The past and present status of *Moneses uniflora* (L.) Gray (Pyrolaceae) in Scotland

J. A. WRIGHT and P. S. LUSBY

Royal Botanic Garden, Inverleith Row, Edinburgh, EH3 5LR

ABSTRACT

Moneses uniflora (L.) Gray (Pyrolaceae), One-flowered Wintergreen, is a nationally rare plant in Britain. It is now restricted to three vice-counties in Scotland. The history, decline and present status of the plant are described. Botanical collecting, deforestation and other land use changes are identified as causes of decline. Sensitive management and effective communication are vital for the survival of colonies in commercial forests.

KEYWORDS: Woodland, conservation, forestry.

INTRODUCTION

Moneses uniflora (L.) Gray (Pyrolaceae), One-flowered Wintergreen (hereafter *Moneses)* is a nationally rare plant in Britain. It is not protected under Schedule 8 of the *Wildlife and Countryside Act* (1981) but is classified as vulnerable in the *British red data book for vascular plants* (Perring & Farrell 1983). The species has been previously reported from at least 15 vice-counties with doubtful records from a further three, including the English vice-county of Westmorland (69) (not included in Fig. 1 which shows the distribution of the species). There has been a marked decline and it is presently recorded in twelve 10-km squares in three vice-counties (Table 1).

TABLE 1. PRESENT SITES AND POPULATION SIZES OF *MONESES UNIFLORA* IN SCOTLAND

Site	Vice-county	10-km square	Population sizes
Culbin Forest	95	NH/9.5	A
Culbin Forest	95	NH/9.6	A, B, C, C
Culbin Forest	95	NJ/0.6	A
Old Grantown Wood	95	NJ/O.2	A
Burgie Wood	95	NJ/l.5	B
Lethenhill	95	NJ/l.5	A
Glen Affric	96	NH/2.2	A, C
Strathfarrar	96	NH/2.3	A
Strathfarrar	96	NH/3.3	A
Glen Einich	96	NH/9.0	A
Rothiemurchus	96	NH/9.0	A
Loch Morlich	96	NH/9.0	A
Loch Loy	96	NH/9.5	A
Abernethy Forest	96	NJ/0.1	A
The Mound	107	NH/7.9	A
Balblair Wood	107	NH/8.9	D

Vice-counties: 95 Moray, 96 Easterness, 107 Sutherland East. Population sizes: A – 1–199 rosettes, B – 200–499 rosettes, C – 500–999 rosettes, D – >1000 rosettes.

