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The Vanishing Viper 2025: Themes from a meeting to discuss better conservation for *Vipera berus*, with emphasis on landscape-level approaches

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ABSTRACT – In September 2025, the fourth Vanishing Viper conference was held to maintain focus on the conservation of the northern viper or adder *Vipera berus*, a species subject to significant population declines and local extirpations in Britain. Compared to previous conferences in the series, Vanishing Viper 2025 considered a wider range of topics including: genomics, process-based modelling, habitat management, translocations, the role of volunteer work, and included the unveiling by Amphibian and Reptile Conservation Trust of a national strategy document that offers guidance on conservation translocations for viper recovery. The discussions following these many topics were wide-ranging and included some cautions that our current understanding of viper genetics is still inadequate to support the safe use of genetic rescue of populations considered to be inbred. There were also two workshops, one examining what defines disturbance for vipers and the other considering the role and challenges of conservation translocations, these are both presented in more detail in Supplementary Material. The rise in conservation actions for *V. berus* at the landscape-level gives cause for some optimism that conservation outcomes will be increasingly successful.

BACKGROUND

The Vanishing Viper (VV) series of conferences are a response to the evidence of declining populations of northern vipers or adders *Vipera berus* across Britain (Baker et al., 2004; Gleed-Owen & Langham, 2012; Gardner et al., 2019). These declines are reflected in the revised IUCN Red List status of *V. berus* to Near Threatened in Wales and Scotland and Vulnerable in England (Foster et al., 2021). VV conferences have brought together specialists to discuss current conservation priorities for Britain's only venomous snake in the light of the latest scientific information and the viewers of land managers.

In November 2011, the Kent Reptile and Amphibian Group (KRAG) organised the first national conservation meeting focused on *V. berus*, which also included participants from other European countries. This meeting passed a unanimous motion "The adder is in more urgent need of new conservation efforts than any other reptile or amphibian species in Britain". This was followed in 2016 by a second national meeting in Somerset, 'Vanishing Viper: Priorities for viper conservation', organised by the Reptile and Amphibian Group of Somerset (RAGS) with Amphibian and Reptile Groups of the UK (ARG UK) and Amphibian and Reptile Conservation Trust (ARC Trust); and in 2019 by a third meeting, 'Vanishing Viper 2019: A European approach to developing an adder conservation strategy', at the University of Bangor, once again organised by ARG UK, ARC Trust and the North Wales Amphibian and Reptile Group (NWARG) with numerous other European participants.

The latest in the series, Vanishing Viper 2025, was held on 6 & 7 September 2025 in partnership with ARG UK, the University of Chester and ARC Trust. It also attracted a broad delegate group with 120 attendees from the UK and further afield, including representatives from The Netherlands, Hungary and Belgium. The key themes of the conference are explored below.

Novel technologies for assessing viper presence/usage of landscapes

The benefits of radio tracking were considered by Nigel Hand (Central Ecology/ARG UK). This can be done by taping small, light-weight radio tags with a whisker aerial to a snake's lower body (Fig. 1); they will be detached later when the snake sloughs. The snakes appear unaffected by the tag, and have been observed feeding, in combat and mating with the tag attached. Typically, tags are applied after the first spring slough to capture movements during the mating

Figure 1. Female *Vipera berus* with a light-weight radio tag and whisker aerial attached dorsally

season, or in late August/September to monitor the snakes as they forage prior to hibernation. The vipers are then tracked using a hand-held aerial and receiver. This gives an understanding of differences in range and movement between individual vipers in different populations, and between males and females. This information is particularly useful for land managers, as it can help them to understand which landscape features are of greatest importance to these vipers, what features constitute a barrier to movement and where better connectivity could be created. Furthermore, tracking can reveal how translocated animals respond to being moved, answering some of the questions about whether translocated animals become disorientated and are more prone to predation. This information will be of especial importance for future conservation translocations, which were discussed in the second workshop of the conference (see the Conservation Translocations section).

In quite a different approach to the understanding of viper use of the landscape, Emma Gardner of the UK Centre for Ecology and Hydrology (UKCEH) presented the add4pop process-based model (Fig. 2). This identifies areas of high habitat suitability and predicts the size of viper populations across landscapes based on the availability of foraging and hibernation resources. Its development was informed by expert opinions from ecologists across Britain and northern Europe. Adapted from the rept4pop model, add4pop was created initially to inform volunteer survey effort for the Cannock Chase Adder Conservation project in Staffordshire (Gardner et al., 2024). This project was later revisited by Richard Harris (Land Management Officer, Cannock Chase National Landscape Partnership - CCNLP), who provided a land manager's perspective of the project, and discussed how the add4pop process-based model was used by the CCNLP to assess landscape suitability for vipers, to highlight areas where they were expected to be flourishing, or conversely, were potentially absent. ARG UK and UKCEH also worked with local land managers applying the model to help identify areas of potential connectivity for creating green corridors for vipers, e.g. by thinning dense woodland cover, or improving the complexity of the vegetative structure. Subsequent presentations by John Dickson (RAGS) and Tom Wells (Natural England - NE) also demonstrated how the model is being used to identify viper habitats in the landscapes of Somerset, Norfolk and Suffolk, as the basis for developing a landscape-based viper conservation strategy in these counties.

Genomics as a contribution to viper conservation

Many British and continental European populations of *V. berus* now comprise small and potentially genetically isolated populations, which have become fragmented by human activities. For example, by creating barriers to movement such as busy roads, agricultural land with low vegetative complexity and urbanisation. These genetically isolated populations are at increased risk of inbreeding, reduced fitness and ultimately, localised extinctions.

