1-1-2011

Chapter nine: Understanding Declines in Rusty Blackbirds

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CHAPTER NINE

Understanding Declines in Rusty Blackbirds

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> An enormously abundant migrant. . . . 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.
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> E. E. THOMPSON (1891), *Birds of Manitoba*

Abstract. The Rusty Blackbird (*Euphagus carolinus*), a formerly common breeding species of boreal wetlands, has exhibited the most marked decline of any North American landbird. North American Breeding Bird Survey (BBS) trends in abundance are estimated to be −12.5%/yr over the last 40 years, which is tantamount to a >95% cumulative decline. Trends in abundance calculated from Christmas Bird Counts (CBC) for a similar period indicate a range-wide decline of −5.6%/yr. Qualitative analyses of ornithological accounts suggest the species has been declining for over a century. Several studies document range retraction in the southern boreal forest, whereas limited data suggest that abundance may be more stable in more northerly areas. The major hypotheses for the decline include degradation of boreal habitats from logging and agricultural development, mercury contamination, and wetland desiccation resulting from global warming. Other likely reasons for decline include loss or degradation of wooded wetlands of the southeastern U.S and mortality associated with abatement efforts targeting nuisance blackbirds. In addition, the patchy breeding distribution of this species may inhibit population consolidation, causing local populations to crash when reduced to low levels. Progress in understanding the causes and mechanisms for observed declines has remained limited until recently. Here we present initial attempts to understand the habitat requirements of Rusty Blackbirds and offer specific predictions associated with each of the hypotheses for decline as a way of guiding future research.

Key Words: contaminants, *Euphagus carolinus*, habitat use, limiting factors, population decline, population movements, Rusty Blackbird.

Greenberg, R., D. W. Demarest, S. M. Matsuoka, C. Mettke-Hofmann, D. Evers, P. B. Hamel, J. Luscier, L. L. Powell, D. Shaw, M. L. Avery, K. A. Hobson, P. J. Blancher, and D. K. Niven. 2011. Understanding declines in Rusty Blackbirds. Pp. 107–126 *in* J. V. Wells (editor). Boreal birds of North America: a hemispheric view of their conservation links and significance. Studies in Avian Biology (no. 41), University of California Press, Berkeley, CA.

The boreal zone provides the most extensive forested habitat for high-latitude birds. Because large parts of the region are inaccessible by road, even large changes in the status of a boreal forest species may go unnoticed, or if detected, remain challenging to investigate and understand. The Rusty Blackbird (*Euphagus carolinus*) is a widespread boreal breeding songbird that has undergone a precipitous decline, as evidenced by data collected through breeding and wintering surveys from across its North American range (Greenberg and Droege 1999, Niven et al. 2004, Sauer et al. 2005). Unlike many migratory species that breed in remote boreal habitats, the Rusty Blackbird winters entirely in temperate North America, providing an opportunity to monitor the status of the entire population and evaluate how it may be responding to threats occurring throughout the year. However, the inconspicuous behavior of Rusty Blackbirds, coupled with their use of relatively inaccessible habitats during winter (e.g., forested wetlands and swamps), complicate efforts to assess status on the less remote wintering grounds. Thus, despite the fact that the decline of Rusty Blackbirds has spanned several decades and has been widely recognized for over fifteen years (Avery 1995, Link and Sauer 1996, Greenberg and Droege 1999), only very recently has research attempted to understand and address the causes. In this paper, we summarize what we currently know or strongly suspect about the basic ecology and conservation of Rusty Blackbirds, describe ongoing efforts to fill critical information gaps and present a research strategy for future work on this species. We present this paper because of the intrinsic importance of understanding and addressing such a concerning decline in a formerly common and widespread bird, and to provide insights to approaches that might be applicable to other boreal species that present some of the same research challenges.

GENERAL DISTRIBUTION AND ECOLOGY

An estimated 80–90% of all Rusty Blackbirds breed across the boreal forest region of North America (Blancher and Wells 2005), from Alaska to Newfoundland and south into the Maritime Provinces, Adirondack Mountains, and the coastal rainforest zone of southeastern Alaska (Kessel and Gibson 1978, Godfrey 1986, Avery 1995). Breeding is closely tied to forested or tall shrubby wetlands and riparian zones (Erskine 1977, Avery 1995), with birds remaining largely absent from adjacent upland interior forests and shrublands (Whitaker and Montevecchi 1997, 1999). Rusty Blackbirds winter almost entirely in temperate North America, where the core wintering area is located within the southeastern United States (Avery 1995). The species winters primarily in shallowly flooded wooded wetlands of the Mississippi Alluvial Valley and South Atlantic Coastal Plain. Current population estimates developed using data and extrapolations from North American Breeding Bird Survey (BBS), the Canadian Breeding Bird Census Database, and other sources range from 158,000 to 2 million individuals (Rich et al. 2004, Savignac 2006), and are strongly influenced by the validity of a few key assumptions that have not been rigorously evaluated (Rosenberg and Blancher 2005, Thogmartin et al. 2006).

EVIDENCE FOR THE DECLINE

Analyses of long-term data sets including the BBS (Sauer et al. 2005) and Christmas Bird Count (CBC) (Niven et al. 2004) have documented consistent and significant declines in Rusty Blackbirds over the past 40 years. Additional careful review of historical accounts (Greenberg and Droege 1999) suggests that Rusty Blackbirds had already gone from conspicuously abundant to uncommon in many areas even before these modern survey efforts began tracking them. Collectively, these observations and data describe alarming and sustained population declines, range retractions, and local extirpations from across the range.

North American Breeding Bird Survey

BBS data currently provide the only standardized long-term assessment of large-scale breeding season abundance of the Rusty Blackbird. For the period 1966–2005, these data indicate a survey-wide population decline that averages approximately −12.5%/yr ($CI_{95\%}$ ± 6.3%/yr, $P < 0.01$; Table 9.1, Fig. 9.1) (Sauer et al. 2005). This trend corresponds to a loss of >95% of the population since 1966, and represents one of the largest population declines documented by the BBS (Link and Sauer 1996, Sauer et al. 2005).

TABLE 9.1

North American Breeding Bird Survey annual trend estimates (%/yr) for Rusty Blackbird, 1966–2005 (Sauer et al. 2005)

Region	Trend[a]	P[b]	n[c]	Mean Birds/Route
Alaska[d]	−5.3	0.04	27	0.84
Yukon Territory[d]	−12.8	0.05	7	0.32
British Columbia	−33.0	0.21	7	0.05
Ontario	−14.9	0.01	11	0.24
Quebec	−9.8	0.01	15	0.46
Newfoundland[d]	−7.7	0.20	15	2.03
New Brunswick	−8.9	0.02	17	0.28
Nova Scotia	−3.8	0.29	20	0.53
Maine	28.0	0.31	9	0.11
New Hampshire	−0.2	0.90	6	0.11
New York	2.5	0.70	7	0.07
Surveywide[e]	−12.5	<0.01	97	0.26

[a] Data for population trends are considered deficient in either sample sizes ($n < 14$ routes) or the mean number of detected birds per route (<1.0 birds/route; Sauer et al. 2005).

