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Using Breeding Bird Atlas Data to Evaluate GIS-Mapping of a Wildlife Corridor in Northern New York

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Introduction

Scientists have been studying and debating the benefits of wildlife corridors (e.g., Diamond 1975, MacClintock et al. 1977, Noss 1983, Noss 1987, Bennett 1990, Reed 1996, Perault & Lomolino 2000, Tewksbury et al. 2002, Haddad et al. 2003, Levey et al. 2005a, Levey et al. 2005b) and their costs (e.g., Simberloff & Cox 1987, Simberloff et al. 1992, Hess 1994, Dunn 1996, Clinchy 1997, Earn et al. 2000, Hannon & Schmiegelow 2002, Orrock & Damschen 2005, Proches et al. 2005) for the better part of three decades and have yet to agree on a set of standards and principles to guide their design. Meanwhile, despite a lack of consensus about corridor science and faced with the mandate to halt and/or restore ecosystem degradation and species loss, conservation practitioners have been designing and implementing corridors at local (Burley 1995, Taylor et al. 1995, Bryant in press, Frischenbruder & Pellegrino in press), regional (Bueno et al. 1995, Fleury 1997, Hunter et al. 2003, Rottle in press, Toccolini et al. in press), state/multi-state (Dawson 1995, Foreman et al. 2000, Hoctor et al. 2000, Long & MacKay 2000, Noss 1999/2000, Quinby et al. 2000, Ryan et al. in press, Weber et al. in press), national (List & Manzano-Fischer 2002, Haaren & Reich in press, Tan in press, Turner in press, Yu et al. in press), and continental (Mann & Plummer 1993, Soule & Terborgh 1999, Raimer & Ford 2005) levels throughout the world. A primary motivation of these corridor initiatives is an acceptance of the need to act now or lose many habitats irrevocably (Reed 1996). Perhaps the most basic corridor design principle that can be derived from the corridor science to date, which has established that there are both benefits and costs associated with creating corridors, is that corridors will function optimally only if the unique ecological conditions of each corridor region are understood and reflected in the design of each individual corridor (Perault and Lomolino 2000).

Recently, coarse-scale, regional ecological features were assessed and analyzed for a corridor design proposal to maintain and restore wildlife habitat connectivity between Algonquin Park in central Ontario and Adirondack Park in northern New York State (Quinby et al. 1999, Quinby et al. 2000; see Fig. 1). For the New York portion of the Algonquin to Adirondacks (A2A) Corridor (focus of this study), these features included road density, presence of major roads, human population density, land cover type (30 categories), and hydrology at 90 x 90 m cell resolution for more than 2 million cells covering the 19,865 km^2 study area. The proposed A2A Corridor (in New York) is ~55 km in length, with an area of ~1,045 km^2, and varies in width from ~10 km at the northwest end to ~30 km at the southeast end. The Corridor location was selected primarily because of its high ecological integrity (lowest road density and human population density) relative to the other portions of the study area. The dominant ecosystem type within the study area and the A2A Corridor is maple-beech-birch forest (70% and 90%, respectively; Table 1). Of the 12 main ecosystem types in the study area, eight are well-represented (% difference <2%; Table 1) within the Corridor. However, the maple-beech-birch forest type is over-represented by ~20%, the spruce-fir (-3.96%), oak-hickory (-3.22%), and white-red-jack pine (-2.44%) forest types are all mildly under-represented, and non-forested

Figure 1. Four-County Study Area and Proposed A2A Corridor in New York State

terrestrial ecosystems are under-represented by ~10%. Wetland and aquatic ecosystems are well-represented within the Corridor.

Although the proposed Corridor is located in the portion of highest ecological integrity within the study area and represents the ecosystem types there fairly well, the ability of the Corridor to support species and communities at levels significantly higher than areas outside of the Corridor remains to be tested. Thus, the purpose of this study was to compare the abundance of breeding bird populations within the proposed Corridor to the abundance of breeding bird populations outside of the proposed Corridor area. Given its extensive size, the proposed Corridor provides permanent wildlife habitat as well as habitat for wildlife movement including migration (e.g., see animal home range sizes in DeGraff et al. 1992). For example, based on home range sizes for great horned owls in central New York (mean of 11.4 km^2/pair; Hagar 1957), which is the largest common top avian carnivore in the study area, the Corridor area can support a permanent population of ~90 pairs of these large predators.

