Cyfoeth Naturiol Cymru
Natural Resources Wales

Assessing the scale of Sphagnum moss collection in Wales

Jenny Wong, Bryan Dickinson & Adam Thorogood
Wild Resources Ltd & Llais y Goedwig

NRW Evidence Report No 185

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We work to support Wales' economy by enabling the sustainable use of natural resources to support jobs and enterprise. We help businesses and developers to understand and consider environmental limits when they make important decisions.

We work to maintain and improve the quality of the environment for everyone and we work towards making the environment and our natural resources more resilient to climate change and other pressures.

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- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
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Cynhwysir mwsog Migwyn yn Atodiad V o Gyfeireb Cynefinoedd sy'n mynnu y dylai Aelod-Wladwriaethau sicrhau bod eu defnydd a casgliad o samplau yn y gwyllt yn gydnaws â'u cynnal mewn cyflwr ffafriol. Mae Erthygl 17 y Gyfeireb yn ei wneud yn ofynnol i adrodd ar statws rhywogaethau bob 6 mlynedd. Disgwylir yr adroddiad nesaf yn 2017. Er mwyn rhoi tystiolaeth o raddfa'r defnydd o Figwyn, comisiynwyd arolwg o weithgarwch cynaeafu mwsogl yng Nghymru gan Gyfoeth Naturiol Cymru. Adroddir hynny yma.

Cesglir Migwyn ar y cyd â mwsogl eraill a mae'n gael ei gasglu i'w defnyddio mewn basgedi crog, torchau a defnydd mewn fifariymau a maen't yn gael eu henwi'n annibynadwy yn aml mewn masnach. Felly, i asesu Migwyn roedd yn angenrheidiol arolygu pob math o fwsoglau. Er mwyn cael trosolwg o'r gadwyn gyflenwi mwsogl i gyd, ymgymerodd yr arolwg â chyfweliadau ansoddol â chasglwyr (a enwyd weithiau'n "fwsoglwyr"), gwerthwyr (cyfanwerthu a manwerthu), perchnogion tir a rheolwyr. Cyfwelwyd rhanddeiliaid eraill fel unedau troseddau bywyd gwyllt yr Heddlu, Parciau Cenedlaethol ac ati. Paratowyd rhestrau o fwsoglwyr hysbys a nodwyd eraill gan ddefnyddio dull 'caseg eira'. Ymgymerwyd â chyfanswm o 54 cyfweliad yn 2016 a cyfunwyd y data gyda 12 cyfweliad a wnaed gan brosiect StarTree yn 2014 i roi trosolwg o weithgarwch mwsogl dros dair blynedd.

Mae cynaeafu mwsogl ar gyfer gwerthiant masnachol ar raddfa fawr yn digwydd yn bennaf o ardal Mynyddoedd Cambria a ledled canolbarth Cymru. Mae o wedi bod yng nghyfle arallgyfeirio incwm sefydledig i ffermwyr a choedwigwyr yng Nghymru ers y Rhyfel Byd Cyntaf o leiaf. Mae'r ymwybyddiaeth o sut i gasglu mwsogl, ac, yn bwysicaf oll, y cysylltiadau â chyfanwerthwyr a pherchnogion coedwigoedd, wedi cael eu trosglwyddo i lawr o fewn teuluoedd neu gan fentoriaid i brentisiaid wrth ymddeol. Mae sawl teulu sydd wedi bod ynghlwm â masnachu mwsoglau am dair cenhedlaeth a mae bob un wedi datblygu cadwyni cyflenwi annibynnol i farchnadoedd sy'n gwasanaethu gwahanol rannau o Loegr. Adroddwyd bod brig masnach wedi digwydd oddeutu 30 mlynedd yn ôl pan oedd llawer o fwsoglwyr yn cyflogi dimoedd o 15-12 casglwr ac yn gwerthu degau ar filoedd o fagiau o fwsogl bob blwyddyn. Cynaeafwyd y rhan fwyaf o blanhigfeydd conwydd ifanc. Ers 15 mlynedd mae'r maint y mwsogl a gasglwyd wedi dirywio'n gyflym oherwydd:

- cyhoeddusrwydd negyddol ynghylch effeithiau cadwriaethol defnydd mawn mewn garddwriaeth,
- gostyngiad yng ngraddfa marchnadoedd traddodiadol fel torchau angladdau,
- dyfodiad leininau modern, wahanol ar gyfer basgedi crog,
- mewnforiad mwsogl sych yn benodol o Seland Newydd, Chile a Tsieina, a
- heneiddiad planhigfeydd conwydd, sy'n lleihau'r ardal sydd ar gael ar gyfer cynaeafu mwsogl.

Mae masnach fwsogl yn parhau er ar lefel llawer is nac yn flaenorol a cheir ond ychydig o ymgeiswyr newydd yn defnyddio gwerthiannau rhyngrwyd i archwilio marchnadoedd arbenigol. Gweithia'r rhan fwyaf o gasglwyr mewn coedwigoedd dan gytundebau gyda'r perchnogion tir neu eu gweithredwyr.

Mae'r cysylltiadau hyn yn seiliedig ar ymddiriedaeth ac ystyrir mai prin yw effaith y gweithgarwch a'i fod yn gynaliadwy i bawb sydd ynghlwm.

Cynaeafir mwsogl yn bennaf o blanhigfeydd conwydd ifanc, cyn llwyrgwympo ac ar ôl teneuo clystyrau Llarwydd ac o ardaloedd agored o fewn y goedwig. Mae'r mwsoglau orau mewn ardaloedd gwlyb neu gyda lleithder uchel ac mae'r rhywogaethau a gymerir o'r cynefinoedd hyn yn gyffredin iawn gan fwyaf, yn ffurfio carped a'i alw'n "mwsoglau pluog" fel rhywogaethau *Rhytidiadelphus, Pseudoscleropodium* a *Pleurozium*. Cynaeafir y mwsogl â llaw neu gribinio ysgafn ac adrodda cynaeafwyr eu bod ond yn disodli rhan o'r mwsogl a mae aildyfiant yn ddigonol i ganiatáu cylch cynaeafu am 2-7 mlynedd.

Mae rhywfaint o gasglu mwsogl o goetiroedd collddail ond nid yw hyn yn digwydd yn eang, roedd yr un enghraifft lle daethpwyd ar ei draws yn targedu mwsogl pluog cyffredin gan gynaeafu'n ofalus â llaw. Ar hyn o bryd ymddengys nad oes unrhyw gynaeafu ffurfiol o gorsydd yr ucheldir ac ychydig o dystiolaeth sy'n bodoli o unrhyw weithgarwch cynaeafu mwsogl anghyfreithlon yn y 6 mlynedd diwethaf. Awgryma tybiaeth o raddfa cynaeafu mwsogl bod rhwng 30,000 a 40,000 o fagiau'n cael eu llenwi bob blwyddyn. Mae hyn yn cynrychioli o bosib 400 tunnell o fwsogl tamp.

Dim ond mewn ychydig o enghreifftiau y canfuwyd *Sphagnum* fel y rhywogaeth a dargedir. Roedd y rhain yn rhywogaethau fel *S. quinquefarium, S. capillifolium rubellum* a *S. fallax* sy'n rhywogaethau sy'n ffurfio carped cyffredin ar briddoedd mwynol mewn coetiroedd llaith. Ychydig iawn o *Sphagnum* a nodwyd fel rhywogaeth ddiangen a gasglwyd. I gyd, mae rhywogaethau *Sphagnum* efallai'n cyfrif am ganran fach iawn o gyfanswm mwsogl a dynnir ac a gesglir o Gymru.

Mae'r holl reolwyr tir a mwsoglwyr a gyfwelwyd yn gyffredinol ymwybodol o bryderon cadwraeth o ran cynaeafu mwsogl o gorsydd yr ucheldir. Ymddengys nad oes dadl gref dros ymyrryd yn y trefniadau caniatáu presennol neu gyfyngu ar weithgarwch presennol i warchod corsydd Migwyn. Serch hynny, dylid parhau i fonitro gweithgarwch cynaeafu mwsogl rhag ofn y newidia'r sefyllfa.

