ENGLISH NATURE

Report Number
666

Conservation status of the adder *Vipera berus* in Greater London

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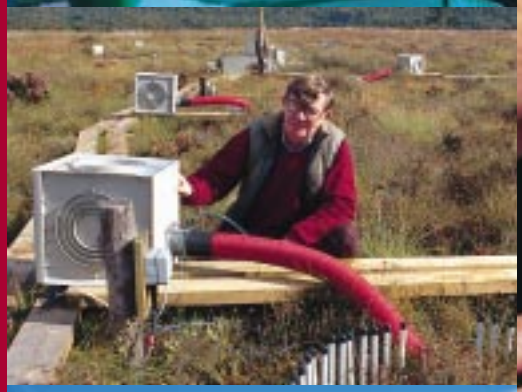

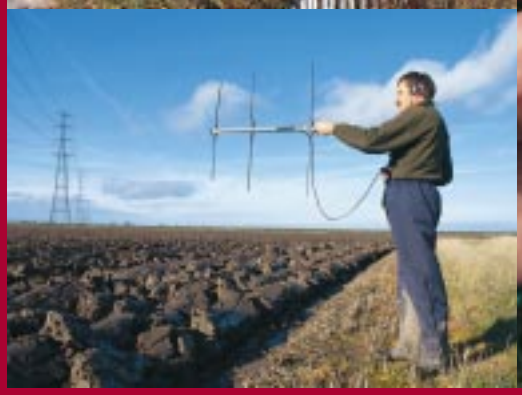

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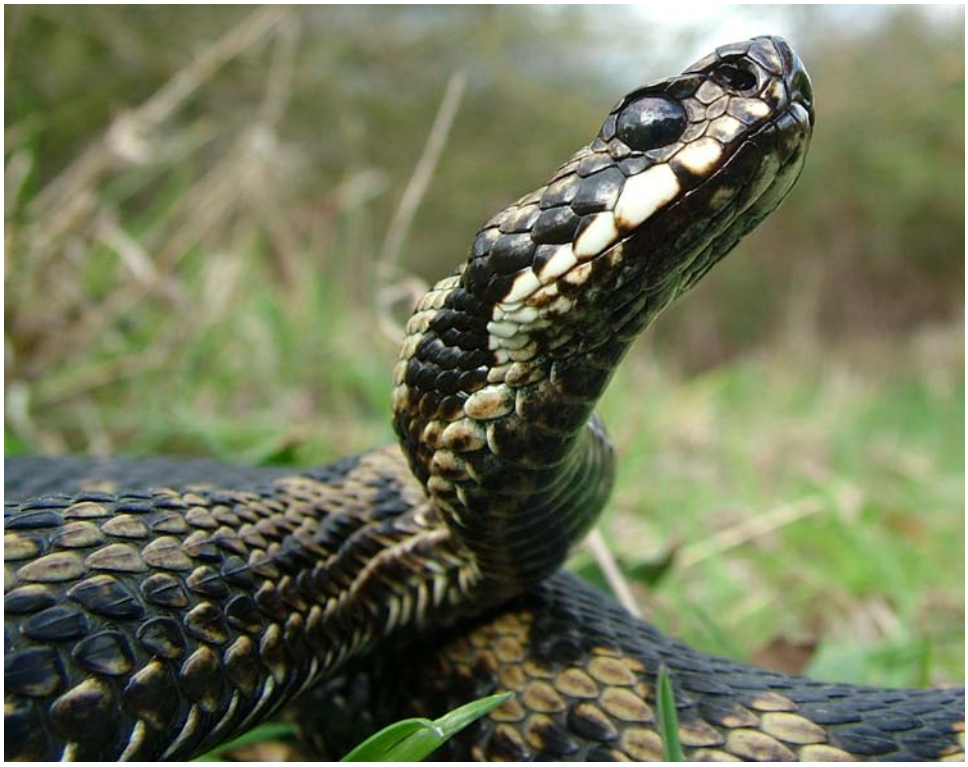
Conservation status of the adder *Vipera berus* in Greater London

Will Atkins
London Essex and Hertfordshire Amphibian and Reptile Trust



'Adders certainly come nearly within the sound of Bow bells, for they have been met with in the little woods around Hampstead, Highgate and Hornsey'

M.C.Cooke, 'Our Reptiles and Batrachians' (W.H.Allen 1893).

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Cover note

This report is the result of a project commissioned by English Nature on behalf of the London Biodiversity Partnership's Reptiles Species Action Plan and undertaken by the London Essex and Hertfordshire Amphibian and Reptile Trust (LEHART). The lead researcher and author was Will Atkins of LEHART. The project was developed in consultation with the Reptiles SAP Working Group. The project officer at English Nature was Rachel Cook. The views in this report are those of the author and the contributing herpetologists and do not necessarily represent those of English Nature.

It is normally the policy of English Nature to make freely available information on the occurrence and distribution of wildlife. However, we will withhold wildlife information if it is in the best interests of the species concerned. We will comply with access to information requests to the extent necessary to enable us to comply with our statutory obligations under the Environmental Information Regulations 2004. In this instance, it is our view, that by applying the Countryside Agencies' Open Information Network Guidance Note 1 - *The 'Environmental Exception' and access to information on sensitive features* the details of the location of adder sites within Greater London should be withheld as these sites are supporting small populations, which are vulnerable to collection, persecution and disturbance. Therefore, the sites are listed as site W, X, Y, Z.

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Londoners are fortunate to be living in one of the greenest of major world cities. A long history of open space provision and protection has left us with many beautiful and internationally renowned open spaces that support a wealth of wildlife.

Adders have very special requirements for their survival. Like all animals, they need food, shelter and places to breed. However, these requirements are found in only a handful of sites where there are sufficient areas of traditional heathland. I believe we all have a responsibility to protect and conserve adders, and to pass them on to future generations of Londoners, thriving, rather than struggling to survive. It would be sad indeed should the adder become extinct in London.

I welcome this report on a study of London's remaining adder populations and their requirements, undertaken for the London Action Plan for Reptiles. The leadership and funding of this work by English Nature was crucial to producing this framework for adder conservation in London. I am pleased that my support for the London Biodiversity Partnership has assisted with the production of this report.

I congratulate English Nature, and the other partners who are working on the action plan, and look forward to seeing the required action implemented over the next few years.

Ken Livingstone
Mayor of London

Executive summary

This report was commissioned by English Nature and written by the London, Essex and Hertfordshire Amphibian and Reptile Trust (LEHART, registered charity number 1089466), contract reference LO100P.

Aims

The key objectives of the project were to:

- Evaluate the conservation status of the adder *Vipera berus* in Greater London by reviewing published literature, interviewing local herpetologists, naturalists and site managers, and by assessing the suitability of habitat within the four known adder sites in Greater London and the extent of suitable habitat outside of site boundaries.
- Produce individual site 'management briefs', which could be used as working documents to enhance the adder populations at the four known sites in London. A summary of each site and its management recommendations is presented as an Appendix to this report.

Current status in Greater London

The adder is widespread within Greater London, but rare, given that it is restricted to only four widely dispersed sites (referred to as W, X, Y and Z within this report). The species remains undersurveyed in spite of recent efforts to address this problem through surveys carried out by members of the London Biodiversity Partnership's Reptiles Action Plan in 2004. It is possible that it occurs in very low numbers at other locations within Greater London at the present time.

Within the four sites, the populations vary greatly. There are only seven known individuals at one site where they occupy less than a hectare of the site. At two sites, between 10 and 20 animals have been counted during emergence counts, and up to 10 individuals have been counted at the fourth site, although precise and systematic data (for example, in the form of annual emergence counts) is often lacking.

In all cases, medium to long-term (that is 10 years from now and beyond) problems arising from inbreeding are likely without artificial input of new animals. This is because of the relatively low estimated size of the populations and the lack of genetic exchange between them. At only one site is there any possibility of adders being found in adjacent habitats outside the site boundary, that could allow for such exchange to occur.

Although the size of each population is considered to be low, relative to the larger populations of adder found in more extensive areas (such as tracts of heathland outside of London) the 'management recommendations' that are made in the individual site management briefs are considered to be capable of enhancing the site status of the adders in all of the four sites. Each set of 'management recommendations' has been made by liaising with the relevant managers and local herpetologists.

At one site the very low number of adders makes extinction in the near future more likely. Hence it is possible that one of the four populations will suffer extinction in the medium term. The extent of suitable habitat is small at the moment at this site, and so it is recommended that more adders are introduced to 'top up' the existing population at the same time as extensive habitat restoration is undertaken. Should extinction occur in the interim, habitat restoration would make a re-introduction easier to justify in the future. At another two sites, some introduction of novel alleles will be needed in the longer term.

Reasons for current status

The lack of a co-ordinated recording strategy to date results in an incomplete understanding of the historical status of the adder in Greater London. However, it is clear that underlying geology is of importance in determining the original distribution of adders in London, (as is the case elsewhere in the United Kingdom). There is a strong positive correlation between adder occurrence and either sand and gravel or chalky soils; conversely they are rarely found on clay soils. This is reflected in the preference of the species for drier habitats, such as heathland and chalk scrub. However within this natural limitation there is evidence of a severe decline in populations this century because of human pressure, for example as a consequence of increased urban development or direct persecution.

Mature heathland and acid grassland: this combination of dense vegetation for shelter and open areas for basking is ideal for adder

Present day pressures on the populations vary from site to site, but at three sites there is a threat to populations from arson, and at three sites there has been a loss of suitable habitat associated with lack of, or inappropriate, management. Direct persecution of animals is a

risk, but is not common, probably because of the relatively few animals at the sites and their generally inconspicuous nature. The lack of awareness of most local residents about the presence of adders may also have helped to conserve them, and it is strongly recommended that the current practice of non-disclosure of adder sites is maintained.

Comparison of sites

Each of the four adder populations occurs on land that has been afforded some degree of protection through planning designations. This varies from the national (for example, Sites of Special Scientific Interest) to more local designations, such as Grade 1 Site of Nature Conservation Importance. At two sites the habitat requirements of the adders have been addressed within the main management objectives of the reserve areas, but in the other cases the management regime has not been generally beneficial to the adders. Thus, it is simplistic to suggest that site protection alone has been of benefit to adders in Greater London.

Of the four known sites, three would not occur in London today, were it not for the creation (in 1965) of Greater London, which included parts of rural Essex, Middlesex, Surrey and Kent.

Of the four known sites, only one is thought not to be either completely or partly composed of animals deliberately introduced by humans. One is the result of a re-introduction of animals which took place only a few years ago, using animals sourced from a development site outside the Greater London boundary. The remaining two sites have both been restocked at various times in the past when the original populations diminished, using animals from a variety of locations, in one case from over a hundred miles away. The introduction of alleles may benefit the long term genetic viability of the populations. However, it does not follow the current conservation orthodoxy of using genetic stock sourced as close as possible to the recipient population.

Status of adders in London in the national and regional context

In the national context, Greater London has a low number of adder populations compared with many counties, especially in the south and west of England. Within the south-east of England, the counties to the north of Greater London, such as Buckinghamshire and Hertfordshire, have (apparently) always had few adder populations, and today they have fewer even than Greater London. This is surprising given the greater degree of urbanisation in Greater London. However, underlying geology and intensive agriculture combine to restrict the number of populations in these counties. To the east and south of Greater London, in Essex, Surrey and Kent, there are still many more populations, for example there are ninety separate adder sites in Surrey (Anstis, pers. comm). However, according to local herpetologists, populations in these counties which are close to the boundary with Greater London are often rare and, due to lack of site protection, appear more threatened with immediate loss than some of the Greater London sites. If this situation is not addressed, a hinterland which is devoid of adders could result.

