On the Decline of the Rusty Blackbird and the Use of Ornithological Literature to Document Long-Term Population Trends

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Abstract: *Unlike most North American blackbirds, Rusty Blackbirds (*Euphagus carolensis*) have shown steep population declines. Declines of approximately 90% are indicated for three recent decades from the Breeding Bird Survey, Christmas Bird Counts, and Quebec Checklist Program. Analyses of abundance classifications in bird distribution books and annotated checklists reveal an overlooked but long-term decline dating back to at least the early part of this century. Rusty Blackbirds were described as very common to abundant in 56% of the pre-1920 published accounts, 19% of the 1921–1950 accounts, and only 7% of the post-1950 accounts. Rusty Blackbirds were described as uncommon in none of the pre-1950 accounts, 18% of the 1951–1980 accounts, and 43% of the post-1980 accounts. A similar pattern was found for analyses based on local checklists. Destruction of wooded wetlands on wintering grounds, acid precipitation, and the conversion of boreal forest wetlands could have contributed to these declines. Systematic analysis of regional guides and checklists provides a valuable tool for examining large-scale and long-term population changes in birds.*

Declive de Poblaciones del Mirlo *Euphagus carolensis* y Uso de la Literatura Ornitológica para Documentar Tendencias Poblacionales de Largo Plazo

Resumen: *En contraste con la mayoría de los mirlos americanos,* Euphagus carolensis *ha mostrado declives poblacionales pronunciados. Disminuciones de aproximadamente un 90% han sido indicadas para las tres últimas décadas por los Muestreos de Aves Anidando, Los Conteos de Aves en Navidad y el Programa de Listas de chequeo de Quebec. los análisis de clasificación de abundancia en libros de distibución de aves y las listas de chequeo con anotaciones revelan una disminución pasada por alto, pero de largo plazo que se remota a por lo menos la parte temprana del este siglo. Esto mirlos fueron descritos como muy comunes y abundantes en 56% de los conteos publicados pre-1920, 19% de los conteos entre 1921–1950 y solo 7% de los conteos post-1950, fueron descritos como poco comunes en ninguno de los conteos pre-1950, 18% de los conteos entre 1951–1980 y 43% de los conteos post-1980. Un patrón similar se observó para los análisis basados en listas locales. La destrucción de humedales boscosos en las tierras donde la especie pasa el invierno, la lluvia ácida y la conversión de humedales boscosos boreales pudiéron haber contribuído a estas disminuciones. Un análisis sistemático de las guías regionales y las listas provee una herramienta valiosa para examinar cambios de gran escala y a largo plazo en poblaciones de aves.*

Introduction

Centuries of agricultural and urban expansion favored populations of most North American blackbirds. Grackles (*Quiscalus* spp.), Brewer's Blackbird (*Euphagus cyanocephalus)*, and Red-winged Blackbirds (*Agelaius phoeniceus*) have all benefited from access to fields with waste grain and their acceptance of dissected woodlands, hedgerows, old fields, and suburban plantings as breeding sites. In contrast, the Rusty Blackbird (*Euphagus carolinus*) has not capitalized on these re-

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sources and habitats, remaining an invertebrate-feeding species of wooded wetlands (Avery 1995). Given the heavy and ongoing loss of wooded wetlands in North America, the suggestion that Rusty Blackbird numbers may have diminished in recent decades (Avery 1995; Cyr & Larivée 1995) is not a surprise. Our own interest in the possible decline in this species was peaked when, during the course of two summers' field work in the boreal forest of the Northwest Territories and Ontario, we found only a single pair in areas where, historically, they were considered common (McIlwraith 1894; Preble 1908). Still, the concern over this species has not been universal. The Rusty Blackbird was not included on the National Audubon Society's Blue List (Ehrlich et al. 1992) or the list of species of management concern of the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 1995), and it was considered a declining species at the lowest level of concern in the Partners in Flight species priority list (Carter et al. 1996).

