Golf courses are not just areas for playing the game, but also act as protectors of the environment and are important in nature conservation. Is this statement true or false? The answer depends on who you ask, but here Alan Gange and Della Lindsay, of Royal Holloway, University of London present some scientific evidence to support it

The birds & bees

Golf courses are perceived by some as being bad for the environment. Vociferous anti-golf lobbies often claim that large amounts of water, fertiliser and pesticides are used and that little thought is given to the management of the non-playing areas of the course. We suspect that virtually every greenkeeper in the country knows that these statements are not true, but what is the opinion of the general public?

When one starts delving into the literature on this subject, it is immediately apparent that there is very little published information on the broader aspects of golf course conservation and even less on the public understanding of it. We therefore decided to perform a survey of local people, to ask them their opinions of golf courses. We spoke to several hundred people in Surrey and south east London and among a series of questions, asked them if they thought that golf courses are good or bad for the environment and whether they play golf.

The results were very interesting, but worrying at the same time. Among golfers, 77% thought golf courses were environmentally friendly, but among non-golfers, this figure dropped to an alarming 43%. This result is perhaps not surprising to readers of Greenkeeper International, but shows that there is a lack of knowledge among the general public. The majority of golfers know that courses are good for conservation purposes, but of those people who have never been on a course, the majority think they are bad for the environment.

We therefore believe that there is a distinct need for information on the role that golf courses play in the landscape and so recently, a number of our students have performed habitat surveys of courses. Looking at the literature, we decided that in many previous studies, the wrong ecological questions had been asked. Usually, workers have compared the diversity of species on a course with a nearby area of natural habitat. However, we believe that a more ecologically realistic question to ask is - How does the species diversity of a course compare with the nearest piece of habitat, which the course would be, if it was not used for golf? In many cases, the nearest piece of

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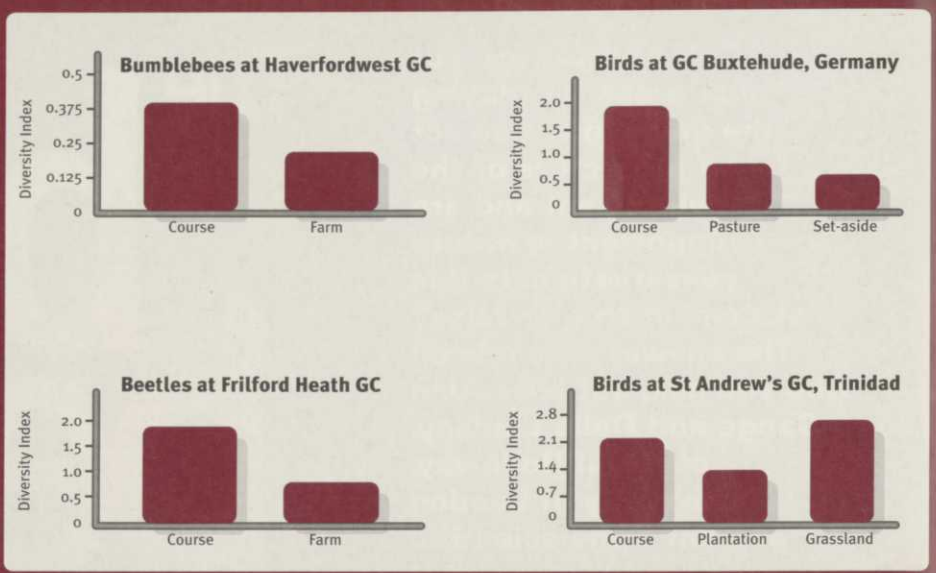

Captions for slides

1. [slide label: Haverfordwest GC] Haverfordwest GC is situated amongst farmland and provides a varied selection of habitats, particularly for bumblebees.
2. [slide label: pitfall@Berks] Pitfall traps are a simple way of monitoring populations of ground-dwelling insects
3. [slide label: carabid adult] Carabid beetles may look fearsome, but they are some of Nature's most useful predators
4. [GC, Trinidad] Set amongst natural habitats, St Andrews GC, Trinidad is a haven for bird life
5. [slide label: Egrets, Trinidad] Avian spectators on St. Andrews GC.

habitat which the golf course would have been is not undisturbed habitat, but farmland or semi-natural habitats such as set-aside land.

Faunal surveys of golf courses are ideal for final year student research projects and with suitable training, students can walk golf courses on a defined route, identifying and counting target groups as they go. Such survey techniques are well established in Ecology, and the data produced can be subjected to a variety of statistical techniques. Certain groups of insects and birds are easy to identify in the field and for larger insects, such as bumblebees and beetles, the specimens can be captured, marked with a small spot of non-toxic paint and released. Counts of these insects can therefore be very reliable, as we know if the same insect has been caught before.

At Royal Holloway, a number of these surveys have been performed in the last couple of years and in this article we present the results from four case studies, from different parts of the world. In all cases, we record the number of species and the numbers of individuals of each species. These two quantities are then used in the calculation of an index of Diversity. Diversity is an often misused term in Ecology and is frequently (wrongly) equated with the number of species in an area. In fact, diversity is a composite term, which takes into account the number of species and the spread of individuals across species. A habitat that has a similar number of each species is considered to be more diverse than one in which one or a few species dominate, even if the total number of species in each habitat is the same.

