

Woolly Willow



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Summary

- Woolly willow is a montane species that is vulnerable in Scotland because most of its few remaining populations are small and threatened with the further loss of individuals. It was listed as a Priority species under the UK Biodiversity Action Plan (UKBAP), and is included on the Scottish Biodiversity List. It is also a component of subarctic willow scrub, a habitat type listed on Annex I of the EC Habitats Directive.
- The species is confined to 13 sites in Scotland, of which three are functionally extinct and three are at risk. Several of the remaining seven sites require reinforcement.
- It is now a plant restricted to wet basic rocks and similar areas with late snow-lie with a northerly aspect at altitudes of 620–1,036 m. It is vulnerable to grazing and is becoming increasingly threatened by reduced snow-lie.
- Techniques for recovery involve reducing grazing by fencing or deer/sheep control, and the planting of container-grown willows sourced from local seed or cuttings. Plants are put out in summer at the end of their second or third growing season.
- A total of 1,587 woolly willows have been used to reinforce the populations at three sites and create two new sites. Care was taken to maximise genetic variation in the planted stock by using material from 30 parent plants where possible.
- Good plant hygiene must be used during the taking of cuttings and during propagation and planting to avoid the introduction of novel pests, especially fungal infections.
- A rationale for any planting should be formulated and a standardised monitoring programme devised so that lessons may be learned. Consideration should be given to the avoidance of compromising other habitats and so threatening other scarce species.

