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Conservation assessment and monitoring methods for the Annex V Clubmoss group (*Lycopodium* spp.) in Ireland

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Cover photo: *Diphasiastrum alpinum*, Photo by N. Smyth, © NPWS

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Executive Summary

Clubmoss species are moss-like plants without flowers. Ireland is home to four members of the Clubmoss group (Lycopodiaceae): *Huperzia selago* (L.) Bernh. ex Schrank & Mart., *Diphasiastrum alpinum* (L.) Holub, *Lycopodium clavatum* L. and *Lycopodiella inundata* (L.) Holub.

All four species are listed as a group in Annex V of the European Union Habitats Directive (92/42/EEC). Annex V lists species whose taking in the wild may be subject to management measures. Under Article 11 of the Directive, each member state is obliged to undertake surveillance of the conservation status of the species in the Annexes and under Article 17, to report to the European Commission every six years on their status. The conservation status of a species is assessed under four parameters: Range, Population, Habitat for the species and Future prospects. This project investigated these four parameters for the four species in the group and devised methods and protocols for the next round of reporting 2012-2018 which is due in 2019.

The range and number of sites for *H. selago*, *L. clavatum*, *D. alpinum* and *L. inundata* is known to have declined in the historic past with many sites lost pre-1930 due to habitat destruction, agricultural improvement and drainage. In upland areas some sites were lost due to heather burning and overgrazing. The current range for *L. inundata, H. selago* and *L. clavatum* were found to be stable while the range for *D. alpinum* was found to have expanded slightly due to new record finds by the National Parks and Wildlife Service (NPWS) which are likely to have always existed and do not represent an expansion in the actual range.

From 2009-2014, population data for each species was sourced from the Herbarium at the National Botanic Gardens (DBN), National Parks and Wildlife Service unpublished records (NPWS), the Botanical Society of the Britain and Ireland (BSBI) records, and records published on the National Biodiversity Network Gateway (NBN).

Following scrutiny of the records the number of individual populations of each species was finalised at 17 for *L. inundata*; 38 for *L. clavatum*; 41 for *D. alpinum* and 579 for *H. selago*. The number of colonies (discreet separate individual patches within a population) was considered the most reliable indicator for estimating population size for future monitoring with 40 colonies of *L. inundata*; 56 colonies of *L. clavatum* and 96 colonies of *D. alpinum* estimated. For *H. selago* 4,343 colonies were estimated but the existing records are not

detailed enough to fully determine a true colony number so the unit used for the population assessment in this case was 10km^2 records with 178:10km^2 grid square recorded for the species consisting of 579 individual population records.

Vegetation and ecological data used to assess the habitat for each species were collected across the range of the group at 21 sites [12 populations of *Huperzia selago* (200 relevés); 4 populations for *Diphasiastrum alpinum* (46 relevés); 3 populations for *Lycopodium clavatum* (42 relevés) and at 2 populations for *Lycopodiella inundata* (10 relevés**).** A further 10 sites were searched i.e. 2 for *D. alpinum*, 4 for *L. clavatum* and 4 for *L. inundata* but the target species were not refound.

The results of multivariate analysis on the vegetation and ecological data collected indicate that all four species were ecologically distinct. *H. selago* was the most ecologically widespread of all the species, while *D. alpinum* and *L. clavatum* occupied very discrete and distinct ecological space within the overall scatter. *L. inundata* vegetation quadrats were also very different to those of *D. alpinum and L. clavatum.*

Significant factors affecting the populations of *H. selago* were found to be the cover of *Calluna vulgaris* and the cover of bare rock. *H. selago* occurs in higher densities where the vegetation cover is intact with less than 10% bare surface and *Calluna vulgaris* is a dominant feature of the vegetation occurring with a cover value up to 50%. Pressures and threats impacting *H. selago* were trampling and overuse and intensive grazing.

D. alpinum populations were also found where the cover of *Calluna vulgaris* had values to 50% with up to 10% bare surface/rock very similar to *H. selago*. Pressures and threats recorded at sites with *D. alpinum* were trampling, overgrazing but also dumping of sand and gravel at one site in Wicklow. *D. alpinum* was also not refound at two of its previously known sites.

With *L. clavatum* the converse occurs, where a lower cover of *Calluna vulgaris* (up to 10%) and a higher cover value for bare ground/rock (10-75%) occurred this proved favourable to higher cover densities for this species. In this case trampling may prove beneficial to the species. However, much more data needs to be collected for a more thorough assessment for this species as it was not refound at 4 of its previously known sites.

L. inundata, the rarest of the group, had two sites assessed for habitat. The cover of *Nardus strictus* and *Schoenus nigricans* of (25-75%) was found at sites it occupied along with bare

ground ranging from 10-75%. Mixed low density grazing was thought to favour its occurrences.

All species in the Clubmoss group were assessed as favourable for Range and Population. Due to the ongoing pressures (particularly inappropriate grazing regimes and trampling) on the habitats in which these species occur, Habitat for the species and Future Prospects for *D. alpinum, L. clavatum and H. selago* were assessed as inadequate. There was no evidence of the exploitation of any of these species for trade

This report presents national assessments for each species (Appendix 1), an assessment for each of the populations surveyed (21) (Appendix 2) and the recommendations for the future monitoring (Appendix 3).

Acknowledgements

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In memory of our co author and dear friend Dr Caoimhe Muldoon may she rest in peace

1. Introduction to the Clubmoss group

The Clubmoss group is an ancient group of plants that has an evolutionary line stretching back to the Devonian period. Tree-like forms of lycophytes were the dominant plants of the coal forming forests during the Carboniferous period. Lycopodiaceae itself consists of 10-15 genera with approximately 1000 living species (Raven *et al*. 2004) and their distribution extends from the Artic to the Tropics.

Ireland is home to four members of the Clubmoss family (Lycopodiaceae): *Huperzia selago* (L.) Bernh. ex Schrank & Mart., *Diphasiastrum alpinum* (L.) Holub, *Lycopodium clavatum* L. and *Lycopodiella inundata* (L.) Holub.

They are all moss-like plants in nature, but are much more robust in appearance. They have a typical two-stage lifecycle (diplohaplontic) with the sporophyte being the most dominant and obvious lifeform. Upon germination, the spores of *Lycopodiaceae* give rise to bisexual gametophytes which can be rather small (~10mm), green and irregularly shaped (*Lycopodiella*) or subterranean, non-photosynthetic and more mycorhizal like in nature (*Lycopodium, Huperzia, Diphasiastrum*). The development and maturation of archegonia and antheridia in gametophytes of *Lycopodiaceae* can take as long as six and up to 15 years. Water is a requirement for fertilization. The sporangia, which contain the spores, are borne either singly, in leaf axils or packed together in a strobilus or cone (Raven *et al.* 2004). A typified lifecycle for *Lycopodium* sp. and a photograph of *Lycopodium clavatum* in the field are illustrated (Figure 1a & b).

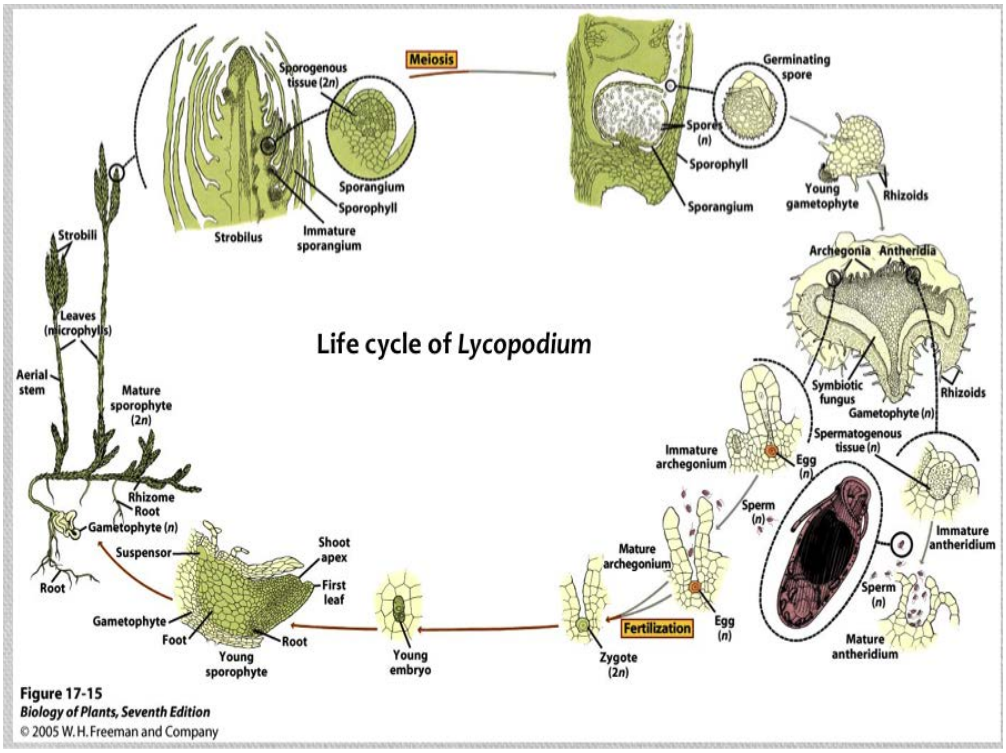


Figure 1a. The life cycle of a *Lycopodium* showing strobilus, spores and gametophyte generation. (Raven *et al.* 2004)

Figure 1b. *Lycopodium clavatum* showing strobilus photographed at Kippure Mountain, Co. Wicklow.

2. The Clubmoss Group (*Lycopodium* spp.) in Ireland

2.1 *Huperzia selago* FIR CLUBMOSS

Huperzia selago (L.) Bernh. ex Schrank & C.Martius All names: *Lycopodium selago* L. ; *Urostachys selago* (L.) Herter.

H. selago is a semi-decumbent evergreen perennial herb found on acidic, nutrient-poor, sandy or peaty soils in grassland, heathland, blanket bog, montane communities and, rarely in sand quarry tips (Figure 2).

In Ireland, *H. selago* has a very widespread distribution in upland areas (Parnell & Curtis 2012) and is found in all Irish vice counties (Scannell & Synnott 1987). Irish records for this species were obtained from the National Herbarium at Glasnevin (DBN), National Parks and Wildlife Service (NPWS) unpublished records, Botanical Society of Britain and Ireland (BSBI), published and unpublished reports and papers.

Most losses for this species were before 1930, which were due to habitat destruction, agricultural improvement and drainage. In the uplands, some sites have been lost to heather burning and overgrazing, but its current distribution is considered to be stable (Preston *et al.* 2002).

Figure 2. *Huperzia selago* (Fir Clubmoss) photographed on Muckish Mountain, Co. Donegal.

2.2 *Diphasiastrum alpinum* ALPINE CLUBMOSS

Diphasiastrum alpinum (L.) Holub All names: *Diphasiastrum complanatum ssp. alpinum* (L.) Jermy; *Diphasiastrum alpinum* (L.) Rothm.; *Lycopodium alpinum* (L.)

D. alpinum is an evergreen herb found in short acidic grassland, on mountains and moors, where it grows on moist but well-drained, thin peaty soils, especially those directly overlying rocks (Figure 3). Vegetative propagation is much more frequent than sexual reproduction. There has been little change in the distribution of this species in the uplands since the 1962 *Atlas* (Preston *et al.* 2002). Some of its lowland sites have been lost to agricultural improvement but mainly before 1930. *D. alpinum* has a more restricted distribution than *H. selago* across Ireland and it is absent from the midlands and is found in much fewer localities in the extreme North, South, East and West (Parnell & Curtis 2012). *D. alpinum* is listed as occurring in seven vice counties in the Republic of Ireland: West Galway [16], Wicklow [20], Dublin [21], West Mayo [27], Leitrim [29], Louth [31] and East Donegal [34] (Scannell & Synnott 1987). Irish records for this species were obtained from the National Herbarium at Glasnevin (DBN), National Parks and Wildlife Service (NPWS) unpublished records, Botanical Society of Britain and Ireland (BSBI), published and unpublished reports and papers. New Irish records for this species for Co. Waterford and Kerry have been found recently (Hodd & Roche *in press*, Roche 201; Roche & Perrin 2010).

Figure 3. *Diphasiastrum alpinum* (Alpine Clubmoss) photographed at Camaderry, Co. Wicklow

2.3 *Lycopodium clavatum* STAGS HORN CLUBMOSS.

Lycopodium clavatum L. All names: *Lepidotis clavata* (L.) P. Beauv.

L. clavatum is a prostrate, evergreen perennial herb of heaths, moors and mountains (Figure 4). It is often found on base-rich micaceous soils, but also occurs on more acidic *Calluna* heath and *Nardus* grassland. Propagation is mostly vegetative, but spores can colonise new sites, particularly the disturbed soil of roadside embankments and quarries.

L. clavatum is very scattered in much smaller occurrences than the previous two species (*H. selago* & *D. alpinum*) throughout Ireland in suitable upland habitat (Parnell & Curtis 2012). *L. clavatum* was listed as extant in eleven Irish vice counties with six of these in the Republic of Ireland: Dublin [21], Wicklow [20], Cavan [30], Louth [31] and East and West Donegal [34 & 35] (Scannell & Synnott, 1987). Irish records for this species were obtained from the National Herbarium at Glasnevin (DBN), National Parks and Wildlife Service (NPWS) unpublished records, Botanical Society of Britain and Ireland (BSBI), published and unpublished reports and papers.

Many lowland sites of *L. clavatum* were lost before 1930. Populations elsewhere are somewhat transient, with losses owing to overgrazing, heather burning, conversion to scrub and agricultural improvement being offset by the establishment of new populations (Preston *et al.* 2002).

Figure 4. *Lycopodium clavatum* (Stags horn Clubmoss) photographed at Cloghernagh Mountain, Co. Wicklow

2.4 *Lycopodiella inundata* MARSH CLUBMOSS

Lycopodiella inundata (L.) Holub All names: *Lepidotis inundata* (L.) P.Beauv.; *Lycopodium inundatum* L.; *Lycopodium inundatum* L.

L. inundata is a prostrate perennial herb of wet, bare, peaty or sandy margins of lakes, pools, flushes and trackways (Figure 5). It can rapidly colonise substrates kept open by winter inundation, cattle poaching or peat cutting and is found from 0-390 m. Many sites for *L. inundata* were lost before 1930, and losses have continued due to drainage, a lack of grazing, and conversion to scrub. However this species is easily overlooked and additional sites may be found.

L. inundata is the most restricted and rare of all the species in the group in Ireland. *L. inundata* is the only member of the group listed in National Legislation i.e. The Flora Protection Order 1999. The species was listed as occurring in six Irish vice counties with five of these in the Republic of Ireland: West Galway [16], Offaly [18], Wicklow [20], West Mayo [27] and West Donegal [35] (Scannell & Synnott 1987). Two former lowland midland populations were not refound during this survey work in Offaly [18] neither was it refound in Wicklow [20] or West Donegal [35]. Irish records for this species were obtained from the National Herbarium at Glasnevin (DBN), National Parks and Wildlife Service (NPWS) unpublished records, Botanical Society of Britain and Ireland (BSBI) published and unpublished reports and papers.

Figure 5. *Lycopodiella inundata* (Marsh Clubmoss) photographed at Cornamona, Co. Galway

3. Habitats of the Clubmoss Group in Ireland (*Lycopodium spp.*)

In Ireland the Clubmoss group occupies wet acidic lowland and upland sites and generally occurs in lake-margins, wet lowland and upland bogs, moorlands, heaths and mountains (Parnell & Curtis 2012).

The Irish habitat classification this group has the most affinity with is Montane Heath HH4 (Fossitt 2000). This habitat type has a high cover of dwarf shrubs and mosses and occurs at high altitudes on mountains or in very exposed locations in the uplands or the coast. In a recent survey of the uplands *D. alpinum* was found to be an obligate artic–alpine species in Ireland and occurs in what has been categorised as Montane blanket bog. Its sister species *H. selago* was defined as occurring in Montane Heath (Perrin *et al.* 2014).

This group of species occur in a variety of habitat types listed in Annex I of the Habitats Directive, e.g. alpine heath (EU 4060), wet heath (EU 4010), *Nardus* grassland (EU 6230) and blanket bog (EU 7130). The recent conservation status assessments for these habitat was Unfavourable bad (NPWS, 2013).

With the exception of *H. selago*, which is locally frequent, *D. alpinum*, *L. clavatum* and *L. inundata* are regarded as rare and declining species in Ireland (Parnell & Curtis 2012). These species were formerly more widespread throughout Britain and Ireland but their lowland ranges have been drastically reduced over the past decades due to habitat destruction and degradation of bogs, and over-collection for "miniature landscaping" of model railways and architecture models (Preston *et al.* 2002). However, a study commissioned in 2006 by the National Parks & Wildlife Service, Department of Environment, Heritage & Local Government, Ireland to investigate Wildlife trade in Ireland showed there was no evidence of collection of any species from this grouping for trade in Ireland (Ferriss *et al.* 2007).

4. Conservation obligations and project aims

All four species (*H. selago, L. clavatum, D. alpinum and L. inundata*) contained within the Clubmoss group in Ireland and are protected by international legislation. They are all currently listed in the checklist of protected and rare species in Ireland (Kingston 2012). *L. inundata* is the only member of the group listed in national legislation i.e. The Flora (Protection) Order 1999 and assessed as rare in Ireland (Curtis & McGough 1988). The Clubmoss group (*Lycopodium* spp.) species are listed in Annex V of the Habitats Directive which has been transposed to Irish Law Law (Statutory Instrument 477 of 2011 specifically Part VI- 52 Protection of Flora referred to in the First Schedule (First Schedule Part II-8 Ferns and Relatives).

The European Union Habitats Directive aims to maintain or restore at a favourable conservation status the habitats and species that are of Community importance (European Commission, 1992; Evans & Arvela, 2011). Article 17 of the Habitats Directive requires that each member state must report to the European Commission every six years on the conservation status of listed habitats and species (European Commission, 1992; Evans & Arvela, 2011). The guidelines for assessing and reporting on the conservation status of habitats and species were updated in 2011 (Evans & Arvela, 2011).

The conservation status of a species is defined as the sum of influences acting on a species that may affect its long term distribution and the abundance of its populations. Four criteria must be met for a population to be in a "Favourable" conservation status. These criteria are: Population, Range, Habitat for the species and Future prospects. Populations of Clubmoss group (*Lycopodium* spp.*)* were assessed at the national level using these four criteria with site data from 20 sites feeding into these assessments.

1. **Population** – the populations must be maintaining themselves on a long term basis and be a viable component of their natural habitat.
2. **Range**- the natural range of the species is not found to be declining nor is likely to decline in the foreseeable future. The range is considered the outer limit of the overall area in which a species is found. Not all the area within the total range will be actually occupied by the species. Normally calculated and mapped on a 10km^2 basis.

3. **Habitat for the species**– under consideration for this criteria the habitat must be sufficiently large enough and in good enough condition to maintain the species into the long-term future.
4. **Future prospects**- the prospects for the species survival at must be favourable with no significant threats or pressures.

The aims of this project were to:

- amalgamate all records for all the species from all sources and to develop the national assessments for each species (Appendix 1).
- use a sub-sample of twenty of these records across the distributional range from which ecological and population baseline data was gathered to assess the conservation status at population level for each species (Appendix 2).
- analyse data collected to develop a recording and monitoring card with protocols for a future assessment framework (Appendix 3).

Conservation status assessments submitted in 2007 and 2013 were at the group level for these species as instructed by the assessment guidelines (Evans & Arvela, 2011). Exceptions can be made for individual species with a group where it is thought that a species may require special attention. One of the objectives of this survey was to assess the species individually to determine whether special attention, if any, would be required for any of the species in the group.

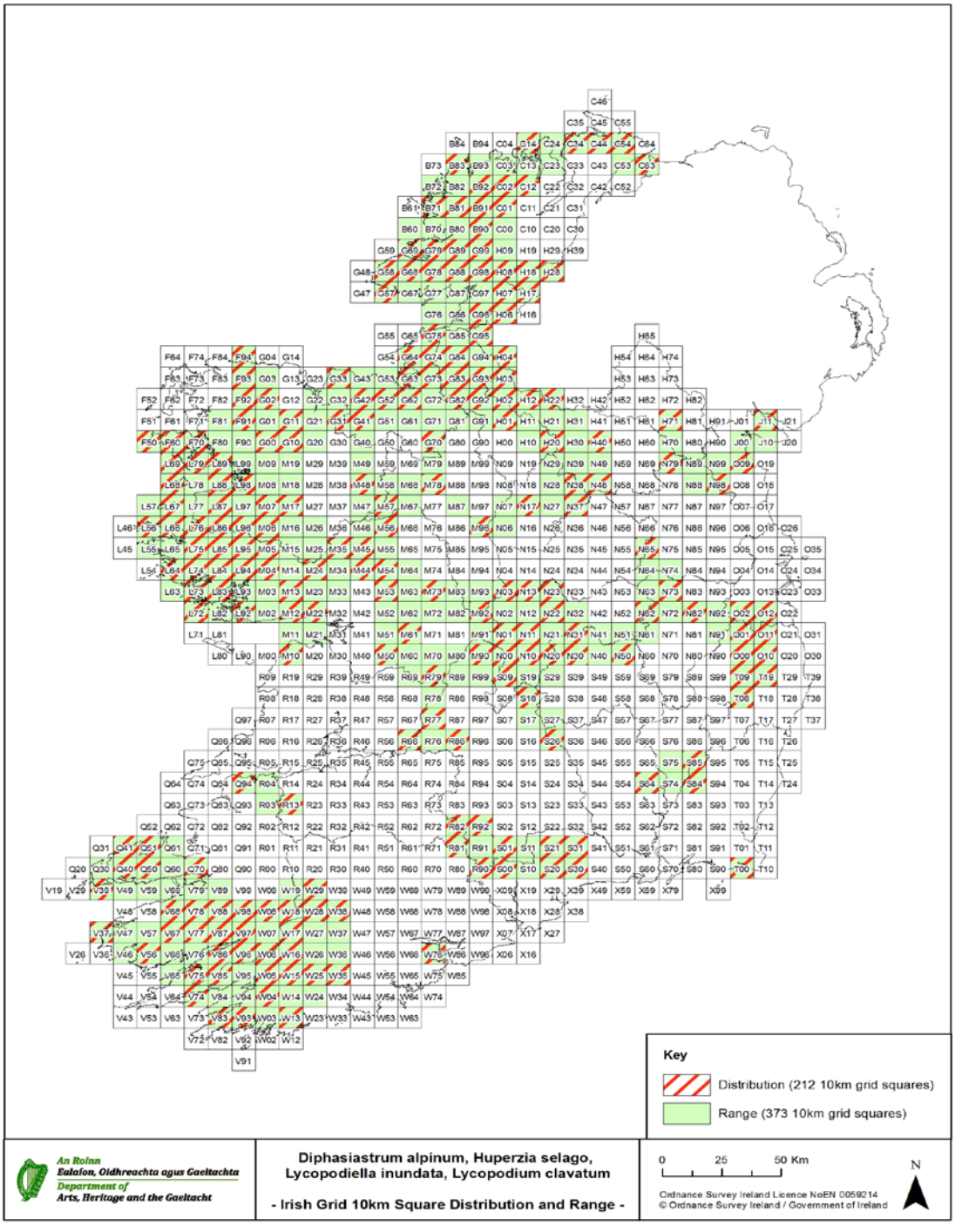
5. Monitoring methods and results

5.1 Range Assessment

Distribution records were sourced for all the species in this group (*H. selago, L. clavatum, D. alpinum & L. inundata*) for Ireland. These were obtained from the National Herbarium at Glasnevin (DBN), National Parks and Wildlife Service (NPWS) unpublished records, Botanical Society of Britain and Ireland (BSBI), published and unpublished reports and papers. Additional records incidental to habitat and other surveys (Hodd & Roche *in press*, Roche 2011 and Roche & Perrin 2010) along with records from the literature (Brodie & Sheehy Skeffington 1990, Conaghan 2006, Curtis & Wilson 2010, Doyle *et al.* 2010, McClintock *et al.* 1974, Nash 1993, O'Connell & Sheehy Skeffington 1985, O'Reilly 1976, Reynolds 2005, Scannell 1993, Stelfox 1952, Winder 2001 and Winder 1995) were sourced. Only post 1969 records were used for *L. inundata, L. clavatum* and *D. alpinum.* All known records for *H. selago* were used as upland areas, though heavily grazed, still have extensive niche habitat available for the species and have changed little since the first records for *H. selago* were published in the 1800's. A summary of the number of records and the number of 10km grid squares mapped for each species is presented in Table 1. The Range envelope encompassing the distribution is illustrated in Map 1. Individual species range maps are presented with the national conservation assessments in Appendix 1. These combined records give a current distribution for the Clubmoss group i.e. all four species (*H. selago, L. clavatum, D. alpinum* and *L. inundata*) of 212: 10km grid squares or 2120 km^2 and a range of 373**:** 10km grid squares or 3730 km^2. These records increase the number of 10km grid squares by 53 since the last reporting period in 2007. This increase is due to improved knowledge rather than a genuine range expansion.

Table 1. Summary of 10km records found for each species and total number of 10 km grid square per species mapped for distribution and range in Map 1.

Clubmoss species	Records (10km²)	Range (10km²)
H. selago	178	302
D. alpinum	22	27
L. clavatum	31	43
L. inundata	15	25



Map 1. Range and distribution of the *Clubmoss group* in Ireland

5.2 Population Assessment

The most suitable unit for measuring the population for this group of species was considered to be the colony, which was defined as a discrete (i.e. unconnected) "patch" as three of the species (*L. clavatum, D. alpinum* and *L. inundata*) are rhizomatous and stoloniferous nature which makes identification of an individual in the field difficult. The only species in the group which grows as single multistemmed tufts is *H. selago.* As the amount of population information for this species was scant the number of 10km^2 records was used as a proxy for population size in this case.

The use of category classes for shoot numbers is also very useful for monitoring purposes and a colony or population should also not lower its size class from one recording and monitoring period to the next (Table 2 Evans & Arvela 2011).

Table 2. Classes for reporting population size (Evans & Arvela 2011)

Class	Population
1	0-50
2	50-100
3	100-500
4	500-1000
5	1000-5000
6	5000-10000
7	10000-50000
8	50000-100000
9	100000-500000
10	500000-1000000

The national population assessment for the Clubmoss species *L. inundata*, *L. clavatum* and *D. alpinum* also used number of individual population records, as a the population measure (Table 3) but given the scant amount of information available for *H. selago* the number of 10km^2 grid squares was the most accurate assessment method for population size (see Appendix 1).

Table 3 Population measures for the Clubmoss species *L .inundata, L. clavatum* and *D. alpinum* in Ireland

Clubmoss species	Population number	Colony number	Average size class / population
D. alpinum	41	96	3
L. clavatum	38	56	4
L. inundata	17	40	1

At the population level for each species at each of the 20 sites monitored a total of five different indicators of population size and fertility were used:

1. The number of discrete colonies present at a site were counted and a minimum of one relevé recorded for each colony.

2. The maximum population area was marked out using bamboo canes and measured with tape (m^2).

3. The Domin cover (Table 4) of the target species (*D. alpinum, H. selago, L. clavatum and L. inundata* was recorded in each quadrat (1 m^2) and these were averaged per population at a specific site.

Table 4. Domin cover class with percentage values (Kent 2012) and equivalent percentage conversion (Currall 1987) for use in data analysis

Domin cover class	Percentage within Domin class	Conversion to percent (Currall, 1987)
10	91 – 100	**99.5**
9	76 – 90	**75.7**
8	51 – 75	**55.7**
7	34 – 50	**39.4**
6	26 – 33	**26.4**
5	11 – 25	**16.4**
4	4 – 10	**9.2**
3	< 4 % with many individuals	**4.3**
2	< 4 % with several individuals	**1.5**
1	< 4% with few individuals	**0.3**
+	one individual	

4. The number of shoots per colony was counted as far as 50, and thereafter abundance categories following a broken logarithmic scale as recommended by Evans & Arvela 2011 (Table 2).

5. The number of fertile cones in each 1 m^2 was recorded (maximum of 10:1x1m^2 per population

The Population attribute at site level for each species was assessed using the criteria in Table 5. (see Appendix 2 for individual species assessments at individual sites).

Table 5 Population Assessment indicators and targets for populations where individual species for the Clubmoss group with example data *from L. inundata* , Clare Island Co. Mayo.

Indicator	**Target**	***L. inundata* Clare Island Baseline target**	***L. inundata* Clare Island Result**	***L. inundata* Clare Island Pass/Fail**
Total colony number	No loss of colonies	≥ 2	2	**Pass**
Population size (combined area of occupancy of colonies)	No reduction in population size	54m^2	54m^2	**Pass**
Total Domin cover area of target species (*L. inundata*) in m^2	No decrease in target species cover	≥Cover value of 6 (26-33%)	6 (26-33%)	**Pass**
Population size class	No reduction. If there is a reduction in shoot numbers with no obvious pressure attributable to loss, the result is a pass,	≥ 3	3 (100-500)	**Pass**
Fertile cones present	Fertile cones present	Fertile cones present	Fertile shoots found at colonies	**Pass**
Conservation Assessment	**Favourable (Green): 4-5 passes** **Unfavourable-Inadequate (Amber): 2-3 passes** **Unfavourable-bad (Red): 0-1 pass**			**Pass**

The individual population condition is considered favourable (green) if five of population assessment criteria are passed, unfavourable inadequate (amber) if only 2-3 of the population assessment criteria are passed and unfavourable bad (red) if none or only one of the criteria is passed. In this example case of *L. inundata* at Clare Island, Co. Mayo (Table 5) all five criteria for population assessment were passed and the population of *L. inundata* at this site on Clare Island is considered to be considered in favourable population conservation status. The values can be considered as a reference baseline if there are no obvious pressures considered to be currently impacting the Population measure. These data can be repeatedly measured into the future to ascertain whether the population at this site is stable, increasing or decreasing. Ideally no decrease from this baseline should occur at any of the Clubmoss

species sites assessed. However, expert judgment can be used to apply an appropriate margin of error to changes from the baseline data that are considered to be due to human derived variation (e.g. an error margin of 10%).

5.3 Habitat for the species Assessment

In Ireland, the Clubmoss group occupies a wide variety of wet acidic lowland and upland sites ranging from wet lowland and upland bogs, moorlands, heaths and mountains (Parnell & Curtis 2012; Preston *et al.* 2002). As these are such a broad selection of habitat types a random selection of sites for each species were chosen to encompass the range and distribution of the group in Ireland for monitoring purposes from the known records.

A total of 21 different populations were monitored during the project period 2009-2014. Baseline data was recorded from 12 sites with *H. selago,* three sites with *L. clavatum,* four sites with *D. alpinum* and two sites with *L. inundata.* Monitoring quadrats were randomly selected within each colony at each population to a maximum of ten per site, where population size permitted.

Two different sized quadrats were used: 1x1m and 25x25cm. The GPS location of each quadrat was recorded to an accuracy of ±3m using a handheld GPS (Garmin) set to the Irish Grid. The Domin cover (Table 4) of the target species was recorded along with all other plant species found associated. Species that could not be identified in the field were collected and identified under a binocular microscope (Optika SZM-2) using the required flora (Parnell & Curtis 2012, Stace, 2010, Atherton *et al*. 2010 and Smith, 2004). Scientific names of bryophytes follow Hill *et al*. (2008) and names of vascular plants follow Stace (2010). Total Domin cover of vegetation within a quadrat, along with vegetation category e.g. bryophytes, grasses, and lichen were recorded and also Domin cover values for bare rock, bare ground, dung and peat.

The mean maximum vegetation height in cm was recorded as a proxy for grazing pressure at a site. The slope of each quadrat was recorded using a clinometer and the aspect using a compass. The main vegetation type, land tenure and protection status were also recorded where possible.

Assignment of Ellenburg values for each quadrat was carried out in MAVIS (Modular Analysis of Vegetative Information System) Plot analyser Version 1.0 (Smart 2000) after Domin scale values for species recorded were converted to percentage (Currall, 1987) (Table

4) and entered into MAVIS. Derived values were obtained for fertility, light, wetness and pH and these were subsequently used in the analysis.

All data recorded on a monitoring field sheet (Appendix 3) were entered into Microsoft Excel and arranged into the required formats for analysis in software programmes PC-ORD Version 6 (MjM Software, Oregan). Outlier analysis using Sørenson distance measure and a cut of 2-standard deviations from the mean was carried out. Vegetation classification techniques of Ordination Non-Metric Multidimensional Scaling (NMS) with Sørenson distance measure (settings of slow and through) were carried out in PC-ORD 6.

Analysis of the 1x1m quadrats provided the most ecologically meaningful data for the Clubmoss group. A total of 131 quadrats were included in the final analysis: 88 quadrats with *H. selago*, 17 with *D. alpinum*, 21 with *L. clavatum* and five with *L. inundata*.

As anticipated, *H. selago* occurred as the most widespread and ecologically variable of the four species encompassing the same ordination space as all the other species bar the majority *of L. clavatum* relevés and relevés with *L. inundata*. However, it must be borne in mind that over 67% of the data was obtained from *H. selago* relevés.

The final stress for a 3-dimensional solution was 12.52 with a final instability of 0.00073 and 200 iterations. A Monto Carlo test demonstrated that stress (Legendre & Legendre 1998) in the preliminary runs was significantly (P=0.0196) lower than would be expected by chance (Table 6). The best 3-dimensional solution from the runs was used as the starting position for the final ordination (Figure 6).

Table 6 Stress and "p" values for NMS of 4 dimensions for the dataset of DOMIN species values for 131 quadrats for the Clubmoss Group in Ireland.

Stress in real data (50 runs)				**Stress in randomised data Monto Carlo test, 50 runs**			
Axes	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**p**
1	36.350	49.137	57.380	45.067	51.673	57.293	**0.0196**
2	20.202	23.267	41.522	25.288	27.493	29.819	**0.0196**
3	12.515	16.675	33.074	17.485	18.717	20.073	**0.0196**
4	9.252	12.055	27.361	12.845	13.897	26.698	**0.0196**

p = proportion of randomised runs with stress < or = observed stress
i.e., p = (1 + no. permutations <= observed)/(1 + no. permutations)

The percentage represented by each axis based on the r^2 between distance in the ordination space and the distance in the original spaces was 36.35% for Axis 1, 20.20% for Axis 2 and 12.51% for Axis 3. Environmental variables in the second matrix were overlain on the ordination graph (Figure 6). The position of the plots in the ordination space reflects the results of the positioning of relevés with regard to their similarities or differences in ordination space for the different species.

When all four species were analysed (NMS) (Figure 6) *Huperzia selago* was the most generalist of the Clubmoss group (*Lycopodiaceae* spp.) it encompasses the ordination space of all other species but mostly very distinct from *Lycopodiella inundata*.

Within the data analysed both *Diphasiastrum alpinum* and *Lycopodium clavatum* were found to occupy very discrete ecological envelopes of space from each other *D. alpinum* and the high cover of *Calluna vulgaris* were intricately linked. Sites with high percentage cover of *C. vulgaris* also favoured *D. alpinum* and *D. alpinum* often is found sprawling through *C. vulgaris*. The mountain mosses (*Racomitrium spp* and *Polytrichum spp*.) and high total grass cover were indicative of *L. clavatum* sites. Very few quadrats had very a high cover of bare rock. *L inundata* sites are very distinct from the other members in the group occupying mostly lowland wet heath.

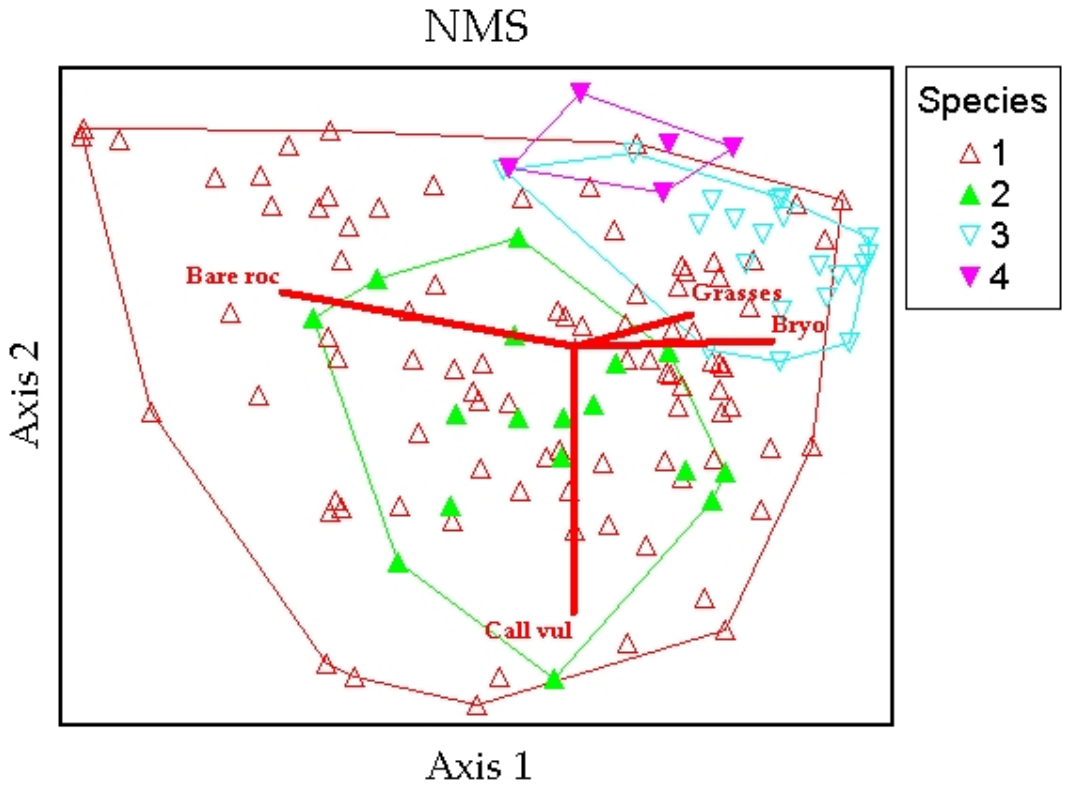


Figure 6. Clubmoss group NMS Ordination*: Species 1 = Huperzia selago-Red open Δ; Species 2 = Diphasiastrum alpinum-Green filled Δ; Species 3 = Lycopodium clavatum -Blue open ∇ ; Species 4 = Lycopodiella inundata -Purple filled ∇*

5.3.1 *Habitat for the Species-*Huperzia selago *FIR CLUBMOSS*

Huperzia selago is very generalist in its vegetation associations in upland areas. It was found in both short sheep-grazed alpine grassland and rough tall (>30cm) *Calluna vulgaris* alpine heath. The plant was found to be fertile and sporing in both short grazed and ungrazed habitats. Where vegetation is tall (>15cm*) H. selago* also grows tall and where vegetation is grazed and short (<10cm) *H. selago* also is short. Unlike its sister species *Diphasiastrum alpinum* and *Lycopodium clavatum* it does not associate or favour bare ground in the majority of sites where it was recorded.

Table 7 *Huperzia selago* species associations - species frequently and significantly associated, with positive and negatively associated species and environmental variables on Axis 1, 2, and 3

Huperzia selago
Associated species found in *H. selago* quadrats - *Calluna vulgaris, Erica cinerea, Potentilla erecta, Narthecium ossifragum, Empetrum nigrum, Hypnum jutlandicum, Polytrichum alpinum, Racomitrium lanuginosum, Thuidium tamariscinum, Agrostris tenuis*
Positively correlated species and environmental variables
Calluna vulgaris
Total Bryophytes
Total Grass
Negatively correlated environmental variables
Bare rock

(significant at p=0.05 for Pearson product moment correlation n=131, df =129, p0.05 ≥0.195)

The results of the NMS analysis and expert judgment were used to formulate the Habitat Assessment for sites with *H. selago* (Table 8). The indicators used were vegetation height (a proxy for grazing pressure at the habitat), the cover of *Calluna vulgaris* with values in the range of Domin 5-7 (or 11-50%) *C. vulgaris* is a positive indicator species for *H. selago*. The total vegetation cover found at *H. selago* sites ranged from Domin 8-10 (51-100%). *H. selago* was found to be more abundant in sites with intact vegetation cover and low percentage cover of bare ground and bare rock Domin 0-4 (0-10%). This Habitat Assessment would be applicable for any habitat where *H. selago* occurs.

Table 8 Habitat Assessment indicators and targets for populations where *Huperzia selago* occurs with example data *from H. selago* at Camaderry, Co. Wicklow.

HABITAT ASSESSMENT *Huperzia selago* at Camaderry Co. Wicklow			
Indicator	**Target**	**Result**	**Pass/Fail**
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	>3cm	9	**Pass**
Domin scale cover of *Calluna vulgaris*	5-7 (between 11-50%)	7	**Pass**
Domin cover bare rock	≤ 4(4 – 10%)	0	**Pass**
Total vegetation cover	8-10 (51-100%)	9	**Pass**
Conservation Assessment	**Favourable (Green): 4 passes** **Unfavourable-Inadequate (Amber): 2-3 passes** **Unfavourable-bad (Red): 0-1 pass**		**Favourable**

5.3.2 Habitat for the Species - Diphasiastrum alpinum *ALPINE CLUBMOSS*

Diphasiastrum alpinum was found to occupy part of the same ordination space (Figure 6) as *Huperzia selago* though much more restricted than *Huperzia selago* but also very distinct from *Lycopodium clavatum* and *Lycopodiella inundata*. *Diphasiastrum alpinum* is considered specialist in its vegetation associations in alpine areas and it is listed as one of the key species in Alpine heath habitat (EU 4060).

It was found mainly associated with *Calluna vulgaris* and bare rock (Table 9). In tall (>30cm) *Calluna vulgaris* alpine heath it was found to sprawl though the stems of *Calluna vulgaris*. The plant was found to be fertile and sporing.

Table 9 *Diphasiastrum alpinum* species associations - species frequently and significantly associated, with positive and negatively associated species and environmental variables on Axis 1, 2, and 3

Diphasiastrum alpinum
Associated species found in *D. alpinum* quadrats - *Calluna vulgaris, Huperzia selago, Potentilla erecta, Hypnum jutlandicum, Polytrichum alpinum, Racomitrium lanuginosum, Hylocomnium amoricum & Cladonia spp.*
Positively correlated species and environmental variables
Calluna vulgaris
Bare rock
Negatively correlated environmental variables
Total Grass

(significant at p=0.05 for Pearson product moment correlation n=131, df = 129 , p0.05 ≥0.195).

The results of the NMS analysis and expert judgment were then used to formulate the Habitat Assessment for sites with *D. alpinum* (Table 10). These indicators were the same as those used for *H. selago* (Table 8).

Table 10 Habitat Assessment indicators and targets for populations where *Diphasiastrum alpinum* occurs with example data *from D. alpinum* at Camaderry, Co. Wicklow

HABITAT ASSESSMENT *Diphasiastrum alpinum* at Camaderry, Co. Wicklow			
Indicator	**Target**	**Result**	**Pass/Fail**
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥3cm	7.8cm	**Pass**
Domin scale cover of *Calluna vulgaris*	5-8 (up to 75%)	7	**Pass**
Domin cover bare rock	0-4 (up to 10%)	4	**Pass**
Total vegetation cover	8-10 (up to 100%)	8	**Pass**
Conservation Assessment	**Favourable (Green): 4 passes** **Unfavourable-Inadequate (Amber): 2-3 passes** **Unfavourable-bad (Red): 0-1 pass**		**Favourable**

5.3.3 *Habitat for the Species-*Lycopodium clavatum *STAGSHORN CLUBMOSS*

Lycopodium clavatum was found to occupy a mainly distinct ordination space (Figure 6) separate to both *Huperzia selago and Diphasiastrum alpinum*. *Lycopodium clavatum* is a more pioneering species on bare ground and bare rock in upland areas It was found mainly in associated with lower Domin cover values of *Calluna vulgaris* (1-4) and increased cover values of bare ground and bare rock (4-8) (Table 11) . The plant was found to be fertile and sporing. Naturally eroded areas in mountains and erosion due to trampling are likely to benefit *Lycopodium clavatum* but further investigation is required for this species as it was only relocated at two sites.

Table 11 *Lycopodium clavatum* species associations - species frequently and significantly associated, with positive and negatively associated species and environmental variables on Axis 1, 2, and 3

Lycopodium clavatum
Associated species found in *L. clavatum* quadrats - *Nardus strictus, Vaccinum myrtilis, Galium saxatile, Empetrum nigrum, Polytrichum alpinum, Racomitrium lanuginosum, Calluna vulgaris*
Positively correlated species and environmental variables
Bryophytes
Bare rock
Negatively correlated environmental variables
Total Grass

(significant at p=0.05 for Pearson product moment correlation n=131, df = 129 , p0.05 $\geq$0.195).

The results of the NMS analysis and expert judgment were then used to formulate the Habitat Assessment for sites with *L. clavatum* (Table 12). These habitat indicators are distinct from Habitat indicators used for all other the species in the Clubmoss group i.e. *H. selago, D. alpinum & L. inundata.*

Table 12 Habitat Assessment indicators and targets for populations where *Lycopodium clavatum* occurs with example data *from L. clavatum at* Cloghernagh Mountain, Co. Wicklow

HABITAT ASSESSMENT *Lycopodium clavatum* at Cloghernagh Mountain, Co. Wicklow			
Indicator	**Target**	**Result**	**Pass/Fail**
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	>15cm	40	**Pass**
Domin scale cover of *Calluna vulgaris*	1-4 (up to 10%)	1	**Pass**
Domin cover bare rock/ground	4-8 (up to 75%)	8	**Pass**
Bryophyte cover	5-7 (between 11-50%)	7	**Pass**
Conservation Assessment	**Favourable (Green): 3-4 passes** **Unfavourable-Inadequate (Amber): 1-2 passes** **Unfavourable-bad (Red): 0-1 pass**		**Favourable**

5.3.4 Habitat for the Species- Lycopodiella inundata *MARSH CLUBMOSS*

Lycopodiella inundata occupies distinct ordination space from the more generalist clubmoss species *Huperzia selago*. *L. inundata* species associations are also very distinct from the associations and habitat occupied by *Diphasiastrum alpinum.* In the quadrats recorded from Galway (Cornamona) (purple) (Figure 6) the site was found to be grazed and dry during monitoring in September. Small amounts of low density mixed grazing at the sites in both Galway (Cornamona) and Clare Island (Mayo) was beneficial to the species keeping the vegetation low and keeping the substrate with open patches of bare ground, allowing it to colonise and creep along without competition. Competition has been noted as detrimental to the species (JNCC 2004).

Table 13 *Lycopodiella inundata* species associations - species frequently and significantly associated, with positive and negatively associated species and environmental variables on Axis 1, 2, and 3

Lycopodiella inundata
Associated species found in *L. inundata* quadrats - *Nardus strictus, Schoenus nigricans, Erica tetralix, Narthecium ossifragum, Polytrichum juniperum & Racomitrium sp.*
Positively correlated species and environmental variables
Nardus strictus
Bare ground
Negatively correlated environmental variables
Calluna vulgaris

(significant at p=0.05 for Pearson product moment correlation n=131, df = 129 , p0.05 $\geq$0.195).

The results of the NMS analysis and expert judgment were then used to formulate the Habitat Assessment for sites with *L. inundata* (Table 14). These habitat indicators are distinct from Habitat indicators used for all other the species in the Clubmoss group i.e. *H. selago, D. alpinum & L. clavatum.*

Table 14 Habitat Assessment indicators and targets for populations where *Lycopodiella inundata* occurs with example data from *L. inundata* at Clare Island, Co. Mayo

HABITAT ASSESSMENT *Lycopodiella inundata* at Clare Island, Co. Mayo			
Indicator	**Target**	**Result**	**Pass/Fail**
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	$\geq$6	6.5	**Pass**
Domin scale cover of *Schoenus nigricans & Nardus strictus*	5-8	8	**Pass**
Domin cover bare rock/ground	4-8	6	**Pass**
Bryophyte cover	5-7	7	**Pass**
Hydrology	Ground damp to touch	Yes	**Pass**
Conservation Assessment	**Favourable (Green): 4-5 passes** **Unfavourable-Inadequate (Amber): 2- 3 passes** **Unfavourable-bad (Red): 0-1 pass**		**Favourable**

The niche habitat for the Clubmoss group i.e. four species at 20 population sites were accurately measured and are presented in Appendix 2. For the overall national conservation assessment of habitat for the species for each individual species was deemed inadequate (Appendix 1) as the total value for the actual niche habitat area for all species is currently inadequate because of poor quality assessments of habitat at many of the sites , though estimates for *L. clavatum, D. alpinum* and *L. inundata* are presented (Appendix 1).

