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# THE IRISH JUNIPER MONITORING SURVEY 2017

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Oidhreachta agus Gaeltachta
Department of Culture,
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**Coastal heath**, Howth Head, Co Dublin, Maurice Eakin; **Red Squirrel** *Sciurus vulgaris*, Eddie Dunne, NPWS Image Library; **Marsh Fritillary** *Euphydryas aurinia*, Brian Nelson; **Puffin** *Fratercula arctica*, Mike Brown, NPWS Image Library; **Long Range and Upper Lake**, Killarney National Park, NPWS Image Library; **Limestone pavement**, Bricklieve Mountains, Co Sligo, Andy Bleasdale; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott; **Barn Owl** *Tyto alba*, Mike Brown, NPWS Image Library; **A deep water fly trap anemone** *Phelliactis* sp., Yvonne Leahy; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson

Main photograph:

*Juniperus communis* at Dawros Head, Co. Donegal. Photo by J. Martin.

# The Irish Juniper Monitoring Survey 2017

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# Contents

## Executive Summary

This report presents details of a monitoring survey conducted in 2017 to assess the conservation status of the Annex I habitat "5130 *Juniperus communis* formations on heaths or calcareous grassland". The definition of a Juniper formation used for the 2017 survey is "any cluster of ≥50 Juniper plants where no plant is more than 20 m from another." In practice this means that Juniper plants should achieve a minimum density of 25 plants per hectare to qualify as a formation.

Prior to commencement of the 2017 survey, a review was carried out of the methodology used in the baseline survey of Cooper *et al*. (2012). Amendments to the survey and assessment methodology are outlined in the report. These updated methods were followed in the 2017 survey.

Twenty-seven sites were surveyed. At each site an initial Juniper shrub count was carried out to ascertain if a formation was present. Three sites were disqualified as formations at this stage of the survey due to insufficient Juniper shrubs. Two other sites were in such close proximity to each other that to assess them separately was not ecologically meaningful and they were merged into one site for reporting purposes. This gave a total of 23 sites that were subjected to a full assessment.

An extensive walkover was conducted to map accurately the extent of 5130 Juniper formations. Only areas that consisted entirely of 5130 habitat were mapped; this meant that in some cases several smaller 5130 polygons were mapped within a site rather than one large polygon. Using this method, a total of 82 separate formations, covering an area of 1,346.9 ha, were mapped across the 23 sites, representing 77% of the total national resource of 5130 Juniper formations.

Three parameters, *Area*, *Structure & functions* and *Future prospects*, were assessed at each site. Monitoring stops were recorded in confirmed 5130 Juniper formations using plots measuring 5m x 5m. At each stop, *Structure & functions* assessment data were collected on the number of fruiting female Juniper shrubs, seedlings, presence of germination niches (as bare soil or rock), occurrence of dead or browning Juniper shrubs, browser damage, and negative species. *Area* was assessed by quantifying the area of 5130 Juniper formation habitat lost since the previous monitoring period (2007-2012). Pressures, threats and activities, both positive and negative, occurring throughout the site were also analysed and used to determine the *Future prospects* of the site with regard to its *Area* and *Structure & functions*. Each site received an assessment of Favourable (green), Unfavourable-Inadequate (amber) or Unfavourable-Bad (red) for each of the three parameters, which were then combined to evaluate the overall condition assessment result for the site.

Twenty-one of the twenty-three sites received a Favourable assessment for *Area*. Permanent loss of 5130 Juniper formation habitat was found to have occurred at two sites since the previous monitoring period, giving them Unfavourable *Area* assessment results (one amber and one red).

*Structure & functions* were generally good. Fourteen sites were assessed as having Favourable *Structure & functions*, six were Unfavourable-Inadequate, and three were Unfavourable-Bad. The criterion that failed the assessment most frequently was the presence of seedlings, followed by availability of germination niches, both of which could signal problems for the sustainability of the habitat if not addressed in the long term.

The *Future prospects* of the *Area* and *Structure & functions* parameters were assessed at each site, taking pressures, threats and activities into account. Few serious impacts were recorded in 5130 habitat in 2017. Grazing was recorded at most sites and was usually considered beneficial, although some browser damage was noted. Overgrazing was occasional and erosion was an issue at some sites; however, the long-term effects of this impact on 5130 habitat require further investigation. At the site level, twelve sites were assessed as having Favourable *Future prospects*, seven were assessed as Unfavourable-Inadequate, and four were assessed as Unfavourable-Bad.

Combining the assessments of the three parameters at each site resulted in twelve sites receiving an overall assessment of Favourable, while seven sites received an Unfavourable-Inadequate assessment, and four received an Unfavourable-Bad assessment.

At the national level, the *Area* parameter received an Unfavourable-Inadequate assessment due to the permanent loss of some 5130 habitat and the *Future prospects* of *Area* was assessed as poor because of this decreasing trend. A total of 92% of the 5130 habitat area surveyed achieved a Favourable result for *Structure & functions*, and the *Future prospects* of *Structure & functions* was assessed as good for the habitat deemed to be in Favourable condition. Combining these results, the national conservation status assessment for the Annex I habitat 5130 Juniper formations was then evaluated, and a result of **Unfavourable-Inadequate** was obtained.

The report concludes with recommendations for refining the methodology in future monitoring cycles and for improving the conservation status of less favourably scored sites.

## Acknowledgements

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# 1 Introduction

## 1.1 *Juniperus communis*

*Juniperus communis* (Juniper) is one of only two native conifers in Ireland. Its ecology and genetics have been the subject of many studies, prompted partly by the continued decline of the species in the UK over the past number of decades (Wilkins & Duckworth, 2011; Ward & Shelswell, 2017). A full ecological account of Juniper was presented by Thomas *et al.* (2007). Additional reports by Scottish Natural Heritage (Sullivan, 2003) and Plantlife International (Wilkins & Duckworth, 2011; Plantlife, 2015) also provided information on the status of the plant in upland areas of Scotland and the lowland South Wessex Downs of England, the two main strongholds of the species in Britain. Cooper *et al*. (2012) carried out the first baseline study of Juniper in Ireland and conducted morphological and genetic studies on the species. The most recent review of current knowledge on the plant was undertaken by Ward & Shellswell (2017) which draws on these and other publications, and updates a previous account of Juniper by Lena Ward (Ward, 2007) following many decades of work by her on the species in Britain. The following brief account is summarised from Ward & Shellswell (2017) unless otherwise indicated:

> The taxonomic status of Juniper is still under review, but it is likely that it will be split into two varieties: *Juniperus communis* var. *communis* (equivalent to *J. communis* ssp. *communis*) and *J. communis* var. *saxatilis* (includes what is referred to in the literature as *J. communis* ssp. *nana*). For ease of comparison with previous studies, however, the currently accepted *J. communis* ssp. *communis* and *J. communis* ssp. *nana* will be referred to in this report where scientific nomenclature is used. *J. communis* ssp. *communis* occurs as erect or spreading bushes, while *J. communis* ssp. *nana* is the dwarf Juniper which is prostrate and usually grows in the uplands; however, it may be found at sea level in western Ireland. *J. communis* ssp. *communis* is associated with steep, exposed slopes in some parts of England, sometimes on north-facing slopes on shallow, drought-prone soils, whereas ssp. *nana* occurs on flat to gently-sloping land with a moderately sheltered, mostly southerly aspect. Subspecies *communis* is also more associated with limestone, while ssp. *nana* is often found on weathered acidic scree, particularly in northwest Scotland (Thomas *et al*., 2007). The latter subspecies also tends to grow on rocky outcrops or on a surface composed of a mosaic of rock, bare soil and vegetation, possibly indicating a need for areas with less competition from *Calluna vulgaris* or a favourable microsite for establishment (Thomas *et al*., 2007).
>
> Juniper has separate male and female bushes, both of which produce cones. Male cones generally produce pollen between March and June. The female cones are fleshy and berry-like, and are sometimes referred to as galbuli or galbulae. To prevent confusion between male and female reproductive structures, female cones will be referred to as berries or galbulae in this report. Bushes become reproductively mature after approximately 6-8 years (Thomas *et al*., 2007), although this can vary with sex (females are often later than males), region and soil type. Thereafter cones are produced annually, and berries take 2-3 years to mature. Female plants of ssp. *nana* are preferentially grazed over male plants in winter, possibly made more attractive to grazers by the berries (Thomas *et al*., 2007). The berries are primarily dispersed by birds, particularly members of the thrush family, Turdidae. Each berry contains up to three seeds, although not all seeds are viable. Reasons for decreased viability include age of the Juniper bush (generally decreased viability in old bushes), insect predation or empty seeds due to pollination failure or seed abortion (Thomas *et al*. 2007). Seeds usually remain dormant for two years before germination but do not persist in the seed bank. The best situation for germination is a relatively open area on bare, nutrient-poor mineral soil (e.g. created by trampling from cattle), free from predation by rabbits and other small rodents.

Juniper regeneration seems to occur best in situations of intermittent heavy grazing interspersed with periods of no grazing (abandonment), during which the seedlings can develop to reproductive maturity. Seedling mortality, however, is extremely high, estimated by one researcher in Spain at 75-80% in the first year. While grazing, even heavy grazing, can be beneficial by producing the bare ground needed for seeds to germinate, heavy grazing is a problem as the seedlings and saplings may be browsed off and killed. Occasionally Juniper can reproduce by vegetative layering, where branches spreading along the ground take root. This is more prevalent in boggier or upland situations, and individuals can be difficult to distinguish from each other, particularly among more prostrate forms.

Juniper is frost-tolerant and is relatively drought-tolerant, but it is intolerant of flooding (Thomas *et al*., 2007). *Juniperus communis* ssp. *nana* is particularly vulnerable to burning and a single fire may cause local extinction; however ssp. *communis* can be tolerant of low-intensity fires, killing only isolated individuals, and fire may even be beneficial by encouraging natural regeneration and so rejuvenating ageing stands (Thomas *et al*., 2007). Inappropriate burning, however, remains a threat to Juniper.

## 1.2 Rationale for the survey

### 1.2.1 Article 17 of the EU Habitats Directive

Annex I habitats are habitats of European importance which are listed under Annex I of the EU Habitats Directive (92/43/EEC). Under Article 17 of the Habitats Directive, all EU Member States that are signatories of the Directive have a legal obligation to report on the conservation status of the Annex I habitats that occur within their boundaries. These national conservation status assessment reports are produced every six years. The next round of reporting, covering the period 2013-2018, is due in 2019. This is the third round of reporting carried out under Article 17 where the conservation status is assessed.

The National Parks & Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht commissioned BEC Consultants Ltd to carry out the Juniper Monitoring Survey, a one-year survey conducted in 2017 to monitor and assess the Annex I habitat "5130 *Juniperus communis* formations on heaths or calcareous grasslands", hereafter referred to as 5130 Juniper formations. The outputs of the survey will feed into Ireland's 2019 Article 17 report.

### 1.2.2 Assessment of Annex I habitats

Annex I habitats are assessed under four parameters of conservation status: *Range*, *Area*, *Structure & functions* and *Future prospects*. Guidance on assessment is provided by the EU (DG Environment, 2017). Evaluation of conservation status requires the separate assessment of the four parameters. Each parameter can receive an assessment of Favourable (green), Unfavourable-Inadequate (amber) or Unfavourable-Bad (red). The individual parameter assessments are then combined, with the aid of an evaluation matrix (Table 1), to give an overall national assessment of conservation status for the habitat.

**Table 1** General evaluation matrix for assessment of Conservation Status (CS) (adapted from DG Environment, 2016).

| | Conservation Status | | | |
|---|---|---|---|---|
| **Parameter** | **Favourable ('green')** | **Unfavourable – Inadequate ('amber')** | **Unfavourable - Bad ('red')** | **Unknown** |
| *Range* | Stable or increasing AND not smaller than the 'favourable reference range' | Any other combination | >1% decline in range per year over specified period OR More than 10% below 'favourable reference range' | No or insufficient reliable information available |
| *Area* | Stable or increasing AND not smaller than the 'favourable reference area' AND without significant changes in distribution pattern within range (if data available) | Any other combination | >1% decline in area per year over specified period OR With major losses in distribution pattern within range OR More than 10% below 'favourable reference area' | No or insufficient reliable information available |
| *Structure & functions* | Structure and functions in good condition and no significant deteriorations / pressures | Any other combination | > 25% of the area is unfavourable as regards its specific structures and functions | No or insufficient reliable information available |
| *Future prospects* | The habitat's prospects for its future are excellent / good, no significant impact from threats expected; long-term viability assured | Any other combination | The habitat's prospects are bad, severe impact from threats expected; long-term viability not assured. | No or insufficient reliable information available |
| **Overall assessment of CS** | All 'green' OR three 'green' and one 'unknown' | One or more 'amber' but no 'red' | One or more 'red' | Two or more 'unknown' combined with green or all 'unknown' |

This survey assesses three parameters at each site: *Area*, *Structure & functions* and *Future prospects*. *Range* will be assessed separately for the final national conservation status assessment report.

*Area* is assessed by examining the current extent of the habitat and comparing it with that mapped in previous surveys, or by comparing areas across different series of aerial photographs and satellite imagery. Area losses are expressed as percent loss on an annual basis over a specified period.

To assess the *Structure & functions* of the 5130 habitat at the sites, the survey methodology follows what has now become standard practice in Ireland in using monitoring stops (or plots). *Structure & functions* are assessed by means of several criteria (devised by each Member State to assess the habitat

according to local conditions) that examine key attributes of the habitat and compare the current values with set benchmarks or thresholds that reflect the habitat when it is in Favourable condition. The criteria are examined and assessed at a monitoring stop, which is usually a plot of fixed size delimited on the ground using a measuring tape or quadrat square. The dimensions of the plot and the number of monitoring stops recorded vary depending on the type and extent of the habitat.

The *Future prospects* assessment at each site requires an examination of the habitat's stability in terms of its *Area*, *Structure & functions* in the context of the impacts and activities taking place in the 5130 habitat across the site. The balance between positive and negative impacts is weighed up and the *Future prospects* of the habitat at the site over the next two reporting periods (12 years) are evaluated.

## 1.3 Juniper surveys in Ireland

### 1.3.1 Baseline survey of Cooper *et al*. (2012)

In 2008, NPWS commissioned a baseline survey of 5130 Juniper formations in Ireland, the first comprehensive field-based survey of the habitat in the country (Cooper *et al*., 2012). Cooper *et al*. (2012) defined Juniper formations in Ireland as "any discrete cluster of more than 50 [Juniper] shrubs likely to be capable of recruitment and long-term persistence whilst avoiding inbreeding depression". They identified a total of 51 formations in Ireland using this definition, covering an estimated area of 47.4km$^2$. The four parameters *Range*, *Area*, *Structure & functions* and *Future prospects* were assessed and determined to be Favourable for *Range* and *Area*, and Unfavourable-Inadequate for *Structure & functions* and *Future prospects*. The overall conservation status for the habitat was therefore assessed as Unfavourable-Inadequate. The results of that survey were used to inform the Article 17 reports submitted in 2013.

As the survey was a baseline, the *Area* parameter was assessed as Favourable because there were no previous mapped extents available with which to make comparisons. Formations were mapped by means of the minimum convex polygon method, which defined a single polygon boundary based on the locations of a limited number of geo-referenced Juniper shrubs. *Structure & functions* were assessed on a number of criteria including reproductive capabilities of the formations (i.e. proportion of shrubs comprised of fruiting female bushes), presence of seedlings, indicator/typical species and sward height. Shrub numbers within the formation were also estimated to provide a point of comparison for future monitoring programmes. *Future prospects* were assessed by analysing the activities impacting negatively on the formations.

### 1.3.2 National Parks & Wildlife Service survey (2015)

In 2015, NPWS field staff were asked to survey a number of sites described in the baseline survey as 5130 Juniper formations. The survey was aimed at collecting general data on the occurrence of formations, such as stating if the current mapped boundary of the formation was appropriate, delimiting the new area if it had changed, and estimating the number of shrubs in given interval classes (e.g. 50-100, 101-300). Based on the results of this survey, some areas previously mapped as formations were found no longer to contain the requisite 50 shrubs, while other areas were found to be more extensive than previously thought (NPWS, unpublished results).

## 1.4 The 2017 survey

NPWS commissioned BEC Consultants to carry out the survey detailed in this report. The aims of the survey, as set out by NPWS, were as follows:

- Review and revise, where necessary, the monitoring methods developed by Cooper *et al*. (2012) and the definition of a formation;
- Undertake the monitoring of the conservation status of a representative sample of the reviewed formations across the country in 27 selected sites falling inside and outside of SACs, almost all of which were covered by Cooper *et al*. (2012) and/or verified by NPWS 2015 surveys;
- Complete a National Conservation Status Assessment and audit trail for the habitat using the latest available Commission and NPWS guidance.