Byddai rhai mwsoglwyr yn gwerthfawrogi mwy o wybodaeth am y mwsogl a gasglant. Gellir cyfuno hyn gyda pharatoi canllawiau cynaeafu gwirfoddol fel sy'n digwydd yn yr Alban. Byddai dilysu cyfraddau twf a chynaliadwyedd cyfnodau a thechnegau cynaeafu yn ddefnyddiol ar gyfer casglwyr a rheolwyr tir. Mae hyn yn arbennig yng ngoleuni cynigion i gynnwys cynaliadwyedd cynaeafu cynnyrch coedwigoedd di-bren yng Nghynllun Ansawdd Coetiroedd y Deyrnas Unedig (UKWAS) 4.

2. Executive Summary

Sphagnum Bog-mosses are included on Annex V of the Habitats Directive which requires that Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favourable condition status. Article 17 of the Directive requires reports of species status every 6 years with the next report due in 2017. In order to provide evidence of the scale of exploitation of Sphagnum Bog-mosses a survey of moss harvesting activity in Wales was commissioned by NRW and is reported here.

Sphagnum Bog-mosses are collected alongside other mosses harvested for use in hanging baskets, wreathes and vivarium use and are often unreliably named in trade. Therefore, to assess Sphagnum it was necessary to survey all mosses. In order to obtain an overview of the whole moss supply chain, the survey undertook qualitative interviews of pickers (sometimes called “mossers”), sellers (wholesale and retail), landowners and managers and other stakeholders such as the Police wildlife crime units and National Parks etc.. Lists were prepared of known mossers and others were identified using a ‘snowball’ method. In total 54 interviews were undertaken in 2016, these data were put together with 12 interviews done by the StarTree project in 2014 to give an overview of mossing activity over three years.

Harvesting of moss for large scale commercial sale is mainly from the area known as the Cambrian Mountains and across mid-Wales. It is an established income diversification opportunity for farmers and foresters in Wales going back at least as far as the First World War. The know-how on moss picking and most importantly the contacts with wholesalers and forest owners have been handed down the generations within families or from mentors to apprentices on retirement. There are several families who have been engaged in moss trade for three generations each of which developed independent supply chains to markets serving different parts of England. The peak of the of trade was reported to be around 30 years ago when many mossers employed teams of 5-12 pickers and sold tens of thousands of bags of moss per year, mostly harvested from young conifer plantations. From around 15 years ago the volume of moss harvested has declined rapidly due to:

- negative publicity about the conservation impacts of the use of peat in horticulture,
- a reduction in the scale of traditional markets such as funeral wreathes,
- introduction of alternative linings for hanging baskets,
- importation of dried moss particularly from New Zealand, Chile and China, and
- the aging of the conifer plantations which reduces the area available for moss harvesting.

Moss trade continues albeit at a much lower level than previously with a few new entrants using internet sales to explore niche markets. Most pickers work in forests under agreements with the landowners or their agents. These relationships are based on trust and the activity is considered to be of low impact and sustainable by all involved.

Moss is mainly harvested from young conifer plantations, prior to clearfelling and after thinning in Larch stands and from open areas within the forest. The mosses are best in areas which are wet or with high humidity. The species taken from these habitats are mostly very common, carpet forming species known as “feather-mosses” such as *Rhytidiadelphus, Pseudoscleropodium* and *Pleurozium* species. The moss is harvested by hand or gentle raking and harvesters report that they remove only a portion of the moss and regrowth is sufficient to allow for a 2-7 year harvesting cycle.

There is some moss picking from deciduous woodland but this is not widespread and the one instance where it was encountered harvesting was targeted on a common feather moss and sympathetically harvested by hand picking. Currently there appears to be no formalised harvesting from upland bogs, and little evidence of any illegal moss harvesting activity in the past 6 years. A guesstimate of the scale of moss harvesting suggests removal of between 30,000 and 40,000 bags per year, representing possibly 400 tonnes of damp moss.

In only a few instances were *Sphagnum* found to be taken as the target species and these were species such as *S. quinquefarium, S. capillifolium rubellum* and *S. fallax* which are common carpet forming species on mineral soils in humid woodland. Very little *Sphagnum* was identified as by-catch. In all, *Sphagnum* species perhaps account for a few percent of the total moss removed from Wales.

All the land managers and mossers we interviewed are generally aware of conservation concerns regarding moss harvesting from upland bogs, and there seems to be no strong argument for intervening in the current permitting arrangements or restricting current activity to protect Sphagnum Bog-mosses. Nevertheless, monitoring of moss harvesting activity should be continued in case the situation changes.

Some mossers would appreciate more information on the moss they pick and this could be combined with preparation of voluntary harvesting guidelines as in Scotland. Verification of growth rates and sustainability of harvesting periods and techniques would be useful information for both pickers and land managers especially in light of proposals to include the sustainability of harvesting of non-wood forest products in UKWAS 4.

3. Background

Every six years, Member States of the European Union are required to report on implementation of the Habitats Directive (by Article 17 of the Directive). The Habitats Directive report focuses on an assessment of conservation status of all habitats and species of community interest. The reporting format set by the European Commission requires a separate analysis for each species and each habitat in each biogeographic region which that country covers. In the UK the reporting is the responsibility of the devolved administrations and the amalgamated report is coordinated by the Joint Nature Conservation Committee. In Wales the habitats and species reports were compiled for Welsh Government by the Habitat and Species Specialists of the Countryside Council for Wales and are now the responsibility of Natural Resources Wales.

The 2012/13 reporting round revealed a lack of essential baseline data for a number of habitats and species and these were reported either as unknown or with low data confidence. An aim since 2013 therefore has been to ensure that Natural Resources Wales has better quality data available for the next reporting round.

Sphagnum Bog-mosses are included on Annex V of the Habitats Directive: Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favourable conservation status. To prepare an Article 17 report on *Sphagnum*, NRW need to know the scale of "exploitation and taking in the wild". To provide the data required for Article 17 reporting due in 2017, NRW commissioned a study to determine the scale of commercial *Sphagnum* harvesting in Wales. The study was to report on commercial harvesting with landowner permission and informal collection for sale was to be assessed, rather than small scale ad hoc collection for private use. Interviews of harvesters and sellers was anticipated and the methods used were to be reportable and repeatable.

4. Methods

Previous investigations on moss harvesting (Wong & Dickinson 2003) and surveys undertaken by Llais y Goedwig in 2014 for the StarTree project suggested that moss harvesters are difficult to locate and interview. This is because moss picking (harvesting) is a self-employed, part-time occupation which does not require formal registration so no lists of moss enterprises is readily available. We therefore had to employ a 'snowball' sampling strategy to generate a list of active harvesters to interview. This relied on asking people in the trade who they purchased moss from; forest and land managers who they permit to harvested moss, and pickers who else they knew picked moss.

In order to give the best possible chance of identifying moss harvesters and to more fully understand the Welsh moss supply chain four categories of stakeholder in the moss supply chain were identified as being relevant to the study:

- Pickers (people who harvest moss)

- Buyers/Sellers (wholesalers, Garden centres, possibly some pickers who sell direct, etc.)
- Landowners/Managers (e.g. Tilhill, Fountain, NT, RSPB, Wildlife Trusts, NRW)
- Other data holders, Wildlife Crime Units etc., National parks etc.

A short list of key questions was prepared for each group of stakeholders (see Annex 1) and were applied in unstructured interviews, usually over the telephone or sometimes by email correspondence. Table 1 indicates the number of people identified in each stakeholder group who were contacted during the study and the percentage of these who provided useful information. The data derived from the 2016 surveys undertaken for this present study were combined with interviews conducted in 2014 as part of the StarTree project. Responses to some of the questions suggest that markets continued to decline from 2014 to 2016 with the loss of some pickers and permitted areas but the species and methods of picking are likely to have remained constant and so these data have been pooled to increase the representativeness of the study.

