Proc. Univ. Bristol Spelaeol. Soc., 2003, 23 (1), 27-34

THE FLORA OF POULNAGOLLUM POT, Co. CLARE, IRELAND

by

SHARON PILKINGTON

ABSTRACT

A survey of the entrance pitch of Poulnagollum Pot found several distinctive vegetation sub-communities occupying different biophysical zones. These communities were found to be in stark contrast to the vegetation on the nearby surface, being defined by a rich variety of mosses, liverworts and woodland field-layer plants, and resembling the field and ground layers of semi-natural Ash climax woodland. After analysis of data collected in 2002, it was suggested that variation in the vegetation sub-communities was attributable to local but significant differences in soil reaction and water availability.

INTRODUCTION

The Burren area of County Clare in western Ireland is deservedly famous for its flora. Its ecology has been well studied over the years, and the region continues to attract countless botanists and nature lovers from all over the world. Nowhere else does the vegetation seem to combine so many disparate elements. Here, characteristic plants of limestone pavement e.g. Dog's Mercury *Mercurialis perennis* and Hart's-tongue *Phyllitis scolopendrium* form local assemblages with maritime species such as Sea Spleenwort *Asplenium marinum* and Buck's-horn Plantain *Plantago coronopus*. British mainland rarities including Shrubby Cinquefoil *Potentilla fruticosa* and Spring Gentian *Gentiana verna* mingle with arctic-alpine species that are normally confined to upland Britain (e.g. Mountain Avens *Dryas octopetala* and Mountain Everlasting *Antennaria dioica*). The area has remained more or less untouched by the agricultural changes that have contributed to an enormous decline in the occurrence and abundance of many British species elsewhere since the end of the Second World War.

In caving circles, the Burren is well-known for its active stream caves. The cave considered in this study was Poulnagollum Pot, the largest cave system in the region. Its funnel-shaped entrance shaft lies in a meadow on the eastern flank of Slieve Elva, at an altitude of 225 m (grid reference M1610 0375) and approximately 4 km inland of the coastal village of Craggagh. The pot takes a small stream at its northern end, and the bottom of the entrance pot is more than 10 m below the meadow.

To set the vegetation community of the cave entrance in context, it is necessary to first describe the surrounding vegetation, which is strongly defined through its underlying geology. Poulnagollum Pot lies close to the boundary between the Clare Shales, which outcrop on the upper slopes of Slieve Elva, and the underlying Carboniferous Limestone, which dominates the landscape of the Burren, forming extensive sheets of limestone pavement.

Limestone grassland

A species-rich short sward was found in the meadow between the road and the cave. Shallow rendzina soils over limestone supported a calcicolous vegetation community that most closely approximates to the *CG9 Blue Moor-grass – Limestone Bedstraw grassland* community

in the British National Vegetation Classification (NVC) though strictly speaking the NVC does not extend to Eire.

NVC has been a standard means of classifying British vegetation since the 1990s. It qualifies plant communities in terms of their species composition and relative abundance, and is widely used by botanists as a tool to describe the ecological importance of local plant populations.

