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Habitat preferences of European adders at Loch Lomond, Scotland

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ABSTRACT

An analysis of habitat types used by the European adder *Vipera berus* in the vicinity of Loch Lomond, Scotland is described. Three sites with different local geographies were chosen and studied, with hibernacula, mating and feeding areas mapped. Topography, fauna and flora were also monitored. Common features were identified between the sites, but striking differences were noted, emphasizing the flexibility in habitat requirement of this species. These observations suggest that adders could be far more widespread in Scotland than is currently recorded, and implies that their fragmentary distribution is controlled by other factors, such as human activities.

INTRODUCTION

The European adder is one of the mostly widely distributed reptiles in the world. Its breeding range extends across the Palearctic region from Britain in western Europe to north China and Sakalin in eastern Asia, with animals found north to above the Arctic Circle (Beebee and Griffiths, 2000).

The adder is one of the most investigated reptiles, with much known about its biology. Research, particularly in Europe, has revealed information about the annual breeding cycle and habitat requirements (Morrison, 1924; Viitanen, 1967; Prestt, 1971; Frazer, 1983; Neumeyer, 1987; Stafford, 1987; Beebee and Griffiths, 2000; Anderssen, 2003; Phelps, 2004a; Phelps, 2004b; McPhail, 2011; McInerny, 2013). Such studies have shown that populations of adders undergo regular behavioural patterns during the year. They hibernate through the winter in underground sites known as hibernacula, emerging in early spring to bask at sunning positions for a few weeks before undergoing ecdysis, as a prelude to courtship and mating (Fig. 1). Males and unmated females then move to adjacent wetter areas to feed, with gravid females remaining near hibernacula while incubating young, giving birth to live young in mid to late summer (Fig. 2). Animals return to hibernacula areas in late summer to bask, before entering hibernation in late autumn.

Studies have also identified habitat features used by adders (Prestt, 1971; Frazer, 1983; Neumeyer, 1987; Beebee and Griffiths, 2000; Anderssen, 2003; Phelps, 2004a; Phelps, 2004b; McInerny, 2013). Hibernation sites are required that usually have a southerly aspect, which can be either on a slope or gully, but can also be on flat ground. Crucially, these wintering areas need to be well drained, and so free from flooding. Often they are covered with thicker vegetation, such as gorse *Ulex* spp or bramble *Rubus fruticosus*, and are usually associated with stands of bracken *Pteridium* spp. Adjacent habitats are often described as "complex" with areas of wet or marshy ground, and streams or ponds. These provide the range of areas which adders require to bask, to retreat to safety after disturbance, and to find food items.

Though adders are widely distributed in Scotland, found currently in all regions apart from Shetland, Orkney and the Outer Hebrides, their recorded distribution is fragmentary, and much reduced from that observed in the past (Harvie-Brown, 1887-1911; Arnold, 1995; Reading et all, 1996; Beebee and Griffiths, 2000). To understand why this might be I studied three populations near Loch Lomond which occurred at locations with very different local geographies. These studies revealed features common to all three sites, but also showed strong differences, which suggested that adders are adaptable and can inhabit a range of habitats. Hence, the fragmentary Scottish distribution is likely to be due not to limiting areas of suitable habitat, but instead results from other reasons, such as human influence.

METHODS

Three sites containing populations of adders were chosen for study near Loch Lomond, Scotland, as they show striking differences in local geography. The first is an upland moor, the second a lowland replanted native woodland, and the third a lowland golf course. The population of adders, along with other reptiles, at the lowland replanted native woodland, has been described (McInerny, 2013). The exact locations of these three sites are withheld to protect the reptile populations.

Fig. 1. Male adder *Vipera berus*, which had recently undergone ecdysis, searching for females to mate, 29 April 2013.

The sites were visually inspected from mid-February through to mid-October during 2011, 2012 and 2013, typically from 8 - 10 AM on sunny or warm days, the optimum time and conditions for finding adders; each site was visited a minimum of six times. Individuals were recognised through head patterns, which are unique and diagnostic (Benson, 1999; Sheldon and Bradley, 1989; Garbett, 2008; Sheldon and Bradley, 2011), and through repeated observations of individuals at particular sunning locations; this allowed numbers to be estimated. Hibernacula were identified where reptiles were noted on repeated occasions in early spring and late autumn. The locations of hibernacula, regular sunning positions, mating and feeding areas were mapped. Flora and fauna at each site, and the topography and geography, were also monitored.

RESULTS

Study site A

The site is an upland moor of predominantly heather *Calluna vulgaris*, at an altitude of 200 - 250 m, with a shallowly descending northerly aspect, on the south side of Loch Lomond. The moor, of *c.* 6 km^2, is surrounded by coniferous forestry plantations on three upper sides and sheep-grazed fields on the lower side, and is crossed by a burn through a gully of some 4 - 8 m in depth and up to15 m in width, which empties in a northerly direction to Loch Lomond. The slopes of the gully are covered mostly in bracken, with small areas of gorse. The geology is a mixture of peat moorland and exposed granite rock.

Fig. 2. Juvenile adder *Vipera berus*, born, 4 August 2013.