Table 1. Ecosystem Types in the Proposed A2A Corridor in New York Compared with the Greater Study Area (numbers in parentheses for each column total to 100 as do the numbers in each column that are not in parentheses; adapted from Quinby et al. 1999)

Ecosystem Types	Greater Study Area		A2A Corridor		Difference (%)
	area (km^2)	%	area (km^2)	%	
Terrestrial Ecosystem Types	18,357	(92.41)	969	(92.73)	0.32
Maple-Beech-Birch Forest	13,876	69.85	940	89.95	20.10
Non-Forested Ecosystems	2,116	10.65	6	0.57	-10.08
Oak-Hickory Forest	848	4.27	11	1.05	-3.22
Spruce-Fir Forest	805	4.05	1	0.10	-3.96
White-Red-Jack Pine Forest	693	3.49	11	1.05	-2.44
Elm-Ash-Cottonwood Forest	19	0.10	0	0.00	-0.10
Wetland Ecosystem Types	987	(4.97)	56	(5.36)	0.39
Forested Wetlands	917	4.62	52	4.98	0.36
Non-Forested Wetlands	70	0.35	4	0.38	0.03
Aquatic Ecosystem Types	521	(2.62)	20	(1.91)	-1.01
Reservoirs	307	1.55	1	0.10	-1.45
Lakes	198	1.00	19	1.82	0.82
Bays and Estuaries	10	0.05	0	0.00	-0.05
Streams, Rivers and Canals	6	0.03	0	0.00	-0.03
Grand Total	19,865	100.00	1,045	100.00	

Methods

Bird species presence data from the New York State Breeding Bird Atlas (Andrle & Carroll 1988), which used 5 x 5 km survey blocks for the period 1980-85, were used to test the hypothesis that the abundance of breeding bird populations inside the A2A Corridor in New York is higher than the breeding bird abundance outside the Corridor. There are a number of limitations of this data set that are associated with using volunteers to collect data over a large (~20,000 km^2) and variable study area. Most importantly, few survey blocks resulted in a complete inventory of breeding birds due to variation in amount of time spent in each block, difficulty of access in some areas, weather, habitat type, and observer ability (Andrle & Carroll 1988). Despite these limitations many researchers have used breeding bird atlas data to address ecological questions at regional levels (e.g., Turner et al. 1988, Venier et al. 1999, Titeux et al. 2004, Shephard et al. 2005, Virkkala et al. 2005) including reserve design (Donald & Fuller 1998, Fairbanks et al. 2001, Gaston & Rodrigues 2003). Due to these limitations, particularly the difficulty of access within the Corridor where the presence of roads is roughly two thirds lower than outside the Corridor, only data resulting from the least demanding level of bird species and activity observation was used: (1) visual identification made during the breeding season in possible nesting habitat and/or (2) male song recognition or breeding calls heard during the breeding season (Andrle and Carroll 1988).

To test the hypothesis, the bird presence data for the 54 survey blocks within the 1,045 km^2 Corridor area were compared with the presence data for the 54 randomly chosen blocks outside of the Corridor area. Since the portion of the study area north of the Corridor made up 35% of the study area outside of the Corridor, 19 of the 54 blocks or samples (35%) were randomly located there. Similarly, 35 of the 54 samples (65%) were randomly located in the study area south of the Corridor. Since each inventory block was treated as an individual sample, abundance was determined by the number of blocks each species was observed in with a maximum abundance of 54 for a species either inside or outside the Corridor. To evaluate differences in abundance within versus outside the Corridor, bird species were classified into 14 guilds based on taxonomy and function (e.g., Bishop & Meyers 2004) according to Sibley (2003), and into a group associated with "mature and old-growth forest" based on DeGraaf et al. (1992), with a minimum of six species per group. Groups with less than six species were lumped together, e.g., the "wrens, kinglets, gnatcatchers, shrikes & vireos guild". The paired t-test was used to compare the mean abundance of the species in each group and for all species combined within the Corridor versus outside the Corridor.

