Response of avian communities to invasive bush honeysuckle (*Lonicera* spp.)

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PROJECT OBJECTIVES

The overall objective of this study is to assess the impact of invasive *Lonicera* spp. on avian communities. To reach this goal, I will address three key issues:

1) Comparison of bird communities at sites with invasive *Lonicera* spp. versus bird communities at sites with native flora in both the summer and winter. I will compare species richness and density of birds (individually and combined) between the two types of sites.

2) Comparison of summer versus winter bird communities within a site. I will determine whether bird species richness and density fluctuate with season and compare the changes in the communities over time for invaded and native sites.

3) The effects of colder temperatures on wintering bird communities. In addition to comparing invaded and native sites, I will further assess whether temperature has an effect on the differences or similarities of the communities in the two types of sites. Also, I will determine if there is a higher rate of removal for invasive *Lonicera* spp. fruits during colder periods and relate this to any changes in the density of birds.

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COMPLETED PROJECT DESCRIPTION

Invasive bush honeysuckle, *Lonicera* spp., is often considered undesirable, however it can create a dense understory for nests in the summer and provide a source of food for birds in winter. I investigated how avian communities respond to the presence of *Lonicera* spp. in the summer and winter in east central Illinois. During the summer, species that nest in the understory (e.g. northern cardinals, American robins, and gray catbirds) are more common in sites with *Lonicera* spp. These differences appear to be due to the percent of total shrub cover and *Lonicera* spp. cover. In contrast, eastern wood-pewees tend to avoid areas with *Lonicera* spp. Total density of birds and species richness was similar between *Lonicera* spp. and native shrub sites, but there was a difference in overall community structure. In the winter, local abundances of frugivorous birds (e.g. northern cardinals and American robins) are greater in *Lonicera* spp. areas. The total winter bird density was not different between sites, but did change over years. The winter avian community and species richness was similar between sites. In general, *Lonicera* spp. appears to be having a beneficial impact on several bird species in east central Illinois. While honeysuckle removal has obvious benefits for native plant communities, management strategies for *Lonicera* spp. often involve complete removal of an understory in forested areas. This may prove to be detrimental for shrub nesting birds and frugivorous birds in the winter if the loss of *Lonicera* spp. is not replaced with other native shrub species that can provide nesting substrate and a winter food resource. In addition, *Lonicera* spp. may be contributing to the range expansion of some frugivorous birds in the winter due to the increase in food resources.

INTRODUCTION

Invasive species are a growing global problem that can cause detrimental effects on native flora and fauna and often result in negative economic and environmental impacts (Pimentel et al. 2000). One way to assess the impact of invasive species on native flora and fauna is to compare community structure between areas with and without an invasive species. Native species can respond either negatively or positively to invasions by showing changes in density, species richness, diversity, survival, and fecundity. In theory, native species can respond to invasive species in four different ways: no response (equivalency), negatively (inhibition), positively (facilitation), or a combination of both positive and negative responses, such as increased species richness but decreased fecundity (compensation) (Sax et al. 2005). Many studies have focused on the negative impacts invasions have on the native biota through increased competition, predation, pest infestation, diseases susceptibility and loss of biodiversity (Rodriguez 2006). There is, however, the potential for invasions to lead to positive outcomes for native biota through facilitation.

Facilitation is the interaction of two species that results in at least one of the species experiencing an increase in local density, biomass or fitness. Native species may benefit from the presence of an invasive species through several different mechanisms including, but not limited to, habitat modification and/or trophic subsidy (Rodriguez 2006). Habitat modification, or ecosystem engineering, is the physical modification and/or creation of habitats (Jones et al. 1997). Invasive species can create novel habitat structure and can lead to changes in abiotic condition or provide refugia and/or substrata (Rodriguez 2006).

Trophic subsidy results in the enhanced availability of a food source either through an increase in nutrients, prey or hosts. Invasive species may provide a trophic subsidy by increasing the diversity of prey and providing a limiting resource to higher trophic levels. As the invading species becomes more abundant it is more likely that native species will use it as a food source (Rodriguez 2006). Both trophic subsidy and habitat modification can have impacts on the native flora and fauna of the area, including impacts on the avian community.

Many studies have focused on the response of avian communities to invasive non-native plants. Responses can greatly vary, however they are often negative, leading to a decreased density and/or richness of birds. For example, the grass *Phragmites australis* has been rapidly expanding into Connecticut wetlands where the number of bird species in *Phragmites* dominated marshes has diminished mostly due to the tall, thick, monoculture stands it creates through habitat modification (Benoit and Askins 1999). In Victoria, Australia native eucalypt forests have higher species richness and abundance than exotic pine plantations (Friend 1982) and South African native forests have higher species richness and abundance of birds compared to exotic pine plantations and non-native *Prosopis* woodlands (Armstrong and van Hensbergen 1994; Dean et al. 2002). Ferdinands et al. (2005) found that birds prefer native wetland habitats over areas invaded by para grass (*Urochloa mutica*).

Responses to invasive species may not necessarily lead to a decline in density or richness of birds, but may result in a change in the avian community structure. Despite the occurrence of invasive eucalypt trees in woodlots in California, avian species richness and patterns of diversity are similar when compared to native woodlots, however species composition differs markedly between the two sites (Sax 2002). Invasive saltcedar (*Tamarix chinensis*) and native cottonwood (*Populus fremontii* var. *wixlizeni*) also support similar bird species richnesses but with different species compositions (Ellis 1995).

Responses of avian communities fall mainly into the inhibition or equivalancy categories. Overall, very few studies have shown facilitative affects of invasive species on native bird species. In Malaysia, it was found that some groups of birds readily used an exotic tree plantation (*Albizia falcatoria*) due to the increased infestation of pest insects in the plantation, which provided an abundant food resource for insectivorous birds. However in this system, some avian groups were poorly represented due to lack of fruits and nest holes (Mitra and Sheldon 1993). While not a true facilitative response, the insectivorous birds did respond positively to the indirect food source the plantation provided. Another example of facilitation has occurred in Flathead Lake, MT, where introduced kokanee salmon (*Oncorhynchus nerka*) has lead to an increase in bald eagles (*Haliaeetus leucocephalus*) and recent declines in the salmon may lead to increased mortality of eagles due to the decrease in their other historic food resources (Spencer et al. 1991).

These two examples represent rare positive responses of native species to invasive species. However, some other invasive species may provide resources that lead to similar outcomes. This thesis investigates the potential positive impacts that invasive non-native *Lonicera* spp. (bush honeysuckles, hereafter referred to as *Lonicera* spp.) may play on avian communities. *Lonicera* spp. may positively affect birds in two ways; via habitat modification, through increase in understory density, and trophic subsidy, through provision of fruits in the late fall and winter when food sources are limited. During the breeding season, *Lonicera* spp. may provide ideal nesting substrate for shrub nesting birds due to its dense branch architecture and increased understory structure. During the winter, *Lonicera* spp. retain fruits into the winter months and may provide a limited food resource for overwintering birds.

Lonicera spp. were introduced from Eurasia during the mid-1700s and 1800s as ornamental shrubs (Wyman 1949; Dirr 1975; Luken and Thieret 1996). Habitat disturbance, creating more open sunlit habitats, is key to the invasion of these species and therefore they did not begin spreading across the eastern United States and into Ontario, Canada until the mid-1900s when more disturbance was occurring across the landscape (Pringle 1973; Nyboer 1992; Luken and Thieret 1996). Many different species of *Lonicera* spp. were introduced to the United States during this time, and in Illinois (the location of this study) there are now four primary invasive bush honeysuckle species, *Lonicera maackii*, *L. tatarica*, *L.* x *bella* and *L. morrowii*. *Lonicera maackii* is the most common and abundant in east central Illinois, *L. tatarica* and *L. x bella* are less common and *L. morrowii* is rare (J. Ellis, per comm). These species are all upright, multistemmed, deciduous shrubs that leaf out early in the spring and retain leaves late into the fall (Wyman 1949; Dirr 1975; Trisel and Gorchov 1994, Luken and Thieret 1996). The bright red fruits of invasive *Lonicera* spp. develop in the fall, are persistent into the winter and are primarily consumed and dispersed by birds (Ingold and Craycraft 1983; Luken and Thieret 1996; Drummond 2005; Bartuszevige and Gorchov 2006).

Ecological effects of invasive *Lonicera* spp. have been well documented and include diminished native plant richness, abundance, density, fecundity and survival in areas with invasive *Lonicera* spp. (Woods 1993; Gould and Gorchov 2000; Collier et al. 2002; Gorchov and Trisel 2003; Miller and Gorchov 2004). These effects may be due to shading or allelopathic compounds produced by invasive *Lonicera* spp., both of which can inhibit germination and growth of other plants (Nyboer 1992; Dorning and Cipollini 2006; Cipollini et al. 2008). The presence of *Lonicera* spp. can cause structural changes in the invaded habitats by creating a dense understory not historically found in these areas, which can ultimately lead to indirect effects on native fauna. Structural changes in vegetation brought about by *L. maackii* were shown to benefit the snake population while harming frog and turtle populations, resulting in an overall decrease in reptile and amphibian diversity and evenness (McEvoy and Durtsche 2004).

Birds nesting in invasive *Lonicera* spp. also suffer indirectly from structural changes in habitats. Several species of birds have been found nesting in *Lonicera* spp., including the wood thrush (unless otherwise noted, all scientific names of birds are in Table 4 or 8), gray catbirds, American robins and northern cardinals (Whelan and Dilger 1992; Hoover and Brittingham 1998; Schmidt and Whelan 1999; Borgmann and Rodewald 2004) . American robins and northern cardinals that nested in *Lonicera* spp. showed higher depredation and greater daily chick mortality rates compared to individuals that nested in native plants (Schmidt and Whelan 1999; Borgmann and Rodewald 2004). Invasive *Lonicera* spp. may provide a branch architecture that is appealing to birds as nest substrate, but also may allow increased predator movement (Whelan and Dilger 1992; Schmidt and Whelan 1999). In addition, nests in invasive *Lonicera* spp. tend to have a lower nest height and are initiated earlier in the spring due to *Lonicera*'s earlier leaf flush, both of which may contribute to increases in predation (Schmidt and Whelan 1999; Borgmann and Rodewald 2004). Despite the negative effects birds may be experiencing while nesting in *Lonicera* spp., the bushes do provide ideal branch architecture for nests (Whelan and Dilger 1992) and may result in increasing number of birds choosing invaded areas leading to an overall increase in density of birds.

Lonicera spp. may also have a positive effect on the wintering bird community. *Lonicera* spp. fruits are persistent into the late winter and can provide an extra food source for overwintering birds (Ingold and Craycraft 1983; Luken and Thieret 1996; Drummond 2005; Bartuszevige and Gorchov 2006). Generally it is thought that fall migrating birds (as well as other wildlife) are the primary consumers of fruits, but wintering birds may also consume fruits if they are persistent into the winter (McCarty et al. 2002). Fruit resources are important for overwintering birds when other resources (e.g. arthropods) are absent (Kwit et al. 2004). Other invasive species have been shown to provide these limited resources. Birds use invasive European privet (unless otherwise noted, all scientific names of plants are in Table 2) as a food supplement during the winter (Lochmiller 1978) and northern mockingbirds feed on invasive multi-flora rose hips during winter months (Stiles 1982).