[b] Probability that the estimated trend differs from 0%/yr.

[c] Number of routes included in the analyses.

[d] Trends from Alaska, Yukon Territory, and Newfoundland are based on data from 1980–2005.

[e] Surveywide trend analysis excludes data from Alaska, Yukon Territory, Newfoundland, and northern portions of some provinces.

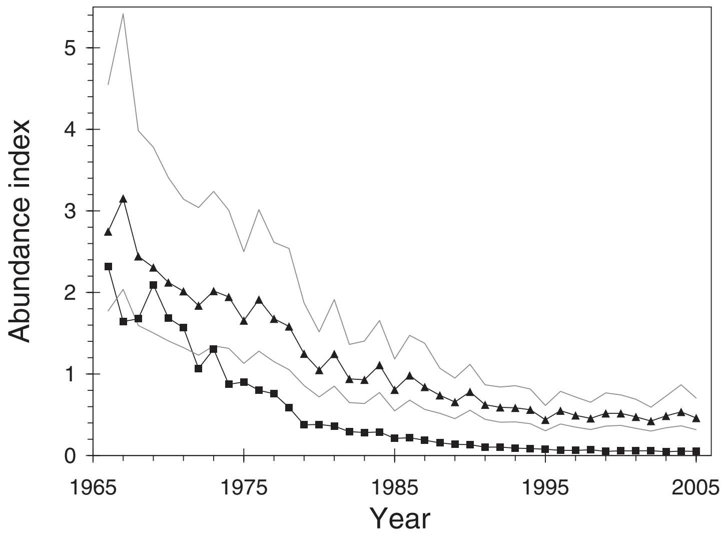

Figure 9.1. Trends in the abundance index of Rusty Blackbirds from 1966 to 2005 as estimated from the Christmas Bird Count (▲, with 97.5% credible interval in gray) and North American Breeding Bird Survey (■; Sauer et al. 2005). Christmas Bird Count data were from Bird Conservation Regions where the species was recorded on ≥4 count circles (Niven et al. 2004).

Although more variable and less precise than the survey-wide trend estimate, regional BBS analyses are also demonstrative of widespread declines (Table 9.1).

The magnitude, significance, and apparent long-term consistency of the survey-wide BBS trend for Rusty Blackbird provide compelling but somewhat limited evidence for a sharp range-wide downturn in population size. First, Rusty Blackbirds are detected on relatively few BBS routes (approximately 150), many of which have been surveyed sporadically and have frequent observer turnover. Combined with the low average number of detections per route, these factors contribute to a relatively wide confidence interval (i.e., poor precision) for the trend estimate. Second, survey coverage is limited to <30% of the breeding range and is concentrated in the southern portion of the boreal forest. Thus, the possibility exists that survey-wide BBS data are not representative of trends in more northerly breeding areas. For example, the survey-wide trend estimates exclude data from survey routes in Alaska, Newfoundland, Yukon Territory, and northern portions of some provinces because few routes in these areas encompass the long-term period of analysis (Bystrak 1981, Sauer et al. 2005). Although regional trend analyses for these northern areas do indicate declines of magnitude similar to the survey-wide estimate (Table 9.1), the precision of regional trend estimates is thought to be considerably poorer than the survey-wide estimate (Sauer et al. 2005).

Christmas Bird Count

The CBC is an invaluable source of data on the status of Rusty Blackbirds because count circles are distributed across the entire winter range of the species. Thus, we estimated winter population trend from CBC data for the period 1966–2005 following the methods of Niven et al. (2004). The range-wide trend estimate for Rusty Blackbird is −4.5%/yr (95% credible interval ± 1.2%/yr; Fig. 9.1). Though of smaller magnitude than the BBS trend estimate for the same time period (−12.5%/yr), this decline is significant and tantamount to a total decline of approximately 85% for the 40-year period. This estimate is based on data from 1,611 count circles. This sample size is an order of magnitude greater than the number of BBS routes with Rusty Blackbird detections (i.e., 150) and may contribute to the smaller confidence interval on the CBC trend estimate. CBC data indicate a decline in all of the Bird Conservation Regions (BCR) where Rusty Blackbirds were detected. In particular, a strong and consistent (3.7–5.1%/yr) decline was estimated for the four BCRs with the highest relative abundance (Central Hardwoods, West Gulf Coastal Plain, Southeastern Coastal Plain, and Mississippi Alluvial Valley).

Two patterns are evident in the CBC data and may provide insight into the Rusty Blackbird decline (Fig. 9.1). First, the rate of decline has diminished in recent decades. The estimated annual decline over the ten-year period from 1994 to 2003 is only −2.1%/yr (Savignac 2006), whereas a period of marked decline occurred in the early 1970s. This observation suggests that factors contributing to declines in Rusty Blackbirds may have been particularly profound during or immediately preceding the 1970s. Second, the relative annual variation in counts was much greater prior to the late 1970s, and fluctuations around the estimated trend line have dampened as the population has continued to drop. Though variability might inherently diminish as abundance approaches zero, this pattern is worth further exploration as it may indicate that natural population cycling is no longer occurring—or that the ability of existing programs to detect significant population changes with such low numbers is rapidly approaching effort-related limits.

In comparing the two surveys, CBC data are less constrained by limited geographic coverage and small sample size than are those from BBS; thus the trends estimated from CBC may have greater external validity. On the other hand, the sampling effort for the BBS is far more carefully controlled, meaning that BBS data may have greater internal validity. Further, because the two surveys track populations at different points in the annual cycle, valid biological explanations may account for the differences in trend estimates. For example, the less severe decline suggested by the CBC trend may reflect tempering of the trend estimate by the annual production of young available for counting during early winter, whereas the BBS trend is based largely on overwinter survival and the recruitment of adults into the breeding population. Specifically, if fecundity or winter survivorship of Rusty Blackbirds increases as populations or densities decrease, then higher reproductive

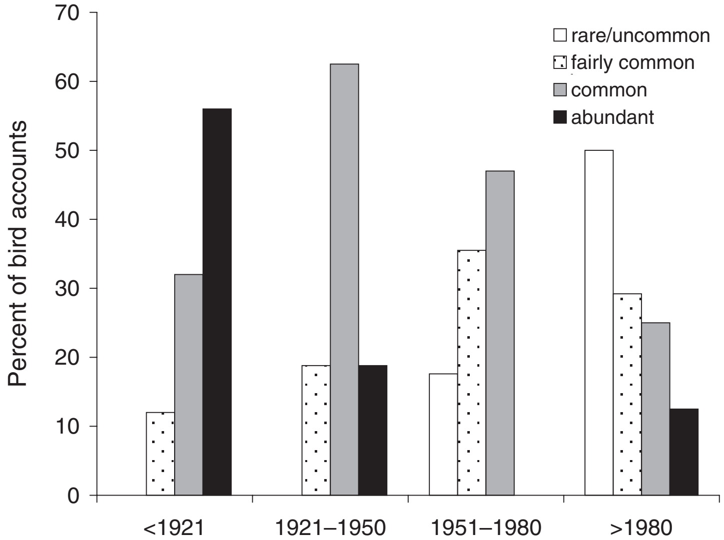

Figure 9.2. Percent of regional or state ornithological accounts (n = 86) listing the Rusty Blackbird in four different abundance classes and time periods.

output and early winter survivorship resulting from breeding population declines could potentially bias early winter trend estimates upward, effectively dampening apparent declines. This demonstrates an important need to understand post-breeding and overwinter survivorship and their influence on population regulation.

