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The avian communities of a suburban grassland refugium: population studies at an airport in Northeastern United States


Abstract. Grassland habitats and their associated avian communities historically occurred along the mid Atlantic coast of the United States. Urbanization has decimated these habitats with the concomitant loss of the associated natural avian communities. Airports are ubiquitous features of urban areas, and in the Northeast United States they provide among the largest tracts of grassland habitats available. In this study our goal was to determine if the grassland habitats of an eastern airport serve as a refugium for avian grassland communities. We compared the avian community at an airport in Eastern United States with the natural avian communities of the region. We determined the composition of the avian community at Atlantic City International Airport from 1991–1994. We used cluster analysis to compare community composition at the airport with communities of the surrounding habitats. We found that the airport did serve as a refugium for individual species, but the overall community was likely quite different from the avian grassland communities of the region in presettlement times. These differences were mainly the result of influences from the avian communities of the altered habitats surrounding the airport.

Key words: urban, avian, grassland community, airport, cluster analysis, refugium

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INTRODUCTION

The Great Plains of Central United States encompass the largest tract of grassland habitats on the North American continent. Nonetheless, grasslands and their associated avian communities historically occurred along the mid Atlantic coast of the United States as habitat islands surrounded by traditional eastern deciduous forest. Examples like the Hempstead Plains on Long Island, New York (Askins 1993) were likely maintained as prairie habitat by fires set by Native Americans. However, grasslands of the mid Atlantic coast have largely disappeared due to large-scale changes in the regional landscape related to the urbanization process. European colonization not only increased urbanization and agriculture, but also increased fire suppression. As a result, northeastern grasslands have been greatly reduced, along with many of their associated plant and animal communities.

The avian grassland community traditionally included specialists adapted to the unique conditions of prairie habitats. Most of the grassland habitats vanished before critical assessments could be made, so information is lacking on the structure and composition of the original communities. However, accounts for individual birds are available. For example, the Greater Prairie Chicken Tympanuchus cupido is currently found only in the Midwestern United States, yet it was abundant in the northeast during early settlement times (Askins 1993). Other traditional grassland species (e.g., Upland Sandpiper Bartramia longicauda, Grasshopper Sparrow Ammodramus savannarum) have declined more recently in the
Northeast. These and other grassland specialists are near the point of local extinction due to the loss and fragmentation of grassland habitat (Knopf 1994, Melvin 1994).

Airports are ubiquitous features of virtually every heavily urbanized area of the world. In the Northeastern United States the unique requirements for safe air operations results in land management practices that create grassland habitats that appear similar to natural grasslands. In heavily urbanized areas these airport grasslands are generally among the largest unbroken patches of grassland habitat that remain relatively undisturbed over long periods. The avian communities that develop at eastern airports often include substantial numbers of grassland species as well as components from the surrounding urban and natural habitats (Caccamise et al. 1995, Askins 1993).

In this study our goal was to determine if the grassland habitats of an eastern airport serve as a refuge for avian grassland communities. Our approach was based on comparisons of the avian community at an airport in Eastern United States with the natural avian communities of the region. We determined the composition of the avian community at Atlantic City International Airport (ACY) from 1991–1994. We used cluster analysis to compare community composition at the airport with that in the surrounding habitats (Brady 1980).

METHODS

Study sites

Our study site at Atlantic City International Airport/FAA Technical Center (ACY) was located in Atlantic County, New Jersey (Fig. 1). This airport encompasses roughly 2,000 ha of grassland/scrub oak habitat fringed by native pine-oak forests and urban-suburban development. Urban developments occur south and east of the airport and extend to the Atlantic coast 18 km to the east. To the west and north, there are areas of less dense suburban development that become a mixture of pine-oak forest and agriculture.

We distinguished three general habitat types at ACY (Fig. 1): grass, scrub, and forest. Grass habitat included frequently mowed sections ("managed grass") bordering the air operation areas (AOA) and around structures as well as infrequently managed areas ("grass/forbs" e.g., Poa, Andropogon, Solidago, Lespedeza) distant from the AOA. Scrub habitats were composed of pitch pine Pinus rigida, scrub oak Quercus ilicifolia, sassafras Sassafras albidum, grape Vitus labrusca, and other shrubs. Scrub was maintained by a long-standing practice of an annual mowing. The forest was a mixed pine-oak forest. Within the forest were two waterbodies: the Atlantic City Reservoir and a retention basin supplied with pumped groundwater.