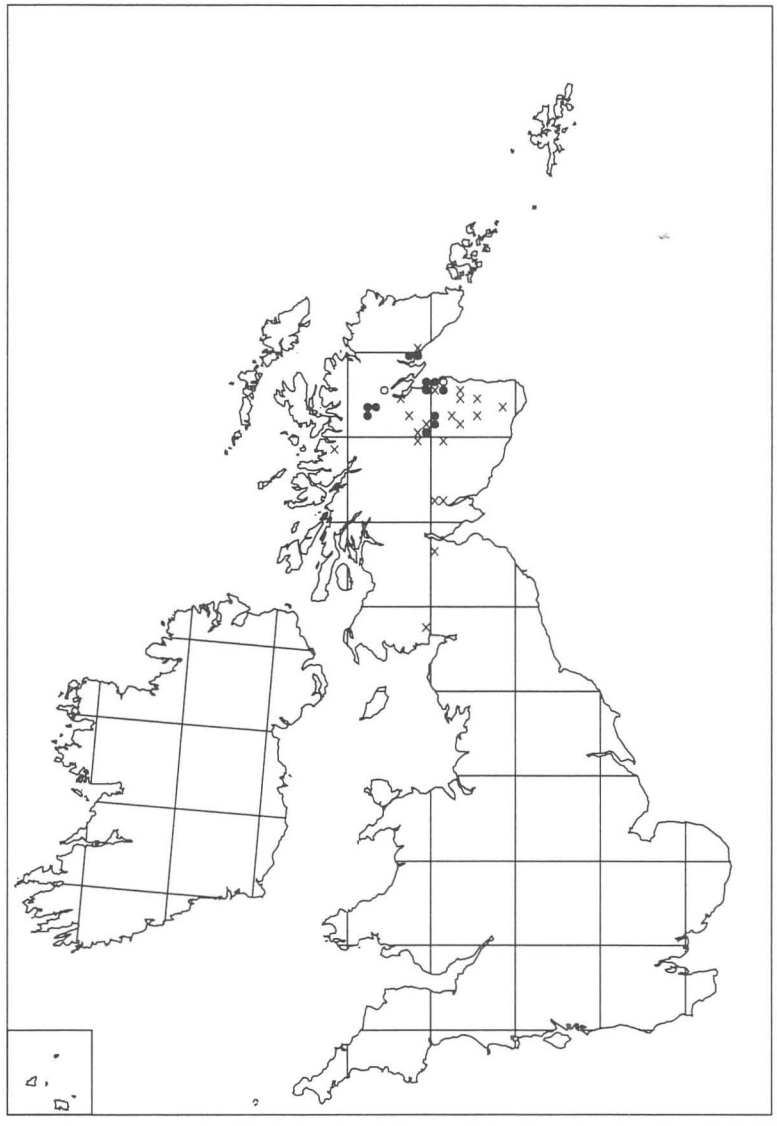

FIGURE 1. The distribution of *Moneses uniflora* in the British Isles. Symbols: ● – 1985 onwards, ○ – 1970–1984, × – pre-1970

Moneses is a member of the Circumpolar Boreal-montane element of the British flora and its occurrence in Britain represents the westernmost limit of its distribution in Europe (Preston & Hill 1997). The species ranges from central and northern Europe, south to the southern Adriatic and east to the Novosibirsk region in Russia. It also occurs in abundance in the eastern United States of America.

In central and northern Europe *Moneses* mainly grows in humid spruce woods but also occurs in drier forest dominated by Scots Pine (*Pinus sylvestris*). The field layer of these woods is dominated by dwarf ericaceous shrubs. In the Swiss Alps *Moneses* is a characteristic species of subalpine spruce woods with *Lycopodium annotinum, Listera cordata* and *Linnaea borealis* (Ellenberg

TABLE 2. VEGETATION OF *MONESES UNIFLORA* SITES IN SCOTLAND

Site	NVC Community (where identified) or other vegetation type
Lethenhill	M15b*
Balbair Wood	W18a*
Little Ferry	W18
The Mound	W18
Burgie Wood	W18a*
Culbin Forest	W18a*
Culbin Forest	Corsican Pine (*Pinus nigra* var. *maritima*)*
Glen Emich	W18b
Strathfarrar (both sites)	W18b
Rothiemurchus	W18b
Old Grantown Wood	W18c*
Abernethy	W18d
Glen Affric (both sites)	W18d

* = forest plantation.
Key to NVC communities (see Rodwell 1991a,b)
M15 *Scirpus cespitosus – Erica tetralix* wet heath; b = typical subcommunity.
W18 *Pinus sylvestris – Hylocomium splendens* woodland subcommunity, a = *Erica cinerea – Goodyera repens* subcommunity; b = *Vaccinium myrtillus – V. vitis-idaea* subcommunity; c = *Luzula pilosa* subcommunity; d = *Sphagnum capillifolium – S. quinquefarium* subcommunity.

1988). On the German island of Rügen, *Moneses* occurs in moss-rich pinewoods on young wooded dunes (Meusel 1951), habitats similar to the Scottish coastal sites in Moray and East Sutherland. However, the plant communities of most of the Scottish sites (Table 2), are similar, both floristically and structurally, to the pine/birch forests of western Norway (Aune 1977). Across its total range *Moneses* occurs more abundantly in humid spruce forests rather than in drier pinewoods. At one locality near Elgin, *Moneses* has been found in a wet-heath (NVC M15b) (Table 2), but many plants did not appear healthy.

There are no fossil records of *Moneses* or any other Pyrolaceae in Britain or Ireland.

This paper reports the results of a field and literature survey carried out by the Scottish Rare Plant Project of Scottish populations of *Moneses*. Original sources were consulted to determine as precisely as possible the location of old records. Vice-county recorders, nature reserve wardens, staff of various conservation organisations, foresters, local botanists and others have been consulted in gaining up-to-date information on the status of different populations. Records were obtained from 24 herbaria. Unpublished and manuscript sources have been checked for additional records.

DISCOVERY OF *MONESES UNIFLORA* IN BRITAIN

Moneses was known only as a cultivated garden plant to herbalists in Britain in the sixteenth and seventeenth centuries (Gerard 1597; Parkinson 1640). Miller (1763) reported that *Moneses* grew "naturally in shady woods in the northern parts of Europe", but he did not know it was native in Britain. Philip Miller cultivated *Moneses* in 1748, making this the earliest record of the plant growing in Britain, albeit as an introduction (Murray 1799).

