The extensive natural border areas on the golf course provide a natural buffer zone that separates the golf course from some of the nearby housing developments.

The Bird Communities of Prairie Dunes Country Club and Sand Hills State Park

"All wilderness areas, no matter how small or imperfect, have a large value to land-science."
— Aldo Leopold, wildlife biologist

by MAX R. TERMAN, Ph.D.

IN THE WAKE of alarming declines in the populations of wild birds, wildlife experts and other concerned persons are calling for increased efforts to incorporate more wildlife habitat into managed landscapes. Many golf courses, both old and new, have incorporated wild areas into their designs. This is, in part, due to a desire to give the course more *character,* but more recently, to meet the growing public desire for environmentally responsible golf developments.

How effective are the habitats on a golf course in promoting bird diversity? One way to answer this question is to compare the birds using a naturalized golf course with a similar nearby natural area. While golf courses are not natural areas, this kind of study may inform us about what kinds of birds utilize golf courses and which do not. This in turn may lead to more informed decisions about how to promote a higher diversity of birds on human-dominated landscapes.

Study Areas and Methods

This article reports the results of a three-year study of the birds found on

TABLE 1
Site Descriptions and Overall Bird Census Numbers

	Prairie Dunes Country Club	Sand Hills State Park
Description	Naturalized, links-style golf course surrounded by a natural buffer zone and housing development	Natural prairie with public trails
Human use	35,000 rounds of golf/year highly maintained	Light-moderate use by hikers, horseback riders
Size of total area (hectares)	105 (260 acres)	455 (1,123 acres)
Size of survey area (hectares)	64.8 (160 acres)	56.7 (140 acres)
Transect surveyed (kilometers)	4.4 (4,812 yards)	3.5 (3,820 yards)
Number of bird species (10/93-10/95)	57	63
Species/hectare	0.88	1.11
Total number of birds	2,020	1,000
Birds/kilometer	459.1	285.7

the Prairie Dunes Country Club in Kansas and a nearby natural area, Sand Hills State Park. This study is part of an innovative cooperative arrangement between Prairie Dunes Country Club and Tabor College. Sponsored by the USGA Green Section, this unique team approach combines the resources of the academic and golf communities in the important endeavor to understand and preserve biodiversity on human-dominated landscapes.

Prairie Dunes and Sand Hills present an ideal situation for an ecological study of this type. With the exception of tees, fairways, greens, and buildings, Prairie Dunes is very similar to Sand Hills State Park in topography and vegetation. Both have native prairie plants and rolling dunes typical of the sand hills biotic region of Kansas. The public trail used for the bird census in the park is approximately the same shape and distance as a loop through both nine-hole layouts of the golf course.

Prairie Dunes is a highly regarded, intensively managed golf course that hosts more than 35,000 rounds of golf per year. Approximately 74 percent of the country club property is in a natural state, with native plants growing not only in the roughs and out-of-play areas, but also in a natural buffer zone that partially surrounds the course, separating it from some of the nearby housing developments. Under the leadership of superintendent P. Stan George, C.G.C.S., Prairie Dunes has achieved full certification in the Audubon Cooperative Sanctuary Program administered by Audubon International for its efforts to be environmentally responsible. Even prescribed burning of on-course grass areas is carried out when conditions allow.

Sand Hills State Park is a valuable natural area under the control of the Kansas Department of Wildlife and Parks. To control woody plant invasions and maintain the dominant herbs and grasses, the park is burned periodically. Local residents treasure the natural beauty of the sand dunes, grasslands, wetlands, and woodlands. Located approximately four miles from Prairie Dunes, its 1,123 acres contain public walking trails accessible only to walkers and permitted horseback riders. Compared to the golf course, the park is a low-impact area with minimal human disturbance to the wildlife.

