

An update on the status of *Seligeria carniolica* in England and Scotland

David Long and **Richard Lansdown** provide a positive reassessment of the populations of this rare species

Summary

Following the re-discovery of the rheophytic moss *Seligeria carniolica* in its original Scottish locality and also in a new site in Roxburghshire in 2014, new surveys in Northumberland in 2018 resulted in the discovery of much larger stands in the original English location than other recent surveys had found, and a small population in a new locality nearby. We conclude that *S. carniolica* is no longer threatened in England or Scotland, and suggest that due to natural processes of winter scouring by floods, which regularly create new micro-habitats, and because of its production of spores and possibly protonemal gemmae, it is holding its own and has the ability to rapidly recolonise in favourable years, then decline sharply in unfavourable years. Nevertheless, threats exist requiring practical conservation measures to ensure its long-term survival in all four currently known sites.

Historical background

Seligeria carniolica (Breidl. & Beck) Nyholm

(formerly *Trochobryum carniolicum* Breidl. & Beck) was first discovered in Britain in Scotland on the Black Burn near Newcastleton in Roxburghshire by Evelyn Lobley in 1948 (Warburg, 1949). Unfortunately, the plants were not noticed in the field, but detected later by E.F. Warburg, mixed with *Seligeria recurvata*. The plants were thought to have been growing on a small north-facing limestone outcrop at between 225 and 275 m altitude. They were fertile, bearing the characteristic trumpet-shaped capsules (Fig. 1). Unfortunately on several subsequent visits Miss Lobley was unable to re-locate the original site (Lobley, 1965). In September 1961 the BBS visited the Black Burn but also failed to find the moss (Milne-Redhead, 1962). However, in 1964 Lobley found *S. carniolica* again, this time new to England on a tributary (Grain Sike) of the Forest Burn near Rothbury in the Northumberland National Park (Lobley, 1965). She described its habitat as on intermittently submerged highly calcareous sandstone boulders in the stream. She also raised the possibility that the habitat in the Black Burn could have been similar.

Fortunately, the precise location of the English find was well-documented, enabling subsequent observations to be made by a number of bryologists in 1964, 1965, 1972, 1976 and 1996 (Hodgetts, 2002) which allowed more observations of its ecology to be made. In contrast, at the Black Burn, visits by bryologists in 1961, 1971, 1976, 1977 and 1996 (Long, 2015b) all failed to re-find the plant and not until 2014 was it seen again.

Summary of recent studies

2001 – Northumberland. The first detailed survey of *Seligeria carniolica* in Northumberland was carried out for Plantlife in 2001 and reported by Hodgetts (2002). In addition to Grain Sike (the only known English site at the time), eight other streams within a range of 2.5 km of Grain Sike were investigated by Nick Hodgetts in November 2001, but in none was *S. carniolica* found. Limestone was recorded in five of these. In Grain Sike only two populations were found, about 5 metres apart, ‘on damp impure limestone just above water level’, both in

▽**Fig. 1.** *Seligeria carniolica* on the Black Burn at Blackburn Farm, showing the characteristic capsule shape, August 2018. All photos R.V. Lansdown

places where the moss had been seen before. The plants were reported as being ‘in good health’ but no sporophytes were seen. Because no precise data from earlier visits were available, it was not possible to assess if the population had increased or decreased prior to 2001. However, as these were the only two populations of *S. carniolica* known to exist in Britain in 2001, their clear vulnerability led to its designation in the Red Data Book (Church *et al.*, 2001) as Critically Endangered in Britain.

2004 – *in vitro* cultivation. As sporophytes had been recorded in Grain Sike on several visits prior to 2001, it was reasonable to conclude that spores were the main agents of dispersal in this moss. However, as part of a study of *in vitro* cultivation of bryophytes (including a number of rare and endangered species) plants of *Seligeria carniolica* were shown by Duckett *et al.* (2004) to produce protonemal gemmae in cultivation on an agar-based medium, the first report of asexual propagules in the genus *Seligeria*. These have not been demonstrated in wild plants but their possible importance in the reproductive biology of *S. carniolica* in Britain is discussed below.

2006 – Northumberland. A new survey of





△Fig. 2. Location of a fertile stand of *Seligeria carniolica*, on the Black Burn at Blackburn Farm

Grain Sike and other possible sites for *Seligeria carniolica* in Northumberland was carried out by Nick Hodgetts, commissioned by Plantlife, in November 2006, with the joint aims of searching for new sites, and of monitoring the colonies previously reported in 2002 (Hodgetts, 2006). Twenty-two additional sites were investigated over a much larger area than previously searched, but the result was the same, with no new finds, even though highly calcareous rocks were evident in several of these. In Grain Sike one of the 2001 colonies was no longer visible, presumably washed away by natural events. The other colony was still extant and consisted of hundreds of shoots on two adjacent boulders, and had possibly increased in size. A small colony nearby, discovered in June 2006 by Nick Hodgetts and Richard Lansdown, had already disappeared by

November the same year. Again, no sporophytes were seen. The two conclusions from this survey were that no new sites had been found in 2006, and that although the species was still present in Grain Sike, it was very limited in extent and very vulnerable to local catastrophic events.