Stakeholder group	Sub-group	This study 2016		StarTree 2014 interviews
		Contacted	Completed interviews	
Policy	Welsh government	-	-	2
Science	Ecologist	-	-	3
Pickers	Active 2014 - 2016	19	9	2
Managers	NRW (LAMs)	8	4	3
	Private	11	11	1
Buyers/Sellers	Wholesalers	5	1	1
	Garden centres	67	19	
	ebay	12	4	
Others	National Parks	3	2	
	Trade association	1	0	
	Wildlife crime officers	5	4	
Total number of interviews			54	12

Table 1: Response rate by stakeholder group

Sphagnum denotes a genera of bryophytes to a botanist but to the trade it is more loosely used as a synonym for all bryophytes in trade while “moss” can be used as synonym for peat derived from a bog. Identification of bryophytes by pickers and traders is mostly according to simple characters such as colour or general appearance. In order to identify the actual species collected for sale, we purchased nine bags of moss from pickers and retail outlets and the contents were examined by Sam Bosanquet for species identification.

5. Species impacted by moss picking

There between 600-700 species of bryophyte known to occur in Wales with around 200+ in each 10x10 km square. Common knowledge of bryophytes is very low and many common and abundant species do not have consistent common names which is reflected in very low awareness of moss identification among the pickers as shown in
Table 2. In trade the naming is even cruder and “sphagnum” is often used as a synonym for any moss as well as specifically for Sphagnum. To confuse things further “moss” is also used as a synonym for peat, while “Finland or Reindeer moss” is Cladonia rangiferina a boreal lichen and “Irish moss” is Chondrus crispus also known as Carragheen and is a seaweed.

The names used by the pickers (
Table 2) are generic and individual to the pickers and describe the look of the moss or where it is picked (Figure 1. Although the pickers do appreciate that there are different types of moss on different substrates and light conditions they had poor knowledge of the identity of the species being collected. Several pickers were aware of this and expressed an interest in learning more about the mosses they pick.

Picker[1]	Pickers names for moss they pick	Habitat	Notes
A	Sphagnum	Watercourses	Likely to be *Sphagnum*
	Yellow moss	Conifer	
	Ground moss	Conifer	
B	Curly moss	Woodland	
	Sphagnum	Conifer	Likely to be *Sphagnum*
	Staghorn moss	Conifer	
C	Hypnum “ordinary moss”[2]	Conifer	
	Woolly green moss	Conifer	Heavy moss, dirty on the bottom as it grows out of the needles
D	Sphagnum feather moss (Figure 1)	Woodland	Is not *Sphagnum*
E	Sphagnum (Figure 1)	?	Is not *Sphagnum*
F	Green moss	Conifer	
	Sphagnum	Conifer	Likely to be *Sphagnum*
	No name - orangey coloured moss	Conifer	
G	Sphagnum	?	Is *Sphagnum*
H	Woodland moss	Conifer	
I	No name – curly moss	Conifer	

Table 2: Pickers names for moss

[1] The number of respondents is low, so the letters signifying different pickers are changed in each table to protect the identity of respondents.

[2] “Ordinary moss” also used as common name for *Brachythecium rutabulum* by Wildlife Trusts Wales (http://www.wtwales.org/species/ordinary-moss)

Credit: Cadfoss

Credit powystrading

Figure 1: Samples of moss retailed as “sphagnum”

Table 3 lists the contents of nine samples of commercially harvested moss. The bags contained 17 species of moss, five liverworts and a collection of other plant debris. All species listed in Table 3 are common and typical of acidic and damp habitats in Wales. Each bag was predominantly made up of one or two similar species which are obviously the “target” species which have desirable characteristics with the other material as by-catch. There are two types of moss targeted by pickers: pleurocarpous or weft (mat) forming species which are commonly called “feather moss” (see Figure 1), the other is true *Sphagnum*.

The feather moss group is a number of species with similar appearance which are all equally common and abundant in different sites but of different species; some in more open habitats, with other species in conifer and deciduous woodland. This group includes: *Kindbergia praelonga, Pleurozium schreberi, Pseudoscleropodium purum, Rhytidiadelphus loreus* and *Rhytidiadelphus squarrosus.*

The two bags of Sphagnum contained three species; *Sphagnum quinquefarium* in one (Figure 2) and *Sphagnum capillifolium rubellum* together with *Sphagnum fallax* in the other. These are all species which grow as dense carpets in damp woodland on mineral soil and are not bog-forming or uncommon species.

Credit: Adam Thorogood

Figure 2: Compacted Sphagnum

Item	Species	English common name	Habitat notes	Percent within bags of commercial moss from sources across Wales								
				A	B	C	D	E	F	G	H	I
Bryophytes	*Brachythecium rutabulum*	Rough stalked feather-moss	In shade in woodland, hedge banks and open at lower altitudes.									20
	Dichranum majus	Greater fork-moss	On soil in sheltered, acidic woodlands, banks and scree							+		
	Dicranum scoparium	Broom fork-moss	On ground in woodland, heathland, mires, sand dunes and short turf in uplands.					+	+			
	Kindbergia praelonga	Common feather-moss	Banks, in turf, on ground in woodland			+	+					60
	Hylocomium splendens	Glittering wood-moss	Abundant amongst grass and heather on heaths and moorlands and in acidic woodlands.			30				+		
	Hypnum jutlandicum	Heath plait-moss	Abundant on ground in acidic heathland, upland grassland, woodland, conifer plantations, tracksides.	+	+			1	3	+		
	Mnium hornum	Swan's neck thyme-moss	On acidic soil, often abundant in woodland							+		
	Plagiothecium undulatum	Waved silk-moss	Acidic soil in deciduous woodland, conifer plantations & heathland						5	+		
	Pleurozium schreberi	Red-stemmed feather-moss	Amongst grass and heather in open heathy woods			60	+		10			+
	Polytrichastrum formosum	Bank haircap	Acidic woodland and well-drained moorland									+
	Polytrichum commune	Common haircap	Damp, acidic habitats, tolerates shade.		+	+	+					
	Pseudoscleropodium purum	Neat feather-moss	Unimproved acidic grassland and heaths, on banks and less shady woodland.			7	20	75				
	Rhytidiadelphus loreus	Little shaggy-moss	Acidic upland woods, grassland and heathy slopes.	98	+		+	4	85	+	100	
	Rhytidiadelphus squarrosus	Springy turf-moss	Unimproved grassland where grass is short.			3	80	20		+		15

Item	Species	English common name	Habitat notes	Percent within bags of commercial moss from sources across Wales								
				A	B	C	D	E	F	G	H	I
	Sphagnum capillifolium rubellum	Red bog-moss	Bogs, heathland, wet woodland, well drained mineral soils and shallow peat in humid places.						+	60		
	Sphagnum fallax	Flat-topped bog-moss	Wide range of permanently damp or wet habitats.							40		
	Sphagnum quinquefarium	Five-ranked bog-moss	Well drained ground e.g. banks in western oceanic woodland.	1	100							
Liverworts	*Calypogeia fissa*	Common pouchwort	Acidic soil, rotting logs and Sphagnum tussocks.						2	+		+
	Cephalozia bicuspidata	Two-horned pincerwort	Acidic habitats on peat, rotting wood and damp mineral soil.						+			
	Lophocolea bidentata	Bifid crestwort	On ground in woodland, grassland and heathland.		+			+	+	+		+
	Lophozia ventricosa	Tumid notchwort	Very common in acidic places in uplands						1			
	Pellia epiphylla	Overleaf pellia	By streams, rivers and ditches and wet woodland, marches and flushes.									5
Tree litter	*Picea stichensis*	Sitka spruce	Commonest conifer plantation species	+					+			
	Betula spp.	Birch	Pioneer tree in wide range of habitats					+				
	Fagus sylvatica	Beech	Usually planted tree					+				
	Quercus spp.	Oak	Natural woodland & plantation								+	
Other material	*Pteridium aquilinum*	Bracken	Moorland, hill pasture and other habitats on acidic soil					+				
	Erica tetralix	Cross-leaved heath	Marshes, heaths and moors.						+			
	Empetrum nigrum	Crowberry	Moors and mountain tops						+			
	Eriophorum vaginatum	Hare's tail cotton grass	Bogs and acidic wetlands.			+						
	Galium saxatile	Heath bedstraw	Grassland, moors, heaths and woods.			+	+					
	Calluna vulgaris	Heather	Heaths and moorland.						+			

