

Orkney's arable bryophytes

Chris Preston, John Crossley and Mark Hill take a first look at the bryophytes of Britain's most northerly arable fields

The geology of Orkney is predominantly Old Red Sandstone and all the islands except Hoy have a flat and fertile terrain which differs markedly from that of most other islands in northern Scotland, whether in the Hebrides to the west or in Shetland to the north. Orkney is therefore unusually suitable for arable agriculture. The archaeological evidence demonstrates that arable cultivation was undertaken in a mixed farming system alongside livestock husbandry and fishing from the Neolithic onwards (Ritchie, 1995). A revealing description of farming in the Viking era is given in the *Orkneyinga Saga*, which describes the life style of Svein Asleifarson in the 12th century:

This is how Svein used to live. Winter he would spend at home on Gairsay, where he entertained some eighty men at his own expense. His drinking hall was so big, there was nothing in Orkney to compare with it. In the spring he had more than enough to occupy him, with a great deal of seed to

sow which he saw to carefully himself. Then when that job was done, he would go off plundering in the Hebrides and in Ireland on what he called his 'spring-trip', then back home just after mid-summer, where he stayed till the cornfields had been reaped and the grain was safely in. After that he would go off raiding again ... This he used to call his 'autumn-trip' (translated by Pálsson & Edwards 1981, p. 215).

Archaeological sites from this period such as that at Beachview, Birsay, have abundant carbonised grains of oats, both *Avena sativa* and *A. strigosa*, and six-rowed barley, *Hordeum vulgare* (Morris, 1996). Arable agriculture continues as part of the farming system in Orkney to this day, although the modern farmers, unlike Svein, combine it with other more peaceful agricultural activities.

The only description we have traced of Orkney's arable bryophytes is in the report of the BBS summer meeting on Orkney in the



◁Fig. 1. Recording arable bryophytes at Stonehall, Deerness. All photos by CDP.

first week of September 1974. Appleyard (1975) reported that “although several crop fields were searched during the meeting they were found to be virtually devoid of bryophytes”. There is a contrast implied here with the bryologically rewarding fields which had been visited the previous week in Caithness and West Sutherland on the adjacent mainland (Long, 1975). We did not include any arable fields from Orkney in the Survey of the Bryophytes of Arable Land (SBAL) conducted by the BBS in 2001–05 (Preston *et al.*, 2010). Ever since the SBAL project, CDP has wanted to look at Orkney’s arable fields and he eventually made it to the archipelago in February 2018. He managed seven days fieldwork (21–27 February), joined on two days by JC, until snowy weather (‘the Beast from the East’) put a stop to the study. In this article we present the results, and compare them to those obtained from fields sampled in Caithness during the SBAL survey. Is there any evidence to indicate that the arable

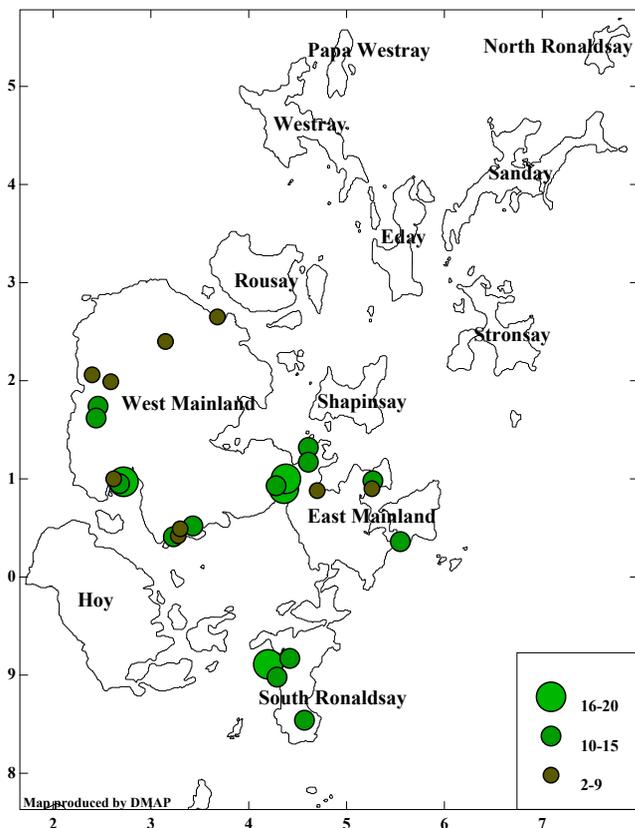
flora of the two areas is really as different as the BBS meeting report suggests?

