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Observations on felt and corrugated roof sheeting as materials for constructing coverboards to assess slow worm (*Anguis fragilis*) and common lizard (*Zootoca vivipara*) populations

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ABSTRACT - An eight-week study in open areas of Collyweston Great Wood and Eastern Hornstocks NNR utilised 120 coverboards laid in groups of 20 with alternating felt and black corrugated roof sheeting construction materials. Adult slow-worms (*Anguis fragilis*) showed no significant preference for lying beneath coverboards of either material, but juvenile slow-worms were significantly more likely to be found beneath felt and common lizards (*Zootoca vivipara*) were significantly more likely to be found basking on corrugated roof sheeting. Numbers of *A. fragilis* fluctuated significantly week on week, and more slow-worms were found during the afternoon than during mornings. The significance of these results is discussed with particular reference to the importance of considering construction materials, time of sampling and weather conditions when planning surveys of reptiles utilising coverboards.

INTRODUCTION

Laying down pieces of material which animals can use for shelter and sometimes for thermoregulation has become a standard technique for assessing numbers of reptiles and amphibians in many kinds of terrestrial habitats: the population estimates that results are usually relative rather than absolute. The refuges are now usually called coverboards. The technique became widely used from the 1990s; for a discussion of its application to some British species, see Riddell (1996) and Reading (1997) and for recent appraisals see Willson & Gibbons (2009) for amphibians and Dorcas & Willson (2009) for snakes. Coverboards are usually made of felt, corrugated iron, tin or plywood (Halliday and Blouin-Demers, 2015) but other materials have been used from time to time (Adams et al. 1999; Chavel et al. 2012; Beebee et al. 2009; Sewell et al. 2012).

The results reported here arose as incidental to an investigation of the effects on slow-worm (*Anguis fragilis*) and common lizard (*Zootoca vivipara*) numbers of coppicing small-leaved lime woodland (Collyweston Great Wood and Eastern Hornstocks National Nature Reserve on the Northamptonshire-Cambridgeshire border in the UK, further details in Fish (2016). Coverboards were made of felt or black corrugated roofing sheets (CRS): since these were laid out in grids with alternating materials, it was possible to compare the effectiveness of the two.

MATERIALS AND METHODS

The coverboards used in this study were made of felt or of CRS with the trade name "Bitumin". These materials were chosen on the basis of ready availability. All boards measured 50 cm x 50 cm. Initially 100 boards were used, laid out in five areas in grids of 4 x 5 boards with all boards separated by 5 m from edge to edge with felt and CRS alternating in both dimensions. Two weeks after the commencement of the study a further 20 boards were added. All the boards were in relatively open areas of the predominantly wooded nature reserve because no reptiles were found associated with boards in coppiced woodland (Fish, 2016). The open areas consisted mostly of grassland or were dominated by young, low-growing vegetation, such as bracken (*Pteridium aquilinum*), brambles (*Rubus fruticosus*) or stinging nettles (*Urtica dioica*) and had a little or no canopy shading them.

The coverboards were placed in position on 15th June 2013 and finally removed on 5th August. After being put in position, the coverboards were left undisturbed for one week, for the local reptile population to acclimatise to them being there, as well as for them to sink further into the vegetation, as is standard with coverboard studies (Willson and Gibbons, 2009). The sites were sampled on 3-6 days a week for 8 weeks. Each day, alternately, half the boards were sampled in the morning (approximately 8-10 a.m.) and the other half in the afternoon (approximately 2-5 p.m.).

The count data of slow-worms and common lizards under or on the boards contained a considerable number of zeros and so was not normally distributed. As not more than 5 reptiles were recorded in association with a board on any single occasion, it was decided to transform the data to presence-absence data as suggested by Thompson et al. (1998) and Crawley (2005). By having the count data in presence-absence form, it was possible to carry out binomial regressions as general linear models using the statistical programme R (Crawley, 2005). A non-binomial GLM was used for time of day data because this variable is categorical.

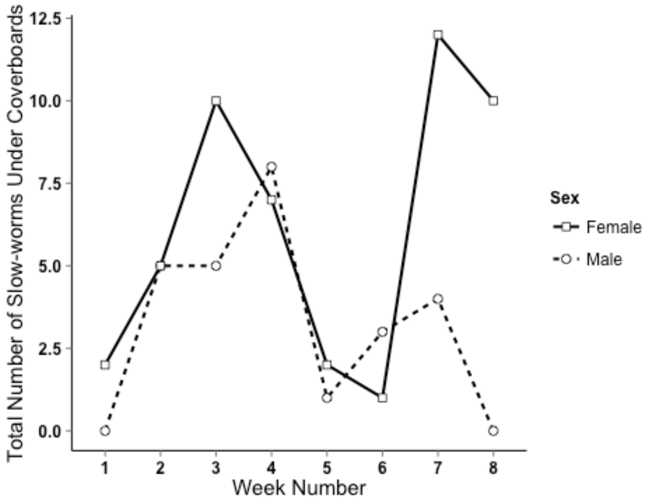

Figure 1. Graph showing the total number of adult *A. fragilis* found between mid-June to mid-August (8 weeks). See text for details.