Item	Species	English common name	Habitat notes	Percent within bags of commercial moss from sources across Wales								
				A	B	C	D	E	F	G	H	I
	Deschampsia flexuosa	Wavy hair grass	Acid heaths, moorland, hill-pasture and open woodland			+					+	
	Vaccinium oxycoccos	Wild cranberry	Bogs and very wet heaths.						+			
	Staphylinid	Beetle						+				
	Cepea nemoralis?	Snail	Damp vegetation						+			

Table 3: Species encountered in commercial Welsh moss

Sphagnum quinquefarium

Credits Adam Thorogood

Rhytidiadelphus loreus

Pellia epiphylla by-catch

5.1. By-catch

Conservation concern is not limited to the target species as it is possible that sensitive species may be picked as by-catch. Table 3 lists a number of species of moss and liverworts gathered in small quantities (less than 2% or a few stands). All of these are common species and not of particular conservation concern.

5.2. Other species

It is possible that some rarer species may be inadvertently be caught up in moss picking, for example, the rare 'Silurian' moth (*Eriopygodes imbecilla*) whose caterpillars overwinter in moss tussocks in amongst very old mossy bilberry. Moss raking in open areas included within plantations is ungrazed heath including bilberry but all sites for commercial moss picking are outside the known range of the Silurian moth (upland NW Monmouthshire and on Herefordshire border) so impacts on this species is unlikely.

6. Habitats impacted by moss picking

As far as it is possible to ascertain without extensive field investigations, commercial moss picking in Wales is from woodland habitats (see Table 2). The majority of these woodlands are plantations of exotic conifer, with two exceptions being deciduous woodland. Several of the longer established pickers were at pains to mention that they did not pick from deciduous woodland nor from open or upland (bog) sites – they were also most sensitive to questions concerning *Sphagnum* indicating that they were aware that this was of concern.

From the species mixes in the bags sampled in Table 3 it is possible to infer something of the habitats from which the moss was harvested. For example, sample A contains species typical of W17 Oceanic woodland within a Sitka spruce plantation. Sample F represents the most natural woodland assemblage of species again under Sitka spruce. Under Sitka spruce the target species was *Rhytidiadelphus loreus.* Sample G contains species suggestive of a recent planting on a steep slope while sample I is an assemblage typical of an east Wales woodland. Two of the bags contained litter of deciduous trees; one with oak was a pure *Rhytidiadelphus loreus* while the other was probably an open birch woodland with *Pseudoscleropodium purum* as the target species. The *Sphagnum* species are those which are also common in conifer woodland. In Table 2 "watercourses" were mentioned as a source of sphagnum but the species appearing in Table 3 are consistent with picking from ditches or pools within conifer plantations.

Although many of the pickers refer to 'forest' it appears that harvesting takes place both under the trees and in open areas within the permit areas. These open areas can be unplanted (the UK Woodland Assurance Standard prescribes a minimum of 10% open area within the woodland boundary) or areas where planting has failed. The site shown in Figure 3 is bilberry, crowberry and cranberry with moss growing in and around the tall shrubs. The Sitka spruce stand surrounding this area was planted around 25 years ago when grazing was also excluded. Picking is now just from the open areas but in the early years was taken from under the trees until ticket stage when the canopy closed, the stand became impenetrable and the moss was shaded out. Sample C in Table 3 is the most likely to be derived from an open site.

Credit: Adam Thorogood

Figure 3: Moss picked from rank, heathy upland grassland within forest boundary

A few pickers reported picking from farmland with the permission of the farmer. One picker harvested from their own family farm. In these cases, picking was from a variety of habitats from open slopes to deciduous woodland patches. It is here that picking may take place from habitats which may be of conservation interest. One newer enterprise picks moss from the 100 acre family farm which contains 20 acres of oak woodland where it is “dark, damp and moist and moss grows in amongst the bilberry plants” (see Figure 4). However, the harvesting is done lightly and harvesting was deemed by the picker to be endorsed by the Tir Gofal scheme since no objections were raised by the Tir Gofal advisors to a bit of moss picking here and there.


Credit powystrading

Figure 4: Oak woodland moss picking site on a farm

Those pickers who did know *Sphagnum* and reported picking it all concurred that demand for it had fallen sharply from around 2007. In 2016 it seems that four pickers were confirmed as collecting *Sphagnum* species to fulfil specific orders. This was in small quantities (one did 100 bags a year, another is a single part-time picker). Picking was from woodland though it was noted by one picker that *Sphagnum* was taken from ditches within the woodland.

7. Geographical extent of moss harvesting

In terms of the distribution of moss picking across Wales, it proved difficult to obtain a list of sites currently being picked for several reasons; locations were often rather vague e.g. “Hafren forest”, private owners and commercial operators were reluctant to divulge locations or retailers simply hadn’t enquired about the source of moss. Figure 5 shows the locations of interviewed pickers, known moss harvesting permits and garden centres which reported sourcing moss from local suppliers. With a few outliers, this clearly shows that moss harvesting is mostly confined to the area known as the Cambrian Mountains in mid-Wales.

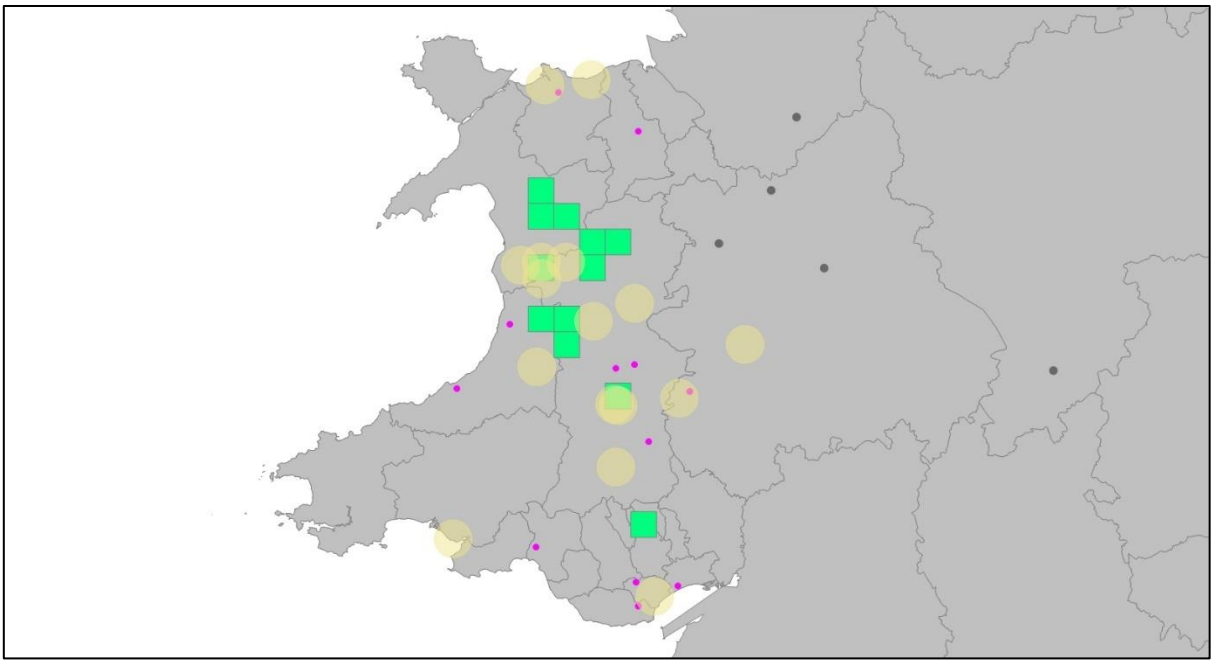


Figure 5 Location of moss picking in Wales 2014-16

8. Harvesting practices

Moss remains the same throughout the year but demand peaks in the spring and early summer for hanging baskets and before Christmas for festive wreathes. This translates into two main picking seasons, one from March to June and anther from September to December.