5.4 Future prospects

From observations of each species in the wild (Smyth, Nienhuis, Muldoon and Roche *pers obs.*) and from the analysis of quadrat data it is not prudent to treat the Clubmoss group as one single entity. The threats and pressures that *Huperzia selago* face alongside *Diphasiastrum alpinum* and *Lycopodium clavatum* in their smaller niches are similar. *Lycopodiella inundata,* of all the species in the group, occupies a very different and specialised niche in lowland wet heath; this habitat is the one most likely to be under the most immediate threat from drainage. Two different lists of threats and pressures were drawn up, one for *H. selago, D. alpinum* and *L. clavatum* and the other for *L. inundata* (Table 15 & Table 16).

For assessing the future prospects of each of the species, any negative impacts and threats to populations and extent of damage were recorded using EIONET reference list for Threats, Pressures and Activities final version (EIONET 2011).

Table 15. Future Prospects Assessment of potential impacting activities (with EU code) including location, influence, intensity and area affected for Clubmoss group colonies of *H. selago, D. alpinum* and *L. clavatum populations*

Activity	Location "Within" or "Outside" colonies	Influence Positive/Negative/ Neutral	Intensity High/Medium/ Low	Area affected (m^2)
Trampling and overuse (G05.01)				
Disposal of inert materials in this case sand and gravel (E03.03)				
Intensive sheep grazing (A04.01.02)				
Climate change rise of temperatures and extremes (M01.01)				

Table 16. Future Prospects Assessment of potential impacting activities (with EU code) including location, influence, intensity and area affected for *Clubmoss group colonies of l. inundata populations*

Activity	Location "Within" or "Outside" colonies	Influence Positive/Negative/ Neutral	Intensity High/Medium/ Low	Area affected (m^2)
Trampling and overuse (G05.01)				
Intensive sheep grazing (A04.01.02)				
Climate change rise of temperatures and extremes (M01.01)				
Drainage (J02)				
Fertilisation (A08)				
Problematic native species i.e. Bracken (I02)				

The Future Prospects Assessment for individual populations is subjective. If there was no significant impact from the activities, the Future Prospects are assessed as *Favourable* (green); moderate impact should be assessed as *Unfavourable - inadequate* (amber) and severe impact as *Unfavourable - bad* (red). For populations where there are more than one impacting activity recorded, or if any of the impacting activities are having a moderate impact, the overall future prospects assessment is amber for that population. Likewise, if any of the impacting activities are having a severe impact in an individual population, the overall future prospects assessment is red for that population.

5.4.1 Assessing Overall Conservation Condition for Individual populations

The Overall conservation condition of each individual population is derived by combining the results from each of the assessments (Population, Habitat for the Species and Future Prospects) using the following criteria:

Table 16. The overall conservation assessment table for the Clubmoss Group

All Assessments Green	**1-4 Amber Assessments**	**Any Red Assessments**
Green	Amber	Red
Favourable	Unfavourable inadequate	Unfavourable bad
Good	Inadequate	Bad

An example of an overall conservation condition for the population of *L. inundata* on Clare Island, Co. Mayo is set out in Table 17. In this case all population assessment targets are green/favourable, habitat assessment targets are green/favourable. However under criteria for future prospects in the threats drainage (J02) is recorded as medium pressure and is given a status of amber/inadequate. So in this case the whole population is assessed as inadequate/amber.

Table 17. Overall conservation assessment indicators for *Lycopodiella inundata* with example data *from L. inundata at* Clare Island, Co. Mayo

POPULATION	**TARGET**	**FIGURE**	**RESULT**
Total colony number	≥2	2	PASS
Population size (combined area of occupancy of colonies)	≥54m²	54m²	PASS
Total Domin cover area of target species (L. inundata) in m²	≥6	6	PASS
Population size class	2 (100-500)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	**TARGET**	**FIGURE**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥6	6.5	PASS
Domin scale cover of *Schoenus & Nardus*	5-8	8	PASS
Domin cover bare rock/ground	4-8	6	PASS
Bryophyte cover	5-7	7	PASS
Hydrology	Ground damp to touch	Yes	PASS
FUTURE PROSPECTS	**TARGET**	**FIGURE**	**RESULT**
Trampling and overuse (G05.01)	NONE	LOW	PASS
Intensive sheep grazing (A04.01.02)	NONE	LOW	PASS
Drainage (J02)	NONE	MEDIUM	FAIL
Fertilisation (A08)	NONE	LOW	PASS
Problematic native species i.e. Bracken (I02)	NONE	LOW	PASS

5.4.2 Assessing Conservation Status

The Clubmoss group populations in the current study are a very small sample (n=20) though considered to be representative across the natural range of the Clubmoss group in Ireland. As the group is represented across its Range, any losses that occurred before the Habitats Directive came into force were not be assessed negatively.

L. inundata, the rarest of the species in the group, has suffered a dramatic decline in its range from one that once included sites in Cos Cork, Donegal, Galway, Kerry, Mayo and Offaly. Much of this decrease occurred before the Directive came in force in 1994, but during this project the species was not refound at five locations searched.

The discovery of new sites for *D. alpinum* in 2010 and 2014 (Hodd & Roche *in press*; Roche 2011; Roche & Perrin 2010) in Co. Waterford, which was well outside the known current range for the species (Cos Donegal, Galway, Mayo and Wicklow) and a new record for its former range in Co. Kerry, lends credence to the theory that the apparent historic declines shown by this and other Clubmoss group species may be partly explained by under-recording rather than genuine losses. However, in saying that, there has been an extensive survey of some upland sites in Ireland (Perrin *et al.* 2014) and the new records in Waterford and Kerry were the only new ones for *D. alpinum* and the group as a whole. During this project *D. alpinum* was not refound at two of its formerly known sites.

Most of the populations at the sites monitored had fertile shoots although not all colonies in a population were necessarily fertile, nor were all shoots in a colony fertile. Lack of fertility at populations does not mean a population is in poor conservation status, however, should fertile shoots be not observed for a period of two reporting cycle (or twelve years) this may be indicative of an unobserved pressure. If shoot numbers remain stable or increase at colonies within populations, regardless of evidence of fertility, then the status remains Favourable (green). If the area of colonies within populations declines by more than 10%, or if a negative impact occurs at any colonies, then this attribute will be downgraded to Unfavourable- inadequate (amber). If the area of colonies within populations declines by more than 20% at any colonies at five or more populations, this attribute will be downgraded to Unfavourable- bad (red).

Range may also be affected by any losses; however, this will depend on where the population is located. Any new discoveries of colonies or populations may result in an

adjustment of Favourable baselines. New discoveries are likely to be populations or colonies that were overlooked rather than an expansion in the Range of the species. The discovery of a new site for *D. alpinum* in 2010 and 2014 in Co. Waterford and Co. Kerry is an example of this.

The summary of national conservation assessments for each species in the group is presented in Table 18 (see Appendix 1 for detailed analysis)

Table 18 Overall national conservation assessments for individual species in the Clubmoss group Annex V (see Appendix 1 for details).

Species	**10km**	**Range**	**Population**	**Habitat for the species**	**Future prospects**	**Overall Assessment**
H. selago	178	Favourable	Favourable	Inadequate	Inadequate	Inadequate
D. alpinum	22	Favourable	Favourable	Inadequate	Inadequate	Inadequate
L. clavatum	31	Favourable	Favourable	Inadequate	Inadequate	Inadequate
L. inundata	17	Favourable	Favourable	Inadequate	Inadequate	Inadequate

As a group, 10 sites out of 21 surveyed (46.7%) received a favourable conservation status result, 11 received an inadequate conservation status mainly due to current pressures found (see Table 15 and Table 16). The list of pressures highlight those pressures that are being repeatedly observed e.g. such as grazing and trampling. If these continue to occur at an intensity that results in a decline in *Population* or *Habitat for the Species* into the future, the severity of the impact can be measured and will determine whether each individual species is assessed as *Unfavourable – inadequate* (amber) or *Unfavourable – bad* (red). Climate change (M01.01) is an ongoing pressure of low intensity for three members of this group i.e. *H. selago, D. alpinum and L. clavatum,* as alpine plants have limited possibility for adaptation (Berry 2003; Wyse Jackson 2007). Unusually, climate change pressures are thought to favour the expansion of *L. inundata* range (Berry *et al.* 2007).

The individual conservation assessments for each site monitored during this study are given in Appendix 2. The baseline monitoring sites are presented in Table 19.

Table 19. Overall Conservation Condition for 21 populations of the 4 Clubmoss species (*H. selago, D. alpinum, L. clavatum* inadequate because of poor quality assessments of habitat at many of the sites and *L. inundata*). See Appendix 2 for individual site assessments

Species	Location	10km	Population	Habitat for the species	Future prospects	Overall Assessment
D. alpinum	Camaderry	T09	Favourable	Favourable	Favourable	Favourable
D. alpinum	Edendoosish	B92	Favourable	Favourable	Inadequate	Inadequate
D. alpinum	Kippure	O11	Favourable	Favourable	Favourable	Favourable
D. alpinum	Maumturk	L94	Favourable	Inadequate	Inadequate	Inadequate
L. inundata	Clare Island	L78	Favourable	Favourable	Inadequate	Inadequate
L. inundata	Cornamona	M05	Favourable	Inadequate	Favourable	Inadequate
L. clavatum	Kippure	O11	Favourable	Favourable	Favourable	Favourable
L. clavatum	Clohernaagh	T09	Favourable	Favourable	Favourable	Favourable
L. clavatum	Camaderry	T09	Favourable	Favourable	Favourable	Favourable
H. selago	Tully Mountain	L66	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Muckish	C02	Favourable	Favourable	Favourable	Favourable
H. selago	Maumtrasna	L96	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Lough Crutie	Q41	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Knockowen	V85	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Kippure	O11	Favourable	Favourable	Favourable	Favourable
H. selago	Healy Pass	V75	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Derryveagh	B92	Favourable	Favourable	Favourable	Favourable
H. selago	Connor Pass	Q50	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Camaderry	T09	Favourable	Favourable	Favourable	Favourable
H. selago	Kilcrohane	V83	Favourable	Inadequate	Inadequate	Inadequate
H. selago	Cloghernagh	T09	Favourable	Favourable	Favourable	Favourable

Full details for each species assessment is outlined in more detail in Appendix 1 and Appendix 2 with a suggested monitoring site sheet for future monitoring to feed into site and national assessments in Appendix 3.

5.5 Recommendations for ongoing monitoring

5.5.1 Site visits and timing

Much of what is recommended in Perrin *et al.* 2014 for surveying in the uplands is relevant to this group in that working in the uplands of Ireland requires weather conditions to be favourable and stringent health and safety procedures should be observed.

Sites can be surveyed any time of year once weather is permitting but for *L. inundata* JNCC (2004) recommend two site visits one in autumn/winter in wetter conditions and one in summer for full species identifications. One site for *L. inundata* at Cornamona was considered "dry" in September, thus, further investigation of the hydrology of this site in winter is recommended in line with the JNCC (2004) recommendations.

5.5.2 Monitoring recommendations

The objective of this project was to gather baseline information to determine whether a combined assessment could be made for the Clubmoss group. Through analysis it was shown that each species should be dealt with individually for future reporting. Monitoring of the 21 populations surveyed during this reporting period can now provide the baseline data against which future monitoring at these locations can be compared.

Prior to the survey being carried out, the surveyor should ensure they have the necessary skills to identify each of the Clubmoss species in question and familiarisation with previous surveys of the sites under investigation and research into further population records to be included for monitoring purposes to expand the baseline monitoring for this group. A more targeted sampling approach to cover the range of variation can be further developed when more population level data is available for each species.

Survey equipment should include but is not limited to:

- The site survey cards for sites previously monitored (see Appendix 2);
- New site survey cards for newly selected sites (see Appendix 2)
- Population monitoring cards (Appendix 3)
- A handheld GPS receiver (e.g. Garmin or a handset with the capacity to capture more detailed ecological data and display map layers e.g. Trimble Geo Explorer).
- Appropriately scaled maps (digital and paper)
- Bamboo canes (min 10) and string
- 1 m quadrats
- 5m tape measure & 30cm ruler
- Plant identification guides (Parnell & Curtis 2012, Stace 2010, Atherton *et al*. 2010)
- Compass
- Mobile phone
- Mountain safety equipment where necessary (e.g. whistle, blanket. See Perrin *et al.* (2014) for further details)

New site data collection should include and record all information detailed in the current site survey card (Appendix 2) including name of species, name of site, recorder, date, Irish grid reference, general information on the site, along with general information on the whole population i.e. area (m^2) and number of colonies along with a shoot count. An appropriately scaled map showing the location of the population with arrows and a simple sketch of the population should also be recorded (see Appendix 2). A 1x1m quadrat of associated vegetation with Domin scale cover values is also a minimum requirement along with all information required on the monitoring sheets devised (Appendix 3). For existing sites the minimum information to be gathered is also detailed in the monitoring card (Appendix 3). Additional quadrat data can also be collected but is not required for existing sites until the next round of monitoring.

The current recommendations for assessing the conservation status for the purposes of EU reporting i.e. range, population, habitat for the species and future prospects are outlined in

the Monitoring methods section of this report and found in Appendix 3. These methods can be refined over time as more data becomes available on each individual species.

L. inundata was found to be the rarest and the most threatened species in the clubmoss group. It is recommended that biannual visits be made every three years to the two populations that contain colonies that are considered to be at risk i.e. *L. inundata* at Clare Island Co. Mayo and Cornamona, Co. Galway. The 15 other known population records for the species should also be surveyed and monitored as a matter of urgency (see records in Table 1 in *L. inundata* Conservation Assessment Appendix 1). Five sites were searched during this project; two are possibly still extant: Lough Belshade and Knockowen while three others considered extinct with no areas of suitable habitat found at Lough Nadirkmore, Lough Guitane, and Glendalough. The timing of site visits should be summer (June/July) and autumn (September/October) to gain a better understanding of the habitat for the species and its ecology. This suggested survey would involve a full census of all the known population records for this species. Once all sites are surveyed, the timing and frequency of monitoring for ongoing reporting can then be decided upon.

Four *D. alpinum* sites were monitored during this project from a possible 41 population records. Another 11 sites should be monitored to expand the baseline monitoring for reporting to a minimum of 25% of the total known populations Two sites were searched and the species was not refound at Lough Eske and Tully Mountain. However, new sites have been found in Waterford and Kerry (Table 1 *D. alpinum* Conservation Assessment Appendix 1).

Lycopodium clavatum was monitored at three sites in Wicklow (Camaderry, Cloghernagh and Kippure Mountains). Two other sites were searched in the north and west, however, the species was not refound. The first site i.e. G99 near Lough Eske, was searched but as most of the area around Lough Eske is now used for agricultural and amenity gardens it is not suitable habitat. However, three other recent records (see Table 1 in *L. clavatum* Conservation Assessment Appendix 1) for G99 are still likely to support the species as these are in the Blue Stack mountains where suitable habitat does exist. The second site searched was Maamtrasna Mountain (L96), however, the habitat at this site also remains suitable for *L. clavatum* so further searches are recommended for the species at both these locations. There are 38 known population records for this species (see Table 1 in *L. clavatum* Conservation Assessment Appendix 1) and additional monitoring of another nine sites across the northern,

southern and western distribution of the species to encompass monitoring of 25% of the total population in Ireland is recommended. Care needs to be taken in these mountain sites as inclement weather was a hindrance to the searches during this projectand the safety guidelines outlined by Perrin *et al.* (2014) need to be strictly adhered to for future searches.

Huperzia selago is distributed widely across the uplands and has been recorded for 178 (10x10km) grid squares. A total of 579 discrete records currently exist for the species. The species was refound at all historic location records searched and it is likely to be found in all suitable upland habitat in Ireland. This species is the most widespread of all the species in the group. 11 unique 10km^2 records were monitored across the full range of the species (B92, C02, L66, L96, O11, Q41, Q50, T09, V75, V83 and V85). These should be monitored into the future and expanded to include a further 34 sites (unique 10km^2 records) to ensure 25% of the 178 (10km^2) records across the full distribution of the species are monitored i.e. 45:10km^2; some of these sites may be covered as part of the ongoing NPWS Uplands survey.

Additional *H. selago* mapping beyond the population level site recording card (Appendix 2) and monitoring card (Appendix 3) should be compiled at each of the sites selected to also include a mapped polygon encompassing the extent of the species. Future monitoring may detect changes in this extent that may indicate habitat or climate induced impacts.

The Habitat for the species assessment at each site was undertaken using a number of proxy values to assess the condition of the habitat with threshold values devised e.g. for grazing intensity (the average height of the target species shoots in 1m^2), vegetation disturbance, trampling intensity (the cover of bare rock and total vegetation cover) and the habitat suitability for the species (habitat classification of Fossitt HH4 for *D. alpinum* and *H. selago)*. Specific individual Habitat for the species assessments can be found in the monitoring site card Appendix 3. For each species to receive a *Favourable* assessment for habitat for the species, a pass for all criteria is required, however, high-quality sites which narrowly fail on only one or two criteria can be re-examined and, using expert judgment, a decision can be made on whether a *Favourable* assessment for habitat for the species can be assigned.

The assessment of future prospects for each species is to ensure that each species remains in favourable conservation status into the future. In order to assess this likelihood, the pressures, threats and activities (including management) were recorded at each site monitored for each species. Any negative impacts and threats to the population and the

extent of damage were referred using EIONET reference list for Threats, Pressures and Activities final version (EIONET 2011). At a minimum, the impacting activity is recorded, along with the location of the activity i.e. within or outside colonies; whether the influence is positive, negative or neutral along with the intensity (high, medium or low) and the area affected (see future prospects section and Table 15 and Table 16). When assessments are repeated in future years, it will be possible to record whether a particular impact is increasing, decreasing or stable in trend by comparing with assessment data from previous years. Using a method devised by O Neill *et al. (*2013) (Table 20 below), overall impact value scores can be devised by multiplying together the scores of intensity and area, and then combining the result with the negative, positive or neutral effect of each (i.e., by multiplying the score by -1, +1 or 0 respectively). A final score for each impact can then be produced (see example calculation inTable 20). A neutral impact would always receive a score of 0 under this scheme.

Table 20 Scoring system used to calculate future prospects scores for Annex I grassland habitats assessed in 2010-2012 (O Neill *et al.* 2013) and adapted for use to assess the future prospects scores for each individual clubmoss species at each monitored site.

Impact Value Score	
% Area of Habitat for the species impacted	**Score**
<1%	0.5
1-25%	1
26-50%	1.5
51-75%	2
76-99%	2.5
100%	3
Intensity of impact	
High	1.5
Medium	1
Low	0.5
Effect of Impact	
Positive	+1
Negative	-1
Neutral	0

* Example calculation: a site with *L. inundata* has 30% of its area being impacted by drainage, the intensity of this impact is currently low, but it is a negative impact this would give a score of 1.5 x 0.5 x -1= -0.75 = Unfavourable

For the Areas of Annex I grassland habitat (O 'Neill *et al.* 2013) that scored ≥ 0, these were determined to have *Favourable* future prospects, while those scoring between <0 and -3 were *Unfavourable – Inadequate* and <-3 *Unfavourable – Bad*. The assessment then was signed off by an expert surveyor to determine whether the score was a true reflection of the future prospects for this habitat. The same method could be applied for future monitoring of each individual clubmoss species.

It is recommended that for all species, the oldest records be prioritised for survey and that species are continued to be assessed individually. It is also recommended that monitoring of *Clubmoss* populations of *H. selago, D. alpinum* & *L. clavatum* be carried out every five years and monitoring for *L. inundata* biannually every three years.

5.6 Conclusion

The increased range distribution for the group since the last reporting period is more a reflection of increased scrutiny of records rather than any expansion, except for the new *D. alpinum* records found by Hodd and Roche (Hodd & Roche *in press*; Roche 2011; Roche & Perrin 2010). However, these populations are thought to have always existed and had been overlooked due to under-recording in the uplands. Other populations known from the historic records were refound in many instances highlighting the stability of populations in their locations in uplands habitats.

The Clubmoss group have suffered severe losses of habitat in the historic past (~1930s) due to drainage and agricultural improvement. The most threatened member of the group currently is *L. inundata* in its lowland habitat, which is still under threat from site drainage. Pressures that are being repeatedly observed such as grazing and trampling are a concern and if these continue to occur at current intensity, they will impact on the populations into the future. It is recommended that the data collated in the future should continue to feed into separate national conservation status assessments for each species.

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Appendix 1 National Conservation Assessments

The following Conservation Assessments are presented in a standard format, which is agreed at European level.

For further information see http://bd.eionet.europa.eu/article17/reference_portal

Huperzia selago

Report on the main results of the surveillance under article 11 for annex II, IV and V species (Annex B)

0.1 Member State **IE**

0.2.1 Species code **1413**

0.2.2 Species name **Huperzia selago** (L.) Bernh. ex Schrank & C.Martius

0.2.3 Alternative species scientific name: Huperzia Lycopodium selago L.; Urostachys selago (L.) Herter.

0.2.4 Common name **Fir Clubmoss**

1. National Level

1.1 Maps

1.1.1 Distribution Map Yes

1.1.1a Sensitive species No

1.1.2 Method used - map Estimate based on partial data with some extrapolation and/or modelling (2)

Huperzia selago is found in upland heath across Ireland, it is generally found above 300m (Parnell & Curtis 2012) though it can be found from sea level to 1310m in the United Kingdom (Preston *et al.* 2002). According to the Census Catalogue of the Flora of Ireland, *H. selago*, has been previously been recorded in all vice counties in Ireland (Scannell & Synnott 1987). This distribution remains unchanged and *H. selago* has been recorded for 178 (10x10km) grid squares. A total of 579 discrete records currently exist for the species. Records were sourced from NPWS, BSBI, NBN gateway and DBN herbarium.

1.1.3 Year or period 1882-2014

A species distribution map with no cut-off date was chosen as some of the upland and lowland sites for this species are still considered as having suitable habitat for the species e.g. the pre 1969 records for mountain sites included were: Mangerton mountain (Kerry V98), Seecawn mountain (Wicklow O01), Cliffs over Lough Ouler (Wicklow O00), Muckish

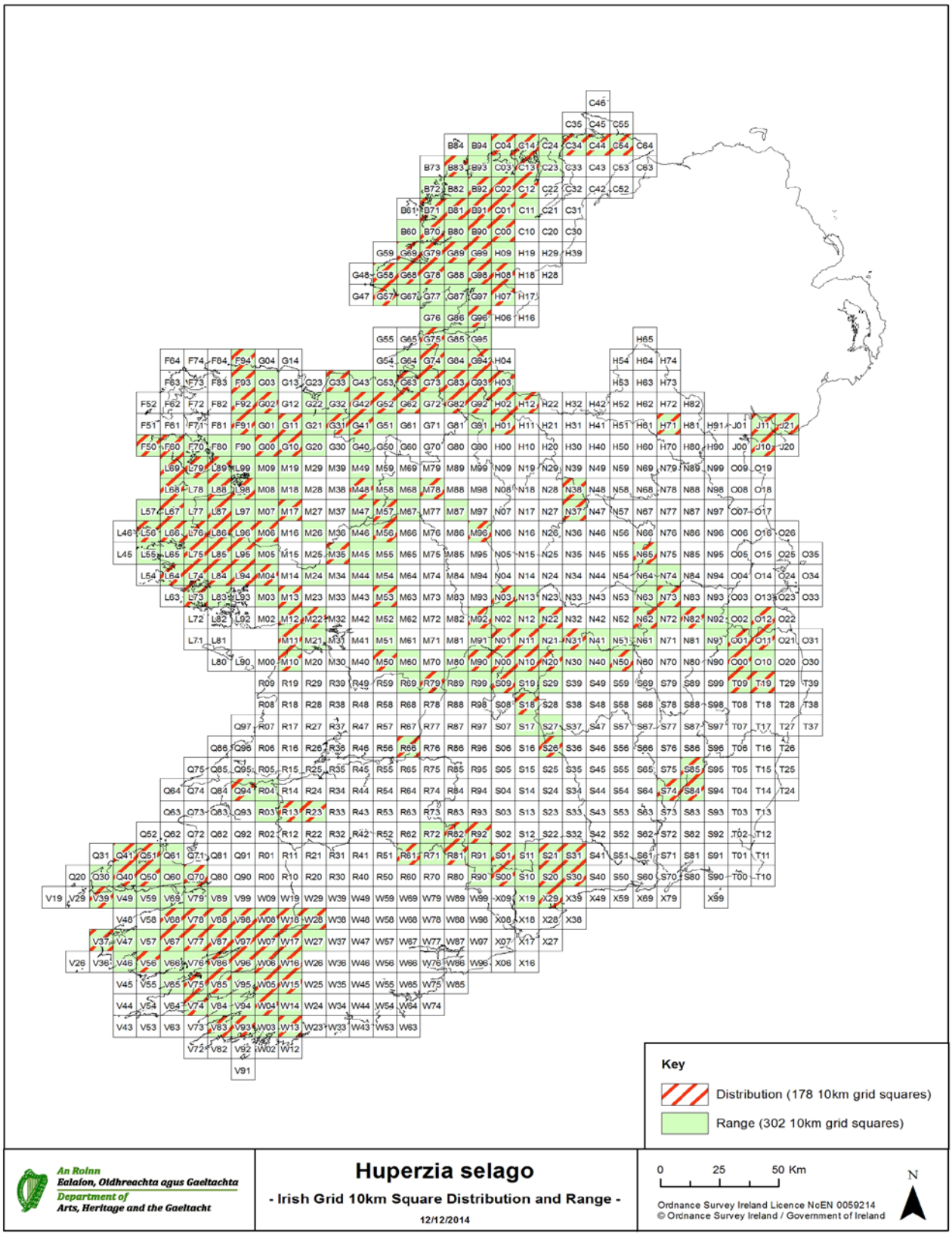
mountain (Donegal C02) and Urrisbeg (Galway L68). One lowland bog site at Cloncreen Bog, Clonbulloge (Offaly N62) was also included as it is possible that some suitable habitat still exists and two 10km grid records for sites in West Mayo (G10 and G11) with no detailed information were also included as they also harbour areas of suitable habitat.

1.1.4 Additional map

The validated records with all other sourced records (NPWS, BSBI, DBN, NBN gateway) were intersected with the Irish National Grid 10km² square grid for the distribution map.

1.1.5 Range map

The distribution map consists of 178 (10km²) grid cells in which the species is recorded as occurring. The range envelope consists of 302 (10km²) grid cells with 124 outlying cells in which the species is not recorded but is derived as part of the range by the range tool. There is only grid cell record (H71) in which the species occurs outside the main range blocks in Co Monaghan.


Key
Distribution (178 10km grid squares)
Range (302 10km grid squares)
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Huperzia selago
- Irish Grid 10km Square Distribution and Range -
12/12/2014
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25
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Ordnance Survey Ireland Licence NoEN 0059214
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2. Biogeographical Or Marine Level

2.1 Biogeographical Region **Atlantic (ATL)**

2.2 Published sources

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2.3 Range

2.3.1 Surface area - Range (km²) 30,200km²

This figure has been derived from the range map and range tool outlined in 1.1.5.

2.3.2 Method - Range surface area Estimate based on partial data with some extrapolation and/or modelling (2)

All records are assumed to be extant. Areas with suitable habitat and no current records were also included

2.3.3 Short-term trend period 2001-2012.

The recommended short term trend period has been used.

2.3.4 Short-term trend direction Stable (0)

Twelve sites (with 90 discrete colonies) across the range for the species were visited between 2009 and 2014 (Table 1) and the species was relocated at all twelve sites where associated species and ecological data were obtained. As there are no confirmed losses the trend is considered to be stable.

Table 1 Twelve of the 178 known 10km² grid records visited between 2009 - 2014

County	10km grid	Location
Kerry	Q50	Connor Pass
Kerry	Q41	Lough Cruttia
Cork	V75	Healy Pass
Cork	V85	Knockowen
Cork	V83	Kilcrohane
Wicklow	T09	Camaderry
Wicklow	T09	Cloghernagh
Wicklow	O11	Kippure Mountain
Donegal	B92	Derryveagh Mountain
Donegal	C02	Muckish Mountain
Galway	L66	Tully Mountain
Mayo	L96	Maumtrasna Mountain

2.3.5 Short-term trend magnitude

2.3.6 Long-term trend period

2.3.7 Long-term trend direction

2.3.8 Long-term trend magnitude	min	max
2.3.9 Favourable reference range	area (km²)	30,200
	operator	N/A
	unknown	No

Method

The favourable reference range is set as the current range of 30,200km². There is no evidence of decline in this species since the Directive came into force in 1994 and the current range represents the full geographic range for this species. This distribution and consequential range value derived were from BSBI database, NPWS records and DBN herbarium records and published sources and is considered to be the Fir Clubmoss baseline.

2.3.10 Reason for change Improved knowledge/more accurate data.

More detailed examination of the distribution records has been undertaken since the 2007 assessment, which was made at the group level (i.e. Lycopodiaceae)

2.4 Population

2.4.1 Population size **Unit 178 (10km^2)**

Given the information presently available the number of 10km grid squares (i.e. 178) is the most reliable indicator of population size. An estimate of colony number (one colony i.e. a discreet unconnected and measurable patch found within a population site) was devised but bearing in mind that only twelve of the 178 (10km^2) populations (or 90 of the 579 discrete individual records) have an actual number of discrete patches/colonies recorded. The minimum estimated number is 4343 colonies (see calculations in Table 2). The particular number of shoots in the size categories outlined by Evans & Arvela (2011) was also recorded for twelve known sites (see Table 2). Using figures from the 12 sites (90 colonies) data was extrapolated upwards to devise a figure for the total population size of *H. selago* in Ireland (see Table 2).

Table 2. Population size in the various population unit measurements (Evans & Arvela 2011) for Fir Clubmoss (*Huperzia selago*)

Population Number	Year last recorded	10km Grid	Site name	Population count/ shoots	Population size class (Evans and Arvela 2011)	Population Size (m^2)	No of colonies
1	2009	Q50	Connor Pass	30	1	0.0125	4
2	2011	Q41	Lough Cruttia	25	1	0.02	2
3	2009	V75	Healy Pass	103	3	5.0	7
4	2009	V85	Knockowen	90	2	0.6	10
5	2009	V83	Kilcrohane	69	2	0.3	5
6	2011	T09	Camaderry	289	3	1.5	10
7	2009	T09	Cloghernagh	50	1	1.5	2
8	2011	O11	Kippure Mountain	314	3	11.7	10
9	2009	B92	Derryveagh Mountain	210	3	5.5	10
10	2009	C02	Muckish Mountain	368	3	10.0	10
11	2009	L66	Tully Mountain	44	1	1.6	10
12	2009	L96	Maumtrasna Mountain	44	1	3.0	10
			Totals	**1636**	**5**	**40.73**	**90**
			***Average per population**	***18**	**1**	**0.45**	****7.5**
			Total *H. selago* (579 population)	****78,165**	**8**	****1954**	**4343**

Report on the main results of the surveillance under article 11 for annex

II, IV and V species (Annex B)

2.4.2 Population size	Unit
(other than individuals)	min **4343 colonies** max
2.4.3 Additional information	Problems

This species was assessed as part of the Clubmoss group in 2007 and for population it was deemed inadequate. While some survey work has been carried out since the last assessment, the species was refound at twelve sites (90 colonies) searched. Shoot counts, population areas and number of colonies at the other sites not visited could not be gathered from data within NPWS and BSBI records. Any loss in the number of recorded population sites i.e. 178 (10x10km grid) and/or colonies i.e. 4343 (i.e. discreet unconnected and measurable patches of the species) has greater conservation status implication for the species rather than losses in individual shoot numbers, as shoot number can vary depending on time of year recorded and individual recorder. However, the use of category classes for shoot numbers is very useful for monitoring purposes and a colony or population should also not change its size class from one recording and monitoring period to the next (Table 3 Evans & Arvela 2011).

2.4.4 Year or period	1882-2014 based on partial data with some extrapolation
2.4.5 Method – population size	Estimate based on partial data with some extrapolation and/or modelling (2)
2.4.6 Short-term trend period	2001-2012
2.4.7 Short term trend direction	Stable (0)

The limited data available from field data, NPWS records, BSBI records, the literature (e.g. Scannell and Synnott 1987) suggest there has been no loss of populations since 2001.

2.4.8 Short-term trend magnitude	min	max	confidence interval

2.4.9 Short-term trend method

2.4.10 Long-term trend period

2.4.11 Long term trend direction	N/A			
2.4.12 Long-term trend magnitude	min		max	confidence
interval				
2.4.13 Long-term trend method	N/A			
2.4.14 Favourable reference	number	178 (10x10km grid) and 4343 colonies		
population	operator	N/A		
	unknown	No		

Method

The population figure of 178 (10x10km grid squares) and 4343 colonies derived from the 1882-2014 (field data, BSBI data and submissions to NPWS) see section 2.4.1 above. This number is considered to represent the population baseline. As there is no evidence of any significant decline in the number of colonies since the Directive came into force and the current figure is considered adequate to ensure the long term survival of the species. The current population estimate is set as the Favourable reference population.

2.4.15 Reason for change Improved knowledge/more accurate data.

H. selago was assessed as part of the Clubmoss group in 2007. For this assessment analysis data from individual records for populations of *H. selago* were obtained from a field survey, the historic herbarium record, from NPWS and BSBI record sources and notes and the population size was estimated as outlined in Table 2.

2.5 Habitat for the Species

2.5.1 Surface area - Habitat (km²) **Unknown km²**

2.5.2 Year or period 1882-2014

(NPWS records, BSBI records, DBN records and this survey)

2.5.3 Method used - habitat Estimate based on partial data with some extrapolation (2)

The very minimum value for habitat area is 0.001954km². This area was calculated in Table 2, section 2.4.1. Given the large amount of unknown data for some populations this figure is the very minimum estimate for 579 populations in Ireland. The niche habitat for twelve of

these the populations were accurately measured using canes and string (Table 2 and Section 1.1.3).

2.5.4 a) Quality of habitat **Moderate (based on partial data with some extrapolation)**

Huperzia selago is the most generalist species of all the Clubmoss group (*Lycopodiaceae* spp.) occurring in the same habitats as both *Diphasiastrum alpinum* and *Lycopodium clavatum*. *Huperzia selago* is also very generalist in its vegetation associations in alpine areas. It was found in both short sheep grazed alpine grassland and rough tall (>30cm) *Calluna vulgaris* alpine heath. The plant was found to be fertile and producing spores in both short grazed and ungrazed habitats. Where vegetation is tall (>15cm*) H. selago* also grows tall and where vegetation is grazed and short (<10cm) *H. selago* also is short. Unlike its sister species *Diphasiastrum alpinum* and *Lycopodium clavatum* it does not associate or favour bare ground in the majority of sites where it was observed.

The results of the NMS analysis (Smyth *et al.* 2015) and expert judgment were used to formulate a conservation assessment for sites with *H. selago*. The indicators used were vegetation height (a proxy for grazing pressure at the habitat), the cover of *Calluna vulgaris* with values in the range of Domin 5-7 (or 11-50%) *C. vulgaris* is a positive indicator species for *H. selago*. The total vegetation cover found at *H. selago* sites ranged from Domin 8-10 (51-100%) and this species was found to be more abundant in sites with intact vegetation cover and low percentage cover of bare ground and bare rock Domin 0-4 (0-10%).

Recent assessment of Alpine and subalpine heaths (EU 4060), Dry heaths (EU 4030) and Wet heath (EU 4010) (NPWS 2013) the habitats which this species occurs have been assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments, which does not bode well for an upland alpine species such as *H. selago* reliant on these mountain habitats.

2.5.4 b) Quality of habitat - method

Twelve sites with 90 colonies were accessed across the full range of the species -North, South, East and West in Ireland. The Domin scale (Kent 2012) was used to record species associations and abundance in 1x1 m quadrats. Total vegetation cover within a quadrat, along with the vegetation category e.g. bryophytes, grasses, and lichen were recorded and also Domin cover values for bare rock, bare ground and dung (Smyth *et al.* 2015).

H. selago was found growing in association with a wide variety of typical upland ericaceous vegetation. Including the ericaceous shrub species*: Calluna vulgaris, Erica cinerea* and *Empetrum nigrum;* the herbs*: Potentilla erecta* and *Narthecium ossifragum;* the grasses*: Agrostris tenuis, Deschampsia flexuosa* and *Nardus strictus* and the mountain mosses: *Racomitrium lanuginosum, Polytrichum alpinum, Hypnum jutlandicum* and *Thuidium tamariscinum.*

Expert judgment was used to formulate a habitat conservation assessment for sites with *H. selago*. The indicators employed were vegetation height (a proxy for grazing pressure at the habitat), the cover of *Calluna vulgaris* with target values of Domin 5-7 (or 11-50%), total vegetation cover with target values of Domin 8-10 (51-100%), intact vegetation cover and low percentage cover of bare ground and bare rock with target values of Domin 0-4 (0-10%). The vegetation found at the twelve sites searched and monitored for the species fits most closely with the Fossit (2000) habitat categorisation of HH4 Montane heath.

Four populations were assessed as Favourable and eight as Unfavourable inadequate.

Further searches and monitoring is required for all known sites to refine the indicators and derive a more comprehensive assessment for this species.

2.5.5 Short term trend period 2001-2012

Repeat visits to the sites 2009 to 2014 did not show any loss in the area of occupancy for the species.

2.5.6 Short term trend direction Stable (0)

H. selago (Fir Clubmoss) has a mostly upland alpine distribution. The limited data on the areas occupied by this species in the past (historic records- DBN, NPWS, BSBI; Scannell & Synnott 1987 & Preston *et al.* 2002) suggest there have been no recent losses in the area occupied by *H.* selago.

2.5.7 Long-term trend period

2.5.8 Long term trend direction N/A

2.5.9 Area of suitable habitat (km^2) Unknown (0 km^2)

H. selago is a very generalist alpine species; the area of habitat for this species is unknown as much of the uplands and the mountainous areas of Ireland contain suitable habitat for the species.

2.5.10 Reason for change Improved knowledge/more accurate data

This species was assessed as part of the Clubmoss group in 2007. While some survey work has been carried out since the last assessment, the species was refound at twelve sites (90 colonies) searched. An overall accurate area of suitable habitat could not be gathered from the other record sources within DBN, NPWS and BSBI records.

2.6 Main Pressures

Pressures or impacting activities were recorded at 90 of the 4343 likely colonies. Intensive sheep grazing (A04.01.02) trampling and overuse (G05.01) were found at sites monitored at Derryveagh (Donegal) and Tully mountain and Maumtrasna (Galway), Connor Pass (Kerry), Healy Pass and Knockowen (Cork) and disposal of sand and gravel (E03.03) a pressure at Camaderry (Wicklow). Ongoing climate change with the rise of temperature and extremes (M01.01) is a constant pressure for this species in that it is a mostly alpine species with limited possibility for adaptation.

Pressure	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Medium importance (M)	N/A
Intensive sheep grazing (A04.01.02)	Medium importance (M)	N/A
Trampling and overuse (G05.01)	Medium importance (M)	N/A
Climate change (M01.01)	Low importance (L)	N/A
Disposal of inert materials (E03.03)	Low importance (L)	N/A

2.6.1 Method used – pressures Based on real data from 12 sites (3)

2.7 Main Threats

The main long term threat to *H. selago,* with limited possibility for adaptation, is climate change as it is vulnerable along with all montane species and their montane heath habitats (Berry *et al*., 2003). *H. selago* is a generalist alpine species in the Irish context (Fossit, 2000) and is like all Irish alpine species potentially threatened by climate change by 2050 (Wyse Jackson, 2007). A low level of grazing is ideal with overgrazing a current threat to the species along with excessive trampling from hikers.

Threat	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Medium importance (M)	N/A
Intensive sheep grazing (A04.01.02)	Medium importance (M)	N/A
Trampling and overuse (G05.01)	Medium importance (M)	N/A
Climate change (M01.01)	Low importance (L)	N/A
Disposal of inert materials (E03.03)	Low importance (L)	N/A

2.7.1 Method used – threats Expert opinion (1)

2.8 Complementary Information

2.8.1 Justification of % thresholds for trends

2.8.2 Other relevant Information

2.8.3 Trans-boundary assessment

2.9 Conclusions (assessment of conservation status at end of reporting period)

2.9.1 Range assessment **Favourable (FV)**

qualifiers N/A

H. selago is widespread in upland areas across the country especially in mountainous areas, with one grid cell record occurring outside the main range in Co Monaghan (H71). The range for this species is assessed as favourable as there is no evidence of decline since the Directive came into force. However, searches of these outlying range records should be carried out to refine the range.

2.9.2. Population assessment **Favourable (FV)**

qualifiers N/A

The population for this species was assessed as 178 (10km grid square) records with an estimated 579 colonies (Table 2). One of the largest populations surveyed was at Kippure mountain in Wicklow where ten distinct colonies were recorded with 314 shoots found in 11.7m^2. *H selago* differs from the other Clubmoss species (*Lycopodiella inundata, Diphasiastrum*

alpinum and *Lycopodium clavatum*) in that often is occurs as single tuft and is generally not found in large aggregated colonies. As the species is quite widespread and this is the first baseline assessment for population it is expected that there are more colonies and populations of the species. The species is considered to be stable (Preston *et al.* 2002) and there is no evidence of decline in population size since the Directive came into force, therefore the population attribute is deemed to be favourable.

2.9.3. Habitat assessment

Inadequate (U1)

qualifiers N/A

The value for habitat area is unknown. This area could not be calculated given the current data available from survey work and known records (DBN, NPWS, BSBI) as there is such a large amount of unknown data for some populations. Some data was available for 90 of the likely 4343 colonies known from NPWS and BSBI records. The niche habitat for twelve of these the populations were accurately measured as assessed using standard vegetation description methods (Kent 2012) quadrats and percentage cover of associated species. The habitat at 4 populations was assessed as Favourable and 8 as Inadequate. Ongoing monitoring of the main habitat types that this species occurs in Alpine and Boreal heaths (EU 4060), Dry heaths (EU 4030) and Wet heath (EU 4010) (NPWS 2013) have been assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments. The particular niche habitat for this species is assessed as inadequate based on the quality data at the subset of populations.

2.9.4. Future prospects assessment

Inadequate (U1)

qualifiers N/A

Many of the known colonies and populations of *H. selago* are protected within Special Areas of Conservation (SACs) and National Heritage Areas (NHAs) and as it mostly occurs in the EU Annex 1 protected habitats i.e. Alpine and Boreal Heath (EU4060), Dry Heath (EU 4030) and Wet Heath (EU 4060).

Pressures or impacting activities were recorded at 90 of the likely 4343 colonies. Intensive sheep grazing (A04.01.02) trampling and overuse (G05.01) were found at sites monitored

along with disposal of sand and gravel (E03.03) at one site in Wicklow (Camaderry). Ongoing climate change with the rise of temperature and extremes (M01.01) is a constant pressure for this species in that it is an alpine species with limited possibility for adaptation. There was no evidence of collection of any Clubmoss species *H. selago* for trade in Ireland (Ferriss 2006). The current pressures are likely to have an ongoing negative impact on the quality of the habitat therefore the future prospects are assessed as Inadequate (U1).

2.9.5 Overall assessment of Conservation Status

Inadequate (U1)

Diphasiastrum alpinum

Report on the main results of the surveillance under article 11 for annex

II, IV and V species (Annex B)

0.1 Member State **IE**

0.2.1 Species code **1413**

0.2.2 Species name **Diphasiastrum alpinum L. (Holub.)**

0.2.3 Alternative species scientific name: ***Diphasiastrum complanatum ssp. alpinum*** **(L.) Jermy;** ***Diphasiastrum alpinum*** **(L.) Rothm.,** ***Lycopodium alpinum*** **L.**

0.2.4 Common name **Alpine Clubmoss**

1. National Level

1.1 Maps

1.1.1 Distribution Map Yes

1.1.1a Sensitive species No

1.1.2 Method used - map Estimate based on partial data with some extrapolation and/or modelling (2)

D. alpinum has a wide distribution in the North, South, East and West in mountainous areas of Ireland and it is absent from the midlands. It has been recorded for 22 (10x10km grid squares) in Ireland. It has recently (Hodd 2011) been refound in the South of the country (V88) (Kerry), previous to this it was last recorded for Kerry in the 1830's. A species distribution map with a cut-off date of 1969 was chosen for mapping purposes, as this date represents the first of the more recent and accurate site location records for the species. Previous to this the records date from the 1800's with the first record for the species recorded in West Galway in 1832 (Neff 2000). *Diphasiastrum alpinum* species records were sourced from the herbarium at the National Botanic Gardens (DBN), NPWS files and BSBI and NBN databases. Records from the literature were also sourced (Conaghan 2006, Curtis 2010; Hodd & Roche *in press*; O, Reilly 1976; Roche 2011; Roche & Perrin 2010; Winder 2001; Winder 1995). *D. alpinum* is considered an obligate alpine species in the Irish context (NPWS 2013)

and has been identified as being potentially threatened by climate change by 2050 (Wyse Jackson, 2007). *D, alpinum* has also suffered dramatic losses being confirmed from only 17 hectads in Ireland since 1987 (Preston *et al.* 2002). However, as Conaghan (2006) highlighted, some of this was due to under recording, as recent NPWS surveys of the uplands in Ireland have found three new records for the species (Hodd & Roche *in press*, Roche 2011 and Roche & Perrin 2010).

1.1.3 Year or period 1969-2014

Six of the twenty two (10km^2) records were visited between 2009 and 2014 and data obtained. The species was not refound at two of the historically sites: an 1884 herbarium record from Lough Eske was removed from the records as most of the area around Lough Eske is now used for agricultural and amenity gardens with no suitable habitat available for the species; the second site searched was Tully Mountain, Galway and surrounds. DBN herbarium has an undated specimen from Tully Mountain collected by Dr. L. Leake this specimen is possibly is the first record for the species in Ireland. This mountain is heavily grazed and eroded due to hiking , however as the record for this location could be assigned to either L76 or L75 they are retained for mapping purposes as more recent records from 1980s exist for both these 10km squares.

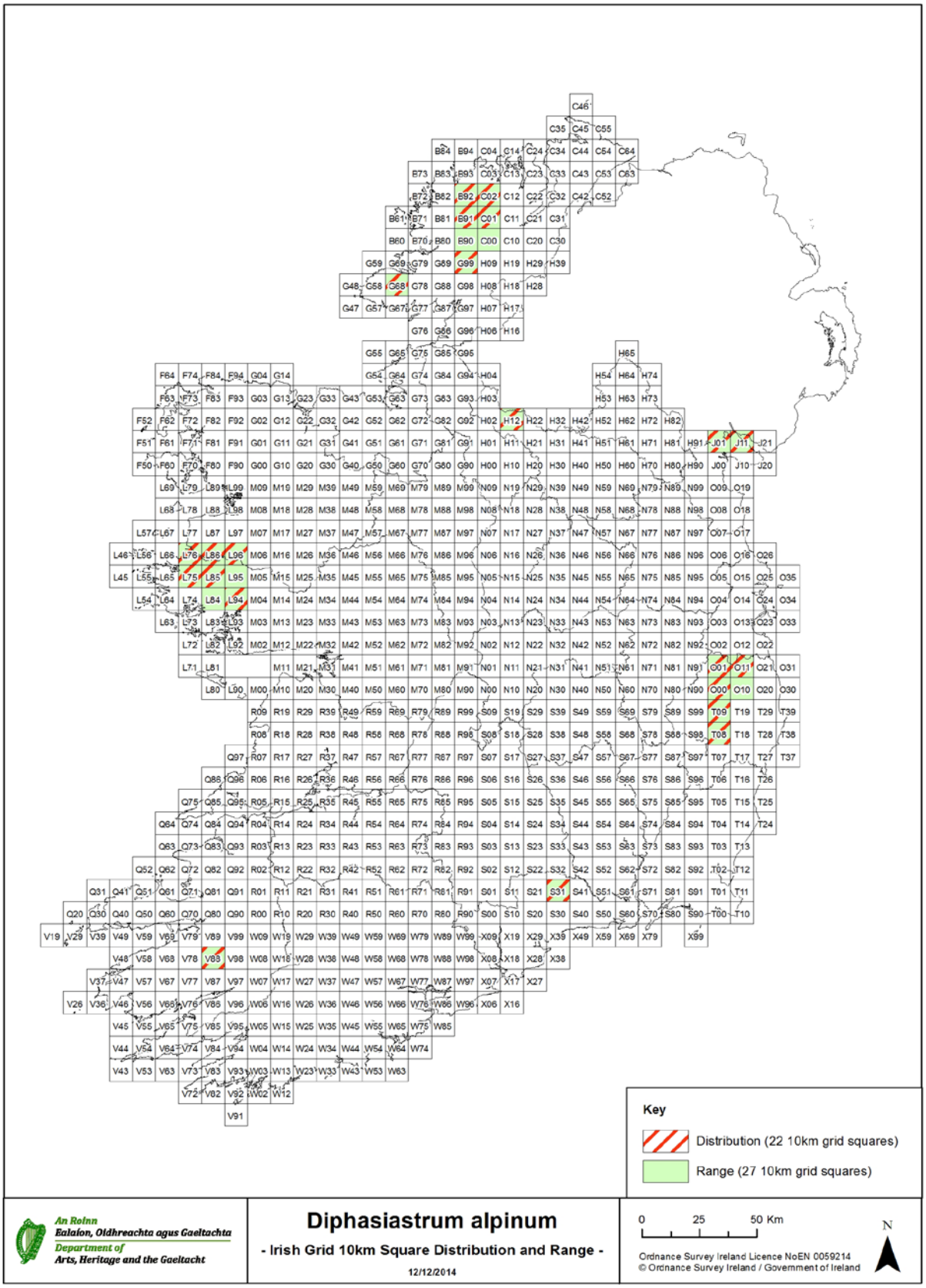
1.1.4 Additional map

The validated records with all other records post 1969 were intersected with the Irish National Grid 10km^2 square grid for the distribution map.