The survey was required to gather assessment data on 5130 habitat in Ireland, using a sub-set of the formations identified in the baseline survey of Cooper *et al*. (2012) and additional formations identified since the baseline survey. Data from the 27 sites surveyed in 2017 were used to evaluate the current national conservation status of 5130 Juniper formations in Ireland. The assessment process is outlined in this report.

### 1.4.1 Review of survey methodology and assessment for the 2013-2018 reporting period

#### *1.4.1.1 Definition of a formation*

On reviewing the baseline Juniper survey and assessment methodology of Cooper *et al*. (2012) it was noted that the definition of a formation as set out for the baseline survey did not specify a minimum Juniper density or any maximum distance between Juniper plants in the same formation. For the 2017 survey, it was not considered appropriate for a formation to include areas of habitat where the Juniper plants were sparse and widely scattered. This is supported by the German Federal Agency for Nature Conservation, which specifies that "individual bushes or stands with only a few specimens or which are very scattered are excluded [from the Annex I habitat 5130 Juniper formations] and are to be assigned to the relevant heath or dry grassland type" (www.bfn.de/en.html). While it was accepted that there would certainly be variations in Juniper shrub density throughout a formation, it was decided that, for the 2017 survey, extensive areas of widely scattered shrubs (more than 20 m apart) should not be included within a formation. Therefore, it was concluded that Juniper abundance and relatively high density should be taken as a prerequisite for the habitat to be called 5130.

No reference could be found to the threshold of 50 plants being applied anywhere else in the EU in the context of Annex I 5130 Juniper formations. The source and apparently only other reference to this threshold is Long & Williams (2007) in relation to Juniper populations, which are not synonymous with formations. However, the threshold of 50 plants is deemed to be appropriate as it represents a sub-population of Juniper plants with a good probability of having adequate numbers of mature male and female shrubs, suitable for the production of female berries. Genetic studies cited by Cooper *et al*. (2012) on one species of *Juniperus* demonstrated that there was no wind-mediated pollen dispersal beyond 2km and populations separated from each other by less than that distance were genetically similar, indicating some level of gene flow between them (bird dispersal of berries could have been another factor). Thomas *et al*. (2007) noted that most British populations appeared to be genetically separate, even when separated by as little as 1km, except for those in the Scottish Borders, which exhibited little between-population diversity; however the cause of this may be fragmentation of a once-larger metapopulation. Bearing in mind the requirement stated above for a minimum density of plants, it was not considered feasible to include within the same formation all Juniper plants that are potentially part of the same inter-breeding population, i.e. within 1-2km of each other, as the practicalities of monitoring such disparate formations would be challenging. Therefore a formation may be regarded as an informal sub-set of a population that is feasible to monitor.

Following field testing early in the field season, the definition of a formation used for the 2017 survey is "any cluster of ≥50 Juniper plants where no plant is more than 20m from another." In practice this means that Juniper plants should achieve a minimum density of 25 plants per hectare to qualify as a formation. Thus the definition of a formation now takes Juniper shrub density into account.

#### 1.4.1.2 Assessment criteria

The UK's Joint Nature Conservancy Council (JNCC) published Common Standards Monitoring guidelines for dealing with habitats containing significant amounts of Juniper (JNCC, 2009). They referred National Vegetation Classification (NVC) heath and grassland types with abundant and frequent non-prostrate Juniper to the JNCC feature of interest Juniper heath and scrub (upland) / Annex I habitat 5130, while heath types with the prostrate *Juniperus communis* ssp. *nana* were referred to the JNCC feature of interest Alpine dwarf-shrub heath / Annex I habitat 4060, rather than habitat 5130. However, Cooper *et al*. (2012) noted that separating ssp. *communis* from ssp. *nana* is difficult ecologically, morphologically and even genetically, and that the two may be varieties of *Juniperus communis* rather than separate sub-species. This is supported by more recent publications (Ward & Shellswell, 2017). Therefore, for the purposes of this survey, no attempt was made at a sub-specific determination of the Juniper plants, and clusters of ≥50 Juniper plants separated by no more than 20 m were automatically assigned to 5130 Juniper formations, regardless of whether the situation was upland or lowland. This is in contrast to Perrin *et al*. (2009, 2014), who, in the National Survey of Upland Habitats (NSUH), mapped Juniper-dominated areas of Corraun Plateau SAC (one of the sites surveyed in the 2017 Juniper Monitoring Survey) as Annex I habitat 4060 rather than 5130. It should be noted that, on phenotypic grounds, the NSUH referred all prostrate Juniper plants to ssp. *nana* (which with the prevalence of rocks in Corraun was a reasonable conclusion), but some may have been genotypical ssp. *communis*.

The criteria used by Cooper *et al*. (2012) to assess the health and reproductive potential/success of Juniper – i.e. the percentage of plants with berries, percentage of plants that are seedlings, percentage of plants that are dead/alive and the percentage of bare soil within monitoring stops – were retained. Other criteria, namely species richness, positive indicator species (typical species) and sward height, were deemed to be more relevant to the habitats with which 5130 Juniper formations were associated, e.g. 6210 Calcareous grassland or 4030 Dry heath, rather than the 5130 habitat itself. As such, they were considered not to be relevant to the conservation status of the 5130 habitat and were not carried forward to the 2017 assessment. Some of the JNCC (2009) monitoring guidelines, such as assessing the health of Juniper plants in terms of browning/die-back and browser damage, were incorporated into the 2017 assessment.

The seven criteria used in the 2017 *Structure & functions* assessment are as follows:

- *%_berried*: Assessed in the baseline survey; examines the potential for reproduction in the formation by setting a threshold for the proportion of mature, reproducing female shrubs in the formation.
- *%_seedlings*: Assessed in the baseline survey; examines the level of seedling recruitment in the formation by setting a threshold for the number of seedlings found in the formation. Because of the difficulty in determining the age of Juniper plants it was decided to confine this criterion only to plants that were undeniably seedlings (<15cm tall with minimal side branching).
- *Germination niches (bare soil / bare rock)*: Only the bare soil component was assessed in the baseline survey. Seedling recruitment depends not only on the production of female berries but also on the successful germination of the seeds within these berries. While seed viability is one reason for the degree of success of seedling recruitment, the availability of suitable niches for germination is equally important. One of the *Structure & functions* criteria for 5130 Juniper formations is therefore the availability of suitable germination niches. In contrast to the baseline survey, which based the assessment on bare soil only, in 2017 this criterion was assessed using two components, bare soil (which in this context also includes bare peat or

sand) and bare rock, which were then combined to give a single result for germination niche availability. Bare soil, peat or sand is an obviously suitable substrate for Juniper seeds to germinate; rock is less self-evident. While seedlings cannot establish on bare rock, it is often possible for them to germinate at the boundary between rock and soil, even if the soil is vegetated, or in grikes on limestone pavement, where conditions are more sheltered. Many limestone rocks in limestone pavement areas also have small accumulations of humus or protosoil in hollows on the surface of the rocks which can provide a substrate for seedling germination. This criterion aims to assess the availability of these niches.

- *%_alive*: Assessed in the baseline survey; examines the level of die-off of individual Juniper plants in the formation.
- *%_browning*: Not assessed in the baseline survey. While die-off assesses the level of whole-plant death in the formation, examining the prevalence of die-back, or browning, may also provide an early indication of problems in the formation, for example, due to factors such as fungal disease (e.g. *Phytophthora austrocedri*, a pathogen currently causing problems in the UK's Juniper stands (Forestry Commission, 2017); note: referred to as *Phytophthora austrocedrae* in some publications, e.g. Ward & Shellswell (2017)) or water stress. Browning is calculated as the percentage cover of Juniper within the plot that is dying back due to stress.
- *Browsing & bark stripping*: Not assessed in the baseline survey. Damage from browsers and grazers was assessed by examining shoots for signs of browsing and main Juniper trunks for signs of bark stripping due to grazers. For prostrate plants it was not possible to differentiate bark stripping due to grazing from bark stripping due to trampling.
- *Negative species*: Assessed in the baseline survey using a different suite of species. In 2017, any non-native species and species indicative of agricultural improvement, such as *Lolium perenne* and *Trifolium repens*, were assessed as negative species. Scrub species such as *Corylus avellana* and *Rubus fruticosus*, which were regarded in the baseline survey as negative species, were not considered negative in 2017 as they might act as nursery species for Juniper (Cooper *et al*., 2012).

#### 1.4.1.3 Plot size

Early field-testing of the methodology saw the need for a larger plot size for monitoring stops, a possibility which was recognised by Cooper *et al*. (2012). A 5m x 5m plot was used instead of the 2m x 2m plot used in the baseline. This gives an area of 25m² for each monitoring stop rather than 4m², which is more appropriate to the size of the target species, Juniper, some plants of which can attain a diameter of 6 m.

#### 1.4.1.4 Monitoring stops

The number of monitoring stops per site was also reviewed in 2017. Because the size of plots was increased it was not always feasible to record the same number of stops as before; for example, some very small sites could only accommodate one 5m x 5m plot. The number of stops recorded was based on the area of the habitat according to the scale in Table 2.

**Table 2** Proposed number of stops per habitat area

| Area (ha) | No. stops |
|---|---|
| < 0.4 | 1 |
| 0.4-2 | 2 |
| 2-10 | 4 |
| >10-20 | 6 |
| >20 | 8 |

#### 1.4.1.5 Mapping

Some issues were apparent with the baseline mapping of the 5130 Juniper formations habitat, as a minimum convex polygon was drawn around the outer shrub location points (which were often widely spaced apart) rather than an accurate boundary. Also, polygons were not clipped to coastlines or waterbodies. This led to overestimation of the habitat area in some cases, particularly where an outlier Juniper plant was included in the formation. These issues were addressed in the current survey by means of tighter mapping around formations and the exclusion of outliers, as each individual within a formation could be no more than 20 m from its nearest neighbour.

#### 1.4.1.6 Other assessment criteria

Species within the category of "Negative species" used in the baseline survey were reviewed. Cooper *et al*. (2012) included the invasive non-native species *Cotoneaster integrifolius* and *Rhododendron ponticum*, and four native species that their survey found problematic in Juniper habitats: *Pteridium aquilinum*, *Rubus fruticosus*, *Corylus avellana* and *Molinia caerulea*. However, the 2017 survey included any non-native species, as well as standard indicators of agricultural intensification such as *Lolium perenne*, *Trifolium repens*, *Cirsium arvense* and *Cirsium vulgare*. The problematic native species assessed during the baseline survey were not included as negative species, as Cooper *et al*. (2012) acknowledged that there may be some function for these species acting as nursery species for young Juniper plants. Problematic native species that were having a negative impact on the Juniper formations were, however, assessed separately under impacts as part of the Future prospects assessment.

The presence of local indicators such as the rare Juniper Shield Bug (*Cyphostethus tristriatus*; Figure 1) was added as a criterion. If no local indicators are found at a site, the criterion is not assessed; however, if a rare species is recorded at a site in one monitoring period, its continued presence should be assessed in future monitoring periods.

**Figure 1** Juniper Shield Bug (*Cyphostethus tristriatus*). Photo ©entomart, https://commons.wikimedia.org/w/index.php?curid=806192

# 2 Methodology

## 2.1 Site selection

Twenty-seven sites were selected by NPWS prior to commencement of the survey. Most of the sites had been surveyed during the baseline survey, but a small number of sites identified after the baseline survey were also included. Sites were chosen to cover a range of Juniper habitat types and a wide geographic spread. Emphasis was also placed on sites where there were inconsistencies in mapping or Juniper shrub numbers between the baseline survey and the 2015 NPWS survey. The site numbers used throughout this report correspond to those used in the baseline survey, except for two new Co. Galway sites, which were assigned the next available GY numbers, GY30 and GY31. Figure 2 shows the 2017 survey locations superimposed on the national 10km distribution map of 5130 Juniper formations habitat from the 2007-2012 Article 17 report (NPWS, 2013).

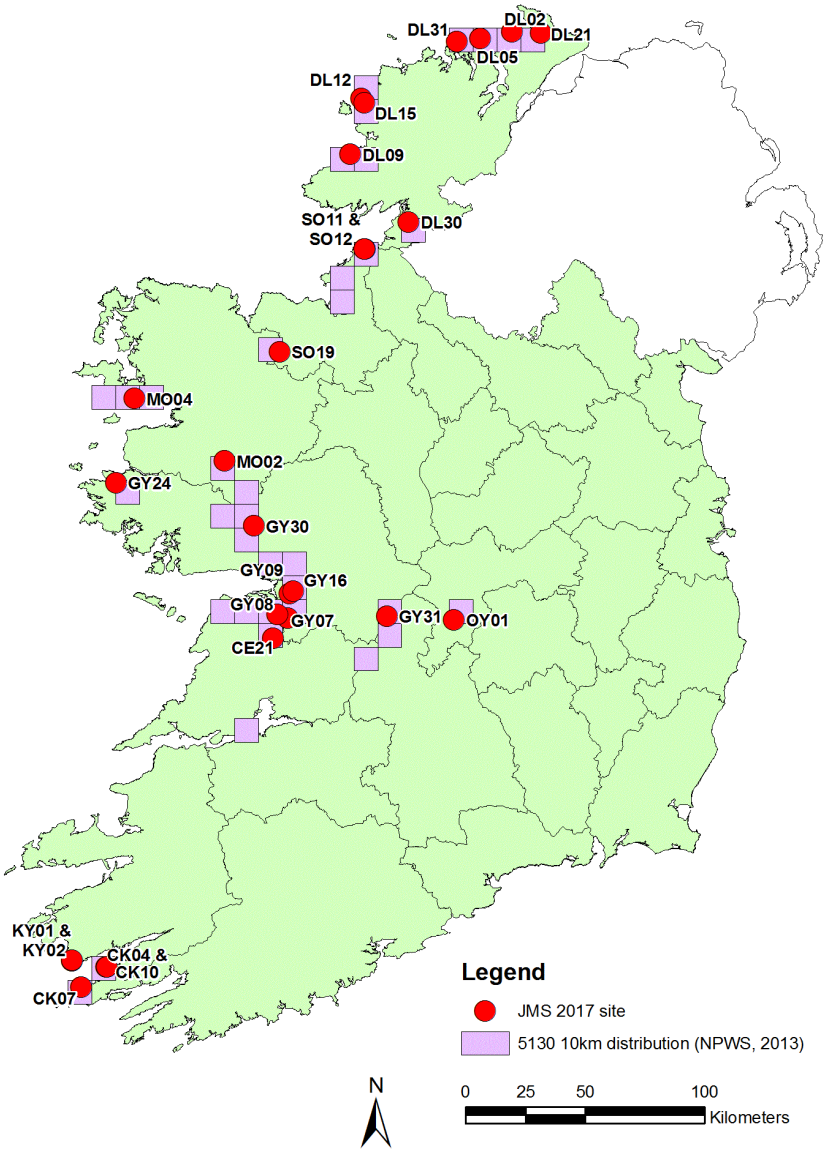


**Figure 2** Location of sites for the Juniper Monitoring Survey 2017 overlaid on to the current national 10km distribution of 5130 Juniper formations habitat.

## 2.2 Survey preparation

*Site packs*

A site pack was set up for each site, containing the baseline site report produced by Cooper *et al*. (2012), a field map consisting of an aerial photograph of the site with the formation boundary outlined on it, and information on the NPWS Ranger in whose jurisdiction the site was located. Land Registry (www.landdirect.ie) was checked for ownership information beforehand and owner details were included in the site pack where available. A blank site summary data sheet was also included in the pack, to be completed by the ecologists at the end of the site survey (see Appendix 1).

NPWS rangers, most of whom had participated in the NPWS 2015 Juniper habitat review, were contacted in advance of the survey. Permission from landowners was sought on privately owned land.

*Trimble Nomads*

Hand-held Trimble Nomads were set up to record GPS waypoints in ArcPad and to record monitoring stop and vegetation data in Turboveg CE (Alterra, The Netherlands). The shapefiles created during the baseline survey were uploaded onto the Trimbles to enable the surveyors to navigate directly to site polygons and monitoring stops.

## 2.3 Site surveys

Sites were surveyed between March 23rd and September 7th 2017. Survey teams consisted of a minimum of two ecologists, but a team of three operated on DL09 Dawros Head Complex and DL15 Viking House, and a team of four surveyed DL12 Cruit Island. Due to access issues at one site, GY31 Forest Pk Lavins Caravan was surveyed in place of GY23 Rineen.

During all stages of the survey, surveyors recorded any information of interest or relevance, including features or species of interest, botanical or otherwise. Where possible, these were photographed. Any local indicators, such as the rare Juniper shield bug (*Cyphostethus tristriatus*), were recorded and photographed. Notable plant species (e.g. Flora Protection Order, Red List) were recorded, photographed, the population estimated, and a grid reference taken for inclusion in the project's Recorder Excel spreadsheet. Photographs of site features (e.g. impacts, management) were taken as appropriate for inclusion in the project's Image Databank.