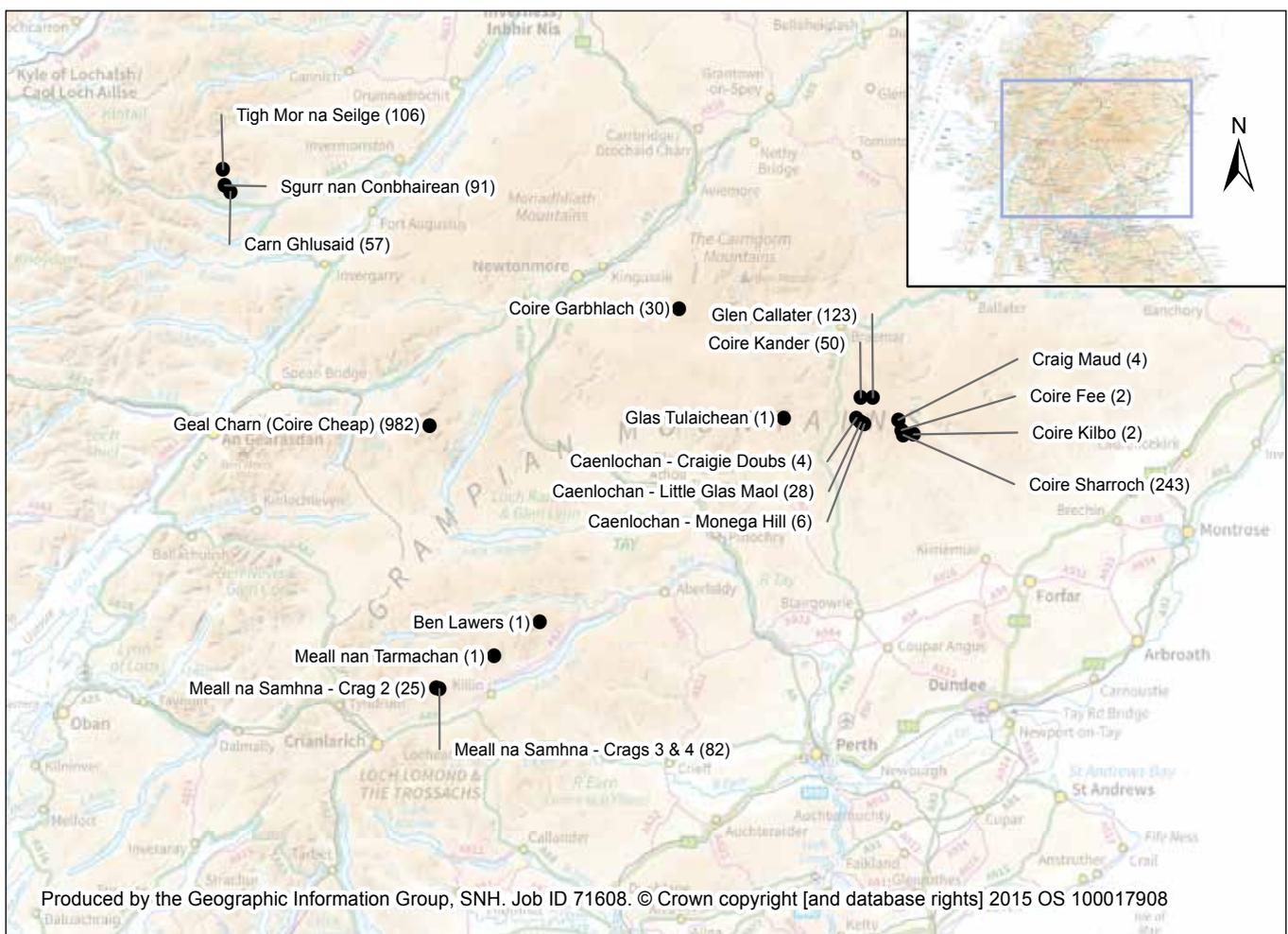


Fig 1. Location of known sites for woolly willow in Scotland, with estimated numbers of plants in 2007 (see Table 1).

- Formal monitoring should take place after two to three years and then at approximately five year intervals, but qualitative monitoring should be annual to diagnose problems. Subsequent plantings should be a reinforcement of successful establishment and growth rather than a repeated attempt to plant in an area that is apparently unsuitable.

Introduction

Woolly willow (*Salix lapponum*) is a vulnerable montane willow confined in the UK to 13 sites in Scotland (Marriott in Wigginton, 1999; Fig. 1 and Table 1). It is a plant found on wet, basic rocks at altitudes of 620–1,036 m. All sites have a northerly aspect. Its rarity in Scotland is a reflection of the scarcity of basic rocks at high altitude and its vulnerability to grazing. Hence the sites where it occurs are inaccessible and rocky, and/or are areas with late snow-lie. Late snow-lie may protect the willows from frost and wind damage,

Table 1. The 13 woolly willow sites in Scotland.

Site Name	Grid reference	Designation	Estate numbers at 2007	Surveys	
1. Ben Lawers	NN 653 442	Ben Lawers NNR, SSSI, SAC	1	Marriott, 1994, Crook, 2000	
2. Meall nan Tarmachan	NN 578 389	Ben Lawers NNR, SSSI, SAC	1	Marriott, 1994	
3. Meall na Samhna: Crag 3 & 4	NN 488 336	Meall na Samhna SSSI, SAC	82	Watson and Boddington, 1994, Crook, 2000	
Crag 2	NN 483 337		25		
4. Glas Tulaichean	NO 054 766	Cairngorms NNR, SSSI, SAC	1	Marriott, 1994, plant much reduced by 2007	
5. Coire Kander	NO 18 80	Cairngorms NNR, SSSI, SAC	50	Part surveyed 1994, part surveyed Crook, 2000, Marriott, 2004	
	NO 19 80				
6. Glen Callater	NO 20 80	Cairngorms NNR, SSSI, SAC	123	Part surveyed Crook, 2000, resurveyed Marriott, 2006	
	NO 20 79				
7. Caenlochan: Craigie Doubs	NO 173 767	Cairngorms NNR, SSSI, SAC	4	Surveyed 2005, needs resurvey	
	Monega Hill		NO 186 757	6	Surveyed 2000, 2008
	Little Glas Maol		NO 18 76	28	Resurveyed 2011
8. Coire Fee: Coire Sharroch	NO 25 74	Cairngorms NNR, SSSI, SAC	243	NCC 1986-9, Leishman, 1989	
	Coire Fee		NO 247 748	2	Needs resurvey
	Coire Kilbo		NO 267 741	2	Needs resurvey
	Craig Maud		NO 242 764	4	Needs resurvey
9. Coire Garbhlach	NN 882 940	Cairngorms NNR, SSSI, SAC	30	Marriott, 1994, part surveyed Crook, 2000	
10. Tigh Mor na Seilge	NH 133 163	none	106	Marriott, 1994, Crook, 2000	
11. Sgurr nan Conbhairean	NH 136 137	none	91	Marriott, 1994	
12. Carn Ghlusaid	NH 145 127	none	57	Surveyed 2004	
13. Geal Charn (Coire Cheap)	NN 472 755	Ben Alder & Aonach Beag SSSI, SAC	982	Marriott, 1994, Moore and Mardon, 2008, Marriott, 2010	
Total			1838		