1.1.5 Range map

The distribution map consists of 22 (10km^2) grid cells in which the species is recorded as occurring. The range envelope consists of 27 (10km^2) grid cells with 4 outlying cells in which the species is not recorded but is derived as part of the range by the range tool. There are four single one grid cell records which occur outside the main range blocks for the species in Cos Donegal, Cavan, Kerry and Waterford.

The increased range distribution for individual species within the *Lycopodium* group since the last reporting period is more a reflection of increased scrutiny of records and some incidental finds during other survey work with new county records found for this species (Hodd & Roche *in press*, Roche 2011 and Roche & Perrin 2010) during NPWS upland surveys (Perrin *et al.* 2014).


Key
Distribution (22 10km grid squares)
Range (27 10km grid squares)
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Diphasiastrum alpinum
- Irish Grid 10km Square Distribution and Range -
12/12/2014
0
25
50 Km
N
Ordnance Survey Ireland Licence NoEN 0059214
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2. Biogeographical Or Marine Level

2.1 Biogeographical Region **Atlantic (ATL)**

2.2 Published sources

Smyth, N., Nienhuis, C., Muldoon, C, & Lynn, D. (2015) Conservation and monitoring methods for the Annex IV Clubmoss group (Lycophyta) in Ireland. *Irish Wildlife Manual*s, No. 86. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

Other useful and/or important references containing information on the species.

Berry, P.M., Dawson, T.P., Harrison, P.A., Pearson, R. & Butt, N. (2003) The sensitivity and vulnerability of terrestrial habitats and species in Britain and Ireland to climate change. *Journal for Nature Conservation* **11**: 15-23.

Evans, D. & Arvela, M. (2011) Assessment and Reporting Under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the Period 2007-2012. European Topic Centre on Biological Diversity, Paris.

Ferriss, S.E., Inskipp, T.P., Kloda, J. & Sinovas, P. (2007) Wildlife trade in Ireland – a review. Confidential report to the National Parks and Wildlife Service, Ireland. UNEP World Conservation Monitoring Centre, Cambridge. 85 pp.

Fossit, J. A. (2000) A guide to habitats in Ireland. The Heritage Council.

Kent, M. (2012) Vegetation Description and Data Analysis. A practical approach. Wiley-Blackwell, UK.

NPWS (2013) The status of EU protected Habitats and species in Ireland. Overview Volume 1. Unpublished Report National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor Deirdre Lynn.

Parnell, J. & Curtis, T. (2012) Webb's An Irish Flora. Cork University Press, Cork

Perrin, P.M. Barron, S.J. Roche, J. R. & O'Hanrahan, B. (2014) Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Dublin.

Preston, C. D., Pearman, D. A. & Dines, T. D. (2002) *New Atlas of the British & Irish Flora*, Oxford University Press, Oxford.

Scannell, M.J.P. & Synnott, D.M. (1987) *Census Catalogue of the Flora of Ireland*, 2nd ed. Stationery Office, Dublin.

Wyse Jackson, P.S. (2008) The potential impact of climate change on native plant diversity in Ireland http://www.botanicgardens.ie/news/20080122.htm Accessed 21st January 2015.

2.3 Range

2.3.1 Surface area - Range (km²) 2700km²

This figure has been derived from the range map and range tool outlined in 1.1.5.

2.3.2 Method - Range surface area Estimate based on partial data with some extrapolation (2)

The range map consists of 22 (10km²) grid cells in which the species is recorded as occurring and the overall range consists of 27 (10km²) grid cells with 5 outlying cells in which the species is not recorded but is derived as part of the range by the range tool.

2.3.3 Short-term trend period 2001-2012.

The recommended short term trend period has been used.

2.3.4 Short-term trend direction Stable (0)

There have been no confirmed losses of the species since 2001. Six sites have been searched (Smyth *et al*. 2015) and the species was refound at four of these. All site records since 1969 are included in the distribution (see 1.1.3). The two sites searched at Tully Mountain and Lough Eske are excluded as they are pre 1969 records. The species has also been recorded at three new sites since 2001 in Nephin Mountain, Mayo (G10) Coumlara, Comeragh Mountains, Waterford (S31) and Shedy Mountains, Kerry (V88). The new site in Waterford (S31) is the first record of the species for that county, but it is unlikely to be a range expansion *for D. alpinum* as the population probably existed at this site for many years but overlooked due to under recording in the Comeragh mountains. Conaghan (2006) highlighted under recording as being an issue for this species.

2.3.5 Short-term trend magnitude

2.3.6 Long-term trend period

2.3.7 Long-term trend direction

2.3.8 Long-term trend magnitude	min	max
2.3.9 Favourable reference range	area (km²)	2700
	operator	N/A
	unknown	No

Method

The favourable reference range is set as the current range of 2700km². There is no evidence of decline in this species since the Directive came into force in 1994. There are possible historic losses for this species in Ireland i.e. pre 1969. This distribution and consequential range value derived from BSBI database, NPWS records and published sources considered to be the Alpine Clubmoss baseline.

2.3.10 Reason for change Improved knowledge/more accurate data.

There has been a historic loss of this species (pre 1969) with habitat loss known for the demise some of the lowland sites e.g. around Lough Eske due to agricultural improvement and garden development. However, new sites have been discovered in recent years with the latest from Kerry (V88) in 2011. This is a possible relocation of an earlier Scully record from the early 1830's but the record from Waterford in 2010 (S31) (Roche & Perrin 2010) is a new record never previously recorded, more survey work in the uplands has the potential to discover other sites for the species.

2.4 Population

2.4.1 Population size Unit Colony number

Given the information presently available the number of colonies is the most reliable indicator of population size. As one colony i.e. a discreet unconnected and measurable patch found within a population site, is the very minimum number that can be recorded for a site.

Nine of the forty one populations have an actual number of discrete patches/colonies recoded. The species is stoloniferous in nature and what constitutes an individual can be difficult to define. The particular number of shoots in the size categories outlined by Evans & Arvela 2011 was recorded for four of the known sites at Kippure and Camaderry (Wicklow), Derryveagh Mountain (Donegal) and Maumturk Mountain (Galway). Scant notes on size and population counts on other populations were obtained from notes on those populations

from the actual recorder or NPWS and BSBI record notes (Table 1 below these are marked in red).

These figures were then extrapolated in Table 2 to give estimate numbers for shoot counts, area and colony number for *D. alpinum* populations in Ireland.

Table 1. Population size in the various population unit measurements (Evans & Arvela 2011) for Alpine Clubmoss (*D. alpinum*)

Population Number	Year last recorded	10km Grid	Site name	Population count shoots	Population size class	Population Size (m)	No of colonies
1	1996	B89	Aghla Mountain	unknown	unknown	unknown	1
2	1975	B91	Staghall mountain	unknown	unknown	unknown	1
3	2010	B92	Aghla Beg Mountain	unknown	unknown	unknown	1
4	2009	B92	Derryveagh Mountain, Donegal	1001-3000	5	25 x 25 (625 m^2)	10
5	2002	B92	Errigal Mountain, Donegal	unknown	unknown	unknown	1
6	1976	C01	Glendowan	unknown	unknown	unknown	1
7	1969	C02	No site name available	unknown	unknown	unknown	1
8	2010	G10	Carrowskeheen on Nephin Mountain	unknown	unknown	5x5 (25m^2)	2 (Recorder)
9	2009	G57	Slieve League	unknown	unknown	unknown	1
10	1989	G68	No site name available	unknown	unknown	unknown	1
11	1998	G99	Just north-west of small lake 500 m, East of Lough Asgarha, Co. Donegal	unknown	unknown	unknown	1
12	1998	G99	Ridge north-west,Lavagh Beg, Co. Donegal	unknown	unknown	unknown	1
13	1998	G99	L. Asgharha, 500m. E of	50 (NPWS)	unknown	unknown	1
14	1998	G99	Ridge NW of Lavagh Beg	50 (NPWS)	unknown	unknown	1
15	1991	H12	Summit of Cuilcage	unknown	unknown	unknown	1
16	1973	J11	VCH31 Co. Louth	unknown	unknown	unknown	1
17	1973	J01	Clermont Carn Mtn	unknown	unknown	unknown	1
18	1984	L75	Ben Breen	unknown	unknown	unknown	1
19	1993	L75	Maamturks, Ben Caonaigh	unknown	unknown	unknown	1
20	1984	L75	Twelve Bens- summit Ben Breen	unknown	unknown	unknown	1
21	1983	L76	Benchoona	unknown	unknown	unknown	1
22	1980	L85	E of Knocknahallion	unknown	unknown	unknown	1
23	2010	L86	Sheefry Hills NW/L.Bawn	unknown	unknown	unknown	3 (Recorder)
24	2010	L87	Mweelrea Sheefry	unknown	unknown	unknown	1 (Recorder)
25	2009	L94	Maumturk Mountain, Galway	500-1000	4	10x 10 (100m^2)	4
26	1970	O00	Mullaghcleevaun	unknown	unknown	0.38 x 0.45	1

Population Number	Year last recorded	10km Grid	Site name	Population count shoots	Population size class	Population Size (m)	No of colonies
						(0.17m²) NPWS	
27	1999	O00	Tonalagee Mtn.	unknown	unknown	unknown	1
28	1990	O01	Seachain Mtn. WSW face	unknown	unknown	unknown	1
29	1965	L96	VCH16 West Galway	unknown	unknown	unknown	1
30	1975	L96	S. of Leynabrika	unknown	unknown	unknown	1
31	1980	L96	Dirkmore&Dirkbeg corries	unknown	unknown	unknown	1
32	2009	O11	Kippure, Wicklow	100-500	3	4 x 3 (12m²)	2
33	1975	O32	WSW of Seachan Mountain	unknown	unknown	unknown	1
34	2010	S31	Coumlara, Comeragh	unknown	unknown	unknown	1
35	1969	T08	Wicklow	unknown	unknown	unknown	1
36	1997	T09	Conowalla	unknown	unknown	unknown	1
37	2004	T09	Slievemaan, SW of Lug na Quilla	unknown	unknown	unknown	1
38	2005	T09	Cannow Mountain,near Lugnaquillia Co. Wicklow	**unknown**	**unknown**	**unknown**	**1 (NPWS)**
39	2009	T09	Camaderry, left of reservoir, Wicklow	**73**	**2**	**1 x 2.25 (2.25m²)**	**1**
40	2007	T09	Luqnaquilla, above south prison Co. Wicklow	**unknown**	**unknown**	**unknown**	**1**
41	2011	V88	Shehy Mtn	**few hundred**	**3**	**20x30 (600m²)**	**1 (Recorder)**
				*16,896	*7	**6237m²	***96

*Using these data an estimate of population size was calculated using the following method i.e. *using the average of population shoot count of 7 populations for the unknown sites

[(2000+50+50+750 +300+73+300)/7= 503, the average shoot count for seven populations is then 503/7 these in turn have 20 colonies 3253/20 this would give a minimum estimated population shoot count of 20635 for 41 populations and 16910 for the 96 estimated colonies a size class 7 (Evans & Arvela 2011).

Table 2. Population size estimate calculations for *D. alpinum*

Population Size *D. alpinum*	***Population count shoots**	****Population Size (m)**	*****No of colonies**
Total	**3523**	**1364**	**28**
Average (of the 7 populations)	503	195	2
These 7 pops have 20 colonies	176	65	
Extrapolated to 41 populations (503*41)	20635	7992	96
Extrapolated to 96 colonies (176*96)	**16896**	**6237**	**96**
	Size class 7		

2.4.2 Population size Unit (other than individuals) min **96 colonies** max

2.4.3 Additional information Problems

This species was assessed as part of the Clubmoss group in 2007 and for population it was deemed inadequate. While some survey work has been carried out since the last assessment, the species was refound at two of the six sites searched. Shoot counts, population areas and number of colonies at the other sites not visited were estimated from notes within NPWS and BSBI records. Shoot counts do not necessarily represent individual plants as the species grow in aggregate and it is difficult to say what is an individual. Any loss in the number of recorded population sites and colonies i.e. discreet unconnected and measurable patches of the species found within a population site has greater conservation status implications for the species than losses in individual shoot numbers as shoot number can vary depending on time of year recorded and individual recorder. The use of category classes which uses estimates of shoot counts are very useful for monitoring purposes and a colony or population should also not change its size class from one recording and monitoring period to the next (Table 3 Evans & Arvela 2011).

2.4.4 Year or period 1969-2014

2.4.5 Method – population size Estimate based on partial data with some extrapolation (2)

2.4.6 Short-term trend period 2001-2012

2.4.7 Short term trend direction Stable (0)

The limited data available from field data, NPWS records and BSBI records suggest there has been no loss of populations in the recent past i.e. post 1994 since the Directive came into force. In saying that some populations have not been refound (Lough Eske (Donegal) and Tully Mountain (Galway) (Smyth *et al.* 2015) while three other new records have been discovered (Roche 2010, Roche & Perrin 2011 & Hodd & Roche *in press*). This species remains a high priority for survey work into the future as it is one of Ireland's true obligate alpine species which in under threat from climate change (Wyse Jackson 2007).

2.4.8 Short-term trend magnitude min max confidence interval

2.4.9 Short-term trend method

2.4.10 Long-term trend period

2.4.11 Long term trend direction N/A

2.4.12 Long-term trend magnitude min max confidence interval

2.4.13 Long-term trend method N/A

2.4.14 Favourable reference number 96 colonies

population operator N/A

unknown No

Method

The population figure of 96 colonies was derived from the 1969-2014 (field data, BSBI data and submissions to NPWS) see section 2.4.1 above and Table 2. This number is considered to represent the population baseline. As there is no evidence of any significant decline in the number of colonies since the Directive came into force the current population estimate is set as the FRP.

2.4.15 Reason for change Improved knowledge/more accurate data.

The four species in the Clubmoss group were assessed together in 2007. For this assessment analysis data from individual records for populations of *D. alpinum* were obtained from a field survey, the historic herbarium record and from NPWS and BSBI record sources and notes and the population size was estimated as outlined in Table 1.

2.5 Habitat for the Species

2.5.1 Surface area - Habitat (km²) 0.0062km²

2.5.2 Year or period 1969-2014

2.5.3 Method used – habitat Estimate based on partial data with some extrapolation (2)

The minimum value for habitat area is 0.0062km². This area was calculated in table 1, section 2.4.1. Given the large amount of unknown data for some populations this figure could be considered as a very minimum. Some data was available for twelve of the estimated forty one populations in Ireland derived from NPWS and BSBI records. The niche habitat for four of these the populations were accurately measured using canes and string i.e. the populations at Kippure & Camaderry (Wicklow) Derryveagh Mountain (Donegal) and Maumturk Mountain (Galway).

2.5.4 a) Quality of habitat **Moderate**

Five habitat indicators and associated targets were developed for monitoring *D. alpinum* including vegetation height, the cover of *Calluna vulgaris* which is a positive species associate, a low cover of bare rock and a high total vegetation cover and habitat equating to Fossit (2000) Habitat HH4 (Montane Heath).

The height of *D. alpinum* stems was taken as a proxy for grazing density. Intensive sheep grazing is detrimental to *D. alpinum* and shoot lengths below 7.8cm are an indicator of intensively highly stocked sheep grazed sites.

D. alpinum was found growing in association with *Calluna vulgaris*, *Huperzia selago*, *Potentilla erecta*, the lichens- *Cladonia* spp. and the bryophytes-*Racomitrium lanuginosum*, *Polytrichum alpinum, Hylocomnium amoricum* and *Hypnum jutlandicum*. It was found to be significantly positively associated with *Calluna vulgaris* in an NMS analysis (Smyth *et al*. 2015). For monitoring purposes *Calluna vulgaris* cover up to and in excess of 50% is deemed necessary to the species as a climbing frame. At the sites monitored a mostly intact total vegetation cover (80-100%) was found, with only small amounts of bare ground/rock (<20%) exposed.

The habitat at two of the sites monitored was under pressure from intensive sheep grazing and trampling due to excessive hiking at Derryveagh (Donegal) and Maumturk (Galway). One site at Camaderry (Wicklow) had dumping of sand and gravel close to the *D. alpinum* population while another Wicklow site at Kippure was in good condition with an intact vegetation cover and less intensive sheep grazing.

As this species was only located at four of six sites searched (Smyth *et al.* 2015) further searches and monitoring is required for all known sites to refine the indicators and derive a more comprehensive assessment for this species, especially as it is one likely to be affected by climate change in Ireland (Berry *et al.* 2003 & Wyse Jackson 2007).

Recent assessment of Alpine and Boreal heaths (4060) (NPWS 2013) the habitat which this species occurs in has been assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments, which does not bode well for obligate alpine species such as *D. alpinum* reliant on this habitat.

2.5.4 b) Quality of habitat - method

Only four populations out of the forty one known populations were fully assessed for *D. alpinum*. The Habitat was assessed at these 4 sites, 3 were assessed as Unfavourable inadequate and one Favourable. This was part of the rationale for assessing habitat quality as Moderate.

2.5.5 Short term trend period 2001-2012

Repeat visits to the sites 2009 to 2014 did not show any loss in the area of occupancy for the species.

2.5.6 Short term trend direction stable (0)

Diphasiastrum alpinum (Alpine Clubmoss) has an upland distribution, occurring on mossy heaths or bare peat on mountain ridges. The limited data on the area of occupancy calculated from field data at four sites (Derryveagh (Donegal), Maumturk (Galway) , Camaderry and Kippure (Wicklow); NPWS data collected from Lugnaquilla (Wicklow) and the Recorder information for another four sites i.e. Nephin, Sheefry, Mweelrea (Mayo) and Shehy (Kerry), suggest there have been no losses in the area occupied by *D. alpinum* in the recent past. The remaining 32 sites have not been assessed and it is only presumed they would demonstrate a similar stable trend. The new site in Waterford (S31) is the first record of the species for that county, but it is unlikely to be a range expansion *for D. alpinum* as the population probably existed at this site for many years but overlooked due to under recording in the Comeragh mountains as Conaghan (2006) highlighted under recording as being prevalent predicament for this group of species.

2.5.7 Long-term trend period

2.5.8 Long term trend direction N/A

2.5.9 Area of suitable habitat (km^2) 0.006km^2

D. alpinum is a very niche specific species obligate alpine species; this area is considered the very minimum for the area of suitable habitat for the species. As the species is likely to be unrecorded for Ireland there may be many other upland areas with suitable habitat.

2.5.10 Reason for change Improved knowledge/more accurate data

2.6 Main Pressures

D. alpinum is closely associated with montane heath and it is listed as a characteristic species of Alpine and Boreal heaths (4060) a habitat which appears on Annex I of the EU Habitats Directive and is of international conservation importance (NPWS 2013). This habitat was assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments, which does not bode well for obligate alpine species such as *D. alpinum* reliant on this habitat.

Pressures or impacting activities were recorded at four of the forty one likely populations. Intensive sheep grazing (A04.01.02) trampling and overuse (G05.01) were found at site monitored in Derryveagh (Donegal) and Maumturk (Galway) and disposal of sand and gravel (E03.03) a pressure at Camaderry (Wicklow). Ongoing climate change with the rise of temperature and extremes (M01.01) is a constant pressure for this species in that it is an obligate alpine species with limited possibility for adaptation.

Pressure	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Medium importance (M)	N/A
Intensive sheep grazing (A04.01.02)	Medium importance (M)	N/A
Trampling and overuse (G05.01)	Medium importance (M)	N/A
Climate change (M01.01)	Low importance (L))	N/A
Disposal of inert materials (E03.03)	Low importance (L)	N/A

2.6.1 Method used – pressures Based on real data from limited number of sites visited (3)

2.7 Main Threats

The main threats to D. alpinum with limited possibilities for adaptation, montane species and their montane heath habitats are very vulnerable to the effects of climate change (Berry *et al*., 2003). *D. alpinum* is considered an obligate alpine species in the Irish context (NPWS, 2013) and has been identified as being potentially threatened by climate change by 2050 (Wyse Jackson, 2007). A low level of grazing is ideal with overgrazing a threat to the species

and excessive trampling from hikers along the summit and ridges of mountains also considered a long term threat to the species.

Threat	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Medium importance (M)	N/A
Intensive sheep grazing (A04.01.02)	Medium importance (M)	N/A
Trampling and overuse (G05.01)	Medium importance (M)	N/A
Climate change (M01.01)	Low importance (L)	N/A
Disposal of inert materials (E03.03)	Low importance (L)	N/A

2.7.1 Method used – threats Expert opinion (1)

2.8 Complementary Information

2.8.1 Justification of % thresholds for trends

2.8.2 Other relevant Information

2.8.3 Trans-boundary assessment

2.9 Conclusions (assessment of conservation status at end of reporting period)

2.9.1 Range assessment **Favourable (FV)**

qualifiers N/A

The range of *D. alpinum* is very scattered in the extreme North, South, East and West of the country in mountainous areas with the largest number of records for the species centred in West Galway and West Mayo. Some of the records in Donegal and Mayo were searched for during 2009-2014 and they were not refound. However, areas of suitable habitat still exist at these sites. There are four single one grid cell records which occur outside the main range blocks of the species in Donegal, Cavan, Kerry and Waterford.

The range for this species is assessed as favourable as there is no evidence of decline since the Directive came into force. However, searches of these outlying range records should be carried out to refine the range.

The increased range distribution for the group since the last reporting period is more a reflection of increased scrutiny of records and some incidental finds during other survey work with new county records found (Hodd & Roche *in press*, Roche 2011 and Roche & Perrin 2010) during NPWS upland surveys (Perrin *et al.* 2014).

2.9.2. Population assessment **Favourable (FV)**

qualifiers N/A

A population can comprise of a single colony or many colonies. There is a large variation in the number of shoots found in different population ranging from the smallest populations with 50 shoots to the largest population found at Derryveagh Mountain, Donegal with 1001-5000 shoots recorded (Size Class 5 Evans and Arvela 2011).

The largest population at Derryveagh Mountain, Donegal has ten distinct colonies recorded. The smallest population was recorded at Asgharha and Lavagh Beg (Mayo) with only 50 shoots recorded (NPWS records). The current number of populations is estimated at 41 comprising of 96 colonies. As the species is quite rare and this is the first baseline assessment for population it is expected that there are possibly more colonies and populations of the species. The species is likely to be unrecorded in Ireland (Preston *et al.* 2002, Conaghan 2006) and examples of this can be illustrated by the new finds of *D. alpinum* in Kerry (R89) by Hodd, Nephin (Mayo) by Roche and the new county record for the species in the Comeraghs Waterford (S31) by Roche (see Hodd & Roche *in press*, Roche 2011 and Roche & Perrin 2010). There is no evidence of decline in population size since the Directive came into force, therefore the population is deemed to be favourable.

2.9.3. Habitat assessment **Inadequate (U1)**

qualifiers N/A

The minimum value for habitat area is 0.006km. This area was calculated in the table outlined in section 2.4.1. Given the large amount of unknown data for some populations this figure should be considered as a very minimum. Some data was available for twelve of the forty one likely populations from NPWS and BSBI records. The niche habitat for four of these the

populations were accurately measured using standard vegetation description methods (Kent 2012) quadrats and percentage cover of associated species at Derryveagh (Donegal), Maumtaurk (Galway), Camaderry (Wicklow) and Kippure (Wicklow). The quality at these sites was Moderate. Ongoing monitoring of the main habitat types that this species occurs in Alpine and Boreal Heath (EU 4060) were assessed as Bad (NPWS 2013). There has been a known decline in the quality of habitat niche this species occurs in since the Directive came into force in 1994 so habitat is deemed inadequate.

2.9.4. Future prospects assessment **Inadequate (U1)**

qualifiers N/A

The majority of colonies and populations of *D. alpinum* are protected within Special Areas of Conservation and as it mostly occurs in the EU Annex 1 protected habitat Alpine and Boreal Heath (EU4060) which is also protected and monitored. This habitat however, was assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments, which does not bode well for obligate alpine species such as *D. alpinum* reliant on this habitat.

Pressures or impacting activities were recorded at four of the forty one likely populations. Intensive sheep grazing (A04.01.02) trampling and overuse (G05.01) were found at site monitored in Derryveagh (Donegal) and Maumturk (Galway) and disposal of sand and gravel (E03.03) a pressure at Camaderry (Wicklow). Ongoing climate change with the rise of temperature and extremes (M01.01) is a constant pressure for this species in that it is an obligate alpine species with limited possibility for adaptation.

There was no evidence of collection of any Clubmoss species *D. alpinum* for trade in Ireland (Ferriss 2006). The recent finds of a new populations of *D. alpinum* (see Hodd & Roche *in press*, Roche 2011 and Roche & Perrin 2010) suggests that the species may be under recorded in Ireland as suspected by Preston *et al.* (2002) and Conaghan (2006). Overall given the large number of populations not assessed

The current pressures are likely to have an ongoing negative impact on the quality of the habitat therefore the future prospects are assessed as Inadequate (U1).

2.9.5 Overall assessment of Conservation Status	**Inadequate (U1)**
2.9.5 Overall trend in Conservation Status	N/A

Lycopodium clavatum

Report on the main results of the surveillance under article 11 for annex

II, IV and V species (Annex B)

0.1 Member State **IE**

0.2.1 Species code **1413**

0.2.2 Species name **Lycopodium clavatum L. (Holub.)**

0.2.3 Alternative species scientific name: ***Lepidotis clavata*** **(L.) P. Beauv.)**

0.2.4 Common name **Stags Horn Clubmoss**

1. National Level

1.1 Maps

1.1.1 Distribution Map Yes

1.1.1a Sensitive species No

1.1.2 Method used - map Estimate based on partial data with some extrapolation (2)

L. clavatum has a very scattered occurrence throughout Ireland in suitable upland habitats (Parnell & Curtis 2012). *L. clavatum* was listed as extant in eleven Irish vice counties with six of these in the Republic of Ireland in 1987: Dublin, Wicklow, Cavan, Louth, East and West Donegal (Scannell & Synnott, 1987).This distribution has expanded (Cork, Sligo, Roscommon, Galway, Tipperary, Kilkenny) mostly due to incidental records by the Botanical Society of the British Isles and NPWS staff survey work. It is likely these records were overlooked and do not represent an expansion in the range of the species. It was formerly recorded in lowland sites in Cos Offaly and Westmeath (Preston *et al*. 2002) these are now considered extinct. Historic upland records exist for Cos Waterford (Green 2008) and Kerry (V98) (Scully 1916). It has been recorded for 31 (10x10km grid squares) in Ireland. A species distribution map with a cut-off date of 1969 was chosen for mapping purposes.

Records from the literature were also sourced (Conaghan 2006, Curtis 2010; Winder 2001; Winder 1995). *Lycopodium clavatum* has been identified as being potentially threatened by

climate change by 2050 (Wyse Jackson, 2008). *L. clavatum* has reportedly suffered dramatic losses reported by Preston *et al* 2002), however, as Conaghan (2006) highlighted, some of this is possibly due to under recording in the uplands.

Five sites were searched and three historic record sites were relocated at Cloghernagh Mountain and Kippure Mountain both of which had a very large population of *L. clavatum* (5000-10,000 shoots) and Camaderry Mountain which had a very small single occurrence of the species with just 3 stems, all these sites are in Co Wicklow. The species was searched for but not refound at two of the historical sites. The first record i.e. G99 near Lough Eske, was searched but as most of the area around Lough Eske is now used for agricultural and amenity gardens no suitable habitat is available for the species. However, three other recent records (see table 1) for G99 are still likely these are in the Blue Stack mountains where suitable habitat does exist so these records remain. The second site searched was Maamtrasna Mountain (L96), this mountain was found to be heavily grazed and eroded due to hiking, however, the habitat at this site also remains suitable for *L. clavatum* so further searches are recommended for the species at both these locations. Care needs to be taken in these mountain sites as inclement weather was a hindrance to the searches and the safety guidelines outlined by Perrin *et al.* 2014 need to be strictly adhered to for future searches.

1.1.3 Year or period 1969-2014.

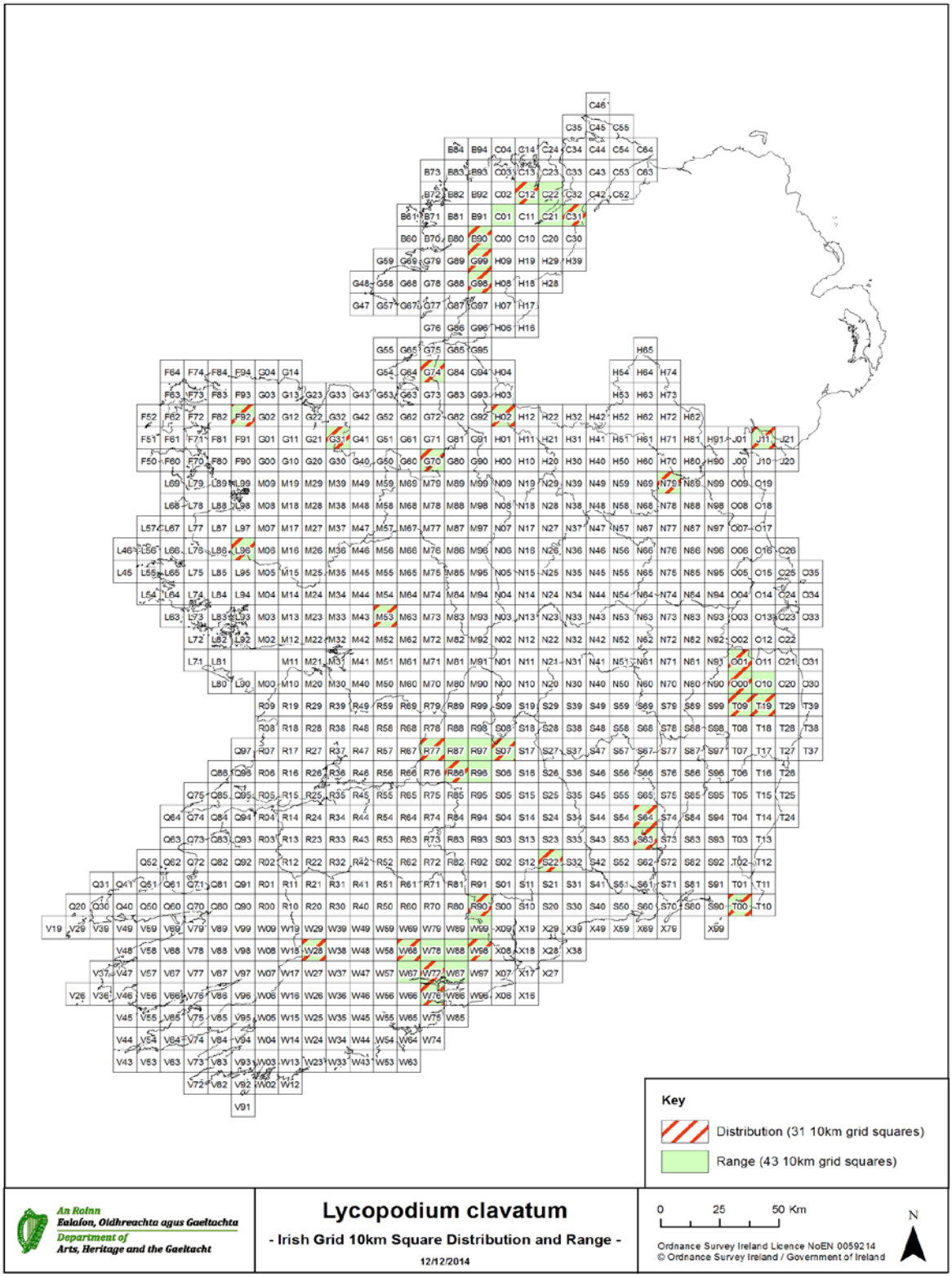
Five population records were visited between 2009 and 2014 and the species was relocated at three of these sites.

1.1.4 Additional map

The validated records with all other records post 1969 were intersected with the Irish National Grid 10km^2 square grid for the distribution map.

1.1.5 Range map

The distribution map consists of 31 (10km^2) grid cells in which the species is recorded as occurring. The range envelope consists of 43 (10km^2) grid cells with 12 outlying cells in which the species is not recorded but is derived as part of the range by the range tool. There are also 12 single one grid cell records in which the species occurs outside the main range blocks for the species in Counties Donegal, Tipperary, Cork, Kilkenny and Wicklow.


Key
Distribution (31 10km grid squares)
Range (43 10km grid squares)
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Lycopodium clavatum
- Irish Grid 10km Square Distribution and Range -
12/12/2014
0
25
50 Km
N
Ordnance Survey Ireland Licence NoEN 0059214
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2. Biogeographical Or Marine Level

2.1 Biogeographical Region **Atlantic (ATL)**

2.2 Published sources

Smyth, N., Nienhuis, C., Muldoon, C, & Lynn, D. (2015) Conservation and monitoring methods for the Annex IV Clubmoss group (Lycophyta) in Ireland. *Irish Wildlife Manuals*, No. 86. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

Other useful and/or important references containing information on the species.

Berry, P.M., Dawson, T.P., Harrison, P.A., Pearson, R. & Butt, N. (2003) The sensitivity and vulnerability of terrestrial habitats and species in Britain and Ireland to climate change. *Journal for Nature Conservation* **11**: 15-23.

Evans, D. & Arvela, M. (2011) Assessment and Reporting Under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the Period 2007-2012. European Topic Centre on Biological Diversity, Paris.

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Preston, C. D., Pearman, D. A. & Dines, T. D. (2002) *New Atlas of the British & Irish Flora*, Oxford University Press, Oxford.

Scannell, M.J.P. & Synnott, D.M. (1987) *Census Catalogue of the Flora of Ireland*, 2nd ed. Stationery Office, Dublin.

Wyse Jackson, P.S. (2008) The potential impact of climate change on native plant diversity in Ireland http://www.botanicgardens.ie/news/20080122.htm Accessed 21st January 2015.

2.3 Range

2.3.1 Surface area - Range (km²) 4300km²

This figure has been derived from the range map and range tool outlined in 1.1.5.

2.3.2 Method - Range surface area Estimate based on partial data with some extrapolation (2)

The range map consists of 31 (10km²) grid cells in which the species is recorded as occurring and the overall range consists of 43 (10km²) grid cells with 12 outlying cells in which the species is not recorded but is derived as part of the range by the range tool.

2.3.3 Short-term trend period 2001-2012.

The recommended short term trend period has been used.

2.3.4 Short-term trend direction Stable (0)

Five sites have been searched (Smyth *et al*. 2015) and the species was refound at three of these. All site records since 1969 are included in the distribution (see 1.1.3). The two sites searched at Mauntransna Mountain and Lough Eske occur in 10km² for which post 1969 records exist. Conaghan (2006) highlighted under recording as being an issue for this species, therefore expert judgement was used to set the trend as stable.

2.3.5 Short-term trend magnitude

2.3.6 Long-term trend period

2.3.7 Long-term trend direction

2.3.8 Long-term trend magnitude min max

2.3.9 Favourable reference range area (km²) 4300

operator	N/A
unknown	No

Method

The favourable reference range is set as the current range of 4300km^2. There is no evidence of decline in this species since the Directive came into force in 1994 and the current range represents the known geographic range for the species in Ireland. There are possible historic losses for this species in Ireland i.e. pre 1969. This distribution and consequential range value derived from BSBI database, NPWS records and published sources considered to be the Stags Horn Clubmoss baseline.

2.3.10 Reason for change Improved knowledge/more accurate data.

This species was originally assessed as part of the Clubmoss group. There has been a historic loss of this species (pre 1969) with habitat loss known for the demise some of the lowland sites e.g. Offaly and Westmeath.

2.4 Population

2.4.1 Population size Unit Colony number

Given the information presently available the number of colonies is the most reliable indicator of population size. As one colony i.e. a discreet unconnected and measurable patch found within a population site, is the very minimum number that can be recorded for a site. Only three of the 38 populations have an actual number of discrete patches/colonies recorded. The species is stoloniferous in nature and what constitutes an individual can be difficult to define. The particular number of shoots in the size categories outlined by Evans & Arvela 2011 was recorded for three of the known sites at Cloghernagh, Kippure and Camaderry (Wicklow).

Table 1. Population size in the various population unit measurements (Evans & Arvela 2011) for Stags Horn Clubmoss (*L. clavatum*)

Population Number	Year last recorded	10km Grid	Site name	Population count shoots	Population size class	Population Size (m²)	No of colonies
1	1999	B90	VCH35 West Donegal	unknown	unknown	1 (min estimate)	1
2	1989	C12	VCH35 West Donegal	unknown	unknown	1 (min estimate)	1
3	1989	C31	VCH34 East Donegal	unknown	unknown	1 (min estimate)	1
4	1999	F92	Muganerin	unknown	unknown	1 (min estimate)	1
5	1999	G31	VCH28 Co. Sligo	unknown	unknown	1 (min estimate)	1
6	1999	G70	VCH25 Co. Roscommon	unknown	unknown	1 (min estimate)	1
7	2007	G74	Truskmore	unknown	unknown	1 (min estimate)	1
8	1987	G98	Blue Stack Mountains,Sruell Gap	unknown	unknown	1 (min estimate)	1
9	1999	G99	The Grey Mare's Tail	unknown	unknown	1 (min estimate)	1
10	1998	G99	East of Lough Asgarha, Co. Donegal	unknown	unknown	1 (min estimate)	1
11	1998	G99	Lavagh More, the Bluestacks, Co. Donegal	unknown	unknown	1 (min estimate)	1
12	1999	G99	Lough Eske	unknown	unknown	1 (min estimate)	1
13	23/06/2011	H02	Corlisbannan, NE of Dowra, Co. Cavan	unknown	unknown	1 (min estimate)	1
14	12/04/1968	J11	By stream on E side of Clermont Carn, Carlingford Pennisula	unknown	unknown	1 (min estimate)	1
15	1993	L96	Maumtrasna	unknown	unknown	1 (min estimate)	1
16	1993	M53	VCH17 North-east Galway	unknown	unknown	1 (min estimate)	1
17	1987	N79	VCH30 Cavan	unknown	unknown	1 (min estimate)	1
18	27/07/2003	O00	0.75km NE of Mullaghcleevaun, East Top	unknown	unknown	1 (min estimate)	1
19	30/07/2000	O01	100m SE of TV station on Kippure mountain	unknown	unknown	1 (min estimate)	1
20	1999	R77	Ballina	unknown	unknown	1 (min estimate)	1
21	1970	R86	Lough Duff	unknown	unknown	1 (min estimate)	1
22	1986	R90	VCH7 South Tipperary	unknown	unknown	1 (min estimate)	1

Population Number	Year last recorded	10km Grid	Site name	Population count shoots	Population size class	Population Size (m²)	No of colonies
23	1969	S07	Devils Bit	unknown	unknown	1 (min estimate)	1
24	1999	S22	Waterford/Tipperary?	unknown	unknown	1 (min estimate)	1
25	1969	S63	Kilkenny	unknown	unknown	1 (min estimate)	1
26	1969	S64	Kilkenny	unknown	unknown	1 (min estimate)	1
27	31/10/1993	T00	Stoney mountain plateau, above Kelly's Lake	unknown	unknown	1 (min estimate)	1
28	15/05/1993	T09	Clohernagh Mountain, Glenmalure	unknown	unknown	1 (min estimate)	1
29	26/08/2009	T09	Camaderry, left of reservoir, Wicklow	**3**	**1**	**0.01**	**1**
28	17/09/2009	T09	Clohernagh Mountain, Wicklow	**5001-10000**	**6**	**200x100**	**10**
30	2011	T11	Kippure	**5001-10000**	**6**	**150x100**	**10**
31	Jul. 2006	T09	ca. 100 m S of summit of Camenabullogue mountain	unknown	unknown	1 (min estimate)	1
32	14/08/2005	T09	Cannow Mountain, Co. Wicklow	unknown	unknown	1 (min estimate)	1
33	1969	T19	VCH20 Co. Wicklow	unknown	unknown	1 (min estimate)	1
34	1999	W28	West Cork	unknown	unknown	1 (min estimate)	1
35	1999	W68	East Cork	unknown	unknown	1 (min estimate)	1
36	1999	W76	Mid Cork	unknown	unknown	1 (min estimate)	1
37	1999	W77	East Cork	unknown	unknown	1 (min estimate)	1
38	1999	W98	East Cork	unknown	unknown	1 (min estimate)	1
						****35036.01**	***56**

*Assuming a minimum of one colony at each of the record sites

** Assuming a minimum of 1m² for each population at the record sites

2.4.2 Population size Unit (other than individuals) min **56 colonies** max

2.4.3 Additional information Problems

This species was assessed as part of the Clubmoss group in 2007 and for population it was deemed inadequate. While some survey work has been carried out since the last assessment,

the species was refound at three of the five sites searched. Shoot counts, population areas and number of colonies at the other sites not visited could not be estimated from notes within NPWS and BSBI records. Shoot counts do not necessarily represent individual plants as the species grow in aggregate and it is difficult to say what is an individual. Any loss in the number of recorded population sites and colonies i.e. discrete unconnected and measurable patches of the species found within a population site has greater conservation status implications for the species than losses in individual shoot numbers as shoot number can vary depending on time of year recorded and individual recorder. The use of category classes which uses estimates of shoot counts are very useful for monitoring purposes and a colony or population should also not change its size class from one recording and monitoring period to the next (Table 3 Evans & Arvela 2011).

2.4.4 Year or period	1969-2014 based on partial data with some extrapolation
2.4.5 Method – population size	Estimate based on partial data with some extrapolation (2)
2.4.6 Short-term trend period	2001-2012
2.4.7 Short term trend direction	Stable (0)

The limited data available from field data, NPWS records, BSBI records, the literature (e.g. Scannell and Synnott 1987) and Preston *et al.* 2002 suggest there has been no loss of populations in the recent past. In saying that some populations have not been refound (Lough Eske (Donegal) and Mauntrasna Mountain (Galway) (Smyth *et al.* 2015). This species remains a high priority for survey work into the future as it is one of Ireland's true obligate alpine species which in under threat from climate change (Wyse Jackson 2008).

2.4.8 Short-term trend magnitude	min	max	confidence interval
2.4.9 Short-term trend method			
2.4.10 Long-term trend period			
2.4.11 Long term trend direction	N/A		
2.4.12 Long-term trend magnitude	min	max	confidence interval

2.4.13 Long-term trend method N/A

2.4.14 Favourable reference population

number 56 colonies

operator N/A

unknown No

Method

The population figure of 56 colonies was derived from the 1969-2014 (field data, BSBI data and submissions to NPWS) see section 2.4.1 above. This number is considered to represent the population baseline. As there is no evidence of any significant decline in the number of colonies since the Directive came into force and the current figure is considered adequate to ensure the long term survival of the species, the current population estimate is set as the FRP.

2.4.15 Reason for change Improved knowledge/more accurate data.

The four species in the Clubmoss group were assessed together in 2007. For this assessment analysis data from individual records for populations of *L. clavatum* were obtained from a field survey, the historic herbarium record, from NPWS and BSBI record sources and notes and the population size was estimated as outlined in Table 1.

2.5 Habitat for the Species

2.5.1 Surface area - Habitat (km^2) 0.0035km^2

2.5.2 Year or period 1969-2014

(NPWS records, BSBI records, DBN records and this survey)

2.5.3 Method used - habitat

The minimum value for habitat area is 0.0035km^2. This area was calculated in table 1, section 2.4.1. Given the large amount of unknown data for some populations this figure is the very minimum estimated for the thirty eight populations in Ireland. The niche habitat for three of these the populations were accurately measured using canes and string i.e. the populations at Kippure, Cloghernagh & Camaderry (Wicklow).

2.5.4 a) Quality of habitat **Moderate**

Lycopodium clavatum was found to be a pioneering species on bare ground in upland heath and grassy mountain slopes. It was found mainly in associated with lower Domin cover values of *Calluna vulgaris* (1-4) and cover values of bare ground and bare rock ranged from (1-7). It was found in association with two other Clubmoss species *Huperzia selago* and *Diphasiastrum alpinum*. Naturally eroded areas in mountains and erosion due to trampling are unusually likely places for this species but in saying that it was only relocated at three sites. Four habitat indicators were developed for monitoring *L. clavatum* including vegetation height, the cover of *Calluna vulgaris*, cover of bare rock and bryophyte cover.

The height of *L. clavatum* stems was recorded as a proxy for grazing density with shoot lengths above 25cm recorded. Intensive sheep grazing is detrimental to *L. clavatum* and shoot lengths below 25cm are an indicator of intensively highly stocked sheep grazed sites.

L. clavatum was found growing in association with grass species *Deschampsia flexuosa* and *Nardus strictus*, the ericaceous shrubs *Calluna vulgaris*, *Empetrum nigrum* and *Vaccinum myrtilis*, the herb species *Gallium saxatile*, the clubmoss species *Huperzia selago* and *Diphasiastrum alpinum* and the mountain mosses *Racomitrium lanuginosum*, *Polytrichum commune* along with more generalist *Hypnum jutlandicum*, *Rhytidiadelphus loreus* and *Thudium tamariscinum.* It was found to be significantly associated with total grass cover in an NMS analysis (Smyth *et al.* 2015). For monitoring purposes Total grass cover of >26-50% (6-7), *Calluna vulgaris* cover of up to 10% (1-4) and bare rock/bare ground cover of up to 50% (1-7) along with a bryophyte cover of >11-75% (5-8) are indicators of suitable habitat. A larger percentage of bare ground/bare rock was found in association with this Clubmoss species in contrast to the other species in the group.

The habitat at one of the sites monitored was under pressure from intensive sheep grazing and trampling due to excessive hiking at Cloghernagh (Wicklow). One site at Camaderry (Wicklow) had dumping of sand and gravel close to the *L. clavatum* population while another Wicklow site at Kippure was in good condition with less intensive sheep grazing and trampling.

As this species was only located at three of five sites searched (Smyth *et al.* 2015) further searches and monitoring is required for all known sites to refine the indicators and derive a more comprehensive assessment for this species, especially as it is one likely to be affected by climate change in Ireland (Berry *et al.* 2003 & Wyse Jackson 2008).

Recent assessment of Alpine and subalpine heaths (EU 4060), dry heaths (EU 4030) and wet heath (EU 4010) (NPWS 2013) the habitats which this species occurs in has been assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments, which does not bode well for obligate alpine species such as *L. clavatum* reliant on these mountain habitats.

2.5.4 b) Quality of habitat - method

Only three populations out of the thirty eight known populations were fully assessed for *L. clavatum*. Further searches and monitoring is required for all known sites to refine the indicators and derive a more comprehensive assessment for this species, especially as it is one likely to be affected by climate change in Ireland (Berry *et al.* 2003 & Wyse Jackson 2007). *Lycopodium clavatum* (Stags Horn Clubmoss) has an upland distribution, occurring on mossy heaths or bare peat on mountain ridges. The limited data on the area of occupancy calculated from field data at three sites, Cloghernagh, Camaderry and Kippure (Wicklow); suggest there have been no losses in the area occupied by *L. clavatum* in the recent past. The remaining thirty five sites have not been assessed though two historic records for sites at Lough Eske (Donegal) and Maumtrasna (Galway) were search and the species was not refound. At the 10km grid square level sites in suitable habitat are known for both Donegal (G99) and Galway (L96). Records since the 1987 Census Catalogue (Scannell and Synnott 1987) has shown the distribution has expanded but this expansion is mostly due to incidental records by the Botanical Society of the British Isles and NPWS staff during survey work. It is likely these records were overlooked and are not an expansion in the range of the species. It was formerly recorded in lowland sites in Cos Offaly and Westmeath (Preston *et al*. 2002) these are now considered long extinct but likely historic upland records exist for Cos Waterford (Green 2008) and Kerry (V98) (Scully 1916). Conaghan (2006) highlighted under recording as being prevalent predicament for this group of species.

2.5.5 Short term trend period 2001-2012

2.5.6 Short term trend direction stable (0)

Repeat visits to the sites in 2009 and 2014 did not show any loss in the area of occupancy for the species, therefore the trend within the default period is considered to be stable.

2.5.7 Long-term trend period

2.5.8 Long term trend direction N/A

2.5.9 Area of suitable habitat (km²) 0.035 km²

L. clavatum is a very niche specific species obligate alpine species; this area is considered the very minimum for the area of suitable habitat for the species. As the species is likely to be unrecorded for Ireland there may be many other upland areas with suitable habitat.