The survey methodology can be broadly divided into four main tasks:

- Conduct initial count(s) of Juniper to confirm the presence of a formation and record population-specific data;
- Establish and map the extent of the site;
- Record monitoring stop data;
- Complete the site summary data sheet including impact recording.

### 2.3.1 Initial counts of Juniper

At the beginning of each survey a tally of 50 Juniper plants was carried out to confirm that a formation was present. The definition of a formation as "any cluster of ≥50 Juniper plants where no plant is more than 20 m from another" was followed in establishing that this was the case. At least one such ad hoc count of 50 plants was conducted at each site. There were some sites in which individual Juniper shrubs were difficult to differentiate due to intermeshing of branches from several plants, but

surveyors made every effort to trace plants back to their origin to ensure that no plant was counted more than once.

The number of male and female plants counted was also noted during the 50-plant tally. Bushes bearing female cones (i.e. galbulae or berries) were counted as female.[1] Bushes on which galbulae were not evident were counted as male, although it is possible that they were immature females. As the count was undertaken to measure the percentage of mature (fruiting) females in the population, this distinction was not deemed to be important in the context of the overall aim of the count.

Any seedlings encountered at this stage were also recorded. On the basis of the observations of Cooper *et al*. (2012) on the difficulty of judging the age of Juniper bushes on factors such as girth and height, no attempt was made to categorise Juniper plants according to age (e.g. old or juvenile), except for seedlings. Generally Juniper seedlings were taken to be plants with a single, unbranched, thin stem, less than 15cm tall and 2mm wide or less. Two branches were acceptable if the plant was obviously young and still flexible.

Finally, the approximate area covered by the 50 plants was estimated by eye or by recording GPS points. As well as confirming the existence of a formation on site, these count data were used at the end of the site survey to help estimate the number of shrubs and the density of Juniper plants in the site and to help determine the approximate proportion of male to female plants in the formation. Juniper shrub count estimations were assigned to interval classes, following (Cooper *et al*., 2012): "101-300, 301-500, 501-1000, 1001-3000, 3001-10000, >10000 (following Plantlife criteria)". The highest class (>10,000) was further subdivided into 10,001-50,000, 50,001-100,000 and >100,000. Juniper shrub densities (expressed as shrubs per hectare) were assigned to the following classes: 25-100, 101-250, 251-500, 501-750, >750. Note that a shrub density of less than 25 shrubs per hectare does not represent a formation.

### 2.3.2 Mapping habitat extent

The boundary of the 5130 Juniper formation was established by walking over the site, using the baseline survey polygons as a guideline. As the definition of a formation used in 2017 was different from that employed during the baseline survey, it was inevitable that many of the baseline polygons were found not to be an accurate reflection of 5130 Juniper formations thus defined. Therefore, extensive site walkovers across the entire site had to be conducted to map the extent accurately.

Formation boundaries were drawn on field maps with the aid of waypoints taken on a hand-held Trimble Nomad. Polygons were only drawn around areas that conformed in their entirety to the definition of a formation, i.e. at least 50 plants within 20 m of each other. Therefore, a site might now have more than one formation mapped within it, unlike in the baseline survey when a site only ever comprised one polygon.

### 2.3.3 Monitoring stop recording

The appropriate number of monitoring stops was recorded according to the area-to-stops scale in Table 2. Where the site area had changed significantly from the baseline survey, the new area was estimated from the field map and the appropriate number of stops recorded. Where possible, monitoring stops were recorded where the baseline stops had been recorded; if not, they were placed in a similar vegetation type.

Monitoring stops measuring 5m x 5m were delineated on the ground using a tape measure and tent pegs. In contrast to the baseline survey, full relevés (full species lists with percentage cover values) were not routinely recorded at monitoring stops in 2017. However, if a formation occurred in a

[1] Hereafter, to avoid confusion the terms "berry" or "galbulae" will be used in preference to "cones" to describe fruiting females, as "coned plants" could signify either male or female reproducing plants.

vegetation type for which no baseline relevé had been recorded in that site, a full relevé was recorded at the monitoring stop in addition to the usual assessment data.

A GPS waypoint was recorded on the Trimble at every monitoring stop, and photographs were taken, including at least one close-up of the plot and another more general view to show the plot in the context of the landscape.

The following data were recorded at each monitoring stop for the *Structure & functions* assessment:

- Number of mature females rooted in the plot
- Number of males/immature females rooted in the plot
- Number of seedlings in the plot
- Percentage cover of bare ground in the plot
- Percentage cover of bare rock in the plot
- Number of dead plants rooted in the plot
- Percentage cover of Juniper in the plot (includes cover provided by Juniper plants rooted outside the plot)
- Percentage cover of browning Juniper in the plot (as a percentage of the plot, not as a percentage of the Juniper, so as to eliminate errors caused by estimating two variables at once)
- Evidence of browsing, recorded as Y or N
- Number of shrubs showing evidence of bark stripping by grazers/browsers
- Percentage cover of negative species

Other structural data, such as the cover of graminoids and bryophytes, were also recorded for information purposes but not used in the assessment. Appendix 2 gives the full list of data items recorded in Turboveg at each monitoring stop.

### 2.3.4 Site summary data

Surveyors completed a site summary data sheet (see Appendix 1) at the end of each site survey. This allowed surveyors to give general descriptive information about the site, including their overall impression of the site, and any impacts or management taking place that might affect the 5130 habitat. Impacts and activities were recorded with the impact code (Ssymank, 2011), magnitude, influence, and percentage of 5130 habitat affected. The site's area in hectares was derived from GIS after field maps had been digitised in the office. Data from the site summary data sheets are presented in Appendix 3 as brief site reports.

The following site summary information was derived based on data from the monitoring stops and 50-plant counts:

- *Population*: The number of shrubs in the formation was estimated based on average density data (number of plants per hectare) calculated primarily from the ad hoc counts of 50 live plants in which the area occupied by 50 plants was estimated. Shrub count data from monitoring stops were not generally used to estimate the number of shrubs in the formation as the placement of stops was inevitably biased towards areas where Juniper was present, so the stops would not represent areas of lower density. Results were averaged if several 50-plant tallies were conducted. Plant density varied over most sites and this was taken into account where possible. For example, in GY08 Cappacasheen it was estimated that 50% of the site was comprised of 5130 Juniper formations on limestone pavement which had the lowest possible density of Juniper for it to qualify as a formation (25 plants per hectare), while the

remainder was comprised of medium- to high-density formations. The estimation of the formation's Juniper population took this into account.

- *%_berried*: The percentage of shrubs with galbulae (both immature and ripe) was counted or estimated from population size estimates, using data from both the *ad hoc* 50-plant tallies and from monitoring stops. This gave a more site-wide evaluation of the proportion of mature females in the formation.
- *%_seedlings*: The percentage of shrubs classed as seedlings was estimated, based mainly on data gathered from monitoring stops. Juniper seedlings were defined as plants less than 15cm high that were still flexible (2mm or less) and single-stemmed, or with only two branches at most. A number of small plants that contained several branches were seen but were instead classed as juvenile plants rather than seedlings. Because the growth habit of Juniper in sub-optimal conditions can result in stunted plants that are nevertheless reproductively mature, it was considered best to confine this criterion to plants that were incontrovertibly seedlings. Seedling counts in 2017 may therefore have been slightly lower than those in the baseline survey of Cooper *et al*. (2012) due to a difference in interpretation of what constitutes a seedling. Because seedlings were generally difficult to discern among taller vegetation, they were not generally searched for during the site walkover or ad hoc 50-plant tallies. Likely germination niches, such as rocky crevices in the vicinity of suspected mother plants, and pockets of bare ground acting as germination micro-sites, were checked outside monitoring stops if time allowed, but seedling detection was generally confined to within the monitoring plot where a thorough search could be conducted.
- *%_dead*: The number of dead Juniper shrubs was counted while carrying out the 50-plant tallies and recording monitoring stops. Only dead shrubs in areas still mapped as formations were counted; larger swathes of dead Juniper in areas which were now mapped out as non-formation were not counted (e.g. Tirneevin) as this factor was already counted as an area loss under the *Area* parameter.
- *%_prostrate*: The estimated proportion of Juniper plants on site that were prostrate or semi-prostrate rather than upright was recorded to provide information on the type of Juniper formation present. This was an approximate figure gauged by eye simply to give an impression of the gross morphology of the formation.
- *Impacts and activities*: Any issues affecting the condition of the habitat, such as problematic natives or invasive non-natives, overgrazing or burning, were noted, including the percentage of the 5130 Juniper formations habitat affected and the intensity of the impact (high, medium or low). The same data were recorded for any activities judged to be having a beneficial effect on the habitat.
- *Site summary/Management*: A brief summary was written for each site, including notes on the general condition of the population, site management, and any pressures and threats observed.
- *Other site-level data*: Any other information of interest or relevance was noted, including any features or species of interest, botanical or otherwise.

## 2.4 Assessments

### 2.4.1 *Area* assessment

The *Area* parameter was assessed in the field, taking note of any recent (<6 years) losses in habitat evident during the survey. Google Earth® time-series images were also consulted in the office for a number of sites to determine if area losses due, for example, to construction of housing or other structures, had taken place since the baseline survey. The area loss was calculated as a percentage of the original (pre-loss) area as follows:

(Current area / (Current area + area lost)) x 100

This was then divided by the number of years since the site was surveyed in the baseline survey to derive the annual percentage loss in area.

### 2.4.2 *Structure & functions* assessment

Assessment criteria were examined at the monitoring stop level and extrapolated up to the site level to obtain a pass or fail for each criterion. The *Structure & functions* assessment for the site was based on the number of criteria that passed for the site. A summary of the assessment procedure is shown in Table 3.

Targets for criterion passes at the site level were evaluated individually using expert judgement. Criteria that indicate severe degradation of the habitat, such as the incidence of dead or ailing plants or excessive bark stripping and browser damage, were judged to require a higher pass rate among stops, hence a pass target of ≥75% of stops was set. Criteria that signify a lesser degree of stress to the habitat were set a less stringent pass target for stops. Hence the %_berried criterion was set a pass rate of ≥50% of stops and the Germination niches criterion was set at ≥25% of stops as it was considered important that some, but not necessarily all, stops should pass these criteria in order for the habitat to be able to regenerate. Given the low level of seedling recruitment in Juniper across much of its range in Europe (Thomas *et al*. 2007), the occurrence of one seedling was considered sufficient to indicate that the formation has the capacity to recruit new seedlings.

**Table 3** Summary of *Structure & functions* assessment for 5130 Juniper formations followed in 2017.

| Criterion | Target for pass at stop level | Target for pass at site level |
|---|---|---|
| %_berried | ≥10% of Juniper shrubs rooted in plot are berried | ≥50% of stops pass the criterion |
| %_seedlings | >0%, i.e. at least 1 seedling recorded in plot | >0% of stops pass the criterion |
| Germination niches | ≥5% bare ground and/or ≥5% bare rock recorded in plot | ≥25% of stops pass the criterion |
| %_alive | ≥90% of Juniper shrubs rooted in plot are alive | ≥75% of stops pass the criterion |
| %_browning | ≤20% of Juniper in plot is browning, calculated as:<br>(%browning in plot / %Juniper in plot) x 100 | ≥75% of stops pass the criterion |
| Browsing & bark stripping | No browsing of shoot tips, and ≤10% of Juniper shrubs in plots showing evidence of trunk bark stripping | ≥75% of stops pass the criterion |
| Negative species | ≤10% cover of negative species in plot | ≥50% of stops pass the criterion |
| *Structure & functions* assessment result for the site: | | Favourable =<br>6-7 criteria pass |
| | | Unfavourable-Inadequate =<br>5 criteria pass |
| | | Unfavourable-Bad =<br>0-4 criteria pass |

### 2.4.3 *Future prospects* assessment

EU guidance states that the habitat's *Future prospects* parameter "should be evaluated by individually assessing the expected future trends and subsequently future prospects of each of the other three parameters [*Range*, *Area* and *Structure & functions*], taking primarily into account the current conservation status of the parameter, threats (related to the parameter assessed) and the conservation measures being taken or planned for the future. Once the future prospects of each of the other three parameters have been evaluated, they should be combined to give the overall assessment of Future prospects" (DG Environment, 2017).

*Future prospects* were assessed at the site level by evaluating the future prospects and future expected trend of *Area* and *Structure & functions* at each site, and examining the current pressures, future threats and beneficial management practices operating on the habitat. Guidance provided by the EU (DG Environment, 2017) was followed to determine the future trends and future prospects of each parameter. For 5130 Juniper formations habitat to be assessed as having Favourable *Future prospects*, its prospects had to be judged to be good, with no severe impacts expected from threats and the habitat expected to be stable or improving in the long term. For it to be assessed with Unfavourable-Bad *Future prospects*, its prospects were judged to be bad, with severe impacts expected from threats and the habitat expected to decline or disappear in the long term. An assessment of Unfavourable-Inadequate *Future prospects* was between these two extremes.

To help evaluate *Future prospects* according to the above guidance, the pressures, threats and positive activities occurring on each site were recorded according to the impact codes of Ssymank (2011) (the 2017 impact codes were not available at the commencement of the project). The magnitude of the impact (high, medium or low), influence (positive, negative or neutral) and percentage area of habitat affected were also noted. An impact score for each site was calculated, following the procedure outlined in Table 4 and used previously in other projects (e.g. Delaney *et al.*, 2013; Martin *et al.*, 2017).

While this score was not used in the assessment of *Future prospects*, it was useful to gain an overall understanding of how the positive activities and negative pressures balanced out across each site.

**Table 4** Scoring system used to quantify impacts in Annex I 5130 sites (from Delaney *et al*., 2013). The *Future prospects* score of a site is the sum of its individual impact scores.

| Attribute of impact | Value | Attribute score |
|---|---|---|
| 1. Intensity of impact | High | 1.5 |
| | Medium | 1.0 |
| | Low | 0.5 |
| | | |
| 2. Effect of impact | Positive | 1 |
| | Neutral | 0 |
| | Negative | -1 |
| | | |
| 3. % Area of Annex I polygon impacted | <1% | 0.5 |
| | 1-25% | 1.0 |
| | 26-50% | 1.5 |
| | 51-75% | 2.0 |
| | 76-99% | 2.5 |
| | 100% | 3.0 |
| Impact score is the mathematical product of all three attribute scores | | |

### 2.4.4 Overall conservation assessment

The overall conservation status assessment for the habitat at each site was evaluated based on the results of all three parameters, according to the evaluation matrix in Table 1 and using the guidance provided by the EU (DG Environment, 2017).

# 3 Results

## 3.1 Overall statistics

### 3.1.1 Number of formations

Of the 27 sites surveyed, two had insufficient numbers of Juniper shrubs to be regarded as a formation (CK10 Cleanderry roadside and KY01 Abbey Island), one was found to contain no Juniper at all (SO19 Ballinderreen), and two sites were in close enough proximity to each other to be merged into one site (SO11 Skerrydoo 4 and SO12 Skerrydoo 2, hereafter referred to as SO11/12 Skerrydoo 4/2). The total number of sites surveyed in 2017 that contained at least one formation was, therefore, 23. More than one formation polygon was mapped in some sites, giving a total of 82 individual formations.

Table 5 lists the 27 sites surveyed, together with the number of monitoring stops and the number of formation polygons mapped within the site.

**Table 5** Sites surveyed during the Juniper Monitoring Survey 2017.

| Site ID | Site name | No. of stops | No. of formations |
|---|---|---|---|
| CE21 | Rinecaha | 2 | 2 |
| CK04 | Cleanderry track | 1 | 1 |
| CK07 | Cod's Head, Allihies | 4 | 1 |
| CK10 | Cleanderry roadside | 0 | 0 |
| DL02 | Binnion A | 2 | 1 |
| DL05 | Fanad A | 4 | 1 |
| DL09 | Dawros Head Complex | 9 | 27 |
| DL12 | Cruit Island | 8 | 12 |
| DL15 | Viking House | 8 | 5 |
| DL21 | Malin | 2 | 1 |
| DL30 | Ballynacarrick | 4 | 2 |
| DL31 | Melmore Head | 4 | 1 |
| GY07 | Tirneevin | 6 | 3 |
| GY08 | Cappacasheen | 8 | 1 |
| GY09 | Cloghboley A | 4 | 1 |
| GY16 | Caherateige | 9 | 3 |
| GY24 | Dawros More | 6 | 1 |
| GY30 | Lough Corrib | 4 | 1 |
| GY31 | Forest Pk Lavins Caravan | 2 | 2 |
| KY01 | Abbey Island | 0 | 0 |
| KY02 | Derrynane | 1 | 1 |
| MO02 | Aghinish | 7 | 2 |
| MO04 | Corraun/Clew | 8 | 10 |
| OY01 | Island Fen Birr | 2 | 1 |
| SO11/12 | Skerrydoo 4/2* | 2 | 2 |
| SO19 | Ballinderreen | 0 | 0 |
| **TOTAL** | | 107 | 82 |

* There was one stop and one formation each in SO11 and SO12

Sites with multiple formations can be regarded as complexes of formations that have been retained under a single site code to allow comparison with, and traceability to, the baseline survey of Cooper *et al*. (2012) or other historical data files held by NPWS. Sites with multiple formations were assessed at the site level, not at the formation level. This means that, while monitoring stops were recorded in 5130 habitat across the site as a whole, not every formation necessarily had a monitoring stop recorded in it. For example, nine monitoring stops were recorded in DL09 Dawros Head Complex, but 27 separate formations were mapped there.