The first native record is of doubtful authenticity. There are two specimens in the herbarium of Sir J. E. Smith (**LINN**) labelled "From the western Isles of Harris and Bernera gathered in 1783 by Jas. Hoggan". These were sent to Smith in 1793 by R. Gotobed. There are no other records of *Moneses* from the Western Isles (Pankhurst & Mullin 1991).

James Brodie found *Moneses* in pinewoods near Brodie House, Forres, in 1792 (Clarke 1900); undated specimens collected by Brodie survive in **E**. The same year James Hoy, secretary and librarian to the Duke of Gordon at Gordon Castle, Fochabers, sent a specimen collected locally to the Linnean Society (Sowerby 1794).

WEST SUTHERLAND (V.C. 108)

A single collection by Collins from Scourie in 1905 (**LRS**) constitutes the northernmost record for *Moneses* in Britain (Fig. 1).

EAST SUTHERLAND (V.C. 107)

The largest and best known population in Britain is at Balblair Wood near Golspie; several thousand plants occur in a Scots Pine plantation covering about 40 ha. The first record was by Crawford in 1890 (Kenworthy 1976). Specimens labelled "Golspie" and "near Golspie" may be from this locality, but those labelled "Ferry Wood" and "Little Ferry" probably came from Ferry Wood which is separated from Balblair by a road. Certainly Anthony (**E**) made this distinction.

The present plantation of Scots Pine at Balblair is just over 75 years old and was established on the site of native pinewood which suffered windblow. The wood is owned by Sutherland Estates. Its conservation importance was recognised in 1970 when, in conjunction with Sutherland Estates, the Scottish Wildlife Trust established a wildlife reserve. Balblair Wood is also part of the Loch Fleet Site of Special Scientific Interest notified by The Nature Conservancy Council in 1975. A Nature Research Agreement has recently been secured by Scottish Natural Heritage with the intention to declare the area as a National Nature Reserve (F. Symonds, pers. comm., 1998).

Moneses was also collected from The Mound, 2·5 km north-west of Balblair, where it was first recorded by Foggit (Kenworthy 1976) and Crawford (**E**) in 1900. Druce noted that *Moneses* grew "in immense quantity in a larch wood near Golspie (a second locality)" (**OXF**). Druce's 1923 collection was the last known record from The Mound until Symonds rediscovered a small patch on the south side of The Mound within the Mound Alder Woods National Nature Reserve in 1997.

There are several collections (**ABD**, **BM**, **E**, **RNG**) dated 1939 from Cambusmore on the western shore of Loch Fleet. These are the only known records from this locality. There is also a single record from Dunrobin, north of Golspie (Watson 1837).

EAST ROSS-SHIRE (V.C. 106)

There are no extant sites in East Ross-shire. Records from the chief locality, variously known as "Knock Farril", "Coul Wood" or "The Cat's Back", near Strathpeffer, span the period 1830 to 1872. The most precise details are on a specimen dated 1835 (**ABD**) "In the Coul fir wood, about a mile [2 km] to the west of the Strathpeffer pump-room, ... in two or three large patches". Gordon (1867, ms letter to Dr J. Mitchinson, **ELN**) reported that "the firwood has been cut down, so I suppose the plants have perished for lack of shade". Hillhouse (1889) declared *Moneses* extinct at Knock Farril. However, *Moneses* was found at Strathpeffer in 1966 by Duncan (1980), but a programme of tree felling and replanting began there in 1968. Selby monitored the status of *Moneses* and made his last sighting about 1970. Brebner & Hulme (pers. comm., 1994) knew a few plants beside a track near Strathpeffer Youth Hostel during the mid-1970s, but these were unwittingly destroyed by widening and re-routing of the track.

A specimen collected by McRae dated 1905 (**E**) and labelled from the Black Isle may represent a second locality but is as likely a vague reference to Strathpeffer which is close to the Black Isle.

The plant has never been refound at Torr Achilty, south-west of Contin, where it was recorded in 1863 (Duncan 1980).

MID EBUDES (V.C. 103)

Moneses was listed from Torosay, east Mull, "according to Mr Middleton at Achnacroish" by Clerk (1845), but has not been included in any other plant lists for Mull.

MAIN ARGYLL (V.C. 98)

Marshall reported *Moneses* from Kilmory Estate near Lochgilphead, Argyll: "Sir John Campbell-Orde, Bart recently showed me this plant growing on his estate near Lochgilphead, and assured me it was not an introduction. This appears to be the first certain station for it in west Scotland" (Marshall 1896). No other record is known.