Increasing the status of adders in London through introduction and re-introduction

The question of whether the status of the adder in Greater London might be increased through either an introduction or re-introduction programme is examined. Herpetologists, naturalists and site managers with knowledge of Greater London's ecology were asked to comment on

the suitability of any former or new sites for adder re-introduction or introduction respectively.

Currently there is no site that is considered suitable for adder re-introduction in Greater London. This is because:

- A number of sites that used to support adder populations have since been developed.
- It would take several years to restore significant areas of suitable habitat.
- The site threats responsible for the original extinction may still be present.

However, with political will and funding it may be possible to restore a few sites to the level required to make a re-introduction worthwhile, for example, at Rainham Marshes in Havering, where historical records for the species exist.

In London, the presence of historic records at one site proved useful to galvanise support for the re-introduction of adders. However, introductions to new sites could be more ecologically feasible but there are legal implications of introducing a venomous species to any site with public access in Greater London. Notwithstanding these difficulties, it is recommended that possible opportunities are explored with a view to introducing adders at several new sites in the medium term. This should not divert attention from securing the future of the extant adder populations.

Adder monitoring and conservation strategy

As a final component of the report, a list of recommendations is made to enhance the conservation status of adders in Greater London. These recommendations involve the implementation of individual site management briefs, including restoration of habitat to improve the population viability and the addition of new animals at three of the sites to improve the genetic viability of the adders.

There should be a co-ordinated monitoring policy which includes making systematic and, as far as possible, replicable counts during the adders' Spring 'lying out' phase to allow relative judgements to be made on population status within and between sites year on year. Attempts should also be made at this time to identify the key hibernacula on site to avoid damage to these features during other conservation management. Further work should be undertaken in the summer to determine the use of summer feeding areas and the spread of animals, especially in the case of the most recent introduction. In early autumn, proof of breeding in the form of gravid females and newborn young at the hibernacula should be sought.

The results of work at each site should be monitored by organisations with specialist knowledge of adder conservation through the Reptiles Species Action Plan. Communication between specialists and owners and managers of sites should be developed; it is hoped that this report and the management briefs will be a step in this direction.

Further survey work to identify potential other adder sites is an urgent priority, especially given the consensus view that opportunities for introduction and especially for reintroduction are poor in the short term (that is, within the next several years).

Conclusion

The status of the adder in Greater London today is widespread but rare. There are only four known adder sites and these are widely dispersed within Greater London. At each site the population size is either low or very low. In the past there were more populations within the area now known as Greater London, although these may have been restricted by the underlying geology (see, for example, Langton and others 2005 in prep).

It is therefore considered a matter of urgency that the management recommendations which are suggested in the individual site briefs are implemented, and that there is an investigation of the possibility that adders still occur elsewhere in Greater London. At three sites at least, a system of introducing new alleles in the form of new individuals from other sites will be required. Finally, opportunities to introduce adders into new but suitable sites (for example in worked-out quarries and landfills) should be investigated.

If these actions are undertaken then it is feasible that the future of the adder can be secured and its status improved over the coming years. Conversely, without appropriate habitat and species management it is still possible that the adder will go extinct in Greater London in the medium to long term.

Acknowledgements

The London Essex and Hertfordshire Amphibian and Reptile Trust (LEHART) wishes to acknowledge the financial support of English Nature in the construction of this report. It would also like to thank Rachel Cook and Jim Foster for their guidance.

LEHART is also grateful to those who contributed to the construction of the report:

Jonathan Bustard, Lee Brady, Jon Cranfield, Andrew George, Tony Gunton, Clive Herbert, Stuart Hunt, Richard Hutton, Tom Langton, Paul Losse, Gareth Matthes, Peter Massini, John Meehan, Doug Napier, Steve Pash, Tony Phelps, David Scott, Chris Slack, Mary Smith, Bill Whitaker, Steve Whitbread and Danial Winchester, and Mike Waite.

All photographs credited to LEHART.

Contents

1 Introduction

This report was commissioned in November 2004 by Rachel Cook, English Nature (London) as part of the continuing work of the London Biodiversity Partnership's Reptiles Species Action Plan and its commitment to the conservation of native species of reptile including the adder *Vipera berus,* which are found in Greater London.

The report was commissioned as part of the London Reptiles Species Action Plan in the light of evidence, which suggested a decline in adders at the national, regional and Greater London levels over the past few decades. The evidence for this is presented in the next section. It was also commissioned in recognition of the lack of an existing central pool of knowledge and records of adders at the known sites and of their requirements. In turn this required the construction of individual site reports and briefs for each of the four populations found in the Greater London area.

The aims of the contract were to focus initially on the four known sites and to construct site reports and management briefs for each of the sites. Each report would examine the following details:

- Site location and size.
- Site status and ownership.
- Habitat description.
- Connectivity.
- Summary of current management.
- Threats to the adder population.
- Other issues of interest.
- Maps showing important habitats and locations of main adder sightings.

In addition to the above, an important element was the inclusion of the historical details of the adder population on the site including, where possible, details of population status in the past and a comparison with current status. Finally, for each report a realistic and attainable set of management recommendations has been made, which can be deployed to enhance the status of adders in the future.

It was also a key aim that, arising from the management briefs as well as a thorough a review of the main sources of published literature, some generalised comments were to be made on the conservation status of the adder in Greater London and published in an English Nature Research Report. As well as comments relating to individual sites, the aims of the report are to include the following:

- An evaluation of the conservation status of the adder at the London scale.
- An evaluation of the population and genetic viability of London adder populations.
- Species management potential in terms of introduction of adders to existing populations to improve population and / or genetic viability as well as an analysis of the feasibility of introducing or re-introducing entire populations.

- Recommendations for a London adder monitoring strategy including survey methods and effort, data management and co-ordination.

1.1 Methodology

Between October 2004 and January 2005 inclusive, a series of visits were made to each of the four sites where adders occur. Interviews were conducted with those directly concerned with the management of the sites (either through their professional involvement as site managers or in a voluntary capacity as local experts) and habitat maps drawn up and field notes made which could be formalised into individual site management briefs.

In addition to site visits, a number of herpetologists with direct experience in surveying for adders and / or in managing their habitats in the London area were consulted and asked to comment on issues relating to adder conservation at the London scale. For example, opinions were sought on the future of adders in Greater London, the possibility of adders occurring elsewhere in Greater London, and the feasibility or otherwise of undertaking introductions and re-introductions.

2 Changes in adder status

2.1 National level

A decline in adders has been described in several parts of England, including the West Midlands, East Anglia and south England (Cooke & Scorgie 1983). The correlation with adders and areas of low human population density has also been reported (Swan & Oldham 1993). This relationship has implications in the London context because of its high human population density. Declines in population are also noted over much of England in other reports (for example, Langton, Beckett & Dunmore 1993). This last reference estimated that there were 130,000 animals in the United Kingdom which occurred in 1,308 populations, though there are no details of how this figure was calculated. This compared with an estimated 320,000 grass snakes *Natrix natrix helvetica* in 5,365 populations from the same source. This is in spite of the grass snake having a much more restricted range in the United Kingdom than the adder.

The continuing trend in adder decline has been monitored nationally, in many cases over several decades, at particular sites by local herpetologists, whose observations are collated and analysed in the *English Nature Research Reports* No. 546. Status of the adder *Vipera berus* and slowworm *Anguis fragilis* in England (Baker, Suckling & Carey 2004). Relevant deductions include evidence of a continuing decline in the status of adders (but not in the case of slowworms). Furthermore they observe that human pressure (disturbance) was the most frequently recorded negative factor affecting both species, and that for the adder, population stability was more frequent on large sites – sites which are greater than five hectares. This last comment has implications for the Greater London adders, as two of the four sites currently occupied are approximately one and two hectares in size. At the other two, one contains up to five hectares of suitable habitat and the last includes several tens of hectares of suitable habitat.

Evidence of a national decline in adders was also obtained from a small-scale questionnaire-based survey conducted on behalf of LEHART for the south-east regional Herpetofauna

Groups of Britain and Ireland (HGBI) conference (Atkins unpubl. 2002). For the purposes of this exercise the named county representative in England listed in the 2000 *Herp Workers Guide* was contacted and asked to comment on the current status of adders at county level compared with their status several decades ago. No respondent mentioned an increase in status at county level, 27 per cent reported declines and a further 27 per cent judged the status to be too low to judge any change during the last 20 to 30 years. The main causes of population loss and decline were given (in decreasing order of importance) as agricultural improvement, overgrazing / unsympathetic management, fragmentation of populations, afforestation, increased natural predation (for example by pheasants), increased persecution / human disturbance and arson.

Although agricultural improvement has not been important in the recent loss of populations from Greater London, given its more urban character, several factors listed for declines in other counties are significant, especially arson, human pressure and lack of sympathetic management.

Tree and scrub encroachment can adversely affect adder populations where they remain.

2.2 Regional level

The term 'regional level' is taken to comprise the Herpetofauna Groups of Britain and Ireland (HGBI) counties which constitute the south-east region of England, namely Greater London, Surrey, Sussex and Kent, as well as the remaining counties whose boundaries abut that of Greater London, that is, Buckinghamshire, Hertfordshire and Essex.

A complete literature review of these counties' adder records was beyond the scope of this report, but the following main sources of information were consulted in order to gain an overview of the adder's status in those counties nearest to Greater London.

- A distribution map representing the latest adder records from Kent (Brady pers.comm. 2005).
- The provisional *Atlas of Reptiles in Kent* (Philp 1998).
- A report from the Essex Amphibian and Reptile Group (EARG) summarising the status of the adder in Essex (Cranfield pers.comm. 2005).
- Responses to requests for data on changes in adder status from those herpetologists cited in the references section at the end of this report.
- Relevant replies to the national questionnaire-based survey referred to above (Atkins unpubl. 2002).
- County Herpetofauna Atlases for Surrey and Sussex (2001 and 2000 respectively).

The current status of the adder is summarised in the table below. However, caution should be exercised when comparing the absolute number of populations because of the different years when the data were collated, and more importantly because what constitutes an 'adder site' will vary from one part of a county to another. For example, a large block of heathland in Surrey may hold a large metapopulation of snakes with no effective barriers to dispersal. Consequently this might be categorised in the same way as a much smaller relict adder population as a single 'adder site'.

Table 1 Regional status of the adder in the south-east of England

County	Number of sites (range)	Status of adder
London	4	rare
Hertfordshire	0 (1 unproven)	extinct
Buckinghamshire	2	rare
Surrey	90	common*
Sussex	50-100	common*
Kent	c.50	frequent*
Essex	c.50	frequent*

*though distribution is often skewed to certain favourable parts of the county such as blocks of heathland, chalk downland or coastal fringes.

Evidence that there has been a decline in regional status is to be found in the published Atlases (for example, see Wycherley & Anstis 2001) as well as in personal responses to the questionnaire-based survey (for example, Scott pers.comm. 2002) and also from county maps (for example, Brady pers.comm. 2005). In Kent for example, there are 27 records from 1950 to1979, which have not been recorded since that time period, a further 33 from 1980–1999 but not more recently, compared with 46 records post 2000. This suggests that there has been a sharp decline of adders in at least one county close to London in the past half century. The decline may be steeper than the figures would suggest, given that Kent has experienced a much greater recording effort for adders and other reptiles since the formation of the current Kent Reptile and Amphibian Group in 1994 (Brady 1998), though it is possible that small

numbers may hang on in some sites which have as yet not been surveyed intensively (Brady pers.comm. 2005).