The adder population consists of at least 22 individuals, with two hibernacula identified, where snakes were found in early spring and late autumn, on multiple occasions. One hibernaculum was found on a south-facing slope of the gully, which is covered in bracken and some gorse; here up to 14 adders were found emerging in early spring (Fig. 3a). Ecdysis, courting and mating were observed, with animals moving down into the burn, and across the moor, through the summer. The other hibernaculum was found on a south facing rock

outcrop on the moor, which is partially covered in heather and bracken (Fig. 3b); here at least eight adders were noted. At both hibernacula, common lizards *Zootoca vivipara* were also detected, but no slow-worms *Anguis fragilis*.

Fig. 3. Adder *Vipera berus* hibernacula on an upland moor at study site A. (a) South facing gully slope covered in bracken and some gorse. (b) South facing rock outcrop, with some heather and bracken.

Fig. 4. (a) Adder *Vipera berus* habitat on a lowland replanted native woodland at study site B. (b) & (c) Typical adder hibernacula on south facing slopes with bracken and gorse. (d) A more cryptic hibernaculum on flat ground, but with dense vegetation.

Study site B

The site is an area of south and west facing replanted native forest on the hills flanking the east shore of Loch Lomond, at an altitude of 40 - 90 m, of some 50 hectares (McInerny, 2013). The habitat consists of a mosaic of birch *Betula* spp. rowan *Sorbus* spp. and oak *Quercus* spp., interspersed with bracken, gorse, bramble, heather, and other native plants. The site is fenced, preventing the entry of deer, and is rich in native fauna and flora. It contains areas of exposed granite and mica schist rock, slopes and boggy areas, with a burn along its northern edge. The lower parts were once a sheep-farm (Fig. 4a). Many original dry stonewalls have collapsed, which have subsequently been overgrown by bracken, bramble and gorse; these piles of covered rocks have created hibernacula suitable for reptiles.

The adder population consists of at least 75 individuals. Over 22 hibernacula were identified, with each containing 1 - 3 snakes. The hibernacula occupy different locations, some being on south-facing slopes, with associated bracken and gorse (Fig. 4b and 4c). In other cases hibernacula are more cryptic, on flat ground, although they were always associated with denser vegetation (Fig. 4d). Ecdysis, courtship and mating were observed at the lower, flat parts of the site, with all snakes, apart from gravid females, moving during the summer period to wetter areas. This site also contains healthy populations of common lizards and slow-worms.

Study site C

The site is a golf course to the east of Loch Lomond on a south facing slope that rises from an altitude of 30 - 70 m, with a forestry plantation above, and a car road below. It contains large, managed areas of very short, cut grass on the greens and fairways, and areas of thicker grass, in the "rough". These managed areas are interspersed with large sections of bracken, gorse and bramble in which a number of small burns pass through (Fig. 5a). The geology is a mixture of glacial moraine and conglomerate rocks. A number of dry stonewalls pass through the site, and many dry stonewall bases have been created for golf tees.

The adder population consists of over 30 individuals. Hibernacula for adders and common lizards, which are also present, were found in dry stonewalls (Fig. 5b) and in conglomerate rock outcrops (Fig. 5c), and in areas of gorse. Ecdysis, courtship and mating were observed in the vicinity. Slow-worms were not found at this site.

The reptiles at this site benefit from the tolerance of the groundsmen, Club officials and players. Many have occasionally seen snakes and common lizards, but have chosen to co-exist with them, and indeed enjoy seeing the reptiles on the course (groundsmen, Club Secretary, and numerous players, *pers. comm.*).

DISCUSSION

This study describes the examination of three populations of adders in different locations in the vicinity of Loch Lomond, to understand habitat features required for this species in Scotland. These studies have revealed that though adders can inhabit sites at different altitudes, local geography and flora, and varying degrees of human management, common features emerge. An important requirement is the availability of suitable locations for underground wintering in hibernacula. These were found to often be on south facing, well drained slopes, associated with bracken, bramble and gorse; occasionally they were found on flatter ground, where dry, subterranean holes were present. The flora appears to be important, with adders invariably associated with bracken, and usually found near bramble or gorse, which provide areas suitable for basking and retreat after disturbance. At all sites burns, along with wet, marshy ground, were found in the vicinity, which provide areas for snakes to move to in the summer when finding prey items. These features are similar to those observed at adder sites elsewhere in the U.K. and Europe (Prestt, 1971; Neumeyer, 1987; Beebee and Griffiths, 2000; Anderssen, 2003; Phelps, 2004a; Phelps, 2004b). Finally, but importantly, at all three sites near Loch Lomond, the adders avoided human persecution, either through remoteness (site A), protection (site B), or tolerance (site C).

The habitat features noted here used by adders are found in many places across Scotland that apparently do not have snakes (Arnold, 1995; *pers. obs.*), which leads to the question if and why they are absent in these places. In part this can be explained by the under-recording of reptiles across the country; adders, particularly, are difficult animals to locate. However, at the three sites described in this paper an important common feature is that adders are found where they avoid human interference. In each case it is for a different reason: remoteness of the moorland at site A, protection at the reserve at site B, and tolerance of the golfers at site C. But this observation can be generalised to help explain the distribution across Scotland as a whole (Beebee and Griffiths, 2000). Elsewhere, adders are found in nature reserves, on private land, on islands, and in remote, little visited areas. Where they are (rarely) found in proximity to humans, this is usually the result of local tolerance.

