

Heathland Study, Howth Head, Co. Dublin

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1. Introduction

Fingal County Council (FCC) appointed BEC Consultants Ltd to conduct a heathland study on Howth Head in north County Dublin. The Dry Heath (EU Annex I habitat code 4030) on Howth Head occurs primarily within Howth Head Special Area of Conservation (SAC; site code 000202) and is one of two Qualifying Interests (QIs) for this designated site, the other being Vegetated Sea Cliffs (EU Annex I habitat code 1230). Sections of Howth Head SAC are also covered by Howth Head Coast Special Protection Area (SPA) on the basis of cliff-nesting birds. The aims of the current study are:

- to provide baseline information for the conservation objectives for the Dry Heath habitat within Howth Head SAC, and
- to determine the quality status of the Dry Heath habitat on Howth Head.

The results of this study, and other ecological studies taking place on Howth Head during 2019, will provide the basis for a detailed management plan for the heathland on Howth which is to be prepared in 2020.

Throughout this report 'Dry Heath' is used in reference to the EU Annex I habitat 4030 European Dry Heath which on Howth Head is generally composed of Heather (*Calluna vulgaris*), Western Gorse (*Ulex gallii*) and Bell Heather (*Erica cinerea*). 'Heathland' refers to the broader heathland landscape which incorporates other habitat types associated with the Dry Heath such as Gorse scrub (*Ulex europaeus*) and dense Bracken (*Pteridium aquilinum*).

2. Methodology

2.1. Desk study

Available historical information on the heathland at Howth Head was reviewed to assess if the current condition of heath could be compared with the historical condition. This comprised information contained in the NPWS site file for Howth Head SAC, data provided by FCC and other sources available online. The attributes and targets set for Dry Heath within Howth Head SAC were reviewed to identify where site-specific information is lacking or where attributes or targets should be amended.

2.2. Fieldwork and assessment

Field mapping was conducted between August and September 2019. Prior to fieldwork, a network of polygons, representing parcels of homogeneous patterning in recent satellite imagery and/or parcels of consistent topography based on contour data, was developed. The integrity of these polygons was then ground-truthed, with merges, splits and transfers made as required. Surveyors in the field navigated throughout this polygon framework using real-time GPS data on a mobile computer (Trimble Nomad).

Within each polygon, all habitats were recorded according to Heritage Council categories (Fossitt, 2000) and heath communities were recorded according to the Irish Vegetation Classification (Perrin *et al.* 2018). The aim was to define polygons dominated by a single habitat, but the occurrence of some habitat mosaics was inevitable. A rapid assessment of the quality of the heath was made (good, moderate or poor) based on the overall condition of the heath in relation to negative and invasive species, bare ground, trampling and evidence of inappropriate

burning. Within polygons dominated by Heather (*Calluna vulgaris*), the growth phase of the Heather was also recorded: pioneer, building, mature or degenerate. Areas dominated by non-native species were mapped.

Quadrats (plots) were distributed across the Dry Heath area ($n = 23$), positioned to be representative of the surrounding habitat. Six-figure co-ordinates in ITM mapping projection were recorded and photographs taken. Quadrat locations were not otherwise marked on the ground. Each quadrat was 2 m × 2 m in size. Within each quadrat, a full list of vascular plant species, bryophytes and lichens was made and cover abundance of each species was recorded on a percentage scale. Heights of the dwarf shrub layer, the field layer and the bryophyte layer were recorded using maximum leaf height within each quadrant of the quadrat. Four replicate soil depths were later recorded from the vicinity of each quadrat. Species abundance data were used to statistically classify quadrats to communities of the IVC using the ERICA v.4.0 online application. Quadrats were assessed using the condition assessment criteria for Dry Heath (Perrin *et al.* 2014). On the basis of the data recorded, recommendations are made in relation to amending the attributes and targets for the site. Also, proposals for management are made which can be considered during the development of the forthcoming management plan.

2.3. Review of Site-Specific Conservation Objectives

Subsequent to the fieldwork being completed, a review of the attributes and targets contained in the Site-Specific Conservation Objectives (SSCOs) for Howth Head SAC (NPWS 2016) was conducted. The review aimed to assess if amendments could be made to make the attributes and targets more relevant to the Dry Heath at Howth Head. The original attributes and targets for Dry Heath are largely based on the monitoring criteria for upland habitats presented in Perrin *et al.* (2014). Any amendments to the attributes and targets would therefore be linked to the monitoring criteria for the site.

3. Results

3.1. Historical information

Available historical information on the heath at Howth Head was reviewed to determine if the current status of heath could be assessed against the historical condition. The following two reports are available on www.NPWS.ie:

- Goodwillie & Fahy (1973) prepared a report on the ecology of Howth Head within the Areas of Scientific Interest (ASI) in County Dublin.
- Goodwillie *et al.* (1988) comprises an update of the 1973 report with additional notes appended.

On request, the following information from the NPWS files was made available to the project as scanned documents:

- NPWS Howth Head SAC, Archive File. Revisions of site synopses and maps.
- NPWS Howth Head SAC, Background Information. Including: The Geology of Howth Village, Threatened Plant Survey (1992).
- NPWS Howth Head SAC, Site Map. Boundary check (1994).

- NPWS Howth Head SAC, Site Notes. National ASI survey cards with boundary survey (1993).
- NPWS Howth Head SAC, Woodland Unit Files. Bryophyte species list for Ben of Howth (1981), Heathland Survey Sheets (1981), comprising ten assessments carried out on the Ben of Howth.
- NPWS Howth Head SAC, Draft Management Plan. Draft Conservation Plan for Howth Head cSAC & Howth Head Coast SPA (NPWS 2005).

More recent surveys and data sources utilised were:

- An assessment of the extent of Rhododendron (*Rhododendron ponticum*) on the Ben of Howth area (Ní Dhúill and Smyth 2018a) with associated GIS
- An invasive species survey of coastal cliffs of Howth (Ní Dhúill and Smyth 2018b)
- A Draft Howth Heathland Management Plan was prepared for Howth Special Amenity Area Order Management Committee (Tubridy 2015) which includes GIS mapping of the condition of Dry Heath from Shielmartin and the Ben of Howth area.

A version of Tubridy (2015) (without appendices) was on www.fingal.ie. A copy of Ní Dhúill and Smyth (2018a) and the appendices for Tubridy (2015) were made available to the project by Fingal County Council.

The area identified as being of scientific interest by Goodwillie *et al.* (1988) encompassed East Mountain, extending along the coast from the Nose of Howth to the Great Bailey, with a separate area at Redrock. Thus, it did not include the heath areas at Shielmartin or the Ben of Howth, and the cliffs from Bailey Lighthouse west to just beyond Drumleck Point were also omitted. The area within the ASI did include some heath but Goodwillie & Fahy (1973) put emphasis on the importance of other habitats at the site rather than the heath: “The most interesting parts are the areas of natural vegetation adjacent to the cliffs. The summit vegetation is of heath and bog, two formations widely represented in Dublin and Wicklow”. This was repeated again in Goodwillie *et al.* (1988). The area at Redrock is noted in both reports as being “rich in invertebrates” including ants, woodlice, grasshoppers, butterflies and moths.

Within the NPWS site notes for Howth Head there is a record of Green-winged Orchid (*Orchis morio* = *Anacamptis morio*) from 1992 near Windgate Road which is within the SAC. The location was noted as being species-rich grassland at the time, with scrub invasion being a threat. Recent satellite imagery of this location indicates the area is now under a cover of trees and more recent records of the species were not located. Bird’s-foot (*Ornithopus perpusillus*) was recorded in 1991 from ‘rough grazing’ at Redrock. Threats were noted as encroachment by Bracken, Bramble (*Rubus fruticosus* agg.) and scrub. More recently Brady (2018) recorded four colonies of Bird’s-foot from the Redrock area, one of these from the transition zone of calcareous grassland to Dry Heath while the others were from rock outcrops. Spring squill (*Scilla verna*) was also recorded from the Dry Heath (Brady 2018). Other rare plants recorded by Brady (2018) were associated with grassland or rocky habitat rather than heath. A national survey of rare plants was conducted on behalf of NPWS during 2019 but Curved Hard-grass (*Parapholis incurva*), a species found on the sea cliffs, was the only species searched for at Howth (Jim Martin pers. comm.). Ní Dhúill and Smyth (2018b) found 32 invasive plant species along the coast between Bellingham’s Farm (to the east of Redrock) and the Great Bailey but these predominantly occurred on cliffs or along the cliff path rather than in heathland.

The NPWS Site Synopsis for the site from 1998 references various insect records including the beetles *Trechus rubens*, from a storm beach on the eastern cliffs, and *Phaonia exoleta*, from woods at Deerpark. The most notable record is that of a hoverfly *Sphaerophoria batava*, which is noted as occurring on heathland habitat. The National Biodiversity Data Centre has four records of this species in Ireland, all attributable to Martin Speight. The one for Howth is a 1 km record from 1973. The 1 km square is mainly golf course, with the only extant heath being at Muck Rock. These invertebrate records are cited frequently in subsequent references to Howth Head such as the unpublished Draft Conservation Plan for Howth Head cSAC & Howth Head Coast SPA (NPWS 2005) and the Natura 2000 – Standard Data Form (NPWS 2017), but there is no indication within the available site notes that more recent survey work for these species has been conducted.

The Draft Conservation Plan for Howth Head cSAC & Howth Head Coast SPA (NPWS 2005) states the area of 4030 Dry Heath to be 169 ha, though a habitat map prepared by NPWS at approximately the same time indicates the Annex I habitat to cover less than half this area (80.33 ha). The Natura 2000 – Standard Data Form, prepared initially in 1996 but most recently updated in 2017, records the area of Dry Heath as 131.2 ha. It is noted in the Site-Specific Conservation Objectives document (NPWS 2016) that Dry Heath had not been mapped in detail and the “area of the qualifying habitat is unknown”.

As regards threats to the heathland habitat, in Goodwillie & Fahy (1973) under the heading “Vulnerability” it is noted “fire can injure vegetation stands but it is a greater threat on the heathy summit where there is more inflammable material. Some of the species of dry open sites are favoured by fire which curtails the spread of shading vegetation”. From this it can be interpreted that burning of vegetation did occur at the site though it is not evident if it was perceived as a significant threat at the time. The later report (Goodwillie *et al.* 1988) is broadly similar but adds specific reference to “gorse” as an example of inflammable material.

Burning is also noted in the 1981 Heathland Survey Sheets recorded for the Ben of Howth. Part of the 1993 ASI Survey was to record threats from a tick list of potential issues which included burning and the site was noted as having “no known threats”. The Draft Conservation Plan (NPWS 2005) notes “severe burning during recent summers, particularly on the summit and along east facing slopes”. These records indicate that there has been burning at the site for around 40 years but not until 2005 that it was recorded as a significant threat.

GIS data from an assessment conducted in 2011 (Tubridy 2015) include the condition of Dry Heath from Shielmartin and the Ben of Howth areas. All areas assessed were considered to be in good condition. Four areas were recommended for burning, though this recommendation appears to have been made on the basis of the fuel load the heath represents in close proximity to houses rather than for ecological reasons. A further area, east of Dun Hill, was noted as requiring management for invading Birch (*Betula pubescens*).

Ní Dhúill and Smyth (2018a) provide a thorough assessment of the extent of Rhododendron (*Rhododendron ponticum*) on the Ben of Howth area. The issue of Rhododendron was not highlighted in the Draft Conservation Plan for Howth Head cSAC & Howth Head Coast SPA (NPWS 2005) or the 2011 condition assessment (Tubridy 2015). There were records of Rhododendron from the Ben of Howth Heathland Survey Sheets from 1981. Though the parameters of the survey and the locations where the assessments were conducted cannot be

easily ascertained (e.g. the same grid reference is given for numerous assessments and some do not tally with aspect) it is evident that Rhododendron was recorded as an issue for eight of the ten assessments. Other recorded issues for the heathland were encroachment by Birch and to a lesser extent Scots Pine (*Pinus sylvestris*) and Sycamore (*Acer pseudoplatanus*), burning, rabbit grazing, over-grazing (unspecified grazer) and trampling. Based on review of these assessments it can be concluded that the Dry Heath in the vicinity of the Ben of Howth was facing considerable pressures at that time, though it is again notable that the 1993 ASI Survey recorded the site as having “no known threats” with “invasive plants” being remaining unticked on the tick list.

A Draft Howth Heathland Management Plan was prepared for Howth Special Amenity Area Order Management Committee (Tubridy 2015). This compiles information on the site including a goat grazing trial, a synopsis of other biodiversity research, an assessment of the terrain for flail cutting, an operational plan for the management of the heathland, and records of heathland fires in 2013. It is a valuable resource for the forthcoming management plan. The threats to the heathland area are listed as:

1. The spread of the invasive plants Birch, Rhododendron, Tall Gorse (presumed to be Gorse, *Ulex europaeus*) and Bracken.
2. Regular uncontrolled fires in popular and accessible locations.
3. The absence of grazing.
4. Lack of easily available information to owners and managers about heathland biodiversity and management.

In addition, Clark (1968) is a scientific paper which includes quantitative botanical data from Howth heath. Four stands were recorded, three from the south of the headland which were Heather-dominated and one from the north of the headland which was dominated by Western Gorse (*Ulex gallii*). As one of these plots is dominated by Western Gorse it can be inferred that Western Gorse was relatively common on Howth Head at the time of survey with plots positioned to reflect the communities present. The occurrence of the species is not, therefore, a recent development, though it must be noted this is based on records from just four plots.

Further comparison of the vegetation composition and/or structure between the historical resources and the existing situation would be unreliable.

3.2. Mapping

A habitat survey was conducted to map the extent of Dry Heath habitat. The initial survey area comprised Howth Head SAC (Map 1) which covers an area of 374.72 ha. Following review of available satellite imagery this was augmented with areas of heathland habitat adjoining and in the vicinity of the SAC (Map 2). This brought the survey area up to 387.70 ha.

The focus of the survey was to identify areas of Dry Heath and aerial photographs were used for review of sections not supporting heathland habitat. Map 3 shows the 32 Fossitt (2000) habitats and mosaics of habitat that were used to record the habitats within the survey area; the areas of these are presented in Table 1. To simplify the presentation of these data and to allow focus on the heathland, habitats were combined into four broad habitats categories (Map 4). These are:

- Dry Heath (synonymous with the Annex I habitat ‘European Dry Heath’),

- Bracken and scrub (dense Bracken and scrub comprised primarily of Gorse, and also Bramble scrub),
- Semi-natural grassland,
- Woodland, and
- Other (including marine and coastal areas, sea cliffs, artificial surfaces and improved grassland).