### 3.1.2 Area of habitat

Table 6 shows the area of each site in hectares recorded in 2017. The area mapped in the baseline survey is shown for comparison, and a reason for the change, if any, is given in the Site notes column.

**Table 6** Comparison of area in hectares of sites with formations surveyed in the baseline survey (Cooper *et al*., 2012) and the Juniper Monitoring Survey 2017.

| Site ID | Site name | Site area (ha) | | Site notes |
|---|---|---|---|---|
| | | Baseline | 2017 | |
| CE21* | Rinecaha | - | 0.35 | |
| CK04 | Cleanderry track | 0.09 | 0.07 | Formation occurs along rocky ridge. Slight area change due to refined mapping. |
| CK07 | Cod's Head, Allihies | 0.04 | 4.3 | Boundary coincides with that mapped by NPWS 2015. No indication of genuine change since baseline. |
| DL02 | Binnion A | 2.3 | 1.3 | Baseline survey outliers excluded, site remapped, not genuine change. |
| DL05 | Fanad A | 3.0 | 3.9 | Site extended from baseline, not genuine change. |
| DL09 | Dawros Head Complex | 2,673.7 | 219.0 | Significant area change due to interpretation and more accurate mapping. |
| DL12 | Cruit Island | 312.2 | 36.9 | Significant area change due to interpretation and more accurate mapping. |
| DL15 | Viking House | 62.3 | 17.7 | Significant area change due to interpretation and more accurate mapping. |
| DL21 | Malin | 0.7 | 0.31 | Area change due to refined mapping. |
| DL30 | Ballynacarrick | 1.4 | 6.6 | Site extended from baseline, not genuine change. |
| DL31 | Melmore Head | 1.3 | 4.5 | Site extended from baseline, not genuine change. |
| GY07 | Tirneevin | 29.1 | 11.6 | High Juniper mortality probably result of extended flooding; significant loss of numbers and area due to natural processes. |
| GY08 | Cappacasheen | 285.4 | 502.4 | Site extended from baseline, not genuine change. |
| GY09 | Cloghboley A | 2.1 | 1.3 | Area change partly due to habitat loss from motorway construction, partly due to more accurate mapping. |
| GY16 | Caherateige | 33.7 | 74.4 | Site extended from baseline, not genuine change. |

| Site ID | Site name | Site area (ha) | | Site notes |
|---|---|---|---|---|
| | | Baseline | 2017 | |
| GY24 | Dawros More | 10.5 | 16.1 | Site extended from baseline, not genuine change. |
| GY30 | Lough Corrib | - | 9.2 | Flooding may have reduced area of 5130 but survey was inconclusive; small amount of Juniper clearance may be clean-up operations. |
| GY31 | Forest Pk Lavins Caravan | - | 1.1 | Boundary coincides with that mapped by NPWS 2015. |
| KY02 | Derrynane | 0.4 | 0.3 | Large mass of plants, difficult to count accurately, but included as formation due to high plant density and mass. Area change due to refined mapping. |
| MO02 | Aghinish | 14.2 | 38.7 | Site extended from baseline, not genuine change. |
| MO04 | Corraun/Clew | 961.2 | 393.3 | Significant area change due to interpretation and more accurate mapping, not genuine change. |
| OY01 | Island Fen Birr | 4.4 | 1.6 | Site boundary refined but no loss of Juniper habitat. |
| SO11/12 | Skerrydoo 4/2 | 2.5 | 2.2 | Two sites merged. Some agricultural improvement, 5130 probably lost but comparison with baseline mapping inconclusive. |
| | *Total area surveyed in 2017 (ha)* | | 1,346.9 | |

* The area suggested by Cooper *et al*. (2012) for survey in this locality was Rinecaha townland, but the area selected for survey in 2017 was that surveyed by NPWS rangers in 2015, which is in Lyan townland.

The largest formations were found at GY08 Cappacasheen, MO04 Corraun/Clew and DL09 Dawros Head Complex. There were significant differences for most sites between the area of 5130 Juniper formations mapped during the 2017 and baseline surveys. The vast majority of these differences can be ascribed solely to methodological differences relating to mapping and habitat definition. As described in the Methodology (section 2), the mapping strategies used by the two surveys were very different. The baseline survey mapped one large polygon for each site, sometimes delimited by just a few Juniper shrubs around the perimeter of the formation, regardless of Juniper density. In contrast, the 2017 survey delimited formations based on all Juniper shrubs around the perimeter of the formation where Juniper density reached at least 25 shrubs per hectare, a practice that excluded some areas that had been mapped as part of a formation in the baseline survey, and sometimes resulted in more than one formation polygon being mapped in a site.

The nature of the differences in mapped area between the surveys was not consistent, with the areas mapped being larger at nine sites in the 2017 survey compared to the baseline, but smaller at ten. Some of the largest sites in the baseline survey (e.g. DL09 Dawros Head Complex, DL12 Cruit Island and MO04 Corraun/Clew) were mapped significantly smaller in 2017, a consequence of adhering to a more the strict definition of a formation. Other sites, such as CK07 Cod's Head Allihies, DL30 Ballinacarrick and GY16 Caherateige, were extended as the habitat was more or less continuous beyond the baseline site boundary, and the surveyors continued to map the 5130 habitat until it transitioned to another habitat.

The smallest sites, CK04 Cleanderry track, DL21 Malin and KY02 Derrynane, were found to coincide closely to the boundary mapped in the baseline survey. Only minor changes were made to refine the habitat boundaries. However, because of the already small area covered by these sites, even minor changes made a significant difference to the calculated area of the habitat – the mapped area of DL21 Malin, for example, was more than halved from 0.7 ha to 0.3, but it was clear during the 2017 survey that the actual area of the habitat had not changed since the baseline.

For one site, SO19 Ballinderreen, repeated searches for 5130 Juniper formations carried out in 2015 by NPWS personnel and in 2017 for the current survey failed to discover any 5130 habitat. In 2017, surveyors noted that conditions at the site appeared too wet to support Juniper, either now or in the past. It is surmised on this basis that the site coordinates for SO19 may have been logged inaccurately. Consequently, the absence of 5130 from the site in 2017 is regarded as being due to a mapping error rather than an actual loss of habitat, and the national *Area* assessment for the habitat remains unaffected.

### 3.1.3 Number of shrubs

The number of Juniper shrubs on site was estimated from the 50-plant tallies and an average density of shrubs per hectare was calculated based on the site area. Shrub counts and densities were assigned to interval classes, as described in section 2.3.1. Table 7 lists the shrub count estimations and densities. Higher counts were generally estimated in larger sites, as would be expected, although shrub density varied. The most frequent density interval class recorded was 251-500, and the median density of Juniper plants in formations across all of the sites surveyed in 2017 was approximately 350 plants per hectare. High plant densities (in excess of 750 plants per hectare) were found at a number of sites, the most notable being MO04 Corraun/Clew. A population of over one million plants was estimated here, with an exceptionally high plant density noted over a substantial proportion of the site. This was the only true upland site surveyed and its high density may indicate a formation comprised predominantly of *Juniperus communis* ssp. *nana* rather than ssp. *communis*.

There were significant differences between the estimated numbers of shrubs in the baseline and 2017 surveys (Table 7), but these were most likely due to methodology (extrapolation of counts from sub-samples to full-site counts) rather than actual change.

Some smaller sites, CK04 Cleanderry track and KY02 Derrynane, had populations estimated in the baseline survey at 30 and 23 respectively; hence they were described in the baseline survey as non-formation. The 2017 survey estimated both of these formations at around 50 plants, but the count for KY02 Derrynane in particular was approximate, the plants here being very difficult to count as the shrubs were large, apparently old and much intermeshed. Based on other similar sites, however, where Juniper shrubs generally seemed to achieve a maximum diameter of 6 m, the Juniper cluster at KY02 was deemed sufficiently large in area and plant density to conform to a formation. Further Juniper clusters exist in this area, with KY01 Abbey Island (a non-formation) present about 70 m to the south across a stretch of sandy beach, and another unsurveyed area of Juniper (shrub count unknown) on a steep cliff to the northeast.

**Table 7** Estimated Juniper shrub numbers and densities in sites surveyed in the Juniper Monitoring Survey 2017.

| Site ID | Site name | Est. no. of shrubs | | Shrub density 2017 (shrubs/ha) |
|---|---|---|---|---|
| | | Baseline | 2017 | |
| CE21 | Rinecaha | n/a | 50-100 | 251-500 |
| CK04 | Cleanderry track | 30 | 50-100 | 501-750 |
| CK07 | Cod's Head, Allihies | 100 | 3,001-10,000 | 501-750 |
| DL02 | Binnion A | 50 | 301-1,000 | 251-500 |
| DL05 | Fanad A | 100 | 1,001-3,000 | 251-500 |
| DL09 | Dawros Head Complex | 3500 | 50,001-100,000 | 251-500 |
| DL12 | Cruit Island | 3000 | 10,001-50,000 | >750 |
| DL15 | Viking House | 79 | 1,001-3,000 | 101-250 |
| DL21 | Malin | 60 | 50-100 | 251-500 |
| DL30 | Ballynacarrick | <50 | 3,001-10,000 | >750 |
| DL31 | Melmore Head | 50 | 301-1,000 | 101-250 |
| GY07 | Tirneevin | 300 | 1,001-3,000 | 251-500 |
| GY08 | Cappacasheen | 2000 | >100,000 | 251-500 |
| GY09 | Cloghboley A | 750 | 1,001-3,000 | >750 |
| GY16 | Caherateige | 100 | 10,001-50,000 | 501-750 |
| GY24 | Dawros More | 250 | 3,001-10,000 | 251-500 |
| GY30 | Lough Corrib | n/a | 1,001-3,000 | 101-250 |
| GY31 | Forest Pk Lavins Caravan | n/a | 301-1,000 | 251-500 |
| KY02 | Derrynane | 23 | 50-100 | 101-250 |
| MO02 | Aghinish | 100 | 10,001-50,000 | 251-500 |
| MO04 | Corraun/Clew | 1500 | >100,000 | >750 |
| OY01 | Island Fen Birr | 50 | 101-300 | 101-250 |
| SO11/12 | Skerrydoo 4/2 | 350 | 1,001-3,000 | 501-750 |

## 3.2 *Area* assessment

Because of the differences in mapping methods employed by the baseline survey and the 2017 survey, it was not possible to compare site areas between the two monitoring periods directly. This *Area* assessment, therefore, is based largely on losses that were seen by surveyors in the course of the survey, rather than losses detected by comparing areas mapped during the two surveys.

Genuine habitat losses were found at GY07 Tirneevin, GY09 Cloghboley A and SO11/12 Skerrydoo 4/2 (Table 8). Habitat loss at GY07 was apparently due to prolonged turlough flooding, as large numbers of dead shrubs were found at the edges of the formation within the flood zone. Because the loss was due to a natural cycle in another Annex I habitat (3180 Turloughs) rather than being anthropogenic in origin, and as it is likely that the loss is temporary (although restoration will probably be measured in decades rather than years), the loss was not deemed to result in an adverse assessment for the *Area* parameter for the site.

**Table 8** Results of the *Area* assessment for 5130 Juniper formations sites surveyed in 2017.

| Site ID | Site name | Area (ha) 2017 | Area lost since 2009 (ha) | %Area loss per annum (8 years) | *Area* |
|---|---|---|---|---|---|
| CE21 | Rinecaha | 0.35 | 0 | 0 | Fav |
| CK04 | Cleanderry track | 0.07 | 0 | 0 | Fav |
| CK07 | Cod's Head, Allihies | 4.3 | 0 | 0 | Fav |
| DL02 | Binnion A | 1.3 | 0 | 0 | Fav |
| DL05 | Fanad A | 3.9 | 0 | 0 | Fav |
| DL09 | Dawros Head Complex | 218.9 | 0 | 0 | Fav |
| DL12 | Cruit Island | 37.7 | 0 | 0 | Fav |
| DL15 | Viking House | 17.7 | 0 | 0 | Fav |
| DL21 | Malin | 0.3 | 0 | 0 | Fav |
| DL30 | Ballynacarrick | 6.6 | 0 | 0 | Fav |
| DL31 | Melmore Head | 4.5 | 0 | 0 | Fav |
| GY07 | Tirneevin | 11.6 | 0* | 0 | Fav |
| GY08 | Cappacasheen | 502.4 | 0 | 0 | Fav |
| GY09 | Cloghboley A | 1.3 | 0.45 | 3.3 | U-B |
| GY16 | Caherateige | 74.4 | 0 | 0 | Fav |
| GY24 | Dawros More | 16.1 | 0 | 0 | Fav |
| GY30 | Lough Corrib | 9.2 | 0* | 0 | Fav |
| GY31 | Forest Pk Lavins Caravan | 1.1 | 0 | 0 | Fav |
| KY02 | Derrynane | 0.26 | 0 | 0 | Fav |
| MO02 | Aghinish | 38.7 | 0 | 0 | Fav |
| MO04 | Corraun/Clew | 393.3 | 0 | 0 | Fav |
| OY01 | Island Fen Birr | 1.6 | 0 | 0 | Fav |
| SO11/12 | Skerrydoo 4/2 | 2.2 | 0.1 | 0.6 | U-I |

* Area losses incurred were due to natural causes, therefore not counted as an area loss for this assessment.

Habitat loss at GY09 Cloghboley A was due to motorway construction, which was still ongoing in 2017. The site was therefore given an Unfavourable assessment for the *Area* parameter. Calculation of the area lost was based partly on the original formation boundary mapped during the baseline survey, particularly the northwestern boundary, and partly on the more refined boundary mapped in 2017.

Some habitat loss due to scrub clearance was noted at SO11/12 Skerrydoo 4/2. Surveyors estimated that approximately 5% of the habitat had been lost.

Some Juniper mortality had occurred at GY30 Lough Corrib, again probably due to prolonged flooding. Some Juniper clearance and burning also appeared to have taken place on the site, although this may have been in the course of clean-up operations to remove dead shrubs. GY30 was not surveyed during the baseline survey so there is no previous baseline area available for comparison. Because the scale of mortality was less than at GY07 Tirneevin and Juniper shrub density appeared to be maintained to the edges of the site, rather than there being clear signs of a contraction of the site boundary, the current area was taken as the baseline area for this site.

While some habitat loss from dispersed housing appeared to have taken place at DL12 Cruit Island and DL15 Viking House in the past, a search through time-series images from Google Earth® did not show any clear evidence of these losses having occurred since the baseline survey was conducted in 2008-2010. The *Area* assessment for these two sites was therefore Favourable.

## 3.3 *Structure & functions* assessment

Assessment of the *Structure & functions* parameter in 2017 was carried out using a different set of criteria compared to the baseline survey. The new criteria were designed to assess the 5130 Juniper formation habitat specifically, rather than any associated habitats such as grassland or heath. It is therefore not possible to directly compare the *Structure & functions* assessment results of the baseline and 2017 surveys. A total of 14 sites (61%) were assessed as Favourable with regard to *Structure & functions*. Six sites (26%) were assessed as Unfavourable-Inadequate, and three (13%) were assessed as Unfavourable-Bad. The criteria assessed and the *Structure & functions* assessment result for each of the sites is given in Table 9. As, no local indicators were recorded during the current survey, this criterion was not assessed.

