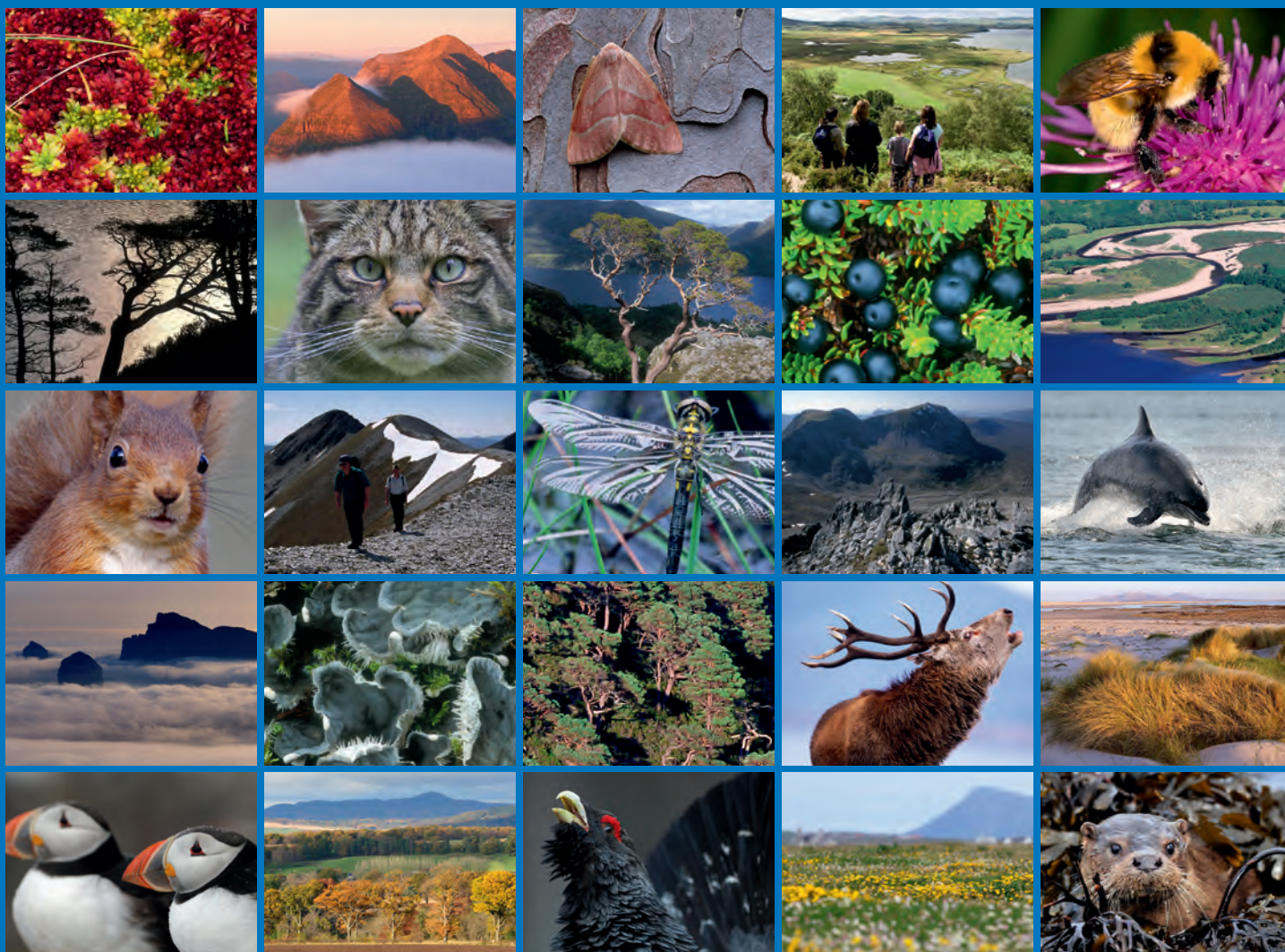


Juniper survey of Perth and Kinross, 2010





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COMMISSIONED REPORT

Commissioned Report No. 920

Juniper survey of Perth and Kinross, 2010

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COMMISSIONED REPORT

Summary

Juniper survey of Perth and Kinross, 2010

Commissioned Report No. 920

Project No: 10578

Contractor: Liz Lavery

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Keywords

Juniper; Perth; Kinross; condition; health; regeneration.

Background

This survey was commissioned in 2010 by SNH to monitor the condition of juniper outside designated Juniper Wood SSSIs in Perth and Kinross. In particular the health of populations and regeneration were looked at on sites. More than 7,500 bushes were monitored at 96 sites. Of these sites, 22 had more than 50 bushes, the number generally considered to constitute a viable population (Forestry Commission Scotland, 2009). Records were grouped into 7 geographical areas. These are shown in Figure 4.

1. North and west of Pitlochry
2. North east of Pitlochry and north of Blairgowrie
3. Pitlochry to Ballinluig
4. Loch Tay, Ben Lawers
5. River Tay west side from Aberfeldy to Dunkeld
6. Dunkeld, east side of River Tay
7. Comrie and Braco area

Main findings

- Populations monitored showed clustering around Juniper Wood SSSIs, near Comrie, near Dunkeld, on the west side of the River Tay near Balnaguard and near Ballyoukan south of Pitlochry, 21 out of 22 populations with more than 50 bushes occurred in these areas. In areas 1 and 2 only 3 sites out of 55 surveyed had more than 50 bushes.
- Sites up to 350m altitude were in woodland or upland pasture and many bushes were engulfed in tall bracken at the time of the survey. All sites monitored above 350m were in areas 1 and 2, usually confined to burn gorges and inland cliff sites. Only one site over 350m had more than 50 bushes, at Creag Odhar.
- The majority of sites had some healthy bushes with vigorous green growth. Diseased bushes were not a prominent feature at any site. An abnormally high number of dead bushes were found on Lurgan Hill, Comrie. Bushes were doing poorly at several sites because of shading, browsing damage by deer, mechanical damage from rubbing or snow damage.
- The majority of bushes were mature (2084 bushes) or overmature (4121 vigorous bushes, 581 moribund or dead bushes). Young bushes were found at only 20 sites and seedlings at 7. Sites with seedlings had a complete age range of bushes present with a

good source of berries nearby. On most sites with regeneration, young bushes and seedlings were found in low numbers in suitable habitats with low competition from other species, such as small areas with short vegetation or rocky bare soil. Good regeneration was found at a new site above Ballyoukan SSSI and on the woodland edge at Coire-n-eassan, not far from Balnaguard SSSI. Regeneration was outstanding at one site, Shillinghill near Glenartney Juniper Wood SSSI, with nearly 1000 young and mature bushes in 18 hectares.

- There was a good source of berries at 39 sites. Many overmature bushes had abundant berries. There was no regeneration at most sites as no suitable habitat was available for germination and growth of young seedlings. Where seedlings were found the vegetation was less than 10cm. On Shillinghill mixed grassy heath (Nation Vegetation Classification M15, U4) was grazed very short by cattle and sheep to about 5cm but grazing pressures did not seriously impact on the young juniper. At most sites the vegetation surrounding bushes was more than 20cm tall, often thick tussocky grasses or tall bracken preventing seedling establishment. Shading from bracken makes regeneration very unlikely on many hill pasture sites below 350m.
- Active regeneration is vital for the survival of juniper populations and is dependent on suitable habitat being available. Balanced grazing levels are needed to create suitable areas for germination on sites where there is a good source of berries from mature and overmature bushes. Rabbit grazing and intensive winter grazing by sheep and deer are probably most harmful to young bushes.

Update on dieback at Glenartney Juniper Wood SSSI/SAC

Since the completion of this study and report, the pathogen causing juniper dieback at Glenartney Juniper Wood SSSI/SAC was identified in 2012 as *Phytophthora austrocedri*.

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My thanks to everyone who sent records into the 'Great Perthshire Juniper Hunt. My thanks to all land owners and land managers who gave us permission to survey and all those who provided important information about the management and history of juniper on their land. In particular my thanks to Jane Anderson curator of Atholl Estates Archive for information about the history of Juniper on Atholl Estates and Mr Macbeth, Balnaguard Farm for information about Balnaguard Juniper Wood.

1. INTRODUCTION

Scottish Natural Heritage commissioned this survey to assess the condition of juniper, *Juniperus communis*, outside protected Juniper Wood SSSIs in Perth and Kinross in 2010. In particular regeneration and signs of serious disease were to be monitored.

Juniper has been a UK Biodiversity Action Plan Species since 1999. It is a Schedule 8 species protected under the Wildlife and Countryside Act 1981 and the Nature Conservation (Scotland) Act 2004. It has suffered a serious decline in the UK over the past 25 years both in range and size of populations (Long & Williams, 2007). Scotland now supports approximately 80% of the UK population of juniper (Forestry Commission Scotland, 2008).

There are four juniper woods designated as Sites of Special Scientific Interest in Perthshire:

- Fungarth Juniper Wood SSSI, NO045 425, near Dunkeld has the largest area of juniper scrub in east Perth & Kinross (54.74ha).
- Ballyoukan Juniper Wood SSSI, NN968 570, south east of Pitlochry, important for its large area of juniper scrub (20.26ha)
- Balnaguard Glen SSSI, NN940 514, 8km east of Aberfeldy, important for its juniper scrub woodland (58.48ha)
- Glenartney Juniper Wood SSSI, NN761 181, is the largest juniper woodland in Tayside Region (96.8ha).