Farming in present-day Orkney

The BBS meeting in Orkney and Caithness in 1974 came at a time of change in farming in the far north. Many more and smaller holdings then existed, and a greater variety of crops with their attendant methods and seasons for cultivation were grown; harvest was often still carried on with labour-intensive methods rather than with combine-harvesters. All this was being replaced by more modern systems and thorough mechanisation. By the end of the 1970s the process was virtually complete. Today, farming in Orkney is dominated by beef cattle rearing, with a few dairy farms, and sheep on the more marginal ground. A lot of feed is required for livestock housed over the long winters, and with supply chains being long and expensive, and the soil fertile, almost all of it is home-grown in the islands. Most of this is silage, but cereals too, almost all barley, are grown in some quantity (nearly 4,000 hectares in 2018), making for a landscape surprising for any visitor expecting more of the north-west Highlands. Those long winters are too harsh for autumn-sown crops to thrive, so spring-sowing is the norm, with stubbles left over winter after a September–October harvest. Hence the area of potential habitat for arable bryophytes is considerable, although one could assume that the former systems would have offered more variety of habitat.

Bryophytes of the Orkney fields

Our fieldwork on Orkney was restricted to two of the larger islands, Mainland and South Ronaldsay. We identified the main areas of arable agriculture from aerial views on ‘Google Earth’ and from JC’s personal knowledge of



△Fig. 2. Map of Orkney, showing the sites of the sampled fields with the number of taxa recorded in them. The 10-km grid squares are shown along the edge of the map.

the islands. We then aimed to sample fields in as many different 10-km squares as possible, to give a broad coverage of these islands. We visited 26 fields in ten hectads, recording 1–4 fields per hectad (Figs 1, 2). Fields were chosen without prior knowledge of their arable flora, and recorded (whether or not they appeared to be species-rich) using the same recording form and methods as the SBAL project (Preston *et al.*, 2010). If fields were relatively homogeneous we recorded the entire field, but where the edges and the interior of the fields differed we recorded just the edges.

The rather uniform geology of the islands, with soils largely derived from glacial till overlying the Old Red Sandstone bedrock, was reflected in the narrow range of soils in the fields we surveyed, most of which were mildly acidic loams. We measured a pH between 6.0 and 6.9 at 19 of

▽Fig. 3. Arable field by Bay of Myre, Orphir. The conspicuous car has been abandoned by the field in an attempt to deter grazing geese.



Table 1. Taxa recorded from the Orkney arable fields in 2018, with the number of the 26 recorded fields in which they were found. Taxa present in ten or more fields are highlighted in bold.

<i>Anthoceros punctatus</i> (4)	<i>Bryum violaceum</i> (9)	<i>Kindbergia praelonga</i> (26)
<i>Barbula convoluta</i> (18)	<i>Calliergonella cuspidata</i> (2)	<i>Leptobryum pyriforme</i> (4)
<i>Barbula unguiculata</i> (5)	<i>Ceratodon purpureus</i> (8)	<i>Marchantia polymorpha</i> (2)
<i>Brachythecium mildeanum</i> (2)	<i>Cratoneuron filicinum</i> (3)	<i>Oxyrrhynchium bians</i> (12)
<i>Brachythecium rivulare</i> (1)	<i>Dicranella schreberiana</i> (10)	<i>Phaeoceros</i> (2)
<i>Brachythecium rutabulum</i> (24)	<i>Dicranella staphylina</i> (22)	<i>Phascum cuspidatum</i> (2)
<i>Bryum argenteum</i> (3)	<i>Didymodon insulanus</i> (2)	<i>Pleuridium acuminatum</i> (2)
<i>Bryum dichotomum</i> (4)	<i>Drepanocladus aduncus</i> (1)	<i>Pleuridium subulatum</i> (3)
<i>Bryum klinggraeffii</i> (7)	<i>Ephemerum minutissimum</i> (4)	<i>Poblia camptotrachela</i> (1)
<i>Bryum rubens</i> (24)	<i>Fossombronia</i> (6)*	<i>Poblia wahlenbergii</i> (2)
<i>Bryum ruderales</i> (4)	<i>Funaria hygrometrica</i> (17) †	<i>Pseudephemerum nitidum</i> (2)
<i>Bryum sauteri</i> (7)	<i>Homalothecium sericeum</i> (1)	<i>Rhytidiadelphus squarrosus</i> (5)
<i>Bryum subapiculatum</i> (2)	<i>Hypnum cupressiforme</i> (1)	<i>Tortula truncata</i> (24)
		<i>Trichodon cylindricus</i> (21)

* Fruiting *Fossombronia* in one field was identified as *F. pusilla* but the rest were vegetative plants.