Moss picking is purely manual with opinions divided on whether moss should be hand-picked straight into bags or raked into windrows for bagging.

Consideration of the pickers practices (**Error! Reference source not found.**) suggests that both hand picking and raking can leave a site with the potential to regrow sufficient moss for return picking in 2-4 years. Raking has perhaps earned a bad name by association with more unscrupulous pickers (the type who “rape and pillage and give our industry a bad name”) and illegal activities. However, the pickers who use rakes say that it is possible to tease the moss out of the shrubs or grass without doing much damage to the vegetation and that it is important not to go too deep or be too vigorous as this will produce moss of lower quality (Figure 6). Most pickers and managers agreed that the sign of a good picker is that once they have left the site you can’t tell that they’ve been there.

Credit: Adam Thorogood

Figure 6: Moss harvested by raking from rank grassland

Many pickers remarked that picking was beneficial to the moss – in terms of quality because the regrowth will be ‘clean’ with fewer twigs and debris and also because if left too long the moss grows tall and starts to die off at the base and become ‘slimy’ underneath. This was confirmed by a bryologist as a common growth pattern in weft forming bryophytes. For example, a species such as *Hylocomium splendens* will have a year’s growth as a flattish plate and in the second year will put up branches which supports another plate. Gradually older plates die off and the living moss will be perhaps three or four years of growth.

The pickers and land managers had quite detailed opinions on the optimal stand conditions for moss growth. Light is the main determinant of the species and quality of moss present followed by humidity. Open areas e.g. failed planting, checked growth, roadside strips (3-4 m under trees), rides and glades are all good for moss and it is these which are often the focus of pickers’ activities. Under the canopy of the trees it was noted that Larch was the best species, presumably because it is deciduous and ‘drip-fed’ the moss but this was counteracted somewhat by problems with contamination with falling needles and twigs. Moss can be harvested from Sitka spruce, the commonest

plantation species in Wales, from planting up to about 20 years when the canopy closes and moss dies off in the deep shade. Picking is also possible after thinning. Clearance of moss is also possible immediately prior to clearfelling of larch as the site will be lost once the trees are felled. All respondents reported a decline in suitable locations for moss picking as the conifer plantations mature. This is offset by picking over larger areas but and there is considerable uncertainty on whether suitable moss will grow or be easily harvestable from second rotation sites. An interesting comment was that areas that are good at producing moss are often those which are bad for timber and some of these areas have been picked non-stop since planting some 30 years ago.

Picker	Harvesting practices
A	I'd take 25% of what was there, just tickle it, then return to the patch 5-7 years later, but you need a lot of land to do it properly, 1000s of acres.
B	The last thing I want to do is damage the environment, I take it sparsely from patches and gradually work across taking a small percentage of what's there. Picks by hand from clumps around 1 m^2 taking 1 or 2 handfuls and then moves on to the next clump. If you pick it right it grows back better, less leaf mould. It likes growing on rotting stuff on the woodland floor, that's what it thrives on, leave the dead wood as a support for it to grow on.
C	Focusses on "green moss" often under Sitka spruce using a rake. Once you've mossed in certain places it'll come again but only if there's enough residue for it to grow. He's had a few of the same spots over the years though once the canopy closes it goes. When you're picking, you've got to know when to stop, I always say if you're a good gardener you'd make a good mosser.
D	Picks by hand from clumps with the right depth and quality. "I just take a ball from that area and put it in the bag. I don't do it continually or strip the moss." Moss regrowth is encouraged by leaving moss and stamping in clumps of moss into the 40 cm diameter bare areas left after picking. "If you do that it recovers, and joins together and grows, there is minimal impact on the ground - it grows back almost straight away." The same area has been picked in this manner about every 3 years for 40 years.
E	Picks from small/young conifer plantations. "we try to pick them in stages, not go there and pick a whole area, try and sort of keep it in blocks – you pick so much this year, and then move over next year." Estimates 3 years for regrowth and has returned over 15 years to the same patches. Rakes moss into rows, removes twigs, clods etc. and bags it. "Just rake it gently, if you go in too deep you tear everything up, all you're trying to do is to get it out of the grass … and it depends on the depth of the moss, if it's only thin you don't want to go in far." Trying to do it sustainability, so you've got a constant harvest – "we're not going to pick the one place once and then the moss is gone after 3 maybe 4 years and it's back as it was".

F	“Just rake it off really … leave some to grow back natural. When we pick a patch, in 3 – 4 years it’s grown back.” Has been picking from same sites in this manner since 1994.

Table 4: Moss harvesting practices reported by pickers

8.1. Sustainable supply?

All pickers remarked that the key to sustainability is to leave sufficient moss behind for vegetative regrow to cover the area and build to sufficient depth for a subsequent harvest. Opinions about the length of time required for regrowth varied from 3 to 7 years but was generally estimated as 3-4 years. Bryologists consulted for this study generally confirmed the observations of the moss pickers particularly regarding growth rates. Despite their lack of skills in species identification moss pickers are familiar with the growth and development of their target species. Furthermore, a bryologists view on harvesting was "the moss growing under conifers is always going to be common stuff, will always be sustainable, and frankly as much can be taken as is needed, whereas under broadleaved there is more of a potential impact. Most of the stands dominated by the big bulky pleurocarpous mosses won't have anything very significant from a bryophyte point growing through it there may be a few common small liverworts. If a stand is being picked rotationally then rare things won't have come in anyway, the only risk will be on a pristine site, if there happened to be something else there, something rare. I'm thinking about an area of SAC woodland on edge of Mynydd Mallan there you have very steep ground and you have the mat of *Rhytidiadelphus* and through it are growing various quite uncommon liverworts. That's a really pristine ecosystem, it's a wonderful ancient Annex 1 woodland. It sounds as though people aren't going collecting in that sort of stuff anyway."

In general moss picking is considered sustainable by the pickers, forest managers and bryologists based on long experience. However, there is little hard evidence to back this up. Collected commercial moss harvesting experience in Scotland has been distilled into a commercial moss picking guidelines (see Annex 2). A voluntary code for moss harvesting has been developed in Scotland[3] and there maybe scope to develop something similar for use in Wales.

Moss and *Sphagnum* is imported into Europe and the UK from other temperate countries, principally New Zealand but also from Chile, Tasmania, China and Canada. Much of the imported material is credited with being 'sustainably harvested' and further investigation revealed that there is a body of research on moss harvesting from a range of natural habitats including protected bogs to support these claims. Further investigation of research findings in these countries would be beneficial if moss harvesting were to expand in the future.

9. Pickers and their livelihoods

Estimating the number of moss pickers from Table 1 and comments from land managers suggested there are around 20-25 active pickers operating in Wales in 2016. This is an industry established in the 1950's which after a high around 30 years ago has been in sharp decline since 2007. At the height of the trade established pickers would employ gangs of 10-15 seasonal pickers often

[3] Available from: http://www.forestharvest.org.uk/guidelines/mosscode_commercial.htm

including family members and neighbours and this was a significant source of casual employment in rural areas. At this time many pickers were turning over upwards of 5-10 thousand bags a year and “moving artics of the stuff”. Family ties are especially important with family members joining in picking with know-how, contacts with land managers and markets being passed through the generations. There were at least six farming families who have picked moss for three generations each harvesting their own patch and supplying different regional markets in England. Some of these are still picking with the fourth generation of young people as casual workers.

At its height, demand for moss was sufficient to provide for a few full-time moss enterprises such as Booth Moss & Foliage and Welsh Moss Ltd. both of which have ceased trading apparently on retirement of their proprietors in the last few years. There is apparently only one *full-time* moss picker left and he is well past retirement age.