Birds were censused in good weather on transects (paths) located on the

TABLE 2
Numbers (birds/kilometer) and Relative Abundance (percent of total) for Birds at Prairie Dunes Country Club (PD) and Sand Hills State Park (SH) Arranged in Descending Order of Prairie Dunes Bird Numbers

	Birds/Kilometer		Relative Abundance	
Species	**PD**	**SH**	**PD**	**SH**
American robin	91.6	26.0	20.0%	9.1%
European starling	70.5	2.6	15.3%	0.9%
American tree sparrow	51.1	8.0	11.1%	2.8%
House sparrow	23.9	0.0	5.2%	0.0%
Harris sparrow	21.8	10.6	4.8%	3.7%
Barn swallow	17.0	0.9	3.7%	0.3%
Eastern kingbird	16.8	12.0	3.7%	4.2%
Common grackle	15.5	4.6	3.4%	1.6%
Mourning dove	12.7	8.3	2.8%	2.9%
Northern cardinal	12.7	12.6	2.8%	4.4%
Blue jay	12.5	8.9	2.7%	3.1%
Black-capped chickadee	9.3	20.3	2.0%	7.1%
Dark-eyed junco	8.0	8.9	1.7%	3.1%
House wren	7.7	10.3	1.7%	3.6%
American goldfinch	7.0	15.1	1.5%	5.3%
Northern oriole	7.0	5.4	1.5%	1.9%
Bell's vireo	6.8	4.3	1.5%	1.5%
Field sparrow	6.1	4.0	1.3%	1.4%
Western kingbird	6.1	1.1	1.3%	0.4%
Northern flicker	5.2	16.6	1.1%	5.8%
Brown-headed cowbird	4.1	2.6	0.9%	0.9%
Cattle egret	3.4	0.3	0.7%	0.1%
Northern bobwhite	3.4	9.4	0.7%	3.3%
Eastern meadowlark	3.2	4.3	0.7%	1.5%
Red-winged blackbird	3.0	11.7	0.6%	4.1%
Canada goose	2.7	1.4	0.6%	0.5%
Killdeer	2.5	0.3	0.5%	0.1%
Chimney swift	2.3	0.3	0.5%	0.1%
Gray catbird	2.3	5.7	0.5%	2.0%
Brown thrasher	2.0	3.7	0.4%	1.3%
Song sparrow	2.0	0.6	0.4%	0.2%
American crow	1.8	13.4	0.4%	4.7%
Franklin's gull	1.8	0.0	0.4%	0.0%
Red-headed woodpecker	1.6	2.9	0.3%	1.0%
Wild turkey	1.4	0.0	0.3%	0.0%
Common yellowthroat	1.1	6.0	0.2%	2.1%
Eastern bluebird	1.1	1.7	0.2%	0.6%
Grasshopper sparrow	0.9	5.1	0.2%	1.8%
Orchard oriole	0.9	0.3	0.2%	0.1%
Red-tailed hawk	0.9	4.3	0.2%	1.5%
Yellow-rumped warbler	0.9	0.6	0.2%	0.2%
Downy woodpecker	0.7	1.7	0.1%	0.6%
Great blue herron	0.7	0.6	0.1%	0.2%
Upland sandpiper	0.7	0.0	0.1%	0.0%
American kestrel	0.5	0.0	0.1%	0.0%
Belted kingfisher	0.5	0.0	0.1%	0.0%
Mississippi kite	0.5	0.9	0.1%	0.3%
Ring-necked pheasant	0.5	0.0	0.1%	0.0%
Yellow-billed cuckoo	0.5	0.6	0.1%	0.2%
Chipping sparrow	0.2	0.0	0.0%	0.0%
Dickcissel	0.2	9.4	0.0%	3.3%
Great crested flycatcher	0.2	1.1	0.0%	0.4%
House finch	0.2	0.0	0.0%	0.0%
Northern harrier	0.2	0.6	0.0%	0.2%
Northern mockingbird	0.2	0.3	0.0%	0.1%
Red-bellied woodpecker	0.2	2.3	0.0%	0.8%
Turkey vulture	0.2	2.0	0.0%	0.7%
Bewick's wren	0.0	0.3	0.0%	0.1%
Blue grosbeak	0.0	0.3	0.0%	0.1%
Carolina wren	0.0	0.6	0.0%	0.2%
Rufous-sided towhee	0.0	3.1	0.0%	1.1%
Eastern wood-peewee	0.0	0.6	0.0%	0.2%
Hairy woodpecker	0.0	0.6	0.0%	0.2%
Indigo bunting	0.0	0.3	0.0%	0.1%
Lark sparrow	0.0	0.3	0.0%	0.1%
Least flycatcher	0.0	0.6	0.0%	0.2%
Rose-breasted grosbeak	0.0	0.6	0.0%	0.2%
N. rough-winged swallow	0.0	0.3	0.0%	0.1%
Vesper sparrow	0.0	0.9	0.0%	0.3%
White-breasted nuthatch	0.0	0.3	0.0%	0.1%
White-throated sparrow	0.0	2.3	0.0%	0.8%
Yellow-breasted chat	0.0	0.6	0.0%	0.2%
TOTALS	**459.1**	**285.7**	**100.0%**	**100.0%**