Tom Wells (NE) introduced a new landscape-scale, partnership population genomics project, between NE, Bangor University and Newcastle University, with support from land managers from the Nidderdale National Landscape, North Pennines National Landscape 'Adders Up', project and the Norfolk and Suffolk Adder Working Group, funded

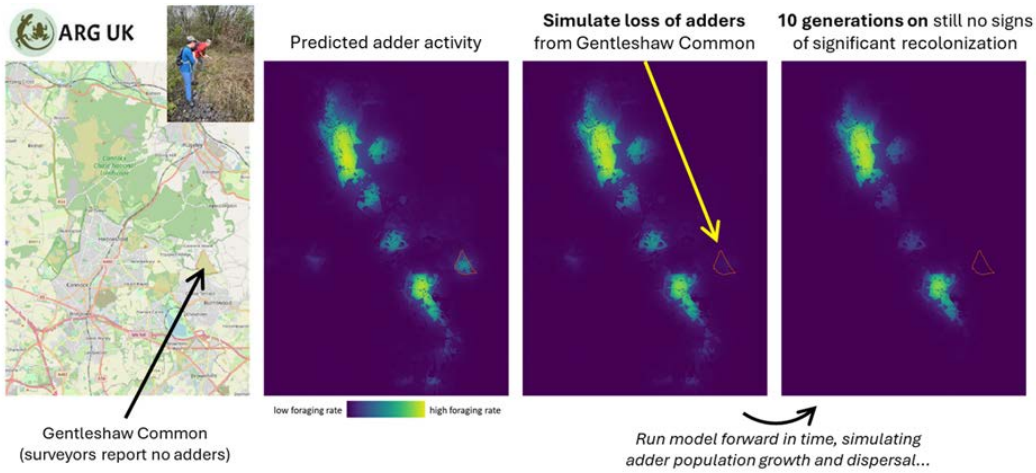

Figure 2. Add4pop model outputs illustrating one of the many applications for the add4pop model. In this case, testing volunteer surveyors' theory that, after complete extirpation of its resident vipers, Gentleshaw Common in Staffordshire, has too many physical barriers (including major roads, development and agricultural land) between its nearest viper populations to allow for recolonisation. Cannock landscape map from OpenStreetMap and photo of Nottinghamshire Amphibian and Reptile Group surveyors.