Table 1: Fossitt habitats and mosaics of habitats from the Howth Head survey area, areas and notes.

Fossitt Code	Fossitt category	Notes	Area (ha)
BL3	Buildings and artificial surfaces	Roads and buildings	1.62
BL3/ GA2	Buildings and artificial surfaces / Amenity grassland		2.33
BL3/ WD	Buildings and artificial surfaces / Highly modified woodland		0.42
BL3/ WL1	Buildings and artificial surfaces / Hedgerows	One area near The Summit	0.11
CS1	Rocky sea cliffs		35.59
ED4/ BL3/HH1	Active quarry / Buildings and artificial surfaces / Dry siliceous heath	Quarry area at Ben of Howth	2.11
ER1/ HH1	Exposed siliceous rock / Dry siliceous heath	Areas of heath with significant areas of bare rock	3.81
GA2	Amenity grassland (improved)	Mainly sections of golf course within the SAC	2.98
GS	Semi-natural grassland		20.39
GS/ ER1/HH1	Semi-natural grassland / Exposed siliceous rock / Dry siliceous heath	Area around granite seat	0.078
GS/HD1	Semi-natural grassland / Dense bracken		7.74
GS/HD1/ HH1	Semi-natural grassland / Dense bracken / Dry siliceous heath		1.84
GS/HD1/ WS1	Semi-natural grassland / Dense bracken / Scrub		9.55
GS/HH1	Semi-natural grassland / Dry siliceous heath		0.11
GS/WD1	Semi-natural grassland / Mixed broad-leaved woodland		0.29
GS/WS1	Semi-natural grassland / Scrub		1.70
HD1	Dense bracken		18.08
HD1/WD/WS1	Dense bracken / Modified woodland / Scrub		2.54
HD1/WN	Dense bracken / Semi-natural woodland		0.94
HD1/WS1	Dense bracken / Scrub		37.70
HD1/WS1/ GS	Dense bracken / Scrub / Semi-natural grassland		0.65
HD1/WS1/ WN	Dense bracken / Scrub / Semi-natural woodland		0.44
HD1/WS3	Dense bracken / Non-native shrub	Two areas of Rhododendron clearance	0.67
HH1	Dry siliceous heath		88.36
HH1/WS1	Dry siliceous heath / Scrub	Viewing point at Nose of Howth	0.78
L	Littoral (intertidal)	Beaches and rocky shores	6.47
M	Marine water body		80.32
WD	Highly modified woodland	Includes Howth reservoir	24.79
WD/HD1	Highly modified woodland / Dense bracken		6.42
WN	Semi-natural woodland		6.46
WN/WS1	Semi-natural woodland / Scrub		1.40
WS1	Scrub	Mainly Gorse, but some areas of Bramble scrub	19.01
Total			387.70

The components of these broad habitat categories are detailed in Table 2. As noted above, the Dry Heath category is synonymous with the Annex I habitat Dry Heath. Where it occurred in mosaic with other habitats (exposed siliceous rock, semi-natural grassland or scrub), the dwarf shrubs comprised over 25% of the polygon area.

Table 2: Broad habitat categories, their component Fossitt habitats, the area of each category and the percentage of the survey area.

Broad habitat	Component habitats	Area (ha)	Percentage of survey area
Dry Heath	ER1/HH1 GS/ER1/HH1 GS/HH1 HH1 HH1/WS1	93.14	24.02
Bracken and scrub	GS/HH1 HD1 HD1/WD/WS1 HD1/WN HD1/WS1 HD1/WS1/GS HD1/WS1/WN HD1/WS3 WS1	91.28	23.54
Semi-natural grassland	GS GS/HD1 GS/HD1/HH1 GS/WD1	32.27	8.32
Woodland	WD WD/HD1 WN WN/WS1	39.06	10.07
Other habitats	BL3 BL3/GA2 BL3/WL1 CS1 ED4/BL3/HH1 ER1/GS/HD1/WS1 GA2 L M WD/BL3	131.95	34.03
Total		387.70	100

The area of Dry Heath habitat recorded from the survey area is 93.14 ha. It should be noted that this includes areas of heathland adjoining and close to the SAC. The area of Dry Heath within the SAC is mapped as 78.7 ha which is a similar finding to the area of Dry Heath mapped by NPWS between 1995 and 2005 (80.33 ha). The recorded area of Dry Heath within the SAC is considerably less than that cited in the Draft Conservation Plan for Howth Head cSAC & Howth Head Coast SPA (NPWS 2005) (169 ha) or that presented in the Natura 2000 – Standard Data Form (NPWS 2017) (131.2 ha).

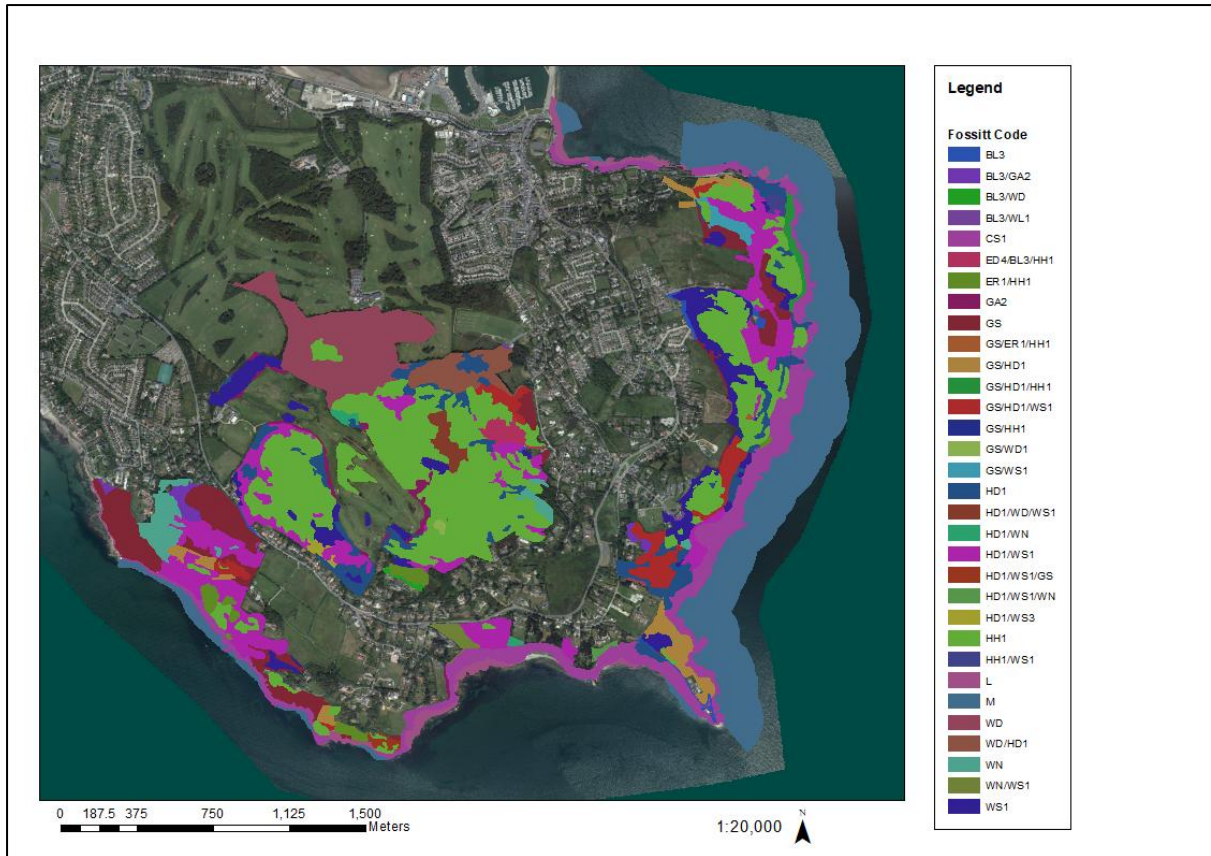
The area of Dry Heath is approximately 24% of the survey area. Areas of Bracken and scrub comprise a similar percentage of the survey area (24%). Semi-natural grassland and woodland comprise approximately 8% and 10% of the survey area respectively.



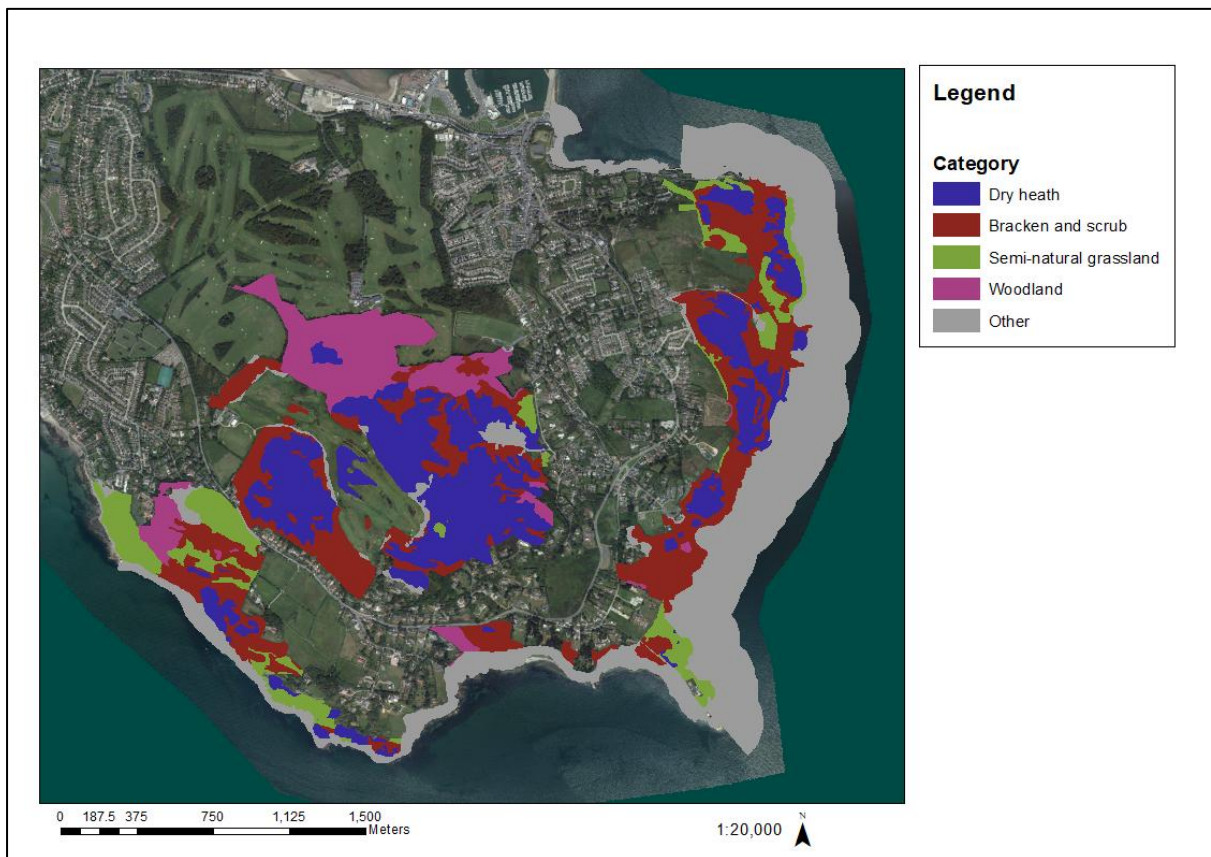
Map 1: Howth Head SAC



Map 2: Howth Head survey area and place names used in this report



Map 3: Howth Head habitat map.



Map 4: Howth Head broad (simplified) habitats map.

The heathland landscape at Howth Head can be considered to be composed of Dry Heath, Bracken and scrub (mainly Gorse), semi-natural grassland and woodland (Table 3). Considering just these four broad habitats allows focus to be on the Dry Heath, which forms 36% of the heathland landscape, and puts it into context with the other semi-natural terrestrial habitats. It omits the marine and coastal areas, built land, amenity grassland, quarries and also sea cliffs, which form the other QI for the SAC (1230 Vegetated sea cliffs). Omitting the sea cliffs prevents potential conflict with the conservation status of this Annex I habitat. Though some heath habitat was noted on the sea cliffs it was a minor feature, with dense Bracken and semi-natural grassland being the main vegetated habitats on the sea cliffs. Any heath habitat occurring on sea cliffs would be considered part of the Vegetated Sea Cliffs Annex I habitat and therefore not the focus of this study. Woodland areas are less integral to the broad heathland landscape than the other habitats but there are some small wooded blocks within the heathland mosaic and the interface between woodland and heathland provides structural diversity. However, the woodlands are a seed source for Rhododendron and Birch which are encroaching on the Dry Heath.

Table 3: Broad habitats area and the percentage of the heathland landscape

Broad habitat	Area (ha)	% of heathland landscape
Dry Heath	93.14	36.42
Bracken and scrub	91.28	35.69
Semi-natural grassland	32.27	12.62
Woodland	39.06	15.27
Total	255.75	100

3.3. Rapid Condition Assessment

A rapid assessment of the quality of the Dry Heath (good, moderate or poor) was made on a polygon basis (Map 5, Appendix 4) with reasons for the decision being recorded in the attribute table within the GIS. It should be noted that the rapid assessment does not replicate the detailed assessment of attributes and targets as detailed in NPWS (2016) but can be taken as a guide to the condition of the habitat. Factors which resulted in a poor assessment included extensive bare soil, high cover of grasses, substantial areas of dead Heather, encroaching scrub or Rhododendron, extensive trampling and dominance of regrowth of Heather from seed rather than rootstock following burning. Discrete patches of dead Heather were observed throughout the site and it was not known if this was due to damage from the Heather Beetle (*Lochmaea suturalis*) or desiccation following the drought conditions of summer 2018. The recent beetle survey for Howth Head may clarify this situation but regardless of the cause, if the cover of dead Heather was significant then this contributed to the area being assessed as poor. The appropriateness and effects of burning are difficult to assess through a one-off assessment visit. Burning is best conducted during the building phase (12-20 years) (Glaves *et al.* 2005) and regeneration from seed rather than rootstock can indicate burning of older stands of Heather or a hot burn; both types of regeneration were observed across burned areas. Regeneration from seed can result in areas taking much longer for vegetation cover to return and during this time the underlying soil is exposed to erosion and small, slow-establishing plants are prone to trampling. An area was generally considered as poor quality through evidence of a combination of the factors outlined here. Areas considered good quality did not show significant evidence of the above-mentioned negative influences, while areas considered as moderate quality were between these two extremes. Additionally, any area of Dry Heath dominated by Western Gorse

was considered to be moderate quality. This is reflective of the attribute in relation to dwarf shrub composition (NPWS 2016), the target for which is the 'proportion of dwarf shrub cover composed of bog-myrtle (*Myrica gale*), creeping willow (*Salix repens*) and western Gorse (*Ulex gallii*) is less than 50%'. In the notes on this NPWS (2016) states 'high proportions of Western Gorse may indicate a history of undesirable levels of grazing'.

