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An assessment of the importance of heathlands as habitats for reptiles

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SPELLERBERG, I. F., 1989. **An assessment of the importance of heathlands as habitats for reptiles.** Britain has a species-poor reptile fauna of six species. Although they occur in association with various types of plant communities, most species seem to be associated with heathlands. The lizard *Lacerta agilis* is particularly associated with heathlands but data presented here suggests that the vegetation structure of typical, undisturbed, lowland heathlands is less suitable for this species than disturbed heathland with more structural diversity.

ADDITIONAL KEY WORDS:—Vegetation structure – *Lacerta agilis*.

CONTENTS

INTRODUCTION

The reptile fauna of Britain consists of three lizard species (*Anguis fragilis, Lacerta agilis, Lacerta vivipara*) and three snake species (*Coronella austriaca, Natrix natrix, Vipera berus*). The habitats of these reptiles are varied and include deciduous woodlands, ride verges in forest plantations, scrub, hedgerows, sand dunes and heathlands. Populations of all six species are found on lowland heathlands but there are few instances of all six species occurring together in any other type of plant community. Ericoid shrub communities seem therefore to be a very important habitat for reptiles, particularly the endangered species (*Lacerta agilis* and *Coronella austriaca*), but as with other plant communities and other animal taxa, the reduction, fragmentation, isolation and change in heathland communities has had a profound effect on reptile habitats and distribution patterns (Nature Conservancy Council, 1983).

Although local populations of all six species have diminished rapidly in Britain (many becoming extinct) over the last few decades and continue to diminish in size, it has been impossible to quantify changes in population levels on a country-

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wide basis and difficult, if not impossible, to measure population size of snakes at a local level. This is because the behaviour of snakes prevents complete population counts. However, it has been possible to estimate size and density of some lizard populations, for example House & Spellerberg (1983) estimated the population density of *Lacerta agilis* on heathlands at six localities. The population densities varied from 0.3 to 18.3 lizards per ha and higher densities were found on disturbed heathland, suggesting that either increased plant species richness or vegetation structure could be an important component of the reptile habitat.

The aim of this paper is to assess the value of heathlands as habitats for reptiles with particular reference to vegetation structure.

ENDANGERED REPTILE SPECIES IN BRITAIN

Both *Coronella austriaca* and *Lacerta agilis* are totally protected species under the Wildlife and Countryside Act 1981 and are considered to be endangered in Britain (Nature Conservancy Council, 1983). The distribution of the smooth snake is limited to the southern counties and there they are found in heathlands and other plant communities. The prey of smooth snakes includes lizards and small mammals, and although nestling young of mice and shrews seem to be an important component of the smooth snake diet, this snake is considered to be an opportunistic predator, taking prey according to availability (Goddard, 1984). Results from radio-telemetry studies indicate that although this species is not particularly vagile, there are few barriers preventing dispersal of smooth snakes in heathlands, forests and other plant communities.

The distribution of the *L. agilis* is fragmented, with a small population in the north-west of England and many scattered populations in the south. This lizard is an opportunistic predator, feeding on Coleoptera, Hymenoptera (particularly ant queens), Araneae, Opiliones, insect larvae and Isopoda (woodlice). However, there is both seasonal and site variation in their feeding ecology (Nicholson, 1980). Reproductive requirements of the oviparous *L. agilis* are specialized and in June or July a clutch of about six eggs is laid about 7 cm below the ground surface. The female lizards select nest sites (House & Spellerberg, 1980) but do not protect the nest or care for the young. Large areas of open heathland provide a range of conditions which are suitable for these nest sites and incubation of the eggs.

MATERIAL AND METHODS

Study sites

This research is based partly on a new analysis of data collected by House & Spellerberg (1983), and partly on new field data from two study sites. The study sites were selected to investigate features of heathlands associated with the lizard *L. agilis* but all six species of reptiles occurred on both study sites. The heathland at study site A was very fragmented and occurred as patches (up to 0.3 ha) of all growth phases amongst mature pine (mainly *Pinus sylvestris*), bracken (*Pteridium aquilinum*), rhododendron and other garden shrubs. Most patches of heather contained invasive species and the area supporting *L. agilis* had a complex plant community structure as well as a complex topographic structure, created largely by sand and clay waste. The area (80 ha) was previously subjected to mineral extraction but is now managed as a nature reserve. By way of contrast, study site B was on typical, wet and dry heathland (building and mature growth phases) and acid bog with only small amounts of the 75 ha site subjected to any disturbance. Plant invasion of the ericoid shrub community was minimal in the central region where *L. agilis* and other reptile species occurred.