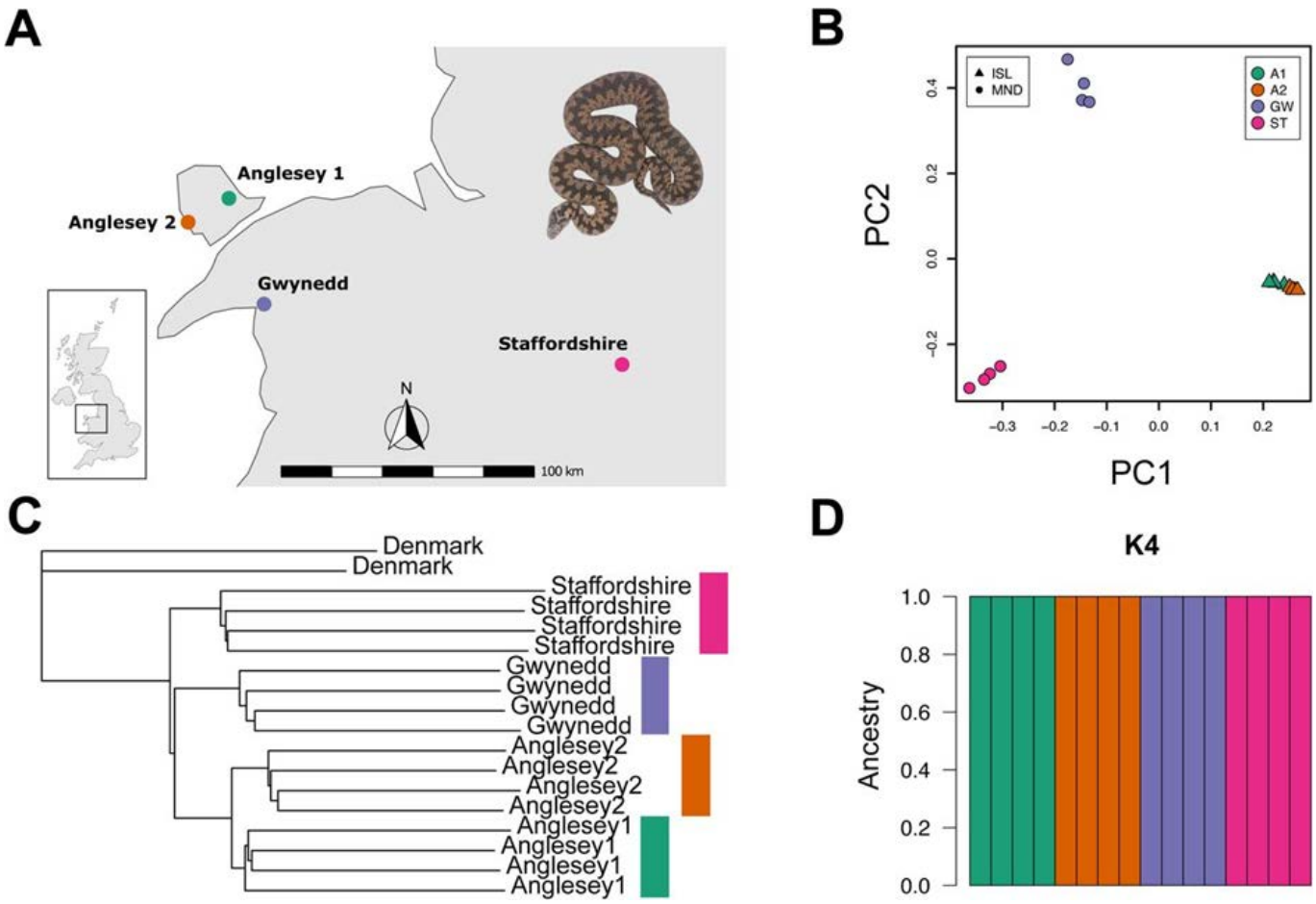

Figure 3. Preliminary results from a whole genome analysis of genetic diversity in populations of vipers from North West Wales and Staffordshire - **A.** Four vipers were sampled from each of the four populations from the island of Anglesey (Anglesey 1, A1; Anglesey 2, A2), mainland Wales (Gwynedd, GW) and England (Staffordshire, ST), **B.** Principal component analysis performed on over 7.6 million variable sites obtained from the four viper populations. Each point represents a different individual. Principal component 1 (PC1) explains 11.4% of the total variation, while principal component 2 (PC2) explains 10.1% of the total variation. Individuals cluster into three groups corresponding to the Staffordshire, Gwynedd and Anglesey 1 and 2 populations, **C.** Whole genome NJ tree of the four viper populations. Genome sequences from two Danish vipers were used to root the tree. The analysis reveals four distinct lineages corresponding to the four sampled populations. The four different colours represent: green for Anglesey 1, orange for Anglesey 2, purple for Gwynedd and fuchsia for Staffordshire. **D.** Population structure analysis performed using NGSadmix (K = 4) supports four distinct populations with no evidence of recent admixture. Each bar of the plot quantifies the ancestry proportion of each sampled genome to the respective populations. The four different colours represent the four sampled populations: green for Anglesey 1, orange for Anglesey 2, purple for Gwynedd and fuchsia for Staffordshire (diagram taken from Pozzi et al., 2023).

by the Natural England Species Recovery Programme. This research builds on the genetic analysis presented at VV 2019 (Ball et al., 2020) and will use whole-genome sequencing to assess the genetic health and connectivity of isolated viper populations facing decline. Then, Ben Owens (U. of Bangor) showed that by using low to medium coverage genomics, it is possible to identify areas of reduced gene flow and compare the effects of natural vs anthropogenic barriers between viper populations in North West Wales, including on the island of Anglesey (Fig. 3). The group also assessed the genetic health of viper populations by measuring genome-wide diversity and identifying runs of homozygosity which can be used to measure the level of inbreeding within populations. The results from this analysis will inform future conservation efforts and guide methods from a genomic perspective not only for *V. berus* in Britain but also reptile populations globally as human encroachment continues (Owens et al., 2025; Pozzi, 2023). Henry Crisp (U. of Bangor) showed how whole genome sequencing had been used to evaluate the genetic health of *V. berus* across Wales by testing sloughed skins from different viper populations in partnership with Natur am Byth and ARC Trust. Using low coverage whole genome sequencing, the genomes of 70 individuals were analysed for potential inbreeding and other signs of poor genetic health, that could signal potential issues in the future (including heterozygosity, low genetic diversity and runs of homozygosity).

The analysis indicated that the genetic health of vipers across Wales is generally poor compared with other populations in Europe, for example those in Romania. The level of heterozygosity differed slightly between populations from North to South Wales, with some populations showing markers for low genetic health and indicators of recent inbreeding (long runs of homozygosity). Based on this evidence, the group aim to improve understanding of the main issues faced by different viper populations and the

opportunities for translocation and genetic rescue. Genomic methods can also provide us with a tool to identify priority areas of reduced gene flow, which can in turn support the management and conservation of isolated populations across fragmented landscapes.

The genomics of *V. berus* is still at an early stage, and much of the understanding of the long-term impact of introducing individuals from other populations into an inbred population is based on experience in Sweden (Madsen et al., 1999) and summarised in Julian & Hodges (2019). The session discussion included questions about the relationship between genomic and physiological fitness and genetic heterogeneity. Two specific concerns relating to the introduction of individuals from other sites in order to introduce genetic diversity were raised, the potential for unintended disruption of local adaptations to specific habitat and behaviours (outbreeding depression), and the unintended introduction of deleterious recessive alleles which are likely to be at a higher frequency in large populations with high heterozygosity. There has to be balance and understanding from a genomic perspective between sourcing donor animals from populations which may be inbred, and introducing vipers from populations with high heterozygosity.

Understanding and managing the impacts of public disturbance

Analysis of the long running national 'Make the Adder Count' dataset reveals that many reptile surveyors consider public pressure to be the most important negative factor on viper conservation status (Gardner et al., 2019). However, the survey did not fully elucidate what public pressure constitutes. Rebecca Turner (UKCEH) presented her re-analysis of the 'Make the Adder Count' data, which compared observed counts of vipers against modelled predictions of relative abundance from the add4pop model. The findings suggest that public pressure can account for some situations where the correlation between observed counts and modelled predictions break down. This potentially provides the first quantitative evidence that public pressure may be limiting viper populations at some sites, but the effect was also confounded by other factors (Turner, 2025).

Figure 4. Adder advocate badge awarded to Cubs and Scouts from the 1st Stanhope Scouts, for participating in a viper-themed programme, learning about viper ecology and folklore, and developing outreach materials