The consumption of invasive *Lonicera* spp. fruits during the winter is no exception. The red fruits of *Lonicera* spp. are readily consumed by birds (Bergtold 1930; McRae 1980; Ingold and Craycraft 1983; White and Stiles 1992; Drummond 2005; Bartuszevige and Gorchov 2006). American robins are the primary consumers of *L. maackii* , but cedar waxwings, European starlings, hermit thrushes and northern mockingbirds are also major consumers of the fruits as well as twelve other species (Bartuszevige and Gorchov 2006). Even northern bobwhites (*Colinus viginianus*) consume *L. tatarica* in February in Georgia (McRae 1980). Birds are not the only frugivores eating invasive *Lonicera* spp. fruits. In central New York deer feces were found to contain honeysuckle remnants (*L. tatarica, L. morrowii* and *L*. x *bella*) (Vellend 2002) and in Ohio, small mammals use *L. maackii* as a food source during the early winter months (Williams et al. 1992).

While birds readily use invasive *Lonicera* spp. as a winter food source, it has been suggested that it and other winter fruit resources are poor quality foods. There are four patterns of fruit presentation throughout the year and *Lonicera* spp. fruits fall into the 'fall low-quality fruit' category. Fall low-quality fruits contain low lipid levels and are characterized by their presentation at the beginning or the peak of fall bird migration and are persistence on the plant well into winter (Stiles 1980). Invasive *Lonicera* spp. fruits are low-quality fruits because of their low protein and lipid content, making these fruits a poor energy source (Ingold and Craycraft 1983; White and Stiles 1992; Drummond 2005). While it has been shown that birds may actually prefer *L. tatarica* over other species (Drummond 2005), it is believed that consumption of higher quality foods (arthropods or other fruits) occurs first and that these low-quality fruits will be eaten last (Stiles1980; White and Stiles 1992). This may be one reason why *Lonicera* spp. fruits are retained into winter. While they are available to migrating birds during the fall, migrants choose other high quality resources first and leave the *Lonicera* spp. fruits. Frugivorous birds will track food resources which can lead to increases in density where resources are abundant (Rey 1995; Moegenburg and Levey 2003; Borgmann et al. 2004; Oliveira et al. 2006; Hasui et al. 2007). The consumption of *Lonicera* spp. fruits may lead to a short term increase in the density and abundance of frugivorous species in the winter and possibly long-term changes in migration, survival and range (Ingold and Craycraft 1983; White and Stiles 1992; Luken and Thieret 1996; Drummond 2005; Bartuszevige and Gorchov 2006).

Invasive *Lonicera* spp. plays an important role in the structure of forested landscapes in Illinois and surrounding areas. It can drastically change the composition and structure of vegetation in an area. While this is detrimental to many animal and plant species, breeding and overwintering birds may benefit if invasive *Lonicera* spp. provides a nesting substrate and a limited food source. This study investigated the potential differences in the breeding avian community and overwintering avian community between forested areas infested with *Lonicera* spp. and forested areas that contain native shrubs.

METHODS

Study Sites

Many forested areas in Illinois have been invaded by *Lonicera* spp., creating a dense monoculture understory in areas that historically have had a variety of shrubs in a more open understory. This study was conducted at ten sites in the east central Illinois area in Piatt, Champaign and Vermilion counties (see Table 1 for GPS locations and site names). Five sites contained *Lonicera* spp. and five contained a native shrub/sapling layer (hereafter referred to as native sites) (Figure 1). The native sites were chosen specifically to contain a native shrub/sapling layer. A list of shrubs and saplings that were found in these areas are in Table 2. In addition to the native shrubs, there were other invasive shrubs that were present in both types of sites, these included European privet, autumn olive and multi-flora rose. Within each of these sites I conducted unlimited radius point counts for assessing the avian community and vegetation surveys.

Field Methods

Avian counts. I estimated the local density of birds in the summers of 2006 and 2007 (May-June) and winters of 2006-2007 and 2007-2008 (December-February) using the unlimited point count method. The number of point counts within a site differed according to the size of the site, ranging from two to six in each site. Each point count was at least 200 meters from another point count and each was visited twice each summer and five times each winter. More point counts were conducted during the winter due to the increased movement and variability of bird populations. All counts lasted five minutes and were conducted between sunrise and 10am in the summer and between 8am and 1pm in the winter. During the five minute period I recorded and identified all birds heard and seen and estimated the distance to the bird. In addition, after the five minute point count during the second winter, I played a screech owl call on a FOXPRO XR6 game caller for one and a half minutes and record all birds that respond during the call and up to 30 seconds after the call.

Vegetation Surveys. Surveys for vegetation were based on the BBIRD field protocol (Martin et al. 1997) but were modified for relevance to this study. At each point count, four randomly positioned 5 x 5 meter plots were sampled for vegetation. Each plot was a random distance (up to 50 meters) from the point count. Direction of the plot from the point count was random with one restriction, each point count had a plot in each of four quadrats, northeast (0º-90º), southeast (91º-180º) southwest (181º-270º) and northwest (271º-360º). The chosen random point indicated the southwest corner of the plot. Rope with knots at five meter increments was used to mark off the plot. Within each plot all woody plants were identified and counted. Using a diameter tape, woody plants with a diameter at breast height (dbh) of 7 cm or greater were considered trees. Woody plants with dbh less than 7 cm were classified as shrub and included tree saplings since they are a part of the understory. All individual shrub stems at 10 cm above ground were counted and identified to species. *Lonicera maackii* is not reproductive less than one meter tall (Deering and Vankat 1999) therefore, only stems that were greater than a meter tall were counted. All stems less than one meter tall were considered part of the herb layer and were not individually measured. In addition, the percent cover of *Lonicera* spp. and total shrub layer in the plot was visually estimated.

Canopy closure was measured using a densiometer (Lemmon 1956). For each plot a densiometer reading was recorded from the center of the plot in each of the cardinal directions and an average canopy closure of the four measurements was used. In order to estimate ground cover, a 1 x 1 meter plot was constructed from wooden dowels. The plot was randomly placed within the four quadrats of the 5 x 5 meter plot (designated by the cardinal directions) and a percentage estimate to the nearest ten percent was recorded for amount of herb cover.

Analysis of Field Data

Habitat characteristics. To describe the difference in characteristics between the two types of sites, univariate t-tests were calculated on the vegetation characteristics between *Lonicera* spp. sites and native sites. Analyses were conducted on contiguous (the size of the forest tract) and sampled (the size of the actual area sampled) areas of the sites, percentage of total shrub cover, number of total shrub stems per hectare, percent of *Lonicera* spp. cover, number of *Lonicera* spp. stems per hectare, number of trees per hectare, percent herb cover and canopy closure. Species richness of shrubs was also calculated as average number of shrub species present per quadrat. In addition, a Pearson's correlation table was completed for the above variables in order to reduce redundancy in the data for further analysis; due to multiple comparisons, significance values were calculated with Bonferroni-Dunn test.

Avian densities. To investigate the differences in bird abundance and community, program DISTANCE 5.0 (Thomson et al. 2006) was used to estimate densities (birds per hectare) of birds. DISTANCE models the decline in detectability with distance from the observer of a species or group to generate an estimate of population density (Buckland et al. 2001). By calculating a detection probability, the program can take into account that an observer is unlikely to see or hear all birds during a point count. Due to low sample size, individual detection functions for each site were not available for computation, therefore all data was pooled to estimate detection functions. DISTANCE computations are robust to pooling of data across heterogeneity (Thomson et al. 2006). However, to incorporate some heterogeneity into the estimates, DISTANCE allows the addition of covariates that may play a role in an observers ability to detect a bird (Buckland et al. 2001, Buckland et al. 2004). I included, year, the average percent total shrub cover per site and the presence/absence of *Lonicera* spp. as covariates that may effect detection probabilities.

DISTANCE was used to estimate the density of total bird population, individual species, family guilds, habitat use guilds (summer only) and diet guilds (winter only). Since DISTANCE requires a minimum number of detections to obtain reliable estimates of density, estimates could not be obtained for all individual species. In order to incorporate more species into the analysis, species were classified into the above guilds based on The Birds of North America Online (Poole 2005). During the summer, I expect birds to be effected by the change in habitat due to *Lonicera* spp., therefore species were classified into habitat use guilds. These guilds include: Upper-story- species that nest and forage in the canopy, Mid-story- species that either nest or forage in both the canopy and the shrub layers and Low-story- species that forage and nest low to the ground and in shrubs. During the winter, I expect birds to respond to the novel food source *Lonicera* spp. provides, so I chose to place species into diet guilds. These diet guilds were not strict diet classifications due to the wide range of items birds will consume during the winter, therefore I chose to place species into guilds based on whether or not they will consume fruits during the winter, including the consumption of *Lonicera* spp. fruits. These categories included: Non-frugivorous- species that never consume fruits, Facultative frugivorous- species that will eat fruits if they were present, but not likely to seek them out and are a small proportion of their winter diet, and Frugivorous- species that consume a substantial amount of fruit during the winter. Akaike's Information Criterion (AIC) was used to chose between the models for the individual species or guilds.

Once generated, the average density estimates were compared between *Lonicera* spp. sites and native sites with repeated measure ANOVAs to address potential year*site effect. To further investigate the role of *Lonicera* spp. on the avian community, density estimates of the guilds (habitat use in the summer and diet in the winter) were also analyzed with robust regression with M-estimators and relevant habitat variables (robust regression were computated due to small sample size and the inclusion of outliers in the data). Since the guilds were specifically chosen to address which birds might be affected by *Lonicera* spp., only these were used in the regressions. Each robust regression included one of the following habitat variables: contiguous area, sampled area, percent total shrub cover, percent *Lonicera* spp. cover, canopy closure and shrub species richness. For each regression, Akaike Information Criterion values were calculated for small sample size (AICc) and used to compare models. Models with ΔAICc values less than two were considered competitive and were used to explain the data.

To obtain insight into the avian community structure, the individual species density estimates and the Paridae family guild were used in a principle component analysis (PCA) ordination. The Paridae family guild was included due to the similarity of the three species included in it, tufted titmouse, Carolina and black-capped chickadees. Due to low sample size, none of the other families could be calculated without one of the individual species that was already included in the PCA and therefore no other families could be used. Based on the PCA, I calculated factor scores for each site and used robust regressions with M-estimators to determine whether *Lonicera* spp. cover and/or total shrub cover was driving the variation in the factor scores. In addition, avian species richness (average number of species detected per point) were compared between the two types of sites using univariate t-tests. Due to the lack of consistent responses of birds to the screech owl recording in the second winter, the data was considered unreliable and further analysis could not be completed on it.