We estimated species composition and population sizes for birds at ACY by conducting systematic surveys from 4 June 1991 through 20 May 1994. Our bird surveys were based on a modified variable circular-plot method (Reynolds et al. 1980). In 1991 we established a series of 23 survey sites (sites 1–23) on and near the AOA at ACY (Fig. 1). We added a 24th site (site 49) in 1992. We selected survey sites at ACY to represent the 3 major habitat types available: grass, scrub, and forest. Surveys were performed at rates of approximately 5 surveys per week in 1991–1992, 3 surveys per week in 1992–1993 and 3 surveys per 10 days in 1993–1994.

We visited individual survey sites sequentially beginning at opposite ends of the sequence on each successive survey day. Surveys were begun either at 6:00, 10:00 or 14:00 hr alternating sequentially over successive survey days. For each survey we attempted to count all birds within view. As we approached each survey site we recorded any birds flushed. By assuming that flushed birds would have been counted in the normal survey interval, we attempted to minimize bias against more easily frightened birds or against birds that frequented areas near survey sites. We then identified all birds seen or heard at each site for a period of 3 minutes. In addition, we kept a list of species not previously seen during surveys at ACY. Species from the surveys and the list were included in the current analysis. The circular-plot technique provided estimates of species abundance for ACY. However, here we used only presence-absence information in the cluster analysis because the regional data we used for comparison (Brady 1980) only provided species lists.

We compared avian communities at ACY with communities reported by Brady (1980) for the major habitat types in New Jersey. Avian composition of Brady’s communities were compiled from the literature
including National Audubon Christmas Counts, banding records, reports of state and federal agencies, and local birding associations. She determined species composition in 17 habitat types of the Pinelands National Reserve located in the southern two-thirds of the Pine Barrens of New Jersey (Fig. 1). Types included typical Pine Barrens habitat such as pine forest, swamp, coastal region, and urban development.

Analysis

We used cluster analysis to compare the species composition of avian communities at the airport with the regional communities defined by Brady (1980) for the major habitat types of the Pine Barrens. Species composition from the 24 survey sites at ACY and 17 habitat types in Brady's report (hereafter referred to as types) were submitted to an hierarchical cluster
analysis (SPSS for Windows, release 6.0, 1993) using Ward’s method with distance calculated as binary Euclidean distances.

We performed cluster validation by comparing numbers of species among clusters within breeding habitat categories (i.e., aquatic, forest, woodland, grassland, savannah, shrubland, or urban). Species were assigned to breeding habitat categories based on the habitat most frequently utilized (using categories from Askins 1980, Ehrlich et al. 1988, National Breeding Bird Survey). Total number of species within each preferred breeding habitat for each site was calculated and submitted as the dependent variable in a one-way ANOVA (SPSS for Windows, release 6.0, 1993) with cluster assignment used as the independent variable. Student-Newman-Keuls tests were used to compare the means.

We selected breeding habitat as the characteristic to compare because we expected differences in requirements for breeding habitat to result in variation in the distribution of species among the clusters; i.e., clusters with the most aquatic habitats would tend to attract the most aquatic species. We also expected that the pattern in tests of significance among the cluster means would vary depending upon the breeding habitat examined; i.e., mean comparisons would not be the same among analyses. If no variation is found among habitats, then the reason for cluster formation is obscure and possibly biologically irrelevant.

RESULTS

Habitats at the Airport and region

We found a total of 127 avian species at ACY as compared to 301 regional species listed in Brady. On average Brady’s types held 83 species (SE = 8.03) which was significantly less than the total at the airport (Z = −5.48, P < 0.001). There were, however, several different habitats at ACY, ranging from forest to oak scrub to short grass and pavement. ACY averaged about 53 species per site (SE = 2.48) and this average was significantly smaller than the average for the region (t-test for unequal variances, t = 3.56, DF = 19, P < 0.01). The smaller variation at ACY reflected the more uniform nature of the airport as compared to the region.