Sampling methods

The habitat of *L. agilis* was recorded by way of a 2 m^2 quadrat centred on each lizard sighted (House & Spellerberg, 1983). Most lizards sighted were basking. The percentage cover (5% steps) of the plant species at six height categories, percentage bare ground and percentage visible litter was recorded in each quadrat. The six height categories were as follows: less than 3 cm, 3–10 cm, 10–30 cm, 30–50 cm, 50–100 cm, greater than 100 cm. A total of 76 quadrats were recorded at site A and 50 at site B.

The following species diversity index (a form of Simpson's or Yule's index) was used to analyse the structural diversity of each quadrat:

$$D = \frac{1}{\Sigma(P_i)^2}.$$

This index is a measure of evenness and P_i is the proportion of the *i*th species (the higher the index, the more even the proportional distribution of species in the community). The percentage cover of each plant species height category and also percentage bare ground and visible litter was used as a basis for measuring the structural diversity. Scoring of percentage cover was in 5% intervals and so therefore the maximum index was 20 (minimum 1). For example one 2 m^2 quadrat gave the following results: *Calluna vulgaris* 30–50 cm (20%), *Ulex europaeus* 50–100 cm (10%), *Erica cinerea* 30–50 cm (20%), bare ground (50%). The proportions are therefore 20 : 10 : 20 : 50 and in the equation are expressed as follows:

$$D = \frac{1}{\Sigma(0.2)^2 + (0.1)^2 + (0.2)^2 + (0.5)^2}$$
$$= 2.9.$$

In this instance, a value of 2.9 indicates an unevenness in the proportional percentage cover of plant species and bare ground or a low value in terms of structural diversity.

RESULTS

The seventy-six 2 m^2 quadrats at study site A gave 18 species categories (bryophytes, 'various herbs', 'mixed grasses' in addition to plant species identified) and ten species categories resulted from the 50 quadrats at site B. Most quadrats (up to 67%) had three or four plant species and very few had either one or six species. The plant species common to quadrats at both study sites was similar (Table 1) with *Calluna vulgaris, Erica cinerea,* bare ground and plant litter being the most common species and features recorded. In terms of the

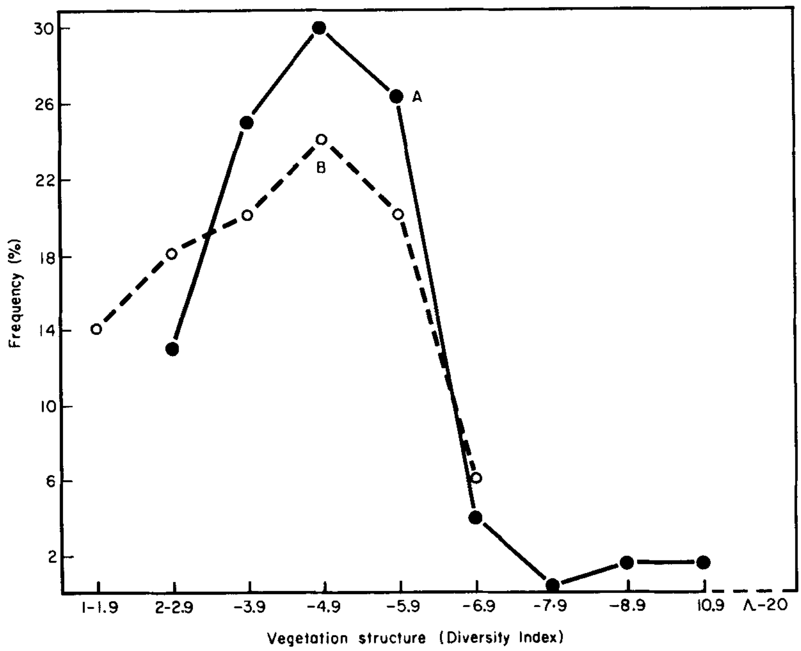

Figure 1. Range and frequency of structural diversity for all quadrats at both sites.

plant species composition of the lizard quadrats, there was little difference between the two sites.

Vegetation structure can be measured and expressed in many ways. The several height categories combined with percentage cover of plant species, bare ground and litter provided a basis for a measure of structure in each quadrat by way of a diversity index. Quadrats with a high structural diversity contained several plant species height categories and quadrats with low structural diversity contained only one or two plant species of uniform height. The range and frequency of structural diversity for all quadrats at both sites is shown in Fig. 1.