EASTERNESS (V.C. 96)

Moneses was collected by Ballie in 1890 (**BM**) "in a fir wood in rather boggy ground". In 1990 it was recorded from the margin of Loch Loy by North. Two small colonies, separated by a few

metres, are extant. The habitat is an open mixed Scots Pine and Downy Birch (*Betula pubescens*) wood.

There are extant populations in Strathfarrar and Glen Affric. *Moneses* was found in Strathfarrar by Miss Fraser Lovat in 1867 (Farquharson & Selkirk 1868). There was no other record from Strathfarrar until 1980 when Cameron discovered one of the extant colonies, east of Loch Beannacharan, at about 275 m altitude, in native pinewood. The flora is dominated by *Vaccinium myrtillus* and observations over the last ten years suggest an increase in density of this species, while the number of *Moneses* rosettes has declined. It may be necessary to reduce the competition from *V. myrtillus* to preserve this colony. The second population, on a trackside towards the eastern end of Strathfarrar, was discovered in 1992 by Mrs E. Lennard. The track is used at present for access to a hydroelectric installation, so this colony is also vulnerable.

In Glen Affric, *Moneses* was found in 1975 by Crawley (**E**), north-east of Loch Beinn a' Mheadhoin; this record is not included in McCallum Webster (1978). Despite recent searches, this colony has not been refound and may have been eliminated by tall heather (M. Barron, pers. comm., 1995). In 1988 and 1990 two populations were found on the margins of lochans on the south side of Glen Affric. Here the plants are growing just above summer water levels and are occasionally submerged in winter. One population comprises four small colonies distributed over some 200 m; the other is a single colony of a few rosettes. A further population in Glen Affric was found by Lennard on the lower slopes of Creag Dubh above Cougie (Lennard, pers. comm., 1993). A colony from a "field near the dam at Kingsmill, Inverness" found by Galloway before 1888 is no doubt lost and another from Strathdearn (McCallum Webster 1978) has not been recorded since.

Records from Abernethy are often imprecise but Traill (1910) and Davidson (**ABC**) recorded *Moneses* from Loch Mallachie on the southern margin of Abernethy forest. No recent records from this area are known. An extant population within Abernethy Forest was found by Horn in 1988 and consists of fewer than 100 rosettes scattered over an area of about 25 m^2. The vegetation is dominated by *Calluna vulgaris* and *Vaccinium myrtillus* with frequent *Carex nigra* and *C. panicea* in wet channels. A specimen labelled "Boat of Garten" (1919, (**E**)) may be from Abernethy Forest.

The forests of Rothiemurchus and Loch an Eilean have been known sites for *Moneses* since 1882 (Keith & Groves (**FRS**, **BM**)). MacMillan (1907) reported the plant "in some abundance in the woods at the south-west end of the Loch". Hillhouse (1889) noted that it was "disappearing from Rothiemurchen [sic] ... from the rapacity of collectors". Over 50 plants were gathered between 1882 and 1894, but at this site, at least, *Moneses* was not collected to extinction.

One small colony is extant in Rothiemurchus, in Glen Einich. About 20 rosettes occur at the base of a dead pine tree in atypically open, dry conditions. The associated vegetation is dominated by *Vaccinium myrtillus,* with *V. vitis-idaea* and common pleurocarpous mosses. The population occurs between two drainage channels which direct water away from the plants. This could account for lack of vigour in this colony.

Records from Loch Morlich and Glen More are first represented by a specimen collected by King and exhibited to the Natural History Society of Glasgow in 1885 by Boyd (Stirton 1887). Since then populations have been recorded intermittently. Two small colonies have been washed away by flash floods and another destroyed by Sitka Spruce plantation (D. Ross, pers. comm., 1990). In 1994 a population was found near Loch Morlich by Jones.

A colony at Kincraig, between Aviemore and Kingussie (McCallum Webster 1978) and one in Glen Feshie (Steven & Carlisle 1959), have not been confirmed by our survey.

MORAY (V.C. 95)

Moray is considered the headquarters for *Moneses* in Scotland. Although the extent of all colonies does not approach the size of the Balblair population, more populations have been recorded in Moray than in any other vice-county.

After Brodie's discovery in 1792 there are no further records from Brodie House other than a specimen in **DBN** dated 1798 (Nelson 1995). Several botanists reported the plant's disappearance at this site which was attributed to tree felling and gorse invasion (Bishop 1826; Brichan 1842; Ogilvie 1845). Therefore the original site was lost within about 30 years of its discovery.