Results & Discussion

The mean abundance of all 160 species seen or recognized by call during the breeding season in possible nesting habitat within the study area between 1980 and 1985 was 22.4% higher inside versus outside the New York portion of the A2A Corridor ($t=4.17$; $p=.000$, Table 2). Eleven bird guilds were more abundant inside the Corridor by at least 16%, however, only five of these guilds had differences that were statistically significant: (1) chickadees, nuthatches & allies; and tanagers, cardinals & allies (77.1% higher, $p=.018$), (2) wrens, kinglets, gnatcatchers, shrikes & vireos (53.8% higher, $p=.019$), (3) woodpeckers (50% higher, $p=.043$), (4) others (31% higher, $p=.014$), and (5) wood warblers (27% higher, $p=.011$). In addition, the abundance of mature & old-growth forest species was significantly higher inside the Corridor (29.5% higher, $p=.001$) compared with outside the Corridor. Three bird guilds were more abundant outside the Corridor by at least ~15%, however, none of these differences were statistically significant (Table 2). These three guilds included the wading birds; ducks, duck-like birds & swimming birds; and birds of prey & foul-like species.

Of the 160 bird species included in this study, 65 of them are known to prefer mature and old-growth forest habitat (DeGraaf et al. 1992). Although no direct measure of forest age and integrity is currently available for the Corridor area, low road density and human population generally indicate relatively high ecological integrity (Trombulack & Frissell 2000, Bishop & Meyers 2004). Road density outside of the Corridor is at least three times greater than inside the Corridor (DeLorme Mapping Company 1988) and human population is at least ten times higher outside of Corridor than inside the Corridor, based on the population of the seven largest cities and towns inside compared with outside the Corridor (U.S. Census Bureau 2005). Since ~92% of the landscape inside the Corridor is forested, much of the difference between the higher abundance of birds inside the Corridor compared to outside the Corridor is likely due to greater amounts of high integrity forested habitat in the Corridor. For six of the 11 guilds, at least 50% of their species are known associates of mature and old-growth forest including the finches & old world sparrows; thrushes; wood warblers; chickadees, nuthatches, tanagers, and cardinals; wrens, kinglets, gnatcatchers, shrikes & vireos; and the woodpeckers (Fig. 2). Of these guilds, the woodpeckers are most noted for their association with mature and old-growth forests (Mikusinski et al. 2001).

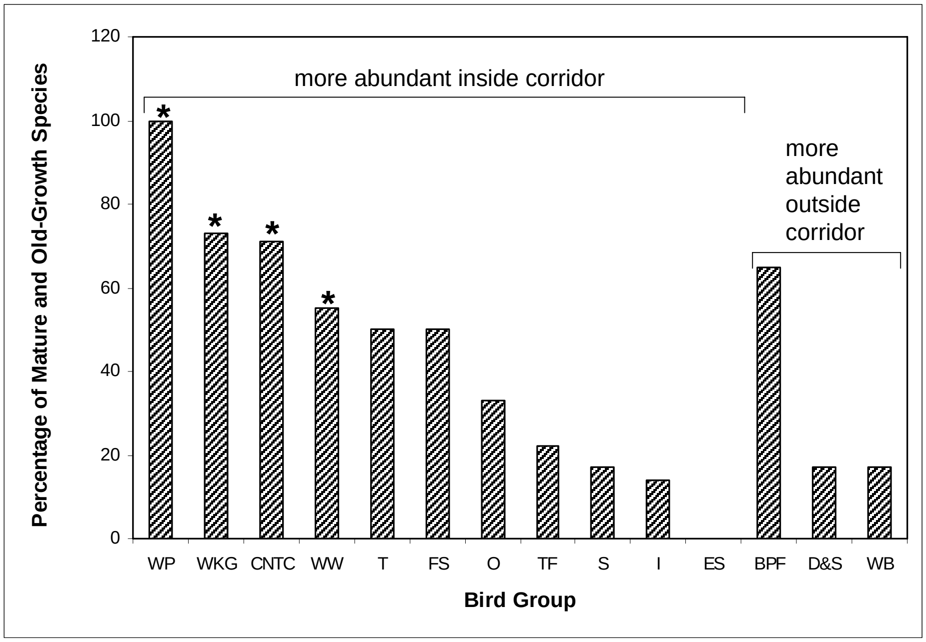
For the three guilds that are more abundant outside the Corridor, only the birds of prey & foul-like species guild has a high percentage of mature and old-growth forest associates (65%). With a large home range, it would not be unusual for a large avian predator with most of its home range inside the Corridor to be sighted along the boundaries of the Corridor, recorded as a sighting in a block outside of the Corridor, and not be recorded inside the Corridor due to its low road density and corresponding remote access. For example, the great horned owl, which breeds in the study area, has a mean home range of 11.4 km^2/pair (Hagar 1957) and a diameter of almost 4 km for a circular home range. This diameter represents 40% of the width of the Corridor at its narrowest location. The other two guilds that are more abundant outside the Corridor are composed of birds that are associated with aquatic habitats (Table 2). Representation of wetland ecosystems inside and outside the Corridor differs very little (0.39% higher inside), however, aquatic ecosystems have 1.01% greater representation outside the Corridor. In addition, the ~10 km of coastline along the St. Lawrence River inside the Corridor represents only 3.3% of the entire ~300 km Lake Ontario-St. Lawrence River coastline in the study area, whereas the Corridor makes up 5% of the study area resulting in under-representation by 1.7%.