Further support for this premise is the observation that adders were in the past much more widely distributed across Scotland, being found in many areas where they are now absent (Harvie-Brown, 1887-1911; Arnold, 1995; Reading et al, 1996;

Beebee and Griffiths, 2000). This reduction in range is in part due to deliberate human persecution: there are recorded instances of adders being killed, sometimes in large numbers, as they were considered pests (Service, 1902).

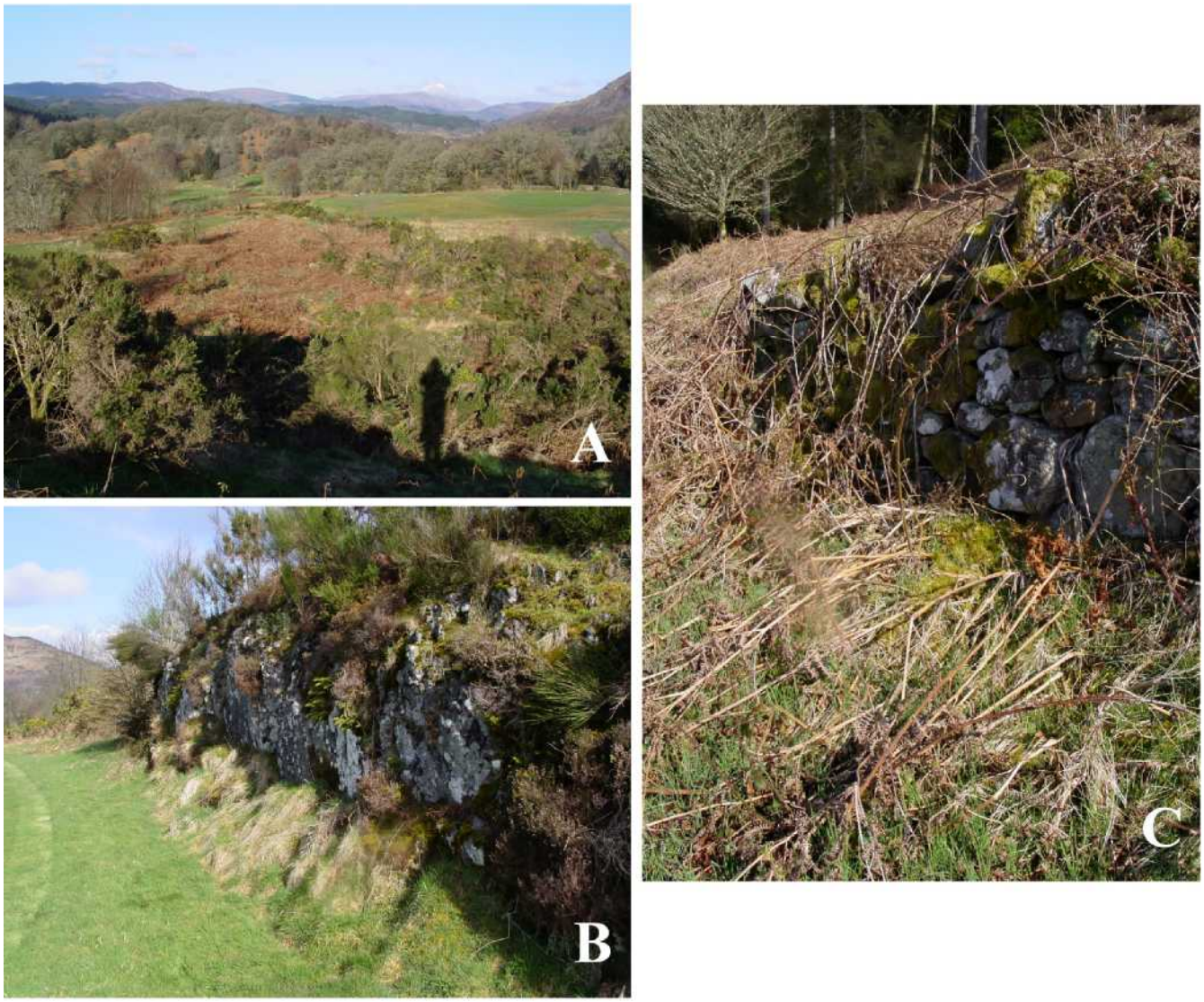

Fig. 5. (a) Adder *Vipera berus* habitat on a lowland golf course at study site C. (b) Adder hibernaculum on a south facing conglomerate rock outcrop. (c) Adder hibernaculum on a south facing dry stonewall.

The sites described in this paper illustrate that adders are extremely adaptable, being able to live in a range of different habitats, provided they have a few important features. That these features are found in many parts of Scotland raises the hope that with a more enlightened attitude by humans to snakes in the future, adders may again become more widespread.

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