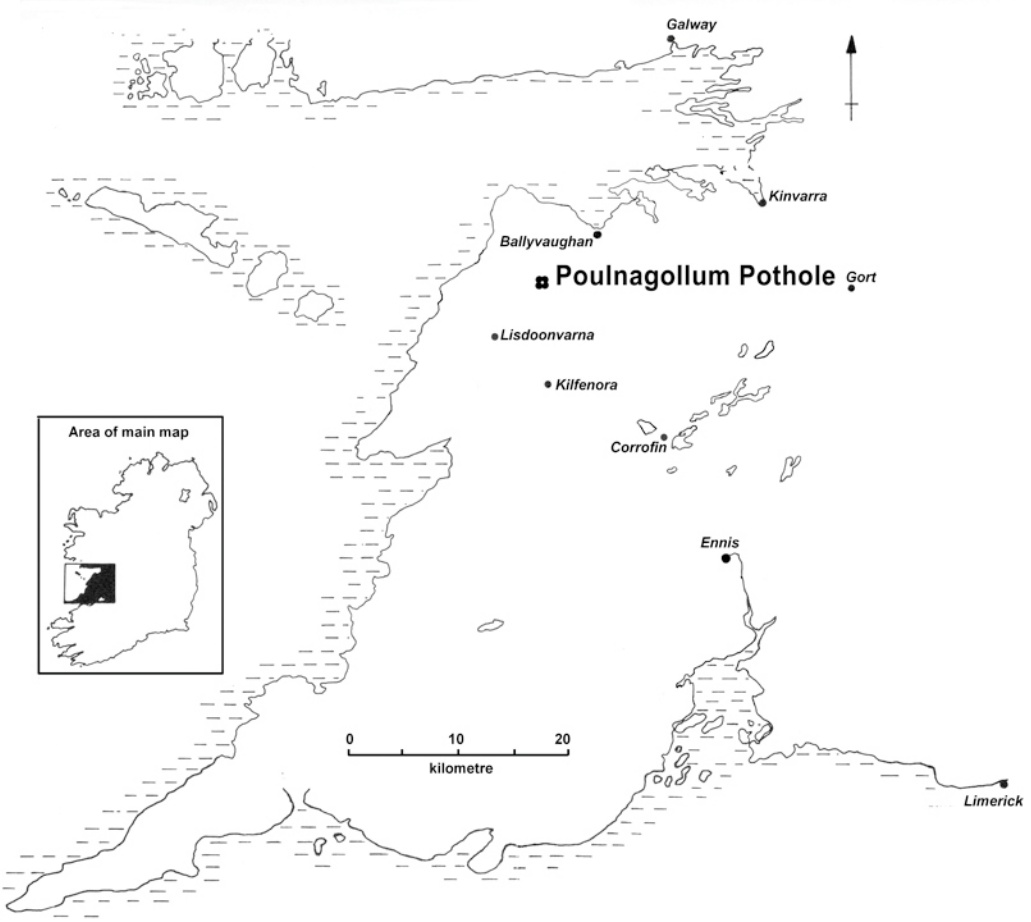

Figure 1. *Location Map.*

CG9 is a highly distinctive and local community with constant limestone grassland indicator species including Quaking-grass *Briza media*, Sheep's Fescue *Festuca ovina*, Common Rock-rose *Helianthemum nummularium*, Limestone Bedstraw *Galium sterneri* and Blue Moor-grass *Sesleria caerulea* with its distinctive dark blue inflorescences. On the British mainland, the CG9 community is confined to the Carboniferous Limestone of the Morecambe Bay area, to the Craven district of North Yorkshire, and to the borders of Cumbria, Durham and North Yorkshire around Upper Teesdale (Rodwell, 1992). Many rare species occur in this turf, including, in the Burren and Teesdale only, the diminutive and beautiful Spring Gentian *Gentiana verna,* which was noted growing on rock ledges within a few metres of Poulnagollum Pot in 2002.

Moorland

Shale on the upper slopes of Slieve Elva was clearly defined by a very different vegetation, dominated by ericaceous shrubs especially Ling *Calluna vulgaris* and Bilberry *Vaccinium myrtillus*, along with typical moorland mosses such as Red-stemmed Feather-moss *Pleurozium schreberi* and Heath Plait-moss *Hypnum jutlandicum*. As a general rule, heathland communities are relatively species-poor, and this was no exception. In terms of the NVC, it is likely that the moorland close to Poulnagollum Pot would be referable to the *H12 Ling – Bilberry heathland* community that is widespread throughout sub-montane Britain (Rodwell, 1991b).