In summary there is both anecdotal and published evidence that adders have declined in counties such as Kent, Essex, Surrey and Sussex, especially in areas close to urban centres with development and increased human pressure probably causing local extinctions. In Buckinghamshire and Hertfordshire adders appear to have been rare for over a century (for example see Leighton 1901).

2.3 The London area

2.3.1 Problems defining the search area

Historically, the London area has been defined differently. For example, until 1 April 1965 the administrative region known as Greater London did not exist. This area comprises the 32 London Boroughs as well as the City of London. Prior to this, London was bounded by areas such as Middlesex, which have no formal status today, and also by certain parts of present-day counties that have since become subsumed into Greater London, such as Upminster and Hornchurch (formerly in Essex), Biggin Hill and Bromley (formerly in Kent). Records of adder which pre-date 1965 will therefore not appear as Greater London records and those outside the 'old' London boundary must be re-interpreted in the light of these alterations.

A further difficulty in trying to establish a comparison between present-day and former adder status is the definition of the recording area used by one of the main sources of information on the distribution of the species. The London Natural History Society (LNHS) defines its recording area as that within a 20 mile radius of St Paul's Cathedral. The resulting boundary extends well outside those of Greater London. This has resulted in more adder populations being recorded by the LNHS than actually exist in Greater London.

The completion of the M25 London Orbital motorway in the late 1980s also forms an obvious boundary within which adder conservation could be considered as a unified whole (Langton pers.comm. 2005).

The following account of historical adder distribution in Greater London does not represent an exhaustive search of all the available literature; this was outside the scope of this report. It is likely that more adder records exist within the journals of local natural history societies and in other archives.

A final difficulty in attempting to assess the change in status of adders in Greater London has been the lack of systematic recording until very recently. In 2004, members of the London Reptiles Species Action Plan (SAP) undertook surveys of sites with historical records of adder in order to ascertain present day presence or absence. There have been very few attempts to publish or to collate data on London's adder distribution and status. However, a review of the status of the adder in Greater London was published in *The London Naturalist,* the publication of the LNHS (Langton 1991).

2.3.2 Adders in Greater London – the historical context

The first published account of adders in London dates from the mid nineteenth century (Bell 1849). However this refers only to adders frequenting parts of the present-day Borough of Haringey, and no other records are given.

Adders in Haringey are again referred to almost 50 years later (Cooke 1893). Additionally there is a record of adders having disappeared from Hampstead Heath (London Borough of Haringey) before the end of the nineteenth century. At a similar time, reference is made to the extinction of adders in one part of the present-day Borough of Sutton, on the other side of London. This account gives the first reference to urbanisation as the probable cause of this local extinction (Leighton 1901).

Early reference is also made to the preference of adders for chalky and sand / gravel geology (for example, Leighton 1901). It is therefore likely that many parts of London, especially on clay, will rarely have held adder populations even before their urbanisation.

Records of adder until the mid twentieth century in the London area are rare. However, some are collated in *A Check-list of the Mammals, Reptiles and Amphibia of the London Area 1900–1949* (Fitter 1949). This article includes data from within the London Natural History Society (LNHS) recording area. Reference here is made to adders occurring in Eynsford in Kent, and Warlingham and Oxshott, both in Surrey and at Scratch Wood, which is in the present-day London Borough of Barnet. Reference is made to Epping Forest in parts outside the present-day boundary with Greater London, and to Tilbury Docks in Thurrock, Essex. Hence only one of these sites – Scratch Wood – lies within Greater London. Adders were reliably last recorded here in the late 1950s (Yalden 1965).

Several post-1950 accounts of adders in the London area exist. For example, they are mentioned from Coppetts Wood, London Borough of Barnet (Hall 1978); from Woldingham, Surrey (King 1981); from Banstead Heath, Surrey (King 1983); from Scratch Wood (mentioned above), Epping Forest, (Essex part), Westerham, Shoreham, Warlingham, Farningham and Eynsford, all in Kent, and Esher in Surrey (Yalden 1965).

Of these records for adders in the London area only two actually pertain to sites currently within Greater London. This suggests that from the start of the twentieth century adders had become fairly rare, but it is equally important to note that recording was often casual and no adder survey had been undertaken at Greater London level. In addition, local natural history journals contained some adder records which were never published in the London-wide recording area publication of *The London Naturalist*. For example, at one current site in Greater London there are references to adders extending back to the mid 1970s in the publications of the local natural history society.

The first attempt to publish an overview of the status of the adder at the London level was produced by Langton in 1991. Again, his report is based on the 20 mile radius recording area of the LNHS.

In this report data on status and distribution is presented as two maps, both given at a resolution of 10 by 10 kilometre squares to protect the confidentiality of the sites. The first contains records prior to 1980 and the second presents confirmed records from 1981–1990.

The number placed at the centre of each of these squares is the total of 1 by 1 kilometre squares which have at least one record of adder within them.

The total number of 1 by 1 kilometre square records of adder pre-1980 is 27; from 1981–1990 the number is 29. However, these data should not be interpreted as evidence that adders were much more common in Greater London until the last decade. This is because it is not possible to make a direct comparison using this data with the total number of populations known from Greater London today given the recording area includes areas outside the Greater London boundary, which are known to have reasonable numbers of populations at the present day. Of equal importance, a 'record' in the maps given by Langton in 1991 is not necessarily the same as a 'population' as defined in this report. Instead, a record is simply at least one confirmed sighting in a 1 by 1 kilometre square. A single adder population may extend beyond an individual 1 by 1 kilometre square; hence several records may refer to only a single population.

There was probably also an increased recording effort in the 1980s compared with the previous decades, as the rarity of the adder in and around Greater London began to be appreciated.

In spite of these limitations, there is sufficient detail in the maps to make the following comparison between the apparent status of the adder in Greater London pre- and post-1980:

- North of the Thames, within the LNHS recording area, the number of one kilometre squares with records fell from twelve to five.
- Excluding the Essex sites, there is only one record from north of the Thames post 1980.
- To the south of the Thames, it appears that there are fewer than four records within Greater London post 1980; it is not possible to state how many there were prior to this using the information in the paper.

In conclusion, the true status of the adder from at least 1980 onwards in Greater London appears to have been genuinely rare and widespread. When this information is combined with the knowledge that records of the species in London have been local since records began (Yalden 1967), the overall change in status in adders over the past 40 to 50 years can be summarised as a slow decline from 'widespread and uncommon' to the present situation of 'widespread and rare'.

Langton concludes by making reference to the fact that at the time of writing, only two populations were known to be extant in Greater London. He predicts that the species, "could well become extinct within the LNHS recording area before the end of the [twentieth] century unless substantial resources are put into its conservation" (Langton 1991).

2.3.3 Changes in status from 1991 to the present

In 1991, only two adder populations were definitely known to exist in Greater London. Today there are four separate populations. However this apparent increase is misleading. It is not due to the species recovering and undergoing an improvement in status, rather it is due to the following:

- One of the four populations is of recent origin, being a re-introduction.
- One of the four was only 'discovered' after the 1991 (after the London Natural History Society paper by Langton, referred to previously, had been written).
- One population, at least, which was not included by Langton in his paper has since gone extinct. This population was itself a re-introduction to a former site in Croydon. The re-introduction was made in the mid-1980s and adders persisted until 1992 (Corbett & Whitaker pers.comm).

It is therefore correct to state that, since 1991 there has been one extinction at the four sites which held extant populations at this time, that is, the Croydon site, which equates to 25 per cent extinction until the re-introduction of adders to site X a few years ago.

The status of the populations at sites W, Y and Z from the 1990s to the present day is given in the summaries of the management briefs in the Appendix.

Overall the position of adders in Greater London in the 1990s became more precarious, despite the identification of site W in the late 1990s and the restoration of site X a few years later.

In spite of a targeted survey effort undertaken in 2004 by several partners of the London Reptiles Species Action Plan, which utilised historical records and the 'best guess' survey list compiled by partners themselves, no new adder sites have been found nor have any historical sites been re-confirmed as extant adder sites. However, the surveys are ongoing and it has recently been established that in the case of the closely related asp viper *Vipera aspis* at least twelve visits may be needed to infer absence of a low population with 95 per cent confidence (Kery 2002). This may also be the case with the adder, given its generally similar behavioural ecology.

Finally, there are other areas which are currently lacking in systematic surveys for adders, for instance in parts of Bromley and Havering, as well as railway lands, which often harbour relict populations of reptiles. Hence it cannot be concluded that all the adder sites in Greater London have definitely been identified.

2.3.4 Summary of known Greater London adder sites 2005

Site code	**W**
Site description	Former gravel extraction, succession to variety of habitats.
Habitat description	Neutral grassland and scrub. Some denser patches and wet woodland. Raised embankments contain main hibernacula.
Historical status of adders	Colonisation after disuse from surrounding suitable habitat in 1980s.
Current status of adders	In the region of 20-40 adults.
Connectivity	Neighbouring areas of suitable habitat exist with some connectivity. Casual observations suggest these may hold adders.
Current management	No formal management.
Threats to adder populations	Scrub encroachment, arson, and motorbike scrambling represent the more serious threats.

Management recommendations	Clear scrub on key embankments, leaving sufficient to deter bikers. Restore open areas to grassland for feeding. Allow some amenity grassland to develop into more favourable adder habitat. Survey surrounding areas for additional populations and manage accordingly.

Site code	**X**
Site description	Former sand and gravel extraction site, with areas infilled with soil raising pH level as it is now more neutral / alkaline in places.
Habitat description	Extensive area of neutral and acid grassland and scrub, with some heathland, and a variety of other habitats. Heathland compartment well used by adders.
Historical status of adders	Unconfirmed records only.
Current status of adders	Eight animals recorded in spring 2004; combat, courtship, breeding and new-born young all recorded.
Connectivity	Good within-site connectivity, as well as corridor features and considerable potential habitat in the surrounding area.
Current management	Very sympathetic management of grass and scrub mosaic. Heathland restoration work in place.
Threats to adder populations	Large fires are a short-term risk, as this population is not widely dispersed. Inbreeding may become a problem as there are no known surrounding populations.
Management recommendations	Continue current management of grassland and heathland. Manage surrounding areas to encourage dispersal, and systematically monitor the population on and off site.

Site code	**Y**
Site description	Open common land used for grazing, with a small area of relict heathland. The total area is in the region of 20-40 hectares.
Habitat description	Adders utilise only a small area of heathland approximately one hectare in size.
Historical status of adders	Few historical records of adders here, but more regular surveys in the 1980s put the population at about ten, with surveys recognising individuals. The 1990 numbers declined to local extinction; however a small release left a small but stable population.
Current status of adders	Thought to be 2 females and up to 5 males.
Connectivity	The site contains good habitat, however the small population size reduces the need to disperse. Off-site conditions do not favour colonisation.
Current management	Grazing prevents scrub encroachment; however there are good areas of important woodland habitat nearby which is subsequently not managed for adders. A local conservation group work to protect the adders here.
Threats to adder populations	The small size makes this population highly vulnerable to 'chance extinction', and its longer term genetic viability is questionable.
Management recommendations	Restocking in the short term will boost the current numbers, and clearance of recently succeeded woodland nearby to a grass-scrub matrix will provide more suitable habitat.

