

Sematophyllum substrumosum: a rapidly changing picture

Bryophytes as indicators of climate change? Sam Bosanquet reports.

Bark Signal-moss *Sematophyllum substrumosum* is a small, straight-leaved pleurocarpous moss with a very short costa and seems, at first glance, unprepossessing and easily missed. However, it is a moss on the move, and is arguably one of the most dynamic and interesting British bryophyte species of the 21st century, giving us an insight into climate change in a way that only a handful of other bryophytes can do. This insight is significantly helped by the modelling work of Sérgio *et al.* (2011), who found parameters that largely explained the pre-1995 distribution of *S. substrumosum* with most colonies in Macaronesia and western Iberia, and then mapped the species' potential distribution under a relatively widely-accepted climate change scenario, before testing the predictions using recent observations from southern Britain, northern France, Belgium and The Netherlands. The 2020 predicted distribution reveals suitable conditions in parts of south-west England, south-west Ireland and Pembrokeshire, as well as the East Midlands, whilst the 2050 map suggests consolidation in south-west England, colonisation of south-east



△Fig. 1. *Sematophyllum substrumosum* growing with *Lophocolea heterophylla*. Sam Bosanquet

Ireland and the Hampshire/Sussex coast, and scattered penetration as far north as Lancashire and Lincolnshire. The principal predictors of the model are: 1) the average minimum temperature of the coldest month; 2) the Emberger Index¹; and 3) altitude (negatively correlated).

Observations in Britain initially backed up the model very well; indeed even the most recent records corroborate the overall prediction of a northward and north-eastward spread, however they suggest that it is happening much more rapidly than predicted, with the 2020 range largely occupied in Britain already and some records coming from 2050 areas or even further north.

The first British collection of *Sematophyllum substrumosum* was made at Kingley Vale in West Sussex in 1964. The significance of this early northern outlier was missed by Sérgio *et al.* (2011), who assumed the record related to 2004, the year of publication (Een, 2004). There are

¹ The Emberger Index combines moisture and temperature: it is the ratio between mean precipitation and the difference between squared maximum and minimum temperatures for a certain time period.



△ Fig 2. *Sematophyllum substrumulosum* habitat at Mescoed Mawr, Monmouthshire. Sam Bosanquet

many similar northern outliers of Mediterranean mosses in Britain, and it is assumed that Kingley Vale provided suitably warm, frost-free, damp conditions thanks to its abundant Yew trees (*Taxus baccata*), along with the moss' favoured substrate of conifer bark or conifer logs. The next record came from the Scilly Isles in 1996, and *S. substrumulosum* was established on all of the main islands of the Scillies by 2003 (Holyoak & Paton, 2005). It is now abundant on wooden benches as well as logs at its original Scilly site on Tresco, and has clearly increased in abundance there in the last decade (SDSB pers. obs., 2012). The first known mainland Cornish site was Par in 2004, and this was followed by others at St Just-in-Roseland in 2005 and two sites on the Lizard Peninsula in 2006, and the species had reached Kingswear in South Devon by 2008. The first Welsh records were from two woods in coastal Pembrokeshire in 2006, and the first Irish collection, from Muckcross in Co. Kerry in 2005, was followed by three more records from islands in Co. Kerry between 2006 and 2008.

With the exception of the West Sussex outlier, all of the preceding records fit the modelling of Sérgio *et al.* (2011) well because they lie within the zones considered suitable by 2020. The first hint of more rapid change came in late 2011, when *S. substrumulosum* was found on a log in a conifer plantation in inland Monmouthshire: an

area that was not predicted to be suitable until after 2020 (but before 2050). The same is true of Co. Wexford in south-eastern Ireland, but conscious searching for *Sematophyllum* there in 2012 produced four records from three hectads, and at the last two sites it was discovered as soon as the first decorticated conifer logs with *Lophocolea heterophylla* were located. An even more dramatic discovery was a population in forestry just south-west of Coleraine in Co. Londonderry in summer 2012, some 300 km north of any other records. This opens up the possibility of *S. substrumulosum* being present in much of lowland Ireland, Wales and England, or perhaps even south-west Scotland. Again, the key to finding this colony was searching for decorticated conifer logs with *L. heterophylla* and then scrutinising the *Lophocolea* patches for moss sporophytes. The same tactic yielded a second Monmouthshire record, 20 km from the first, in late 2012 (Figures 1 & 2) and a first Carmarthenshire record from a plantation some 25 km from the coast. There have been failures despite deliberate searching at three other sites in Carmarthenshire, one in Glamorgan, one in Pembrokeshire, two in West Sussex and one in Denbighshire in north-east Wales, and upland-edge plantations certainly seem unsuitable in south Wales at present. The habitat preferences of the species were expanded slightly further

by the discovery of a second Carmarthenshire colony on at least eight gorse bushes on the edge of a coastal spruce plantation: a situation reminiscent of some *Daltonia splachnoides* sites in south-west Ireland. A final northern outlier was found in December 2012 in a coastal conifer plantation next to the Menai Straits on Anglesey. When *Sematophyllum substrumosum* was first found on Tresco, there were suggestions that it might have been introduced. The 1964 Sussex record, subsequent observations from England, Wales and Ireland, and documented northward spread through Europe all indicate that natural colonisation is considerably more likely than accidental importation to the Scilly Isles. Sérgio *et al.* (2011) point out that a small spore size (12 µm) and abundance of sporophytes make *S. substrumosum* a very effective colonist: like most epiphytes, it needs to move from host tree to host tree, and in this case also from decaying log to decaying log. As environmental conditions further north have become more suitable for *Sematophyllum*, both through climate change and widespread conifer plantation, so spores arriving in Britain and Ireland have been able to grow and reproduce more widely.

The problem with using *Sematophyllum* as an indicator of climate change, is that it is considerably smaller and more easily overlooked than Great White Egret [which bred for the first time in Britain in 2012 having colonised The Netherlands in recent decades] or even Small Red-eyed Damselfly [which is now found throughout much of England as far north as Yorkshire and as far west as Cornwall, having arrived as recently as 1999]. The lack of records from an area cannot be taken as genuine absence until somebody has consciously sought the species, so a concerted effort by BBS members to locate *S. substrumosum* in their area would be extremely useful. The first Scillonian records came from the

bark of a fallen pine and from living *Pinus*, but most subsequent records are from decorticated conifer logs and this is the easiest habitat to search. A key thing to remember about *S. substrumosum* is that its sporophytes are very small, so although their shape is reminiscent of *Rhynchostegium confertum* they are about half the size. Patches of pure *Sematophyllum* on a log are usually a glossy, bronzy colour, but despite the general abundance of sporophytes, it often takes a second glance to actually see the tiny spore capsules and know that you are not just looking at a *Hypnum*. Plants growing among *L. heterophylla* are even more difficult to spot, and it is clear that *S. substrumosum* is a moss that needs to be consciously sought.

An accurate picture of the distribution of *Sematophyllum substrumosum* now will help to put future colonisation into context, and may reveal a wider range than we currently realise. I would be grateful for any records of *S. substrumosum* from Britain and Ireland, and also for information on localities that have been specifically searched without success.

References

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