Observations on the distribution of melanistic snakes in Britain

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ABSTRACT - Records of melanistic British snakes were sourced from several databases and individuals. Of the three native snake species there were 217 records of melanistic northern vipers (*Vipera berus*), nine grass snakes (*Natrix n. helvetica*) and four smooth snakes (*Coronella austriaca*). The geographical spread of melanistic individuals appeared to reflect the general countrywide distribution of their cryptically coloured counterparts.

INTRODUCTION

Melanism has been reported from a wide range of taxa and in snakes the phenomenon has a wide geographical distribution (Bittner, 2003). One of the best known examples is that of the northern viper (*Vipera berus*) where melanistic individuals have been found across most of its range and as far north as the Arctic circle in Sweden (Andrén & Nilson, 1981; Luiselli, 1992; Monney et al., 1996).

Melanistic snakes differ from their regularly coloured counterparts by being significantly darker or entirely black. Such colour difference is fairly easy to observe and can be seen in sloughed skins (King, 2003; Strugariu & Zamfirescu, 2009). In melanistic snakes there is greater production of melanin by the melanocytes in the stratum basale layer of the skin (Bechtel, 1978), under the influence of a melanophore stimulating hormone. It is generally considered that a recessive 'loss of function' gene mutation is responsible for melanism in snakes and in the garter snake *Thamnophis sirtalis* inheritance follows a recessive Mendelian pattern (Lawson & King 1996; King 2003).

Melanism is a phenotypic polymorphism and its occurrence would appear to be of adaptive significance (Strugariu & Zamfirescu, 2009). For snakes, three adaptive benefits have been postulated; thermoregulation - where snakes could benefit from faster solar heat absorption (Gibson & Falls, 1979; Lawson & King, 1996; Clusella-Trullas et al., 2007); predator avoidance - where snakes could avoid predation by visual searching predators (Andrén & Nilson, 1981; Luiselli, 1992; Forsman, 1995; Lindell & Forsman, 1996; Bittner, 2003; Wüster et al., 2004; Tanaka, 2005); and reproductive fitness - where melanistic snakes could obtain larger, more sexually competitive body sizes (Forsman & Ås, 1987; Capula & Luiselli, 1994; Bittner et al., 2002). In this study we obtained records of melanistic snakes from the databases of several British organisations and have plotted them to facilitate an analysis of geographical spread.

MATERIALS AND METHODS

Records of melanistic snakes in the British Isles were accessed through consultation with Amphibian and Reptile Conservation Trust (ARC-Trust) which maintains a repository of British herpetological data. The ARC-Trust database was explored using the search term 'melani', which captured records of melanism, melanistic and melanic. The search term 'black' was deliberately excluded due to complications of overlapping phenotypic descriptions (i.e. black pattern coloration of northern vipers).

Additional records were requested from individual Amphibian and Reptile Groups (ARG-UK) and from volunteers of the National Amphibian and Reptile Recording Scheme (NARRS). Where possible, records were verified through accompanying photographic evidence and by comparing the geographical locality against known species ranges. Records have been plotted at low resolutions on map figures to protect sensitive site locations.

RESULTS

Melanism has been recorded in all three native British snakes; northern viper *V. berus* (Fig. 1), grass snake *Natrix n. helvetica* (Fig. 2) and smooth snake *Coronella austriaca* (Fig. 3).

Melanistic northern viper records totalled 217 and these ranged from the south coast of England to the Scottish Highlands (Fig. 4). With the exception of the Isle of Arran, the majority of the records were present in the south of England. Although present throughout Great Britain, melanistic northern vipers appeared to be more prevalent in coastal regions.

There were nine records of melanistic grass snakes (Fig. 4), predominantly in the south of England. A notable exception was a recent record of a sub-adult specimen from Derbyshire. Regretfully, shortly after receiving the record, the animal in question was found dead from an undetermined cause.

Figure 1. Melanistic *V. berus* (photograph John Baker).

