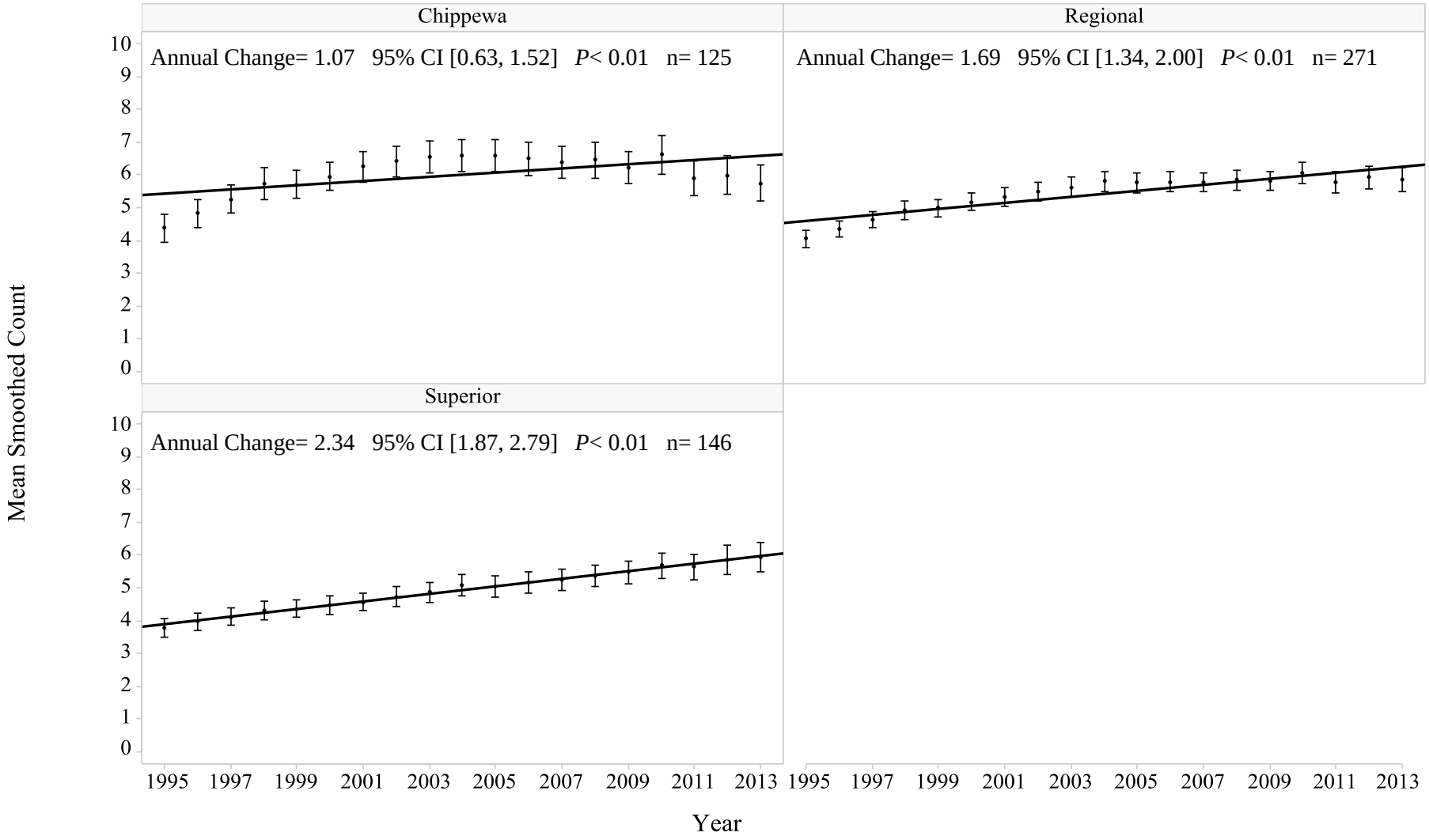
Permanent Residents



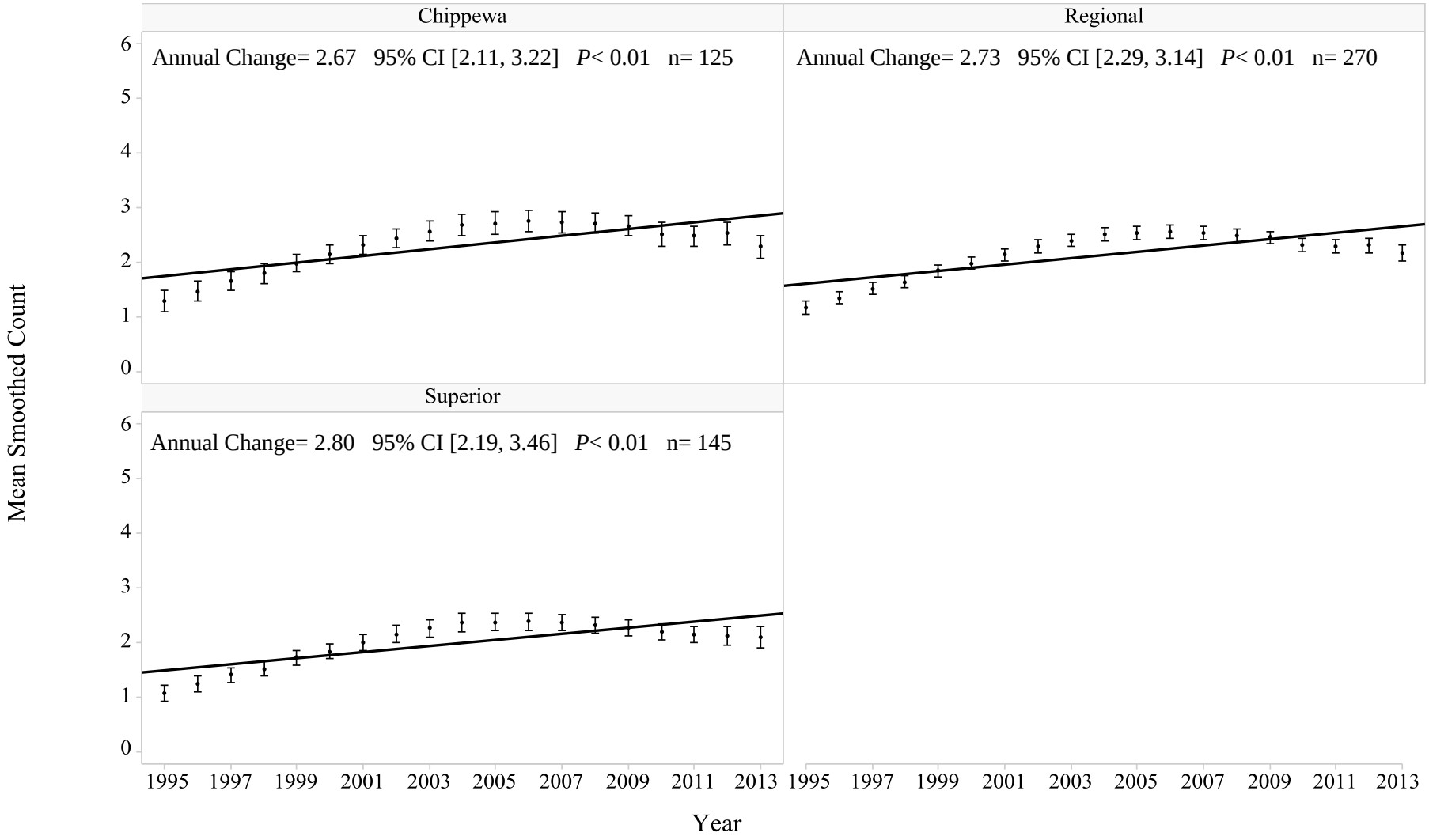
Short Distance Migrants



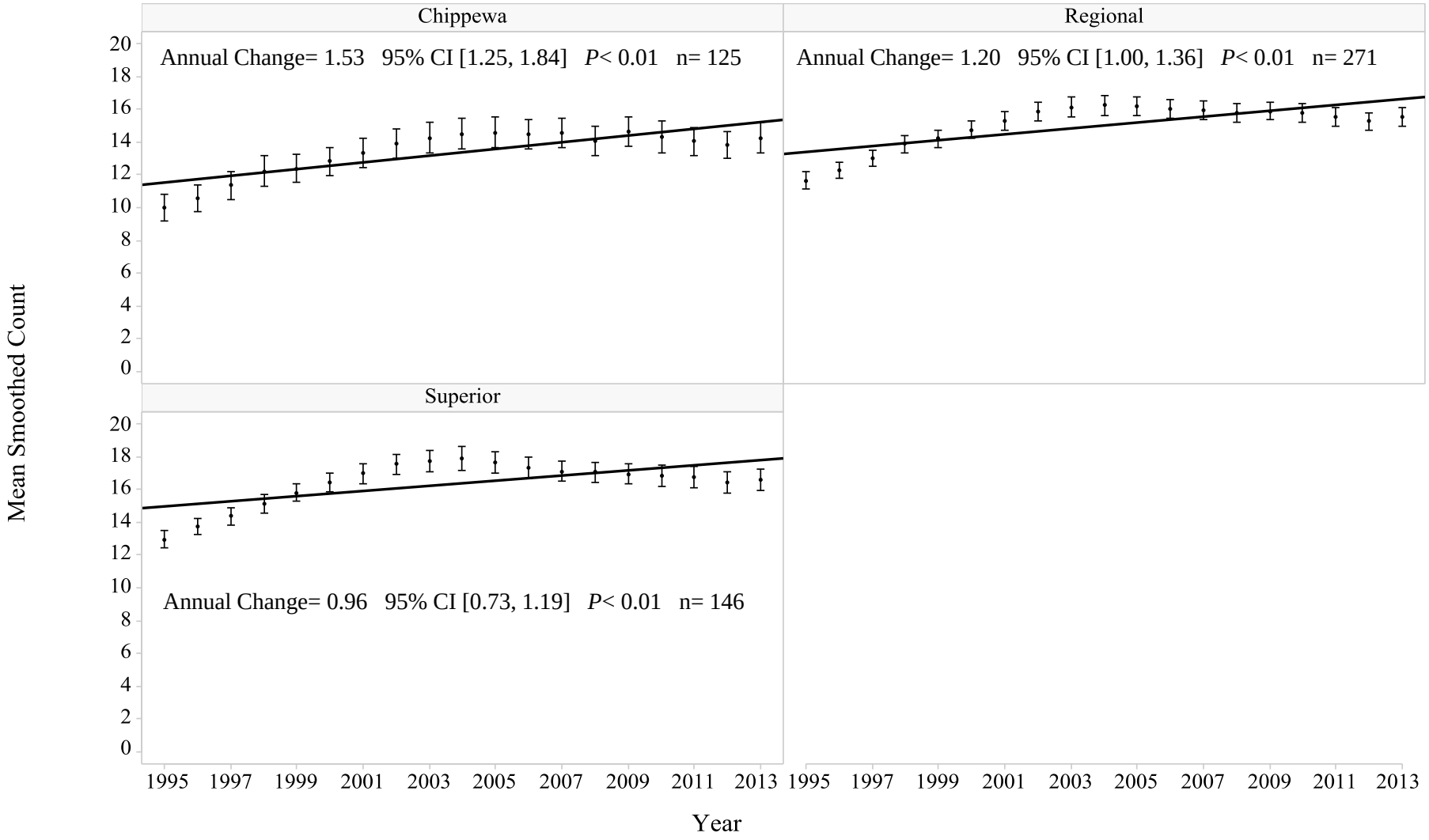
Canopy Nesting



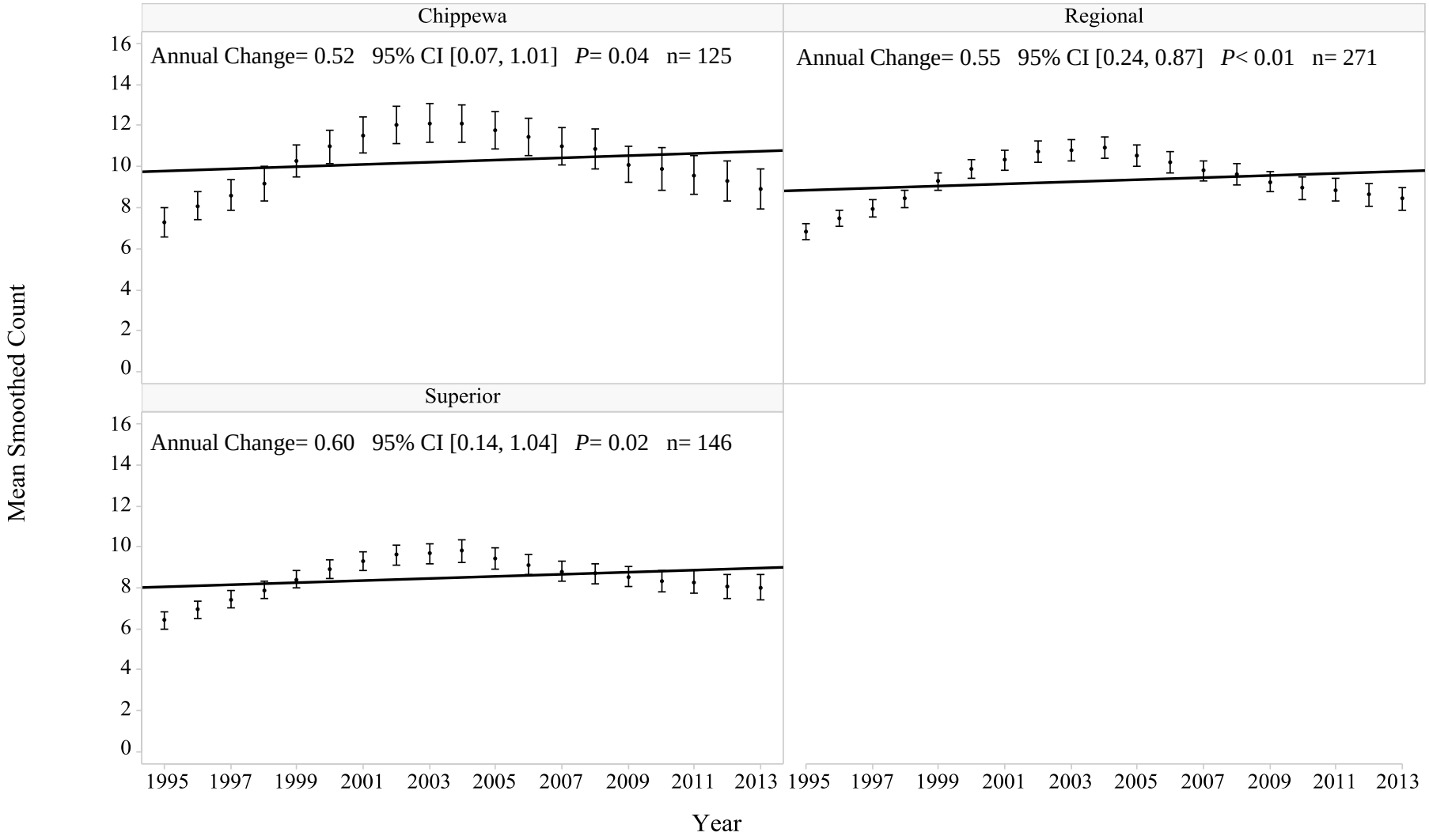
Cavity Nesting



Ground Nesting



Sub-canopy Nesting



Appendix D. Number of observations on the Chippewa National Forest for species not tested for population trends in 2013. Includes flyovers and all birds regardless of distance.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
American Bittern					1														1
American Kestrel								1			1							1	
American White Pelican					1				2				3	7					
American Woodcock									2		2			2				1	1
Bald Eagle		1			1	1	1	1			1	1	2		2			1	
Baltimore Oriole	5	5	1	2	2	5	1	2	11	1	1	3	2				1	3	
Bank Swallow														2					
Barn Swallow						2		1											
Barred Owl				3	1	2		2	4	3	1	5	2	1		1	2	3	3