as well as grazing. It is classed as 'Vulnerable' in the *Red Data List for Great Britain* (Cheffings and Farrell, 2005) because most of its few remaining populations are small and threatened with the further loss of individuals, though it is not threatened in Europe. It was identified as a UKBAP Priority species and is included on the Scottish Biodiversity List. It is a component of subarctic willow scrub, which is a habitat type listed on Annex I of the EU Habitats Directive.

It is a dioecious species (male and female catkins occur on separate plants) and so three 'populations' of single plants are functionally extinct (Table 2). It is likely that the separate sexes need to be well within an estimated 50 m of each other for effective pollination by flies and bumblebees (Mardon, 2000). It is also likely that bumblebees are the more effective pollinators over longer distances.

It has been suggested (Marriott in Gilbert *et al.*, 1997) that the requirements to maintain a viable population of a montane willow are:

1. Male and female plants well within an estimated maximum 50 m of each other for effective pollination.
2. Bare ground for seedling establishment.
3. Appropriate (low) levels of grazing.
4. Snow cover that protects plants from frost damage and grazing during the winter and late spring.
5. Relatively cool/damp soil conditions.
6. A minimum number of plants to produce sufficient 'seed rain' to colonise bare ground at rates equal to the loss of mature plants.

In May 1999 the Woolly Willow Steering Group (WWSG) was constituted to implement a Woolly Willow Species Action Plan. The lead partner was the National Trust for Scotland (NTS). Among the first tasks that were tackled was an attempt

to complete the survey of the woolly willow sites started by Marriott (1994) and also to identify what constituted a 'viable' population. With respect to the latter, the habitat requirements that would support a viable population (see above) were broadly accepted with the qualification that the soils should be base-rich, the altitude over 600 m, and the vegetation characterised by National Vegetation Classification types W20, U17 and CG12 (Averis *et al.*, 2004). It was suggested that a viable population would also require a minimum of 50 plants with approximately equal numbers of males and females. It had taken much of the intervening time between 1999 and 2007 to arrive at reasonably accurate counts for the different populations.

A total of 1,838 plants were estimated to be present in 2007. Of the 13 sites for woolly willow (Table 1) seven could initially be classified as apparently viable, three as at risk and three as functionally extinct (Table 2). However, when the sites were looked at in more detail, some of the larger colonies were found to consist of very small sub-colonies separated by more than 50 m from their neighbours and were, therefore, in need of reinforcement.

The original UKBAP Species Action Plan objectives were therefore modified and made more realistic in the light of experience, and adopted as the targets for the Species Action Framework (SAF) project (Sydes, 2008). Fortunately by the start of the SAF project there had also been some important research work on montane willows carried out in 2002-05 (Scottish Montane Willow Research Group, 2005). This helped inform the project, especially with reference to the genetic variability of the different populations.

Table 2. An assessment of the viability of the woolly willow populations.