Qualitative Historical Assessment

CBC and BBS trend estimates suggest an 85–95% population decline over the past four decades, but it is important to determine if this decline represents only part of a longer historical process. Unfortunately, no quantitative surveys are available from earlier time periods. However, qualitative information on historical abundance illustrates how population status may have been changing even before CBC and BBS (Greenberg and Droege 1999). For example, several observers in the late 19th and early 20th centuries provided graphic descriptions of the high local abundance of this species during migration in the northern Great Plains, New England, and the Mississippi Valley (e.g., Beal 1890, Thompson 1891, J. H. Langille quoted in Beadslee and Mitchell 1965) that are not rivaled by any accounts since this period.

In addition, analysis of regional and state ornithological accounts indicates a long-term shift in descriptions of Rusty Blackbirds from “common to abundant” to “rare or uncommon” (Fig. 9.2). Much of this change in the description of the species’ status occurred prior to the recent 40-year decline documented by CBC and BBS. Analyses of a larger sample of local checklists show the same pattern in the qualitative descriptions of Rusty Blackbird abundance (Greenberg and Droege 1999). Such a long-term decline is more consistent with trends and patterns in winter habitat loss than with environmental change in the boreal forest, which is a more recent phenomenon. Interestingly, the pattern of change in the abundance descriptions for Rusty Blackbirds is similar between the Mississippi Alluvial Valley and the Southeastern Coastal Plain.

Past and Current Breeding Distribution

Another line of evidence for the decline of Rusty Blackbirds is the contraction of the breeding range, particularly in the southern boreal forest. Recent surveys from Canada suggest an apparent range contraction from southern areas traditionally occupied by Rusty Blackbirds. For example, recent surveys of 937 small wetlands in Alberta, Saskatchewan, and Manitoba have resulted in only 14 total detections (J. Morrisette, pers. comm.). Similar patterns have been observed in boreal uplands; in more than 20,000 point count surveys conducted across the western boreal forest in 1993–2006, only 80 locations documented Rusty

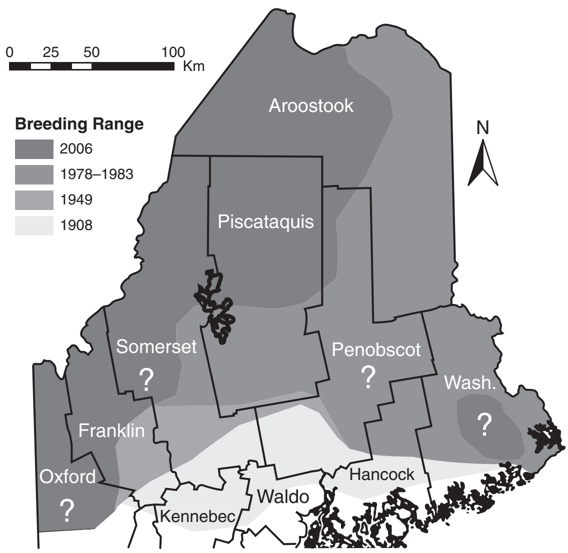

Figure 9.3. Range contraction of Rusty Blackbirds from the counties of eastern and northern Maine over the last century. Question marks indicate areas where knowledge of the current range remains anecdotal.

Blackbirds (S. Van Wilgenburg, J. Morrisette, and the Boreal Avian Modeling Project, http://www.borealbirds.ca). Additionally, several wetlands and lakes in eastern Saskatchewan and western Manitoba that were occupied in the 1970s are apparently no longer occupied (K. Hobson and A. Smith, unpubl. data).

The most complete analysis of range contraction comes from recent work in Maine, which suggests that the breeding range of Rusty Blackbird has contracted 65–160 km over the last century (Fig. 9.3). Early records (e.g., Knight 1908) report Rusty Blackbirds as summer residents throughout most of northern Maine and in southern parts of the state in Washington, Hancock, Waldo, and Kennebec counties. However, by 1950, Waldo, Kennebec, and southwestern Penobscot counties were not included in the Maine breeding range (Palmer 1949). The Maine Breeding Bird Atlas conducted from 1978–1983 confirmed the general distribution of breeding Rusty Blackbirds in Maine as described earlier by Palmer (Adamus 1987). Thus, although population declines may have occurred between the period of Palmer (1949) and the Maine atlas, a substantial range contraction during this time is not evident.

Two decades later, Hodgman and Hermann (2003) and L. Powell (unpubl. data) surveyed Rusty Blackbirds in Maine using call–response techniques at nearly 400 wetlands in core breeding areas in northern Aroostook, Piscataquis, and Somerset counties. Rusty Blackbirds were recorded at fewer than 10% of surveyed wetlands having apparently suitable habitat. Similar call–response surveys conducted from 2004 to 2005 at 350 wetlands in former breeding areas to the north and east did not yield a single confirmed detection (Hodgman and Yates 2007). Recent anecdotal evidence for Washington County suggests that perhaps only a few breeding pairs remain. These data and observations indicate that a substantial contraction in the breeding distribution of Rusty Blackbirds in Maine occurred between the 1980s and 2000.

Limited data from more northerly regions of the boreal forest suggest that range retractions or general declines may not have been as pronounced among these more remote areas. For example, resurveys of 45 of the original 61 wetland sites censused in 1975 as background data for the impact of a proposed gas pipeline in the Mackenzie Valley, Northwest Territories, suggested that wetland occupancy by Rusty Blackbirds had not changed substantially over the 30-year period (Machtans et al. 2007). This analysis suggests that even if local declines had occurred in the Northwest Territories, they are not of the magnitude that would be expected if the population had declined at a rate similar to that detected from Christmas Bird Count data (Machtans et al. 2007). Data from the Ontario Breeding Bird Atlas suggest substantial declines throughout the province except for the Hudson Bay Lowlands in the extreme north (Cadman et al. 2008).