2.5.10 Reason for change Improved knowledge/more accurate data

2.6 Main Pressures

L. clavatum is closely associated with montane heath Alpine and subalpine heaths (4060), dry heath (4030) and wet heath (4010) these habitats appears on Annex I of the EU Habitats Directive and is of international conservation importance (NPWS 2013). These habitats were assessed as bad for structure and function, bad for future prospects and given an overall bad status in 2013 assessments, which does not bode well for obligate alpine species such as *L. clavatum* reliant on this habitat.

Pressures or impacting activities were recorded at three of the thirty eight likely populations. Intensive sheep grazing (A04.01.02) trampling and overuse (G05.01) were found at Cloghernagh (Wicklow) and disposal of sand and gravel (E03.03) a pressure at Camaderry (Wicklow). Ongoing climate change with the rise of temperature and extremes (M01.01) is a constant pressure for this species in that it is an obligate alpine species with limited possibility for adaptation.

Pressure	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Medium importance (M)	N/A
Intensive sheep grazing (A04.01.02)	Medium importance (M)	N/A
Trampling and overuse (G05.01)	Medium importance (M)	N/A
Climate change (M01.01)	Low importance (L)	N/A
Disposal of inert materials (E03.03)	Low importance (L)	N/A

2.6.1 Method used – pressures Estimate based on partial data with some extrapolation (2)

2.7 Main Threats

The main threats to L. clavatum with limited possibilities for adaptation, montane species and their montane heath habitats are very vulnerable to the effects of climate change (Berry *et al*., 2003) and has been identified as being potentially threatened by climate change by 2050 (Wyse Jackson, 2008). A low level of grazing is ideal with overgrazing a threat to the species and excessive trampling from hikers along the summit and ridges of mountains also considered a long term threat to the species.

Threat	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Medium importance (M)	N/A
Intensive sheep grazing (A04.01.02)	Medium importance (H)	N/A
Trampling and overuse (G05.01)	Medium importance (H)	N/A
Climate change (M01.01)	Low importance (L)	N/A
Disposal of inert materials (E03.03)	Low importance (L)	N/A

2.7.1 Method used – threats Estimate based on expert opinion with minimal sampling (1)

2.8 Complementary Information

2.8.1 Justification of % thresholds for trends

2.8.2 Other relevant Information

2.8.3 Trans-boundary assessment

2.9 Conclusions (assessment of conservation status at end of reporting period)

2.9.1 Range assessment **Favourable (FV)**

qualifiers N/A

The range map consists of 31 (10km^2) grid cells in which the species is recorded as occurring and the overall range consists of 43 (10km^2) grid cells with 12 outlying cells in which the species is not recorded but is derived as part of the range by the range tool. There have been no confirmed losses of the species since 2001. Five sites have been searched (Smyth *et al*. 2015) and the species was refound at three of these. All site records since 1969 are included in

the distribution (see 1.1.3). The two sites searched at Mauntransna Mountain and Lough Eske still included as post 1969 records exist for both these grid squares. There are also 12 single one grid cell records in which the species occurs outside the main range blocks for the species in Cos Donegal, Tipperary, Cork, Kilkenny and Wicklow. Other sites are likely with further survey work Conaghan (2006) highlighted under recording as being an issue for this species. There is no evidence of a decline in range since the Directive came into force and the species is still distributed across its natural range, therefore Range is assesses as Favourable.

2.9.2. Population assessment **Favourable (FV)**

qualifiers N/A

A population can comprise of a single colony or many colonies. There is a large variation in the number of shoots found in different population ranging from the smallest populations with 3 shoots at Camaderry (Wicklow) to the largest populations found at Kippure and Cloghernagh (Wicklow) with 5000-10,000 shoots recorded (Size Class 6 Evans and Arvela 2011).

The largest populations at Kippure and Cloghernagh have each ten distinct colonies recorded. The current number of populations is estimated at 38 comprising of 56 colonies. As the species is quite rare and this is the first baseline assessment for population it is expected that there are possibly more colonies and populations of the species. The species is likely to be unrecorded in Ireland (Preston *et al.* 2002, Conaghan 2006). There is no evidence of decline in population size since the Directive came into force and the number of populations is considered to be adequate for the long term survival of the species, therefore the population is deemed to be favourable.

2.9.3. Habitat assessment **Inadequate (U1)**

qualifiers N/A

The minimum value for habitat area is 0.0035km^{2}This area was calculated in the table outlined in section 2.4.1. Given the large amount of unknown data for some populations this figure should be considered as a very minimum. The niche habitat for three of these the populations were accurately measured using standard vegetation description methods (Kent

2012) quadrats and percentage cover of associated species at Cloghernagh, Camaderry and Kippure (Wicklow). Ongoing monitoring of the main habitat types that this species occurs in Alpine and subalpine Heath (EU 4060), Dry heath (EU4030), wet heath (EU4010) were assessed as Bad (NPWS 2013). Given the limited amount of data available on the specific habitat niche for this species it is assessed as inadequate.

2.9.4. Future prospects assessment **Inadequate (U1)**

qualifiers N/A

The majority of colonies and populations of *L. alpinum* are protected within Special Areas of Conservation and as it mostly occurs in the EU Annex 1 protected habitat Alpine and subalpine Heath (EU 4060), Dry heath (EU4030), wet heath (EU4010)which is also protected and monitored. These habitats however, were given an overall bad status in the 2013 assessments, which does not bode well for obligate alpine species such as *L. clavatum* which is reliant on this habitat. Pressures or impacting activities were recorded at three of the thirty eight likely populations. Intensive sheep grazing (A04.01.02) trampling and overuse (G05.01) were found at site monitored in Cloghernagh (Wicklow) and disposal of sand and gravel (E03.03) a pressure at Camaderry (Wicklow). Ongoing climate change with the rise of temperature and extremes (M01.01) is a constant pressure for this species in that it is an obligate alpine species with limited possibility for adaptation. There was no evidence of collection of any Clubmoss species *L. clavatum* for trade in Ireland (Ferriss 2006).

Future prospects are assessed as inadequate due to ongoing pressures of a moderate intensity.

2.9.5 Overall assessment of Conservation Status	**Inadequate (U1)**
2.9.5 Overall trend in Conservation Status	N/A

Lycopodiella inundata

Report on the main results of the surveillance under article 11 for annex II, IV and V species (Annex B)

0.1 Member State **IE**

0.2.1 Species code **1413**

0.2.2 Species name **Lycopodiella inundata L. (Holub.)**

0.2.3 Alternative species scientific name ***Lepidotis inundata* (L.) P. Beauv. and *Lycopodium inundatum***

0.2.4 Common name **Marsh Clubmoss**

1. National Level

1.1 Maps

1.1.1 Distribution Map Yes

1.1.1a Sensitive species No

1.1.2 Method used – map Estimate based on partial data with some extrapolation (2)

L. inundata has a very restricted distribution in Ireland. It is found mainly in the West of Ireland in Counties Galway and Mayo. It has been recorded from the midlands with a record in Offaly and in the East in Wicklow. A new but unconfirmed record has recently been discovered in Tipperary in 2014 (BSBI). A species distribution map with a cut-off date of 1969 was chosen for mapping purposes, as this date represents the first of the more modern and accurate site location records for the species. Previous to this date the records date from the late 1800s to 1930s.

This cut-off date has excluded the Wicklow population at Glendalough which was last recorded in 1930, it was searched for during this project but it was not refound and no suitable habitat for the species currently exists at this site. The other records excluded include Praeger records from Achill Island (Mayo) not recorded since 1905 and Inisbofin Island (Galway) not recorded since 1911. The flora of Inisbofin Island was re-surveyed by Brodie &

Sheehy Skeffington (1990) and the species was not refound. Another Praeger record from Lough Nadirkmore, Maamtrasna (Galway) in 1932 was also excluded. The other records excluded are from Lough Guitane shore, Killarney (Kerry) recorded by Scully in 1887 and two late 1800 records (1873 & 1883) from Cork (BSBI database records). Excluding these sites this leaves a total of 17 populations for the species recorded since 1969. However, three of the sites: Lough Belshade (G98) (Donegal), Knockowen (V85) (Cork) and Woodfield bog (N23) (Offaly), were searched for during this project (Smyth *et al.* 2015) and the species not refound. These sites are still included in the distribution as suitable habitat for the species still exists for the species at these locations.

1.1.3 Year or period 1969-2014

Seven of the recorded population sites were visited between 2009 and 2014, however only two of these records were validated in the field; these were the populations at Cornamona (Galway) and Clare Island (Mayo). Five others were searched and the species was not refound these were: Lough Belshade (G98) (Donegal); Lough Nadirkmore, Maamtrasna (L96) (Galway); Knockowen (V85) (Cork); Lough Guitane shore, Killarney (Kerry) (W08) and Woodfield bog (N23) (Offaly). One new site has been recorded in 2014 at The Commons of Carnay (R89) (Tipperary) (BSBI record P. Green) this record has yet to be validated but it is included here for completeness.

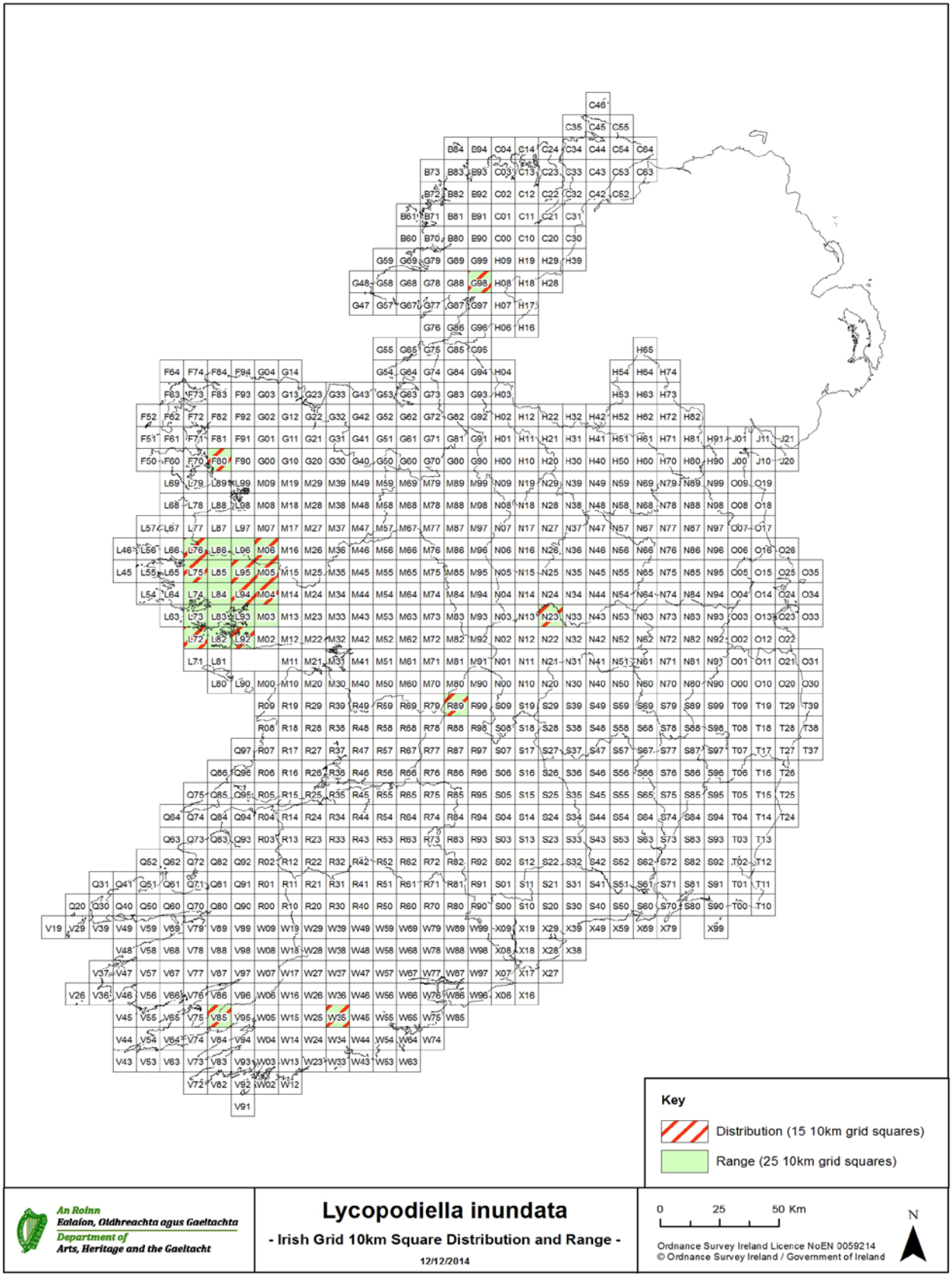
1.1.4 Additional map

Two of the seven records validated in the field 2009-2014 as part of this project were mapped and of the five others searched for and not refound, three were included, where the habitat was still deemed suitable for the species. The validated records with all other records post 1969 were intersected with the Irish National Grid 10km^2 square grid for the distribution map.

1.1.5 Range map

The distribution map consists of 15 (10km^2) grid cells in which the species is recorded as occurring. The range envelope consists of 25 (10km^2) grid cells with 10 outlying cells in which the species is not recorded but is derived as part of the range by the range tool. There are three single one grid cell records which occur outside the main range of the species in

Galway and Mayo. The single outliers are found in Donegal (G98), Offaly (N23) and Tipperary (R89).



2. Biogeographical Or Marine Level

2.1 Biogeographical Region **Atlantic (ATL)**

2.2 Published sources

Smyth, N., Nienhuis, C., Muldoon, C, & Lynn, D. (2015) Conservation and monitoring methods for the Annex IV Clubmoss group (Lycophyta) in Ireland. *Irish Wildlife Manuals*, No. 86. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

Other useful and/or important references containing information on the species.

Berry, P.M., Dawson, T.P., Harrison, P.A., Pearson, R. & Butt, N. (2003) The sensitivity and vulnerability of terrestrial habitats and species in Britain and Ireland to climate change. *Journal for Nature Conservation* **11**: 15-23.

Berry, P.M., O'Hanley, J.R., Thomson, C.L. Harrison, P.A. Masters, G.J. & Dawson, T.P. (Eds.) (2007) *MONARCH 3*, A synthesis for biodiversity conservation Full Technical (Modeling Natural Resource Responses To Climate Change) available from http://www.eci.ox.ac.uk/research/biodiversity/monarch3/full technical pdf. Accessed 18th February 2015.

Brodie, J. & Sheehy Skeffington, M. (1990) Inisbofin: A re-survey of the Flora. *The Irish Naturalists' Journal*, **Vol. 23, No. 8**: 293-298.

Curtis, T. G. F. & McGough, H. N. (1988) The Irish Red Data Book 1: Vascular Plants. Government Stationary Office.

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JNCC. (2004) Common Standards Monitoring Guidance for Vascular Plant Species. Version February 2004. Joint Nature Conservation Committee, Peterborough. (Vascular plant species of ephemeral ponds, ruts and puddles Species Suite 11).

Kingston, N. (2012) Checklist of protected and rare species in Ireland. Unpublished National Parks & Wildlife Service Report.

Rich, T.C.G., Beesley, S. & Goodwillie, R. (2001) Changes in the vascular plant flora of Ireland between pre-1960 and 1987-198 the BSBI Monitoring Scheme *The Irish Naturalists' Journal*, **Vol. 26, No. 10**:333-350.

Scannell, M.J.P. & Synnott, D.M. (1987) *Census Catalogue of the Flora of Ireland*, 2nd ed. Stationery Office, Dublin.

Wyse Jackson, P.S. (2008) The potential impact of climate change on native plant diversity in Ireland http://www.botanicgardens.ie/news/20080122.htm Accessed 21st January 2015.

2.3 Range

2.3.1 Surface area - Range (km²) 2500km²

This figure has been derived from the range map and range tool outlined in 1.1.5.

2.3.2 Method - Range surface area Estimate based on partial data with some extrapolation (2)

The range map consists of 15 (10km²) grid cells in which the species is recorded as occurring and the range consists of 25 (10km²) grid cells with 10 outlying cells in which the species is not recorded but is derived as part of the range by the range tool.

2.3.3 Short-term trend period 2001-2012.

The recommended short term trend period has been used.

2.3.4 Short-term trend direction Stable (0)

There have been no confirmed losses of the species. Seven sites have been searched during this project and the species was refound at two of these. Two are excluded as they are pre 1969 and no suitable habitat exists and the other three were mapped as part of the current distribution as areas of suitable habitat still remain and the occurrence of the species at these sites is still expected. The species has also been recorded though not confirmed at a new Irish site in Tipperary (R69).

2.3.5 Short-term trend magnitude

2.3.6 Long-term trend period

2.3.7 Long-term trend direction

2.3.8 Long-term trend magnitude	min	max
2.3.9 Favourable reference range	area (km²)	2500
	operator	N/A
	unknown	No

Method

The favourable reference range is set as the current range of 2500km². As there is no evidence of a decline since the Directive came into force the current range is set as the favourable reference range.

2.3.10 Reason for change Improved knowledge/more accurate data.

There has been a historic loss of this species (pre 1969) with habitat loss known for the demise of the most easterly population at Wicklow and southerly populations in Kerry. However, this species is cryptic and easily overlooked more survey work could discover other sites (for example a new site was discovered in 2014 (BSBI database) in North Tipperary (R69).

2.4 Population

2.4.1 Population size Unit Colony number

Given the information presently available, colony number is the most reliable indicator of population size. As one colony i.e. discrete unconnected and measurable patches of the species found within a population site is the minimum number that can be recorded for a site. Eight of the seventeen populations have an actual number of discrete patches/colonies recoded. The species is stoloniferous in nature and what constitutes an individual can be difficult to define. The number of shoots in each population was recorded for two of the known sites at Clare Island (Mayo) and Cornamona (Galway) during this project and converted to size class using Table 3 in Evans & Arvela (2011). Size and counts for the other populations were obtained from notes on those populations from NPWS and BSBI record (Table 1 below).

Table 1. Population size in the various population unit measurements (Evans & Arvela 2011) for Marsh Clubmoss (*L. inundata*)

Population Number	Year last recorded	10km Grid	Site name	Population count shoots	Population size class (Evans & Arvela 2011)	Population Size (m)	No of colonies
1	1982	F80	Srahduggan	unknown	unknown	unknown	1
2	1982	G98	L.Belshade, SW corner	unknown	unknown	unknown	1
3	2014	L72	Capnagower, Clare Island	175 (actual)	3	12 x 7 m (actual)	2
4	1986	L75	W Galway	unknown	unknown	unknown	1
5	1974	L76	Altnagaighera	unknown	unknown	unknown	1
6	1969	L92	Carraroe	unknown	unknown	unknown	1
7	2006	L94	Oorid Lough	100 (NPWS)	2	10m² (NPWS)	2
8	2006	L94	Lough Corrib shore east of Lackavrea hill	20 (NPWS)	1	along 200m (NPWS)	1
9	1971	L95	Maam Bridge	unknown	unknown	unknown	1
10	1971	M04	Owenwee River	unknown	unknown	unknown	1
11	2009	M05	Cornamona, Galway	400 (actual)	3	10 x 50 m (actual)	3
12	2004	M06	Glensaul	unknown	unknown	unknown	4
13	2004	M06	by Lough Mask SE. of Derrypark	unknown	unknown	3 x 1 m (NPWS)	3
14	1972	N23	Woodfield Bog	unknown	unknown	19.5 x 12.5m (NPWS)	3
15	2014	R89	The commons of Carnay	unknown	unknown	unknown	1
16	1969	W35	West Cork	unknown	unknown	unknown	1
17	1999	V85	Knockowen	50 (BSBI)	1	unknown	1
				***3720**	***6**	***5205m²**	****40**

Using these data an estimate of population size was calculated using the following method

i.e. *using the average of population shoot count of 5 populations for the unknown sites

[(175+100+20+400 +50)/5= 149, the five populations have an average colony size of 2

this would give a minimum estimated population shoot count of 2533 for 17 populations and 3725 for the 40 estimated colonies a size class 6 (Evans & Arvela 2011).

Table 2 . Population size estimate calculations for *L. inundata*

Population Size *L. inundata*	***Population count shoots**	****Population Size (m2)**	*****No of colonies**
Total	**745**	**1041**	**19**
Average (of the 5 populations)	149	174	2
8 pops have 19 colonies	93	16	
Extrapolated to 17 populations	2533 (17*149)	2958 (17*174)	
Extrapolated to 40 colonies	**3720 (93*40)**	**5205**	**40**

2.4.2 Population size Unit (other than individuals) min **40 colonies** max

2.4.3 Additional information Problems

This species was assessed as part of the Clubmoss group in 2007 and for population it was deemed inadequate. While some survey work has been carried out since the last assessment, the species was refound at only two of the seven sites searched. Shoot counts, population areas and number of colonies at the other sites not visited were calculated from notes within NPWS and BSBI records. Shoot counts do not necessarily represent individual plants as the species grow in aggregate and it is difficult to say what is an individual. Any loss in the number of recorded population sites and colonies i.e. discrete unconnected and measurable patches of the species found within a population site has greater conservation status implications for the species than losses in individual shoot numbers as shoot number can vary depending on time of year recorded and individual recorder. The use of category classes which uses estimates of shoot counts are very useful for monitoring purposes and a colony or population should also not lower its size class from one recording and monitoring period to the next (Table 3 Evans & Arvela 2011).

2.4.4 Year or period 1969-2014 based on partial data with some extrapolation

2.4.5 Method – population size Estimate based on partial data with some extrapolation (2)

2.4.6 Short-term trend period 2001-2014

2.4.7 Short term trend direction stable (0)

The limited data available from field data, NPWS records and BSBI records suggest there has been no loss of populations in the recent past i.e. post 1994 since the Directive came into force. In saying that some populations have not been refound during this recent survey (i.e. since 2007) these remain a high priority for survey work into the future, as suitable habitat still remains at these sites it is considered likely that the populations still exist.

2.4.8 Short-term trend magnitude min max confidence interval

2.4.9 Short-term trend method

2.4.10 Long-term trend period

2.4.11 Long term trend direction N/A

2.4.12 Long-term trend magnitude min max confidence interval

2.4.13 Long-term trend method N/A

2.4.14 Favourable reference population

number	28 colonies
operator	N/A
unknown	No

Method

The population figure of 40 colonies was derived from the 1969-2014 (field data, BSBI data and submissions to NPWS) see section 2.4.1 above. This number is considered to represent the population baseline. As there is no evidence of any significant decline in the number of colonies since the Directive came into force the current population estimate is set as the FRP.

2.4.15 Reason for change Improved knowledge/more accurate data.

The four species in the Clubmoss group were assessed together in 2007. For this assessment analysis data from individual records for populations of *L. inundata* were obtained from a field survey, the historic herbarium record and from NPWS and BSBI record sources and notes and the population size was estimated as outlined in Table 1.

2.5 Habitat for the Species

2.5.1 Surface area - Habitat (km²) 0.0052km²

2.5.2 Year or period 1969-2014

(NPWS records, BSBI records, DBN records and this field survey)

2.5.3 Method used - habitat Estimate based on expert opinion with minimal sampling (1)

The minimum value for habitat area is 0.0052km². This area was calculated in the table outlined in section 2.4.1 (Table 1). Given the large amount of unknown data for some populations this figure could be considered as a very minimum. Some data was available for six of the seventeen populations assessed from NPWS and BSBI record. The niche habitat for two of these the populations were accurately measured using canes and string i.e. the populations at Clare Island (Mayo) and Cornamona (Galway).

2.5.4 a) Quality of habitat Good

Five habitat indicators were developed for monitoring *L. inundata* including vegetation height/grazing level, positive and negative species associations, hydrology and the presence of bare patches for the species to colonise. The height of *L. inundata* stems were taken as a proxy for grazing density, with shoot lengths above 6cm recorded. The species *Schoenus nigricans*, *Nardus strictus* and bryophytes spp. should all be present. Small patches of bare ground are deemed necessary for the species with a suggested minimum value of 10 % and each site should have a damp to touch substrate. Of the two populations assessed for *L. inundata* both were assessed as good with one attribute failing for the population at Coromona, where the substrate was not damp to touch, as this site was assessed in September a winter monitoring visit to sites is recommended.

2.5.4 b) Quality of habitat - method

Only two populations out of the seventeen known populations were fully assessed for *L. inundata*. The species found associated with *L. inundata* at two populations (Clare Island and Coromona) in five 1x1m quadrats were *Nardus strictus*, *Schoenus nigricans*, *Erica tetralix*, *Narthecium ossifragum*, and the bryophytes *Polytrichum juniperum* and *Racomitrium spp.* In an non metric multi-dimensional scaling analysis (NMS) of all clubmoss species (*Huperzia selago*, *Diphasiastrum alpinum*, *Lycoopodium clavatum and Lycopodiella inundata*) occurrence of *L. inundata* was negatively correlated with *Calluna vulgaris* and bare ground and bare patches

were important and positively correlated with *L. inundata*. In this case mixed low density grazing is thought to favour its occurrence of the species as it would be easily outcompeted. The cover of *Nardus strictus* and *Schoenus nigricans* ranged from 25-75% at the two sites occupied and bare ground/surface ranged from 10-75%. The JNCC (2004) suggest that hydrology is also important to this species as an indirect habitat attribute. *L. inundata* was included as part of the UK Guidance on conservation objectives for monitoring designated sites with the interest features of vascular plant species of ephemeral ponds, ruts and puddles (Suite 11) and they suggest that some evidence of flooding or direct evidence of dampness should be observed at sites during the winter (JNCC 2004). At Clare Island water (stream) was observed in the vicinity (<1m) away from the population and the substrate was damp to touch. The substrate at the Coromona population was dry to touch in September, but large rocks in the vicinity (<1m) away had moist substrate surrounding them, due to water run off. As this species was only located at two of seven formerly known sites, further searches and monitoring is required to refine the indicators and derive a more comprehensive assessment.

2.5.5 Short term trend period 2000-2012

2.5.6 Short term trend direction stable (0)

The limited data on the area of occupancy calculated from field data at two sites (No 3 & No 11 i.e. Clare Island and Cornamona) , and NPWS data collected at four other sites (No 7, 8, 13 & 14 i.e. Oorid Lough, Lough Corrib, Lough Mask and Woodfield bog) suggest there have been no losses in the area occupied by *L. inundata* in the recent past. The remaining 11 sites have not been assessed and it is presumed they demonstrate a similar stable trend.

2.5.7 Long-term trend period

2.5.8 Long term trend direction N/A

2.5.9 Area of suitable habitat (km^2) 0.0052km^2

L. inundata is a very niche specific species; this area is considered the very minimum for the area of suitable habitat for the species. As the species is easily overlooked there may be many other areas with suitable habitat i.e. in *Nardus* grassland and blanket bog habitats.

2.5.10 Reason for change Improved knowledge/more accurate data

2.6 Main Pressures

Pressures or impacting activities were recorded at two of the seventeen known populations. Drainage (J02) and Problematic native species (I02) were noted as occurring at one site Clare island (Mayo). The population at this site is in need of ongoing monitoring as drains are regularly cleaned and reopened on nearby agricultural land. Grazing (A02) both intensive (A02.01) and lack of (A04.03) are having a negative impact at both sites monitored i.e. Clare Island and Coromona. Problematic native species i.e. Bracken (I02) was found occurring in the vicinity of the population on Clare Island any expansion of this native aggressive species would cause the demise of *L. inundata* at this site.

Pressure	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Low importance (L)	N/A
Intensive sheep grazing (A04.01.02)	Low importance (L)	N/A
Abandonment of pastoral systems, lack of grazing (A04.03)	Low importance (L)	N/A
Drainage (J02)	Medium importance (M)	N/A
Problematic native species i.e. Bracken (I02)	Medium importance (M)	N/A

2.6.1 Method used – pressures Based on real data from sites visited (3)

2.7 Main Threats

The main threats to the species are drainage and both under and overgrazing. A low level of mixed grazing is ideal with both under and overgrazing a threat to the species. Low levels of mixed grazing keeps aggressive native species such as bracken contained and keeps the more competitive vegetation such as native grasses and *Calluna vulgaris* from colonising sites where *L. inundata* is growing as it dislikes competition. Open drains were observed near the population on Clare Island these should be closely monitored. No loss or drop in the water table was observed and the substrate is damp to touch, however any further expansion of the drains network at this site would have negative consequences for the species. Other activities not observed currently but which are likely to negatively impact on the species are Fertilisation (A08) and Trampling and overuse (G05.01).

Threat	ranking	pollution qualifier(s)
Intensive grazing (A04.01)	Low importance (L)	N/A
Intensive sheep grazing (A04.01.02)	Low importance (L)	N/A
Abandonment of pastoral systems, lack of grazing (A04.03)	Low importance (L)	N/A
Drainage (J02)	Medium importance (M)	N/A
Fertilisation (A08)	Low importance (L)	N/A
Problematic native species i.e. Bracken (I02)	Medium importance (M)	N/A
Trampling and overuse (G05.01)	Low importance (L)	N/A

2.7.1 Method used – threats Expert opinion (1)

2.9 Conclusions (assessment of conservation status at end of reporting period)

2.9.1 Range assessment **Favourable (FV)**

qualifiers N/A

The range of *L. inundata* is centred in West Galway and West Mayo with single record outliers in Donegal, Cork, Kerry, Offaly and more recently Tipperary (2014). Some of the outlying records in Donegal, Cork, Kerry and Offaly were searched for during 2009-2014 and they were not refound. However, areas of suitable habitat still exist at three of these sites, these outlying records were included in the current range 17 populations in 15 (10 km^2) grid squares. The range for this species is assessed as favourable as there is no evidence of decline since the Directive came into force. However, searches of these outlying range records should be carried out to refine the range.

2.9.2. Population assessment **Favourable (FV)**

qualifiers N/A

A population can comprise of a single colony or many colonies. Most populations are small with 50-400 shoots recorded (Size class 3 Evans and Arvela 2011). The largest population at Glensaul (2004) has four distinct colonies recorded. The smallest population recorded was Lough Mask SE. of Derrypark only 3m² (NPWS records). The current number of populations is estimated at 17 comprising of 28 colonies. As the species is quite rare and this is the first baseline assessment for population it is expected that there are possibly more colonies and populations of the species. The species is easily overlooked and an example of this can be illustrated by the new yet unconfirmed find of *L. inundata* in 2014 in Tipperary (R89) by Green (BSBI). There has been no evidence of a decline in population size since the Directive came into force, therefore the population is deemed to be favourable.

2.9.3. Habitat assessment **Favourable (FV)**

qualifiers N/A

The minimum value for habitat area is 1.142km. This area was calculated in the table outlined in section 2.4.1. Given the large amount of unknown data for some populations this figure should be considered as a very minimum. Some data was available for six of the seventeen populations assessed from NPWS and BSBI records. The niche habitat for two of these the populations were accurately measured at Clare Island (Mayo) and Cornamona (Galway). The species is very habitat specific and 0.0052km² as the *L. inundata* area is considered the very minimum. As the species is easily overlooked there may be many other populations in areas of suitable habitat i.e. *Nardus* grassland and blanket bog. Ongoing monitoring of the main habitat types that this species occurs in i.e. *Nardus* grassland (EU 6230) and blanket bog (EU 7130) which were both assessed as Bad and declining (NPWS 2013) is recommended. There has been no evidence of a decline in the very specific habitat niche this species occurs in since the Directive came into force in 1994 so habitat is deemed favourable.

2.9.4. Future prospects assessment **Favourable (FV)**

qualifiers N/A

The majority of colonies and populations of *L. inundata* are protected within Special Areas of Conservation and the species is also listed on the Flora Protection Order 1999 (Kingston 2012). The species is under threat from drainage and change in grazing regimes at one of its known population sites, Clare Island, Co. Mayo. However, these pressures are currently not having an impact on the size of the population there. There are no other known pressures impacting on *L. inundata* populations, bearing in mind that only two populations out of 17 were monitored for this report. There was no evidence of collection of any Clubmoss species or *L. inundata* for trade in Ireland (Ferriss 2006). A recent find of a new population of *L. inundata* in Tipperary in 2014 suggests that the species may be under recorded in Ireland. The species however, was located at only two of seven formerly known sites during this project, therefore further monitoring and searches should be carried out as the assessments of the main habitat type that this species occurs in i.e. *Nardus* grassland (EU 6230) and blanket bog (EU 7130) were both assessed as Bad and declining (NPWS 2013).

2.9.5 Overall assessment of Conservation Status **Favourable (FV)**

Appendix 2 Site Monitoring Cards

Standard monitoring sheet *Huperzia selago*

MONITORING CARD Page 1

Site name	e.g. Kippure Co . Wicklow	Recorder:
Date		NOTES:
GPS Irish Grid		
Photographs SITE/Colonies		
POPULATION ASSESSMENT		**Population Assessment COLONY CLASS**
Total colony number		
Population size	**(i.e. combined area of occupancy of colonies : LARGE - GPS points to make a polygon or SMALL -bamboo canes)**	
Total Domin cover in total area of target species (*H. selago*)		
Population size class		
Fertile cones present		
SITE LEVEL HABITAT ASSESSMENT		
Grazing /Vegetation Height (average shoot length of 5 shoots /m²		
Domin scale cover of *Calluna vulgaris* in total area		
Domin cover bare rock in total area		
Total vegetation cover in total area		
Fossit Habitat in total area		
Site sketch		

Class	Population
1	0-50
2	50-100
3	100-500
4	500-1000
5	1000-5000
6	5000-10000
7	10000-50000
8	50000-100000
9	100000-500000
10	500000-1000000
11	1000000-5000000
12	5000000-10000000
13	10000000-50000000
14	50000000-1000000000

Standard monitoring sheet *Huperzia selago*

MONITORING CARD Page 2

ASSESSMENT OF FUTURE PROSPECTS	**Location/within the total area or within the site**	**Influence (positive/ negative/ neutral)**	**Intensity (High/medium/low)**	**Area of damage m²**	**Impact value score**
Trampling and overuse (G05.01)					
Disposal of inert materials in this case sand and gravel (E03.03)					
Intensive sheep grazing (A04.01.02)					
Climate change rise of temperatures and extremes (M01.01) -any decrease in cover of mountain mosses ?? -any decrease in cover of target species ??					
Notes					
VEGETATION QUADRATS	1x1m	1x1m	1x1m	1x1m	1x1m
GPS (Irish Grid)					
SPECIES					
DOMIN COVER					
H. selago					
Calluna vulgaris					
Bare ground/rock					
Total vegetation Cover					

DOMIN SCALE:
+ = 1 individual with no measurable cover
1 = <4% with few individuals
2 = <4% with several individuals
3 = <4% with many individuals
4 = 4-10%
5 = 11-25%
6 = 26-33%
7 = 34-50%
8 = 51-75%
9 = 76-90%
10 = 91-100%

Site Notes

Standard monitoring sheet *Diphasiastrum alpinum*

MONITORING CARD Page 1

Site name	e.g. Kippure Co . Wicklow	Recorder:
Date		NOTES:
GPS Irish Grid		
Photographs SITE/Colonies		
POPULATION ASSESSMENT		
Total colony number		**Population Assessment COLONY CLASS**
Population size	**(i.e. combined area of occupancy of colonies :LARGE - GPS points to make a polygon or SMALL -bamboo canes)**	
Total Domin cover in total area of target species (*D. alpinum*)		
Population size class		
Fertile cones present		
SITE LEVEL HABITAT ASSESSMENT		
Grazing /Vegetation Height (average shoot length of 5 shoots /m²		
Domin scale cover of *Calluna vulgaris* in total area		
Domin cover bare rock in total area		
Total vegetation cover in total area		
Fossit Habitat in total area		
Site sketch		

Class	Population
1	0-50
2	50-100
3	100-500
4	500-1000
5	1000-5000
6	5000-10000
7	10000-50000
8	50000-100000
9	100000-500000
10	500000-1000000
11	1000000-5000000
12	5000000-10000000
13	10000000-50000000
14	50000000-1000000000

Standard monitoring sheet *Diphasiastrum alpinum* MONITORING CARD Page 2						
ASSESSMENT OF FUTURE PROSPECTS	**Location/within the total area or within the site**	**Influence (positive/ negative/ neutral)**	**Intensity (High/medium/low)**	**Area of damage m^2**	**Impact value score**	
Trampling and overuse (G05.01)						
Disposal of inert materials in this case sand and gravel (E03.03)						
Intensive sheep grazing (A04.01.02)						
Climate change rise of temperatures and extremes (M01.01) -any decrease in cover of *Calluna vulgaris*? -any decrease in cover of target species ?						
Notes						
VEGETATION QUADRATS	1x1m	1x1m	1x1m	1x1m	1x1m	**<u>DOMIN SCALE</u>:** **+ = 1 individual with no measurable cover** **1 = <4% with few individuals** **2 = <4% with several individuals** **3 = <4% with many individuals** **4 = 4-10%** **5 = 11-25%** **6 = 26-33%** **7 = 34-50%** **8 = 51-75%** **9 = 76-90%** **10 = 91-100%**
GPS (Irish Grid)						
SPECIES						
DOMIN COVER						
D. alpinum						
Bare ground/rock						
Calluna vulgaris						
Total vegetation cover						
Site Notes						

Standard monitoring sheet *Lycopodium clavatum*

MONITORING CARD Page 1

Site name	e.g. Kippure Co . Wicklow	Recorder:
Date		NOTES:
GPS Irish Grid		
Photographs SITE/Colonies		
POPULATION ASSESSMENT		
Total colony number		
Population size	**(i.e. combined area of occupancy of colonies :LARGE - GPS points to make a polygon or SMALL -bamboo canes)**	**Population Assessment COLONY CLASS**
Total Domin cover in total area of target species (*L. clavatum*)		
Population size class		
Fertile cones present		
SITE LEVEL HABITAT ASSESSMENT		
Grazing /Vegetation Height (average shoot length of 5 shoots /m²		
Domin scale cover of *Calluna vulgaris* in total area		
Domin cover bare rock in total area		
Total Bryophyte cover in total area		
Fossit Habitat in total area		
Site Sketch		

Class	Population
1	0-50
2	50-100
3	100-500
4	500-1000
5	1000-5000
6	5000-10000
7	10000-50000
8	50000-100000
9	100000-500000
10	500000-1000000
11	1000000-5000000
12	5000000-10000000
13	10000000-50000000
14	50000000-1000000000

Standard monitoring sheet *Lycopodium clavatum* MONITORING CARD Page 2						
ASSESSMENT OF FUTURE PROSPECTS	**Location/within the total area or within the site**	**Influence (positive/ negative/ neutral)**	**Intensity (High/medium/low)**	**Area of damage m^2**	**Impact value score**	
Trampling and overuse (G05.01)						
Disposal of inert materials in this case sand and gravel (E03.03)						
Intensive sheep grazing (A04.01.02)						
Climate change rise of temperatures and extremes (M01.01) -any decrease in cover of mountain mosses ?? -any decrease in cover of target species ??						
Notes						
VEGETATION QUADRATS	1x1m	1x1m	1x1m	1x1m	1x1m	**DOMIN SCALE:** **+ = 1 individual with no measurable cover** **1 = <4% with few individuals** **2 = <4% with several individuals** **3 = <4% with many individuals** **4 = 4-10%** **5 = 11-25%** **6 = 26-33%** **7 = 34-50%** **8 = 51-75%** **9 = 76-90%** **10 = 91-100%**
GPS (Irish Grid)						
SPECIES						
DOMIN COVER						
L. clavatum						
Total bryophyte cover						
Bare ground/rock						
Calluna vulgaris						
Site Notes						

Standard monitoring sheet *Lycopodiella inundata*

MONITORING CARD Page 1

Site name	e.g. Capnagower, Clare Island, Co. Mayo	Recorder:
Date		NOTES:
GPS Irish Grid		
Photographs SITE/Colonies		
POPULATION ASSESSMENT		
Total colony number		**Population Assessment COLONY CLASS**
Population size	**(i.e. combined area of occupancy of colonies :LARGE - GPS points to make a polygon or SMALL -bamboo canes)**	
Total Domin cover in total area of target species (*L. inundata*)		
Population size class		
Fertile cones present		
SITE LEVEL HABITAT ASSESSMENT		
Grazing /Vegetation Height (average shoot length of 5 shoots /m²		
Domin scale cover of *Schoenus & Nardus* in total area		
Domin cover bare rock/ground in total area		
Bryophyte cover in total area		
Hydrology (damp to touch) in total area		
Site sketch		

Class	Population
1	0-50
2	50-100
3	100-500
4	500-1000
5	1000-5000
6	5000-10000
7	10000-50000
8	50000-100000
9	100000-500000
10	500000-1000000
11	1000000-5000000
12	5000000-10000000
13	10000000-50000000
14	50000000-1000000000

Appendix 3d: Standard monitoring sheet *Lycopodiella inundata*
MONITORING CARD Page 2

ASSESSMENT OF FUTURE PROSPECTS	Location/within the total area or within the site	Influence (positive/ negative/ neutral)	Intensity (High/medium/low)	Area of damage m²	Impact value score
Trampling and overuse (G05.01)					
Intensive sheep grazing (A04.01.02)					
Climate change rise of temperatures and extremes (M01.01) -any increase in cover of target species ??					
Drainage (J02)					
Fertilisation (A08)					
Problematic native species i.e. Bracken (I02)					
Other					
VEGETATION QUADRAT	1x1m	1x1m	1x1m	1x1m	1x1m
GPS (Irish Grid)					
SPECIES					
DOMIN COVER					
L. inundata					
Schoenus nigricans					
Nardus strictus					
Total bare ground					

DOMIN SCALE:
+ = 1 individual with no measurable cover
1 = <4% with few individuals
2 = <4% with several individuals
3 = <4% with many individuals
4 = 4-10%
5 = 11-25%
6 = 26-33%
7 = 34-50%
8 = 51-75%
9 = 76-90%
10 = 91-100%

Site Notes

Appendix 3 Population Conservation Assessments

Monitoring sites *Huperzia selago*

Huperzia selago

***Huperzia selago* monitoring sites and individual quadrats -** all historic records searched were refound

Site name	**GPS Irish Grid**	**Quadrat Code and No**	**Conservation Assessment**
Connor Pass	50342/06083 (+ 3m)	CPHS1	Inadequate
Connor Pass	50336/06090 (+ 3m)	CPHS2	
Connor Pass	50332/06068 (+ 3m)	CPHS3	
Connor Pass	50325/06067 (+ 4m)	CPHS4	
Lough Cruttia	47782/10562 (+ 4m)	LCHS1	Inadequate
Lough Cruttia	47740/18615 (+ 5m)	LCHS2	
Healy Pass	78569/53562 (+ 7m)	HH1	Inadequate
Healy Pass	78574/53565 (+ 3m)	HH2	
Healy Pass	78596/53556 (+ 3m)	HH3	
Healy Pass	78607/53508 (+ 3m)	HH4	
Healy Pass	78599/53533 (+ 3m)	HH5	
Healy Pass	78592/53555 (+ 3m)	HH6	
Healy Pass	78586/53559 (+ 3m)	HH7	
Knockowen	80879/55448 (+ 3m)	KOHS1	Inadequate
Knockowen	80921/55457 (+ 3m)	KOHS2	
Knockowen	80971/55501 (+ 3m)	KOHS3	
Knockowen	81045/55510 (+ 3m)	KOHS4	
Knockowen	81066/55494 (+ 3m)	KOHS5	
Knockowen	81059/55456 (+ 3m)	KOHS6	
Knockowen	80994/55407 (+ 3m)	KOHS7	
Knockowen	80863/55385 (+ 3m)	KOHS8	
Knockowen	80867/55417 (+ 3m)	KOHS9	
Knockowen	80946/55456 (+ 3m)	KOHS10	
Kilcrohane	80908/39358 (+ 3m)	KHHS1	Inadequate
Kilcrohane	80908/39359 (+ 3m)	KHHS2	
Kilcrohane	80903/39357 (+ 3m)	KHHS3	
Kilcrohane	80912/39373 (+ 3m)	KHHS4	
Kilcrohane	80902/39371 (+ 3m)	KHHS5	
Camaderry	06743/99074 (+ 3m)	WGR1	Favourable
Camaderry	06782/99123 (+ 3m)	WGR2	
Camaderry	06771/99111 (+ 3m)	WGR3	
Camaderry	06789/98989 (+ 3m)	WGR4	
Camaderry	06787/98983 (+ 3m)	WGR5	
Camaderry	06764/98988 (+ 3m)	WGR6	
Camaderry	06753/98993 (+ 3m)	WGR7	

Site name	GPS Irish Grid	Quadrat Code and No	Conservation Assessment
Camaderry	06753/98975 (+ 3m)	WGR8	
Camaderry	06745/98995 (+ 3m)	WGR9	
Camaderry	06737/99012 (+ 3m)	WGR10	
Kippure	11725/15313 (+ 3m)	KMHS1	Favourable
Kippure	11699/15311 (+ 3m)	KMHS2	
Kippure	11694/15344 (+ 3m)	KMHS3	
Kippure	11667/15398 (+ 3m)	KMHS4	
Kippure	11651/15447 (+ 3m)	KMHS5	
Kippure	11633/15490 (+ 3m)	KMHS6	
Kippure	11675/15485 (+ 3m)	KMHS7	
Kippure	11678/15469 (+ 3m)	KMHS8	
Kippure	11698/15376 (+ 3m)	KMHS9	
Kippure	11702/15361 (+ 3m)	KMHS10	
Derryveagh	97373/22304 (+ 4m)	DVHS1	Favourable
Derryveagh	97377/22297 (+ 3m)	DVHS2	
Derryveagh	97375/22274 (+ 3m)	DVHS3	
Derryveagh	97366/22271 (+ 3m)	DVHS4	
Derryveagh	97331/22243 (+ 3m)	DVHS5	
Derryveagh	97414/22246 (+ 3m)	DVHS6	
Derryveagh	97423/22265 (+ 3m)	DVHS7	
Derryveagh	97419/22290 (+ 3m)	DVHS8	
Derryveagh	97416/22290 (+ 3m)	DVHS9	
Derryveagh	97415/22319 (+ 3m)	DVHS10	
Cloghernagh	05497/91993 (+ 3m)	CMLC4	Favourable
Cloghernagh	05421/92073 (+ 3m)	CMLC6	
Muckish	00102/28199 (+ 4m)	MMDA1	Favourable
Muckish	00113/28187 (+ 4m)	MMDA2	
Muckish	00086/28163 (+ 3m)	MMDA3	
Muckish	00124/28165 (+ 3m)	MMDA4	
Muckish	00103/28142 (+ 3m)	MMDA5	
Muckish	00090/28121 (+ 3m)	MMDA6	
Muckish	00114/28098 (+ 3m)	MMDA7	
Muckish	00131/28085 (+ 3m)	MMDA8	
Muckish	00117/28063 (+ 3m)	MMDA9	
Muckish	00129/28036 (+ 3m)	MMDA10	
Tully Mountain	67219/61263 (+ 3m)	TMHS1	Inadequate
Tully Mountain	67237/61238 (+ 3m)	TMHS2	
Tully Mountain	67260/61200 (+ 3m)	TMHS3	
Tully Mountain	67285/61163 (+ 3m)	TMHS4	
Tully Mountain	67270/61139 (+ 3m)	TMHS5	
Tully Mountain	67250/61155 (+ 3m)	TMHS6	
Tully Mountain	67231/61182 (+ 3m)	TMHS7	

Site name	**GPS Irish Grid**	**Quadrat Code and No**	**Conservation Assessment**
Tully Mountain	67216/61203 (+ 3m)	TMHS8	
Tully Mountain	67187/61229 (+ 3m)	TMHS9	
Tully Mountain	67230/61206 (+ 3m)	TMHS10	
Maumtrasna	98325/62331 (+ 3m)	MMHS1	**Inadequate**
Maumtrasna	98307/62320 (+ 3m)	MMHS2	
Maumtrasna	98321/62302 (+ 3m)	MMHS3	
Maumtrasna	98354/62307 (+ 3m)	MMHS4	
Maumtrasna	98351/62235 (+ 3m)	MMHS5	
Maumtrasna	98361/62301 (+ 3m)	MMHS6	
Maumtrasna	98363/62280 (+ 3m)	MMHS7	
Maumtrasna	98385/62291 (+ 3m)	MMHS8	
Maumtrasna	98402/62287 (+ 3m)	MMHS9	
Maumtrasna	98392/62252 (+ 3m)	MMHS10	

Camaderry Mountain, Co. Wicklow (T06743/99074 Vice-County H20)