Apparently viable	At risk	Functionally extinct
3. Meall na Samhna	5. Coire Kander	1. Ben Lawers
7. Caenlochan	6. Glen Callater	2. Meall nan Tarmachan
Coire Sharroch (8. Coire Fee)	9. Coire Garbhlach	4. Glas Tulaichean
11. Sgurr nan Conbhairean		
12. Carn Ghlusaid		
13. Geal Charn		
7 sites	3 sites	3 sites

Aims

Aims and objectives for 2007-2012

Three objectives/targets were set for the SAF woolly willow project:

- To increase total population size to over 2000 plants by 2010.
- To ensure that populations are stable or increasing at all known sites by 2015.
- To increase the range of the species by ensuring that populations at four sites can expand by 2015.

Management Action

Summary of the main actions carried out

The SAF project included work in four main areas:

- Seeds and cuttings were collected from plants in Coire Sharroch, Caenlochan, Coire Kander, Glen Callater and Meall na Samhna.
- Seeds and cuttings were grown at Royal Botanic Garden Edinburgh (RBGE) and Stonehaven (first author's garden) and then pricked out into root trainers. Plants for Ben Lawers National Nature Reserve (NNR) and Meall na Samhna were grown at the NTS nursery in Killin.
- A total of 1,587 woolly willows were planted at five sites (Table 3).
- Monitoring of the planted willows was carried out at Glas Tulaichean and Coire Garbhlach.

Propagation and Planting

By 2007 it was already known that it was possible to propagate montane willows in large numbers, as had been done in the pioneering work by NTS staff at Ben Lawers (Mardon, 2000, 2003). However, achieving population growth at any site required that the factors preventing regeneration were also being addressed. The enclosure at Coire Sharroch, erected in 1991, had shown that fencing on its own would not necessarily facilitate population expansion. So reinforcement was

planned at this site to provide an opportunity to test the hypothesis that woolly willows would grow successfully if planted in areas of late snow-lie with reduced grazing in late winter and spring.

Fortunately by 2007 deer numbers were being significantly reduced on Glen Feshie estate, thus making Coire Garbhlach a candidate site. A reduction in the numbers of deer was also about to happen at Caenlochan. There was a very large enclosure at Creag an Lochain (Meall nan Tarmachan), erected in 2000, and there were already enclosures at Ben Lawers (Mardon, 2003) and Coire Sharroch. Planting had already been carried out at Glas Tulaichean in 1999 (Phil Lusby, pers. comm.). Much later, sheep were removed from Meall na Samhna making reinforcement possible there too, in 2012.

The target for planting at any site was to grow seed from at least 30 parent plants. Sometimes cuttings were taken if there were not enough parent plants producing seed. No seeds were seen or were accessible in 2008 in Coire Garbhlach although some cuttings were taken.

The aim was also not to over-represent one parent amongst the progeny. For traceability the seed parents (for plants grown at RBGE) were photographed, a GPS reading recorded and a leaf taken and put in silica gel to allow future tracing by DNA analysis.

The SAF project funding enabled the shade tunnel (Fig. 2) and other resources to be purchased for RBGE and supported the purchase of materials for the NTS nursery at Killin (Fig. 3); this greatly increased the output (Table 3).



Fig 2. The shade tunnel at RBGE in 2009, showing willows in root trainers.



Fig 3. The NTS willow nursery at Killin.

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Planting was carried out during the summer months. At Coire Sharroch this was always in August when the plants had finished growth for the year. Fertilizer was not used for the month or so before planting out so that they were not too lush, in case this made them more vulnerable to grazing by voles or slugs. Plants were thus put out at the end of their second season's growth (13-14 months after the seed was collected). They were sometimes kept for an extra season before planting out. These plants were sturdier and possibly had a better chance of survival but there was the greater risk of them picking up rust disease or being attacked by vine weevil while at RBGE.