Site code	Z
Site description	This area of around 70-90 hectares has now much less suitable adder habitat than in previous years owing to succession.
Habitat description	The relict heathland is bounded by busy roads, but the soil conditions prevent nutrient build up which maintains this well. Recent woodland with open glades characterises the surrounding area.
Historical status of adders	The former openness of the area suggests a larger population in years gone by, but few records support this. Although systematic recording has not been in place, spring emergence counts of 12-20 animals since the 1980s demonstrate a high population density in recent history.
Current status of adders	Herpetologists suggest a high remaining population density; approximately 20 individuals.
Connectivity	Local connectivity is good, with corridors for expansion into the woodland glades, however external dispersal opportunities are poor due to local roads.
Current management	The core site is managed sympathetically for adders, and some woodland is being cleared to improve connectivity within the compartment. Heathland outside of this is being managed for adder to be completed over the next 5-10 years.
Threats to adder populations	Although not a problem recently, the danger of fire does remain. Inbreeding is not thought to be a major problem in the short term. Poor management is unlikely to be of concern.
Management recommendations	Continue current management, and extend to increase area of suitable habitat. Clear encroaching scrub, and widen fire breaks.

2.3.5 Summary of survey history and survey data on extant sites

For each of the four extant sites there is a range in terms of quality and quantity of data which exists. It is true to say that for all four sites there are gaps in recording, and a general lack of systematic survey efforts. This can be seen in the table below; for example data are lacking or rare for all sites prior to the 1980s. Ironically, site Y, with the lowest status, has been the most intensively recorded.

The data availability for each site is summarised below:

Table 2

Site code	Years for which records exist	Approx total number of records	Survey methods*
W	**1998-2004**	**c. 10**	**DO**
X	**1991, 2000-2004**	**c.60**	**DO / R**
Y	**1975, 1981-2004**	**c.100+**	**DO / R**
Z	**1960s (1 record)**	**c.50**	**DO**
	1982, 1985-1987,		
	1995-2004		

*see key below:

DO direct observation
R refugia (artificial materials such as metal ‘tins’ under which adders may bask)

3 Overview based on the four adder sites

3.1 Comparison of the four current adder sites in Greater London

Although the four extant adder populations occupy different types of site, are widely dispersed around London, and may lack comprehensive data sets, there are some important general conclusions which may be drawn:

- In all sites with the possible, but as yet unconfirmed, exception of site W (which may receive a natural input of novel alleles from immigrant animals originating from adjacent sites), there is a medium to long term (as defined in section 2.2) threat to the viability of the populations from genetic effects arising from inbreeding. In one population, at site Y, this danger will arise in the medium rather than the long term (should the population survive that long). However, at no site has any definitive observations been made to suggest that the consequences of inbreeding are currently a problem. No specific study has been undertaken at any site to investigate this possibility. The lack of confirmed breeding at Y in recent years may be related to inbreeding effects, but this is unproven.
- There has been a historical lack of systematic data collection at each of the four sites which persists to this day. Most records are casual and, at best, represent the efforts of a local herpetologist or natural history society to gather data when possible to do so.
- Three of the four sites would not have existed within the former boundary of London; only since the inception of Greater London in 1965 have they become incorporated into the current political definition of 'London'.
- At least three of the four populations' gene pools are composed either partly or wholly of alleles derived from animals which are not indigenous to the site. In one case the entire population is thought to consist of animals derived from about 15 kilometres away, in another it is likely that alleles are derived from animals sourced from Dorset, more than 100 miles away. In the third case, the exact provenance of the alleles in the current gene pool of the population is unknown, but it is known that at least one introduction has been made.
- At no site can the population status be considered healthy at the present time. As there is no accepted methodology for estimating reptile populations, the estimates of population size on the sites are by definition tentative. However, the four sites are thought to contain a range of population sizes from around forty adults through to no more than seven adults. In the latter population, no recruitment has been proven for over 20 years (and the appearance of previously unknown animals is a consequence of at least one introduction to the site rather than through natural immigration).
- In all cases, there is a risk of an incident which might wipe out all, or most, of the population. The most likely form which this disaster could take is fire damage, either accidentally caused by a discarded cigarette or through deliberate arson. In at least two of the sites this possibility is rendered more likely, though still unquantifiable, because of the restricted distribution of the entire population.
- At all of the sites there exists some form of site protection. This is by way of contrast to many adder sites in England and also with the situation faced by the other three species of native reptile found in Greater London, which often occur on sites lacking

protection – for example 'brownfield' sites such as old railway lands, former industrial sites and allotments. However, designation is not enough to protect adders from decline, and naturally management is of utmost importance. The management regimes employed at two of the four sites have benefited the adders directly. However, at the other two the main management has not generally benefited the adders.

'Chance' factors, such as this localised arson event at a main hibernaculum in early spring, can wipe out small adder populations.

3.2 Evaluation of the viability of London adder populations

Making these predictions inevitably involves a degree of speculation, as the data availability at each site is imperfect, as described in the section above. This is especially true of sites W and X and Z. In addition, it is the case that all of the sites may, to a greater or lesser degree, be subject to the risk of arson, which could render any discussion of medium and long term viability irrelevant.

For the purposes of evaluating the viability of the populations in the future, the risk of fire has not been incorporated into the assessment below. It is an evaluation based on the current situation at sites.

Table 3 below presents a summary of the viability of the four Greater London adder populations in the short, medium and long term. 'Short', 'medium' and 'long' term are only roughly defined as 'within 10 years'; 'between 10 and 20 years'; and 'more than 20 years', respectively.

Table 3 Viability of adder populations at the four Greater London sites

Site code:	Short term	Medium term	Long term
W	high	medium	low
X	high	high	medium
Y	medium	low	low
Z	high	medium	low

3.2.1 Population viability – discussion

Viability of adder populations is mainly dependent on their ability to survive the immediate threats identified previously, such as habitat degradation, fire damage and direct persecution, as well as the ecological challenges presented to any species in the wild, such as food supply, climatic events etc. In the longer term, issues relating to genetic viability will take on a greater importance than they presently have, especially in the smallest and initially least heterozygous populations.

Currently there is no adder population in Greater London which has a high population (high population is taken to mean over 400 individuals to avoid long term inbreeding). At W and Z the number of adults is estimated to be in the low tens, at X the number may be rather less because of the incidence of arson in 2003, and at Y the population is no more than seven adults.

In more natural conditions, where adders occur in large expanses of unbroken suitable habitat, populations may consist of many more animals, which are often capable of genetic exchange as young individuals in particular move from their natal population to another (Phelps 2004), the populations thereby forming a loose assemblage called a metapopulation.

Such natural populations will therefore be able to withstand localised events such as arson or habitat degradation making their extinction less likely. In the Greater London populations, their current low size, restricted distribution and lack of connectivity with other populations (with the possible, but unproven exception of W) makes them more vulnerable to threats than populations in the wider countryside (and possibly even to extinction, especially in the case of Y).

However, the population viability at site X may improve in the future, as there is an opportunity for this new re-introduction to spread much further on the site, and to move beyond its boundaries, with a consequent increase in population size.

At the other three sites, if management recommendations are implemented, more habitat will be created which is suitable for adders, and so the population size should also increase.

3.2.2 Genetic viability

Should each population survive in the short-term, then issues pertaining to their genetic viability will become increasingly relevant. This is especially true of the smaller populations,

such as site Y and those where there has been restricted input of novel alleles over a long period of time.

There is no methodology for calculating the precise degree of threat from inbreeding effects in adder populations, and how many animals would need to be released to counteract its effects, though a recent study by Madsen and others (1999) is of relevance. In the original study, an isolated and inbred population of adders at a coastal site in Sweden was temporarily 'topped-up' with 20 males from genetically variable populations. These males were allowed to mate for four seasons after which the survivors were released back into their sites of origin. Various signs of outbreeding and consequent increased vigour were identified, including a higher birth rates, lowered incidence of still-births, higher overall population size and increased survival of juveniles. The increased heterozygosity was confirmed directly by a genetic analysis of the population. Furthermore, these effects have continued to last for a further four years (Madsen, Ujvari & Olsson 2004).

In order to predict the likelihood of reduced genetic viability becoming a serious problem at the London sites, information on the provenance of the adders on each site would be required – information that is impossible to acquire in the case of sites Y and Z. It would also be necessary to show that no natural input of novel alleles has occurred on the site through immigration of animals from nearby populations. This is certain to apply for sites X, Y and Z but is uncertain for W. Finally, at site X although the source of the introduced adders are known, the original degree of 'relatedness' of the translocated animals to each other is not known, although they were all derived from a single population within a larger block of suitable habitat.

The conclusion from the paragraph above is that for different reasons each of W, X, Y and Z would present problems in deriving a risk of inbreeding calculation even if a standard methodology existed. As it is not possible to evaluate the threat of inbreeding exactly, it would be advisable to develop a strategy for introducing animals from donor populations which are robust enough to withstand the removal of at least several animals as soon as possible, that is, to assume a 'worst case' scenario. It would be dangerous to leave the issue of genetic viability until consequences of inbreeding become visible in these populations. In the meantime, while these plans are being made, careful observations should be made to check that no signs of inbreeding (such as lowered fertility and recruitment, genetic defects and skewed population structure) are starting to appear earlier than predicted.

For site Y, with the smallest extant population, there is a danger of extinction in the medium term and more animals may be needed as a complete re-introduction rather than just a 'top-up'. It is recommended that further animals are introduced as soon as possible, but it is essential that this introduction is concurrent with major management works to restore a reasonable block of habitat.

3.3 Evaluation of conservation status of adders at the London scale

The terms of reference for assessing the conservation status of adders in Greater London are important. Notwithstanding the fact that grass snakes are highly mobile and may therefore be over-recorded, it is reasonable to ask whether adders should be expected to be as common in Greater London as grass snakes. The correlation between adder distribution and underlying geology indicates that adders would never have been as widespread in Greater London as the grass snake, but the scant historical data provides some evidence that a reduction in site

occupancy has occurred over the past century, and that there has been a more rapid decrease in the last 50 years.

To evaluate the status of adders more precisely it is necessary to summarise the relevant information presented in the regional status and historical status sections.

The national status of the adder was estimated to comprise 1,308 populations a decade ago (Langton, Beckett & Dunmore 1993). Even allowing for site extinctions over the past decade, the total should still be in excess of 1,000 populations.

At the regional level, the number of populations has been estimated at between 200 and 300 sites in total, shared between seven counties (albeit with a wide disparity between those counties to the north and west of Greater London, containing few sites, and those to the south and east, with far more).

Even allowing for the smaller size of Greater London than most of the surrounding counties, it is obvious that the status of the adder here is far lower than the average for both the country as a whole and the region. This is mainly explained by the urbanisation of many, formerly more open, areas of Greater London and its environs and the consequent increase in human pressure on those remaining sites which were not directly built on in the twentieth century.

Historically, there is evidence of a decline in adder populations beginning as early as the end of the nineteenth century (see, for example, Leighton 1901). Given the lack of precise baseline data on the number of adder sites at the start of the twentieth century and even 50 years ago it is not possible to quantify the rate of decline precisely.

Calculations about the rate of decline are likely to be exaggerated if records of dubious status are included. For instance, records from fairly restricted habitats in predominantly urban parts of Greater London lacking connectivity with larger sites or railway lines are likely not to be valid, instead representing cases of mistaken identity of grass snakes or slowworms. This is presumed to have been the origin of several of the more surprising anecdotal and published records of adder investigated in 2004 during the 'Adder Surveys for Greater London' programme by partners of the London Reptiles Species Action Plan.

However, using the post Second World War records in *The London Naturalist* for analysis, it is possible to record that several sites have suffered extinctions in the last 50 years. The last confirmed site extinction in Greater London was around 1992. Based only on those sites where adders have been confirmed in Greater London and at which they no longer occur (using sources such as *The London Naturalist* and the knowledge of local herpetologists) it is very roughly estimated that perhaps between 5 and 10 adder sites have disappeared over the last 50 years or so.