There is very little or no natural regeneration occurring on these SSSIs. Site Condition Monitoring in September 2004 found all sites were in unfavourable condition, though Ballyoukan and Balnaguard were unfavourable but recovering.

- Fungarth Juniper Wood was judged unfavourable because of 'the ratio of pioneering/ailing bushes and the presence of undesirable species (*Pteridium aquilinum*)'
- Balnaguard Juniper Wood was unfavourable but recovering with some regeneration
- Glenartney Juniper Wood was unfavourable declining
- Ballyoukan was unfavourable 'on account of the density of pioneer/regenerating bushes and the presence of undesirable species (*Cirsium arvense*) but was recovering.

There is serious die back of juniper at Glenartney Juniper Wood SSSI. Die back was first noted in the 1990s and first reported by the tenant farmer in 2000. Forest Research was contracted by SNH to investigate the causes in 2007 (Broome *et. al.*, 2008). They found dieback is not related to population age and is affecting bushes of all ages. 'Vegetation changes in the past two decades point to an increased site wetness' and 'several factors support dieback is linked to site wetness'. They found 'clear evidence of a pathogen attacking the juniper bushes' and 'Field symptoms suggest an oomycete such as *Phytophthora undulata* may be involved'. The report suggests progressive waterlogging, due to a combination of increased autumn rainfall since the 1980s and deterioration of the field drainage system since the 1950s resulting from changes in farming practices on the hill may have made bushes more susceptible to fungal infections, in particular the juniper pathogen, *Phytophthora undulata*. They advise that the presence and extent of *Phytophthora* should be tested in the juniper population (Broome *et. al.*, 2008).

Dieback with a high number of dead bushes has also happened at Mardale Juniper Wood, Cumbria (pers. comm. David Shackleton).



Figure 1. Mardale Juniper Wood dieback, July 2006 © David Shackleton



Figure 2. Mardale Juniper Wood dieback, July 2006 © David Shackleton

2. SURVEY

2.1 Records

Juniper records were provided by SNH as an Excel spreadsheet obtained from NBN Gateway and as a map showing the exact position of records with 6 or 8 figure grid reference and highlighting 1 kilometre squares, 2km, 5km and 10 kilometre squares for which records exist (Map 28546: Juniper Survey of Perth and Kinross). Other records were obtained from BSBI (Botanical Society of the British Isles) database (Map 31727, Excel 31727); BSBI vice-county recorders, Alistair Godfrey and Jim McIntosh (VC88 Mid Perth) and Martin Robinson (VC89 East Perth). Records also came from Plantlife's 'Juniper Survey across the British Uplands' in 2004-2005 (Long & Williams, 2007) and from Graham Sullivan's report to SNH on the 'Extent and condition of juniper scrub in Scotland' (Sullivan, 2003). To gather in new records SNH launched 'The great Perthshire juniper hunt' with a prize offered for the best new record submitted.

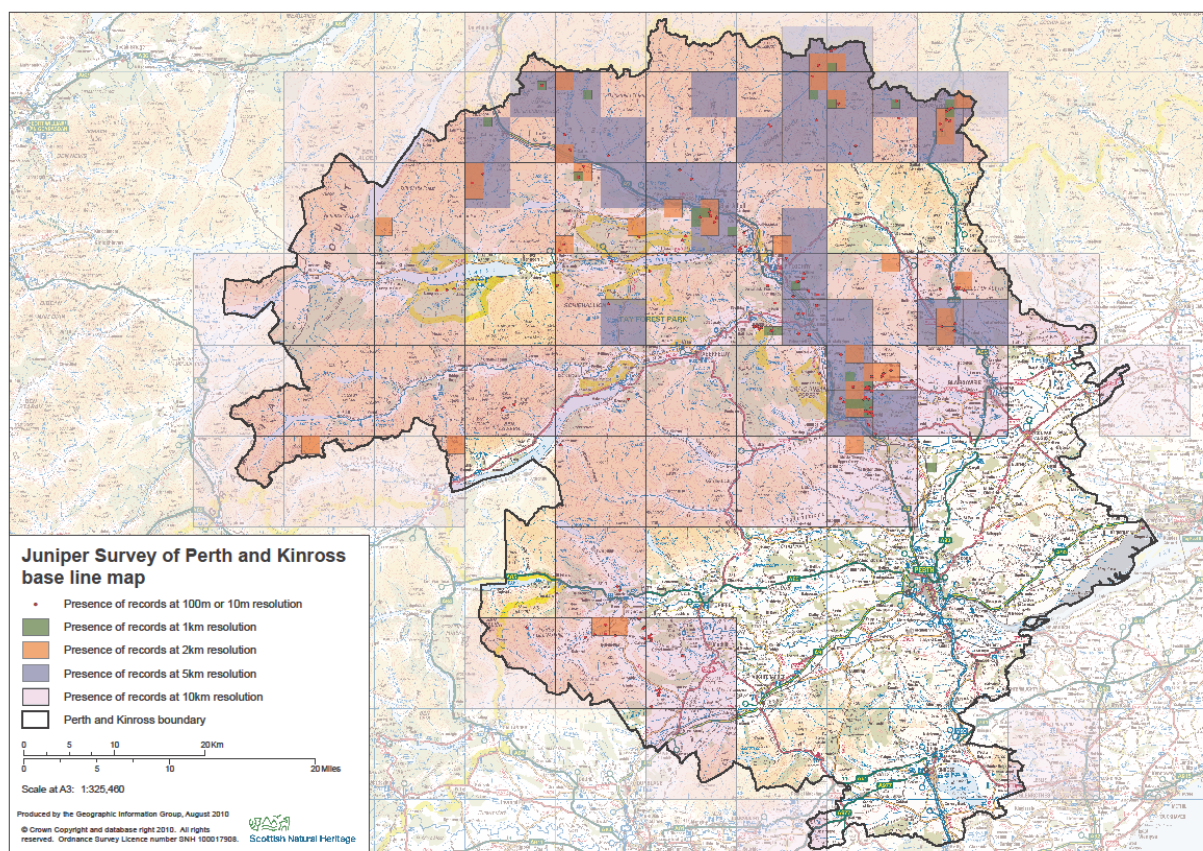


Figure 3. Juniper survey of Perth and Kinross base line map

2.2 Survey method

Three surveyors, Ro Scott, Martin Robinson and Liz Lavery, monitored sites between September and November 2010. A training day to standardise monitoring was held on the 5/09/2010 at Balrobbie Farm and a survey form designed to record juniper. Information on number of bushes, age range of bushes, health, sizes, berries, grazing, mechanical damage, habitat and extent of juniper is recorded on the form.

The age of bushes on sites was defined by size:

- Seedlings (S) – height & spread < 25cm
- Young bushes – height and spread <1m, no berries

- Young mature bushes (YM) – height and spread 50 – 150cms, single stems, berries may be present
- Mature bushes (M) – height and spread >25cms, trunks and stems < 15cm diameter, berries present, green and black, can have multiple thin stems, trunks not collapsed nor horizontal
- Overmature bushes (OM) – large old bushes often with broken and collapsed, horizontal multiple trunks, frequently covered with moss or lichen, having a trunk diameter >10-15cms.

Health of bushes was assessed by the presence of vigorous green shoots, small brown patches (usually brown/dead needles) and large brown patches (damaged/diseased brown branches).

- Healthy OM bushes, MAD (more alive than dead) are regenerating by producing vigorous, green upright shoots
- Moribund, unhealthy OM bushes, MDA (more dead than alive) have less than 50% green shoots, small and large patches of brown needles and bare branches.

When counting bushes and estimating the number of bushes in dense clumps of juniper the surveyors have estimated on the low side. Finding and getting close to bushes was sometimes very difficult in early autumn. This became progressively easier as vegetation and bracken died down and trees lost their leaves in November. Juniper would be easiest to survey in late winter or early spring before bracken has grown up and trees are in leaf.

The number of bushes with berries was recorded as a percentage of all bushes and ranked as more or less than 10%. Locations were recorded using a GPS.

Only records with 6 figure grid references were checked during this survey. Records were plotted onto memory-map to establish their distribution. On the basis of this, sites were grouped into survey days to minimise travelling time between sites and maximise the number of sites surveyed. Wider areas, 10km, 5km, 2km and 1km squares, shown on the map of Perth and Kinross as having records for juniper, were not searched as this would have been very time consuming. However several new sites were found while surveying other sites. Some Plantlife survey sites (Long & Williams, 2007) and sites described by Graham Sullivan (Sullivan, 2003) with precise grid references were included as were sites reported from 'The Great Perthshire Juniper Hunt'.

Permission to survey sites was obtained from land managers and owners on the day or before visiting a site. Contacts are given on the juniper survey forms.

Survey forms were completed for every site visited. This was not always simple as multiple records exist for some sites, either duplicate records at the same grid reference by different recorders or as several site records if juniper is spread over a wide area. Surveyors have used their own judgement to decide on site boundaries.

2.3 Sites surveyed in 2010

Juniper was surveyed at 129 sites between September and the last week in November. No juniper was found at 33 of the sites visited. Juniper was found at 31 sites with no previous records for that 100m square (6 figure grid references).

2.4 Sites not surveyed in 2010

Juniper survey forms have been completed for 4 sites not visited by surveyors using information from reliable observers. Records for juniper on Ben Lawers were supplied by

Dan Watson, NTS (National Trust for Scotland) ecologist for Ben Lawers. Information on Logierait Mires SSSI was supplied by Peter McPhail, SNH, and for Tummel Flushes SSSI by Peter McPhail and Nicki McIntyre, SNH. At Craiglush Marshes problems contacting the owner for access were circumvented when Peter Ferns, SWT, offered to look for records. SWT has permission to enter this area and was able to carry out the survey by canoe. Only old bushes were found (pers. comm. Peter Ferns) and the full results of this survey will be added at a future date.