HYPOTHESES FOR THE CAUSES OF DECLINE

The reasons for the decline of the Rusty Blackbird are currently unknown. However, multiple factors operating at different spatial and temporal scales are likely responsible for the chronic and acute patterns of decline observed both regionally and range-wide. Greenberg and Droege (2003) propose three principal reasons, including: (1) winter habitat loss and degradation due to conversion and hydrologic alteration of bottomland hardwood habitats; (2) breeding habitat degradation due to logging, wetland drying, acidification, and mercury contamination; and (3) direct mortality associated with efforts to abate nuisance blackbird problems, particularly during winter. Each of these is discussed below along with possible predictions and tests that could help in evaluating their relative importance in explaining the observed declines.

Loss or Degradation of Winter Habitat

An estimated 75–80% of bottomland hardwood habitats in the United States have been converted to agriculture since European settlement (Hefner and Brown 1988, Hefner et al. 1994, Twedt and Loesch 1999). Certainly, the gross loss of wooded wetlands that has occurred in the southeastern United States would be consistent with a severe long-term decline in any species dependent on these habitats. The more difficult question is whether the pattern of decline indicated by BBS and CBC over the past 40 years is consistent with spatial patterns and rates of forested wetland loss during the same time period (Greenberg and Droege 1999).

For example, some low-lying and seasonally flooded regions of the Mississippi Alluvial Valley remained uncultivated until the 1970s because of low anticipated crop revenues and the high costs associated with converting these areas into production farmlands. By the 1970s, high soybean (*Glycine max*) prices enticed growers to convert and farm these areas, which may have been some of the best remaining wintering habitats for Rusty Blackbirds in the region. A distinct temporal pattern of land clearing from relatively drier contours more conducive to farming, to more flood-prone areas (Rudis 2001) likely had large implications for birds dependent on forested wetlands (Twedt et al. 2006). Subsequent declines in soybean prices, however, led to afforestation efforts, principally those undertaken as part of the U.S. Department of Agriculture Wetland Reserve and Conservation Reserve Programs (King et al. 2006). An estimated 162,000 ha were enrolled in the Wetland Reserve Program during 1990–2005 (Ducks Unlimited 2007). Considerable additional interest in afforestation has been spurred by utility industry investments in carbon sequestration programs that seek to offset carbon emissions while restoring cleared forests in an ecologically compatible manner (Caspersen et al. 2000, Houghton 2002, Shoch et al. 2009). This pattern of habitat loss followed by stabilized habitat trends and then a slow, steady gain appears to be consistent with the pattern seen in the CBC data, which show a precipitous drop in Rusty Blackbird abundance in the early 1970s. Emphasis of the Wetland Reserve and Conservation Reserve Programs on marginally productive croplands will result in afforestation activities that follow in reverse of earlier clearing patterns. This anticipated pattern suggests that as afforested lands mature into forests over the next several decades, considerable new habitat may become available for wintering Rusty Blackbird populations.

Nonetheless, this positive scenario of a net future return of Rusty Blackbird winter habitat needs to be kept in perspective. The great flexibility of the agricultural community to respond to changing markets, exemplified by earlier land clearing in response to rising soybean prices, suggests that markets for new commodities could quickly shift the habitat balance in the southeastern United States back again to agricultural lands. Currently, large shifts in crop production are occurring in response to new opportunities for biofuels such as corn (*Zea mays*) for ethanol. Overall biofuel production is increasing faster than 10% per year worldwide (Starke 2007), and corn production in the United States may double in the coming decades (Ringelman 2007). Some of this expansion is occurring at the expense of lands presently enrolled in wetlands conservation easements. Corn production has undergone recent expansion in the lower Mississippi Alluvial Valley in the past two years, but it is unclear how this will affect currently forested areas, or areas available for afforestation.

Another consideration is the management of existing wooded wetlands. As a primarily terrestrial, insectivorous species that forages in saturated or flooded soils, Rusty Blackbirds may be particularly sensitive to changes to natural forest flooding regimes resulting from drainage and diversions of water. In particular, the effects of the enormous water control projects of the Mississippi River and its major tributaries (Barry 1997) on Rusty Blackbirds is potentially quite large but has not been estimated. In much of the coastal Carolinas, wooded wetlands were historically impounded for rice production (Tompkins 1987). Many of these areas have regrown into second growth forest, but water levels are managed principally for waterfowl or are not managed at all. Management of water levels appropriate for blackbirds in both public and privately owned impoundments represents a significant opportunity for habitat enhancement and may also provide a means for research to examine how the depth, timing, duration, and spatial extent of inundation influence suitability of forested wetlands for Rusty Blackbirds. Thus far, only anecdotal natural history of the species suggests its sensitivity to the details of surface hydrology, and research is being undertaken to more rigorously test the impact of surface water conditions on the condition and survival of wintering blackbirds.

Loss or Degradation of Breeding Habitat

Until recently, the perception of the boreal forest as a vast expanse of undisturbed habitat has prevented many from invoking breeding habitat loss or degradation as an important factor in boreal forest bird declines. However, several widespread disturbances are noteworthy and deserve consideration as factors contributing to recent population reductions in Rusty Blackbirds and other species. Increasing surface air temperatures across Alaska and northwestern Canada have resulted in increases in the frequency, intensity, and extent of fire (Soja et al. 2006), as well as widespread drying of boreal wetlands (Klein et al. 2005, Riordan et al. 2006). In Alaska, the latter has resulted in a 19% loss of closed basin ponds, changes in water chemistry, decreases in macroinvertebrate abundance, and invasions of woody plants (Corcoran 2005, Klein et al. 2005, Riordan et al. 2006).

While the northern boreal forest feels the indirect effect of climate change, the southern boreal plains have long been impacted by direct human settlement and resource exploitation, often focused on wetland habitats. Large hydroelectric projects and concomitant reservoir development has led to the loss of riparian habitats and wetlands in several areas (Greenberg and Droege 1999). For example, over 1 million ha of forest was flooded in central Quebec (Gauthier and Aubry 1996). Furthermore, wetland changes have also been caused by the displacement of large volumes of underground and surface water during oil and gas extraction (Schmiegelow et al. 1997, Whitaker and Montevecchi 1999, Hobson et al. 2002, Bayne et al. 2005, Savignac 2006). Overall, the southern boreal forest has been impacted by timber harvest, agriculture, mining, and oil and gas development. Timber extraction is arguably the greatest threat to the overall integrity of the boreal forest. More than 60% of the commercially viable southern boreal forest has already been allocated to timber companies. However, other forms of land use have led to substantial habitat loss or degradation, particularly in the southern portion of the boreal plain. Eight percent of the boreal forest biome had been directly impacted by oil and gas extraction activities as of 2003 (Gauthier and Aubrey 1996). Approximately 79% of the forest plain ecozone at the southern edge of the boreal forest in Saskatchewan had been converted to agriculture since European settlement. Ongoing annual rates of deforestation in this ecozone across southern Canada range from 0.8 to 1.7% per year (Hobson et al. 2002). As a result of all this economic activity, the amount of intact habitat in the southern boreal forest is estimated to be no more than 75% of the pre-European coverage (Lee et al. 2006), and other estimates are much lower (Ricketts et al. 1999).