<table>
<tr><td>Locality

Camaderry</td><td>Land owner/Occupier

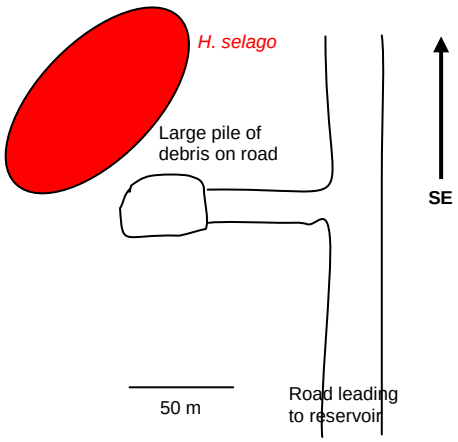
Unknown</td><td colspan="2">cSAC/pNHA

Probably private</td></tr>
<tr><td>Grid Ref. GPS? Yes

T06743/99074 (± 3 m)</td><td>Altitude (m)

660 - 670 m</td><td>Date (D/M/Y)

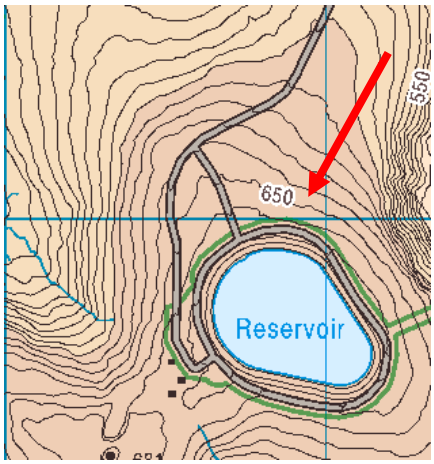
26/08/09</td><td>Recorder

Caroline Nienhuis
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Population growing on moist and in parts steep (25 - 90º) and peaty ground below and N of Camaderry reservoir. Area covered in low growing bryophytes, grass and heather. Area covered in low growing bryophytes, grass and heather equating to HH4 of Fossit (2000) Montane heath
The site not immediately threatened but erosion due to hikers and dumping of debris and gravel which has been noted nearby may pose future threats.
Spores present

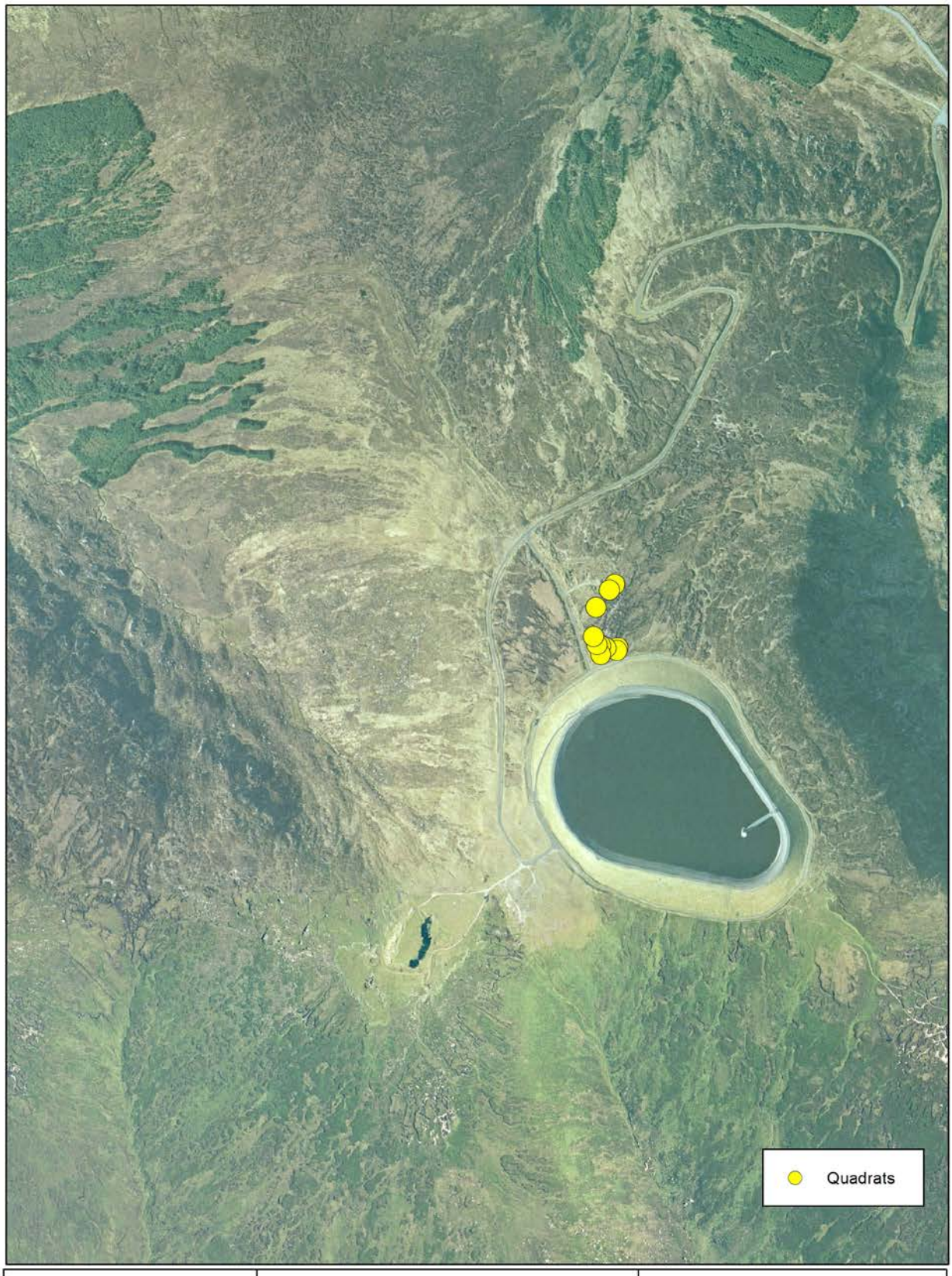
Yes</td></tr>
<tr><td colspan="2">Size of population
Large population of about 1001 – 3000 stems counted in 200x100 m.
Average length of three longest stems: 9.1 cm</td><td colspan="2">Quadrats
WGR1-10</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat Average n=10)	DOMIN scale
Huperzia selago	2
Agrostis sp., *Nardus stricta*	5
Calluna vulgaris	6
Dicranella heteromalia, Fissidens adianthoides, Hyocomium armoricum, Hypnum jutlandicum, Polytrichum commune, Racomitrium lanuginosum, Thuidium tamariscinum	7
Empetrum nigrum	3
Erica cinerea	1
Galium saxatile	1
Juncus squarrosus	+
Narthecium ossifragum	1
Vaccinium myrtillus	4
Bare rock	1
Peat	3

***H. selago* growing on boggy ground among bryophytes and rocks below Camaderry reservoir, Co Wicklow**



An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Camaderry Resevoir, Co. Wicklow Map 1
Huperzia selago

0 140 280 Meters

N

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Camaderry Resevoir, Co. Wicklow Map 2
Huperzia selago

0 25 50 Meters

N

Conservation Assessment of *H. selago* at Camaderry Reservoir

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥10	10	PASS
Population size (combined area of occupancy of colonies)	≥2000m²	2000m²	PASS
Total Domin cover area of target species (H. selago) in m²	≥2	2	PASS
Population size class	3 (1000-5000)	3	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥9	9	PASS
Domin scale cover of *Calluna vulgaris*	5-7	7	PASS
Domin cover bare rock	0-4	0	PASS
Total vegetation cover	8-10	9	PASS
Fossit Habitat	HH4	HH4	PASS
FUTURE PROSPECTS	Impact	Figure	
Trampling and overuse (G05.01)	None	LOW	PASS
Disposal of inert materials in this case sand and gravel (E03.03)	None	MEDIUM	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Favourable

Connor Pass, Co. Kerry (Q50342/06083 Vice-County H1)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H1</td><td colspan="2">Vice-county

South Kerry</td></tr>
<tr><td>Locality

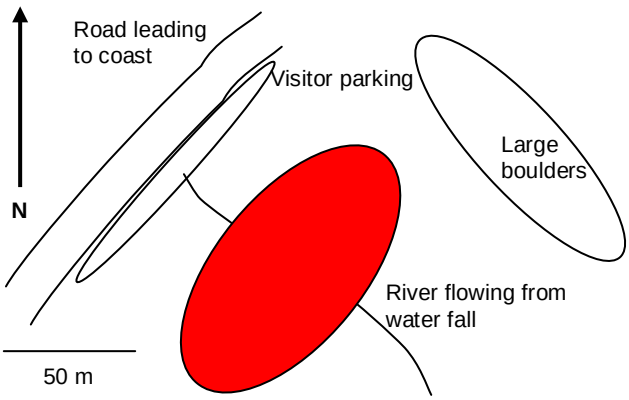
Connor Pass</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref.

Q50342/06083 (± 3m)</td><td>Altitude (m)

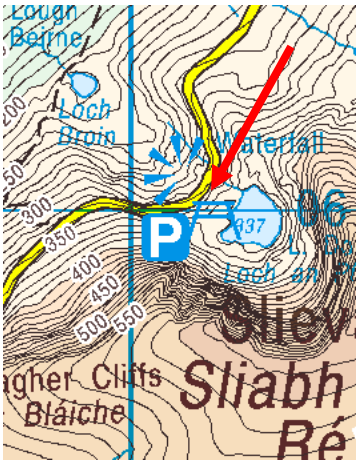
370 - 380 m</td><td>Date (D/M/Y)

14/08/09
2010 & 2011</td><td>Recorder
Emer Ni Dhuill,
Caroline Nienhuis
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale

 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

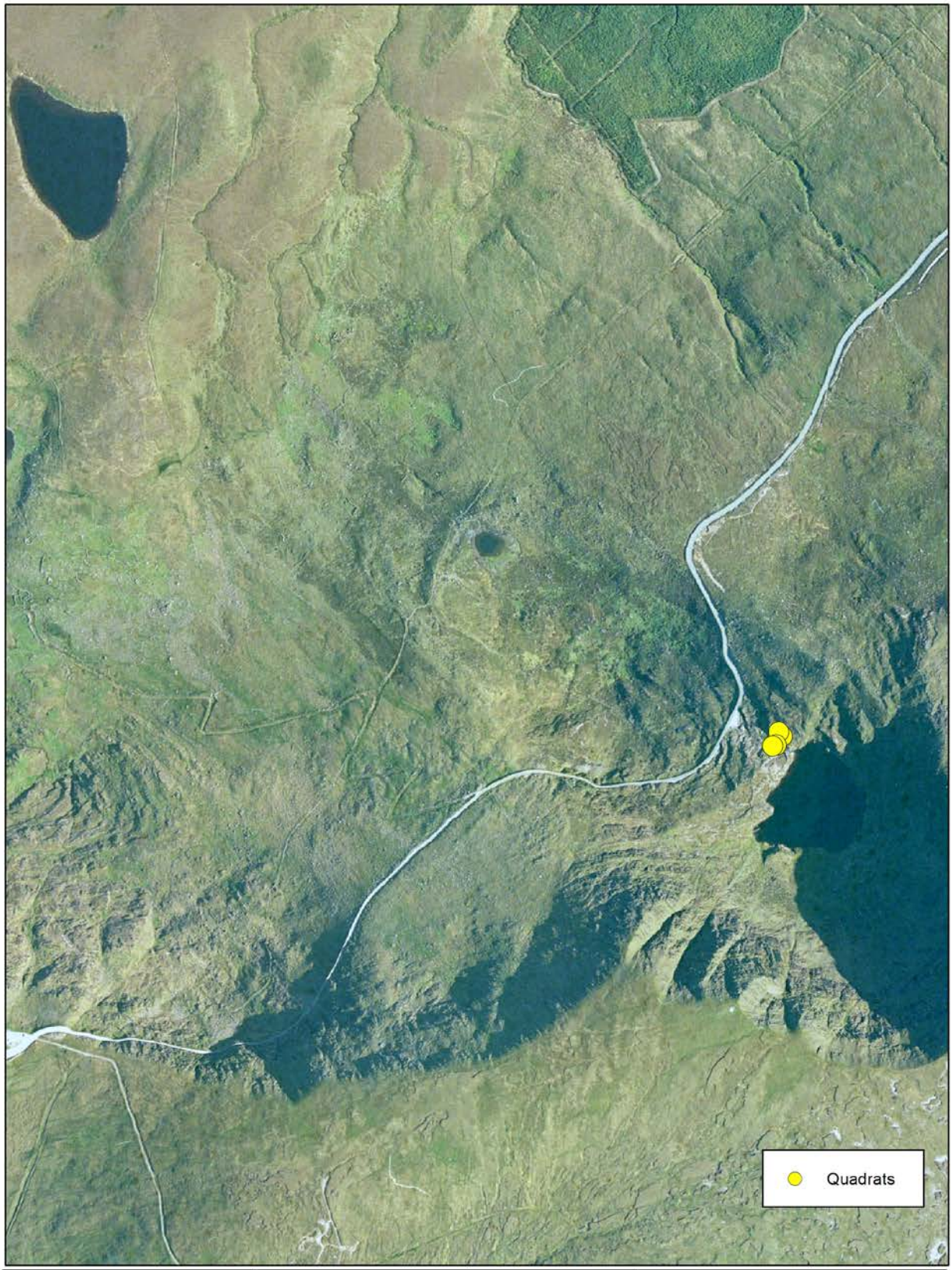
Population growing on rocky ground on slope right and left of river flowing into Lough Cruite. Area covered in low growing bryophytes, grass and heather. Area covered in low growing bryophytes, grass and heather equating to HH4 Montane Heath of Fossit (2000).
The site is threatened by overgrazing by sheep and trampling erosion due to hikers.
Spores present: Yes</td></tr>
<tr><td colspan="2">Size of population
Small population of about 301 - 1000 stems counted in four 100x50 m.
Average length of three longest stems: 3.1 cm</td><td colspan="2">Quadrats:
CPHS1-4</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat	DOMIN scale
Huperzia selago	+
Agrostis tenuis,	
Festuca vivipara	5
Blechnum spicant	1
Calluna vulgaris	5
Erica cinerea	6
Hyocomium armoricum,	
Racomitrium lanuginosum	5
Lichen	1
Potentilla erecta	1
Saxifraga x *polita*	1
Bare rock	8

***H. selago* with spores growing among large boulders, bryophytes, grass and heather at Connor Pass, Co. Kerry**



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Department of Arts, Heritage and the Gaeltacht

Connor Pass , Co. Kerry Map 1
Huperzia selago

0 110 220 Meters

N

Conservation Assessment *Huperzia selago* at Connor Pass, Co. Kerry

POPULATION	TARGET	FIGURE	RESULT
Total colony number	**≥4**	**4**	**PASS**
Population size (combined area of occupancy of colonies)	**≥100 x 50 m**	**100x50**	**PASS**
Total Domin cover area of target species (H. selago) in m^2	**≥+**	**+**	**PASS**
Population size class	**2 (500-1000)**	**2**	**PASS**
Fertile cones present	**Yes**	**Yes**	**PASS**
HABITAT	**Target**	**Figure**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	**≥3**	**3.1**	**PASS**
Domin scale cover of *Calluna vulgaris*	**5-7**	**5**	**PASS**
Domin cover bare rock	**0-4**	**8**	**FAIL**
Total vegetation cover	**8-10**	**4**	**FAIL**
Fossit Habitat	**HH4**	**Eroded**	**FAIL**
FUTURE PROSPECTS	**Impact**	**Figure**	
Trampling and overuse (G05.01)	**None**	**Medium**	**FAIL**
Intensive sheep grazing (A04.01.02)	**None**	**Medium**	**FAIL**

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Derryveagh Mountain Co. Donegal (B97377/22297 Vice-County H35)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H35</td><td colspan="2">Vice-county

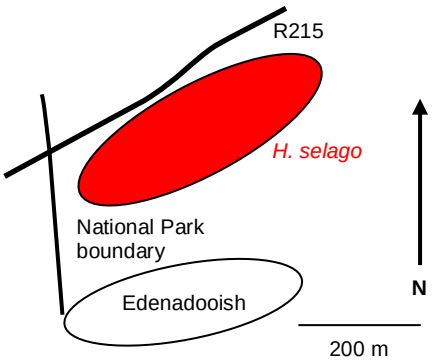
West Donegal</td></tr>
<tr><td>Locality
Derryveagh Mountain/ Edenadooish</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA

Unknown</td></tr>
<tr><td>Grid Ref.

B97377/22297 (± 3 m)</td><td>Altitude (m)

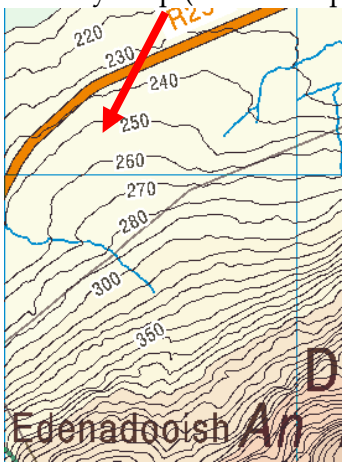
240 m</td><td>Date (D/M/Y)

02/09/09</td><td>Recorder
Emer Ni Dhuill,
Caroline Nienhuis</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Population growing on wet and peaty ground below Edenadooish Mountains, next to R251.
Vegetation rather sparse but consisting mainly of bryophytes, heather and grass.

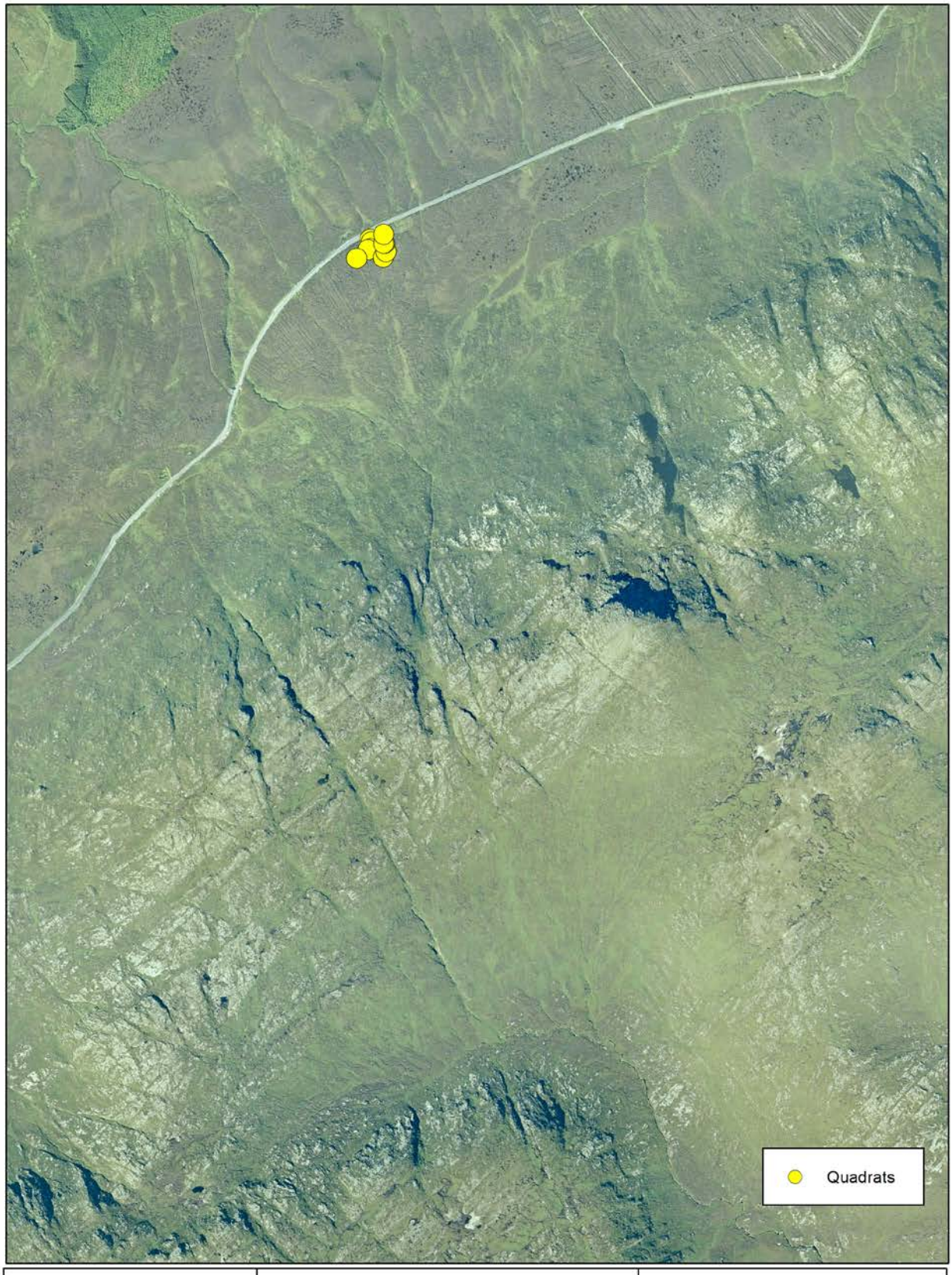
No immediate threats are obvious and population is covering whole plateau. Erosion due to hikers and grazing deer and sheep, and vegetation encroachment may pose future threats
Spores present: Yes</td></tr>
<tr><td colspan="2">Size of population
Large population of about 1001 – 5000 stems counted in ten 300x50 m.
Average length of three longest stems: 6.7 cm</td><td colspan="2">Quadrats
DVHS1-10</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=10)	**DOMIN scale**
Huperzia selago	3
Agrostis spp., Schoenus nigricans	8
Anagallis tenella	+
Calluna vulgaris	4
Cladonia unicalis	2
Hypnum jutlandicum, Racomitrium lanuginosum, Scropidium scorpioides, Sphagnum palustre	6
Erica cinerea	1
Erica tetralix	4
Juncus squarrosus	+
Lichen	3
Narthecium ossifragum	2
Potentilla erecta	2
Bare ground	4

H. selago **growing on peaty ground covered by bryophytes, grass and heather below Edenadooish, Derryveagh Mountains, Co. Donegal**

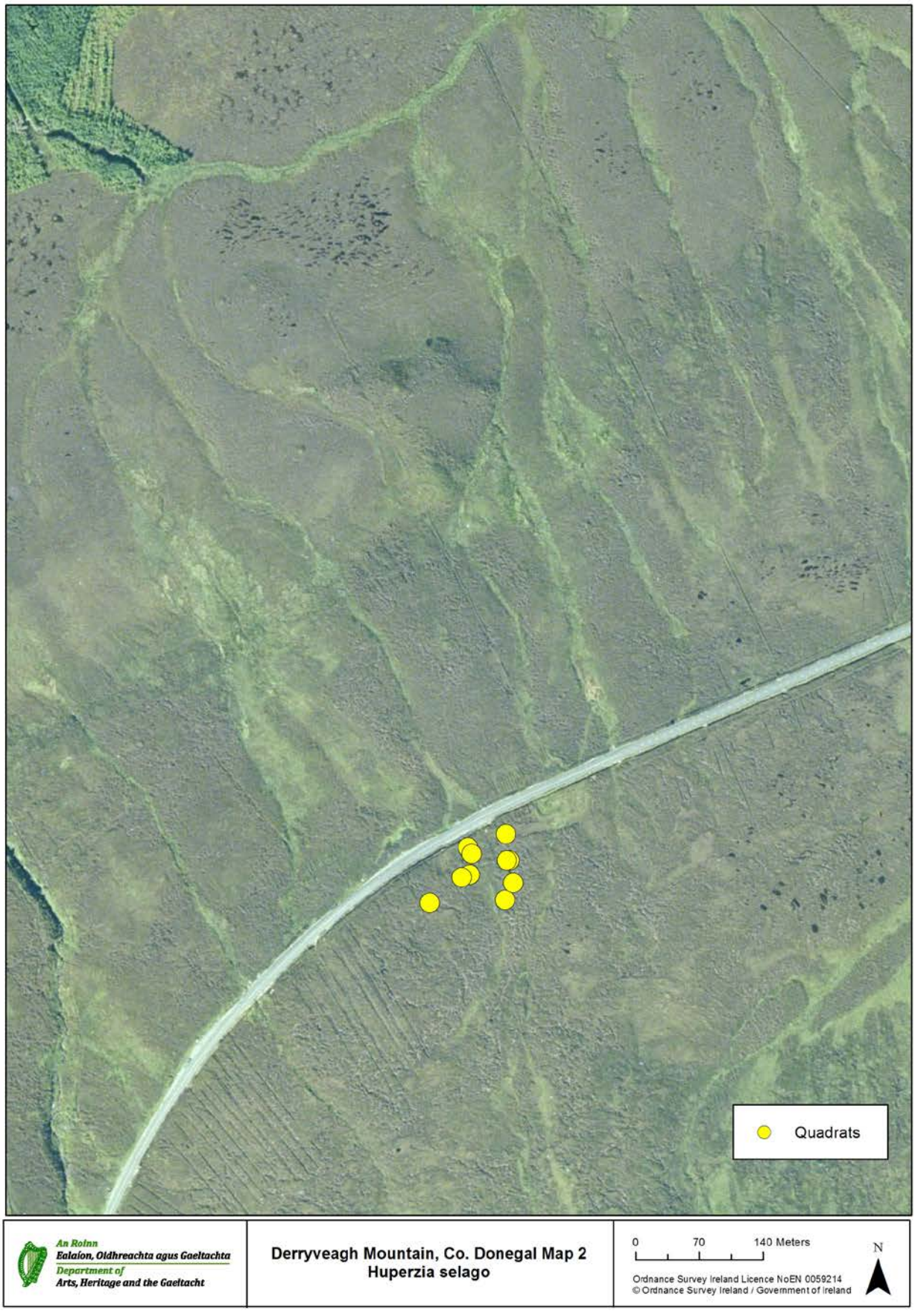


An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Derryveagh Mountain, Co. Donegal Map 1
Huperzia selago

0 210 420 Meters

N


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Derryveagh Mountain, Co. Donegal Map 2
Huperzia selago
0
70
140 Meters
N
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Conservation Assessment for *Huperzia selago* at Derryveagh Mountain

POPULATION	TARGET	FIGURE	RESULT
Total colony number	**≥10**	**10**	**PASS**
Population size (combined area of occupancy of colonies)	**≥300 x 50 m**	**300x50**	**PASS**
Total Domin cover area of target species (H. selago) in m^2	**≥3**	**3**	**PASS**
Population size class	**3 (100-5000)**	**3**	**PASS**
Fertile cones present	**Yes**	**Yes**	**PASS**
HABITAT	**Target**	**Figure**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	**≥6**	**6.7**	**PASS**
Domin scale cover of *Calluna vulgaris*	**4-7**	**4**	**PASS**
Domin cover bare rock	**0-4**	**4**	**PASS**
Total vegetation cover	**8-10**	**8**	**PASS**
Fossit Habitat	**HH4**	**HH4**	**PASS**
FUTURE PROSPECTS	**Impact**	**Figure**	**Result**
Trampling and overuse (G05.01)	**None**	**Low**	**PASS**
Intensive sheep grazing (A04.01.02)	**None**	**Low**	**PASS**

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)
OVERALL CONSERVATION ASSESSMENT: Favourable

Healy Pass, Co. Cork (V78569/53562 Vice-County H3)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H3</td><td colspan="2">Vice-county

West Cork</td></tr>
<tr><td>Locality

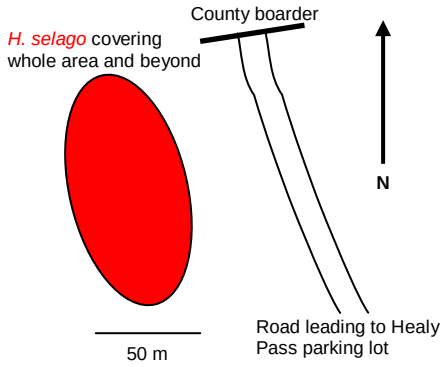
Healy Pass</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref.

V78569/53562 (± 7m)</td><td>Altitude (m)

300 m</td><td>Date (D/M/Y)

19/08/09
2010</td><td>Recorder

Caroline Nienhuis
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

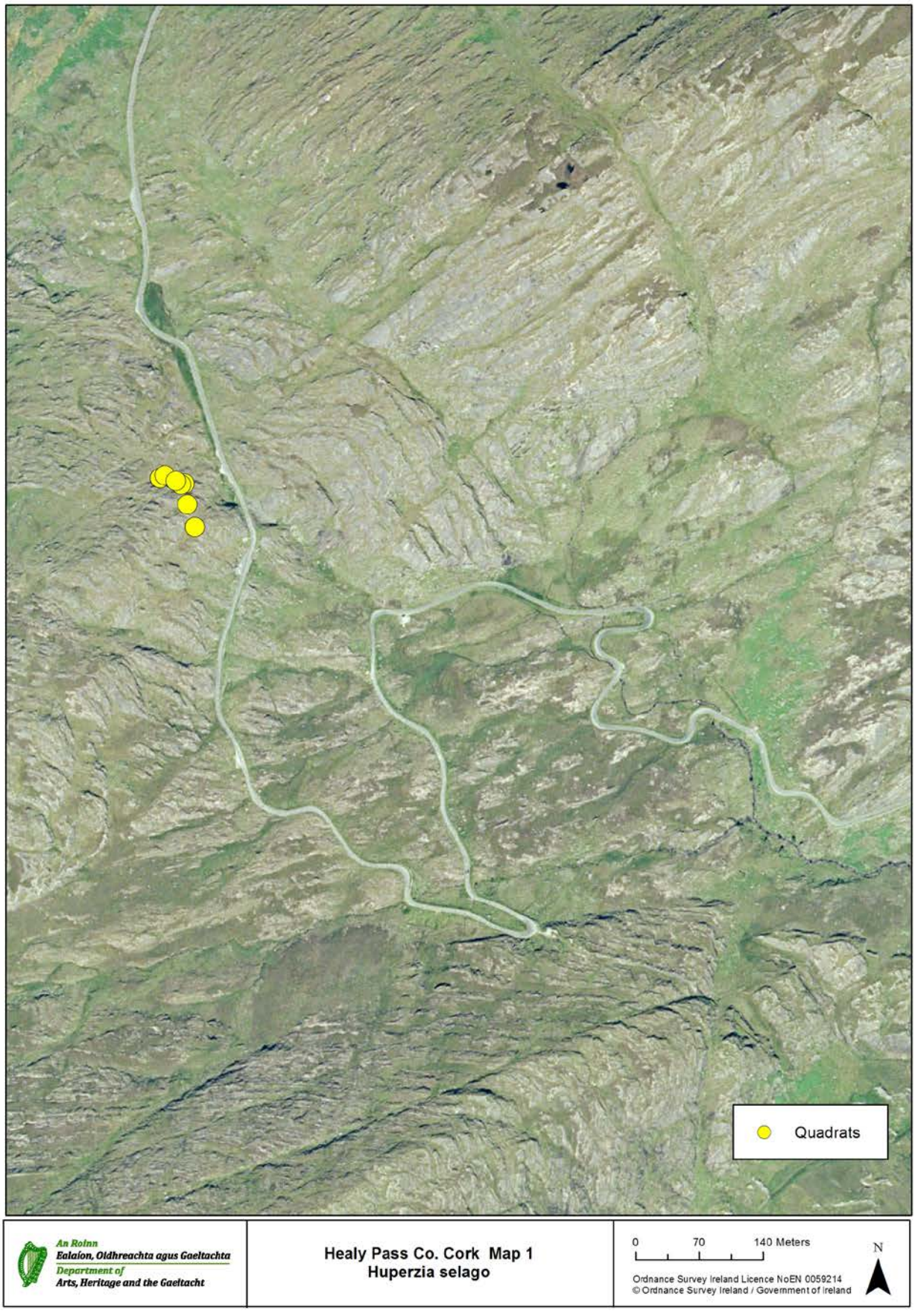
Population growing on rocky ground around Hungry Hill mountain.
Area covered in low growing bryophytes, grass and heather.
Site well grazed and erosion due to hikers and grazing sheep may pose future threats.
Spores present

Yes</td></tr>
<tr><td colspan="2">Size of population
Population of about 501 - 1000 stems counted in seven 100x50 m.
Average length of three longest stems: 3.6 cm</td><td colspan="2">Quadrats
HH1-7</td></tr>
</table>

Locality Map (1:50 000 if possible)

Associated species in 1 m² quadrat	**DOMIN scale**
Huperzia selago	3
Agrostis sp., *Deschampsia flexuosa*, *Nardus stricta*	6
Blechnum spicant	+
Calluna vulgaris	1
Dicranella heteromalla, Hypnum jutlandicum, Polytrichum commune, Polytrichum juniperinum, Racomitrium lanuginosum, Scorpidium scorpioides, Sphagnum palustre, Thuidium tamariscinum	4
Erica tetralix	+
Galium saxatile	+
Juncus squarrosus	1
Lichen	3
Narthecium ossifragum	1
Potentilla erecta	1
Bare rock	8

***H. selago* growing among bryophytes, heather and rocks on above Healy Pass, Co. Cork**


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Healy Pass Co. Cork Map 1
Huperzia selago
0
70
140 Meters
N
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Department of Arts, Heritage and the Gaeltacht

Healy Pass Co. Cork Map 2
Huperzia selago

0 10 20 Meters

N

Conservation Assessment for *Huperzia selago* at Healy Pass, Co. Cork

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥7	7	PASS
Population size (combined area of occupancy of colonies)	≥100 x 50 m	100x50	
Total Domin cover area of target species (H. selago) in m²	≥3	3	PASS
Population size class	2 (500-1000)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥3	3.6	PASS
Domin scale cover of *Calluna vulgaris*	4-7	1	FAIL
Domin cover bare rock	0-4	8	FAIL
Total vegetation cover	8-10	4	FAIL
Fossit Habitat	HH4	ERODED	FAIL
FUTURE PROSPECTS	Impact	Figure	Result
Trampling and overuse (G05.01)	None	Medium	FAIL
Intensive sheep grazing (A04.01.02)	None	Low	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Kippure Mountain, Co. Wicklow (T11675/15485 Vice-County H20)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H20</td><td colspan="2">Vice-county

Wicklow</td></tr>
<tr><td>Locality

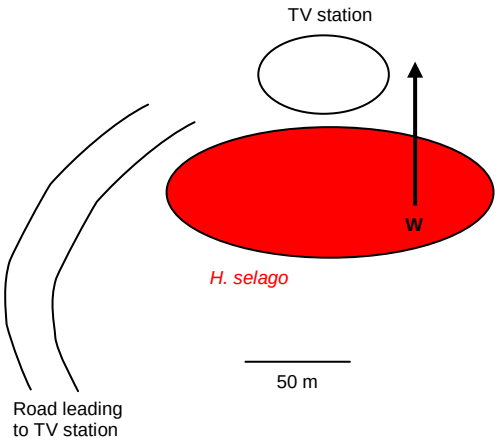
Kippure Mountain</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA

SAC</td></tr>
<tr><td>Grid Ref
T11675/15485 (± 3m)</td><td>Altitude (m)

650 – 710 m</td><td>Date (D/M/Y)

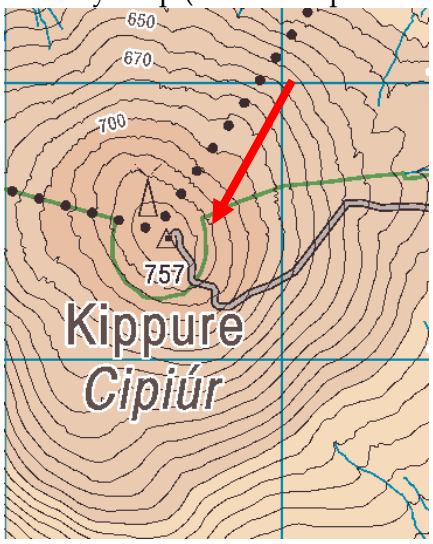
28/08/09
2010, 2011</td><td>Recorder

Caroline Nienhuis & Noeleen Smyth
Christina Campbell</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Large population growing on moist slope (5 - 30º) on boggy ground below and SE of TV station on Kippure Mountain.
The Slope covered in low growing bryophytes, grass and heather. Site not immediately threatened but erosion due to hikers and grazing sheep may pose future threats
Spores present: Yes</td></tr>
<tr><td colspan="2">Size of population
Very large population of about 501 - 1000 stems counted in 150x50 m.
Average length of three longest stems: 5.5 cm</td><td colspan="2">Quadrats

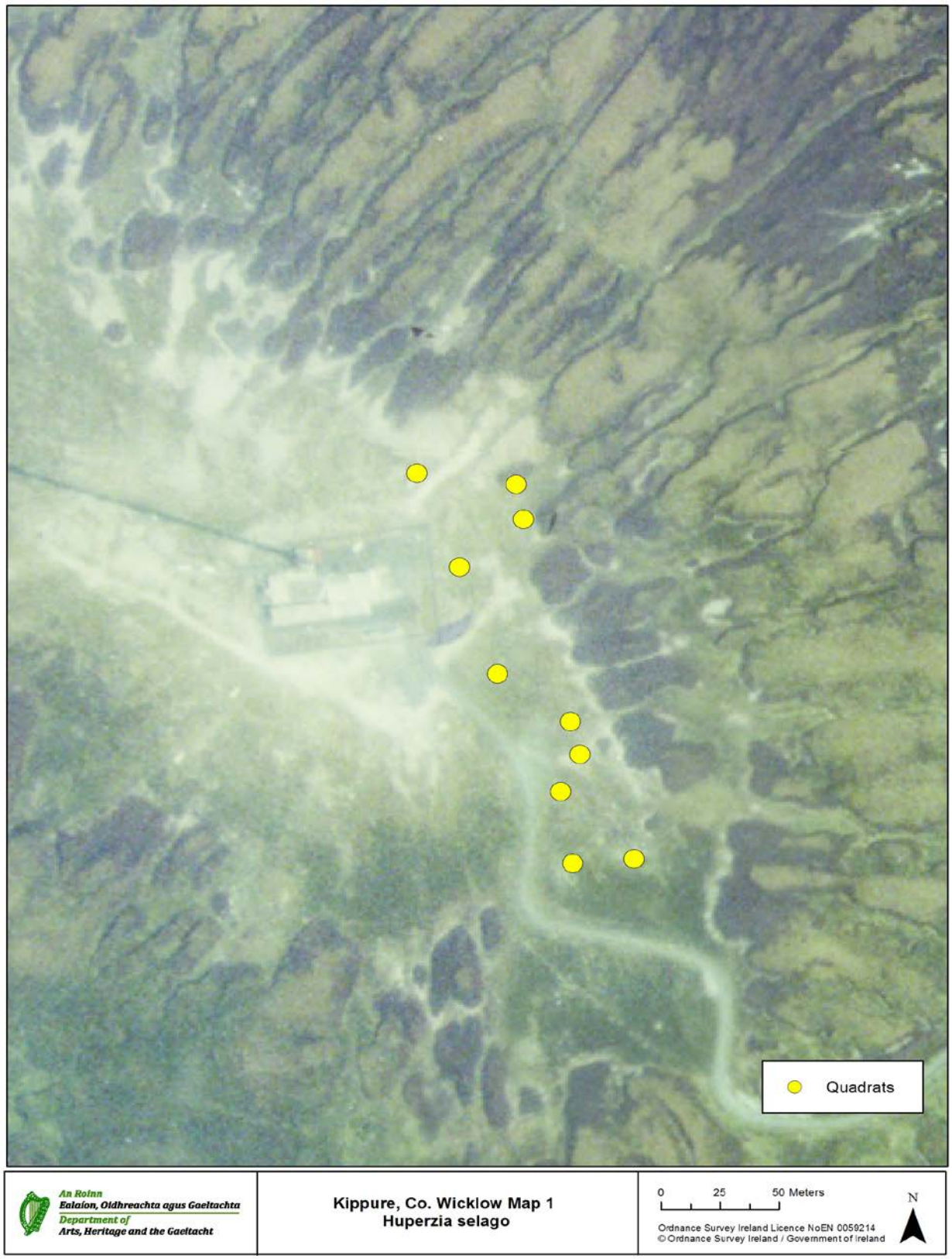
KMHS1-10</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=10)	**DOMIN scale**
Huperzia selago	3
Agrostis sp., *Deschampsia flexuosa*, *Nardus stricta*	8
Calluna vulgaris	3
Cladonia unicalis	+
Galium saxatile	4
Hypnum jutlandicum, Polytrichum commune, Polytrichum juniperinum, Racomitrium lanuginosum, Thuidium tamariscinum	7
Juncus squarrosus	2
Lycopodium clavatum	1
Vaccinium myrtillus	2
Bare ground	1
Bare rock	3

***H. selago* growing among bryophytes, heather and rocks below TV station on Kippure Mountain, Co Wicklow**


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Kippure, Co. Wicklow Map 1
Huperzia selago
0
25
50 Meters
N
Ordnance Survey Ireland Licence NoEN 0059214
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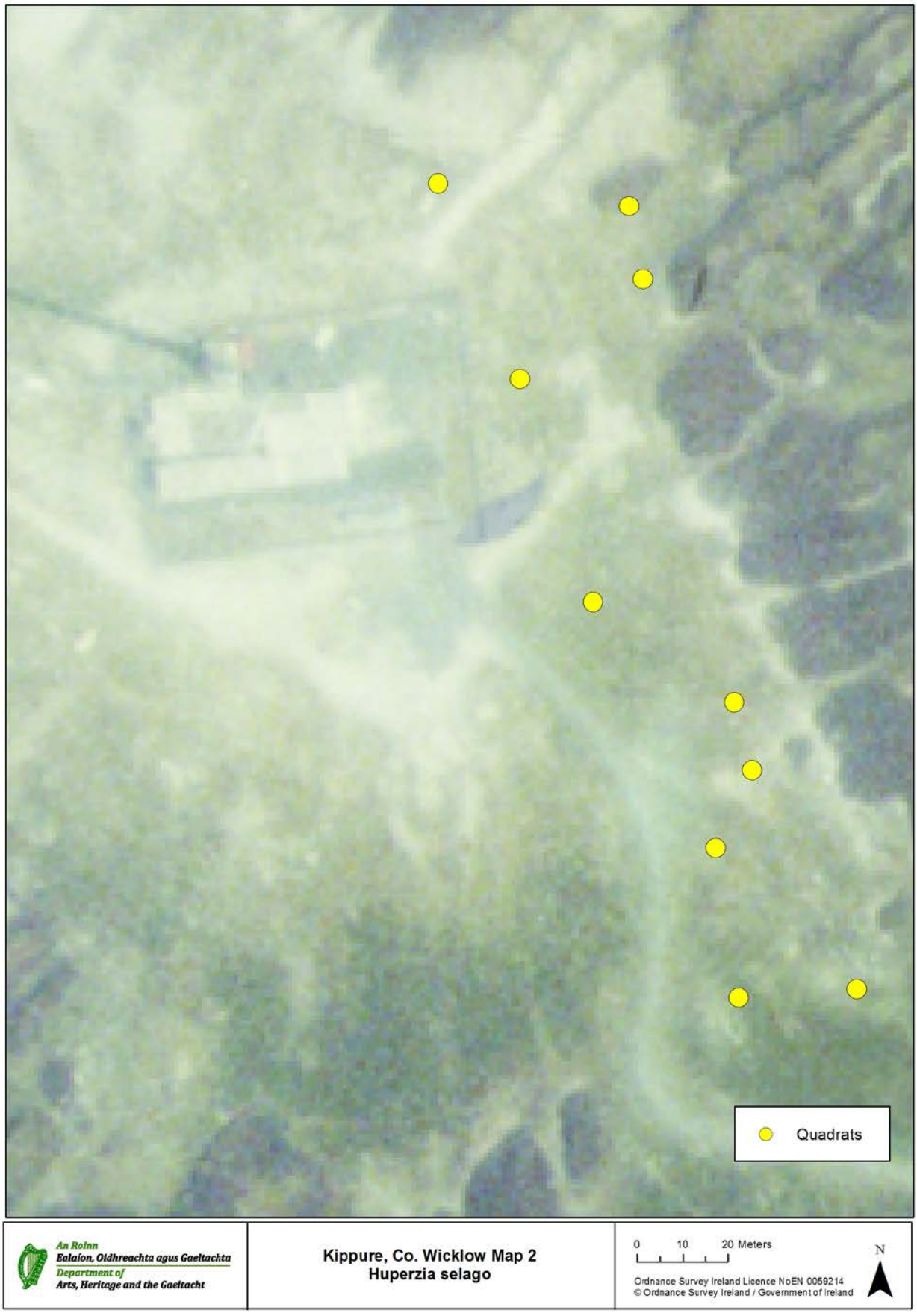

Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Kippure, Co. Wicklow Map 2
Huperzia selago
0 10 20 Meters
N
Ordnance Survey Ireland Licence NoEN 0059214
© Ordnance Survey Ireland / Government of Ireland

Conservation Assessment for *Huperzia selago* at Kippure, Co. Wicklow

POPULATION	TARGET	FIGURE	RESULT
Total colony number	**≥10**	**10**	**PASS**
Population size (combined area of occupancy of colonies)	**≥150 x 50 m**	**150x50**	**PASS**
Total Domin cover area of target species (H. selago) in m^2	**≥3**	**3**	**PASS**
Population size class	**2 (500-1000)**	**2**	**PASS**
Fertile cones present	**Yes**	**Yes**	**PASS**
HABITAT	**Target**	**Figure**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	**≥6**	**6.1**	**PASS**
Domin scale cover of *Calluna vulgaris*	**3-7**	**3**	**PASS**
Domin cover bare rock/ground	**0-4**	**4**	**PASS**
Total vegetation cover	**8-10**	**8**	**PASS**
Fossit Habitat	**HH4**	**HH4**	**PASS**
FUTURE PROSPECTS	**Impact**	**Figure**	**Result**
Trampling and overuse (G05.01)	**None**	**Low**	**PASS**
Intensive sheep grazing (A04.01.02)	**None**	**Low**	**PASS**

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Favourable

Knockowen Mountain, Co. Cork (V80879/55448 Vice-County H20)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H3</td><td colspan="2">Vice-county

West Cork</td></tr>
<tr><td>Locality

Knockowen Mountain</td><td>Land owner/Occupier

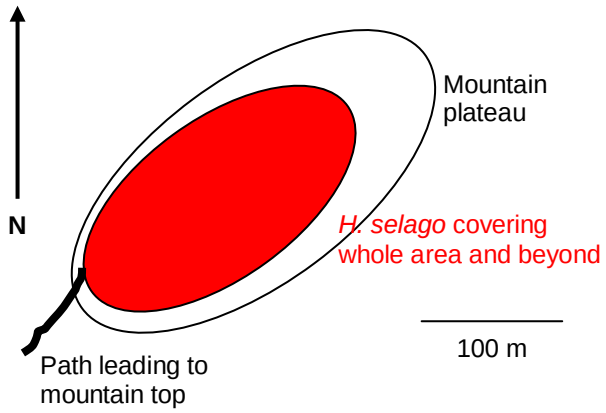
Unknown</td><td colspan="2">cSAC/pNHA

Unknown</td></tr>
<tr><td>Grid Ref. GPS? Yes

V80879/55448 (± 3m)</td><td>Altitude (m)

670 – 690 m</td><td>Date (D/M/Y)

23/09/09</td><td>Recorder

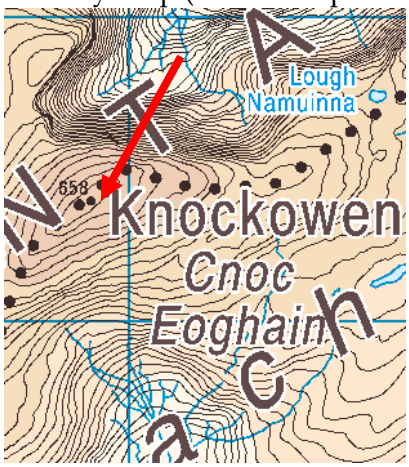
Caroline Nienhuis & (Noeleen Smyth)</td></tr>
<tr><td>Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="3">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Population growing on boggy ground on mountain top and around edges (5 - 30º) of Knockowen Mountain.
Area covered in low growing bryophytes, grass and heather.
Site not immediately threatened but patchy with erosion due to hikers and grazing sheep which may pose future threats