TABLE 1. Occurrence of plant species in quadrats

Plant species/feature	Percent occurrence in quadrats Site A (76 quadrats)	Site B (50 quadrats)
Calluna vulgaris	85.5%	100 %
Erica cinera	76.3	62.0
Bare ground	67.1	44.0
Litter	56.5	42.0
Ulex europaeus	48.6	28.0
Molinia caerulea	27.6	16.0
Agrostis sp.	27.6	22.0
Bryophytes	27.6	20.0
Erica tetralix	11.8	18.0
Pteridium aquilinum	9.2	10.0
Pinus spp.	9.2	—
Ulex minor	7.8	40.0

The mean diversity index for site A was 4.4 (S.D. 1.29) and the mean value for site B was 3.8 (S.D. 1.46). These are significantly different ($t=2.47$, $P>.02$).

DISCUSSION

House & Spellerberg (1983) have shown that the basking sites of *L. agilis* in heathlands are not randomly distributed and that this species seems to select basking sites. Two important features of heathland communities providing habitats for *L. agilis* and other reptile species could be plant species richness and vegetation structure. The species composition of the quadrats on the two study sites in this research are very similar but vegetation structure (as measured by a diversity index) was significantly different. Fewer suitable conditions at site B would support a smaller population of lizards and this is supported by the difference in lizard population density: 9.2 ha at site A; 0.3 at site B (House & Spellerberg, 1983).

The main ecological requirements of reptiles include space, food, heat (for maintenance of precise, body temperatures) and protection from both predators and unfavourable weather conditions. In general, snakes are more mobile (vagile) than lizards and therefore space requirements (expressed as home ranges) are much larger than home ranges of lizards (Spellerberg, 1988a). The six species of reptiles eat a range of prey from insects to small mammals (Table 2). Reproduction, digestion, rate of growth, visual acuity, locomotion and other forms of behaviour are temperature dependent and therefore reptiles devote much time to behavioural thermoregulation. The structure of ericoid shrub communities provides protection from some predators but of more importance the structure is particularly suitable for basking and for precise regulation of body temperature. Alternating between sunlit and shaded areas is a basic form of behavioural thermoregulation common amongst reptiles and is a means of control of heat uptake for precise regulation of body temperature. The mosaic of sunlit and shaded areas within heathland communities and within ericoid shrubs enables reptiles to shuttle between these areas, making optimum use of the heathland microclimate.

TABLE 2. Distribution, size, reproduction and some ecological characteristics of Britain's reptiles

	Anguis fragilis	*Lacerta agilis*	*Lacerta vivipara*	*Coronella austriaca*	*Natrix natrix*	*Vipera berus*
Distribution	ESW	E	EHSW	E	EW	ESW
Weight (g)	15	9.7	3.6	34	98	76
Length (cm)	16	7.8	5.8	42	60	45
Reproduction	V	O	V	V	O	V
Tb (°C)	23	31	32	27	26	30
C (°C)	2.7	3.0	−0.9	0.3	1.6	−0.5
Prey	Slugs Worms	Insects Spiders	Spiders Insects	Nestlings Small mammals Lizards	Fish Amphibians Small mammals	Small mammals Lizards

E, England; S, Scotland; W, Wales; H, Ireland.
V, Viviparous; O, oviparous; Tb, mean body temperature.
C, Lowest temperature for activity.
From Spellerberg (1988b).

If *L. agilis* is selecting basking sites with a high vegetation structural diversity, the benefits would probably be linked to behavioural thermoregulation and food requirements. Utilization of sites with maximum variation in structure would allow the lizards to alternatively bask and seek shade with minimum costs. As well as providing suitable microclimates for *L. agilis* and other reptiles, a structurally complex heathland site may also support higher levels of invertebrate prey items which in turn could contribute to the presence of higher levels of small mammal communities. Undisturbed, open expanses of lowland heathlands probably support poor populations of small mammals (Webb, 1986) but in areas where the typical ericoid shrub community has been altered with invading plant species and where the ground has been disturbed as a result of the construction of embankments and other earthworks, small mammals may be more abundant. An abundance of small mammals, and structurally complex vegetation and topography would form the basis of habitats suitable for *C. austriaca* and the other two snake species.

Where reptiles do occur on heathlands, management directed at the conservation of heathland plant communities would not be detrimental to the reptile populations. It is suggested that open heathland sites should continue to be managed with a view to the normal considerations and protection of heathland floristics and more importantly structure. Sparse populations of *L. agilis* will survive in such areas but higher densities of lizards can occur if scrub, bracken, trees and various forms of ground disturbance are included in the area. An overriding problem for conservation of wildlife on heathlands is the continual process of reduction in area, fragmentation and isolation of this plant community. The remaining fragments of heathland cannot all be managed to satisfy the conservation needs of all taxa and therefore there seems to be a need for compromise and possibly the establishment of priorities in terms of management strategies. Restoration of heathlands (now well researched; British Gas, 1988) and possibly recreation of this diminishing resource may alleviate such difficulties.

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