United States Department of Agriculture | Forest Service | Rocky Mountain Research Station Albuquerque Lab | 2205 Columbia Dr. SE Albuquerque, NM 87106 (505) 766-2384

Executive Summary
Annual Report to the United States Golf Association
Green Section Research

Project: Golf Courses as Hotspots of Avian Diversity in the Desert Southwest

Principal Investigator: Michele Merola Zwartjes, Ph.D.

Riparian habitats in the desert southwest serve as a fundamental resource for many wildlife species. Natural riparian habitats are quickly disappearing, however, due to the demands of a growing human population on these areas for water, recreation, and development. The increased need for water for municipal and agricultural uses has led to numerous political conflicts over water rights and the loss of critical wildlife habitat in the southwestern U.S. Golf courses in the desert southwest have an unusual opportunity to contribute to regional wildlife conservation and to demonstrate responsible water usage practices. Golf courses are open spaces that typically have access to reliable water supplies, and are capable of supporting vegetation reminiscent of natural riparian areas. These attributes create the potential for golf courses to provide important habitats for wildlife in the desert southwest. The particular objectives of this study are to: 1) evaluate the possible role of golf courses in mitigating the loss of riparian habitats for resident and migratory birds; and 2) to determine how the type and distribution of vegetation on golf courses may influence its value as habitat for resident and migratory birds.

Field studies were recently initiated in July 2000 on five golf courses and five control areas in the Albuquerque, New Mexico, area. Participating golf courses include the Albuquerque Country Club, Four Hills Country Club, Paa-ko Ridge Golf Club, Paradise Hills Country Club, and University of New Mexico Championship Course. These courses all vary in factors such as overall size, shape, type of vegetation on course, and presence of standing water. Each of these courses has been paired with a natural control area, an area of nearby open space that as closely as possible represents the natural habitat that existed at each course site prior to the construction of the course. Bird surveys by point counts are being conducted at each site once a month throughout the year over a period of two years. In addition, mist-net surveys are being conducted at three of the courses and their comparison sites to gain further data on species of migratory birds utilizing the sites. Mist-netting also provides information that is not available through visual or auditory surveys, such as data on the number of young birds produced (by aging birds in the hand), or the physical condition of the birds (inferred by evaluation of fat levels on the birds). Comparison of the diversity of bird species between the five courses and between the courses and their associated control sites will provide us with information on the potential importance of golf courses in the desert as refugia for both resident and migratory bird species. Furthermore, extensive measures and analyses of the types of vegetation on each of the courses and the correlation of these measures with bird diversity will provide managers with valuable insight as to how to best manage their courses to enhance bird habitat. If, as expected, bird diversity is correlated with the extent of native vegetation on the courses, particularly shrubby vegetation, management for bird habitat through increasing the coverage of native plants and shrubs should also result in significant water savings for the courses.

Although it must be stressed that too few data are available at this early stage to present any conclusive results, the trend in our surveys so far indicates that most of the golf courses support a greater number of unique bird species than do their counterpart control areas. If this trend is supported over the coming years of data collection, then golf courses may indeed offer birds an unusually rich habitat in the desert environment, similar to that offered by riparian areas.

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Principal Investigator: Michele Merola Zwartjes, Ph.D.

Introduction and Background. This project is in its first year; I (Michele Zwartjes) assumed lead responsibility for the project from the original principal investigator, Jeffrey F. Kelly, in July of 2000. At that point funds had not yet been received from the U.S. Golf Association[1], and no research had yet begun. I started working based on the research plan that Dr. Kelly had originally submitted to the USGA. Although the proposal was entitled "Golf Courses as Hotspots of Biodiversity in the Desert Southwest" and contains references to sampling for birds, small mammals and herps, Dr. Kelly conveyed to me that the reviewers of the proposal had indicated that the USGA was really most interested in the avian component of the research. Based upon this information, I moved forward to design a study that is focused specifically on avian biodiversity of golf courses, rather than animal diversity as a whole. I suggest that a more appropriate revised title for this project is "Golf Courses as Hotspots of Avian Diversity in the Desert Southwest."

The objectives of this study are to: 1) evaluate the possible role of golf courses in mitigating the loss of riparian habitats for resident and migratory birds in a desert environment; and 2) to determine how the type and extent of different vegetation types on golf courses affects their value as habitat for resident and migratory birds.