Table 4: Results of the rapid assessment of the quality of the Dry Heath, area and the percentage of the heathland landscape

Condition	Area (ha)	%
Good	61.13	65.63
Moderate	20.83	22.36
Poor	8.91	9.57
Not assessed	1.27	1.36
Total	93.14	100

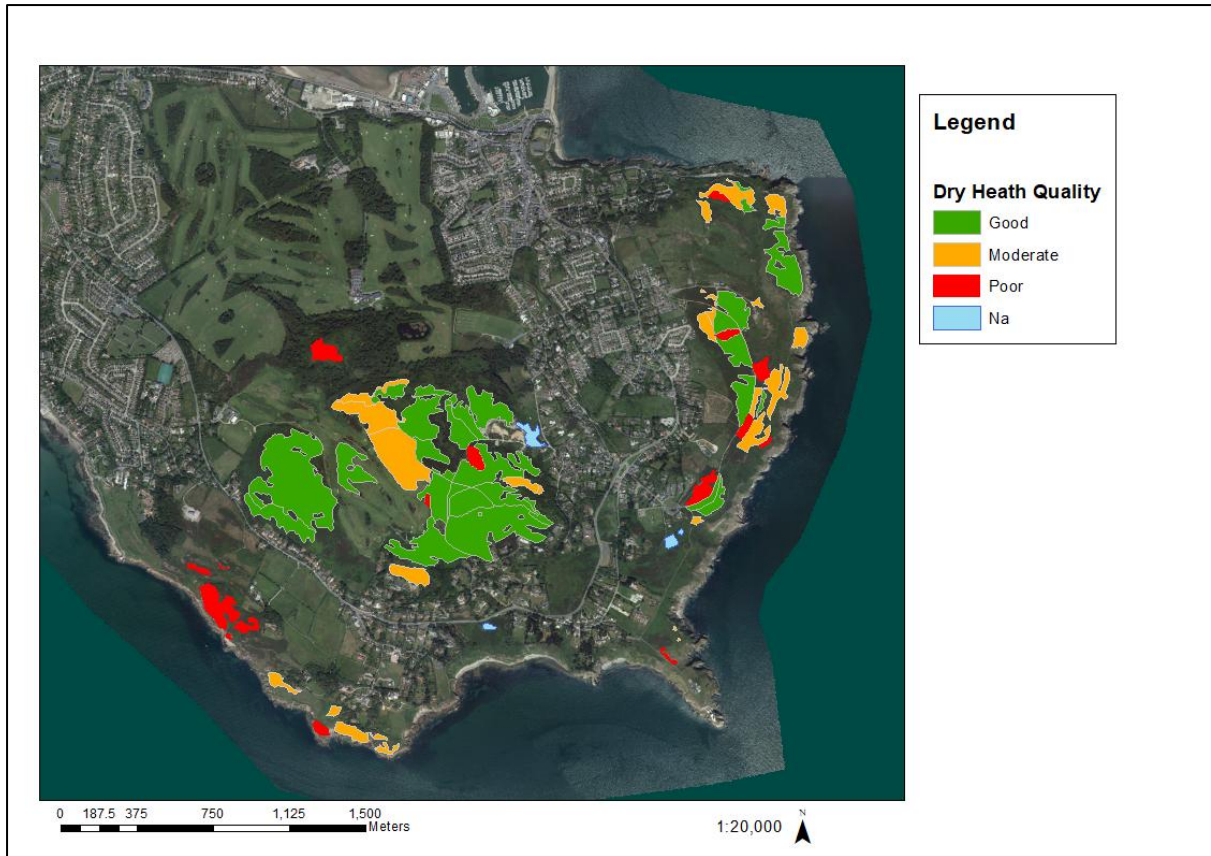
The majority of the Dry Heath habitat (66%) was assessed as being good quality (Table 4) through the rapid assessment. This included much of the Dry Heath at The Ben of Howth and that occurring at Shielmartin. Much of the Dry Heath along the upper cliff path and a block towards the Nose of Howth was also considered to be good quality.

22% of the Dry Heath (20.83 ha) was assessed as being of moderate quality. At Drumleck Point much of the Heather was dead and the Dry Heath was fragmented by paths and grassy patches. The Dry Heath at Dun Hill and on the south-eastern approach to this hill was also considered moderate quality. At the northern end there was encroachment from Birch and Rhododendron and severe erosion due to the network of paths. The main body of Dry Heath, on approach to the summit of Dun Hill from the south-east, had significant grassy areas and large patches of the invasive moss species Heath Star-moss (*Campylopus introflexus*). Areas along the eastern coast were assessed as moderate due to high cover of bare soil, while those near the Nose of Howth showed significant evidence of trampling.

Approximately 10% (8.91 ha) of the Dry Heath was considered to be poor quality. Areas at Redrock had been recently burnt and there was observation of the substrate having been burnt, erosion of the soil, sparse recovery of Heather and trampling. The Dry Heath at Muck Rock was also considered poor quality. It appears to be reducing in area due to encroachment from Rhododendron and significant pressure from trampling, and much of the taller Heather was dead. West of The Summit car park, much of the Dry Heath contained significant amounts of grass and also the invasive Heath Star-moss. Other areas assessed as poor quality in the vicinity of East Mountain showed similar signs of pressures and threats.

3.4. Negative indicator species

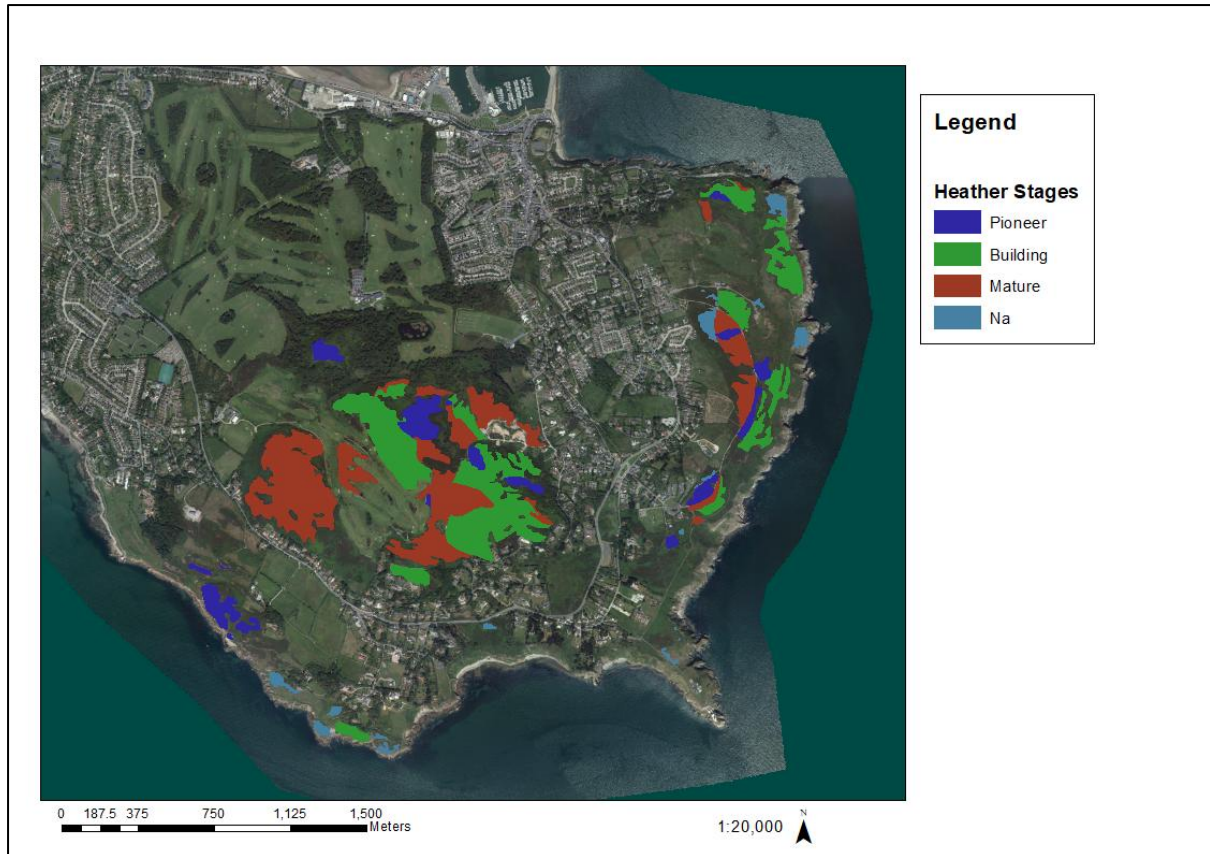
Two main negative indicator species were recorded, the invasive Heath Star-moss and the invasive shrub Rhododendron. Heath Star-moss was found in Dry Heath throughout site, being particularly abundant where there had been recent burning. Rhododendron had previously been mapped around the Ben of Howth by Ní Dhúill and Smyth (2018a). These records and additional points recorded by the present survey are shown in Map 6. It will be seen that Rhododendron occurs at multiple locations on Shielmartin and one location near The Summit car park.



Map 5: Rapid Condition Assessment of the Dry Heath within the Howth Head survey area. 'Na' indicates not assessed.



Map 6: Records of Rhododendron from the survey of Ní Dhúill and Smyth (2018a) and the present survey



Map 7: Growth stages of Heather within the Dry Heath at Howth Head survey area. ‘Na’ indicates not assessed.

3.5. Growth stages

The growth stages of Heather – pioneer, building, mature or degenerate – are shown in Map 7. The approximate ages of each of the stages are given in Table 5 together with the area and percentage of the Dry Heath area. Though Glaves *et al.* (2005) categorise Pioneer stage to be from approximately 6-10 years, for practical reasons areas with plants younger than six years were included in the pioneer category. No areas of degenerate Heather were recorded. The oldest areas of Heather are likely to be on the north face of Shielmartin. Though considered late mature, they did not show signs of degeneration. The 2011 GIS data (part of the Tubridy 2015 study) noted the Heather in this location may not have been burnt in the last 50 years. The assessment of Heather stages does not apply to areas of Dry Heath dominated by Western Gorse.

Table 5: Heather growth stage, approximate age and indicators of stage (adapted from Glaves *et al.* 2005) with the corresponding area and percentage of Dry Heath on Howth Head.

Stage	Approximate age (years)	Indicator	Area (ha)	%
Pioneer	0-10	Plants establishing, discontinuous cover	12.65	13.58
Building	12-20	Bush-like form covers larger area	37.21	39.95
Mature	20-25	Centre of bush thinning and many shoots prostrate	38.55	44.31
Degenerate	>30	All shoots prostrate, bush very thin.	0	0
Not assessed	-	-	4.73	5.08
Total			93.14	100

3.6. Plot vegetation

A total of 23 Dry Heath plots were recorded: five on East Mountain (plots 1-5), twelve around the Ben of Howth (plots 6-17), four on Shieltmartin (plots 18-21) and two at Redrock (plots 22-23) (Map 8). A total of 28 taxa were recorded from these plots: three dwarf shrubs, nine other vascular plants, eight bryophytes (mosses and liverworts) and eight macrolichens (see Appendix 1). Only one non-native species was recorded from these plots, Heath Star-moss. Fingered Cowwort (*Colura calyptrifolia*) was recorded for the first time at Howth in plot 6. This is the first record of this species in Co. Dublin since 1893, when it was recorded at Luttrellstown.

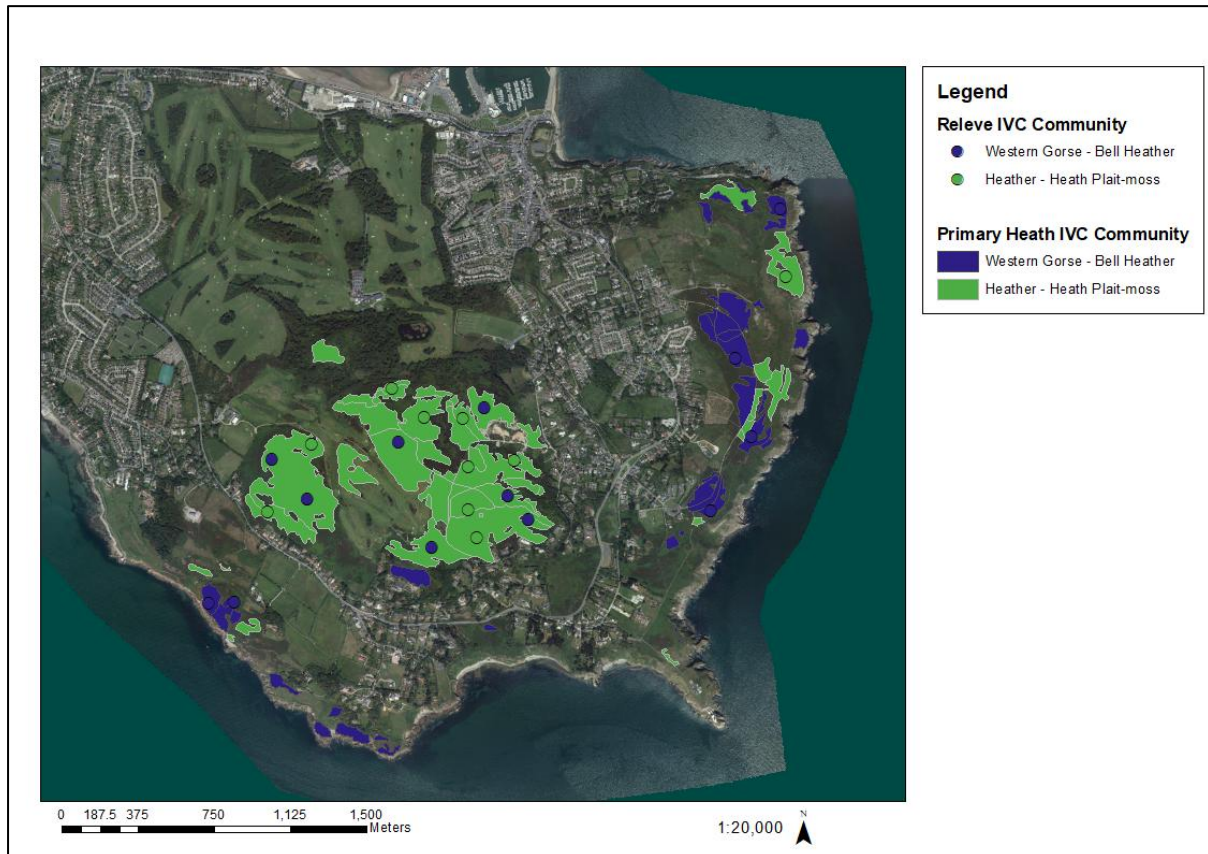


Map 8: Location of vegetation plots

The vegetation was typically dominated by a mixture of Heather, Western Gorse and Bell Heather (*Erica cinerea*). These dwarf shrubs were occasionally accompanied by a very sparse grass component which included Common Bent (*Agrostis capillaris*), Wavy Hair-grass (*Deschampsia flexuosa*) and Purple Moor-grass (*Molinia caerulea*). Forbs (broadleaved herbs) were very rare. Beneath the dwarf shrubs, the bryophyte layer was also typically sparse, but occasionally abundant. The main species were Heath Star-moss in recently burnt areas, and Heath Plait-moss (*Hypnum jutlandicum*) beneath dense Heather. A range of *Cladonia* lichen species were recorded, with *Cladonia portentosa* the most frequent. These were also associated with areas of more recent burning.