Boreal forests are dynamic habitats prone to natural disturbance regimes. More permanent habitat change can result from an interaction of natural forces and human management responses. For example, a massive outbreak of spruce budworms (*Choristoneura fumiferana*) from 1968 to 1985 defoliated balsam fir and spruce across 55 million ha of forest spanning the boreal zone from Lake Superior east to the Atlantic coast (Blais 1983, Bolgiano 2004). This and related salvage logging may have caused widespread changes to Rusty Blackbird breeding habitats.

The eastern boreal forest may be suffering a disproportionate impact from the fallout of industrial pollutants in heavily populated portions of the U.S. and Canada. Industrial pollution has decreased the quality of wetlands in the northeastern United States and eastern Canada by lowering pH, depleting environmental calcium (Greenberg and Droege 1999), and increasing concentrations of methylmercury (MeHg) (Lovett et al. 2009). Although aquatic ecosystems sensitive to environmental mercury loading are well established as having adverse impacts on piscivorous birds such as the Common Loon (*Gavia immer*) (Burgess and Meyer 2008; Evers et al. 2008), only recently has the availability of MeHg in wetland birds been identified as a major threat (Schwarzbach et al. 2006). Concentrations deemed to have adverse effects on egg hatchability, based on Heinz et al. (2008), have been documented for wild breeding populations of Icterids, including the Red-winged Blackbird (*Agelaius phoeniceus*) (Evers et al. 2005) and Rusty Blackbird (Evers, pers. comm.). Current sampling efforts of Rusty Blackbird tissues have documented significantly higher blood mercury concentrations in breeding versus wintering individuals, with highest levels recorded in the northeastern United States (BioDiversity Research Institute, unpubl. data). Reasons for elevated levels may be related to Rusty Blackbirds foraging on high trophic level invertebrates (e.g., arachnids; Cristol et al. 2008) from low-pH wetlands with frequent water level changes that are conducive to high methylation rates (Driscoll et al. 2007).

It should be noted that a number of other species that co-occur with Rusty Blackbirds in boreal wetlands during the breeding season are also suffering steep declines over the past few decades. These include Lesser Scaup (*Aythya affinis*); Black (*Melanitta nigra*), Scoters; Horned Grebe (*Podiceps auritus*), White-winged (*M. fusca*), and Surf (*M. perspicillata*); and Lesser Yellowlegs (*Tringa flavipes*) (Austin et al. 2000, Hannah 2004, North America Waterfowl Management Plan Committee 2004, Sauer et al. 2005, U.S. Fish and Wildlife Service 2006). Thus, Rusty Blackbirds may be responding to factors causing degradation in boreal wetlands that are having much broader impacts.

Blackbird Control Efforts

Rusty Blackbirds are not considered crop pests, but they do join other blackbirds and European Starlings (*Sturnus vulgaris*) in large communal winter roosts. Because of nuisance, property damage, and health concerns, winter roosts have been subjected to extensive control programs in the southeastern United States (Garner 1978, Heisterberg et al. 1987). During 1974–1992, 83 roosts were sprayed with a surfactant (PA-14) which killed approximately 38 million blackbirds, principally Common Grackles (*Quiscalus quiscula*), European Starlings, Red-winged Blackbirds, and Brown-headed Cowbirds (*Molothrus ater*) (Dolbeer et al. 1997). Rusty Blackbirds have been estimated as comprising less than 1% of the birds in these mixed-species winter roosts (Meanley and Royall 1976). Thus, it was estimated that only 120,000 Rusty Blackbirds were affected by the PA-14 applications at the 83 winter roosts (Dolbeer et al. 1997). The use of the surfactant was discontinued when the EPA registration lapsed in 1992 and was not renewed. The period covered by this program coincides with that of the steepest decline as documented by the CBC data. The mortality estimates from control efforts do not suggest a magnitude that is equivalent to that of the global population declines (which would be on the order of millions of birds based on available trend and population estimates). Nonetheless, it would be instructive to examine the regional patterns of decline and how they relate to specific control events. Currently, the Rusty Blackbird–specific mortality estimates and the population estimates based on CBC appear to be insufficiently precise to support such an analysis.

The toxicant DCR-1339 (Starlicide®) is currently applied in rice-growing areas of Texas and Louisiana to reduce blackbird depredations to early-sprouting rice (Cummings and Avery 2003). Laced bait is applied on staging areas to affect birds entering and leaving large winter blackbird roosts. In parts of the Rusty Blackbird winter range, this toxicant is also used at feedlots and dairies for starling control (Homan et al. 2005). There is no estimate of the take of Rusty Blackbirds from DRC-1339 through either of these applications. Similarly, there is no information on how Rusty Blackbirds might be affected by legal removal of blackbirds as authorized in U.S. regulations under a blackbird depredation order (50 CFR 21.43) or by illegal shooting and trapping activities.

Migratory Allee Effect

Regardless of the external factors driving the decline of Rusty Blackbirds, two aspects of its life history may contribute to strong, negative density dependence at low population size (Allee effect). First, the species is often patchily distributed, following the local occurrence of appropriate wetland habitat across the landscape. Second, the migratory nature of the species means that individual birds settling to breed across the boreal landscape may not coalesce into viable breeding populations because of difficulty in locating mates or forming the loose nesting colonies observed in Alaska and Newfoundland (see below under Assessing Habitat Use on the Breeding Ground). A similar argument was made to account for the last stages of extinction of the Bachman's Warbler (*Vermivora bachmani*; Wilcove and Terborgh 1984). In particular, birds nesting in groups may be much more successful on a per capita basis than individual pairs due to group defense against nest predators, as has been found in Red-winged Blackbirds (Picman et al. 1988, Yasukawa et al. 1992). Taken together, the regional population size at which an extinction vortex (Gilpen and Soule 1986) is reached may be relatively high for migratory species, such as Rusty Blackbirds, compared to local resident species. This may explain rapid range contractions in regions, such as the southern boreal forest, where today seemingly appropriate breeding habitat is available but unoccupied.