The second record from Moray is in Gordon's *Collectanea for a Flora of Moray* (1839): "Discovered by John Lawson esq. about 20 years ago [1819] in the oakwood, near Aldroughty. It was afterwards lost sight of until 1836, when a few specimens were gathered by J. Shier, esq. and

pupils". One specimen is in **ELN**. This locality was recorded by Hooker (1830) as "Knock of Alva [Alves]". Other localities near Elgin are Loch Avain (Todd 1867, 1887 (**CGE**)) and Roseisle Forest, near Burghead, recorded by Cuthbertson in 1974 (McCallum Webster 1978). In 1908 the plant was found in Balnacoul Wood, west of Fochabers by Watson (Burgess 1935) but no specimen has been traced. This site is now a forestry plantation.

There are five extant localities for *Moneses* in Moray. Chief of these is the afforested sand dune system of Culbin Forest which occupies nearly 3000 ha of the southern coast of the Moray Firth between Nairn and Forres. Planting began on Culbin Sands in 1839 but was most extensive between 1922 and 1963 (McCallum Webster 1968). Without exact details it is not possible to ascertain whether records were from within Culbin Forest or whether they were from woodland outside its present boundary. Specimens labelled "Forres" dating from 1840 to 1871 could be from woodland existing prior to afforestation, but an 1869 collection from "Clunie Hill" (south-east of Forres) (Brown (**ABD**, **BM**)) is clearly a separate locality. No subsequent records of the latter site are known. Burgess discovered three stations in Dyke (0·8 km north of Brodie) in 1901 which may be within Culbin Forest and a specimen from "Snab Wood" collected by Patton in 1923 (**GL**) could also be from Culbin.

Miss Mary McCallum Webster knew Culbin Forest and the localities of *Moneses* better than any other botanist but was always vague regarding sites. Precise details were never handed on in her lifetime. Those fortunate enough to be shown a colony were led on a deliberately tortuous route along forest tracks which made relocation practically impossible! Consequently, it is not certain which sites discovered since the death of Miss McCallum Webster coincide with the ones she knew.

To date six colonies have been found in Culbin Forest by North, Farrell, White, Edelsten and Young. Population sizes range from less than 20 rosettes to several hundred, and habitats vary from very wet to dry (Table 1).

Records from Burgie date from 1870 with collections by Innes and Keith (**ABD**, **BM**, **FRS**, **K**, **OXF**). It was found again in 1910 by MacGregor (Burgess 1935) and in 1920 by McCallum Webster (**E**). A small colony was found under Scots Pine and Larch (*Larix decidua*) at the edge of Burgie Wood (now a large forest plantation) by Lusby in 1993. Immediately to the east of Burgie Wood at Lethenhill, Matthews found a small colony of *Moneses* among scattered Scots Pine and Juniper (*Juniperus communis*) in wet heath (Tables 1 & 2). This was the wettest site for *Moneses*; a number of rosettes displayed veinal chlorosis.

Records from Grantown-on-Spey (MacKechnie 1954, (**E**)) and Castle Grant (McCallum Webster 1978) probably refer to Old Grantown Wood where the plant is extant but in a precarious condition. Timber extraction has destroyed some colonies and grazing threatens others. *Moneses* is accompanied by abundant *Linnaea borealis, Goodyera repens* and *Ptilium crista-castrensis* at this site.

In the early 1950s Lennard recorded *Moneses* from "open heathy moorland but close to natural pinewood" (Lennard, pers. comm., 1993) about 3 km east of Nethy Bridge and south of Craigmore Wood but this has not been confirmed by our survey.

BANFFSHIRE (V.C. 94)

Moneses was collected between Dufftown and Drumuir in 1840 and 1890 (Anon (**E**)). Blizzard Bell (Greville 1841) and Dickie (1860) recorded the plant from Mortlach which could also be the same locality. It was found in Glen Livet by Keith in 1870 (**CMM**).

NORTH ABERDEEN (V.C. 93)

The earliest record for v.c. 93 is a collection from Haddo by Stewart in 1893 (**E**), but it has not been recorded subsequently from this site. Farther west, *Moneses* was collected in 1861 (Anon (**ABD**)) from a wood between Rhynie and Clatt. Since then, any habitat suitable for *Moneses* has been lost to agriculture.