In order to achieve these objectives, I needed to design a study that would document whether the abundance and diversity of birds on golf courses are different from the abundance and diversity of birds in the surrounding natural habitat. This will tell us whether golf courses do indeed attract more birds, and different species of birds, than would otherwise utilize the area if the golf course did not exist. To demonstrate this difference, I will be surveying birds on five different golf courses in the Albuquerque area. These courses include the Albuquerque Country Club, Four Hills Country Club, Paa-ko Ridge Golf Club, Paradise Hills Country Club, and University of New Mexico Championship Golf Course. Birds on each course will be surveyed using

[1] This was, as far as I can tell, due to the failure of the Forest Service to process the required paperwork in a timely manner, and does not reflect any lapse of responsibility on the part of the USGA.

variable radius point counts once a month throughout the year for just over two years from August 2000 through October 2002. In addition, during the summer and fall months mist-netting will be conducted to gain information on the identity of the migratory bird species that may be moving through the area, and also to gather data that cannot be inferred from simple visual or auditory surveys, such as productivity (gauged by proportion of young birds captured) and physiological condition (gauged by fat levels). For comparison purposes, surveying and mist-netting will also be carried out on "control" areas for each course. Each course will have a comparison site, a nearby natural area that as closely as possible reflects the habitat that existed on the site of its partner golf course prior to the course's development. Data from such controls will allow us to infer the impact of the course in providing habitat for native and migratory birds, by providing for a comparison of the abundance and species diversity of birds in the area both with and without a golf course. Between the courses and the controls, this brings the total number of study sites to ten. A map of the golf courses and their associated control natural areas is attached.

To meet the second objective of the study – the evaluation of the different vegetation types on the courses as bird habitat – I will be assessing the different habitat components of each of the courses and the control areas by a combination of vegetation sampling and analysis of aerial photos utiling geographic information systems (GIS) technology. Vegetation in a 0.04 ha circle centered on each of the points in the survey areas on the courses and comparison sites will be characterized according to the methods of James and Shugart 1970 (e.g., identification of all plant species, shrub layer, tree densities, canopy height, etc.). The total amount of vegetation cover in various classes (e.g., turf, native vegetation) will be estimated for each of the courses and comparison sites using GIS analysis of aerial photos. These measures will allow me to evaluate how the different vegetative characteristics of each of the golf courses corresponds with the abundance and diversity of bird life found there, and also to compare these measures between the five courses. In addition, I will be able to assess how closely the vegetative characteristics of each course correponds with the characteristics of its comparison site, and to determine the degree of correlation, if any, between the amount of natural vegetation remaining on the course and the number of representatives of the native bird community that is retained there. The study courses represent a diversity of available habitat types, ranging from the turf-dominated, park-like setting of the Albuquerque Country Club to the densely wooded, pinyon-juniper habitat of the Paa-ko Ridge Golf Course.

When all of the information from this study has been collected, I will be making use of data from Rio Grande Bird Research, a group that has been banding birds in the riparian forest of the Rio Grande in Albuquerque for over twenty years. A comparison of the avian diversity of birds on Albuquerque golf courses with that of the Rio Grande forest will enable me to determine whether golf courses do indeed play a similar role to that of riparian areas in providing important habitat for migratory and resident birds.

There is an educational component to this study as well. I will be conducting surveys on each course to determine the attitudes of golfers toward issues such as water conservation, the provision of wildlife habitat on golf courses, and the use of native plant landscaping on courses. I anticipate that the results of my research will show that courses with a greater extent of native vegetation, and particularly the presence of dense patches of shrubs, will also have a greater

diversity of native birds. This information, combined with the results of the golfer surveys, will allow me to make management recommendations to course managers that hopefully will provide simultaneously for both increasing the habitat value of golf courses for both resident and migratory birds, and result in significant water savings (and therefore financial savings) for the course through the use of native plants.

Progress to Date. The following is a list of accomplishments on this project from July 2000 through November 2000.

- Finalized study design to achieve stated objectives of research.
- Acquired necesaary permits and equipment to carry out research (e.g., GPS unit, mist nets).
- Contacted golf courses and met with managers and superintendent of courses that expressed interest in participating in study. I attempted to obtain permission from courses that represent a wide range of habitats and landscape designs on their grounds. Secured participation of five area courses, and established survey schedules in agreement with course superintendent to minimize disruption of normal course maintenance and activity.