Spores present

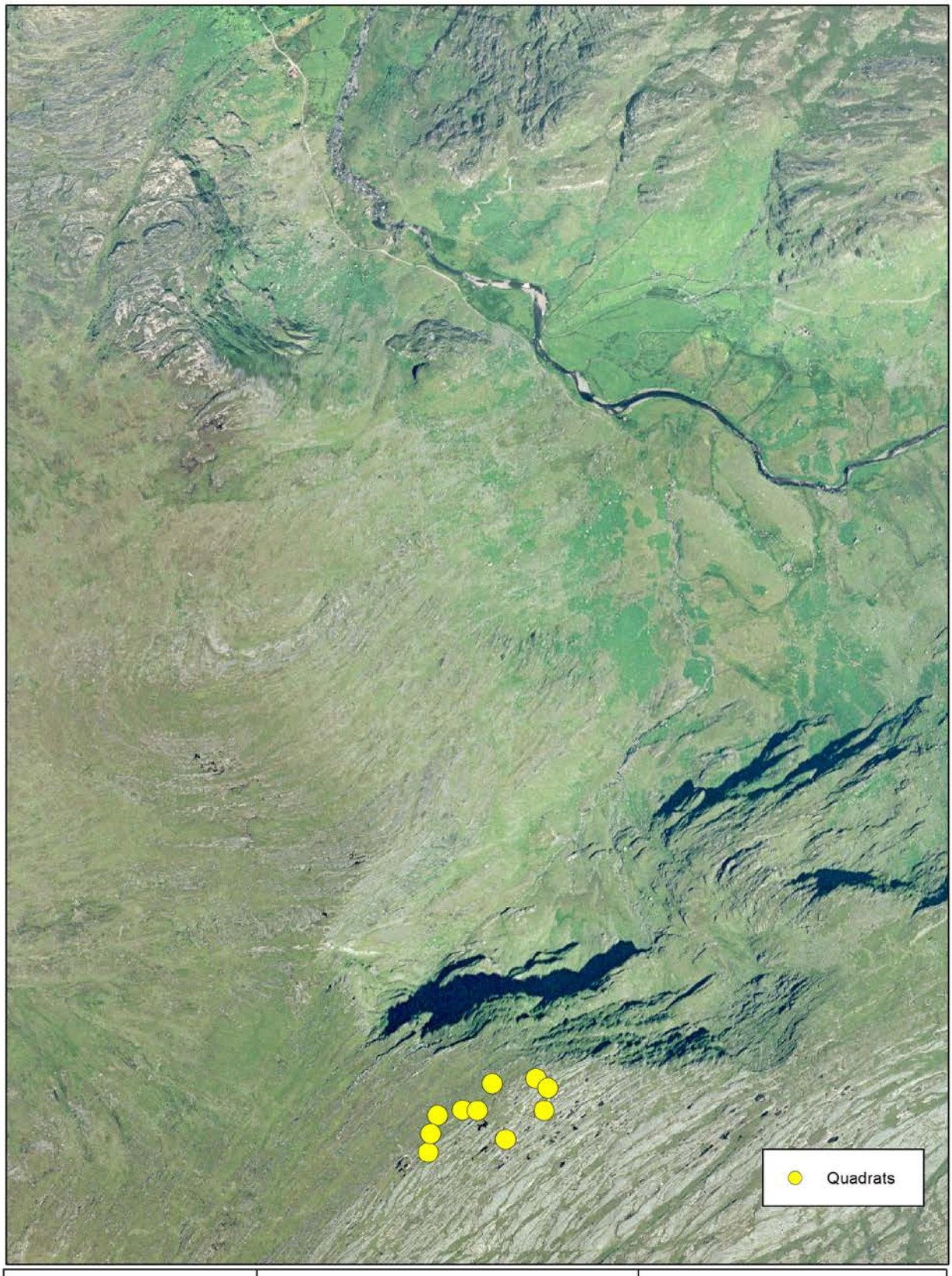
Yes</td></tr>
<tr><td>Size of population
Large population of about 501 - 1000 stems counted in ten 150x50 m.
Average length of three longest stems: 5.1 cm</td><td colspan="3">Quadrats
KOHS1-10</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n = 10)	DOMIN scale
Huperzia selago	2
Agrostis sp., *Deschampsia flexuosa*, *Festuca vivipara*, *Nardus stricta*	6
Blechnum spicant	1
Calluna vulgaris	4
Cladonia portentosa	+
Fissidens adianthoides, *Hypnum jutlandicum*, *Polytrichum commune*, *Racomitrium lanuginosum*, *Thuidium tamariscinum*, *Scorpidium scorpioides*, *Sphagnum palustre*	6
Galium saxatile	1
Lichen	1
Potentilla erecta	+
Bare ground	1
Bare rock	6

***Huperzia selago* with freshly emerged microphylls (small leaves)**



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Department of Arts, Heritage and the Gaeltacht

Knockowen Co. Cork
Huperzia selago

0 110 220 Meters

N

Conservation assessment for *Huperzia selago* Knockowen, Co. Cork

POPULATION	TARGET	FIGURE	RESULT
Total colony number	**≥10**	**10**	**PASS**
Population size (combined area of occupancy of colonies)	**≥150 x 50 m**	**150x50**	
Total Domin cover area of target species (H. selago) in m^2	**≥2**	**2**	**PASS**
Population size class	**2 (500-1000)**	**2**	**PASS**
Fertile cones present	**Yes**	**Yes**	**PASS**
HABITAT	**Target**	**Figure**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	**≥5**	**5.1**	**PASS**
Domin scale cover of *Calluna vulgaris*	**3-7**	**4**	**PASS**
Domin cover bare rock/ground	**0-4**	**7**	**FAIL**
Total vegetation cover	**8-10**	**4**	**FAIL**
Fossit Habitat	**HH4**	**HH4**	**FAIL**
FUTURE PROSPECTS	**Impact**	**Figure**	**Result**
Trampling and overuse (G05.01)	**None**	**Medium**	**FAIL**
Intensive sheep grazing (A04.01.02)	**None**	**Low**	**FAIL**

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Lough Cruite, Brandon Mountain, Co. Kerry (Q47782/10562 Vice-County H1)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H1</td><td colspan="2">Vice-county

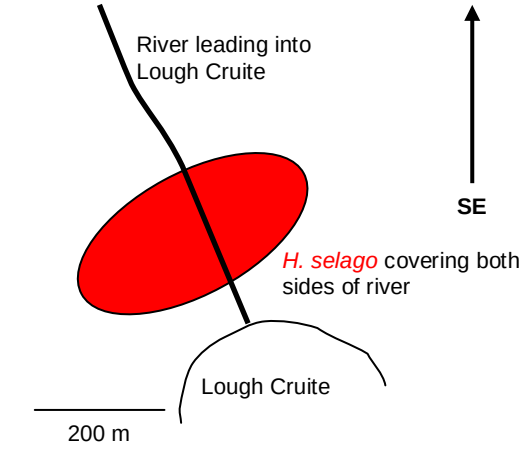
South Kerry</td></tr>
<tr><td>Locality

Lough Cruite</td><td>Land owner/Occupier

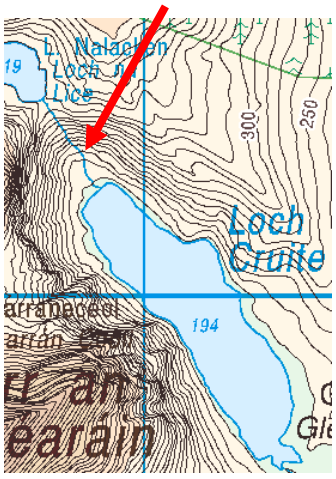
Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref. GPS? Yes

Q47782/10562 (± 4m)</td><td>Altitude (m)

190 - 240 m</td><td>Date (D/M/Y)

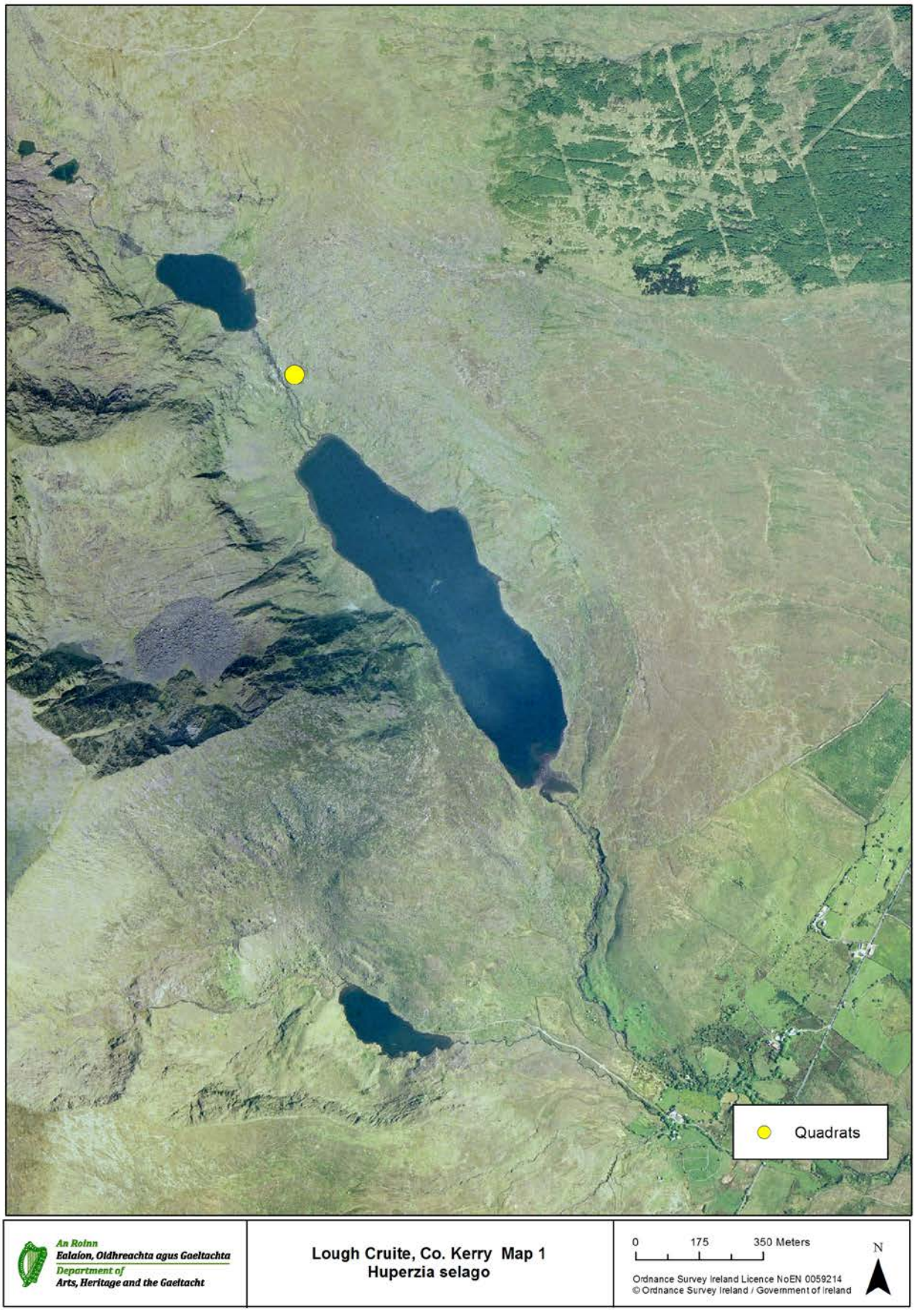
14/08/09
2011, 2012</td><td>Recorder
Emer Ni Dhuill,
Caroline Nienhuis
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Population growing on rocky ground on slope right and left of river flowing into Lough Cruite.
Area covered in low growing bryophytes, grass and heather.
Site with erosion due to hikers and grazing sheep population here under future threat is high level of grazing continues.
Spores present: Yes</td></tr>
<tr><td colspan="2">Size of population
Population of about 501 - 1000 stems counted in 200x200 m.
Average length of three longest stems: 4.9 cm</td><td colspan="2">Quadrats

LCHS1 & LCHS2</td></tr>
<tr><td colspan="2">Locality Map (1:50 000 if possible)
 
</td><td colspan="2">Associated species in 1 m² quadrat (Average n=2) — DOMIN scale
Huperzia selago 1
Calluna vulgaris 1
Deschampsia flexuosa, Nardus stricta 1
Dryopteris affinis 1
Erica cinerea +
Lichen 5
Pedicularis sylvatica +
Polytrichum commune, Racomitrium lanuginosum, Rhytidiadelphus loreus, Thuidium tamariscinum 5</td></tr>
</table>

	Potentilla erecta	1
	Saxifraga x *polita*	1
	Bare rock	8

H. selago *sporophylls with yellow sporangium*


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Lough Cruite, Co. Kerry Map 1
Huperzia selago
0
175
350 Meters
N
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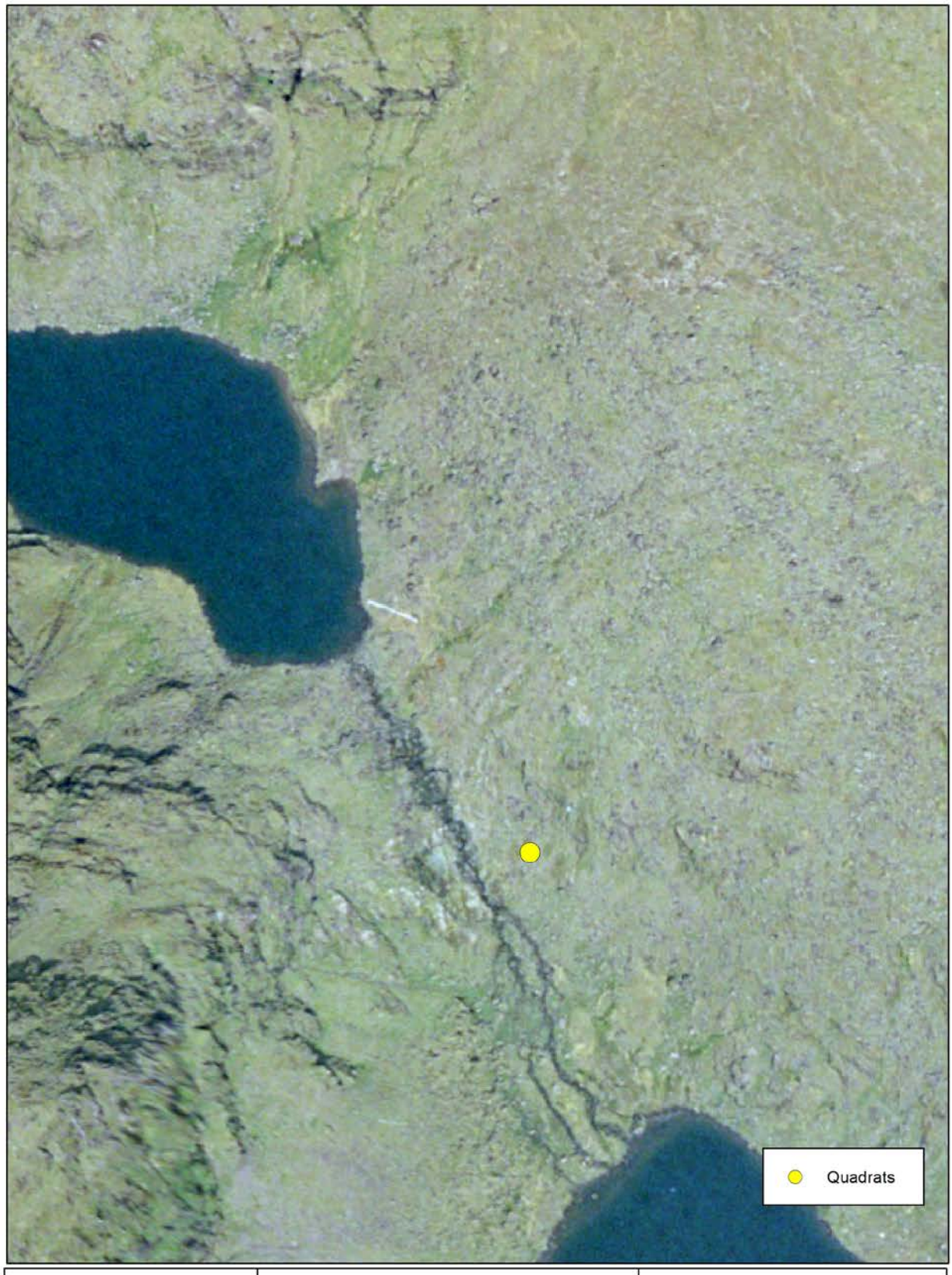

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Department of Arts, Heritage and the Gaeltacht

Lough Cruite, Co. Kerry Map 2
Huperzia selago

0 40 80 Meters

N

Conservation assessment for *Huperzia selago* at Lough Cruite, Co. Kerry

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥2	2	PASS
Population size (combined area of occupancy of colonies)	≥200 x 200m	200x200	
Total Domin cover area of target species (H. selago) in m^2	≥1	1	PASS
Population size class	2 (500-1000)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥4	4.9	PASS
Domin scale cover of *Calluna vulgaris*	3-7	1	PASS
Domin cover bare rock/ground	0-4	8	FAIL
Total vegetation cover	8-10	4	FAIL
Fossit Habitat	HH4	ERODED	FAIL
FUTURE PROSPECTS	Impact	Figure	Result
Trampling and overuse (G05.01)	None	Medium	FAIL
Intensive sheep grazing (A04.01.02)	None	Medium	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Maumtrasna Mountain, Co. Galway (L89325/62331 Vice-County H27)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

H27</td><td colspan="2">Vice-county

Galway</td></tr>
<tr><td>Locality

Maumtrasna Mountain</td><td>Land owner/Occupier

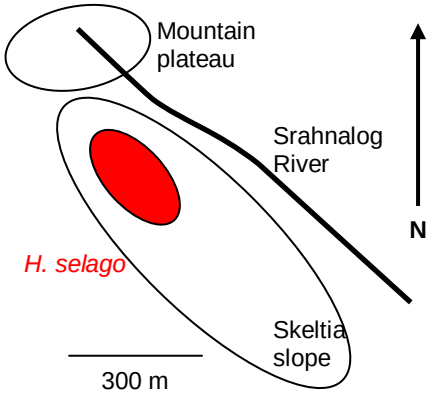
Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref. GPS? Yes

L98325/62331 (± 3m)</td><td>Altitude (m)

515 - 533 m</td><td>Date (D/M/Y)

29/09/09</td><td>Recorder

Caroline Nienhuis</td></tr>
<tr><td>Sketch map of site showing location of species: indicate North (arrow) and scale

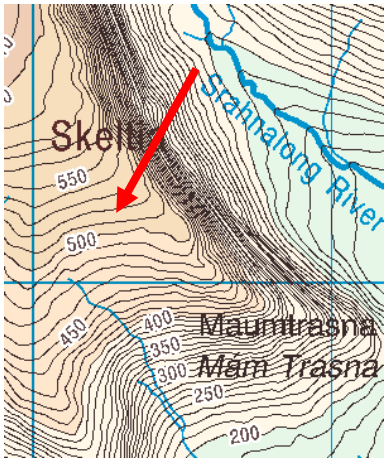
 
</td><td colspan="3">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Population growing on peaty ground covered in rocks on slope (5 – 90º) leading to plateau of Maumtrasna Mountain.
Area covered in low growing bryophytes, grass and heather. Site possibly threatened by erosion due to hikers and grazing sheep.

Spores present: Yes</td></tr>
<tr><td>Size of population
Population of about 501 - 1000 stems counted in 200x100 m.
Average length of three longest stems: 3.8 cm</td><td colspan="3">Quadrats

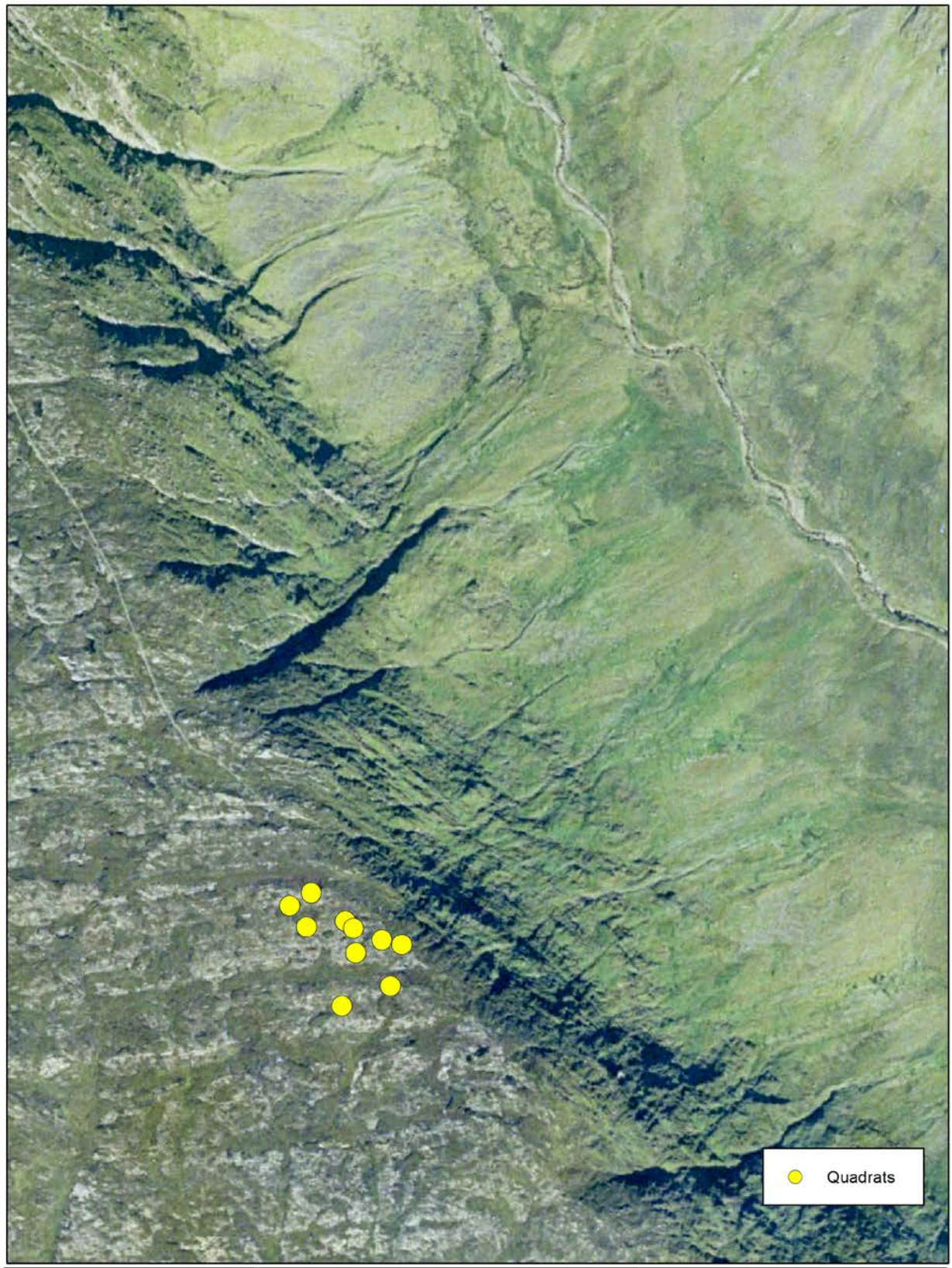
MMHS1 - 10</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m^2 quadrat (Average n=10)	DOMIN scale
Huperzia selago	2
Agrostis sp., *Nardus stricta*, *Schoenus nigricans*	7
Calluna vulgaris	6
Cladonia portentosa, Cladonia unicalis	2
Erica cinerea	4
Narthecium ossifragum	2
Potentilla erecta	2
Racomitrium lanuginosum, *Scorpidium scorpioides, Sphagnum palustre*, *Thuidium tamariscinum*	6
Bare ground	4
Bare rock	3

H selago **on trackway trampled by hikers and very sparse vegetation due to sheep grazing at Maumtrasna Mountain Co. Mayo**



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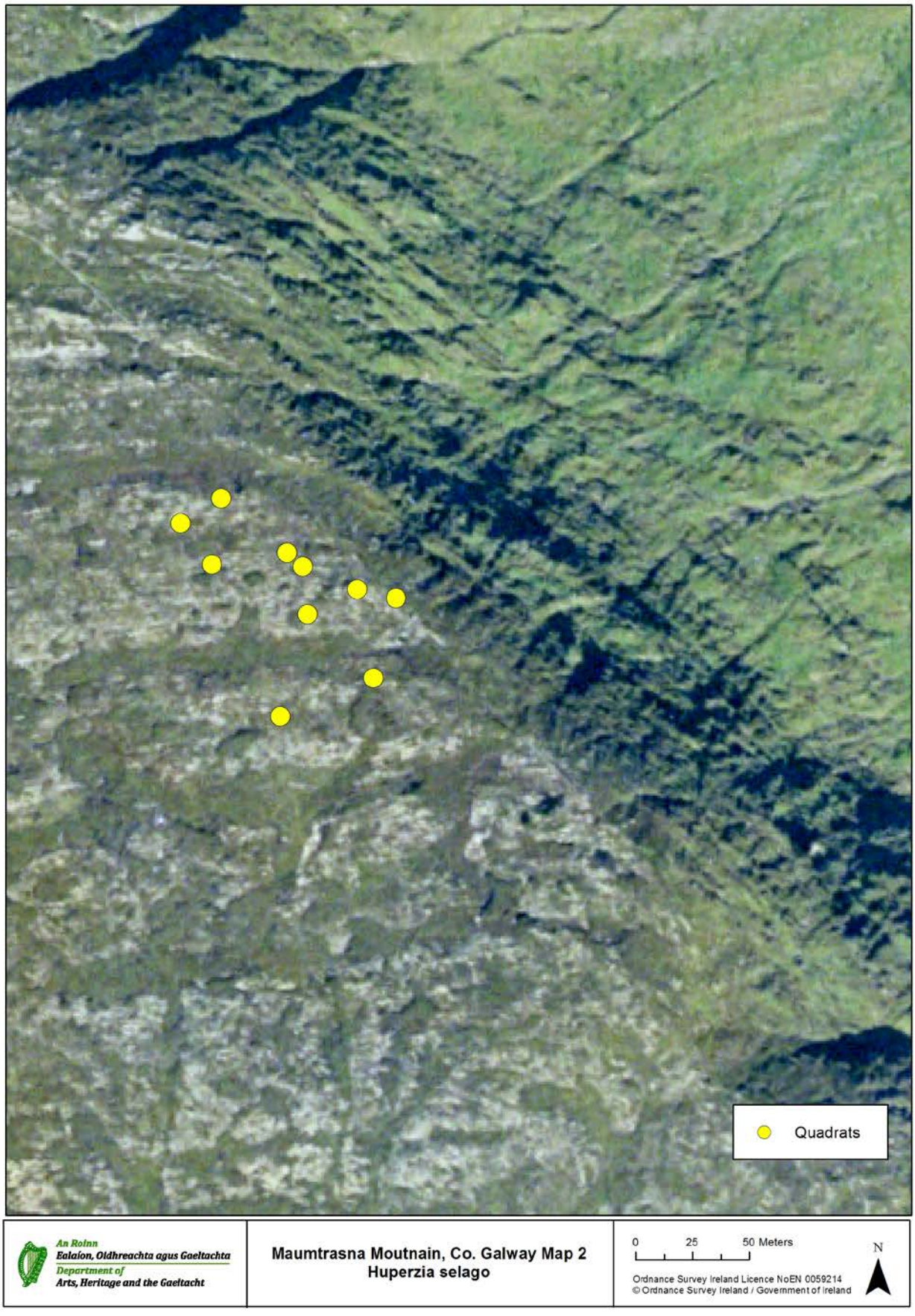
Department of Arts, Heritage and the Gaeltacht

Maumtrasna Moutnain, Co. Galway Map 1
Huperzia selago

0 50 100 Meters

N


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Maumtrasna Moutnain, Co. Galway Map 2
Huperzia selago
0
25
50 Meters
N
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Conservation Assessment for *H. selago* Maumtrasna mountain, Co. Galway

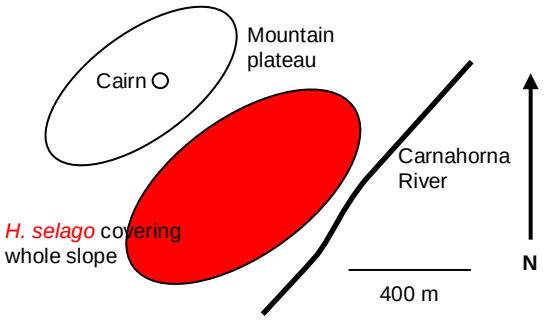
POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥10	10	PASS
Population size (combined area of occupancy of colonies)	≥200x100 m	200x100 m	
Total Domin cover area of target species (H. selago) in m^2	≥2	2	PASS
Population size class	2 (500-1000)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥3	3.8	PASS
Domin scale cover of *Calluna vulgaris*	3-7	6	PASS
Domin cover bare rock/ground	0-4	7	FAIL
Total vegetation cover	8-10	4	FAIL
Fossit Habitat	HH4	ERODED	FAIL
FUTURE PROSPECTS	Impact	Figure	Result
Trampling and overuse (G05.01)	None	Medium	FAIL
Intensive sheep grazing (A04.01.02)	None	Medium	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Muckish Mountain, Co. Donegal (C00102/28199 Vice-County H35)

Species	Vice-county number	Vice-county	
Huperzia selago	H35	West Donegal	
Locality	Land owner/Occupier	cSAC/pNHA	
Muckish Mountain	Unknown	Probably private	
Grid Ref. GPS? Yes	Altitude (m)	Date (D/M/Y)	Recorder
C00102/28199 (± 4 m)	600 - 630 m	03/09/09	Caroline Nienhuis & (Noeleen Smyth)

Sketch map of site showing location of species: indicate North (arrow) and scale



Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Population growing on moist, rocky and in parts steep (8 - 32º) slope below peak of Muckish Mountain.
Area covered in low growing bryophytes, grass and heather.
Site is not threatened as erosion due to hikers and grazing sheep is very minimal

Spores present: Yes

Size of population
Very large population of about 5001 - 10000 stems counted in 800x400 m. Average length of three longest stems: 6.9 cm

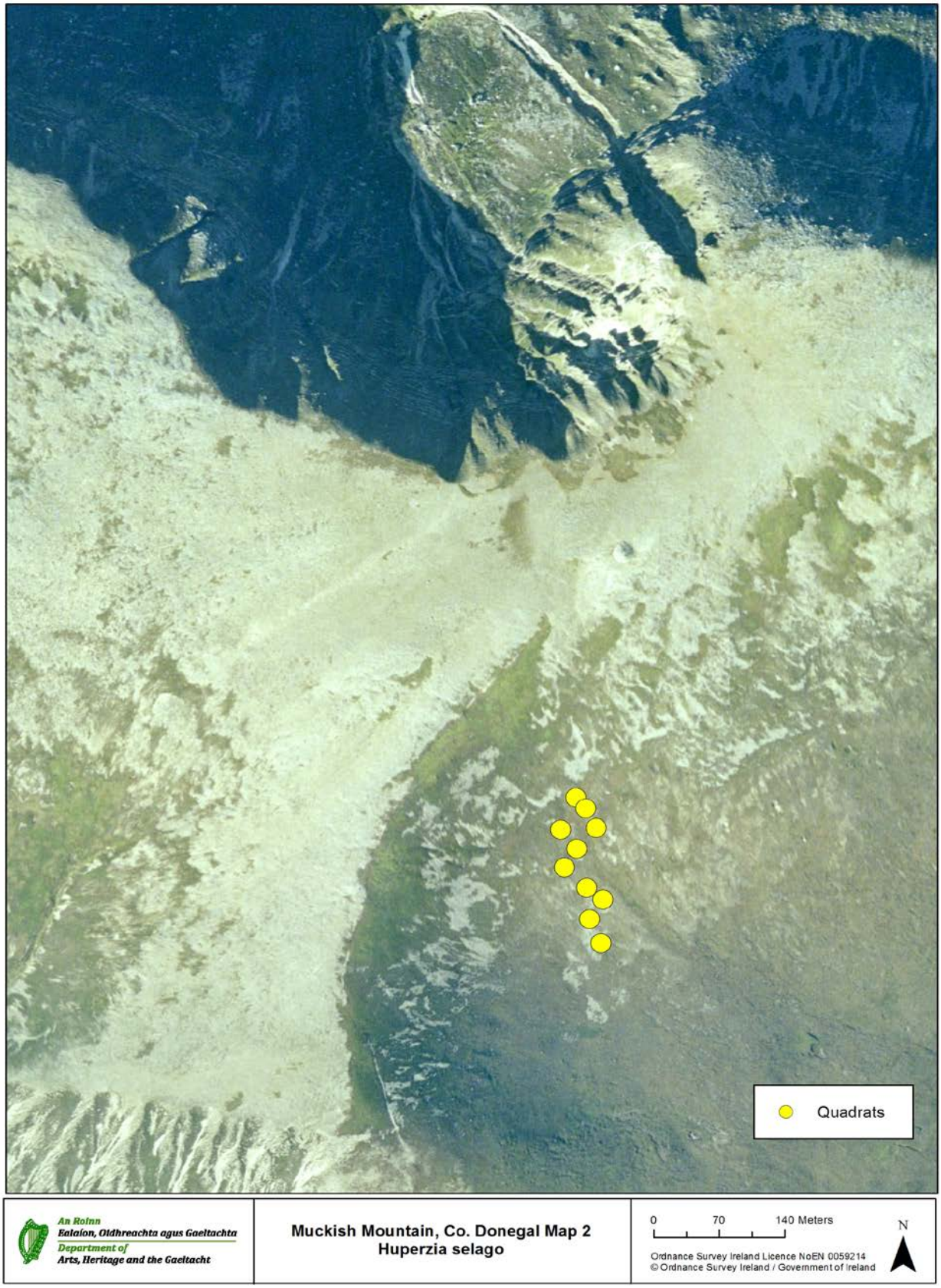
Quadrats
MMDA1-10

Locality Map (1:50 000 if possible)

Associated species in 1 m^2 quadrat (Average n=10)	DOMIN scal
Huperzia selago	3
Agrostis sp., *Deschampsia flexuosa*, *Nardus stricta*	5
Calluna vulgaris	5
Cladonia portentosa, *Cladonia unicalis*	+
Dicranella heteromalla, *Hypnum jutlandicum*, *Racomitrium lanuginosum*, *Rhytidiadelphus loreus*, *Scorpidium scorpioides*	6
Erica cinerea	7
Lichen	3
Potentilla erecta	3

	Bare ground 1 Bare rock 3

***H. selago* growing on peaty ground among bryophytes, grass, heather and rocks on the slope leading to Muckish Mountain, Co. Donegal**


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Muckish Mountain, Co. Donegal Map 2
Huperzia selago
0
70
140 Meters
N
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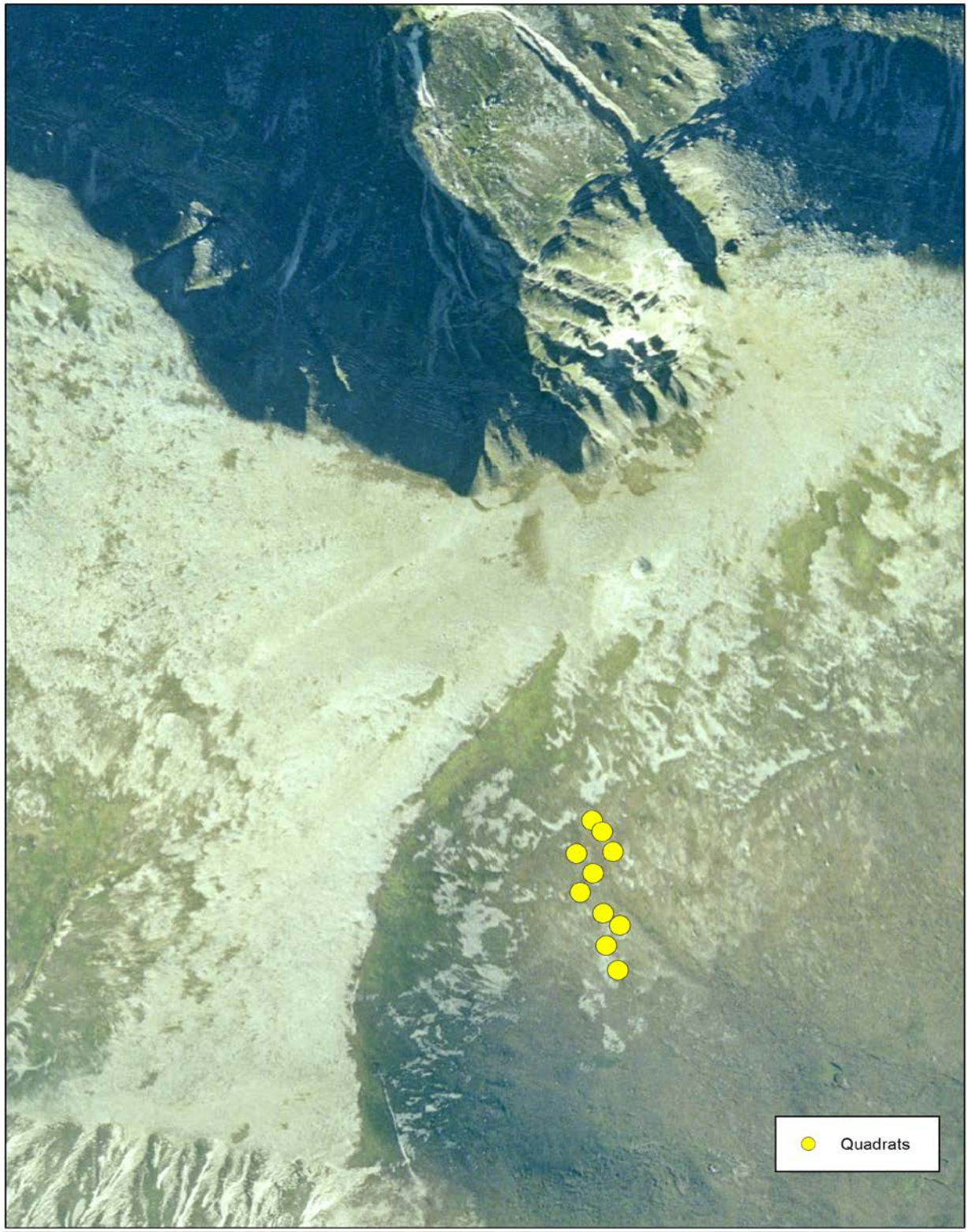

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Department of Arts, Heritage and the Gaeltacht

Muckish Mountain, Co. Donegal Map 2
Huperzia selago

0 70 140 Meters

N

Conservation Assessment for *H. selago* on Muckish mountain

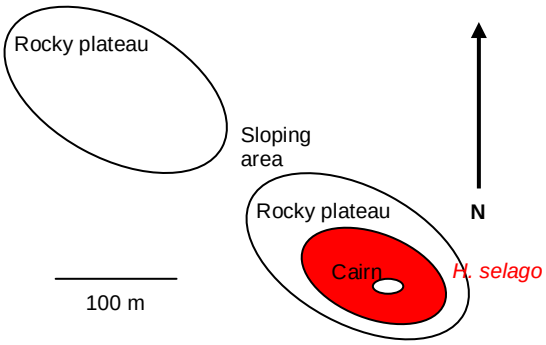
POPULATION	TARGET	FIGURE	RESULT
Total colony number	**≥10**	**10**	**PASS**
Population size (combined area of occupancy of colonies)	**≥800x400 m**	**800x400 m**	**PASS**
Total Domin cover area of target species (H. selago) in m^2	**≥3**	**3**	**PASS**
Population size class	**5 (5000-10000)**	**5**	**PASS**
Fertile cones present	**Yes**	**Yes**	**PASS**
HABITAT	**Target**	**Figure**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	**≥6**	**6.9**	**PASS**
Domin scale cover of *Calluna vulgaris*	**3-7**	**5**	**PASS**
Domin cover bare rock/ground	**0-4**	**4**	**PASS**
Total vegetation cover	**8-10**	**9**	**PASS**
Fossit Habitat	**HH4**	**HH4**	**PASS**
FUTURE PROSPECTS	**Impact**	**Figure**	**Result**
Trampling and overuse (G05.01)	**None**	**Low**	**PASS**
Intensive sheep grazing (A04.01.02)	**None**	**Low**	**PASS**

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)
OVERALL CONSERVATION ASSESSMENT: Favourable

Tully Mountain, Co. Galway (L67219/61263 Vice-County H16)

Species	Vice-county number	Vice-county	
Huperzia selago	H16	West Galway	
Locality	Land owner/Occupier	cSAC/pNHA	
Tully Mountain	Unknown		
Grid Ref. GPS? No	Altitude (m)	Date (D/M/Y)	Recorder
L67219/61263 (± 3 m)	345 - 350 m	28/09/09 2010 & 2011	Caroline Nienhuis

Sketch map of site showing location of species: indicate North (arrow) and scale



Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

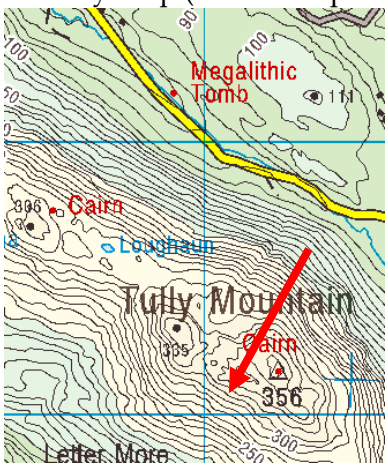
Population growing on plateau and on slopes (5 - 20º) of Tully Mountain.
Area covered in small rocks and large boulders, only sparse cover of bryophytes, grass and heather.
The species at this site is threatened by erosion due to hikers and grazing sheep.
Spores present

Yes

Size of population
Population of about 501 - 1000 stems counted in 150x100. Average length of three longest stems: 3.3 cm.

Quadrats
TMHS1 -10

Locality Map (1:50 000 if possible)

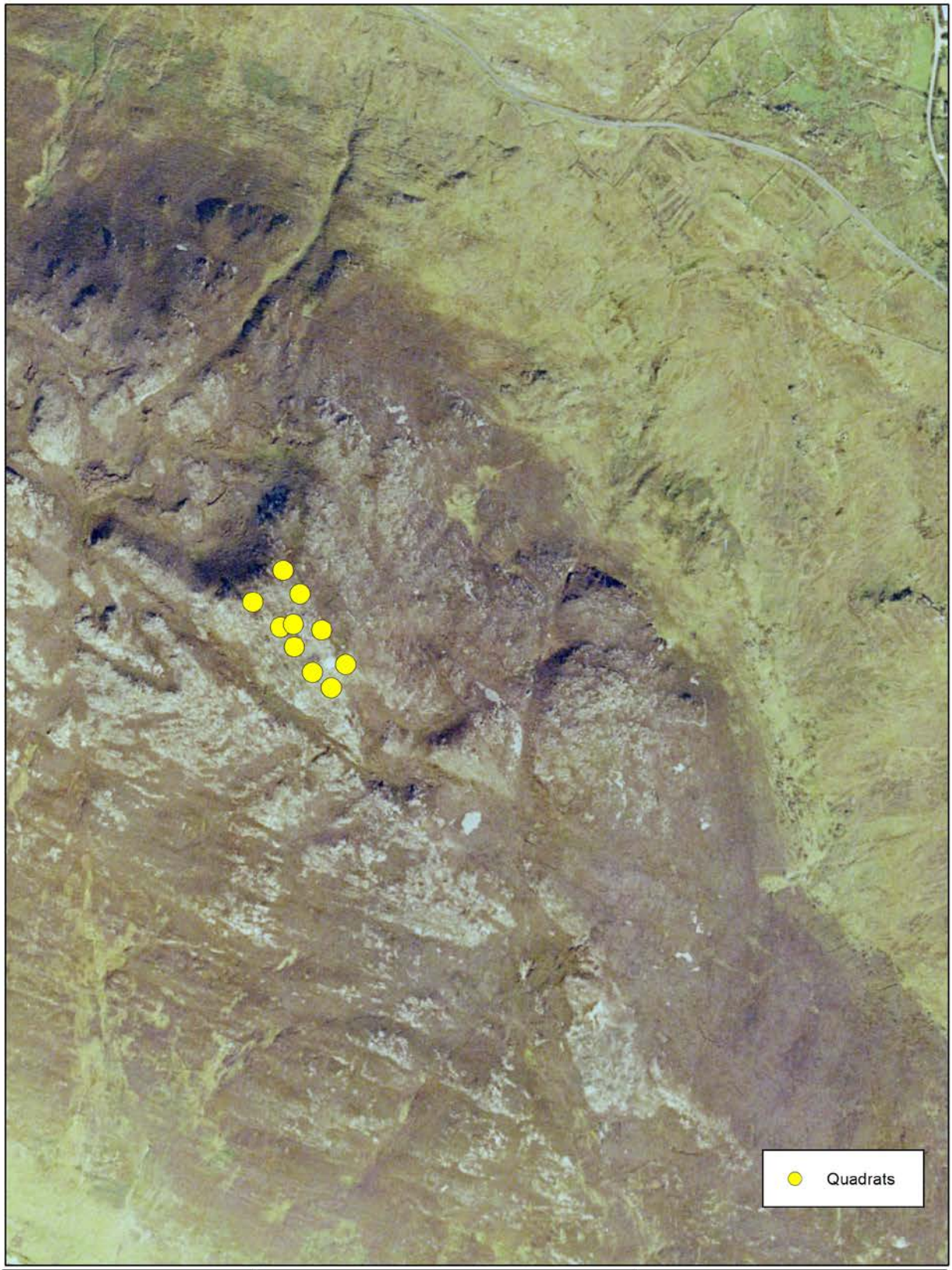


Associated species in 1 m² quadrat

(Average n=10)	**DOMIN scale**
Huperzia selago	1
Agrostis sp., *Deschampsia flexuosa*, *Nardus stricta*, *Schoenus nigricans*	3
Calluna vulgaris	4
Cladonia portentosa, *Cladonia unicalis*	2
Erica cinerea	4
Erica tetralix	1
Galium saxatile	1
Hypnum jutlandicum, *Racomitrium lanuginosum*	3

	Juniperus communis alpina	2
	Lichen	3
	Bare ground	3
	Bare rock	5

***H. selago* growing among small rocks, bryophytes, grass and heather on Tully Mountain, Co. Galway.**



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Department of Arts, Heritage and the Gaeltacht

Tully Mountain, Co. Galway Map 2
Huperzia selago

0 70 140 Meters

N

Conservation assessment for *Huperzia selago* at Tully Mountain, Co. Galway.

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥10	10	PASS
Population size (combined area of occupancy of colonies)	≥150x100 m	150x100 m	
Total Domin cover area of target species (H. selago) in m^2	≥1	1	PASS
Population size class	2 (500-1000)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥3	3.3	PASS
Domin scale cover of *Calluna vulgaris*	3-7	4	PASS
Domin cover bare rock/ground	0-4	8	FAIL
Total vegetation cover	8-10	4	FAIL
Fossit Habitat	HH4	ERODED	FAIL
FUTURE PROSPECTS	Impact	Figure	Result
Trampling and overuse (G05.01)	None	Medium	FAIL
Intensive sheep grazing (A04.01.02)	None	Medium	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Clohernagh Mountain, Co. Wicklow (T05373/91981 Vice-County H20)

<table>
<tr><td>Species

Huperzia selago</td><td>Vice-county number

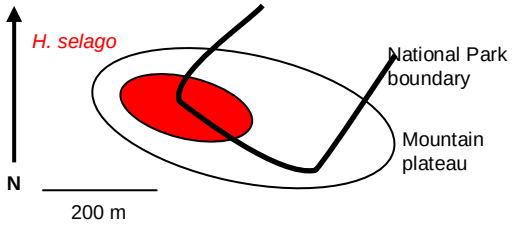
H20</td><td colspan="2">Vice-county

Wicklow</td></tr>
<tr><td>Locality
Clohernagh
Mountain
Glenmalure</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA
Parts of population lie within Glendalough National Park boundary</td></tr>
<tr><td>Grid Ref. GPS? Yes

T05479/91993 no 4 and T 05421/92073 no 6) (± 3m)</td><td>Altitude (m)

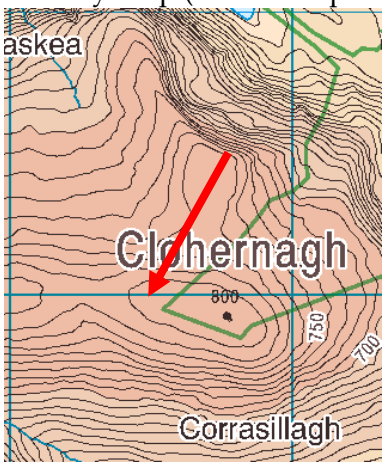
785 – 792 m</td><td>Date (D/M/Y)

17/09/2009
2010, 2011</td><td>Recorder
Anke Dietzsch
Caroline Nienhuis
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Large population growing on moist peaty ground on top of mountain plateau on Clohernagh Mountain.
Plateau covered in low growing bryophytes, grass and heather.
Site not immediately threatened but further erosion due to hikers and grazing sheep may pose future threats
Spores present: Yes</td></tr>
<tr><td colspan="2">Size of population
Very large population of about 3001 – 1000 stems counted in 200x100 m.
Average length of three longest stems: 40 cm</td><td colspan="2">Quadrats

CMLC4 & 6</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat	DOMIN scale
Huperzia selago	+
Calluna vulgaris	1
Deschampsia flexuosa, Nardus stricta	7
Diphasiastrum alpinum	1
Empetrum nigrum	6
Galium saxatile	3
Lycopodoim clavatum	5
Hypnum jutlandicum, Polytrichum commune, Racomitrium lanuginosum, Rhytidiadelphus loreus, Thuidium tamariscinum	7
Juncus squarrosus	+
Vaccinium myrtillus	4
Bare rock	+

Conservation assessment for *Huperzia selago* at Cloghernagh mountain, Co. Wicklow see also map for *L. clavatum* .