No forms were completed for several sites, though information was received about them. Rob Coope, Biodiversity Manager for Tay Forest District provided information about 2 juniper records on Forestry Commission land.

Richard Thompson, Forest Enterprise Ecologist is co-ordinating 'national effort to record and manage and monitor juniper' in Forestry Commission woodland. Richard is unaware of any additional sites but future FC surveys may provide additional information about juniper sites in Perth and Kinross on Forestry Commission land. Juniper is a priority species in the National Forest Estate in Scotland.

A site at Knowehead Farm, on Cardney Estate could not be visited in the autumn as access was refused because of shooting (UID 93). Access to some sites on Dalnacardoch Estate was denied because of stalking in October.

The onset of early heavy winter snow in late November 2010 meant that several visits planned for the end of November and early December were abandoned. In particular a visit had been planned to a new site with juniper reported by Mr McBeth, Balnaguard Farm, just SE of Balnaguard Juniper Wood SSSI. Juniper has increased on the open hillside since he acquired the site in 1981 and grazed the area in summer with sheep and cattle. It is not grazed in winter except by deer (Section 3. 5).

3. RESULTS OF THE JUNIPER SURVEY

3.1 Distribution of sites surveyed

Sites surveyed fall into 7 geographical areas of Perth and Kinross. Table 1 shows the geographical distribution of the sites surveyed, the number of bushes found in each area, the number of sites and the number of sites with more than 50 bushes in each area.

Table 1. Distribution of sites and bushes

Area	Bushes	Sites	Sites with >50 bushes
1 North and west of Pitlochry	598 - 798	33	2
2 North east of Pitlochry, north of Blairgowrie	152	22	1
3 Pitlochry to Ballinluig	>174	11	2
4 Loch Tay, Ben Lawers	10	1	0
5 Tay west side, Aberfeldy to Dunkeld	>912	5	3
6 Dunkeld east side of Tay, north & east	2616 - 4616	27	4
7 Comrie – Braco area	>2877	30	10
Total	7522 - 9522	129	22



Figure 4. The seven geographical areas with juniper in Perth and Kinross. (Base map copyright free from Wikicommons)

- The largest number of bushes was found around Dunkeld, 2000-4000 of these were at one site on Cardney Estate; 616 bushes are spread over the other 26 sites surveyed in the Dunkeld area on the east side of the Tay.
- The second highest number of bushes was recorded in the Comrie area, and the most sites with more than 50 bushes.
- Three large sites were surveyed on the west side of the Tay and 2 with only 1 bush.
- Dispersed small populations were found on sites north east of Pitlochry and north of Blairgowrie.
- Most sites were found north and west of Pitlochry. These sites are widely dispersed; only 2 had more than 50 bushes and most were small populations or single bushes.

Records have a restricted geographical range and sites show distinct clustering around Comrie, in the Tay Valley around Dunkeld and at Balnaguard. Hill pasture and woodland sites between altitude 100m and 350m showed clustering around Juniper Wood SSSIs in the Comrie and Dunkeld areas and near Balnaguard and Ballyoukan. The largest sites with big patches of dense overmature are in these areas. The 10 sites with more than 50 bushes in the Comrie area are all within 3 kilometres of Glenartney Juniper Wood SSSI. All sites surveyed in the Dunkeld area are within 5 kilometres of Fungarth Juniper Wood SSSI. The three sites on the west side of the Tay with more than 50 bushes are all within a 3 kilometre radius of Balnaguard Juniper Wood SSSI. The 2 sites with more than 50 bushes between Pitlochry and Ballinluig are near to Ballyoukan Juniper SSSI.

North and west of Pitlochry 7 montane burn sites were above 350m, other sites ranged from 110-300m altitude. North east of Pitlochry and north of Blairgowrie most sites were scattered along mountain burns or on inland cliffs above 350m.

Comrie area

All sites with juniper, with the exception of 2 sites on Braco Castle Estate, are within 6 km of Glenartney Juniper wood SSSI. There are extensive areas of overmature bushes, scattered bushes and dense clumps, on Culloch Hill (UID 115), Lurgan Hill (UID 120) and beside the minor road from Blairinroar to Dunruchan Farm (UID 118, 119, 123, 125). An outstanding young population with circa 1000 young bushes occurs on Shillinghill (UID 116). All these sites are within 3km of Glenartney Juniper Wood SSSI. In Glenartney on the north side of the River Ruchill, about 1.5km from Glenartney Juniper Wood SSSI, there are clumps of dense juniper in woodland and scattered bushes on the open hill (UID 109, 110, 111). On both Lurgan Hill and at Dalrannoch (UID 110) localised regeneration was found restricted to craggy outcrops with thin soils and around rabbit scrapes at Dalrannoch. The most distant sites, approx. 5.5km from Glenartney SSSI, are 3 small sites on Dunira Estate at the mouth of Glenlednock (UID 100, 101, 102). Dense bracken swamping old bushes is restricting available ground for regeneration at many of the sites. Very few diseased bushes were found on the Comrie sites but an exceptionally high number of dead bushes were counted on Lurgan Hill (UID 120).

Several records from Braco Castle Estate were checked. A healthy population of less than 50 mostly mature bushes was found scattered in small groups in mature pine woodland (UID 128), a few young bushes were found beside the only mature bushes found with berries. Juniper appears to have been lost from Buille Burn on Braco Castle Estate (UID 129). There are now two large duck fighting ponds at this site.

Dunkeld area

Three large areas of dense old juniper occur within 4km north of Fungarth Juniper Wood SSSI;

- The Glack or Birkenburn Juniper Wood (UID 79). There is regeneration nearby.
- Cardney Juniper Wood (UID 82, 81) has the largest number of juniper bushes found during this survey, estimated 2000-4000 mature and old bushes in birch/pine woodland. There is recent regeneration, 150 younger bushes, on the open hill (UID 81) but this area is now swamped in bracken. These areas are used for rearing pheasant and partridge.
- Dense overmature juniper at Macmaridge (UID 94, 95, 96) with no regeneration. This area is used for rearing pheasant and partridge.

Small populations and scattered bushes occur on the east side of the Tay at Craig a Barns and north from Mill Dam to Loch Ordie (UID 74, 75, 76, 77). Small young populations (UID 76, 78) were found near Mill Dam close to The Glack Juniper Wood. No wild juniper was found east of Butterstone Loch. At Roughstones overmature bushes were monitored growing in a garden which the juniper bushes probably predate (UID 98).

West side of the River Tay

Three sites had hundreds of bushes, 2 on Kinnaird Estate and one at Coire-n-eassan above Grandtully. All 3 sites are within 3km of Balnaguard SSSI.

- Balmacneil, Kinnaird Estate (UID 70), overmature bushes engulfed in bracken with no regeneration. This area is used for rearing pheasants.
- Balnamuir, Kinnaird Estate (UID 69), overmature bushes, a few young bushes grazed and not doing well. This area is used for rearing pheasants.
- Coire-n-eassan, Sketewan Wood (UID 68), extensive area of very old moribund bushes in the shade of ancient birch wood, big patches of healthy overmature and mature bushes in open areas near the edge of the wood, a good source of berries. Good regeneration on the woodland edge, seedlings and young bushes in several places in the adjacent field.

Two sites had only single bushes, an overmature bush in mixed oak woodland at Dalguise (UID72) and a mature bush at Glach Glas (UID 71) at the confluence of the Tay and Tummel. Both bushes had some green berries. The bush at Glach Glas is directly opposite and 0.5km east of Balmacneil (UID 70). The single bush at Dalguise is about 4 km from potential seed sources at Balmacneil and The Glack (UID 79).

Loch Tay, Ben Lawers

Juniper sites at An Stuc and Meall Garbh on Ben Lawers on the north side of Loch Tay were not visited but information was provided by Dan Watson, NTS (National Trust for Scotland) Ecologist for Ben Lawers (UID 67). There was no natural regeneration at these sites in 1995. The results of a recent survey by Tom McDonald in 2008 are still to be submitted. Since 1995, 7 live and 3 dead bushes have been recorded growing wild.

Between 2003 and 2010 5,475 Juniper bushes have been planted in 2 enclosures on Ben Lawers, Craig an Lochan, 189 hectares, altitude 650-700m and East End enclosure, 9 hectares at 770-900m (UID 67, map). Head nurseryman at Ben Lawers, Andrew Warwick described sourcing and propagation. Seeds are collected every second year from a site in Coire Etchachan, Mar Lodge Estate, from bushes growing at a similar altitude to those on Ben Lawers. Berries were collected from 20% of bushes in 2001, 2003, 2005, 2007. Seeds are stored in big pots loosely covered in soil over winter and then potted on in the spring. Germination is variable and slow, usually best in the second year after potting. Andrew's advice is 'never throw seeds out'; seeds may take up to 6 years to germinate. Seedlings are grown on in pots and planted out on Ben Lawers after 3 years; the earliest planting in 2003

is now almost ready to produce berries. Vole damage to seedlings in enclosures has been a problem in some years.

