Daily energy expenditure in the face of predation: hedgehog energetics in rural landscapes

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Introduction

The hedgehog is declining in the UK and declines are thought to be more severe in rural areas. Arable land is typically under-selected by hedgehogs, which show an attraction to urban habitats such as rural villages, possibly due to poor habitat quality on arable land, in combination with the presence of their main predator, the badger.

The hedgehog mainly preys on invertebrates and arable land may be unfavourable due to a lack of prey, resulting from agricultural activities. Residential areas have abundant mowed grass habitats – e.g. parks, sports pitches and garden lawns- which typically have higher earthworm abundance than arable fields. Hedgehogs may also benefit from being fed by humans in gardens and warmer temperatures than on arable land. Badgers are more abundant on farmland than in rural villages, and hedgehog presence is negatively correlated with badger sett numbers.

In rural landscapes hedgehogs' food availability, temperature and relative safety from badger predation are all likely to decrease with increasing distance from buildings. Our study investigated variations in hedgehog energy expenditure and ranging behaviour along a gradient of habitats from rural villages to arable farmland at sites with and without badger populations, to dissect the causes of hedgehogs' preference for villages and gardens.

Methods

We studied hedgehogs at four sites, two in North Norfolk and two in North Yorkshire. Each site comprised a predominately arable farm with a village within 2.5km of the farmstead. In each country sites were selected with badgers present at one and absent from the other, to test the effect of badger presence on energy expenditure.

Hedgehogs were captured using red-filtered spotlights in July-September 2013 and April-September 2014. Under anaesthesia hedgehogs were fitted with a radio-tag. Hedgehogs were injected with heavy water (made from heavy isotopes of Oxygen and Hydrogen) and a blood sample was collected before releasing the animals for four days, during which hedgehogs were radio-tracked. Hedgehogs were then relocated and a second blood sample was collected.

Fig.1 A hedgehog being weighed at a site in North Yorkshire, showing the hedgehog's coloured markers used for identification

Blood samples were sent to the University of Aberdeen, where the daily energy expenditure of the hedgehogs was calculated based on the amount of heavy oxygen that had been lost from the hedgehog's bodies over the four day release period.

Results

In this study hedgehogs on sites with badgers had lower energy expenditures than those on sites without badgers (Fig.2). Although we did not measure the productivity of arable land, the finding that hedgehogs had lower energy expenditure where badgers were present may

reflect the inability of hedgehogs to take advantage of available resources when under risk from predation, due to spending time sheltering from badgers.

Another possibility is that hedgehogs compensated for the loss of food intake in the face of predation by decreasing their energy use in some way. It could be that hedgehogs lower their body temperature in order to conserve energy when food intake is reduced due to predation risk.

We found a positive relationship between daily energy expenditure and the mean distance a hedgehog was from buildings during radio-tracking. We speculate that this finding arose from lower prey densities and food availability in arable habitats, compared with villages, requiring hedgehogs to spend more time looking for food in arable habitats. This finding is supported by the fact that hedgehogs that stayed closer to buildings did not travel as far in the four day release period as those further away from buildings.

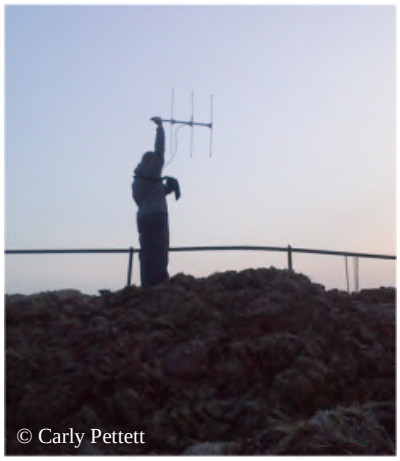

Fig.2 Radio-tracking hedgehogs in North Yorkshire

Temperature was positively correlated with energy expenditure. This relationship could be because hedgehog activity, and therefore energy expenditure, increased with temperature, due to increased invertebrate activity at higher temperatures.

Conclusions

The preference of villages by hedgehogs is at least partially explicable by increased energetic costs the further hedgehogs are from buildings, which may be related to decreasing food abundance and temperatures. Our finding of lower hedgehog energy expenditure on sites with badgers also suggests that predator presence may alter hedgehog energy budgets, potentially by reducing their ability to forage in the face of predation.

These results are of conservation concern for hedgehogs. At present 25% of the land in the UK is arable land, which represents substantial unsuitable areas with low connectivity between rural villages. To increase suitability of arable land for hedgehogs may require increasing invertebrate prey densities by increasing the abundance of grassy field margins and reducing pesticide use. Both may decrease foraging costs for hedgehogs and also provide alternative prey for badgers. Likewise reinstating hedgerow cover on arable land may provide shelter from badgers.

This summary was based on the following scientific paper:
http://jeb.biologists.org/content/220/3/460

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