Analysis of these data with the ERICA tool classified all of the plots into just two communities of the Irish Vegetation Classification: HE2A *Ulex gallii* – *Erica cinerea* heath (Western Gorse – Bell Heather heath) ($n = 13$) and HE2B *Calluna vulgaris* – *Hypnum jutlandicum* heath (Heather –

Heath Plait-moss heath) ($n = 10$). At Howth, vegetation with high abundances or proportions of Western Gorse or Bell Heather would be HE2A, whilst vegetation in which Heather dominates would be HE2B. This corresponds with the vegetation described by Clarke (1968). These communities are distributed across the site (Map 9). HE2A dominates many areas on East Mountain and near Redrock. HE2B dominates the areas on the Ben and Shieltmartin, but patches of HE2A are still to be found at these locations as evidenced by the plot classification.



Map 9. Classification of plots (relevés) to the IVC and primary IVC heath community in each polygon.

The mean number of all species per plot was 5.6 species, with the mean number of bryophytes per plot being just 1.2 species. Data are also available for Dry Heath plots of the same size from Carlingford Mountain, Co. Louth, another east coast site, although one which encompasses much higher altitudes. In the Carlingford plots ($n = 10$), the mean number of all species was 15.5 and the mean number of bryophytes was 5.6. Species common in the Carlingford plots (present in $\geq 60\%$ of plots) but absent from the Howth plots comprise Sheep's-fescue (*Festuca ovina*), Mat-grass (*Nardus stricta*), Tormentil (*Potentilla erecta*) and Glittering Wood-moss (*Hylcomium splendens*). This comparison highlights that the Dry Heath vegetation at Howth is quite species-poor. These differences may reflect differing altitudes and soil conditions; soils at Howth had mean depth of 5.2 cm (range 2.3 to 10.8 cm) and were mineral types, whereas soils at Carlingford had a mean depth of 16 cm (range 7 to 33 cm) and included mineral and shallow peat types. However, the history of burning on Howth Head is likely to be a reason for the impoverished bryophyte flora (Joanne Denyer, pers. comm.). Comparisons with other low altitude east coast sites, for example Bray Head SAC or Clogher Head SAC, would be illuminating but suitable data are not available.

Cover of bare ground ranged from 0% in dense, mature heathland to 60% in a very recently burnt area above the coastal path at Redrock (plot 22) with a mean of 6% (Appendix 2). Cover of bare rock ranged from 0% to 30% in plot 22 with a mean of 3%. Dwarf shrub height at the plot level ranged from 10 cm in plot 22 to 92 cm in plot 19 on the western side of Shielmartin (which has not been burnt in many years), with a mean of 45 cm. Field layer height at the plot level ranged from 0 cm (absent) to 34 cm with a mean of 7 cm. Bryophyte layer height at the plot level ranged from 0 cm (absent) to 12 cm with a mean of 3 cm.

3.7. Plot assessments

Only one plot (plot 6) out of twenty-three passed all of the applicable criteria applied to assess the condition of the dry heath (Table 6). Only five plots passed the criterion testing richness of the bryophyte/lichen community; other plots supported fewer than three species (excluding Heath Star-moss). One plot failed the number of positive indicator species criterion because it contained only one dwarf shrub species, and plot 22 failed the cover of positive indicator species criterion because it had been very recently burnt. In four plots the dominance of Western Gorse within the dwarf shrub layer caused them to fail another criterion. Five plots failed criteria testing the presence of non-native species due to cover of Heath Star-moss. Cover of Bracken in the vicinity of one plot was a problem, as was the abundance of footpaths in the vicinity of another.

Table 6: Structure and Functions assessment of plots following Perrin *et al.* (2014). P = Criterion passed, F = Criterion failed and NA = Criterion not applicable

Plot no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
No. bryophytes/macrolichens $\geq 3^a$	F	F	F	F	F	P	F	F	F	F	F	P	F	F	P	P	F	F	F	P	F	F	F
No. positive indicators $\geq 2^b$	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P	P
Positive indicators $\geq 50\%$	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F	P
Dwarf shrub = <i>Ulex gallii</i> <50%	P	F	P	F	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P	F	P
Negative (weed) indicators <50%	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Aliens <1% of plot ^c	P	P	P	P	P	P	P	F	F	P	F	P	P	P	F	F	P	P	P	P	P	P	P
Aliens <1% vicinity ^d	P	P	P	P	P	P	P	F	F	P	F	P	P	P	F	F	P	P	P	P	P	P	P
Scattered trees/shrubs <20%	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
<i>Pteridium aquilinum</i> <10% vicinity	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P	P
<i>Juncus effusus</i> <10% vicinity	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Heather = senescent <50% plot	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
No. browsed shoots <33%	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
No burning in sensitive areas ^{e,f}	P	NA	NA	NA	NA	P	F	F	F	NA	NA	P	P	F	P	F	NA	NA	NA	NA	NA	F	F
Structure outside sensitive areas ^f	NA	F	F	F	F	NA	NA	NA	NA	F	F	NA	NA	NA	NA	NA	F	F	F	F	F	NA	NA
Disturbed ground <10% plot	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Disturbed ground <10% vicinity ^g	F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

- Not including Heath Star-moss
- Within this dataset these comprise Heather, Bell Heather, Western Gorse
- Within this dataset this refers only to Heath Star-moss
- Extrapolated from plot data
- Plots failed where there was evidence of recent burning
- Areas with soils <5 cm were regarded as sensitive areas
- Single failure due to high density of footpaths in vicinity of that plot

Areas with shallow soils (<5 cm deep) are deemed by the assessment procedure to be sensitive to disturbance and no evidence of burning should occur in these areas as it could lead to soil erosion. Seven of the twelve plots in these areas failed this criterion; these comprised plots from the Ben of Howth and Redrock. Outside these sensitive areas, a criterion requiring the

occurrence of each of the growth phases of Heather in the vicinity of each plot was applied. This is only applied outside sensitive because the variation in growth phases is often promoted through managed burning. All eleven plots in these non-sensitive areas failed this criterion due to the absence of degenerate phase Heather and, in burned areas, the uniformity of structure.

3.8. Conservation status

Conservation status assessments for Annex I habitats require consideration of three parameters: Structure and Functions, Area, and Future Prospects. The plot assessments assess the Structure and Functions at a site, Area is the consideration of whether the area of the habitat is stable/increasing or declining, and Future Prospects consider the likelihood of impacts to the habitat in the future from threats and pressures. Further details of the assessment of conservation status of upland habitats in Ireland can be found in Perrin *et al.* (2014). Once each of the three parameters has been considered, an overall assessment of the conservation status of an Annex I habitat can be made using the criteria in Table 7.

As indicated in Table 5, just 1 of the 23 plots (4.3%) passed all the applicable Structure and Functions assessment criteria. The Structure and Functions parameter is therefore considered Unfavourable-Bad as >25% of the Dry Heath habitat is in an unfavourable condition. The Rapid Condition Assessment which, using less detailed criteria, indicated that 31.8% of Dry Heath area was moderate or poor quality supports this assessment.

Table 7: General evaluation table for determining conservation status (from Perrin *et al.* 2014).

Parameter	Conservation status			
	Favourable (green)	Unfavourable - Inadequate (amber)	Unfavourable - Bad (red)	Unknown (insufficient information to make an assessment)
Area	Stable (loss and expansion in balance)	Any other combination	Large decrease in surface area: Equivalent to a loss of more than 1% per year	<i>No or insufficient reliable information available</i>
Structure and functions	Structures and functions (including typical species) in good condition and no significant deteriorations / pressures	Any other combination	More than 25% of the area is unfavourable as regards its specific structures and functions (including typical species)	<i>No or insufficient reliable information available</i>
Future prospects	The habitat's prospects for its future are excellent / good, no significant impact from threats expected; viability over next twelve years assured.	Any other combination	The habitat's prospects are bad, severe impact from threats expected; viability over next twelve years not assured	<i>No or insufficient reliable information available</i>
Overall assessment of conservation status	All 'green' OR two 'green' and one 'unknown'	One or more 'amber' but no 'red'	One or more 'red'	Two or more 'unknown' combined with green or all "unknown"

There are insufficient data to quantify loss of area of Dry Heath habitat within the site but evidence of encroachment by Rhododendron and Birch was noted in the field in addition to

trampling causing losses at a local scale. As such, the Area assessment is considered to be Unfavourable-Inadequate. Future Prospects would also be tentatively considered as Unfavourable-Inadequate due to there being significant threats to the habitat. As more than one of the three parameters is assessed as Unfavourable-Bad then, following the criteria in Table 7, the conservation status of the Dry Heath habitat within the site can be considered to be Unfavourable-Bad (Table 8).

Table 8: Conservation status assessment for Dry Heath at Howth Head SAC.

Parameter	Area	Structure and functions	Future Prospects	Overall assessment
Summary of result	Losses noted in the field but unlikely to equate to more than 1% per year	More than 25% of plots failed the assessment.	Threats were noted in the field	One or more 'red'
Assessment	Unfavourable - Inadequate (amber)	Unfavourable - Bad (red)	Unfavourable - Inadequate (amber)	Unfavourable - Bad (red)

4. Discussion and recommendations

In this section, we discuss the review of the Site-Specific Conservation Objectives (SSCOs) in combination with the findings from the rest of the study and make recommendations that should be considered when writing the forthcoming management plan. It is worth emphasising with regards to this discussion the distinction between the broader heathland landscape, at which site level management is likely to occur, and the specific Annex I Dry Heath habitat, which is the focus of the assessment procedures and SSCOs.

4.1. Overall conservation objective for Dry Heath

SSCOs are prepared for SACs by NPWS. Despite their title, the approach taken with these documents is still rather generic and is often developed based on existing, available site information rather than from dedicated fieldwork. Objectives are set in relation to the conservation status of the Qualifying Interests (QIs) for the SAC. If a QI (such as Dry Heath) is considered to be in favourable condition, then its overall conservation objective would be to '*maintain the favourable condition*'. If the habitat is considered to be in an unfavourable condition, then the overall conservation objective would be to '*restore the favourable condition*'.

The SSCOs for Howth Head SAC (NPWS 2016) give the overall conservation objective for Dry Heath as '*maintain the favourable condition*'. However, based on the assessment presented above, it is more appropriate for the overall objective to be '*restore the favourable condition*'. The obvious implication is that active management is required to address the factors that are contributing to this unfavourable conservation condition rather than a situation of maintaining the status quo. The development of a management plan can quickly improve the Future Prospects of a site as, where there is evidence of a management plan being implemented, the trend for the Future Prospects will improve. It may, however, take some time for an altered management regime to be evident in an improved Structure and Functions assessment (see recommendations below).

Recommendation:

- Change overall conservation objective for Dry Heath in the SSCOs for Howth Head SAC to '*to restore the favourable condition*'.

4.2. Area, distribution and communities

Dry Heath is a plagioclimax community, a habitat where human influence prevents the community developing further. Without intervention, Dry Heath would succeed towards woodland habitat. As such, management of the habitat is required to maintain it as Dry Heath. Currently, the area of Dry Heath habitat appears to be decreasing due to encroachment by Rhododendron and Birch scrub, and potentially by Bracken. Trampling, particularly following wildfires, may also be a factor. Some of the issues facing the Dry Heath at the site are shown in photographs in Appendix 3. In locations such as Redrock and Muck Rock where Dry Heath is under significant pressures, there is potential for the habitat to be no longer present within a timeframe of 10-20 years if the current regime continues. Dry Heath would also likely be further restricted and fragmented around The Summit and to the south of this point. Habitat area is a standard attribute within SSCOs (see attribute No. 1, Table 9), the target for which is for the area to be '*stable or increasing*', but the area of Dry Heath at Howth is currently listed as unknown. There is also an SSCO attribute relating to habitat distribution (No. 2, Table 9) which addresses the spatial distribution across the site. This attribute puts additional importance on outlying patches of Dry Heath such as those at Muck Rock, Glenaveena and The Great Bailey, because if these are lost the distribution of the habitat within the site will be in decline. Attribute No. 4 (Table 9.) addresses community diversity within the Dry Heath. Previously this was unknown.

Recommendations:

- Change the notes for attribute No.1 for Dry Heath in the SSCOs for Howth Head SAC to reflect the accurate area measurement of habitat of 86 ha.
- Change notes for attribute No. 2 to highlight vulnerable areas at Redrock, Great Bailey and Glenaveena.
- Change notes for attribute No. 4 to reflect presence and areas of HE2A and HE2B.

4.3. Soils and footpaths

There is an extensive network of paths through the Dry Heath and some of these are eroding and facilitating soil loss. Erosion from trampling is evident at numerous places along the upper and lower cliff walks, including on the summit above the Nose of Howth, the viewing area northeast of The Summit car park, and on the paths south-east of The Summit car park. There are additional areas leading to the summit of Dun Hill from the north-west and around the aerials on the Ben of Howth. Fires (such as the recent fire at Redrock) expose the underlying soil to erosion due to rainfall and wind, and also open up areas to trampling, which in turn impedes vegetation recovery (for example on East Mountain).