3.4 Species management potential

As several adder sites have been lost in Greater London over the last few decades, it is logical to consider the potential for species management in terms of:

- The introduction of new alleles to extant populations to maintain and enhance their size and genetic viability.
- The possibility of establishing new populations as introductions or re-introductions.

The former technique of species management has already been discussed in the section on population and genetic viability of adders in Greater London. It has been concluded that all sites with the possible exception of W will require 'top-ups' to enhance genetic diversity. At site Y, it is recommended that consideration be given to implementing a 'top-up' strategy as soon as possible in conjunction with the restoration of a significant amount of former open habitat that has recently succeeded to secondary woodland. This is both to enhance the population viability and to reduce the likelihood of closely related individuals mating, so reducing genetic viability.

The rest of this section deals with an evaluation of the current and future potential for introducing and re-introducing adders to sites in the Capital.

3.4.1 Re-introduction and introduction potential

Re-introduction has been a successful conservation technique in many species, including those of several native reptiles and amphibians (see, for example, in Gent 1994, 2002, Corbett 1989, 1992, Beebee & Griffiths 2000).

Given the proven extinction of adders at several sites at least in Greater London over the past few decades, the concept of re-introduction would initially appear to be an attractive one. However, it is the opinion of local experts that in order to justify the re-introduction of adders to an area where they originally occurred, an exhaustive list of criteria must be satisfied:

- The cause of the original extinction must be identified and removed or sufficiently reduced to render it negligible.
- No other major threat can have developed in the interim on the site.
- The habitat must be protected from future development or major disturbance.
- Human pressure (for example, through land use for recreation) must not be sufficiently high to threaten the establishment of adders.
- The site must still comprise areas of extensive suitable habitat.
- The legal implications of releasing a venomous species must have been addressed.
- There must be a donor population reasonably nearby (at least within the nearest adjoining county) which could withstand the removal of enough animals to provide a translocated population (a minimum of perhaps 30 to 40 adults).

Ideally a re-introduction could be followed up a few years later with a second 'top-up' to consolidate the population if it can be proved to be surviving and recruiting successfully.

Not all of the above criteria have been addressed in previous re-introductions, including at least one of the surviving Greater London populations. However, this does not justify their disregard in the future.

In this context, site X could be seen as a model for evaluating the success of a recent re-introduction to a site which is believed to have once held adders. Site X had been identified as being theoretically suitable for adder release and was stocked with adders captured from a development site.

There are thought to be no sites from which adders have recently become extinct which are currently suitable for re-introduction. This is partly because several have been developed or the original habitat has been lost, for example, to secondary woodland. It is also because some still suffer from the threats which caused the original population to go extinct. This is the case at the Croydon site referred to previously, for example, where arson remains a persistent problem.

It may therefore be more reasonable to evaluate 'new' sites for their potential as introduction sites rather than to concentrate on re-introductions (Langton pers.comm. 2005). The criteria for making this assessment should include the following:

- There should be no existing adder population.
- It should hold extensive habitat of good quality.
- It should contain sufficient food in the form of small mammals and viviparous lizards.
- It should be safeguarded from development or other changes in land use and guaranteed sympathetic management in the future
- It should be reasonably undisturbed by members of the public.
- There is a strong likelihood that permission for adder release can be formally obtained.

Ideal sites for adder release might include disused quarries, landfills and railway lands, but this strategy should not distract from the task of conserving those sites which contain extant populations.

In conclusion, possible sites for introduction seem ecologically more feasible than those for re-introduction, since the latter sites may have been destroyed or rendered unsuitable for adders, or the original threat(s) may remain. However, it may be politically easier to approve adder release in sites where records previously exist.

3.5 Evaluation of possible adder occurrence at other sites

The history of adder recording in Greater London has suffered from the lack of a co-ordinated approach and also from a lack of thorough surveying, both at known sites and at possible sites elsewhere. Given the limited opportunities for creating new sites or restoring adders to previously occupied ones, the most effective way to increase the status of the adder in the short term would be to undertake a more thorough survey effort in the hope of finding 'new' populations which could then be actively managed. From a conservation perspective, this is judged a high priority, especially given the persistent rumours of there being several unidentified small populations.

There are several reasons to believe that adders may still be under-recorded in Greater London, in spite of the recent survey efforts which have attempted to address this area (for example, through the 'adder surveys for Greater London' project 2004, referred to previously). These reasons include the following:

- Not all the surveys undertaken in the 'adder surveys for Greater London' project have been completed. The difficulty of finding snakes at low population densities has

already been referred to in the 'changes in adder status – London section' (see, for example, Kery 2002).

- There are parts of Greater London, especially in the extreme south and east, which have been under-surveyed in the past. This means that some possible sites will not have been selected for survey in 2004, which was based mainly on sites which held historical or unverified records for the species. For example, the possibility that adders may be found in new areas close to site W has already been mentioned.
- The specific possibility that relict adder populations may exist on suburban railway lands in otherwise more urbanised habitats has yet to be investigated properly. It is beyond the scope of this report to identify those parts of the Greater London railway network where this would be most likely; however it is important to note that reptiles, including snakes, can utilise railway lands such as sunny embankments even in 'inner city' areas.
- It is possible that there are some small scale introductions, which are not known to members of the London Reptiles Species Action Plan despite their attempts to find out.

3.6 Recommendations for a London adder monitoring / conservation strategy

The following recommendations are based on the conclusions which have been made in the previous sections, especially with reference to filling the gaps in our current knowledge and in improving our understanding of the distribution and status of adders in Greater London. It is hoped that this integrated approach to adder conservation will secure the future for adders in the short to medium term, and enhance their status in the long term. At existing sites, measures to maintain and improve habitat as well as the introduction of new animals where necessary should help to achieve this aim.

3.6.1 Monitoring / data recommendations

Surveys on sites with extant adder populations

The following methodology is recommended, with a view to achieving a more systematic approach than has sometimes been the case in the past. This should permit relative comparisons on the status of a particular population from year to year, even if it may not allow inter-population comparisons to be made in terms of absolute numbers because of differences in ease of surveying, observer bias etc.

- A minimum of four visits should be made annually each spring in ideal weather conditions to make counts during the lying-out phase to allow intra-population comparisons year on year.
- A minimum of two pre-hibernation visits should be made annually each autumn to assess breeding success in terms of newborns and gravid females (given that breeding is typically biennial, some gravid females will always be present in a healthy population).
- Several visits should be made to the site through the summer to determine the extent of summer feeding grounds which are often (though not always) different from the hibernation / breeding / birthing area.

- For those sites where there are opportunities for dispersal to other areas either on or off-site or both, surveys should be made at least once in the spring and once in the summer to determine the extent of dispersal to, and colonisation of, these areas. Records from members of the public should be investigated in this context.
- The surveys should be undertaken by experienced or trained individuals to obviate the need for artificial refugia, which could result in conflict between adders and members of the public.
- At site Y the adders should be individually identified photographically to assist with determining whether any 'new' animals appear on the site and whether the population is any larger than the current estimate of fewer than 10 animals.
- The data collected for each site should be used to establish a 'Case File' for each site which will be used by the owner / manager in conjunction with the London Reptiles Species Action Plan (SAP) to augment the conservation strategy in the specific site management briefs written for this report.

Should those involved on site not be able to fulfil the recommendations above then a contingency should be arranged in order not to miss the recording of any important data, for example, through contact with the London Essex and Hertfordshire Amphibian and Reptile Trust (LEHART)**.**

Survey of potential sites

Surveys of potential adder sites include, or should include, the following:

- The 'adder surveys for Greater London' project initiated in 2004 is being continued, where necessary, in 2005 to establish the true number of populations in Greater London.
- The under-surveyed areas of Greater London should be investigated for adder presence by LEHART and others, especially in the vicinity of site W, the most recently 'discovered' adder site.
- Network Rail and London Underground Limited should be approached to obtain survey permission for adders specifically and for reptiles in general.

Data management and co-ordination

Site data should remain confidential to the site owner and those concerned with the monitoring and management of the adder population, as well as LEHART and English Nature.

A review of the success or otherwise of adder conservation measures should continue to be an integral part of the Reptiles Species Action Plan (SAP); it should be reviewed in the winter of each year in terms of change in status and number of populations in Greater London and management which has occurred, both positive and negative, at each of the sites.

Conservation recommendations

In addition to the recommendations listed above, which pertain specifically to the monitoring and dissemination of survey information on adders in Greater London, the following actions are recommended to complete the strategy for adder conservation:

1 Actions recommended in the separate site briefs should be implemented as far as possible. These include measures to maintain and enhance the amount of habitat available to adders.

2 The process of identifying and evaluating potential introduction sites for adders (such as disused workings, restored areas of heathland etc) should become a 'next step' in the enhancement of the status of adders in Greater London, as long as this does not detract from the conservation of extant populations. Only sites from counties adjacent to Greater London should be considered as sources of donor animals (or possibly involving the artificial movement of animals between the Greater London sites, once populations become sufficiently healthy).

3 Details of proposals to 'top-up' at sites X, Y and Z with adders sourced from healthy donor populations (see 2) should be worked out by the London Reptiles SAP Working Group, potential Site Managers to avoid the dangers associated with inbreeding which threaten these three populations in particular.

4 The co-operation of local authorities and landowners should be sought with a view to securing introductions of adders to new sites in the long term through liaison with them and the London Reptiles SAP Working Group.

5 Any new adder sites should be recommended to the Local Authority for designation as a Site of Importance for Nature Conservation because of their regionally important herpetofauna interest.

6 Lines of communication should be developed with those responsible for conserving adder populations which are close to, but technically just outside, the Greater London boundary. These populations are often more threatened by direct loss of habitat than the Greater London ones, because the land does not often have a nature conservation designation. The loss of these populations would create an 'adder-free hinterland' around Greater London.

7 Greater protection for adders at a national level should be sought (adders received legal protection as recently as 1991 under the Wildlife and Countryside Act 1981, as amended). The current review of the Act would provide a suitable forum for lobbying for this. Precedents exist where species may be locally common but which are declining (such as great crested newt *Triturus cristatus* and common dormouse *Muscardinus avellanarius*) which receive protection not only from killing and injuring but also from disturbance and damage to their habitats.

8 Although the individual recommendations of the site briefs have been designed to be relatively inexpensive, funding should be sought to implement all the recommendations of this strategy, especially those concerned with ongoing annual recommendations such as on and off-site survey, liaison with owners and managers

and the preparation of sites for introduction and re-introduction. A salaried post of London Reptile Conservation Officer would be an effective means of achieving these aims.

9 The public image of adders should be improved through the implementation of a public awareness campaign – an action within the current London Reptiles SAP – perhaps by highlighting their relationship with 'wilderness' areas. Recent attempts to improve the image of wolves as emblematic of frontier lands are comparable in this respect. Alternatively, efforts to focus attention on 'the last few individuals' at a single (anonymous) site and their demise might be more successful than a traditional generic 'help adders' campaign.

10 It should be ensured that adder sites continue not to be disclosed in publications including incidental reference to adders being present on sites in documents pertaining to the general ecology or nature conservation of sites.

11 The implementation of the management briefs by Site Managers should be supported and a network to assist in dissemination of information should be created.

12 The possibility of direct genetic analysis of Greater London adders in a decade should be reviewed, especially as the technology becomes cheaper and easier to use. However the increased knowledge concerning the degree of inbreeding within populations should be weighed against the amount of potentially harmful disturbance it would entail.