public trail in Sand Hills and on the golf course proper at Prairie Dunes. Another trained observer, Paul Jantzen, and I counted and recorded by species all birds seen along the public trail in the park and near the tees, fairways, roughs, and greens on the golf course proper. To adequately sample all birds using the areas in different seasons, we performed a total of 12 censuses over three years, with five censuses occurring during the autumn, one during winter, two during spring, and four during summer.

The off-course natural areas at Prairie Dunes were not censused, and all Prairie Dunes bird observations are restricted to the golf course proper. Future studies will census the natural areas at Prairie Dunes.

Results

Tables 1, 2, and 3 provide an overall synopsis of important statistics and comparisons. Both the golf course and the natural area supported complex bird communities, sharing many species in common (Table 2). In terms of the number of species using the two areas (species richness), the golf course compared favorably to the natural area, and a statistical comparison indicated no significant differences in this measure of species diversity. However, there were significant differences in other measures. Statistical tests comparing indices of relative abundance (the specific kinds, numbers, and proportions of the total in each kind) revealed that the kinds of birds and the numbers per species were different between the two areas. Measures of community similarity and species diversity also indicated noticeable differences.

Sand Hills had more species of birds than Prairie Dunes, but fewer individuals. Figures 1 and 2 graphically illustrate the comparisons in species richness and relative abundance. Sand Hills had 15 species that did not occur on Prairie Dunes and 9 species occurred on the golf course but not in the park (Table 2). For the most part, birds with larger natural habitat requirements and perhaps less tolerance for disturbance (e.g., least flycatcher, yellow-breasted chat) occurred more frequently in the state park, while those with less restrictive habitat needs and higher tolerances for disturbance frequented the golf course (e.g., American robin, common grackle, eastern kingbird).

Native prairie vegetation lines the golf holes at Prairie Dunes Country Club in Hutchinson, Kansas.

TABLE 3
Summary of Statistics

Statistical Tests for Significant Differences

1. Chi-square contingency table analysis for differences in kinds and numbers of birds in the two sites. Chi-square value = 195.73, df = 27, $p<.001$ (statistically significant differences).
2. Chi-square contingency table analysis for differences in species richness between the two sites. Chi-square value = 13.286, df = 11, $p>.10$ (no statistically significant differences).

Community Similarity Indices (0 = no similarity, 1 = nearly the same)

Jaccard Coefficient	0.680
Horn Index	0.721
Morisita's Index	0.566
Proportional Similarity	0.504

Species Diversity Indices	Prairie Dunes	Sand Hills
Species richness	57	63
Number of individuals/kilometer	459	286
Number of equally abundant species	19.59	34.12
Simpson diversity (range 0-1)	0.912	0.964
Sheldon evenness (range 0-1)	0.343	0.541

Summary

Are the areas the same regarding the bird communities?	Yes and no — There are no significant differences in the number of species in the two areas. However, they do differ in the specific kinds and relative abundance of the birds. The community similarity and species diversity indices indicate that the two areas are moderately similar.
How do they differ?	The golf course has different species and higher densities in fewer kinds. The natural area has fewer individuals but they are more evenly spread among more kinds. The natural area has 15 species that did not occur on the golf course. The golf course has 9 species that did not occur in the natural area.
How are they the same?	Because the golf course has natural habitat, it supports almost as many bird species as the natural area (but not the same kinds in the same proportions).