The path network through Dry Heath should be reviewed with the objective of no new paths being allowed to develop and consideration given to reducing the extent of the path network

through Dry Heath areas. Footpath maintenance work within Dry Heath areas needs to be cognisant of the sensitivities of the surrounding habitat, particularly in steeper areas, and be of a stone type which will not influence surrounding pH levels.

It may be appropriate to have an additional SSCO attribute with a target such as '*<1% of habitat showing signs of soil erosion*' as is included in the UK in the Common Standards Monitoring Guidance for Lowland Heathland (JNCC 2009). This can be assessed through the Structure and Functions assessment in the local vicinity of the assessment plots; it would not be appropriate to assess this just within the 2 m × 2 m plots. Where soil erosion is identified as a significant threat to the integrity of the site, additional monitoring of this may be required as soil erosion will influence other management decisions

Dry Heath is characteristically a low fertility ecosystem. Attribute No. 3 (in Table 9) requires that soil nutrient status is maintained within its natural range. No specific nutrients are currently stated for this attribute although nitrogen deposition is noted as relevant. Soil nutrients which may be relevant to Dry Heath include total and available phosphorus, nitrates, nitrites and ammonia, magnesium and potassium (Niemeyer *et al.* 2005). It would also be useful to have measures of soil pH and soil organic content, and more complete data on soil depth. The natural ranges for these parameters within Irish Dry Heath still need to be determined and may differ between uplands and lowland sites.

Recommendations:

- Conduct a review of the footpath network with specific regard to areas of erosion.
- Conduct footpath maintenance to reduce erosion using appropriate materials or close paths where necessary.
- Create an additional SSCO attribute (No. 19, Table 9) to address soil erosion.
- Conduct a soil survey of Dry Heath at Howth Head to records soil nutrients and other edaphic parameters.
- Request further research by NPWS to establish the natural ranges of these parameters within Irish Dry Heath.

4.4. Non-native species

Rhododendron control in areas of Dry Heath should be prioritised. An assessment similar to that conducted by Ní Dhúill and Smyth (2018a) should be conducted for Shielmartin and a GIS-based Rhododendron Eradication Plan developed. Higgins (2008) should be consulted to assist with the development of suitable eradication approaches. It will be necessary to work in areas where all of the nearby Rhododendron can be removed and include private land and gardens, such that seed sources are removed. For example, recent work at Shielmartin has removed significant areas of Rhododendron but plants remain as a seed source in adjoining gardens.

Management options for Heath Star-moss, such as herbicide treatment or burial of sods, are impractical and likely to be of limited success, given the species' widespread abundance, high fertility and readily distributed spores (CABI 2019). As this species readily colonises disturbed soils, its cover could be restricted by limiting areas of burning within the heathland (see subsection 4.7).

Recommendations:

- Assess Rhododendron on Shielmartin.
- Develop and enact a Rhododendron Eradication Plan for the SAC which addresses seed sources.

Table 9: Site-Specific Conservation Objectives for Dry Heath at Howth Head from NPWS (2016). Recommended amendments and additions are underlined.

No.	Attribute	Measure	Proposed Target	Notes
1	Habitat area	Hectares	Area stable or increasing, subject to natural processes	<u>European dry heath within the SAC has been mapped as 86 ha.</u>
2	Habitat distribution	Occurrence	No decline, subject to natural processes	See note on area above. <u>Small, outlying areas at Redrock, Great Bailey and Glenaveena are particularly vulnerable.</u>
3	Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	Relevant nutrients and their natural ranges are yet to be defined. However, nitrogen deposition is noted as being relevant to this habitat (NPWS, 2013)
4	Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	<u>IVC communities HE2A (36 ha) and HE2B (56 ha) occur at the site.</u> Information on vegetation communities associated with this habitat is presented in Perrin <i>et al.</i> (2014)
5	Vegetation composition: lichens and bryophytes	Number of species at a representative number of 2m x 2m monitoring stops	Number of bryophyte or non-crustose lichen species present at each monitoring stop is at least three, excluding <i>Campylopus</i> and <i>Polytrichum</i> mosses	Attribute and target based on Perrin <i>et al.</i> (2014). Dry heath is not necessarily rich in lichen and bryophyte species, but a minimum amount should still be present
6	Vegetation composition: number of positive indicator species	Number of species at a representative number of 2m x 2m monitoring stops	Number of positive indicator species present at each monitoring stop is at least two	Attribute and target based on Perrin <i>et al.</i> (2014), where the list of positive indicator species for this habitat, which is composed of dwarf shrubs, is also presented.
7	Vegetation composition: cover of positive indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of positive indicator species at least 50% for siliceous dry heath	Attribute and target based on Perrin <i>et al.</i> (2014), where the list of positive indicator species for this habitat, which is composed of dwarf shrubs, is also presented
8	Vegetation composition: dwarf shrub composition	Percentage cover at a representative number of 2m x 2m monitoring stops	Proportion of dwarf shrub cover composed collectively of bog-myrtle (<i>Myrica gale</i>), creeping willow (<i>Salix repens</i>) and	Attribute and target based on Perrin <i>et al.</i> (2014). Of these three species only Western Gorse occurs. This is a component of dry heath, but high proportions of it may indicate a history of undesirable levels of grazing

			western gorse (<i>Ulex gallii</i>) is less than 50%	
9	Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of negative indicator species less than 1%	Attribute and target based on Perrin <i>et al.</i> (2014), where the list of negative indicator species for this habitat is also presented
10	Vegetation composition: non-native species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%	Attribute and target based on Perrin <i>et al.</i> (2014). Non-native species can be invasive and have deleterious effects on native vegetation. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances. Rhododendron (<i>Rhododendron ponticum</i>) occurs in places on dry heath in this SAC
11a	Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	<u>Cover of scattered native trees and shrubs <15%</u>	<u>Attribute and target based on Perrin <i>et al.</i> (2014) but the upper threshold is reduced from 20%</u>
11b	<u>Vegetation composition: native trees and shrubs</u>	<u>Percentage cover at the site level</u>	<u>Cover of scattered native trees and shrubs >1%, <10%</u>	<u>Low cover of trees and shrubs provides structural and niche diversity</u>
12	Vegetation composition: bracken	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of bracken (<i>Pteridium aquilinum</i>) less than 10%	Attribute and target based on Perrin <i>et al.</i> (2014). High cover of bracken would indicate that the habitat may be succeeding towards a dense bracken community
13	Vegetation composition: soft rush	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of soft rush (<i>Juncus effusus</i>) less than 10%	Attribute and target based on Perrin <i>et al.</i> (2014). High cover of soft rush would suggest undesirable hydrological conditions. Note however, that poor flushes dominated by soft rush can naturally occur in mosaic with this habitat. Discrete areas of this separate habitat should not be considered here
14	Vegetation structure: senescent heather	Percentage cover at a representative number of 2m x 2m monitoring stops	Senescent proportion of ling (<i>Calluna vulgaris</i>) cover less than 50%	Attribute and target based on Perrin <i>et al.</i> (2014). Senescence is part of the natural cycle of ling, but a dominance of ling in the senescent phase would indicate a lack of management (appropriate grazing or burning) to promote ling regeneration
15	Vegetation structure: signs of browsing	Percentage of shoots browsed at a representative number of 2m x 2m monitoring stops	Less than 33% collectively of the last complete growing season's shoots of ericoids showing signs of browsing	Attribute and target based on Perrin <i>et al.</i> (2014)

16	Vegetation structure: burning	Occurrence in local vicinity of a representative number of monitoring stops	No signs of burning in sensitive areas	Attribute and target based on Perrin <i>et al.</i> (2014). The Dry Heath throughout the site is deemed to be a sensitive area due to the vulnerability of the soil
17	Vegetation structure: growth phases of heather	Percentage cover in local vicinity of a representative number of monitoring stops	Outside sensitive areas, all growth phases of ling (<i>Calluna vulgaris</i>) should occur throughout, with at least 10% of cover in the mature phase	Attribute and target based on Perrin <i>et al.</i> (2014). As Dry Heath throughout the site is deemed to be a sensitive area due to the vulnerability of the soil it is not reasonable to require the stated diversity of growth phases at this site
18	Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground less than 10%	Attribute and target based on Perrin <i>et al.</i> (2014). Disturbance can include hoof marks, wallows, human foot prints and vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species and presage erosion for heaths and peatlands
19	<u>Physical structure: soil erosion</u>	<u>Percentage cover at, and in local vicinity of, a representative number of monitoring stops</u>	<u><1% of habitat showing signs of soil erosion</u>	<u>Target based on JNCC (2009). Soil erosion occurs through the actions of rainfall, wind and trampling. Excessive soil erosion can occur as a result of burning</u>
20	Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat	This includes species listed in the Flora (Protection) Order, 2015 and/or the red data lists (Curtis and McGough, 1988; Lockhart <i>et al.</i> , 2012)

4.5. Cover of native trees, shrubs and dwarf shrubs

The SSCO attribute (No. 11a, Table 9) relating to cover of scattered native trees and shrubs on Dry Heath is currently set at a threshold of <20% cover and none of the assessments failed this criterion. Birch encroachment is, however, a concern in some locations, particularly on the northern slopes of Dun Hill and in other locations near woodland. As such it tends to be an issue on the edges of the Dry Heath, rather than throughout the habitat. On review, the <20% threshold may be rather high and if this threshold were being exceeded it would already represent an issue of some magnitude. As such it is proposed to reduce the threshold to <15% for this site to enable encroachment issues to be flagged at an earlier stage. Adding a minimum site-level threshold of >1% should also be considered in recognition of the enhanced structural and niche diversity provided by scattered native shrubs and trees.

It has been planned that the areas of Birch scrub developing on Dry Heath to the north of Dun Hill be allowed to develop to Birch woodland due to the steepness of the slope and the difficulty in maintaining the vegetation (Hans Visser, pers. comm.). It should be noted that development of woodland here would constitute a loss in area of the Annex I habitat and would need to be compensated with comparable areas of Dry Heath habitat creation elsewhere on the site.

In the assessment four plots failed the assessment for cover of Western Gorse being <50%. This attribute is also reflected in the rapid assessment where polygons with a dominance of HE2A Western Gorse – Bell Heather heath were assessed as Moderate. This stems from the JNCC (2009) which notes Western Gorse as a nitrogen fixer which “could lead to persistent and dramatic changes in the community”. They recommend Western Gorse should make up no more than 50% of the total cover of dwarf-shrubs. While this is not the most urgent of ecological issues at Howth Head, where there are large areas dominated by Western Gorse steps could be taken to reduce the dominance of Western Gorse through selective cutting or burning.

Recommendations:

- Amend attribute No. 11a to reflect a <15% threshold for scattered native trees and shrubs in the vicinity of assessment plots.
- Create an additional SSCO attribute (No. 11b, Table 9) to address minimal cover of scattered trees and shrubs.
- Remove significant areas of Birch encroachment (e.g. Dun Hill) or compensate for loss of Dry Heath habitat elsewhere.
- In large areas of Dry Heath dominated by Western Gorse reduce the dominance of Western Gorse.

4.6. Dense Bracken and Gorse scrub

Areas of dense Bracken and Gorse scrub (composed of *Ulex europaeus*) cover 91 ha of the heathland landscape and are approximately equivalent in extent to the area of Dry Heath. Dense Bracken occurs as large blocks some of which adjoin areas of Dry Heath and also as smaller areas of bracken within the Dry Heath. Locations of particular concern would be the eastern slopes of Dun Hill, the lower slopes of Shielmartin and East Mountain, between Redrock and the Carrickbrack road, and eastern sections of the Ben of Howth. Gorse scrub occurs in many areas but is particularly noticeable along the western side of the upper cliff walk on East Mountain.

These habitats provide cover for some birds and animals, niches for bryophytes and can in small patches add to the structural diversity. They do not, however, constitute an Annex I habitat and from the perspective of the EU Habitats Directive would be regarded as being of lower ecological value.

Any encroachment of Bracken onto Dry Heath must be controlled as this would lead to deterioration or even loss of Dry Heath habitat. Cover of Bracken was a minor component (3% cover) of 1 of the 23 relevés recorded, but the amount of Bracken within the local vicinity of the plot was sufficient for the plot to fail the Structure and Functions assessment (>10%). It is not possible with a single overview of a site to determine if Bracken is increasing at the expense of Dry Heath, and monitoring of this would be desirable. It is likely in the future that assessment will be possible through review of satellite imagery but at present the images available are not of sufficient quality (particularly historical images) to assess this. Establishing markers on the ground encompassing the outer extent of a patch of Bracken within a Dry Heath area, though labour-intensive to set up, would provide information on the rate of encroachment at the site and help to formulate suitable management. Information on options for management of Bracken through chemical applications and mechanical cutting are given in Tubridy (2013).

The RSPB (2019) consider Gorse as being valuable as scattered bushes or discrete clumps up to 0.25 ha and recommend a maximum of 10% Gorse cover on 'priority habitats or farmed land'. It is notable that RSPB consider Gorse (*Ulex europaeus*) and Western Gorse (*Ulex gallii*) under the same management prescriptions but Western Gorse at Howth Head is considered an integral component of the Dry Heath and its cover is considered in section 4.5. In the assessment criteria Gorse (*Ulex europaeus*) is considered under the native trees and scrub has a threshold of < 20%. Cover of dense Bracken is set in the assessment criteria as a maximum cover of 10%. It should be noted both these thresholds are set in relation to the Bracken and Gorse being a component of the Dry Heath, whereas consideration here is given to their cover within terms of the broader heathland landscape. As such a combined upper threshold of 20% for dense Bracken and Gorse scrub would likely be appropriate. Currently this broad habitat covers approximately 36% of the heathland landscape. A target within the forthcoming management plan of reducing the area of these habitats from the current 36% and creating or restoring areas of Dry Heath, semi-natural grassland or native woodland in their place could be set. Target habitats for specific areas would be dependent on soil conditions, but Dry Heath should be preferred where possible.

When deciding on the location of areas which would be suitable for Bracken and Gorse scrub control it will be necessary to consider a range of factors including where fuel load created by Gorse scrub needs to be reduced, whether access by machinery is possible to carry out the works, would these management changes be acceptable to nearby local residents/interest groups, what the future management of these areas will be and whether they are suitable for this in terms of soil conditions and topography.