One would expect that if wooded wetland loss has caused declines in Rusty Blackbird populations, the temporal pattern of population trends would be consistent with that of habitat loss. For example, because wooded wetland loss has been ongoing since European settlement, the declines should be detectable for a long period prior to the initiation of recent population monitoring programs. Furthermore, the amount of population loss should be consistent with the magnitude of habitat conversion. Population trends in Rusty Blackbirds have not been analyzed sufficiently to evaluate these predictions. We examined a variety of data sets to evaluate recent and long-term population trends of this specialized blackbird.

Natural History of Rusty Blackbirds

The breeding range of the Rusty Blackbird encompasses most of the northern boreal forests of North America (American Ornithologists' Union 1998). The species now breeds only sparingly in most regions (Welsh & Lougheed 1997; R.G. & S.D., personal observation; A. Erskine, personal communication; G. West, personal communication), however, with scattered reports of dense populations from some sections of interior Alaska (Andres & Brann 1997). Nevertheless, Erskine (1977) believed that Rusty Blackbirds were most common in the eastern boreal forest (Maritime Provinces). Rusty Blackbirds winter primarily east of the Rockies and reach peak abundance, based on Christmas Bird Count data, in a belt from central Oklahoma to central North Carolina, dipping south to southern Alabama (Sauer et al. 1996).

Rusty Blackbirds breed in swamps, wooded bogs, and along lake and stream borders in the boreal forest; they winter primarily in wooded vegetation along streams, river bottomlands, and flooded woodlands. The anthropogenic habitats with which Rusty Blackbirds are most commonly associated are livestock feedlots and manured fields (Bent 1958). During the non-breeding season they often roost with large numbers of other blackbirds but usually forage in small, single-species flocks (Beal 1900; Neff & Meanley 1957).

Rusty Blackbirds forage more for aquatic invertebrates than do other blackbirds (Beal 1900; Martin et al. 1951; Neff & Meanley 1957), commonly flipping dead leaves at the edge of water like a waterthrush or, at times, wading in shallow water (Bent 1958). Beal (1900) and Neff and Meanley (1957) found a relatively high frequency of snails and mollusks in their diet.

Methods

Population Survey Data

Published trend analyses from the North American Breeding Bird Survey (BBS; Sauer et al. 1997), the Christmas Bird Count (CBC) data (Sauer et al. 1996), and the Quebec Checklists Program (ÉPOQ; Cyr & Larivée 1995) were used to assess population change over the past four decades.

The BBS data represent randomly placed point-count surveys along roadsides within North America. Points are located at half-mile intervals, and all birds detected within 3 minutes are recorded. Although a total of nearly 3000 routes are surveyed, the trend analysis for Rusty Blackbirds is based on only 83.

Christmas Bird Counts are time- and area-constrained searches of 15-mile-diameter circles surveyed throughout North America during the Christmas and New Year holiday season. Circles are nonrandomly placed. Coverage of circles is uneven, and a largely unregulated mix of amateur birdwatchers and professional biologists collects the data. Although the sampling regime lacks rigor, sample sizes, effort, and regional coverage are often high (Rusty Blackbird estimates are based on 1201 count circles) and population trends show good correspondence with BBS data (Butcher 1990; Sauer et al. 1996). We analyzed both CBC and BBS data using estimating equations as described by Link and Sauer (1994).

Data from the ÉPOQ program come from a network of bird clubs within Quebec. Birders fill out checklists every time they go birdwatching, noting the time spent, geographic location, weather, and number of individuals of each species. Locations are chosen by the observer, and thousands of checklists are submitted each year. Despite the obvious sources of bias implicit in such a system, there is independent corroboration of the direction of trends from comparisons with BBS data from the same region (Dunn & Hussell 1995). We used trend data from 1970–1995 (A. Cyr & J. Larivée, personal communication) that were updated from similar trends (1969–1981) published by Cyr and Larivée (1995).