A day or two before planting, the willows were removed from their root trainers and wrapped in bundles of six with cling film (the cling film roll was cut in half). This made it easier to transport them up the hill in planting bags while wearing harnesses. Using the harnesses made planting on steep ground much easier. At Coire Sharroch

and Coire Garbhlach each bundle of plants was of carefully mixed parentage. Planting dibbers, trowels and a tool that cut a plug sized slot were all used for planting. Planting was done by volunteers and staff from SNH, NTS and RBGE (Fig. 4). At Coire Sharroch the sites to be planted were marked a few days beforehand using forestry flags and the volunteers then planted six or twelve plants around each flag as instructed. At Coire Garbhlach planting was mostly done by two climbers employed from Glenmore Lodge because of the difficulty of the terrain. They were directed by walkie-talkie and the area they planted was marked by forestry flags so that the planting areas could be photographed from a vantage point across the corrie. An account of the 2009 plantings at Coire Sharroch is given in Fleming (2009) and at Coire Garbhlach in Moore (2009).



Fig 4. Volunteers planting woolly willow at Coire Sharroch, 11/8/2011.

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Table 3. Summary of woolly willows planted at each site, by year, to 2012.

Site	1999	2002	2008	2009	2011	2012	Totals
1b.Lairig Innein (new)		34	9	10		71	124
2b.Creag an Lochain (new)		60	66	135		70	331
3.Meall na Samhna						204	204
4.Glas Tulaichean	28						28
Coire Sharroch (8. Coire Fee)				312	324		636
9.Coire Garbhlach				250		14	264
Total	28	94	75	707	324	359	1587

Achievement of targets

Not all the planted willows had been monitored by the end of the project period. They are not easy to find in the first year or two after planting, although casual checking had proved that there were good numbers surviving at some sites (Figs. 5 and 6). A major monitoring programme in 2013 at Coire Sharroch found promising rates of survival and growth (See details below in 'New and ongoing work' section). The only site that has been monitored over several years is Glas Tulaichean where 28 were planted in 1999. By 2003 this number had dropped to 17 surviving plants and in 2007 there were only seven (25%).



Fig 5. Woolly willow transplant, Coire Sharroch 2010.

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Fig 6. Four-year old transplant, Coire Sharroch, showing the first catkin buds, 2012.

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In 2012 the opportunity was taken during the planting at Coire Garbhlach (Fig. 7) to monitor the 2009 plantings. Fifty-one surviving transplants were seen and measured out of the 250 originally planted. This is a minimum figure as it was not possible to access all areas and some plants may have been missed due to size. This makes it almost certain that this population will have been boosted to well over the theoretical minimum of 50 by 2015, especially with the 14 plants added in 2012.



Fig 7. Volunteer planting at Coire Garbhlach with the help of a climber from Glenmore Lodge, 2012.

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The number of woolly willows planted, therefore, has to be adjusted if a calculation is to be made as to whether the target number for the total Scottish population of 2000 plants by 2010 was achieved. If we take a possibly pessimistic estimate of 25% survival and assume no significant losses of the 'original' (pre-SAF work) plants then the target was narrowly achieved in 2010 (1,838 original plants + 904 planted willows \times 0.25 = 2,064). By 2015 this will be a little more secure (Table 4) because of the plantings in 2011 and 2012.

Woolly willows were due to be planted at Caenlochan in 2012, if the areas proposed did not have other botanical interests which might be damaged. Unfortunately this assessment could not be carried out because heavy rainfall made the access track impassable. This planting was rescheduled for 2013 (See 'New and ongoing work' section below) and has since made the achievement of the first target even more secure with the addition of c. 200 plants.

The second target of ensuring that populations are stable or increasing by 2015 has now been achieved at 10 of the 13 sites, where the numbers

Table 4. Projected numbers of woolly willows by 2015. This does not include 2014 plantings at Caenlochan and in Coire Fee (see New and ongoing work section).