Recommendations:

- Monitor and control of Bracken and Gorse encroachment onto Dry Heath.
- Reduce the proportion of dense Bracken and Gorse scrub within the heathland landscape from 36% (91.28 ha) to 20% (51 ha) or less by conversion to Dry Heath, grassland or woodland.

4.7. Growth phase diversity

Having a diversity of the growth phases of Heather is one of the attributes used to define the conservation status of Dry Heath within the SAC (No. 17, Table 9). The target in the SSCOs in relation to diversity of structure is "*Outside sensitive areas, all growth phases of ling (Heather) should occur throughout, with at least 10% of cover in the mature phase*". At Howth, all relevant assessment plots failed the associated criterion due to the lack of degenerate stage Heather and, in burned areas, the uniformity of structure.

The requirement for a diversity of structure in Dry Heath in general stems from its benefit to fauna. The leading example of this is management of heath for Red Grouse which is conducted by gun clubs and Red Grouse projects across Ireland (NRGSC 2013). Red Grouse does not occur at Howth and given the relatively small, isolated area of heathland and the high level of disturbance from visitors it is perhaps unlikely too, even with improved management. Nevertheless, maintaining a diverse vegetation structure on lowland heath is, from the viewpoint of management for a diversity of invertebrates (e.g. spiders, bees, wasps, craneflies, ground beetles, damselflies), "the most important management aim" (Buglife.org.uk).

The variation in growth phase is typically promoted through managed burning, grazing or mowing. There is currently no grazing at the site. It may be possible to obtain a diversity of structure in the Dry Heath through reinstating grazing using goats, cattle, ponies or sheep (there have been recent goat grazing trials at Howth), but there are practical issues on this unfenced and heavily frequented site. In non-sensitive areas only (i.e. on deeper soils and less steep slopes), small-scale managed burning could possibly be employed to create structural diversity in the Heather. Burning trials are planned for this site (Hans Visser, pers. comm.). Currently, any burning occurring is through fires started accidentally or through vandalism (unmanaged burning) which burn large areas uniformly. Any managed burning regime would need to account for unmanaged burning. Terrain and proximity to housing may also limit the areas which can be safely burned. An alternative would be the implementation of a suitable cutting or flailing regime. This was examined by Tubridy (2015) in the context of the broader heathland landscape; cost of operation is a key factor. Site-specific data on how Heather regenerates when using these different techniques would better inform management plans.

Recommendations:

- Conduct small-scale managed burning trials and monitor regeneration of Heather.
- Conduct small-scale cutting trials and monitor regeneration of Heather.
- Monitor regeneration of Heather in areas used for the previous goat-grazing trial.
- Allow some current areas of mature Heather to develop to the degenerate phase.

4.8. Unmanaged burning

Unmanaged burning is undoubtedly an issue at the site and caused multiple plots to fail the assessment. Though burning of Dry Heath may not directly result in negative impacts in itself, it does act in combination with other factors such as soil erosion, trampling and facilitating colonisation of bare peat by the invasive Heath Star-moss. The large numbers of people walking on Howth Head is a particular management issue for Dry Heath, with short Heather particularly susceptible to trampling. Whereas tall Dry Heath vegetation will largely confine walkers to established paths, the short vegetation present in the years after a burn allows people to walk throughout these areas. People are naturally attracted to higher ground to obtain the best views, and recovering areas of Dry Heath on higher ground are particularly vulnerable to trampling. Consideration should be given to temporarily fencing areas of Dry Heath that have been burnt and/or are being excessively trampled.

Unmanaged burns can occur throughout the year, and when they occur during the summer, temperatures can be very hot and surface soils and peat can be damaged (Glaves *et al.* 2005). It is generally accepted that the greater the temperature, the poorer the recovery of the system (Glaves *et al.* 2005). Unmanaged burns occur in areas of Gorse scrub as well as Dry Heath. These burns can be particularly damaging to soil as they tend to be hotter due to the high amount of combustible material. It was noted in Glaves *et al.* (2005) that burning is not an effective means of control of Gorse as it has the effect of breaking seed dormancy, resulting in the appearance of young seedlings to re-populate the burnt area. It may be possible to counter this with subsequent grazing by goats which was found in a study in New Zealand to reduce gorse numbers to near negligible amounts within 2-3 years on agricultural grassland (Ratcliffe 1985).

It is understood further detail on this has been collated through the goat-grazing experiments reported by Tubridy (2015).

Due to the history of unregulated burning, consideration should also be given to the public perception of the site being actively managed through this means and whether use of burning as a management tool might encourage a continuation of unregulated burns.

Recommendations:

- Prevent unmanaged burning of the site through public awareness and legal enforcement.
- Consider fencing off burned areas adjacent to paths to prevent trampling.

4.9. Habitat restoration

Consideration should be given to the restoration (or creation) of Dry Heath areas within the SAC. This is considered desirable to reverse the loss of habitat that is thought to have occurred, to enhance the future prospects of the habitat at the site (which are likely to remain under significant pressure from unregulated burning and trampling in certain areas) and to increase the resilience of the habitat in relation to the pressures of a changing environment. Restoration (or creation) of Dry Heath will not necessarily be a straightforward task and locations may require litter removal, soil disturbance and the introduction of seed sources (e.g. Heather). Details of the processes required are documented in Hawley *et al.* (2008). Areas which have had dense vegetation removed (such as Gorse scrub or Rhododendron) or are proposed for clearance of dense vegetation (see recommendations for subsection 4.6) should be considered for Dry Heath restoration. Additional areas which could be considered are areas of dense Bracken or improved grassland. The lower slopes of Shielmartin and below The Summit car park are two areas with abundant Gorse/Bracken which may be suitable for this management application.

Recommendations:

- Increase the proportion of Dry Heath within the heathland landscape from 36% (93.14 ha) to 46% (~118 ha) through conversion of other habitats.

4.10. Cover of lichens and bryophytes

It is noted for the SSCO attribute relating to the cover of lichens and bryophytes (No. 5, Table 9) that Dry Heaths are “not necessarily rich in lichen and bryophyte species but a minimum amount should still be present”. The minimum amount is set at three, and this, in the context of Dry Heath found at other sites through Ireland, is not considered an onerous target, yet only 5 of the 23 assessment plots passed this criterion. The recent bryophyte survey has speculated that the frequent burning of the heath has been a factor in lowering bryophyte diversity at Howth (Joanne Denyer, pers. comm.). Therefore, this low diversity can perhaps be best addressed through appropriate management of burning as discussed above.

Recommendations:

- Follow the recommendations of the recent bryophyte survey with regards promotion of bryophyte diversity within the heathland landscape.

4.11. Quality Indicators

Diversity within the Dry Heath habitat at Howth Head is very low in terms of both plant community diversity and floral diversity. The mean number of all species per plot was 5.6 species, with the mean number of bryophytes per plot being just 1.2 species. It would therefore be difficult to develop meaningful quality indicators based on the floral or community diversity other than the standard criteria developed for Dry Heath and detailed in the SSCOs for the site.

As has been suggested in the subsections above, if there is a particular species or group of species for which areas of the survey site should be managed, it is likely to be found among the faunal records rather than those of plants or vegetation communities. It is understood that baseline surveys for some groups (lizards and beetles) were conducted in 2019 and these may reveal particular indicators towards which management could be targeted. Review of the historical data has indicated a number of flora and fauna species which were present on Howth Head in the 1970s and there may be scope for managing at least some areas with a view to enhancing the habitat for these. Groups for which there is some history of recording at the site include hoverflies, woodlice, ants, moths and butterflies. It should, however, be noted of these records that only the record for hoverfly *Sphaerophoria batava* has been specifically associated with the Dry Heath and further specialist review would be necessary in order to target management for such species.

Improving the Heather growth phase diversity for invertebrates has been proposed above and a diverse vegetation structure is generally regarded as a positive provision for this large and varied group. There is scope to enhance the structural diversity of other elements of the heathland landscape within the SAC for invertebrates by generating and maintaining bare ground and improving the diversity of the grassland through implementing a suitable cutting regime. Baseline surveys for species will provide more focussed management targets and measures, without which management for this group would be speculative.

Recommendations:

- Conduct invertebrate surveys for groups including bees, hoverflies, woodlice, ants, moths and butterflies.
- Develop SSCO targets based on specialist review of the new data (could be included as indicators of local distinctiveness).
- Manage other habitats to promote a diversity of invertebrates.

4.12. Monitoring

Twenty-three quadrats have been established on the site; the locations are indicated by coordinates (Appendix 1). The quadrats provide data on plant diversity, percentage cover and height of different layers of vegetation. In addition, information on soil depth and the cover of bare ground and bare rock was recorded. Future assessments at these locations should also record the amount of habitat showing signs of soil erosion. The plots provide baseline information on the current condition of the habitat and also provide an assessment framework by which changes in the vegetation's Structure and Functions can be monitored. A monitoring frequency of approximately every five years is likely to be appropriate to record changes in vegetation and response to altered management regimes. It should be noted that the

assessment of quadrats should be conducted together with a review of areas where management issues have been highlighted and an overview of the site, such that any additional pressures and threats can be identified and their management incorporated into future revisions of the management plan.

- Resurvey plot network in 2024.

4.13. Public perception

Tubridy (2015) notes that due to a lack of knowledge of the historic role of farming practices in creating and maintaining heathland, a common public perception of the site is that it is an 'unmanaged wilderness'. Future, active management actions such as fencing trampled areas, managing large areas of the site through grazing or cutting, removal of vegetation, or controlled burning may therefore be met with some resistance. This should be addressed through clear communication with the public about the needs for management and the benefits to biodiversity.

- Engage with the public and stakeholders in relation to management issues.
- Erect interpretation signage in areas of active management to inform the public of its purpose.

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Appendix 1: Vegetation plot data

Percentage cover of plant species, species richness and IVC communities.

A = HE2A *Ulex gallii* – *Erica cinerea* heath (Western Gorse – Bell Heather heath)

B = HE2B *Calluna vulgaris* – *Hypnum jutlandicum* heath (Heather – Heath Plait-moss heath)

Plot no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Dwarf shrubs																							
<i>Calluna vulgaris</i>	65	0	65	0	90	55	90	60	20	90	75	90	55	80	50	60	30	95	65	60	75	0.7	65
<i>Ulex gallii</i>	35	45	25	60	10	35	7	7	40	15	3	5	50	0.1	30	3	60	0	50	45	20	10	40
<i>Erica cinerea</i>	5	45	15	45	3	15	0	3	50	5	0	1	5	1	15	1	30	0	5	25	10	2	3
Field layer																							
<i>Festuca rubra</i>	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Agrostis capillaris</i>	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Deschampsia flexuosa</i>	0	0	0	0	0	1	0	0	0	0	0	0	0.7	0	0	0	0.3	0	0	0	0	0	0
<i>Molinia caerulea</i>	0	0	0	0	0	0	0.3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Carex binervis</i>	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypochaeris radicata</i>	0	0.3	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygala vulgaris</i>	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0
Bryophytes																							
<i>Bryum cf. bornholmense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
<i>Campylopus introflexus</i>	0	0.3	0	0.5	0	0	0.3	40	50	0	50	0.5	0	0.1	10	35	0.1	0	0	0	0.3	0.1	0.3
<i>Ceratodon purpureus</i>	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Colura calyptrifolia</i>	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dicranum scoparium</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
<i>Hypnum jutlandicum</i>	0	0	0.3	0	0.3	0.3	0	0	0	15	0	3	0	0	0	0	0	50	5	5	0	0	1
<i>Kindbergia praelonga</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0.1	0	5	5	0	0	0.3
<i>Lophocolea bidentata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0	0
Lichens																							
<i>Cladonia portentosa</i>	0	0	0	0	0	0	0.1	0	0	0	0	7	0	0	0.3	0.3	0	0	0	0	0.3	0	0
<i>Cladonia floerkeana</i>	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cladonia furcata</i>	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Cladonia cf. scabruscula</i>	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cladonia cf. ramulosa</i>	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1	0.1	0	0	0	0	0	0	0	0
<i>Cladonia species</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0	0	0	0	0	0.5	0
<i>Cladonia cf. coniocraea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	1	0	0	0	0	0	0	0
<i>Cladonia cf. chlorophaea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0
Species richness	4	6	4	6	5	7	6	6	4	4	3	8	5	6	8	8	6	3	5	6	6	7	6
IVC community	A	A	A	A	B	A	B	B	A	B	B	B	A	B	A	B	A	B	A	A	B	A	A

Appendix 2: Additional plot data

Percentage cover of bare ground and percentage bare rock

Quadrant maximum height measurements (cm) for the dwarf shrub, field and bryophyte layers with means of these values

Soil depth (cm) replicates and means

Easting and northings (Irish Transverse Mercator)

Plot no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Bare ground	0	7	0	0.5	0.3	0	5	10	0.7	0	25	5	0	20	0	0	0	0	0	0	1	60	0
Bare rocks	0.5	0.5	0	0	0	0	0.5	1	5	0	5	2	0	1	3	7	0.3	0	0	0	3	30	10
Dwarf height 1	50	33	69	31	34	60	30	25	38	71	27	34	73	19	24	15	74	58	108	82	39	7	49
Dwarf height 2	48	27	50	38	22	58	31	19	40	64	24	35	51	25	36	17	75	48	82	69	42	8	50
Dwarf height 3	52	33	70	40	28	48	28	20	41	80	24	31	71	17	40	12	80	45	95	77	54	14	59
Dwarf height 4	52	40	66	33	35	81	26	19	25	75	27	34	77	27	28	14	88	54	81	82	63	10	76
Dwarf mean	51	33	64	36	30	62	29	21	36	73	26	34	68	22	32	15	79	51	92	78	50	10	59
Field height 1	0	27	0	34	7	20	13	0	0	0	0	31	35	0	0	0	45	0	0	0	0	2	0
Field height 2	31	26	0	20	7	17	14	0	0	0	0	17	51	0	0	0	58	0	0	0	0	8	0
Field height 3	0	22	0	35	0	0	0	0	0	0	0	0	28	0	0	0	34	0	0	0	0	0	0
Field height 4	0	29	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field mean	8	26	0	31	4	9	7	0	0	0	0	12	29	0	0	0	34	0	0	0	0	3	0
Bryo height 1	0	0.5	0	0.5	1	5	0.5	1	1	5	0.5	1	0	0.5	1.5	1	5	8	9	5	0.5	0.5	1
Bryo height 2	0	0.5	0	0.5	0	5	0.5	1	1	4	0.5	3	0	0	1.5	1	0	8	6	10	1	0.2	6
Bryo height 3	0	0.5	8	0.5	0	0	0	1	1	4	0.5	8	0	0	1.5	1	0	8	24	18	0	0.2	9
Bryo height 4	0	0	14	0	0	0	0	1	1	6	0.5	2	0	0	0	1	0	9	8	16	0	0.2	0
Bryo mean	0	0	6	0	0	3	0	1	1	5	1	4	0	0	1	1	1	8	12	12	0	0	4
Soil depth 1	2	8	7	4	5	2	2	4	2	20	3	2	5	5	3	3	6	5	6	11	10	3	4
Soil depth 2	2	7	9	9	3	8	4	5	2	5	5	2	2	4	1	5	12	3	4	6	7	3	6
Soil depth 3	4	6	6	5	8	1	5	3	3	10	9	2	0	5	1	2	16	7	6	12	8	4	3
Soil depth 4	5	10	1	6	6	4	4	6	2	4	6	3	2	4	11	5	3	7	4	14	3	2	2
Soil mean	3	8	6	6	6	4	4	5	2	10	6	2	2	5	4	4	9	6	5	11	7	3	4
Easting	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952	738877	729952
Northing	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809	737752	729809

Appendix 3: Photographs



Figure 1. Die-back of heather on the south side of Shieltmartin.