ACY attracted species most often found in short grass and open habitat environments. The six most abundant species at ACY were the European Starling *Sturnus vulgaris*, Laughing Gull *Larus atricilla*, Eastern Meadowlark *Sturnella magna*, American Crow *Corvus brachyrhynchos*, Tree Swallow *Tachycineta bicolor* and Canada Goose *Branta canadensis*. Grasshopper Sparrows *Ammodramus savannarum* and Upland Sandpipers *Bartramia longicauda* were two grassland birds in conspicuous abundance. Other grassland specialists at ACY included the Northern Bobwhite *Colinus virginianus* and the Savannah Sparrow *Passerculus sandwichensis*. Savannah species like American Goldfinch *Carduelis tristis* and shrubland species such as the Field Sparrow *Spizella pusilla* were common at ACY.

At the airport, the sites with the greatest number of species occurred in the pine-oak forest. Site 22 had 86 species and site 49 had 74 species. These forested sites included the reservoir and waste water pond, respectively, and thus both waterfowl and forest dwelling species were present. Site 4 had the fewest species with only 39. The vegetation at site 4 was uniformly low, and it was far from the cover provided by forest and structures. Other sites with low numbers of species were located either near the main hangar (site 23) or in the managed grass adjacent to the highway (site 11).

The barrier beach strip and coastal marshes were regional habitat types highest in species numbers. The barrier beach strip, with 154 species, had nearly twice as many species as the most abundant sites at ACY (sites 22 and 49). Barrier beach strips are dense with fruit-bearing shrubs and their location along the Atlantic flyway attract many migrants in route (Welty 1975). Coastal marshes, like many estuarine habitats, are high in diversity and production, attracting a large variety of species. Lowest number of species occurred in the cedar swamps (39 species) and developed areas (42 species). Cedar swamps are characteristically composed of trees with high dense crowns and sparse or absent understory and typically support few species (McCormick 1970).

Cluster formation

We based the cluster analysis on 24 survey sites at ACY and Brady’s 17 habitat types. The analysis distinguished six clusters (Fig. 2) consisting of forested
areas ("Forest"), barrier beach strips ("Barrier Beach"), salt- and freshwater habitats ("Aquatic"), highly modified habitats ("Anthropogenic"), grass and shrub dominated habitats at the airport ("ACY-Grass/shrub"), and forest-dominated habitats at the airport ("ACY-Forest"). The number of sites or types contributing to clusters varied from one ("Barrier Beach") to 16 ("ACY-Grass/shrub"). Two clusters included only airport sites ("ACY-Grass/shrub", "ACY-Forest") while the remaining clusters were composed entirely of Brady’s habitat types.

Number of clusters

We established the number of clusters as six from the relationship between fusion coefficients and the number of clusters present at the time of their formation (Aldenderfer and Blashfield 1984). This number of clusters represents the most clusters that can be formed before the amount of information with regard to the structure of the data diminishes insignificantly.

Clustering

The first branch produced by the analysis separated Forested from Non-forested clusters (Fig. 2). Within the Forested branch there were two distinct clusters: "Forest" and "Barrier Beach". The "Forest" cluster consisted of habitat types dominated by trees while "Barrier Beach" was based on a single habitat type. The Non-forested branch separated into two groups: "Aquatic" and "Terrestrial". The "Aquatic" cluster included both salt and fresh water environments.
Table 1. Means and standard deviations () of the number of avian species per family for each cluster. The Barrier Beach cluster contained only one habitat and is therefore represented by the sum of species within each family.

[Tabela 1. Średnie i odchylenia standardowe () liczby gatunków dla poszczególnych zestawów (clusters) biotopowych. Zestaw Barier Beach, składający się tylko z jednego biotopu, jest przedstawiony jako suma gatunków każdej rodziny.]

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<th>Family</th>
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<th>Aquatic n=6</th>
<th>Anthropogenic n=5</th>
<th>ACY-Grass/shrub n=16</th>
<th>ACY-Forest n=8</th>
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<td>1.4 (0.89)</td>
<td>0.1 (0.25)</td>
<td>0</td>
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Terrestrial habitats separated into three clusters: Brady’s “Anthropogenic” types, and the two airport clusters. The “Anthropogenic” cluster contained a habitat type called “non-forested” which included industrial areas, golf courses, and airports. One of the airports listed in Brady’s non-forested habitat types was the National Aviation Facilities Experimental Center (currently FAA Technical Center) which is located at ACY. The two clusters at the airport were characterized by either sites within or near a forest (“ACY-Forest”) or by grass- or shrub-dominated sites (“ACY-Grass/shrub”).