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥2	2	PASS
Population size (combined area of occupancy of colonies)	≥1x0.5 m	1x0.5m	PASS
Total Domin cover area of target species (H. selago) in m^2	≥1	1	PASS
Population size class	1 (0-50)	1 (0-50)	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥3	4	PASS
Domin scale cover of *Calluna vulgaris*	3-7	0	PASS
Domin cover bare rock/ground	0-4	4	PASS
Total vegetation cover	8-10	6	PASS
Fossit Habitat	HH4	ERODED	FAIL
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Favourable

Kilcrohane, Co. Cork (V80908/39358 Vice-County H3)

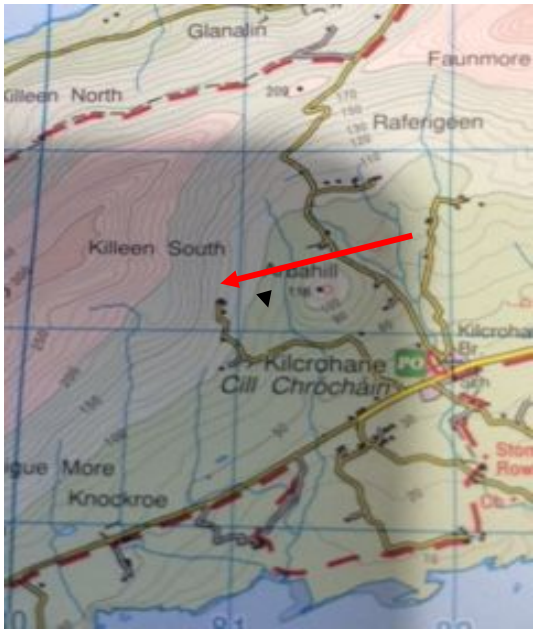
Species	Vice-county number	Vice-county	
Huperzia selago	H3	West Cork	
Locality Kilkrohane - near Sheep's Head trail	Land owner/Occupier Unknown	cSAC/pNHA	
Grid Ref. **V80908/39358**	Altitude (m) 179-168m	Date (D/M/Y) 24/09/2009	Recorder Caroline Nienhuis Noeleen Smyth

Size of population
Very small population 0.5m²
Average length of three longest stems: 19.3 cm

Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Five discreet patches with *H. selago* hiking path near and above Sheep's head trail and vegetation encroachment from grass and heather
Site not immediately threatened but further erosion due to hikers could be an issue
Spores present Yes

Locality Map (1:50 000 if possible)



Quadrats
KHHS1-5

Associated species in 1 m² quadrat Average n=5)	DOMIN scale
Huperzia selago	2
Bryophytes (Fissidens adianthoides, Polytrichum juniperinum, Sphagnum palustre, Thuidium tamariscinum)	5
Bare rock	6
Lichen	3
Agrostis sp., Nardus stricta	6
Calluna vulgaris	6
Potentilla erecta	0
Pedicularis sylvatica	3

Conservation assessment for *Huperzia selago* at Krohane, Co. Cork

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥5	5	PASS
Population size (combined area of occupancy of colonies)	≥0.5m x 0.5m	0.5m x 0.5m	
Total Domin cover area of target species (H. selago) in m^2	≥2	2	PASS
Population size class	2 (50-100)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥3	3.9	PASS
Domin scale cover of *Calluna vulgaris*	3-7	6	PASS
Domin cover bare rock/ground	0-4	6	FAIL
Total vegetation cover	8-10	3	FAIL
Fossit Habitat	HH4	ERODED	FAIL
FUTURE PROSPECTS	Impact	Figure	Result
Trampling and overuse (G05.01)	None	Medium	FAIL
Intensive sheep grazing (A04.01.02)	None	Medium	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)
OVERALL CONSERVATION ASSESSMENT: inadequate

Monitoring sites *Diphasiastrum alpinum*

Diphasiastrum alpinum

Diphasiastrum alpinum Monitoring Sites and individual quadrats

Positive site record

Site name	GPS Irish Grid	Quadrat Code and No	Conservation Assessment
Camaderry	06782/99123 (+ 3m)	WGRB1+2	Inadequate
Kippure	11739/15303 (+ 3m)	KMDA1+2	Favourable
Kippure	11732/15307 (+ 3m)	KMDA3+4	
Cloghernagh see recording sheet for *L. clavatum*	05435/91975 (+ 3m)	CMLC3	
Cloghernagh see recording sheet for *L. clavatum*	05343/92007 (+ 3m)	CMLC7	
Derryveagh	97016/20609 (+ 3m)	DVDA1	Inadequate
Derryveagh	97019/20601 (+ 3m)	DVDA2	
Derryveagh	97024/20597 (+ 3m)	DVDA3	
Derryveagh	97023/20588 (+ 3m)	DVDA4	
Derryveagh	97019/20585 (+ 3m)	DVDA5	
Derryveagh	97015/20592 (+ 3m)	DVDA6	
Derryveagh	97007/20592 (+ 3m)	DVDA7	
Derryveagh	97009/20605 (+ 3m)	DVDA8	
Derryveagh	97013/20599 (+ 3m)	DVDA9	
Derryveagh	97016/20609 (+ 3m)	DVDA10	
Maumturk	93611/49139 (+ 3m)	MMDA1+2	Inadequate
Maumturk	93609/49146 (+ 3m)	MMDA3+4	
Maumturk	92881/49350 (+ 3m)	MMDA5	
Maumturk	92880/49350 (+ 3m)	MMDA6+7	

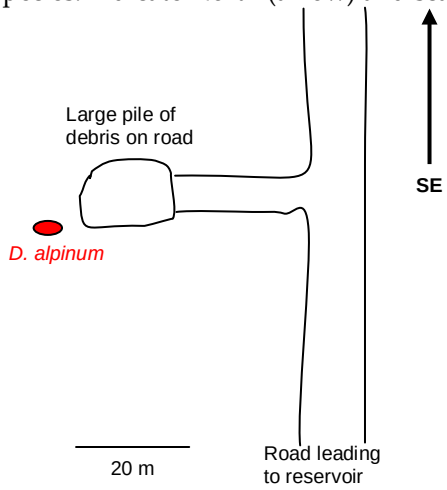
Negative site record

Site name	GPS Irish Grid
Tully Mountain	L672612
Lough Eske	G98

Camaderry Co. Wicklow (T06782/99123 Vice-county H20)

Species	**Vice-county number**	**Vice-county**	
Diphasiastrum alpinum	H20	Wicklow	
Locality Camaderry	**Land owner/Occupier** Probably private	**cSAC/pNHA**	
Grid Ref. T06782/99123	**Altitude (m)** 630 m	**Date** August 2009, 2011 & 2012	**Recorders** Caroline Nienhuis Noeleen Smyth

Sketch map of site showing location of species: indicate North (arrow) and scale



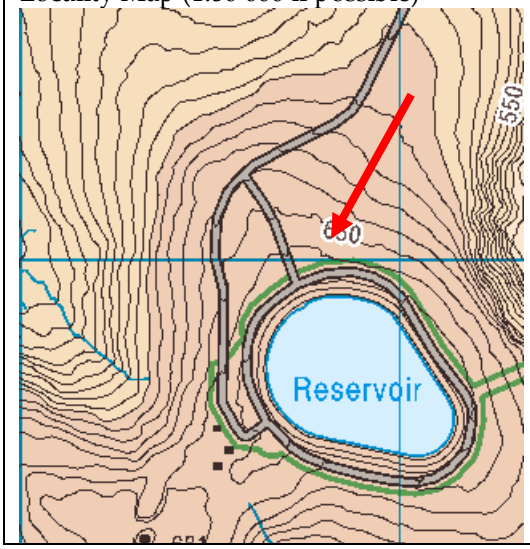
Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height
Population growing on moist and flat ground in boggy area below and N of Camaderry reservoir. Area covered in low growing bryophytes, grass and heather. The species found associated were the typical mountain mosses *Polytrichum commune* and *Racomitrium lanuginosum* and heather *Calluna vulgaris.* Site is considered threatened with erosion due to hiking tracks and the dumping of debris and gravel may pose future threats

Spores present: No

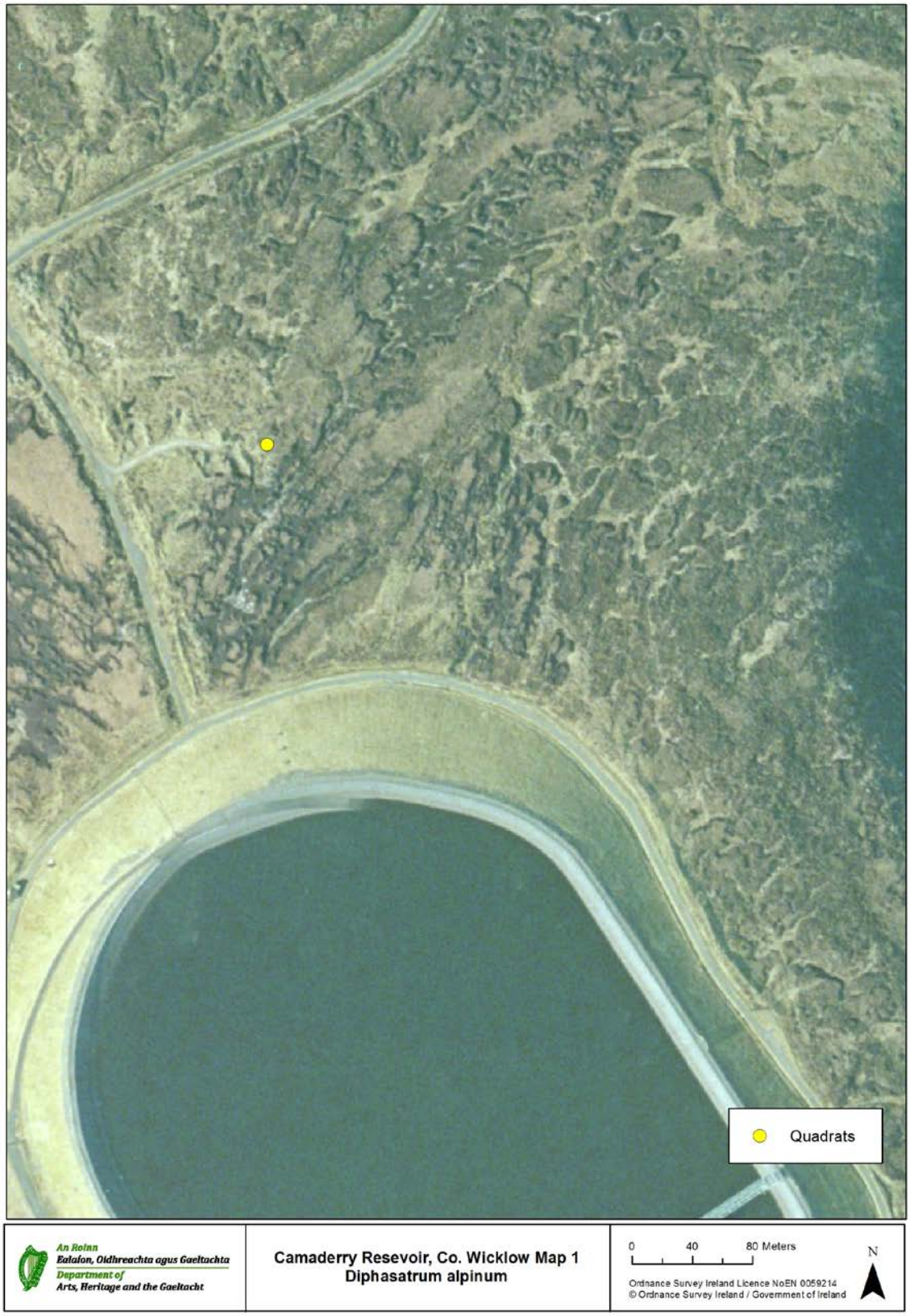
Size of population
Small population of about 70 stems counted in 2.25 m².
Average length of three longest stems: 7.8 cm

Quadrats
WGRB1+2 T06782/99123 (+ 3m)

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=2)	**DOMIN scale**
Diphasiastrum alpinum	5
Polytrichum commune	
Racomitrium lanuginosum	8
Calluna vulgaris	7
Deschampsia flexuosa	4
Empetrum nigrum	4
Galium saxatile	4
Juncus squarrosus	4
Vaccinium myrtillus	5
Bare rock	4
Lichen	3


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Camaderry Resevoir, Co. Wicklow Map 1
Diphasatrum alpinum
0
40
80 Meters
N
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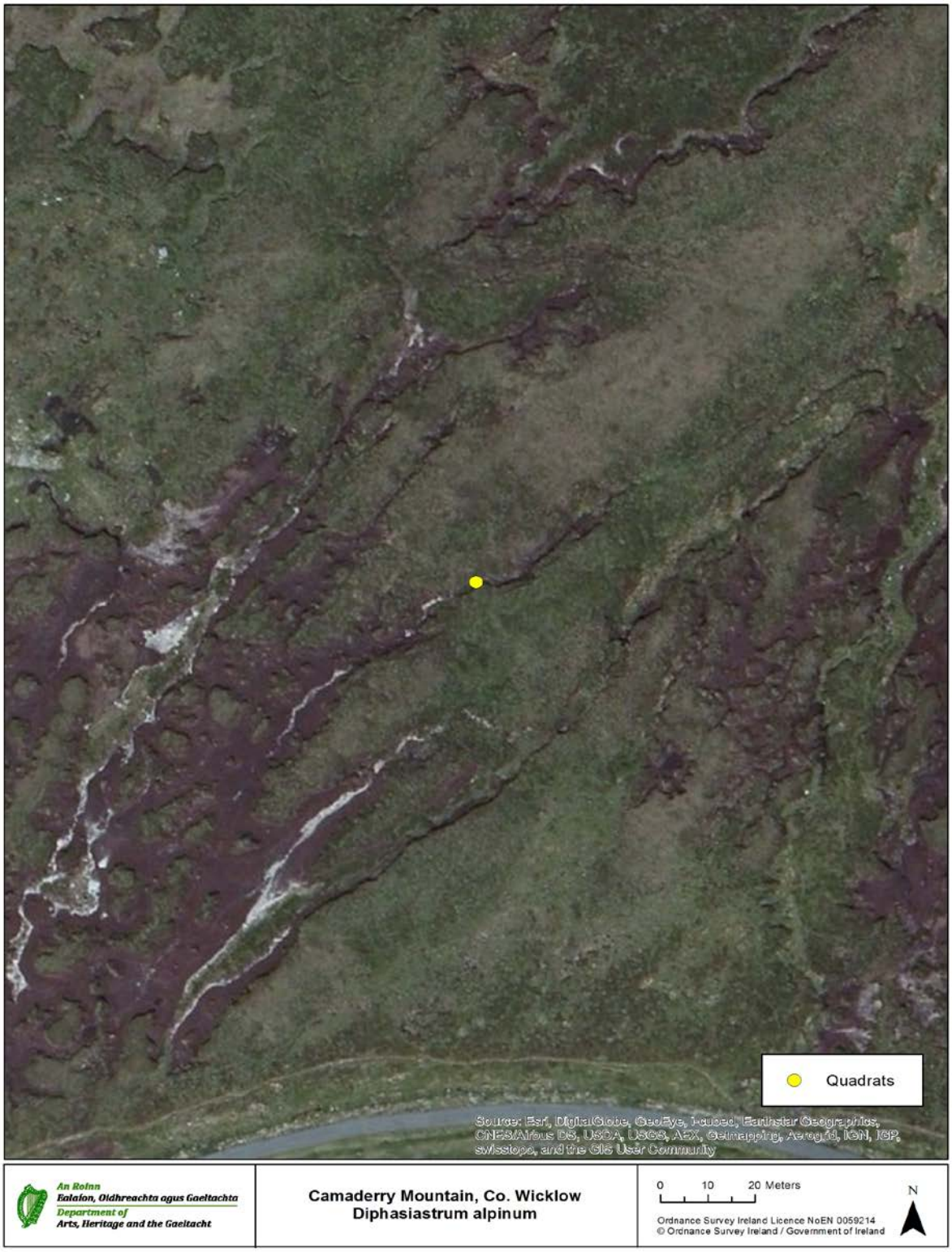
© Ordnance Survey Ireland / Government of Ireland


Quadrats
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Camaderry Mountain, Co. Wicklow
Diphasiastrum alpinum
0 10 20 Meters
N
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Conservation Assessment for *D. alpinum* Camaderry, Co. Wicklow

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥ 1	1	PASS
Population size (combined area of occupancy of colonies)	≥ 2.25 m²	2.25 m²	PASS
Total Domin cover area of target species (D. alpinum) in m²	≥5 (11-25%)	5	PASS
Population size class	≥2 (50-100)	2 (50-100)	PASS
*Fertile cones present (see methods section)	Yes	No	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥7.8cm	7.8cm	PASS
Domin scale cover of *Calluna vulgaris*	5-7 (up to 50%)	7	PASS
Domin cover bare rock	0-4 (up to 10%)	4	PASS
Total vegetation cover	8-10 (up to 100%)	8	PASS
Fossit Habitat	HH4	HH4	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Disposal of inert materials in this case sand and gravel (E03.03)	None	LOW	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Favourable

Derryveagh/ Edenadooish Co. Donegal (B97013/20608 Vice-county H35)

<table>
<tr><td>Species

Diphasiastrum alpinum</td><td>Vice-county number

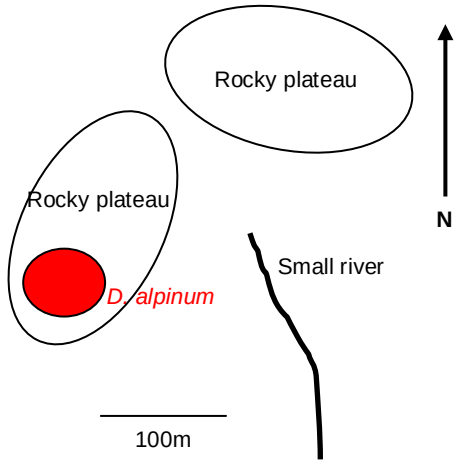
H35</td><td colspan="2">Vice-county

West Donegal</td></tr>
<tr><td>Locality
Derryveagh Mountain</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref.
B97013/20608 (± 3 m)</td><td>Altitude (m)

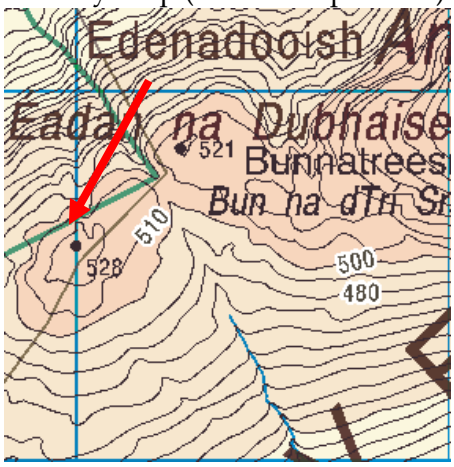
528 m</td><td>Date (D/M/Y)

03/09/09</td><td>Recorder

Caroline Nienhuis</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height
Ten large patches growing on rocky plateau on mountain peak of Edenadooish (see map). Vegetation rather sparse but consisting mainly of bryophytes, heather and grass. The vegetation at this site is sparse with a high percentage of bare rock (DOMIN 5). The other Clubmoss species Huperzia selago was also found growing at this site. The typical mountain mosses, Polytrichum commune and Racomitrium lanuginosum along with the heather Calluna vulgaris were the co dominant species at this site. Erosion due to hikers and grazing deer and sheep, along with vegetation encroachment may pose future threats to the species here.

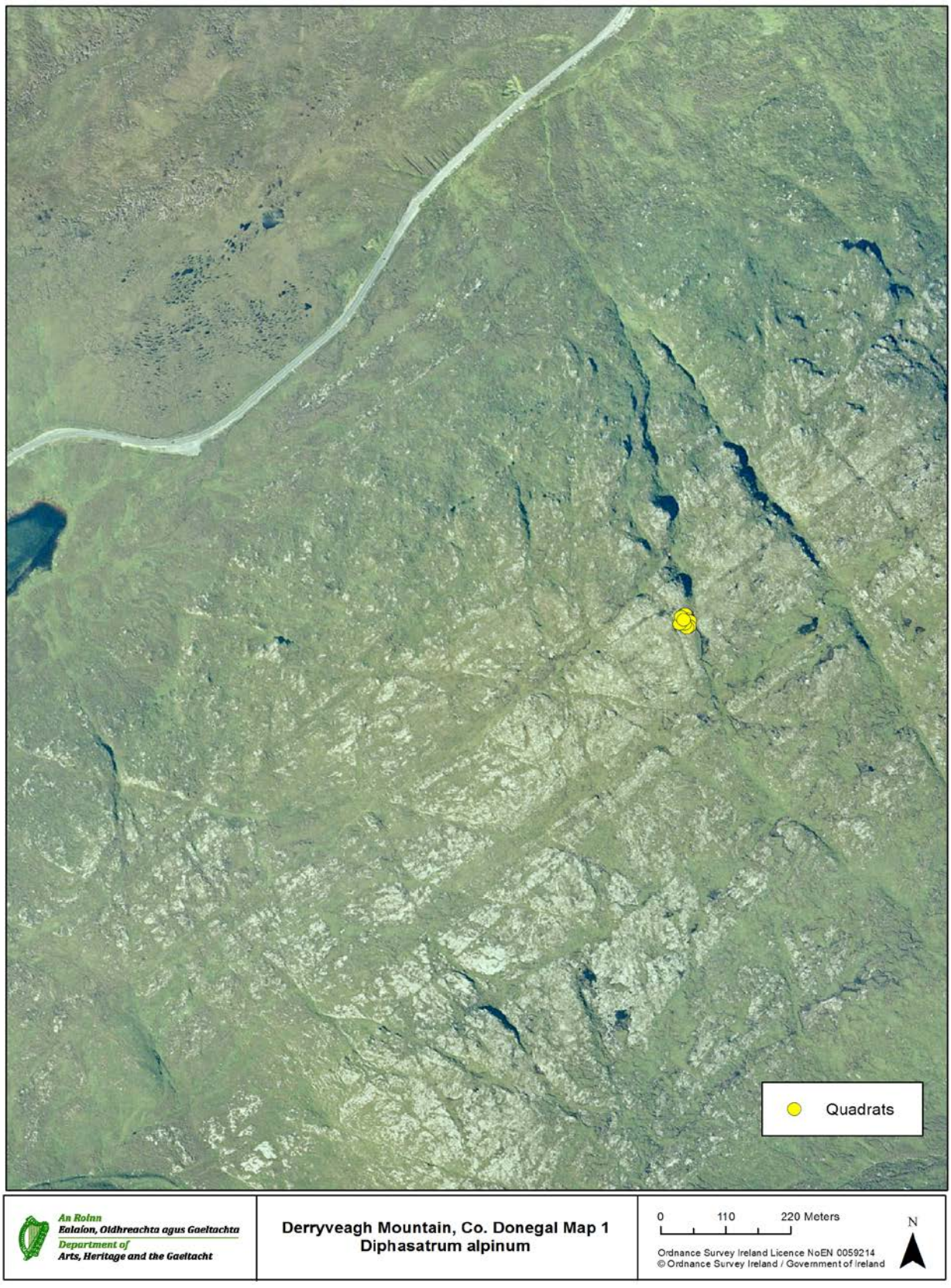
Spores present: Yes but sparse</td></tr>
<tr><td colspan="2">Size of population
Large population of about 1001-3000 stems counted in 25x25 m^2.
Average length of three longest stems: 4.3 cm</td><td colspan="2">Quadrats
DVDA No: 1-10 see table</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=10)	**DOMIN scale**
Diphasiastrum alpinum	5
Huperzia selago	1
Hypnum jutlandicum, Polytrichum commune, Racomitrium lanuginosum	7
Agrostis tenuis, Nardus stricta	7
Calluna vulgaris	7
Cladonia unicalis	1
Galium saxatile	4
Potentilla erecta	2
Salix sp.	1
Bare ground	+
Bare rock	5
Lichen	1

D. *alpinum* growing among bryophytes, heather, grass and rocks on rocky mountain plateau and with sporing cones on Derryveagh Mountains, Co. Donegal.


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Derryveagh Mountain, Co. Donegal Map 1
Diphasatrum alpinum
0
110
220 Meters
N
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Department of Arts, Heritage and the Gaeltacht

Derryveagh Mountain, Co. Donegal Map 2
Diphasatrum alpinum

0 10 20 Meters

N

Conservation Assessment *D. alpinum* Derryveagh Mountain, Co. Donegal

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥ 10	10	PASS
Population size (combined area of occupancy of colonies)	≥ 25x25 m	≥ 25x25 m	PASS
Total Domin cover area of target species (D. alpinum) in m^2	≥5 (11-25%)	5	PASS
Population size class	5 (1000-5000)	5	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥4.3cm	4.3cm	PASS
Domin scale cover of *Calluna vulgaris*	5-7 (up to 50%)	7	PASS
Domin cover bare rock	0-4 (up to 10%)	5	PASS
Total vegetation cover	8-10 (up to 100%)	8	PASS
Fossit Habitat	HH4	HH$	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	MEDIUM	FAIL
Intensive sheep grazing (A04.01.02)	None	MEDIUM	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (inadequate)

OVERALL CONSERVATION ASSESSMENT: Inadequate

Kippure, Co. Wicklow (011739/15303 Vice-County 20)

<table>
<tr><td>Species

Diphasiastrum alpinum</td><td>Vice-county number

H20</td><td colspan="2">Vice-county

Wicklow</td></tr>
<tr><td>Locality

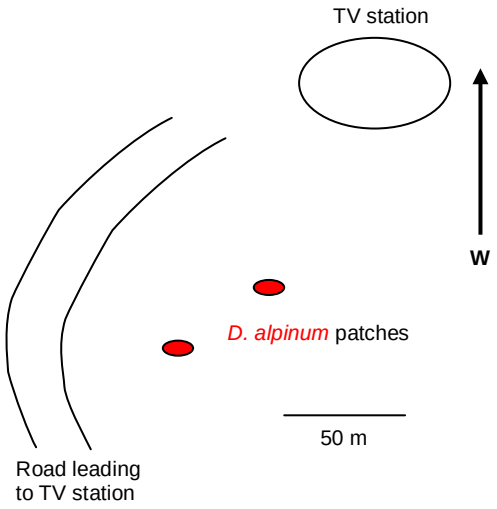
Kippure Mountain</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA

SAC</td></tr>
<tr><td>Grid Ref.
O11739/15303 (± 3 m)
O11732/15307 (± 3 m)</td><td>Altitude (m)

630 – 640 m</td><td>Date (D/M/Y)

August 2009, 2011, 2012
February 2013</td><td>Recorders

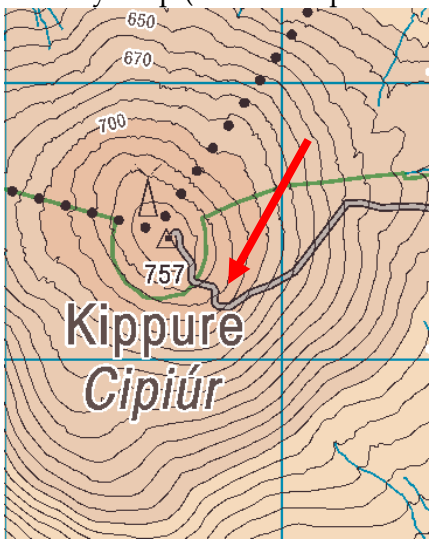
Caroline Nienhuis
Christina Campbell
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Two small patches growing on moist slope (5 - 10º) below and SE of TV station on Kippure Mountain.
Slope covered in low growing bryophytes and heather. The habitat equates to Montane Heath HH4 of Fossit (2000). With Calluna vulgaris and the montane mosses Polytrichum commune and Racomitrium lanuginosum. The future prospects for the species at this site is good as is not immediately threatened but erosion due to hikers and grazing sheep may pose future threats.

Spores present: Yes</td></tr>
<tr><td colspan="2">Size of population
Small population of about 101-300 stems counted in 4 m².
Average length of three longest stems: 10 cm</td><td colspan="2">Quadrats

KMDA1-4 (see table)</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=4)	DOMIN scale
Diphasiastrum alpinum	6
Hypnum jutlandicum	
Hyocomium armoricum	
Polytrichum commune	
Racomitrium lanuginosum	7
Agrostis tenuis	6
Calluna vulgaris	7
Galium saxatile	3
Empetrum nigrum	+
Juncus squarrosus	2
Vaccinium myrtillus	4

***D. alpinum* growing among bryophytes, heather and rocks below TV station on Kippure Mountain, Co. Wicklow**

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Department of Arts, Heritage and the Gaeltacht

Kippure Mountain, Co. Wicklow Map 1
Diphasatrum alpinum

0 20 40 Meters

N


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Kippure Mountain, Co. Wicklow Map 2
Diphasatrum alpinum
0 10 20 Meters
N
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Conservation Assessment *D. alpinum* Kippure Mountain, Co. Wicklow

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥ 2	2	PASS
Population size (combined area of occupancy of colonies)	≥ 8 m²	≥ 8m²	PASS
Total Domin cover area of target species (D. alpinum) in m²	≥5 (11-25%)	6	PASS
Population size class	3 (100-500)	3	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥10cm	10cm	PASS
Domin scale cover of *Calluna vulgaris*	5-7 (up to 50%)	7	PASS
Domin cover bare rock	0-4 (up to 10%)	0	PASS
Total vegetation cover	8-10 (up to 100%)	10	PASS
Fossit Habitat	HH4	HH4	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Favourable

Maumturk Mountains, Teernakill South, Co. Galway
(L92880/49350 Vice-County H16)

<table>
<tr><td>Species

Diphasiastrum alpinum</td><td>Vice-county number

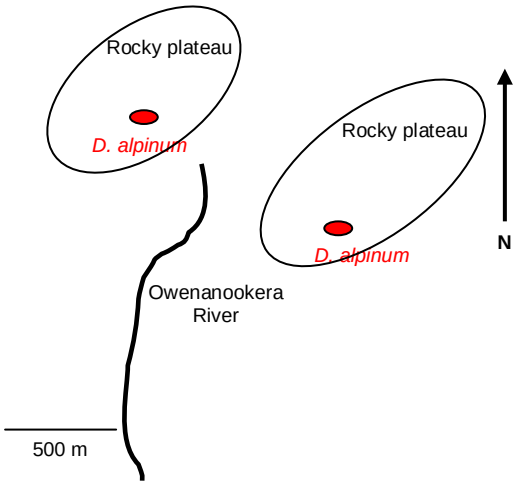
H16</td><td colspan="2">Vice-county

Galway</td></tr>
<tr><td>Locality
Maumturk Mountains
Teernakill South</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref
L92880/49350 (± 3 m)
L93611/49139 (± 3 m)</td><td>Altitude (m)

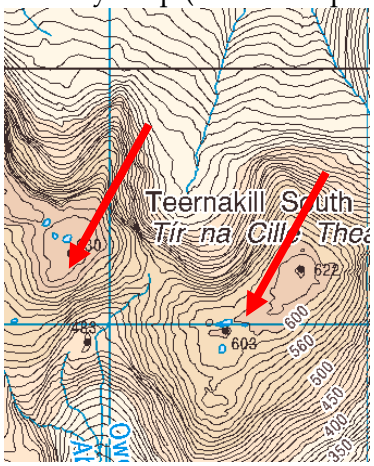
600 - 630 m</td><td>Date (D/M/Y)

01/10/09</td><td>Recorder

Caroline Nienhuis</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Small patches with two patches each growing on rocky plateaus on two mountain peaks of Teernakill South (see map below).
Vegetation rather sparse but consisting mainly of bryophytes, heather and grass.
There small patches with two patches each were found growing on rocky plateaus on two mountain peaks of Teernakill South. The vegetation rather sparse with a high percentage of bare rock and bare ground but consisting mainly of bryophytes, heather and grass. The habitat most equating to HH4 Montane Heath of Fossit (2000). There are threats and the population is small with erosion due to hikers and grazing sheep may posing future threats.
Spores present : No</td></tr>
<tr><td colspan="2">Size of population
Two small populations of about 500-1000 stems counted in 10x10m.
Average length of three longest stems: 4 cm</td><td colspan="2">QUADRATS
MMDA1-7 (see table)</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=	DOMIN scale
Diphasiastrum alpinum	5
Huperzia selago	1
Racomitrium lanuginosum	
Rhytidiadelphus loreus	7
Calluna vulgaris	6
Cladonia unicalis	+
Erica cinerea	3
Festuca vivipara	
Nardus stricta	7
Galium saxatile	2
Juncus squarrosus	2
Bare ground	3
Bare rock	7
Lichen	5

***D. alpinum* growing among bryophytes, heather, grass and rocks on rocky mountain plateaus of Maumturk Mountain, Co. Galway**

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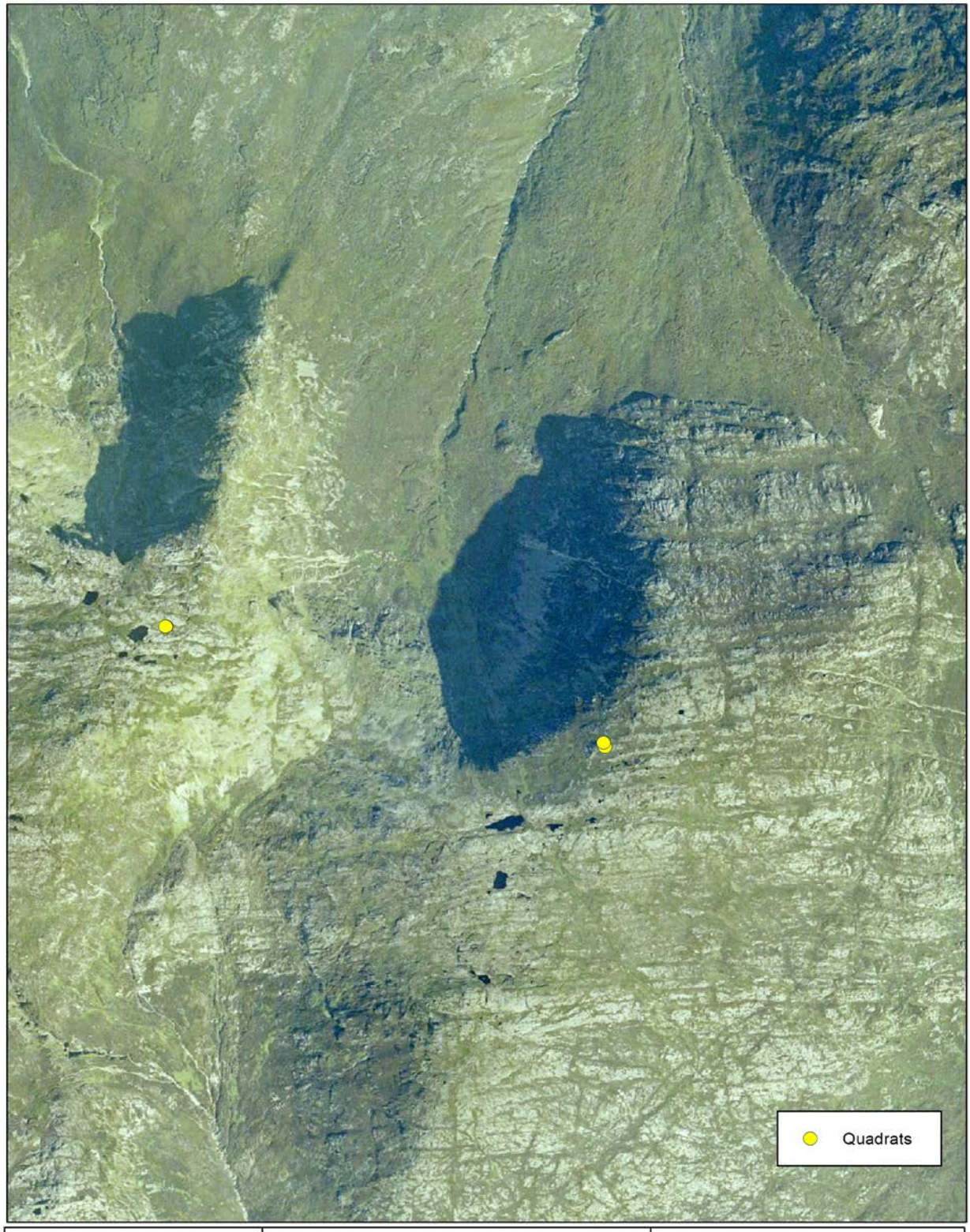
Department of Arts, Heritage and the Gaeltacht

Maumturk Mountain, Co. Galway Map 1
Diphasatrum alpinum

0 210 420 Meters

N


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Maumturk Mountain, Co. Galway Map 2
Diphasatrum alpinum
0
110
220 Meters
N
Ordnance Survey Ireland Licence NoEN 0059214
© Ordnance Survey Ireland / Government of Ireland

Conservation Assessment *D. alpinum* Maumturk. Co. Galway.

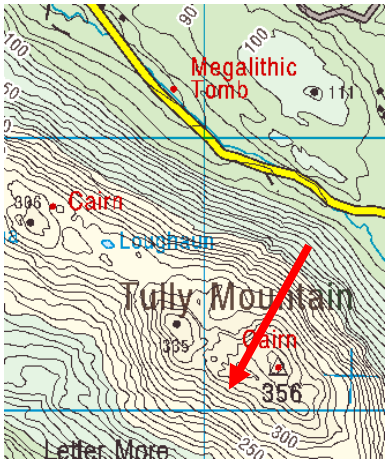
POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥ 4	4	PASS
Population size (combined area of occupancy of colonies)	≥ 10 x 10m²	≥ 10 x 10m²	PASS
Total Domin cover area of target species (D. alpinum) in m²	≥5 (11-25%)	5	PASS
Population size class	4 (500-1000)	3	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m²	≥4cm	4cm	PASS
Domin scale cover of *Calluna vulgaris*	5-7 (up to 50%)	6	PASS
Domin cover bare rock	0-4 (up to 10%)	7	FAIL
Total vegetation cover	8-10 (to 100%)	7	PASS
Fossit Habitat	HH4	HH4	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	MEDIUM	FAIL
Intensive sheep grazing (A04.01.02)	None	MEDIUM	FAIL

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (inadequate)

OVERALL CONSERVATION ASSESSMENT: Inadequate

Tully Mountain, Co. Galway (L672/612 Vice-County H16)

Previous population recorded by Dr. L. Leake a National Botanic Gardens DBN herbarium record. The area search was covered in small rocks and large boulders and only very sparsely covered by vegetation which consisted of bryophytes and heather. The site is overgrazed by sheep and the whole mountain is heavily eroded due to hikers.

Species *Diphasiastrum alpinum*	**Vice-county number** H16	**Vice-county** Galway	
Locality Tully Mountain	**Land owner/Occupier** Unknown	cSAC/pNHA	
Grid Ref. L672612	**Altitude (m)** 330 - 360 m	**Date (D/M/Y)** 28/09/09	**Recorder** Caroline Nienhuis
Sketch map of site showing location of species: indicate North (arrow) and scale Area of grid reference and surrounding area intensely searched but *D. alpinum* was not located. Locality Map (1:50 000 if possible)  		Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded Describe habitat features e.g. aspect, slope, vegetation cover/height Whole area covered in small rocks and large boulders, only sparsely covered by vegetation (bryophytes and heather).	

Lough Eske, Ardnamona, West Donegal (G98 Vice-County 35)

There was a previous record by A.R. Wallace 29/09/1894 at Lough Eske (a National Botanic Gardens herbarium record). This site was chosen as it encompassed the northerly distribution of the species.

Most of area around Lough Eske is used for agricultural purposes and is thus intensively grazed by sheep. Some parts are used for gardens at Ardnamona. No suitable habitat was found for the species at this location.

A northerly site at Aghla Beg Mountain (B96597/25129) Co. Donegal was since discovered by Dr. Anke Dietzsch and Dr. Chloe Galley of Trinity College Dublin in 2010 this site was not monitored.

<table>
<tr><td>Species

Diphasiastrum alpinum</td><td>Vice-county number

H35</td><td colspan="2">Vice-county

Donegal</td></tr>
<tr><td>Locality
Lough Eske
Ardnamona</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA

Unknown</td></tr>
<tr><td>Grid Ref.

G98</td><td>Altitude (m)

528 m</td><td>Date (D/M/Y)

04/09/09</td><td>Recorder

Caroline Nienhuis</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale

No exact grid reference given. Area along and surrounding Lough Eske, Ardnamona intensely searched but D. alpinum was not located.</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Most of area is used for agricultural purposes and is thus intensively grazed by sheep. Some parts are used for gardens at Ardnamona, Co. Donegal.</td></tr>
</table>

Monitoring sites *Lycopodium clavatum*

***Lycopodium clavatum* strobili on aerial stems**

L. clavatum Monitoring Sites and individual quadrats

Site name	GPS Irish Grid	Quadrat Code and No	Conservation Assessment
Cloghernagh	05373/91981 (+ 3m)	CMLC1	Favourable
Cloghernagh	05411/91983 (+ 3m)	CMLC2	
Cloghernagh	05435/91975 (+ 3m)	CMLC3	
Cloghernagh	05497/91993 (+ 3m)	CMLC4	
Cloghernagh	05464/92018 (+ 3m)	CMLC5	
Cloghernagh	05421/92073 (+ 3m)	CMLC6	
Cloghernagh	05343/92007 (+ 3m)	CMLC7	
Cloghernagh	05418/92028 (+ 3m)	CMLC8	
Cloghernagh	05438/92024 (+ 3m)	CMLC9	
Cloghernagh	05453/92000 (+ 3m)	CMLC10	
Kippure	11697/15290 (+ 3m)	KMLC1	Favourable
Kippure	11697/15290 (+ 3m)	KMLC2	
Kippure	11734/15309 (+ 3m)	KMLC3	
Kippure	11710/15358 (+ 3m)	KMLC4	
Kippure	11691/15336 (+ 3m)	KMLC5	
Kippure	11701/15386 (+ 3m)	KMLC6	
Kippure	11686/15426 (+ 3m)	KMLC7	
Kippure	11661/15442 (+ 3m)	KMLC8	
Kippure	11633/15494 (+ 3m)	KMLC9	
Kippure	11667/15358 (+ 3m)	KMLC10	
*Camaderry	06774/99125 (± 3m)	WGRA 1	Favourable
*see recording sheet and map for *D. alpinum* at Camaderry			

Clohernagh Mountain, Co. Wicklow (T05373/91981 Vice-County H20)

<table>
<tr><td>Species

Lycopodium clavatum</td><td>Vice-county number

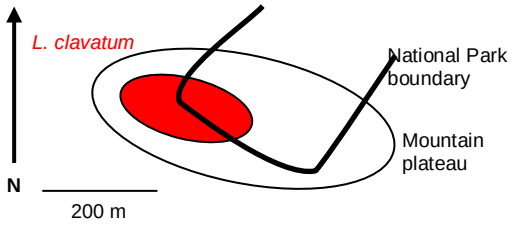
H20</td><td colspan="2">Vice-county

Wicklow</td></tr>
<tr><td>Locality
Clohernagh
Mountain
Glenmalure</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA
Parts of population lie within Glendalough National Park boundary</td></tr>
<tr><td>Grid Ref.

T05373/91981 (± 3m)</td><td>Altitude (m)

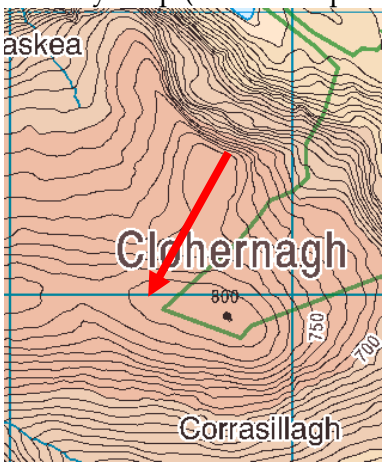
785 – 792 m</td><td>Date (D/M/Y)

17/09/2009
2010, 2011</td><td>Recorder
Anke Dietzsch
Caroline Nienhuis
Noeleen Smyth</td></tr>
<tr><td>Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="3">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Large population growing on moist peaty ground on top of mountain plateau on Clohernagh Mountain.
Plateau covered in low growing bryophytes, grass and heather.
Site not immediately threatened but further erosion due to hikers and grazing sheep may pose future threats.