Figure 2. Melanistic *N. n. helvetica* (photograph Todd Lewis).

Figure 3. Melanistic *C. austriaca* next to a cryptically coloured specimen (photograph Stuart Woodley).

The earliest record of a melanistic smooth snake in Britain dates from the 19th century and until recently was considered an anomaly (Cambridge, 1894). More recently there have been further records (Pernetta & Reading, 2009; Woodley, 2015) increasing the total to four, all from Dorset (Fig. 4).

DISCUSSION

Some details of melanism in British snakes have been given in the current standard work on the British herpetofauna (Beebee & Griffiths, 2000) but the distribution information within is limited. This is updated and extended by our synthesis of data from three different recording schemes and individual recorders.

The observed occurrence and scarcity of melanistic smooth snakes is consistent with the very restricted range of this species in southern England (Pernetta & Reading, 2009; JNCC, 2010; Woodley, 2015). It is possible that melanistic smooth snakes are under recorded in Britain not least due to their very secretive nature. Other reports of melanistic smooth snakes have come from southern France (Reich, 2012) and a single specimen has been recorded in Russia (Idrisova, 2014).

There were very few melanistic grass snake records, and of these, most were from southern England. Melanistic grass snakes are known from wider Europe with recent reports from Bulgaria (Naumov & Tomovic, 2005; Mollov, 2012), Croatia (Zadravec & Lauš, 2011), Finland (Terhivuo, 1990), Montenegro (Gvozdenovic & Schweiger, 2014), Slovakia (Jandzik, 2004), Sweden (Nilson & Andrén, 1981; Andrén, 2004), Switzerland (Reich, 2012) and Turkey (Habiboglu et al., 2016). On the Baltic island of Gotland, melanistic grass snakes comprise up to 50% of the population (Andrén, 2004). However, despite being a readily encountered and abundant snake in Britain, the numbers of melanistic individuals seemed disproportionately low; the situation on the Swedish mainland appears to be similar (Andrén, 2004). Perhaps, as active foragers, natural selection particularly favours the normal cryptic colouration of grass snakes.

Unlike the other two species, there were a much greater number of northern viper records, largely from southern England. Greater numbers of populations with melanistic individuals have been recorded on the Isle of Arran and within Exmoor National Park than elsewhere, and the small clusters of melanistic northern vipers in Norfolk, Exmoor, Scotland and East Sussex are interesting. However, all these cases could result from surveyor bias as much as a

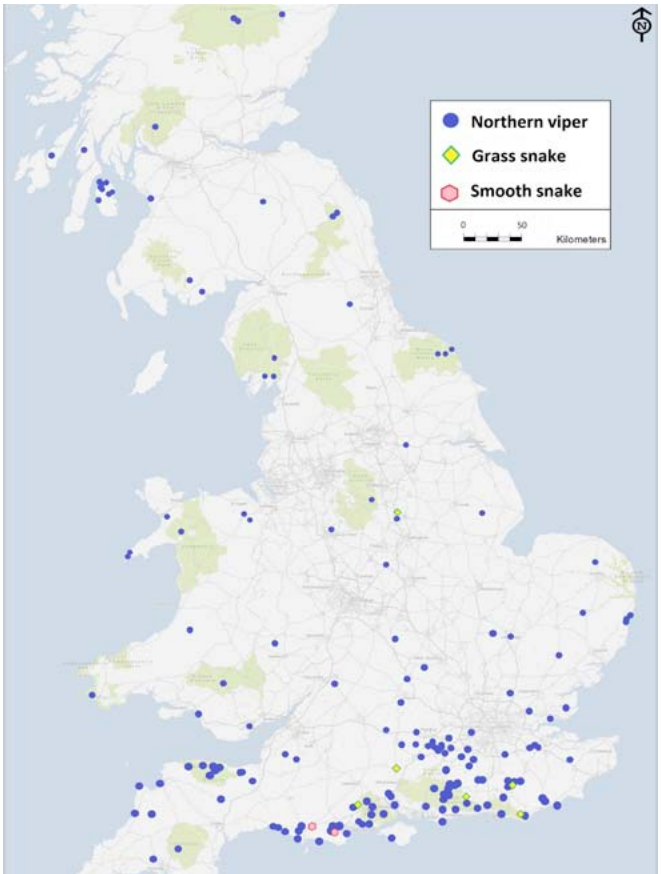

Figure 4. Geographical spread of the records of melanistic snakes in Britain. Note that a single locality record may represent more than one individual melanistic snake.

genuine exceptional frequency of melanism.