State and Regional Books and Annotated Lists

We examined 84 published state and regional avifaunal accounts as well as published annotated checklists from eastern and central North America, where Rusty Blackbirds commonly migrate or winter (reference list available from first author). For each account we recorded the following adjectives used by the author to describe the abundance of Rusty Blackbirds: uncommon, fairly or locally common, common, very common, and abundant. We conducted several simple nonparametric tests by substituting integer values for these descriptors: uncommon, 1; fairly or locally common, 2; common, 3; and very common to abundant, 4. This coding system is an ordinal representation of true population sizes: category 4 probably represents thousands of birds, whereas category 1 might represent populations of only a few birds. For the analyses we used the estimate for the season with the maximum abundance. Accounts were published from 1877 to 1997 and divided into four time periods for analysis (<1920, 1920–1950, 1951–1980, >1980).

Checklists and the Distribution and Migration Card File

Most field observations of the abundance of Rusty Blackbirds have been made during the migration season. We used 307 regional accounts, checklists, and data from the old Migration Card Program (which ran from approximately 1880 through the late 1940s; data now housed at Patuxent Wildlife Research Center) and from recently published checklists for wildlife refuges and parks to examine changes in relative abundance in 30 states and provinces that were outside of the primary wintering range of the Rusty Blackbird.

Observation period (years) often was not published, so we used the publication date in all analyses. Consequently, the actual dates that these records represent were often several years prior to the publication date. Given the 144-year time span of the records and the coarse measure of abundance used, the consequences of this lag should not be severe. Coding of abundance categories was similar to the analysis of state accounts except that the descriptor "very common" was never encountered and categories 2 and 3 were lumped because of low numbers of records in category 2. Time series were smoothed by LOWESS curve smoothing, with a tension setting of 0.4 (Systat 6.0).

Other Data and Observations

We located one additional quantitative data set: P. Taylor and R. Koes provided their counts of Rusty Blackbirds during migration in their field notes from Manitoba from 1979 to 1996.

In addition to quantitative data sets, we obtained additional impressions of recent population trends in Rusty Blackbirds with a questionnaire sent to pre-selected observers and posted on existing internet bulletin boards.

Results

Trends from Population Surveys

Data from the North American BBS, which covers populations primarily at the southern edge of the Rusty Blackbird's range, indicate steep declines. From 1966 to 1996, populations were estimated to have declined by 92.8% ($p \leq 0.1$, 95% CI = −99.7–+38.8; Sauer et al. 1997). Christmas Bird Count data from 1958–1988 indicated declines of 89.6% ($p \leq 0.01$, CI = −98.8–−55.1; Sauer et al. 1996). Trend analysis based on ÉPOQ data estimated a 92.1% decline ($p \leq 0.01$) from 1970 to 1995 (Cyr & Larivée, personal communication). Despite the high variances, the sample sizes and magnitude of the trends were sufficiently high for the three estimates to be statistically significant. When yearly indices of abundance from CBC and BBS data were standardized and overlaid, the slopes were similar (Fig. 1). The pattern is one of steep population declines in the 1970s, bracketed by periods of gradual decline.

When population trends for the BBS and CBC were estimated at the level of states or provinces, significant trends were all negative. For BBS the two trend estimates were significantly negative. Of the 34 population estimates at the state level for the CBC, 24 were negative (7 significantly so) and none were significantly positive.

Analysis of data from P. Taylor and R. Koes showed a decrease in flock size at a rate of 102 individuals per year ($r = -0.58$, df = 17, $p < 0.003$) between 1979 and