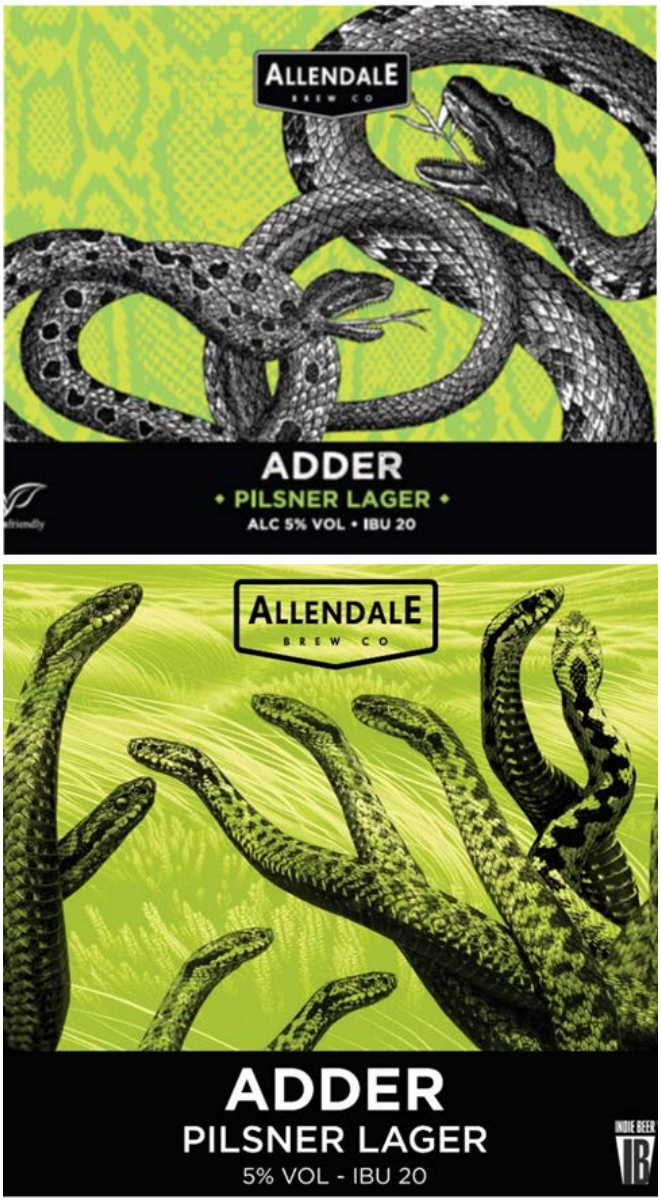

Figure 5. Changing Allendale's Adder Pilsner Lager label from an aggressive (top) to a more biologically accurate image (bottom)

Many of the presentations referenced education and outreach as a way of redressing some of the widespread public misunderstandings of the northern viper. Given that this is the only venomous species in Britain, there is a long history of persecution, and even today the media often use fear of this timid animal to create viral 'click bait' type articles (Kelly et al., 2023). Many land managers are actively trying to improve the viper's image and lessen public conflict and fear, particularly among dog owners. This is being achieved by promoting safe practices including keeping dogs under close

control, through signage, leaflets and social media. Other approaches were discussed in subsequent presentations; Henry Barrett, North Pennines National Landscape Team (NPNLT) discussed an innovative outreach programme developed during the North Pennines 'Adders Up' project, including painting adder stones, developing games and the creation of an 'adder advocate' badge for a local scout troop (Fig. 4). These special badges were awarded to Cubs and Scouts as part of an ongoing collaboration between the North Pennines National Landscape and the Stanhope 1st Scouts. The syllabus for this badge included learning about the conservation status, ecology, folklore and common misconceptions surrounding the viper through a programme of games and activities. The programme also included visits to a viper hibernaculum, constructed by a local landowner in collaboration with the North Pennines National Landscape adder team. Another cultural output from the Adders Up was project was working alongside the local Allendale Brew Co., Adder Pilsner Lager, to transform the beer labels from an emotive presentation of aggressive striking snakes to a more biologically accurate representation of male vipers in combat (Fig. 5).

Matt Cooke from ARC Trust, reminded us of the Welsh Government funded 'Adders are Amazing!' partnership project from Pembrokeshire (Julian & Hodges, 2019; Kelly et al., 2023). ARC Trust have continued to expand a blended art and science educational programme with their Natur Am Byth funded project, running viper outreach sessions with the wider public in South Wales.

The challenges surrounding public disturbance were further explored in the first workshop of the conference, led by Kevin Palmer (University of Chester) and Becky Turner (UKCEH), 'Defining disturbance to vipers, its impacts, and considerations for land management', which aimed to:

- Clarify various definitions of disturbance;
- Evaluate the impact of disturbance at individual and population scales; and
- Suggest how disturbance impacts may be avoided and mitigated through landscape-scale approaches to management.

This was a whole conference workshop, where 120 delegates were divided into 12 groups, each comprising 8–10 individuals. Each group was allocated one of three different themes to discuss - 1) Types of disturbance, 2) Impacts resulting from disturbance, and 3) Mitigation and management of disturbance and its impacts. For full details of this workshop's outcomes see Supplementary Material 1.

The first theme focussed on identifying the types of public pressure that could cause disturbance to vipers; exploring delegates' own viper disturbance experiences; and asking whether we should differentiate between the impacts of incidental or deliberate disturbance.

Delegates agreed that disturbance should be broadly defined as anything that has the potential to alter species-typical (normal) behaviour, albeit this should be further refined to differentiate between direct and indirect disturbance, incidental and purposeful disturbance, and chronic and acute disturbance, all of which are likely to have a different effect. A broad range of types and sources of potential disturbance to vipers were identified, from both recreational and non-recreational user groups. Uncontrolled dogs were the most frequently cited concern, followed by overly intrusive photography and then motorised vehicles and mountain biking, which were given an equal ranking.

Of non-recreational sources of disturbance, planned burns, e.g. muirburn, wildfires and unsympathetic land management practices were most frequently perceived to cause disturbance to vipers, followed by the impact of game birds (and their management).

The second theme considered the perceived impacts of disturbance on vipers. Questions were asked about the impacts of public pressure, whether other factors exacerbate public pressure and which activities had the greatest impact.

Delegates agreed there were a diverse range of impacts affecting different aspects of viper ecology and physiology (Table 1). These included concerns about effects on viper

Table 1. Impact of disturbance on *Vipera berus* identified by workshop delegates, with specific examples based on experience, the frequency with which each impact was mentioned in feedback from the group-based discussions and the proportion of total responses attributed to each impact category

Form of impact	Likely effects on vipers (individuals or populations)	Frequency cited	Percentage (%) of total contributions
Physiological	Elevated cortisol levels; delayed spermiogenesis in males; poor body condition; becoming immunocompromised	6	15.4
Spatial ecology	Becoming more sedentary; dispersal leading to abandonment of key (micro) habitats; occupancy of suboptimal habitats	6	15.4
Reproduction	Reduced reproductive fitness; reduced fecundity; disrupted mating/ reproductive behaviours; potentially smaller populations; genetic erosion	7	17.9
Behaviour	Habituation with repeated exposure; disruption to behavioural thermoregulation	4	10.3
Diet/feeding	Reduction in prey availability; regurgitation of prey when disturbed; disturbed foraging behaviour	4	10.3
Survivorship	Higher predation risk (if persistently disturbed); being trampled; general injury and/or death; dog attacks	8	20.5
Other (direct/indirect)	Bites to dogs; advertising viper presence; negative PR; misdirected conservation efforts	4	10.3