Pirie (1906) recorded a small patch of *Moneses* from Bin Wood, 3 km north-west of Huntly, but recent searches have failed to refind the plant.

SOUTH ABERDEEN (V.C. 92)

Moneses has been recorded from possibly three localities. However, the collection from Braemar by White in 1877 (**ABD**) and the record from Ballochbuie Forest by Steven & Carlisle (1959) could

be the same locality. An undated specimen from "Burnwood, Kincardinshire" (Anon (**ABD**)), is probably from Burn of Wood near Kirkton of Glenbuchat.

ANGUS (V.C. 90)

Don recorded *Moneses* as "rare" in the Clova Mountains (Don 1813) but Gardiner (1848) questioned this locality. Don offered *Moneses* for sale from his Forfar nursery in 1813 but whether the source of Don's cultivated material was the Clova Mountains can only be guessed. This is the only known Angus record apart from a dubious specimen in **OXF.** This record is not included in Fig. 1.

EAST PERTH (V.C. 89)

Moneses was first reported from "near Perth ... in considerable abundance" by Bishop (1826) but less than a century later Barclay (1908) blamed collectors for the "greatly lessened quantity".

The plant was avidly collected from Scone between 1825 and 1833 (e.g. Gardiner 1848). Drummond-Hay holds the record for the largest number of specimens (25) on a single sheet. From this period 69 herbarium sheets and another 20 collections have been traced.

Sim (1859a) stated that *Moneses* "was found under the trees, among moss and grass, sparingly distributed over an area of about two acres [1 ha] ..." but revisited the site the next summer and "could only obtain a few rather stunted specimens" (Sim 1859b). However, the subsequent year he was more successful, advertising, "specimens of *Moneses grandiflora* ... will be supplied" (Sim 1860).

Several botanists including Hillhouse (1889), White (1898) and Barclay (1908) lamented the decline of *Moneses* at Scone and the last record traced from Scone is a specimen dated 1922 (**PTH**).

Records from Muirward Wood and New Scone are probably the same site and represent a second locality. Specimens were collected by Sadler in 1857 (**E**) (Balfour 1902) and the last record is Drummond-Hay's specimen of 1869 (**PTH**).

MID PERTH (V.C. 88)

Specimens collected from Methven by McNab in 1836 and Campbell in 1837 are in **CGE** and **E** respectively. However, Sadler and others failed to locate the plant there on an excursion in 1857 (Balfour 1902). A recent record for Craigvinean Forest in Strathtay requires confirmation (Turl, pers. comm, 1998).

MIDLOTHIAN (V.C. 83)

Learmonth (1841) recorded *Moneses* from "Harburn Firwood", just south of West Calder. The rarer plants he listed have disappeared from this wood.

KIRKCUDBRIGHTSHIRE (V.C. 73)

This is the most southerly Scottish record. It was reported by Hillhouse (1889) as "Extirpated from Woodhead Hill, Traqueer [sic], Dumfriesshire". Woodhead Hill is within Mabie forest which is in the parish of Troqueer, south-west of Dumfries. No records of *Moneses* can be traced in the Floras of Dumfries or Kirkcudbrightshire.

WESTMORLAND (V.C. 69)

Borrer recorded *Moneses* from Bardsea, near Ulverston, where "he sought it unsuccessfully, not withstanding 'a very particular direction' by Wright of Keswick" (Watson 1849). Baker (1885) doubted this record. The only English specimen is labelled "Westmorland" (det. Shillito 1820 (**LIV**)).

DISCUSSION

Moneses has been lost from at least 28 Scottish sites. More than half of these losses have been from north-eastern Scotland. There has apparently been not only a decrease in the abundance of the species but also a considerable contraction of its British range. As *Moneses* is easily overlooked, and appears to exist mostly in very small populations, it is possible that the plant is under-recorded, especially in the larger remnants of native pinewood. However, discoveries distant from well known areas for the plant are rare.

TABLE 3. HERBARIUM COLLECTIONS* OF *MONESES UNIFLORA* FROM SCOTLAND (FROM 24 BRITISH HERBARIA)

Decade	Perthshire	Moray	East Sutherland	Easter Ross	Speyside	Grampian	Other	Total
1790s		3						3
1820s	1							1
1830s	31	1		31				63
1840s	30	1		3		1	1	36
1850s	9							9
1860s	14	2				1	1	18
1870s	3	26		1		2	2	34
1880s	1	2			4			7
1890s		4	9	1	18		2	34
						subtotal 1790–1899		205
1900s		1	9				1	11
1910s					2			2
1920s	1	2	6					9
1930s		1	9					10
1940s		1	1					2
1950s		2			3			5
1960s		1	5					6
1970s		1	1				1	3
1980s		2					1	3
						subtotal 1900–1989		51
Undated	8	2	2	1	2	1	0	16
Total	98	52	42	37	29	5	9	272

*A collection is defined as a plant or plants gathered from a named locality by one collector (where recorded) attached to a single herbarium sheet. Where two or more sheets with the same date, locality and collector have been distributed to different herbaria, these have been counted as separate collections.