Site no.	Site Name	Number of original plants at 2012	Number planted by 2012	Number of planted stock surviving to 2015 assuming 25% survival	Projected total number of plants by 2015 (Cols 3 + 5)
1	Ben Lawers	1			1
1b	Lairig Innein (new)	-	124	31	31
2	Meall nan Tarmachan	1			1
2b	Creag an Lochain (new)	-	331	83	83
3	Meall na Samhna	102	204	51	153
4	Glas Tulaichean	1	28	7	8
5	Coire Kander	50	0	0	50
6	Glen Callater	123	0	0	123
7	Caenlochan: Craigie Doubs	4	0	0	4
	Monega Hill	6	0	0	6
	Little Glas Maol	72	0	0	72
8	Coire Fee : Coire Sharroch	243	636	159	402
	Coire Fee	2	0	0	2
	Coire Kilbo	2	0	0	2
	Craig Maud	4	0	0	4
9	Coire Garbhlach	30	264	66	96
10	Tigh Mor na Seilge	106	0	0	106
11	Sgurr nan Conbhairean	91	0	0	91
12	Carn Ghlusaid	57	0	0	57
13	Geal Charn	829	0	0	829
Total		1724	1587	397	2121

of plants are thought to be above 50, although it is not possible to predict that any will be increasing. The position is different for the other three sites. The Glas Tulaichean site can scarcely hold 50 plants because of the grazing levels, and the Ben Lawers and Meall nan Tarmachan sites cannot be supplemented as there is little refuge from grazing. Thus these three sites cannot really be regarded as 'stable'.

The plantings at Lairig Innein and Creag an Lochain (sites 1b and 2b, Table 4) are not in 'native' sites, but are really substitutes for not being able to plant at the original Ben Lawers (Meall Garbh) and Meall an Tarmachan (also called Meall Garbh) sites, and so do not contribute to the third target

of 'increasing the range of the species by ensuring that populations at four sites can expand by 2015'. Both plantings are acknowledged to be experimental as they are south and east facing sites (Mardon, 2000, 2003) whereas all known natural woolly willow sites have a northerly aspect.

Lessons Learnt, Further Work and Future Recommendations

Lessons learnt

1. Targets for a montane species such as woolly willow take a long time to achieve because of the remoteness of the sites where it grows, difficulties of access and the need to mitigate the causes of decline.
2. Obtaining accurate data to inform the recovery programme takes a long time for similar reasons, and also because of weather limiting survey work, and the need for skilled surveyors. Thus it was fortunate that SAF resources became available just as the WWSG had finally (after eight years) collected reasonably accurate counts at all sites (except one where this was achieved in 2011). There are still four small sub-sites where survey is required (Table 1).
3. The techniques for collecting and propagating woolly willows pioneered by NTS and adopted in this programme worked well. It is perfectly possible to produce large numbers of montane willows, transport them to remote sites and plant them. It takes two to three years from the decision to plant somewhere and identify suitable source material, to the actual planting taking place.
4. Propagation by seed is to be preferred where possible because large numbers of genetically variable plants can be produced, but some propagation by cuttings is useful where plants of known sex are needed or there is a need to boost the number of parental sources.
5. While it was known that deer and sheep can have a serious effect through grazing, it was not appreciated at Coire Sharroch how much damage is caused by mountain hares (*Lepus timidus*). Grazing of flowering shoots may have a serious effect on seed production.
6. Continuity of the people involved in the programme is important. Some delay was caused by the high turnover of staff in SNH at one site.

Future action

Standardised monitoring of the willows planted is vital if lessons are to be learned from the planting done so far. This is particularly important in evaluating the success of the planting at a micro-habitat level. Repeat surveys of the pre-existing woolly willows will also be necessary at longer intervals to plot their progress, and especially to assess any progress in alleviating problems due to grazing. It will also be important to monitor populations where reducing snow cover may make them more vulnerable e.g. Geal Charn (Coire Cheap). Lessons learned from the planting programmes should be used in further work to make all the woolly willow populations more secure. The numerical target of 50 plants per population was only a minimum. Security of the existing populations will only be assured when we see recruitment and this will require a good 'seed rain' from many female plants.