Table 2. Mitigation and management interventions to counter disturbance of *Vipera berus* identified by workshop delegates, including the number of times each intervention was mentioned in feedback and the proportion of total responses attributed to each factor

Mitigation type	Intervention	Frequency cited	Percentage (%) of total contributions
Habitat management	Access management for viper sensitive areas (i.e. naturalistic or artificial barriers)	8	15.4
	Better maintenance of paths/routes	1	1.9
	Complete public exclusion	1	1.9
	Enhancing habitat connectivity	2	3.8
	Fire management (i.e. firebreaks)	1	1.9
Education, awareness and communication	Highlight vipers as a species champion	1	1.9
	Best-practice guidance for recreational users	1	1.9
	Educational signage at sites	5	9.6
	Positive messaging and narratives aimed at target recreational user groups	1	1.9
	Public engagement events and campaigns	3	5.8
	Sharing best practices and positive outcomes (management)	4	7.7
	Zoo-based education	1	1.9
Policy, legislation and enforcement	Enforcement on sites	3	5.8
	Include vipers in site designations	1	1.9
	Legislate recreational activities	2	3.8
	Legislate sites	1	1.9
	Legislate species	3	5.8
Capacity building	Collaboration with other NGOs and charities	1	1.9
	Secure funding	1	1.9
Other	Dedicate alternative spaces/facilities for recreation	5	9.6
	Effective survey design and methods	3	5.8
	Not publicising viper presence	2	3.8
	Sensitive placement/positioning of feeders for game birds	1	1.9

survival, their reproductive ability and changes in their spatial ecology. What was less clear was how measurable impacts on individuals could be translated into forecasting population-level effects in the absence of any robust research evidence. The lack of empirical evidence to quantify perceived impacts, which are largely based on anecdotal evidence and speculation, was also highlighted.

The groups suggested that the type and magnitude of effects resulting from disturbance will likely reflect many other factors, for example, season, weather, predation pressure, habitat quality, public access to land, social media and signage. There is also likely to be site-specific variance in the impact of any particular type of disturbance, and in some cases, disturbance may be of lesser concern, relative to other threat factors.

The third theme focussed on mitigation and management of disturbance. Questions included identifying solutions to disturbance, finding out more about the personal experience of delegates and highlighting the benefits and challenges of different measures. A final question asked what land managers would require to develop a sustainable long-term plan to manage public pressure.

Potential interventions identified included the importance of education and awareness, which was rated as most important, followed by habitat management to manage visitor movements. Other suggestions included policy legislation and enforcement and finally capacity building (Table 2).

For interventions, managing access to sensitive areas for vipers, e.g. hibernacula or favoured basking sites, through naturalistic and/or artificial barriers was suggested most often, followed by educational signage and dedicating alternative spaces and/or facilities for recreational use. The need to share best practices and positive outcomes resulting from research and experimental land management practices was also highlighted.

Habitat management

Habitat management was a key theme identified throughout the conference. For example, the pace of peatland restoration has been steadily increasing across Britain, with Peatland Action in Scotland aiming to restore 250,000 hectares of peatland by 2030, and the England Peat Action Plan committing to restore 35,000 hectares of peatland by 2025 (UK Government, 2021; Peatland Action, 2025). Peatland restoration is key to the fight against climate change due to its role in carbon capture, but the restoration of peatlands provides both challenges and opportunities when it comes to the conservation of vipers and other species of amphibians and reptiles (Leifeld & Menichetti, 2018; Stückler et al., 2024). Two talks addressed the differing challenges of peatland restoration in two different parts of the country, with Stephen Corcoran (Corcoran Consultants) presenting his professional work mitigating for reptiles in Scotland, and John Dickson (RAGS) presented a volunteer-led monitoring programme on the Somerset Levels. On the

Figure 6. A flooded *Vipera berus* hibernaculum in Somerset, marked with a white cane, following planned flooding by a peatland restoration programme. No vipers emerged from this hibernaculum during the spring immediately after the flooding, despite consistent previous records over a relatively long period.

Somerset Levels, local populations of vipers were found to be strongly associated with land that had not been converted to agriculture, or used for peat cutting, but this has resulted in small, isolated viper populations. In a landscape already prone to flooding, despite an extensive drainage network in place, vipers are usually found on slightly higher land, or man-made embankments, e.g. an old railway line. However, recent capital peatland restoration projects that involve landscape level re-wetting were highlighted as a major threat to vipers, with hibernacula being subjected to water table rise, even where they had previously been identified and marked out. The flooding resulted in no vipers emerging from hibernation during the springtime at one site, despite records from the previous year (Fig. 6). For Scotland the 'Reptile Survey and Mitigation Guidance for Peatland Habitats' was highlighted. This is the first guidance of its kind to deal with the effects of peatland restoration on reptiles and how to mitigate for this (Cathrine, 2024). The main focus of this guidance revolves around the identification and maintenance of important hibernation sites and other habitat features for reptiles. Despite the guidance some sites, particularly those being restored at landscape scale – for example those that are being transformed from plantation forestry to bog and where identification of individual hibernacula and other important reptile features is tricky – present significant challenges when balancing the needs of peatland restoration with the challenges of viper conservation. Several case studies were presented to attest to this fact. Superficially these sites have very different landscapes, with Scotland having much larger areas of peatland restoration, and more diverse topography; whilst the Somerset Levels cover a much smaller area, and are generally fairly flat, with a maximum elevation of just 8 m above sea level, which makes them more accessible for reptile monitoring. However, despite their differences, the need for better consideration of reptiles during the planning stages of peatland restoration processes was highlighted in both talks.