**Table 9** Results of the *Structure & functions* (*S&F*) assessment for 5130 Juniper formations sites surveyed in 2017. Favourable = 6-7 criteria passed; Unfavourable-Inadequate=5 criteria passed; Unfavourable-Bad=0-4 criteria passed.

| Site ID | % berried | % seedlings | Germin. niches | % alive | % browning | Browsing /bark strp | Negative species | No. passes | *S&F* |
|---|---|---|---|---|---|---|---|---|---|
| CE21 | Pass | Pass | Pass | Pass | Pass | Fail | Pass | 6 | Fav |
| CK04 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| CK07 | Fail | Fail | Pass | Pass | Pass | Pass | Pass | 5 | U-I |
| DL02 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| DL05 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | 7 | Fav |
| DL09 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | 7 | Fav |
| DL12 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| DL15 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| DL21 | Pass | Fail | Fail | Pass | Pass | Pass | Pass | 5 | U-I |
| DL30 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | 7 | Fav |
| DL31 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| GY07 | Pass | Fail | Pass | Fail | Pass | Pass | Pass | 5 | U-I |
| GY08 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | 7 | Fav |
| GY09 | Pass | Fail | Pass | Pass | Pass | Fail | Pass | 5 | U-I |
| GY16 | Pass | Fail | Pass | Pass | Pass | Fail | Pass | 5 | U-I |
| GY24 | Pass | Pass | Pass | Pass | Pass | Fail | Pass | 6 | Fav |
| GY30 | Pass | Fail | Pass | Fail | Pass | Fail | Pass | 4 | U-B |
| GY31 | Pass | Fail | Fail | Pass | Pass | Pass | Pass | 5 | U-I |
| KY02 | Fail | Fail | Fail | Pass | Pass | Pass | Pass | 4 | U-B |
| MO02 | Pass | Pass | Pass | Pass | Pass | Fail | Pass | 6 | Fav |
| MO04 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| OY01 | Pass | Fail | Pass | Pass | Pass | Pass | Pass | 6 | Fav |
| SO11/12 | Pass | Fail | Fail | Pass | Fail | Fail | Pass | 3 | U-B |

Evaluation of the overall national conservation assessment for an Annex I habitat also requires an indication of the area of the habitat that is in Favourable condition with regard to *Structure & functions*. Table 10 shows these details, based on the data in Tables 8 and 9. From this it is evident that the majority of the 5130 habitat, 92%, has good *Structure & functions*, as assessed by the criteria described in this section, with 8% of the habitat judged to be in poor or bad condition.

**Table 10** Total area of 5130 habitat surveyed in 2017 in Favourable and Unfavourable condition with regard to its *Structure & functions*.

| *S&F* assessment | Area (ha) | % of total area |
|---|---|---|
| Favourable | 1,242.2 | 92.2 |
| Unfavourable-Inadequate | 93.0 | 6.9 |
| Unfavourable-Bad | 11.7 | 0.9 |
| Total | 1,346.9 | 100.00 |

Table 11 shows the pass rates for the individual *Structure & functions* criteria across monitoring stops and sites. Each of the seven assessment criteria is then examined in turn.

**Table 11** Pass rates of criteria used to assess *Structure & functions* in the Juniper Monitoring Survey 2017.

| Criterion | Target | Level of assessment | Pass rate of monitoring stops (%) (n=107) | Pass rate of sites (%) (n=23) |
|---|---|---|---|---|
| %_berried | ≥ 10% plants with berries | Plot + Site level | 76 | 91 |
| %_seedlings | Seedlings recorded in site | Site level | 10 | 30 |
| (a) %bare soil | ≥ 5% | Plot level | 22 | - |
| (b) %bare ground | ≥ 5% | Plot level | 55 | - |
| Germination niches | At least one of (a) or (b) passes | Plot level | 62 | 83 |
| %alive | ≥ 90% plants alive | Plot (+ site) level | 94 | 91 |
| %_browning | ≤ 20% of Juniper cover is browning | Plot level | 93 | 96 |
| Browsing & bark stripping | No browser damage to shoot tips, ≤10% of Juniper shrubs in plot with trunk bark stripping | Plot level | 80 | 74 |
| Negative species | ≤ 10% cover within plot | Plot level | 98 | 100 |

### 3.3.1 %_berried

The percentage of female plants with galbulae was based mainly on data from the monitoring plots, but data from the 50-plant tallies were also used, particularly for sites with only one monitoring stop. The calculated value had to reach or exceed the imposed threshold of 10% to pass the criterion. Most of the 107 stops (76%) passed the threshold with ease.

The criterion was deemed to pass for the site if it was passed by ≥ 50% of stops. Any cases of failure were further investigated, with the 50-plant tallies also included in the calculation to verify whether or not the site had a genuinely low proportion of fruiting females. Two sites failed this criterion. Even

when the 50-plant tallies were taken into account, only 2.4% of plants sampled in CK04 Cod's Head Allihies and 5% of plants in KY02 Derrynane were found to be mature, berried females. The reasons are unclear but cattle or hare grazing is a possibility on CK04, as both grazers were present, while excessive shading from vegetation may be a possible explanation on KY02, where adjacent vegetation was relatively tall. The baseline survey (Cooper *et al*., 2012) also recorded 0% reproducing females at CK04 and KY02, suggesting that this problem has been on-going for some time.

### 3.3.2 %_seedlings

Seedlings and juveniles were recorded more frequently where there had been some disturbance, such as erosion or burning. Only one seedling was found at GY07 Tirneevin, where substantial losses of shrubs (not just Juniper) had taken place due to prolonged flooding; however, *Ulex europaeus* appeared to be reproducing more successfully, with its seedlings far more numerous than Juniper. Juniper seedlings were not found in areas where vegetation cover was closed, such as where heath communities of *Calluna vulgaris*, *Empetrum nigrum*, *Erica* spp. and *Ulex gallii* formed a dense dwarf-shrub layer.

Overall, seedling recruitment in the formations surveyed in 2017 was either absent or very low, in all cases far below the 10% minimum threshold applied in the baseline survey. As the threshold set during the baseline survey was judged in 2017 to be set too high, it was adjusted significantly downwards so that any record of a seedling would allow the site to pass the criterion. Therefore a site was deemed to pass the %_seedlings criterion if a seedling was found in any monitoring plot, i.e. if it was found in >0% of stops. Even with this considerable reduction in the threshold, the criterion was passed by just 10% of monitoring plots, and 8 of the 23 sites (35%).

Comparison with the baseline survey (Cooper *et al*., 2012) indicates some differences between the sites then and now. For example, DL12 Cruit Island was recorded in the baseline survey as having a good seedling recruitment rate, with 9% of Juniper plants recorded as seedlings. In 2017, however, no seedlings were recorded. A high recruitment rate (6%) was also recorded in the baseline survey for DL02 Binnion A, but again no seedlings were recorded in 2017. The reasons are unclear but may be linked to insufficient grazing at both sites, which can result in vegetation becoming too tall, shading out new seedlings, or could be due to other hidden factors such as poor seed viability. A slight difference in interpretation of what constitutes a seedling may have been partly responsible for the very low numbers of seedlings recorded in 2017 (further discussion in section 5.4), but overall, numbers of Juniper juveniles and seedlings were low across all sites surveyed in 2017.

### 3.3.3 Germination niches (bare soil / bare rock)

As outlined in section 1.4.1.2, in 2017 this criterion was assessed using two components, bare soil and bare rock, which were then combined to give a single result for germination niche availability. A minimum threshold of 5% was applied to each component. A monitoring stop passed the germination niches criterion if it passed either of the two components of the criterion, i.e. if it had at least 5% cover of bare soil and/or at least 5% cover of bare rock. No upper limit was imposed in either case, meaning that even severely eroded plots could pass. The issue of erosion was assessed separately under Impacts/Activities and *Future prospects*.

The bare soil component of the criterion was passed by 22% of monitoring plots. A higher proportion of plots, 55%, passed the bare rock component, reflecting the fact that many of the Juniper formations surveyed in 2017 occurred on areas with a high proportion of bare rock, such as limestone pavement and rocky outcrops in coastal, scrubby or heathy areas. In total, 62% of stops passed the combined germination niches criterion.

The criterion was deemed to pass for the site if it was passed by ≥ 50% of stops. Eighteen of the 23 sites (78%) passed the germination niches criterion. The five sites that failed were DL21 Malin, DL30 Ballynacarrick, GY31 Forest Pk Lavins Caravan, KY02 Derrynane and SO11/12 Skerrydoo 4/2, which

were all assessed as providing inadequate germination niches for Juniper seeds. All suffered to some extent from encroachment of other vegetation such as scrub or rank grassland, resulting in more closed vegetation with less exposed soil or rock available. The baseline survey (Cooper *et al.*, 2012) assessed only the bare soil component, and the results are the same as for the 2017 survey, i.e. low availability of bare soil in the sites for which the criterion was assessed (DL21, DL30, SO11 and SO12).

### 3.3.4 %_alive

The level of die-off of Juniper was generally low, with most sites having only a small number of dead plants, if any. The exceptions to this were GY07 Tirneevin and GY30 Lough Corrib, which had both apparently been subjected to prolonged flooding of sufficient severity to bring about the death of a number of well-established Juniper shrubs. GY30 Lough Corrib also seemed to have suffered shrub losses due to burning or scrub clearance, but this may have been due to clean-up in the aftermath of flooding. A small number of dead Juniper shrubs were also noted in monitoring plots in MO02 Aghinish and GY16 Caherateige but overall the amount of die-off at these sites was low and not deemed to be a significant problem. A minimum threshold of 90% was applied to the percentage of live Juniper plants within the plot, a threshold which was passed by 94% of monitoring stops.

The criterion was deemed to pass for the site if it was passed by ≥ 75% of stops. The overall pass rate for the sites was 91% (21 of 23 sites), all other sites apart from GY07 and GY30 having passed the criterion.

The baseline survey (Cooper *et al.*, 2012) showed a similar result, in that GY07 Tirneevin had the lowest percentage of live plants recorded among the 51 formations assessed (70%), so the issue of shrub mortality at this site would appear to be of long standing.

### 3.3.5 %_browning

Browning was calculated as the percentage cover of Juniper within the plot that was dying back due to stress. The threshold to pass this criterion was for Juniper within plots to exhibit less than 20% browning. Most plots (93%) passed this criterion, as did most sites (96%), but Juniper shrubs in one of the stops at SO11/12 Skerrydoo 4/2 were found to be exhibiting a high degree of browning. While the exact cause was unclear, the formation at this site was being impacted by a number of activities that could potentially be damaging to above- and below-ground parts of the shrubs, including earth moving and rock extraction using heavy machinery.

The criterion was deemed to pass for a site if it was passed by ≥ 75% of stops. As only two stops were recorded at SO11/12 Skerrydoo 4/2, the site failed the criterion assessment, a result which the surveyors judged to be appropriate.

### 3.3.6 Browsing & bark stripping

Browsing and bark stripping were recorded separately but their results were combined, as both assess damage caused by grazers. Damage was assessed by examining shoots for signs of browsing and main Juniper trunks for signs of bark stripping due to grazers. The latter was difficult to separate from mechanical damage due to the shrubs abrading off each other or off the frequently rocky substrate. Some bark damage judged to be caused by grazers was observed and was above the threshold (of 10% of shrubs in the plot) in 22% of stops. Occasionally some damage to older branches was noted from cattle or other animals treading on the plants, but this did not appear to be a serious problem and was not counted, as grazing was generally found to be non-intensive, with animals roaming over a relatively large area rather than being confined to a small area and causing severe damage to Juniper.

Juniper does not appear, from the results of this survey, to be popular among browsers. In OY01 Island Fen Birr, for example, where upright Juniper shrubs were growing in association with *Taxus baccata* trees, browser damage was much more prevalent on the latter while the Juniper plants were

virtually untouched. This was found to be the case in other sites also, with any browsing found to be light where it was observed (noted in just 4% of plots).

Overall, 75% of stops passed the combined browsing and bark stripping criterion. The criterion was deemed to pass for the site if it passed in ≥ 75% of stops. Sixteen of the 23 sites (70%) passed.

### 3.3.7 Negative species

Negative species included any non-native species and species indicative of agricultural improvement, such as *Lolium perenne* and *Trifolium repens*. Scrub species such as *Corylus avellana* and *Rubus fruticosus*, which were regarded in the baseline survey as negative species, were not considered negative in 2017 as Cooper *et al*. (2012) noted that they might act as nursery species for Juniper. Both species were found in proximity to Juniper in established formations and did not appear to be problematic. *Molinia caerulea* and *Pteridium aquilinum*, listed as negative species in the baseline survey, were similarly not included in the category in 2017. *Molinia caerulea* was generally found not to be an issue in itself, as it was usually the hydrological unsuitability of the habitat that tended to exclude Juniper from areas where it was frequent. In drier areas where *Molinia* remained frequent, such as GY16 Caherateige, *Molinia* did not appear to be a barrier to persistence of Juniper, although it may indeed form a barrier to establishment, as do many other species such as *Calluna vulgaris*.

*Pteridium aquilinum*, if present, usually only occurred in small amounts at a level too low to be a problem. Where it was present at a high density at the edge of the formation, it was scored as a problematic native species under Impacts/Activities and *Future prospects*. This was the case at DL02 Binnion A, where very dense bracken stands occurred down-slope of the Juniper formation.

The negative species criterion was passed by all except one of the 107 monitoring plots: one plot at MO02 Aghinish failed due to excessive cover of the non-native shrub *Cotoneaster integrifolius*. A stand of the non-native shrub *Berberis thunbergii* was also noted at this site.

The criterion was deemed to pass for the site if it was passed by ≥ 50% of stops. Overall, MO02 Aghinish was judged to have passed the criterion as negative species were a problem at only one of its seven stops. Therefore all sites passed this criterion.

## 3.4 Pressures, threats and other activities

Prior to evaluating the *Future prospects* parameter, the activities, both positive and negative, recorded in 2017 on 5130 Juniper formations habitat were examined. These are shown in Table 12, with pressures and threats recorded as having a negative influence, and other activities having a neutral or positive influence. Depending on the context, the same activity may have either a positive or negative effect. The table also includes the frequency of the impacts by intensity (high, medium or low) and by the percentage of the habitat affected.

Grazing by a number of different grazer types was the main activity noted, with cattle the most frequent type of grazer. Overall, 20 instances of grazing by domesticated livestock were recorded, with grazing by wild herbivores (deer and hares) additionally recorded at four sites. Grazing effects were most frequently scored as positive or neutral (Table 12) and intensity was rarely high but it usually occurred across the whole site. One instance of sheep grazing in the uplands at MO04 Corraun/Clew was seen as a negative pressure on the habitat, and overgrazing by horses on part of MO02 Aghinish was also scored as a negative impact.

Problematic species were the next most frequent impact. Invasive non-native species were recorded at eight sites, in almost all cases scored as a negative effect. Problematic native species such as bracken were noted at five sites, two of them regarded as having a negligible (neutral) effect. Succession to other habitats, usually scrub, which is often a consequence of undergrazing, was recorded at four

sites. These impacts were generally of a low intensity and affected only a small proportion of the 5130 habitat.

Overall, there were few impacts that negatively affected large areas of 5130 Juniper formations, although it was noted in the few instances where inundation and burning occurred that death of Juniper plants often resulted. There were four sites in which Juniper scrub removal was also recorded, a cause for some concern, even if the areas affected were all small. The other significant impact that caused permanent area loss was motorway construction, seen at GY09 Cloghboley A. The majority of the remaining impacts each occurred in only a small number of cases and affected a low proportion of the habitat.

The issue of dispersed housing (E01.03) was highlighted by Cooper *et al*. (2012) as a pressure on 5130 habitat in some parts of the country, particularly in Co. Donegal. This was not recorded as a pressure but potentially remains a threat; however, conducting appropriate assessments in or near SACs should prevent further losses of Annex I habitat.

Climate change was not recorded as an impact in 2017 but it is likely to affect the altitudinal and latitudinal range of 5130 in Ireland in decades to come if average temperatures continue to rise, particularly as Juniper seed requires two cold winters to germinate and produces seedlings that are susceptible to summer drought (Wilkins & Duckworth, 2011).