THE STUDY AREA

During the study in 2002 in the entrance shaft of Poulnagollum Pot a vegetation quite different from either surface community was at once evident. Away from a well-trodden caver's path entering the pot from the south and descending to the bottom, a lush carpet of ferns and mosses dominated in the humid, sheltered conditions. Observation of the variation of distribution of the plants in the pot led directly to the main objective of the current survey, namely:

> *To evaluate the distribution of plant species within the entrance pot in terms of different biophysical conditions*.

Vegetation was present throughout the entrance shaft nearly all the way to the bottom (more than 10m below ground level) where light was very limited, growing on muddy slopes and near-bare rock faces:

Mud breakdown slope

With a northerly aspect, and a gradient of up to 45°, the slope consisted of a deep viscous mud formed of shale breakdown products and decomposing organic matter. A similar, but much steeper and inaccessible slope was also present at the northern end of the pot.

Limestone rock faces

Near-vertical limestone walls were also covered in vegetation, where soil derived from shale and/or organic matter had become trapped in pockets and cracks, enabling colonisation to take place. Thalloid liverworts and trailing or mat-forming bryophytes were a dominant feature of these cliffs. On the eastern wall, lime-rich water irrigated the rock-face from above; the other rock faces were wetted by frequent rainfall, and kept moist by the very high humidity in the cave entrance.

EXPERIMENTAL DETAILS

Field survey was undertaken in May 2002, when conditions were favourable for access, and at a time of year when most species were readily identifiable. Species were either identified in the field, or, in the case of some bryophytes, positive identification was made only after detailed examination of microscopic characters.

In this account, vernacular and systematic names of higher plants follow Stace (1997). All names of mosses and liverworts follow the nomenclature currently adopted by the British Bryological Society.

Field Survey Method

Twenty quadrats, each measuring 1 m x 1 m, were placed in accessible locations within the entrance pitch; the location and broad biophysical characteristics of each quadrat area were also noted.

Aerial cover of different species found in each quadrat were estimated using a percentage scale.

Data analysis

Sample data was first entered in VESPAN II, a database designed specifically for use with British vegetation (Malloch, 1988). It was then analysed by TWINSPAN (Two-way Indicator Species Analysis) (Kent and Coker, 1992) to divide the samples into groups with similarities in terms of species composition and cover. Finally, the combined data for each of the artificial groups of samples produced by the TWINSPAN analysis were entered into MATCH II (Malloch 1996) and referred to plant communities described in British Plant Communities (Rodwell 1991a) in order to attempt NVC classification of the entrance pot communities.

THE DATA

In total, 23 species of higher plant and 17 bryophytes (mosses and liverworts) were recorded in the survey (Table 1). An additional nine species did not occur in any of the quadrats, but were found in small numbers in the entrance pot; these have been assigned a frequency of 0 in Table 1.

Vernacular name	**Systematic name**	**Frequency** (quadrats)*
Higher plants		
Bramble	*Rubus fruticosus* agg.	2
Brittle bladder-fern	*Cystopteris fragilis*	6
Bush Vetch	*Vicia sepium*	0
Common Dog-violet	*Viola riviniana*	0
Common Sorrel	*Rumex acetosa*	0
Common Valerian	*Valeriana officinalis*	1
Daisy	*Bellis perennis*	0
Dandelion	*Taraxacum* sp.	0
Great Wood-rush	*Luzula sylvatica*	14
Hart's-tongue	*Phyllitis scolopendrium*	15
Herb-robert	*Geranium robertianum*	1
Hogweed	*Heracleum sphondylium*	7
Intermediate Polypody	*Polypodium interjectum*	1
Ivy	*Hedera helix*	6
Lady Fern	*Athyrium filix-femina*	8
Lesser Celandine	*Ranunculus ficaria*	7
Lords-and-Ladies	*Arum maculatum*	1
Meadowsweet	*Filipendula ulmaria*	14
Opposite-leaved Golden-saxifrage	*Chrysosplenium oppositifolium*	17
Primrose	*Primula vulgaris*	1
Sanicle	*Sanicula europaea*	4
Scaly Male-fern	*Dryopteris affinis*	0
Self-heal	*Prunella vulgaris*	0