Ballinluig to Pitlochry

Two sites were recorded with more than 50 bushes. A large, previously unrecorded site of 3 hectares was found with a young population of hundreds of bushes (UID 56) outside the Juniper wood SSSI at Ballyoukan. A site at Blairchroisk (UID 61) had more than 60 mature and overmature bushes over 0.5 hectares, about 2.5 km from Ballyoukan. A single young bush was found nearby (UID 62). Fewer than 10 bushes were found at all other sites. Juniper was not found at 3 reported sites but was found at 4 new sites. Sites with single bushes are in line of sight and about 1km from nearby sites. Peter McPhail, SNH, reported on Juniper at Logierait Mires SSSI (UID 66), where there are scattered bushes. None were found at the grid reference on NBN Gateway for Juniper at Logierait Mires SSSI (UID 63).

East of Pitlochry and north of Blairgowrie.

Sites were more dispersed in a mountainous area. Of the 22 monitored, 9 had only one bush (5 mature and 4 overmature), no bushes were found at 9 sites, 3 sites had 2, 5 and 9 bushes. Six were upland montane burn sites or inland rock sites at altitudes from 390m to 565m with bushes surviving in places inaccessible to animals. The single bushes must be bird sown at many of these sites. A cluster of small sites was monitored around Blackhall Farm (UID 49, 50, 51, 52), altitude 260 – 280m, with a total of 16 mature and old bushes and one younger bush. One low ground site north of Blairgowrie at Steps of Cally (UID 55) has more than 100 bushes.

North and west of Pitlochry

Of the 33 sites monitored 10 were new sites without previous 100m records. No juniper was found at 7 sites with 6 figure grid references records. Ten sites had single bushes (3 mature and 7 overmature). Of the remaining 16 sites, 8 had fewer than 10 bushes, 5 sites had fewer than 30 bushes. Only 2 sites had more than 30 bushes - Glackmore (UID 21) with approximately 90 bushes, nearly all overmature with only 3 mature bushes. Creag Odhar (UID23) is an upland moorland/cliff site with 300-600 mature bushes. Both of these sites are near Tullach Hill, Blair Atholl. Many sites on lower ground were in Forestry Commission Woodland.

Sites do not show distinct clustering. Sites west and south of Blair Atholl fall into loose groups which may represent meta-populations.

- Black Wood of Rannoch – 4 sites with a total of 9 bushes, two sites with single bushes, ones site with 7, no juniper found at one site, no bushes had berries (UID 1, 2, 3, 4). Overall health was poor.
- Near Tummel Bridge – 4 sites with a total of 15 bushes, 3 new sites and one previously recorded site; 2 with single bushes, a site with 4 bushes with berries shaded by developing birch scrub and one with 9 bushes under a wayleave with young, mature and overmature bushes and >10% berries (UID 14, 15, 16, 17).
- Linn of Tummel and Bonskeid - 5 sites with a total of 39 bushes (UID 24, 25, 26, 27, 31). A new site under a pylon wayleave in Bonskeid wood had 30 bushes with more than 10% berries (UID 25).
- Near Killiecrankie – A planted site in a car park and garden at Tigh Ur, was also monitored with 14 bushes (UID 29). 17 very overmature bushes were found at Balrobbie (UID 30).
- Tullach Hill opposite Blair Atholl (UID 21, 23).

At an isolated site at Loch Tummel Flushes SSSI juniper (UID 18), not visited in 2010, Juniper is healthy and responding well to management of the SSSI for *Schoenus ferrugineus* (Nicki McIntyre, Peter McPhail, SNH). Three other sites (UID 7, 8, 9) west of Tummel Bridge near Dunalastair were monitored, of these only one (UID 7) had juniper, 1 overmature bush at Lassintullich limestone.

Upland sites monitored north and west of Blair Atholl are widely dispersed montane burn /inland rock sites, ranging in altitude from 300 – 485m. Healthy Juniper was found at 3 montane burn sites. Allt Coire Easan (UID 6), altitude 485m, was unique among burn gorge sites visited in having more than 25 bushes (8 young, 15 mature and 2 overmature), more than 10% of bushes had berries. A burn gorge beside the A9 (UID 10), altitude 390m, has 9 mature juniper bushes scattered along 250m. Allt a' Chireachain burn (UID13), altitude 350m, has 19 bushes (1 young, 9 young mature and 9 mature) scattered along 1.5km of the burn gorge before leading to the A9, more than 10% of bushes had berries.

3.2 Number of bushes and age

Number of bushes

Table 2 groups the number of bushes found at sites into number classes. No juniper bushes were found at 33 sites visited, despite careful searching. Frequently bushes were found in the same general area at a different grid reference. Before the use of GPS to record the position of records, grid references were dependent on the recorders map reading ability and were more subject to human error. While juniper may have been lost at some sites, many of the apparent losses seem to be a result of recording errors in old surveys. A total of 31 new, previously unrecorded sites were surveyed. These were in many cases within 500 metres of sites where plants had been previously recorded but not refound. On balance, there does not seem to be a real decrease in juniper sites although juniper may have been lost from a few individual sites.

Table 2. Number of sites in each bush number class

Number of bushes/site	Number of sites	%* of sites in each bush class
0	33	-
1	30	31%
1 - 5	13	14%
6 -10	11	12%
11-25	10	9%
26 - 50	5	5%
51 – 100	7	8%
101 - 500	11	12%
501 – 1000	2	2%
>1000	2	2%
No count	5	5%
Total	129 (96 with Juniper)	

*Percentages are rounded up or down to whole numbers

A high percentage of sites monitored (31%) had single bushes, 57% had fewer than 11 bushes. Only 22 sites out of the 96 sites with juniper had more than 50 bushes. A population of 50 bushes is generally considered to constitute a viable population (Forestry Commission Scotland, 2009). On this basis, 24% of sites surveyed have viable populations.

Age of bushes

The age of bushes was recorded at each site, defined by size. The actual age of bushes is not known at the majority of sites. As Balnaguard Juniper Wood has grown up since a

change of tenancy in 1940, most juniper bushes are 80 -100 years old (Mr McBeth, Balnaguard Farm, pers. comm.). At Tigh Ur (UID 29) the owner told Ro Scott he had planted bushes just thirty years ago that were surveyed as overmature. At Shillinghill, all except overmature bushes at the edge of the field had grown up in the last 15 years (Mr. Patterson, Dunruchan Farm pers. comm.).

Many populations are predominantly overmature bushes. These frequently look very similar and appear to be the same age. This is particularly true of overmature bushes on Riemore Estate at Macmaridge (UID 94, 95, 96), on Cardney Estate (UID 82), at The Glack or Birkenburn (UID 79) on Atholl Estates and on Kinnaird Estate (UID 69, 70). It has been suggested that juniper may have been maintained in the Dunkeld area as a source of berries for the Edinburgh Gin Company in the mid nineteenth century (Magnus Linklater, Riemore Estate, pers. comm.).

Table 3. The number of bushes and sites in each bush age class

Age class	Number of juniper	% of total number bushes	Number of sites with age class	Distribution of bushes Range & no. bushes (no. sites)
Seedlings	42	0.5%	7	Range 1-15 bushes 1bush (1site), 2-10 (4), 10-15 (2)
Young bushes	573	7.0%	20	Range 1-310 1 (1), 2-11(14), 15-20(2), 50-100 (1), 310 (1)
Young mature	681	8.4%	5	Range 1-165 1 (1), 2-10 (1), 11-20 (2), 645 (1)
Mature	2084	25.8%	58	Range 1 >1000 1 (15), 2-10 (13), 11-25 (9), 26-50 (4), 51-100(5), 100-500 (10), >1000 (2)
MAD* (vigorous old bushes)	4121	51%	61	Range 1 > 500 1 (11), 2-10 (24), 10-20 (8), 21-50 (5), 51-100 (4), 101-500 (8), >500 (1)
MDA (moribund bushes)	398	4.9%	39	Range 1 >100 1 (14), 2-10 (16), 11-20 (3), 21-50 (5), >100 (1)
Dead	183	2.3%	21	Range 1-71 1 (7), 2-10 (11), 11-20 (1), 45 (1), 71 (1)
Total	8082			

*MAD – more alive than dead, MDA – more dead than alive

The majority of bushes, more than 50%, were vigorous old, overmature bushes with green shoots. Reassuringly less than 8% of bushes were moribund or dead. Very few sites with seedling juniper were found. Fewer than 16% of all bushes surveyed were young mature or young bushes. Of the 1296 young and seedling bushes counted during the survey, 969 bushes (14 seedlings, 955 young/mature) were at one site, Shillinghill, Comrie (UID 116). Young bushes were present in very low numbers at the other 19 sites.

Table 4 shows the age range of bushes (seedlings, young, mature, overmature) and number of sites with each combination of bushes.

Table 4. The number of sites with age range of bushes

Age range of bushes	Number of sites	% of sites
All age classes present (S, Y, M, OM)	7	7
Only young bushes (Y)	1	1
Only young and mature (Y,M)	3	3
Young, mature and old present (Y, M, OM)	8	8
Young and old only (Y, OM)	1	1
Mature bushes only (M)	20	21
Mature and old/overmature bushes (M, OM)	20	21
Old /overmature only	31	32
Age structure not monitored	5	5
Total number of sites:	96	

M mature, OM overmature/old, Y young, S seedling. % rounded up or down.

Overmature bushes with multiple, moss covered collapsed trunks > 10-15 cm diameter were found at 67 sites. These are very long lived parent bushes which have provided a seed source for nearby populations. Their ages could range from 50 years to over 200 years old; no studies have been made of the life span of Juniper in Scotland (Ward, 2003). 31 sites had only overmature bushes and have had no successful regeneration for a very long time.