Although the results of this study show that breeding birds in northwestern New York State generally prefer the A2A Corridor area, future work is needed to do similar analyses for other groups of taxa such as mammals, amphibians and reptiles, and vascular plants. In addition, more detailed studies of habitat composition and integrity both inside and outside of the Corridor are needed. Finally, studies alone will not protect species and ecosystems – parks, easements, and more ecologically-based resource management will be required to ensure a functional A2A Corridor.

Table 2. Mean Abundance (Number of Blocks) of Bird Guilds Inside Compared to Outside the Algonquin to Adirondack Wildlife Corridor in New York State

Bird Species Category (n=number of species)	**Inside Corridor (mean no. of blocks)**	**Outside Corridor (mean no. of blocks)**	**% Difference (Inside relative to Outside)**	**t-statistic & probability level**
chickadees, nuthatches & allies; tanagers, cardinals & allies (n=7)	**19.3**	**10.9**	**77.1**	**3.22; p=.018**
Icterids (n=7)	11.6	7.1	63.4	1.90; p=.106
wrens, kinglets, gnatcatchers, shrikes & vireos (n=11)	**8.0**	**5.2**	**53.8**	**2.80; p=.019**
woodpeckers (n=6)	**18.0**	**12.0**	**50.0**	**2.70; p=.043**
swallows (n=6)	6.8	4.7	44.7	1.17; p=.295
finches & old-world sparrows (n=7)	5.4	4.1	31.7	0.66; p=.531
others (n=17)	**14.8**	**11.3**	**31.0**	**2.76; p=.014**
mature & old-growth forest species (n=65)	**11.4**	**8.8**	**29.5**	**3.60; p=.001**
thrushes (n=6)	10.0	7.8	28.2	0.95; p=.387
tryant flycatchers (n=9)	11.4	8.9	28.1	1.43; p=.191
wood warblers (n=20)	**9.4**	**7.4**	**27.0**	**2.85; p=.011**
all species (n=160)	**9.3**	**7.6**	**22.4**	**4.17; p=.000**
Emberizine sparrows & allies (n=14)	10.0	8.6	16.3	1.20; p=.251
wading birds (n=12)	7.7	10.9	-29.8	-1.90; p=.085
ducks, duck-like birds & swimming birds (n=18)	2.3	2.7	-14.8	-0.61; p=.550
birds of prey & foul-like spp. (n=20)	5.8	6.8	-14.7	-1.17; p=.257

Figure 2. Percentage of Bird Species Associated with Mature and Old-Growth Forests within 14 Bird Guilds in the New York Portion of the A2A Corridor Area (WP-woodpeckers; WKG-wrens, kinglets, gnatcatchers, shrikes & vireos; CNTC-chickadees, nuthatches, tanagers, cardinals, & allies; WW-wood warblers; T-thrushes; FS-finches & old-world sparrows; O-others; TF-tryant flycatchers; S-swallows; I-Icterids; ES-Emberizine sparrows & allies; BPF-birds of prey & foul-like spp.; D&S-ducks, duck-like birds & swimming birds; WB-wading birds)



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