  Participating courses are:

  - Albuquerque Country Club
    - Established 1929; 100 acres; open, park-like, entirely turf with scattered mature trees; no standing water on grounds
  - Four Hills Country Club
    - Established 1957; 160 acres; mostly open, park-like, turf with scattered mature trees; some remaining stands of native shrubs and two ponds, one with significant emergent vegetation
  - Paa-ko Ridge Golf Course
    - Established 2000; 220 acres, but only 160 acres irrigated turf; turf minimized, mostly native pinyon-juniper woodland; two ponds
  - Paradise Hills Golf Course
    - Established 1960; 160 acres; mostly open, park-like, turf with scattered mature trees; few areas of native grassland; one pond with some emergent vegetation
  - University of New Mexico Championship Course
    - Established 1965; 220 acres; large areas of native shrubs and grasses; three ponds, all with significant surrounding emergent vegetation and trees
      - Due to logistical limitations, mist-netting and banding will take place only on the Four Hills, Paradise Hills, and UNM Championship courses and their comparison sites

- Identified appropriate natural areas to serve as control comparison sites for each of the golf courses. Contacted landowners and secured permits or written permission, as appropriate, to conduct bird surveys and mist-net on control sites throughout the life of the study. Selected control sites are:

  - Tingley Beach Bosque (control site for Albuquerque Country Club)
    - Wooded riparian forest directly across street from Albuquerque Country Club; part of Rio Grande State Park.
  - Four Hills Open Space (control site for Four Hills Country Club)
    - Albuquerque City Open Space area in foothills less than 0.5 mile from golf course.
  - San Pedro Creek Estates Nature Preserve (control site for Paa-ko Ridge Golf Course)
    - 250 acre wooded nature preserve within newly established low density development just north of golf course.
  - Piedras Marcadas Canyon (control site for Paradise Hills Country Club)
    - Albuquerque City Open Space adjacent to Petroglyph National Monument, directly south of golf course and less than one mile away from course
  - UNM Comparison site (control site for UNM Championship Course)
    - Undeveloped property directly across interstate from UNM course, less than 0.25 mile away. Currently controlled by First Commercial Property.

- Hired an experienced biological technician, John DeLong, to assist with mist-netting and banding and occasional surveys

- Established point count survey routes on each of ten study sites.
  - A total of thirty point counts have been conducted to date covering nine* sites.

- Began fall mist-netting at three courses and their control sites. Mist-netting operations to sample migratory birds took place in September and October.
  - 98 individuals were banded at the six banding study sites this fall.

- Consulted with native plant landscaping design specialist and secured agreement from Four Hills Country Club to establish a small, experimental native plant project on their course to demonstrate the value of native plants to wildlife and also to highlight the water savings of such a project.

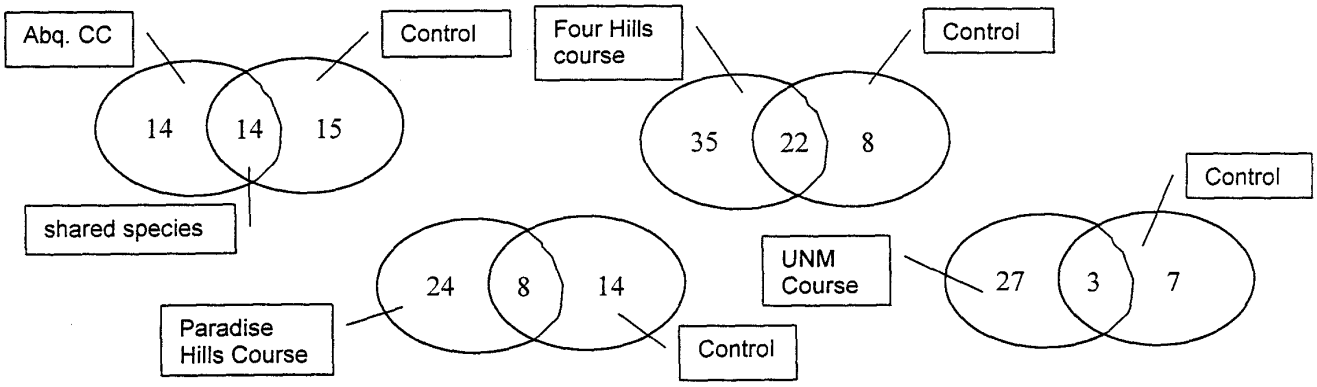
- August 8, 2000. Traveled to Washington, D.C. to attend meeting of Wildlife Links Grantees and Steering Committee and make presentation of proposed research and study design.