Recently discovered populations have been spotted by chance, not by systematic searches of "lost" sites. *Moneses* is apparently able to persist for a considerable length of time in small, fragmentary populations, for example in Burgie Wood and The Mound. The small size of nearly all extant populations (Table 1) renders the plant vulnerable to habitat disturbance, a fact borne out by reports of *Moneses* disappearing from sites due to tree-felling or track-widening. Secrecy from those who should know about localities, rather than ensuring the plant's protection, is often more likely to result in its unwitting destruction, especially in managed plantations.

Although botanical collecting during the mid- to late-1800s (Table 3) was a major cause of decline of *Moneses* in Britain, this threat has now subsided. With the exception of traits that render *Moneses* sensitive to changes in its habitats, the main current threat is poor communication between conservationists, botanists and land managers.

Forestry practices have had both positive and negative effects on *Moneses* populations. Where modern plantations of exotic conifers have replaced old pinewoods, *Moneses* has been drastically reduced or lost, whilst some old Scots Pine plantations have either been colonised by *Moneses* or the plant has been introduced with stock. The latter may have been the origin of some populations on estates with large conifer plantings, for example Scone and Kilmory Estate, Lochgilphead.

Most of the British population of *Moneses* occurs on land which is managed for timber production. Therefore the future of the plant depends on sensitive management within areas of forests. In furthering this aim, considerable progress has been made in recent years by Scottish Natural Heritage (North Area) and Forest Enterprise maintaining regular and effective communication regarding the whereabouts of *Moneses* populations.

ACKNOWLEDGMENTS

We wish to thank Shaun Ince, Jonathan Hughes, Jonathan Stacey, Ben Averis, Margaret Lennard, John Edelsten, Fraser Symonds and others who have helped us find *Moneses* at certain sites. Thanks also to Gordon Rothero for producing the distribution map using DMap. We also thank Douglas McKean, Tim Rich and the library staff of the Royal Botanic Garden, Edinburgh.

REFERENCES

AUNE, E. I. (1977). Scandinavian pine forests and their relationship to the Scottish pinewoods, in BUNCE, R. G. H. & JEFFERS, J. N. R. eds. *Native pinewoods of Scotland.* Institute of Terrestrial Ecology, Cambridge.

BAKER, I. G. (1885). *Flora of the English Lake District.* George Bell & Sons, London.

BALFOUR, J. H. (1902). Botanical excursions made by John Hutton Balfour. *Notes from the Royal Botanic Garden Edinburgh* **8**: 21–481.

BARCLAY, W. (1908). Address to Society. *Proceedings of the Perth Society of Natural Sciences* **4**: 189–194.

BISHOP, D. (1826). Rare native plants found in Perthshire. *Edinburgh philosophical journal* **14**: 180–181.

BRICHAN, J. B. (1842). Notes on the British Pyrolae. *Phytologist* **1**: 26.

BURGESS, J. J. ed. (1935). *Flora of Moray.* Moray Field Club, Elgin.

CLARKE, W. A. (1900). *First records of British flowering plants.* West, Newman & Co., London.

CLERK, D. (1845). The Parish of Torosay. *Statistical account of Scotland: Renfrew and Argyle* **7**: 277–296.

DICKIE, G. (1860). *Botanist's guide to the Counties of Aberdeen, Banff and Kincardineshire.* A. Brown & Co., Aberdeen.

DON, G. (1813). Account of the native plants in the County of Forfar, and the animals to be found there, in HEADRICK, J. *General view of the agriculture of the County of Angus or Forfarshire.* Neill & Co., Edinburgh.

DUNCAN, U. K. (1980). *Flora of East Ross-shire.* Botanical Society of Edinburgh, Edinburgh.

ELLENBERG, H. (1988). *Vegetation ecology of Central Europe.* Cambridge University Press, Cambridge.

FARQUHARSON, J. & SELKIRK, A. M. (1868). Notes of a visit to Strath Glass and its tributary glens. *Transactions of the Botanical Society of Edinburgh* **9**: 474–479.