Bay-breasted Warbler														3		1	1		
Belted Kingfisher		3	3	1	1		4	5	3	2	1	3	4			2			1
Black-backed Woodpecker	1			1	3	2	2	4	1	2			13		1				
Black-billed Cuckoo	3	1	2		9	2	2	7	2	1		21	11	3			2		5
Blackpoll Warbler			1											1					
Black-throated Blue Warbler	2		2	1	3						1	1							
Boreal Chickadee	1						1	4	4	4	5								
Brewer's Blackbird				3		3	6	4											
Broad-winged Hawk	4	5	2	6	1	4	6	7	8	10	5	5	8	6	3	2	2	5	9
Brown Thrasher						1	1				2			2	7		1		
Canada Goose					2		3		4			2	2	2	1	1		1	55
Cape May Warbler	2				4		1	1	2			1	1	4	7			2	6
Chimney Swift				1		2	2	3					2	3	1	2	1		
Clay-colored Sparrow			2	2			10	10	8	5	6		7		6		4		
Cliff Swallow						12													
Common Grackle	1	1		2	9	14	2	2	5		3	6	7	2	1	1	3	2	
Common Merganser						1			9				1				2		
Common Nighthawk	1				5	3			2			1					1		3
Cooper's Hawk					1		1	2		1			1						