RESULTS

102 slow-worms were found under cover boards during the 8-week study period: 49 adult females, 26 adult males and 27 juveniles. There was no significant difference in the numbers of adults found beneath felt or CRS coverboards ($p>0.05$) but juveniles showed a significant preference for felt (21 vs 6: z-value using a binomial GLM = 2.27, $p=0.02$). Numbers of adult slow-worms fluctuated significantly from week to week (males: $z=-2.73$, $p=0.01$, females: $z=-2.23$, $p=0.03$, see Fig. 1), though there was no significant relationship found between the total numbers of slow-worms found and weather or daily rainfall. Weekly rainfall was shown to affect the total number of reptiles seen ($z=2.74$ and 2.22, $p=0.03$ respectively), particularly in the case of common lizards ($z=3.97$, $p=0.01$).

More slow-worms were found under cover-boards during the afternoon than during the morning and this appeared to be the trend for all the categories of reptiles, although the differences were significant only for adult female and juvenile slow-worms ($z=2.33$ and 2.22, $p=0.01$ and 0.03 respectively). Unlike slow-worms, common lizards were almost always found on – not underneath - the coverboards. Of the 41 common lizards seen, a significant proportion showed a preference for CRS (31 vs 10: $z=-2.29$, $p=0.02$).

DISCUSSION

There are at least three reasons why coverboards might attract slow-worms. They might act as shelter (Halliday and Blouin-Demers, 2015). They might be used for thermoregulation by contact (this has been called thigmothermy, see Pough & Gans, 1982), utilising heat derived from solar radiation transferred by conduction from the upper to the lower surface, as described in Bustard's classic studies of some Australian geckos living under loose bark and since confirmed for many lizards and snakes (Avery, 1982). They might act as a food source, since many invertebrates were also preferentially found under coverboards in this study. There are few studies on this matter that are specific to slow-worms, though coverboards have been used successfully in the past to survey slow-worms (Stumpel and van der Werf, 2012) and are regularly used by ecological consultancies to estimate slow-worm population sizes. This study is empirical: it does not seek to distinguish between these possibilities – which are, of course, not mutually exclusive. Why juvenile slow-worms should show an apparent preference for felt coverboards is conjectural, but this may have been due to their body size, as it is possible it is easier for them to get close to the warming material of flat felt coverboards than the corrugated CRS coverboards and thus thermoregulate more efficiently. It has been mentioned in the literature before that some adult and juvenile reptiles have been shown to have ontogenetic differences in habitat choice (Heatwole, 1977), which may be the case in terms of artificial refugia here. It is also possible that the juvenile slow-worms were avoiding other reptiles, including adults of their own species, as the others were generally found more often under CRS coverbards. That being said, there were several instances where juvenile and adult slow-worms and even occasionally juvenile slow-worms and common lizards were found utilising the same coverboards.

The probable relationship between common lizards and coverboards is more clear cut. They almost certainly use them as substrates for basking. Although there is much anecdotal evidence for preferential use of different substrates by common lizards (see Beebee & Griffiths, 2000), there has been no systematic study of the relationships between substrate and basking efficiency in this, or indeed in any, lizard species. CRS is probably a more satisfactory substrate for basking than felt: it almost certainly has a higher thermal capacity and a lower thermal conductivity than felt, both factors which would increase its effectiveness in retaining heat and facilitating its transfer to a basking lizard. It is significant in this context that many reptiles, including lacertid lizards, often use bitumen road surfaces preferentially for basking (see Meek, 2014).

The results of this study confirm that, in both planning and interpreting the data of studies of reptile populations using coverboards, a considerable number of factors need to be taken into consideration. The first highlighted here is the material from which the boards are constructed. Felt and CRS are differentially attractive for slow-worms and other lizards, and there is no reason to suppose that many other materials which might be used could also differ in this respect. Recorded numbers of both slow-worms and common lizards were greater during the afternoon than during the morning, so the timing of sampling is an important factor (see also Stumpel, 1985). The recorded numbers of slow-worms varied greatly week on week. Casual observation suggested that the weather was an important factor: slow-worms and common lizards both appeared to be recorded in greater numbers during overcast or wet weather, although sample sizes are too small to test this rigorously. This is clearly an aspect of the interpretation of coverboard data, which needs to be investigated further.

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