RESULTS

Vegetation surveys. Of the nine habitat characteristics that were measured at each site, total shrub stems per hectare, percentage of total shrub cover, *Lonicera* spp. stems per hectare and percent *Lonicera* spp. cover were different between the two types of sites. In both areas, trees per hectare, canopy cover and age were not different between the sites (Table 3). As expected, native sites had little or no *Lonicera* spp. present. The native sites had less total shrub cover, which appears to be the main difference between the two types of sites. The generated correlation matrix reveals that percent *Lonicera* spp. cover was negatively correlated with percent of other shrub species (r = -0.872, p= 0.045) and was positively correlated to *Lonicera* spp. stem density (r = 0.951, p= 0.001). Both of these variables were not used for further analyses. While not significant, percent total shrub cover and total shrub stems per hectare were correlated (r = 0.819, p= 0.169); and it was decided that only percent cover would be retained for other analyses. In addition, percent total shrub cover and percent *Lonicera* spp. were loosely correlated (r = 0.837, p= 0.113), but both were retained since *Lonicera* spp. is the focus of this study.

Summer avian communities. Over the two summers, I conducted 152 point counts (80 in *Lonicera* spp. sites and 72 in native sites) and recorded 68 species and 2076 individuals. A list of the 68 birds species can be found in Table 4. Sixteen species, nine family groups, three habitat use guilds and total bird density were analyzed with DISTANCE. Average density estimates over the two summers in *Lonicera* spp. and native sites can be found in Table 5. Differences between the density estimates were analyzed with repeated measures ANOVA (Table 6). Four species (American robin, blue jay, gray catbird and northern cardinal) show significant differences between *Lonicera* spp. and native sites. All four demonstrated increased density in the *Lonicera* spp. sites over both years. In contrast, the density the eastern wood-pewees was lower in *Lonicera* spp. sites. Two family groups, Mimidae and Turdidae, were more dense in *Lonicera* spp. sites. Densities of the Paridae and Tyrannidae were lower in *Lonicera* spp. sites. Densities of birds in the upper-story guild were similar in both sites over both years, however birds in the mid-story guild were more dense in *Lonicera* spp. sites and members of the lower-story guild showed a trend for increased densities in *Lonicera* spp. sites. Total bird density was similar between the *Lonicera* spp. sites and native sites over both years. Several species have differences in densities between the two years, however there were no strong site and year interactions.

Robust regression with M-estimators of the habitat use guilds indicate that different habitat variables are affecting the habitat guilds (Table 7). In 2006, the upper-story guild was most effected by the size of the contiguous habitat, while in 2007, contiguous habitat and percent of total shrub cover affected upper-story density estimates. The mid-story guild did not appear to be driven by any of the habitat variables in 2006 and only contiguous area in 2007. The lower-story guild appears to be most affected by percent total shrub cover and percent *Lonicera* spp. in 2006 and only percent total shrub cover in 2007.

The PCA for the summer species density estimates, including the Paridae family, indicate that the summer avian communities are different between *Lonicera* spp. and native sites in both years (Figure 2). Based on the Kaiser-Guttman criterion of eigenvalues >1 and the scree plot criterion (McGarigal et al. 2000), the first five components were retained in 2006, explaining 89% of the data. In 2007, five components were also retained, explaining 86% of the data. Component loadings >0.5 were considered important for the differences between the types of sites. In both years, most of the component loadings >0.5 were in the first two components and explained 55% of the data in 2006 and 49% in 2007. Regression of the first factor scores with percent *Lonicera* spp. and percent total shrub cover in both years indicates that in 2006, total shrub cover was predictive of the community of birds (R^2=0.678, $F_{1,8}$=16.817, p=0.003). In 2007, the first factor score was not as predictive, but percent cover of *Lonicera* spp. (R^2=0.315, $F_{1,8}$=3.682, p=0.091) was a better predictor than percent total shrub cover (R^2=0.091, $F_{1,8}$=1.983, p=0.197) . Mean species richness values were nearly identical for *Lonicera* spp. sites and native sites over both years (Figure 3).

Winter avian communities. Over the two winters, I conducted 380 point counts (200 in

Lonicera spp. sites and 180 in native sites) and recorded 36 species and 2693 individuals. List of species can be found in Table 8. Eight species, five families, three diet guilds and total bird density were analyzed using Distance to obtain density estimates (Table 9). These densities were used in repeated measures ANOVAs (Table 10). No species were significantly different between the two types of sites, however four species (American goldfinch, American robin, downy woodpecker and northern cardinal) showed strong trends toward increased in density in *Lonicera* spp. sites. Of the family groups, Fringillidae only had a strong difference between the two types of sites, while Emberzidae and Turdidae showed minor differences. All three families have increased densities in *Lonicera* spp. sites. Of the three diet guilds, only the frugivorous guild showed a marginal increase in *Lonicera* spp. sites. Densities of three species (blue jay, Carolina wren and red-bellied woodpecker) were different between years, but only total bird density showed an interaction between site and year. This interaction can be seen in Figure 4.

The diet guilds were used in robust regressions with M-estimators (Table 11). Results from the regressions indicate that in 2006-2007 the density of the non-frugivorous guild and the frugivorous guild are both affected by percent total shrub cover and percent *Lonicera* spp cover. Both guilds were positively affected by both shrub cover estimates. The density of the facultative frugivorous guild is affected positively by the contiguous area and negatively by the sampled area. In 2007-2008, we saw less conclusive evidence for what habitat variable is determining density of any of the three guilds.

The winter PCA, with individual species densities and the Paridae family, indicate that there is no difference between the two communities of birds (Figure 5). Following the same criteria from the summer PCAs, in 2006-2007, the first four components were retained and explained 88% of the data, in 2007-2008 the first three components were retained and explained 84% of the data. However, similar to the summer PCAs, the first two components contained most of the component loadings >0.5. These two factor loadings explained 53% of the variation in 2006 and 64% of the variation in 2007. Comparing the first factor score to percent *Lonicera* spp. cover and total shrub cover with robust regression with M-estimators does not indicate a pattern that is related to the percent cover of *Lonicera* spp. (2006-2007: R^2=0.000, $F_{1,8}$=0.081, p=0.783; 2007-2008: R^2=0.000, $F_{1,8}$=0.011, p=0.918) or total shrub cover (2006-2007: R^2=0.089, $F_{1,8}$=0.917, p=0.366; 2007-2008: R^2=0.152, $F_{1,8}$=1.478, p=0.259). Over the two winters, mean species richness values between sites were not different from each other (Figure 6).

DISCUSSION

Summer communities. Invasive *Lonicera* spp. is impacting the avian populations in east central Illinois forests during the summer and winter. During the summer months, we saw no difference in total bird density between *Lonicera* spp. sites and native shrub sites. However, birds in the families Turdidae and Mimidae, particularly American robins and gray catbirds, as well as northern cardinals were found at much higher densities in the *Lonicera* spp. areas. These are all birds that commonly use shrubs as nesting substrate. Shrub density was increased in the *Lonicera* spp. sites, indicating that these areas provide more nesting sites and substrate for these species of birds. Previous studies have shown that these birds do indeed use *Lonicera* spp. as a nesting substrate (Whelan and Dilger 1992; Schmidt and Whelan 1999; Borgmann and Rodewald 2004). *Lonicera* spp. in this case is positively affecting these birds through modification of the habitat, by increasing shrub density and creating more nesting sites. Even though the native sites did provide a shrub layer, the density of shrub cover was much lower and therefore fewer nest sites were available.

Despite this apparent benefit of invasive *Lonicera* spp., the use of *Lonicera* spp. for nesting may not be beneficial in the long-term. Previous research has indicated that American robin and northern cardinals nesting in *Lonicera* spp. experience higher daily predation rates and daily chick mortality rates (Schmidt and Whelan 1999; Borgmann and Rodewald 2004). This may be due to lower nest heights and/or earlier nest initiation in *Lonicera* spp., which may make nests more susceptible to predation. Birds that nest in *Lonicera* spp. may be falling into an ecological trap; nesting in *Lonicera* spp. may lead to a sink population that is responding to an over exaggerated cue (shrub density) that in the long-term may be detrimental.

In addition to the increased densities in shrub nesting birds, densities of blue jays also were higher in *Lonicera* spp. sites. While they do not nest in shrubs, blue jays are a common nest predator in Illinois and they may be benefiting from the increase in shrub nesting birds that are its prey (Schmidt and Whelan 1998; Schmidt and Whelan 2005), thereby indirectly benefiting from the presence of *Lonicera* spp.

The habitat use guilds indicate that the mid-story and lower-story birds were at higher density in *Lonicera* spp. sites. Both of these guilds include birds that use shrubs for either nesting or foraging substrate. However, we find that only the lower-story guild appears to be responding to the percent of total shrub cover and/or the percent of *Lonicera* spp. cover while the mid-story birds appear to be more responsive to the size of the sites. The American robin, gray catbird and northern cardinal are all included in the lower-story guild and are attracted to areas that have higher shrub density. Total shrub cover and *Lonicera* spp. cover are correlated characteristics, so it is not surprising that both were included in model selection in the first summer.

The upper-story guild of birds was most affected by the size of the site in both years, but also negatively affected by the percent of total shrub the second year. This is not surprising as two groups of upper-story birds appear to avoid *Lonicera* spp. areas. The Paridae and Tryannidae families both show trends for decreases in density in *Lonicera* spp. sites. A Tryannidae family member, the eastern wood-pewee, was rarely found in *Lonicera* spp. sites. Studies involving the removal of understory shrubs have shown similar effects on eastern wood-pewees; once the understory is removed the densities of these birds increased (Stauffer and Best 1980; Wilson et al. 1995; Rodewald and Smith 1998). Due to the nature of the eastern wood-pewee's aerial foraging strategy, the dense *Lonicera* spp. understory may prohibit efficient foraging (Rodewald and Smith 1998).

These differences in bird densities have led to a change in the summer avian community structure. As we saw in the principal component analysis, the two groups of sites appear to separate themselves based on the amount of total shrub cover and *Lonicera* spp. cover. This is most likely due to the increase of lower-story birds and a decrease in a few upper-story birds in *Lonicera* spp. sites leading to an overall change in the community. Species richness indicated that the number of species seen in either site was similar, but the species observed are different at the different types of site. Several other studies have shown similar trends, where some groups of birds benefit from the invasive species and others are negatively affected (Friend 1982; Fraser and Crowe 1990; Mitra and Sheldon 1993; Ellis 1995; Benoit and Askins 1999; Sax 2002). The presence of *Lonicera* spp. leads to an increase in lower-story nesting birds, but not upper-story birds in the summer.