Despite the few high density clusters of melanistic northern vipers, it appears that the overall geographical pattern of melanism in Britain is correlated with the general abundance and distribution of the three snake species. Although melanism has previously been associated with habitat type (Clusella-Trullas et al., 2007), the metadata with the British records are insufficient for us to draw any conclusions. More detailed mining of the National Amphibian and Reptile Recording Scheme (NAARS) database, to contrast melanistic with cryptic snake populations, may be profitable. Furthermore, in the face of rather scarce data on snakes, the inclusion of melanistic lizards may help to provide the critical mass of data needed to draw further conclusions.

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REFERENCES

Andrén, C. (2004). *Forsmark site investigation amphibians and reptiles*. Svensk Kärnbränslehantering AB, Sweden.

Andrén, C. & Nilson, G. (1981). Reproductive success and risk of predation in normal and melanistic colour morphs of the adder, *Vipera berus*. *Biological Journal of the Linnaean Society* 15: 235-246.

Beebee, T.J.C. & Griffiths, R.A. (2000). *Amphibians and Reptiles: A Natural History of the British Herpetofauna*. The New Naturalist Library, London.

Bechtel, H.B. (1978). Color and pattern in snakes (Reptilia, Serpentes) Pp 270. *Journal of Herpetology* 12: 521-532.

Bittner, T.D. (2003). Polymorphic clay models of *Thamnophis sirtalis* suggest patterns of avian predation. *Ohio Journal of Science* 103: 62-66.

Bittner, T.D., King, R.B., Kerfin, J.M. & Gatten, R.E. Jr. (2002). Effects of body size and melanism on the thermal biology of garter snakes (*Thamnophis sirtalis*). *Copeia* 2002: 477-482.

Cambridge, P.O. (1894). Reptiles of Dorset. *Proceedings of the Dorset Natural History Field Club* 15: 90-102.

Capula, M. & Luiselli, L. (1994). Reproductive strategies in alpine adders, *Vipera berus*. The black females bear more often. *Acta Ecologica* 15: 207-214.

Clusella-Trullas, S., van Wyk, J.H. & Spotila, J.R. (2007). Thermal melanism in ectotherms. *Journal of Thermal Biology* 32: 235-245.

Forsman, A. & Ås, S. (1987). Maintenance of colour polymorphism in adder, *Vipera berus*, populations: A test of the popular hypothesis. *Oikos* 50: 13-16.

Forsman, A. (1995). Heating rates and body temperature variation in melanistic and zigzag *Vipera berus*: Does colour make a difference? *Annales Zoologici Fennici* 32: 365-374.

Gibson, A.R. & Falls, R.B. (1979). Thermal biology of the common garter snake *Thamnophis sirtalis*. The effects of melanism. *Oecologia* 43: 99-109.

Gvozdenovic, S. & Schweiger, M. (2014). Melanism in *Natrix natrix* and *Natrix tessellata* (Serpentes: Colubridae) from Montenegro. *Ecologica Montenegrina* 1: 231-233.

Habiboglu T., Çiçek K. & Tok C.V. (2016). A case of melanism in the grass snake, *Natrix natrix* (L., 1758) (Reptilia: Colubridae) from Gökçeada (Imbros), Turkey. *Biharean Biologist* 10: art.152304.

Idrisova, L. (2014). Peculiarity of external morphology of colubrid snakes (Colubridae) found on Saralinsky district of the Volga-Kama Wildlife Sanctuary. *Herpetological Facts Journal* 1: 33-41.