**Table 12** Frequency of impacts, by intensity, %habitat affected and influence, in 5130 Juniper formations in 2017. Intensity is categorised as high (H), medium (M) or low (L).

| | | Intensity | | | % habitat affected | | | | | | Influence | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Impact code | Impact description | H | M | L | <1 | 1-25 | 26-50 | 51-75 | 76-99 | 100 | Positive | Negative | Neutral | Frequency |
| A04.02.01 | Non-intensive cattle grazing | 1 | 3 | 4 | | 1 | 1 | 1 | | 5 | 7 | | 1 | 8 |
| I01 | Invasive non-native species | | | 8 | 5 | 2 | | | | 1 | | 7 | 1 | 8 |
| A04.02.05 | Non-intensive mixed animal grazing | | 4 | 2 | | | | | | 6 | 4 | | 2 | 6 |
| A10.01 | Removal of hedges and copses or scrub | 4 | | 1 | 3 | 2 | | | | | 1 | 4 | | 5 |
| I02 | Problematic native species | | 1 | 4 | 4 | | 1 | | | | | 2 | 3 | 5 |
| K02.01 | Species composition change (succession) | | 2 | 3 | 2 | 2 | 1 | | | | | 5 | | 5 |
| D01.01 | Paths, tracks, cycling tracks | 1 | | 3 | 2 | 2 | | | | | | 1 | 3 | 4 |
| G01.03.02 | Off-road motorized driving | 1 | | 3 | 3 | 1 | | | | | | 3 | 1 | 4 |
| J01.01 | Burning down | 3 | | 1 | 1 | 2 | | 1 | | | | 4 | | 4 |
| K01.01 | Erosion | 1 | 2 | 1 | | 1 | | 1 | 1 | 1 | | 1 | 3 | 4 |
| K04.05 | Damage by herbivores (including game species) | | | 4 | | | | | | 4 | 2 | | 2 | 4 |
| A04.02.02 | Non-intensive sheep grazing | | 3 | | | | | 1 | | 2 | 1 | 1 | 1 | 3 |
| A04.02.03 | Non-intensive horse grazing | 1 | 2 | | | 2 | | | | 1 | 2 | 1 | | 3 |
| E03.03 | Disposal of inert materials | 3 | | | 2 | 1 | | | | | | 2 | 1 | 3 |
| G05.09 | Fences, fencing | | | 3 | | | | | | 3 | 1 | | 2 | 3 |
| J02.07 | Water abstractions from groundwater | | 2 | 1 | | 2 | | 1 | | | | | 3 | 3 |
| A05.02 | Stock feeding | 1 | 1 | | 2 | | | | | | | 2 | | 2 |
| E03.01 | Disposal of household / recreational facility waste | 1 | | 1 | 2 | | | | | | | 2 | | 2 |
| G01.02 | Walking, horse-riding and non-motorised vehicles | | | 2 | | 2 | | | | | | | 2 | 2 |
| H05.01 | Garbage and solid waste | | | 2 | 2 | | | | | | | 1 | 1 | 2 |
| L08 | Inundation (natural processes) | 1 | 1 | | | | 2 | | | | | 2 | | 2 |
| A04.03 | Abandonment of pastoral systems, lack of grazing | | | 1 | | | | 1 | | | | 1 | | 1 |
| D01.02 | Roads, motorways | 1 | | | | 1 | | | | | | 1 | | 1 |
| G05.01 | Trampling, overuse, | | 1 | | | 1 | | | | | | | 1 | 1 |
| J02.11.01 | Dumping, depositing of dredged deposits | 1 | | | 1 | | | | | | | 1 | | 1 |
| J03.02 | Anthropogenic reduction of habitat connectivity | | | 1 | | | | | | 1 | | 1 | | 1 |
| | *Frequency* | *20* | *22* | *45* | *29* | *22* | *5* | *6* | *1* | *24* | *17* | *42* | *28* | *87* |

The impacts and activities were converted to scores to assess the balance between positive and negative activities. Table 13 shows the sites and whether the activities were weighed in favour of positive activities, negative impacts, or in balance, i.e. neutral (Table 13). Sites that received a positive or neutral score were generally judged to have sufficient positive activities occurring to balance out any negative impacts that might be operating on site. Sites that received a negative score were examined further to determine what effect the activities would have on the habitat in the future.

Most of the sites that received negative scores were found to have one or more impacts occurring over a small proportion of the site, such as invasive or problematic species, succession caused by undergrazing, or dumping of rubbish or spoil. The most serious impacts were judged to be occurring on SO11/12. SO11/12 is a small site, so the relative proportion of the habitat affected by even localised impacts was greater than would be the case on a larger site. Although the areas affected by high-intensity impacts such as rock-spoil deposition, clearance of Juniper scrub and burning were in themselves relatively small on this site, they nevertheless represented between 1% and 5% of the 5130 habitat recorded there and were not sufficiently balanced out by the beneficial effects of the grazing that also occurred across the site. There is also a high probability that these negative impacts will continue to occur on this site as the land is being actively improved for agriculture.

MO04 was scored negatively due to medium-intensity sheep grazing, which is regarded as a negative impact in the uplands generally. However, there were signs during the survey that grazing levels were down on previous levels and, despite the grazing, the Juniper had good *Structure & functions*, and occurred at a high density and over a large area, so the habitat's prospects were deemed to be good here. However, the long-term effects of sheep grazing at this upland site should be monitored.

**Table 13** Balance of positive, negative and neutral impacts acting on 5130 Juniper formations at sites surveyed in 2017. S&F = *Structure & functions*.

| Site ID | Site name | Balance | Notes on impacts |
|---|---|---|---|
| CE21 | Rinecaha | Positive | No pressures, appropriate management |
| CK04 | Cleanderry track | Neutral | Negative pressures from burning and fragmentation but situated on rocky outcrop with non-intensive horse grazing occurring on site. |
| CK07 | Cod's Head, Allihies | Negative | Grazing (domestic stock and hare grazing) may affect berry availability and was scored as neutral due to both positive and negative effects. Burning has occurred on site. |
| DL02 | Binnion A | Neutral | Cotoneaster not judged to be having a significant negative effect but *Pteridium* will limit expansion of the formation down-slope. Otherwise, the site is undisturbed, Juniper plants are large and growing densely. |
| DL05 | Fanad A | Neutral | Effects of sheep grazing and erosion overall deemed to be neutral but should be monitored. Small area of quarrying adjacent used for old machinery but pre-dates the baseline survey. |
| DL09 | Dawros Head Complex | Positive | Large site with appropriate grazing regime. |
| DL12 | Cruit Island | Neutral | Minor impacts, mainly low intensity. No obvious grazers; hare grazing positive, keeps vegetation open, berries plentiful. Threats from dispersed habitation should be countered by appropriate assessment. |
| DL15 | Viking House | Negative | Large parts of the site are undergrazed or abandoned, negative impacts such as Juniper scrub removal are occurring, no obvious positive management taking place. Erosion scored as neutral. Threats from dispersed habitation should be countered by appropriate assessment. |
| DL21 | Malin | Negative | Site very small and unmanaged, vulnerable to losses. *Corylus* scrub encroachment occurring due to lack of management. |
| DL30 | Ballynacarrick | Positive | Scrub encroachment counteracted by appropriate grazing |
| DL31 | Melmore Head | Neutral | Non-intensive cattle grazing causing some erosion and trampling but not expected to adversely affect area or S&F of 5130 in the long term. |

| Site ID | Site name | Balance | Notes on impacts |
|---|---|---|---|
| GY07 | Tirneevin | Negative | Losses from flooding still a possibility; strongly regenerating gorse may succeed to scrub at expense of 5130; grazing is scored neutral here – largely beneficial but could also damage developing seedlings. Grazing should be monitored here. |
| GY08 | Cappacasheen | Positive | Large grazed site of excellent quality on limestone pavement; any negative impacts occurring over a very small area. |
| GY09 | Cloghboley A | Positive | Site is appropriately grazed. |
| GY16 | Caherateige | Negative | Large grazed site with strong Juniper population, but some grazing imbalance (overgrazing and undergrazing). |
| GY24 | Dawros More | Positive | Appropriately grazed with any negative impacts occurring over a small area. |
| GY30 | Lough Corrib | Negative | Negative activities causing habitat loss are occurring, such as flooding, scrub clearance and burning (though the last two could be merely clean-up of dead bushes). |
| GY31 | Forest Pk Lavins Caravan | Negative | Prevalence of Scots pine seedlings may result in succession to non-Juniper scrub, particularly in absence of grazing. |
| KY02 | Derrynane | Negative | Site very small and unmanaged; vulnerable to losses, particularly from sea erosion. Walking tracks were scored as neutral as negative trampling effects were balanced by positive opening up of habitat. |
| MO02 | Aghinish | Negative | Horse grazing was recorded as a negative; several minor impacts occurring over small areas, none affecting S&F; Juniper clearance actively occurring, may reduce habitat area in the future if it continues; many non-native species in and around the site. |
| MO04 | Corraun/Clew | Negative | Large upland site with dense formations of Juniper; erosion (possibly due to past overgrazing by sheep) scored as neutral; sheep grazing should be monitored in the long term. |
| OY01 | Island Fen Birr | Positive | Formation of upright Juniper shrubs, regularly grazed |
| SO11/12 | Skerrydoo 4/2 | Negative | Beneficial grazing on site, but many negative impacts damaging to Juniper have occurred and are likely to continue into the future. |

## 3.5 *Future prospects* assessment

### 3.5.1 Site level assessment of *Future prospects*

Table 14 shows the *Future prospects* assessment for the 23 Juniper sites surveyed in 2017 when the effects of negative impacts and positive activities were weighed up against each other in the context of each site's *Area* assessment and *Structure & functions* assessment. *Future prospects* were assessed over the next 12 years (two reporting periods).

**Table 14** *Future prospects* (FP) assessment for the 23 sites surveyed in the Juniper Monitoring Survey 2017. F=Favourable, U-I=Unfavourable-Inadequate; U-B=Unfavourable-Bad.

| Site ID | Site name | FP of Area | FP of S&F | FP of site | Rationale |
|---|---|---|---|---|---|
| CE21 | Rinecaha | Fav | Fav | Fav | Suitable grazing regime |
| CK04 | Cleanderry track | Fav | Fav | Fav | Small site but formation is on stable rocky outcrop, largely protected from excessive grazing by horses |
| CK07 | Cod's Head, Allihies | Fav | U-I | U-I | Berries and seedlings may be being grazed off by mammals; some burning has taken place in recent years |
| DL02 | Binnion A | Fav | Fav | Fav | Bracken not likely to cause reduction in area or to impact S&F over next 12 years |
| DL05 | Fanad A | Fav | Fav | Fav | All impacts judged to be neutral at present, though effects of grazing and erosion need to be monitored and if necessary adjusted in next reporting period |
| DL09 | Dawros Head Complex | Fav | Fav | Fav | Large site, no serious negative impacts |
| DL12 | Cruit Island | Fav | Fav | Fav | Favourable; possible threats from dispersed housing should be countered by appropriate assessment. |
| DL15 | Viking House | U-I | U-I | U-I | No obvious positive management taking place; parts of the site are undergrazed or abandoned. Negative impacts such as Juniper scrub removal are occurring. Threats from dispersed habitation should be countered by appropriate assessment. |
| DL21 | Malin | U-I | U-I | U-I | Small site, low recruitment, vulnerable to losses from scrub encroachment due to lack of management |
| DL30 | Ballynacarrick | Fav | Fav | Fav | Some scrub encroachment occurring but balanced out by grazing |
| DL31 | Melmore Head | Fav | Fav | Fav | All impacts judged to be neutral at present, though effects of grazing need to be monitored |
| GY07 | Tirneevin | Fav | U-I | U-I | Flooding poses on-going threat |
| GY08 | Cappacasheen | Fav | Fav | Fav | Suitable grazing regime |
| GY09 | Cloghboley A | U-B | Fav | U-B | Area loss from road construction |
| GY16 | Caherateige | Fav | U-I | U-I | Generally suitable grazing regime but some damage caused to Juniper shrubs by grazers, possible overgrazing in some areas |
| GY24 | Dawros More | Fav | Fav | Fav | Suitable grazing regime |
| GY30 | Lough Corrib | Fav | U-B | U-B | Flooding and other negative impacts pose on-going threat |
| GY31 | Forest Pk Lavins Caravan | Fav | U-I | U-I | Encroachment by Pinus sylvestris poses a threat |
| KY02 | Derrynane | Fav | U-B | U-B | Small site, low fruiting and recruitment, vulnerable to losses due to lack of management |
| MO02 | Aghinish | U-I | U-I | U-I | Pressures from Juniper clearance and non-native invasive plants |
| MO04 | Corraun/Clew | Fav | Fav | Fav | Large, dense formation, favourable S&F at present. Sheep grazing levels should be monitored in the long term. |
| OY01 | Island Fen Birr | Fav | Fav | Fav | Suitable grazing regime |
| SO11/12 | Skerrydoo 4/2 | U-B | U-B | U-B | Multiple pressures and threats from agricultural improvement and land clearance |

### 3.5.2 National assessment of *Future prospects*

Following EU guidance (DG Environment, 2017), the following national assessment was made for the *Area* and *Structure & functions* parameters of the 5130 habitat.

*Area:*

- The short-term (i.e. over the next 12 years) future trend for the area of 5130 habitat is assessed as stable as future threats and positive activities likely to occur on 5130 habitat are expected to be in balance overall.
- The current conservation status of the *Area* parameter has been assessed as Unfavourable-Inadequate (section 3.2).
- The *Future prospects* of the *Area* parameter are therefore assessed as poor.

*Structure & functions:*

- The short-term future trend for the *Structure & functions* of 5130 habitat is assessed as stable as fragmentation and other negative impacts are not currently impacting significantly on ecological processes, with the balance of positive activities such as grazing generally balancing out negative impacts such as scrub encroachment.
- The current conservation status of the *Structure & functions* parameter has been assessed as Favourable as >90% of habitat is in "good" condition (section 3.3).
- The *Future prospects* of the *Structure & functions* parameter are therefore assessed as good.

Recommendations are given at the end of the report for a number of measures that, if implemented, could increase the future trend of the *Structure & functions* parameter from stable to improving. However, because there is no guarantee that any such measures will be carried out over the next monitoring period, the future trend of this parameter must be assessed as stable. It should also be recognised that the management regimes of most Juniper formations are currently driven by the landowner rather than by any formal management plan or policy; therefore the continued operation of the management regimes currently in place, which have contributed to the favourable result for *Structure & functions*, is assumed but not guaranteed.

## 3.6 Overall conservation assessment

### 3.6.1 Overall conservation assessment at the site level

The assessments of the individual parameters at each site were combined according to the evaluation matrix in Table 1 to obtain the overall conservation assessment for 5130 habitat at each site. This resulted in twelve sites receiving a Favourable assessment across the three parameters, seven received an Unfavourable-Inadequate assessment, and four received an Unfavourable-Bad assessment (Table 15). It should be noted that the sites that received an Unfavourable-Bad overall assessment are relatively small, with the largest sites generally receiving Favourable assessments across all three parameters.

**Table 15** Results of the overall conservation assessment at the site level when all three parameters were assessed in the Juniper Monitoring Survey 2017.

| Site ID | Site name | Area | S&F | FP | Overall (site) |
|---|---|---|---|---|---|
| CE21 | Rinecaha | Fav | Fav | Fav | Fav |
| CK04 | Cleanderry track | Fav | Fav | Fav | Fav |
| CK07 | Cod's Head, Allihies | Fav | U-I | U-I | U-I |
| DL02 | Binnion A | Fav | Fav | Fav | Fav |
| DL05 | Fanad A | Fav | Fav | Fav | Fav |
| DL09 | Dawros Head Complex | Fav | Fav | Fav | Fav |
| DL12 | Cruit Island | Fav | Fav | Fav | Fav |
| DL15 | Viking House | Fav | Fav | U-I | U-I |
| DL21 | Malin | Fav | U-I | U-I | U-I |
| DL30 | Ballynacarrick | Fav | Fav | Fav | Fav |
| DL31 | Melmore Head | Fav | Fav | Fav | Fav |
| GY07 | Tirneevin | Fav | U-I | U-I | U-I |
| GY08 | Cappacasheen | Fav | Fav | Fav | Fav |
| GY09 | Cloghboley A | U-B | U-I | U-B | U-B |
| GY16 | Caherateige | Fav | U-I | U-I | U-I |
| GY24 | Dawros More | Fav | Fav | Fav | Fav |
| GY30 | Lough Corrib | Fav | U-B | U-B | U-B |
| GY31 | Forest Pk Lavins Caravan | Fav | U-I | U-I | U-I |
| KY02 | Derrynane | Fav | U-B | U-B | U-B |
| MO02 | Aghinish | Fav | Fav | U-I | U-I |
| MO04 | Corraun/Clew | Fav | Fav | Fav | Fav |
| OY01 | Island Fen Birr | Fav | Fav | Fav | Fav |
| SO11/12 | Skerrydoo 4/2 | U-I | U-B | U-B | U-B |

### 3.6.2 Overall national conservation assessment

The assessments of the individual parameters were combined according to the evaluation matrix in Table 1 to obtain the overall national conservation assessment for 5130 habitat.

Following the guidelines for habitat assessment at a national level (DG Environment, 2017), based on the results presented here and taking into account the area of 5130 habitat with Favourable *Structure & functions* (Table 10 in section 3.3 above), the estimated future trends of the habitat's *Area* and *Structure & functions* based on the pressures and threats operating on the habitat and positive management and conservation measures in place, the national Overall Conservation Assessment result for the 5130 Juniper formations habitat is **Unfavourable-Inadequate** and the trend is **stable**. The following data detailed in this report were used to arrive at this result:

- minor area losses since the previous monitoring period, the biggest area loss deemed to be due to a once-off development in an area outside an SAC (see section 3.2);

- a large area (>90%) of surveyed 5130 achieving a Favourable *Structure & functions* assessment;
- relatively minor pressures occurring on the 5130 sites which do not generally appear to be impacting significantly on the habitat in the long term. The issues of grazing and erosion, however, will need to be monitored and, if necessary, addressed to ensure that this remains the case.

Table 16 summarises this result.