Case study 1: Haverfordwest Golf Club, South Wales

Haverfordwest GC is nearly 100 years old and is surrounded by pasture grassland, supporting sheep, with some beef and dairy cattle. Therefore, if the golf course did not exist the land would most probably be used for livestock farming. In this study, we compared the bumblebee fauna of the course and an adjacent farm over one summer.

The diversity of bumblebees on the golf course was significantly higher than that of the farmland (Fig. 1). Two reasons accounted for this fact – more bumblebee species were found inhabiting the golf course and the number of individuals of these species was also higher. Table 1 shows the mean number of individuals captured per day over the summer for the five commonest species. Most species were significantly commoner on the course and only one species was more abundant on the farm.

Bumblebee species	Golf course	Farmland
Bombus lapidarius	93	17
B. lucorum	77	38
B. pascuorum	67	40
B. terrestris	56	54
B. pratorum	44	17
B. hortorum	21	34

Table 1. Average number of bumblebees caught (and released!) per day

These data are very interesting because in recent years there has been much concern over the decline of bumblebee populations in the UK. These insects are extremely important pollinators of a number of our crops and agricultural intensification has often been cited as a reason for their loss. It appears that golf courses may provide valuable habitats for these insects, because unlike farmland, the habitat structure is more varied, providing nest sites and abundant flowers for food. The former reason is certainly the case for B. lapidarius, which prefers to nest in dry, stony areas, with little vegetation. Such microhabitats were rare on the farm, but common in banks on the course. Flowers for foraging bees were available all summer in the natural habitats on the course, but the only flowers in abundance on the farm were thistles and clovers, neither of which flower all summer, meaning that there were gaps in the availability of food.

Case study 2:
Frilford Heath GC, Oxfordshire

Frilford Heath possesses three 18 hole courses and we compared the most recent course, opened in 1994, with a nearby arable farm. Our target insects this time were ground beetles, known scientifically as carabids. These beetles are predatory and there has been much recent research aimed at enhancing their numbers on farmland, where they can act as important control agents of pests, such as slugs and cereal aphids. Carabids are easy to catch in pitfall traps, where a small plastic cup is inserted into the ground so that its rim is flush with the soil level. The beetles are mainly active at night and an early morning survey reveals those beetles which have fallen into the traps.

As with the bumblebees, we found that carabid diversity was much higher on the course,

being over twice that of the farmland (Fig. 1). Carabids were also more abundant on the course; we caught an average of 5.6 beetles per trap per week on the course, compared with only 2.9 per trap per week on the farm.

Golf courses could therefore act as potential reservoirs of these predators in an agricultural landscape. On farms, special areas are often created, known as 'beetle banks' in which carabids can breed, before dispersing into a crop. From a beetle's point of view, the course could represent the Bank of England, but we need more research to determine whether these insects can disperse from courses on to neighbouring farms.

Case study 3:
Golf Club Buxtehude, Germany

Golf Club Buxtehude is situated in Lower Saxony, Germany and is about 15 years old. Nearby are two habitats which the course might have been, one is pasture grassland and the other is a large area of 'set-aside' land, where farming has ceased and natural habitat regeneration is occurring. In theory, the latter habitat should encourage species diversity, as the use of pesticides and fertilizers is banned there.

Birds were our target group here and the diversity was recorded over a summer season. As can be seen from Fig. 1, the golf course had a considerably higher diversity than the pasture or set-aside. It may seem surprising that the set-aside, which is designed to encourage diversity, actually had the lowest value. The likely reason is that a greater variety of habitats existed on the golf course, because shrubs and trees had yet to establish on the set-aside area. A total of 19 bird species were recorded using the golf course (i.e. either feeding or breeding there), compared with 17 in the pasture and 14 in the set-aside area.

Agricultural intensification has also been cited as the main reason for the decline in populations of many farmland birds. However, by construction of the appropriate habitats on courses, we believe that many of these declines could be reversed in the future.

Case study 4:
St Andrew's GC, Trinidad, West Indies

Our most exotic location was St Andrew's GC, a mature course situated on the island of Trinidad. The course forms part of a large estate and is surrounded by cocoa plantations and areas of natural grassland. At the time of our study, the grassland had been earmarked for a housing development. We recorded bird diversity in the three habitat areas during the latter part of the wet season (June-September).

This was the only example where the golf course habitat did not exhibit the highest diversity (Fig. 1), being slightly lower than the grassland. However, diversity was higher than the plantation habitat and shows that if the grassland must be lost, it would be better to convert this land into a golf development, rather than plantation, or indeed, bricks and mortar. Eighteen bird species were found using the course, compared with 19 in the grassland and 16 in the plantation.

We found a great similarity in the identity of the bird species using the golf course and the grassland habitat, but those in the plantation were quite different. The bird faunas of course and grassland were dominated by insectivorous species, while that of the plantation was dominated by frugivorous species. These data suggest to us that golf courses are able to maintain the species diversity that is normally associated with natural habitats and this could be very important in maintaining the fragile faunas on islands such as Trinidad.

Conclusions

We realise that we may be preaching to the converted in this article, but our aim here has been to stimulate interest in the subject. Many golf club members are excellent natural historians and perhaps in the future they could combine their rounds with some bird, butterfly or bee surveys. If any clubs are interested in such surveys, please contact us. Perhaps such surveys could be promoted locally, thus bringing them to the attention of non-players.

Undoubtedly, it is the non-golfing public that we need get this information to as well. We are currently in the minority, as neither of us play golf, but both believe that courses are good for the environment. It would be nice in future to be in the majority!

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