Avian families within clusters

We calculated the mean number of species per avian family for each cluster (Tab. 1). Avian families corresponded with basic ecological characteristics of the sites or types forming the cluster. Such concordance provided insight into the ecological basis for cluster formation.

Formation of the “Forest” cluster was most heavily influenced by high numbers of Passeriformes (passe- rines), Piciformes (woodpeckers), and Strigiformes (owls) — all typical forest species. The “Barrier Beach” cluster was unique in that it was formed from a combination of passerines and Charadriiformes (gulls, terns, and shorebirds). This cluster emerged on the Forested rather than the Aquatic branch because of the lack of herons (Ciconiiformes) and possibly the presence of owls. Families in the “Aquatic” habitat types included the Anseriformes (waterfowl), Charadriiformes, and Ciconiiformes while Passeriformes were uncommon. In the “Anthropogenic” cluster Charadriiformes, Falconiformes (bird of prey), and Passeriformes were most
common. The “ACY-Grass/shrub” cluster had only a moderate number of Passeriformes and Charadriiformes. “ACY-Forest” sites had an abundance of woodland species (woodpeckers and warblers) as well many waterbirds.

**Validation of clusters**

To validate the formation of the clusters, we examined the variation in number of species among clusters for 6 categories of breeding habitats. We classified each species according to their primary breeding habitat. Habitats included aquatic, forest, woodland, grassland, savannah, shrubland, and urban. We performed one-way ANOVAs for each of the preferred breeding habitats and compared the mean number of species for each cluster using the Student-Newman-Keuls test. The “Barrier Beach” cluster was not included in the analyses because it had only one habitat type.

We found significant differences among clusters for every breeding habitat (Tab. 2). The greatest number of species preferring to breed in aquatic environments occurred in the “Aquatic” cluster. These included ducks, shorebirds, and waders. We found several species of waterfowl in “ACY-Forest” cluster associated with the Atlantic City Reservoir and the waste water pond, but the average number of water-associated species at these sites was not significantly different from the “Forest”, “Anthropogenic”, and “ACY-Grass/shrub” clusters.

The “Forest” cluster had a significantly greater number of both forest and woodland species (passerines, owls, and woodpeckers) than any other cluster. The “Aquatic” and “ACY-Grass/shrub” clusters had the fewest forest species. We found no differences in number of woodland species in the “Aquatic”, “Anthropogenic”, and the two airport clusters.

Species breeding in grassland were most abundant in the “Anthropogenic” and two airport clusters. These included plovers, sparrows, and harriers. Lowest number of grassland species were in the “Forest” and “Aquatic” clusters. The Upland Sandpiper, a grassland species declining in the Northeast, was found in 15 of the 16 “ACY-Grass/shrub” sites and two of the “Anthropogenic” habitat types (including one airport type).

Numbers of species in the savannah, shrubland, and urban breeding habitats were generally lower than in other habitats, but we still found differences among clusters. Savannah species (bluebirds, swallows, and birds of prey) were most abundant in the two airport clusters and least abundant in “Anthropogenic”, “Aquatic”, and “Forest” clusters. Shrubland species, such as sparrows and warblers, were most abundant in “Forest”, “ACY-Forest”, and “Anthropogenic” clusters. They were least abundant in the “ACY-Grass/shrub” and “Aquatic” clusters. Urban species were most abundant in the two airport clusters and least abundant in the “Aquatic” cluster. Urban birds included doves, corvids, and granivores such as grackles and sparrows.

We also compared the total number of species present in each cluster regardless of habitat preference (Tab. 2). The “Forest” and “Aquatic” clusters contained the highest number of species due to the many forest and aquatic species present. The “ACY-Grass/shrub” and “Anthropogenic” clusters had the fewest species, being composed largely of grassland, savannah, and urban birds.

The “Barrier Beach” cluster was not tested because it contained only a single habitat (Beach Strip). Therefore in order to compare “Barrier Beach” with other clusters, we calculated normal deviate Z values. We made comparisons only in breeding habitats where the “Barrier Beach” observation was larger than the largest cluster mean; i.e., for grassland, savannah, and shrubland breeding habitats.