Figure 2. Felling of birch saplings within the heathland on the north side of Shieltmartin.



Figure 3. An area of HE2A *Ulex gallii* – *Erica cinerea* heath on East Mountain.



Figure 4. An area of HE2B *Calluna vulgaris* – *Hypnum jutlandicum* heath on the northern side of Shielmartin.



Figure 5. Boundary between a recently burnt area (left) and an unburnt area (right) near plot 7, north side of the Ben.



Figure 6. Very recently burnt area of HE2A heath at Redrock, above the coastal path.



Figure 7. Bracken invading heathland, southeast of the Ben.



Figure 8. Birch invading heathland, northwest of the Ben.

Appendix 4: Dry Heath Quality

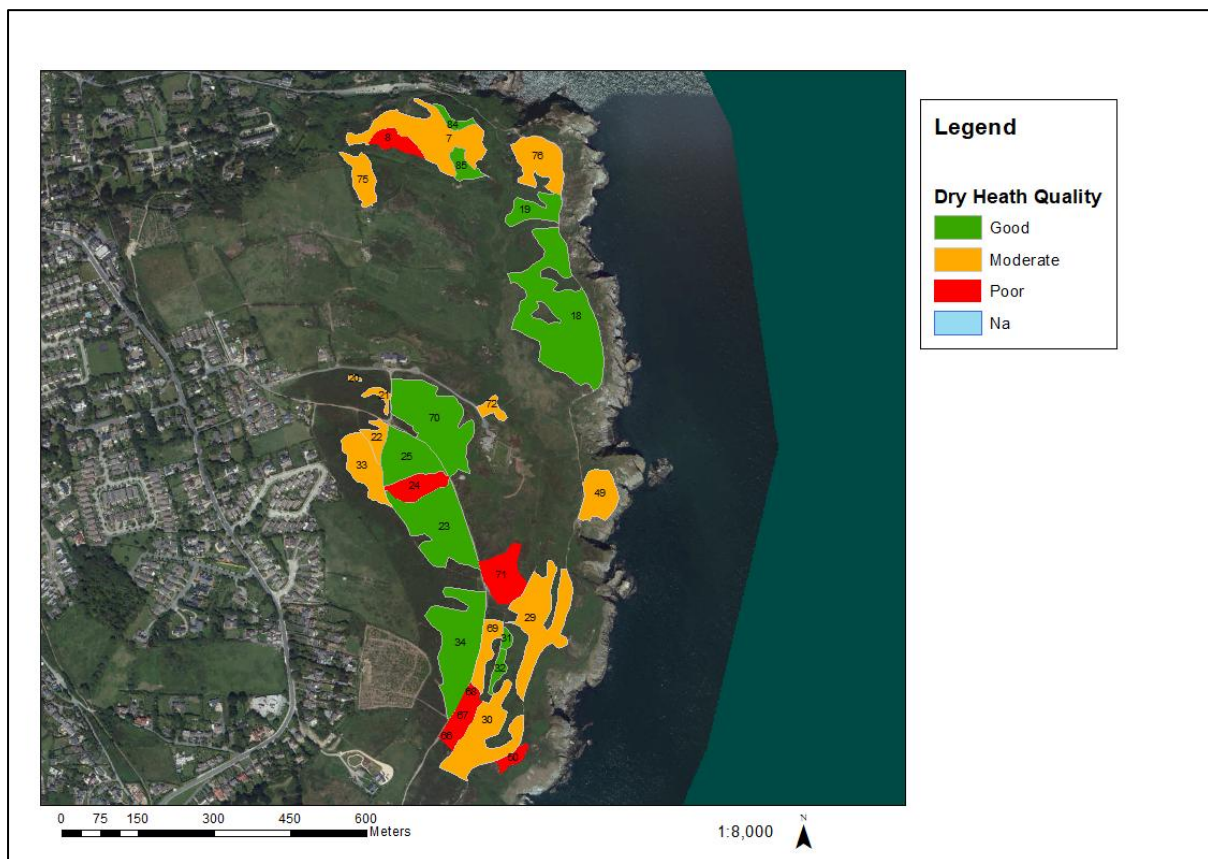
Further consideration of the rapid condition assessment is presented here. The notes taken in the field in relation to the rapid assessment are presented in the Table below with the number (No.) referring to the polygon number indicated on maps A4.1-4. It should be noted only polygons representing Dry Heath habitat are presented.

Table A4.1: Rapid assessment notes

No.	Assessment	Rapid Assessment Notes
1	Good	
2	Moderate	Occasional Rhododendron and Birch.
3	Poor	Headland of heath but most of Heather appears dead.
4	Moderate	
5	Moderate	Much of the heath is fragmented, grassy. Much of the Heather dead
6	Moderate	Patchy heath with bare rock.
7	Moderate	Some Heather up to 70cm tall. Other sections recently burned and/or more exposed so shorter. Trampling an issue.
8	Poor	Heather here very short (<7cm). Has been burned and is trampled and on thin soils.
9	Poor	Recovering from burn
10	Poor	Recovering from burn
11	Na	Viewed from outside the site
12	Moderate	Small patch of Western Gorse heath
13	Moderate	Small patch of Western Gorse heath
14	Poor	Patchy heath on rocky outcropping
15	Poor	Western Gorse heath. Has small patches of Heather in centre, mostly grey and dead.
16	Poor	Western Gorse heath. Has small patches of Heather in centre, mostly grey and dead.
17	Poor	Grassy heath. Heather patches up to 40cm tall, but other patches <15cm. <i>Campylopus introflexus</i> also.
18	Good	
19	Good	
20	Moderate	Small remnant areas of heath, dominated by Western Gorse.
21	Moderate	Small remnant areas of heath, dominated by Western Gorse.
22	Moderate	Western Gorse heath
23	Good	Tall 40-60cm closed canopy. Heather mixed with Western Gorse.
24	Poor	Short (5-10cm) Heather, dead and desiccated. Bare soil. Plants growing from seed, implies a hot burn.
25	Good	Tall 40-60cm closed canopy. Heather mixed with Western Gorse.

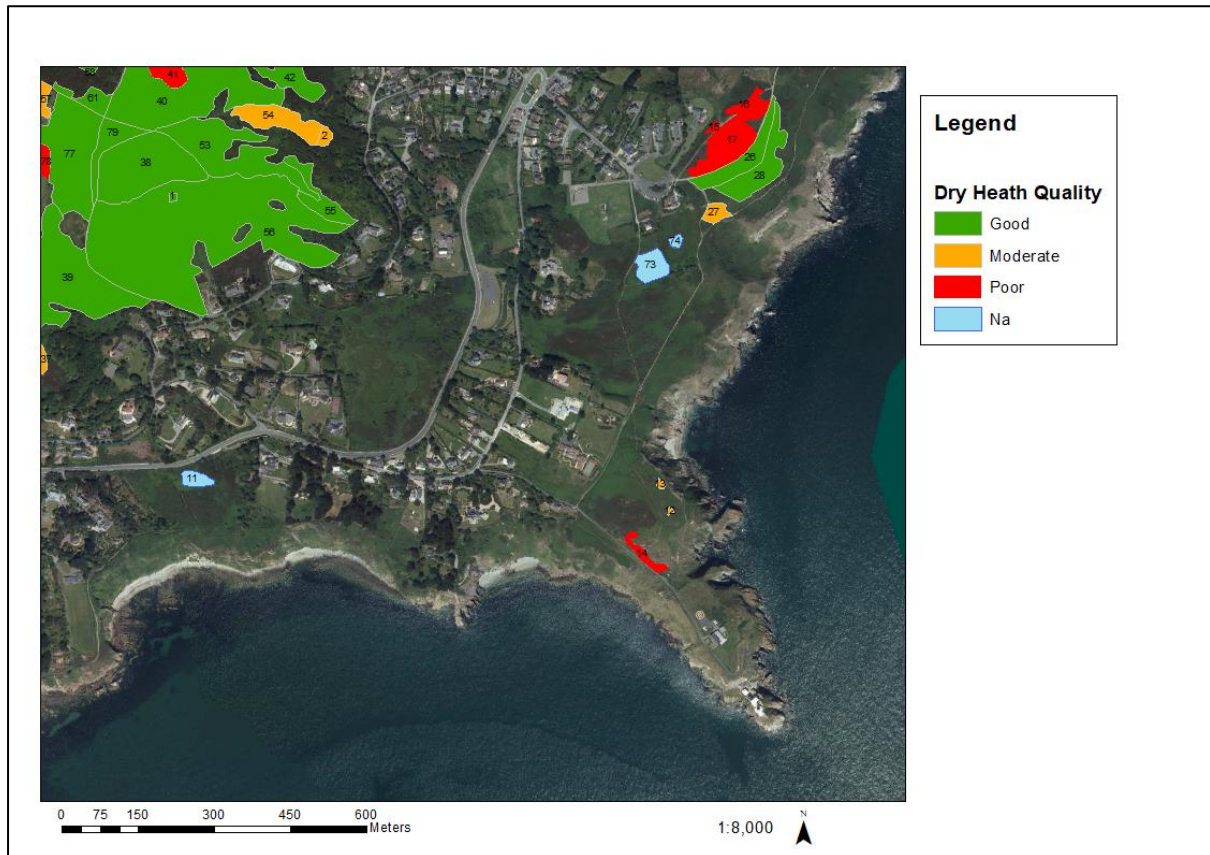
26	Good	Western Gorse heath. Some Heather, Bell Heather. Where Heather occurs it is up to 50cm.
27	Moderate	Tall Heather, with large number of heavily eroded paths.
28	Good	
29	Moderate	Heather is rather patchy from pioneer to building <20cm. Lots of bare soil. Heather recovering from seed. Bell Heather also.
30	Moderate	Heather is rather patchy from pioneer to building <20cm. Quite grassy in places.
31	Good	Heather 10-20cm tall. Amid Western Gorse
32	Good	
33	Moderate	Mainly Western Gorse heath
34	Good	Tall 40-60cm closed canopy. Heather mixed with Western Gorse.
35	Poor	Heath under pressure from Rhododendron encroachment and trampling. Much of the Heather is dead. Regrowth is <2cm and being trampled.
36	Na	Did not access, appeared associated with quarry.
37	Moderate	Heath rather patchy among the rock. Trampling. Exposure also contributing.
38	Good	Heather 40cm
39	Good	
40	Good	Heather 20-30cm
41	Poor	Recent burning and bare patches. Trampling, many paths..
42	Good	Eastern margins a mix of these with heath being invaded by birch.
43	Good	Heather 30-50cm high. Has occasional patches of Birch and scattered Rhododendron.
44	Good	Short Heather 10-20cm high.
45	Good	Heather up to 50cm tall.
46	Good	Small area of recent burn
47	Poor	Heather short and sparse. Greyed stems. Western Gorse dead also.
48	Poor	Sparse Heather on outcropping rock. Enough to assign as HH1 but some is dead.
49	Moderate	Western Gorse dominated heath
50	Poor	Substantial erosion of heath though trampling.
51	Good	No indication of recent burning. Heather up to 120cm on lower northern slopes but generally <50cm. Some birch encroachment and Rhododendron on western slopes and in the southeast.
52	Good	No indication of recent burning. Heather up to 120cm on lower northern slopes but generally <50cm. Some birch encroachment and Rhododendron on western slopes and in the southeast.
53	Good	In general heath is tall, up to 120cm, but occasional patches of 7-20cm. On summits Heather is shorter also.
54	Moderate	Occasional Rhododendron and birch.
55	Good	Significant Rhododendron and birch incursion on this eastern side.
56	Good	Good expanse of Heather heath. Mostly 7-20cm tall, some 50-60cm. Canopy not full closed.
57	Moderate	Large body of heath rather patchy with grassy areas, birch and European Gorse. Large patches of <i>Campylopus introflexus</i> .

58	Good	Heather up to 40cm.
59	Good	Large area had been burned. Heather generally <15cm
60	Good	
61	Good	Heather up to 40cm.
62	Moderate	Heath under significant pressure from birch encroachment and Rhododendron to a lesser extent. Also severe erosion due to path network. Path 8m wide in places.
63	Moderate	Heath under significant pressure from birch encroachment and Rhododendron to a lesser extent. Also severe erosion due to path network.
64	Good	Heather 10-20cm tall. Bare peat within.
65	Moderate	Heath on steep slopes and around summit has patches of bracken and European Gorse. Bare soil in places. Also the network of paths.
66	Poor	An open grassy area where heath is being out-competed.
67	Poor	Bare soil, patchy cover of low Heather. Growing from seed, being trampled.
68	Poor	Area around granite seat. Trampling removing any remaining heath and soil.
69	Moderate	Bare soil, patchy cover of low Heather.
70	Good	Some sections dense Western Gorse (60cm) other areas Heather (<10cm).
71	Poor	Heath is eroded by trampling, recovering from burn, with bare patches. Tallest Heather <20cm
72	Moderate	Remnant Western Gorse heath
73	Na	From APs and plants growing back considered HH1. Recent hot burn. Significant soil erosion.
74	Na	Did not view in the field. Putative HH1
75	Moderate	Old quarry regenerating with heath species. Rather patchy due to the recolonisation
76	Moderate	Tall Western Gorse heath with European Gorse scrub. Many paths and lots of bare ground.
77	Good	Heather mainly 40cm but 60cm in places, nearer the golf course. Growing with Western Gorse, Bell Heather. Some Heather is dead.
78	Poor	Appears to have been drained and burned/mown. APs suggest a deterioration in quality.
79	Good	Heather <20cm
80	Poor	Endeavouring to recover from burn but Heather is sparse. Some Western Gorse, stonecrops, Nardus stricta on thin soils with rock outcropping and trampling.
81	Poor	Burned heath on rock-outcropping. Very little sign of recovery in places. Bare burned peat and rock. Trampling.
82	Poor	Heather mostly dead/grey, fringes burned. Young Heather growing back. Western Gorse also.
83	Poor	Rocky heath with recovering Heather
84	Good	
85	Good	Western Gorse, Heather and Bell Heather heath. Heather 10-25cm high. Some bare patches.
86	Moderate	Unable to access
87	Good	Outside SAC.
88	Moderate	HH1 above and below the path. Above is in to private lands. Heath naturally fragmented by rock, much of Heather is dead.