LEGAL AND CONSERVATION STATUS OF THE RUSTY BLACKBIRD

Despite the evidence for a profound population decline, Rusty Blackbirds have only very recently received heightened conservation attention from governmental and private conservation entities. In the United States, Rusty Blackbirds receive the same legal protection afforded most migratory birds under the Migratory Bird Treaty Act (16 USC 703–711). The act establishes a federal prohibition against unauthorized pursuit, hunting, and killing of birds identified in various bilateral treaties between the United States and Great Britain (for Canada), Japan, and Russia. However, the act does not provide for the protection of habitats, nor does it mandate proactive conservation and management to sustain populations of protected species. Further, the act does allow for the permitted take of protected species when they threaten agricultural crops or human health or safety. In Canada, the Migratory Birds Convention Act (1994, c. 22, s. 19) implements the bilateral treaty between Canada and the United States for the protection of migratory birds. However, this act does not confer the same protections afforded blackbirds in the United States by the Migratory Bird Treaty Act, largely because of the flexibility this affords the Canadian government in addressing crop depredation and other nuisance situations caused by blackbirds.

Until January 2011, the Rusty Blackbird could be legally taken in the United States without a permit under an existing depredation order for blackbirds, cowbirds, grackles, crows, and magpies (50 CFR 21.43). This order facilitates the lethal control of these birds when "committing or about to commit depredations . . . or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance." In conjunction with all affected stakeholders, the U.S. Fish and Wildlife Service has excluded Rusty Blackbirds from this depredation order in acknowledgment of the increasing vulnerability of Rusty Blackbird populations to extirpation, the minimal threat they have on crops or other commodities, and their limited potential to congregate in numbers constituting a health or safety concern.

Non-regulatory designations add weight for the prioritization of funding and other resources dedicated to conservation, research, and monitoring of this species. Probably the most significant listing for the Rusty Blackbird is its recent inclusion on the IUCN Red List as a "vulnerable" species (IUCN 2007). NatureServe (2006) ranks Rusty Blackbirds as being secure at the range-wide scale, but notes vulnerabilities at state and provincial levels. Partners in Flight's North American Landbird Conservation Plan (Rich et al. 2004) lists Rusty Blackbird as a species of Continental Concern that is moderately abundant and widespread, but experiencing declines and high threats. The U.S. Fish and Wildlife Service has designated Rusty Blackbird as a Bird of Conservation Concern (U.S. Fish and Wildlife Service 2002), which earns the species additional attention and consideration in various activities of the agency. Similarly, the Committee on the Status of Endangered Wildlife in Canada recently identified Rusty Blackbird as a species of Special Concern (Savignac 2006).

Also outside of the regulatory arena was the formation of the International Rusty Blackbird Working Group in April 2005. This ad hoc group has consisted of approximately over 60 scientists, biologists, and program managers focused on (1) developing an overarching research and monitoring strategy to understand and reverse the species' decline; (2) providing information about the species and its decline to the greater scientific, conservation, and resource management community as well as to bird enthusiasts and the general public; and (3) serving as a forum for the real-time exchange of information among partners having a stake in Rusty Blackbird conservation. As of 2008, members of the working group had initiated research programs in both northern boreal habitats (particularly Alaska and Maine) and southeastern bottomland hardwood ecosystems (Mississippi, Arkansas, and South Carolina), supported by U.S. Fish and Wildlife Service, Department of Defense Legacy Program, U.S. Geological Survey, and the U.S. Forest Service. In 2008, efforts were initiated to collaborate with the eBird program (Cornell Laboratory of Ornithology and the National Audubon Society) to locate "hotspots" for the species during the winter and migration periods. All of these efforts are helping better describe the spatial and temporal distribution of Rusty Blackbirds as a basis for ongoing and planned research, monitoring, and conservation activities.

EFFORTS TO FILL CRITICAL INFORMATION GAPS

Habitat loss and degradation figure prominently in hypotheses for why the Rusty Blackbird is declining. Therefore, a complete understanding of habitat requirements and what features contribute to habitat quality is necessary to evaluate habitat-based hypotheses.

Habitat Use on the Breeding Ground

Understanding of the life history of the Rusty Blackbird has advanced surprisingly little since Bent (1958). In particular, information on habitat use on the boreal breeding grounds is scant and largely restricted to observations of limited numbers of birds in New England (Kennard 1920, Ellison 1990) and recent studies in Alaska (Corcoran 2006, Shaw 2006, P. Meyers, unpubl. data). Rusty Blackbirds are generally described as breeding solitarily and at low densities, but may also be found in small groups of a few to several pairs in Alaska and Newfoundland (Peters and Burleigh 1951, Gabrielson and Lincoln 1959, Ellison 1990), where the species appears to be most abundant (Sauer et al. 2005; Table 9.1). Rusty Blackbirds are patchily distributed and have often been reported occupying the same locations annually, with old nests noted near active nests (Kennard 1920, Shaw 2006, R. Corcoran, pers. comm.). Recent studies in Alaska found nests as close as 75 m to one another but more typically >250 m apart. At sites with multiple pairs in Alaska, adults joined into groups of 3–7 individuals to mob potential predators near nests, particularly during the late nestling stage (Corcoran 2006, Shaw 2006, P. Meyers, pers. obs.).

The species breeds in bogs, wet meadows, or along ponds, lakes, and streams (Kennard 1920, Gabrielson and Lincoln 1959, Ellison 1990, Avery 1995, Sinclair et al. 2003). To many observers, the gestalt of a Rusty Blackbird breeding area includes a mixture of open water, flooded meadow or floating emergent vegetation, and conifers or tall shrubs. The dominant breeding habitat, however, varies among the principal regions where it has been studied. For example, Rusty Blackbirds are almost completely restricted to beaver ponds in New England, whereas in western Alaska they can be locally common in shrub and meadow vegetation along rivers, and in southern Alaska they are found along sloughs in early successional forests dominated by Sitka spruce (*Picea sitchensis*). Many observers have commented that Rusty Blackbirds can be seen flying great distances within or outside of the wetlands where their nests are located. Telemetry studies are needed to determine how extensive an area they require to forage during the breeding season and the nature of the overall habitat mosaic on which they depend.

Based on anecdotal accounts, it seems unlikely that the nest site itself is limiting the distribution of the species. This species builds a large nest low (<6 m) in small live or dead conifers (*Picea* or *Abies* spp.) or tall shrubs (*Salix* or *Alnus* spp.) (Kennard 1920, Gabrielson and Lincoln 1959, Ellison 1990, Sinclair et al. 2003, Shaw 2006). Although dependence on small conifers for nest sites is particularly marked in New England (Kennard 1920, Ellison 1990), the preferred tree or shrub species used for nesting appears to vary regionally. For example, along the drainage of the Yukon River and its tributaries in interior Alaska, over 75% of 37 nests were found in live or dead willows and often over water—fewer nests were found in live or dead spruce (*Picea glauca* and *P. mariana*; Corcoran 2006, Shaw 2006, K. Martin, unpubl. data, K. Sowl, unpubl. data). In contrast, in the coastal rainforest zone on the upper Copper River Delta, Alaska, 87% of 17 nests were found in Sitka spruce and the remainder in alder (P. Meyer, unpubl. data). It is likely that these regional patterns reflect differences in the availability of small trees rather than geographic variation in preference.