For grassland breeders, the “Barrier Beach” cluster with 11 species was not significantly different from the “Anthropogenic” cluster (mean number species = 8.4, Z = -0.77, P = 0.22). However, there were significantly more savannah species in the “Barrier Beach” (11) than in the “ACY-Forest” (mean = 8.4, Z = -4.23, P < 0.001). Although mean values were the same, the smaller variances in “ACY-Forest” resulted in the significant Z values. There were also significantly more shrubland species in the “Barrier Beach” cluster than in the “Forest” cluster (Z = -13.42, P < 0.001). The comparison of total species in “Barrier Beach” with total species in the other clusters was significant (Z = -12.68, P < 0.001) indicating that there were more species at the “Barrier Beach” than in any other cluster.
Table 2. Analysis of variance and mean comparisons (Student-Neuman-Keuls test) of the number of species, as classified by habitat preference, among clusters. For each comparison, the F-value, mean number of species and standard error (in parentheses) are reported. The results of the mean comparison test are indicated by letters below the means. Significantly different means are shown as different letters. The Barrier Beach cluster was represented by a single site and was therefore not tested, but is presented here to illustrate its unique characteristics.

* df = 4.25 for all comparisons  ** P<0.001


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<th>Breeding Habitat</th>
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<td>A</td>
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<td>B</td>
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<td>C</td>
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DISCUSSION

Atlantic City International Airport attracted a variety of birds, as suggested by the 127 species we observed during our three year study. Although this was significantly more than the average found in the surrounding regional habitat types (83 species per type), it was not unexpected as ACY is made up of at least two dissimilar habitats: grass-shrubs-pavement and pine/oak forest-water habitats. While individual ACY sites averaged fewer species per site than were found regionally, the avian communities at the two habitats differed significantly. Grass/shrub sites were exploited by sparrows, swallows, and gulls while warblers and waterfowl were attracted to the forests and waterways. The combination of these two different communities resulted in the higher total number of species at the airport. Thus, the airport as a whole attracted more species than most regional habitat types. The regional exception was the barrier beach strip, where temporal variation resulted as forest migrants used this habitat type at very specific times of the year, in contrast to the usual presence of primarily aquatic species.

Grassland birds were among the species attracted to ACY. Expansive grasslands were maintained at ACY in
different states, ranging from short, manicured lawns to fields of tall grass mixed with shrubs. Disturbance, in the form of mowing, occurred only once a year in some areas. This disturbance was enough to maintain the presence of grass and prevent the domination of shrubs and trees. Grassland species prefer large, unfragmented habitat since they are less likely to be outcompeted by generalists attracted to the edge of fragmented habitats (Askins 1993). The grasslands areas at ACY were substantial, and likely among the largest areas of unbroken grassland in the region.

The high numbers of species reflected site variability and often indicated mixed habitats at both the airport and region. Sites with the highest number of species at ACY were associated with areas where two distinct environments occurred; e.g., waterways amidst pine-oak forest. Thus, both waterfowl and forest species were attracted to these sites. The regional habitat types with many species included barrier beach strips and coastal marshes. Barrier beach strips, like the ACY sites, are also located near water. Barrier beaches are dense with fruit-bearing shrubs and their locations along the Atlantic flyway attract many migrants en route, including both forest species and waterfowl (Weltz 1975). Coastal marshes like many estuarine habitats, are high in diversity and production, and the ability of such a habitat to support many species is expected.

Lower numbers of species occurred in less diverse habitats. At ACY, lowest numbers generally occurred at sites that lacked cover. These included sites located far from forest or shrub edges, at ends of active runways, or areas of intense human use (hangars). Regionally, the lowest number of species were in cedar swamps where sparse undercover and high tree crowns provided little cover (McCormick 1970). Not unexpectedly, developed areas such as suburbs provided ample cover but probably limited food.

In our cluster analysis, clusters were formed describing six different habitats: "Forest", "Barrier Beach", "Aquatic", "Anthropogenic", "ACY-Grass/shrub", and "ACY-Forest". The clusters were distinct, with little overlap. Since clusters were based on the species composition of the habitats, clusters reflected the ecological requirements of the species that occupied them. We did find significant differences among clusters in the number of species classified by preferred breeding habitat. Also, differences among clusters were evident in the means and standard errors of the number of species within avian families that comprised the clusters. Both of these profiles (breeding preferences and avian family) have a broad ecological base.