Demand for moss is strongly seasonal with busy periods from Easter up to June for hanging baskets, quiet all summer until September from when it picks up again in the run up to Christmas. This seasonality which complements busy periods in farming and forestry meant that mossing was, and remains, a secondary income. Most pickers are also farmers, forestry workers, employed or retired. Some combine mossing with collection and sale of other forestry products such as foliage and Christmas trees. For many, moss incomes have been an important supplement to farm incomes with one noting “but in the last few years in a way the moss has been keeping the farm going – with the price of stock going up and down”.

Moss pickers characterise themselves as “loners, they do just go out in the woods, and that’s what they want to do”. Know-how is passed down and relationships with land owners, forest managers and buyers based on established mutual trust.

It is difficult to estimate the earnings from moss picking given the general (understandable) reluctance to reveal commercial information. However, extrapolating from a few example prices and annual harvested volumes it is possible to estimate annual incomes of around £2,000-5,000 for pickers, £5,000 to £10,000 for intermediaries and around £3,000 for direct sellers. As expected this is insufficient to be a main income but is a useful second income especially in rural areas where there are few income opportunities which can be accommodated in the farming routine.

10. Regulation and permitting of moss harvesting

Sphagnum bog mosses are listed under Article 17 because they are keystone species in bog habitats for which the UK has particular responsibility in Europe. In addition, damp deciduous woodlands especially those falling into the Atlantic oakwoods habitat are host to internationally important assemblages of bryophytes. Much of this habitat is protected by designation as SSSI and SAC and several species are the subject of species action plans and appear in the bryophyte Red Data list (Bosanquet & Dines 2011) but are not listed in Article 17. Any commercial harvesting of oceanic bryophytes from

Atlantic oakwoods has the potential to be a major conservation concern. However, Wong & Dickinson (2003) report that moss harvesting was targeted on conifer woodlands outside the core area of bryophyte diversity sometime prior to 2000 by the expediency of the Forestry Commission District Officer for Coed y Mynydd imposing a voluntary restriction on permitting moss harvesting outside known bryophyte hot spots (Snowdonia) and restricting access to SSSI's, SAC's and PAWS sites. The large private forestry interests likewise also only give permits for conifer stands and restrict access to open areas, designated conservation sites and areas where they are aware of biodiversity interest. These precautions are generally considered acceptable by bryologists.

Picking of wild species for commercial purposes requires the permission of the landowner (Theft Act 1968). There are no formal regulations for these mossing permissions and the form and content varies from verbal agreements through to elaborate public procurement processes and formal contracts. Generally, the larger the land owner the more formal the permitting system will be. In order to assess the number of possible moss permits; the location and size of permitted sites and any conditions placed on the moss pickers around 39 area managers were contacted, covering NRW, private forest management agencies (Tilhill, Fountains Forestry and SelectFor), Dŵr Cymru, Wildlife Trusts, RSPB and the National Park Authorities. Of these, the three largest forestry management agencies (NRW, Tilhill and Fountains) issued 11 permits for moss picking in the years from 2014-16. These agencies all noted that mossing was in decline and there were more permits and moss pickers in the past. They repeated the comments from the pickers that this is because the stands are maturing and there are fewer suitable sites for good moss production. They also noted that moss permits are now on the scale of 100's of hectares (over several sites) for one picker to allow sufficient area to support harvesting.

There are a number of variants on the duration, pricing and procurement of permits with different agencies having evolved their own approach to regulating moss harvesting in the forest. The basis for all permits is a site plan which marks the area for which permission is granted and usually clearly excludes designated sites and areas of special concern including biodiversity hotspots (see example map in Figure 7). In addition to a plan a permit will specify the cost of the permit, the duration of the agreement and a definition of what the picker is allowed to do such as "don't leave litter, don't block the roads, don't damage the trees, don't make a mess". Some permits are more detailed and will specify whether rakes can be used and the number of bags that can be taken but generally the moss picker is free to pick according to their own norms.

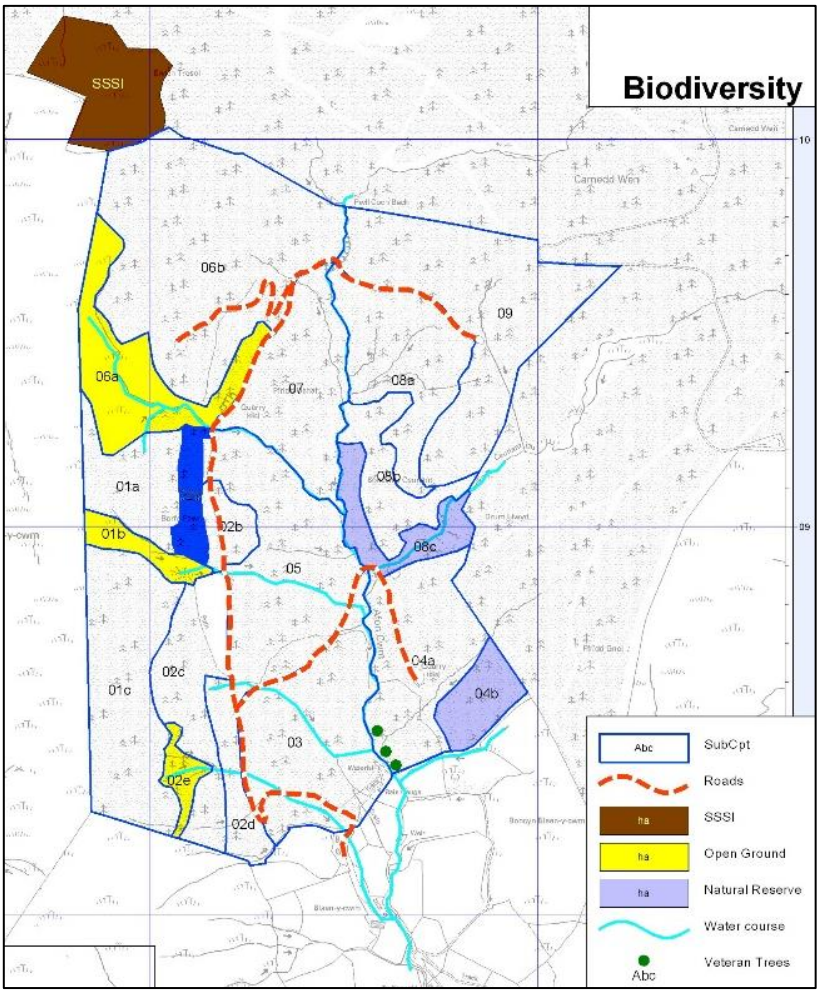


Figure 7: Biodiversity map used to support moss harvesting permit

Trust built up over long acquaintance and experience (some of the pickers have worked the same forests for more than 10 years and some for more than 30 years) is fundamental to the operation of the permits. Responsible moss pickers take care not to damage the forest or trees by using quad bikes and minimising damage by fitting double wheels and using pallets to bridge drains and other features. They also brash the forest to gain access to the stands, keep the sites clear of litter and by picking moss help control spontaneous Sitka spruce regeneration. The foresters' motives for issuing the permits are multifarious and are often centred on providing opportunities for local people with one remarking - "I try to help them for their sake and their gangs rather than for commercial reasons." Though for others there is more of an interest to at least recoup costs and operate a bidding system though permits generally still go to the same people who pick the same sort of places over a long period of time. Generally, forest managers consider the moss pickers and their activities as benign or beneficial to the forest.

Permits for access to woods and hillsides on private farmland is usually much more informal and often is simply a verbal agreement. In one case, the farmer invited the picker to pick for a small per-bag fee on areas of open hill and woodland as moss had accumulated following a decline in sheep stocking

density. This underlines the point that without grazing moss will grow to sufficient depth for harvesting on open ffridd.