**Table 16** Summary of the national conservation assessment of 5130 Juniper formations, based on the results of the Juniper Monitoring Survey 2017.

| Parameter | Conservation status | Trend | *Future prospects* |
|---|---|---|---|
| *Area* | Unfavourable-Inadequate | Stable | Poor |
| *Structure & functions* | Favourable | Stable | Good |
| OVERALL NATIONAL CONSERVATION ASSESSMENT | Unfavourable-Inadequate | Stable | |

It should be noted that the current survey did not include an assessment of the *Range* parameter; therefore the assessment results for *Future prospects* and for the habitat overall are preliminary, pending an assessment of *Range*.

## 3.7 5130 Juniper formations inside and outside of the SAC network

In Ireland, any Annex I habitat that lies outside an SAC, or that occurs within an SAC but is not listed as a Qualifying Interest (QI) for that SAC, does not have the same level of legal protection as a habitat listed as a QI and occurring within an SAC.

Most of the 5130 Juniper formations surveyed in 2017 (97% of the area mapped, covering an area of 1,309 ha) occur within the SAC network. However, four sites lie completely outside the network: DL02 Fanad A, DL21 Malin, GY09 Cloghboley A and SO11/12 Skerrydoo 4/2. The combined area of these sites is 7.6 ha, just 0.6% of the surveyed area. Four sites lie partly within the SAC network: DL09 Dawros Head Complex, DL12 Cruit Island, DL15 Viking House and MO02 Aghinish. The area of these sites that lies outside of the SAC network amounts to 29.0 ha. In total, therefore, the area of the surveyed 5130 sites that lies outside of the SAC network is 36.6 ha.

Table 17 lists the sites surveyed in 2017, together with their status in relation to the SAC network. However, not all of these SACs list 5130 as a qualifying interest (QI). Of the 5130 habitat surveyed in 2017 that occurs within the SAC network, 1,233.1 ha (94.5%) of it is listed as a QI and is therefore accorded the highest level of legal protection. The 75.7 ha of 5130 that occurs within SACs that do not list 5130 as a QI have a certain amount of protection but less than if 5130 was listed as a QI. The remaining 38.9 ha that lies outside the SAC network has the lowest level of protection and is therefore at the highest risk of being subjected to damaging impacts.

**Table 17** Sites surveyed in the Juniper Monitoring Survey 2017 in the context of the SAC network. QI=Qualifying Interest.

| Site ID | Site name | % of site within SAC | SAC code | SAC name | 5130 listed as QI |
|---|---|---|---|---|---|
| CE21 | Rinecaha | 100 | 001926 | East Burren Complex | Y |
| CK04 | Cleanderry track | 100 | 001043 | Cleanderry Wood | N |
| CK07 | Cod's Head, Allihies | 100 | 002158 | Kenmare River | Y |
| DL02 | Binnion A | 100 | 002012 | North Inishowen Coast | N |
| DL05 | Fanad A | 0 | Not in SAC | n/a | n/a |
| DL09 | Dawros Head Complex | 95 | 000197 | West of Ardara/Maas Road | Y |
| DL12 | Cruit Island | 94 | 001141 | Gweedore Bay and Islands | Y |
| DL15 | Viking House | 11 | 001141 | Gweedore Bay and Islands | Y |
| DL21 | Malin | 0 | Not in SAC | n/a | n/a |
| DL30 | Ballynacarrick | 100 | 000115 | Ballintra | N |
| DL31 | Melmore Head | 100 | 000194 | Tranarossan and Melmore Lough | N |
| GY07 | Tirneevin | 100 | 000252 | Coole-Garryland Complex | Y |
| GY08 | Cappacasheen | 100 | 001926 | East Burren Complex | Y |
| GY09 | Cloghboley A | 0 | Not in SAC | n/a | n/a |
| GY16 | Caherateige | 100 | 002244 | Ardrahan Grassland | Y |
| GY24 | Dawros More | 100 | 002031 | The Twelve Bens/Garraun Complex | N |
| GY30 | Lough Corrib | 100 | 000297 | Lough Corrib | N |
| GY31 | Forest Pk Lavins Caravan | 100 | 002241 | Lough Derg, North-East Shore | Y |
| KY02 | Derrynane | 100 | 002158 | Kenmare River | Y |
| MO02 | Aghinish | 98 | 001774 | Lough Carra/Mask Complex | N |
| MO04 | Corraun/Clew | 100 | 000485 | Corraun Plateau | Y |
| OY01 | Island Fen Birr | 100 | 002236 | Island Fen | Y |
| SO11/12 | Skerrydoo 4/2 | 0 | Not in SAC* | n/a | n/a |
| All sites | Percentage within SAC network | **97** | | | |

* 000625 adjacent

# 4 Discussion

## 4.1 Conservation assessment of 5130 Juniper formations

### 4.1.1 Overall national conservation status of 5130

Based on the results of this survey, the overall national conservation status of 5130 Juniper formations is assessed as Unfavourable-Inadequate. The less than Favourable assessment overall is due mainly to a number of area losses that have occurred since the baseline survey. The fact that the site affected by road development, GY09 Cloghboley A, was outside an SAC was likely a contributory factor to Annex I 5130 habitat loss here, as appropriate assessments must now be conducted to ensure that no developments negatively impact on protected habitats and species within the Natura 2000 network, of which SACs form a part. However, protection for protected species and natural habitats is available even outside these areas through the Environmental Liability Regulations (SI 547 of 2008), which came into force in Ireland in 2009. These Regulations aim to prevent and remediate environmental damage by mandatory reporting of environmental damage which includes, among other things, damage to protected species and natural habitats (EPA, 2017). If this legislation is enforced, then such area losses should be curtailed or stopped in the future.

While there was no change in the overall national conservation status assessment of 5130 between this monitoring period and the last, there were changes in some of the individual parameters. The *Area* parameter, formerly assessed as Favourable, now receives an Unfavourable-Inadequate result and a decreasing trend, mainly due to area losses since the previous monitoring period. These losses can mainly be ascribed to once-off impacts from road construction. The *Structure & functions* parameter was assessed as Unfavourable-Inadequate in 2007-2012 but is now deemed to be Favourable; this change is largely due to use of a different method and a new set of criteria to assess the parameter. The result for the *Future prospects* parameter was Unfavourable-Inadequate, the same across both monitoring periods.

### 4.1.2 *Area*

The *Area* parameter was mostly favourable across all sites, with the exception of GY09 Cloghboley A, which suffered from area loss due to construction of a motorway. This is a rare occurrence and further losses at the site are not expected to occur in the foreseeable future. Loss in area was also a problem at SO11/12 Skerrydoo 4/2, where scrub removal occurred in the course of active agricultural improvement. Further losses at this site cannot be ruled out. Area losses due to non-anthropogenic factors were suffered by two sites which were subjected to prolonged flooding, one from a turlough (GY07 Tirneevin) and one from a lake (GY30 Lough Corrib). Further area losses from flooding cannot be ruled out at these sites either; however, as this impact is a natural phenomenon which has doubtless occurred several times in the decades over which these Juniper formations have become established, they have not been deemed relevant in assessment of the *Area* parameter, which is concerned with anthropogenic losses.

### 4.1.3 *Structure & functions*

A 5130 Juniper formation in Favourable condition is characterised by having a good proportion of fruiting female bushes, evidence of successful seedling recruitment, or suitable conditions for seedlings to establish (e.g. patches of bare ground or grikes in limestone rock), and generally healthy bushes with few dead or browning individuals and little or no damage from grazing and browsing animals. The habitat should retain any features of local distinctiveness recorded in a previous monitoring period (e.g. presence of Juniper shield bug) and should not be subject to high-intensity

damaging impacts such as overgrazing, impacts from non-native invasive species, or succession to another habitat such as overtopping scrub. On this basis, the *Structure & functions* of the habitat were generally Favourable, with the area in good condition overall estimated by adding up the area of sites that received a Favourable result for their *Structure & functions* assessment. A total of 92% of the area of the habitat was deemed to be in good (Favourable) condition.

The main reason that sites failed the *Structure & functions* assessment in the previous period was poor recruitment (low numbers of seedlings). In this reporting period, account has been taken of the fact that Juniper seedling recruitment occurs at a slow rate. While seedling recruitment was also low in this reporting period, the criterion was allowed to pass at sites where microsites existed for germination (e.g. on bare soil or peat). The rate of Juniper reproduction is not constant, with the most extensive and successful populations of Juniper occurring where there have been short periods of intense disturbance interspersed with little or no disturbance and low grazing and browsing pressure (JNCC, 2009). Therefore a more long-term view over several decades may need to be taken when assessing regeneration in 5130 Juniper formations.

Some issues identified in the previous reporting period (e.g. sheep overgrazing) do not appear to be a continuing problem in this reporting period; however, other sites which achieved excellent conservation ratings in the previous period appear to have declined in condition, due to factors such as erosion (perhaps caused by overgrazing or burning) and Juniper scrub removal. Because these changes in condition appear to balance each other out, and because of the change in methodology between the two reporting periods in assessing the status of *Structure & functions*, the short-term trend of habitat area in good condition is taken to be stable.

The largest sites surveyed in 2017, such as GY08 Cappacasheen, DL09 Dawros Head Complex and MO02 Corraun/Clew, showed few problems; management (if any) was judged to be appropriate, usually by means of grazing, and the density of Juniper plants within these formations was frequently the highest of all those surveyed in 2017. MO02 Corraun/Clew in particular had substantial areas of almost continuous Juniper, and the number of plants may well have been underestimated. The exception in terms of plant density was GY08 Cappacasheen. This site, because of its situation in a limestone pavement area interspersed with dry heath, displayed two Juniper densities: formations directly on limestone pavement were less dense, with a density at or around the minimum of 25 plants per hectare, while formations in heath achieved a much higher density, in excess of 800 Juniper plants per hectare. Regardless of the low density areas, the site was seen as an excellent example of the habitat, the condition of the site was assessed as Favourable, and its *Future prospects* were equally bright.

GY16 Caherateige, also a large site (74 ha), was generally in good condition but suffers slightly from unsuitable grazing, with both undergrazing and overgrazing seen in parts of the site, no seedlings recorded and bark stripping noted on shrubs in a number of monitoring stops, which gave the site an Unfavourable-Inadequate result for the *Structure & functions* and *Future prospects* assessments. These effects are partly balanced out by the fact that grazing serves to keep the area from becoming rank. As such, while some slight adjustment to grazing level or timing may be required to minimise damage to Juniper plants and to improve survival prospects for seedlings, management appears to be generally appropriate in that the population of Juniper here is strong and the majority of plants are healthy. Any adjustments to grazing should be such that they do not cause sward rankness to become a problem or impact on other Annex I habitats in the area – 4060 Alpine and Boreal Heaths is a qualifying interest for the SAC and was found in association with 5130 Juniper formations. Other solutions, such as protective cages for plants (see Wilkins & Duckworth, 2011), may be more appropriate here and could also address the problem of lack of regeneration.

Several of the smaller sites (<2 ha) received a poor *Structure & functions* assessment, and this can be ascribed mainly to a lack of germination niches. Sites such as DL21 Malin and KY02 Derrynane are less than 1 hectare in extent and are characterised by dense vegetation surrounding the Juniper formation. Undergrazing is a problem at these sites, and this has led to a build-up of leaf litter, rank

vegetation or scrub encroachment. The KY02 Derrynane formation in particular is comprised of some very large Juniper shrubs, probably all of a similar age, intermeshed with each other and able to extend and grow undisturbed by human activities. However, the density of the Juniper plants in the formation itself, and the thickness of the grassy sward adjacent to the formation, allow no opportunities for new Juniper seedlings to become established. This opens up the possibility that this even-aged formation may die off through lack of regeneration. The small formation size also means that there is a smaller edge around which seedlings could establish, if niches were available, and the formation itself is vulnerable to individual shrub losses that could downgrade it from a formation to a non-formation (<50 shrubs). It may be worthwhile trialling small-scale clearance of dense grasses at the edge of the formation to see if seedlings will establish. Hand planting of Juniper seeds or seedlings established from berries taken from within the formation or nearby populations may also be beneficial, and the use of frames to protect developing seedlings, as described by Wilkins & Duckworth (2011), may also be warranted. As this site is the only stand of 5130 Juniper formations currently recorded within this 10km square, it is a key site that needs to be monitored and maintained to prevent a contraction of range of 5130.

CK07 Cod's Head Allihies was deemed to be in Unfavourable condition because of its lack of reproducing females and seedlings. Some signs of old burning were also observed, and Juniper is acknowledged to be highly sensitive to burning. In many other respects this formation appeared to be in good condition, with a satisfactory density of healthy Juniper shrubs maintained throughout. No seedlings were found, but sufficient bare ground for germination to occur was present. Negative species were not a particular problem and grazing seemed to be appropriate for the habitat. However, no females with galbulae were counted during the 50-plant tally, and only one was recorded across all four monitoring plots. The site is grazed by cattle, horses, sheep and hares (although not all four necessarily occur together), and it is possible that the berries may have been removed by grazers from female plants, which Thomas *et al*. (2007) noted may be grazed in preference to males in winter. Protective structures for seedlings, as mentioned above for GY16 Caherateige, could prove equally useful here.

### 4.1.4 Impacts/Activities and *Future prospects*

Serious adverse impacts were relatively rare in the sites surveyed, although overgrazing and erosion were recorded at some locations. Most sites were grazed to some extent. Grazing is beneficial in that it prevents vegetation from becoming too closed or rank, introduces bare patches which can act as germination niches for Juniper seeds, and prevents dense growth of other shrub species such as *Corylus avellana* and *Ulex* spp., which could otherwise out-compete Juniper for the same niche. Undergrazed sites run the risk of providing no germination niches for Juniper seeds, which usually require bare soil and a certain amount of light to germinate and grow, at least for a number of years.

The issue of grazing is complex. While an appropriate amount of grazing is acknowledged to be beneficial, too much grazing can be detrimental to Juniper by causing trampling of adult plants and seedlings, or browsing shoots or saplings. The findings from this survey suggest that overgrazing of Juniper is not a serious problem for 5130 Juniper formations habitat, at least not in the short term. Browsing of Juniper shrubs by grazers was either low or absent. Trampling was noted at some grazed sites, and the frequency and size of Juniper shrubs in a more heavily grazed area of one site (DL31 Melmore Head) did appear to be slightly reduced compared to adjacent less grazed areas; overall, however, the 5130 habitat at DL31 covered a reasonable area, cattle grazing was non-intensive, and no shrub mortality was seen. It should be noted, however, that the condition of the associated heath habitats was not assessed during this survey and their assessment results could be less favourable, particularly if peat erosion is occurring.

Erosion can occur as the result of overgrazing, or as a result of natural causes such as excessive rainfall, drying out or exposure. The short- and medium-term effects of erosion on 5130 Juniper formations were difficult to assess on a single visit to a site. It is unclear from recent surveys whether

erosion is beneficial to Juniper formations, by creating bare patches and reducing competition from other species, or negative, stressing the Juniper to the point where it barely survives. In most cases erosion was scored as a neutral rather than a negative impact, due to the fact that Juniper tended to be frequent on the exposed rocky outcrops prevalent in such eroded sites. Juniper formations surveyed in 2017 were seen to persist even in the presence of severe erosion, and Juniper density was often found to be highest in areas where outcropping rock was freely interspersed through bare peat or heathy vegetation, such as on MO04 Corraun/Clew. Even in these stressful situations, however, the fruiting female:male ratio remained satisfactory. In contrast, sites which were characterised by intact dwarf-shrub layers (e.g. *Empetrum nigrum*, *Ulex gallii* and *Calluna vulgaris*) were found to be the least likely to harbour Juniper plants. Much of the southwest corner of DL12 Cruit Island, for example, was covered by swathes of intact *Empetrum nigrum* heath but was completely devoid of 5130 Juniper formations. The points noted above with regard to grazing also apply to erosion. Other habitats often occur in association with 5130 Juniper formations, and because many of these are also Annex I (e.g. 4030 Dry heath, 4060 Alpine and Boreal heath and 6210 Calcareous grassland), their needs and condition must also be considered when planning any conservation management. A coordinated approach needs to be adopted with regard to the management and conservation of 5130 Juniper formations where they occur with other Annex I habitats, to ensure that the requirements of all habitats are taken into account. Where possible, management plans for SACs and other areas of conservation interest should be drawn up.

Road and housing construction remains a threat to 5130 Juniper formation but proper enforcement of planning policies – for example, conducting appropriate assessments of Annex I habitats in the start-up phases of construction projects – should benefit 5130, particularly in SACs. This measure is less useful for 5130 sites that lie outside the SAC network as they are not protected to the same degree as areas within the network. It is important that any laws or regulations that safeguard 5130 be implemented and enforced, as a failure to enforce legislation is the equivalent of having no legislation in place. As a general rule and wherever possible, construction of houses and road developments should be confined to non-Annex habitats and appropriate assessments need to be carried out by competent ecologists as required.