GARDINER, W. (1848). *Flora of Fofarshire.* Longman, Brown, Green & Longmans, London.

GERARD, J. (1597). *The Herball or Generall historie of plants.* John Norton, London.

GODWIN, H. (1975). *The history of the British flora,* 2nd ed. Cambridge University Press, Cambridge.

GORDON, G. (1839). *Collectanea for a Flora of Moray.* G. Gordin, Elgin.

GREVILLE, R. K. (1841). Communications. *4th and 5th Annual Report of the Proceedings of the Botanical Society of Edinburgh.* Edinburgh.

HILLHOUSE, W. (1889). The disappearance of British plants. *Journal of botany* **27**: 359–365.

HOOKER, W. J. (1830). *Flora Scotica.* Archibald Constable & Co. and Hurst Robinson & Co., London.

LEARMONTH, W. (1841). Parish of West Calder. *Statistical account of Scotland* **1**: 304–309.

KENWORTHY, J. B. (1976). *John Anthony's Flora of Sutherland.* Botanical Society of Edinburgh, Edinburgh.

MCCALLUM WEBSTER, M. (1968). *A checklist of the flora of Culbin State Forest.* M. McCallum Webster, Moray.

MCCALLUM WEBSTER, M. (1978). *Flora of Moray, Nairn and East Inverness.* Aberdeen University Press, Aberdeen.

MACMILLAN, H. (1907). *Rothiemurchus.* Dent & Co., London.

MARSHALL, E. S. (1896). *Moneses grandiflora* in Argyll. *Journal of botany* **34**: 400.

MEUSEL, H. (1951). Vegetationskundliche Studien über mitteleuropaische Waldgesellschaften. *Berichte Deutschen Botanischen Gesellschaft* **64**: 222–240.

MILLER, P. (1763). *Gardener's dictionary,* 5th ed. John Rivington, London.

MURRAY, C. (1799). *The British garden: a description of hardy plants, indigenous, or cultivated in the climate of Great Britain.* S. Hazard, Bath.

NELSON, E. C. (1995). Scottish botanical history preserved in the National Botanic Gardens, Glasnevin, Dublin. *Scottish naturalist* **107**:137–162.

OGILVIE, W. (1845). The Parish of Dyke and Moy. *Statistical account of Scotland; Banff Elgin, Nairn* **13**: 218.

PANKHURST, J. & MULLIN, J. M. (1991). *Flora of the Outer Hebrides.* Natural History Museum, London.

PARKINSON, J. (1640). *Theatrum Botanicum.* Thomas Cotes, London.

PERRING, F. H. & FARRELL, L. (1983). *British red data books 1: vascular plants,* 2nd ed. Royal Society for Nature Conservation, Lincoln.

PIRIE, J. (1906). *The Parish of Cairney.* J. Pirie, Banff.

PRESTON, C. D. & HILL, M. O. (1997). The geographical relationships of British and Irish vascular plants. *Botanical journal of the Linnean Society* **124**: 1–120.

RODWELL, J. S., ed. (1991a). *British plant communities. Vol. 1. Woodlands and scrub.* Cambridge University Press, Cambridge.
RODWELL, J. S., ed. (1991b). *British plant communities. Vol. 2. Mires and heaths.* Cambridge University Press, Cambridge.
SIM, J. (1859a). Plants of Perth. *Phytologist* **3**: 33–44.
SIM, J. (1859b). Botanical rambles in June 1859. *Phytologist* **3**: 359–362.
SIM, J. (1860). Botanical notes, notices, and queries. *Phytologist* **4**: 317.
SOWERBY, J. E. (1794). *English botany,* Vol. 2. J. E. Sowerby, London.
STEVEN, H. M. & CARLISLE, A. (1959). *The native pinewoods of Scotland.* Oliver & Boyd, Edinburgh.
STIRTON, J. (1887). Communication, summer session, 1885. *Proceedings of the Natural History Society of Glasgow,* New Series **1**: lxv.
TRAILL, J. W. H. (1910). Botanical notes. *Annals of Scottish natural history* **76**: 253.
WATSON, H. C. (1837). *New Botanists' Guide*. Longman, Brown, Green & Longmans, London.
WATSON, H. C. (1849). *Cybele Britannica.* Longman & Co., London.
White, F. B. W. (1898). *The Flora of Perthshire.* Perthshire Society of Natural Science, Edinburgh.

(Accepted February 1998)