Discussion

Is it worthwhile to include natural habitat areas on golf courses? If providing a home for a significant number of birds is important, the answer is yes. Fifty-seven species of birds used Prairie Dunes in my survey, and knowledgeable observers have added 15 to 20 more species to the list. Some birds using Prairie Dunes, such as the grasshopper sparrow, yellow-billed cuckoo, and Mississippi kite, have experienced significant regional declines in their populations. My students have studied other golf courses (unpublished data) without wildlife habitat in the area, and seldom does the species count exceed 27, and rarely do we find as many sensitive species such as the yellow-billed cuckoo, grasshopper sparrow, and dickcissel. In truth, the bird community on Prairie Dunes differs from these conventional courses in much the same way that Sand Hills differs from Prairie Dunes. On naturalized golf courses, the occurrence of sensitive species is much more frequent and the distribution of individuals among the species is more even and stable. Providing habitat on privately managed landscapes does attract an exceptional number of birds. Furthermore, these areas may be especially important to migratory birds needing a place to stop and refuel (yellow-rumped warbler) or to spend the winter (Harris sparrow).

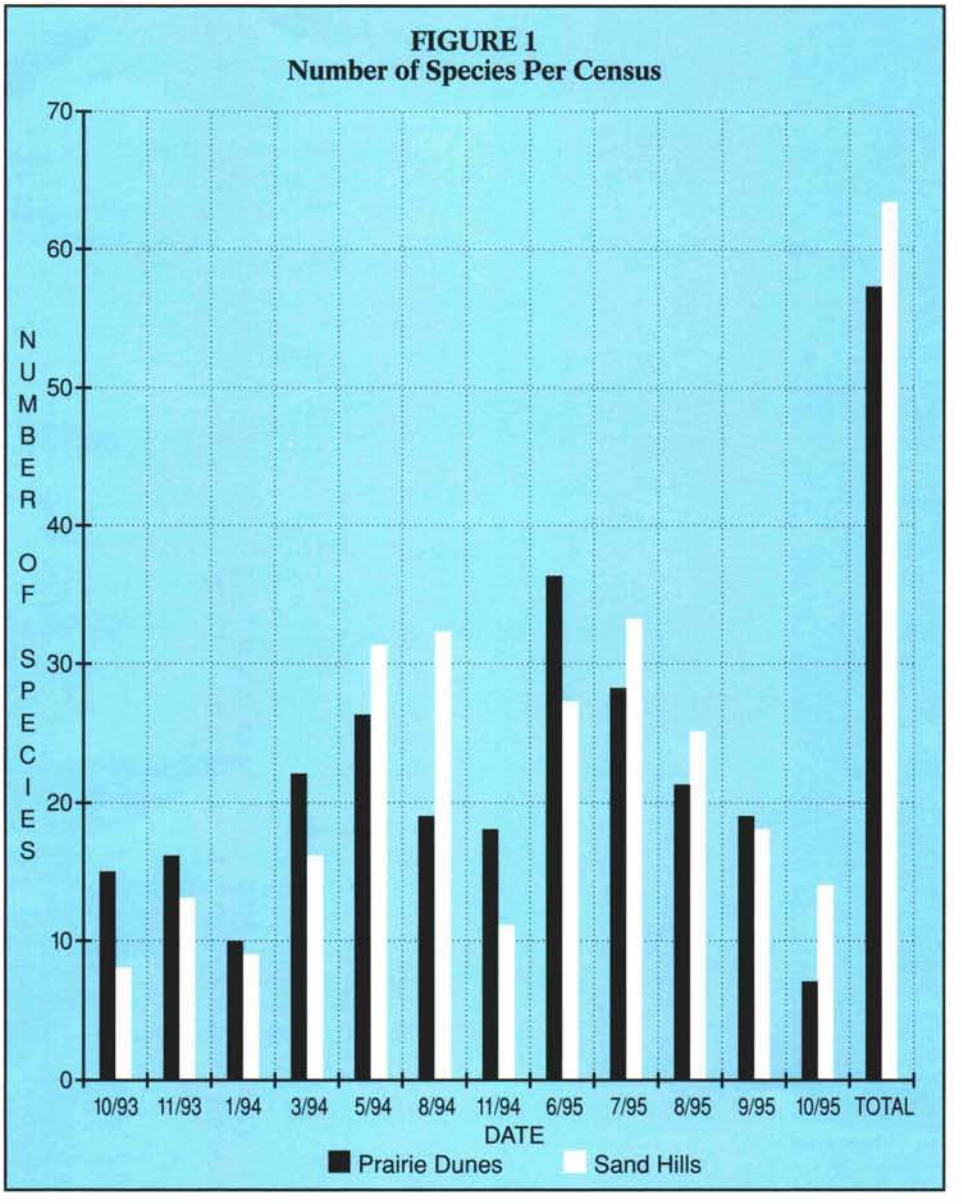
Are naturalistic golf courses' natural areas the same in the kinds of bird communities they support? The answer here is no, since there are many birds that require the larger, less-fragmented and impacted habitats found in undisturbed areas away from human activities. The large amount of patchiness and edge habitat on golf courses is problematic for many birds that preferentially choose large, connected habitats. For this reason, natural areas may lose many species of birds, depending on the type of golf course constructed on the site. This is an important consideration in decisions regarding the siting of golf courses. It is unknown whether golf courses that include larger areas of undisturbed habitat (such as the approximately 100 acres of natural area on Prairie Dunes) will lose fewer numbers of bird species. Our future studies of these undisturbed areas on Prairie Dunes should provide more information in this regard.