Periodic flooding from turloughs or lakes (which led to the death of Juniper shrubs and some area loss) was listed as an impact. However, it is difficult to quantify the long-term effect of this occurrence as it is likely to be one that the Juniper habitat has had to adapt to over many decades. Further monitoring and research will be required to determine if such episodic occurrences are damaging or, in fact, ultimately beneficial by invigorating the formation through the creation of seed germination niches and thus promoting seedling recruitment.

## 4.2 Challenges during the survey

A number of challenges were presented by this survey. The first was the issue of what constitutes a single Juniper plant. Juniper is known to reproduce by layering in some situations (Thomas *et al*. 2007), so there is a possibility that some plants apparently separated from each other by some distance could in fact be genetically identical, or even still joined beneath the surface over which additional soil or peat accumulated over the years. Formations that occurred in dense vegetation, with little or no exposed rock or soil, presented greater difficulties in estimating numbers, particularly where the Juniper plants were themselves growing in a high density cluster, or where the plants were large and spreading – some plants reached a diameter of 6 metres. Tracing branches back to their origin in such habitats was difficult. In areas where there was much exposed soil or rock, the task was easier but still not always definitive. Therefore, while every effort was made to distinguish individual plants, it is inevitable that there will have been instances where the number of Juniper plants was either overestimated or underestimated.

Another variable that was difficult to estimate was the number of shrubs in the formation. In small formations this was less of a problem as an absolute count could be carried out (e.g. DL21 Malin, CK04 Cleanderry track). In larger sites, particularly where density varied across the site, population estimation was less straightforward. The area occupied by the 50 plants tallied at the start of each site survey was used to help estimate shrub numbers, although it is recognised that a single count would be unlikely to represent the density of the site as a whole. For some larger sites, more than one 50-plant tally was conducted in areas of different densities. In sites such as DL09 Dawros Head Complex and DL12 Cruit Island, where several formation polygons were mapped, separate counts had to be carried out for each polygon mapped to be certain that each polygon was a formation, and in some cases whole-polygon estimates were made even when the 50-plant count was exceeded.

Estimates of density were sometimes made during the site walk-over (e.g. a large area of MO04 Corraun was found to have one Juniper plant approximately every metre in one area, while the remainder was every 10-15 metres) and these figures were used to extrapolate an estimated population. The figures arrived at are only approximations, and so the use of population size classes, such as those suggested by Plantlife and used in this report in modified form (see section 2.3.1), are more appropriate to use when comparing between monitoring periods.

Plot data were generally not used for estimating the number of shrubs in the formation, as plots tended to be biased towards areas of higher plant numbers because of the need to feature Juniper in the plot. However, search intensity employed during the 50-plant tallies was less intensive than that used to carry out the counts in the monitoring plots and could therefore slightly underestimate shrub numbers. Thus, the more intensive searches within plots are likely to find more Juniper plants, especially smaller ones, than would be found if that area was within the area of the *ad hoc* tally. Overall, however, the figure derived for the number of shrubs should be sufficient to carry over for comparison in future monitoring periods, should these comparisons be deemed necessary.

Due to differences in methodology, no comparisons or assessment of trends could be made between the estimates for the number of Juniper plants made during the baseline and current monitoring periods. The differences were greatest over the larger sites, so they are likely to be caused by differences in how sub-sampled counts were extrapolated upwards to the site as a whole. Even in relatively small sites, though, the difference was significant. For example, for OY01 Island Fen Birr there was a five-fold discrepancy between counts across the two surveys. This site was considered relatively easy to count individuals in as the Juniper plants were mainly upright shrubs or trees, less intermeshed than the more prostrate form, although some intermingling did occur. In this site in 2017, 50 Juniper shrubs were counted within an area estimated to cover approximately one-fifth of the site, and the total for the site was extrapolated up to 250. This contrasts with the baseline survey's estimation of 50 plants in total.

For many of the larger sites it seems almost certain that the actual number of shrubs is greater than that estimated during the baseline survey. Even at the minimum density of 25 shrubs per hectare, sites such as GY08 Cappacasheen would have a minimum population of over 7,000 shrubs within the original area mapped during the baseline, higher than the 2,000 estimated during the baseline survey. Cappacasheen was the most consistent site surveyed in 2017 in terms of continuity of cover of 5130 Juniper formation. Very few areas were excluded on the basis of insufficient Juniper density, so the majority of the area mapped during the baseline as 5130 Juniper formations was retained and additional areas were included. Approximately half of the site – the half under limestone pavement – was found to support 5130 with the minimum density of Juniper plants, while the remaining half was comprised of 5130 with a medium to high density of Juniper plants, estimated on average at more than 800 plants per hectare, and in some cases at considerably higher than that.

Similarly, the 2017 mapped area of MO04 Corraun (393 ha, smaller than that mapped in the baseline) would have a minimum population of 9,825 Juniper plants at the minimum density. In practice, surveyors found that a large portion of the site had an exceptionally high density of Juniper plants,

with individual plants found approximately every 1-5 metres in places, giving a total shrub count well in excess of the 1,500 estimated in the baseline survey.

The issue of overlapping Annex I habitats also had to be considered during this survey. Large areas of 4060 Alpine and Boreal heath were recorded in association with 5130 Juniper formations at some sites, notably GY08 Cappacasheen, GY16 Caherateige and MO02 Corraun/Clew. The 5130 habitat occurred in intimate association with 4060, such that mapping the two habitats separately was impossible. Some practitioners, such as Perrin *et al*. (2014) and JNCC (2009), make a distinction, based partly on phenotypic properties, between Juniper stands found in the lowlands and those found in the uplands growing in association with upland heath habitats; the former stands, which may often include upright Juniper shrubs, are assigned to 5130 Juniper formations, while the latter (mostly comprised of prostrate Juniper) are assigned to 4060 Alpine and Boreal heath. However, prostrate forms of Juniper have been noted at sea-level in Ireland (Ward & Shellswell, 2017) and the evidence of this survey was that the majority of Juniper formations, both upland and lowland, were comprised of prostrate or semi-prostrate Juniper shrubs. Were this distinction to be adhered to for 5130 in Ireland, there would be only a small number of 5130 Juniper formations recorded in Ireland, perhaps only four or five, and the extensive areas of prostrate Juniper habitat that are not associated with another Annex I habitat would be accorded no protection or recognition at all. For this reason, and in consultation with NPWS, the decision was taken to map any areas that conformed to the 2017 definition of a Juniper formation, with regard to minimum Juniper shrub numbers and density, as 5130 Juniper formations, regardless of whether it occurred in an upland or lowland situation.

Areas of Annex I 8240 Limestone pavement that supported significant populations of Juniper, such as GY08 Cappacasheen, were also overlapped with mapped Annex I 5130 Juniper formations, although it is suggested in Ward & Shellswell (2017) that such a community would be referred only to Annex I 8240 Limestone pavements rather than 5130 Juniper formations in other EU countries.

# 5 Recommendations

## 5.1 Research into the effects of disturbance

Regarding the issue of serious disturbances, such as burning, inundation and erosion, it is difficult to ascertain whether these are ultimately beneficial or detrimental to the future long-term success of the habitat. This survey noted a very low incidence of Juniper where plants such as *Empetrum nigrum*, *Calluna vulgaris* and *Ulex gallii* formed a dense, intact layer, even when Juniper was present in the area. If it is assumed that the main reason for the absence of Juniper is the inability of Juniper seeds to germinate in these closed communities, then disturbance is likely to exercise a beneficial effect on the habitat by opening up patches of bare ground. Maintaining prolonged disturbance is not recommended, but indications in the literature are that the management of sites following removal of the cause of the disturbance is crucial to the establishment of Juniper. If, as seems probable, Juniper seedling production increases following these disturbances because of more germination niches, it is important that the habitat is managed in such as way as to allow the developing seedlings to survive and thrive. This could be achieved, for example, by the sensitive management of grazing levels to maintain a fine balance between the positive effects (e.g. keeping the sward open) and negative effects (e.g. trampling) of grazing. For example, grazing at a site such as GY07 Tirneevin, which was severely impacted by flooding but now has many suitable bare patches of ground for recolonisation, should be closely monitored to ensure that grazing is managed so that developing seedlings are given the best possible opportunity to develop into reproducing adults. Determining the point at which the balance between too much or too little disturbance is reached may require research into the most beneficial grazing animals, stocking rates and timing of grazing for 5130 Juniper formations. More constant (e.g. annual) monitoring of these managed areas may be needed to determine what methods work best. It is important to elucidate the long-term effects of these seemingly negative impacts on the overall health and persistence of 5130 Juniper formations.

## 5.2 Targeted remedial work

Small sites with few germination niches, particularly KY02 Derrynane and DL21 Malin, could be targeted for remedial work to clear small areas of tall vegetation, open up some bare ground in the sites and to plant seeds or seedlings of local provenance. KY02 lacks large numbers of fruiting females, but nearby KY01 Abbey Island, which is not currently a formation due to insufficient shrubs, could be used as a seed source. As KY02 is currently the only stand of 5130 Juniper formations recorded within this 10k square, it is imperative that it be monitored and any necessary steps taken to maintain it to prevent a contraction of range. KY01 also offers potential as a non-formation site that could be targeted for planting at its edges, as there are several small Juniper plants that are currently surviving (although undergoing stress) near a trampled path. KY01 is in danger of further reductions at the seaward side due to coastal erosion, but the boundary of the site could be extended upslope and appropriate fencing installed in the short to medium-term, with the landowner's permission and cooperation, to protect the developing plants and assist in their establishment.

Other conservation measures that are not currently being implemented, but whose implementation would improve the *Structure & functions* of the habitat generally, include the cessation of Juniper scrub removal (and reinstatement if necessary), the control or removal of non-native species, particularly invasive species such as Cotoneaster spp., and the cessation of burning, particularly in the vicinity of small Juniper formations. Restoration or assisted regeneration through the planting of seeds (preferably using clean seeds removed from berries of local provenance and protected from predation by small rodents; Thomas *et al*., 2007) or the establishment of cuttings could be beneficial for even-aged or ageing stands, but monitoring is essential to maximise success. Wilkins & Duckworth (2011) and McBride (2011) provide detailed guidance on maximising the success of Juniper restoration efforts

including enhancing the germination of Juniper seeds and the protection of developing plants, and are recommended reading for managers of 5130 Juniper formations habitat.

## 5.3 Refinements to the SAC network and qualifying interests

Some 5130 sites are within SACs which do not list 5130 as a qualifying interest (QI). These SACs should be examined with a view to including 5130 on their list of QIs, to accord the habitat the highest level of protection. Table 18 is modified from Table 15 to show only the sites that are within an SAC which does not list 5130. The site areas have also been included for reference. An additional 75.7 ha of 5130 habitat could be brought under full protection of EU law if these additions were to be made to the QIs of the seven SACs.

**Table 18** List of 5130 sites surveyed in 2017 located in SACs that do not currently list 5130 as a QI.

| Site ID | Site name | Area (ha) | % of site within SAC | SAC code | SAC name |
|---|---|---|---|---|---|
| CK04 | Cleanderry track | 0.07 | 100 | 001043 | Cleanderry Wood |
| DL02 | Binnion A | 1.3 | 100 | 002012 | North Inishowen Coast |
| DL30 | Ballynacarrick | 6.6 | 100 | 000115 | Ballintra |
| DL31 | Melmore Head | 4.5 | 100 | 000194 | Tranarossan and Melmore Lough |
| GY24 | Dawros More | 16.1 | 100 | 002031 | The Twelve Bens/Garraun Complex |
| GY30 | Lough Corrib | 9.2 | 100 | 000297 | Lough Corrib |
| MO02 | Aghinish | 38.7 | 98 | 001774 | Lough Carra/Mask Complex |
| Total area within SAC | | 75.7* | | | |

* Excludes the 0.75 ha of MO02 Aghinish that is located outside the SAC

## 5.4 Refinements to future assessment methodology

*Population estimates in the assessment of 5130 habitat:*

Because 5130 Juniper formations is an Annex I habitat rather than an Annex II species, and the extent of the habitat is of more relevance than the number of individual Juniper shrubs comprising that habitat, the population of the formation is not of direct importance for the site's assessment. The population figures derived are approximate at best, given the variation in density that occurs throughout even a medium-sized formation. Small shrub losses would be unlikely to be picked up by the population estimation methods used in either the baseline or 2017 survey. If any significant shrub losses were to occur, for example due to flooding or burning, these would be detected by the *Structure & functions* or *Area* assessments.

Therefore, it is proposed that the assessment of population numbers should generally be discontinued as part of the monitoring of the 5130 habitat. The exception to this is for smaller populations of fewer than 100 individuals. For these sites, all individuals should be counted as it is practical to do so and it is important to accurately monitor any changes in the number of individuals in these smaller formations, especially if the population numbers are decreasing.

*Definition of a Juniper seedling and recruitment target threshold:*

The target of one Juniper seedling per site may be seen as too lenient and future monitoring programmes may reset this threshold to a more stringent level. In part, this increased leniency was put in place to counteract a more restricted definition of what constituted a Juniper seedling, in the absence of definitive knowledge of its age. The definition of a Juniper seedling as being up to 25cm high with a stem less than 1cm wide, which was used as a guide for the Plantlife Scottish survey (Plantlife, 2013), was considered too broad for Juniper shrubs in Ireland as it would encompass prostrate or stunted forms that could be reproductively mature. The definition used by Cooper *et al*. (2012) in the baseline survey, which allowed for plants with stems up to 0.75cm, was also considered to be too broad for the same reason, as some plants with these dimensions were seen to be reproductively mature in 2017. It is therefore possible that the 2017 survey omitted juvenile plants that would have been counted as seedlings in the baseline survey, which would account for some of the differences in results seen – although it should be noted that even the occurrence of (presumed) juveniles was low. The dimensions and morphology of a typical Juniper seedling in Irish formations may therefore need some adjustment to capture the maximum number of new seedlings with the minimum amount of error. If necessary, the seedling criterion could be amended to include young reproducing plants with dimensions that fall within the definition of a seedling used by Cooper *et al*. (2012).

While the difficulties in gauging the age of Juniper plants were noted by Cooper *et al*. (2012) and seen during the current survey, the more general age-structure approach taken by JNCC (2009) in assessing upland Juniper heath and scrub could be followed. One of the JNCC's criteria is that the "cover of 'pioneer' bushes should exceed cover of old, 'ailing' or dead bushes". JNCC (2009) class Juniper plants as "pioneer" if they are less than 75cm tall (unless dead wood is also present) or when they are obviously seedlings or saplings, i.e. small, sparsely branched, without a fully developed canopy and with relatively vigorous growth. Old, "ailing" or dead bushes, according to the JNCC (2009) definition, may be undergoing loss of branches and/or foliage, may have a thin or incomplete canopy, or may be composed partly or entirely of dead wood. While the maximum pioneer bush height of 75cm might not be directly applicable to the more prostrate formations seen in this survey (several were below 50cm), it could perhaps be modified for Irish formations. It would also have to be determined whether such a criterion would be applied at a monitoring stop level or at a more general formation or site level.

*Number of monitoring stops:*

For sites with multiple formations, it may be deemed more appropriate to base the number of stops on the number of formations as well as, or instead of, the total area of 5130 habitat at the site. For example, DL09 Dawros Head had nine monitoring stops recorded but 27 formations were mapped there. Now that the formations have been accurately mapped and quantified, future monitoring surveys can, if necessary, consider the number of formations, as well as the area of 5130 habitat, at a site when deciding on the number of monitoring stops needed to assess the habitat adequately.

## 5.5 Other recommendations

Juniper was found at all but one of the surveyed sites, SO19 Ballinderreen. This site was visited in the baseline survey (Cooper *et al*., 2012) and a population of 100 shrubs was estimated for the site, although no monitoring data were recorded. Two subsequent visits during the 2015 NPWS survey did not find any Juniper plants. Surveyors for this project were similarly unsuccessful, despite searching both within and beyond the boundary mapped by the baseline. Their assessment of the site was that it was too wet (consisting of fen and flush habitat) to support Juniper and was unlikely ever to have supported a formation. A search through a list of Co. Sligo townlands did not find any townland called Ballinderreen; however, there is one Ballinderreen townland in Co. Galway which appears on the aerial photograph to contain habitat likely to support 5130; this area is also located close to an existing area of 5130 habitat (GY20 Cregballymore, surveyed by Cooper *et al*. (2012) and in 2015 by NPWS, but not surveyed in 2017). The outline of the SO19 polygon could be superimposed over part of Ballinderreen townland, Co. Galway to delimit an area of potential 5130 habitat. Therefore it is concluded that the GPS coordinates for SO19 Ballinderreen are inaccurate and that the polygon mapped does not coincide with 5130 habitat in this area of Co. Sligo. It is recommended that this site be removed from the monitoring programme and from all GIS shapefiles of 5130 habitat held by NPWS.

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