The presence of mature bushes indicates that regeneration may have taken place within the last 30 or 50 years. One quarter of bushes recorded have been classed as mature (Table 3) and were found on 58 sites (Table 4). 20 sites had only mature bushes, 15 were single bushes and can be counted as accidental, probably bird sown from nearby populations, 3 are montane stream/inland rock sites with <10 bushes (UID 10, 45, 60), a roadside with 3 bushes (UID 105) and one site with 300-600 bushes not surveyed in detail at Creag Odhar (UID 23).

Active regeneration was found on 20 sites where there are young bushes. A complete age range of bushes was found at all 7 sites with seedlings – seedlings, young, mature and overmature bushes.

24% of sites have viable populations if viability is measured as sites with more than 50 bushes (Table 2). 20% of sites monitored show recent active regeneration with young bushes (Table 3) though these are not the same sites as the 24% with more than 50 bushes. Table 5 shows that out of the 20 sites with young bushes, 10 sites had more than 50 bushes and 10 sites less than 50 bushes.

The 7 sites with seedlings and a complete age range of bushes are spread over 6 number classes, one site had fewer than 10 bushes, 5 sites had more than 50 bushes. Young bushes are only frequent on Shillinghill (UID 116), at other sites with more than 100 bushes, seedlings and young bushes are confined to small areas. Details of the 7 sites with seedlings are given in Table 8 in Section 3.4.

Table 5. Sites with number of bushes per site and age range of bushes present

Age range of bushes on site	Number of sites with age structure									Total sites
	Number of bushes per site /population size									
	1	2-5	6-10	11-25	26-50	51-100	101-500	501-1000	>1000	
S, Y, M, OM			1		1	1	2	1	1	7
Y	1									1
Y, M				2			1			3
Y, M, OM			1	3	1		2		1	8
Y, OM							1			1
M	15	2	2					1		20
M, OM		4	3	4	2	4	3			20
OM	14	7	4	1	1	2	2			31
Totals	30	13	11	10	5	7	11	2	2	91
No count										5
Total										96

M mature, OM overmature/old, Y young, S seedling

Table 6 is derived from Table 5 and compares the population sizes of sites with young bushes and those without young bushes. Most sites, 85%, with young bushes have 11 bushes or more while 72% of sites without young bushes have 10 or less bushes.

Table 6. Summary of population size and age range

Population size class	Sites with Young bushes		Sites without Young bushes/ mature & old	
	Number	% /20	Number	%/70
1	1	5	29	41
2-5	0	0	13	18
6-10	2	10	9	13
Total 1-10	3	15%	51	72%
11- 50	7	35	8	11
>50 bushes	10	50	12	17
Total 11- >50	17	85%	20	28%
Total sites	20		71	

Sites with young bushes

- One aberrant site had a single bush
- None were in size class 2-5
- 50% had more than 50 bushes
- 85% have more than 10 bushes

Sites without young bushes

- 41% had single bushes
- 20% were in size class 2-5
- 17% had more than 50 bushes
- 72% have fewer than 11 bushes

This agrees with the accepted view that regeneration is least likely on smaller sites and most likely on larger sites (FCS, Plantlife).

3.3 Health

The health of bushes at each site was measured by the abundance of small and large brown patches. Dead needles, small brown patches, were very common and present on most mature and overmature bushes and seem to be quite natural. The percentage of bushes with healthy green vigorous shoots has been taken as a measure of site health and ranked I, very good 100-75% of bushes with healthy green shoots, II good 75-50% green shoots, III poor 50-25% green shoots to IV failing / mostly moribund bushes <25% healthy green shoots. Tables 7 and 7a-e show the health of juniper sites by number class of bushes at each site and by age range of bushes on sites.

Table 7. Health of Juniper populations surveyed in 2010

Site size class	Health ranking, I very good to IV failing, very poor*				Total sites
	I	II	III	IV	
Bushes/ site					
1	11	9	6	4	30
1 - 5	1	6	4	2	13
6 -10	1	7	2	1	11
11-25	2	4	2	2	10
26 - 50	0	4	0	1	5
51 – 100	1	2	0	2	5
101 - 500	1	5 + 1 (II-III varies)	3	1 (I-IV varies)	11
501 - 1000		1	1	0	2
>1000	1	1	0	0	2
Totals	18	40	18	13	89
No score					7
Total sites with juniper					96

Table 7a

Age Structure of sites	Health ranking of Sites, I very healthy to IV failing*				Total sites
	I	II	III	IV	
S, Y, M, OM	2	1+1(II-III)	1	1, 1(I-IV)	7
Y	1	0	0	0	1
Y, M	2	1	0	0	3
Y, M, OM	1	6	1	0	8
Y, OM		1	0	0	1
M	10	6	2	2	20
M, OM		9	5	5	19
OM	2	15	9	4	30
Totals	18	40	18	13	89
Health %	20%	45%	20%	15%	
No score					7
Total sites with juniper					96

*I = 100-75% healthy green shoots, very good; II = 75-50% healthy green shoots, good; III = 50-25% healthy green shoots, poor; IV = <25% healthy green shoots, very poor. **not assessed

Table 7b

Health rating	Sites with < 50 bushes		Sites with > 50 bushes		%/20	Total
I	15	22%	3	15%		18
II	30	43%	10	50%		40
III	14	20%	4	20%		18
IV	10	15%	3	15%		13
Total	69		20			

Table 7c

Sites - Number of bushes	Health I,II		Health III,IV	
< 50	45	65%	24	35%
>50	13	65%	7	35%

Table 7d

Health rating	Sites with young bushes		Sites without young bushes	
I	6	30%	12	17%
II	10	50%	30	43%
III	2	10%	16	23%
IV	2	10%	11	17%
Total	20		69	

Table 7e

Sites	Health I, II		Health III, IV	
With young bushes	16	80%	4	20%
Without young bushes	42	61%	27	39%
Mature bushes only	16	80%	4	20%
Overmature bushes only	17	57%	13	43%

Health was monitored on 89 sites. Health was rated very good or good at 58 sites (65%) and poor or very poor at 31 sites (35%). There was no difference between the health of sites with more than 50 bushes and less than 50 bushes (Table 7c). Health was poor or very poor on 35% (24/69 sites) of sites with <50 bushes and 35% (7/20) of sites with >50 bushes. 15% of sites (13/89) were moribund or failing, with bushes with less than 25% green shoots (Table 7). Sites with single bushes were less healthy than sites with more than one bush, of 30 sites with single bushes 4 were moribund and 6 less than 50% healthy and this is the size class with most unhealthy bushes.

Sites with seedlings showed a complete range from very healthy to failing (Table 7a). 80% of sites with young bushes were healthy compared to 65% of sites without young bushes. Sites with only overmature bushes were least healthy, 57% were rated I, II (Table 7e).

Factors affecting juniper health

High shade, extreme old age, lack of grazing of surrounding vegetation and high deer numbers resulting in heavy browsing accounted for the poor and failing health of bushes at sites where health scored <50%. No signs of serious widespread disease were recorded. Very few bushes showed browning that could be a result of disease. Nearly all damage to bushes - dead branches and larger areas of browned foliage, looked like the result of shading, mechanical damage (snow lie, animals rubbing against bushes), or grazing.

An unusually high number of dead bushes was found at Lurgan Hill (UID 120), 18 on the open hill and 53 in the enclosure erected to promote juniper regeneration. The management of these two areas is different. Within the enclosure, with no grazing, bushes have become very overgrown by gorse, broom and bracken. On the open hill 250 sheep graze in winter and prevent scrub cover developing, so only bracken is present. Dieback due to shading by bracken and scrub development was seen at other sites and the situation at Lurgan did not seem significantly more intense. At nearby Glenartney Juniper Wood SSSI there has been serious die back within the last ten years, thought to be related to increased soil wetness (Broome *et. al.*, 2008). This is unlikely at Lurgan, the site is well drained because of the slope and aspect. The high number of dead bushes at this site may be caused by an as yet unidentified factor and should be investigated.

Shade was the main factor affecting the health of bushes on woodland sites. On sites with dense bracken shading prevents successful regeneration.

Ro Scott reported shading as 'a significant threat at sites such as at Bohally Wood (UID 16) and the Black Wood (UID 1, 3, 4) and noted 'the encouragement of tree regeneration by fencing and / or deer control has led to a proliferation of dense regeneration of birch and pine which is now shading out junipers'. She found juniper doing better under power line wayleaves at 4 sites (UID 14, 25, 26, 31) without shading, seedlings had the chance to establish in disturbed ground when the wayleave was installed. She found no sign of *Phomopsis* infection on the sites she visited; all dead branches and browning of foliage looked like the result of shading, mechanical damage, weather or snow.

Juniper was faring less well inside the enclosure on Lurgan hill (UID 120) where it had become overgrown by broom and gorse, it was failing in Auchingarrich Woodland (UID 112), a site with a complete age range of bushes including seedlings, where Sitka plantation had grown up and was shading the forest track. At Coire-n-eassan (UID 68) very old juniper is failing in dense shade under mature birch in an area of ancient woodland, overmature and mature bushes are much healthier in open sites on the edge of Coire-n-eassan/Sketewan wood and regeneration with seedlings is occurring in the open here. Tall bracken engulfing bushes on many open hillside sites does not appear to affect the health of bushes directly but does make regeneration very unlikely.

3.4 Regeneration

Failure to regenerate is the most serious threat to a population. Many juniper populations are persisting as overmature bushes which regenerate by producing new vigorous green shoots from very old root stock. The presence of mature bushes means regeneration has very likely taken place in the last 30 to 50 years. Very few sites were found with active regeneration (Table 4). Young bushes were only found at 20 sites and seedlings at 7 sites.