Winter communities. During the winter of 2006-2007 we saw a large increase in the total number of birds in the *Lonicera* spp. sites, as was predicted based on the winter food resources provided by *Lonicera* spp, but we did not see this difference in the winter of 2007-2008. However, bird densities were similar between native and *Lonicera* spp. sites in the winter of 2007-2008 due to the increased density of birds in the native sites. In the spring of 2007, east central Illinois experienced a late hard freeze that appeared to have damaged some of the *Lonicera* spp. bushes, leading to a visual decrease in the number of fruits that were produced by the plants (C. M^{c}Cusker, pers. obs.). There were, however, some *Lonicera* spp. fruit in all of the *Lonicera* spp. sites, though in reduced abundance at some sites. In addition, whether or not related to the freeze, multi-flora rose appeared to produce a larger number of rose hips during the fall and winter of 2007-2008 than in the previous year. Multi-flora rose was found in all the sites in this study and produced rose hips that were also available to birds during the winter months and which, more importantly, are readily consumed by frugivorous birds (Schmid 1958; Morgan and Gates 1982; Stiles 1982). Fruit from the multi-flora rose never appeared to be as abundant as *Lonicera* spp. fruits, however rose did provide a source of food in the native sites that was less abundant in the first winter and which may have ultimately led to an increase in birds in the native areas during the second winter. We can see that something changed from the first year to the second in the habitat characteristics that predict the diet classes. In the first year, the birds in the frugivorous guild were being driven by the amount of *Lonicera* spp. cover and total shrub cover, however in the second year there is no clear predictor of the distribution of the frugivorous birds, or for that matter members of the other two diet guilds. Despite the differences over years in total density of birds and bird guilds some species still maintained a preference for the *Lonicera* spp. sites.

American goldfinches, American robins, downy woodpeckers and northern cardinals were all more common in *Lonicera* spp. sites. These species will consume *Lonicera* spp. fruits (Bergtold 1930; Ingold and Craycraft 1983; Bartuszevige and Gorchov 2006). None of the individual species showed decreases in *Lonicera* spp. sites. The three family groups that were more dense in *Lonicera* spp. sites, Emberzidae, Fringillidae and Turdidae, all include species that readily consume fruits during the winter. Other studies have shown that members of the Turdidae family, including the American robin, are primary consumers and dispersers of *Lonicera* spp. fruits and may be contributing to the spread of the plant (Bergtold 1930; Ingold and Craycraft 1983; Bartuszevige and Gorchov 2006).

Over the two winters several species were observed consuming *Lonicera* spp. fruits, including northern cardinals, American robins, American goldfinches, cedar waxwings, purple finches and house finches (C. McCusker pers. obs.). Cedar waxwings are another primary consumer of *Lonicera* spp. fruits (Ingold and Craycraft 1983; Drummond 2005; Bartuszevige and Gorchov 2006) and research has shown that their consumption of *Lonicera* spp. fruits often leads to changes in the color of their rectrices from yellow to orange (Mulvihill et al. 1992; Witmer 1996). Cedar waxwings are common in central Illinois in the winter and were expected to be numerous in these areas, but in this study their sample size was unexpectedly low and density estimates could not be obtained. However, observations of cedar waxwings only occurred in *Lonicera* spp. sites and almost all were observed in *Lonicera* spp. bushes, indicating a clear preference for sites with *Lonicera* spp.

Despite the fact that a few species show a preference for *Lonicera* spp. sites during the winter, the overall community structure was not different between the two types of sites. This is not unexpected, as birds during the winter are very mobile and may be only visiting a site for a couple of days depending on the availability of appropriate resources. Those species that favored *Lonicera* spp. sites may have found resources in the sites (like *Lonicera* spp. fruits) that provoked them to stay and increase in density. Overall, the winter avian community does not appear to be affected by the presence of *Lonicera* spp. A few species do show preferences for the *Lonicera* spp. indicating a positive affect from the invasive plant, however, unlike during the summer, no species or groups appear to be negatively affected by *Lonicera* spp.

The short-term effects of *Lonicera* spp. invasion may lead to an increase in density of bird species in a localized area during the winter, however as this invasive food source becomes persistent over time, long-term effects may lead to changes in migration patterns, range expansion and survival of frugivorous birds (White and Stiles 1992). Several factors may influence range expansion, one possibility is the provision of extra food sources, during the winter. Due to the fact that food sources are most limited in the winter, if an extra food source is provided for birds they may be able to use this resource to survive colder temperatures and thus expand northward. Northern mockingbirds have been found to expand their range during the winter with the provision of multi-flora rose hips (Stiles 1982) and invasive *Lonicera* spp. may be providing a similar limited food source and facilitating range expansion of other overwintering birds.

Implications for management. Due to the negative effects of *Lonicera* spp. on the native plant community (Nyboer 1992; Woods 1993; Gould and Gorchov 2000; Collier et al. 2002;

Gorchov and Trisel 2003; Miller and Gorchov 2004; Dorning and Cipollini 2006; Cipollini et al. 2008), it is actively being removed, an action that may affect both summer and winter bird communities. Forested areas invaded by *Lonicera* spp. often have little or no other native shrub layer, leading to a complete loss of an understory when *Lonicera* spp. is removed. This can lead to a loss of nesting substrate for birds during the summer and a loss of a limited food resource during the winter. As this study indicates, some birds may be negatively affected by the removal of *Lonicera* spp, such as American robins and northern cardinals, but some, like the eastern wood-pewee, may benefit. While ultimately the removal of *Lonicera* spp. may prevent nesting birds from falling into an ecological trap (Schmidt and Whelan 1999; Borgmann and Rodewald 2004), total loss of a shrub layer may discourage many birds from using an area. Land managers removing invasive *Lonicera* spp. may need to consider replacement of *Lonicera* spp. with native shrubs that can provide comparable nesting substrate and food resources. *Lonicera* spp. is a difficult plant to eradicate and control methods may need to go beyond simple removal of the species where it may take several years for a native shrub understory to establish (Luken et al. 1997; Hartman and McCarthy 2004; Runkle et al. 2007). Management strategies may have to include planting of native shrubs that can supply nesting substrates and food resources as well as establish a source for the spread of native shrub seeds.

SUMMARY

In summary, during the summer, shrub nesting birds preferred areas with *Lonicera* spp. while the eastern wood-pewee avoided these areas. Total summer bird density was not different between the two types of sites, however the community of birds changed between them. Species richness was similar between the sites.

During the winter, frugivorous birds tended to prefer areas with *Lonicera* spp., however they showed differences between the two years. Total winter bird density was also different over years, in the first winter, density of birds was much higher in *Lonicera* spp. sites, while in the second winter the two sites had similar densities of birds. No birds appeared to avoid *Lonicera* spp. sites in the winter. The community of birds and species richness of birds was similar between the two types of sites.

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TABLES

Table 1. Locations of the ten sites used in this study.

Site name	**Site**	**Latitude**	**Longitude**	**Section**	**Township**	**Range**	**Township Name**
Philips Tract	1	40.129224015	-88.151451889	2	19N	R9E 3PM	Urbana
Taylor (private property)	2	39.982803063	-88.657124480	29	18N	R5E 3PM	Willow Branch
Kickapoo State Park	3	40.158968372	-87.746124342	32	20N	R12W 2PM	Oakwood
Homer Lake Forest Preserve	4	40.065357853	-87.981903171	31	19N	R14W 2PM	South Homer
Nanney Research Area	5	39.886419475	-88.178725932	34	17N	R9E 3PM	Crittenden
Rutan Research Area	6	40.073234746	-87.908506449	26	19N	R14W 2PM	Vance
Allerton Park	7	40.001201844	-88.634305710	21	18N	R5E 3PM	Willow Branch
Middle Fork Woods Nature Preserve	8	40.142647885	-87.744746190	5	19N	R12W 2PM	Oakwood
Vermilion River Observatory-A	9	40.065283002	-87.557355920	36	19N	R11W 2PM	Danville
Vermilion River Observatory-B	10	40.068148775	-87.561609400	36	19N	R11W 2PM	Danville

Table 2. Shrubs and tree saplings (dbh < 7cm) recorded in the ten sites. X indicates a species was found in at least one plot.

		***Lonicera* spp sites**					**Native sites**				
Scientific name	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Acer negundo	Boxelder	X									
Acer saccharum	Sugar maple			X			X		X		X
Aesculus glabra	Ohio buckeye			X			X				
Ailanthus altisima	Tree of heaven						X				
Carya cordiformes	Bitternut hickory						X				
Carya glabra	Pignut hickory							X		X	
Carya ovalis	Red hickory										X
Carya ovata	Shagbark hickory			X			X				
Celtis occidentalis	Common hackberry		X				X	X			X
Cercis canadensis	Eastern redbud			X							
Cornus drummondi	Roughleaf dogwood			X	X		X		X	X	X
Cornus florida	Flowering dogwood								X		
Crataegus crus-galli	Cockspur hawthorn					X					
Crataegus mollis	Downy hawthorn	X				X					
Crataegus pruinosa	Waxyfruit hawthorn									X	X
Crataegus sp.	Hawthorn sp.	X					X				X
Diospyros virginiana	Common persimmon									X	
Elaeagnus umbellata	Autumn olive	X	X	X	X				X	X	X
Fraxinus americana	White ash		X				X	X	X	X	X
Fraxinus pennsylvanica	Green ash		X	X					X		
Gleditsia triacanthos	Honeylocust			X			X				X
Ligustrum vulgare	European privet							X			
Lindera benzoin	Northern spicebush			X					X		

Table 2. Con't

		***Lonicera* spp sites**					**Native sites**				
Scientific name	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Liriodendron tulipifera	Tuliptree									X	
Lonicera spp.	Bush honeysuckles	X	X	X	X	X			X	X	X
Morus alba	White mulberry	X	X		X						
Ostrya virginiana	Hophornbeam						X				
Prunus serotina	Black cherry	X	X	X	X	X	X		X		X
Ptelea trifoliata	Common hoptree										X
Quercus imbricaria	Shingle oak		X	X		X					
Quercus macrocarpa	Bur oak						X			X	
Quercus muehlenbergii	Chinkapin oak			X							
Quercus sp.	Oak sp.		X								
Quercus velutina	Black oak										X
Ribes missouriense	Missouri gooseberry		X	X			X	X	X	X	
Rosa multiflora	Multi-flora rose	X	X	X	X	X	X	X	X	X	X
Sassafras albidum	Sassafras								X		X
Staphylea trifolia	American bladdernut		X					X			
Symphoricarpos orbiculatus	Coralberry										X
Tilia americana	American basswood						X				
Toxicodendron radicans	Easter poison ivy						X			X	
Ulmus americana	American elm	X	X	X					X		X
Ulmus rubra	Slippery elm						X	X		X	
Viburnum prunafolium	Blackhaw			X				X	X		X
Zanthoxylum americanum	Common pricklyash				X			X			

Table 3. Vegetation characteristics of *Lonicera* spp. and native shrub sites (n=10). *t*-tests indicate habitat differences between sites, df = 8 for all tests.

Habitat variable	**Mean in *Lonicera* sites (± 1 SE)**	**Mean in native sites (± 1 SE)**	**p**
Area sampled (ha)	12.41 ± 1.43	11.12 ± 0.98	0.615
Contiguous area (ha)	426.14 ± 149.34	428.25 ± 145.47	0.994
Lonicera spp cover (%)	48.81 ± 6.17	0.00	n/a
Lonicera spp stems per hectare	9194.33 ± 846.10	30.67 ± 13.05	0.000
Total shrub cover (%)	62.59 ± 3.25	40.50 ± 3.99	0.016
Total shrub stems per hectare	14068.33 ± 686.54	8091.33 ± 1066.83	0.010
Shrub species richness	2.52 ± 0.46	3.73 ± 0.49	0.240
Trees per hectare	642.67 ± 81.56	640.67 ± 65.15	0.990
Canopy cover (%)	90.07 ± 1.52	90.50 ± 2.51	0.921
Herb cover (%)	50.79 ± 4.59	56.41 ± 4.78	0.566

Table 4. Summer bird species recorded in the ten sites. X indicates species occurring in at least one point count in either 2006 or 2007. XX indicates species present in at least one point count in both years.