Aquatic habitats were characterized, not surprisingly, by many aquatic species — ducks, shorebirds, and waders — while forests had more forest species (songbirds, woodpeckers, and owls). Airport clusters differed from other clusters by the presence of many grassland, savannah, shrubland, and urban species. Surprisingly, urban species were not found in the greatest numbers in the "Anthropogenic" cluster, but at both airport clusters (Tab. 2). However, the lower mean number of urban species in the "Anthropogenic" cluster appears to be the result of the depauperate numbers in the cedar swamp (the other habitats in the "Anthropogenic" cluster appear comparable to the airport habitats).

Airport sites were more similar to each other than to any regional site. "ACY-Grass/shrub" contained not only fewer species than other sites, but also showed the least variability with regard to number of species by preferred breeding habitats (as reflected in the small standard errors). This similarity may be due to the more uniform nature of the airport sites as compared to the regional sites.

"ACY-Forest" sites were clearly distinct from the regional pine-oak forests despite substantial airport forested areas. The presence of waterfowl and shrubland species suggest that both waterways and edge effects influenced the forest avian community. Like the grass sites at the airport, the forested sites were also influenced by urban species. All of our forest survey sites included open habitat (water, scrub, forest edge) and thus the forest community at ACY was best described as a community of savannah, shrubland, and urban species, with modest contributions by forest and water species.

**SUMMARY**

ACY attracted grassland, savannah, and shrubland species which were most likely attracted by the similarity of ACY habitats to native grasslands that
existed in the Northeast prior to their decline. However, the airport also attracted other species, most notably urban species. The proximity of the airport to the Atlantic coast also resulted in a marine influence — Laughing Gulls and other seabirds were common at ACY. The avian community therefore did not represent the pre-colonial communities, but rather a mixture of portions of these communities with modern urban exotics. However, several of the grassland birds that are on the decline in the Northeast (Grasshopper Sparrow, Upland Sandpiper) appeared to do well at the airport (Caccamise et al., 1995) and thus ACY may be a valuable avian resource that serves as a refugium for individual species.

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REFERENCES


STRESZCZENIE

[Zgrupowania ptaków podmiejskiego obszaru trawiastego: badania na lotnisku w płn.-wschodniej części USA]

W przeszłości biotopy trawiaste i zasiedlające je zgrupowania ptaków były rozprzestrzenione wzdłuż środkowego atlantyckiego wybrzeża Stanów Zjednoczonych. Urbanizacja w znacznym stopniu wyeliminowała ten rodzaj biotopu wraz z jego typową awifauną. Lotniska są nieodłącznym składnikiem krajobrazu zuurbanizowanego. W płn.-wschodniej części USA są one jednymi z najrozleglejszych obszarów trawiastych. Celem badań było określenie czy biotopy trawiaste lotniska w tej części kraju stanowią ostoję dla awifauny typowej dla naturalnych obszarów trawiastych. W latach 1991-1994 zbadano skład awifauny na międzynarodowym lotnisku miasta Atlantic City (ryc. 1) w stanie New Jersey i porównano go ze zgrupowaniami ptaków w biotopach naturalnych omawianego regionu. Podstawą porównania była analiza zestawów (cluster analysis) awifauny 24 miejsc prób reprezentujących różne biotopy lotniska (ryc. 2, tab. 1 i 2) oraz 17 awifauny 17 środowisk typowych dla okolicy, znanej z opracowania Brady (1980).

Stwierdzono, że lotnisko było miejscem bytowania gatunków związanych z naturalnymi biotopami trawiastymi, sawanną i zaroślami krzewiastymi. Obecność tych ptaków była związana z podobieństwem biotopów lotniska do pierwotnych środowisk naturalnych regionu. Na lotnisku występowały również gatunki typowe dla terenów zurbanizowanych oraz ptaki morskie przylatujące z pobliskiego wybrzeża Atlantyku. Skład awifauny badanego terenu
nie był więc kontynuacją pierwotnych lokalnych zgrupowań ptaków, a raczej ich mieszanką z elementami napływowymi związanymi z rozwojem cywilizacji. Mimo to pomimo bywały tu niektóre gatunki z naturalnych terenów trawiastych, które zanikają w omawianym regionie (Caccamise et al. 1995). Lotnisko spełniało więc rolę cennej ostoii tych zagrożonych gatunków.