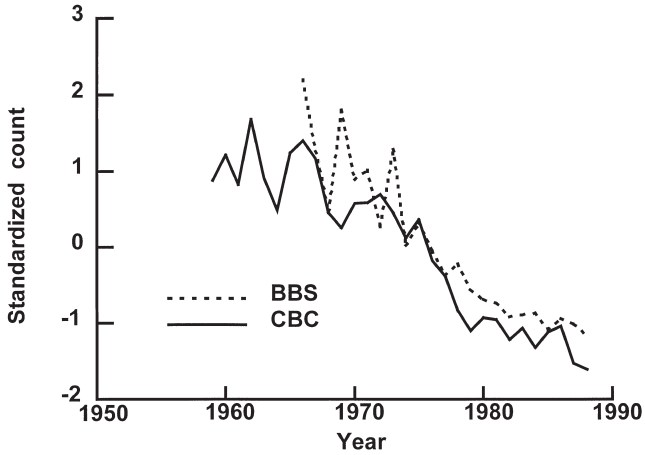

Figure 1. Annual standardized counts (annual mean − overall mean/standard deviation of overall mean) for Rusty Blackbirds on Christmas Bird Count (CBC) and Breeding Bird Survey (BBS) during the period 1959–1989.

Table 1. Frequency of abundance estimates (%) in different abundance categories for state or regional avifaunal publications for four time periods between 1870 and 1997.

		Category			
Time period	n	*Uncommon*	*Fairly common*	*Common*	*Abundant*
<1920	25	0	12.0	32.0	56.0
1920–1950	16	0	18.8	62.5	18.8
1951–1980	17	17.6	35.5	47.0	0
>1980	28	42.9	25.0	21.5	10.7

1996. The last flock of over 1000 was recorded in 1985 and the last flock of over 100 in 1992.

We received 15 responses from birders with extensive experience with Rusty Blackbirds. Thirteen reported declines and 2 reported stable populations.

Qualitative Assessment of Long-Term Trends

Accounts of the Rusty Blackbird in the literature from the turn of the 19th century suggest that it was formerly a much more common species. J. H. Langille reported that "on the first day of May 1880, as I stood on an iron bridge crossing a sluggish stream of Tonawanda [Oak Orchard] Swamp, I saw the Rusty Grakles [sic] (*Scolecophagus ferrugineus*) constantly trooping by in immense numbers. . . . The sombre wave, thus constantly rolling on, must have carried hundreds of thousands over this highway in a day. . . . On being alarmed . . . these Grakles would rise in a dense, black cloud, and with a rumbling sound like that of distant thunder" (Beardslee & Mitchell 1965).

Beal (1900) noted that "One of the most familiar sights . . . and one which assures . . . that spring is really at hand, is a tree full of blackbirds, all facing the same way and each one singing at the top of its voice. These are rusty blackbirds. . . ." Beal went on to state that "In their migrations they are seen in immense numbers, especially in the Mississippi Valley."

Thompson (1891) who opens his *Birds of Manitoba* account of Rusty Blackbirds by calling them an "enormously abundant migrant" reports that on 21 April "the thousands of Grackles have been increased to tens of thousands. They blacken the fields and cloud the air. The bare trees on which they alight are foliated by them. Their incessant jingling songs drown the music of the Meadow Larks and produce dreamy, far-away effect, as of myriads of distant sleigh bells."

Rusty Blackbirds were described as very common to abundant in 56% of the pre-1920 published accounts (Table 1), 19% of the 1920–1950 accounts, and only 6.7% of the post-1950 accounts. Similarly, when we combined the common and abundant categories we found the species described as such in 88% of the pre-1920 checklist accounts, 81% of the 1920–1950 accounts, and only 38% of the post-1950 accounts. Rusty Blackbirds were described as uncommon in none of the pre-1950 accounts, 18% of the 1951–1980 accounts, and 43% of the post-1980 accounts.

To eliminate bias due to different geographic coverage in different time periods in our sample of regional accounts, we compared abundance estimates for different time periods within states and provinces (Table 2). To maintain sample sizes, we pooled two periods to form a single, large middle time period (1920–1980). If more than one abundance estimate was available for a state in a time period, we used the mean value. Decline in mean values occurred in eight states between early and middle time periods, whereas no change occurred in six states and provinces (Wilcoxon signed rank $T = 0.0$, $n = 14$, $p = 0.01$). Comparisons of mid- to late-period status documented 11 declines in status, one increase, and two in-

Table 2. Median abundance category* for the same state during three different time periods between 1877 and 1997.