Since most sites surveyed had only old or mature, the few sites with seedlings are of particular importance in understanding why regeneration is not occurring at other sites. All sites with seedlings had a complete age range of bushes present. A broad age range of juniper including old overmature bushes indicates juniper has been growing in the area for a long time and a good, viable seed source is present. The 7 sites with seedlings are listed in Table 8. Outstanding regeneration has occurred at Shillinghill (UID 116) but regeneration is very limited at the other 6 sites.

Table 8. Sites with a complete age range of bushes (S, Y, M, OM) present

UID	Site name	Geographical area	Number of bushes					% berries	Health
			S	Y	M	OM	Total		
68	Coire-n-eassan	Tay, west side	15	67	108	>320	>410	<10%*	I - IV
100	Glenlednock, near the Shaky Bridge	Comrie area	2	1	3	1	7	42%	II
110	Glen Artney, Dalrannoch	Comrie area	4	16	12	125 (16 dead)	150-200	<10%*	II -III
112	Auchingarrich Woodland, failing site shaded	Comrie area	4	7	13	>10	>.34	0	IV
116	Shillinghill, Dunruchan Farm	Comrie area	14	310, YM 645	105	26	1103	>10%	I
119	Dunruchan 4, Comrie	Comrie area	1	7	30	34(1dead)	72	>10%	I
120	Lurgan Hill	Comrie area	12	18, YM14	208	286 (71 dead)	c.500	<10%*	III

S seedlings, Y young, YM young mature, M mature, OM overmature.

*Berries locally >10% in area with regeneration.

Vegetation was less than 10 cm at all locations where seedlings were found. Bushes with abundant berries were present in all areas with seedlings except at Auchingarrich.

Lack of suitable habitat is the main reason why germination is not occurring at many sites. The other factor is the availability of a good source of berries. The presence of bushes with berries at or very nearby a site is crucial when assessing viability. Sites with more than 10% berried bushes are assumed to have the potential for germination and establishment of seedlings if suitable ground is available. Berrying varies from year to year and berries remain on bushes for at least 2 years. The number of bushes with berries noted during this survey only gives a general indication of seed availability in a population.

Table 9. Number of sites with berries

Berries	Number of sites	% sites / 84	Regeneration
No berries present	32	38%	Not possible
Berries present	52	62%	
< 10% of bushes	13	15%	Unlikely
No good source of berries	45	53%	
>10% of bushes at site	36	42%	Possible
< 10%, part site > 10%	3*	4%	Local on part of site
Good source of berries	39	46%	
Total recorded	84		
Not recorded	12		
Total	96		

*All 3 sites had seedlings in part of the site with >10% berries

Table 10a. Age structure and % of berries

Age structure	Number of sites	Sites with berried bushes		
		None	<10%	>10%
S, Y, M, OM – all age classes present	7	1	3*	3
Y – only young bushes	1	1		
Y, M – only young and mature	3		1	2
Y, M, OM – young, mature and old present	8		3	5
Y, OM – young and old only	1		1	
Total number of sites with regeneration present (seedling and young bushes)	20	2	8	10
M – mature only	20	12	2	6
M,OM – mature and old bushes	16	2	1	13
Total sites with mature but no young bushes, regeneration has taken place in the recent past	36	14	3	19
OM – overmature /old only	28	16	5	7
Totals	84			
Berries not recorded	12			
Total sites with juniper	96			
Regeneration possible, berries >10% (No young)				26

M mature, OM overmature/old, Y young, S seedling. *Berries locally >10% in area with regeneration

Table 10b. Size class and number of sites with berried bushes

Site size class	Sites with berried bushes			Total sites
	No berries	<10% bushes	>10% bushes	
1	22		8	30
2 - 5	7		5	12
6 -10	2	2	4	8
11-25		3	5	9
26 - 50	1	2	2	5
51 – 100		1	4	5
101 - 500		4 + 3*	6	11
501 - 1000		1		2
>1000			2	2
Totals	32	16	36	84
Berries not recorded				12
Total sites with juniper				96

3* sites with localized bushes with >10% berries in areas with regeneration

Of the 20 sites with regeneration, young bushes present, 10 had more than 10% berried bushes, 8 had fewer than 10% berried bushes and 2 had none.

Mature and overmature populations with abundant berries (26 sites Table 10a) have potential to provide a good seed source for surrounding areas. Excluding sites with one bush (8) and sites with less than 25 bushes (10), there are 8 sites with only mature/overmature bushes with more than 10% berried bushes. The dense old juniper wood at the Glack (UID 79) falls into this category, regeneration was found nearby at Glack, East (UID 78) and at the north end of Mill Dam (UID76). Sites at Blairinroar (UID113), Shillinghill 2 (UID 117, 46% of bushes with berries) and Dunruchan 3 (UID 118) are very close to Shillinghill (UID 116). Culloch Hill (UID115), with more than 450 mature and overmature bushes and more than 10% with berries, is a good source of seed for the surrounding area including Shillinghill. Recent grazing by cattle at Culloch Hill is poaching the ground and controlling bracken opening up areas suitable for seedling germination in the future.

Sites with regeneration

Regeneration is actively occurring on all sites where seedlings were found (Table 8). It has occurred in the recent past on sites where young or young mature bushes were found.

Sites with seedling bushes and a full age range of bushes (7 sites)

- Shillinghill, Dunruchan, Comrie (UID 116), with almost 1000 young bushes including 14 seedlings.
- Coire-n-eassan, above Grandtully (UID 68), an ancient juniper wood of more than 400 bushes, has good regeneration occurring on the woodland edge, with seedlings on a dyke and in short grass.
- Dunruchan 4, Comrie (UID 119) with more than 70 bushes predominantly old and mature bushes, over 40% with berries, 7 young and 1 seedling growing at the edge of dense juniper on a rocky outcrop on wet heath. This site is very close to Shillinghill and is a very good source of berries. Suitable ground for germination is very limited; vegetation is mostly more than 20 cm tall. The area was lightly grazed by sheep.
- Glenlednock, Comrie (UID 100), a small site becoming overgrown because of lack of grazing with only 7 bushes found in 2010; 2 seedlings and 1 young bush, 3 mature and 1 old. Sheep have been taken off the hill for the last three years and bracken is spreading.
- Dalrannoch, on the north side of the River Ruchill, Comrie (UID 110) is a variable site covering a large area with 150-200 predominantly old bushes. 4 seedlings and 16 young bushes were found in two small areas, an area of bare soil created by rabbit scrapes around a mature bush with abundant berries and an area of thin soil on a rocky outcrop within an enclosure.
- Auchingarrich Woodland, Comrie (UID 112). 4 seedlings and 7 young bushes were found growing along the verge of a forest track, shaded by tall Sitka spruce. A group of more than 30 dense overmature bushes with other scattered mature bushes is beside the track. Many of the young bushes were failing because of shading and browsing by deer. No berries were seen.
- Lurgan Hill, Comrie (UID 120) a large site of over 50 hectares with more than 500 mature and old bushes; 2 seedlings and 32 young and young mature bushes with several mature bushes with abundant berries were found in one small area, a craggy outcrop with short grassy heath at the boundary between bracken covered hillside and heather moorland higher up the hill. Tall bracken and high numbers of sheep wintered on the hill prevent regeneration over most of Lurgan Hill.

Regeneration is occurring at sites where there is open ground with short vegetation <10cms. This is very limited at most sites except at Shillinghill. Shillinghill is the only site with a big area of short grazed grassy heath; sheep graze this area and the wider hill in summer and do not eat young juniper when other more palatable species are available, cattle are wintered in the field and given supplementary feeding. Here stock seem to avoid juniper when there is sufficient other food available. The grazing regime and level appears to be perfect for juniper establishment in this field. There is a good source of berries from old and mature bushes in the field and from nearby old /mature populations at Shillinghill 2 (UID 117), Dunruchan 2 & 3 (UID 117,118) and Culloch Hill (UID 115), all with more than 10% berried bushes.

Regeneration is not occurring over most of the large juniper sites at Dalrannoch (UID 110) and at Lurgan Hill (UID 120) because of dense bracken, and is confined to rocky outcrops and rabbit scrapes. At Dunruchan 4 (UID 119) regeneration is occurring in shorter grassy heath around the edge of a dense stand of juniper. At Auchingarrich (UID 112) regeneration in short vegetation beside the forest track is failing because of shading and browsing, the health of most young bushes was very poor; this site could be improved greatly by sympathetic woodland management.

A single young bush was found on one site (UID 62) beside a woodland ride in a conifer plantation, an outlier of a larger population at Blairchroisk (UID 61) with about 60 mature and old bushes, >10% berried. On other sites regeneration has occurred in the recent past when young bushes are present: 3 sites with young and mature bushes; 8 sites with young mature and overmature bushes; 1 site with young and overmature bushes only (Table 5).

Sites with young and mature bushes (3 sites)

- Allt a' Chireachain, north of Pitlochry (UID 13), a montane burn gorge with 19 bushes along 1.5km, 10 young/young mature bushes with >10% of bushes with berries
- New site just outside Ballyoukan Juniper wood SSSI (UID 56), probably should be included as part of the SSSI, not surveyed in detail, 100s of small bushes with <10% berried
- Beside track from Milldam to Rotmell Loch, Dunkeld (UID 76) a very healthy population of 14 young and young mature bushes, 21% with berries, less than 1km from the big old juniper wood at the Glack (UID 79)

All are healthy sites with potential for more regeneration. The site at Ballyoukan should be surveyed in detailed and evaluated to see if it should be included as part of the SSSI.

