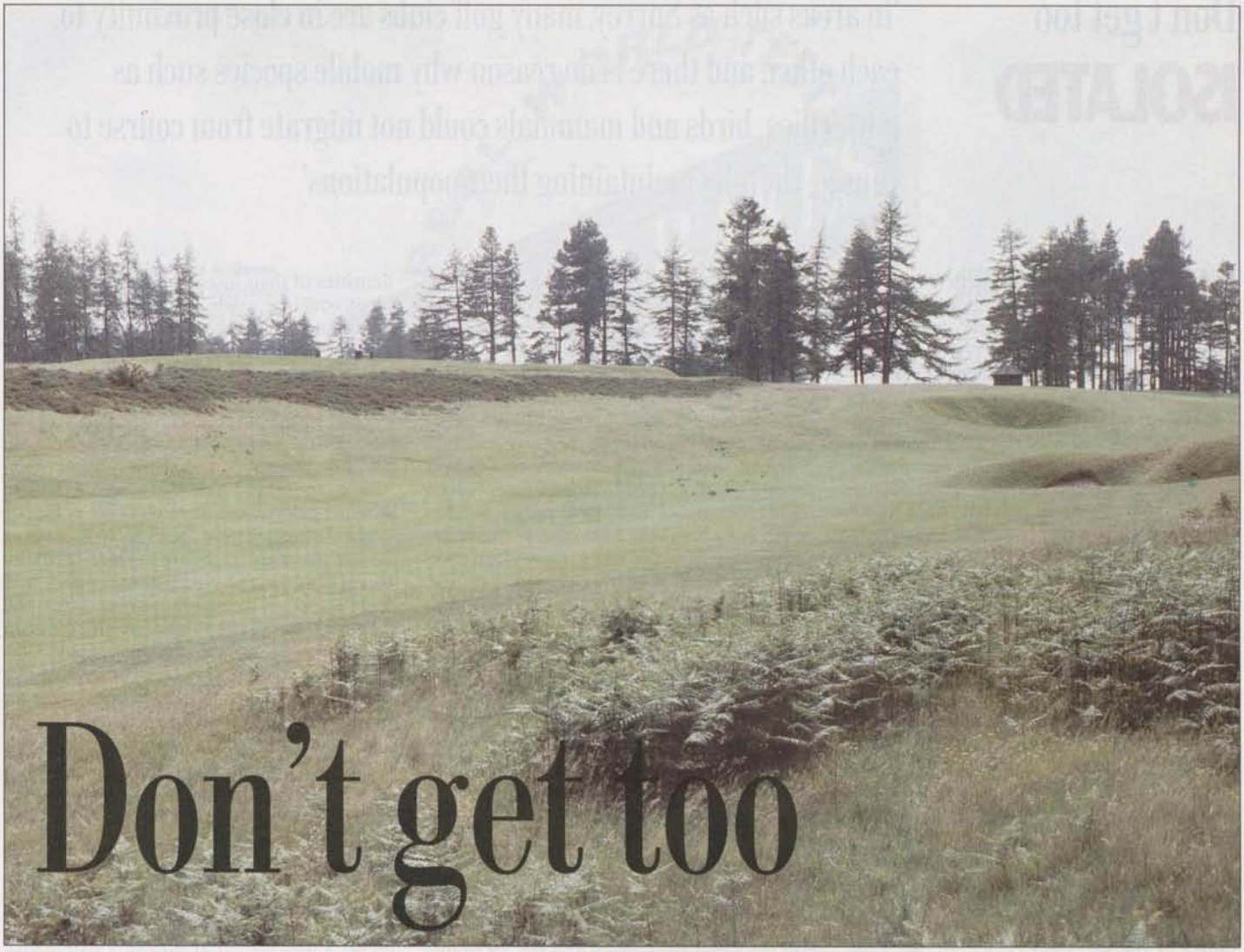

Don't get too ISOLATED

Successful heather management on courses relies on the distance between areas of habitat, writes Dr Alan Gange, School of Biological Sciences, Royal Holloway University of London.

Heathland has become an internationally rare and endangered habitat and is one which has been focused on by conservationists in the last few years. A precise definition of this habitat is difficult to achieve, because it usually defined in terms of its landscape properties. Thus "heathland" can be used to describe an open landscape, generally on nutrient-poor, acid soils with a vegetation dominated by low, woody shrubs of the heather family. The two commonest plant species are usually Ling heather *(Calluna)* and Cross-leaved heath *(Erica)*. Tall shrubs and trees are usually absent, but other species such as Bracken, Gorse and Broom are often present. In Britain, heathland occurs in lowland and upland areas (such as grouse moors) but this article will concentrate on lowland heaths, because upland areas are in a less perilous condition.