Naturalistic golf courses (those using the natural environment of a region as a development template) offer much promise in the larger struggle to preserve plant, animal, and ecosystem diversity. If managed correctly, naturalistic courses fit well into the emerging new philosophy of ecosystem management that recognizes the immense potential of smaller parcels of public and private lands for preserving nature. With the involvement of ecologists, golf courses — commonly thought to be environmental problems — can now become ecological assets in the effort to increase the survival chances of many plants and animals. Especially attractive in this regard are the naturalized golf courses built on already disturbed land such as old mines, landfills, and highly eroded or otherwise negatively impacted landscapes.

In theory, the ecological role of golf courses and smaller habitat parcels may be to serve as *population sinks* for the *population sources* of natural areas. Larger natural areas such as Sand Hills State Park give a wide variety of species a chance to reproduce, and individuals spread out across the countryside from these reproductive *fountains*. Dominant individuals secure territories on the natural area and younger individuals then move out as the area fills up with offspring dispersing from the nests. Prairie Dunes then receives these dispersing individuals (like a sink) and provides them a home if they can adapt to the smaller habitat patches and human activity of the golf course. Not all the species can adapt, but a good number do find a home. How to increase this number is the critical question engaging ecologists. Answers await more ecological research. However, the stakes are high as the fate of many of our favorite birds and other wildlife hangs in the balance.