Dark-eyed Junco (Slate-colored)	10	3	1	1		4		5	1			1		2	6		3		1
Eastern Bluebird				2	1	4	3	9	5		2		1					2	2
Eastern Kingbird	4		3	4	3		3	3	2	6	11	6	5	2	3	3	1		1
Eastern Phoebe	1	2	3	2	2	5		2	5	3	5	4	2	3	6	2	3	2	2
Eastern Towhee	5	2	1	1	8	3	7	7	1	6		7	12	1			4	2	
Evening Grosbeak		3	3	14	20	34	1	14	6	9	9	8	2						
Field Sparrow														1					
Great Blue Heron	2				4	4	4		6	5	4	4	1		3		3	2	
Great Gray Owl						1					1								
Great Horned Owl						1		2							1				1
Green Heron								2	1			2							
Green-winged Teal					5								1						
Herring Gull						2						1						1	
Hooded Merganser								1					2						
House Wren	1			1	6	2	4	1	6	3	2	2	8	1	1				9
Killdeer	1		1			1		2	1				1			3			
Lesser Scaup														1					
Lincoln's Sparrow	1	2	2	4	1	6	1	1		10	7	8	5	5	5	12	1	4	9
Long-eared Owl												3							
Mallard		1			9	7	1	1	1		1	8	1	1	1				