Winter Habitat Characteristics

As in other temperate zone blackbirds, Rusty Blackbirds have two distinct habitat needs during the non-breeding season: foraging areas and roosting sites. In terms of foraging areas, Rusty Blackbirds winter primarily in wet bottomland hardwood forests (Avery 1995). They are common in areas of continuous semi-flooded forest, but in drier areas they can be seen in association with smaller wooded wetlands, such as beaver ponds. They are also regularly found in more open habitats such as pecan (*Carya illinoiensis*) orchards and in forest fragments along creeks (Mettke-Hofmann unpubl. data). The extent to which Rusty Blackbirds use each of these habitats is poorly quantified, as is the effect that the use of these different habitats has on fitness. Within these habitats, birds show a preference for foraging near the edge of shallow water without regard for understory vegetation density or distance to forest edge. Habitat preference, in part, seemed to reflect the availability of preferred food. Rusty Blackbirds appeared to depend on two distinct dietary items: (1) small acorns and pecans, which are often eaten while associating with Common Grackles, whose large, strong bills are able to crack nutshells; and (2) invertebrates picked from water or soil, or captured after flipping leaf litter and floating vegetation. Consequently, Rusty Blackbirds appeared to select areas with the proper species of mast-producing oaks and hickories, or areas having a surface mosaic of water and moist soil that supported the appropriate invertebrate fauna. The qualitative information so far suggests that Rusty Blackbirds prefer forests with mature oaks (particularly willow oaks, *Quercus phellos*), areas with small creeks, and patchily inundated areas of shallow water and exposed substrate. Thus, overstory composition, the availability of mast-producing individuals of key oaks and hickories, the depth and extent of inundation, and general soil moisture regimes all appear to be important characteristics for future studies of winter habitat quality. The relative importance of these factors needs further evaluation.

In contrast to feeding areas, night roosts were more likely in fields than in scrub or forests. Preferred night roosts (20 to 400 birds) were often in afforestation areas with dense vegetation near the ground, but were also in fields with short vegetation, or trees or shrubs in residential yards—in the latter of which birds joined large roosts with other blackbird species. The preference for these relatively open, treeless habitats for night roosts is surprising given the avoidance of these habitats during feeding. Most of the trees in foraging areas are leafless in winter; birds may be quite conspicuous when using them as roosts. Thus, the ample low cover in new afforestation areas and vegetated fields and the dense foliage of evergreen trees in residential yards may give roosting blackbirds important protection against nocturnal predators and cold temperatures. Most Rusty Blackbirds are found either in single-species roosts or mixed with some Red-winged Blackbirds. However, as winter progresses, Rusty Blackbirds are more frequently found in large mixed-species blackbird roosts.

FUTURE RESEARCH

Now that it is understood that the Rusty Blackbird has suffered both a long-term and precipitous range-wide decline, future research needs to address three separate, but related needs: (1) a testing of predictions associated with the proposed causes of decline to begin to evaluate which factors are of paramount importance; (2) a plan consisting of concrete, proactive management recommendations to reverse the decline; and (3) continued monitoring of the population to provide both regional and global data to facilitate the first two objectives.

Testing Hypotheses for the Decline

Because resources are limited and the distribution of the species is vast, our ability to determine the causes of the decline will depend on the formation of specific hypothesis that can be tested by gathering information from well-defined, focal studies. The most important hypotheses are listed in Table 9.2, along with an attempt to define key data that will allow us to test key predictions from these hypotheses. Developing specific testable predictions for these various breeding-ground factors is difficult because of the lack of access to study this sparsely distributed species.

However, while a complete picture of the status of a widely distributed boreal population is impossible, evidence to evaluate the cause of decline could be developed with strategically placed studies. The site occupancy approach is being used for surveys on breeding areas in Maine (L. Powell, unpubl. data) and Alaska (S. Matsuoka and D. Shaw, unpubl. data) and, along with more detailed life history information, can help test specific breeding ground–related hypotheses. For example, because each of the listed hypotheses for decline has a distinct geographic pattern for the likelihood of impact, the local population trend and critical aspects of life history (particularly mating success, breeding success, nestling growth, or post-fledging survival) could be measured at key sites in the boreal region. If simple habitat loss or degradation was the driving force, then the populations should decline or contract away from areas where habitat has been destroyed or degraded. But if further environmental factors affect the quality of habitat, such as MeHg contamination or changes in food supply due to global warming and boreal wetland drying, then the reproductive output and particularly the growth, condition, and survival of young should be affected even in areas of seemingly appropriate habitat. For example, support for the effect of mercury contamination would be provided if (1) Rusty Blackbirds have declined disproportionately in areas that are most affected by mercury accumulation; (2) Rusty Blackbird blood and tissue show relatively high levels of mercury in birds from a region of greatest decline; and (3) reproductive anomalies associated with chronic mercury toxicity are documented. Similarly, acidification of wetlands should cause a distinct geographic pattern of decline associated with specific effects of calcium stress, such as eggshell thinning and poorly developed skeletons in young birds. Finally, if declines are disproportional in regions experiencing greater wetland drying or on a local level, smaller bodies of water might be more immediately affected, and the growth rate and fledging success of birds in these areas may be significantly lower than in less-affected areas (Table 9.2).

Similarly, the case for loss or degradation of winter habitat can be evaluated by exploring the correlation between population declines and land use changes at a finer scale than has been accomplished thus far. For a retrospective analysis, exploration of individual CBC circles could shed light on the temporal and geographic patterns of decline in relation to available data on habitat change. In the future, focused surveying, using site occupancy approaches in different regions of the wintering ground, can be compared to habitat change as well. These abundance data, in conjunction with information on condition and other correlates of blackbird fitness, could be used to assess habitat quality, which can be added to predictive models for future decline. Other issues for ongoing and future research that will illuminate the nature of the Rusty Blackbird decline include:

- a more quantitative analysis of the loss of Rusty Blackbirds due to control efforts;
- sampling of Rusty Blackbirds for mercury and other contaminants in different portions of their breeding and winter range;
- comparisons of demographic variables, such as nest success and survivorship, for different regions of the breeding and wintering season;
- telemetry studies that reveal the details of how Rusty Blackbirds use the habitat mosaic for different aspects of their life history;
- further study of winter roosting behavior and how this affects access to preferred habitat and vulnerability to blackbird control;
- an examination of the possible role of disease and parasites in the decline of Rusty Blackbird populations; and
- more detailed studies of how forest management and hydrological interventions affect habitat quality, particularly on the wintering grounds.