			***Lonicera* spp sites**					**Native sites**				
Family	**Scientific name**	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Accipitridae	*Accipiter cooperii*	Cooper's hawk								XX		
	Buteo jamaicensis	Red-tailed hawk					X					
Bombycillidae	*Bombycilla cedrorum*	Cedar waxwing	X	X	X	XX	X	XX				X
Cardinalidae	*Cardinalis cardinalis*	Northern cardinal	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Passerina cyanea	Indigo bunting	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Pheucticus ludovicianus	Rose-breasted grosbeak	XX									
Columbidae	*Zenaida macroura*	Mourning dove	XX	XX	X	XX	XX	XX	X		X	XX
Corvidae	*Corvus brachyrhynchos*	American crow	X	XX		X	X	X	X	X	X	
	Cyanocitta cristata	Blue jay	XX	XX	X	XX	XX	XX	X	X	X	X
Cuculidae	*Coccyzux americanus*	Yellow-billed cuckoo	XX	XX			XX	XX	XX	X		X
Emberizidae	*Melospiza melodia*	Song sparrow	XX				XX	X			X	X
	Pipilo erythrophthalmus	Eastern towhee	XX	XX	X	XX	XX	XX	XX	X	XX	XX
	Spizella passerina	Chipping sparrow	X	XX					XX	X		
	Spizella pusilla	Field sparrow	XX	XX		X	XX	XX			XX	XX
Fringillidae	*Carduelis tristis*	American goldfinch	XX	X	XX	X	X	X		XX	X	XX
Icteridae	*Agelaius phoeniceus*	Red-winged blackbird	XX	X			XX					
	Icterus galbula	Baltimore oriole	X		X	XX	X	X				
	Icterus spurius	Orchard oriole	X									
	Molothrus ater	Brown-headed cowbird	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Quiscalus quiscula	Common grackle	XX	X							X	
	Sturnella magna	Eastern meadowlark	XX									

Table 4. Con't

			***Lonicera* spp sites**					**Native sites**				
Family	**Scientific name**	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Mimidae	*Dumetella carolinensis*	Gray catbird	XX	XX	XX	XX	XX	X	X		X	X
	Mimus polyglottos	Northern mockingbird		X								
	Toxostoma rufum	Brown thrasher	XX		X	X	X			X	XX	XX
Paridae	*Baeolophus bicolor*	Tufted titmouse		XX		XX	XX	XX	XX	XX	X	X
	Poecile carolinensis	Carolina chickadee	X	X	X		XX	X	XX	XX	XX	X
Parulidae	*Dendroica dominica*	Yellow-throated warbler			X							
	Dendroica magnolia	Magnolia warbler						X				
	Dendroica petechia	Yellow warbler			X							
	Geothlypis trichas	Common yellowthroat	XX	XX	X	X	XX	XX	X	X	XX	XX
	Icteria virens	Yellow-breasted chat		X								
	Oporornis formosus	Kentucky warbler			X				X	X		X
	Oporornis philadelphia	Mourning warbler										X
	Parula americana	Northern parula			X			X	X	X		X
	Seiurus aurocapilla	Ovenbird					X	X		X		
	Seiurus motacilla	Louisiana waterthrush								X		
	Setophaga ruticilla	American redstart			XX	X			X			
	Vermivora peregrina	Tennessee warbler			X						X	
	Wilsonia canadensis	Canada warbler				X						
Picidae	*Colaptes auratus*	Northern flicker	X	X		X	X					X
	Dryocopus pileatus	Pileated woodpecker								X		
	Melanerpes carolinus	Red-bellied woodpecker	XX	XX	XX	X	XX	XX	XX	XX	X	XX
	Melanerpes erythrocephalus	Red-headed woodpecker		X				X				
	Picoides pubescens	Downy woodpecker	XX		X		XX	X		XX	X	X
	Picoides villosus	Hairy woodpecker								X		

Table 4. Con't

			***Lonicera* spp sites**					**Native sites**				
Family	**Scientific name**	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sittidae	*Sitta carolinensis*	White-breasted nuthatch	X	XX	X		XX	XX	X	XX	XX	XX
Strigidae	*Strix varia*	Barred owl				X						
Sylviidae	*Polioptila caerulea*	Blue-gray gnatcatcher			X		XX	X	X	XX		XX
Thraupidae	*Piranga olivacea*	Scarlet tanager								X		
Trochilidae	*Archilochus colubris*	Ruby-throated hummingbird		X					X	X		XX
Troglodytidae	*Thryothorus ludovicianus*	Carolina wren	XX	XX	XX	X	XX	X	XX	XX		
	Troglodytes aedon	House wren	XX	XX		XX	XX		XX	XX	XX	XX
Turdidae	*Catharus minimus*	Gray-cheeked thrush				X						
	Catharus ustulatus	Swainson's thrush	X									
	Hylocichla mustelina	Wood thrush	XX	XX	XX	XX	XX	X	XX		X	X
	Sialia sialis	Eastern bluebird		X						X		
	Turdus migratorius	American robin	XX	XX	XX	XX	XX	XX	XX	XX		X
Tyrannidae	*Contopus virens*	Eastern wood-pewee	X	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Empidonax alnorum	Alder flycatcher	X									
	Empidonax flaviventris	Yellow-bellied flycatcher	X					X				
	Empidonax minimus	Least flycatcher			X							
	Empidonax virescens	Acadian flycatcher			XX		X	X	XX	XX		X
	Myiarchus crinitus	Great-crested flycatcher	X	XX	X	X	XX	XX	XX	XX	XX	XX
	Sayornis phoebe	Eastern phoebe						X				
Vireonidae	*Vireo flavifrons*	Yellow-throated vireo						X		X		
	Vireo gilvus	Warbling vireo	X									
	Vireo griseus	White-eyed vireo		X							XX	XX
	Vireo olivaceus	Red-eyed vireo	XX	X	XX	X	X	XX	XX	XX	X	X

Table 5. Mean density of birds (birds/hectare) in *Lonicera* spp. and native sites in the summers of 2006 and 2007.

	2006		**2007**	
Species or guild	**Mean in *Lonicera* sites (± 1 SE)**	**Mean in native sites (± 1 SE)**	**Mean in *Lonicera* sites (± 1 SE)**	**Mean in native sites (± 1 SE)**
American robin	2.63 ± 0.65	0.75 ± 0.29	2.48 ± 1.49	0.38 ± 0.17
Blue jay	1.56 ± 0.51	0.10 ± 0.07	1.83 ± 0.45	1.10 ± 0.34
Brown-headed cowbird	2.39 ± 0.32	3.23 ± 0.65	3.05 ± 0.84	1.58 ± 0.31
Carolina wren	0.30 ± 0.10	0.15 ± 0.09	0.41 ± 0.11	0.15 ± 0.07
Common yellowthroat	0.48 ± 0.08	0.26 ± 0.12	0.23 ± 0.11	0.20 ± 0.09
Eastern wood-pewee	0.23 ± 0.09	0.81 ± 0.22	0.43 ± 0.11	0.82 ± 0.17
Eastern towhee	0.80 ± 0.26	1.73 ± 0.48	0.89 ± 0.21	1.29 ± 0.27
Gray catbird	3.47 ± 0.82	0.40 ± 0.28	4.00 ± 1.10	0.88 ± 0.60
Great-crested flycatcher	0.43 ± 0.15	0.47 ± 0.14	0.33 ± 0.14	0.48 ± 0.12
House wren	1.02 ± 0.36	0.63 ± 0.30	1.94 ± 0.59	0.86 ± 0.42
Indigo bunting	2.74 ± 0.41	2.23 ± 0.44	2.53 ± 0.44	2.98 ± 0.38
Northern cardinal	2.58 ± 0.35	1.49 ± 0.35	4.15 ± 0.48	2.97 ± 0.55
Red-bellied woodpecker	0.24 ± 0.07	0.22 ± 0.06	0.29 ± 0.08	0.58 ± 0.09
Red-eyed vireo	0.13 ± 0.10	0.56 ± 0.26	0.79 ± 0.19	1.56 ± 0.50
White-breasted nuthatch	0.45 ± 0.14	0.35 ± 0.10	0.19 ± 0.09	0.38 ± 0.15
Wood thrush	0.75 ± 0.23	0.23 ± 0.19	0.88 ± 0.30	0.49 ± 0.21
Emberzidae	1.09 ± 0.33	2.09 ± 0.54	1.65 ± 0.26	2.71 ± 0.75
Icteridae	3.71 ± 0.36	3.26 ± 0.70	3.71 ± 0.36	3.26 ± 0.70
Mimidae	2.10 ± 0.41	0.61 ± 0.23	2.55 ± 0.77	0.78 ± 0.44
Paridae	1.61 ± 0.84	4.04 ± 1.25	2.14 ± 0.69	3.50 ± 0.72
Picidae	0.99 ± 0.18	0.57 ± 0.17	0.87 ± 0.27	1.43 ± 0.26
Troglodytidae	1.26 ± 0.31	0.80 ± 0.36	2.24 ± 0.49	0.95 ± 0.42
Turdidae	3.04 ± 0.51	0.91 ± 0.27	3.13 ± 0.40	1.01 ± 0.24
Tyrannidae	0.76 ± 0.19	1.54 ± 0.40	0.91 ± 0.22	1.66 ± 0.29
Vireonidae	0.32 ± 0.17	1.10 ± 0.28	0.96 ± 0.23	2.09 ± 0.55
Upper-story	5.07 ± 1.46	6.82 ± 1.62	4.91 ± 0.71	8.20 ± 1.51
Mid-story	5.03 ± 1.74	1.44 ± 0.66	3.75 ± 0.78	3.29 ± 0.85
Lower-story	14.21 ± 1.33	9.53 ± 1.21	17.92 ± 1.75	12.47 ± 1.54
Total	26.12 ± 2.31	21.27 ± 2.11	29.51 ± 2.32	26.62 ± 1.57

Table 6. Effects of site type and year on summer bird densities. Results are from a repeated measures ANOVA based on the presence and absence of *Lonicera* spp. df = 1 for all tests.