All of the forestry agencies promote FSC certification though not all private sites may be certified as this will depend on the wishes of the landowner. The UKWAS standard 3.1 contains a standard 7.3 Rural economy “Management and marketing operations shall encourage making the best use of the woodland’s potential products and services consistent with other objectives.” And this can be verified by “Local or specialist market opportunities” while guidance points out that “The woodland’s potential products include non-timber forest products”. Although there is no explicit mention in current certification documentation of moss picking it has been noted that moss permits are a good fit for this criterion and there have been no comments on moss harvesting when it has been encountered on FSC inspected sites. Under the proposed revisions to UKWAS (version 4) which is yet to be approved by FSC, non-timber woodland products (NTWP) would be much more closely integrated into woodland management and commercial activity and NTWPs would be subject to:

- Integration into woodland design and silvicultural systems
- Harvesting of wild products would need to be shown to be at or below a level which can be permanently sustained
- Constrained to an annual allowable harvest
- Furnished with chain of custody documentation

Implementation of all of these standards would require some background research to verify species, describe optimal moss conditions and quantify growth potential. With this in hand, adding FSC certification to moss would perhaps present an opportunity to demonstrate the sustainability of moss harvesting to secure markets and the livelihoods which depend on them.

10.1. Illegal harvesting

From time to time, there are reports of thefts and disturbance related to moss picking. Enquiries with pickers and forest managers suggest that much of this is related to theft of equipment, usually quad bikes, empty bags left in the forest and also full bags of moss. This they attribute to fellow mossers and there is a fair level of distrust between mossers. Forest managers report that they seek to give pickers areas away from each other to avoid problems. There are however, occasional reports of illegal harvesting where moss is removed, often in a clandestine manner, without the permission of the landowner. This type of activity was widely reported across the UK around 2004 when demand for moss was high and moss prices were good. Since this type of activity is a distinct threat to protected sites and species a short questionnaire was sent to the Police Wildlife Crime Units and to other authorities e.g. National Park and NRW staff to ascertain the location and extent of current illegal moss harvesting.

Most responses on illegal harvesting suggested that it was either not something the respondents had encountered or the last time they had heard of

it was 5-10 years ago. There were a few reports of illegal activities over the past year:

- In three NRW forests in the Dyfi area, people were encountered picking moss without a valid permit – these were local people who had worked the area in the past and hadn't bothered going through the permissions system. This was dealt with by NRW and the pickers told to apply for permits.

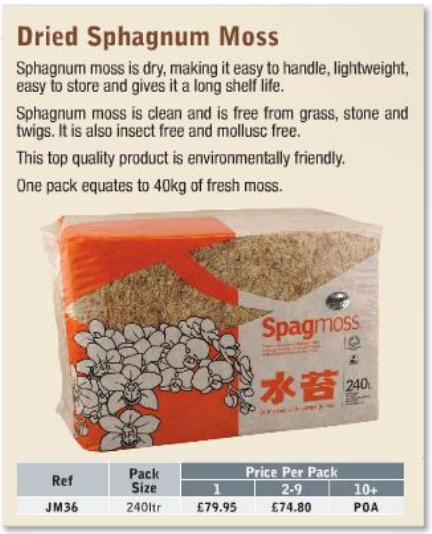
- North Wales Police reported an incident in November 2015 near Trawsfynydd which was also reported by NRW

None of these are a particular cause of concern in terms of significant impact on *Sphagnum* species.

11. Markets and trade

There are many traditional uses for *Sphagnum* which take advantage of its absorbency and mildly antiseptic properties such as a wound dressing, nappy lining and packing for bulbs. *Sphagnum* remains in demand for these properties but now more for use in horticulture as well as well as some novel bulk uses such as filters for pools, spas and hot tub water in US[4].

As we have shown *Sphagnum* harvesting in Wales is relatively small scale and currently most *Sphagnum* is imported (see Figure 8) from New Zealand and China.



Credit: LBS Horticulture Festive catalogue 2016

Figure 8: Imported dried Sphagnum

Moss is traditionally used in wreathes - one older picker recalled a time when big funerals would have 50-60 wreathes all backed with moss but now people just give a charitable donation. Linings for hanging baskets also furnished a

[4] http://web.sanimarc.com/Enews_PoolSpa/PS/Avril11/documents/SphagnumMossPoolNaturally.pdf

steady demand for moss which is also being compromised by negative marketing which equates horticultural use of moss with destruction of peat bogs and advocates the use of alternatives such as coir, wool and other synthetic materials. Celebrity gardeners have also over-simplified the anti-peat/moss message. Competition with imported moss keeps prices low and although living, green moss is a higher quality product there does not appear to be any premium for this at least in UK markets.

Credit: LBS Horticulture Festive catalogue 2016

Figure 9: Moss base for a festive wreath

Large wholesalers generally pay around £2.50 to £2.75 for a 11 kg bag which has to pay the picker (£1), cover costs and provide a margin for the intermediaries (£1) while the wholesaler sells on for £11.80 per bag. A greater margin can be had by the pickers selling directly to local retailers such as garden centres, however, individual garden centres only require small volumes so the opportunity is somewhat limited. Pickers will often sell thousands of bags to a wholesaler and will reserve a few hundred to serve a small circuit of local garden centres.

There have always been niche uses for moss but in the face of competition on traditional uses these are becoming more important as a means to add value to moss. Examples of these niche markets are:

- Vivaria (for reptiles, snakes, spiders etc.)
- Growth medium for orchids and insectivorous plants, (sundews, Venus fly traps etc.) (Figure 8)
- For use in floristry
- Substrate for seed germination
- Frost protection
- Packing for bulbs
- Inclusion in potting mixes
- Christmas decorations

Many of these niche markets require small amounts and are purchased via the internet. An ebay search for “sphagnum” (UK only) showed that 53% of 6,886 sales were advertised as a growth medium for orchids, 33% for use in vivaria, 14% for hanging baskets and just six sales for use with bonsai trees. Prices for direct retail targeted at niche markets are very variable and related more to the novelty of the use than the value of the moss. For example, wholesale bags of

moss sell at £1.07 per kg from the LBS 2016 festive catalogue (see Figure 10); and on ebay (including post and packaging) for £74.00 per kg for use in vivarium. Prices are very variable even for the same use, with vivarium use ranging from £0.70 to £15.50 per 100g. Only three Welsh pickers had a visible presence in online markets.

Credit: LBS Horticulture Festive catalogue 2016

Figure 10: Welsh moss from 2016 LBS Festive catalogue

11.1. Supply chains

Sales by pickers are mostly of large volumes through established contacts to horticultural wholesalers (e.g. LBS in Lancashire or Ayletts in St Albans). These sales are often arranged by an intermediary who organises the permits and sales and engages local pickers (usually on a self-employed basis). Sales are usually in bulk and wholesale prices that have hardly increased over the past five years. A few mossers have considered setting up some co-operation to represent their interests and push up prices but this has not worked. The reason given being that mossers are loners and protective of their relationships which give them access to land and markets. A few, more recently established mossers sell through ebay directly to speciality users.

There have been some attempts to benefit from value addition but this is mostly a few examples of using ebay to target speciality customers rather than processing, repackaging or making finished products such as wreathes. The supply chains are represented in diagrammatic form in Figure 11. Note that no

one mosser will utilise all possible sales opportunities but there are three distinct chains – wholesale either direct or through an intermediary, sales in the same bags but in smaller quantities direct to local retail outlets.