Management Recommendations

An overall management strategy will have to await more definitive information on the causes of the Rusty Blackbird decline. However, many of the hypothesized causes for decline lend themselves to general conservation and environmental measures that are not exclusive to the Rusty Blackbird. For example, to the degree the development of boreal wetlands has contributed to the decline, efforts to protect and restore these ecosystems will contribute to the recovery of populations. Similarly, control of emissions that contribute to

TABLE 9.2

Possible causes, predictions, and necessary data to test predictions for declines in the Rusty Blackbird

Hypothesis	Prediction	Data Needed
	Breeding Season	
Breeding Habitat Loss	Steeper declines in areas/regions suffering greatest loss or conversion of habitat.	Temporal and spatial data on habitat loss, preferably that collected in association with monitoring data (e.g., habitat loss along survey routes).
Boreal Habitat Degradation		
Wetland drying	Steeper declines, lower fitness, and lower food availability in regions with the strongest apparent effect of drying (e.g., decreased surface water availability). Fitness correlates: low chick growth rate and condition (e.g., mass).	Detailed studies of site occupancy and reproductive performance across boreal wetland systems of differing size and varying vulnerability to drying.
Methyl mercury (MeHg) and wetland acidification (also includes wintering habitat conditions)	Steeper declines and lower fitness in regions with higher levels of MeHg contamination or acidification. High levels of MeHg in tissues from these regions. Fitness correlates: low adult survival and chick growth rates, high nest failure, and other reproductive anomalies. For acidification, egg shell thinning and skeletal deformities in chicks.	MeHg levels from areas with Rusty Blackbird surveys. Tissue samples from different boreal regions. Tissue samples from different winter regions if strong connection with breeding region can be established. Focused studies of reproductive success from wetlands with different levels of MeHg contamination.
Allee Effect	Local breeding populations extirpated as regional populations decline in the absence of any identifiable deterioration of habitat. As populations decline, more sites will be populated by unmated birds.	Detailed information on site occupancy, mating success, and reproductive success coupled with regional data on population trends.
	Non-breeding Season	
Non-breeding Habitat Loss	Abundance correlates with changes in area of de- and afforestation. Predictions can be refined as details of habitat quality are developed from studies.	Land use trend data to analyze with long-term data on blackbird abundance (e.g., land use within CBC circles). Bird responses to different habitat types in terms of condition and survival.

TABLE 9.2 (*continued*)

TABLE 9.2 (CONTINUED)

Hypothesis	Prediction	Data Needed
	Non-breeding Season	
Non-breeding Habitat Degradation: Changes in Forest Composition (mast-producing trees) and Hydrology	Within intact habitat, declines occurred in areas with greatest changes in the hydrology and composition of bottomland forests. Remaining concentrations are found in areas managed for ephemeral shallow water and high abundance of small acorn-producing trees.	Fine-scale data on the patterns of decline and the condition of bottomland hardwood forest. Atlas-level data on the distribution of winter concentrations of Rusty Blackbirds with appropriate habitat data.
Blackbird Control	Mortality from targeted and diffuse control efforts is sufficient to have an impact on population processes. Geographic and temporal pattern in declines correlates with major blackbird control efforts.	Number of Rusty Blackbirds taken by control efforts at large roosts. Systematic data on the geographic scope of blackbird control and the composition of roosts coupled with long-term, site-specific population trend data.

global warming, acid rain, and MeHg contamination may help restore Rusty Blackbirds to existing wetlands where they have disappeared. Similarly, policies and actions that protect and restore bottomland hardwood forests and other wooded wetlands would provide more habitat for wintering populations.

Certain more specific management recommendations may also be made proactively, based on the ongoing research focused on the habitat use and roosting behavior of the species. For example, Rusty Blackbirds appear to suffer indirectly from control efforts focused on blackbirds in general. Rusty Blackbirds often feed and roost in areas where relatively few individuals of other blackbirds occur. Control efforts that avoid prime habitat for Rusty Blackbird flocks and roosts would reduce the incidental mortality that might be occurring. Wooded wetlands are often managed for waterfowl and other wildlife. Managing the flooding regime of these areas to create appropriate foraging habitat may be another approach to increase the quality of protected habitats. Finally, afforestation efforts that include management for preferred food plants, such as oaks and hickories, for Rusty Blackbirds may also enhance habitat quality for recently reclaimed agricultural lands. Ensuring that appropriate habitat is maintained in proximity to preferred nesting and roosting areas will require detailed understanding of how Rusty Blackbirds use the complex habitat mosaic associated with both boreal and southern wooded wetlands.

Monitoring

Because the Rusty Blackbird has a large and largely inaccessible breeding distribution throughout the boreal forest, population monitoring is likely to be based on the limited number of boreal BBS routes and the more geographically comprehensive, but less rigorously gathered, CBC data. It is unlikely in the near future that a more extensive monitoring program focused on Rusty Blackbirds will be implemented at either end of the annual cycle. It may be most strategic to incorporate more focused monitoring into studies aimed at testing the specific hypotheses for declines (see Testing Hypotheses for Declines). For example, regionally based citizen-science atlases or surveys using site occupancy approaches could be implemented in each of the BCRs that are most important in supporting wintering populations of Rusty Blackbirds. Such a survey effort could gather relatively unbiased information on the use of different habitats, which could later be correlated with land use change information. This effort could be made more efficient by concentrating on the late winter, when the populations are more stable and singing greatly increases the detectability of blackbird flocks. Increasing the breeding season coverage is even more problematic. However, since appropriate wetlands are often patchy and discrete, a program of conducting site occupancy surveys in a small number of representative regions seems within the realm of feasibility. Increasing the coverage of Rusty Blackbird surveys across the boreal forest region would be most feasible if incorporated with existing surveys for other types of birds, as is being done with waterfowl surveys in the Yukon Territory (P. Sinclair, unpubl. data) or could be done with surveys of boreal-nesting shorebirds (V. Johnston, unpubl. data).

ACKNOWLDGMENTS

The authors wish to thank our colleagues on the International Rusty Blackbird Working Group for continued discussions of the scientific and conservation issues involved in Rusty Blackbird conservation. The USDA Forest Service provided housing, cars, and logistical support. Furthermore, we thank Kathryn Heyden, Gerhard Hofmann, Catherine Ricketts, and Carl Smith for valuable field assistance during telemetry. The Yazoo National Wildlife Refuge (NWR) provided housing for our helpers. We thank the Theodore Roosevelt NWR Complex, the Northern Mississippi NWR Complex, Leroy Percy State Park, the Delta National Forest, the Delta Research and Extension Center, and Frederick Ballard and other individuals who granted permission to work on their refuges and lands. We are grateful to Robin Corcoran, Kate Martin, Paul Meyers, and Christine Sowl for providing unpublished data on nest sites and breeding behavior in Alaska. Jeff Wells supplied important information on the status of boreal forests. Financial support was provided by the U.S. Fish and Wildlife Service, the Canadian Wildlife Service, the Society for Tropical Ornithology, the Arthur-von-Gwinner Foundation, the Max Planck Institute for Ornithology, Friends of the National Zoo, and the Legacy Program of the Department of Defense.

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