	Site			**Year**			**Site*year interaction**		
Species or guild	**SS**	**F**	**p**	**SS**	**F**	**p**	**SS**	**F**	**p**
American robin	19.84	13.11	0.007*	0.34	0.78	0.404	0.06	0.14	0.719
Blue jay	5.92	9.31	0.016*	2.02	2.04	0.191	0.67	0.68	0.435
Brown-headed cowbird	0.48	0.39	0.549	1.25	0.72	0.421	6.67	3.86	0.085
Carolina wren	0.21	3.00	0.121	0.01	0.65	0.442	0.02	0.76	0.408
Common yellowthroat	0.09	2.11	0.184	0.13	7.61	0.025*	0.05	2.76	0.135
Eastern wood-pewee	1.16	5.04	0.055	0.06	0.44	0.526	0.04	0.32	0.588
Eastern towhee	2.22	2.38	0.162	0.16	0.27	0.617	0.34	0.59	0.464
Gray catbird	47.68	13.32	0.006*	1.27	0.40	0.545	0.00	0.00	0.975
Great-crested flycatcher	0.04	0.47	0.515	0.01	0.15	0.711	0.01	0.22	0.648
House wren	2.66	0.76	0.408	1.66	7.88	0.023*	0.60	2.84	0.130
Indigo bunting	0.00	0.00	0.951	0.36	0.32	0.590	1.15	1.00	0.347
Northern cardinal	6.46	6.43	0.035*	11.66	13.05	0.007*	0.01	0.01	0.918
Red-bellied woodpecker	0.09	1.55	0.248	0.22	4.47	0.067	0.12	2.40	0.160
Red-eyed vireo	1.79	1.13	0.318	3.44	19.68	0.002*	0.15	0.85	0.385
White-breasted nuthatch	0.01	0.10	0.763	0.07	1.18	0.308	0.11	1.94	0.201
Wood thrush	1.01	3.01	0.121	0.18	0.67	0.437	0.02	0.08	0.786
Emberzidae	5.33	1.34	0.281	1.74	2.56	0.148	0.01	0.01	0.925
Icteridae	7.78	2.13	0.183	3.10	1.80	0.216	3.10	1.80	0.216
Mimidae	13.32	6.85	0.031*	0.47	0.62	0.452	0.10	0.13	0.725
Paridae	17.79	3.95	0.082	0.00	0.00	0.995	1.44	0.40	0.545
Picidae	0.03	0.04	0.843	0.69	2.87	0.129	1.22	5.06	0.055
Troglodytidae	3.82	1.29	0.289	1.60	9.82	0.014*	0.85	5.20	0.052
Turdidae	22.69	24.52	0.001*	0.05	0.07	0.805	0.00	0.00	0.988
Tyrannidae	2.92	3.47	0.100	0.09	0.32	0.589	0.00	0.01	0.942
Vireonidae	4.55	2.59	0.146	3.28	10.21	0.013*	0.15	0.47	0.512
Upper-story	31.85	1.03	0.339	1.86	0.28	0.613	2.98	0.44	0.524
Mid-story	20.54	6.22	0.037*	0.40	0.07	0.798	12.28	2.14	0.182
Lower-story	128.27	3.81	0.087	55.41	7.52	0.025*	0.74	0.10	0.759
Total	74.85	1.81	0.216	95.44	2.80	0.133	4.77	0.14	0.718

Table 7. AICc analysis of robust regressions with M-estimators on the summer habitat-use guilds and habitat characteristics. Results are in order of the model with the lowest AICc to the highest within each guild. Parameters (K) = 3 for all models.

Models	**Estimate**	**R^2**	**AICc**	**ΔAICc**	**Likelihood**	**Weight**
2006						
Upper-story						
Contiguous area (ha)	0.01	0.60	31.24	0.00	1.00	0.84
% Total shrub cover	-0.19	0.34	35.88	4.64	0.10	0.08
Canopy cover	0.33	0.26	37.23	5.99	0.05	0.04
% *Lonicera* spp cover	-0.05	0.10	38.98	7.74	0.02	0.02
Shrub species richness	0.08	0.00	39.96	8.72	0.01	0.01
Sampled area (ha)	0.18	0.01	40.14	8.90	0.01	0.01
Mid-story						
Sampled area (ha)	-0.32	0.18	28.51	0.00	1.00	0.25
% Total shrub cover	0.08	0.17	28.75	0.24	0.89	0.22
% *Lonicera* spp cover	0.05	0.16	28.82	0.31	0.86	0.21
Contiguous area (ha)	0.00	0.05	29.94	1.42	0.49	0.12
Canopy cover	-0.05	0.02	30.36	1.85	0.40	0.10
Shrub species richness	-0.14	0.00	30.59	2.08	0.35	0.09
Lower-story						
% Total shrub cover	0.24	0.55	31.45	0.00	1.00	0.50
% *Lonicera* spp cover	0.12	0.53	31.72	0.27	0.87	0.43
Contiguous area (ha)	0.00	0.22	36.67	5.22	0.07	0.04
Shrub species richness	-0.77	0.05	38.67	7.22	0.03	0.01
Sampled area (ha)	0.14	0.02	38.95	7.50	0.02	0.01
Canopy cover	-0.02	0.00	39.15	7.70	0.02	0.01
2007						
Upper-story						
% Total shrub cover	-0.13	0.34	32.21	0.00	1.00	0.42
Contiguous area (ha)	0.00	0.31	33.12	0.91	0.63	0.27
% *Lonicera* spp cover	-0.04	0.14	35.10	2.88	0.24	0.10
Canopy cover	0.12	0.05	35.72	3.50	0.17	0.07
Sampled area (ha)	0.15	0.05	35.79	3.58	0.17	0.07
Shrub species richness	-0.18	0.04	35.94	3.73	0.15	0.07

Table 7. Con't

Models	**Estimate**	**R^2**	**AICc**	**ΔAICc**	**Likelihood**	**Weight**
			2007 con't			
			Mid-story			
Contiguous area (ha)	0.00	0.66	9.95	0.00	1.00	0.94
% Total shrub cover	0.07	0.31	16.58	6.63	0.04	0.03
% *Lonicera* spp cover	0.02	0.11	19.17	9.22	0.01	0.01
Canopy cover	-0.05	0.03	19.95	10.00	0.01	0.01
Sampled area (ha)	0.12	0.03	20.01	10.06	0.01	0.01
Shrub species richness	-0.16	0.02	20.10	10.15	0.01	0.01
			Lower-story			
% Total shrub cover	0.23	0.54	35.57	0.00	1.00	0.65
% *Lonicera* spp cover	0.12	0.42	37.70	2.13	0.34	0.23
Contiguous area (ha)	-0.01	0.27	39.94	4.37	0.11	0.07
Shrub species richness	-0.39	0.01	42.95	7.38	0.02	0.02
Canopy cover	-0.19	0.02	42.95	7.38	0.02	0.02
Sampled area (ha)	-0.33	0.02	43.12	7.56	0.02	0.01

Table 8. Winter bird species recorded in the ten sites. X indicates the species occurred in at least one point count in either winter. XX indicates the species was present at least once in a point count in both winters.

			***Lonicera* spp sites**					**Native sites**				
Family	**Scientific name**	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Accipitridae	*Accipiter striatus*	Sharp-shinned hawk										X
	Buteo jamaicensis	Red-tailed hawk						X	X		X	XX
Alaudidae	*Eremophila alpestris*	Horned lark									X	
Bombycillidae	*Bombycilla cedrorum*	Cedar waxwing	XX		X	XX						
Cardinalidae	*Cardinalis cardinalis*	Northern cardinal	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Certhiidae	*Certhia americana*	Brown creeper	X	X			X					
Columbidae	*Zenaida macroura*	Mourning dove	X	X	X	XX	X	X	X	X	XX	XX
Corvidae	*Corvus brachyrhynchos*	American crow	X	XX		XX	X		XX			X
	Cyanocitta cristata	Blue jay	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Emberizidae	*Junco hyemalis*	Dark-eyed junco	XX	XX	XX	XX	XX	XX			XX	XX
	Melospiza melodia	Song sparrow	X			X						X
	Passerella iliaca	Fox sparrow		X			X					
	Pipilo erythrophthalmus	Eastern towhee							X			
	Spizella arborea	American tree sparrow	XX	X			X	XX				XX
	Zonotrichia albicollis	White-throated sparrow	XX	XX		XX			X			
Fringillidae	*Carduelis tristis*	American goldfinch	XX	XX	XX	XX	XX	XX	X	XX	XX	XX
	Carpodacus mexicanus	House finch	X	X		X	X					
Paridae	*Baeolophus bicolor*	Tufted titmouse	X	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Poecile carolinensis	Carolina chickadee	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Passeridae	*Passer domesticus*	House sparrow		X								

Table 8. Con't

			***Lonicera* spp sites**					**Native sites**				
Family	**Scientific name**	**Common name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Picidae	*Colaptes auratus*	Northern flicker		XX	X	XX					X	X
	Dryocopus pileatus	Pileated woodpecker			X	X		XX	X	XX		
	Melanerpes carolinus	Red-bellied woodpecker	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Melanerpes erythrocephalus	Red-headed woodpecker							X	XX		
Picidae (con't)	*Picoides pubescens*	Downy woodpecker	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Picoides villosus	Hairy woodpecker			X					X		
Regulidae	*Regulus satrapa*	Golden-crowned kinglet				X			X			X
Sittidae	*Sitta canadensis*	Red-breasted nuthatch		X								
	Sitta carolinensis	White-breasted nuthatch	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Strigidae	*Bubo virginianus*	Great horned owl					X	X				X
Sturnidae	*Sturnus vulgaris*	European starling		X					X			
Troglodytidae	*Thryothorus ludovicianus*	Carolina wren	XX	XX	X	XX	XX	XX	XX	XX	X	X
Turdidae	*Catharus guttatus*	Hermit thrush		X		X						
	Hylocichla mustelina	Wood thrush		X								
	Sialia sialis	Eastern bluebird		X	X			X			X	X
	Turdus migratorius	American robin	XX	XX	X	XX	XX	X	XX		X	X

Table 9. Mean density of birds (birds/hectare) in *Lonicera* spp. and native sites in the winters of 2006-2007 and 2007-2008.

	2006-2007		**2007-2008**	
Species or guild	**Mean in *Lonicera* sites (± 1 SE)**	**Mean in native sites (± 1 SE)**	**Mean in *Lonicera* sites (± 1 SE)**	**Mean in native sites (± 1 SE)**
American goldfinch	1.20 ± 0.75	0.12 ± 0.08	0.49 ± 0.16	0.39 ± 0.25
American robin	1.24 ± 0.99	0.21 ± 0.14	0.75 ± 0.46	0.03 ± 0.05
Blue jay	0.43 ± 0.17	0.34 ± 0.16	0.76 ± 0.21	0.95 ± 0.23
Carolina wren	0.13 ± 0.07	0.11 ± 0.07	0.11 ± 0.05	0.02 ± 0.02
Downy woodpecker	1.14 ± 0.39	0.61 ± 0.28	0.96 ± 0.33	0.39 ± 0.16
Northern cardinal	2.45 ± 0.57	1.17 ± 0.40	1.96 ± 0.47	1.42 ± 0.55
Red-bellied woodpecker	0.34 ± 0.11	0.32 ± 0.11	0.53 ± 0.14	0.88 ± 0.20
White-breasted nuthatch	0.54 ± 0.26	0.68 ± 0.18	0.70 ± 0.28	0.79 ± 0.27
Emberzidae	2.26 ± 0.93	0.80 ± 0.46	1.58 ± 0.65	0.75 ± 0.45
Fringillidae	1.36 ± 0.85	0.14 ± 0.10	0.74 ± 0.24	0.44 ± 0.28
Paridae	1.65 ± 0.50	1.24 ± 0.51	1.98 ± 0.51	2.01 ± 0.77
Picidae	1.21 ± 0.35	0.81 ± 0.18	1.25 ± 0.27	1.77 ± 0.37
Turdidae	3.08 ± 2.12	0.79 ± 0.45	1.55 ± 0.96	0.27 ± 0.33
Non-frugivorous	2.62 ± 0.74	1.85 ± 0.40	1.92 ± 0.51	2.81 ± 1.05
Facultative frugivorous	3.05 ± 0.76	1.63 ± 0.39	2.75 ± 0.52	3.32 ± 0.68
Frugivorous	5.96 ± 1.50	2.89 ± 0.68	5.40 ± 1.06	4.22 ± 1.02
Total	11.52 ± 2.04	6.41 ± 1.1	9.95 ± 1.58	10.45 ± 1.93

Table 10. Effects of site type and year on winter bird densities. Results are from a repeated measures ANOVA based on the presence and absence of *Lonicera* spp. df = 1 for all tests.