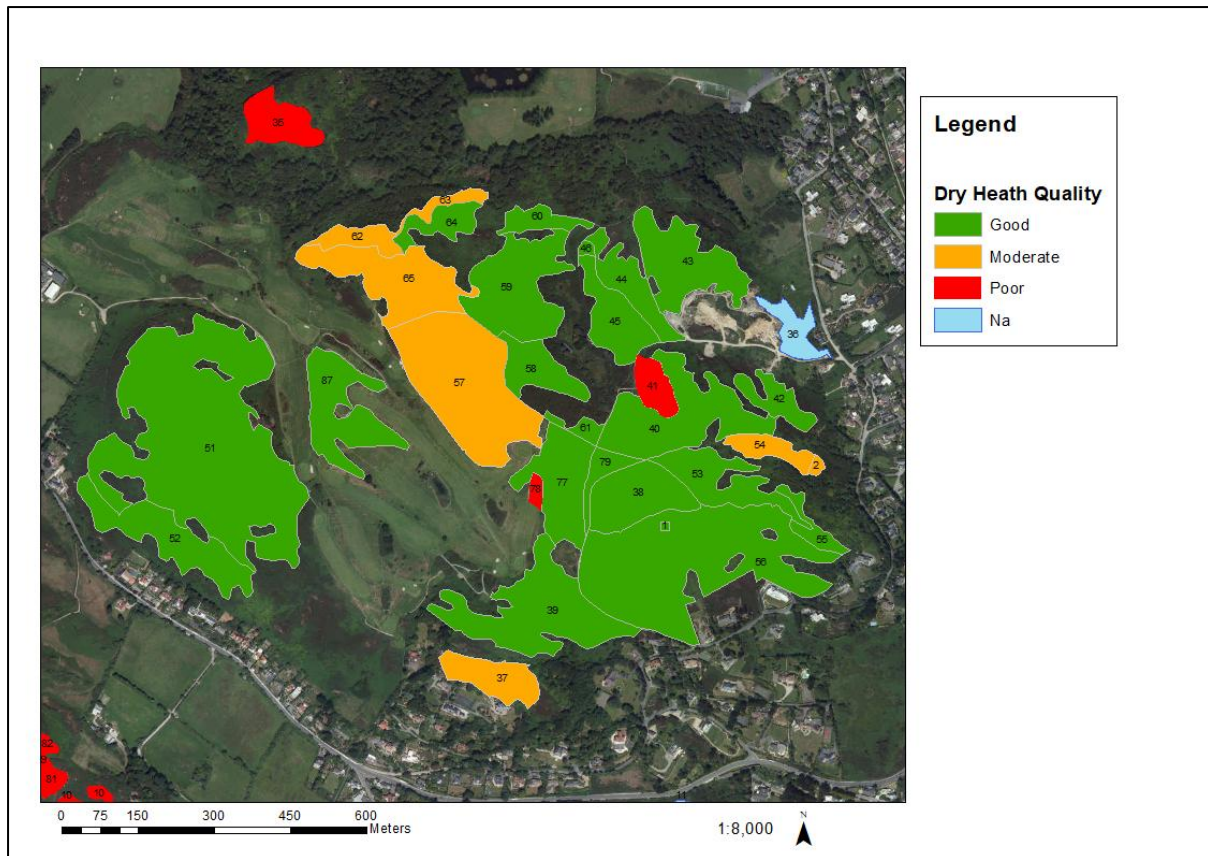
Map A4.1: Dry Heath Quality, Nose of Howth and East Mountain

Five areas of Dry Heath in this section of the site were assessed as poor quality through the rapid assessment (polygons 8, 24, 71, 66-68 and 50). The reason for this assessment for the majority of these areas was a combination of burning and trampling. Low-growing Heather was generally observed as growing from seed, these plants being slower growing than regrowth from rootstock and vulnerable to trampling. Further trampling of these areas should be curtailed to allow recovery of the Dry Heath. This could be done by erecting fences around burned areas. Eradication of uncontrolled burning is required to prevent the combination of burning and trampling causing the deterioration of other areas of Dry Heath on East Mountain. Burning was not recorded in polygon 50 in the far southeast but severe trampling and erosion were noted as issues at this popular viewing point. Control of walkers would be required, fencing sections to allow recovery of the Dry Heath. The majority of the areas assessed as Moderate were Western Gorse dominated (polygons 20, 21, 22, 30, 33, 49, 72, 75 and 76). Where there are large expanses dominated by Western Gorse consideration should be given to reducing the dominance of Western Gorse through selective cutting or burning. In the north (polygons 7 and 76), trampling and large numbers of paths was an issue near the Nose of Howth and consideration should be given to reducing the number of footpaths through Dry Heath areas. Further west from the Nose (polygon 75), trampling and burning was an issue and Dry Heath was developing on an abandoned quarry and was therefore rather patchy. Development to good quality Dry Heath may not be possible here due to underlying soil conditions but control of trampling in the north of the polygon may be possible. Areas in the south around East Mountain were noted as having patchy cover of Heath, considerable areas of bare soil and a grassy sward in places. This is probably due to inappropriate burning and trampling. As for other areas the eradication of uncontrolled burning is required and the restriction of people to a specific path network.



Map A4.2: Dry Heath Quality, The Summit car park and The Great Bailey

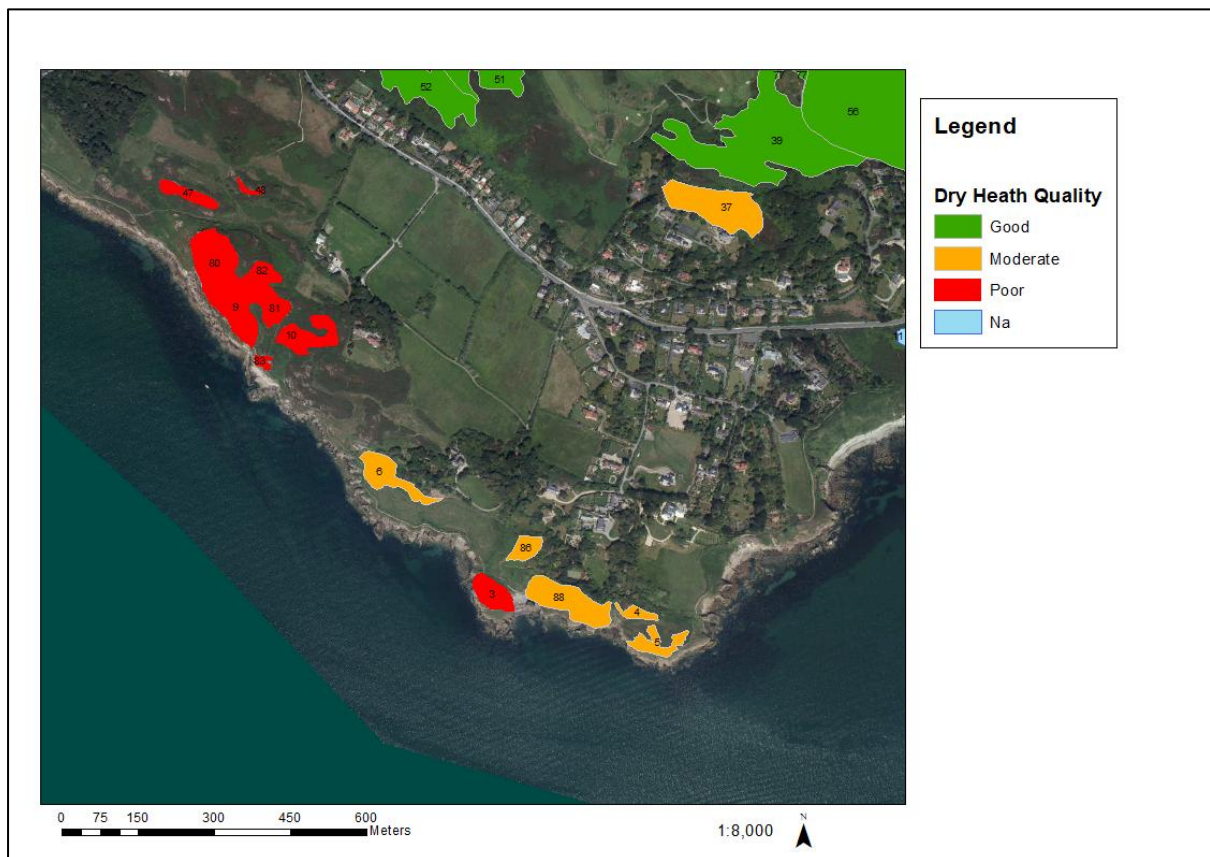
Areas of Dry Heath on The Great Bailey are very fragmentary among a grass and bracken sward. The area on the southern side of the peninsula (polygon 14) is of patchy heath on rocky outcrops. Those on the northern side (polygons 12 and 13) are small patches of Western Gorse dominated heath. To the west of The Great Bailey is a small area of Dry Heath at Glenaveena (polygon 11). This was not viewed in detail in the field being observed from the coastal path to the south and the road to the north. It appeared to be dominated by Western Gorse. Areas directly south of The Summit car park (polygons 73 and 74) were not assessed as they had been subject to a very recent burn, though the regrowth evident was indicative of Dry Heath. Significant soil erosion was evident here. Southeast of The Summit car park there was significant erosion from multiple paths through tall Heather; this area was assessed as moderate (polygon 27) and measures should be considered to reduce the footpath network here. Northeast of The Summit car park (polygons 15, 16 and 17), the Dry Heath was assessed as poor due to the grassy sward through the heath, the occurrence of Heath Star-moss likely due to inappropriate burning. Also patches of dead Heather (possibly from desiccation during the summer of 2018 or Heather Beetle) occur. As for other areas the eradication of uncontrolled burning is required and the restriction of people to a specific path network. Heath Star-moss will be gradually out-competed if the dwarf shrub canopy is allowed to close over.



Map A4.3: Dry Heath Quality, Shielmartin, Ben of Howth and Muckrock

Dry Heath at Muck Rock (polygon 35) was under pressure from encroachment by *Rhododendron*, and trampling. This area assessed as poor. Removal of *Rhododendron* as part of a coherent *Rhododendron* eradication programme is required to remove this threat and also to allow Dry Heath which has been invaded by *Rhododendron* to be reinstated. Areas of dead Heather were also noted here. Regrowth of Heather from seeds was being trampled and walkers should be excluded until the Dry Heath has recovered. An area around the aerials (polygon 41) was assessed as poor due to fragmentation caused by the large number of paths and trampling causing poor recovery on areas recently burnt. As for other areas the eradication of uncontrolled burning is required and the restriction of people to a specific path network. A further area assessed as poor is adjacent to the golf course (polygon 78). This appears to be drained and also mown or burned. Review of historic aerial photographs suggests deterioration in quality since 2005. Consultation should be carried out with the Head Greenkeeper to investigate their proposed management for this area and to ensure this is in keeping with the conservation objectives of the SAC. Areas were assessed as moderate to the south (polygon 37) and the east (polygons 2 and 54) of the Ben of Howth. In the south, the Dry Heath was rather fragmented and exposed. Trampling was impacting the heath as was *Rhododendron*. Removal of *Rhododendron* as part of a coherent *Rhododendron* eradication programme is required to remove this threat and also to allow Dry Heath which has been invaded by *Rhododendron* to be reinstated, as is the restriction of people to a specific path network. In the eastern block the low-growing Heather was impacted by trampling and there was encroachment by Birch and *Rhododendron*. As for other areas of *Rhododendron*, a coherent *Rhododendron* eradication programme is required. As Birch encroachment is a particular issue here consideration should be given to its removal. The large block from Dun Hill (polygons 57, 62, 63 and 65) running alongside the golf course was experiencing significant encroachment in the north from Birch and *Rhododendron*. A coherent *Rhododendron* eradication programme is required. As Birch encroachment is a particular issue here consideration should be given to its removal. There is

significant erosion on the northern face of Dun Hill with a network of paths, some up to 8 m wide in paces. Consideration should be given to the control of people walking in this area, their exclusion or provision be made in the form of footpaths which are sympathetic to the natural surroundings of the hill. Moving south from the summit of Dun Hill there are patches of Bracken, Gorse, Birch, and a grassy sward and also Heath Star-moss patches, the latter likely being due to inappropriate burning in the past. The network of paths contributes to further fragmentation. As for other areas the eradication of uncontrolled burning is required and the restriction of people to a specific path network. Heath Star-moss will be gradually out-competed if the dwarf shrub canopy is allowed to develop.



Map A4.4: Dry Heath Quality, Redrock and Drumleck Point

The Dry Heath around Redrock (polygons 9, 10, 47, 48 and 80-83) was assessed as poor quality. Some of this had been burned recently and this would have negatively affected the presentation of the heath. However, there was evidence of the peat having been burned, together with subsequent trampling of regenerating Heather. Some of the remaining Heather was dead (possibly from desiccation or Heather Beetle). As for other areas the eradication of uncontrolled burning is required and the restriction of people to a specific path network. A further area of Dry Heath towards Drumleck Point was also assessed as poor quality (polygon 3). Here most of the Heather appeared to be dead (possibly from desiccation or Heather Beetle) and there was evidence of trampling. Other areas at Drumleck Point (polygons 4, 5, 6, 86 and 88) were dominated by Western Gorse and therefore assessed as moderate quality. Where there are large expanses dominated by Western Gorse consideration should be given to reducing the dominance of Western Gorse through selective cutting or burning. However as these areas are currently rather fragmented this may not be deemed appropriate.



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