Emma Douglas (Pasture for Life, Gower Meadow Beef), a conservation grazier, spoke about the challenges of grassland management for reptiles, highlighting the pros and cons of different grazing species and their uses for conservation grazing. Correctly timed, grazing can maintain landscape features that are beneficial for reptiles, while at the same time decreasing fuel load that may contribute to wildfires that have devastating effects on reptile populations (Nimmo et al., 2023). Grazing can also help maintain differing sward heights to prevent habitats becoming overgrown through succession, ensuring that sites are suitable for reptiles. Also discussed was the use of virtual fencing referred to as 'no fence'; by deploying GPS-enabled collars on livestock that first emit an auditory signal followed by a small electric pulse if a pre-determined boundary is crossed. Animals can be readily trained to stay within a boundary, which can then be managed remotely using an online app., allowing for grazing to be more tightly controlled and for boundaries to be rapidly adjusted to meet different grazing needs. This is especially useful for conservation grazing, or areas where it is impractical or not cost-effective to install traditional stock fencing. Virtual fencing can be used for more precise management of viper habitat features, such as hibernacula, whilst reducing issues of overgrazing on reptile sites. For welfare reasons the collars are mainly used for cattle, sheep and goats, and are not approved for ponies or very young animals. Collars must comply with the Animal Welfare Act 2006 in England and Wales and the Animal Health and Welfare (Scotland) Act 2006.

Cannock Chase National Landscape in Staffordshire is a historic viper stronghold, but there are concerns centring around anecdotal evidence of population declines. Richard Harris (CCNLP) introduced a new DEFRA 'Farming in Protected Landscapes' (FiPL) funded partnership project to improve the understanding of viper populations across Cannock Chase, and to improve conditions for them by working at a landscape scale. The project comprises a combination of species modelling (by UKCEH), field surveys, volunteer work, education and outreach with local communities and visitors, and landowner support. The importance of balancing the recreational use of The Chase with its role as an important refuge for wildlife is key to the success of the project, as well as acknowledging the social history of the landscape. To highlight this, we were treated to the launch of 'Beneath our Feet, an Adder's Eye view of Cannock Chase', a video made to raise awareness about the history and vulnerability of vipers on Cannock Chase (YouTube, 2025). The video includes conversations with rangers from Staffordshire County Council, members of the former Lea Hall Colliery mining community about their recollections of vipers, and ends with an excerpt from "Adder on the Chase", a poem by Dr. Kuli Kohli, the Wolverhampton poet laureate.

National scale challenges

Many of the presentations explored the challenges of landscape level restoration, but what about the much harder challenge of trying to conserve *V. berus* on a national scale? In this context some lessons can be learnt from the conservation programme for the Hungarian meadow viper *Vipera ursinii rakosiensis*. Bálint Halpern (MME Birdlife Hungary), general manager of the Hungarian meadow viper LIFE-project, presented a case study on the threats

to, and management of, this rare species. In 2004, the entire Hungarian meadow viper population was estimated to be less than 500 individuals, with threats to the species including drainage, ploughing of their grassland habitats, mechanical mowing and, potentially, climate change (Halpern et al., 2004; Halpern & Péchy, 2013). Responding to these concerns, a specialist Hungarian meadow viper conservation and visitor centre was opened, starting with 18 snakes from 6 locations. Over the course of 22 years, more than 5,800 Hungarian meadow vipers were born. The young were given a head start in outside enclosures (soft releases) with the snakes offered a diverse range of invertebrate prey types to determine their feeding preferences. The first two releases were overseen by the president of Hungary himself, and since then there have been over 1,200 releases across 15 sites, with 65 individuals radio tagged to facilitate monitoring (Péchy et al., 2015). Research at the centre has also focused on improving breeding conditions for the snakes, by measuring the effects of an indoor treatment where they do not enter hibernation in the first year, versus an outdoor treatment where they overwinter outside, before transferring all animals to outdoor enclosures during the spring. The experiment highlighted several important findings relating to impact of overwintering on growth rates, preferred operating temperatures, and dispersal; the snakes reared outdoors showed greater dispersal potential. This suggests that head-starting conditions may be critical to the physiology and behaviour of the snakes. The group are also trialling the use of the Adapted-Hunt Drift Fence Technique (AHDriFT), a camera trapping system to survey for small animals, birds and reptiles (Amber et al., 2021). This has proven very successful, and they intend expanding this programme, to monitor viper habitats into the future. Overall, the research findings provide an informative example of how captive breeding efforts can support wild conservation aims.

Yvonne Radstake (RAVON) presented RAVON's Netherlands Adder Working Group (WAN) conservation programme for *V. berus*, now celebrating its 25th year – 'Small country, big data'. There are two large viper populations in the Netherlands, both associated with heathlands and raised bogs, which are monitored by a network of over 4,000 volunteers who have contributed to a large database. There was a preliminary scoping survey at each site followed by more robust data collection, with all the location information and biological data relating to weight, sex and age and head shot photographs of each individual viper uploaded to an online snake portal (https://www.snakeportal.org). This allows the team to track the history of individual snakes and model the population size based on a large and robust dataset. This substantial effort highlights the importance of good data collection for national-scale conservation. The data have also been used to assess genetic fitness, which suggested very low genetic diversity in the case of an isolated population that interestingly also showed head-scale anomalies. In response to this a small number of male vipers were introduced in spring 2025, in an attempt at genetic restoration in the manner achieved in Sweden (Madsen et al., 1999). Juvenile viper DNA will be retested during autumn 2025, to see what effect this has had.

Catherine Whatley (NatureScot) presented the latest viper survey results from Scotland. The first Scottish national survey of *V. berus* was completed in 1994 (Reading et al., 1994), the second survey was completed in 2025 (Ward et al., 2025) as a collaboration between NatureScot, ARG UK and ARC Trust. This survey assessed how the status of the *V. berus* has changed over the last 30 years by a combination of surveys repeated at 17 of the original sites (during the 2022–24 field seasons) and questionnaires to landowners. The surveys showed declines in occupancy at what had previously been considered 'good' viper sites, however, the inherent difficulties of surveying these landscapes, and the small number of sites surveyed made it difficult to extrapolate the conclusions to a larger scale. For the questionnaires, far fewer responses were received compared with the 1994 survey; however, results indicate that the distribution of vipers appears to have contracted in the last 30 years. Vipers in Scotland are threatened by land-use changes, habitat loss and fragmentation, and persecution; and urgent action is needed to help reverse these declines.