4 Constraints and limitations to the project

The following constraints were encountered in the preparation of both this report and the individual site accounts and briefs:

- The time available for the construction of the report was limited to a period of approximately six months, mainly during the winter, which may have prevented all the leads identified during the course of the report's construction from being fully explored. However, it is considered that all the main individuals and organisations involved in the survey and management of the four sites were consulted during the compilation of the site briefs, and in many cases they were also involved in any redrafting process.
- The winter timeframe may have prevented some details of summer vegetation and other seasonal factors from being fully incorporated into the briefs.
- The report's timing prevented data from the 2005 survey season being incorporated within it; however a survey element was not part of the report specification. Furthermore the promise of new survey data being obtained could be used as an excuse to delay a report on adder status indefinitely.
- The lack of systematic records and the problem with defining the specific search area because of the non-existence of Greater London before 1965 has already been mentioned in the report.

- There is a lack of negative records in the various site datasets, preventing an estimate of relative search effort from being made for each site. However the low number of animals seen in peak emergence counts at one site at least is indicative of the genuinely low status of that population.
- The specification required that the report was focused on the four known adder sites in Greater London. During the compilation of the report, several individuals made reference to the possibility of other (small) populations of adder being present in Greater London (possibly as the result of small-scale introductions). However, no details of these populations were supplied to the report's author, and their validity and status await further investigation.

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Appendix – Summary description and management recommendations for known adder sites in Greater London

1 Introduction

The main body of the report contains the details of the individual sites as given in the 'aims' section above. Each site has been accorded a code letter (W, X, Y and Z) arbitrarily in order to maintain the confidential nature of its identity. It has also been necessary to omit any detailed description which might indirectly reveal the site location despite not explicitly naming the site.

Each site description includes the following components:

Site description including size of site

Habitat description

Historical status of adders on site

Current status of adders on site

Connectivity

Summary of current management

Threats to adder populations

Management recommendations

2 Site W

Site description

This site is an area of former gravel extractions which is now disused; the workings have succeeded to form a variety of habitats. The total size of the site is in the range of several tens of hectares, though the area currently used by adders for much of the year (that is, during hibernation and pre- and post-hibernation activities such as mating and giving birth) is about four hectares.

Habitat description

The habitats which have formed at the site include a mixture of neutral grassland and scrub, characterised by gorse and broom, denser patches of hawthorn scrub and wet woodland dominated by sallow. The topography of the site is such that there are several raised embankments, often with a southerly or easterly aspect and containing varying amounts of scrub. It is these embankments which constitute the main areas used by adders on the site,

though summer foraging does take place in the flatter and damper parts of the site. Unlike the three other adder sites in Greater London, there is no heathland found on the site at all.

Adders are not restricted specifically to heathland, but will also occupy areas of rough grass and scrub.

Historical status of adders on site

Following the site's disuse adders are believed to have colonised the wider site, either from the margins of the site, or from suitable habitat which surrounded the workings in the 1970s. There are no confirmed records of adders on the site prior to the 1980s when local residents have stated that adders were common on the site at this time. There is no reason to suggest that the population was introduced from elsewhere although this cannot be proven. Today the population is probably much smaller than it was 20 years ago partly because the site has succeeded in part to dense scrub or secondary woodland. In addition, parts of the site were converted to amenity grassland after the site was reclaimed in the late 1980s, before the presence of reptiles, including adders, was known. There are no references to quantitative data on the adder population and only one anecdotal account of the adders basking in 'large numbers' on piles of old car tyres which were abundant on the site.

The site was first surveyed in 1998, when it came to the attention of London, Essex and Hertfordshire Amphibian and Reptile Trust (LEHART) through a chance remark by the local Borough Conservation Officer. A maximum emergence count of 10 animals has not been repeated since. Instead the maximum counts seen during single visits over the last five years have varied between four and six individuals. It is therefore possible that the population

continues to decline as a consequence of scrub encroachment in key areas, for example on the banks referred to previously.

Current status

It is estimated that the total population size today is in the region of the low tens of animals, with the caveat that no systematic surveys have yet been undertaken at the site, and that encroaching scrub has made it harder to detect adders.

Connectivity

There are several potentially suitable sites for adders in the vicinity of the site itself and there is good connectivity between at least some of these. This presents a possibility that adders may be present at other nearby sites within Greater London at which they have not yet been confirmed due to a lack of recording effort. This site is considered to be unique in terms of the four known adder populations in offering the possibility that natural genetic exchange may occur between neighbouring populations. Adders have been observed on a casual basis by the owner of a nearby fishery, the managers of a country park, and on a disused quarry by a local resident and naturalist. It is therefore a survey priority to look at these sites as soon as possible to determine both whether adders are present and, if so, whether they represent occasional vagrants from the known site or distinct populations within a true metapopulation.

Current management

No formal management brief exists for the site. The restoration works mentioned earlier were designed to improve the amenity value of the site to the general public and just under half of the original site was converted into amenity grassland in the late 1980s.

The management which has since been undertaken has been aimed at maintaining paths and cutting back overhanging vegetation. To an extent, the adders have continued to exist because of this 'benign neglect' though the increasing succession of formerly more open areas is now threatening their status in the medium to long term.

In the winter of 2004/5 a plan to dump thousands of tonnes of silt into a dry valley which contained several key adder hibernacula was narrowly averted by chance when a site visit was made to write the management brief for this report. The site owner was unaware of the sensitivity of the site for adders and the significance of the valley location especially, and so there is a clear requirement at this site to improve lines of communication between site owner, managers and specialists.

Site W almost suffered the loss of hibernacula due to a lack of detailed knowledge of adder requirements at the site. Following this, awareness of adders has been raised with the owners and managers of the site improving the prospects for the species at this site

Threats

The main short term threats to the population are listed in order of importance below:

1 Lack of management for adders on site, including specifically a lack of scrub control on the main hibernation / mating / birthing banks.

2 Arson. Patches of habitat are regularly burned though as yet there has been no major fire along the key embankments; fires are usually confined to patches on the flatter parts of the site.

3 Motorbike scrambling. Although bikers use the site they tend to keep away from the embankments because of their scrubby character; this has implications for scrub control on the banks (see below).

In the longer term, loss of genetic viability may become a problem if it turns out that there is no input of new alleles from any nearby populations which may be present (see above). It may be necessary to introduce animals from nearby populations outside Greater London (provided the threats given above have been addressed) to reduce the effects of inbreeding.

Management recommendations

The key objectives of the detailed management prescription supplied with the individual site report are summarised below. **(NB Actions 1, 5, and 6 are priorities for the short term, 2, 3, and 4 are medium term recommendations)**:

1 Actions should be taken to address the recent rapid succession to dense scrub and woodland in the key area of the east and south-facing embankments. This can be achieved by removing the denser regions of hawthorn and sallow scrub whilst leaving margins of scrub to deter bikers and maintain cover in the immediate vicinity of key habitat foci, such as hibernacula.

2 Work should be undertaken in the longer term to restore some of the open grass of the flatter parts of the site which form attractive summer feeding areas for the adders. This should be achieved by a programme of winter scrub clearance.

3 Opportunities for adders should be developed on certain parts of the site which were once suitable for adders but which were then restored as amenity grassland. This could be achieved by allowing some less well-used parts to develop a matrix of rough grass and scrub.

4 A network of local contacts should be developed. These contacts should become more involved in the safeguarding, monitoring and management, of the site especially where the adders are concerned.

5 Opportunities to develop suitable habitats outside the adder site – but which are directly connected to it – should be explored. For example, by creating wide rides and glades within an area of newly planted woodland immediately to the north of the site.

6 Urgent work should be undertaken to accurately survey the distribution of adders, both on the site, and also in surrounding areas which either appear suitable or have been alleged to hold adders by local residents, managers etc.

3 Site X

Site description

This is an extensive area of neutral and acid grassland and scrub with some relict heathland as well as a variety of other habitats. These include a wetland area, some grazed and mown grassland compartments and some deciduous woodland. The whole site extends to the high tens of hectares and adders could potentially use much of this area as their population grows in the future. The area was once partly used for sand and gravel extraction, and these parts of the site were infilled with soil from various sources. This has made areas of the site more neutral in pH than formerly and therefore heather has not regenerated in these parts. However, an active programme of heathland restoration is being successfully implemented in those parts of the site where the soils remain well drained, low in nutrients and acidic.

Habitat description

The main area used by adders is currently located within a heathland compartment bordering an area of open woodland. This was the site chosen for the original introduction of adders a few years ago (see below). There are no major barriers to dispersal to other suitable blocks of habitat on site, such as the mix of acid / neutral grassland and scrub which predominates over much of the area. Hence there is good within-site connectivity of suitable blocks of habitat and adders have already been recorded at least several hundred metres from the original release site.

Historical status of adders on site

Despite an extensive literature survey and consultation with rangers and herpetologists with local knowledge, there are no records by named sources from the site. However there is an unsubstantiated reference to adders on the site published in the 1990s. A possible record from a nearby site (approximately 0.5 km away) by a local naturalist dates from the early 1990's. The extensive nature of the suitable habitat suggests that adders may have been present on the site until a presumed extinction in the twentieth century, possibly as a result of the extensive use of the area for extractions. After the cessation of these workings, the land was partly restored and subsequently received a degree of statutory protection. The habitat developed as described above.

A release of adders was undertaken in 2000. A survey undertaken prior to release failed to find evidence of even a relict population of adders though the three other native reptile species which occur in London were found to be common on the site. The current population is probably therefore derived from a single release of animals from a 'doomed' site no further than 15 km from site X.

A total of 46 animals were released, including 29 adult males, 14 adult females, several of which were gravid at the time of release, and 3 juveniles. The capture bias towards males, and the fairly low number of animals released, will necessitate consideration of restocking, perhaps in a decade, to avoid problems with inbreeding.

At the time, concern was expressed about the proposed release, mainly because of the significant fire damage which regularly affected the site. However, the decision was taken on balance to release the animals.

In the course of the next two years adders were observed to establish successfully and also to disperse away from the vicinity of the original release site, at least in summer when feeding. Unfortunately in the hot summer of 2003 there were no fewer than 10 major fires which affected several tens of hectares of the site and three dead adders were found after these events.

Current status

An emergence count of eight animals was obtained in the spring of 2004, indicating that a significant number of animals had probably survived the fires of the previous year. In addition, the combat 'dance' and courtship were observed later in the spring and an animal born in the previous year was also found in the spring of 2004.

Two male adders court a female at site X

Thus it can be said that, in spite of a lack of systematic monitoring such as that proposed in the recommendations section of the general report, adders have been recorded annually on the site since the time of their release and that breeding occurred in 2003 and mating was seen a year later. A count of eight animals represents a healthy number in the initial stages of colonisation after a release and would indicate a total population which is perhaps much higher, though there is no accepted methodology to estimate total populations from emergence counts.

In conclusion it appears that the adder population has survived the fires of 2003, and that it is dispersing on site and possibly growing, although it is not possible to say whether the population is greater or less than that of the original number of animals introduced a few years ago.

Connectivity

The potential for adders to colonise much of the site has already been referred to; with the exception of some wider paths and denser patches of woodland there is good within-site connectivity. Provided that major fires do not eradicate the population before it has a chance to spread, the number of adders on site could eventually reach a high level. It is impossible to calculate the likelihood of extinction resulting from fire damage, but every season without a major burn will make this event less likely.

Beyond the site there are several areas which could also be used as corridors, as well as permanent areas of habitat by adders. An extensive area of approximately 15 Ha of rough grass, scrub and light birch and sallow woodland exists just outside the site itself and this area should shortly be managed positively for its nature conservation interest. Beyond this area is a designated nature reserve with suitable habitat compartments for adders. In all, the amount of suitable habitat both within site X and off-site in the vicinity is considerable.