	Site			**Year**			**Site*year interaction**		
Species or guild	**SS**	**F**	**p**	**SS**	**F**	**p**	**SS**	**F**	**p**
American goldfinch	1.74	4.27	0.073	0.25	0.51	0.497	1.20	2.42	0.159
American robin	3.83	3.83	0.086	0.55	1.02	0.341	0.13	0.23	0.642
Blue jay	0.01	0.04	0.842	1.11	11.03	0.011*	0.10	1.03	0.341
Carolina wren	0.01	1.02	0.342	0.02	5.82	0.042	0.01	2.15	0.181
Downy woodpecker	1.52	3.97	0.081	0.19	1.83	0.213	0.00	0.02	0.904
Northern cardinal	4.16	4.02	0.080	0.08	0.21	0.663	0.69	1.78	0.218
Red-bellied woodpecker	0.14	1.19	0.307	0.71	8.09	0.022*	0.16	1.87	0.209
White-breasted nuthatch	0.07	0.18	0.687	0.10	0.67	0.437	0.00	0.03	0.879
Emberzidae	6.60	3.90	0.084	0.68	0.47	0.513	0.48	0.33	0.058
Fringillidae	2.89	5.24	0.051	0.13	0.19	0.675	1.05	1.55	0.248
Paridae	0.18	0.13	0.724	1.51	1.53	0.251	0.24	0.24	0.637
Picidae	0.02	0.04	0.846	1.26	3.89	0.084	1.05	3.26	0.108
Turdidae	15.99	3.66	0.092	5.26	20.61	0.189	1.26	0.49	0.502
Non-frugivorous	0.02	0.01	0.939	0.08	0.10	0.765	3.46	4.05	0.079
Facultative frugivorous	0.90	0.36	0.563	2.42	2.42	0.158	4.96	4.96	0.057
Frugivorous	22.58	3.68	0.091	0.76	0.37	0.559	4.43	2.17	0.179
Total	26.52	2.14	0.182	7.65	1.74	0.224	39.28	8.93	0.017*

Table 11. AICc analysis of robust regressions with M-estimators on the winter diet guilds and habitat characteristics. Results are in order of the model with the lowest AICc to the highest. Parameters (K) = 3 for all models.

Models	**Estimate**	**R²**	**AICc**	**ΔAICc**	**Likelihood**	**Weight**
2006-2007						
Frugivorous						
% Total shrub cover	0.12	0.44	20.51	0.00	1.00	0.49
% *Lonicera* spp cover	0.06	0.35	21.74	1.23	0.54	0.27
Canopy cover	-0.17	0.18	23.85	3.34	0.19	0.09
Contiguous area (ha)	0.00	0.14	24.40	3.89	0.14	0.07
Shrub species richness	-0.19	0.04	25.45	4.94	0.08	0.04
Sampled area (ha)	-0.09	0.01	25.86	5.35	0.07	0.03
Facultative frugivorous						
Contiguous area (ha)	0.00	0.28	12.31	0.00	1.00	0.43
Sampled area (ha)	-0.09	0.13	14.27	1.96	0.37	0.16
Shrub species richness	0.13	0.06	15.06	2.75	0.25	0.11
% *Lonicera* spp cover	0.01	0.08	15.11	2.81	0.25	0.11
% Total shrub cover	0.02	0.07	15.14	2.83	0.24	0.10
Canopy cover	0.03	0.01	15.44	3.13	0.21	0.09
Non-frugivorous						
% Total shrub cover	0.05	0.32	8.95	0.00	1.00	0.50
% *Lonicera* spp cover	0.02	0.19	10.87	1.92	0.38	0.19
Canopy cover	-0.02	0.01	12.61	3.65	0.16	0.08
Shrub species richness	-0.04	0.01	12.66	3.71	0.16	0.08
Sampled area (ha)	-0.01	0.01	12.70	3.75	0.15	0.08
Contiguous area (ha)	0.00	0.00	12.76	3.81	0.15	0.07
2007-2008						
Frugivorous						
Sampled area (ha)	-0.26	0.34	20.91	0.00	1.00	0.33
% Total shrub cover	0.08	0.32	20.99	0.08	0.96	0.32
Canopy cover	-0.15	0.19	22.67	1.76	0.42	0.14
Contiguous area (ha)	0.00	0.09	23.84	2.93	0.23	0.08
% *Lonicera* spp cover	0.02	0.10	23.90	2.99	0.22	0.07
Shrub species richness	0.35	0.06	24.22	3.31	0.19	0.06

Table 11. Con't

Models	**Estimate**	**R^2**	**AICc**	**ΔAICc**	**Likelihood**	**Weight**
			2007-2008 con't			
			Facultative frugivorous			
Canopy cover	0.08	0.19	12.96	0.00	1.00	0.29
Contiguous area (ha)	0.00	0.17	13.36	0.40	0.82	0.24
% Total shrub cover	-0.03	0.10	14.07	1.11	0.57	0.17
Sampled area (ha)	0.04	0.01	14.92	1.96	0.38	0.11
Shrub species richness	-0.15	0.00	15.17	2.21	0.33	0.10
% *Lonicera* spp cover	0.00	0.01	15.25	2.29	0.32	0.09
			Non-frugivorous			
Shrub species richness	0.53	0.25	13.45	0.00	1.00	0.33
Canopy cover	-0.10	0.22	13.74	0.29	0.87	0.28
Sampled area (ha)	-0.11	0.10	15.25	1.80	0.41	0.13
% *Lonicera* spp cover	-0.01	0.05	15.84	2.39	0.30	0.10
Contiguous area (ha)	0.00	0.03	16.25	2.80	0.25	0.08
% Total shrub cover	0.01	0.02	16.34	2.89	0.24	0.08

FIGURES

Figure 1. Locations of the ten sites in east central Illinois. Light gray squares indicate sites with *Lonicera* spp. Black squares indicate native sites.

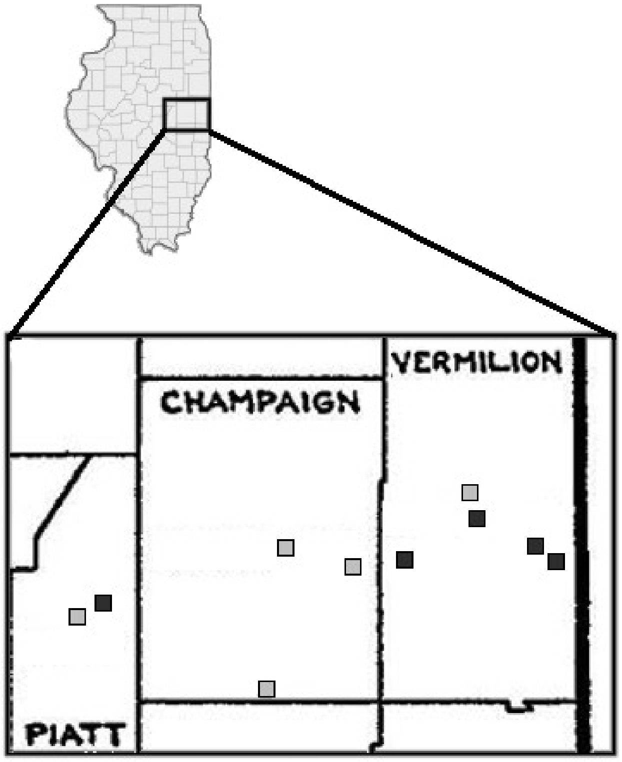


Figure 2. Plot of the first and second factor scores for the summer principal component analysis in A) 2006 and B) 2007.

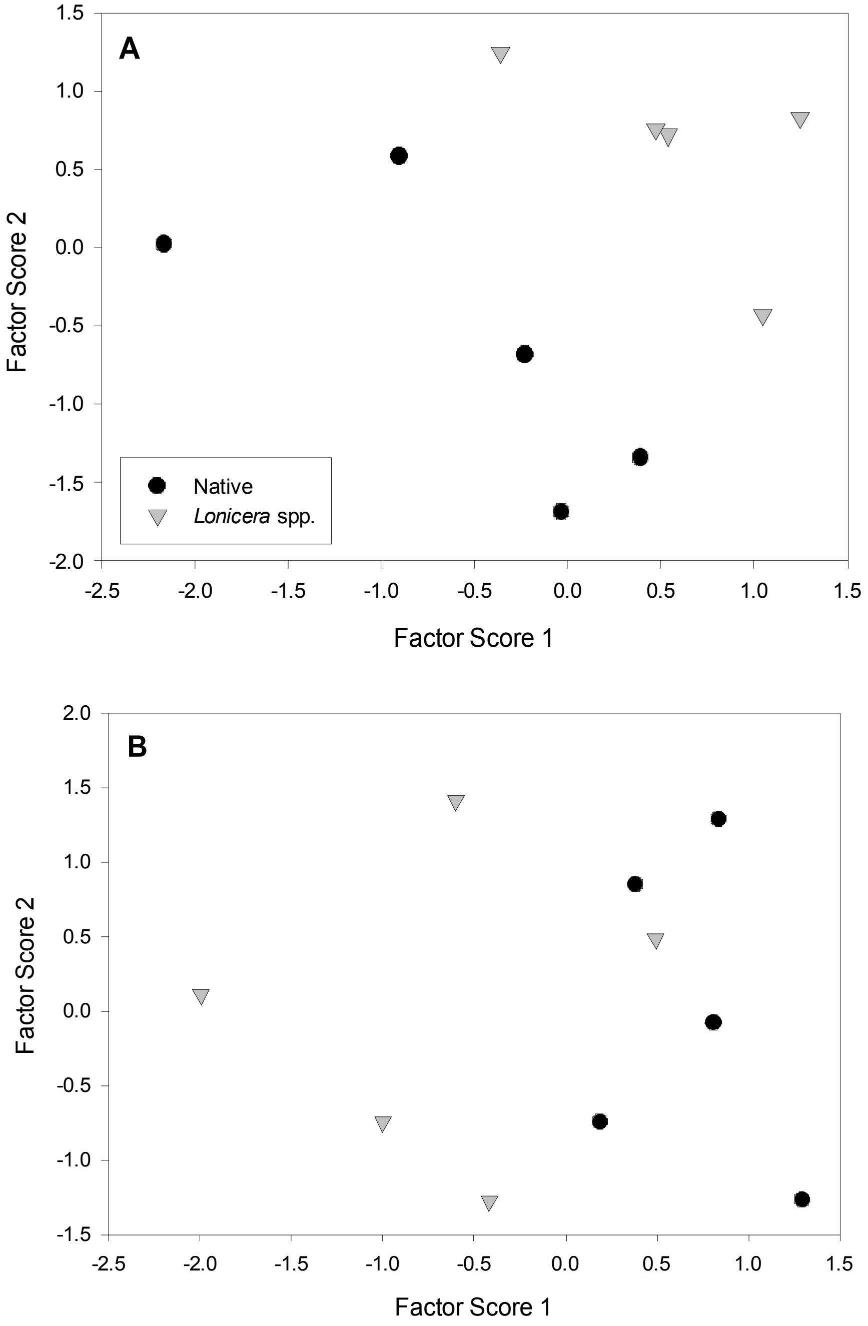


Figure 3. Species richness (average number of birds seen per point count) for the summers of 2006 and 2007.