Vernacular name	Systematic name	Frequency (quadrats)*
Higher plants		
Soft Shield-fern	*Polystichum setiferum*	1
Tutsan	*Hypericum androsaemum*	0
Water Avens	*Geum rivale*	2
Wavy Bitter-cress	*Cardamine flexuosa*	1
Wild Strawberry	*Fragaria vesca*	3
Willowherb	*Epilobium sp.*	4
Wood Avens	*Geum urbanum*	13
Wood Sedge	*Carex sylvatica*	0
Wood-sorrel	*Oxalis acetosella*	10
Lower Plants		
Chalk-comb Moss	*Ctenidium molluscum*	1
Common Feather-moss	*Eurhynchium praelongum*	14
Common Pocket-moss	*Fissidens taxifolius*	10
Common Tamarisk-moss	*Thuidium tamariscinum*	7
Curled Hook-moss	*Palustriella commutata*	1
Dotted Thyme-moss	*Rhizomnium punctatum*	10
Endive Pellia (a liverwort)	*Pellia endivifolia*	12
Fox-tail Feather-moss	*Thamnobryum alopecurum*	20
Greater Featherwort (a liverwort)	*Plagiochila asplenoides*	8
Hart's-tongue Thyme-moss	*Plagiomnium undulatum*	15
Many-fruited Thyme-moss	*Plagiomnium affine*	7
Pointed Spear-moss	*Calliergonella cuspidata*	6
Prickly Featherwort (a liverwort)	*Plagiochila spinulosa*	9
Rough-stalked Feather-moss	*Brachythecium rutabulum*	11
Shining Hookeria (a moss)	*Hookeria lucens*	4
Slender Mouse-tail Moss	*Isothecium myosuroides*	1
Transparent Fork-moss	*Dichodontium pellucidum*	6

Table 1. *Plant species recorded in Poulnagollum Pot*.
*** Frequency is the total number of quadrats (out of 20) in which a species was recorded.**

RESULTS OF ANALYSIS

TWINSPAN analysis divided the twenty samples into four artificial groups based on similarities in species composition and abundance (for details of the divisions, see Appendix I). These groups are given in the lower of the two rows of ones and zeroes below the table. Quadrats (numbered from 1 to 20) are listed in the two top rows above the table (reading the numbers from top to bottom). In this analysis, TWINSPAN divided the data to give four groups of quadrats:

Group A: Quadrats 11,13,14 and 15.
Group B: Quadrats 1,2,3,4,5,6,7,8 and 12.
Group C: Quadrats 16,17,18,19and 20.
Group D: Quadrats 9 and 10.

Attempts to classify these groups in terms of NVC communities or sub-communities were not wholly satisfactory. MATCH gave low coefficients of similarity (between 24.8 and 34.5) to the data-sets and 'best match' NVC communities, suggesting poor affinities with standard NVC types. Woodland communities gave the closest match, with the best being the W8e Ash-Field Maple-Dog's Mercury woodland (Herb Robert sub-community). This is a widespread natural woodland climax community with a predominantly western and/or northern distribution on the mainland. Its distribution in Ireland is not known. The match was very poor as a direct consequence of the lack of woodland canopy and shrub understorey species present in the samples taken.

DISCUSSION AND CONCLUSIONS

TWINSPAN analysis divided the samples into four groups. These groups broadly reflected biophysical differences within the cave. While samples within Groups A and B were collected on the muddy breakdown slope, those in Groups C and D were confined to the sheer rock walls of the pitch. The latter two groups were taken from rock faces on different walls of the pot. Group C samples corresponded to a wet rock-face continually irrigated by a trickle of water from above, and were dominated by large mossy tufts and Endive Pellia *Pellia endivifolia* (a thalloid liverwort). Group D samples, in contrast, were taken on a damp, but non-irrigated wall covered with muddy breakdown products and humus and dominated by Great Wood-rush *Luzula sylvatica* and ferns.