Current management

There is currently a very sympathetic management regime for adders at the site. A programme to maintain the main areas of grass and scrub-mosaic habitat is ongoing and there is also a major drive to restore the relict heathland to some of its former extent. In many ways the commitment to reptile-friendly management at the site could be viewed as an exemplar for other sites in Greater London and more widely. The restoration of heathland is not only beneficial in its own right as it constitutes a rare habitat (and is a UK Biodiversity Action Plan Priority Habitat) in Greater London, but it will also favour adders. However it should be mentioned that the adder, unlike the rarer smooth snake *Coronella austriaca*, for example, is not restricted to heathland and that the species should also spread throughout the rough grass and scrub habitats with equal success.

A small part of the site is currently mown to maintain its character as a summer-flowering meadow and this is potentially a negative aspect of reserve management as adders and other reptiles may be killed or injured. Possible solutions to this problem are listed in the site management brief.

This is the only site in London where the possible occurrence of adders is mentioned in the on-site interpretation. This decision has been taken as a consequence of the recent reinstatement of the population and therefore the possible risk of litigation should a member of the public be bitten. It could be argued that people could not reasonably be expected to be alert to the possibility of adder presence unlike in other places where adders have a long history of occurrence.

Threats

In the short term, the major risk to the population is undoubtedly that it may yet be eliminated by a series of large fires. The population is probably not sufficiently dispersed to have made this impossible. However the major arson events of 2003 failed to render the adders extinct in spite of several dead animals being found. It will inevitably have reduced the degree of heterozygosity in the population and perhaps hastened the appearance of a second longer term threat, namely reduced genetic viability.

In the medium term, the lack of neighbouring populations will necessitate the planning of further ‘top-ups’ of animals preferably from sites not far from site X, but not the same as the original donor population’s place of origin. In this way the local genetic character of the adders would be maintained but the risk of bringing in more of the same alleles of the original donor population would be reduced. The donor population itself may have lacked initial heterozygosity, rendering inbreeding effects more likely in the introduced population, in the medium term.

Direct persecution does not appear to be a threat to the population at present, in spite of the on-site interpretation mentioned earlier. This is thought to be due, mainly, to the large size of the site, with the core release site relatively far from well-used areas.

Management recommendations

The actions which are proposed for X can be summarised as a continuation of the generally sympathetic approach which is currently employed. Actions 1, 4, and 5 have a priority over the medium term (but still important) actions 2 and 3.

1 The brief recommends that the efforts to restore the relict heathland are continued wherever feasible on the site.

2 The planned actions to maintain the large areas of rough grass and scrub-mosaic should be undertaken through a five yearly flail of each compartment. This should be carried out during the winter when animals are hibernating. Key features such as hibernacula are to be exempt from this broad approach, and brush-cutting and other more sensitive approaches used instead. It will also be necessary to survey for new hibernacula as the site becomes more widely used by adders over the coming years.

3 Areas that are suitable for adders outside the site, but which have good connectivity, should be managed on the assumption that they will be colonised by the adder population as it expands over the next several years; in any case, these sites currently contain good numbers of the other species of widespread reptile and these would benefit immediately from this approach.

4 Alternative management strategies are suggested for areas that are cut for summer hay, such as low intensity grazing or cutting later in the season after hibernation has begun.

5 A more systematic monitoring methodology is proposed, for example to include four counts each spring undertaken in optimal conditions, to allow a comparison on relative population status year on year. In addition, the wider area of the site and its connecting habitats should be subject to a summer survey, to determine the extent of adder dispersal on and off-site. Finally, two early autumn surveys should be made to establish the presence of gravid females and / or newborns to prove breeding for that year and to allow some relative estimate of breeding success.

4 Site Y

Site description

The site comprises a flattish area of acid grassland, with a much reduced area of relict heath in the northern section of the site. The whole area extends in size to the low tens of hectares, though the area currently utilised by the adders is barely one hectare in extent (see below). It is surrounded mainly by deciduous woodland that is both extensive in area and of considerable significance in its nature conservation value. The acid grassland area was kept largely free of invading scrub and secondary woodland through historical use as common land for grazing. This continued until the middle of the twentieth century, when a relaxation of the grazing pressure allowed a rapid colonisation of scrub and woodland from the

immediate surroundings. A programme of low intensity grazing and mechanised- and hand-clearance of scrub has restored some of the previously open character of the area over the past few decades.

Site Y - core area complete with one of only a few adders (in the foreground) which make up the population

Habitat description

The area currently used by the adders is restricted to approximately one hectare in size, comprising one small scrubby field close to the main site's car park. Thus far a combination of good fortune and difficult casual access to the field has protected the habitat from significant damage. However, there was a major fire in the field in the mid 1990s.

Historical status of adders on site

In common with the other London adder sites, the historical records of adder are few and equivocal. There is anecdotal evidence of adders being killed nearby by US military personnel shortly after the Second World War, and there is a reliable record from the mid 1970s of adders being found on the site itself. There are no quantitative data available until records from the 1980s onwards which then put the population consistently at fewer than 10 animals, which became individually recognisable to those who regularly surveyed the area. In addition, there is evidence that their present day limited distribution was almost as restricted 20 years ago. Evidence of mating and newborn animals is lacking in spite of the survey efforts within this small area.

By the early 1990s the population had fallen to three large females which presumably diverted their energies into growth rather than reproductive effort. This phenomenon has been reported in other senescing adder populations (Phelps 2004). These females disappeared over a period of several years in the mid 1990s but a different female and eight newborn young were released on the site around this time. It is therefore highly likely that the present population is derived from these animals.

The very small population size means there is a high likelihood of significant problems associated with lack of genetic variability in the medium term, assuming that the low population viability does not render the population extinct before this (see below).

From the late 1990s onwards the maximum numbers of animals seen during annual emergence counts has been consistently between four and six.

A record of a mating pair of adders exists from 2002, but at the time of writing, no gravid females or newborns have been seen on site.

Current status

In spite of some over-management of the scrub field in the winter of 2003/4, a count of four animals including one dead male (probably the result of natural predation) was made in the autumn of 2004. Therefore the population would appear to be remaining at a very low but fairly stable level as it has for much of the past 20 years. The present population is believed to contain at least one adult female and several males.

Connectivity

The restricted distribution of adders to one small scrub field (the 'core site') within a larger area of mixed acid grass and scrub, relict heath and woodland, is due to a number of factors. First, the very small population size reduces competition and hence the need to disperse far from the hibernacula which are sited in the field. Numerous prey items prevent the adders from approaching the carrying capacity even in this small area, so a lack of prey is not an incentive to venture further afield. The relative lack of human and canine disturbance – in contrast to much of the rest of the site – is an incentive to stay in the core site. Males in search of a mate in the spring may return to the core site after trying and failing to find one further away. Finally, there are barriers – such as wide footpaths and short grass areas – which lower the connectivity on-site to other areas.

Away from the site itself, the surrounding habitat is mainly ancient woodland of high nature conservation value, and a large field which is cut for a summer hay crop. Beyond this vicinity there is a large lake, residential development and golf courses which do not contain habitat suitable for adders.

Thus the current opportunities for dispersal of adders on-site and to areas off-site are considered to be fairly poor, especially given the very low numbers of animals currently present. However a possible strategy for enhancing a large area of habitat and improving connectivity to this proposed area for habitat restoration is presented in the management brief for the site (see below).

Current management

The wider area which comprises the ancient woodland is managed with the emphasis on maintaining this valuable habitat. Opportunities for the creation of 'reptile friendly' habitat in these areas are strictly limited. In the main site itself, there has been a reduction of heather in the north of the site over the past decade, which may be due to overgrazing or possibly trampling by people or nutrient enrichment subsequent to a fire which occurred there in the mid 1990s. The grazing regime prevents the establishment of denser scrub, especially in the north of the site. In the south, the scrub is flailed in certain areas to encourage a diverse sward which includes several species of orchid.

The precise needs of the adder field are well understood by the local volunteer conservation group who work closely with the site managers to provide labour and advice on management.

Clearly at this site the requirements of adders must be accommodated within a wide range of other conservation demands for other species and habitats. This has not always been of benefit to the adders and it illustrates an important point, namely that site protection alone will not necessarily guarantee or enhance the status of adders.

Threats

The adder population at site Y is the most threatened of all the four Greater London sites. This is because its small size makes its viability – both genetic and in terms of numbers of individuals – poor in the medium term and worse still in the long term. It is possible that animals will survive as they have done in the past in the scrub field (the core site) but with no evidence of breeding the prognosis for survival is low. This is because with such a small population, chance or natural events which may happen to one or two individuals, will affect the whole population. The lack of any proven breeding in more than 20 years also bodes ill for the medium term survival of the population.

Even if a successful breeding were to occur, this event would still not eliminate the possibility of chance factors operating as a single litter would not increase the population status adequately.

The genetic viability of the population is extremely poor, given that at most only two females may be present and that many, if not all, the animals are siblings. However, if individuals represent survivors of separate releases onto the site, which is not known, then there may be greater genetic variation between this handful of individuals than expected in most relict populations. In any case, within a generation or two this would be offset by virtue of the unavoidable interbreeding of related individuals. Hence, if by some remote chance the population survived and recruited in the next decade, inbreeding effects such as reduced fertility, viability of offspring and congenital defects could all be expected to render the population vulnerable to extinction.

Aside from the inherent problems relating to the very small population of animals, its restricted distribution and proximity to large numbers of people and their dogs, make it entirely plausible that the population could be exterminated through persecution or through arson.

Fortunately, due to the awareness of the managers of the site and the experience of the local nature conservation group, a lack of, or unsympathetic, management is unlikely to impact on the adders in the future.

Management recommendations

The general management strategy for site Y is summarised as follows:

- Given the historical pattern of introduction and subsequent decline of animals at the site, and the lack of immediately suitable habitat close to the scrub field core site, it is recommended that further restocking is undertaken in the short term only if a commitment is made to increase the amount of suitable habitat according to the recommendation made below. If this commitment is made, then a programme involving the release of animals over the next several years should be undertaken.
- It is recommended that an area of recently succeeded secondary woodland comprising mainly birch and young oak (in contrast with the ancient woodland compartments), is cleared back to its original rough grass, bracken and heather character, in a compartment a few hundred metres from the core site. This could provide several hectares at least of suitable habitat for reptile species including adders if they can disperse this distance. As this compartment is not ancient woodland, its loss would not conflict with the stated management aims of the existing site brief which relate to this particular habitat.
- If the commitment to this work were to be made, then the addition of new adders which would bring 'novel' alleles to the existing population should be carried out as soon as possible. In the meantime, if the current population were to go extinct, then new adders could still be released, this time as a re-introduction rather than as a 'top-up' of an existing population.
- If no commitment can be made to increase the adder habitat, the restricted size of area currently available makes the extinction of the population likely and no further 'top-up' should be made. The suggested restoration of recently succeeded secondary woodland to former open acid grass / heath matrix would be a positive conservation measure generally and also could be undertaken in a cost-effective and phased programme (by compartment) over the next few years.

The details of the brief are grouped under the heading of 'macromanagement' to restore the secondary woodland compartment mentioned above, and to develop a corridor for dispersal from the core site to this newly restored area. This micromanagement must take place in parallel with 'micromanagement' of the existing core site.

The macromanagement recommendations are to:

- Restore the former open grass and heath compartment to the north of the core site by felling recent secondary woodland (mainly young oak and birch).
- Improve connectivity between this area and the core site by allowing the margin of the summer hay cut field to 'scrub up' to a width of between 10 and 15 m, to create a corridor for dispersal.