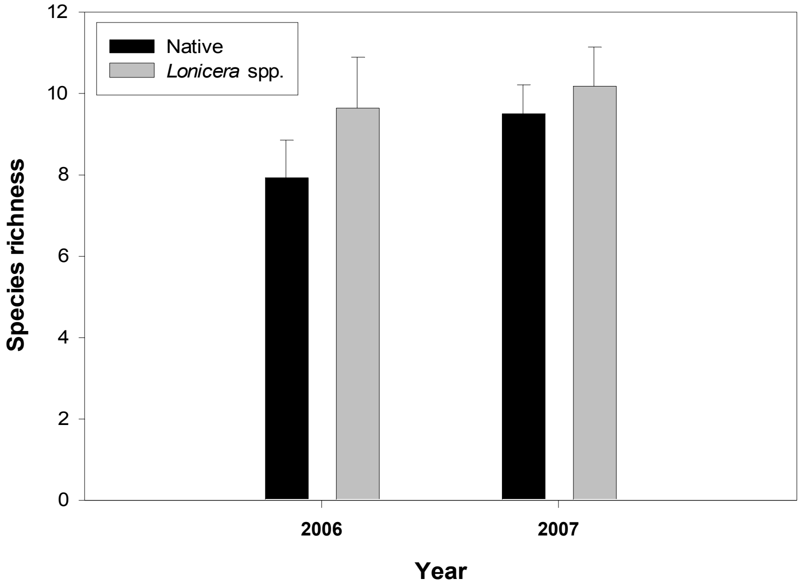


Figure 4. Total winter bird density (birds per hectare) for 2006-2007 and 2007-2008

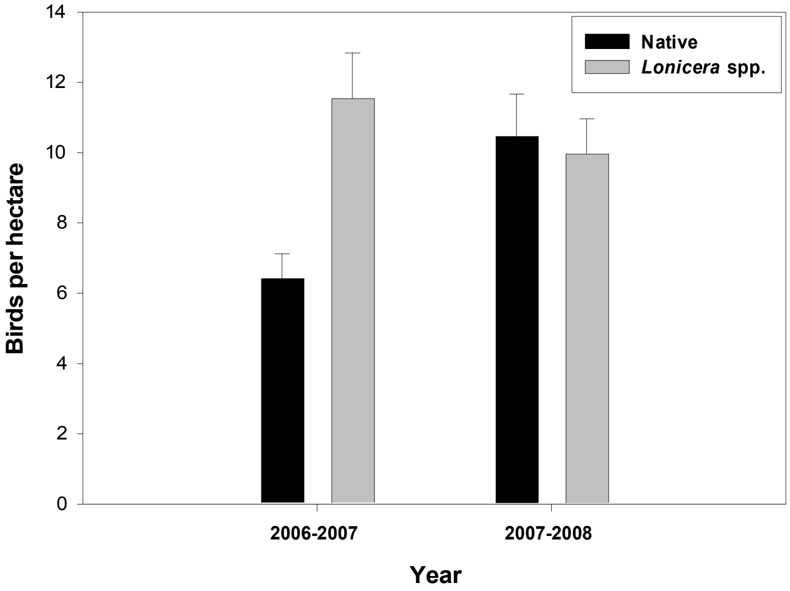


Figure 5. Plot of the first and second factor scores for the winter principal component analysis in A) 2006-2007 and B) 2007-2008.

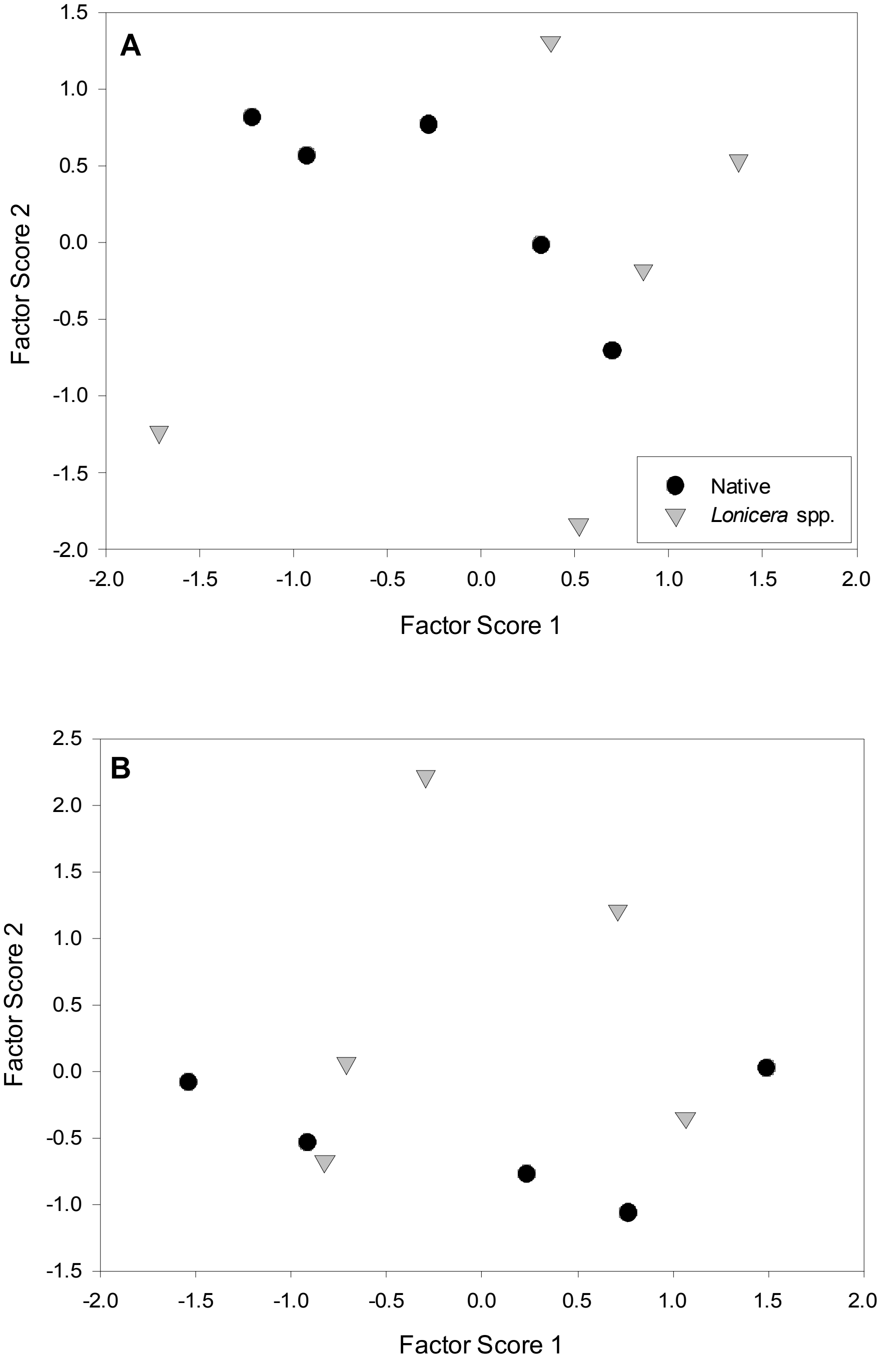
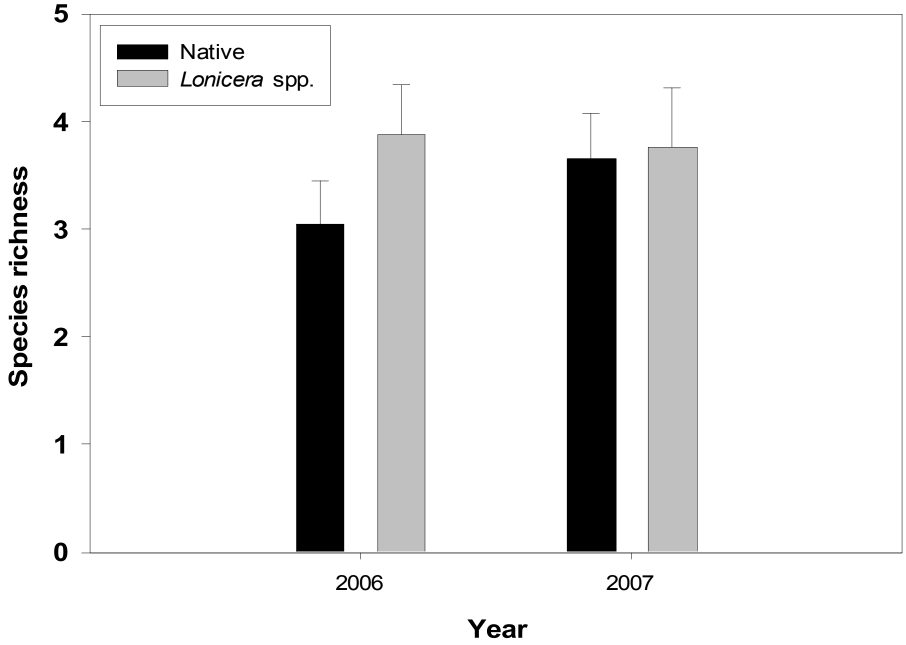


Figure 6. Species richness (average number of birds seen per point count) for the winters of 2006-2007 and 2007-2008.



EXPENDITURES

FUNDS PROVIDED BY THIS GRANT:
All Predator Calls (www.AllPredatorCalls.com)
PO Box 911176, St. George, UT 84791
Item: FOXPRO - XR6 16 Call Remote Controlled Digital Game Call
    Quantity: 1
Item: FOXPRO - XR6 NiMH Batteries and Charger
    Quantity: 1
Purchased: October 9, 2007
Total: $429.57

Mileage Reimbursement
Logged 1647 miles for travel to and from field sites from July 2007- March 2008
Reimbursement rate of $0.445 per mile
Total: $732.92

Total reimbursement expenditures for this project: $1162.49

FUNDS PROVIDED BY OTHER SOURCES:
Mileage Reimbursement provided by the Illinois Natural History Survey for work completed between January 2006 and June 2007
Logged 2017 miles for travel to and from field sites
Reimbursement rate of $0.445 per mile
Total: $897.57