Marsh Wren														1	1				1
Merlin				1					1								1	1	
Northern Goshawk												2				2			
Northern Harrier					1														
Osprey	1				1	1	1		1										
Pied-billed Grebe							7				2	1		3	2			7	1
Pine Siskin	1	4	1		9	23	2	3			10	1	9	3	4		1	3	
Purple Martin					1					3									
Red Crossbill						2	26			2	11	27	5	11					
Red-bellied Woodpecker												1		2	1		4	1	2
Red-headed Woodpecker			1					1								1			
Red-shouldered Hawk		1					1							1					
Red-tailed Hawk	2	1	2	3	4		11	1	7	2	5	2		3	4	3		1	1

Ring-billed Gull							3						1			3		1	3				
Ring-necked Duck								2															
Ruby-crowned Kinglet	3		2	4	3	1		2			2		1	5	15	7			4	4			
Ruffed Grouse	6	7	4	18	13	1	10	3	9	4		5	2	2	3	8	1	2	7				
Sandhill Crane								8			1	2			2	3	3	1	1				
Savannah Sparrow				1																			
Sedge Wren	1	5	4	4	3	1	5	3		5	1		5	3	1					8			
Sharp-shinned Hawk			4																				
Sharp-tailed Grouse																4							
Solitary Sandpiper					1																		
Sora					1	2	1	2							1		1						
Swainson's Thrush	7	1	2	17	5	4	2	4	13			1		1	1	7	4	1	7				
Tennessee Warbler					2	2							1	8			2						
Tree Swallow		1			1	9	2	1		3	1	3	6							2			
Trumpeter Swan																	4			3			
Turkey Vulture		1				1		1		1	1		1							2			
Vesper Sparrow	1									1			8		1								
Virginia Rail												1											
Warbling Vireo		2	3	1							3	2	1			1	1	4	4				
Whip-poor-will					2								2				1			1			
White-winged Crossbill	1	23		1		50							2	81	8								
Wild Turkey														1		2							
Wilson's Snipe		5	2	6	4	6	1	8	10	19	2	2	4	12	4	4	8	4	17				
Willow Flycatcher	2	1		1																			
Wilson's Warbler															4								
Wood Duck					1	1	14	1	4			1								1			
Yellow-billed Cuckoo	8		1	22			2					1		1		3							