- Assess the possibility of restoring the relict heath in the northern section of the site in conjunction with the Heathland Habitat Action Plan for London.

The micromanagement of the core adder site comprises various actions to maintain the grass / scrub matrix without over-managing, for example by flailing. Instead, a regular programme of winter brush cutting and clearance of saplings should be undertaken.

The expertise of the local natural history society should continue to be used in the implementation of these management recommendations.

Actions to source several new animals for 'top-up' purposes should be taken if the commitment to restore secondary woodland to more open habitat is made. This would include seeking the necessary permissions to release animals and to take them from the nearest county which could support such an action (probably Surrey).

5 Site Z

Site description

The area occupied by adders currently comprises only a few hectares of a larger block of habitat which originally contained much more suitable habitat (for example an acid grass / scrub mosaic and heathland) than it does today. The last several decades in particular have seen the area succeed to secondary woodland, mainly young oak, birch and holly. The total area of the site is in the high tens of hectares. The entire site receives protection and is managed for its nature conservation interest.

Habitat description

The main adder site is bounded by several busy roads, and comprises an area of relict heathland. This is the only site in Greater London where the adder population is more or less restricted to this kind of habitat, one that is dominated by ling *Calluna vulgaris*. This heathland has persisted partly because of the exposed gravels on which it is found, whose low nutrient levels have prevented more vigorous species from out-competing the heather.

The immediate vicinity of the core site used by adders consists of secondary woodland of very recent origin, in some cases, 20 years of age or less. There are still open glades in which some relict patches of rough grass, scrub and heather hint at the former open nature of the entire compartment.

Historical status of adders on site

The fact that the area was once a much larger expanse of rough grass, scrub and heathland, suggests that adders were probably more widespread in the area than they are at present. However, in common with the other Greater London sites, there are few historical records of adder in the area. Anecdotal accounts refer to adders approximately 40 years ago being found roughly 1 km to the west of the current site and there is a record from the early 1980s of an adder at the location in which adders are currently found.

During the 1980s the habitat in the immediate vicinity of the core adder site became less suitable and the population status presumably became lower as a consequence of the

contraction in range. In the mid 1980s a herpetologist conducted some management work in the core site to safeguard the relict population and a pair of gravid female adders was introduced to this area from a doomed site in Dorset. The implications of this release in terms of the genetic viability of the population today and in the future are discussed below.

From the mid 1980s the site has been monitored in most years by several herpetologists, and data on emergence counts, proof of breeding and distribution – at and away from the core site – have been collected. However, in common with the other Greater London sites there has been no systematic recording effort year on year.

Nevertheless, it can be concluded that within the small area occupied by the adders, the population density seemed to be as high as that found anywhere in the country. This inference is drawn on the basis of the numbers of animals observed during the spring emergence counts which has regularly been between 12 and 20 animals over the last 15 years. Breeding success has been recorded in almost all years since the latter part of the 1980s as well.

Adders have also been seen in the immediate vicinity of the heathland core compartment in the open glades of the secondary woodland. The adders mainly use this area as a summer feeding habitat, though at least one hibernaculum has been recorded in a glade containing a small patch of relict heathland.

Current status

The density of adders at site Z is considered to be as high as that of any site in the country, albeit within a small area. This deduction is based on the survey experience of several herpetologists, as there is no standard methodology for quantifying reptile abundance. Similarly, there is no reliable method for estimating total population size based on data obtained during emergence counts in the spring. However, a consensus amongst those with experience of the site is that the total population could be in excess of 20 adults with an approximately even sex ratio.

Whether or not this density is a genuine reflection of the high carrying capacity of the area and its general suitability for adders, or whether it represents a transient state as adders have been drawn from the less suitable areas of newly established secondary woodland is an important consideration. The fact that the population has a good age structure, that the habitat is currently in a near-optimal state for adders and that the woodland has been present for 20 years all suggest that the former explanation is more likely.

Connectivity

The core area used by adders at site Z is managed positively for adders. However the current opportunities for them to disperse from the area and to colonise the wider compartment, and especially to cross the busy roads mentioned previously, are poor.

The compartment which contains the core site has a variety of paths and rides which connect with the small patches of remnant open habitat present in the secondary woodland. Adders do use these rides as corridors for dispersal, though infrequently and mainly in the summer when foraging outside the core site. The small patches of open habitat would not attract many adders in any case.

More importantly, adders have thus far been unable to establish a population in a compartment which lies on the other side of one of the roads. Currently there is some suitable habitat, including an area of heathland which is approximately one hectare in size. In the longer term adders should be moved to this area to reduce the risk of a chance event such as a major fire from eradicating the entire population of site Z, but only if certain conditions are met (see below).

Current management

The core site is currently managed sympathetically for its adders. The management is undertaken through discussion with a local professional herpetologist who has a long-standing involvement in the management and monitoring of the site.

The management aims to maintain the heathland which currently exists in the core site and to prevent encroachment especially in the northern section of the site from gorse and oak scrub.

There has been recent work to clear some of the secondary woodland surrounding the core site and in particular to enlarge the relict patches of open grass / scrub and heathland and to widen some of the rides and paths to improve connectivity within the compartment.

In the neighbouring compartment which is separated from the core site by one of the roads, the heathland patch is being managed and extended through the felling of secondary woodland so that it might eventually attain an area of up to 2 ha, that is, not much less than the area currently occupied by adders at site Z. This restoration should be complete within the next 5 to 10 years.

In the long term, there is a proposal to extend the heathland / grass and scrub habitat in suitable areas throughout the entire site, but this is dependent on securing funding and the support of the local community given the amount of tree-felling which will be required to restore its former open character.

Threats

The main risk to the continuing health of the population at site Z is from damage by fire. No major fire has been recorded on the site over the past two decades. However, the proximity of traffic to the site makes the danger of at least a partial burn-out caused by a discarded cigarette a likely event at some point in the future. The localised nature of the adder population makes it vulnerable to such a chance event.

In spite of the presence of roads, the direct human pressure on the site is low; dog walkers make relatively infrequent use of the paths which cross the site and, because it is screened from the road by stands of gorse, there is little to attract casual visitors to the site.

Deliberate arson has not, as yet, been recorded at the site.

The core area is likely to continue to receive sympathetic management for the foreseeable future, so a lack of, or unsympathetic, management is not thought to represent a threat in the core of site Z. However in the wider area around the core site, the continuing development of secondary woodland will further restrict adders to the core site if unchecked.

In the medium to long term, the danger of inbreeding may become a factor which threatens the genetic viability of the population. This is dependent on the provenance of the population. For example, if, as thought most likely, the population is descended partly from a relict population indigenous to the site, and partly from the two gravid Dorset females, then this will have generated an unexpected degree of heterozygosity, which could be expected to persist for several generations at least. The effect of deliberately introducing adders into a senescing and inbred population is known to increase the recruitment and population status (Madsen and others 1999, 2004). The release of animals from as far afield as Dorset may therefore not only have increased the population viability of the adders in the mid 1980s but may also have served to raise its genetic viability as well.

To date there has been no genetic analysis of this (or any other) Greater London adder population, so this hypothesis cannot be evaluated directly. As yet there has been no evidence of effects such as reduced breeding effort, recruitment, a biased population structure or genetic defects observed during the various observations which have been made over the past two decades. In fact the high density of animals and the presence of good numbers of snakes of all ages suggests that there is no current evidence of reduced genetic viability at site Z.

Management recommendations

The aim of the recommendations is to secure the core site mainly through a continuation of the positive regime currently employed and also to extend the availability of suitable habitat in the vicinity. Much of the habitat restoration will also help to regenerate heathland, which is itself a rare habitat in Greater London and the subject of its own Action Plan.

At the core site the following actions are recommended:

- The dense stand of young oak and birch scrub in the northern section should be felled by hand during the winter; stumps should be treated in the growing season to prevent regeneration.
- Encroaching gorse should also be cut back to expose as much ground as possible and cut stumps again treated in the growing season.
- Firebreaks should be extended on site and especially along the road-side of the core site to reduce the fire risk.
- The gorse screen along the road-side of the site should be thinned but not removed so there is still a visual barrier from the road.

In the recently succeeded woodland around the core site the following actions are proposed:

- Extend the largest compartment which contains some relict heath (and the single confirmed adder hibernaculum which is not on the core site) by cutting back into the gorse / birch / young oak surroundings, and cutting and treating stumps as above. This will create another area where some adders may become permanent residents away from the core site, thereby allowing the population to disperse more widely.

- Improve the connectivity between this compartment and the core site by widening various paths and rides between the areas and allowing the edges to scrub up to form a graded ecotone.

Across the road from the core site, the area of relict heathland is the subject of restoration by further felling of young oak and birch woodland. The aim is to restore an area of heathland equal to that of the current core adder site.

It is a recommendation of the brief that if the area above does develop into suitable habitat, then a translocation of some animals from the core site should be made across the road to this second site, to allow the population status of the adders to increase and also to reduce chance events causing the extinction of the currently localised population. However, this should only be attempted if the donor population is robust enough to withstand the removal of some animals for this purpose.

In the longer term the wider area should be the subject of a major management programme to restore the area to the more open character which it had only a few decades previously.

ENGLISH NATURE

Research Information Note

English Nature Research Reports, No. 666

Conservation status of the adder *Vipera berus* in Greater London

Report Author: Will Atkins, London, Essex and Hertfordshire Amphibian and Reptile Trust, 5 Roughdown Villas Road, Hemel Hempstead, Hertfordshire, HP3 OAX Date: Oct 2005

Keywords: biodiversity, adder, reptiles, Greater London

Introduction

The adder *Vipera berus* has suffered drastic declines in Greater London during the twentieth century, and is currently confirmed from four sites. Much of the open habitat adders need has been lost and the remaining habitats are highly fragmented, resulting in isolation and viability issues for the remaining populations.

In 2004 LEHART was commissioned by English Nature as lead for the London Biodiversity Partnership's Reptiles Action Plan to undertake a two part project. The aim was to produce an evaluation of the status of adder in Greater London to inform future conservation action and to produce management briefs to enhance the status of confirmed populations in Greater London.

What was done

The management briefs were written in consultation with local herpetologists and site managers to inform management action and enhance potential adder habitat. Management recommendations were given for the short, medium and long-term in order of priority. An assessment was made of the potential for suitable adder habitat beyond site boundaries. Consideration was made to population viability, as much as there for information available to look at this.

The briefs have been used inform an evaluation of the current status of adder. This was compiled following a literature review, interviews with site managers, local conservationists and herpetologists to produce a current day assessment, comparative to the historic distribution adders in and around Greater London. A list of recommendations for further work has been included within the report.

Continued……

Results and conclusions

The status of adder within Greater London is widespread, but rare given that it is restricted to only four widely dispersed sites. However, there are areas of London which are highlighted as a priority for further survey work where there may be further undiscovered populations.

At each site the population size is either low or very low. In the four known populations, medium to long-term (i.e. ten years from now and beyond) inbreeding is considered likely without artificial input of new animals, because of relatively low population size and lack of genetic exchange between populations.

Systematic monitoring of populations is required as well as action to increase area able to support adders. There is considerable potential to enhance the potential habitat for adders and increase status at all four known sites. There may also be opportunities for colonization beyond existing boundaries. Further surveys are required in several areas in London to identify any unidentified populations, for example that may be on land in private ownership.

English Nature's viewpoint

We welcome this report which offers a best guess assessment of the conservation status of adders in London today. In London, the priority for adders is to ensure the future of the few remaining populations is secure and deliver the recommendations within the briefs, as well as continuing to survey potential areas where as yet undiscovered populations may be found.

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Peter Wakely/English Nature 17,396
Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
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