† Includes 11 fields in which only vegetative plants were recorded, some of which may have been other species of Funariaceae.

the 26 fields, whereas six were more acidic (pH 5.4–5.9). There was just one more calcareous field, pH 7.4, where there was clearly a mixture of sand in the soil. All but two of the fields we surveyed had stubble of spring-sown barley, with standing crops sown to provide food for birds in the other two (oats mixed with Brassicas in one, oats with a seed-mix in the other). The cover of vascular plants differed greatly between stubble fields, but was often high. Some of the fields with a high grass cover (60–75%) had been or were being lightly grazed by sheep or, in one case, by four horses and ponies. Other fields had virtually no vascular plants. Numbers of greylag geese in Orkney are high and there was clear evidence that geese had visited some of the grassier fields (Fig. 3). Indeed, when CDP asked permission to bryologise on one farm he was welcomed on the grounds that he would scare the geese.

The cover of bryophytes in the fields was never

high. The SBAL methodology estimates the percentage of bryophytes on the ground which is not covered by vascular plants or trash and in the Orkney fields this area had 5% bryophyte cover or less in 23 of the 26 fields, with the remaining 95% or more being bare soil. In the remaining three fields 10–20% of the available ground was occupied by bryophytes. Despite these low cover values, the fields were certainly not “virtually devoid of bryophytes”. Forty species (or additional genera unidentifiable to species) were recorded in the fields (Table 1). The mean species count was 12, with most fields supporting between 7 and 17 species. The richest field, at Bu of Cairston, had 20 species. Despite much variation, the number of bryophyte species showed a small but just significant decline with increasing vascular plant cover. The generalist pleurocarps *Brachythecium rutabulum* and *Kindbergia praelonga* and the more specialised



◁Fig. 4. The edge of this field E. of Naverndale, Stromness, had a good population of *Anthoceros punctatus* growing amongst *Poa annua* but the rest of the field was virtually bryophyte-free.

ephemerals *Bryum rubens*, *Dicranella staphylina*, *Tortula truncata* and *Trichodon cylindricus* were present in almost all fields. Other tuberous *Bryum* species were much less frequent than *B. rubens* and even when present appeared to be very scarce in the fields. Hornworts and liverworts were infrequent. We did find *Anthoceros punctatus* in four fields (it was previously known from only a single Orkney site) and *Phaeoceros* in two (although the material could not be identified as *P. carolinianus* or *P. laevis*, neither of which are recorded from Orkney). One factor restricting the growth of hornworts may be drought, as there is little shelter in the fields and the thalli appeared to be drying out on the bright but windy days on which we were recording. *Fossombronina pusilla* was confirmed from one field and was new to Orkney but we failed to find any *Riccia* species (the only species known from Orkney is *R. cavernosa*, on coastal dunes).

In many fields there was a marginal strip along one or more edges which was considerably more bryophyte-rich than the rest of the field (Fig. 4). In some cases there was no obvious reason for the difference, but in other fields the distribution

of the bryophytes appeared to be determined by the microtopography of the soil surface. In the species-rich field at Bu of Cairston, for example, stubble was still upright around the edge and the soil had a varied microtopography with visible lumps and a friable surface. By contrast the stubble in the rest of the field was flattened and the soil surface compressed to a uniform plane surface (Fig. 5) and these large areas held very few bryophytes.

Comparison with the arable of Caithness

The 26 Orkney fields can be compared to 19 fields recorded in Caithness (v.c. 109) for the SBAL project by S.D.S. Bosanquet, E.M. Kungu and C.D.P. on 28–31 January 2005 (Bosanquet *et al.*, 2005). Caithness is geologically similar to Orkney. The fields in Caithness were rather more acidic than those in Orkney, with a mean pH of 5.8 rather than 6.3 and a range of 4.9–6.9. Although we visited fewer fields in Caithness we recorded more bryophytes in total, 45 rather than 40, although the average number per field was similar (11 in Caithness compared to 12 in Orkney).