2014 – Roxburghshire. In September 2014 the autumn meeting of the BBS was held in Edinburgh, and the opportunity was taken to conduct a new survey of the Black Burn as a supplementary field meeting in which ten bryologists took part. The unexpected success of this meeting was reported by Long (2015a, b). An important decision was taken to search the Black Burn from just above its confluence with the Liddel Water, rather than only the upper reaches which earlier searches had concentrated on. Efforts also focused on the yellowish limestone outcrops and boulders in the stream (the habitat in Northumberland), and the low water levels made this straightforward. This paid off handsomely as the *Seligeria* was located

▽Fig. 3. David Long at the location of a fertile stand of *Seligeria carniolica*, on the Hartsgarth Burn



in several places just above Blackburn Farm, on both boulders and bedrock (Fig. 2). One of the colonies bore abundant sporophytes. At other times of year these plants would be submerged and much harder to see. The very similar and nearby Hartsgarth Burn was searched the following day with the same success, the *Seligeria* being found in two areas, in one place bearing sporophytes. These records were the first in Scotland for 66 years, and paved the way to subsequent re-evaluation of the conservation status of *Seligeria carniolica* in Britain.

2015 – Northumberland. The success in Roxburghshire prompted another survey of Grain Sike in August 2015 by Richard Lansdown, from its source in moorland above the known site downstream to its confluence with the River Coquet. However, only a single small colony (bearing one old sporophyte) was found (Lansdown, 2015) near to but in a different location to that discovered in 2006. The conclusion from this survey was that the moss was still in a very precarious state in

Northumberland, in spite of much apparently suitable habitat being available, and in contrast to the thriving colonies in Roxburghshire.

2018 – Roxburghshire. In July 2018 the present authors, aided by low water levels at the end of an exceptionally dry summer, undertook a new but relatively brief survey of both the Black Burn and Hartsgarth Burns in Liddesdale (Lansdown, 2018). The populations located in 2014 were re-located and some new stands found, in total seven in the Black Burn (two bearing sporophytes) and five in the Hartsgarth Burn (also with two stands fertile) (Fig. 3). We concluded that the healthy populations seen in 2014 had not changed in any obvious way in the intervening four years. The lower reaches of the Dinley Burn near Hermitage Castle was also searched briefly but without success, but this and other stream valleys in the Liddesdale area merit further exploration in future.

2018 – Northumberland. The authors then spent a full day re-surveying Grain Sike (Fig. 4) from the public road upstream. In comparison to the unchanged picture in Roxburghshire, the results showed a very striking contrast to those of earlier surveys in that no fewer than 46 separate populations (including two with sporophytes) were found - a truly dramatic increase in only three years. Later, in a brief visit to the nearby Forest Burn (previously searched unsuccessfully in 2001 and 2006) we located a single new sterile colony of the *Seligeria*, the first in England outside Grain Sike (Lansdown, 2018). All these colonies were on mostly detached and otherwise bare boulders of orange-yellow limestone (Fig. 5). These boulders had clearly become exposed by winter scouring events since the previous survey in 2015, suggesting that such events could be key in creating new micro-habitats for the moss before it becomes overrun and out-competed



by larger more dominant bryophytes or other vegetation. The largest and most frequently occurring colonies were in the sections of the stream with the closest tree canopy, dominated by *Alnus*, *Fraxinus* and *Salix*, in contrast to the open sections where colonies were few and small. Full details of the Grain Sike populations recorded in 2018 are given by Lansdown (2018).

Discussion

The most remarkable discovery from surveys in Grain Sike from 2001 to 2018 is that *Seligeria carniolica* can survive in very small fragmented and isolated populations for many years when conditions are apparently not favourable for new colonisation. The trigger for the relatively infrequent population expansion events would appear to be drastic winter scouring of the stream bed causing new limestone rocks and boulders to become exposed and/or scraped clean of other bryophytes. When these new substrates become available, the moss must have the capacity to spread rapidly and establish new colonies. Until recently, it was thought that the only agents of dispersal in *S. carniolica* were spores produced by fertile plants in favourable seasons. However, our surveys in both Northumberland and Roxburghshire indicate that even in favourable seasons, relatively few sporophytes are produced. This is surprising as all British *Seligeria* species are autoicous (Smith, 2004) and most are abundantly fertile.