Sites with young, mature and overmature bushes (8 sites)

- Allt Coire Easan, NW of Pitlochry (UID 6), strong healthy colony of 25 bushes, unique among burn sites surveyed with 8 young bushes and >10% berried.
- Two very big populations on Cardney Estate, near Dunkeld. An old juniper wood dominated by very dense patches of overmature bushes, Cardney 1 (UID 82) is the biggest population found during this survey with 2000-4000 bushes. A younger population of more than 150 predominantly young and mature bushes on the open hillside now engulfed in bracken, 40% of bushes have berries, Cardney 2 (UID 81); this site is derived from the main juniper wood. At Cardney 2 (UID 81) there was no suitable ground for germination. Bracken must have been controlled in the past under different management. The hill is now used to rear pheasants and there are no plans to control bracken as it provides good cover.
- Steps of Cally (UID 55), the only site with more than 100 bushes east of Pitlochry, had 1 young and 12 mature bushes, the health of bushes was ranked as less than 50%.

The site is locally heavily grazed but has potential for regeneration with >33% of bushes having berries.

- Tigh Ur (UID 29) is a garden and car park with planted juniper, interesting because it was possible to give an exact age to the bushes judged to be overmature as they were planted 30 years ago. This illustrates the difficulties in estimating bush age and indicates overmature bushes could range from 30 years to 200 years.

Sites with young and overmature bushes (1 site)

One site at Balnamuir on Kinnaird Estate (UID 69) with predominantly overmature bushes partly within a pheasant rearing pen, included 3 young juniper in a *Molinia* bog at the far end of the site. Berried bushes were less than 10% but regeneration had occurred in the recent past.

Regeneration is possible on sites with a good number of berried bushes, >10%, suitable habitat, short vegetation without a litter build up, and balanced grazing levels that do not impact significantly on new juniper. All sites with seedlings and young juniper had one or more good sources of berries within 500m, often sites with dense overmature juniper with more than 10% of bushes with berries.

Sites without any regeneration

Regeneration may be absent for the following reasons.

- Few bushes; only single bushes or fewer than 10 bushes present at a site,
- No berry source; bushes are not producing berries or less than 10% of bushes have berries,
- No suitable habitat; there is no suitable short vegetation or disturbed ground,
- Competition from other species, dense bracken or tall vegetation,
- Shading,
- Heavy grazing.

No signs of regeneration were seen on 71 sites monitored, 20 with only mature bushes, 20 with mature and overmature old bushes and 31 with overmature bushes only (Table 5).

Sites with mature bushes only (20 sites)

15 sites had one bush only, 4 sites had fewer than 10 bushes. At Creag Odhar UID 23 with 300-600 dense juniper bushes over about 2 hectares only 3% of bushes had berries, the site was not surveyed in detail and regeneration must have been going on in the recent past.

Sites with mature and overmature bushes (20 sites)

Table 5 shows 13 of these sites had fewer than 50 bushes. Regeneration was not occurring at these sites because there was no berry source, long unsuitable ungrazed vegetation, dense choking bracken engulfing bushes, possibly high deer numbers browsing any young seedlings that might germinate (montane burn sites where juniper is confined to rock cliffs inaccessible to deer), shading in woodland sites. At the 7 sites with more than 50 bushes, 6 had more than 10% berried bushes, one site (UID 109) was surveyed using binoculars and the number of berried bushes not recorded – all the sites are a potential source for regeneration.

- at Glackmore wood (UID 21) with mainly old juniper, grazing was low in open birch wood and the vegetation may be too long for seedlings to establish

- at Blairchroisk (UID 61) with about 60 mainly overmature bushes, grazing by sheep and deer is high and remedial management is needed
- at the old juniper wood at The Glack (UID 79), with many berried bushes, most of the old bushes were engulfed in tall bracken and no suitable short vegetation was available. Regeneration was recorded at nearby sites (UID 76, 78)
- at Blairinroar, Comrie (UID 113) there is suitable short grassy heath available, recently heavily grazed by horses. Regeneration is possible if grazing levels are managed
- at Culloch Hill, Comrie (UID 115), with more than 450 bushes more than 10% with berries, has potential for successful regeneration in the future if grazing levels are maintained. Cattle, free to roam from in by fields, graze the hill in late summer and early autumn and are poaching up the ground, creating areas of short vegetation and controlling bracken. Very few sheep graze the hill in winter however rabbits were quite numerous in 2010 and may eat seedlings. The bushes form a good source of seed for the surrounding area, including Shillinghill (UID 116).
- at Dunruchan 3 (UID 118) there are over 100 very dense old juniper bushes with >25% with berries, surrounding bracken, *Molinia* and pasture grassland was too long for regeneration but regeneration is occurring nearby at Dunruchan 4 (119) and at Shillinghill (UID 116).

Sites with only overmature bushes (31 sites)

Table 5 shows 31 sites had only overmature bushes. Table 7e shows 57% were healthy populations regenerating by upright green shoots from old, collapsed, moss covered multiple trunks. 25 of these sites had fewer than 10 bushes and 14 only single bushes. Five sites had more than 25 bushes.

- Kinnaird (UID 70) had >200 overmature bushes, in dense clumps and many engulfed in dense tall bracken, with less than 1% berried bushes. Lack of suitable habitat and a poor source of berries mean regeneration is very unlikely.
- Macmaridge 1 (UID 94) had >170 over mature bushes in dense clumps engulfed in dense tall bracken or in long vegetation in mire and woodland, with less than 10% berried bushes. There was no suitable short vegetation but there was a good source of berries nearby at Macmaridge 2 (UID 95).
- Macmaridge 3 woodland (UID 96) had 20-30 healthy overmature bushes engulfed in tall dense bracken in open mixed birch woodland with less than 10% berried bushes. Lack of suitable habitat and a poor source of berries means regeneration is very unlikely.
- Lurgan Hill (UID 121) over 50 overmature, mainly moribund bushes and dead bushes with only 2 with berries in field well grazed by sheep. Grazing and a poor source of berries mean regeneration is very unlikely.
- Dunruchan roadside (UID 123) has about 60 overmature bushes in dense bracken in woodland. Berried bushes not assessed. No regeneration because of lack of suitable habitat.

Table 10 shows that 7 sites with only overmature bushes had >10% bushes with berries. These could provide a good source of berries for regeneration. Of these 4 were single bushes with berries and one had 3 bushes. Macmaridge 2 (UID 95) had 7 bushes, 3 with abundant berries growing in long wet grassland beside a stream. If suitable habitat became available on the bracken covered hillside at Macmaridge 1 (UID 94) the site could be a good source of berries. More than 17 very old mature and moribund bushes were recorded at Balrobbie (UID 30), 3 with berries; the vegetation was long grass very unsuitable for regeneration.

In summary, the two main reasons for lack of regeneration is low number of berries and unsuitable vegetation, particularly dense bracken or ungrazed long grassland and heath. Sites with only one bush have been excluded from this analysis but could in exceptional circumstances produce seedlings if berries are abundant and suitable habitat is available. One site was found with a single young bush (UID 62) but is an outlier to a bigger population of mature and old bushes at Blairchroisk (UID 61) with >10% berries.

At sites with single bushes, seeds must have been transported to the site, probably bird sown, and were often found along track verges or in situations where disturbance must have produced suitable ground for germination in the past.

3.5 Environmental factors and management

The vegetation community type was recorded, along with management factors such as burning, grazing and mechanical damage. Comments on management from owners and land managers were noted.

Vegetation communities

Juniper sites were in woodland, mainly mixed deciduous and birch woodland, NVC community W11, W17 and pine woodland, W18 and W19. Open sites were pasture in upland grassland and mire, mainly U4 and M15 and grassland dominated by dense bracken, U20. Montane sites were on moorland, H12, and inland rock cliffs, usually beside mountain streams and inaccessible to grazing animals.

Burning

Burning only affected montane sites and no serious damage was found resulting from burning.

Grazing

Nearly all the sites were grazed, most commonly by deer, frequently by sheep, a few by cattle and one site by horses. Grazing was moderate at most sites. Tall grasses, heath or bracken more than 20cms high dominated at the majority of sites. There was little obvious damage to juniper bushes. Damage was usually to mature or young bushes and from rubbing though some bushes showed evidence of topiary.

Rabbits may eat very young juniper. At the time of this survey rabbit numbers were low at all except 6 sites. Regeneration at Dalrannoch (UID 110) was found on rabbit scrapes around mature bushes with abundant berries suggesting rabbits may be beneficial in some areas, creating bare soil for seedlings to germinate.

Voles can be a serious threat to young seedling in good vole years. 50% of seedlings planted out in enclosures on Ben Lawers in 2003 died from vole predation, survival has been much better since then (per. comm. Andrew Warwick). Snow lie may protect young bushes from grazing but vole damage can still go on under the snow.

Management

Grazing regimes are vital to the success or failure of regeneration on sites. Regeneration was absent from many more sites because of lack of grazing, tall tussocky vegetation than as a consequence of overgrazing.