Environmental factors distinguishing Groups A and B were more difficult to identify, and may have been related more to subtle differences in soil reaction. The mud/humus substrate was likely to be neutral to slightly acid in reaction, and deep enough to mask the high pH typical of the underlying limestone. The slightly acid nature of rainfall is likely to further reduce the soil reaction in the root zone.

Both groups supported a distinctive acid woodland flora, dominated by abundant Great Wood-rush and Opposite-leaved Golden-saxifrage *Chrysosplenium oppositifolium*, with occasional ferns and a dense mossy underlayer, characterised especially by the large dendroid Fox-tail Feather-moss *Thamnobryum alopecurum*.

Poulnagollum Pot supported a shade-tolerant, bryophyte-rich flora in contrast to the herb-dominated limestone turf and shrubby moorland above. No rarities were recorded during the survey. That its vegetation was so different is a consequence of the microclimate afforded by the deep, sheltered entrance pot. Within the pot, air temperature and humidity are kept within a narrower range of values in comparison to the open hillside, and the desiccating winds which scour much of the Burren throughout the year are absent.

Leaves of most mosses and leafy liverworts are only one cell thick, and so they need constantly high humidity to prevent desiccation. Poulnagollum Pot supports species with a wide range of tolerance. For example, some common mosses e.g. Common Feather-moss *Eurhynchium praelongum* can survive frequent cycles of desiccation and re-hydration, and consequently are found in a wide range of habitats. Many of the bryophytes found in the survey have a physiological need to be more or less continually irrigated with water e.g. Shining Hookeria *Hookeria lucens*, and Curled Hook-moss *Palustriella commutata* (Watson 1981). These species were mainly restricted to irrigated rock-faces or the wetter parts of the muddy slope.

That many of the plants found in the survey are more normally associated with damp western woodlands is not surprising. Species like Sanicle *Sanicula europaea*, Wood Avens *Geum urbanum*, Wood Sorrel *Oxalis acetosella* and Opposite-leaved Golden-saxifrage, as well

as many ferns, are characteristic woodland species. MATCH analysis of the data also pointed to a resemblance of the vegetation to the field and ground layers of the W8e NVC woodland type, which in its complete form is very rare or absent in the uplands of County Clare. Environmental conditions within the entrance pitch, reduced light, high humidity and a humus-rich damp substrate, resemble those of many semi-natural broadleaved woodlands in the higher rainfall zones of lowland Britain. Ivimey-Cook and Proctor (1966) did not include cave entrance communities in their comprehensive conspectus of the vegetation communities of the Burren. However, they did allude to the complex nature of deeply fissured limestone pavement, describing it as an intimate juxtaposition of grassland, woodland ground flora, fen and rock crevice communities. In this sense, perhaps the deep entrance to Pollnagollum Pot may best be considered as a particularly deep and large grike in the limestone.

In summary, it seems reasonable to conclude that Poulnagollum Pot offers a micro-climate that supports a highly distinctive woodland ground flora community that is rare elsewhere in the exposed, stony and relatively tree-less Clare upland landscape. It is highly likely that similar communities exist in suitable conditions elsewhere, for example in cave/shake-hole entrances, ravines and gorges in North Yorkshire, South Wales and Mendip. Such communities are unlikely to fall within the current scope of vegetation classification represented by the NVC, and are likely to merit separate description and community classification.

ACKNOWLEDGMENTS

Thanks are due to a number of people who helped in various ways with the preparation of this account. In particular, Linda Wilson, for her patient assistance with fieldwork, Jane Tibbotts for considered comments on the first draft, and to Dr Michael Keith-Lucas who was kind enough to check the text and make suggestions for improvement.