For the purposes of analysis, species were coded as follows: rare=3, occasional=4, frequent=5, abundant=6. The data were ordinated by Decorana (Figs 6, 7). There is clearly a general similarity between the fields in the two areas. The Orkney fields 23 and 24, which are the most removed from the Caithness fields, are characterised by *Bryum klinggraeffii* (only 2 Caithness records), *Drepanocladus aduncus* (unique to field 23), *Marchantia polymorpha* (only present in these two fields) and *Phaeoceros* (field 24, absent in Caithness). They are not otherwise exceptional. The Caithness fields 33 and 34 are characterised by *Dicranella rufescens* (only present in these two fields) and *Pohlia camptotrachela* and *P. lescuriana* (each only in one other field). Field 38 is totally exceptional, with wetland species *Amblystegium radicale*, *Brachythecium rivulare*, *Philonotis fontana* and *Warnstorfia fluitans*. None of these except *B. rivulare*, which occurred in one Orkney field, was found elsewhere.

There is no marked separation of the species more frequent in Orkney (Fig. 7). On the other

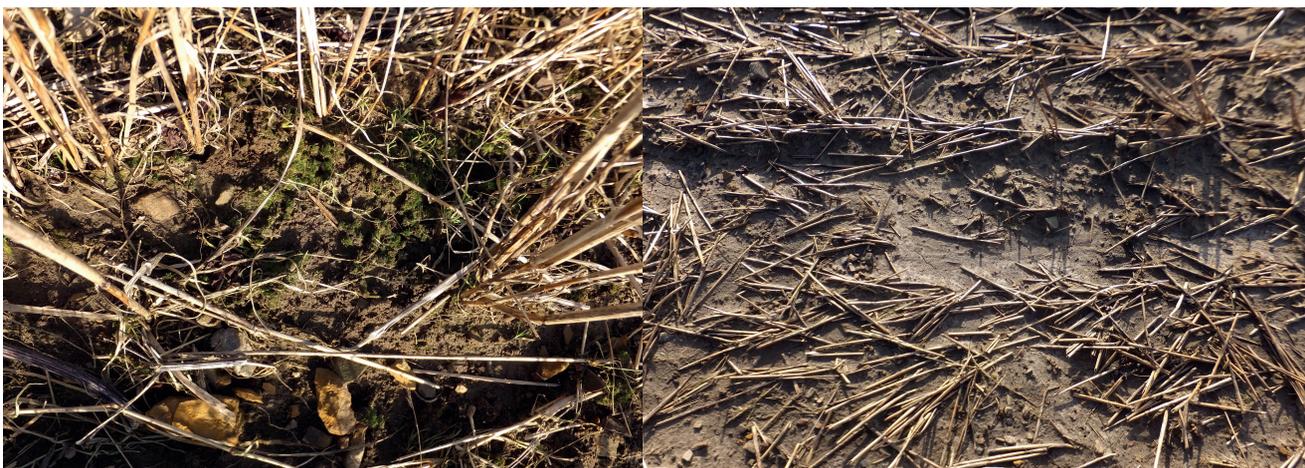
hand *Atrichum undulatum*, *Didymodon insulanus*, *Ephemerum* spp., *Pleuridium subulatum* and *Pseudephemerum nitidum* were more frequent in Caithness, accounting for the absence of Orkney fields from the lower left part of the arable field ordination.

In the national context, all but two of the Caithness fields were allocated to the *Tortula truncata*-*Anthoceros* assemblage by Preston *et al.* (2010), the most northerly of the six assemblages recognised from Britain and Ireland, and the Orkney samples also fit into this group. The differences discussed above should therefore be seen in the context of this overall similarity.