Spores present: Yes</td></tr>
<tr><td>Size of population
Very large population of about 3001 – 1000 stems counted in 200x100 m.
Average length of three longest stems: 40 cm</td><td colspan="3">Quadrats
CMCL1-10adrats</td></tr>
</table>

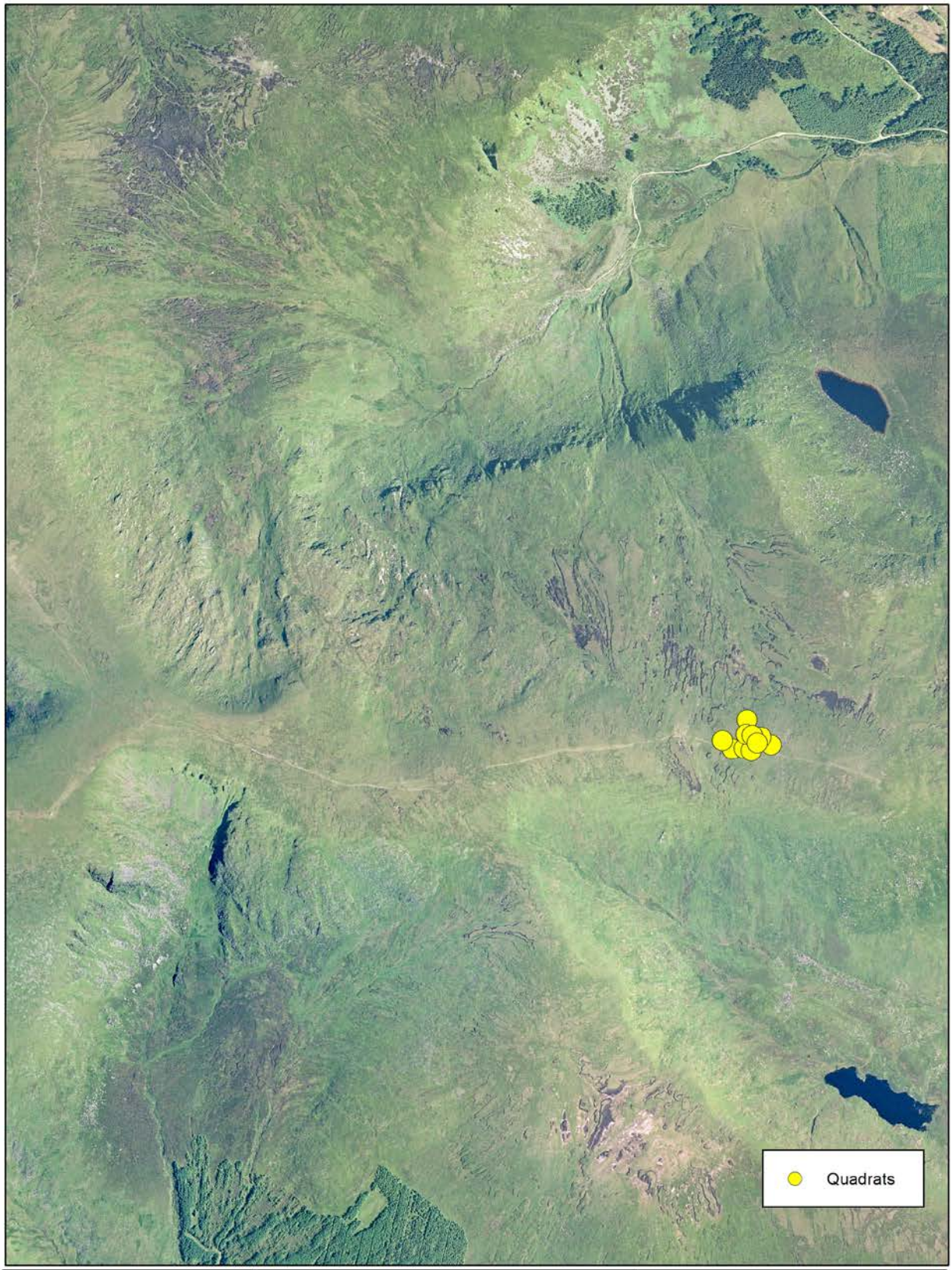
Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (average n=10)	**DOMIN scale**
Lycopodium clavatum	**5**
Calluna vulgaris	1
Deschampsia flexuosa, Nardus stricta	7
****Diphasiastrum alpinum***	**1**
Empetrum nigrum	6
Galium saxatile	3
Huperzia selago	+
Hypnum jutlandicum, Polytrichum commune, Racomitrium lanuginosum, Rhytidiadelphus loreus, Thuidium tamariscinum	7
Juncus squarrosus	+
Vaccinium myrtillus	4
Bare rock	+

* see *Diphasiatrum alpinum* Appendix 2 also

L. clavatum **growing among bryophytes, heather and rocks on top of Clohernagh Mountain, Co. Wicklow**


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Clohernagh Mountain, Co. Wicklow
Lycopodium clavatum
0
210
420 Meters
N
Ordnance Survey Ireland Licence NoEN 0059214
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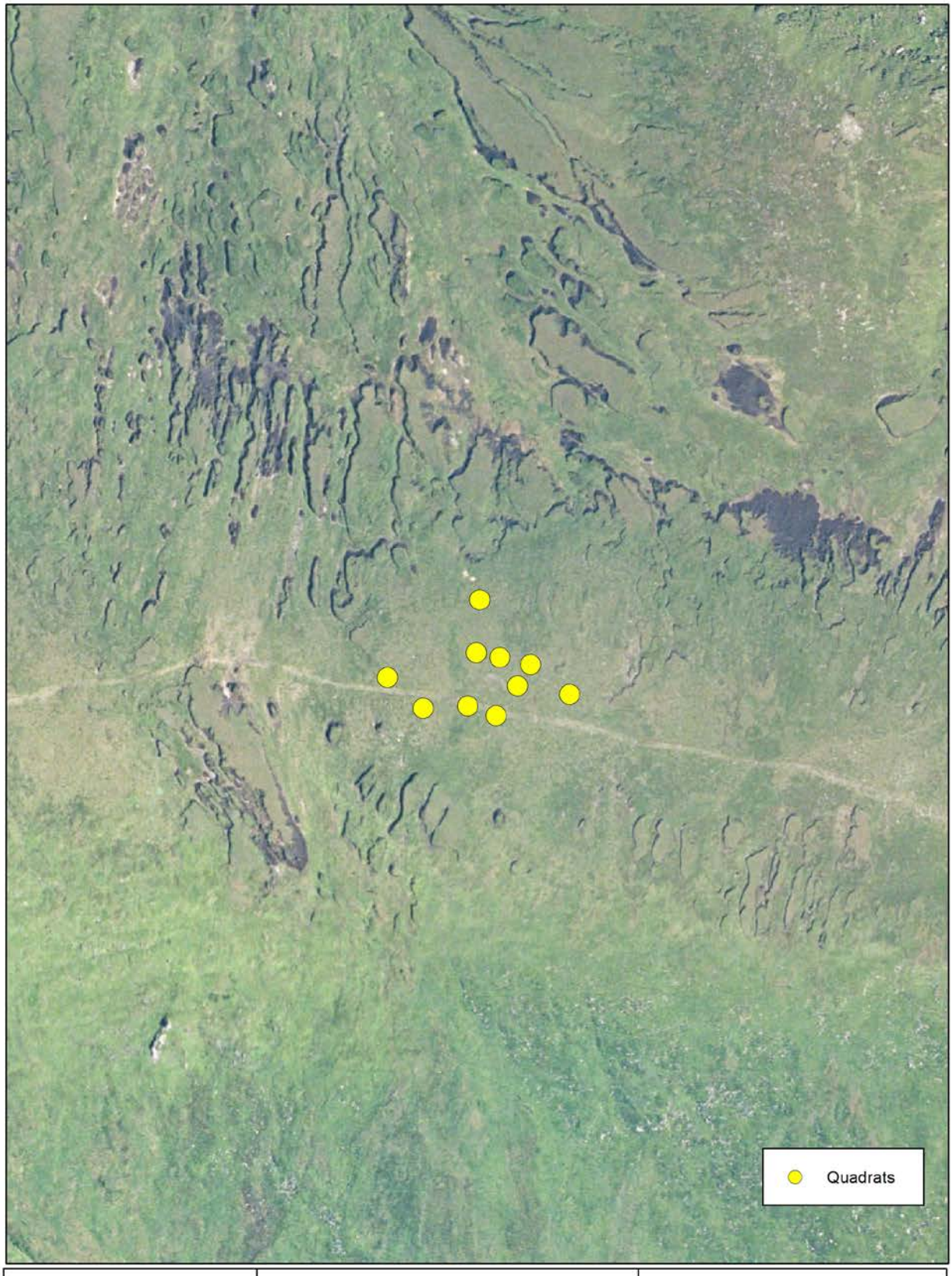


An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Clohernagh Mountain, Co. Wicklow Map 2
Lycopodium clavatum

0 50 100 Meters

N

Conservation assessment for *Lycopodium clavatum* at Clohernagh Mountain, Co. Wicklow

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥10	10	PASS
Population size (combined area of occupancy of colonies)	≥200x100 m	200x100 m	PASS
Total Domin cover area of target species (L. clavatum) in m^2	≥5	5	PASS
Population size class	4 (5000-10000)	5	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥40cm	40	PASS
Domin scale cover of *Calluna vulgaris*	1-4	1	PASS
Domin cover bare rock/ground	4-8	8	PASS
Bryophyte cover	5-7	7	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Disposal of inert materials in this case sand and gravel (E03.03)	None	None	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)
OVERALL CONSERVATION ASSESSMENT: Favourable

Kippure Mountain, Co. Wicklow (T11697/15290 Vice-County H20)

<table>
<tr><td>Species

Lycopodium clavatum</td><td>Vice-county number

H20</td><td colspan="2">Vice-county

Wicklow</td></tr>
<tr><td>Locality

Kippure Mountain</td><td>Land owner/Occupier

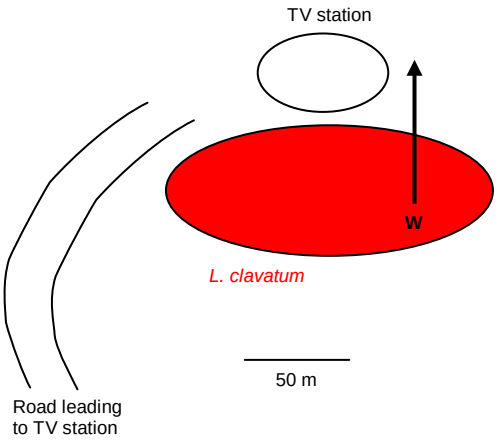
Unknown</td><td colspan="2">cSAC/pNHA

SAC</td></tr>
<tr><td>Grid Ref

T11697/15290 (± 3m)</td><td>Altitude (m)

680 – 700 m</td><td>Date (D/M/Y)

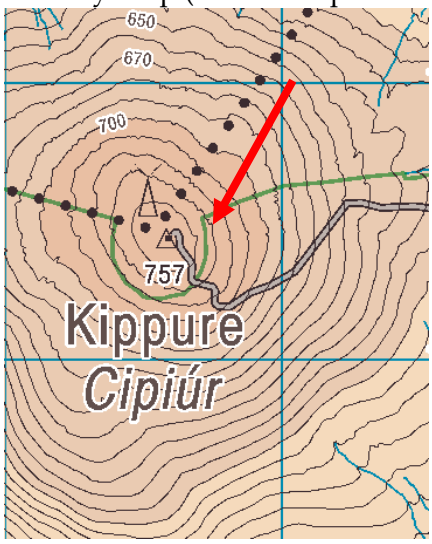
27/08/2009
2010, 2011</td><td>Recorder

Caroline Nienhuis
Christina Campbell &
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Large population growing on moist slope and mountain plateau (0 - 20º) on peaty ground below and SE of TV station on Kippure Mountain.
Slope covered in low growing bryophytes, grass and heather.
Site not immediately threatened but erosion due to hikers and grazing sheep may pose future threats
Spores present

Yes</td></tr>
<tr><td colspan="2">Size of population
Very large population of about 5001 – 10000 stems counted in 150x50 m.
Average length of three longest stems: 25.6 cm</td><td colspan="2">Quadrats
KMLC1-10</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=10)	**DOMIN scale**
Lycopodium clavatum	5
Agrostis sp., *Deschampsia flexuosa,*	
Nardus stricta	7
Calluna vulgaris	2
Cladonia unicalis	1
Dicranella heteromalla, Hypnum jutlandicum, Polytrichum juniperinum, Polytrichum commune, Pseudoscleropodium purum, Racomitrium lanuginosum	8
Galium saxatile	4
Huperzia selago	+
Vaccinium myrtillus	4
Bare ground	1
Bare rock	4

***L. clavatum* growing among bryophytes, heather and rocks below TV station on Kippure Mountain, Co. Wicklow**

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Kippure, Co. Wicklow
Lycopodium clavatum

0 20 40 Meters

N

Conservation assessment for *Lycopodium clavatum* at Kippure, Co. Wicklow

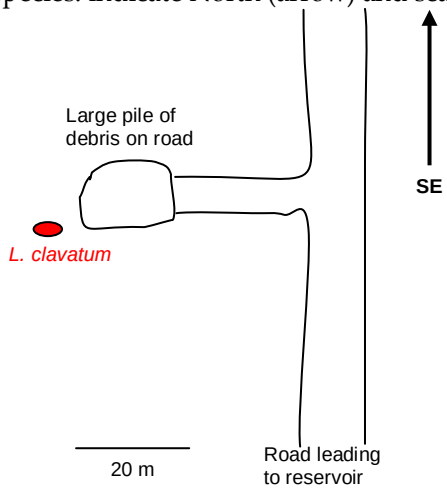
POPULATION	TARGET	FIGURE	RESULT
Total colony number	**≥10**	**10**	**PASS**
Population size (combined area of occupancy of colonies)	**≥150x50 m**	**150x50m**	**PASS**
Total Domin cover area of target species (L. clavatum) in m^2	**≥5**	**5**	**PASS**
Population size class	**4 (5000-10000)**	**5**	**PASS**
Fertile cones present	**Yes**	**Yes**	**PASS**
HABITAT	**Target**	**Figure**	**RESULT**
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	**≥25cm**	**25.6**	**PASS**
Domin scale cover of *Calluna vulgaris*	**1-4**	**2**	**PASS**
Domin cover bare rock/ground	**4-8**	**5**	**PASS**
Bryophyte cover	**5-8**	**8**	**PASS**
FUTURE PROSPECTS	**Impact**	**Figure**	**RESULT**
Trampling and overuse (G05.01)	**None**	**LOW**	**PASS**
Disposal of inert materials in this case sand and gravel (E03.03)	**None**	**None**	**PASS**
Intensive sheep grazing (A04.01.02)	**None**	**LOW**	**PASS**

ASSESSMENT: Population (favourable), Habitat for the species (favourable) & Future prospects (favourable)

Camaderry Mountain, Co. Wicklow (T06774/99125 Vice-County H20)

OVERALL CONSERVATION ASSESSMENT: FavourableSpecies *L. clavatum*	**Vice-county number** H20	**Vice-county** Wicklow	
Locality Camaderry	**Land owner/Occupier** Probably private	**cSAC/pNHA**	
Grid Ref. T06774/99125	**Altitude (m)** 630 m	**Date** August 2009, 2011	**Recorders** Caroline Nienhuis Noeleen Smyth

Sketch map of site showing location of species: indicate North (arrow) and scale



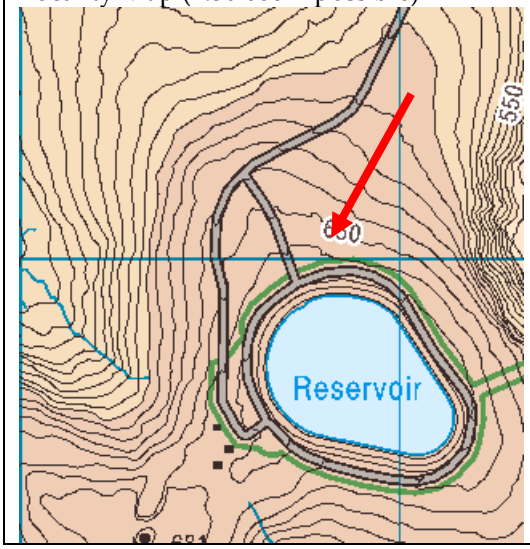
Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height
Population growing on moist and flat ground in boggy area below and N of Camaderry reservoir. Area covered in low growing bryophytes, grass and heather. The species found associated were the typical mountain mosses *Polytrichum commune* and *Racomitrium lanuginosum* and heather *Calluna vulgaris.* Site is considered threatened with erosion due to hiking tracks and the dumping of debris and gravel may pose future threats

Spores present: No

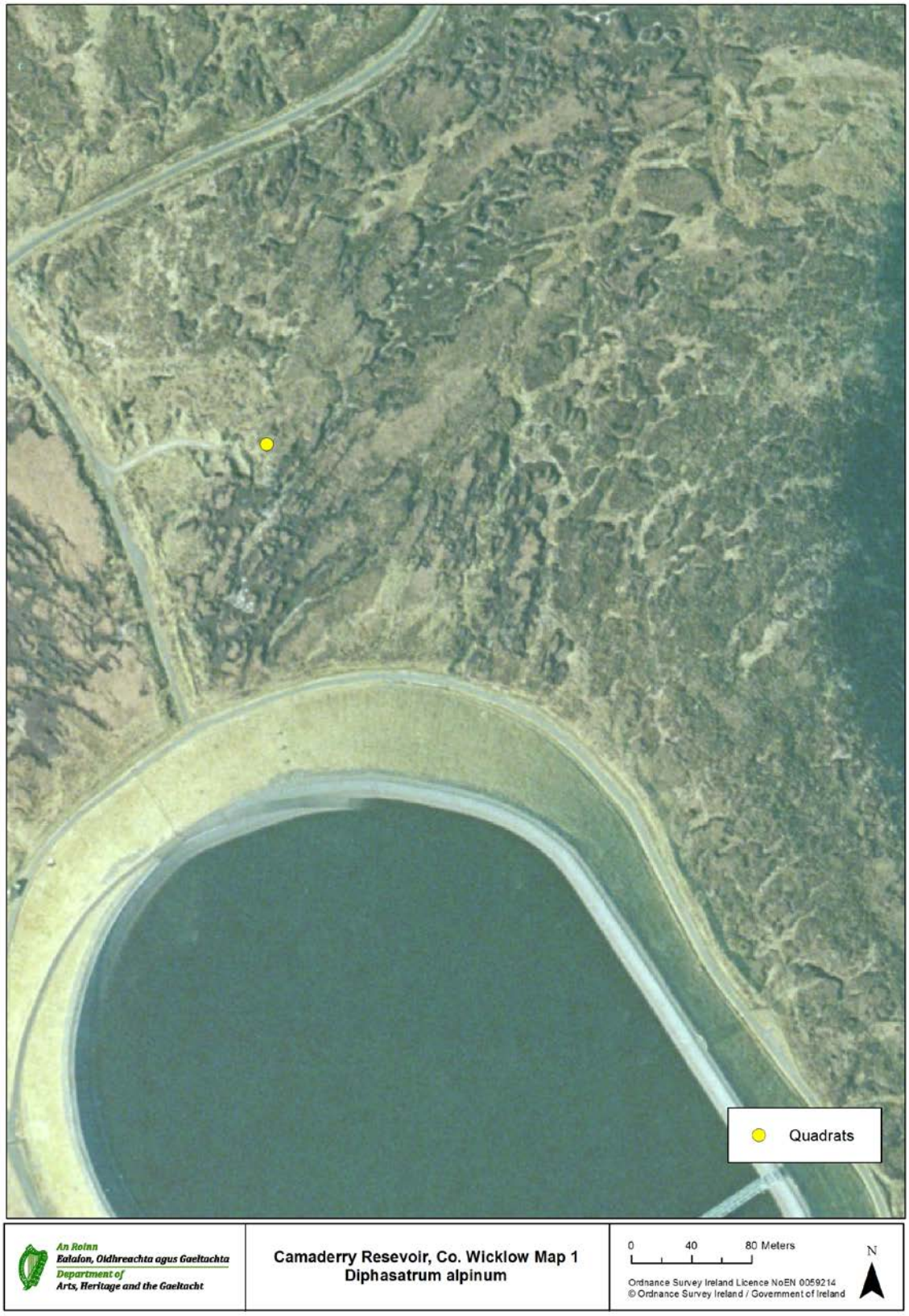
Size of population
Small population of about 70 stems counted in 2.25 m².
Average length of three longest stems: 7.8 cm

Quadrats
WGRB1 T06774/99125 (+ 3m)

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (Average n=1)	**DOMIN scale**
Lycopodium clavatum	+
Hypnum jutlandicum, Racomitrium lanuginosum, Rhytidiadelphus loreus, Polytrichum commune	8
Bare rock	4
Vaccinium myrtillus	4
Calluna vulgaris	3
Juncus squarrosus	6
Deschampsia flexuosa	7
Carex spp.	+
Galium saxatile	5
Lycopodium clavatum	+



***same map as *D. alpinum* at Camaderry both species in the same location**

Conservation assessment for *Lycopodium clavatum* at Camaderry, Co. Wicklow

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥1	1	PASS
Population size (combined area of occupancy of colonies)	≥0.1m	0.1m	PASS
Total Domin cover area of target species (L. clavatum) in m^2	≥+	+	PASS
Population size class	1 (0-50)	1	PASS
Fertile cones present	Yes	No	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥15cm	15	PASS
Domin scale cover of *Calluna vulgaris*	1-4	3	PASS
Domin cover bare rock/ground	4-8	4	PASS
Bryophyte cover	5-8	8	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Disposal of inert materials in this case sand and gravel (E03.03)	None	LOW	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Favourable

Lough Eske, Co. Donegal (G98 Vice-County H35)

Parts of area around lake intensely searched but *L. clavatum* was not located.

<table>
<tr><td>Species

Lycopodium clavatum</td><td>Vice-county number

H34</td><td colspan="2">Vice-county

East Donegal</td></tr>
<tr><td>Locality

Lough Eske</td><td>Land owner/Occupier

Unknown</td><td colspan="2">cSAC/pNHA

Unknown</td></tr>
<tr><td>Grid Ref.

G 98</td><td>Altitude (m)

0 – 40 m</td><td>Date (D/M/Y)

04/09/2009</td><td>Recorder
Anke Dietzsch
Caroline Nienhuis</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale

Parts of area around lake intensely searched but *L. clavatum* was not located.</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

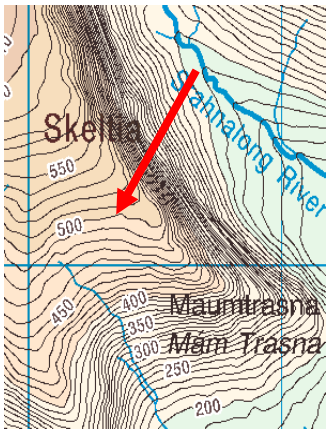
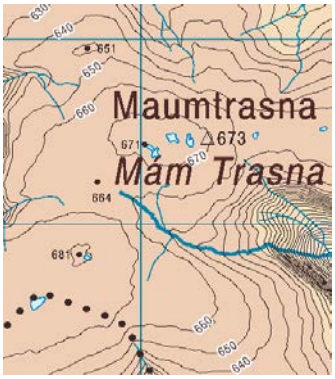
Areas along lake are generally moist and mostly covered in high growing vegetation, grasslands or have been built on.</td></tr>
<tr><td colspan="2">Size of population

NA</td><td colspan="2">Spores present

NA</td></tr>
<tr><td colspan="2">Locality Map (1:50 000 if possible)
 
</td><td colspan="2">Associated species in 1 m² quadrat</td></tr>
</table>

Maumtrasna Mountain , Co. Mayo (L96 Vice-County H27)

Slope (Skeltia) leading up to plateau of Maumtrasna Mountain intensively searched but *L. clavatum* was not located (see map with red arrow below). Site eroded due to hikers and grazing sheep.

Species	Vice-county number	Vice-county	
Lycopodium clavatum	H27	West Mayo	
Locality	Land owner/Occupier	cSAC/pNHA	
Maumtrasna Mountain	Unknown	Unknown	
Grid Ref. GPS? No	Altitude (m)	Date (D/M/Y)	Recorder
L96	NA	29/09/09	Caroline Nienhuis
Sketch map of site showing location of species: indicate North (arrow) and scale		Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded Describe habitat features e.g. aspect, slope, vegetation cover/height	
Slope (Skeltia) leading up to plateau of Maumtrasna Mountain intensively searched but *L. clavatum* was not located (see map with red arrow below). There is a possibility that *L. clavatum* exists on plateau of Maumtrasna Mountain but this area was not searched due to adverse weather conditions (see map below		Slope leading to plateau of Maumtrasna Mountain consists of peaty ground covered by rocks. Area covered in low growing bryophytes, grass and heather.	
Locality Map (1:50 000 if possible) 			

Monitoring sites *Lycopodiella inundata*

***Lycopodiella inundata* found growing on Clare Island, Co. Mayo**

L. inundata Monitoring Sites and individual quadrats

Site name	GPS Irish Grid	Monitoring Quadrats	Record
Cornamona	05020/53222 (± 3m)	CALI1&2	Positive
Cornamona	05021/53225 (± 3m)	CALI3	
Cornamona	05012/53213 (± 3m)	CALI4&5	
Clare Island	71162/83612 (±3m)	CI1	Positive
Clare Island	71091/86407(±3m)	CI2	
Lough Belshade			Negative
Glendalough			Negative
Lough Guitane			Negative
Knockowen			Negative
Lough Nadirkmore			Negative

Cornamona, Co. Galway (M05020/53222 Vice County H16)

<table>
<tr><td>Species

Lycopodiella inundata</td><td>Vice-county number

H16</td><td colspan="2">Vice-county

West Galway</td></tr>
<tr><td>Locality

Cornamona</td><td>Land owner/Occupier

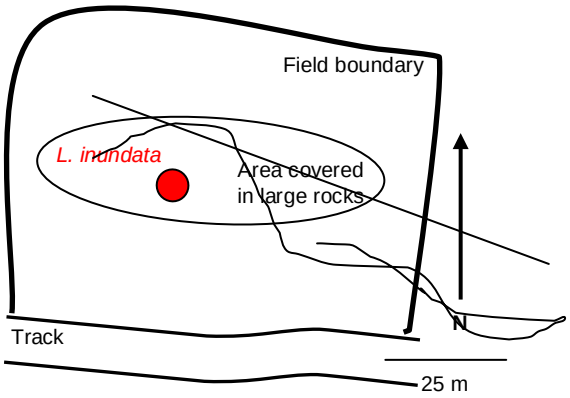
Unknown</td><td colspan="2">cSAC/pNHA</td></tr>
<tr><td>Grid Ref.
GPS? Yes

M05020/53222 (± 3 m)</td><td>Altitude (m)

77 – 82 m</td><td>Date (D/M/Y)

29/09/2009</td><td>Recorder

Caroline Nienhuis</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale

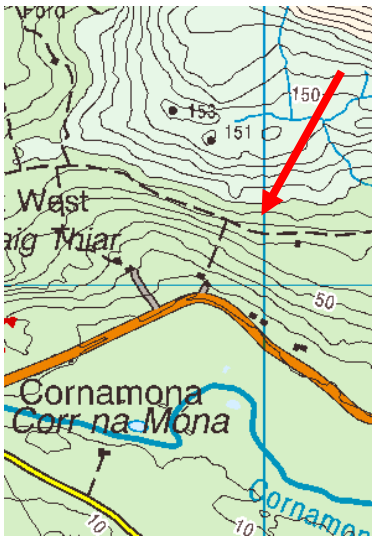
 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Three small patches growing on slope (0 - 30º), which mainly consists of exposed dry ground but is moist where large rocks are present due to water run off.
Slope is covered in low growing bryophytes, heather, grass and large rocks.
(National Botanic Gardens herbarium record).

Site immediately threatened by vegetation encroachment (grass and heather). Intense grazing of livestock and drying out of site may pose future threats.

Spores present: Yes but sparse</td></tr>
<tr><td colspan="2">Size of population
Very small population of about 400 stems counted in 10x50 m.
Average of three longest stems: 6.5 cm</td><td colspan="2">Quadrats
CALI 1-3</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat	**DOMIN scale**
Lycopodiella inundata	6
Anagallis tenella	5
Cladonia portentosa, Cladonia unicalis	1
Erica tetralix	3
Nardus stricta, Schoenus nigricans	8
Narthecium ossifragum	4
Polytrichum juniperinum, Racomitrium lanuginosum, Rhytidiadelphus loreus, Sphagnum palustre	7
Potentilla erecta	1
Bare ground	1
Bare rock	5

***L. inundata* stems growing on peaty ground**

***L. inundata* stems**

***L. inundata* growing among bryophytes, heather and rocks above track at Cornamona, Co. Galway**

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Cornamona, Co. Galway Map 1
Lycopodiella innundata

0 110 220 Meters

N


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Cornamona, Co. Galway Map 2
Lycopodiella innundata
0 10 20 Meters
N
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Conservation assessment of *L. inundata* at Cornamona, Co. Galway.

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥3	3	PASS
Population size (combined area of occupancy of colonies)	≥10x50 m	10x50 m	PASS
Total Domin cover area of target species (L. inundata) in m^2	≥6	6	PASS
Population size class	2 (100-500)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥6	6.5	PASS
Domin scale cover of *Schoenus & Nardus*	5-8	8	PASS
Domin cover bare rock/ground	4-8	6	PASS
Bryophyte cover	5-7	7	PASS
Substrate	Ground damp to touch	No	FAIL
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS
Drainage (J02)	None	LOW	PASS
Fertilisation (A08)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (inadequate) & Future prospects (favourable)

OVERALL CONSERVATION ASSESSMENT: Inadequate

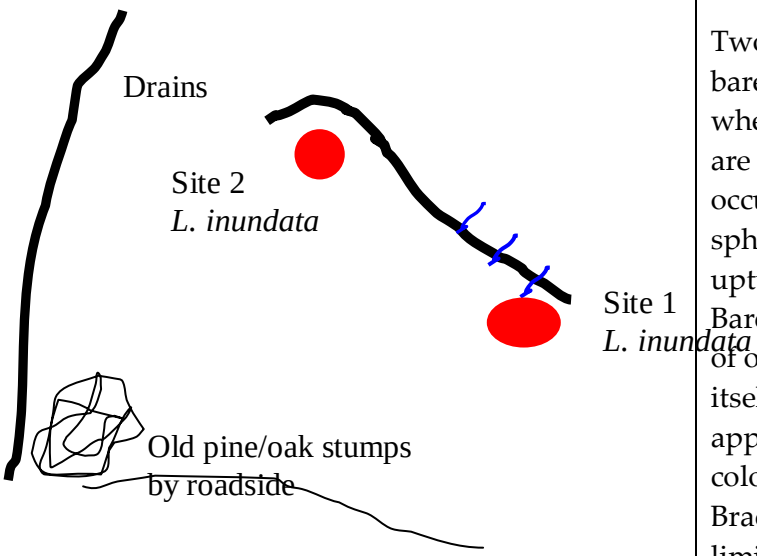
<table>
<tr><td colspan="4">Clare Island, Co. Mayo (L708/865 Vice County H27)</td></tr>
<tr><td>Species

Lycopodiella inundata</td><td>Vice-county number
H27</td><td colspan="2">Vice-county

West Mayo</td></tr>
<tr><td>Locality
Clare Island</td><td>Land owner/Occupier

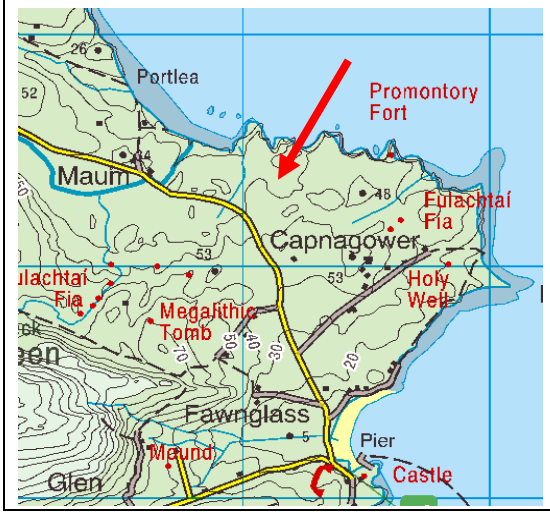
Unknown</td><td colspan="2">cSAC/pNHA
Clare Island SAC</td></tr>
<tr><td>Grid Ref.
L71162.44
86312.160
and
L71091.658
86407.897 (± 3 m)</td><td>Altitude (m)
30m</td><td>Date (M/Y)
05/2010
07/2011,
0/8 2012
& 09/2014</td><td>Recorder

Matthew Jebb
Noeleen Smyth</td></tr>
<tr><td colspan="2">Sketch map of site showing location of species: indicate North (arrow) and scale

 
</td><td colspan="2">Describe substrate(s) e.g. rock/soil/tree type; wet/moist/dry, sunny/shaded
Describe habitat features e.g. aspect, slope, vegetation cover/height

Two colonies are most conspicuous on bare peat surfaces on a slope of 0 - 10^O, where the prostrate branching stems are conspicuous. Some plants also occur where there is a continuous sphagnum canopy, but only the upturned branch tips are then visible. Bare peat surfaces within a few metres of open water, and down to the water itself, supported creeping stems. All appropriate bare surfaces were colonised in the two sites.
Bracken invasion from south-west limits the spread of the colony. Where the plant is present it exists in large numbers, the lack of available niche in the narrow band between the open water and bracken stands is the limiting factor.
Spores present : Yes 2 fertile cones</td></tr>
<tr><td colspan="2">Size of population
Two populations small population one with ca 150 stems the other with 25 stems in 10x5m and 2x2m..
Average of three longest stems: 6.5 cm</td><td colspan="2">Quadrats
CL1 & CL2</td></tr>
</table>

Locality Map (1:50 000 if possible)



Associated species in 1 m² quadrat (average n=2)	**DOMIN scale**
Lycopodiella inundata	6
Carex panicea	5
Calluna vulgaris	1
Nardus stricta,	3
Schoenus nigricans	5
Narthecium ossifragum	4
Polytrichum juniperinum, Racomitrium lanuginosum, Rhytidiadelphus loreus, Sphagnum palustre	7
Bare peat	5
Bare rock	1

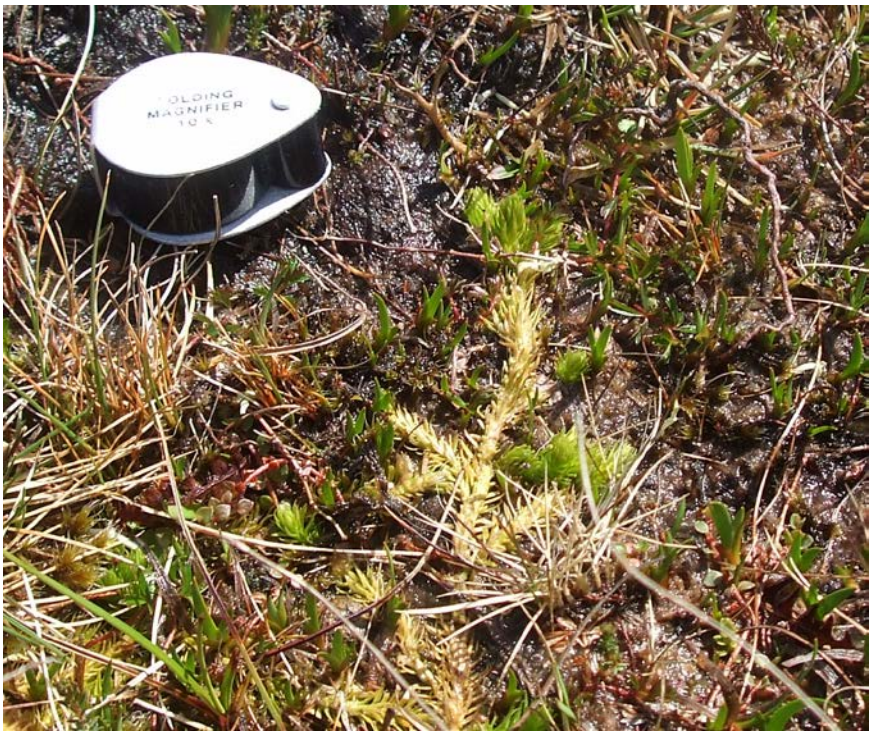
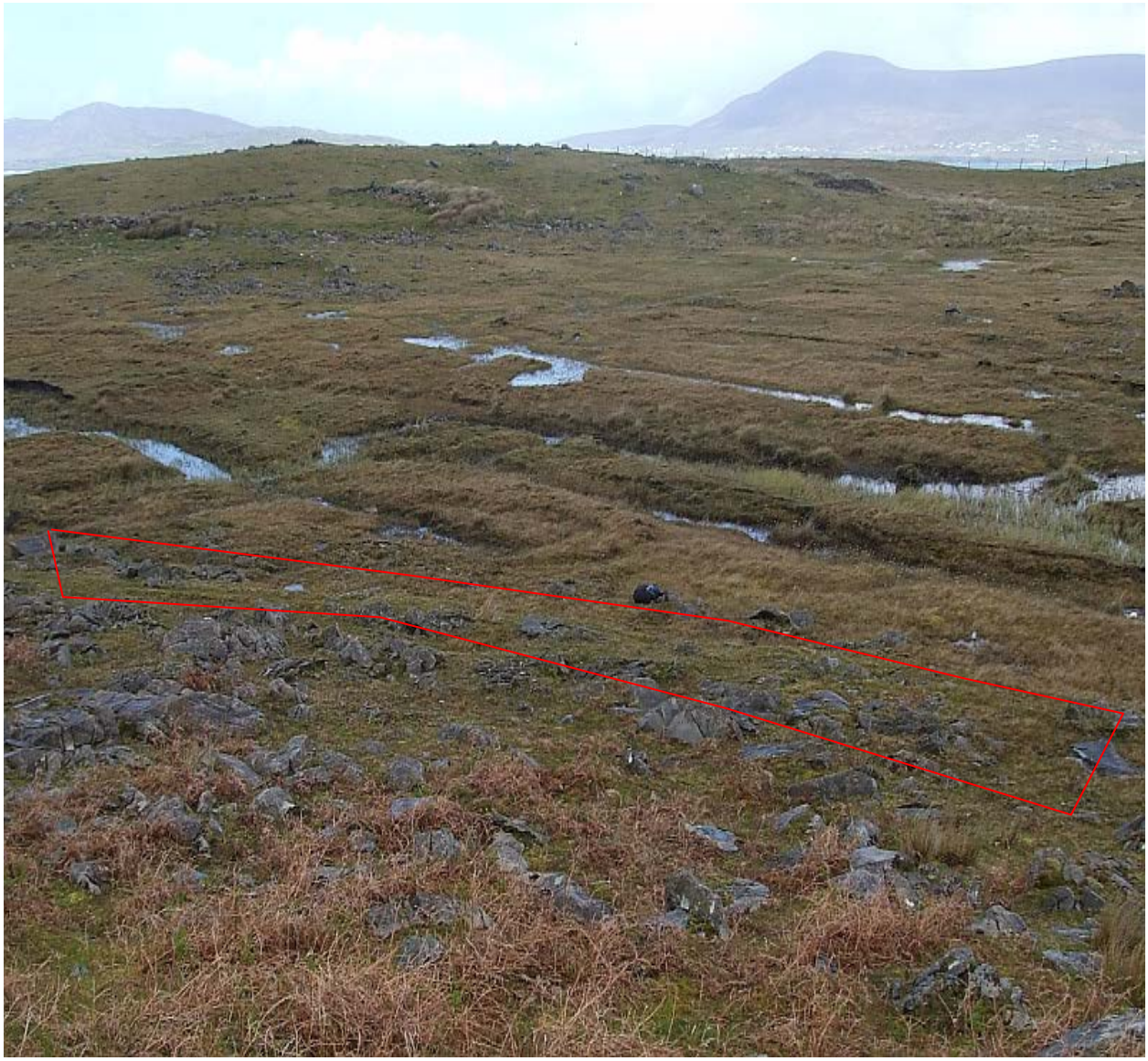
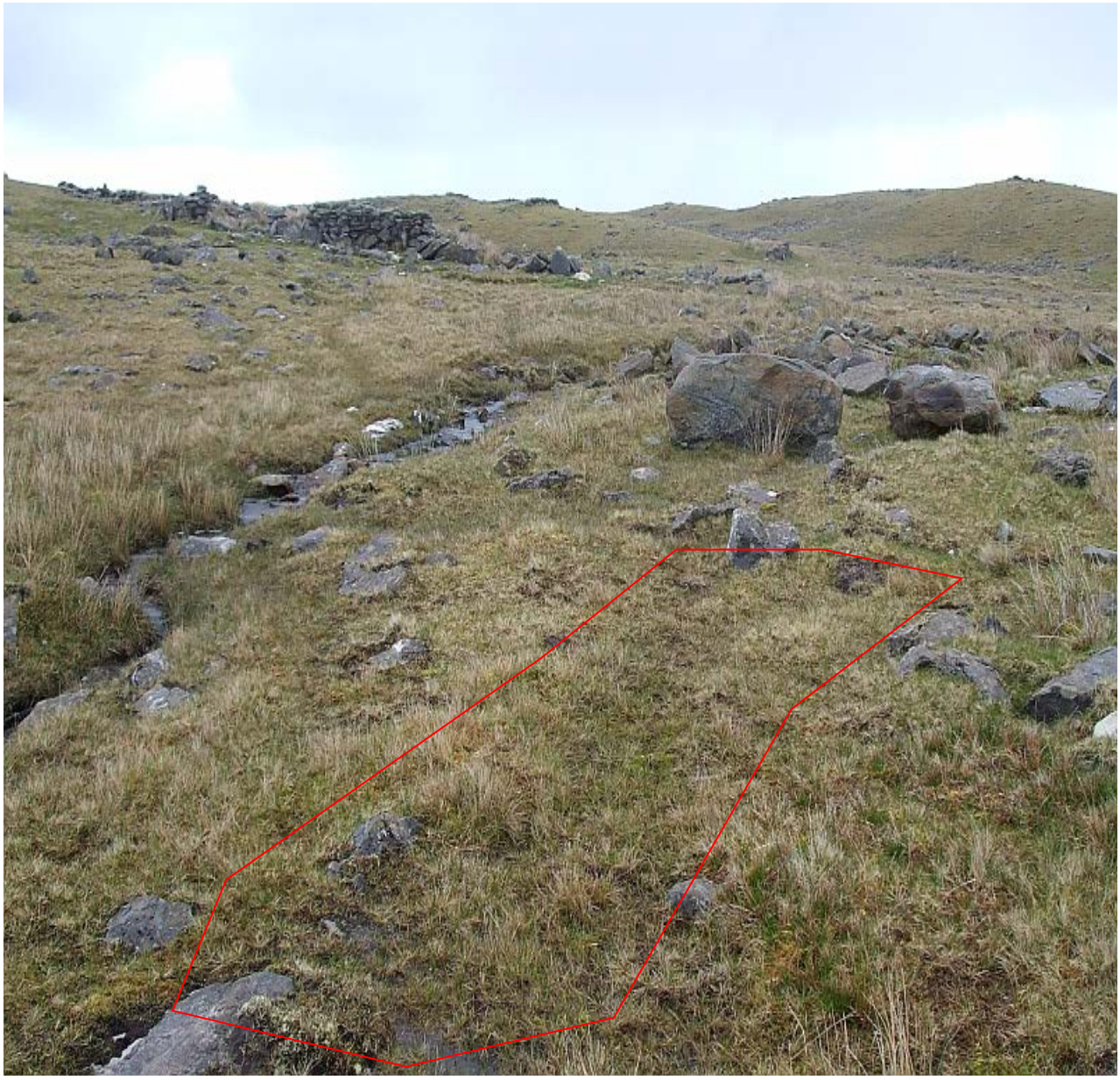


Figure 18. Showing the diminutive size of *L. inundata* at Capnagower, Clare Island.

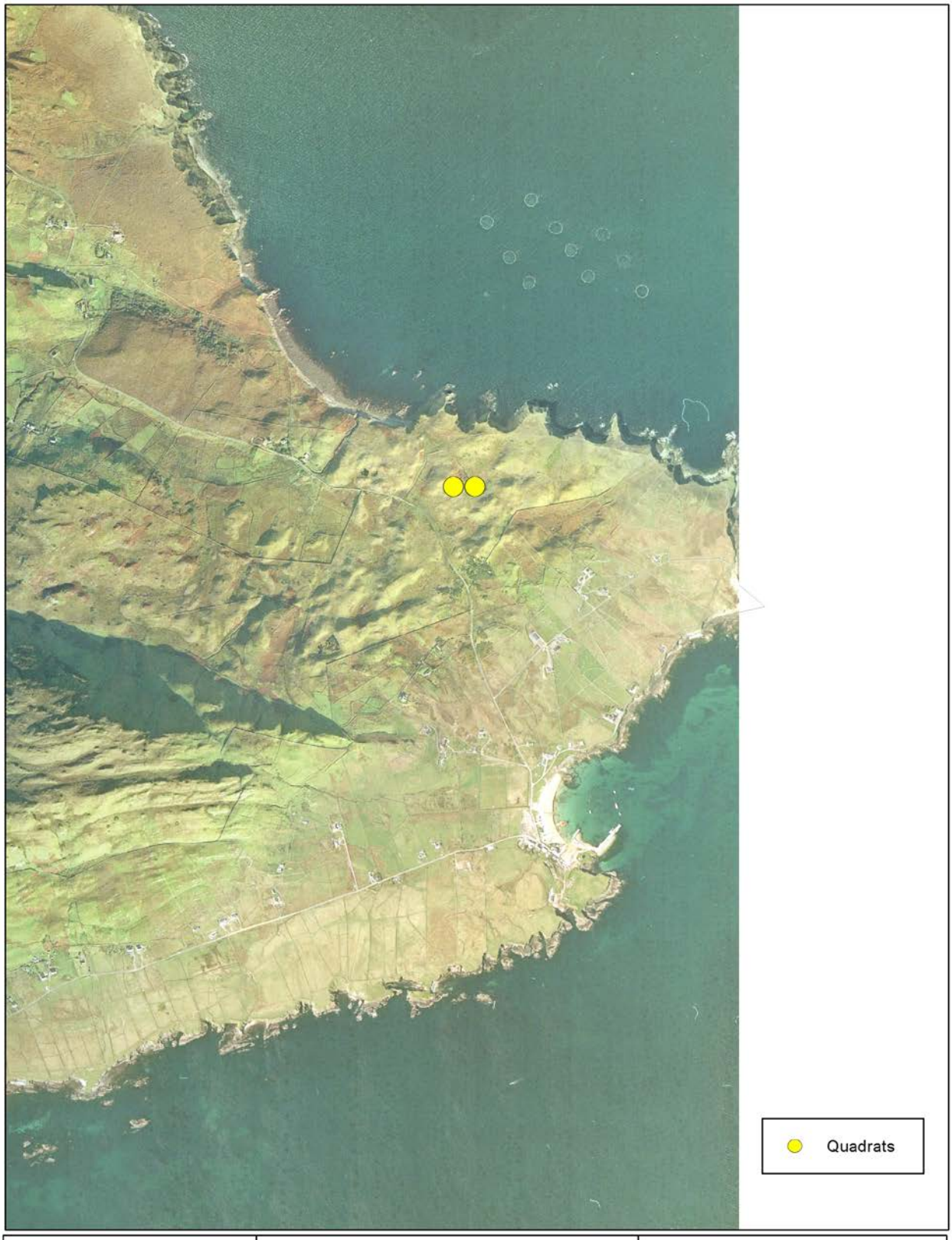
Colony amongst bryophyte covered peat surface



Site 1 viewed from the south near system of drains



Site 2 near stream


Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Capangower, Clare Island, Co. Mayo Map 1
Lycopodiella innundata
0
210
420 Meters
N
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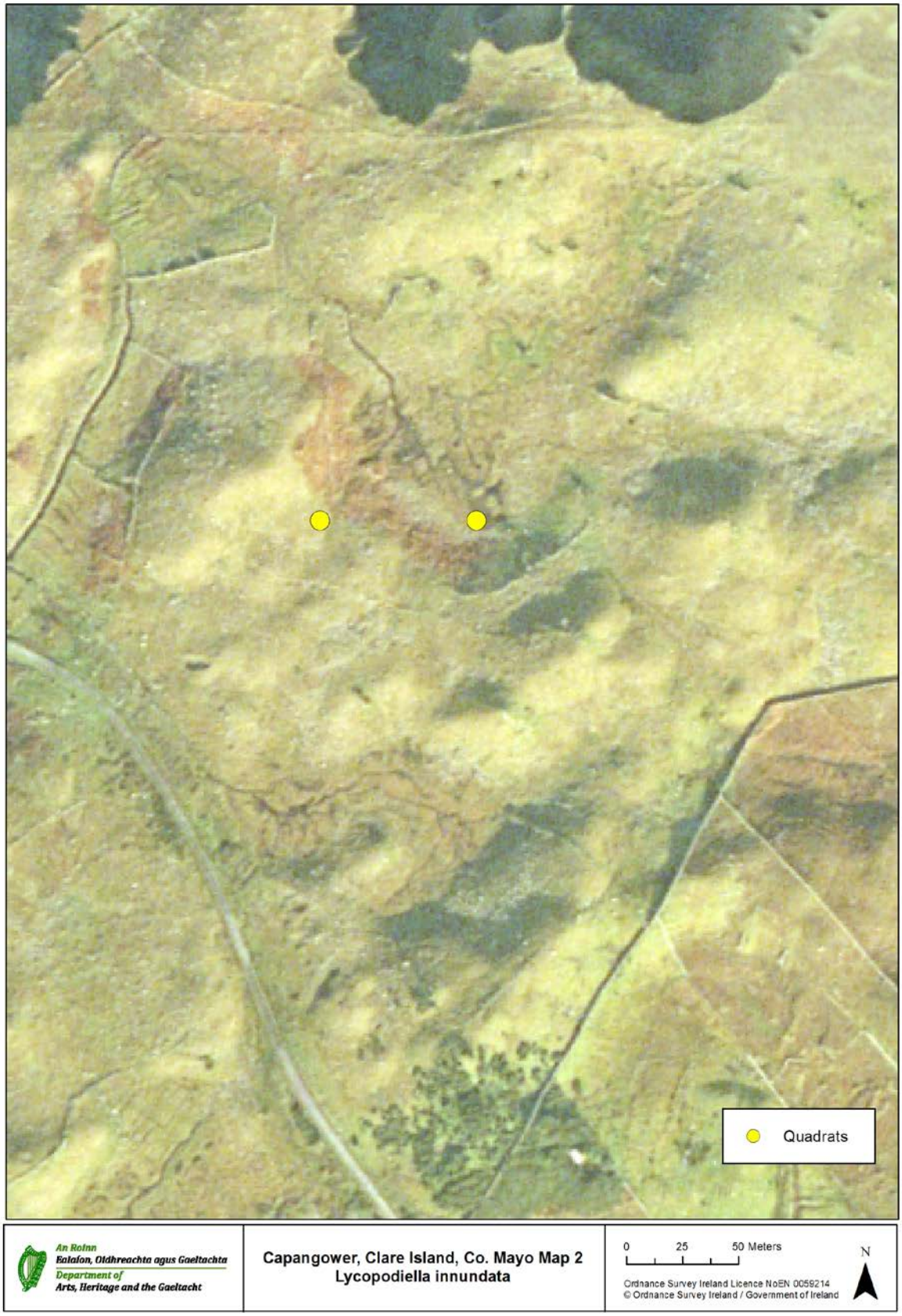
Quadrats
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Capangower, Clare Island, Co. Mayo Map 2
Lycopodiella innundata
0
25
50 Meters
N
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Conservation assessment for *Lycopodiella inundata* on Clare Island

POPULATION	TARGET	FIGURE	RESULT
Total colony number	≥2	2	PASS
Population size (combined area of occupancy of colonies)	≥54m²	54m²	PASS
Total Domin cover area of target species (L. inundata) in m^2	≥6	6	PASS
Population size class	2 (100-500)	2	PASS
Fertile cones present	Yes	Yes	PASS
HABITAT	Target	Figure	RESULT
Grazing /Vegetation Height (average shoot length of 5 shoots /m^2	≥6	6.5	PASS
Domin scale cover of *Schoenus & Nardus*	5-8	8	PASS
Domin cover bare rock/ground	4-8	6	PASS
Bryophyte cover	5-7	7	PASS
Substrate	Ground damp to touch	Yes	PASS
FUTURE PROSPECTS	Impact	Figure	RESULT
Trampling and overuse (G05.01)	None	LOW	PASS
Intensive sheep grazing (A04.01.02)	None	LOW	PASS
Drainage (J02)	None	MEDIUM	FAIL
Fertilisation (A08)	None	LOW	PASS
Problematic native species i.e. Bracken (I02)	None	LOW	PASS

ASSESSMENT: Population(favourable), Habitat for the species (favourable) & Future prospects (inadequate)

OVERALL CONSERVATION ASSESSMENT: Inadequate