Preliminary Results. Since we have only completed a few months of field work, not much can yet be offered in the way of preliminary results. Sample sizes are very small to date, so all information offered here is strictly preliminary and very much subject to change as more comprehensive data are gathered over the next two years of the study. Just out of interest, I have put together the following numbers based on the few point count surveys and banding sessions that have been completed to date.

A simple comparison of the species counts for each of the sites yields the following numbers :

Number of bird species detected	Abq. Country Club	Four Hills Course	Paa-ko Course	Paradise Hills Course	UNM Course
on golf course:	28	57	47	32	30
on control site:	29	30	---*	22	10

It may be more informative to look at these numbers in terms of the number of species that are unique to each site. For each golf course and its control, I have broken out the number of species that are found on the course but not on the comparison site (left), the number of species found on the comparison site but not on the golf course (right), and the number of species that are shared in common between the two sites (middle). This information is represented below:



Perhaps the most noticeable trend in these numbers is the tendency for the golf courses to have a greater number of unique species than the control areas; in three out of the four cases (the exception is the Albuquerque Country Club) the difference between the number of unique species on the golf course and the control area is quite large. The relatively low number of species shared between the courses and their controls is also striking (32.5% shared for the Albuquerque Country Club, 33.8% shared for Four Hills, 19% shared for Paradise Hills, and 8% shared for UNM). Again, one can hardly draw conclusions based on this little data, but so far this trend indicates that, as expected, golf courses offer a habitat that contrasts strongly with the natural habitat surrounding it, resulting in a significant difference in the composition of the avian community between golf courses and the desert environment. Thus far, most courses show

* permission to work on comparison site just granted and survey points only recently established; no official surveys have yet been conducted on the Paa-ko comparison site

greater avian diversity than their counterpart control areas. If these trends receive continued support over the coming years of research, than this may indeed indicate that golf courses play a role similar to that of riparian areas in the desert environment in providing rich habitat refugia for both resident and migratory birds.

Proposed Research Schedule, December 2000 – March 2003. Field work will be carried out for a period of just over two years to collect data for this study. The final months of the project will be used for data analysis and writing up the results of the research for publication in both trade publications and peer-reviewed scientific journals. The research schedule currently is as follows:

December 2000 – May 2001	Conduct point count surveys on each of ten sites once each month.
March 2001	Seed designated native plant demonstration area at Four Hills Country Club.
May 2001	Distribute questionnaires to participating courses.
June - October 2001	Conduct point count surveys on each of ten sites once each month. Mist net and band birds on six banding sites once each month. Gather vegetation data.
November 2001 – May 2002	Conduct point count surveys on each of ten sites once each month. Begin GIS analysis of site vegetation and proximity to urban areas. Compile survey results.
May – June 2002	Determine success of native plant project at Four Hills. If successful (native plants established), install educational signs and make informational brochures available on purpose of project.
June - October 2002	Conduct point count surveys on each of ten sites once each month. Mist net and band birds on six banding sites once each month. Gather final vegetation data.
November 2002 – December 2002	Analysis of complete data set. Acquire data on riparian forest comparison site from Rio Grande Bird Research for incorporation into analysis. Begin writing up results.
January 2003 – February 2003	Submit final manuscripts for publication. Construct web page with results and management recommendations. Organize and hold meetings with area golf course managers for dissemination of results.

Note: data entry and background literature research in preparation for publication of results will be ongoing throughout the life of the project.