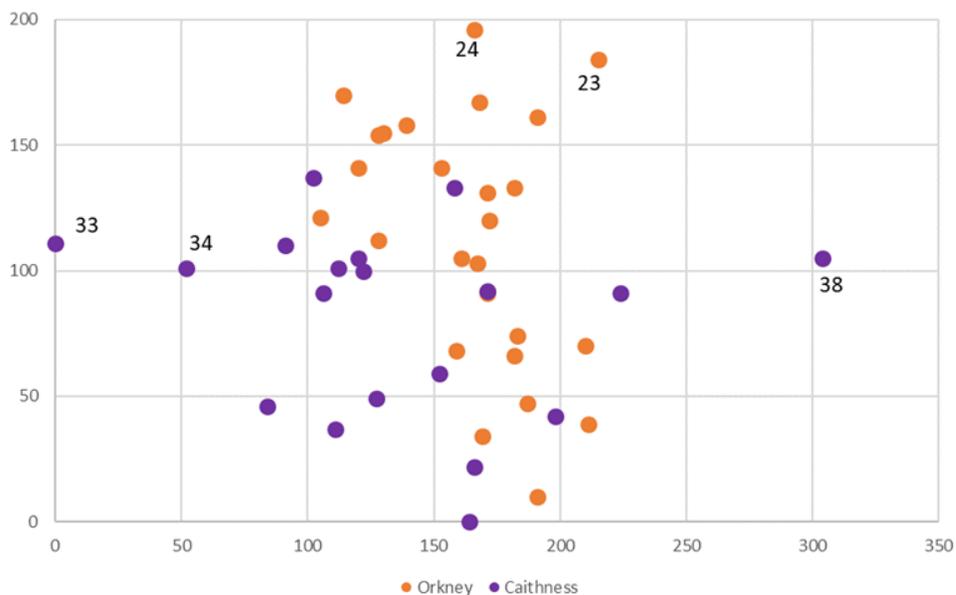
Conclusions

It is something of a paradox that the diversity of bryophytes in arable fields in Britain and Ireland is lowest in the areas in the south and east where there is most arable land, and increases towards the north and west where arable is less frequent. The explanation for the paradox presumably lies in the differing climatic requirements of cereals, which are derived from ancestors from warmer

▽ Fig. 5. The edge of this field at Bu of Cairston had escaped compression (left) whereas the soil surface elsewhere in the field was clearly compacted and had very few bryophytes (right).

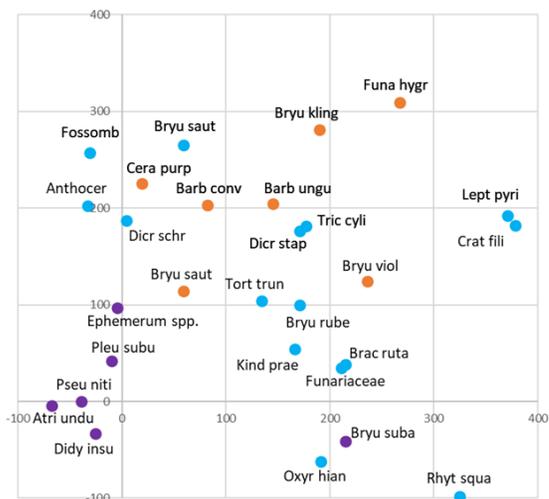


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△Fig. 6. Decorana ordination of arable fields in Orkney and Caithness. The more extreme fields 23 and 24 (Orkney) and 33, 34 and 38 (Caithness) are discussed in the text.

▽Fig. 7. Decorana ordination of the more frequent species in Orkney and Caithness. Species that are at least twice as frequent in Orkney as Caithness are orange, those at least twice as frequent in Caithness as Orkney are purple. The others are shown in blue. The full names of the species are listed in Table 1, except for *Atrichum undulatum*, which was not found in Orkney.



climates than ours, and bryophytes, which are most diverse in the cooler and wetter areas of our islands. This is doubtless reinforced by the decreasing proportion of autumn- as opposed to spring-sown crops in the north and west.

Despite this general trend, the evidence from Caithness and Orkney suggests that there comes a point where the diversity of arable bryophytes eventually falls away as one moves north. There were 38 fields recorded in N.E. Scotland south of Caithness in the SBAL survey (in 100-km squares NH, NJ and NK, from Inverness to Aberdeen) and these were notably richer than those further north, with an average of 16 species per field. A striking difference was the virtual absence of species-poor fields in the more southerly samples, with only two of the 38 fields having fewer than 10 species compared with 16 fields out of 45 in Caithness and Orkney. The richest fields were also more species-rich further south, with eight fields having 20 or more species (to a maximum of 34) compared with just one field with 20 species in Orkney and none in Caithness. The absence of the characteristic arable *Riccia* species from Orkney has already been noted; these were also absent from the Caithness fields but both species were present further south (*R. sorocarpa* in 22 fields and *R. glauca* in 10). Otherwise the major differences lie not in the absence of characteristic arable species from Caithness and Orkney but in the reduced frequency of species such as *Bryum argenteum*, *B. subapiculatum*, *Phascum cuspidatum*, *Pohlia camptotrachela* and *P. wahlenbergii*.

Despite the experience of the BBS meeting in 1974, the arable fields of Caithness and Orkney are broadly similar. The differences between them are usually subtle, although there are quirky fields in Caithness which had no parallel in the more mundane Orkney fields we visited. It is not clear to us why this should be so, but

perhaps one reason may be that the Orkney fields are often surrounded by bryophyte-poor grassland or by the sea rather than by a range of more bryophyte-rich habitats.

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