From Wales, Matt Cooke (ARC Trust) discussed the Natur Am Byth viper programme, which is Wales's flagship green recovery programme for the species. Vipers are historically and culturally very important to communities in Wales, and this was highlighted using examples such as the tale of the 'adder stone', or glain neidr. The project collects data to help build up a more holistic view of the Welsh viper populations and engages in a blend of science and artistic endeavours to educate primary school children.

Conservation translocations and priorities for viper conservation

The translocation of *V. berus* to support the conservation of the species, rather than as a mitigation of development, was a hot topic during the meeting. The question of when conservation translocations are needed, or appropriate, was debated with much gusto. Jim Foster presented a new national strategy national strategy document on how conservation translocations can support viper recovery (ARC Trust, 2025). This new guidance covers the reasons for translocation, outlines when it is appropriate and where other tools may be better placed to help with population recovery, sets out different scenarios for conservation translocation, and evaluates the role of conservation translocations in viper recovery.

David Orchard and Neil Madden (Lancashire Amphibian and Reptile Group & ARCADIS) jointly presented a real-world example of a potential translocation project on the Manchester Mosses, comprising the Risley, Holcroft and Chat Moss National Nature Reserve located between Liverpool and Manchester. Reptiles are relatively rare in the north-west of England, but they appear to thrive at the sites where they persist. The Manchester Mosses possess good prey numbers that could support a viper population, and there is significant scope for habitat restoration. More survey work is needed to determine if this site could be suitable for viper conservation translocations.

In our second workshop of the conference, Richard Griffiths (DICE, University of Kent) and Gemma Harding

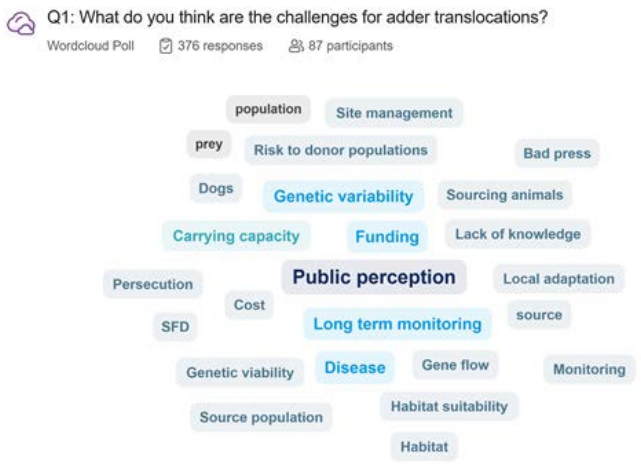

Figure 7. Word cloud of the challenges for viper translocations, based on responses from 87 participants at Vanishing Viper 2025

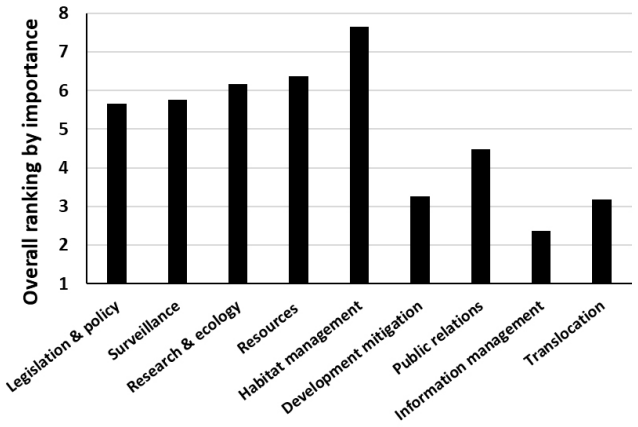

Figure 8. Attendee perceptions of the most important priorities for viper based on a SLIDO powered poll at VV 2025 where all 120 delegates were invited to rank nine different themes for viper conservation (from 1–10) in order of importance

(Natural England) gathered attendees' opinions about the opportunities and challenges for viper conservation translocations in Britain. Attendees were asked a series of questions, and using the interactive polling programme 'Slido' (https://www.slido.com/), word clouds were created in real time, ranking attendees' responses by frequency of use. This allows for the most used phrases or words to be highlighted. When asked "What do you think are the challenges for viper translocations?", 376 responses were received, with the most frequent responses relating to (negative) public perceptions, declining source populations, genetic viability, a lack of long-term monitoring, funding and disease transmission (Fig. 7). When asked "What do you think are the opportunities for viper translocations?", 356 responses were received, with most answers relating to public perception, genetic rescue, research, local extinctions, establishing new populations and creating more resilient populations. Full details of this workshop's outcomes can be found in the Supplementary Material 2.

Some of the main points of the general discussion about viper translocations revolved around:

- Monitoring and long-term success: noting that it is hard to track translocated vipers and assess accurately their long-term survival.
- Genetics and disease: maintaining genetic diversity and avoiding introduction or establishment of diseases, including the recently described snake fungal disease (SFD).
- Habitat and prey: suitable sites, enough food and realistic carrying capacity are often lacking.
- Source population risks: taking animals from donor sites can potentially harm those populations, there needs to be more information about what proportion of the donor populations can safely be moved, and preferred age and gender balance.
- Funding and costs: limited or uncertain budgets threaten long-term planning, monitoring and care.
- Captive breeding: further exploration is needed as a number of important issues are poorly understood.
- Public perception and politics: negative attitudes, persecution and political obstacles can prevent or undermine projects.

The broad spread of issues raised highlight the complexity of viper conservation translocations and the wide range of opinions and concerns that accompany this topic. Successful viper conservation translocations require careful site selection, strong biosecurity and genetics planning, reliable long-term monitoring, stable funding and community and political support. There are still many unknowns relating to viper translocations, however prioritising research, having more collaborative approaches and clear decision-making frameworks could help meet these goals. All translocation projects should meet IUCN (and UK equivalent - England & Scottish codes) guidelines to ensure best practice is followed, and translocations that do not meet these guidelines are unlikely to be licenced or to succeed (DEFRA, 2024; IUCN/SSC, 2023; National Species Reintroduction Forum, 2014).