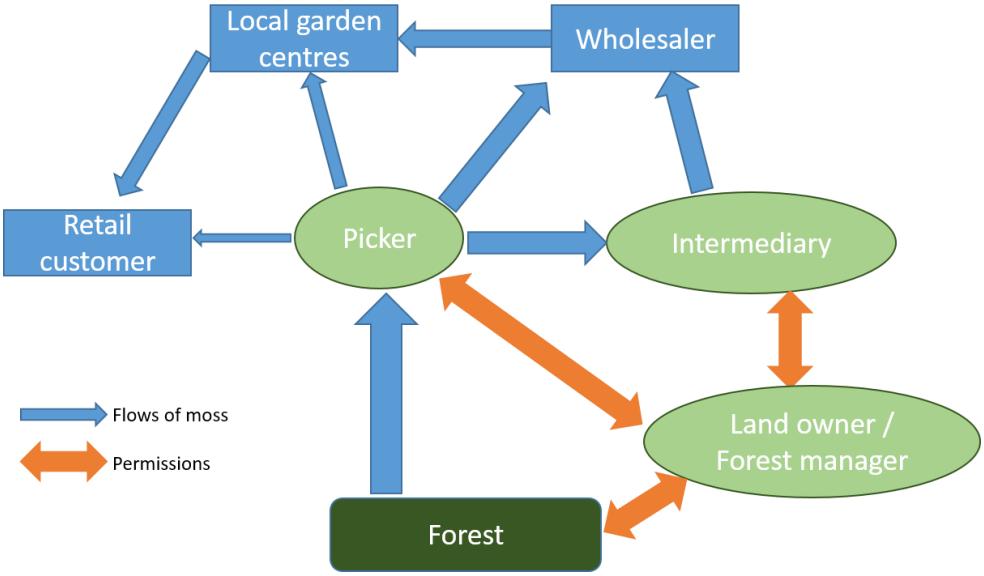


Figure 11: Notional supply chains for Welsh moss

11.2. Phytosanitary considerations

Movement of living plant material is a risk for disease and pest transmission and subject to phytosanitary regulations when it passes international or EU borders. Moss is not exempt from this, especially where moss is to be used in horticultural applications where there is the opportunity for direct contact with live plants i.e. as when it is used in greenhouse plant production. Moss imported into Canada must be subjected to dry heat, steam heat, methyl bromide or vacuum treatment[5] since the moss trade has been linked to introduction of exotic ectomycorrhizal fungi (Ángeles-Argáiz *et al* 2015). In the USA there are also concerns with sporotrichosis[6] infection in garden centre workers[7] and hanging basket makers[8] from handling infected *Sphagnum*. However, it appears that sporotrichosis has not been reported in Europe since 1945 (Chakrabarti *et al* 2014) and this need not be considered a risk for Welsh moss trade at the present time.

There was no awareness by landowners, managers or pickers of any possible risks of transmission of pests or diseases via trade in live moss, and no treatment is apparently done to Welsh moss in UK supply chains and most likely in any movements of moss within the EU.

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[5] http://www.inspection.gc.ca/plants/plant-pests-invasive-species/directives/imports/d-08-04/eng/1323752901318/1323753560467#g3

[6] *Sporotrichosis schenckii* is a dimorphic fungus present worldwide in soil, plants and decaying vegetation. It causes painless lesions which often ulcerate.

[7] https://www.cdc.gov/fungal/diseases/sporotrichosis/ and http://www.cdc.gov/mmwr/preview/mmwrhtml/00001173.htm

[8] http://www.ipm.iastate.edu/ipm/hortnews/1994/7-15-1994/mossy.html

The only mention of pests was by one picker who suggested that the New Zealand flatworm could be transmitted in moss and this was a reason to develop picking in Wales to substitute for imports. Although moss would indeed provide the right conditions for flatworms and they are able to survive drying it was not possible to verify this comment. Nevertheless, the moss samples collected for the study from Wales did contained a live beetle, a snail and a slug which had survived postage and packing (Figure 12) though this is not likely to be a major problem for movements within the UK. A greater concern maybe the transmission of *Phytophthora* from infected larch stands on the vehicles, equipment and boots of mossers. Larch was mentioned as a preferred canopy cover for moss but it seems likely that moss picking would not be permitted in larch stands subject to a Plant Health Notice.

Credit: Adam Thorogood

Figure 12: Live snail (*Cepea nemoralis*?) as by-catch in delivered consignment of moss

12. Conclusions

Although the study sample sizes were small, we did not find anything to suggest anything other than picking of a small range of common and abundant moss species mostly taken from conifer plantations. The few examples from deciduous woodland appear to be from drier sites (i.e. not Atlantic oakwoods) and also targeting common and abundant species. There is some harvesting of open habitats mostly from hillsides. We encountered no suggestion that moss is being harvested from bogs or other protected habitats.

The majority of moss harvested for commercial trade is of pleurocarpous (mat-forming) species which grow as dense carpets on the woodland floor. There was some harvesting of *Sphagnum* species but the species identified are common and abundant and forms carpets on mineral soil under moderate shade. None of the bog-forming species which are the focus of Article 17 listing were encountered. *Sphagnum* harvesting was reported to be of small quantities (~100 bags) to fulfil specific orders so volumes removed are likely to be modest compared to pleurcarpous moss in trade.

Moss harvesting has been a secondary income for mid-Wales farmers for at least three generations but is now in decline due to negative marketing stimulating market substitution and the loss of suitable growing conditions as the forests are felled. At the present time mossing appears to provide a secondary income for around 30 people mostly farmers but also other people residing in rural Wales. Without intervention harvesting is likely to continue to decline and become an increasingly specialised trade of small quantities of material.

Given the rough nature of the estimates of the number of bags in the moss trade and the fact that the size of bags varies between pickers and traders it is not possible to make an accurate assessment of the volumes of moss being harvested in Wales. A guesstimate based on the few 'ball park' figures provided suggests removal of between 30,000 and 40,000 bags. The bags vary in size and are sold by weight as well as volume. Taking 11 kg as a 'typical' bag the most harvest is perhaps 400 tonnes of damp moss. Only a small fraction of the harvest was said to be targeted at Sphagnum and this is mostly common, carpet forming species which are frequent on mineral soils in damp woodland and it is probable that only a few percent of total moss harvests are composed of *Spahgnum* species.

Landmanagers and mossers interviewed were generally aware of conservation concerns regarding upland bogs and there is no strong argument for intervening in the current permitting arrangements or restricting current activity to protect Sphagnum Bog-mosses. Nevertheless, monitoring of moss harvesting activity should be continued in case the situation changes.

Some mossers would appreciate more information on the moss they pick and this could perhaps be combined with production of voluntary guidelines along the lines of those produced in Scotland. Verification of growth rates and sustainability of harvesting periods and techniques would be useful information for both pickers and land managers especially in light of proposals to include the sustainability of harvesting of non-wood forest products in UKWAS 4.

13. References

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14. Appendix

Stakeholder questionnaires

Pickers

1. Do you work alone? If no – how many people do you work with? How do you work - together, formally or informally

2. Where do you pick? E.g. county, nearest town, name of forest, valley etc.

3. How many sites do you pick on per year?
    1. What area do you pick?
    2. Is this broadleaf forest; conifer; open land
    3. What is the best type of place to pick?
    4. Do you need permission to pick? If yes – who gives permission?

4. What types of moss are you looking for?

5. Please describe how you pick the moss (use of rakes etc.)

6. Do you regularly pick the same site? Please describe what you do.

7. When do you pick? (time of year, number of days etc.)

8. Are you aware of any pests and diseases that could transmitted in the moss? If yes – do you treat it in any way to reduce risks?

9. Who do you sell the moss to? (numbers, location and contact details if poss.)
    - One person/company (same one every year?) – do they take everything you pick or do they let you know how much they would like?
    - Several people?
    - Go around local garden centres / markets?
    - To local florists, pet shops etc. ?
    - Ebay (which tags do you use?)?
    - Process and sell as a product e.g. wreaths, hanging baskets etc.?

10. Do any of your buyers ask for moss to be treated in any way?

11. Could we buy a bag of moss from each of your sites to look at which mosses are included?

If possible, a site visit accompanied by a moss picker will be arranged. This will provide an opportunity to ask further in-depth questions, describe the picking technique (including photographs).

Buyers and Sellers

- e.g. LBS, Gardman, van der Vliet, Garden centres, florists etc.

1. Do you buy any moss (not peat) from Welsh or from UK sources?
2. Who from? – how many and what type of suppliers (ask for details)
3. How much?
4. Does demand vary much through the year or from year to year?
5. Do you ask for this to be treated in any way?
6. What type of moss is best?

Landowners

- Forest managers / owners

1. As far as you know, does anyone pick moss on your land?
2. What type of habitats do they pick from?
3. Do they ask for permission? (ask for details)
4. Do you specify where and how much they can pick?
5. What area is affected?
6. Do you have much demand for moss picking?
7. Do you experience or foresee any problems with moss picking?

Others

- National Park, Police etc.

1. Are you aware of moss picking in your area?
2. Please describe…
3. What do you think of this activity?