Shillinghill (UID 116), with successful regeneration, had no young juniper in the field before the present grazing regime was initiated by Mr Patterson, the tenant farmer, 15 years ago. He believes the spread of young juniper is a direct result of his grazing regime. About 40 cattle with supplementary feeding graze the field during winter and 70 sheep during the summer and keep the vegetation very short, c5cm at the time of this survey, ideal for the establishment of seedlings. The steep hillside does not become too boggy to winter cattle. Grazing stock does not impact seriously on the juniper, in summer there is good growth of more palatable species and in winter cattle are fed with hay. The number of animals and timing of grazing is ideal for regeneration. Mr Patterson reported that in other lightly or ungrazed sites nearby on Dunruchan Farm, there is no regeneration and when fenced off, some areas have become choked with bracken. He believes juniper 'dies off where there is no stock' and reported that juniper is dying where fenced on Lurgan hill

At Coire-n-eassan (UID 68) the Tenant farmer, Shona Calder at East Brae Farm, believes juniper is unpalatable to sheep and cows. Rabbits are probably the most important browsers. She suggested the smell of juniper may act as a fly repellent and cattle may rub against bushes as the smell keeps flies away.

At one site, Blairchroisk (UID 61), with about 60 bushes, grazing was high by sheep and rabbits. Ro Scott recommends remedial management is urgently needed to benefit juniper. At Culloch Hill (UID 115), with a high percentage of bushes with berries, recent autumn grazing by a small herd of cattle is opening up ground suitable for germination and controlling bracken. On Lurgan Hill (UID 120) dense, tall bracken covers most of the hillside in summer. 70 sheep graze the hill in summer and a maximum of 300 sheep graze the area in winter. Regeneration was only found in one area on a rocky ridge. Bracken and sheep prevent regeneration over most of the area.

Mr McBeth, Balnaguard Farm reported that juniper has increased on 150 acres of open hillside, SE of the SSSI, since 1981 when he acquired the land. Before 1981 there was very little juniper in this area. It is grazed in summer by about 300 sheep with lambs and 60 cows with calves, as part of a much bigger grazing area of 2000 acres. Sheep graze from April to October and Limousin cattle from June to September when the ground becomes too wet for them. The vegetation is grazed short, less than 15 cm. In winter deer may graze the area, roe and occasionally red and fallow. He has not controlled bracken on the hill but finds cows thin out bracken. Mr McBeth believes winter grazing is most damaging to juniper. His sheep are taken off the hill in winter but 'if stuck there in winter sheep will eat anything'. This site was not visited because of early winter snow.

Juniper at montane burn sites above 350m in northern Perth and Kinross survive because they are mostly on cliffs and crags, inaccessible to deer and sheep. Seedlings cannot establish in tall heather but germination might be possible after burning in some areas of moorland. Controlled muirburn can open up new sites for regeneration (Plantlife Juniper Dossier).

The shelter provided by juniper is recognised as an important asset on sporting estates. Areas with juniper are used for rearing pheasants and partridge on Cardney Estate, Riemore at Macmaridge, Kinnaird Estate, Dunira Estate, Aberuchill at Dalrannoch and Braco Castle Estate where ducks are also reared with the creation of ponds. Dense patches of juniper have been fenced at Kinnaird and at Dalrannoch on Aberuchill Estate and used as sites for pheasant rearing pens.

4. SUMMARY OF MAIN FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

4.1 Main findings

Sites

- Juniper was found at 96 sites
- More than 7,500 bushes were counted
- Juniper is found in 7 distinct geographical areas in Perth and Kinross, but not across the whole county
- Sites show clustering around the 4 Juniper Wood SSSIs in Perth and Kinross
- 30 sites had only one bush and 23 had less than 11 bushes
- Only 22 sites had more than 50 bushes

Age Structure

- Regeneration was very low
- 20 sites had young bushes, 7 sites had seedlings
- Only one site was found with very active regeneration
- Only 7% of bushes were young and only 0.5% seedlings
- All sites with seedlings had a complete age range of bushes present, seedlings, young, mature and overmature bushes.
- 6 out of 7 sites with seedlings had one or more good source of berries close by, often overmature juniper
- The majority of bushes were mature or overmature; 25% of bushes were mature, 51% of bushes were vigorous overmature,
- Only 5% of bushes were moribund and 2% were dead
- The majority of juniper populations are persisting as overmature bushes which regenerate by producing new vigorous green shoots from very old root stock.

Health

- The majority of sites, 65%, were rated as healthy with over 50% of bushes with vigorous green shoots. 20% of sites were in poor health and 15 % of sites were failing. Bushes were failing because of shading, damage from browsing and extreme old age.
- No serious widespread disease was found.
- An abnormally high number of dead bushes were recorded on Lurgan Hill, UID 120, not far from Glenartney SSSI and this should be investigated.

Regeneration

- Berries were found at 62% of sites, 42% had more than 10% berried bushes.
- Overmature and mature juniper populations with more than 25 bushes and over 10% with berries provide a good seed source for the surrounding area. At 8 such sites, young populations were found nearby.
- Seedlings were found where
 - Vegetation height was 5cm or less
 - On open sites with no shading
 - Grazing levels were high enough to reduce competition from other species and
 - Grazing animals did not impact on seedlings and very young bushes
 - There was a good source of berries nearby
- Habitats with young seedlings were
 - Track verges

- Bare soil around rabbit scrapes
- Rocky outcrops, rock ridges and on a grass covered dyke
- Short heath and grass
- Regeneration is possible when
 - There is a good source of berries (>10% of bushes have berries)
 - Suitable disturbed ground or short vegetation is present
 - Grazing levels promote regeneration – high enough to control competition, low enough not to impact on germinated seedlings and young bushes
- Regeneration was not found where
 - There was no available open ground with short vegetation
 - There was tall bracken engulfing mature and overmature bushes
 - The height of heath and grass species was more than 20cm around Juniper bushes
 - There was no source of berries nearby. Single bushes in isolated situations are bird sown.

Management

- Grazing management is the most important factor affecting the success of regeneration. Appropriate grazing levels produce short vegetation suitable for germination and do not have a serious impact on the growth of young juniper.
- If other more palatable food is available sheep and cattle do not graze on young juniper (Shillinghill UID 116)
- Winter grazing when food is scarce and animals are stressed is believed to be most damaging to juniper. Sheep and deer may be more likely to browse Juniper in late winter and early spring when there is very little left for them to eat

4.2 Recommendations

This study highlights some areas that should be researched.

The palatability of juniper to stock and deer should be investigated. Do animals avoid juniper when other species are available? Some topiary of bushes and general browsing was noted but most damage was from rubbing breaking branches, not browsing. If most grazing occurs when there is little else for stock and deer to eat, it will be important not to graze areas with juniper too early or late in the growing season. Deer should be controlled or discouraged in winter from using areas with juniper. Seedlings are at most risk from grazing.

No sites with seriously diseased bushes were found. No die back was found similar to that on Glenartney Juniper Wood SSSI. However the high number of dead bushes on Lurgan Hill (UID 120) should be investigated.

Research into the history and age of some of the larger juniper woods in the Dunkeld area might be extremely useful. The dense juniper in these woods all appear to be roughly the same age. Was juniper planted in the mid nineteenth century for the gin industry or were other land use factors important?

We would recommend that future surveys of juniper should be carried out in late winter and early spring before bracken has grown up and leaves are on the trees. Juniper is most easily seen at this time of year and day length is longer and the weather is better than in winter or late autumn.

4.3 Conclusions

Although it has a restricted distribution in Perth and Kinross, juniper is in a healthy condition. The populations of juniper can only be secured and expanded if existing sites are managed to ensure both a supply of berries and suitable sites from germination and seedling growth. Grazing should be managed to ensure that mature bushes are not swamped by dense plant growth and areas of short vegetation or bare soil are present. At present this is not being achieved by grazing levels and most sites are suffering from undergrazing. There is little evidence on low altitude hill pasture sites that overgrazing is a major factor limiting regeneration, though this may be important on montane sites.

5. REFERENCES

Broome, A., Hendry, S., Smith, M., Byaner, W., Nichol, B., Perks, M., Connilly, T., Tene, A. and Bochereau, F. 2008. Investigation of the possible causes of dieback of Glenartney Juniper Wood SAC Perthshire. Report to Scottish Natural Heritage.

Forestry Commission Scotland. 2009. Action for juniper. Available at: <http://scotland.forestry.gov.uk/images/corporate/pdf/fcs-species-juniper.pdf>

Forestry Commission Scotland. 2008. Support for juniper conservation under the Scottish Rural Development Programme (SRDP). Available at: <http://scotland.forestry.gov.uk/images/corporate/pdf/junipersrdptechnicalnote.pdf>

Long, D. & Williams, J. 2007. Juniper in the British uplands: the Plantlife juniper survey results. Available at: <http://www.plantlife.org.uk/uploads/documents/Juniper-report-2007.pdf>

SNHi link:

Ballyoukan Juniper Wood - SSSI Citation, Site Management Statement. Site code: 134

Balnaguard Glen - SSSI Citation, Site Management Statement. Site code: 139

Fungarth Juniper Wood - SSSI Citation, Site Management Statement. Site code: 662

Glenartney Juniper Wood – SSSI Citation, Site Management Statement. Site code: 730

Sullivan, G. 2003. Extent and condition of juniper scrub in Scotland. *Scottish Natural Heritage Archive Report No. 026*.

Ward, L. 2003. *Juniperus communis* species dossier for Plantlife. Available at: [http://www.plantlife.org.uk/uploads/documents/Juniperus communis Dossier part1.pdf](http://www.plantlife.org.uk/uploads/documents/Juniperus_communis_Dossier_part1.pdf)

APPENDIX 1: SUMMARY OF SITES SURVEYED IN 2010

This appendix can be downloaded from SNH website as separate file.

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