During the meeting, all 120 participants were asked to rank their top nine priorities for overall viper conservation, in order of importance. This revealed that habitat management is the top priority for the conference delegates (Fig. 8), followed by resources, defined as funding and capacity, research and ecology (into dispersal, genetics and habitat use), surveillance (survey and monitoring) and legislation and policy. Public relations, development mitigation, information management and translocation were regarded as least important. A similar type of ranking exercise at the 2016 Vanishing Viper meeting nine years earlier, also revealed that participants prioritised habitat management, followed by surveillance (survey and monitoring), legislation and policy, public relations, information management and development mitigation, research and ecology, and resources. However, all were considered of relatively equal importance at that time, although none were considered to be delivered well (Julian & Hodges, 2019).

The role of volunteers in viper conservation

Volunteer effort is at the heart of many of the viper projects described during the meeting, including those from the network of Amphibian and Reptile Groups (ARGs), from other NGOs, from local wildlife conservation groups and from the wider public. Without this effort very few of the monitoring projects described, including 'Make the Adder Count', would have been possible (Gardner et al., 2019). Volunteers are an important part of the local conservation efforts, and the volunteer-led ARGs often play a key role in conserving their local herpetofauna, acting as the link between land managers and other stakeholders, providing active monitoring of sites. Often where there are otherwise insufficient resources to provide consistent survey and monitoring efforts, and concerns when viper populations are in peril or declining, volunteers can help deliver some of this vital work. In this sense, volunteers are an essential part of the conservation landscape, and it is important that their collective voice and inputs underpin any conservation planning processes.

During VV 2025, we heard a number of presentations from volunteers from around the British Isles. In all cases, the volunteers brought their passion and commitment to describing how they have supported viper conservation programmes in their county, and were often best-placed to give evidence of how viper populations are responding to landscape changes.

One example of this is the Somerset ARG. This dedicated volunteer group monitor a broad spread of sites across the county, identifying previously unknown viper populations, and highlighting important landscape features, including hibernacula and basking sites. This information is passed back to the various site managers, enabling a more coherent viper strategy to be formulated in the county. Such intensive monitoring has highlighted locations where reptile welfare is poorly understood or overlooked; for example it was volunteers who first rang alarm bells about the future of the small and relatively isolated population of vipers on the Somerset Levels. Monitoring at multiple sites, they were able to observe an alarming pattern of viper population declines, and appreciate the implications of major landscape changes, including re-wetting processes, on reptiles living on peatland sites (Fig. 6). Volunteer interventions have resulted in a temporary postponement to some capital works pending additional information gathering to allow new solutions to be devised.

David Orchard and Neil Madden of the Lancashire ARG (LARG) have been translating their local knowledge of the Manchester Mosses, formerly an extensive lowland peatland covering a large area of Greater Manchester, Merseyside and southern Lancashire for reptile conservation. Much like the Somerset levels, large areas of peatland were lost following extensive drainage for agriculture and industrial development, including building the Liverpool to Manchester railway in the 1830s, as well as extensive peat cutting. However, some of the areas that have survived to the present day as degraded raised bog support reptiles, and in some cases, small populations of vipers. LARG in conjunction with the environmental consultants, ARCADIS, have been supporting habitat restoration at Woolden Moss, part of the new Risley, Holcroft and Chat Moss National Nature Reserve designated in honour of the coronation of HM King Charles III. They are also part of the team reviewing its suitability for a viper conservation translocation, by monitoring habitats, the distribution of other widespread reptiles and small rodent prey species.

Dave Pollard from the Cumbria ARG (CARG) rounded up our two-day meeting with a review of how CARG are working with land managers to conserve vipers. This is achieved through improved data collection, identification of key landscape features, undertaking practical habitat management and the creation of positive outreach to raise awareness with local communities and the wider public.

DISCUSSION & CONCLUSIONS

VV 2025 was the fourth in the series of national viper-focussed conferences, spanning a period of 14 years. The first few events were generally pessimistic in their prognosis, highlighting the multiple challenges faced by decision makers, land managers, academics and ecologists to reverse the declines that were being charted; and the difficulties posed by landscape degradation and fragmentation, poor media perceptions and legislative inadequacy to protect these vulnerable animals. However, the perception was that overall the participants of VV 2025 had a greater sense of optimism than those in previous meetings.

This optimism can be derived from three developments. First, there is now a much greater awareness of the plight of the viper, which has been recognised by national and landscape-level decision makers, who are championing vipers, and targeting species recovery through additional funding and long-term conservation strategies. Landscape-level viper conservation strategies were discussed throughout the conference. Second, the broader community including volunteers, professional ecologists, academics and other researchers, students, representatives from NGOs and statutory bodies, and private land managers, have become more cohesive in their actions, with greatly improved communication and knowledge sharing, allowing research findings from both Britain and overseas studies to translate into positive conservation action for the species on the ground. These actions include a better understanding of more viper-sympathetic habitat management including conservation grazing, bracken management and mitigating the impacts of the relatively rapid transformation of landscapes including forestry to bog, and reversing some of the negative impacts of peatland restoration on reptiles. These actions are being supported by novel research technologies including radio and camera tracking, computer modelling and genetic analysis to improve our understanding of viper ecology in ways that will help to identify possible solutions to what were previously regarded as intractable problems. Alongside this, there is potential for new actions, such as translocation and reintroduction present opportunities for boosting existing populations, and restoring the viper to its former range.

Finally, novel education and outreach initiatives and positive publicity including the Cannock Chase National Landscape 'Beneath our Feet' viper film, aimed at the wider

public, are starting to create a groundswell of wonder and excitement around this, one of our most iconic native species. Hopefully this will start to dispel some of the negative perceptions that have driven centuries of persecution that have undermined the viper's conservation status. Creating better awareness and encouraging the community champions that are essential for engaging with recreational landscape users to moderate their impact on vipers, and reduce the impacts of disturbance.

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