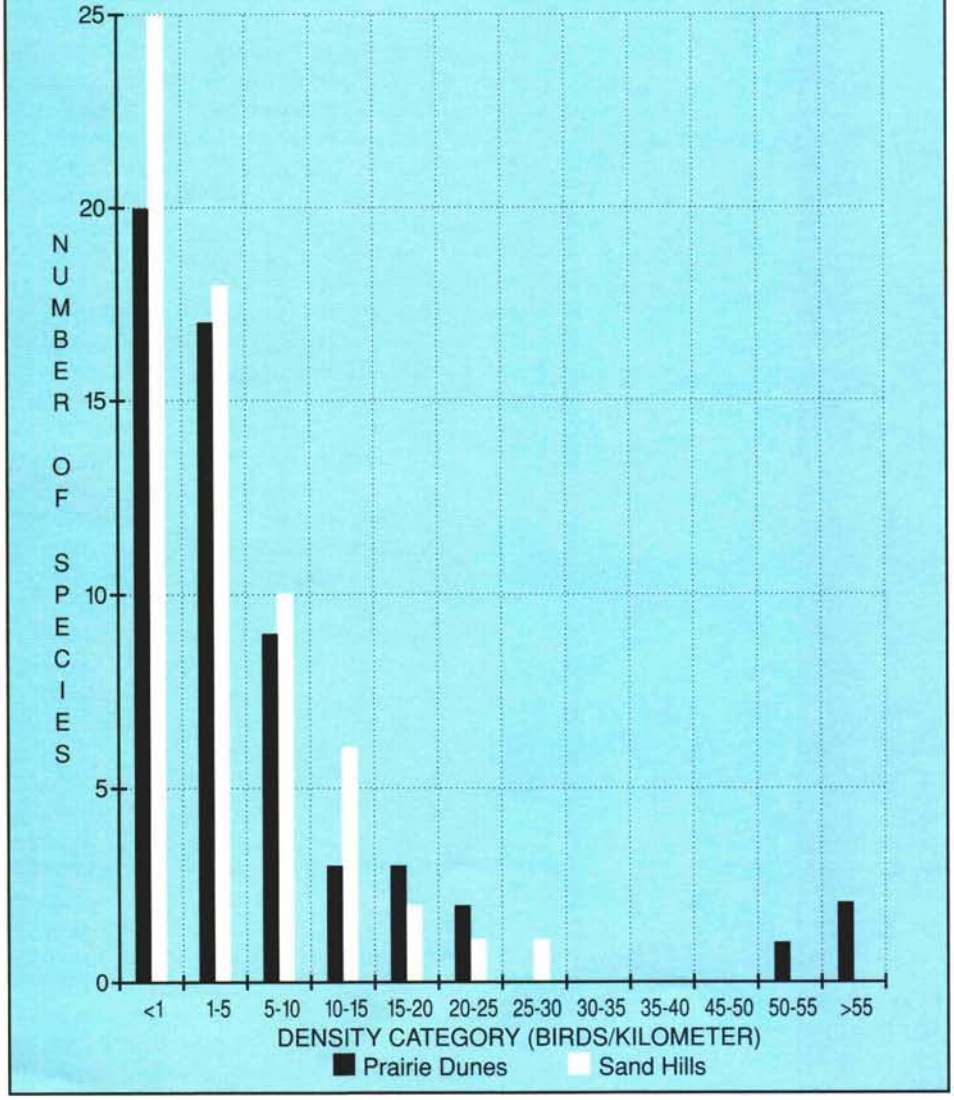
Undisturbed, pristine habitats commonly are the choice of ecologists in search of knowledge about the machin-

FIGURE 1
Number of Species Per Census



Sand Hills State Park is 1,223 acres of sand dunes, grasslands, wetlands, and woodlands. The habitat is very similar to Prairie Dunes Country Club.

FIGURE 2
Number of Species Per Density Category



ery of nature. However, with the spread of urbanization, it is time for ecological scientists to also study human-dominated landscapes such as golf courses. Many opportunities exist for helping the golf community make ecologically sound decisions. This present study is an example of one cooperative effort between a golf course and an academic institution, and a rewarding relationship has developed which benefits us both. Another cooperative effort supported by the USGA is the arrangement between Sienna College and Schuyler Meadows Country Club in New York.

For ecologists who happen to be golfers, the relationship between science and golf is quite natural. Both cultures have become intertwined in my life (see Terman, M. 1996, *Messages From An Owl*, Princeton University Press) to where ecology is more than just a career and golf more than just a game. Both activities bring to my life the best in human relationships — friendship, honesty, integrity, a respect for tradition, a sense of fair play, and decision-making based on objective evidence. With these shared ideals, the common ground between the science of ecology and the golf community becomes fertile soil for future cooperative efforts to protect our common natural heritage. In the final analysis, we are both stewards of the same gifts of creation — those special places for which John Muir so eloquently pleaded with these words:

> *"Man needs beauty as well as bread, places to play in and pray in where nature can heal and cheer and give strength to body and soul alike."*
>
> — John Muir, naturalist

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