It is recommended that monitoring of planted willows follows the protocol drawn up by the Montane Scrub Action Group (in preparation). It is also recommended that the monitoring of the pre-existing woolly willow populations follows the method described by Marriott (2008). There have been too many surveys which just result in a count of individual plants. If this is less than that reported in a previous survey it does not necessarily mean that the population has declined, it may simply be that the surveyor did not find all the plants. This problem is illustrated by one project which surveyed three sites more-or-less accurately but missed 30-94% of woolly willows at the remaining four sites.

Any future planting of woolly willows (or any other montane willow species) must take into account the possibility of accidentally introducing pests or disease. Any such planting should have a written protocol to deal with this potential problem which has been agreed with a suitable authority. This should include:

1. A protocol for dealing with vine weevil.
2. A protocol for dealing with rust infections (e.g. spraying with fungicide, only planting when not in leaf or careful checking before planting).
3. A protocol which includes the sterilising of secateurs between taking cuttings.
4. The cleaning of boots between visits to different sites using appropriate chemicals.

Key Management Messages

- There must be good quality data on population numbers and the distribution of a montane willow of conservation concern before proceeding to any remedial action.
- There should be a proper rationale for any action taken, especially showing how the apparent causes of any decline have been addressed. Consideration must be given to the effect on other species of action taken.
- Where planting is considered to be necessary, it will take 2-3 years from the start of propagation to planting. Consideration must be given to the responsibility for future monitoring and its methods before planting.
- Propagation of plants from seed is practicable and ensures genetic variation and presumably gender balance. Seed should ideally come from a minimum of 30 seed parents. Cuttings work well but make it harder to ensure genetic variation and gender balance unless great care is taken.
- Plant health must be taken very seriously so that fungi and other pathogens are not transferred to wild populations.

New and ongoing work since SAF ended

Caenlochan

In August 2014, 228 seven-year old plants from 10 Caenlochan seed-parents were planted out, with no protection, by RBGE staff. These will be monitored to see if a reduction in deer numbers makes establishment possible (N. Frachon, pers. comm.).

Coire Fee

In August 2014, 300 one-year old plants, taken as cuttings from Coire Sharroch stock maintained at RBGE, were planted out by RBGE and SNH staff in Coire Fee, outside the Coire Sharroch fence. These will be monitored to see if the number of grazing animals is low enough to enable establishment. They were monitored by SNH staff in 2015 and all had survived well with only one plant showing the effects of grazing (F. Mann, pers. comm.).

Coire Sharroch

The woolly willows (also dark-leaved willow (*S. myrsinifolia*) and downy willow (*S. lapponum*)) planted in 2009, 2011 and 2012 were monitored in August 2013 (Marriott, 2014). In four out of

seven sites there was over 60% survival of planted woolly willows. The best growth observed was at a site with only 35% survival. At a site with only 31% survival the losses were in more acidic soil, and plants did better in the wetter, flushed part of the site. The willows were monitored again in 2015, and survival and growth rates of woolly willow were maintained (N. Frachon, pers. comm.).

Further Information

- http://jncc.defra.gov.uk/pdf/ulcn_newsletter16.pdf – 'Looking to the Hills', Issue 16, newsletter of the JNCC Upland Lead Coordination Network, including article on the woolly willow SAF project.
- <http://www.mountainwoodlands.org/publications.asp> – The Scrubbers' Bulletin published by the Montane Scrub Action Group (MSAG).
- A digital archive of the work of the Woolly Willow Steering Group has been prepared (Marriott and McHaffie, 2013) and is to be stored at RBGE.

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The SAF Partners

- [Scottish Natural Heritage](#).
- [The National Trust for Scotland](#)
- The Woolly Willow Steering Group
- The Montane Scrub Action Group
- [Royal Botanic Garden Edinburgh](#)

The Species Action Framework Handbook

This account comes from the Species Action Framework Handbook published by Scottish Natural Heritage. For more information on the handbook please go to www.snh.gov.uk/speciesactionframework.

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