Britain has over 20% of the European heathland, but in Southern England, the area has decreased from 143,250 hectares in 1830 to 39,450 in 1980, a decline of 72%. Much of this land has been used for farming, which elevates the nutrient status of the soil, making it unsuitable for heather growth and this means it is virtually impossible to return the land to its former habitat. Not only has the area of heathland been dramatically reduced, but the habitat has also become greatly fragmented. For example, one has only to read some of the novels by Thomas Hardy to get an idea of the vast tracts of heathland which existed in Dorset during the last century. However, these large areas have now been broken up into about 800 small areas, set in a matrix of forest, farmland and urban land.

Due to the loss and fragmentation of habitat, many animal and plant species which live on heathland have become very rare in Britain. For example, the Marsh Gentian, Dartford warbler, smooth snake and a host of invertebrates are restricted to this habitat. Others, such as the sand lizard, nightjar and the Silver-Studded Blue butterfly are characteristic of heathland, but do live elsewhere as well. English Nature have produced a Management Handbook for lowland heaths, but it is interesting that this otherwise excellent publication appears to make no mention of the important role golf clubs can play in the conservation of this habitat. For example, in the area of north-east Surrey, often known as Surrey Heath, there is a great concentration of golf clubs and many of these have areas of heathland on the course. These clubs therefore represent a series of heathland islands, amidst a sea of urban areas.

In recent years, scientists have become aware that an important feature of any habitat conservation is the degree of fragmentation into islands, and the amount of interplay

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'In areas such as Surrey, many golf clubs are in close proximity to each other, and there is no reason why mobile species such as butterflies, birds and mammals could not migrate from course to course, thereby maintaining their populations'

between them. The technical term for this subject is metapopulation dynamics, which is much simpler than its name suggests. A metapopulation is simply a system of local populations, connected by dispersing individuals. It consists of a number of patches (islands) in which populations of a species are found. All patches may not be inhabited at any one time. The main benefit a metapopulation has over a group of unconnected populations is that if one population on a patch becomes extinct, then it may become populated again by migrants from another patch, hence maintaining the numbers. If there is no migration between patches, then sooner or later, it is likely that all the patch populations will become extinct and the species will disappear from the whole area. Therefore, it does not matter too much if a habitat is fragmented, so long as the fragments are large enough to support a population at any one time, and that there is migration between the patches. Clearly, therefore, the two factors which are likely to affect the persistence of the overall population in this scenario are the size and degree of isolation of individual patches.

At Royal Holloway, my research group has been studying the invertebrate populations associated with patches of heather on one course at the Berkshire Golf Club. We have measured the size and degree of isolation (distance to the nearest neighbour) of heather patches on this course and have sampled the invertebrate community on the patches. Our aim was to see how the patch size and isolation affected invertebrate diversity, so that we can suggest some guidelines for management practises which can maximise species diversity.

Over a range in patch size from $20m^2$ to $1200m^2$, there was no relation between invertebrate numbers and the area of the patch. Therefore, in terms of maximising invertebrate abundance, there is no advantage in a heather patch being very large. This is an interesting result, and one that at first appears to be counter-intuitive. However, an explanation is that for the insects which occur on heather patches on this course, all the patches were large enough to support viable populations, and once one gets over a critical threshold of patch size, there is then no benefit of the patch being large. We hope to perform more detailed sampling to establish just what the critical threshold patch size actually is for different key species.

Perhaps the most critical finding from this study is the relation between invertebrate density and the degree of isolation of a heather patch. There is a clear negative relation between these two measurements, that is patches which are near to others have a much higher density of animals than do patches which are a long way from others. Therefore, the message from this study is that when managing the areas of heather on a golf course, the patches must not become too isolated. From this study, it appears that patches should not be much more than 100m apart if the density of invertebrates is to be maximised. If a patch of heather dies out, then this may not be too critical for species populations if there are others close by, but if the loss of a patch means that others suddenly become very isolated, this could have serious consequences for the invertebrate species living on those patches.

One may ask why we have concentrated on invertebrates in this study. Apart from being relatively easy to measure, they are also very important links in the food chains which support the vertebrates which also live on heathland. For example, in some parts of the country, the Dartford Warbler populations are now on the increase after successful management of the heathland which led to increased densities of their insect food. A similar argument could be made for nightjars and sand lizards and still further up the food chain, the smooth snake, which is particularly fond of eating lizards!

We hope to extend this study to other courses in the south east of England, to see whether the results found on this course are part of a general pattern. However, our main aim is to extend the work to investigate whether golf courses themselves act as islands in the metapopulation "sea". In areas such as Surrey, many golf clubs are in close proximity to each other, and there is no reason why mobile species such as butterflies, birds and mammals could not migrate from course to course, thereby maintaining their populations. We know that the areas of heather on a course are sufficient to support viable populations of rare species, for example two courses close to our college in Egham, Surrey have populations of the sand lizard. What we now need to do is to establish whether there is a movement of species from course to course. If there is, then this would be a clear way in which the golfing industry can positively benefit the conservation of endangered habitats. As pressure on land usage becomes ever more acute, I believe that we need to show that tying land up for a long period of time in a golf course development can, if managed in the right way, be extremely beneficial to the environment.

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