	Time period		
State	*<1920*	*1921–1980*	*>1980*
Arkansas		3.5 (2)	2.3 (2)
Carolinas	3.0 (2)	3.0 (2)	2.0 (1)
Connecticut	3.5 (2)	1.0 (1)	
Florida (northern)		3.0 (2)	1.6 (3)
Georgia		2.0 (6)	1.0 (1)
Illinois	4.0 (3)	3.0 (2)	2.0 (2)
Indiana	4.0 (1)	2.0 (1)	2.0 (1)
Iowa	3.0 (1)		1.0 (1)
Kansas	4.0 (1)		1.0 (1)
Louisiana	4.0 (2)	2.5 (2)	1.0 (1)
Maine	3.0 (1)	3.0 (1)	4.0 (1)
Maryland	4.0 (2)	2.3 (3)	1.0 (2)
Massachusetts	4.0 (2)	3.0 (2)	3.0 (2)
Michigan	4.0 (1)	3.0 (1)	
Minnesota	4.0 (1)	4.0 (1)	3.5 (1)
Missouri	3.0 (1)	3.0 (1)	2.0 (1)
New Hampshire	3.0 (1)		2.0 (2)
New York	3.0 (1)	3.0 (1)	
Rhode Island	3.0 (1)		1.0 (1)
Virginia	2.5 (1)	2.5 (3)	1.5 (2)
Wisconsin	4.0 (1)	3.0 (1)	2.5 (2)
Mean	3.5	2.7	1.9
Median	4.0	3.0	2.0

**Categories: 1, uncommon; 2, fairly or locally common; 3, common; 4, very common to abundant. Number of estimates in parentheses.*

stances of no change ($T = 5.5$, $n = 14$, $p = 0.002$). Finally, the comparison between the early and late period produced 14 declines in status, one increase, and no ties ($T = 2.5$, $n = 15$, $p = 0.002$).

Similar analyses were performed with the checklist data for the spring and fall migration seasons. In the spring the percentage of records listing Rusty Blackbirds as abundant declined across the three time periods, from 32% to 6% to 0%, respectively. Fall records showed a similar pattern of decline, from 38% to 9% to 0%. The uncommon category increased from 6% to 24% to 59% in the spring and 8% to 18% to 57% in the fall, respectively. Broken down by state and province, the patterns for spring and fall changes in population status were the same as for regional bird books, but with even fewer instances of increases between time periods. All combinations of comparison between time periods indicated significant declines in status ($n \geq 13$, $p \leq 0.05$). The last time the word *abundant* was used in any checklist or regional summary was 1944 for spring and 1959 for fall. The plot of fall and spring checklist data revealed a steepening rate of decline with time (Figs. 2 & 3).

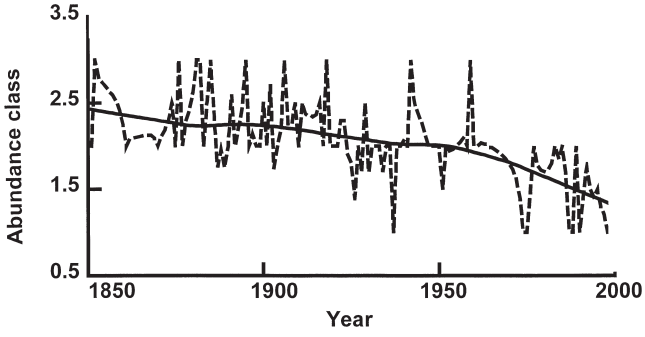

Figure 2. Mean fall abundance class for Rusty Blackbirds based on local and regional checklist by publication year of checklist. Dashed line connects actual values, and solid line is a LOWESS smoothing function with a tension of 0.4.