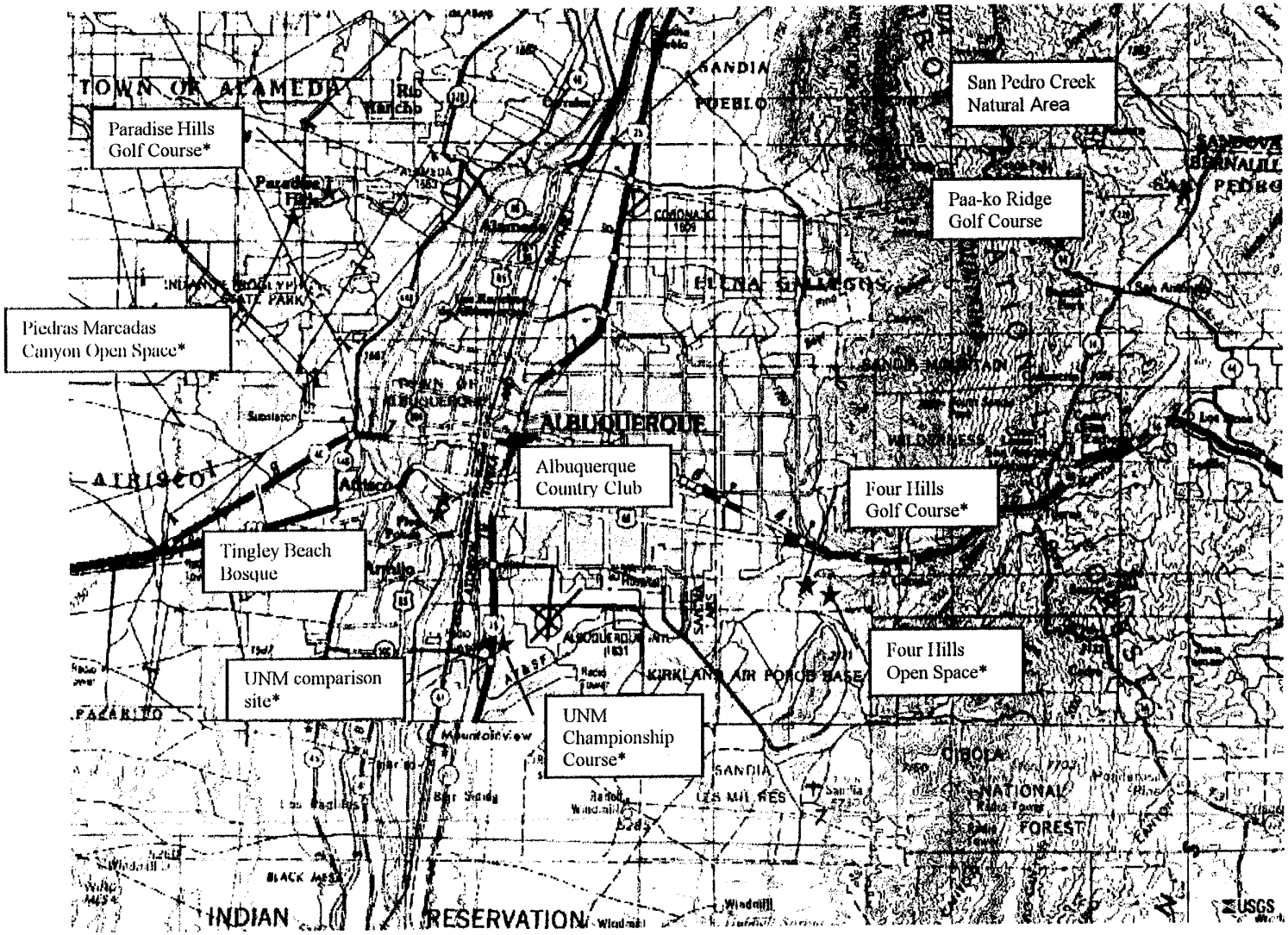
Anticipated results for coming project year. As this project has only just gotten off the ground, I anticipate that by next year, with one full year of complete data from bird surveys, netting, and vegetation analyses, I will be able to provide the USGA with a more comprehensive and statistically sound look at the correlation between avian diversity and golf course habitats in the desert southwest. In addition, within the next year I will have gathered survey information from golfers on their attitudes about improving wildlife habitat on golf courses, water conservation, and native plant landscaping, all of which should prove valuable information for golf course managers working in desert environments.

If I may provide you with any further details or explanation of the information presented here, please do not hesitate to contact me.

/s/

Michele Merola Zwartjes, Ph.D.
Research Wildlife Biologist

Map of golf courses and paired control sites for study



* denotes sites at which mist-netting and banding will be conducted in addition to point count surveys