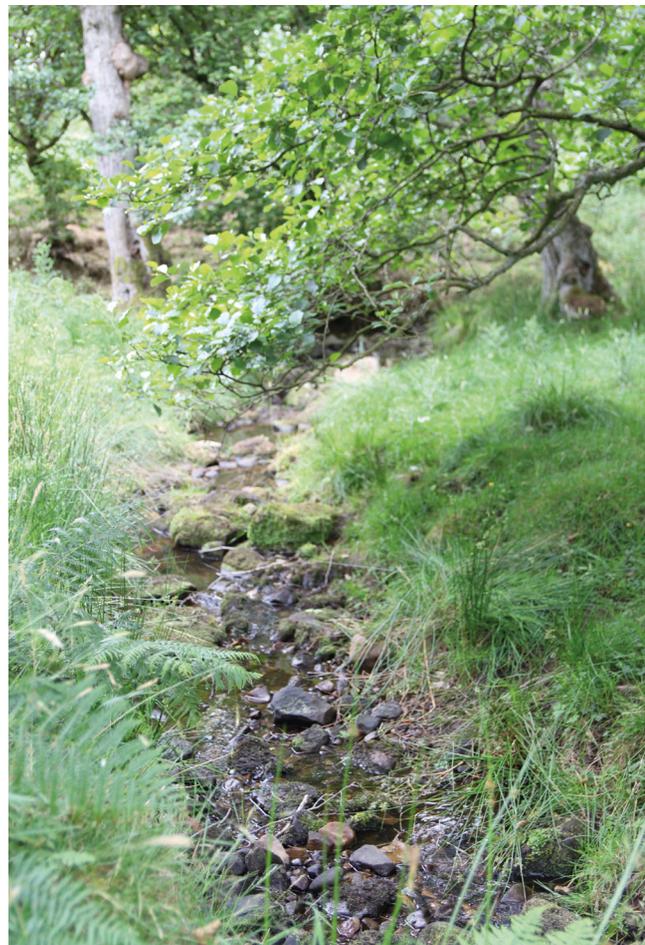
However, the *in-vitro* culture studies of Duckett *et al.* (2004) offer an alternative hypothesis for the apparent very rapid spread of the moss in Grain Sike in only three years. The production of abundant protonemal gemmae by *Seligeria carniolica* plants in culture offers, if replicated in the wild, a possible explanation for this behaviour. Many so-called ‘Colonist

Species’ (During, 1979) which live in relatively short-lived but regularly re-appearing habitats, use both vegetative and sexual reproduction to spread rapidly and establish larger colonies. The dual role of protonemal gemmae and spores could neatly explain the dramatic natural population fluctuations we have observed. In order to test this hypothesis, efforts should be made to search for the production of protonemal gemmae in wild populations.

Future conservation of *Seligeria carniolica*

From the new data now gathered, Lansdown (2018) concluded that the IUCN threat status of

▽Fig. 4. Grain Sike, just upstream of the public road





△Fig. 5. The Black Burn, downstream, of Blackburn Farm, showing the bedded limestone which supports *Seligeria carniolica* elsewhere

the moss in Britain should now be downgraded from Critically Endangered to Near Threatened or even Least Concern. However, all the populations of *Seligeria* grow in streams at least partly shaded by a relatively dense canopy of *Alnus* and *Fraxinus* trees and *Salix* shrubs, and the greatest threat perceived at the present time is loss of this tree cover, both by possible over-grazing with loss of regeneration of woody plants, and more insidiously by the loss of *Fraxinus* trees through Ash Dieback disease caused by the Ascomycete fungus *Hymenoscyphus fraxineus* (formerly *Chalara fraxinea*) which has recently become widespread in Northumberland and the Scottish Borders. Protection from over-grazing and appropriate native woodland restoration are measures which should be considered urgently in all four known localities.

European distribution and ecology of *S. carniolica*

Seligeria carniolica was first discovered in 1882 in Slovenia and described by Breidler & Beck

(1885) as the new genus and species *Trochobryum carniolicum*. The second report was from southern Serbia by Wettstein (1890), followed by the Lake of Zurich in Switzerland (Culmann, 1901), southern Bavaria in Germany (Poelt, 1950), Gotland in Sweden (Pettersson, 1950), Norway (Coker, 1983), Austria (Dirkse *et al.*, 1990) and France (Dirkse *et al.*, 1990; Philippe & Hugonnot, 2016; Philippe & Ochyra, 2017). The most numerous discoveries have now been made in five different regions of France (Philippe & Ochyra, 2017); in the other countries the occurrences are few and isolated. There appear to be two somewhat different habitats, firstly, as in France and Sweden, on marly limestone outcrops irrigated with water with the plants embedded in a bacterial mat encrusted with calcite crystals (Philippe & André, 2014), from sea level up to 540 m altitude; and secondly, as in Norway, Scotland and England, as a rheophyte on intermittently submerged limestone bedrock and boulders in small streams in wooded valleys from 135 m to around 900 m altitude.

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David G. Long, Royal Botanic Garden,
Inverleith Row, Edinburgh EH3 5LR
e d.long@rbge.ac.uk

Richard V. Lansdown, 45 The Bridle, Stroud,
Glos. GL5 4SQ
e rvlansdown@gmail.com