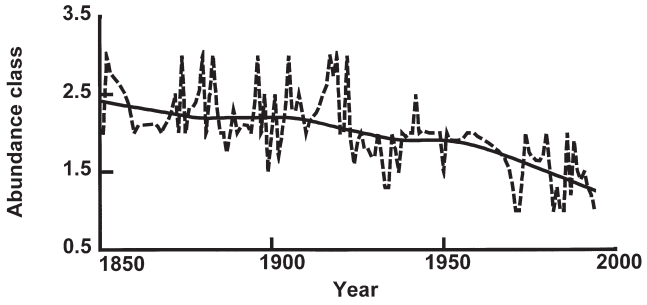

Figure 3. Mean spring abundance class for Rusty Blackbirds based on local and regional checklist by publication year of checklist. Dashed line connects actual values, and solid line is a LOWESS smoothing function with a tension of 0.4.

Discussion

Historical Trends

The historical data show a decline in Rusty Blackbird populations for at least the last century. The very high rate of decline suggested by the quantitative surveys in the past three decades, if accurate, could not have been sustained over the full 120-year period. Therefore, the rate of decline appears to have accelerated. Any hypotheses to account for the decline would have to explain the accelerating rate of population decrease as well.

To examine abundance before the advent of standardized surveys, we documented long-term changes with historical accounts of population size rather than a standardized index based on counts of birds. The implicit assumption in this approach is that the average observer in all time periods uses standard abundance terminology in a similar manner. There is no evidence to indicate that the adjectives used in these reports have undergone any semantic changes during the period of this study. Another possible source of bias would be changes in observer skills. Over this time period the skills of the average observer would more likely increase rather than decrease because modern optical equipment and field guides would increase the quality of observerations, ameliorating rather than augmenting any declines in the abundance index.

Thus, although an index of abundance based on historical accounts is crude in that it has a limited range of outcomes and those outcomes relate to true population size by some unknown power function, we believe that it can document gross population changes predictably. We have documented, for the relatively understudied Rusty Blackbird, that a large sample of such sources of information are available with a broad geographic scope. We estimate that over 300 state and provincial bird books have been written and that information from the Distribution and Migration Card File System contains over 5 million records dating from the late 1900s to the 1940s. Current regional reports and checklists are also available but are only partially centralized (e.g., http://www.npsc.nbs.gov/resource/othrdata/chekbird/chekbird.htm).

Causes for Decline

During the nonbreeding season, the Rusty Blackbird is probably the songbird most dependent on temperate wooded wetlands. Destruction of wooded wetlands is an appealing hypothesis for the decline of Rusty Blackbirds because it has been occurring over a long period of time and has accelerated in recent decades (Hefner et

al. 1994). At least 80% of the flooded bottomland hardwood habitats have been converted to agriculture in the lower Mississippi Valley since colonization (Hefner & Brown 1984) Between the mid-1950s and mid-1980s, approximately 25% of the remaining wooded wetlands in the southeastern United States was lost, an area that encompasses most of the Rusty Blackbird winter range (Hefner & Brown 1984; Hefner et al. 1994).

Loss of wooded wetlands on the wintering grounds, however, may not be sufficient to account for the severity of recent declines in Rusty Blackbirds. First, the 25% loss in 30 years falls far short of the estimated 90% decline in Rusty Blackbird numbers. Also, nearly all the recent checklists used in the analysis of long-term declines have focused on protected areas (refuges or parks), and even in these sites abundance appears to be falling.

Boreal forests, particularly those commonly used by Rusty Blackbirds (such as Black Spruce [*Picea mariana*] bogs), are generally considered to have been little affected by anthropogenic disturbance. Even unperturbed boreal wetlands, however, have been demonstrably affected by acid precipitation due to industrial activities in the eastern United States (Schindler 1988). The region of North America most affected by acidification of wetlands is the eastern portion of the range of the Rusty Blackbird (Schindler 1988), where, at least formerly, Rusty Blackbirds may have achieved their greatest breeding-season abundance (Erskine 1977).