REFERENCES

IVIMEY-COOK R.B, and PROCTOR M.C.F., 1966. *The Plant Communities of the Burren, Co.Clare.* Proceedings of the Royal Irish Academy, Vol. 64, Section B. 211-302.

KENT, M., and COKER P., 1992. *Vegetation Description and Analysis*. John Wiley & Sons Ltd, Chichester.

MALLOCH A.J.C., 1988. *VESPAN II: A computer package to handle and analyse multivariate species data and handle and display species distribution data*. University of Lancaster.

MALLOCH A.J.C., 1996. *MATCH version 2 – A computer program to aid the assignment of vegetation data to the communities and subcommunities of the National Vegetation Classification*. University of Lancaster.

RODWELL J.S., (ed.) 1991a. *British Plant Communities Volume 1: Woodlands and Scrub*. Cambridge University Press, Cambridge.

RODWELL J.S., (ed.) 1991b. *British Plant Communities Volume 2: Mires and heaths*. Cambridge University Press, Cambridge.

RODWELL J.S., (ed.) 1992. *British Plant Communities Volume 3: Grasslands and montane communities*. Cambridge University Press, Cambridge.

SMITH A.J.E., 1978. *The Moss Flora of Britain & Ireland*. Cambridge University Press, Cambridge.

STACE, C.A., 1997. *New Flora of the British Isles*. Cambridge University Press, Cambridge.

WATSON, E.V., 1981. *British Mosses and Liverworts*. Cambridge University Press, Cambridge.

Sharon Pilkington
5 Gainsborough Rise, Trowbridge,
Wiltshire, BA14 9HX.

APPENDIX: TWINSPAN OUTPUT TABLE

```
   1111   1     11112 1
               13451232456786879090

 1 Arum macu  1------------------  00000
17 Poly seti  1------------------  00000
18 Prim vulg  --1----------------  00000
39 Epil sp    1-11--------1-------  00000
 9 Geum riva  -2-----1-----------  00001
12 Hera spho  -1-11111--1---------  0001
16 Poly inte  ---------1----------  00100
25 Cten moll  ------1-------------  00100
30 Isot myos  ---------1----------  00100
 2 Athy fili  -----23221-11-----1-  00101
35 Thui tama  ----1-111-11-------1  00101
 6 Fili ulma  11112-11131-1-1-11--  00110
10 Geum urba  -1111111111-1---11--  00110
11 Hede heli  1-11-1-1----------1-  00111
23 Brac ruta  1-11--1-11111-1-1---  00111
27 Eurh prae  1231-11111-1111---1-  00111
 4 Chry oppo  4111211211122---2111  0100
13 Luzu sylv  1121-11121113-----23  0100
29 Hook luce  -1--------1-1------1  0100
32 Rhiz punc  11111---11-1----1--1  0100
 7 Frag vesc  -11--------------1--  0101
20 Sani euro  -111-------------1--  0101
19 Ranu fica  ---1--1-111-----11--  011
26 Dich pell  ----111--1-----1-1--  011
28 Fiss taxi  1-1111111----11-----  011
15 Phyl scol  1-11--11-111-1111111  10
31 Plag affi  1-1--1-----1-11--1--  10
33 Plag undu  -111-111--1111-11111  10
36 Pell endi  11111-11----11121---  10
 8 Gera robe  -----------------1--  1100
22 Call cusp  1-----1-------1111--  1100
24 Crat comm  -------------1------  1100
 5 Cyst frag  ----------111-12-2--  1101
14 Oxal acet  1--1------1--1111111  1101
37 Plag spin  ---1--1---11131--1-1  1101
34 Tham alop  12111111111112114453  1110
40 Plag aspl  1111----------1--111  1110
 3 Card flex  ----------------1-  1111
21 Vale offi  -----------------1  1111
38 Rubu frut  ----------------11  1111

              00000000000001111111
              00001111111110000011
```

Sharon Pilkington
5 Gainsborough Rise, Trowbridge,
Wiltshire, BA14 9HX.