Jandzik, D. (2004). Partial melanism in the grass snake *Natrix natrix* (Reptilia: Colubridae) from northeastern Slovakia. *Acta Zoologica*, *Universitatis Comenianae* 46: 75-77.

Joint Nature Conservation Committee (JNCC). (2010). *UK priority species data collation*. Coronella austriaca *Version II*. http://jncc.defra.gov.uk/ (Accessed: 01/2012).

King, R.B. (2003). Mendelian inheritance of melanism in the garter snake *Thamnophis sirtalis*. *Herpetologica* 59: 484-489.

Lawson, R. & King, R.B. (1996). Gene flow and melanism in Lake Erie garter snake populations. *Biological Journal of the Linnaean Society* 59: 1-19.

Lindell, L.E. & Forsman, A. (1996). Sexual dichromatism in snakes: support for the flicker-fusion hypothesis. *Canadian Journal of Zoology* 74: 2254-2256.

Luiselli, L. (1992). Reproductive success in melanistic adders: A new hypothesis and some considerations on Andren and Nilson's (1981) suggestions. *Oikos* 64: 601-604.

Mollov, I. (2012). Another case of melanism in the grass snake *Natrix natrix* (Linnaeus, 1758) (Reptilia: Colubridae) from Bulgaria. *ZooNotes* 28: 1-3.

Monney, J.C., Luiselli, L. & Capula, M. (1996). Body size and melanism in *Vipera aspis* in the Swiss Pre-alps and central Italy and comparison with different Alpine populations of *Vipera berus*. *Revue Suisse de Zoologie* 103: 81-100.

Naumov, B. & Tomovic, L. (2005). A case of melanism in *Natrix natrix* (Linnaeus, 1758) (Reptilia: Colubride) in Bulgaria. *Acta Zoologica Bulgarica* 57: 253-254.

Nilson, G. & Andrén, C. (1981). Morphology and taxonomic status of the grass snake, *Natrix natrix* (L.) (Reptilia, Squamata, Colubridae) on the island of Gotland, Sweden. *Zoological Journal of the Linnaean Society* 72: 355-368.

Pernetta, A.P. & Reading, C.J. (2009). Observations of two melanistic smooth snakes (*Coronella austriaca*) from Dorset, United Kingdom. *Acta Herpetologica* 4: 109-112.

Reich, T. (2012). Just a *Natrix*? Melanistic grass snake in Switzerland. Fieldherping.eu (Online Forum). http://fieldherping.eu/Forum/viewtopic.php.

Strugariu, A. & Zamfirescu, S.R. (2009). A melanistic adder (*Vipera berus*) neonate born from a cryptic female: Are black vipers born heavier? *North-Western Journal of Zoology* 5: 218-223.

Tanaka, K. (2005). Thermal aspects of melanistic and striped morphs of the snake *Elaphe quadrivirgata*. *Zoological Science* 22: 1173-1179.

Terhivuo, J. (1990). Relative regional abundance and colour morphs of the adder (*Vipera berus* L.), grass snake (*Natrix natrix* L.), slow worm (*Anguis fragilis* L.) and common toad (*Bufo bufo* L.) in Finland. *Annales Zoologici Fennici* 27: 11-20.

Woodley, S. (2015). Melanistic smooth snake. *Hop Gossip*: 13.

Wüster, W., Allum, C.S.E., Bjargardottir, I.B., Bailey, K.L., Dawson, K.J., Guenioui, J., Lewis, J., McGurk, J., Moore, A.G., Niskanent, M. & Pollard, C.P. (2004). Do aposematism and Batesian mimicry require bright colours? A test, using European viper markings. *Proceedings of the Royal Society London B*. 271: 2495-2499.

Zadravec, M. & Lauš, B. (2011). Melanism variations in *Natrix natrix* (Linnaeus, 1758) and *Zamenis longissimus* (Laurenti, 1768) in Croatia. *Hyla* 2011: 39-42.

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