Although the acidity of wetlands has increased in the boreal zone, the effect on the population of songbirds is unclear. Darveau et al. (1989) posited that the influence of acidification on passerines should be indirect, affecting vegetation composition, which could in turn influence bird abundance. Based on this reasoning, they produced no evidence that the Rusty Blackbird should be a species of concern because blackbirds are often found in habitats with moderately acidic soil conditions. Beyond this level of analysis, however, there are no data on the direct effect that acidification might have on food resources or, hence, on the potential fecundity of Rusty Blackbirds. Although studies have shown that acidity may shift the species composition of invertebrate assemblage away from high calcium-bearing species, the total biomass of aquatic invertebrates is not necessarily reduced (Parker et al. 1992).

Stream vertebrate and invertebrate faunas appear to be more sensitive to acidification than those of lakes (Schindler 1988). Furthermore, it is noteworthy that declines in snail abundance on acidified soils in the Netherlands have been linked to declines in passerine productivity (Graveland et al. 1994). Given the high relative proportion of snails and mollusks in the diet of Rusty Blackbirds and the loss of other calcium-rich invertebrates, the influence of acidification may be further heightened by a loss in calcium and other minerals necessary for eggshell and bone formation.

Despite the remote location of boreal forest wetlands, human activities have had a measurable effect them, particularly in the eastern boreal zone (National Wetlands Working Group 1988). The creation of reservoirs has resulted in the drowning of over 900,000 ha of boreal wetlands. Peat production for horticultural use is another industrial activity that may destroy Rusty Blackbird breeding habitat. Large-scale logging has not been initiated into most boreal wetland habitats, but ditching and draining has commenced in some areas, such as eastern Ontario. Finally, many wetlands in the southern portion of the boreal zone have been cleared for agriculture, primarily for grazing and the production of hay (National Wetlands Working Group 1988).

Blackbird Control Programs

Some efforts have been made to reduce blackbird populations by spraying chemicals on the massive, multi-species roosts in which Rusty Blackbirds are often reported to participate. We do not consider this a likely explanation for the Rusty Blackbird declines because the target species of blackbirds (the bulk of the roosting birds) has shown much more modest population declines in the 30-year BBS data (1.6–2.0% annual decline for Red-winged Blackbird, Brown-headed Cowbird [*Molothrus ater]*, and Common Grackle [*Quiscalus quiscula*], and a 1.9% increase for Boat-tailed Grackle [*Quiscalus major*]).

Conclusion

All of the evidence to date indicates that the Rusty Blackbird was once abundant but has been experiencing a chronic decline since the mid-1800s. This decline may be accelerating, with total decreases estimated at approximately 90% by three independent population surveys. The decline of the Rusty Blackbird has received scant recognition in species conservation priority lists, which suggests that historical analyses such as those presented here may be important in uncovering chronic problems in other species before they become acute.

Given what appears to be an unabated collapse in population size, increased attention needs to be given to this species now, while populations are large enough to make conservation actions effective. Because of the inaccessibility of the bogs, swamps, and sloughs that Rusty Blackbirds inhabit, little quantitative work has been done on the life history of the Rusty Blackbird. Foraging behavior, nest success, breeding-season diet, flocking habits, courtship, and habitat relations are all largely undocumented except by anecdote. Furthermore, comparative studies between this blackbird and its ecologically plastic relatives which focus on phenomena such as neophobia and the development of foraging behaviors would provide insight into the mechanisms underlying

ecological specialization (Greenberg 1983). The comparison is defensible from an ecological and evolutionary perspective because the Red-winged Blackbird, Brewer's Blackbird, and grackles appear to form a monophyletic group with the more specialized Rusty Blackbird (Lanyon & Omland, in press). After all, ecological stereotypy in the face of rapid anthropogenic change is the most likely cause of the decline of the Rusty Blackbird.

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